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July 11, 2016

VIA ELECTRONIC FILING

Ms. Gail Mount
Chief Clerk
North Carolina Utilities Commission
4325 Mail Service Center
Raleigh, North Carolina 27699-4325

Re: Docket No. E-2, Sub 936
Residential Home Energy Improvement Program 2014 EM&V Report

Dear Ms. Mount:

Pursuant to the Commission's April 30, 2009 Order, issued in Docket No. E-2, Sub 936, I submit Duke Energy Progress, LLC's ("DEP") report summarizing the 2014 program year evaluation, measurement and verification ("EM&V") results for its Residential Home Energy Improvement Program. DEP is currently evaluating the recommendations provided in the EM&V report.

Thank you for your attention to this matter. If you have any questions, please let me know.

Sincerely,

Brian L. Franklin

Attachment

cc: Parties of Record

REPORT

Nexant

Reimagine tomorrow.

Home Energy Improvement Program Year 2014 Evaluation Report

Submitted to Duke Energy Progress in partnership with Research into Action

March 1, 2016

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1 Executive Summary

1.1 Program Summary

The Home Energy Improvement Program (HEIP) offers Duke Energy Progress ("Duke" or "DEP") existing residential customers incentives for improving their home's energy efficiency through the installation of energy efficient heating, ventilating, and air conditioning (HVAC) and water heating equipment replacements, HVAC maintenance, duct testing and repair, and attic insulation with air sealing. The program is provided through independent, prequalified contractors who will install the eligible energy efficiency measures consistent with the program standards and guidelines.

1.2 Evaluation Objectives and Results

This report presents the results and findings of evaluation activities for the HEIP program conducted by the evaluation team, collectively Nexant Inc. and our subcontracting partner, Research into Action, in the calendar and program year 2014.

1.2.1 Impact Evaluation

This evaluation of the HEIP program was conducted to estimate gross and net energy, summer demand, and winter demand savings for the entire program and for each major measure type. The evaluation team reviewed available program databases and measure applications to help inform design of the evaluation effort and sampling approach. Activities included an in-situ metering study (n=42) to estimate operational hours of air source heat pumps and central air conditioners, billing analysis to estimate savings for the HVAC Audit measure, and verification surveys with program participants paired with engineering desk analyses to estimate gross savings for all measures in the program. Net savings are a reflection of the degree to which the gross impacts are a result of the program-specific efforts and incentives. Therefore, attribution surveys of program participants and contractors were implemented to calculate the rates of free ridership and spillover. Program level results for the 2014 HEIP are provided in Table 1-1.

Table 1-1 Program Year 2014 Impact Results

Measurement	Reported	Realization Rate	Gross Verified	Net-to-Gross Ratio	Net Verified
Energy (MWh)	5,556	132%	7,340	72%	5,300
Summer Demand (kW)	3,069	78%	2,408		1,739
Winter Demand (kW)	3,218	52%	1,663		1,201

In 2014, the program provided rebates for 13,883 measures installed in single family, multifamily, and manufactured residential homes, resulting in 7,340 MWh in gross verified energy savings. This is a large increase in energy savings (30%) over 2013. Demand savings

for both summer and winter coincident periods fell significantly from 2013, with 52% and 55% reductions respectively.

The program largely incentivized HVAC related improvements (replacements, audits, and duct sealing) that accounted for over 90% of rebated measures and verified energy savings, as shown in Figure 1-1 and Figure 1-2.

Figure 1-1 2014 HEIP Rebated Measures

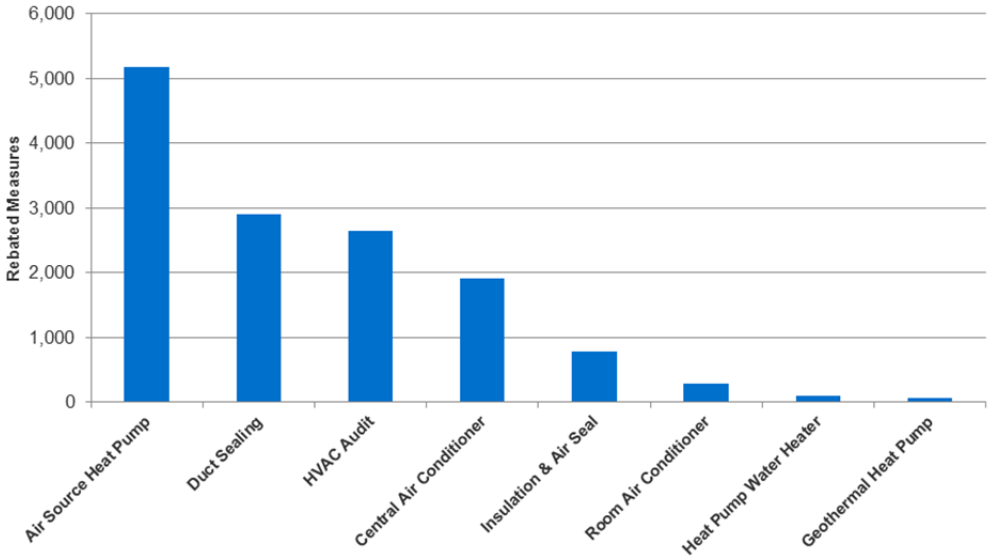


Figure 1-2 2014 HEIP Verified Energy Savings

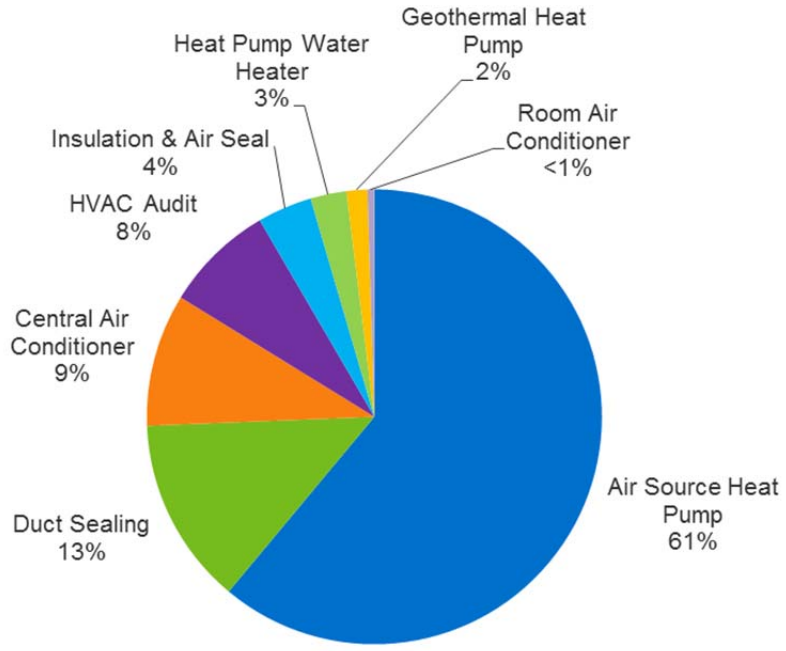


Table 1-2: Program Year 2014 Verified Impacts by Measure

Measure	Gross Energy Savings per unit (kWh)	Gross Summer Coincident Demand per unit (kW)	Gross Winter Coincident Demand per unit (kW)	Free Ridership	Spillover[1]	Net to Gross Ratio
Air Source Heat Pump	865	0.204	0.220	0.43	0.09	66%
Duct Sealing	336	0.077	0.049	0.42	0.09	67%
HVAC Audit	261	0.167	0.035	0.04	0.09	105%
Central Air Conditioner	299	0.211	0.087	0.33	0.09	78%
Insulation & Air Seal	364	0.257	0.082	0.03	0.09	106%
Heat Pump Water Heater	1,978	0.094	0.541	0.49	0.09	60%
Geothermal Heat Pump	1,725	0.684	0.000	0.51	0.09	58%
Room Air Conditioner	124	0.099	0.010	0.28	0.09	81%

1.2.2 Process Evaluation

This process evaluation assessed why and how rebated energy saving measures were implemented through HEIP and identified ways to improve the program design and implementation. To answer these research questions, the evaluation team interviewed program and implementer staff (n=3) and "high volume" trade allies (n=10) and surveyed a stratified random sample of trade allies (n-70), single family participants (n=75), and multifamily participants (n=30).[2]

Program Successes

The 2014 Home Energy Improvement Program found success is the following areas.

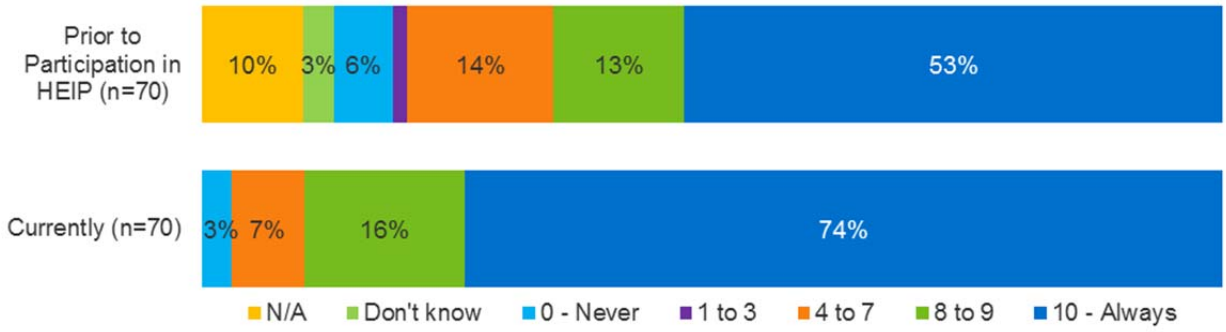
Overall, trade allies and participants are highly satisfied with HEIP. Trade allies were particularly satisfied with their communications with program staff (81% were highly satisfied). Participants were especially satisfied with their contractors (96% of single family and 82% of multifamily participants were highly satisfied).

HEIP influences energy efficiency contracting services in DEP service territory. Trade allies reported that participating in HEIP influenced them to recommend and implement qualifying measures and has increased their knowledge of energy efficient technologies. Further, trade allies recommend energy efficient technologies to their clients significantly more now than prior to participating in the program (Figure 1-3).

[1] Spiilover values are the same for each measure, because the influence was considered to be programmatic in nature and not measureable at the measure level.

[2] High volume trade allies implemented at least 100 rebated measures in 2014.

Figure 1-3 Trade Ally Frequency of Recommending High Efficiency Equipment*



* Asked on a 0-10 scale, where 0 is "never recommend" and 10 is "always recommend."

Trade allies are HEIP's most successful marketing channel. Participant surveys demonstrated that trade allies are the primary source of HEIP awareness (Table 1-3) and are the most influential factor on the customer's decision to implement rebated measures (77% of single family and 67% of multifamily participants rated their contractor as highly influential). Trade allies reported spending time teaching customers about the benefits of energy efficient measures and how HEIP can help subsidize the cost.

Table 1-3 Source of HEIP Program Awareness, by Sector (Multiple Responses Allowed)

Source of Awareness	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Contractor	75%	40%	65%
Direct mail	16%	23%	18%
Utility bill-inserts	*11%*	*13%*	*11%*
Postcard or other advertisements	*5%*	*10%*	*7%*
Duke Energy Website	7%	10%	8%
Family/friends/word-of-mouth	1%	13%	5%
Property management company	0%	10%	3%
Other	4%	10%	6%
Don't know	1%	0%	1%

Program Challenges

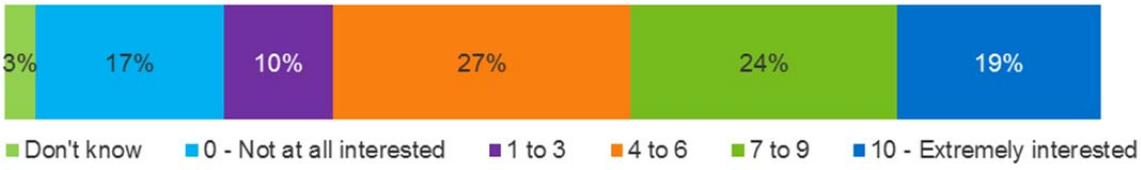
The following concerns were highlighted by interview and survey respondents.

Consumer awareness of HEIP appears to be low. Trade allies reported that most of their customers are unfamiliar with HEIP and cited this as a primary reason as to why they were dissatisfied with DEP's marketing of HEIP. Few (15% of single family and 10% of multifamily) participants were familiar with the HEIP measures outside of the ones they received the rebate for and one-third of participants offering suggestions for improvement said more program

outreach to consumers is needed.

Trade allies could benefit from additional sales training. Most trade allies, particularly those that implemented less than 100 rebated measures in 2014, expressed interest in training to help them sell HEIP measures Figure 1-4. The implementation staff confirmed that many trade allies struggle to explain benefits of higher efficiency equipment to their customers.

Figure 1-4 Trade Ally Interest in Sales Training (n=70)



Many customers do not understand that air sealing is a required component of the attic insulation measure. Two high volume trade allies, who collectively did nearly 100 HEIP attic insulation/air sealing jobs in 2014, said the HEIP website was unclear and that customers are often surprised by the air-sealing requirement, and typically do not want to pay for the added cost of air sealing, ultimately resulting in low conversion rates.

The rebate application process is cumbersome and time consuming, especially since parts of the application must be completed manually. Trade allies would prefer an online submission process and reported that some rebate application problems stem from their customers making clerical errors, failing to submit the rebate application, not knowing all the required information, or refusing to complete the paperwork.

Quasi-Direct Install Activity

The Evaluation Team also became aware of contractors who are providing energy-efficiency improvements to participants at no cost to the customer.

Some trade allies are accepting the HEIP rebate as payment in full for the HVAC audit, duct sealing/repair, and attic insulation/air sealing measures. Trade allies mostly use this "quasi-direct install" model in multifamily buildings. About 6% of trade allies accept the rebate for non-equipment measures as payment in full, and those that use this payment system structure their business model around it. The majority of HVAC audits (at least 73%) were offered at no out-of-pocket charge to customers and all multifamily duct sealing and attic insulation participant survey respondents said the measure was "free."

Although trade allies mostly use this "quasi-direct install" approach in multifamily properties, some are using this approach in single-family homes as well. The three measures referenced above accounted for 91% of gross savings in the multifamily sector, and 16% of single-family savings.

Participant Population Attributes

It is commonly known, and was confirmed in this study, that the types of decision-makers, motivations, and measures commonly implemented vary significantly between the multifamily and single-family sectors. In the multifamily sector, multiple types of decision makers exist: apartment property managers, apartment property owners, duplex/triplex owners, condominium owners, and tenants who received a rebate for a window air-conditioner or an HVAC audit. In the single family sector, homeowners (who reside at the property) are the primary decision makers.

In comparison to single-family participants, multifamily participants were more likely to be motivated by the increase in their property value. Due to this fact, multifamily participants were more likely to proactively replace equipment prior to burnout, and rated the HEIP rebate as being the most influential factor in implementing non-equipment measures. The measures typically implemented also significantly varied by sector; 96% of multifamily rebates were for non-equipment measures, compared to 30% for single family.

1.3 Evaluation Conclusions and Recommendations

Based on evaluation findings, the evaluation team concluded the following and provides several recommendations for program improvement.

Conclusion 1: Trade allies are the driving force of the program, as they inform consumers of the HEIP incentive opportunity and convince them to purchase qualifying equipment. However, marketing and other support could increase their effectiveness.

- **Recommendation 1:** Consider the following suggestions to continue strengthening relationships with trade allies and to improve their effectiveness in generating program savings:
  - Offer cooperative (co-op) marketing – Co-op marketing can help trade allies effectively market the program consistent with DEP objectives and increase customer perceptions of trade ally credibility.
  - Expand sales training - Sales training can help trade allies implement more measures through the program by improving their sales skills.
  - Change website and other attic air sealing marketing content - Expanding the discussion on air sealing benefits, while clarifying that the rebate is for both air sealing and attic insulation, can help trade allies effectively communicate the value of this measure to their customers.
  - Transition to an electronic rebate application and submission system - This system could:
    - Streamline the application process (e.g., alert those submitting an application of missing data and/or errors prior to submission)
    - Allow staff to monitor in real time whether the total cost of the project

equals the incentive amount (e.g., having dashboards to monitor this)

- Minimize lost savings by providing an electronic submission system that is easier for customers and trade allies to use

Conclusion 2: Current incentive levels can cover the full cost of HVAC audit, duct sealing/repair, and attic insulation/air sealing measures.

- **Recommendation 2:** Consider restructuring the rebates for HVAC audit, duct sealing/repair, and attic insulation/air sealing measures, especially for multifamily applications so that the rebates don't cover 100% of the participant incremental cost. This will require analyzing costs of these measures and assessing their effectiveness on participation rates given the way trade allies are using the rebate to implement them for no out of pocket costs to the customer.

Conclusion 3: Single family and multifamily participants are fundamentally different in who, how, and why they participate. Even trade allies serve the two markets differently.

- **Recommendation 3:** Consider separating multifamily from single-family program offerings. This would allow program staff to develop a unique set of program offerings, as well as targeted value proposition messaging aimed specifically at multifamily or single-family decision makers. Since manufactured home owners most closely resemble single-family homeowners, the evaluation team recommends grouping manufactured homes with single-family homes if redesigning sector-based program offerings.

2 Introduction and Program Description

2.1 Program Description

The Home Energy Improvement program (HEIP) offers Duke Energy Progress ("Duke" or "DEP") existing residential customers incentives for improving their home's energy efficiency through the installation of energy efficient HVAC and water heating equipment replacements, HVAC maintenance, duct testing and repair, and attic insulation with air sealing.

The program is provided through independent prequalified contractors who install the eligible energy efficiency measures consistent with the program standards and guidelines. These program requirements are documented in a program manual: *Standards and Installation Procedures for Home Energy Improvement Program – Duke Energy Progress, version January 2015*. The following information comprising the balance of section 2.1 is sourced from the HEIP program manual.

The program outlines the following benefits as objectives for the program contractors:

1) Increased sales and revenues through increased customer uptake,
2) Program standards, sales, and technical training provided by implementer,
3) Marketplace differentiation through presence on prequalified contractor list,
4) Reduced sales costs through high quality customer driven leads, and
5) Duke marketing support from high visibility HEIP Program promotion.

The program outlines the following benefits as objectives for the program participants:

1) Cash incentives to reduce cost of program measures,
2) Increased awareness of energy efficiency benefits through program education,
3) Customer service through program to assist customers in selecting EE measures,
4) Assurance of energy saving benefits through strict program standards,
5) Assurance of quality installation through quality control program, and
6) Assurance of quality service through prequalified contractor network.

2.1.1 Energy Efficiency Measures

Energy efficiency measures included in the HEIP program year 2014 are summarized in Table 2-1.

Table 2-1 2014 HEIP Measures and Incentives

Measures	Rebate Amount	Details
Air Source Heat Pump	$300	15 SEER or higher. No Maximum per household
Duct Sealing	50% of the repair cost up to a maximum of $190 per unit per dwelling.	
HVAC Audit	$100	Available once per unit's life
Central Air Conditioner	$300	15 SEER or higher. No Maximum per household
Attic Insulation & Air Seal	$0.375/SF up to maximum of 1,333 SF - $500 per home	Reduce attic infiltration and bring insulation level up to at least R-30 (from a maximum of R19)
Room Air Conditioner	$25	Energy Star® Qualified units. Up to four (4) units per dwelling.
Heat Pump Water Heater	$350	Energy Star® Qualified units. Must have an EF ≥ 2
Geothermal Heat Pump	$300	19 SEER or higher. No Maximum per household

The following information provides additional detail on measure eligibility and requirements:

HVAC System Replacements, including Air Source Heat Pump, Central Air Conditioner, and Geothermal Heat Pump

The following eligibility requirements are in place for HVAC replacement measures:

- Replacement system must have a minimum AHRI rated SEER of 15.0 for Central Air Conditioners and Air Source Heat Pumps or a minimum AHRI rated EER of 19.0 for Geothermal Heat Pumps
- The indoor coil must be matched so that the combination is rated by AHRI.
- Maximum cooling capacity shall be 60,000 BTUh (5 tons) at AHRI conditions.
- All replacement systems must have a TXV refrigerant metering device installed.

Duct Repair and Sealing

Duct repairs and sealing must significantly reduce the leakage rate of conditioned air from the duct system. Pressure testing of ducts is recommended, but not required, for the duct sealing incentive. The following procedures are a partial list of requirements that must be met by the contractor:

- The entire duct system, from its connection to the heating and cooling system to each supply register and return, must be thoroughly inspected for air leakage or potential air leakage.
- Damaged or disconnected ducts must be reattached and repaired and flexible ducts that are tangled or crushed must be un-crimped and straightened out.
- Where leaks are detected, such connections must be sealed with bucket mastic,

aerosol-based sealant, tape or other duct sealing materials and methods certified by UL 181 are deemed acceptable for use, and that will retain adhesion over the life of the duct.

- Any non-insulated ducts in non-conditioned areas (such as crawl spaces, attics and garages) must be insulated. Where duct insulation has deteriorated or been damaged, replace with new duct insulation.
- Replacement ductwork and previously un-insulated ductwork shall be insulated to at least R-8.

HVAC Audit

The HVAC Audit will consist of a standard HVAC system tune-up and operational check as well as diagnostic testing using the Service Assistant tool™[1], to ensure the system is operating as recommended by the manufacturer. The audit includes the following activities:

- Check thermostat for proper operation
- Clean or replace air filter
- Inspect and clean condensate drain
- Inspect and clean evaporator coil
- Inspect and lubricate the condenser fan motor
- Inspect, clean, and lubricate the evaporator fan motor
- Inspect, clean and straighten condenser coil
- Check refrigerant level and add refrigerant as necessary.

Some eligibility requirements are in place, as outlined below:

1) A Pre-Efficiency Index (preEI) and Post-Efficiency Index (postEI) calculated by the tool must be submitted for each system. If the Pre-Efficiency Index (preEI) reading is 90% or greater, the system is deemed ineligible for the incentive payment.
2) Duke Energy Progress customers may apply for a HVAC Audit incentive only once in the life of the HVAC system;
3) The system on which the HVAC Audit is performed must have been operating for at least one year in order to qualify for the incentive.

Attic Insulation and Air Sealing

Program incentives apply to only new attic or conditioned space ceiling insulation that is installed in conjunction with air sealing of the thermal boundary and in accordance with the following criteria.

[1] The HVAC Service Assistant tool™ an infield diagnostic tool manufactured by Field Diagnostics, Inc. https://www.fielddiagnostics.com/products/hvac-service-assistant

- All holes, cracks, or other openings between the attic and the conditioned space must be blocked and sealed with durable air barrier materials, except where access is so restricted as to make it impractical.
- Insulation shall be installed with no gaps or voids; no compression; no wind intrusion into the insulation; and in contact with the air barrier of the conditioned space.

ENERGY STAR Window Unit HVAC Installation or Replacement

The following eligibility requirements are in place for ENERGY STAR Window Unit HVAC measures:

- HVAC window units are homeowner-installed.
- There is no prequalified contractor requirement for this measure

Heat Pump Water Heater (HPWH)

The following eligibility requirements are in place for Heat Pump Water Heater measures:

- HPWH must be ENERGY STAR® qualified equipment with an Energy Factor (EF) of 2.0 or greater.
- HPWH must be located in an area with at least 700 cubic feet of free space around it. A louvered door may be used to increase access to free space.
- HPWH must be located in a clean, weather protected area that will not get colder than 45 degrees F or below manufacturer ambient temperature specification.

2.2 Program Implementation

The Home Energy Improvement program is largely implemented by Honeywell, Inc. Honeywell recruits and trains interested HVAC, insulation, and home performance contractors to deliver the eligible HVAC, insulation and air sealing measures. As part of the prequalification process, all contractors who wish to participate are required to enter into a Letter of Agreement or Prequalified Contractor Participation Agreement for participation in the program. Contractors who meet program requirements are included in a prequalified contractor listing on the program website. Prequalified contractors have permission to promote HEIP program measures and identify themselves as a program contractor.

Upon selection by the customer, contractors will complete the requested installation in accordance with all HEIP Program standards and guidelines, and all applicable building codes. Contractors assist the customer in completing an incentive application when requested. Prequalified contractors provide written invoices with sufficient detail describing what was installed.

Upon receipt of the application, Honeywell is to verify that the application is complete and accurate, and will follow up with customers or contractors to resolve any discrepancies. Honeywell will conduct quality control inspections on a small share of installed measures; it was noted to be approximately 5% of installed measures. Inspections are to be shared across all contractors, with new contractors and those who have had quality issues being inspected at a

higher rate. Honeywell is to address individual contractor problems with retraining and remediation of failing work (when possible). Upon approval of applications, incentive checks are issued to participating customers for the incentive value.

DEP provides marketing through several channels, including: direct mail campaigns, utility website, participating contractor outreach and advertising, and contractor associations.

Eligibility

DEP residential account holders residing in DEP electric service territories in North and South Carolina are eligible for the Program. All customers participating in the Program must be on a DEP residential electric rate. The Program is open to owners and renters; however, renters must obtain written permission from property owner / landlord for incentive eligibility.

2.2.1 Participation

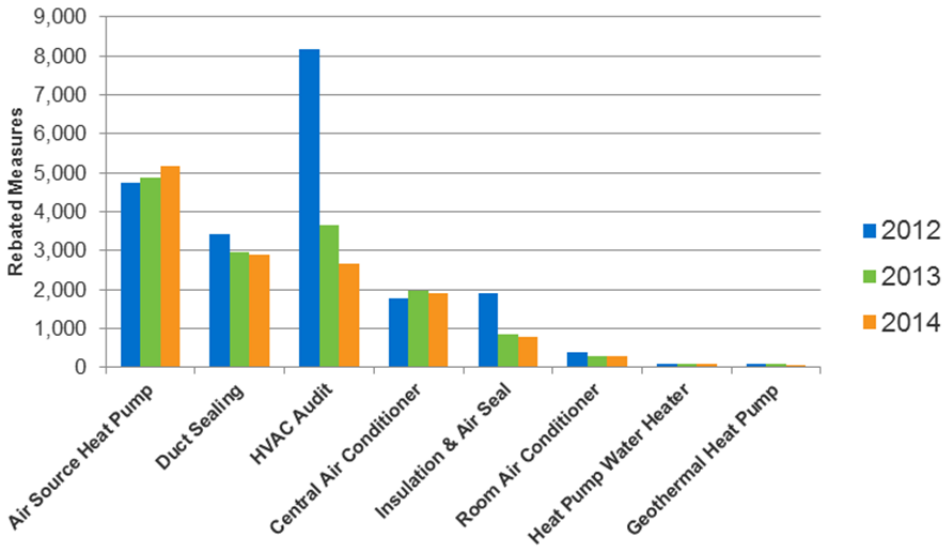
In 2014 the HEIP had 13,883 participating measures. The summary by measure for program years 2012, 2103, and 2014 is shown in Table 2-2.

Table 2-2 HEIP Participation

Measure Name	2012	2013	2014
Air Source Heat Pump	4,746	4,884	5,183
Duct Sealing	3,426	2,956	2,906
HVAC Audit	8,174	3,650	2,649
Central Air Conditioner	1,759	1,979	1,920
Insulation & Air Seal	1,908	834	783
Room Air Conditioner	403	305	284
Heat Pump Water Heater	100	100	95
Geothermal Heat Pump	100	107	63
Total	**20,616**	**14,815**	**13,883**

A comparison of 2014 participation to 2012 and 2013 is available in Figure 2-1

Figure 2-1 HEIP Participation by Year



2.2.2 Program Goals

The 2014 Home Energy Improvement program exceeded targets for participation and energy savings (Table 2-3).

Table 2-3 2014 HEIP Filed Targets

Measurement	Filed Target	Achievement
Participation (rebates)	11,102	13,883
Net Energy Savings (MWh)	3,087	5,300

2.3 Key Research Objectives

Over-arching project goals will follow the definition of impact evaluation established in the "Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency," November 2007:

"Evaluation is the process of determining and documenting the results, benefits, and lessons learned from an energy-efficiency program. Evaluation results can be used in planning future programs and determining the value and potential of a portfolio of energy-efficiency programs in an integrated resource planning process. It can also be used in retrospectively determining the performance (and resulting payments, incentives, or penalties) of contractors and administrators responsible for implementing efficiency programs.

Evaluation has two key objectives:

1) To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.

2) To help understand why those effects occurred and identify ways to improve."

2.3.1 Impact

Over-arching project impact evaluation processes followed standard industry protocols and definitions, where applicable, and include the Department of Energy Uniform Methods Protocol, as an example. As part of evaluation planning, the evaluation team outlined the following activities for this program evaluation:

- Quantify accurate and supportable energy (kWh) and demand (kW) savings for energy efficient measures and equipment implemented in participants' homes;
- Assess the rate of free riders from customer and contractor perspective and determine spillover effects;
- Benchmark verified measure level energy impacts to applicable technical reference manual(s) and other Duke similar programs in other jurisdictions;
- Consider and verify that measure installation vintage aligns with measure baseline definitions, i.e. early replacement, burnout on failure, etc. ; and,
- To the extent possible for the purposes of program planning, the evaluation team will seek to provide estimated per-unit savings by measure for multifamily and single family homes, estimated tune-up per-unit savings for AC tune up and HP tune up, estimated duct repair and replacement per-unit savings by duct location, and other relevant per-unit measure savings breakdown.

2.3.2 Process

The process evaluation was designed to support organizational learning and program adaptation. To this end, the evaluation team sought to research several elements of the program delivery and customer experience as outlined below:

- **Awareness and Engagement:** How aware are customers of the Home Energy Improvement program? What are the primary sources of information (e.g., trade allies, program website, bill inserts) that customers use to learn more about the program? How do customers typically learn about energy efficient technologies? How are trade allies engaged in the Home Energy Improvement program, and what is the most effective engagement source (e.g., Implementer, program website). Is there a need to conduct any additional marketing of the program and/or provide marketing support to trade allies?
- **Program Satisfaction:** How satisfied are participants with the overall program experience, their contractor and the quality of the installation, incentive paperwork and turnaround, comfort after the work was performed, and Duke Energy? How satisfied are trade allies with the program?
- **Program Influence:** Does the program influence participants to engage in other Duke Energy energy-efficient equipment programs? Does the program increase contractor's knowledge of energy-efficient HVAC technologies and/or other Duke Energy equipment incentive programs? Does the program increase how often participating contractors promote energy-efficient equipment to their customers? How has the contractor's

equipment stock changed, if at all, after participating in the program?

- **Challenges and opportunities for improvement:** Are there any inefficiencies or challenges with the application, incentive turnaround, or trade allies? What training opportunities could be offered to trade allies to help them more effectively sell rebated equipment? How engaged are trade allies in using the Implementer web portal or other program resources?
- **Participant characteristics and potential:** What are demographic characteristics of those participating in the program? Are there segments of the population that are not participating but have high participation potential and should be reached?
- **Code Changes:** New Seasonal Energy Efficiency Ratio (SEER) standards will be enforced for air conditioners and heat pumps manufactured or distributed on or after January 1, 2015. What are the program staff's and trade ally's perspectives on how this change will affect the market and the program?

2.4 Evaluation Overview

The evaluation team divided the approach into key tasks to meet the goals outlined:

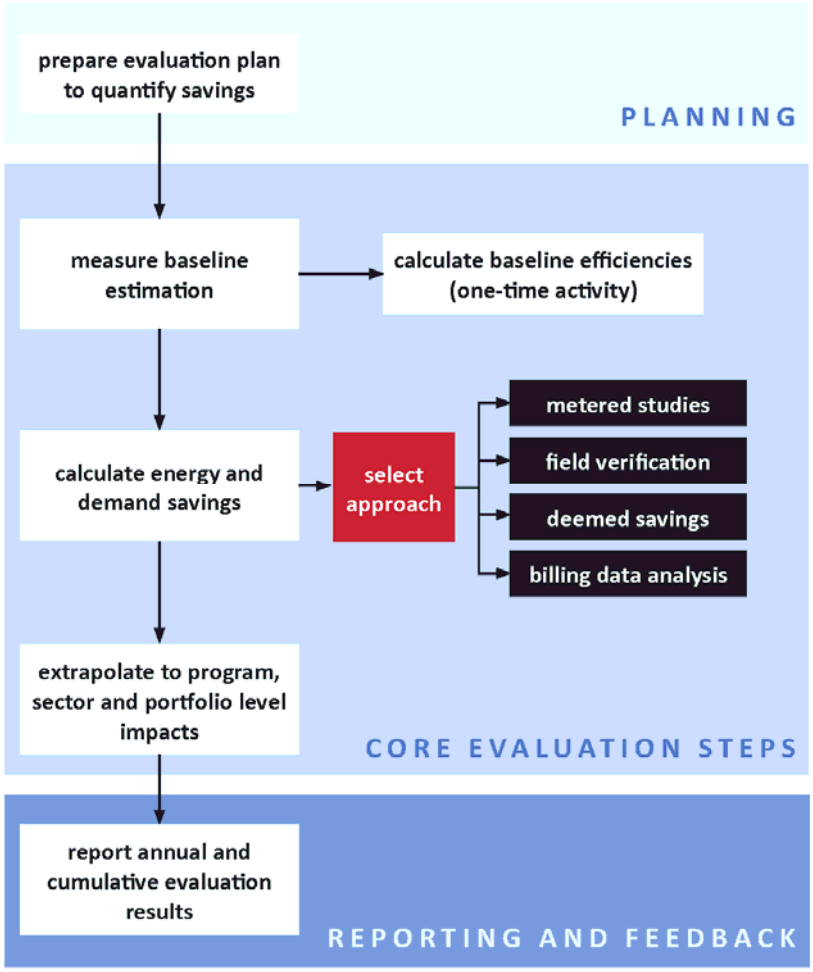
- **Task 1 –** Develop and manage evaluation work plan to describe the processes that will be followed to complete the evaluation tasks outlined in this project;
- **Task 2 –** Conduct a process review to determine how successfully the programs are being delivered to market and identify opportunities for improvement;
- **Task 3 –** Verify gross and net energy and peak demand savings resulting from the HEIP program through on-site measurements and verification activities of a sample of 2014 program participants and projects;

2.4.1 Impact Evaluation

The primary determinants of impact evaluation costs are the sample size and the level of rigor employed in collecting the data used in the impact analysis. The accuracy of the study findings is in turn dependent on these parameters. Techniques that we used to conduct our evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, include on-site inspections and measurements, telephone surveys, documentation review, best practice review, and interviews with implementation staff, trade allies, program participants, and general business customers.

Figure 2-2 demonstrates the principal evaluation team steps organized through planning, core evaluation activities, and final reporting.

Figure 2-2 Impact Evaluation Process



The evaluation team targeted sample sizes for on-site activities were based upon the evaluation team's understanding of the expected significance (or magnitude) of expected participation, the level of certainty of savings, and the variety of measures.

The evaluation generally comprised the following steps, which are described in further detail throughout this report:

- **Design the Sample for Measurement and Verification (M&V):** Review, measurement, and verification of all implemented projects is not plausible or cost-effective given the size of this program. Consequently, a sample of projects was established for M&V. In order to provide the most cost-effective sample, the evaluation team employed a Value of Information (VOI) approach. VOI is used to balance cost and rigor and follows a process to allocate the bulk of the evaluation funds to programs and projects with high impact and high uncertainty.
- **Develop Measure-Specific M&V Plans**: Upon review of the program documents, a unique M&V plan was developed for each program and measure, including a metering protocol, as applicable. M&V methods for each measure type were developed with

adherence to the International Performance Measurement and Verification Protocol (IPMVP) and other well-established engineering analysis procedures.

- **Participant Surveys and On-site Inspections:** The file review for all sampled and reviewed projects concluded with a telephone survey with the participant. For a portion of the reviewed projects, on-site audits and measurement further detailed the information obtained during the file review necessary to calculate energy savings. Table 2-4, in Section 2.4.3 below summarizes the number of surveys and on-site inspections completed. The samples were drawn to meet a 90% confidence and 10% precision level based upon the expected and actual significance (or magnitude) of program participation, the level of certainty of savings, and the variety of measures.
- **Calculate Impacts and Analyze Load Shapes:** Data collected via the on-site visits, desk reviews, utility bill consumption and telephone surveys enabled the evaluation team to calculate gross verified energy and demand savings for each project or measure. Hourly load shapes are important in calculating system on-peak demand savings, especially when the measures installed have daily and seasonal variations in the operating schedule.
- **Estimate Net Savings**: Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and incentives. The evaluation team estimated free-ridership and spillover for each project in the impact sample utilizing self-report methods through surveys with program participants. The ratio of net verified savings to gross verified savings is the net-to-gross ratio as an applied scaling factor to the reported savings.

2.4.2 Process Evaluation

Process evaluation tells the qualitative story behind the quantitative impact evaluation by understanding the program in its unique context. The goal of process evaluation is to perform a systematic assessment of an energy efficiency program by generating feedback that achieves the following outcomes:

- Document program operations
- Recommend improvements to increase the program's efficiency and effectiveness
- Assess stakeholder satisfaction

These outcomes can inform program planning, existing program implementation, or efforts to redesign a program. Process evaluations typically cover all aspects of a program including its design, implementation, marketing and outreach, data tracking, quality assurance, customer and stakeholder feedback, and market conditions. By evaluating the broad context in which a program operates, evaluators can recommend realistic improvements. Evaluators typically examine program aspects through the following mechanisms:

- Database and document review
- Interviews with program staff and key stakeholders, such as trade allies
- Surveys with customers

- Benchmarking research
- Marketing review

Process evaluation activities also inform the calculation of a NTG ratio. Information gathered from customers, nonparticipants, and trade allies can be measured and analyzed to form the basis of a NTG ratio. For example, participant surveys used to assess participant satisfaction also provide opportunity to ask participants about their motivations for participating and the influence of the program on their decisions, both of which are key components of a free ridership calculation. Similarly, the participant surveys are used to assess whether participants installed additional energy savings measures, which could be attributed to spillover.

2.4.3 Summary of Activities

Techniques we utilized to conduct the evaluation, measurement, and verification (EM&V) activities, and to meet the goals for this evaluation, included field inspection and metering, analysis of collected billing data, telephone and web surveys with program participants, documentation reviews and in-depth interviews (IDI) with utility staff, implementer, and trade allies. Table 2-4 provides a summary of the activities Nexant conducted as part of the Home Energy Improvement program process and impact evaluation.

Table 2-4 Summary of Evaluation Activities

Target Group	2014 Population	Sample	Confidence/ Precision	Method
Impact Activities				
Measure Verification	13,883	102	90/10	Telephone Survey
On-Site Measurement	6,984	42	80/10	Field inspection and metering
Billing Analysis	2,649	2,649	census	Billing Analysis
Process Activities				
Duke Energy Program Staff	~5	1	n/a	In-Depth Interview (IDI)
Implementer Staff	~5	2	n/a	IDI
Most Active Trade Allies	~20	10	n/a	IDI
Trade Allies	~500	70	90/10	Telephone Survey
Participants – Single Family	7,866	75	90/10	Telephone Survey
Participants – Multifamily	204	30	90/15	Telephone Survey

2.5 Sample and Estimation

The gross and net verified energy and demand savings estimates presented for the HEIP program were generally determined through the observation of key measure parameters among a sample of program participants. A census evaluation would involve surveying, measuring, or otherwise evaluating the entire population of projects within a population. Although a census

approach would eliminate the sampling uncertainty for an entire program, the reality is that M&V takes many resources both on the part of the evaluation team and the program participants who agree to be surveyed or have site inspections conducted in their home or business. When a sample of projects is selected and analyzed, the sample statistics can be extrapolated to provide a reasonable estimate of the population parameters. Therefore, when used effectively, sampling can improve the overall quality of an evaluation study. By limiting resource-intensive data collection and analysis to a random sample of all projects, more attention can be devoted to each project surveyed.

The nuances and tradeoffs considered by the evaluation team when developing sampling approaches varied by measure across the program and are discussed in more detail in Section 3 and Section 4. However, several common objectives were shared across measures and research objectives. The most important sampling objective was representativeness – that is that the projects selected in the evaluation were representative of the population they were selected from and would produce unbiased estimates of population parameters. A second key sampling objective was to consider the value of information being collected and align sample allocations accordingly. This effort generally involves considering the size (contribution to program savings) and uncertainty associated with the area being studied and making a determination about the appropriate level of evaluation resources to allocate.

The evaluation team relied primarily on Mean-Per-Unit estimation for the HEIP program and separated the program population into a series of homogenous measure categories. This approach works well for residential programs that include a large number of rebates for similar equipment types where the evaluation objective is to determine an average kWh savings per rebated piece of equipment. With mean-per-unit estimation the average kWh savings or NTG ratio observed within the sample is applied to all projects in the population. For several measures the characteristics observed within the evaluation sample were supplemented with parameter values that were available for all members of the population in the program tracking system. For example, the program tracking system stores the cooling capacity (BTU/hour) for every rebated ASHP so the evaluation team used the population mean cooling capacity when calculating average per-unit energy savings rather than the sample mean.

2.5.1 Stratification

The evaluation team used sample stratification for the gross impact, net impact, and process evaluation sampling. Stratification is a departure from simple random sampling (SRS), where each sampling unit (customer/project/rebate/measure) has an identical likelihood of being selected in the sample. Stratified random sampling refers to the designation of two or more sub-groups (strata) from within a program population prior to the selection process. Whenever stratification was employed the evaluation team took great care to ensure that each sampling unit within the population belonged to one (and only one) stratum. In each program sample design where stratification was used, the probability of selection is different between strata and this difference must be accounted for when calculating results. The inverse of the selection probability is referred to as the *case weight* and is used in estimation of impacts when stratified

random samples are utilized. Consider the following simplified example in Table 2-5 based on a fictional program with two measures; central air conditioners and heat pump water heaters.

Table 2-5 Case Weights Example

Measure	Population Size	Sample Size	Case Weight
Central Air Conditioner	15,000	30	500
Heat Pump Water Heater	6,000	30	200

Because heat pump water heaters are sampled at a higher rate (1-in-200) than central air conditioners (1-in-500), each HPWH sample point carries less weight in the program results than an individual CAC sample point. In general, the evaluation team designed samples so that strata with high case weights had low per-unit impacts or were well-understood measures.

The evaluation team felt that stratification was advantageous and utilized it in the sample design for a variety of reasons across the program:

- Increased precision of the within-stratum variability was expected to be small compared to the variability of the population as a whole. Stratification in this case allows for increased precision or smaller total sample sizes, which lowered evaluation costs.
- It enabled the evaluation team to ensure that a minimum number of units within a particular stratum will be verified. For example, HEIP participation in 2014 was dominated by ASHP, CAC, and duct sealing so a simple random sample would have likely only returned zero or one heat pump water heaters. The evaluation team felt it was important to develop primary research results for less common offerings, therefore separate strata were created.
- It is easy to implement a value-of-information approach through which the largest measures are sampled at a much higher rate than smaller projects by creating size-based strata.

2.5.2 Presentation of Uncertainty

There is an inherent risk, or uncertainty, that accompanies sampling, because the projects selected in the evaluation sample may not be representative of the program population as a whole with respect to the parameters of interest. As the proportion of projects in the program population that are sampled increases, the amount of sampling uncertainty in the findings decreases. The amount of variability in the sample also affects the amount of uncertainty introduced by sampling. A small sample drawn from a homogeneous population will provide a more reliable estimate of the true population characteristics than a small sample drawn from a heterogeneous population. Variability is expressed using the coefficient of variation (C_v) for programs that use simple random sampling, and an error ratio for programs that use ratio estimation. The C_v of a population is equal to the standard deviation (σ) divided by the mean (μ) as shown in Equation 1.

Equation 1 Coefficient of Variation

$$C_v = \frac{\sigma}{\mu}$$

Equation 2 shows the formula used to calculate the required sample size for each evaluation sample, based on the desired level of confidence and precision. Notice that the C_v term is in the numerator, so the required sample size will increase as the level of variability increases. For programs that rely on ratio estimation error ratio replaces the C_v term in Equation 2. Results of the previous Duke Energy evaluations and Nexant evaluations from other jurisdictions were the primary source of error ratio and C_v assumptions for the 2014 HEIP evaluation.

Equation 2 Required Sample Size

$$n_0 = \left(\frac{z * C_v}{D}\right)^2$$

Where:

n_0 = *The required sample size before adjusting for the size of the population*

Z = *A constant based on the desired level of confidence (equal to 1.645 for 90% confidence two-tailed test)*

C_v = *Coefficient of variation (error ratio for ratio estimation)*

D = *Desired relative precision*

The sample size formula shown in Equation 2 assumes that the population of the program is infinite and that the sample being drawn is reasonably large. In practice, this assumption is not always met. For sampling purposes, any population greater than approximately 7,000 may be considered infinite for the purposes of sampling. For smaller, or finite, populations, the use of a finite population correction factor (FPC) is warranted. This adjustment accounts for the extra precision that is gained when the sampled projects make up more than about 5% of the program savings. Multiplying the results of Equation 2 by the FPC formula shown in Equation 3 will produce the required sample size for a finite population.

Equation 3 Finite Population Correction Factor

$$fpc = \sqrt{\frac{N - n_0}{N - 1}}$$

Where:

N = *Size of the population*

n_0 = *The required sample size before adjusting for the size of the population*

The required sample size (*n*) after adjusting for the size of the population is given by Equation 4.

Equation 4 Application of the Finite Population Correction Factor

$$n = n_0 * fpc$$

Verified savings estimates always represent the point estimate of total savings, or the midpoint of the confidence interval around the verified savings estimate for the program. Equation 5 shows the formula used to calculate the margin of error for a parameter estimate.

Equation 5 Error Bound of the Savings Estimate

$$Error\ Bound = se * (z - statistic)$$

Where:

se = *The standard error of the population parameter of interest (proportion of customers installing a measure, realization rate, total energy savings, etc.) This formula will differ according to the sampling technique utilized.*

$z - statistic$ = *Calculated based on the desired confidence level and the standard normal distribution.*

The 90% confidence level is a widely accepted industry standard for reporting uncertainty in evaluation findings. Unless otherwise noted, the confidence levels and precision values presented in this report are at the 90% confidence level. The z-statistic associated with 90% confidence is 1.645.

When evaluators or regulators use the term “90/10”, the 10 refers to the relative precision of the estimate. The formula for relative precision shown in Equation 6:

Equation 6 Relative Precision of the Savings Estimate

$$Relative\ Precision_{Verified\ Savings} = \frac{Error\ Bound_{(kWh\ or\ kW)}}{Verified\ Impact_{(kWh\ or\ kW)}}$$

An important attribute of relative precision to consider when reviewing achieved precision values is that it is “relative” to the impact estimate. Therefore measures with low realization rates are likely to have larger relative precision values because the error bound (in kWh or kW) is being divided by a smaller number. This means two measures with exactly the same reported savings and sampling error in absolute terms, will have very different relative precision values, as shown in Table 2-6.

Table 2-6 Relative Precision Example

Program	Reported kWh	Realization Rate	Error Bound (kWh)	Verified kWh	Relative Precision (90%)
Measure #1	4,000,000	0.5	400,000	2,000,000	± 20%
Measure #2	4,000,000	1.0	400,000	4,000,000	± 10%

For HEIP a program-level savings estimate requires summation of the verified savings estimates from several strata. In order to calculate the relative precision for these program-level savings estimates, the Evaluation Team used Equation 7 to estimate the error bound for the program as a whole from the stratum-level error bounds.

Equation 7 Combining Error Bounds across Strata

$$Error\ Bound_{Program} = \sqrt{Error\ Bound_{Stratum1}^2 + Error\ Bound_{Stratum2}^2 + Error\ Bound_{Stratum3}^2}$$

Using this methodology, the evaluation team developed verified savings estimates for the program and an error bound for that estimate. The relative precision of the verified savings for the program is then calculated by dividing the error bound by the verified savings estimate.

3 Impact Evaluation

3.1 Methodology

An impact evaluation was performed to evaluate energy and demand savings attributable to the HEIP. The evaluation was divided into two research areas to determine gross and net savings (or impacts). Gross impacts are energy and demand savings found at a participant's home that are the direct result of a measure installed and rebated through the program. Net impacts are a reflection of the degree to which the gross savings are a result of the program efforts and funds. The evaluation team verified energy and demand savings attributable to the HEIP by conducting the following impact evaluation activities:

- Database and document review
- Sampling of participating measures
- Performing on-site metering for air source heat pump and central air conditioner replacements in single family homes to estimate hours of operation
- Reviewing billing records to inform a comparison group billing analysis for HVAC Audit participants and non-participants
- Completing telephone surveys and engineering desk reviews to verify database inputs and collect supplemental information
- Estimating gross verified savings using data collected in previous tasks
- Comparing the DEP deemed savings to gross-verified savings to determine program and measure level realization rates
- Applying attribution surveys to estimate net-to-gross ratios and net-verified savings at the program level

The impact evaluation activities resulted in adjustment factors, or realization rates, which were applied to the reported savings documented in the program tracking records. The ratio of the savings determined from the site inspections, M&V activities, or engineering calculations to the program-reported savings is the measure realization rate; the program realization rate is the weighted average for all measures in the sample. The adjusted savings obtained by multiplying the program realization rates by the program-reported savings are termed the gross savings and they reflect the direct energy and demand impact of the program's operations.

3.2 Database and Application Review

Review of the program database provided details that informed all evaluation activities. The scope of the evaluation was oriented based on information referenced from the program database, including; the rebate count for each measure, sector (single family, multifamily, or manufactured home), the region of DEP territory, deemed gross and net energy and demand savings, and measure specific installation details. In addition to the program database,

individual measure applications were reviewed to ensure that all data points were captured by the program. All this information was considered when designing approaches and methods to evaluate the program. One key detail that emerged during this review is that the deemed savings provided by the database were based on the results of the 2012 program evaluation, because the 2013 evaluation was in process until summer 2015. The reported savings values informed the program sampling for the 2014 evaluation, but all measure and program level savings used for realization rates and reported savings in the PY2014 evaluation were provided by the results of the most recent evaluation (PY2013). Table 3-1, Table 3-2, and Table 3-3 provide year-over-year energy and demand savings values for HEIP measures, including results from this evaluation as described in section 3.4.

Table 3-1 Historical Per Unit Energy Savings from Evaluation Findings (kWh)

Measure	2011	2012	2013	2014
Air Source Heat Pump	367	373	506	869
Duct Sealing	265	242	273	336
HVAC Audit	384	182	334	261
Central Air Conditioner	283	273	364	299
Insulation & Air Seal	669	504	349	364
Heat Pump Water Heater	n/a	2,885	1,462	1,978
Geothermal Heat Pump	1,725	1,725	1,725	1,725
Room Air Conditioner	n/a	125	124	124

Table 3-2 Historical Per Unit Summer Demand Savings from Evaluation Findings (kW)

Measure	2011	2012	2013	2014
Air Source Heat Pump	0.416	0.409	0.224	0.204
Duct Sealing	0.182	0.170	0.102	0.077
HVAC Audit	0.330	0.157	0.272	0.167
Central Air Conditioner	0.432	0.411	0.324	0.211
Insulation & Air Seal	0.311	0.235	0.223	0.257
Heat Pump Water Heater	N/A	0.496	0.241	0.094
Geothermal Heat Pump	0.690	0.690	0.690	0.684
Room Air Conditioner	N/A	0.100	0.099	0.099

Table 3-3 Historical Per Unit Winter Demand Savings from Evaluation Findings (kW)

Measure	2011	2012	2013	2014
Air Source Heat Pump	0.038	0.044	0.253	0.220
Duct Sealing	0.431	0.387	0.339	0.049
HVAC Audit	0.380	0.180	0.164	0.035
Central Air Conditioner	0.035	0.037	0.087	0.087
Insulation & Air Seal	0.668	0.515	0.339	0.082
Heat Pump Water Heater	N/A	0.567	0.541	0.541
Geothermal Heat Pump	0.000	0.000	0.000	0.000
Room Air Conditioner	N/A	0.010	0.010	0.010

3.3 Sampling Plan and Achievement

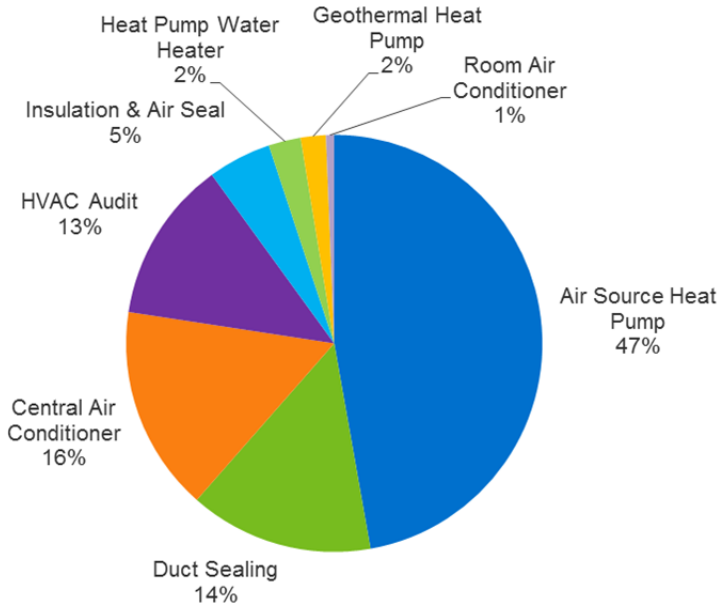
To provide representative results, and meet program evaluation goals, a sampling plan was created to guide all evaluation activity. A random sample was created to target 90/10 confidence and precision at the program level, assuming a coefficient of variation (C_v) equal to 0.5. Using standard energy efficiency practice, 68 unique activities were required to achieve the 90/10 target. Due to additional areas of interest the evaluation team oversampled to gain additional insight.

For program year 2014, equipment replacement measures of air source heat pumps (ASHPs) and central air conditioners (CACs) were the largest measure contributors for both energy and demand savings. Therefore, these measures received the largest share of research activities and the highest level of rigor with on-site equipment measurement.

While a single point estimate of measure performance can be theoretically estimated with only a couple of data points, the evaluation team preferred to collect a minimum number of research points to draw sufficient confidence in a given result for reporting and/or comparison purposes. For this program, with multiple measures, the evaluation team sought to obtain a minimum of 11 data points for a given researched measure or permutation of interest, using a confidence/precision criteria of 80/20.

The evaluation team requested a database extract of 2014 program results, which included details on measures installed, building type (single, multifamily, or manufactured), region, and deemed savings. The distribution of deemed energy savings, shown in Figure 3-1, provided insight to measures with greater influence on total program savings.

Figure 3-1 Reported Energy Savings



HVAC related measures, including replacements, audits (tune-ups), and duct sealing, account for 92% of reported energy savings and were the primary focus of evaluation tasks.

In addition to program savings the evaluation team reviewed the uncertainty of deemed savings estimates to past evaluations, other impact evaluations, and multiple technical reference manuals. The details of the uncertainty analysis are referenced in Table 3-4.

Table 3-4 Comparison of DEP HEIP Energy Savings Estimates to Peer Group Estimates

Measure	DEP HEIP PY11 Evaluation (kWh)	DEP HEIP PY13 Evaluation (kWh)	Georgia Power 2014 Evaluation (kWh)[1]	Ohio 2010 (adjusted) TRM (kWh)[2]	Indiana 2012 TRM (kWh)[3]	Texas 2015 TRM (kWh)[4]	Arkansas TRM (kWh)[5]
Attic Insulation & Air Seal	669	349	223/672[6]	4,604[7]	5,411[8]	n/a	n/a
Central AC Replacement	283	364	361	234	95	429	633
Air Source Heat Pump Replacement	367	506	588/882[9]	519	860	814	1,453
HVAC Audit	384	334	n/a	153	88	n/a	n/a
Duct Sealing	265	273	1,010/1,921[10]	153	121	n/a	n/a
Heat Pump Water Heater	2,890	1,462	1,477	2,076	2,076	1,737	n/a
Room Air Conditioner	125	124	107	35	45	n/a	107
Geothermal Heat Pump	1,725	1,725	n/a	2,118	2,501	n/a	1,910

[1] July 2015 Evaluation Report Public Filing

[2] State of Ohio Energy Efficiency Technical Reference Manual. August 6, 2010; Weather dependent energy savings values were scaled via heating degree and cooling degree ratios to Raleigh, North Carolina

[3] Indiana Technical Reference Manual, version 1.0. December, 2012

[4] Texas Technical Reference Manual, version 3.0, Volume 2 Residential Measures. April, 2015. Amarillo was selected as the most similar location to DEP service territory

[5] Arkansas Statewide Technical Reference Manual, Version 3.0. August, 2013. Fort Smith was selected as the most similar location to DEP service territory

[6] First value represents electric savings from a gas heated home; Second value represents electric savings from an electrically heated home

[7] Value represents electric savings from an electrically heated home

[8] Value represents electric savings from an electrically heated home

[9] First value represents electric savings from a multifamily residence; Second value represents electric savings from a single family residence

[10] First value represents electric savings from a gas heated home; Second value represents electric savings from an electrically heated home

Two measures, attic insulation and heat pump water heater, show large energy savings variations in past evaluations and savings values from other references are also inconsistent. Due to this, additional emphasis was placed these measures.

Evaluation tasks were separated between single family and multifamily buildings, where applicable, to help inform potential savings differences. The program also included manufactured homes, but measures installed in these premises were a very small share of the program (<0.5%), therefore the sampling plan focused on other premise types. The sampling plan designed for the 2014 evaluation is included in Table 3-5.

Table 3-5 Sampling Plan

	Metering Sites		Billing, Analysis Telephone Survey, or Desk Review		
Measure	Single Family	Multifamily	Single Family	Multifamily	Targeted
Air Source Heat Pump	25	0	0	11	36
Central Air Conditioner	17	0	0	11	28
Duct Sealing	0	0	22	0	22
HVAC Audit	0	0	Census	Census	Census
Attic Insulation and Air Seal	0	0	5	6	11
Heat Pump Water Heater	0	0	5	0	5
Geothermal Heat Pump	n/a	n/a	n/a	n/a	n/a
Room Air Conditioner	n/a	n/a	n/a	n/a	n/a
Total[1]	**42**	**0**	**32**	**28**	**102**

3.4 Description of Analysis

The evaluation team applied varying analysis techniques depending on the measure, the measure's prominence within the program, and the availability of data on baseline and retrofit savings. A database of program participation provided useful information about measures installed, participants, and reported savings, as well as additional inputs that varied by measure and informed the analysis. Measure applications were reviewed to determine the type of data requested from the contractor/homeowner, ensure it was tracked by the program, and to help explain data points that needed additional investigation. Table 3-6 shows the type of analysis applied to each measure, and also distinguishes between single family and multifamily homes.

[1] Excludes data points used in census for HVAC Audit billing analysis

Table 3-6 Analysis Approach

Measure	Home Type	Analysis Approach
Air Source Heat Pump	Single Family	Metering Study
	Multifamily	Telephone Surveys
Central Air Conditioner	Single Family	Metering Study
	Multifamily	Telephone Surveys
Duct Sealing	Single Family	Telephone Surveys
HVAC Audit	Single Family	Billing Analysis
	Multifamily	Billing Analysis
Attic Insulation and Air Seal	Single Family	Telephone Surveys
	Multifamily	Telephone Surveys
Heat Pump Water Heater	Single Family	Telephone Surveys
Geothermal Heat Pump	Single Family	Deemed
Room Air Conditioner	Single Family	Deemed

3.4.1 Metering study

Given the large share of program savings from HVAC replacements, specifically ASHPs and CACs, a metering approach was applied for the analysis of these two measures. The program database provided thorough detail on the efficiency and cooling capacity of the retrofit HVAC systems, and these data points are two of the three inputs applied to the engineering calculation for residential HVAC cooling savings. The remaining data point, hours of operation, has the highest level of uncertainty, and the metering study focused on this to estimate the cooling Effective Full Load Hours ($EFLH_{cool}$) for the program. The methodology applied for this evaluation follows the M&V Plan presented in the Uniform Methods Project Chapter 4: Small Commercial and Residential Unitary Split System HVAC Cooling. The approach most closely resembles IPMVP Option A: Partial Retrofit Isolation/Metered Equipment.

3.4.1.1 Data Collection

To complete the metering study, field engineers were dispatched to the homes of single family, HEIP participants who received a 2014 rebate for either an ASHP or CAC replacement. Participants who took part in the metering study were provided $100 incentives, divided across the three visits to their home. In total 42 visits were conducted across all regions (northern, eastern, southern, and western) of the utility territory, between mid-May and the first week of June, 2015. For the first phase of the evaluation study the meters were read-out and re-launched between mid-August 17th and the first week of September, 2015. Data from a few metering participants was unavailable, due to inaccessible data[2], resulting in 38 data sets to be utilized in the regression and analysis. Meters were left in place to capture additional information on shoulder season and winter month operation which will inform the 2015 program year evaluation.

[2] Two participants were unresponsive to calls for data collection, one participant relocated, and one data logger was damaged.

While on-site, field engineers completed a brief survey with the program participants, collected relevant data on system nameplate specifications to verify database inputs and provide additional data, and installed metering devices on the condensing units and blower fans.

Three metering devices were installed at each home. The primary data-point was the electrical current provided to the condensing unit located on the exterior of the home. HOBO CTV-A current transducers (CT) were connected to the lines supplying electricity to the unit, and paired with U12-006 data loggers that stored each data point. The result was a trended data log of electrical current over the period between when the logger was placed and read-out. In addition to placing the logging equipment, field engineers characterized system operation of the condensing unit with spot measurements of voltage and power factor.

The second metering data point was the electrical current supplied to the blower fan, a device that circulates air through the duct system and around the home. Collection of this data point used the same equipment (CT and data logger) as the condenser data loggers, except they were installed inside the home. Blower fan operation was also characterized with spot measurements of voltage and power factor. In addition to electrical current measurements on the blower fan, the field engineers installed a temperature monitoring device inside the duct system.

Data collected during the metering study was used in a regression analysis that supplied an estimated $EFLH_{cool}$ for the single family portion of the HEIP.

3.4.1.2 Analysis, Regression, ELFH Calculation

Three primary inputs were required to estimate annual cooling savings for ASHPs and CACs:

1. Capacity - the size (kBtuh) of the efficient unit
2. Efficiency - the SEER or EER value of the efficient unit
3. Equivalent Full Load Hours ($EFLH_{cool}$) - how often the unit is in operation

$EFLH_{cool}$ is an effective measure for estimating the cooling requirement for a specific region and provides a comparison of cooling energy use between regions and equipment types. The general form for the $EFLH_{cool}$ term is shown in Equation 8.

Equation 8 Equivalent Full Load Hours

$$EFLH_{cool} = \sum_{h=1}^{8760} \frac{Estimated\ Hourly\ Load\ (kW)}{Connected\ Load\ (kW)}$$

Where:

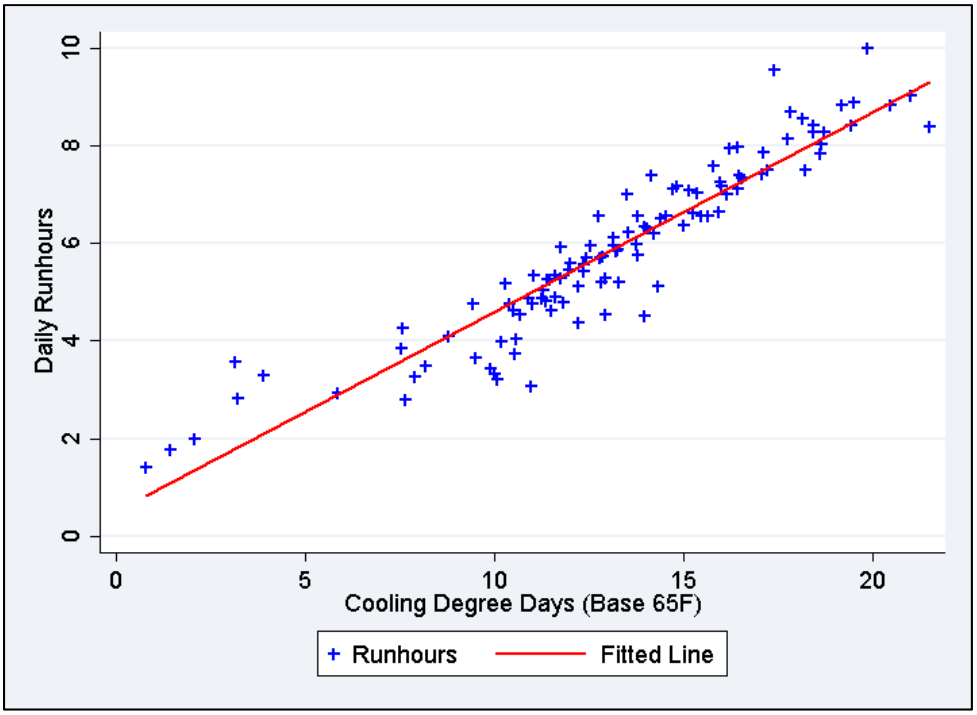
Estimated Hourly Load = Electric demand of the unit in hour *h*
Connected Load = Electric demand draw of the unit when operating at full power

The evaluation team assigned a connected load to each unit in the sample using nameplate

size, efficiency, and spot measurements of voltage and power factor collected on-site. The metered load for each hour was then divided by the connected load to calculate the unit's runtime for the hour.

The evaluation team developed weather-normalized estimates of $EFLH_{cool}$ via regression modeling of the observed daily runtimes for each unit as a function of the observed cooling degree days (CDD) at each of the four Carolina weather stations. Figure 3-2 shows the relationship between average runtimes (hours) and CDD (base 65°F) for the entire metered sample. Each blue + represents the average metered runtime (in hours) of the 38 homes for a given day during the summer of 2015.

Figure 3-2 Daily Run hours vs. Cooling Degree Days – Full Sample

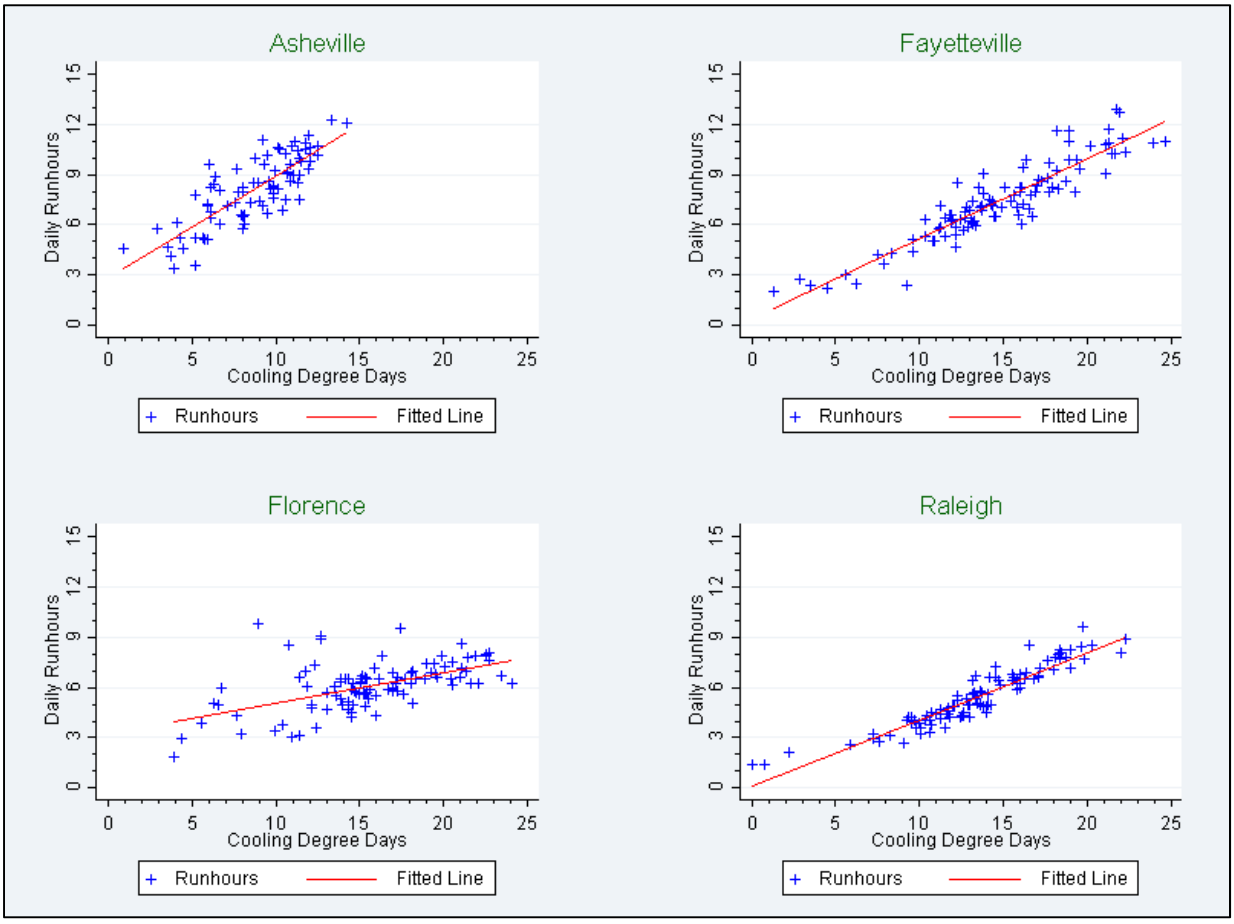


The evaluation team calculated the relationship between average runtime and CDD separately for each weather station. As expected, each region shows a strong positive correlation between CDD and run-hours. Figure 3-3 shows the relationship between CDD and daily cooling equipment run-hours for each region.

Table 3-7 DEP Regions and Weather Stations

DEP Region	Weather Station
Northern	Raleigh, NC
Eastern	Florence, SC
Southern	Fayetteville, NC
Western	Asheville, NC

Figure 3-3 Daily Run-hours vs. Cooling Degree Days – By Region



The evaluation team used a linear regression model specification to quantify the average relationship between runtime and average daily temperature. In addition, the evaluation team opted to suppress the intercept term of the model in order to "fix" it at zero and force the regression through the origin. This approach assumes that when CDD equals zero (i.e. an average daily temperature of 65°F or below), customers do not require any cooling energy use and thus, daily runtime also equals zero.

Table 3-8 shows the regression output for the entire metered sample across all four regions. The key value to consider is the CDD coefficient of 0.434. This term indicates that DEP homes in the HEIP used an average of 0.434 hours, or approximately 26 minutes, of added air conditioning per cooling degree day.

Table 3-8 Regression Output

Model Term	Coefficient	Std. Err.	t-stat	P-value	[95% Conf.	Interval]
CDD	0.434	0.004	101.36	0.000	0.426	0.443

The evaluation team developed a weather normalized estimate of annual runtime using the CDD coefficient and hourly TMY3 data for the four Carolina weather stations. The calculated average annual CDD for each region and used those values to calculate a weighted average CDD for the entire DEP territory. Average CDD was weighted by DEP's regional population. Table 3-9 shows the average annual CDD and population weights for each region.

Table 3-9 Population Weights and Annual CDD – By Region

Region	Population	Population Weight	Typical Annual CDD
Western	490	7%	695
Southern	982	14%	1,483
Eastern	1,879	27%	2,066
Northern	3,634	52%	1,482
Entire Sample	**6,985**	**100%**	**1,584**

The evaluation team ran a similar linear regression model for each weather station to get individual model coefficients for each region. The relatively low annual CDD for Asheville, NC located in the Blue Ridge Mountains, indicates that the region typically has mild summers relative to the other territories. Likewise, the high annual CDD value for Florence, SC indicates that this region, located farther south than the other regions, typically experiences warmer summers. Although Asheville has the lowest CDD, it has the highest coefficient on CDD. This means that customers in this region use more AC when it gets hot. The opposite is true for Florence, SC.

The $EFLH_{cool}$ for each region was calculated by multiplying the region's typical annual CDD (base 65°F) by the CDD coefficient determined by the regression output. Table 3-10 shows regression coefficients, annual CDD and estimated $EFLH_{cool}$ values for each region, as well as for the full metered sample.

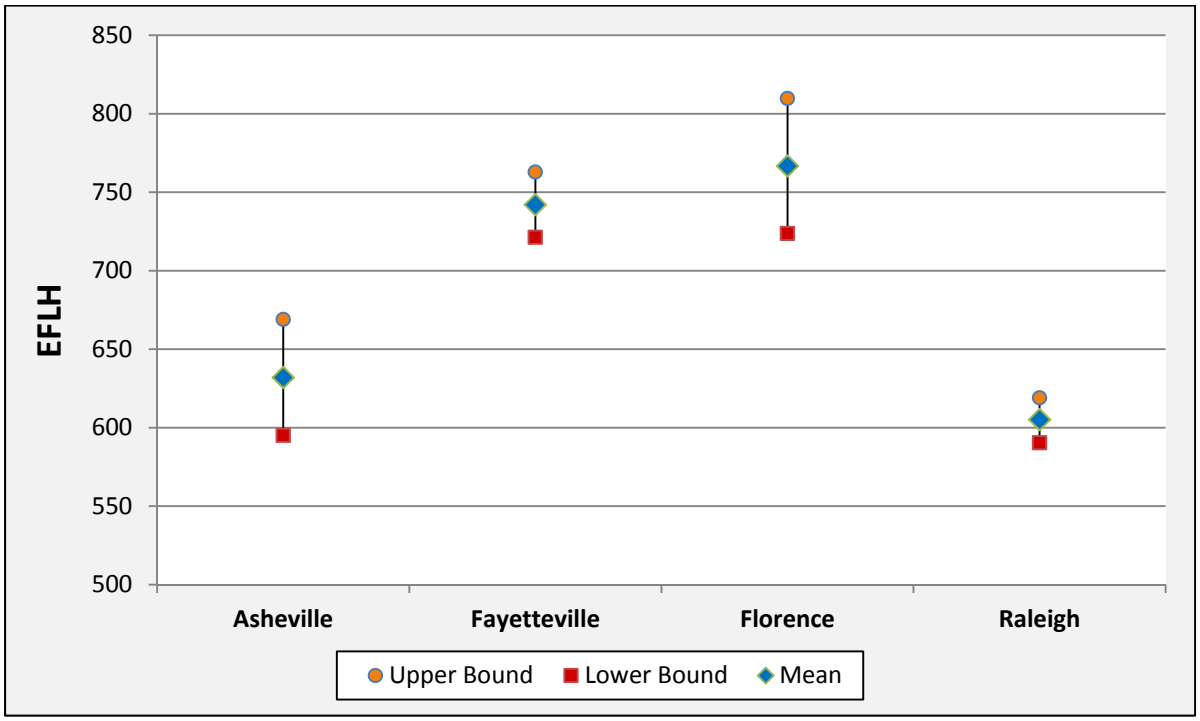
Table 3-10 EFLH Calculation – By Region

Region	Sample Points	Regression Coefficient	Annual CDD (Base 65°F)	EFLH (hours)
Western	4	0.909	695	632
Southern	6	0.500	1,483	742
Eastern	6	0.371	2,066	767
Northern	22	0.408	1,482	605
Entire Sample	**38**	**0.434**	**1,584**	**688**

The evaluation team's sample included a total of 38 metered homes from among the four

regions, with a majority of the homes (57%) located in the Raleigh, NC region. In this case, the sample size of each region determines the margin of error surrounding $EFLH_{cool}$ estimates. Larger sample sizes provide more precise estimates of the population, while small sample sizes generate wider (i.e. less precise) confidence around the model's estimate. Figure 3-4 shows the 95% confidence intervals around each region's $EFLH_{cool}$ estimate. This means there is a 95% chance the confidence interval of each region contains the true population $EFLH_{cool}$.

Figure 3-4 95% Confidence Interval for EFLH – By Region



Field collected meter data also provided the peak summer demand coincidence factor (CF_{summer}). Just as $EFLH_{cool}$ is a necessary component of the annual energy savings calculation, peak coincidence factor is a necessary component of the peak demand savings calculation. Peak summer demand coincidence factor is defined as the probability that the equipment is operating during system peak hours. The basic form of the CF_{summer} term is similar to the $EFLH_{cool}$ form presented in Equation 8. The form for the CF_{summer} term is shown in Equation 9.

Equation 9 Coincidence Factor

$$CF_h = \frac{Load_h\ (kW)}{Full\ Load\ (kW)}$$

Where:

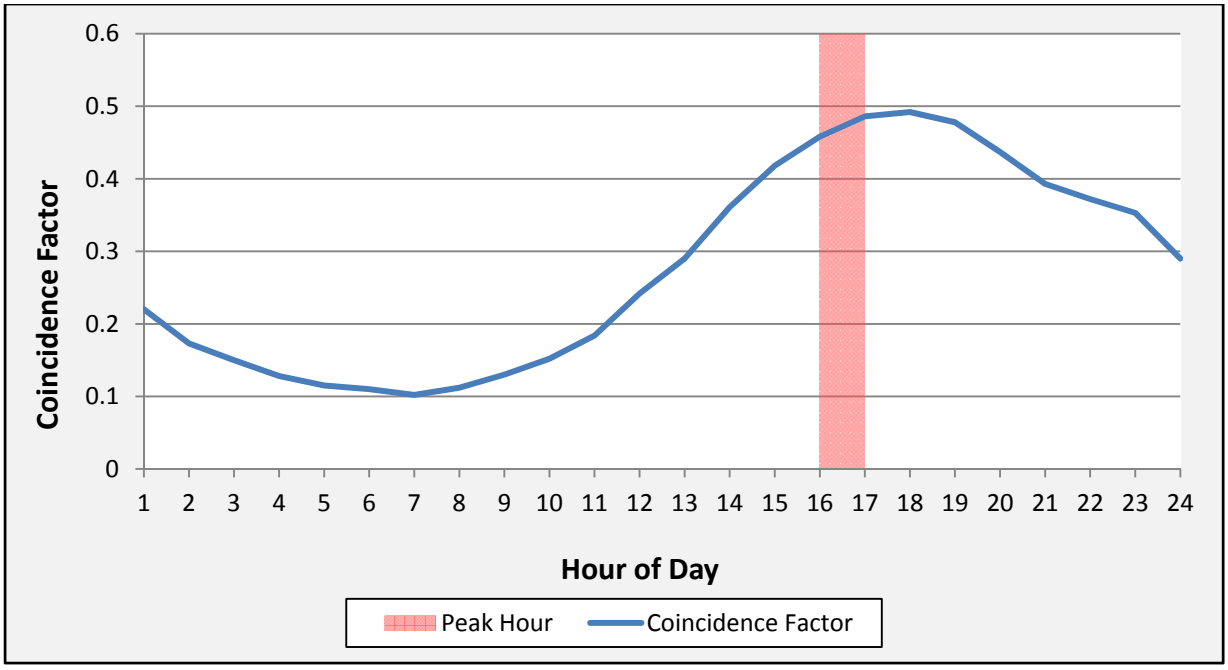
Hourly Load = Electric demand of the unit at hour *h*
Full Load = Electric demand draw of the unit when operating at full power

The evaluation team calculated the peak demand coincidence factor in order to estimate peak

demand savings for the full sample of 38 homes. A system's peak demand period refers to the period of time during which the highest level of power is needed to satisfy electric demand. Duke Energy defines its summer peak period as July weekdays during hour ending 17 (between and 4:00 pm and 5:00 pm).

Figure 3-5 shows average coincidence factors for each hour of the day during July 2015 weekdays for the 38 sampled homes. The system peak – hour ending 17 – is highlighted. The coincidence factor during the system's peak period is 0.486.

Figure 3-5 Summer Peak Demand Coincidence Factor



3.4.1.3 Findings

Savings estimates for the ASHP and CAC measures were determined by engineering algorithms shown in Equation 10 through Equation 14, using the inputs provided in Table 3-11 and Table 3-13. Since the metering period for this evaluation was May – September, 2015, primary data on the heating Effective Full Load Hours ($EFLH_{heat}$) and winter coincident factor for ASHPs was not available. Consequently, the evaluation team applied a calibrated $EFLH_{heat}$ value from primary data collected in a similar study completed for Georgia Power Company in 2014 based on the difference in heating degree days between the utility territories. The $EFLH_{heat}$ value will be updated in the next evaluation based on metered results from homes within DEP territory.

Equation 10 Air Source Heat Pump Energy Savings

$$\Delta kWh_{ASHP} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) + EFLH_{heat} \times Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right)$$

Equation 11 Air Source Heat Pump Summer Demand Savings

$$\Delta kW_{summer} = Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times CF_{summer}$$

Equation 12 Air Source Heat Pump Winter Demand Savings

$$\Delta kW_{winter} = Cap_{heat} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) \times CF_{winter}$$

Table 3-11 Inputs for Air Source Heat Pump Savings

Input	Units	Single Family Value	Multifamily Value	Source
$EFLH_{cool}$	Hours	688	619	Metering study
$EFLH_{heat}$	Hours	1,295	1,283	Proxy from metering study for GPC
$Capacity_{cool}$	kBTUh	31.8	28.4	Program database average
$Capacity_{heat}$	kBTUh	29.7	26.5	Adjusted program database average
$SEER_{base}$	SEER	13	13	Federal minimum
$SEER_{ee}$	SEER	15.8	15.4	Program database average
$HSPF_{base}$	HSPF	7.7	7.7	Federal minimum
$HSPF_{ee}$	HSPF	8.9	8.6	Program database average
CF_{summer}	unitless	0.486	0.486	Metering study
CF_{winter}	unitless	0.432	0.432	Proxy from metering study for GPC

Table 3-12 Air Source Heat Pump Gross Savings

Home Type	Cooling Savings (kWh)	Heating Savings (kWh)	Total Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
Single Family	290	584	874	0.204	0.221
Multifamily	211	350	561	0.165	0.162

Equation 13 Central Air Conditioner Energy Savings

$$\Delta kWh_{CAC} = EFLH_{cool} \times Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right)$$

Equation 14 Central Air Conditioner Summer Demand Savings

$$\Delta kW_{summer} = Cap_{cool} \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) \times CF_{summer}$$

Table 3-13 Inputs for Central Air Conditioner Savings

Input	Units	Single Family Value	Multifamily Value	Source
$EFLH_{cool}$	Hours	688	619	Metering study
$Capacity_{cool}$	kBTUh	31.6	28.1	Program database average
$SEER_{base}$	SEER	13	13	Federal minimum
$SEER_{ee}$	SEER	15.8	15.4	Program database average
CF_{summer}	unitless	0.486	0.486	Metering study
Winter Demand	kW	0.047	0.036	Deemed from 2013 evaluation

Table 3-14 Central Air Conditioner Gross Savings

Home Type	Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
Single Family	300	0.212	0.047
Multifamily	209	0.164	0.036

3.4.1.4 Baseline Change

Starting on January 1, 2015 there will be a shift in the minimum efficiency standards for residential ASHPs and CACs, with the transition towards the new minimum requirements of 14 SEER and 8.2 HSPF for ASHPs and CACs in Duke Energy Progress' territory. An 18-month grace period will be observed and will permit the installation of units that comply with the old efficiency standards (13 SEER and 7.7 HSPF) until June 30th, 2016. This change will influence the HEIP program by reducing savings from ASHP and CAC replacements as the minimum efficiency baseline transitions between the old and new standards.

Based on a review of the participating equipment in the program year 2014 database, the shift in minimum efficiencies will have a minor impact on the eligibility of future replacement systems. All 2014 rebated ASHPs and CACs reported a SEER level of 15 or higher (as required by the program), and 4.4% of ASHPs reported an HSPF below the new standard of 8.2. A larger concern will be the reduction of savings as baseline efficiency levels increase, and how this affects the cost-effectiveness of these measures. Based on the 2014 program database, averages for retrofit SEER, HSPF, and capacity used to calculate a savings estimate, and a shift in the code minimum baselines from 13 to 14 SEER and 7.7 to 8.2 HSPF, results in an estimated savings reduction of at least 40% for these two measures. The program team should consider how to define a measure level baseline for the 2016 and beyond program years, as system efficiency minimum requirements transition to the new standard.

3.4.2 Billing analysis

Billing analysis is a general term for evaluation approaches that apply statistical models to

customers' billed consumption. The goal of these models is to detect differences in consumption that can be attributed to the utility-sponsored energy efficiency program intervention. Billing analysis is another approach for answering the general question of impact evaluations: what would participants' energy consumption have been in the absence of the program?

3.4.2.1 HVAC Audit

The DEP HVAC Audit measure includes a suite of equipment diagnostic services, onsite testing, and general upkeep designed to improve HVAC system operations and efficiency. The measure applies to common HVAC equipment types; unless the equipment is already achieving 90% efficiency (calculated when onsite testing is performed during the audit). The savings achieved by the HVAC Audit accomplishes an improvement to existing equipment, rather than the installation of new, efficient, program-compliant measures or equipment. Replicating or measuring the relative operating efficiency of the HVAC system before and after the HVAC audit is practically impossible, therefore suggesting that billing analysis is the most cost-effective evaluation option.

Billing analysis compares the energy consumption of program participants after the HVAC Audit is performed to a baseline that represents what consumption would have been if the audit was never performed. There are generally two options for this baseline: 1) the consumption of audit participants in the time period prior to the audit, or 2) the consumption of non-participating customers in the time period prior to the Audit. Using the consumption of non-participating customers to establish a comparison group is the preferred approach.

A valid comparison group of non-participating customers is preferred because using each customer's pre-audit consumption as a baseline does not control for external factors that may affect consumption, such as changes in the economy, or any number of other factors that could cause substantial changes to customer's electricity consumption. In contrast, comparison groups composed of non-participating customers control for external factors that may affect broad consumption trends. Valid comparison groups lend credence to the assertion that the only difference between program participants and non-participants is program participation itself. In addition, a valid comparison group, composed of non-participants in the post-audit period, provides a reliable indicator of baseline consumption against which to measure program energy savings.

DEP provided the evaluation team with billing records for all residential customers. The records include a customer identifier and billed energy consumption (kWh) from January 2013 to August 2015. DEP also provided customer premise data that indicated the type of residential structure currently known to be associated with each customer account. The structure type consists of either single family or multifamily residential properties.

Data preparation and analysis identified a valid comparison group of non-participants by taking the following actions:

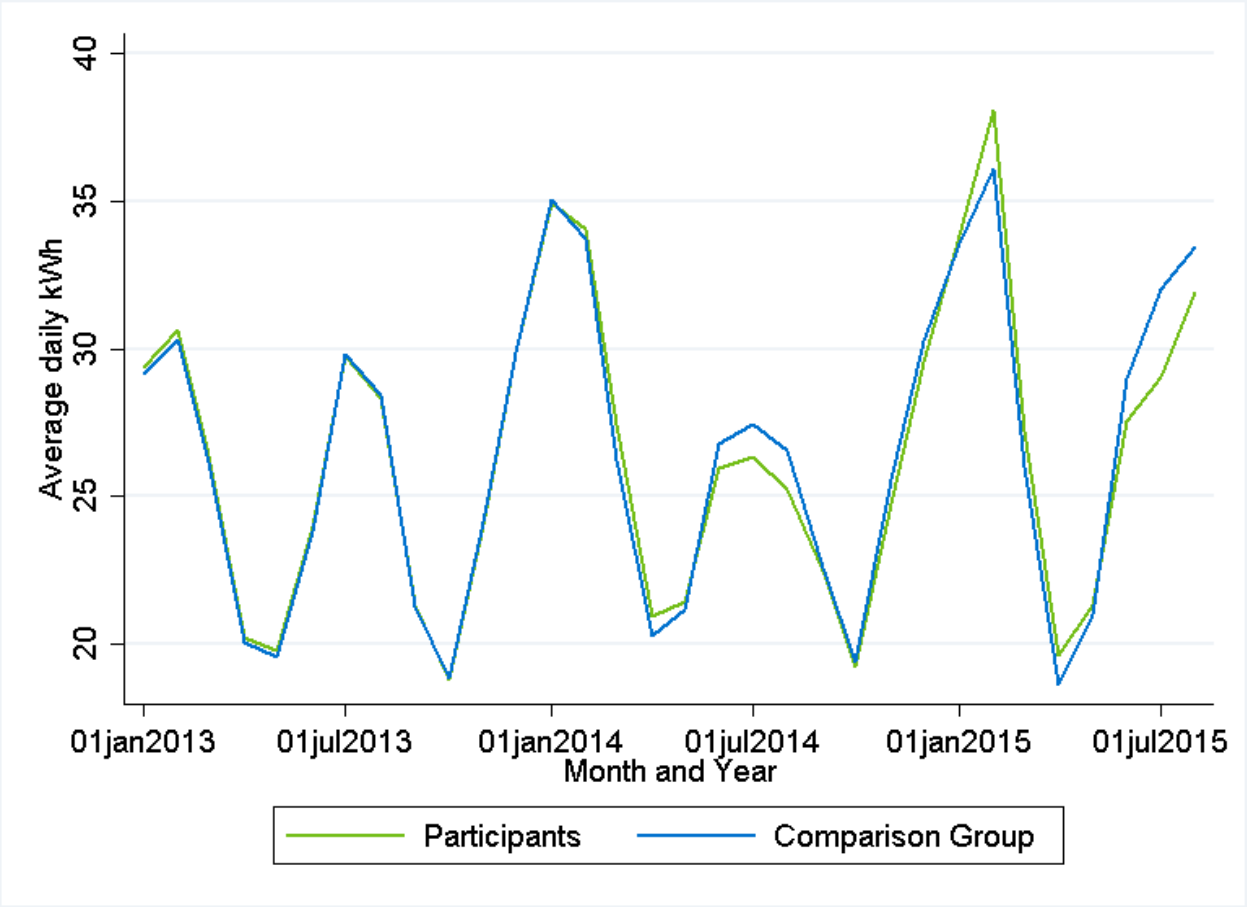
- Verified billed consumption and removed accounts that exhibit billing anomalies, such as billing increments that exceed 63 days or reported implausible energy consumption values.
- Removed customers without 30 months of billed consumption, e.g. those accounts that did not have a continuous billing record in the time period for which data were available.
- Restricted participants to accounts that received an audit only. Including consumption for customers that participated in multiple HEIP measures can potentially confound impact estimates and reduce statistical precision; 8.2% of HVAC audit participants also installed other program-eligible measures.
- Assembled weather station data for each of the four DEP regions.
- Merged customer billing and weather data so that weather-normalized impacts could be estimated.
- Calculated average daily consumption for each customer in each billing period using a consistent definition of each time period for all customers.
- Matched each participating customer with ten non-participating customers that exhibit similar patterns of monthly consumption during the time period prior to the HVAC program year (2013).

These preparatory steps allowed the evaluation team to assemble the data required to estimate a statistical model of HVAC Audit impacts. The following section presents the results of the comparison group assignment process, describes the statistical model applied to the billing data, and reports the energy savings as a result of the analysis.

3.4.2.2 Findings

A valid comparison group was established for the filtered subset of HVAC Audit customers included in the analysis (see the previous section for a description of these filters). Participants were matched to non-participants on the basis of average daily consumption, by month, for the year 2013. Figure 3-6 provides a graphical comparison of average daily consumption for HVAC Audit participants and the matched comparison group.

Figure 3-6 Billed Electricity Consumption for HVAC Audit Participants and Matched Comparison Group



The validity of the matched comparison group depends on the number of non-participating customers available, and the underlying month-to-month variation in electricity consumption. As indicated in the preceding figure, the HVAC Audit participants and the matched comparison group exhibit very similar electricity consumption during the 2013 time period used for matching. Once the HEIP program year begins in January 2014, differences in consumption between the two groups begin to appear, particularly in the summer months, which constitute the expected peak season for HVAC Audit participation, and resulting savings. The illustrated difference in consumption between audit customers and the comparison group is most obvious in the summer of 2014—as indicated by the difference between the two lines shown in Figure 3-6.

The evaluation team developed a statistical regression model to estimate the differences in annual consumption that are indicated in Figure 3-6. The model presents average daily billed consumption as a function of several independent variables, which are the average number of cooling degree days and heating degree days faced by customers in each billing period; whether the customer's HVAC unit is a CAC or ASHP; and, a variable that indicates the post-audit period for each HEIP participant and associated non-participating comparison customers.

The exact model specification is described by Equation 15:

Equation 15 Statistical Regression Model Applied to Estimate HVAC Audit Savings

$$daily\ kWh = \beta 1\ + aCDD * \beta 2 + aHDD * \beta 3 + \ (ASHP * aHDD) * \beta 4 + (treat * aCDD) * \boldsymbol{\beta 5} + (ASHP\ * treat\ * aHDD) * \boldsymbol{\beta 6} + Post * \beta 7 + \varepsilon$$

Where:

$daily\_kwh$	Metered daily consumption
$\beta 1$	Model intercept. Estimated separately for each account. Represents the average non-weather dependent daily usage per home in the pre-treatment period
$aCDD$	The average cooling degree days faced by the customer in each billing period
$\beta 2$	Change in average consumption per CDD
$aHDD$	The average heating degree days faced by the customer in each billing period
$ASHP$	Indicator variable for participants that have electric heating
$\beta 3$	Change in average consumption per HDD
$\beta 4$	Change in average consumption per HDD for customers with electric heating (ASHP)
$treat$	Treatment indicator variable indicating the billing periods after the participant received an audit
$\boldsymbol{\beta 5}$	**Impact of audit per CDD**
$\boldsymbol{\beta 6}$	**Impact of audit per HDD for customers with electric heating (ASHP)**
$Post$	Indicator variable equal to 1 for months after the audit
$\beta 7$	Change in average daily consumption in time period after the audit
ε	The error term

The regression results indicate the HVAC Audit measure has an impact of approximately 237 kWh per year for CAC customers and 277 kWh per year for ASHP customers. These results are achieved with a relative precision of 29% and 51%, respectively, at the 90% confidence level. The precision of billing analysis approaches depends on the savings achieved by participants and the underlying variation in electricity consumption. This is a different type of statistical precision than is typically referenced in demand-side management program evaluations. The most common use of precision for program evaluations refers to sampling precision. Sampling precision expresses how well a given quantity, estimated from a sample, represents the true value of that quantity for the population as a whole (it also relies on corresponding assumptions about the population). In contrast, the precision the evaluation team reports for the HVAC Audit measure describes the ability to detect an energy savings impact of the HVAC Audit in the context of the underlying consumption patterns of the entire population of DEP residential customers and audit participants. In other words, the precision reported for HVAC audits does not reflect the level of sampling effort—instead it is a function of the number of HVAC audit participants, the magnitude of the audit energy efficiency gains, and

the variation in average daily consumption of the DEP residential customer population.

For audit participants with a CAC, the margin of error for the impact estimate is +/- 69 kWh per year; the margin of error for homes with an ASHP is +/- 140 kWh. Overall, the average savings for all HVAC Audit participants is 260 kWh with a relative precision of 34%. The impact results for the average participating unit are summarized in Table 3-15.

Table 3-15 Regression Output and Estimated Savings

Equipment	kWH per CDD	kWh per HDD	CDD	HDD	Est. Annual kWh
Air Source Heat Pump	-0.138	-0.011	1719	3602	-277
Central Air Conditioner		n/a			-237

Extrapolating the results to all participating customers yields a measure savings of 440 MWh contributed by ASHP customers and 251 MWh from CAC customers. The program-level total savings for this measure is 691 MWh. These findings are summarized below, in Table 3-16.

Table 3-16 HVAC Audit Savings Net Savings

Equipment	Participation	Impact per Unit (kWh)	Total Impact (MWh)
Air Source Heat Pump	1,589	277	440.2
Central Air Conditioner	1,060	237	251.2
Total	2,649	261	691.4

The HVAC audit results can also be reported for single family homes versus multifamily homes. Among the 2,649 customers that participated in the program, only 153 were single family homes, representing 6% of total participation. The impacts were estimated for all participants, without separating single family versus multifamily; nevertheless the savings value for each residential segment can be approximated by assuming the impacts per square foot of conditioned spaced are equal for single family and multifamily homes. The weighted average impact per square foot is 0.25 kWh. The average square footage of participation homes was 2,333 and 960 square feet for single-family and multifamily participants, respectively. The associated average impact for a single family home is 586 kWh, and the average impact for a multifamily home is 247 kWh. These results are summarized below in Table 3-17.

Table 3-17 Calculated HVAC Audit Net Impacts by Residential Segment

Residence Type	Participation	Average Square Feet	Billing Analysis, Estimated Average Impact	Average Impact per square foot	Calculated Impact Estimate per Unit
Single Family	153	2,333	N/A	N/A	586 kWh
Multifamily	2,496	960			247 kWh
Total	2,649	1,038	261	0.25 kWh	261 kWh

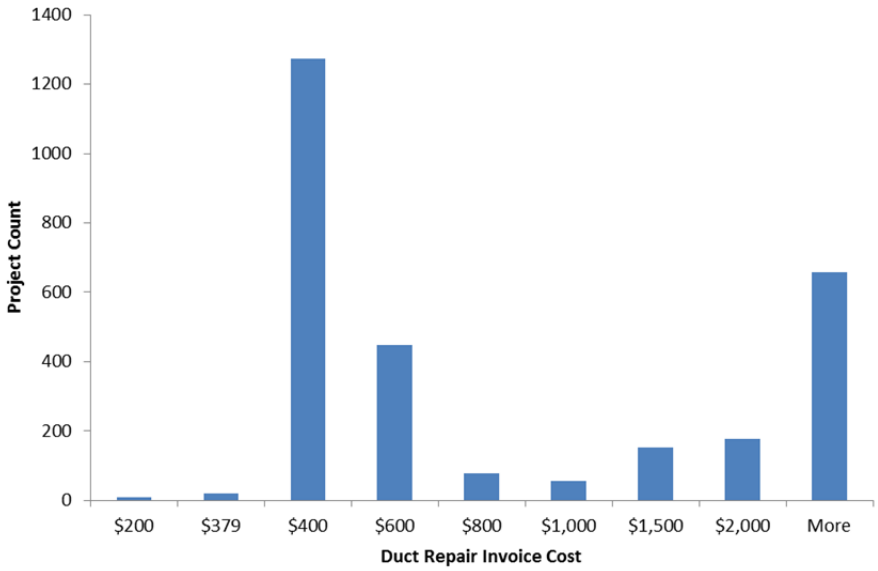
3.4.3 Telephone surveys, desk reviews

In addition to the metering study and billing analysis, other program measures were evaluated using telephone self-report surveys with program participants paired with engineering desk reviews and analysis. This approach was applied to Duct Repair, Attic Insulation and Air Sealing, and Heat Pump Water Heater (HPWH) measures. Responses from the survey were used to verify database inputs as well provide additional information required by the savings algorithms.

3.4.3.1 Duct Repair

The duct repair measure provides an incentive, equal to 50% of the invoice cost up to $190, for improving and sealing ducts located in unconditioned spaces. Nearly all measures in 2014 (99.7%) invoiced at least $380 for the measure and therefore received the maximum incentive value, as shown in Figure 3-7.

Figure 3-7 Frequency of Invoiced Costs for Duct Repair Measures



Equation 16 through Equation 18 outline the utilized algorithms and the parameters from Table 3-18 are used to estimate savings for the Duct Repair measure.

Equation 16 Duct Repair Energy Savings

$$\Delta kWh_{duct\ repair} = \frac{\left[\frac{\Delta CFM_{25}}{\frac{Cap_{cool}}{12{,}000} \times 400}\right] \times EFLH_{cool} \times Cap_{cool}}{\eta_{cool}} + \frac{\left[\frac{\Delta CFM_{25}}{\frac{Cap_{heat}}{12{,}000} \times 400}\right] \times EFLH_{heat} \times Cap_{heat}}{\eta_{heat}}$$

Equation 17 Duct Repair Summer Demand Savings

$$\Delta kW_{summer} = \frac{\left[\frac{\Delta CFM_{25}}{\frac{Cap_{cool}}{12{,}000} \times 400}\right] \times Cap_{cool}}{\eta_{cool}} \times CF_{summer}$$

Equation 18 Duct Repair Winter Demand Savings

$$\Delta kW_{winter} = \frac{\left[\frac{\Delta CFM_{25}}{\frac{Cap_{heat}}{12{,}000} \times 400}\right] \times Cap_{heat}}{\eta_{heat}} \times CF_{winter}$$

Table 3-18 Inputs for Duct Repair Savings

Input	Units	Value	Source
ΔCFM_{25}	CFM @ 25 Pa	81	Secondary Data
$SEER_{avg}$	SEER	15.4	Proxy from metering study for GPC
$HSPF_{avg}$	HSPF	8.8	Telephone surveys
$EFLH_{cool}$	Hours	688	Metering study
$EFLH_{heat}$	Hours	1,249	Proxy from metering study for GPC
$Capacity_{cool}$	kBTUh	32.5	Telephone surveys
$Capacity_{heat}$	kBTUh	31.6	Telephone surveys
ASHP Ratio	%	62.8%	Telephone surveys
CF_{summer}	Unitless	0.486	Metering study
CF_{winter}	Unitless	0.259	Adjusted proxy from metering study for GPC

Overall, the measure had an increase in energy savings (123% realization rate) in 2014 with a decrease in summer demand savings (75% realization rate).

Table 3-19 Duct Repair Gross Savings

Home Type	Cooling Savings (kWh)	Heating Savings (kWh)	Total Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
Single Family	108	228	336	0.077	0.049

3.4.3.2 Attic Insulation & Air Sealing

Overall, information received in the telephone surveys tracked accurately to the database. There was one Attic Insulation and Air Sealing customer who provided an attic area value half of the input provided by the database. To confirm the validity of this finding the evaluation team reviewed an additional 42 Attic Insulation and Air Sealing participants using publically available property information to assess the accuracy of attic square footages provided by the database. The entire sample of 42 participants showed a 100% match of estimated attic area to database reported attic area, so no adjustment was applied to the savings provided by the attic insulation

and air sealing measure.

Equation 19 through Equation 25 summarize the savings methodology for the Attic Insulation and Air Sealing measure, and Table 3-20 and Table 3-21 present the algorithm inputs and measure savings. Measure savings tracked closely to the past evaluation, with a 104% energy realization rate and 115% demand realization rate.

Equation 19 High Level Attic Insulation Energy Savings

$$\Delta kWh_{attic} = \Delta kWh_{cooling} + \left(\Delta kWh_{heating}\right) \times Saturation_{ASHP} + \Delta kWh_{fan}$$

Equation 20 Attic Insulation Cooling Dependent Energy Savings

$$\Delta kWh_{cooling} = \frac{\left(\left(\frac{1}{R_{old}} - \frac{1}{R_{attic}}\right) \times A_{attic} \times (1 - FramingFactor_{attic}) \times 24 \times CDD \times DUA\right)}{\eta_{cool} \times 1000}$$

Equation 21 Attic Insulation Heating Dependent Energy Savings

$$\Delta kWh_{heating} = \frac{\left(\frac{1}{R_{old}} - \frac{1}{R_{attic}}\right) \times A_{attic} \times \left((1 - FramingFactor_{attic}) \times ADJ_{attic}\right) \times 24 \times HDD}{\eta_{heat} \times 3412}$$

Equation 22 Therm Savings for Gas Furnaces

$$\Delta therms = \frac{\left(\frac{1}{R_{old}} - \frac{1}{R_{attic}}\right) \times A_{attic} \times \left((1 - FramingFactor_{attic}) \times ADJ_{attic}\right) \times 24 \times HDD}{\eta_{heat} \times 100{,}067}$$

Equation 23 Furnace Based Fan Savings

$$\Delta kWh_{fan} = \Delta therms \times F_e \times {}^{kWh}/_{therm} \times Saturation_{CAC}$$

Equation 24 Attic Insulation Summer Demand Savings

$$\Delta kW_{summer} = \frac{\Delta kWh_{attic}}{EFLH_{cool}} \times CF_{summer}$$

Equation 25 Attic Insulation Summer Demand Savings

$$\Delta kW_{winter} = \frac{\Delta kWh_{attic}}{EFLH_{heat}} \times CF_{winter}$$

Table 3-20 Inputs for Attic Insulation & Air Sealing Savings

Input	Units	Single Family Value	Multifamily Value	Source
R_{base}	R-value	14.6	13.1	Program Database Average
R_{ee}	R-value	38.2	30.7	Program Database Average
A_{attic}	ft^2	1,576	761	Program Database Average
CDD	CDD	1,698	1,681	Weighted Average TMY3 Data
HDD	HDD	3,627	3,684	Weighted Average TMY3 Data
η_{cool}	SEER	12.6	10	Telephone Surveys
η_{heat}	COP	2.0	2.0	TRM
ADJ_{attic}	%	74%	74%	TRM
DUA	%	75%	75%	TRM
CF_{summer}	Unitless	0.486	0.486	Metering Study
CF_{winter}	Unitless	0.259	0.259	Adjusted proxy from metering study for GPC

Measure savings tracked closely to the past evaluation, with a 104% energy realization rate and 115% demand realization rate.

Table 3-21 Attic Insulation & Air Sealing Gross Savings

Home Type	Cooling Savings (kWh)	Heating Savings (kWh)	Furnace Fan Savings (kWh)	Total Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
Single Family	151	353	8	512	0.361	0.102
Multifamily	94	178	4	276	0.195	0.055

3.4.3.3 Heat Pump Water Heater

Heat Pump Water Heater installations combine the efficiency improvements of a new water heater with a compressor that pulls heat from the surrounding space and uses it to heat water in the storage tank. Due to the heat pump component, homes with HPWHs will see lower cooling loads, since the HPWH pulls heat from the home, and conversely higher heating loads. All three of these impacts are accounted for in Equation 26 through Equation 28, and Table 3-21 and Table 3-23 present the algorithm inputs and measure savings.

Equation 26 Heat Pump Water Heater Energy Savings

$$\Delta kWh_{HPWH} = \frac{\left(\frac{1}{EF_{base}} - \frac{1}{EF_{ee}}\right) \times GPD \times 365 \times 8.33 \times \Delta T}{3413} + Cooling\ Savings - Heating\ Penalty$$

Equation 27 Cooling Savings for Heat Pump Water Heater

$$Cooling\ Savings = \frac{\left[\frac{GPD \times Occ \times 365 \times 8.33 \times \Delta T}{3413} - \frac{\frac{GPD \times Occ \times 365 \times 8.33 \times \Delta T}{3413}}{EF_{ee}}\right] \times LF \times 0.27 \times LM}{COP_{cool}}$$

Equation 28 Heating Penalty for Heat Pump Water Heater

$$Heating\ Penalty = \frac{\left[\frac{GPD \times Occ \times 365 \times 8.33 \times \Delta T}{3413} - \frac{\frac{GPD \times Occ \times 365 \times 8.33 \times \Delta T}{3413}}{EF_{ee}}\right] \times LF \times 0.49}{COP_{heat}}$$

Table 3-22 Inputs for Heat Pump Water Heater Savings

Input	Units	Value	Source
Capacity	Gallons	51.2	Program Database Average
Occupants	People	2.4	Telephone Surveys
Hot Water per Day	Gallons	25.1	USGS
ΔT	°F	65	TRM and telephone surveys
EF_{base}	EF	0.98	Telephone Surveys
EF_{ee}	EF	2.29	Program Database Average
COP_{cool}	COP	3.1	TRM
COP_{heat}	COP	2.0	TRM
LM (latent multiplier)	constant	1.33	Constant

Energy savings for the HPWH measure increased with a 135% realization rate, and summer demand fell with a realization rate of 39%.

Table 3-23 Heat Pump Water Heater Gross Savings

Home Type	Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
Single Family	1,978	0.094	0.541

3.4.4 Deemed Analysis

Due to low uncertainty on measure savings and low program participation the evaluation team applied deemed savings from the previous evaluation for the geothermal heat pump and room air conditioner measures.

3.4.4.1 Geothermal Heat Pump

Energy and demand savings for Geothermal Heat Pumps are provided in Table 3-24.

Table 3-24 Geothermal Heat Pump Gross Savings

Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
1,725	0.684	0.000

3.4.4.2 Room Air Conditioner

Energy and demand savings for Room Air Conditioners are provided in Table 3-25.

Table 3-25 Room Air Conditioner Gross Savings

Energy Savings (kWh)	Summer Demand (kW)	Winter Demand (kW)
124	0.099	0.010

3.5 Targeted and Achieved Confidence and Precision

The HEIP evaluation plan was developed with the goal of achieving a target goal of 10% relative precision at the 90% confidence interval for the program as a whole. As the program is composed of different measures, and the energy savings estimation approach varies by measure, the Evaluation Team assigned sampling, verification, and impact estimate effort among the program measures in accordance with the measures' contribution to total reported HEIP savings. Table 3-5 in Section 3.2 presents the targeted precision and distribution of sampling/analytical effort by measure. The overall confidence and precision targeted by Nexant is 90% and 10%, respectively, for the HEIP program as a whole. As presented in Table 3-26, the evaluation team reported confidence and precision for the program is +/- 3.2% at the 90% confidence level.

Table 3-26 Targeted and Achieved Confidence and Precision

Program	Targeted Confidence/Precision	Achieved Confidence/Precision
Home Energy Improvement	90/10.0	90/3.2

The distribution of achieved impact samples is presented in Table 3-27.

Table 3-27 Achieved Impact Sampling Plan

Measure	Approach	Actual
Central Air Conditioner	Metering – Single Family	23
	Desk Review – Multifamily	11
Air Source Heat Pump	Metering – Single Family	15
	Desk Review – Multifamily	11
HVAC Audit	Billing analysis	Census
Duct Sealing	Desk review	22
Insulation and Air Seal	Desk review	11
Heat Pump Water Heater	Desk review	5
Geothermal Heat Pump	Deemed	n/a
Room AC	Deemed	n/a

3.6 Results

Measure level, per unit energy savings values are detailed in Figure 3-8 and Table 3-28. Large energy savings increases for ASHPs and HPWHs stand out, and most other measure savings are close to +/-20% from the reported values.

Figure 3-8 Per Unit Energy Savings

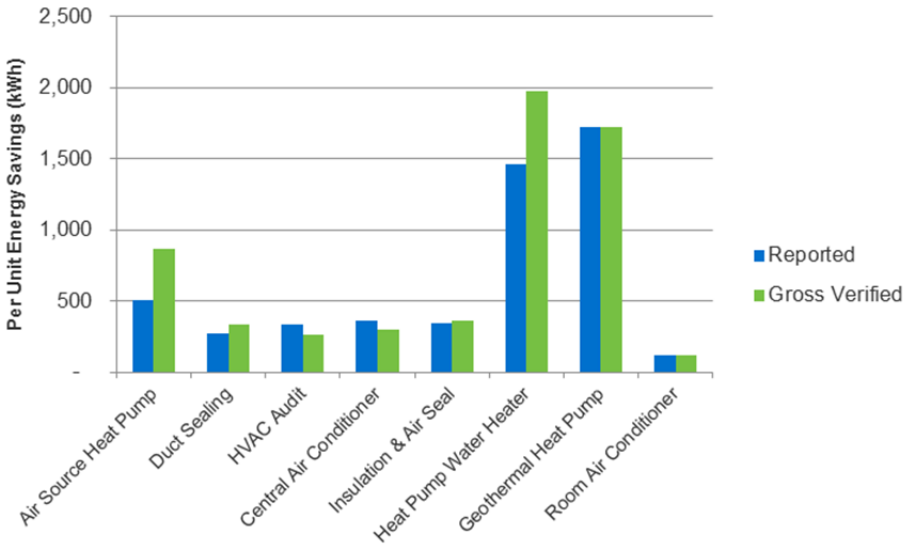


Table 3-28 Measure-Level Reported and Verified Gross Energy Savings

Measure	Rebated Measures	Reported Energy Savings, per unit (kWh)	Realization Rate	Verified Energy Savings, per unit (kWh)	Total Energy Savings (MWh)
Air Source Heat Pump	5,183	506	172%	865	4,481
Duct Sealing	2,906	273	123%	336	977
HVAC Audit	2,649	334	78%	261	691
Central Air Conditioner	1,920	364	82%	299	573
Insulation & Air Seal	783	349	104%	364	285
Heat Pump Water Heater	95	1,462	135%	1,978	188
Geothermal Heat Pump	63	1,725	100%	1,725	109
Room Air Conditioner	284	124	100%	124	35
Total	**13,883**		**132%**		**7,340**

The increase in program level energy savings is connected to a high realization rate (172%) for the air source heat pump measure. Energy savings for the cooling component of the ASHP are estimated at 290 kWh, in line with the savings for the CAC (300 kWh) which has an energy realization rate of 82%. Analysis techniques from past evaluations prevent the Evaluation Team from separating heating and cooling savings on ASHPs, but given that cooling savings dropped for CACs (and both measures use the same algorithm) it stands that the increase in savings is on the heating side of the equipment.

Table 3-29 Measure-Level Reported and Verified Summer Demand Gross Savings[3]

Measure	Reported Demand Savings, per unit (kW)	Realization Rate	Verified Demand Savings, per unit (kW)	Total Energy Savings (MW)
Air Source Heat Pump	0.224	91%	0.204	1.057
Duct Sealing	0.102	75%	0.077	0.222
HVAC Audit	0.272	62%	0.167	0.443
Central Air Conditioner	0.324	65%	0.211	0.405
Insulation & Air Seal	0.223	115%	0.257	0.201
Heat Pump Water Heater	0.241	39%	0.094	0.009
Geothermal Heat Pump	0.684	100%	0.684	0.043
Room Air Conditioner	0.099	100%	0.099	0.028
Total		**78%**		**2.408**

[3] Summer demand savings for all HVAC dependent measures are based on the summer coincident peak determined by the EFLH study.

Table 3-30 Measure-Level Reported and Verified Winter Demand Gross Savings

Measure	Reported Demand Savings, per unit (kW)	Realization Rate	Verified Demand Savings, per unit (kW)	Total Energy Savings (MW)
Air Source Heat Pump	0.253	87%	0.220	1.141
Duct Sealing	0.339	14%	0.049	0.142
HVAC Audit	0.164	22%	0.035	0.094
Central Air Conditioner	0.087	100%	0.087	0.167
Insulation & Air Seal	0.339	24%	0.082	0.065
Heat Pump Water Heater	0.541	100%	0.541	0.051
Geothermal Heat Pump	0.000	100%	0.000	0.000
Room Air Conditioner	0.010	100%	0.010	0.003
Total		**52%**		**1.663**

The impact evaluation for the 2014 program resulted in a program realization rate of 132%, finding that the program exceeded the participation and energy savings targets. Table 3-31 and Table 3-32 present the reported and verified energy and demand savings for 2014.

Table 3-31 2014 Program Level Energy Savings

Measures Installed	Reported Energy (MWh)	Realization Rate	Gross Verified Energy (MW)	Net-to-Gross Ratio	Net Verified Energy (MWh)
13,833	5,556	132%	7,340	72%	5,300

Table 3-32 2014 Program Level Demand Savings

Measurement	Reported Demand (MW)	Realization Rate	Gross Verified Demand (MW)	Net-to-Gross Ratio	Net Verified Energy (MWh)
Summer Demand	3.07	78%	2.41	72%	1.74
Winter Demand	3.22	52%	1.66		1.20

4 Net-to-Gross Methodology and Results

The evaluation team calculated the net savings, which are the amount of savings that occurred as a direct result of influence attributable to the program, by applying net-to-gross (NTG) adjustments to the gross savings. The evaluation team determined the NTG adjustment value via data collected from participant surveys and trade ally surveys and interviews.

To calculate net savings, a NTG ratio must first be established. NTG consists of free ridership (FR) and spillover (SO). Free ridership refers to the portion of energy savings that participants would have achieved in the absence of the program through their own initiatives and expenditures (EPA, 2007).[1] Spillover refers to the program-induced adoption of measures by non-participants and participants who did not receive financial incentives or technical assistance for installations of measures supported by the program (EPA, 2007). The evaluation team used the following formula to calculate a NTG ratio:

$$NTG = 1 - FR + SO$$

Once the NTG ratio is established, the evaluation team used the following formula to calculate net savings:

$$Net\ Savings = Gross\ Savings * NTG$$

The evaluation team estimated nonparticipant spillover from trade ally interview and survey data and estimated participant free ridership and spillover from participant surveys. The following sections fully describe how the evaluation team estimated participant free ridership and spillover values.

4.1 Free Ridership

Free ridership estimates how much the program influenced participants to make the energy saving improvements that the program incents, which is then used to adjust gross savings by the level of attribution the program is able to claim. Free ridership ranges from 0 to 1, with 0 being no free ridership (or, total program attribution), 1 being total free ridership (or, no program attribution) and values in between represent varying degrees of partial free ridership. The evaluation team used participant survey data to inform free ridership estimates. The evaluation team conducted surveys with a stratified random sample of 105 participants (Table 4-1). The participant sample was stratified by sector (single family and multifamily) and is similar to the distribution of measure install rates across a given sector. The evaluation team did not attempt to sample participants from manufactured homes, as less than 1% of all 2014 HEIP measures took place in this sector. The single family sample satisfies 90/10 confidence/precision and the

1 The Environmental Protection Agency (EPA) (2007). Model Energy Efficiency Program Impact Evaluation Guide. Retrieved June 8, 2015 from http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf.

multifamily sample satisfies 90/15 confidence/precision at their respective sector levels, resulting in a 90/10 confidence/precision level for the overall program when the two free rider estimates are combined.

Table 4-1 Proportion of Participant Sample that Installed Each Measure, by Sector[a]

Measure	Single Family (n=75)	Multifamily (n=30)
Air Source Heat Pump	68%	10%
Duct Sealing	40%	10%
Central Air Conditioner	15%	17%
Attic Insulation and Air Sealing	8%	17%
Geothermal Heat Pump	3%	3%
Heat Pump Water Heater	3%	0%[b]
HVAC Audit	1%	43%
Room Air Conditioner	1%	7%

[a] Column totals exceed 100%, as some surveyed participants installed more than one measure.
[b] Only one of these units was installed in a multifamily building in 2014 (Population N = 1) and the participant was not available for surveying.

Since some respondents may have received rebates for multiple measure types and since an individual's free ridership may differ between different measure types, free ridership was first calculated individually for each measure associated with each participant survey respondent. The evaluation team then used this participant-measure-level free ridership values to derive a sector-measure-level free ridership estimate. These were then combined into sector-level estimates, which were then combined into a program-level estimate. This chapter fully describes this process.

4.1.1 Participant-Measure-Level Free Ridership

Participant-measure-level free ridership consists of two components – change (FRC) and influence (FRI) – which both range from 0 to .5. The following formula uses these two components to calculate participant-measure-level free ridership:

$$FR = FRC + FRI$$

4.1.1.1 Free Ridership Change

Free ridership change demonstrates what the participant would have likely done if the program had not provided an incentive for their energy upgrade. To determine this, the evaluation team asked participant survey respondents FRC questions specific to the measures they installed. The generic example below exemplifies how the evaluation team collected FRC data (see Appendix C for the measure-specific FRC questions in the participant survey).

Q1. If you had not received a HEIP incentive for your [PIPE IN INCENTED MEASURE], which of the following is most likely: Would you have…? [READ ALL, SELECT ONE]

1. Not purchased a [PIPE IN INCENTED MEASURE]

2. Delayed purchasing a new [PIPE IN INCENTED MEASURE] for at least a year
3. Purchased a new [PIPE IN INCENTED MEASURE] but a less efficient or less expensive model
4. Bought the exact same [PIPE IN INCENTED MEASURE] anyway, and paid the full cost yourself
5. Or done something else, specify:_____
98. Don't know
99. Refused

For insulation[2] and replacement equipment with less efficient options,[3] the evaluation team asked a follow up question to respondents that reported the third response option above (purchased a less efficient or less expensive measure), as exemplified below:

Q2. [ASK IF Q1=3] You said you would have bought a [PIPE IN INCENTED MEASURE] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy. Do you think it is more likely that you would have bought equipment that was…?

1. Almost as efficient as the one you bought, or
2. Significantly less efficient than the one you bought
98. Don't know
99. Refused

The evaluation team then assigned the following FRC values to each respondent for each rebated measure, based on their response to the questions above, as shown in the Table 4-2.

2 Respondents that report they would have installed less insulation will then be asked to report how much less insulation they would have purchased in a percentage format (e.g.: 50% less). This reported value will be subtracted from 100% and then divided in half; the result will serve as their FRC value.

3 Since HVAC audit and duct sealing/repair are service measures, as compared to equipment measures, there is no less efficient version of these measures. Thus, the counterfactual for these service measures would be to either: 1) not purchase the service, 2) wait a year or more to purchase the service, or 3) purchase the service without the assistance of a rebate. Accordingly, FRC values for these measures are either 0 (would have not purchased or would have waited a year or more to purchase) or .5 (would have purchased without assistance of a rebate).

Table 4-2 Free Ridership Change Values

Q1 Response	Q2 Response	FRC Value
Not purchased a [MEASURE]		0.00
Delayed purchasing a new [MEASURE] for at least a year		0.00
Purchased a new [MEASURE] but a less efficient or less expensive model	Almost as efficient as the one you bought	0.375
	Significantly less efficient than the one you bought	0.125
	Don't know / Refused	0.25
Bought the exact same [MEASURE] anyway, and paid the full cost yourself		0.50
Or done something else		FRC values assigned on a case by case basis, depending on which pre-coded response item they most resemble
Don't know / Refused		Sector-level measure average

Participants who replaced a broken HVAC system or water heater pose a particular challenge to estimating NTG (or free ridership change, specifically): since there is an immediate space heating/cooling or water heating need, it is possible that free ridership could be higher among this group, as "replacement upon burnout" participants may be less likely to report they would not purchase or would delay purchasing a replacement measure (which are responses that garner FRC scores of 0). This is less problematic for HVAC than for water heater replacement participants, as HVAC participants could install a different (and presumably less efficient) *type* of HVAC system (such as a furnace instead of a heat pump), or could rely on plug-in space heaters or air conditioners. These issues expose the possibility of overestimating free ridership for "replacement upon burnout" participants. Testing the possible impact of this scenario is important, considering that 59% of single family and 27% of multifamily HVAC measure participants reported replacing broken equipment (see section 5.2.3.2).

To test the impact of this issue, the evaluation team calculated an alternate FRC and resulting NTG value by assigning *'would have purchased a significantly less efficient measure* responses a FRC value of 0 (instead of .125) and assigning *'would have purchased an almost as efficient measure'* responses a FRC value of .25 (instead of .375). The evaluation team chose these alternate values because purchasing a baseline model (as denoted by *'would have purchased a significantly less efficient measure'* responses) is perhaps a more realistic 0% free ridership counterfactual when replacing upon burnout. After calculating the alternate FRC and NTG values, the evaluation team found they were insignificantly different from those used in this evaluation. Program-wide NTG improved by 1% when using the alternative calculation (note: the alternate calculation had absolutely no effect on multifamily free ridership). Further,

statistical analysis of participant survey data revealed that participants replacing broken HVAC systems demonstrated insignificantly different FRC scores than those replacing still working systems. These results reveal that the evaluation team's free ridership methodology is not systematically biased against replacement upon burnout participants, and that some of these participants are in fact [partial] free riders.

4.1.1.2 Free Ridership Influence

Free ridership influence demonstrates how much influence the program had on a participant's decision to perform the incented energy upgrade. To determine this, the evaluation team asked participant survey respondents the following question, repeating this battery for each unique rebated measure associated with the respondent:

> *I'm going to read a list of factors that might have influenced your decision to make the energy saving improvements to your property we have been talking about. For each factor, please indicate how influential it was in your decision, using a scale from 0 to 10, where 0 means "not at all influential" and 10 means "extremely influential."*
>
> *[INTERVIEWER NOTE: IF RESPONDENT SAYS 'NOT APPLICABLE; I DIDN'T GET/USE THAT,' THEN FOLLOW UP WITH: "So would you say it was "not at all influential?" AND PROBE TO CODE]*
>
> *[PROGRAMMER: For each factor below input 0-10 scale and don't know and refused options.]*
>
> *a. The rebate received*
> *b. Information or advertisements from Duke Energy Progress, including their website and the HEIP page*
> *c. Recommendation from your contractor*
> *d. Did anything else influence you? If so, please specify: _____*
> *[INTERVIEWER: PROBE IF UNCLEAR. RECORD VERBATIM RESPONSE]*

The evaluation team then selected the highest rated program-attributable item for each respondent and assigned the following FRI scores, depending on their high score value (Table 4-3).

Table 4-3 Free Ridership Influence Values

Influence Rating	FRI Value
0	0.5
1	0.45
2	0.4
3	0.35
4	0.3
5	0.25
6	0.2
7	0.15
8	0.1
9	0.05
10	0
Don't know / Refused	Sector-level measure average

The measure-specific FRC and FRI scores were summed for each respondent, resulting in participant-measure-level free ridership (FR) scores.

4.1.2 Measure-Level Free Ridership

The evaluation team used the participant-measure-level FR scores to calculate an average FR score for each measure type per sector. Some respondents (mainly multifamily property managers) received more than one rebate for a given measure type. The degree to which each respondent contributes to the overall sample free ridership is proportional to the number of rebates they received; therefore, the evaluation team calculated a weighted average FR score for each measure category, using the number of rebates each respondent received for a given measure as the weight.

Table 4-4 and Table 4-5 exhibit the weighted mean FR scores (by sector), and the number of respondents and measure counts associated with each FR score. As seen in these tables, mean FR scores vary considerably from measure to measure in a given sector as well as across sectors.

Table 4-4 Single Family Measure-Level Free Ridership Scores (n=75)

Measure	Count of respondents with measure	Number of measure rebates received by sample	Weighted Mean FR Score
Central Air Conditioner	11	11	0.49
Air Source Heat Pump	51	53	0.45
HVAC Audit	1	1	0.00
Duct Sealing	30	30	0.44
Attic Insulation and Air Sealing	6	6	0.60
Room Air Conditioner	1	2	0.00
Heat Pump Water Heater	2	2	0.49
Geothermal Heat Pump	2	2	0.58

Table 4-5 Multifamily Measure-Level Free Ridership Scores (n=30)

Measure	Count of respondents with measure	Number of measure rebates received by sample	Weighted Mean FR Score
Central Air Conditioner	5	16	0.23
Air Source Heat Pump	3	3	0.22
HVAC Audit	13	333	0.04
Duct Sealing	3	3	0.19
Attic Insulation and Air Sealing	5	121	0.00
Room Air Conditioner	2	2	0.56
Heat Pump Water Heater	0	0	-
Geothermal Heat Pump	1	1	0.38

4.1.3 Sector-Level Free Ridership

Next, the evaluation team combined the mean measure-level FR scores for each sector (from Table 4-4 and Table 4-5) into a mean sector-level FR score. Since the mean measure-level FR scores accurately represented the measure-level free ridership, combining them into sector-level estimates required adjusting for differences among the measures in the sampled proportion of the respective populations. To do this, the evaluation team used the following formula to calculate weights for each measure category within each sector:[4]

$$Savings\ Weight = \frac{Measure's\ Proportion\ of\ Sector's\ Gross\ Population\ Savings}{Measure's\ Proportion\ of\ Sector's\ Gross\ Sample\ Savings}$$

The evaluation team calculated each measure's gross population savings as the number of rebates distributed for a given measure in a given sector times the measure's per-unit verified

[4] For measures that had fewer than 20 sampled rebates in a given sector, the evaluation team used a savings weight of 1. This is the most prudent approach as weights for small samples can get extremely high and can dramatically affect the results.

energy savings; the measure's gross sample savings is the number of measures in the sample times the per-unit savings. A measure's proportion of the sector's gross population and sample savings are then that measure's total population and sample savings, divided by the total population and sample savings across all measures in that sector

Applying the above weights to the measure-level FR means scores produces a representative free ridership score for each sector.

Table 4-6 presents the sector-level FR scores, which are derived from the savings weighted mean of each sector's measure-level FR scores. As seen in the table, multifamily participants had lower free ridership than single family participants.

Table 4-6 Sector-Level Free Ridership Scores

Sector	Weighted Mean FR Score
Single Family Participants	0.38
Multifamily Participants	0.24

4.1.4 Program-Level Free Ridership

Next, the evaluation team combined the sector-level FR scores into a program-level FR score. The program-level FR score is the savings weighted mean of the sector-level FR scores presented in Table 4-6. The evaluation team used the same weighting method as employed in the sector-level free ridership calculation, but proportionally weighted on sector savings (as compared to sector-measure savings). The evaluation team calculated savings weights with the following formula:[5]

$$Savings\ Weight = \frac{Sector's\ Proportion\ of\ Gross\ Population\ Savings}{Sector's\ Proportion\ of\ Gross\ Sample\ Savings}$$

While single family savings constituted the majority of the program's gross savings, multifamily savings were the majority of the savings represented by our participant sample, resulting in a large savings weight for the single family sector and a small savings weight for the multifamily sector (Table 4-7). This difference between population and sample savings proportions is because some individual multifamily respondents (namely, multifamily property managers) implemented dozens of rebated measures at their property, compared to single family respondents who implemented comparably fewer measures per building.

Table 4-7 Savings Weights Inputs and Values

Sector	Proportion of Population Gross Savings	Proportion of Sample Savings	Savings Weight
Single Family	89%	36%	2.45
Multifamily	11%	64%	0.18

[5] The numerator in the savings weight formula excludes savings from measures implemented in manufactured homes, as the evaluation team did not purposefully sample manufactured homes.

After combining the sector-level free ridership scores, program level free ridership was .37.

4.2 Spillover

Spillover estimates energy savings from non-rebated energy improvements made outside of the program that are influenced by the program, and is used to adjust gross savings by the additional energy savings garnered and the level of attribution the program is able to claim for these non-rebated measures. Spillover ranges from 0 to infinity, with 0 being no spillover and values greater than 0 demonstrating the existence and magnitude of spillover.[6] The evaluation team used participant survey data and trade ally interview and survey data to estimate spillover: participants to inform participant spillover (PSO) and trade allies to inform nonparticipant spillover (NPSO). These two estimates are summed to calculate total program spillover (SO):

$$SO = PSO + NPSO$$

4.2.1 Participant Spillover

The evaluation team asked participant survey respondents to indicate what energy saving measures or services they had implemented since participating in the program to identify potential spillover (see the Participant Survey in Appendix D for the spillover battery). The evaluation team then asked participants to use a 0 to 10 scale, where 0 means “not at all influential” and 10 means “extremely influential,” to indicate how much influence HEIP had on their decision to purchase these energy saving measures. This question was repeated for each non-rebated measure category a respondent reported implementing. Table 4-8 exhibits how much program influence, ranging from 0% to 100%, is associated with each scale response to the spillover influence question.

[6] Spillover values can be interpreted as percentages, where 1=100%. Thus, a spillover value of .5 demonstrates a savings value of 50% of gross program savings.

Table 4-8 Participant Spillover Program Influence Values

Reported HEIP Influence	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0
Don't know / Refused	Sector-level measure average

The evaluation team used the measure-specific influence value to calculate the participant measure spillover (PMSO) for each measure that each participant reported. Participant measure spillover is calculated as follows:[7]

$$PMSO = Deemed\ Measure\ Savings * Number\ Installed * Influence\ Value$$

The evaluation team then summed all PMSO values associated with each sector and divided them by the sector sample's gross program savings to calculate the sector-level participant spillover estimate:

$$Sector\ Level\ Participant\ SO = \frac{\sum Sector\ PMSO}{Sector\ Sample\ Gross\ Program\ Savings}$$

Although multifamily participants reported slightly more spillover savings (in terms of total kWh), the single family participant spillover value is higher due to the sector's ∑PMSO representing a greater relative proportion to the sector's gross savings (Table 4-9).

[7] Deemed savings for non-program, spillover measures were referenced from various sources that depended on the measure end-use. ENERGY STAR appliance savings were quantified through lists of qualified equipment available on the ENERGY STAR website. These tools provided either the direct energy savings, or annual consumption allowing savings to be calculated. Savings for insulation and water heater measures were deemed using engineering algorithms and site specific inputs provided by the participant. Lighting measure savings were referenced from a recent 2014 residential evaluation that included an extensive lighting study focused on the location of light bulbs and annual hours of use. This same evaluation provided the savings for windows by reviewing the average area of glazing along with installed HVAC equipment in the homes.

Table 4-9 Sector-Level Spillover

Sector	∑Sector PMSO (kWh)	Sector-Level Participant SO
Single Family Participants	4,608	0.06
Multifamily Participants	4,767	0.03

Consistent with our approach to combining sector-level FR scores (see section 4.1.4), the evaluation team used a savings weighted average to combine the sector-level participant SO values into a program-level participant SO value (PSO). After combining the sector-level SO scores, program-level PSO was .06.

4.2.2 Nonparticipant Spillover

Nonparticipant spillover refers to non-rebated program measures implemented by nonparticipants that were directly or indirectly influenced by the program. The evaluation team interviewed (n=10) and surveyed (n=70) trade allies to identify and measure nonparticipant spillover (see section 5.1.2 for trade ally sampling methodology).Trade allies reported how many non-rebated measures they installed in program territory in a given program year, the level of program influence on their practice of recommending these measures, and the proportion of their clients with non-rebated measures that were not influenced by their recommendations.

Collectively, sampled trade allies had experience with all contractor-implemented HEIP measures, and the distribution of their experience with these measures resembled that of the larger trade ally population. Thus, our sample of trade allies is generalizable to the trade ally population, and in turn provides a representative estimate of trade ally-oriented nonparticipant spillover.

Table 4-10 Measure Experience among Sampled Trade Allies

Measure	(n=80)
Air Source Heat Pump	88%
HVAC Sealing and Repair	70%
Central Air Conditioner	61%
Attic Insulation and Air Seal	13%
Geothermal Heat Pump	13%
Heat Pump Water Heater	5%
HVAC Audit	3%

To collect the necessary data to calculate nonparticipant spillover, the evaluation team asked trade allies a series of nonparticipant spillover questions regarding the HEIP measures they implemented in 2014, repeating the nonparticipant spillover battery for up to three measures

(see Appendix C for complete Trade Ally Survey and Interview guides).[8] The evaluation team used the nonparticipant spillover battery to collect the number of non-rebated HEIP measures each trade ally implemented in DEP territory in 2014, the proportion of those non-rebated measures (NRM) that were not influenced by trade ally recommendations, and the level of HEIP influence on trade ally recommendation practices of a given HEIP measure.

The evaluation team used these data to estimate the number of qualified non-rebated measures installed in DEP territory, as well as the amount of attribution the program is able to claim. Nonparticipant spillover was first calculated individually for each of the top three program-qualified measure that trade allies installed. The evaluation team then used trade ally-level spillover values to derive a program-level spillover estimate, which is described later in this section. Like the other NTG influence questions, the evaluation team asked trade allies to use a 10-point scale to rate how much influence the program had on the trade ally's practice of recommending each respective qualified measure they provide. Table 4-11 shows how much program influence, ranging from 0% to 100%, is associated with each scale response to these influence questions.

Table 4-11 Trade Ally Influence Values

Program Influence Rating	Influence Value
0	0.0
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1.0
Don't know / Refused	Measure level average

The evaluation team then used the measure-specific influence value (Table 4-11) when calculating the nonparticipant measure spillover for each of the top three measures each trade ally had experience with. Nonparticipant measure spillover also relies on the previously described non-rebated measure count (NRMC). Thus, nonparticipant measure spillover is calculated as follows:

$$NP\ Measure\ SO = ((NRMC * (1 - \%NRM\ not\ influenced\ by\ TA\ recommendation)) * Measure\ Savings) * Influence$$

[8] For trade allies that implemented two or more rebated measure types in 2014, the Evaluation Team repeated the nonparticipant spillover battery for the top two (or top three, if applicable) most rebated measures a given TA implemented in 2014.

The evaluation team then summed all nonparticipant measure spillover values and divided them by the sample's gross program savings to calculate the program-level nonparticipant spillover estimate:

$$NPSO = \frac{\sum NP\ Measure\ SO}{Sample\ Program\ Savings}$$

This calculation resulted in a NPSO value of .03.

4.2.3 Program-Level Spillover

The evaluation team summed the PSO and NPSO values to calculate the program-level SO value. This calculation resulted in program-lever SO of 0.09.

4.3 Net-to-Gross

After combining all FR and SO estimates, NTG for the program is 0.72 (Table 4-11). Although slightly improved, the 2014 NTG ratio (0.72) was not significantly different from that of the 2013 evaluation (0.68). The evaluation team applied the NTG ratio of 0.72 to program-wide verified gross savings to calculate HEIP net savings.

Table 4-12 Net-to-Gross Results

	Free Ridership	Spillover	NTG
Single Family Participants	0.38	0.06	0.68
Multifamily Participants	0.24	0.03	0.79
Nonparticipants	-	0.03	-
Program	**0.37**	**0.09**	**0.72**

Table 4 13 compares the HEIP NTG ratio with NTG ratios of other similar programs in nearby jurisdictions. There is a considerable variability in NTG ratios across various programs in Table 4 13. Across these programs, HEIP has one of the highest NTG ratios.

These NTG comparisons should be interpreted with caution because of differences between the programs. Each program listed in Table 4-13 incents a slightly different set of measures, uses a different NTG survey battery, and operates at a different geographic location.

Table 4-13: NTG of Similar Programs

Programs	Sector Served	Measures	Program Year	Free Ridership	Participant Spillover	Non-participant Spillover	Total Spillover	NTG
DEP HEIP	SF, MF, MH	ASHP, central AC, geothermal heat pump, HVAC audit, duct sealing, attic insulation, heat pump water heater	2014	0.37	0.06	0.03	0.09	0.72
Other Duke Energy HVAC Programs								
DEC Smart $aver HVAC	SF	Central AC and heat pumps with ECMs	2011, 2012	0.32	not estimated	not estimated	0[a]	0.68
DEC Smart $aver Additional Measures	SF	Attic insulation, air leakage sealing, duct insulation, duct leakage sealing, and HVAC audit	2013, 2014	0.20	0.12	not estimated	0.12	0.90
DEO Smart $aver HVAC	SF	Central air-conditioning and heat pumps with ECMs	2009, 2010	0.37	0	not estimated	0	0.63
Other Nearby Utility HVAC Programs								
Georgia Power Home Energy Improvement	SF, MF	Home energy assessment, air sealing, duct sealing, programmable thermostat, insulation, heat pump, electric water heater tank wrap	2014	0.46	0.03	not included	0.03	0.57
Pennsylvania PPL Electric Utilities Res. Home Comfort	SF	Home energy assessment, duct sealing, insulation, ASHP, ductless heat pump, pool pumps, and rebates for energy-efficient new homes	2014	0.48	0.06	not estimated	0.06	0.58
Maryland EmPOWER Utilities Res. HVAC Programs	SF	Central AC, ASHP, HVAC audit, ductless heat pumps, ground source heat pumps, and duct sealing	2012, 2013	estimated, but not reported	estimated, but not reported	not estimated	0[a]	0.39

SF= Single Family; MF= Multifamily; MH=Manufactured Homes

[a] Assumed to be zero

5 Process Evaluation

5.1 Summary of Data Collection Activities

The process evaluation is based on telephone interviews and surveys with program and implementer staff, trade allies, and participants (Table 5-1).

Table 5-1 Summary of Process Evaluation Data Collection Activities

Target Group	Method	Sample Size	Confidence/Precision
Program and implementer staff	Phone in-depth interview	3	n/a
High volume trade allies[a]	Phone in-depth interview	10	95/10
Trade allies (various rebate volumes)	Phone survey	70	
Single-family participants	Phone survey	75	90/10
Multifamily participants	Phone survey	30	90/15

[a] High volume trade allies implemented at least 100 rebated HEIP measures in 2014.

5.1.1 Program and Implementer Staff

The evaluation team conducted discussions with the HEIP Program Manager and two Honeywell implementation staff in order to understand how the program was working and to capture their insights about the program's operations, challenges, expectations, and interactions with market actors (trade allies, distributors, and customers).

5.1.2 Trade Allies

Participating contractors – called "trade allies" – are the primary program delivery channel for HEIP. Between June and September 2015, the evaluation team conducted ten in-depth interviews and 70 surveys with HEIP trade allies. The interviews and surveys covered various program topics, such as satisfaction with the program and program-related challenges (Table 5-2).

Table 5-2 Trade Ally Research Objectives

Research Objectives
Assess Trade Ally engagement with the program and how they and their customers heard of the program
Assess program satisfaction
Document Trade Ally program experience, including any challenges and opportunities for improving the program
Document Trade Ally perspective about the code changes and the future of the program
Gather data for Net-to-Gross spillover
Ask about Trade Ally firmographics and customer characteristics
Document program influence

In order to ensure the results were generalizable to the larger trade ally population, the evaluation team developed a stratified sample frame of HEIP trade allies, stratifying trade allies by the number of rebated measures they installed in 2014 (Table 5-3). While Stratum 2 trade allies were randomly sampled, the evaluation team attempted a census for Strata 1A and 1B (hereafter referred to as "high volume contractors"). Due to their limited experience with the program, the evaluation team did not sample trade allies with fewer than five rebates (Stratum 3). The resulting sample satisfies 95/10 confidence/precision for the trade ally population.

Table 5-3 Trade Ally Population and Sample Characteristics

Strata	Number of rebated measures in 2014	Sample Frame (N)*	Sample Size (n)	Method
Stratum 1A	100+	22	10	In-depth interview
Stratum 1B			10	Survey
Stratum 2	5-99	215	60	Survey
Stratum 3	1-4	161	0	-
Total		**398**	**80**	

* Due to trade ally list quality issues (such as duplicate entries and missing contact information), we are unable to accurately report the population size. However, sample frame sizes are reasonably close to the actual population sizes. The sample frame – or the list of contacts that could be potentially sampled – includes all unique trade ally companies for which we had contact information.

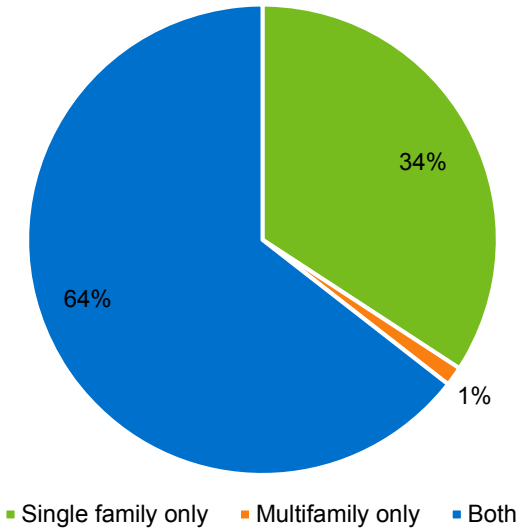
The evaluation team contends that trade ally specializations (such as insulation, for example) can significantly shape trade ally experience with the program. The evaluation team monitored the measures that sampled trade allies had experience with to ensure that the sample was diverse and representative in terms of measure experience. The distribution of the trade ally sample's measure experience generally reflects that of the larger trade ally population (Table 5-4).

Table 5-4 Trade Ally Experience with HEIP Measures in 2014

Measure	Sample (n = 80)	Strata 1 and 2 Sample Frame (N=237)	Entire Sample Frame (N=398)
Air source heat pump	88%	88%	78%
Duct sealing and repair	70%	67%	51%
Central air conditioner	61%	52%	36%
Attic insulation	13%	12%	10%
Geothermal heat pump	13%	11%	7%
Heat pump water heater	5%	3%	7%
HVAC audit	3%	2%	2%

Further, the evaluation team monitored trade ally data as it was being collected to ensure the trade ally sample included both contractors that serve single family customers and contractors that work in multifamily properties (Figure 5-1).

Figure 5-1 Sectors Sampled Trade Allies Serve (n=76)



Stratum 1A trade allies participated in telephone in-depth interviews (IDIs), while trade allies in Strata 1B and 2 responded to telephone surveys. While the survey structure was rigid and predetermined, the evaluation team probed trade allies on new issues they brought up that were not originally included in the IDI guide. As IDIs exposed new issues the evaluation team wanted to ask all subsequently interviewed trade allies about, the evaluation team added new interview topics to the IDI guide for subsequent IDIs. Collectively, the data collected from the IDIs informed the construction of the survey guide. When possible, the evaluation team combined survey and interview responses and reported them together. As a result of these methods, reported (n) values vary.

5.1.3 Participants

From September to October 2015, the evaluation team surveyed 105 HEIP participants: 75 single family participants and 30 multifamily participants. The purpose of this data collection activity was to obtain a more detailed understanding of the customer experience with the program, identify potential areas for program improvement, and collect data to inform NTG estimates. Table 5-5 documents the specific research objectives of the participant survey.

Table 5-5 Participant Research Objectives

Research Objectives
Assess program outreach and marketing
Document customer experience with the program
Document reasons for participation and program influence
Gather feedback needed to estimate Net-to-Gross ratio
Assess population segments the program is reaching

In order to ensure the results were generalizable to the larger participant population, the

evaluation team stratified the sample by sector (single family and multifamily), aiming for 90/10 confidence/precision per sector.[1] Stratifying by sector – and collecting enough sample to achieve a high level of confidence/precision – was important as program experiences (including measures typically implemented, participation process, free ridership, and spillover) varied by sector. The evaluation team ultimately surveyed 105 decision-making participants: 75 from the single family sector and 30 from multifamily (Table 5-6). Recruiting multifamily decision-makers – or those who were directly involved in the decision to pursue and finance HEIP measures – was more difficult than expected, which resulted in completing fewer surveys than anticipated. Two primary issues made it difficult to identify and recruit multifamily decision makers:

1) The evaluation team often lacked a name of the property manager or owner involved in the decision.
2) Since some measures were implemented at no cost to the participant and tenants had to grant the trade ally permission to enter their unit to implement the measure (see sections 5.2.2.1 and 5.2.3.2), both property managers and tenants often reported the other party as being the decision maker for the project.

Nonetheless, the resulting samples achieve high confidence/precision levels at both sector and program-wide levels.

Table 5-6 Stratified Participant Sampling

Sector	Count of Unique Properties with 2014 HEIP Rebates	Sample size needed to satisfy 90/10 confidence/precision	Sample size collected	Achieved confidence/precision
Single Family	7,866	67	75	90/10
Multifamily	204	51	30	90/15
Program-wide	8,070	67	105	95/10

The evaluation team also monitored the resulting sample as it was being collected to ensure that measures implemented by sampled participants were representative of the measures in the sector's population. The evaluation team had to collect an additional eight surveys in the single family sector in order to achieve a representative sample in regards to rebated measures.

5.2 Process Evaluation Findings

The following subsections describe program successes and challenges as well as opportunities for program improvement.

5.2.1 Program Staff and Implementer Feedback

The evaluation team conducted in-depth interviews with the DEP HEIP manager and two Honeywell ("Implementer") staff to obtain a more detailed understanding of the program

[1] The Evaluation Team did not attempt to sample participants from manufactured homes, as less than 1% of all 2014 HEIP measures took place in this sector.

administration and delivery and challenges staff is facing in delivering this program to the market. The following subsections summarize program and implementation staff reports of their experiences with delivery of HEIP services to customers.

Program Strengths

Implementer and HEIP program staff are communicating effectively. Both the DEP program manager and implementation staff reported having ongoing bi-monthly meetings as well as informal meetings that cover: marketing and outreach, quality assurance (QA)[2], invoicing needs, and observations from the field (i.e., updates or concerns from the field representatives). Program manager also receives daily status reports from the implementer on the number of HEIP applications that have been processed, on hold, or in the QA process. The implementation staff noted: "our communication with the [program manager] is open and frequent."

Program has an extensive trade ally network. About 500+ trade allies are affiliated with the program. Various trades are in the trade ally network (HVAC installers, insulation contractors, and plumbers). Additionally, the implementation staff noted, in certain markets such as Raleigh, Wilmington, and Pinehurst customers expect contractors to be affiliated with the program, which drives trade allies to the program.

Program appears to be attracting the "right type" of trade allies and assisting them to make the sale. The implementation staff noted that contractors in the trade ally network promote HEIP rebates to encourage their customers to select higher-end equipment and/or services (e.g., installing 15 SEER or greater heat pumps). The implementation staff explained contractors are motivated to sell higher-end equipment and/or services because:

1) They can earn more money by installing higher-end equipment.

2) Higher-end equipment typically lasts longer and performs better, which leads to higher customer satisfaction over time, and high customer satisfaction helps grow the business.

The implementation staff also noted that contractors unwilling to install higher-end equipment are skeptical of the technology and not interested in dealing with the sophisticated controls.

Program Challenges and Opportunities for Improvement

Many trade allies struggle to explain benefits of higher efficiency equipment to their customers. The implementation staff noted very few trade allies are successful in explaining benefits of program qualifying equipment and services to their customers. Staff explained: "When you ask a plumber that he now needs to convince [customers] to spend $2,500 for a water heater when they could get one for $700, and he doesn't understand the way that the machine works and is incapable of explaining it, he is never going to be able to sell those [$2,500 water heaters]." Trade ally feedback, shown in Section 5.2.2, supports this perspective.

It is difficult to manage an extensive trade ally network. It is challenging for the implementer to communicate program requirements and expectations to 500+ contractors in the trade ally network. Implementation staff contends that more consistent messaging and communication

[2] Implementer audits 2.5% of jobs done by the trade allies. In this report, the evaluation team refers to this activity as Quality Assurance.

from trade allies to homeowners would be easier to accomplish by having a more selective contractor trade ally base. Because the program is well known in certain markets (e.g., Raleigh), the participation levels would likely not decline if the program became more selective of the trade allies in those markets, according to the implementation staff.

Many of the errors on rebate forms relate to checklists. Application errors are infrequent (1-2% of all applications contain errors according to program and implementation staff). Most errors occur on the HVAC replacement, duct sealing, and attic incentive applications. Many of the errors relate to checklists associated with the rebate forms. To minimize this error rate, the implementer is conducting a documentation "refresher" training. Contractors who attended the training are reporting to the implementer that rebate forms, in general, are short and well laid-out, but checklists are difficult to read because of the small font.

Program Process Flow Charts

Program and implementation staff provided a detailed description of the program processes and activities. These processes and activities are shown on a program flow map in Appendix C. The process segments shown in the map are: 1) Application Processing, 2) Quality Assurance, and 3) Final Payment.

5.2.2 Trade Ally Perspective

The evaluation team interviewed ten "high volume" trade allies, which are trade allies that implemented at least 100 rebated HEIP measures in 2014. The evaluation team also surveyed 70 trade allies of varying HEIP rebate submission volumes, ten of which were high volume trade allies. Sampled trade allies represented a wide range of business sizes. Few (10%) worked for a company that had more than one location. Trade allies reported as few as one to as many as 300 employees currently working at their company.

5.2.2.1 Trade Ally Experience with HEIP

This section reports the results from trade ally surveys and interviews regarding their experience participating in HEIP.

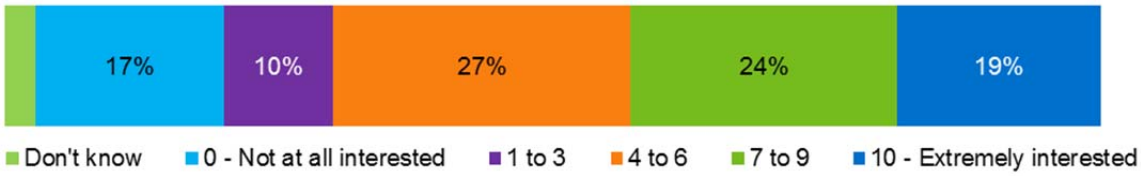
Training

The *Standards and Installation Procedures* manual for participating contractors requires that "Contractors must have at least one representative attend all HEIP mandatory training sessions." We asked trade allies about their experiences with HEIP training, as well as their suggestions for future training opportunities. One-fifth of surveyed trade allies reported they personally had not attended any HEIP training, and thus could not comment on their satisfaction with it. Of the surveyed trade allies that rated their satisfaction with program training offered by Honeywell, about half (54%) were highly satisfied (see Figure 5-9). Nine of the ten interviewed high volume trade allies with training experience said that the training was helpful, and one reported that they were already familiar with the bulk of the training's content. Only one interviewee said they wished the training had covered something else, citing "crawl space encapsulation."

When asked an open-ended question about what other training types they would be interested

in, less than half of surveyed trade allies reported they would be interested in additional training opportunities. Specific training requests varied widely. However, when specifically asked to use a 0 to 10 scale to demonstrate their interest in a training course on how to more effectively sell high efficiency equipment, the majority (80%) expressed at least minor interest in sales training (Figure 5-2). Interviewed high volume trade allies, on the other hand, were largely disinterested in sales training: eight of ten said they were not interested.

Figure 5-2 Interest in Sales Training (n=70)

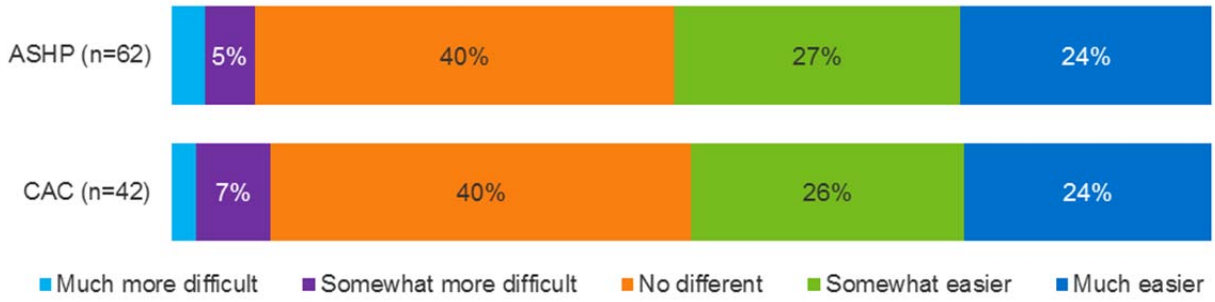


Successful Strategies for Selling Qualified Measures

Although high volume trade allies account for only 5% of the trade ally population, collectively this group did 61% of all rebated measures in 2014. Thus, findings from interviews with this group offer insights on demonstrably successful strategies for selling qualified equipment. High volume trade allies reported exerting significant effort to educate their customers on the benefits of energy efficient equipment and energy saving services (such as duct sealing or HVAC audits). Most commonly, high volume trade allies reported focusing their sales pitch on dollar savings realized from energy efficiency. These trade allies use different techniques to educate their customers on energy efficiency, such as explaining the SEER system or using charts with graphics demonstrating energy use and savings. Some high volume trade allies also use promises of other non-energy benefits as a sales tool (such as comfort or prolonged system life), with one high volume trade ally noting their sales process mainly emphasizes increased comfort (and does not devote much attention to monetary savings).

About half of surveyed trade allies (that install air source heat pumps and/or central air conditioners) said that it is now easier to sell qualified (15 SEER) air source heat pumps (ASHPs) and central air conditioners (CACs) since the U.S. Department of Energy mandated a 14 SEER minimum for ASHPs and CACs manufactured after January 1st, 2015 (Figure 5-3).

Figure 5-3 Difference in Ease or Difficulty in Selling 15 SEER ASHPs and CACs since Code Change



We also asked high volume trade allies about the primary reasons as to why their customers replace HVAC equipment, get ducts sealed, or add attic insulation. While these trade allies reported that their customers get ducts sealed or add insulation explicitly to save money on energy bills, they reported that most new HVAC units are replacing broken or aging systems, and that few customers replace well working standard efficiency HVAC units with high efficiency units just for the energy savings. Single family participant findings (see section 5.2.3.2) corroborate these trade ally reports, as only 3% of single family and 9% of multifamily HVAC replacement participants reported replacing a HVAC unit that was in good working condition.

Recruiting Customers into HEIP

Trade ally interview and survey data – which is further corroborated by participant survey data (see section 5.2.3.1) – reveals that trade allies are largely responsible for recruiting customers into the program. As seen in Figure 5-4, half of surveyed trade allies said that their customers "rarely" or "never" ask about HEIP rebates and about one-third (34%) said their customers occasionally ask about the program. Instead, trade allies typically introduce their customers to HEIP.

Figure 5-4 How Often Customers Ask About HEIP (n=70)

Further, a considerable minority (37% of surveyed trade allies, and four of ten interviewed trade allies) expressed low to moderate satisfaction with DEP's marketing of the program, with dissatisfied survey respondents noting that the marketing is not visible enough and the great majority of their customers are not familiar with HEIP. Additionally, some interviewed high volume contractors said HEIP bill inserts – one of DEP's primary HEIP advertising methods – were ineffective marketing mediums. Participant survey results support these trade ally reports;

a minority of participants reported hearing about HEIP via DEP's marketing efforts (33% of multifamily and 21% of single family participants). Thus, trade allies often need to educate their customers on the benefits of energy efficiency and the availability of HEIP rebates in order to bring new households into the program.

Quasi-Direct Install Approach

An in-depth interview with a high volume HVAC audit contractor revealed that some trade allies offer HEIP's non-equipment measures for no out-of-pocket cost to their customers in return for the customer signing over their rebate to the trade ally. Following that interview, we asked all surveyed and subsequently interviewed trade allies if they were offering any of HEIP's non-equipment measures via this "quasi-direct install" approach. We found that very few (6% of all trade allies, or 7% of trade allies that did non-equipment measures in 2014) utilized a quasi-direct install approach: two trade allies offer "direct install" HVAC audits, three offer "direct install" duct sealing, and one offers "direct install" attic insulation and air sealing.

Trade allies engaging in quasi-direct install approach varied in how often they offered that approach to their customers. Two trade allies considered the rebate as payment in full for 90% of their single family duct sealing jobs and two others for 100% of their multifamily HVAC audit jobs. Conversely, one trade ally reported rarely offering quasi-direct install duct sealing and/or insulation, noting that such an approach could be profitable if the client had multiple properties. Additionally, the two trade allies that primarily use the direct install model for duct sealing in single family homes do not appear to rely on the same payment model for multifamily properties: one reported using the direct install model for 40% of multifamily duct sealing jobs and the other said they did not know how frequently they took the rebate as payment in full for multifamily duct sealing projects.

Although we are unable to estimate the prevalence of quasi-direct install approach of duct sealing and attic insulation measures,[3] the vast majority (at least 73%) of HVAC audits were offered at no out-of-pocket charge to customers.[4] One of the two primary HVAC audit trade allies explained that he built his HVAC auditing business solely around offering HVAC audits in return for HEIP rebate checks, noting that he was able to make this business model profitable by performing audits in as many units as possible in a given apartment complex, which kept his overhead low. Both HVAC audit contractors explained they use the following method for acquiring customers: they approach a multifamily property manager and "sell" them on the no-cost service, after which they must collect permission slips from tenants to enter their unit to perform the HVAC audit in exchange for the rebate. The HVAC auditors reported that the 'permission slip' process is routinely difficult though, since the DEP account number must be accurately reported on the form and the signatory must be the primary account holder (both of

[3] While all surveyed multifamily attic insulation (n=5) and duct sealing (n=3) respondents reported receiving those measures at no charge in return for the rebate, our sample of trade allies did not overwhelmingly report offering these measures using the quasi-direct install approach. Thus, our evidence is inconclusive regarding how prevalent this financing approach is in the HEIP population.

[4] Three trade allies did 99% of all HVAC audits in 2014. We spoke with two of them, which did 73% of all HVAC audits in 2014. We do not know if the other primary HVAC audit trade ally offers the measure at no cost in return for the rebate.

which pose frequent barriers to successful permission granting). Further, one of these trade allies said that some tenants simply do not want to take the time to fill out the form, which further lowers his 'conversion rate.' These HVAC auditors claim they would be able to do significantly more HVAC audits through HEIP if they did not have to collect individual permission slips from each tenant, with one auditor reporting he would do three times as many HVAC audits if he just needed permission from the property manager. Alternatively, one of the HVAC auditors said at the very least he should be able to access a DEP database with account holder names and account numbers, so he could provide tenants pre-filled out letters that just required a signature. Due to the difficulties involved in collecting tenant permission slips, one HVAC auditor said that both his company and another one of the major HVAC auditing companies are no longer performing audits through HEIP.

Rebate Application Process

While HVAC audit permission slips from multifamily units pose their own unique challenges, trade allies reported experiencing challenges with the standard rebate application process as well, constituting the biggest sticking point for trade allies. Although most (61%) reported experiencing problems or frustrations with the rebate application process, only 7% said this was frequent or "always" (Figure 5-5).

Figure 5-5 Frequency of Experiencing Problems or Frustrations with Rebate Application Process (n=70)

Trade allies that reported experiencing problems or frustrations with the rebate application process generally said the application process is overly burdensome due to a "cumbersome" and "time-consuming" paperwork process, which is often exaggerated by customer-caused errors (Table 5-7). Trade allies reported various customer-caused paperwork issues, such as customers making a clerical error or failing to send the paperwork in. The majority (70%) of trade allies reported letting their customers fill out certain portions of the application and leaving it to the customer to mail and submit the application paperwork, which may explain customer-oriented application problems.[5] Additionally, 'rebate application paperwork' was the most frequently cited item (mentioned by six of ten interviewees) when high volume trade allies were asked an open-ended question about 'what they least liked about the program.'

[5] For each measure trade allies had experience with, we asked trade allies to estimate the proportion of their qualified projects that did not receive a rebate due to the customer failing to mail in the application paperwork. Responses to this question were extremely varied and provided no conclusive evidence on the matter.

Table 5-7 Problems and Frustrations with the Rebate Application Process (Multiple Responses Allowed)

Responses	n=43
Customer-caused paperwork issue	21%
Paperwork is cumbersome/time-consuming	16%
Paperwork errors (general)	12%
Missed application deadline	9%
ARI reference number problems	9%
Duke territory confusion	9%
Other	35%

Transitioning to a completely online application system was the most frequent suggestion for improving the rebate application process, and also for improving the program in general. As some trade allies explained, only part of the form can be filled out via computer, while the rest must be written in by hand. Trade allies reasoned that an electronic rebate application submission process would remedy the bulk of the aforementioned problems: time and energy spent, customers failing to mail in applications, account number errors, and other clerical errors.

Despite the prevalence of problems and frustrations associated with the rebate application process, the majority (67%) of surveyed trade allies reported they were highly satisfied with the rebate application submission process (see Figure 5-9).

5.2.2.2 Program Influence on Trade Allies

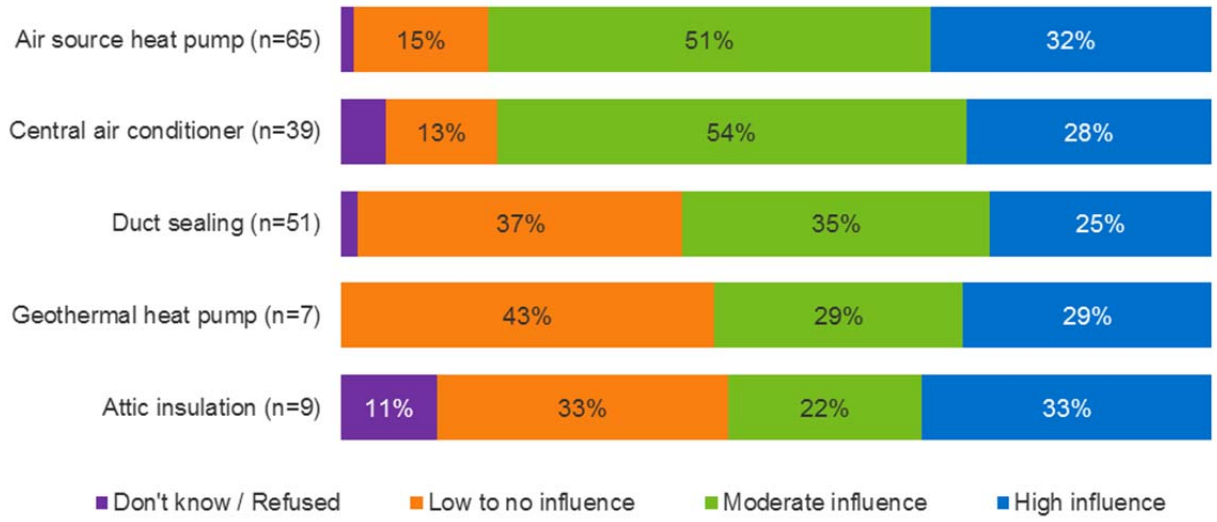
Trade ally interview and survey results reveal that the program is influencing energy efficiency contracting services offered by contractors in the trade ally network. Most (67%) of surveyed trade allies reported their knowledge of energy efficient products and services had increased since they became involved with HEIP, 40% of which said the program was highly influential on their increased knowledge (Figure 5-6).

Figure 5-6 HEIP Influence on Increased Trade Ally Knowledge of Energy Efficient Products and Services (n=47)*

* Asked on a 0-10 scale, where 0 is “not at all influential” and 10 is “extremely influential.” Low to no influence represents responses ranging from 0 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10.

Most trade allies reported that HEIP has at least partially influenced their practice of recommending qualifying measures, with a quarter or more – depending on the measure – indicating HEIP was highly influential (Figure 5-7).

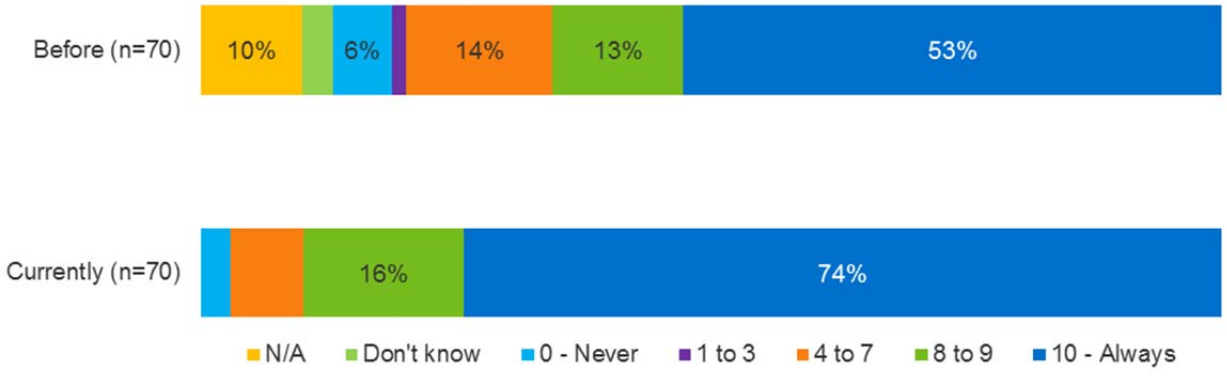
Figure 5-7 HEIP Influence on Trade Ally Practice of Recommending Program Qualified Measure*



* Asked on a 0-10 scale, where 0 is "not at all influential" and 10 is "extremely influential." Low to no influence represents responses ranging from 0 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10. Figure excludes "don't know" and refused responses. Each row represents trade allies who had experience with the measure.

Further, trade allies reported recommending high efficiency equipment significantly more now compared to before they were a participating contractor in HEIP (Figure 5-8).[6]

Figure 5-8 Trade Ally Frequency of Recommending High Efficiency Equipment*



* Asked on a 0-10 scale, where 0 is "never recommend" and 10 is "always recommend."

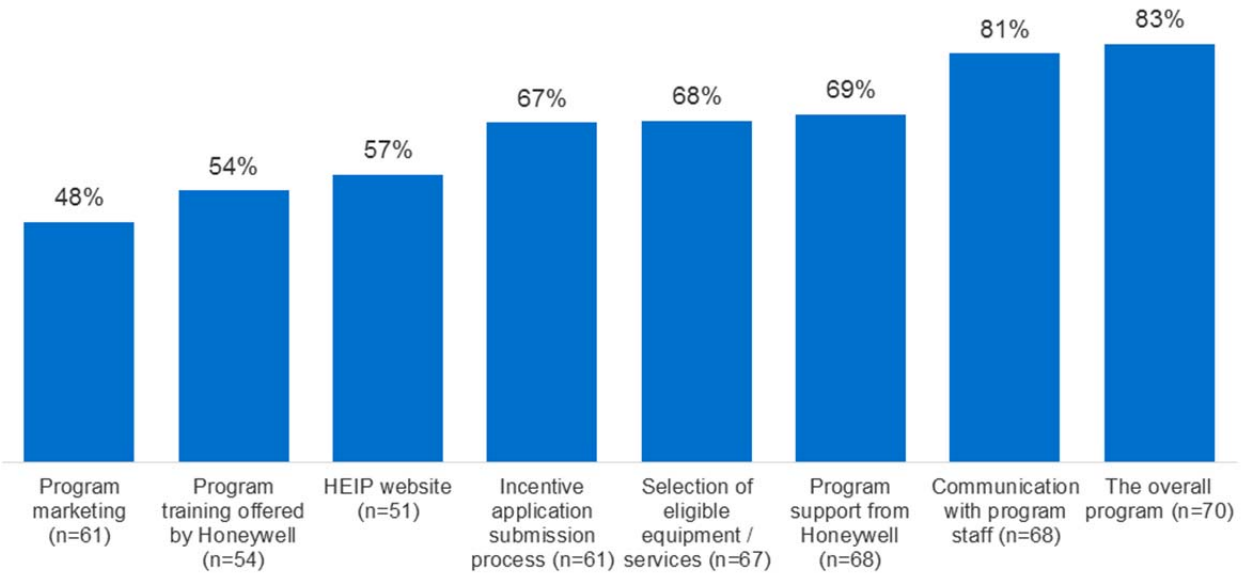
[6] p<.001; Related Samples Wilcoxon Signed Rank Test

However, HEIP influence on stocking of energy efficient equipment was not as strong, as only two of eight trade allies (who reported increased energy efficiency of stocked equipment since joining HEIP) reported HEIP had highly influenced their increased stocking of energy efficient equipment (as indicated by a rating of 8 to 10 on a 0-10 influence scale).[7] Instead, most (six of eight) reported low to moderate influence on their stocking of energy efficient equipment.

5.2.2.3 Satisfaction

Surveyed trade allies were highly satisfied with the program overall, as well as with their communications with program staff (Figure 5-9). These findings echo comments from interviewed high volume trade allies, who reported being satisfied with the program and gave highly laudatory comments on the quality of their communications with program and implementation staff: *"The people in that call center are so good and they really try to help. I don't care who you call – they are helpful and nice."*

Figure 5-9 Percent of Trade Allies Reporting High Satisfaction with Program Elements*



* Asked on a 0-10 scale, where 0 is "very dissatisfied," 5 is "neither satisfied nor dissatisfied," and 10 is "very satisfied." Figure exhibits percent with "high influence" ratings that range from 8 to 10. "Don't know" and "not applicable" responses were excluded when calculating the percentages in the figure.

As seen in Figure 5-9, satisfaction with other program elements was not as high. Surveyed trade allies were moderately satisfied with program support, the selection of eligible measures, and the incentive application process, with about two-thirds reporting high satisfaction with these program elements. Further, surveyed and interviewed trade allies were considerably less satisfied with:

- **HEIP website:** Some trade allies said they thought the website was confusing to use, difficult to find from the DEP website, did a poor job of explaining the air sealing

[7] Most (81%) trade allies said they do not keep stock, instead purchasing equipment on an as-needed basis.

component of the attic insulation measure, and that the "Find a contractor" tool was not user friendly. Five of the six interviewed high volume trade allies that were familiar with the HEIP website said it needed improvement.

- **Program marketing:** Dissatisfied trade allies said that DEP's marketing of the program is not working well, as most customers have never heard of HEIP. Seven of ten interviewed trade allies said DEP's marketing and outreach efforts could be improved, four of which said the HEIP bill inserts are ineffective at marketing the program (note: these four trade allies made these comments unprompted; we did not specifically ask for their opinions on bill inserts). *Supporting evidence: a minority of surveyed participants heard about HEIP via program marketing, and 50% of trade allies said customers rarely or never ask about HEIP.*
- **Program training offered by Honeywell:** Despite demonstrating moderately low satisfaction with program training, few trade allies offered any comments as to why they were dissatisfied with program training. The few trade allies that commented typically said they would like to see more training opportunities. *Supporting evidence: 80% of surveyed* trade *allies expressed interest in sales training.*

5.2.2.4 Suggestions for Improvement

Outside of those previously mentioned (marketing and website improvement), trade allies had few suggestions for improvement, with trade allies typically commenting that the program is generally well run. However, trade allies overwhelmingly requested a completely online rebate application system, with trade allies mentioning this at various points throughout both the interviews and surveys. There was little agreement regarding what other measures should be added to the qualifying measure list, with trade allies most commonly mentioning smart thermostats (7%), programmable thermostats (6%), or humidifiers (6%).

One other suggestion for improvement came from two interviewed high volume trade allies. Unprompted, both trade allies spoke in great depth about the problems they have experienced with the attic insulation measure. These trade allies - who worked at different companies – said that many customers do not realize that air sealing is also required to get the rebate, and that as a result many customers do not move forward with the measure once they find out that air sealing in the attic is also required. The following two quotes illustrate the problem:

- Contractor #1: *"Attic sealing is labor intensive. From $1.5k insulation job to a $3-4k insulation and seal job – and they don't want to spend that kind of money."*
- Contractor #2: *"I went to 15 different houses in the last two months that called us for a [DEP rebated] insulation job – because the air sealing description is so vague on the DEP website (and puts it in a secondary position) – I only had one conversion out of all 15. I think it's because they only see the insulation bit and they don't realize it's more than just that."*

To remedy this problem, these trade allies suggested: 1) making the air sealing requirement clearer on the HEIP website so that customers understand it is required prior to calling a contractor, and 2) educating customers on the value of air sealing, so that they are willing to

incur the out of pocket costs needed to finance the upgrade.

5.2.3 Participant Experience

The evaluation team surveyed 105 HEIP participants, 75 of which were from the single family sector and 30 of which were in the multifamily sector. Nearly all single-family participants reported living in a single-family detached home, with the exception of one participant who reported living in a manufactured home (Table 5-8). About half (57%) of multifamily participants reported living in an apartment or condominium building with four or more units, most of whom either owned the building or worked for the company who managed the property. Nearly all multifamily participants reported either managing or owning the property where the HEIP measures were installed or preformed (57% and 37%, respectively), with the remaining two participants (6%) reporting renting the property.[8]

[8] The two multifamily participants who reported renting the property installed a room air conditioner through HEIP that they paid for without the assistance of property management.

Table 5-8 Housing Type and Tenure, by Sector

Housing Type and Tenure	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Single Family	99%	-	70%
Single family - Owner/Property manager	96%	-	67%
Single Family - Renter	3%	-	2%
Manufactured single family - Owner	1%	-	1%
Apartment or condominium	-	57%	16%
Apartment or condominium - Owner/Property manager	-	53%	15%
Apartment or condominium - Renter	-	3%	1%
Row or townhouse - Owner	-	37%	10%
Duplex of triplex	-	7%	2%
Duplex or triplex - Owner	-	3%	1%
Duplex or triplex - Renter	-	3%	1%
Total	**100%**	**100%**	**100%**

The type of HEIP measures installed or performed in the participant sample varied by sector. Nearly all (85%) single-family participants installed an HVAC measure, primarily air source heat pumps (ASHPs), whereas about two-fifths (43%) of multifamily participants performed an HVAC audit (Table 5-9). Additionally, about two-fifths (39%) of single family participants completed two different measure types, compared to 7% of multifamily participants. Nearly all (97%) single-family participants who completed more than one measure performed duct sealing and repair.

Table 5-9 HEIP Measure Type, by Sector (Multiple Responses Allowed)

Measure	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Any HVAC	85%	30%	69%
Air source heat pump	68%	10%	51%
Central air conditioner	15%	17%	15%
Geothermal heat pump	3%	3%	2%
Duct sealing and repair	40%	10%	31%
Attic insulation	8%	17%	10%
HVAC tune up	1%	43%	13%
Room Air Conditioner	1%	7%	3%
Heat Pump Water Heater	3%	0%	2%

5.2.3.1 Participant Awareness

Contractors are the primary way consumers learn about HEIP. Three-quarters of single family

and two-fifths of multifamily participants reported learning about HEIP from their contractor (Table 5-10). Additionally, single-family participants who performed duct sealing and repair were significantly more likely to report learning about HEIP from their contractor than single-family participants who did not perform that measure (87% compared to 64%, respectively; Pearson Chi-square Test at $p<0.05$). Few participants reported learning about HEIP via DEP's direct mail marketing efforts.

Table 5-10 Source of HEIP Program Awareness, by Sector (Multiple Responses Allowed)

Source of Awareness	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Contractor	75%	40%	65%
Direct mail	16%	23%	18%
Utility bill-inserts	*11%*	*13%*	*11%*
Postcard or other advertisements	*5%*	*10%*	*7%*
Duke Energy Website	7%	10%	8%
Family/friends/word-of-mouth	1%	13%	5%
Property management company	0%	10%	3%
Other	4%	10%	6%
Don't know	1%	0%	1%

Consumers are primarily learning about energy efficient technologies from the web. About half of participants (53% of single-family and 40% of multifamily participants) reported going online to search for information regarding energy savings (Table 5-11).

Table 5-11 Sources of Energy Savings Information, by Sector (Multiple Responses Allowed)

Source of Information	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Online	53%	40%	50%
Read utility information	19%	23%	20%
Go to utility website	11%	23%	14%
Professional organization or trade publication	5%	13%	8%
Mass media (TV, newspapers, magazines)	7%	3%	6%
Go to the store and talk to salespeople	4%	7%	5%
Word of mouth	1%	7%	3%
Other	3%	7%	4%
Don't know	21%	13%	19%

5.2.3.2 Motivation to Participate

The evaluation team asked participants a series of questions to determine why they selected qualifying HEIP measures. For those participants who installed HVAC equipment (ASHP,

geothermal heat pump, central air conditioner, or room air conditioner), The evaluation team asked about the primary reason they installed the new equipment, and then asked why they chose an energy efficient version of that equipment. For those that performed energy saving services (attic insulation, duct sealing and repair, and HVAC audit), the evaluation team asked what motivated them to perform each service.

Overall, multifamily participants were more proactive in HVAC equipment replacement compared to single-family participants. Less than one-third (27%) of multifamily participants reported replacing their HVAC equipment because it was broken (compared to 59% of single-family participants; Z-Test of Proportions at p<0.05; Table 5-12).

Table 5-12 Reason for Replacing HVAC Equipment, by Sector (Multiple Responses Allowed)

Condition of System	Single Family (N=64)	Multifamily (N=11)	Total (N=75)
Broken or malfunctioning	59%	27%[a]	55%
Old	48%	64%	51%
In good working condition	3%	9%	4%

[a] A statistically significant difference between single and multifamily participants (Z-Test of Proportions at p<0.05). Differences between single and multifamily participants should be interpreted with caution due to the small sample size for the multifamily group.

The most commonly reported motivation for selecting highly energy efficient equipment (over standard efficiency equipment) for all participants was to make the property more energy efficient in order to save money (Table 5-13). Multifamily participants were more likely to report selecting energy efficient HVAC equipment to increase the value of their property compared to single-family participants (27% compared to 5%, respectively; Z-Test of Proportions at p<0.05)).

Table 5-13 Motivation for Selecting Energy Efficient HVAC Equipment, by Sector (Multiple Responses Allowed)[a]

Motivation	Single Family (N=64)	Multifamily (N=11)	Total (N=75)
To make property more energy efficient to save money	70%	64%	69%
Wanted one of the best systems available	23%	36%	25%
Contractor's recommendation	16%	18%	16%
To make property more energy efficient to help the environment	16%	18%	16%
To maximize comfort	14%	9%	13%
Interested in incentives / helped justify increased cost	8%	9%	8%
To increase value of the property	5%	27%[b]	8%
Improve health and safety issues (mold, etc.)	0%	9%	1%
Other	9%	9%	9%
Don't know	2%	0%	1%

[a] Only participants who installed an ASHP, geothermal heat pump, central air conditioner, or room air conditioner were asked this question. Differences between single and multifamily participants should be interpreted with caution due to the small sample size for the multifamily group.

[b] A statistically significant difference between single and multifamily participants (Z-Test of Proportions at p<0.05)

Single and multifamily participants reported different motivations for performing energy saving service measures at their property. Among single-family participants, improving the efficiency of their property to save money and their contractor's recommendation were the top two reasons to perform services (35% each; Table 5-14). Whereas about half (52%) of multifamily participants reported being motivated by energy savings and about one-third (29%) reported they performed the services to increase the value of their property.

About three-quarters (71%) of multifamily participants received at least one HEIP service measures free of charge (eight of the 13 who had an HVAC audit and all of those who had insulation or duct services performed). Instead of paying upfront for their measures and subsequently receiving a rebate as partial reimbursement, these participants signed over their rebate to their contractor, which was considered as payment in full for the measure. One-tenth of multifamily participants who reported receiving the service at no charge reported that the free offer was a motivation for performing the service.

Table 5-14 Motivation for Having Energy Saving Services Performed, by Sector (Multiple Responses Allowed)[a]

Motivation	Single Family (N=37)	Multifamily (N=21)
To make property more energy efficient to save money	35%	52%
Contractor's recommendation	35%	10%[b]
To maximize comfort	27%	19%
Improve health and safety issues (mold, etc.)	16%	5%
Wanted one of the best systems available	11%	5%
Age of ducts / Needed to be repaired	8%	0%
To increase value of the property	8%	29%[b]
Interested in incentives / helped justify increased cost	5%	0%
It was free	5%	10%
To make property more energy efficient to help the environment	5%	10%
Maintain equipment functionality	0%	14%[b]
Other	3%	10%

[a] Only participants who installed a ASHP, geothermal heat pump, central air conditioner, or room air conditioner were asked this question.

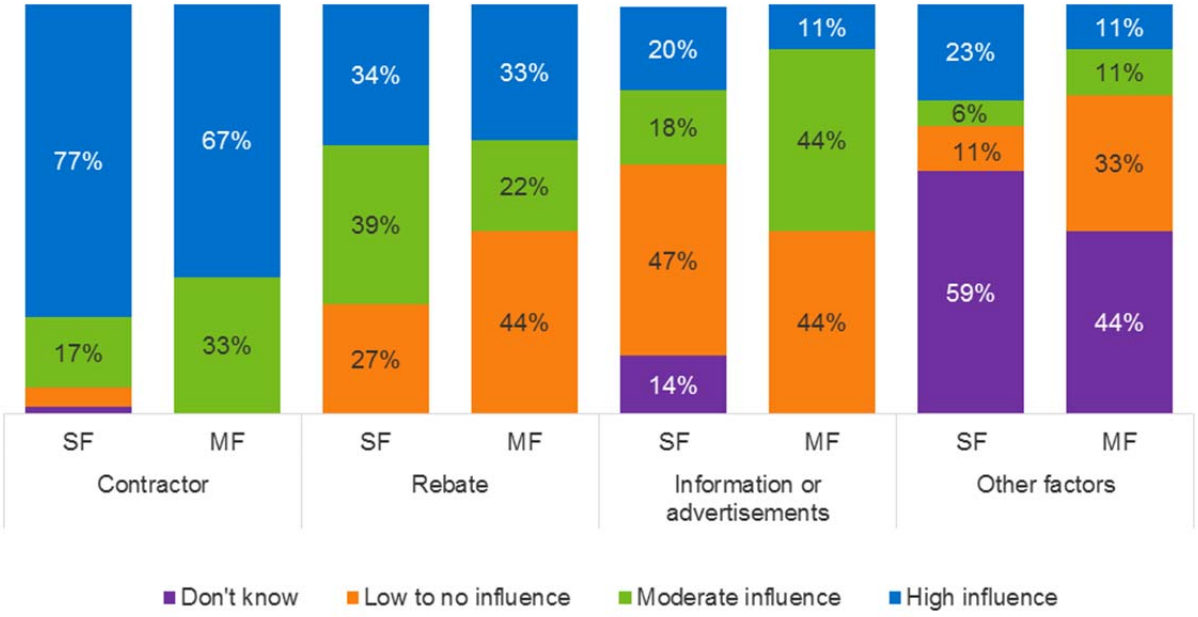
[b] A statistically significant difference between single and multifamily participants (Z-Test of Proportions at p<0.05)

5.2.3.3 Program Influence

About three-quarters of participants (77% of single and 67% of multifamily participants, respectively) who purchased HVAC equipment reported that recommendations from their contractor were very influential (rating of "8" to "10" on an 11-point scale) in their decision to purchase an energy efficient system (Figure 5-10). Contractors were significantly more influential than DEP's rebate, information, or advertisements (Related-Samples Wilcoxon Signed Rank Test; p<0.05). Additional analysis revealed that single family participants who reported learning

of HEIP via a contractor rated their contractor as significantly more influential on their decision to purchase qualifying HVAC equipment (demonstrating an average contractor influence rating of 9.1) as compared to those that learned of HEIP through another channel (demonstrating an average contractor influence rating of 6.9; Mann-Whitney U at p<0.01).

Figure 5-10 Influential Factors in Decision to Purchase Efficient HVAC Equipment (Single Family n=64; Multifamily n=9)[a,b]

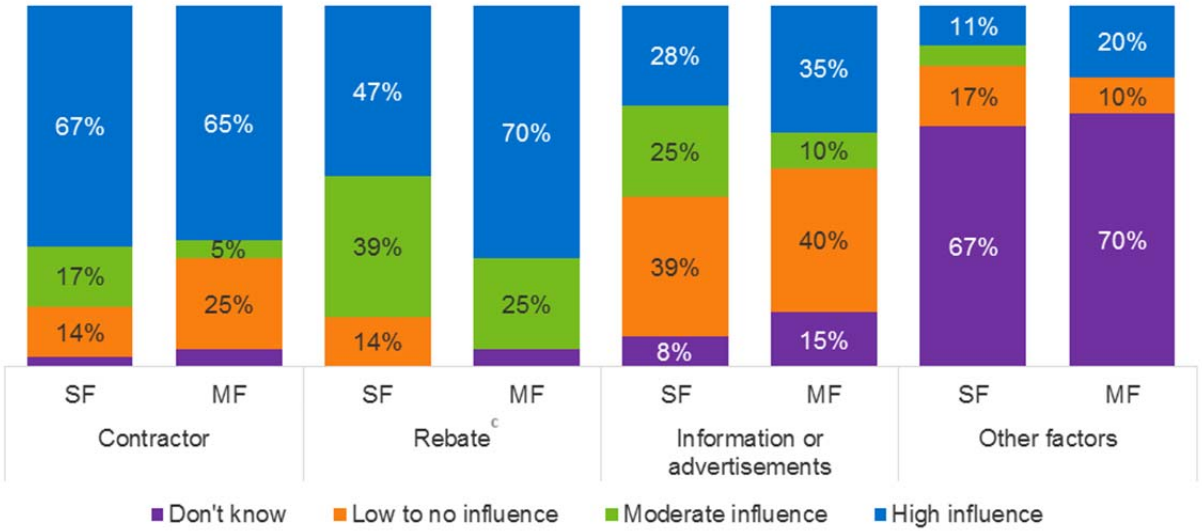


[a] Participants were asked to rate each factor using a 0 to 10 scale where 0 meant "not at all influential" and 10 meant "extremely influential." Low to no influence represents responses ranging from 0 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10.

[b] Differences between single and multifamily participants should be interpreted with caution due to the small sample size for the multifamily group.

Single-family participants also rated their contractor's recommendation as being the most influential factor in performing energy savings services (attic insulation, duct sealing and repair, and HVAC audit; Figure 5-11). However, multifamily participants rated the HEIP rebate as being the most influential factor in performing the services, which was significantly more influential than reported by single-family participants (Mann-Whitney U at p<0.05).

Figure 5-11 Influential Factors in Decision to Perform Energy Saving Services (Single Family n=36; Multifamily n=20) [a, b]



[a] Participants were asked to rate each factor using a 0 to 10 scale where 0 meant "not at all influential" and 10 meant "extremely influential." Low to no influence represents responses ranging from 0 to 3, moderate influence represents responses ranging from 4 to 7, and high influence represents responses ranging from 8 to 10.

[b] Since some participants performed more than one energy savings service, they were asked to rate the influence of each factor for each performed. For this analysis, the evaluation team averaged those participants influence scores.

[c] A statistically significant difference between single and multifamily participants (Mann-Whitney U at $p<0.05$).

HEIP is not a strong "gateway" program. About one-third (31%) of single-family and over half (57%) of multifamily participants reported being familiar with other DEP offers. Among those aware of other DEP offers, about one-tenth reported being aware of other HEIP rebates, specifically (15% and 10%, respectively; Table 5-15). Few participants reported receiving another DEP rebate. Among the six single-family participants who reported receiving another DEP rebate, all reported receiving their rebates prior to completing their most current HEIP project. Of the two multifamily participants who reported receiving another DEP rebate, one reported doing so prior to and the other reported doing so after completing their most recent HEIP project.

Table 5-15 Awareness and Participation in Other DEP Offers, by Sector (Multiple Responses Allowed)

Rebates and Discounts	Count and Percent Aware		Count and Percent of Those Aware Who Participated	
	Single Family (n=75)	Multifamily (n=30)	Single Family (n=23)	Multifamily (n=17)
Other HEIP Rebates	11 (15%)	3 (10%)	4 (17%)	1 (6%)
Heat pump water heater	*3 (4%)*	*1 (3%)*	*2 (9%)*	*0 (0%)*
Heating and cooling system	*2 (3%)*	*1 (3%)*	*0 (0%)*	*0 (0%)*
Window/room AC	*2 (3%)*	*0 (0%)*	*1 (4%)*	*0 (0%)*
Insulation	*3 (4%)*	*0 (0%)*	*1 (4%)*	*0 (0%)*
Duct sealing/replacement	*3 (4%)*	*0 (0%)*	*0 (0%)*	*0 (0%)*
HVAC audit/tune-up	*1 (1%)*	*1 (3%)*	*0 (0%)*	*1 (6%)*
Incentive to recycle old fridge or freezer	8 (11%)	4 (13%)	1 (4%)	0 (0%)
EnergyWise Home bill discounts	5 (7%)	2 (7%)	1 (4%)	0 (0%)
Discounted efficient lighting	3 (4%)	6 (20%)	1 (4%)	1 (6%)
ENERGY STAR home discount	1 (1%)	1 (3%)	1 (4%)	0 (0%)
Other	3 (4%)	3 (10%)	0 (0%)	1 (6%)

HEIP is influencing energy efficient behavior outside of the program, particularly in the multifamily sector. As part of our spillover battery of questions, the evaluation team asked participants what, if any, products or services they have purchased to help save energy at their property since receiving the HEIP rebate. About two-fifths of single and multifamily participants (39% and 43%, respectively), reported purchasing additional products or services since receiving their rebate, primarily energy efficient appliances (Table 5-16). Multifamily participants were more likely to report their participation in HEIP influenced them to purchase these products or services compared to single-family participants (9 of 15 or 60% compared to 10 of 29 or 34% reporting at least minor HEIP influence, respectively; Z-Test of Proportions at $p<0.05$).[9]

[9] Participants were asked to rate the influence of the HEIP rebate on their decision to purchase energy savings products and services using a 0 to 10 scale where 0 meant "not at all influential" and 10 meant "extremely influential." Minor influence included anything and rating above 0.

Table 5-16 Products or Services Purchased Since Receiving HEIP Rebate, by Sector (Multiple Responses Allowed)

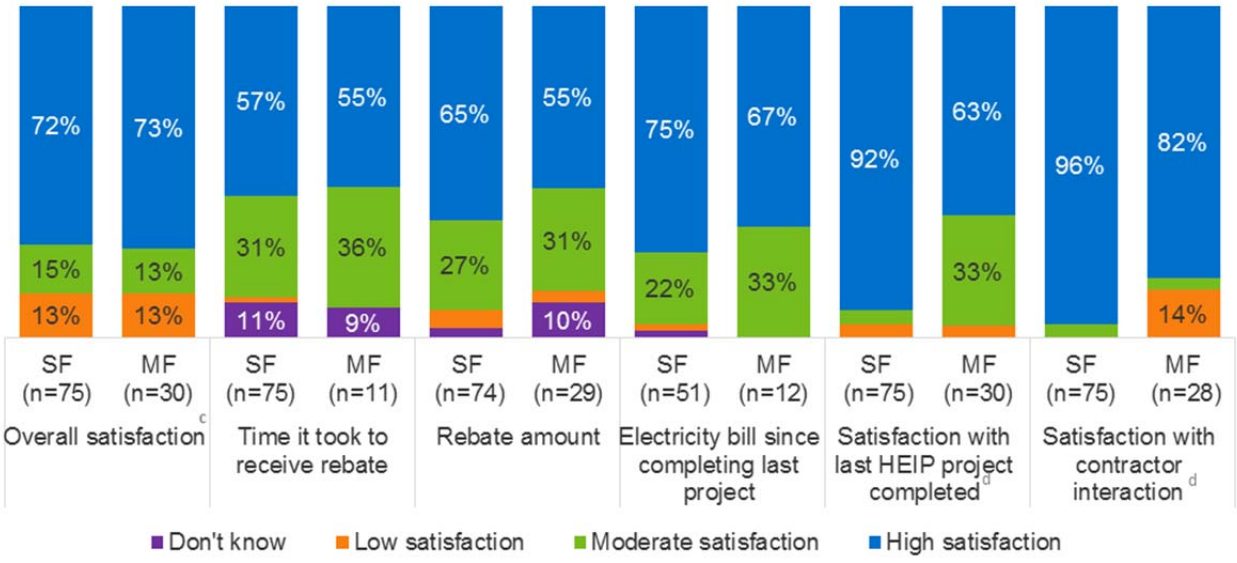
Products or Services Purchased	Single Family (N=29)	Multifamily (N=15)	Total (N=46)
Energy efficient appliances	35%	46%	37%
Energy efficient tank-style water heater	10%	15%	11%
CFLs	10%	8%	9%
LEDs	3%	23%	9%
Efficient heating or cooling equipment	13%	0%	9%
Efficient windows	10%	8%	9%
Added insulation	10%	0%	7%
Tankless water heater	6%	0%	4%
Sealed air leaks	0%	8%	2%
Other	6%	31%	13%

5.2.3.4 Participant Experience with the Program

Satisfaction

A majority of participants reported high satisfaction levels with most program elements (Figure 5-12). Most participants reported being highly satisfied (providing a response of “8” to “10” on an 11-point scale) with their contractor. Participants reported being less satisfied with the time it took to receive the rebate and the rebate amount compared to other program elements. Multifamily participants reported being significantly less satisfied with the last HEIP project they completed and their contractor compared to single-family participants (Mann-Whitney U at $p<0.05$).

Figure 5-12 Participant Level of Satisfaction with Program Elements, by Sector[a,b]



[a] Participants were asked to rate each factor using a 0 to 10 scale where 0 meant "not at all satisfied," 5 meant "neither satisfied nor dissatisfied," and 10 meant "very satisfied." Low satisfaction represents responses ranging from 0 to 3, moderate satisfaction represents responses ranging from 4 to 7, and high satisfaction represents responses ranging from 8 to 10.

[b] Sample sizes vary between program elements because The Evaluation Team excluded "not applicable" response from this analysis.

[c] For this item, participants were asked to rate their overall satisfaction on a five-point scale, from "very dissatisfied" to "very satisfied." The Evaluation Team recoded responses to be comparable with other items in the series.

[d] A statistically significant difference between single and multifamily participants (Mann-Whitney U at $p<0.05$)

To determine what, if any, challenges participants experienced with HEIP, the evaluation team asked those participants who expressed dissatisfaction (a response of "5" or less on an 11-point scale) with their last HEIP project, contractor, or the program overall, what challenges they experienced. A minority of participants mentioned difficulties in their experience with HEIP. Areas of dissatisfaction included utility bill savings not meeting expectations (4 mentions), would have liked a higher rebate amount (3 mentions), and contractor customer service issues (3 mentions).

In addition, the evaluation team asked all participants if they had any suggestions to improve HEIP. Among the 36 participants who provided a response, one-third (12 mentions) reported wanting more customer outreach to increase awareness of the program (Table 5-17).

Table 5-17 Suggestions for Improving HEIP, by Sector (Multiple Responses Allowed)

Suggestion	Single Family (N=24)	Multifamily (N=12)	Total (N=36)
More outreach to increase awareness	8	4	12
Increase rebate amount	8	1	9
Include additional measures	6	2	8
Improvements needed for multifamily customers	0	3	3
Would prefer an online application	2	0	2
Other	4	2	6

About one-tenth (11%) of single-family participants and one-quarter (23%) of multifamily participants reported they contacted DEP staff with questions during the course of participating in HEIP. Of those participants that were in contact with DEP, nearly all (100% of single and 88% multifamily participants) reported doing so via phone. Most participants reported being very satisfied with their interactions with DEP staff (100% of single and 83% of multifamily participants providing a rating of "8" to "10").

Application Process

Over half (56%) of single-family and nearly all multifamily (83%) participants reported they or someone else in their home or business submitted their rebate application (Table 5-18).

Table 5-18 Person Who Mailed Rebate Application, by Sector

Person Who Mailed Rebate Application	Single Family (N=75)	Multifamily (N=12)*	Total (N=87)
Participant or someone at home/business	56%	83%	60%
Contractor	32%	17%	30%
Other	4%	0%	3%
Don't know	8%	0%	7%
Total	**100%**	**100%**	**100%**

* The evaluation team excluded those multifamily participants who received free services from this analysis.

The time it took to receive the rebate ranged from two to 12 weeks, and varied by sector (Table 5-19). On average, the rebate took six weeks to arrive for single-family participants and five weeks for multifamily participants.

Table 5-19 Number of Weeks to Receive Rebate, by Sector

Number of Weeks	Single Family (N=42)	Multifamily (N=10)	Total (N=52)
Two to four	24%	40%	27%
Five to six	14%	20%	15%
Seven or more	24%	0%	19%
Don't know	38%	30%	37%
Refused	0%	10%	2%
Total	**100%**	**100%**	**100%**

6 Conclusions and Recommendations

6.1 Impact

Data collected as part of the impact evaluation has informed the following conclusions and recommendations.

Conclusion 1: Verified gross and net savings values from the PY2014 evaluation differ from previous evaluation results

- **Recommendation 1:** Update the measure level deemed savings to be consistent with the research provided by this evaluation

Conclusion 2: Current measures and deemed savings are applied uniformly even when the building type changes.

- **Recommendation 1:** Single family and multifamily buildings offer the opportunity to target program offerings based on sector. Each building type has characteristics (size, thermal envelope, occupancy patterns, number of occupants) that are unique and provide opportunities to maximize program offerings for the two groups of account holders.

Conclusion 3: Upcoming changes (effective January 1, 2015) in minimum efficiency levels for ASHPs and CACs will influence the savings from these measures. The new standard will not be enforced until June 30th, 2016, but Trade Allies may begin modify the equipment they offer to participants before mid-2016 deadline. This would result in a shifting equipment efficiency baseline for 2015 and 2016.

- **Recommendation 1:** Consider how the shifting baseline efficiencies will affect program level savings and cost-effectiveness for ASHPs and CACs.

6.2 Process

Based on evaluation findings, evaluation team concluded the following and provides several suggestions on how to improve the program.

Conclusion 1: Trade allies are the driving force of the program, as they inform consumers of the HEIP incentive opportunity and convince them to purchase qualifying equipment. However, marketing and other support could increase their effectiveness.

- **Recommendation 1:** Consider the following suggestions to continue strengthening relationships with trade allies and to improve their effectiveness in generating program savings:

- Offer cooperative (co-op) marketing – Co-op marketing can help trade allies effectively market the program consistent with DEP objectives and increase customer perceptions of trade ally credibility.
- Expand sales training - Sales training can help trade allies implement more measures through the program by improving their sales skills.
- Change website and other attic air sealing marketing content - Expanding discussion on air sealing benefits, while clarifying that the rebate is for both air sealing and attic insulation, can help trade allies effectively communicate the value of this measure to their customers.
- Transition to an electronic rebate application and submission system - This system could:
  - Streamline the application process (e.g., alert those submitting an application of missing data and/or errors prior to submission)
  - Allow staff to monitor in real time whether the total cost of the project equals the incentive amount (e.g., having dashboards to monitor this)
  - Minimize lost savings by providing an electronic submission system that is easier for customers and trade allies to use

Conclusion 2: Current incentive levels can cover the full cost of HVAC audit, duct sealing/repair, and attic insulation/air sealing measures.

- **Recommendation 2:** Consider restructuring the rebates for HVAC audit, duct sealing/repair, and attic insulation/air sealing measures, especially for multifamily applications so that they don't cover 100% of the participant incremental cost. This will require analyzing costs of these measures and assessing their effectiveness on participation rates given the way trade allies are using the rebate to implement them for no out of pocket costs to the customer.

Conclusion 3: Single family and multifamily participants are fundamentally different in who, how, and why they participate. Even trade allies serve the two markets differently.

- **Recommendation 3:** Consider separating multifamily from single-family program offerings. This would allow program staff to develop a unique set of program offerings, as well as targeted value proposition messaging aimed specifically at multifamily or single-family decision makers. Since manufactured home owners most closely resemble single-family homeowners, the evaluation team recommends grouping manufactured homes with single-family homes if redesigning sector-based program offerings.

Appendix A Summary Form

Home Energy Improvement Program

Completed EMV Fact Sheet

Description of program

The Home Energy Improvement Program (HEIP) offers Duke Energy existing residential customers incentives for improving their home's energy efficiency through the installation of energy efficient heating, ventilating, and air conditioning (HVAC) and water heating equipment replacements, HVAC maintenance, duct testing and repair, and attic insulation with air sealing.

Date	March 1, 2015 - December 1, 2016
Region(s)	Progress
Evaluation Period	January 1, 2014 – December 31, 2014
Annual kWh Savings	7,340,000
Per Participant kWh Savings	528.7 / measure
Coincident kW Impact	2,408 kW
Net-to-Gross Ratio	72%
Process Evaluation	Yes
Previous Evaluation(s)	2013 - Navigant

Evaluation Methodology

Impact Evaluation Activities

- *25 metered air conditioning units for 3 months using DOE UMP methods.*
- *17 metered heat pump units for 3 months using DOE UMP methods.*
- *60 desk reviews, telephone surveys and analysis of 6 unique measures.*
- *Census billing analysis for HVAC audit measures.*

Impact Evaluation Findings

- *Realization rate = 132% for energy impacts; 78% for summer coincident demand impacts; 52% for winter demand impacts.*

Process Evaluation Activities

- *Trade Allies; 10 interviews with high volume contractors and 70 surveys with additional contractors.*
- *Participants; 75 telephone surveys of single family participants and 30 telephone surveys of single family participants.*

Process Evaluation Findings

- *Strengthen relationships with Trade Allies.*
- *Improve the rebate submission process - Transition to all on-line system.*
- *Consider separating incentives for single family vs multifamily measures.*

Appendix B Measure Impact Results

Table 6-1: Program Year 2014 Verified Impacts by Measure – DSMore Key Measure Parameters

Measure Category	Measure SubCategory	Prod Code	State	Gross Energy Savings (kWh)	Gross Summer Coincident Demand (kW)	Gross Winter Coincident Demand (kW)	Net to Gross Ratio	Net Energy Savings (kWh)	Net Summer Coincident Demand (kW)	Net Winter Coincident Demand (kW)	Measure Life
Prescriptive HVAC	Air Source Heat Pump	SSHEI	PN	864.6	0.204	0.220	66%	294.0	0.069	0.075	15
Prescriptive HVAC	Central Air Conditioner	SSHEI	PN	298.5	0.211	0.087	78%	83.0	0.059	0.024	15
HVAC	Duct Sealing	SSHEI	PN	336.3	0.077	0.049	67%	93.5	0.021	0.014	18
Prescriptive HVAC	Geothermal Heat Pump	SSHEI	PN	1725.0	0.684	0.000	58%	479.4	0.190	0.000	15
Prescriptive Plumbing	Heat Pump Water Heater	SSHEI	PN	1977.6	0.094	0.541	60%	549.6	0.026	0.150	15
Prescriptive HVAC	HVAC Audit	SSHEI	PN	261.0	0.167	0.035	105%	72.5	0.047	0.010	10
Insulation	Insulation	SSHEI	PN	363.5	0.257	0.082	106%	101.0	0.071	0.023	20
Prescriptive HVAC	Room Air Conditioner	SSHEI	PN	124.0	0.099	0.010	81%	34.5	0.028	0.003	9

Table 6-2: Program Year 2014 Verified Impacts by Measure – Single Family

Measure	Gross Energy Savings per unit (kWh)	Gross Summer Coincident Demand per unit (kW)	Gross Winter Coincident Demand per unit (kW)	Free Ridership	Spillover[1]	Net to Gross Ratio
Air Source Heat Pump	874	0.204	0.221	0.45 (n=41)	0.09	64%
Duct Sealing	512	0.361	0.102	0.44 (n=30)	0.09	65%
HVAC Audit	586	0.378	0.080	0.00 (n=1)	0.09	109%
Central Air Conditioner	300	0.212	0.047	0.49 (n=11)	0.09	60%
Insulation & Air Seal	364	0.257	0.082	0.60 (n=6)	0.09	49%
Heat Pump Water Heater	1,978	0.094	0.541	0.49 (n=2)	0.09	60%
Geothermal Heat Pump	1,725	0.684	0.000	0.58 (n=2)	0.09	51%
Room Air Conditioner	124	0.099	0.010	0.00(n=1)	0.09	109%

Microsoft Excel Worksheet

[1] Spiilover values are the same for each measure, because the influence was considered to be programmatic in nature and not measureable at the measure level.

Table 6-3: Program Year 2014 Verified Impacts by Measure - Multifamily

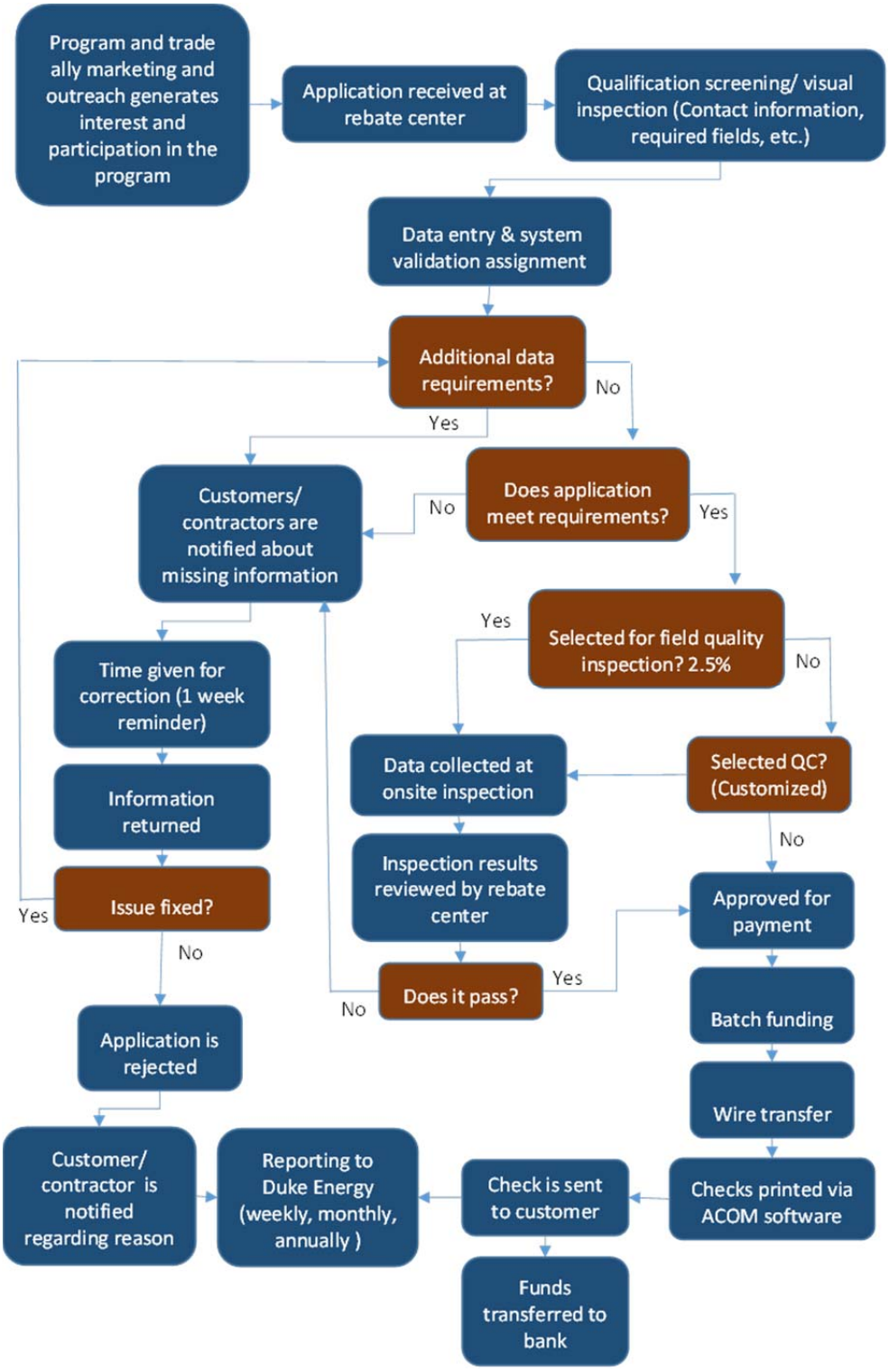
Measure	Gross Energy Savings per unit (kWh)	Gross Summer Coincident Demand per unit (kW)	Gross Winter Coincident Demand per unit (kW)	Free Ridership	Spillover[2]	Net to Gross Ratio
Air Source Heat Pump	561	0.165	0.162	0.22 (n=3)	0.06	84%
Duct Sealing	276	0.195	0.055	0.19 (n=3)[a]	0.06	87%
HVAC Audit	247	0.159	0.034	0.04 (n=14)	0.06	102%
Central Air Conditioner	209	0.164	0.036	0.23 (n=5)	0.06	83%
Insulation & Air Seal	364	0.257	0.082	0.00 (n=5)[a]	0.06	106%
Heat Pump Water Heater	1,978	0.094	0.541	n/a (n=0)	0.06	n/a
Geothermal Heat Pump	1,725	0.684	0.000	0.38 (n=1)	0.06	68%
Room Air Conditioner	124	0.099	0.010	0.56 (n=2)	0.06	50%

[a] Response counts were from the number of facility managers. The number of impacted measures for Duct Sealing was 121 and the number of impacted measures for HVAC Audits was 333.

[2] Spiilover values are the same for each measure, because the influence was considered to be programmatic in nature and not measureable at the measure level.

Appendix C Program Process Flow Chart

Figure 6-1: Application Processing, Quality Assurance, and Final Payment Steps



Appendix D Survey Instruments

D.1 Trade Ally In Depth Interview

Introduction

Hi, I'm ____ calling from Research Into Action on behalf of Duke Energy Progress. We are evaluating the Home Energy Improvement program (or, HEIP) and we are looking to speak with contractors like yourself that have been particularly active in the program. Our program records indicate that your firm completed several projects in 2014 for which a customer received an incentive from Duke Energy Progress's Home Energy Improvement program, is that correct? And are you knowledgeable about those incented projects?

[If "no," ask to speak to someone who is knowledgeable about HEIP work]

Your participation in this study is very important to Duke Energy Progress – this is your chance to tell us what is working well, what isn't, and how Duke Energy Progress can improve the program to better serve you and your customers. Do you have about thirty minutes to speak on the phone with me today about your experiences in the program?

Great. Rest assured, your answers will be kept strictly confidential and will not be tied to you or your firm. Is it okay if I record our conversation for note keeping purposes? It is just so I can go back and clean up my notes after we are done talking, as to ensure I accurately captured everything you said.

Background

My records show your company provides [PIPE IN SERVICES OFFERED: HVAC, plumbing, shell] services through HEIP. Is that correct?

Q1a – Do you serve single family customers, multifamily, or both?

Q1b – Do you ever offer attic insulation to customers at no charge in return for the rebate? If so – how is this economical?

Q1c – Do you ever offer the duct sealing/replacement to customers at no charge in return for the rebate? If so – how is this economical?

And what is your role in your company and how long have you worked there?

Awareness and Engagement

How do you explain the value of energy efficiency upgrades to your customers? What are some successful strategies?

Thinking about all customers – including those that do and don't go through the program, what are the primary reasons your customers replace HVAC and water heating equipment in their home?

How did your company learn about the HEIP?

Approximately what proportion of your HEIP customers knew about the program prior to you mentioning it? [IF NEEDED: about what proportion of your HEIP customers requested HEIP before you had a chance to mention it?]

Would you say the program has the right amount, too much or too little marketing?

How do you think Duke Energy Progress could improve their marketing and outreach efforts?

What do you do to market the HEIP program?

How can Duke better support your HEIP marketing efforts?

Have you attended any orientations or training events from Duke Energy Progress or their contractors Honeywell or Advance Energy? If yes, did the training provide you with information you found useful? Is there anything that you wish had been discussed in the training, but was not?

Would you like additional training opportunities to help your team more effectively sell rebated equipment? [*Probe: what type of training: sales/marketing training*]

Do you ever use the program website to seek information on the program? Is it helpful, or could it use improvement?

Trade Ally Program Experience

What are the challenges you've experienced in the program?

Probes:

QA audit process (common fails? QA process is cumbersome?)

Variety of measures offered

Participation rates

Rebate application process (including denial letters, prefer online format)

Delays

Communications with Duke Energy and Honeywell

Other

Do you have any suggestions on how to improve the program process?

Do you get enough support from program staff? What other support would you like?

Are there any resources not currently offered by the program that you think would be helpful? [IF CONDUCTS AUDITS] Have you had any challenges with the HVAC audit process? [*If yes, ask:*] What type of challenges and what were the solutions?

Program Satisfaction

What do you like best about the program?

What do you like least about the program?

Code Changes [ASK HVAC SPECIALISTS ONLY]

New Seasonal Energy Efficiency Ratio (SEER) standards will be enforced for air conditioners and heat pumps manufactured or distributed on or after January 1, 2015. How might this change affect the work you do through the program?

How might this change affect the wider HVAC market?

Customer Characteristics

What are demographic characteristics of customers who received the incentive through the HEIP?

How are these customers different from:

a) customers that install rebated equipment, but don't apply for rebates?

b) customers that install less efficient or standard-efficiency equipment?

c) [*If not mentioned, ask:*] Are there segments of the population that are not participating but have high participation potential and should be reached?

Program Influence

Thinking back to before you were involved in the HEIP program, about how often did you recommend measures that would have qualified for HEIP rebates?

And what about now?

Using a 0 to 10 scale, where 0 is "not all influential" and 10 is "extremely influential," how much influence has the HEIP program had on your business practice of recommending the measures that qualify for HEIP rebates to your customers?

Why do you say that?

Do you keep the equipment you install in stock, or do you mostly purchase equipment on an as-needed basis?

[IF THEY KEEP STOCK] Would you say the energy efficiency of your stock has increased, decreased, or stayed about the same since you joined the program?

[IF INCREASED] Using a 0 to 10 scale, where 0 is "not all influential" and 10 is "extremely influential," how much influence has the HEIP program had on your increased stocking of energy efficient equipment?

Why do you say that?

Would you say your knowledge of energy efficient [contractor specialty] has increased, decreased, or stayed about the same since you joined the program?

[IF INCREASED] Using a 0 to 10 scale, where 0 is "not all influential" and 10 is "extremely influential," how much influence has Duke's HEIP program had on your increased knowledge of energy efficient [contractor specialty]?

Why do you say that?

Spillover [ASK ALL]

Reviewers: We included nonparticipant spillover questions in this guide. These questions also will be included in the TA survey. For how we will use these questions to estimate the nonparticipant spillover, please see Appendix A. Please note that participant spillover and free-ridership (other components of the NTG calculation) will be obtained from the participant surveys.

[READ PREFACE TO ALL:]

Now we are going to ask you some questions about the work your company did last year in Duke Energy Progress Territory. When answering these questions, please only consider your work in Duke Energy Progress Territory, which includes the Raleigh area, eastern parts of North Carolina, as well as areas within South Carolina and Asheville.

[Base: All respondents]

Do you submit Duke rebate applications for your customers, or do you leave it up to them to fill out the application and mail it in themselves?

We submit rebate applications for our customers

We let customers themselves fill out and submit rebate applications

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[START LOOP – LOOP THROUGH TOP THREE MOST INSTALLED MEASURE TYPES THAT TA INSTALLED IN 2014]

[Base: All respondents]

About what proportion of the [MEASURE] jobs that your company did in Duke territory last year would have qualified for a Duke rebate? Your best estimate is fine. [*Interviewers: Record a number. if they give a range, record a mid-point of that range. For example, if they say 80 to 90%, input 85%*.]

Q36a. [Record response]

[Do not read:]

-98. Don’t Know

-99. Refusal

Program records show that [MEASURE COUNT] of your company's [MEASURE] jobs received rebates through the Duke program in 2014. Other than these [MEASURE COUNT], are there any other [MEASURE] jobs that your company did in Duke's territory in 2014 that would have qualified for a rebate? [IF NEEDED: Your best estimate is fine] [Interviewers: Record a number. if they give a range, record a mid-point of that range.]

Q37a. [Record response] – Go to Q40

No – Go to Q18

[Do not read:]

-98. Don't Know

-99. Refusal

Save Q37a as NON-REBATED MEASURE COUNT

Do you know about what proportion of the [MEASURE]s your company did last year that would have qualified for the Duke rebate actually got rebates through the program? Your best estimate is fine. [*Interviewers: Record a percentage. If they give a range, record a mid-point of that range.*]

Q38a. [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

Save [100% minus Q38a] as NON-REBATED MEASURE PERCENT

That would mean about [NON-REBATED MEASURE PERCENT] of the jobs that would have qualified for a rebate did not receive it. Does that sound about right?

1. Yes

2. No. **Q39_2.** What percent of qualified jobs didn't get a rebate? [Record percent]

[Do not read:]

-98. Don't Know – Go to Q42

-99. Refusal – Go to Q42

Save Q39_2 as NON-REBATED MEASURE PERCENT NEW

About what proportion of those

IF Q37 = 1 SHOW [NON-REBATED MEASURE **COUNT**]

IF Q39 = 1 SHOW [NON-REBATED MEASURE **PERCENT**]

IF Q39 = 2 SHOW [NON-REBATED MEASURE **PERCENT NEW**]

…..specifically requested the [MEASURE] on their own and were not influenced by your recommendation? Your best estimate is fine.

1. **Q40a.** [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

And about what proportion of those

IF Q37 = 1 SHOW [NON-REBATED MEASURE **COUNT**]

IF Q39 = 1 SHOW [NON-REBATED MEASURE **PERCENT**]

IF Q39 = 2 SHOW [NON-REBATED MEASURE **PERCENT NEW**]

…..didn't get the rebate because of a paperwork problem? Your best estimate is fine.

1. **Q41a.** [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

Using a 0 to 10 scale, where 0 is “not at all influential” and 10 is “extremely influential,” how much influence has the Duke program had on your business practice of recommending [MEASURE] to your customers?
[Single Response]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don’t Know
99.	Refused

[END LOOP]

Firmographics

Including yourself, how many employees work at your location?

How many locations does your organization have?

[IF MORE THAN ONE LOCATION] Including yourself, how many employees work at your organization across all locations?

Closing

Thanks so much for your time today. Are there any other comments you would like to provide?

D.2 Trade Ally Survey

Introduction

Hi, I'm ____ calling from Nexant on behalf of Duke Energy Progress. May I speak with whomever is most knowledgeable about the rebated [MEASURE LIST] that your firm has installed through the Duke Energy Progress Home Energy Improvement program?

[IF NEEDED: I need to speak with someone who is knowledgeable about the sales and installation process – which is typically an installer or sales person]

[ONCE APPROPRIATE CONTACT IS ONE PHONE]

We want to get some feedback on how the program is working for your firm - this is your chance to tell us what is working well, what isn't, and how Duke Energy Progress can improve the program to better serve you and your customers. Is this a good time to talk?

IF NEEDED:

The survey takes about 15 minutes, depending on how much you have to say.

If now isn't a good time, when could I call you back?

Great. Rest assured, your answers will be confidential and not tied to you or your firm. Is it okay if I record our conversation? This is just so I accurately capture everything you say.

Screening [ASK ALL]

[Base: All respondents]

How many locations does your company have?

S1a. [Record response]

[Do not read:]

-98. Don't Know

-99. Refusal

[ASK IF 0a>1] We would like to talk today about jobs associated with the [PIPE IN ADDRESS] location. Are you able to speak to the work associated with that location?

YES [CONTINUE]

NO [ASK TO SPEAK WITH ALTERNATIVE APPROPRIATE PERSON]

98. Don't know [ASK TO SPEAK WITH ALTERNATIVE APPROPRIATE PERSON]

99. Refused [THANK AND TERMINATE, RECORD]

[READ PREFACE TO ALL]

In my questions below, when I mention Duke I am referring only to Duke Energy Progress.

[IF NEEDED: Duke Energy Progress serves the eastern parts of North and South Carolina and the Asheville area]

Program Activities

[Base: All respondents]

Do you serve both single family and multifamily clients?

Single family only

Multifamily only

Both

98. Don't know [ASK TO SPEAK WITH ALTERNATIVE APPROPRIATE PERSON]

99. Refused

IF AUDIT FLAG = 1

[ASK IF MEASURE LIST INCLUDES AUDITS] Do you ever provide HVAC audits at no charge to your customers in exchange for their Duke rebate check?

Yes

No

98. Don't know

99. Refused

[ASK IF 0=1 AND 0=1 OR 3] What proportion of your HVAC audits in single-family homes are free of charge to the customer in exchange for their Duke rebate check?

Q3a. [Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

[ASK IF 0=1 AND 0=2 OR 3] What proportion of your HVAC audits in multifamily buildings are free of charge to the customer in exchange for their Duke rebate check?

Q4a. [Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

IF DUCT SEALING FLAG = 1

[ASK IF MEASURE LIST INCLUDES DUCT SEALING] Do you ever provide duct sealing and repair services at no charge to your customers in exchange for their Duke rebate check?

Yes

No

98. Don't know

99. Refused

[ASK IF 0=1 AND 0=1 OR 3] What proportion of your rebate qualified duct sealing and repair jobs in single-family homes are free of charge to the customer in exchange for their Duke rebate check?

Q6a. [Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

[ASK IF 0=1 AND 0=2 OR 3] What proportion of your rebate qualified duct sealing and repair jobs in multifamily buildings are free of charge to the customer in exchange for their Duke rebate check?

Q7a. [Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

IF INSULATION FLAG = 1

[ASK IF MEASURE LIST INCLUDES INSULATION] Do you ever provide insulation services at no charge to your customers in exchange for their Duke rebate check?

Yes

No

98. Don't know

99. Refused

[ASK IF 0=1 AND 0=1 OR 3] What proportion of your rebate qualified attic insulation jobs in single-family homes are free of charge to the customer in exchange for their Duke rebate check?

Q9a. [Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

[ASK IF 0=1 AND 0=2 OR 3] What proportion of your rebate qualified attic insulation jobs in multifamily buildings are free of charge to the customer in exchange for their Duke rebate check?

[Record response in %]

[Do not read:]

-98. Don't Know

-99. Refusal

Nonparticipant Spillover

[READ PREFACE TO ALL:]

Now we are going to ask you some questions about the work your company did last year in Duke Energy Progress Territory. When answering these questions, please only consider your work in Duke Energy Progress Territory, which includes the Raleigh area, eastern parts of North Carolina, as well as areas within South Carolina and Asheville.

[Base: All respondents]

Do you submit Duke rebate applications for your customers, or do you leave it up to them to fill out the application and mail it in themselves?

We submit rebate applications for our customers

We let customers themselves fill out and submit rebate applications

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[IF 0>1, READ] Remember, please only consider jobs associated with the [PIPE IN ADDRESS] location when answering questions.

[START LOOP – LOOP THROUGH TOP THREE MOST INSTALLED MEASURE TYPES THAT TA INSTALLED IN 2014]

[Base: All respondents]

About what proportion of the [MEASURE] jobs that your company did in Duke territory last year would have qualified for a Duke rebate? Your best estimate is fine. [*Interviewers: Record a number. if they give a range, record a mid-point of that range. For example, if they say 80 to 90%, input 85%*.]

Q12a. [Record response]

[Do not read:]

-98. Don't Know

-99. Refusal

Program records show that [MEASURE COUNT] of your company's [MEASURE] jobs received rebates through the Duke program in 2014. Other than these [MEASURE COUNT], are there any other [MEASURE] jobs that your company did in Duke's territory in 2014 that would have qualified for a rebate? [IF NEEDED: Your best estimate is fine] [Interviewers: Record a number. if they give a range, record a mid-point of that range.]

Q13a. [Record response] – Go to Q16

No – Go to Q18

[Do not read:]

-98. Don't Know

-99. Refusal

Save Q13a as NON-REBATED MEASURE COUNT

Do you know about what proportion of the [MEASURE]s your company did last year that would have qualified for the Duke rebate actually got rebates through the program? Your best estimate is fine. [*Interviewers: Record a percentage. If they give a range, record a mid-point of that range.*]

Q14a. [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

Save [100% minus Q14a] as NON-REBATED MEASURE PERCENT

That would mean about [NON-REBATED MEASURE PERCENT] of the jobs that would have qualified for a rebate did not receive it. Does that sound about right?

1. Yes

2. No. **Q15_2.** What percent of qualified jobs didn't get a rebate? [Record percent]

[Do not read:]

-98. Don't Know – Go to Q18

-99. Refusal – Go to Q18

Save Q15_2 as NON-REBATED MEASURE PERCENT NEW

About what proportion of those

IF Q13 = 1 SHOW [NON-REBATED MEASURE **COUNT**]

IF Q15 = 1 SHOW [NON-REBATED MEASURE **PERCENT**]

IF Q15 = 2 SHOW [NON-REBATED MEASURE **PERCENT NEW**]

…..specifically requested the [MEASURE] on their own and were not influenced by your recommendation? Your best estimate is fine.

1. **Q16a.** [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

And about what proportion of those

IF Q13 = 1 SHOW [NON-REBATED MEASURE **COUNT**]

IF Q15 = 1 SHOW [NON-REBATED MEASURE **PERCENT**]

IF Q15 = 2 SHOW [NON-REBATED MEASURE **PERCENT NEW**]

…..didn't get the rebate because of a paperwork problem? Your best estimate is fine.

1. **Q17a.** [Record percent]

[Do not read:]

-98. Don't Know

-99. Refusal

Using a 0 to 10 scale, where 0 is "not at all influential" and 10 is "extremely influential," how much influence has the Duke program had on your business practice of recommending [MEASURE] to your customers?
[Single Response]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

[END LOOP]

Program Influence and Effects on TAs

[Base: All respondents]

Thinking back to before you were involved in the Duke Energy Progress program, how often did you recommend higher efficiency equipment that uses less energy than standard models to your customers? Please use a 0 to 10 scale, where 0 is "never recommended" and 10 is "always recommended."

[SINGLE RESPONSE]

0. Never recommended

Always recommended

[*Do not read:*]

97. Not applicable – I've been involved with the Duke program since starting in the industry/this company

98. Don't know

99. Refused

[Base: All respondents]

And what about now? [IF NEEDED: Currently, how often do you recommend higher efficiency equipment that uses less energy than standard models to your customers? Please use a 0 to 10 scale, where 0 is "never recommend" and 10 is "always recommend."]

[SINGLE RESPONSE]

0. Never recommend

Always recommend

[Do not read:]

98. Don't know

99. Refused

[Base: All respondents]

Do you keep the equipment you install in stock, or do you mostly purchase equipment on an as-needed basis?

Keep stock

Don't keep stock - purchase equipment on an as-needed basis

Both - some products we keep in stock and other are purchased on an as-needed basis

98. Don't know

99. Refused

[ASK IF 0=1 OR 3] Would you say your stock of energy efficient equipment has increased, decreased, or stayed about the same since you joined the program?

Increased

Decreased

Stayed about the same

98. Don't know

99. Refused

[ASK IF 0=1] Using a 0 to 10 scale, where 0 is “not at all influential” and 10 is “extremely influential,” how much influence has Duke Energy Progress’ program had on your increased stocking of energy efficient equipment?

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don’t Know
99.	Refused

[Base: All respondents]

Would you say your knowledge of energy efficient products and services has increased, decreased, or stayed about the same since you became involved with the program?

Increased

Decreased

Stayed about the same

98. Don't know

99. Refused

[ASK IF 0=1] Using a 0 to 10 scale, where 0 is “not at all influential” and 10 is “extremely influential,” how much influence has Duke Energy Progress’ program had on your increased knowledge of energy efficient products and services?

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don’t Know
99.	Refused

Other

IF CENTRAL AIR CONDITIONER FLAG = 1

IF AIR SOURCE HEAT PUMP FLAG = 1

[READ PREFACE IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS OR AIR SOURCE HEAT PUMPS]

As you may know, a new code for air conditioners and air source heat pumps was enforced this year – the minimum SEER went from 13 to 14.

[Base: IF CONTRACTOR INSTALLED CENTRAL AIR CONDITIONERS]

IF CENTRAL AIR CONDITIONER FLAG = 1

How much more difficult or easier is it to sell 15 SEER central air conditioners now that the code

is 14 SEER? Would you say it is: [READ FIRST FIVE RESPONSE OPTIONS]

Much more difficult

Somewhat more difficult

No different

Somewhat easier

Much easier

[Do not read:]

97. Do not sell SEER 15

98. Don't know

99. Refused

[Base: IF CONTRACTOR INSTALLED AIR SOURCE HEAT PUMPS]

IF AIR SOURCE HEAT PUMP FLAG = 1

How much more difficult or easier is it to sell 15 SEER air source heat pumps now that the code is 14 SEER? Would you say it is: [READ FIRST FIVE RESPONSE OPTIONS]

Much more difficult

Somewhat more difficult

No different

Somewhat easier

Much easier

[Do not read:]

97. Do not sell SEER 15

98. Don't know

99. Refused

[Base: All respondents]

What energy efficient products, technologies, or services should be added to the Duke Energy Progress rebate program? [**DO NOT READ**: Choose all that apply]

Modulating furnaces

Heat recovery ventilation (HRV) systems

Boilers

Electronically commutated motor (ECM) furnaces

Tankless water heaters

Programmable thermostats

Web enabled or smart thermostats

Humidifiers

Air handlers

No others should be added

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[Base: All respondents]

Duke Energy Progress has hired Honeywell to administer program-related contractor training. What types of training, if any, would you be interested in receiving from Duke Energy or Honeywell?

Q29a. [OPEN-ENDED RESPONSE]

[*Do not read:*]

98. Don't know

99. Refused

[Base: All respondents]

On a scale from 0 to 10, where 0 is “not at all interested” and 10 is “extremely interested,” how interested would you be in a training course on how to more effectively sell high efficiency equipment to your customers if it was offered by the program?

0.	0. Not all interested
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely interested
98.	Don’t Know
99.	Refused

[Base: All respondents]

How often do your customers ask about the Duke Energy Progress rebates before you’ve had the chance to bring them up? Would you say…[READ FIRST FIVE RESPONSE OPTIONS]

Never

Rarely

Occasionally

Frequently, or

Always

[*Do not read:*]

98. Don't know

99. Refused

[Base: All respondents]

Over the past year, how frequently did you experience problems or frustrations with the rebate application process? Would you say…[READ FIRST FOUR RESPONSE OPTIONS]

Never

Rarely

Occasionally

Frequently, or

Always

[*Do not read:*]

98. Don't know

99. Refused

[ASK IF 0=2-5] What types of problems or frustrations did you experience?

Q33a. [Record response]

[Do not read:]

98. Don't know

99. Refused

[Base: All respondents]

Do you have any suggestions on how Duke Energy Progress could improve the rebate application process?

[Record response]

[Do not read:]

98. Don't know

99. Refused

[Base: All respondents]

Duke Energy Progress also has hired Honeywell to inspect contractors' jobs. Have you ever had a project that failed Honeywell's inspection of the work?

Yes – I've had a project fail inspection

No– I've never had a project fail inspection

I'm not familiar with what you are talking about

Not sure if any of my projects have failed or not

I've never had a project inspected

98. Don't know

99. Refused

[Base: If Q35<>5]

Do you have any suggestions on how Duke Energy Progress and Honeywell could improve the project inspection process?

Q36a. [Record response]

[Do not read:]

98. Don't know

99. Refused

Satisfaction

[Preamble:]

Thanks for your feedback so far, next I have some questions about your satisfaction with the program.

[Base: All respondents]

Please rate the extent to which you are satisfied with the following aspects of the program using a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied." How satisfied are you with:

A	Program training offered by Honeywell
B	The program support available through Honeywell, other than program training
C	Communication with program staff
D	The program website
E	The marketing of the program
F	The incentive application submission process
G	The selection of eligible equipment and services
H	The overall program

[Single Response]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[Base: Ask If 0 =1|2]

[**Programmer's Note:** Repeat 0 for each statement from 0 where 0<5]

Please explain why you were dissatisfied with [INSERT STATEMENT FROM 0 A-H]:

Q38a. [Record response]

[Do not read:]

98. Don't know

99. Refused

Firmographics

Thanks for all of your feedback today. We are almost done. We just need some basic info about your company.

[Base: All respondents]

Including yourself, about how many employees work at ADDRESS?

Q39a. [Record response]

[Do not read:]

98. Don't know

99. Refused

[ASK IF 0>1] Including yourself, about how many employees work at your organization across all locations?

Q40a. [Record response]

[Do not read:]

98. Don't know

99. Refused

Closing

[Base: All respondents]

Thanks so much for your time today. Are there any other comments you would like to provide?

[Record response]

D.3 Participant Survey

The evaluation team will pipe in measure data from the HEIP database in order to reference specific measures respondents have installed. Throughout this survey, pipe in fields are denoted by brackets and bolded capital letters: [**EXAMPLE**]. Table 6-4 explains the pipe in fields used in this survey.

Table 6-4: Database Pipe In Field Descriptions

Pipe In Field	Description
PROJECT#1 LIST	List of all measures participant did at their property for their first project in 2014 (a "project" is defined as a group of measures with the same Measure Start Date value). This field is still populated if participant only did one measure or one multi-measure project.
PROJECT#2 LIST	List of all measures participant did at their property in 2014 subsequent to their first project. This field is not populated if participant only did one measure or one multi-measure project.
PIPE IN WHICHEVER WAS INSTALLED:	Specifies which specific measure the participant installed from a specified list of measures.
LIST ALL MEASURES	List of all measures participant did at their property in 2014.
LAST PROJECT	List of all measures participant did at their property in their last (or only) project in 2014.
MF PROPERTY ADDRESS	Address of multifamily property where HEIP upgrades were performed.
MEASURE	Pipe in a given measure from LIST OF ALL MEASURES (used in 0 loop)

Introduction

[IF CONTACT NAME IS KNOWN:]

Hello, may I speak with _____. [READ IF RESPONDENT IS A SINGLE FAMILY PARTICIPANT OR A MULTIFAMILY 'NO PHONE NUMBER' RECORD] Hi, my name is _____from Nexant. I'm calling on behalf of Duke Energy Progress. Our records show that you received a rebate for [LIST ALL MEASURES] from the Duke Energy Progress Home Energy Improvement Program.

[IF MULTIFAMILY PARTICIPANT CONTACT NAME IS UNKNOWN:]

Hello, may I speak with the person who is responsible for the management of [MF PROPERTY ADDRESS].

[ONCE MF CONTACT IS ON THE PHONE, OR IF GATEKEEPER ASKS WHAT WE ARE CALLING ABOUT]

I'm calling on behalf of Duke Energy Progress. We are calling about the [LIST ALL MEASURES] that were done through the Duke Energy Progress Home Energy Improvement Program at [MF PROPERTY ADDRESS] last year. We need to speak with the person who was most involved in the decision to do this work through the program. *To show our gratitude for answering some questions about the work that was done, we are offering a $50 Visa gift card for completing our brief survey.*

[IF GATEKEEPER OR MF CONTACT THEN ASKS 'WHY,' 'WHAT DO YOU NEED TO KNOW,' ETC., READ:]

We need to ask you some questions about the work that was done and any other work you may have done to the property since.[INTERVIEWER – IF PERSON ON PHONE IS UNAWARE OF THE REBATED WORK, ASK TO SPEAK WITH SOMEONE IN THE PROPERTY WHO MIGHT RECALL RECEIVING A REBATE FROM DUKE ENERGY.

IF PERSON ON THE PHONE IS NOT INVOLVED IN THE DECISION MAKING PROCESS, ASK TO SPEAK WITH THE PERSON WHO WAS MOST INVOLVED.

IF PERSON ON PHONE SAYS THEY ARE A JUST A RENTER (AND/OR THEIR LANDLORD OR PROPERTY MANAGER WAS RESPONSIBLE FOR THE PROJECT), ASK FOR LANDLORD/PROPERTY MANAGER'S NAME AND PHONE NUMBER AND USE THAT AS THE NEW POINT OF CONTACT

IF PERSON ON PHONE IS A MULTIFAMILY PROPERTY MANAGER/OWNER AND SAYS THAT THE TENANTS WERE THE DECISION MAKERS, THEN CONFIRM THAT PROPERTY MANAGER/OWNER WAS NOT INVOLVED IN DECISION. ASK THE FOLLOWING TO CONFIRM:

Do your tenants rent their units or do they own them?

IF TENANTS OWN, THANK, TERMINATE, AND BEGIN CALLING ON CORRESPONDING TENANT LIST FOR THAT PROPERTY.

IF TENANTS RENT, THEN ASK:

Did you or anyone else on the property management team interact with the contractor that did the work and agree to let them do the work, or did the contractor only interact with the tenants?

IF CONTRACTOR ONLY INTERACTED WITH TENANTS, THANK, TERMINATE, AND BEGIN CALLING ON CORRESPONDING TENANT LIST FOR THAT PROPERTY.

IF PROPERTY MANAGER/OWNER INTERACTED WITH CONTRACTOR, PROCEED WITH STANDARD INTRO]

We need to briefly speak with you about the work that was done to the property through the program *and we will send you a $50 Visa gift card for taking time out of your day to answer our questions*. Is now a good time? [IF NEEDED: The survey will take about 10 to 15 minutes, depending on how much you have to say.]

[IF NEEDED: SCHEDULE A TIME TO CALL THEM TO COMPLETE THE SURVEY]

Please note that this call may be monitored or recorded for quality assurance purposes.

Building Type Confirmation

[ASK ALL]

I'm going to read a list of building types. Please stop me when I mention the building type that best describes the residence where this work was done. [*READ LIST*]

[Single RESPONSE]

Single-family detached home [IF NEEDED: NOT A DUPLEX, TOWNHOME, OR APARTMENT; ATTACHED GARAGE IS OK]

Factory manufactured single family home

Row house or town house

Duplex or triplex with two or three units in the building

Apartment or condo building with four or more units

OTHER: (SPECIFY_____)

98. Don't know

99. Refused

[PROGRAMMER: IF 0=1-2, BUILDING TYPE=SF. IF 0=3-5, BUILDING TYPE=MF. IF 0=6-99, USE PRE-CODED BUILDING TYPE FROM LIST]

Direct Install Participant Identification [ASK IF MULTIFAMILY AUDIT, INSULATION, OR DUCT SEALING PARTICIPANT]

[ASK IF RESPONDENT IS A MULTIFAMILY AUDIT PARTICIPANT]

Did you pay your contractor for the HVAC audit or tune up service and receive a rebate check from Duke Energy Progress, or did your contractor provide the service at no charge in return for signing over your rebate to them? *[Do not read list]*

[SINGLE RESPONSE]

Paid contractor for the service and received a rebate

Contractor provided service at no charge in return for signing over rebate

Contractor provided service at no charge, but I don’t know this rebate you are talking about

98. Don't know

99. Refused

[ASK IF RESPONDENT IS A MULTIFAMILY INSULATION PARTICIPANT]

Did you pay your contractor for the insulation service and receive a rebate check from Duke Energy Progress, or did your contractor provide the service at no charge in return for signing over your rebate to them? *[Do not read list]*

[SINGLE RESPONSE]

Paid contractor for the service and received a rebate

Contractor provided service at no charge in return for signing over rebate

Contractor provided service at no charge, but I don't know this rebate you are talking about

98. Don't know

99. Refused

[ASK IF RESPONDENT IS A MULTIFAMILY DUCT SEALING PARTICIPANT]

Did you pay your contractor for the duct sealing and repair service and receive a rebate check from Duke Energy Progress, or did your contractor provide the service at no charge in return for signing over your rebate to them? *[Do not read list]*

[SINGLE RESPONSE]

Paid contractor for the service and received a rebate

Contractor provided service at no charge in return for signing over rebate

Contractor provided service at no charge, but I don't know this rebate you are talking about

98. Don't know

99. Refused

[IF 0, 0, or 0=2, READ:] Since the contractor provided this service at no charge in return for the Duke Energy Progress rebate, you received a rebated service through Duke Energy's Home Energy Improvement program. Throughout this survey we will be asking you questions about the rebate you received – please consider the free service you received as a rebated service and that the rebate you received covered the entire price of the service.

[IF 0, 0, or 0=3, READ:] If the contractor provided this service at no charge, then you signed over a Duke Energy rebate to your contractor as payment for the service. Thus, you received a rebated service through Duke Energy's Home Energy Improvement program. Throughout this survey we will be asking you questions about the rebate you received – please consider the free service you received as a rebated service and that the rebate you received covered the entire price of the service.

Sources of Program Information

[ASK ALL]

How did you first hear about the Duke Energy Progress Home Energy Improvement rebate(s) that you received*? [Do not read list]*

[MULTIPLE RESPONSE]

From my electric or gas bill

Postcard or another direct mail type of ad

Duke Energy Website

Contractor

Family/friends/word-of-mouth

Billboards/Outdoor sign or banner

Email

Community Event

Social media (Facebook, Twitter, etc.)

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK ALL]

Are you familiar with other energy-efficiency rebates that Duke Energy Progress offers, aside from the [LIST ALL MEASURES] rebate(s)**?**

[SINGLE RESPONSE]

Yes

No

98. Don't know

99. Refused

[ASK IF 0= 1 (Yes)]

Which other rebates are you familiar with? *[Do not read list]* [PROGRAMMER: EXCLUDE THE REBATES THAT THEY RECEIVED FROM THE LIST BELOW]

[MULTIPLE RESPONSE]

Heat pump water heater rebate

Heating and cooling system rebate

Window/room AC rebate

Insulation rebate

Duct sealing/replacement rebate

HVAC audit/tune-up rebate

Solar PV panel rebate

ENERGY STAR home discount

Incentive to recycle old fridge or freezer

EnergyWise Home bill discounts (for allowing Duke Energy to ramp down water heaters and HVAC systems during peak usage events)

Discounted efficient lighting (CFLs, LEDs, and fixtures)

Other – please specify: _____

Don’t know

Refused

[ASK IF 0= 1 (Yes)]

Have you received any of these other rebates?

[SINGLE RESPONSE]

Yes

No

98. Don't know

99. Refused

[ASK IF 0= 1 (Yes) AND MORE THAN ONE ITEM SELECTED IN 0; IF ONLY ONE ITEM SELECTED IN 0 AND 0=1, AUTOCODE 0 RESPONSE FOR 0]

Which rebate(s) did you receive? *[Do not read list]*

[MULTIPLE RESPONSE]

Heat pump water heater rebate

Heating and cooling system rebate

Window/room AC rebate

Insulation rebate

Duct sealing/replacement rebate

HVAC audit/tune-up rebate

Solar PV panel rebate

ENERGY STAR home discount

Incentive to recycle old fridge or freezer

EnergyWise Home bill discounts (for allowing Duke Energy to ramp down water heaters and HVAC systems during peak usage events)

Discounted efficient lighting (CFLs, LEDs, and fixtures)

Other – please specify: _____

98. Don't know

99. Refused

Program Influence

[ASK IF 0= 1 (Yes)]

Did you receive the [Insert rebated measures from 0] before or after [**PROJECT#1 LIST**] work was done? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN 0]

[SINGLE RESPONSE]

Before

After

Both before and after

At the same time

98. Don't know

99. Refused

[ASK IF 0= 2 or 3 (“After” or “Both before and after”)]

Using a scale from 0 to 10, where 0 means “Not at all influential” and 10 means “Extremely influential,” how influential was the rebate for [**PROJECT#1 LIST**] in your decision to take advantage of Duke Energy’s [Insert response from 0]? [REPEAT THIS QUESTION FOR EACH REBATE OPTION SELECTED IN 0 WHERE RESPONSE TO 0=2 (“After”) OR 0=3 (“Both before and after”)]

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

[ASK IF RESPONDENT HAS A **PROJECT#2 LIST**]

Using a scale from 0 to 10, where 0 means "Not at all influential" and 10 means "Extremely influential," how influential was the rebate for [**PROJECT#1 LIST**] in your decision to take advantage of additional Duke Energy rebates for [**PROJECT#2 LIST**]?

[SINGLE RESPONSE]

0.	0. Not all influential
1.	1.
2.	2
3.	3
4.	4
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Extremely influential
98.	Don't Know
99.	Refused

Motivations

We'd like to know what motivated you to complete the work we've been talking about that was

rebated through the Duke Energy Progress Home Energy Improvement Program.

[ASK IF AIR SOURCE HEAT PUMP, GEOTHERMAL HEAT PUMP, CENTRAL AIR CONDITIONER, OR ROOM AIR CONDITIONER WAS INSTALLED]

[IF AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS INSTALLED, READ:] Which of the following best describes the condition of the previous HVAC system that you replaced with a [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]?

[IF CENTRAL AIR CONDITIONER OR ROOM AIR CONDITIONER WAS INSTALLED, READ:] Which of the following best describes the condition of the previous air conditioner that you replaced?

[READ – MULTIPLE RESPONSE]

It was broken or malfunctioning

It was getting old, or

It was in good working condition

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF CENTRAL AIR CONDITIONER, ROOM AIR CONDITIONER, AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP WAS INSTALLED]

What motivated you to install an **energy efficient** system rather than a less efficient one that would use more energy?

[Do not read list] [MULTIPLE RESPONSE; *PROBE: Any other reason?*]

Wanted to make property more energy efficient <u>in order to save money on energy bills</u> [PROBE TO CODE]

Wanted to make property more energy efficient <u>in order to help the environment</u> [PROBE TO CODE]

To maximize comfort

To increase value of the property

Wanted one of the best systems available

Improve health and safety issues (mold, etc.)

Contractor's recommendation

Interested in rebates/incentives / rebate helped justify increased cost

Other – please specify: _____

98. Don't know

99. Refused

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

Which of the following best describes the condition of the previous water heater that you replaced?

[READ – MULTIPLE RESPONSE]

It was broken or malfunctioning

It was getting old, or

It was in good working condition

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF HEAT PUMP WATER HEATER WAS INSTALLED]

What motivated you to install an **energy efficient** system rather than a less efficient one that would use more energy?

[Do not read list] [MULTIPLE RESPONSE; *PROBE: Any other reason?*]

Wanted to make property more energy efficient in order to save money on energy bills [PROBE TO CODE]

Wanted to make property more energy efficient in order to help the environment [PROBE TO CODE]

To maximize comfort

To increase value of the property

Wanted one of the best systems available

Improve health and safety issues (mold, etc.)

Contractor's recommendation

Interested in rebates/incentives / rebate helped justify increased cost

Other – please specify: _____

98. Don't know

99. Refused

[ASK IF AUDIT, DUCT SEALING, OR INSULATION WAS PERFORMED/INSTALLED]

What motivated you to [IF AUDIT WAS PERFORMED, READ: get a HVAC audit or tune up; IF DUCT SEALING WAS PERFORMED, READ: repair your ductwork; IF INSULATION WAS INSTALLED, READ: insulate your attic]?

[Do not read list] [MULTIPLE RESPONSE; *PROBE: Any other reason?*]

Wanted to make property more energy efficient in order to save money on energy bills [PROBE TO CODE]

Wanted to make property more energy efficient in order to help the environment [PROBE TO CODE]

To maximize comfort

To increase value of the property

Wanted one of the best systems available

Improve health and safety issues (mold, etc.)

Contractor's recommendation

Interested in rebates/incentives / rebate helped justify increased cost

It was free

Other – please specify: _____

98. Don't know

99. Refused

Free-ridership

I'd like to ask a few questions about what you most likely would have done had you not received assistance from Duke Energy Progress for the [**LIST ALL MEASURES**].

[ASK IF THEY INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have installed the [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**]

Would have postponed the purchase for at least one year

Would have bought a less expensive or less energy efficient heating and cooling system

Would have bought the exact same [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**], and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF 0= 3]

You said you would have bought a/an [**PIPE IN WHICHEVER WAS INSTALLED: AIR SOURCE HEAT PUMP OR GEOTHERMAL HEAT PUMP**] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy Progress. Do you think it is more likely that you would have bought equipment that was…?

Almost as efficient as the one you bought, or

Significantly less efficient than the one you bought

[*Do not read:*]

Don't know

99. Refused

[ASK IF THEY INSTALLED: CENTRAL AIR CONDITIONER, ROOM AIR CONDITIONER]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have installed the [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, ROOM AIR CONDITIONER**]

Would have postponed the purchase for at least one year

Would have bought a less expensive or less energy efficient cooling system

Would have bought the exact same [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, ROOM AIR CONDITIONER**], and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF 0= 3]

You said you would have bought a/an [**PIPE IN WHICHEVER WAS INSTALLED: CENTRAL AIR CONDITIONER, ROOM AIR CONDITIONER**] that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy Progress. Do you think it is more likely that you would have bought equipment that was…?

Almost as efficient as the one you bought, or

Significantly less efficient than the one you bought

[*Do not read:*]

Don't know

99. Refused

[ASK IF THEY INSTALLED: HEAT PUMP WATER HEATER]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have installed the Heat Pump Water Heater

Would have postponed the purchase for at least one year

Would have bought a less expensive or less energy efficient Heat Pump Water Heater

Would have bought the exact same Heat Pump Water Heater, and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF 0= 3]

You said you would have bought a Heat Pump Water Heater that was less expensive or less energy efficient if you had not received the rebate or information from Duke Energy Progress. Do you think it is more likely that you would have bought equipment that was…?

Almost as efficient as the one you bought, or

Significantly less efficient than the one you bought

[*Do not read:*]

Don't know

99. Refused

[ASK IF THEY UPGRADED: ATTIC INSULATION]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have done the attic insulation

Put off doing attic insulation for at least one year

Would have added less insulation

Would have done the exact same upgrade, and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF 0= 3]

You said you would have added less insulation if you had not received the rebate or information from Duke Energy Progress. How much less insulation would you have purchased? Please answer in a percentage, such as "50% less."

[RECORD VERBATIM:] _____

Don’t know

99. Refused

[ASK IF THEY DID DUCT SEALING]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have had ducts sealed or replaced

Would have postponed the work for at least one year

Would have had the exact same work done, and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF THEY DID HVAC AUDIT]

Which of the following statements best describes the actions you would have taken if Duke Energy Progress rebates and information were not available: [READ LIST]

[SINGLE RESPONSE]

Would not have done HVAC audit or tune up

Would have postponed the audit or tune up for at least one year

Would have had the exact same audit or tune up done, and paid the full cost yourself

[*Do not read:*]

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK ALL]

Using a scale from 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential” how influential were the following factors on your decision to purchase the [MEASURE]? How influential was…

[INTERVIEWER NOTE: IF RESPONDENT SAYS ‘NOT APPLICABLE; I DIDN’T GET/USE THAT,’ THEN FOLLOW UP WITH: “So would you say it was “not at all influential?” AND PROBE TO CODE] [MATRIX QUESTION: SCALE]

Elements	0 – Not at all influential	1	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF
The rebate you received													
Information or advertisements from Duke Energy Progress, including their website													
Recommendation from your contractor													
Did anything else influence you? If so, please specify: _____ [INTERVIEWER: PROBE IF UNCLEAR. RECORD VERBATIM RESPONSE]													

[PROGRAMMER: REPEAT 0 FOR EACH MEASURE IN MEASURE LIST. WHEN REPEATING, CALLERS CAN USE ABBREVIATED LANGUAGE (E.G.: “AND FOR THE INSULATION, HOW INFLUENTIAL WAS…”]

Spillover

[ASK ALL]

Since receiving your rebate from Duke Energy Progress for the [**LIST ALL MEASURES**], what other products or services have you purchased to help save energy in your property? [*PROBE: Did you do anything else?*]

[Do not read list] [MULTIPLE RESPONSE]

Installed energy efficient appliances

Moved into an ENERGYSTAR home *[VERIFY:"Is Duke Energy still your gas or electricity utility?" Yes/No]*

Installed efficient heating or cooling equipment

Installed efficient windows

Added insulation

Sealed air leaks [NOT DUCT SEALING – PROBE TO CODE]

Sealed ducts

Bought LEDs

Bought CFLs

Installed an energy efficient tank-style water heater [PROBE TO CODE]

Installed a tankless water heater [PROBE TO CODE]

None – no other actions taken

96. Other, please specify: _____

98. Don't know

99. Refused

[ASK IF 0=5]

Did you add insulation to your attic, walls, or below the floor?

[Do not read list] [MULTIPLE RESPONSE]

Attic

Wall

Below the floor

98. Don't know

99. Refused

[ASK IF 0<>98-99]

[PROGRAMMER: REPEAT 0 FOR EACH ITEM MENTIONED IN 0]

Approximately what proportion of the [ITEM MENTIONED IN 0] space did you add insulation?

[RECORD VERBATIM AS % - INPUT MID-POINT IF RANGE IS OFFERED:]
_____[IF NEEDED: *Your best estimate is fine]*

Don't know

99. Refused

[ASK IF 0=8]

How many of LEDs did you install in your property?

[RECORD VERBATIM:] _____[IF NEEDED: *Your best estimate is fine]*

Don't know

99. Refused

[ASK IF 0 = 9]

How many of CFLs did you install in your property?

[RECORD VERBATIM:] _____[IF NEEDED: *Your best estimate is fine]*

Don't know

99. Refused

[ASK IF 0 = 1]

What kinds of appliance(s) did you buy?

[Do not read list] [MULTIPLE RESPONSE]

Refrigerator

Stand-alone Freezer

Dishwasher

Clothes washer

Clothes dryer

Oven

Microwave

96. Other, please specify: _____

98. Don't know

99. Refused

[ASK IF 0 = 1-11]

Was the [INSERT 0 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

Yes

No

98. Don't know

99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN 0]

[ASK IF 0 = 3]

What type of heating or cooling equipment did you buy?

[Do not read list] [MULTIPLE RESPONSE]

Central air conditioner

Window/room air conditioner unit

Wall air conditioner unit

Air source heat pump

Geothermal heat pump

Boiler

Furnace

Programmable thermostat

96. Other, please specify: _____

98. Don't know

99. Refused

[ASK IF 0= 1-96]

Was the [INSERT 0 RESPONSE] an ENERGY STAR or high-efficiency model?

[SINGLE RESPONSE]

Yes

No

98. Don't know

99. Refused

[REPEAT THIS QUESTION FOR EACH ITEM MENTIONED IN 0]

[ASK IF 0<> 12, 98, 99]

On a scale of 0 to 10, where 0 means “not at all influential” and 10 means “extremely influential”, how much influence did the Duke Energy Progress rebate program have on your decision to…

[MATRIX QUESTION: SCALE]

[LOGIC] Item	1 – Not at all influential	2	3	4	5	6	7	8	9	10 – Extremely influential	98 DK	99 RF
[IF 0 = 1, ELSE SKIP] Install energy efficient appliances												
[IF 0 = 2, ELSE SKIP] Move into an ENERGY STAR home												
[IF 0 = 3, ELSE SKIP] Buy efficient heating or cooling equipment												
[IF 0 = 4, ELSE SKIP] Buy efficient windows												
[IF 0 = 5, ELSE SKIP] Buy additional insulation												
[IF 0 = 6, ELSE SKIP] Seal air leaks												
[IF 0 = 7, ELSE SKIP] Seal ducts												
[IF 0 = 8, ELSE SKIP] Buy LEDs												
[IF 0 = 9, ELSE SKIP] Buy CFLs												
IF 0 = 10, ELSE SKIP] Install an energy efficient tank-style water heater												
IF 0 = 11, ELSE SKIP] Install a tankless water heater												
[IF 0 = 96, ELSE SKIP] **[Q20 open ended response]**												

How They Search For EE Information

[ASK ALL]

Where do you typically search for information on how to save energy in your property?

[Do not read list] [MULTIPLE RESPONSE]

Online – read reviews about products

Go to utility website

Read my utility information – it has tips on how to save energy

Go to the store and talk to salespeople

Look for ENERGY STAR logo on products

96. Other, please specify: [OPEN-ENDED RESPONSE]

97. Not applicable – I don't typically search for information on how to save energy in my property

98. Don't know

99. Refused

Program Satisfaction and Challenges

The next few questions are about your satisfaction with the program.

[ASK ALL]

Using a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied," how satisfied were you with the rebate amount for [**LAST PROJECT**]? [SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK UNLESS PARTICIPANT IS MULTIFAMILY AND LAST PROJECT WAS AUDIT, DUCT SEALING, AND/OR INSULATION AND 0, 0, OR 0<>1]

Who mailed in the rebate application for the [**LAST PROJECT**] – was it you or your contractor?

[Do not read list] [SINGLE RESPONSE]

Me, or someone else in my home/business

Contractor

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK IF 0 = 1 (CUSTOMER SUBMITTED REBATE APPLICATION)]

From the time you submitted the application, about how many weeks did it take to receive your rebate?

[RECORD VERBATIM:] _____[IF NEEDED: *Your best estimate is fine]*

98. Don't know

99. Refused

[ASK UNLESS LAST PROJECT WAS AUDIT, DUCT SEALING, AND/OR INSULATION AND 0, 0, OR 0<>1]

How satisfied were you with how long it took to receive that rebate? Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.” [SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don't Know
99.	Refused

[ASK ALL]

In the course of participating in the Duke Home Energy Improvement program, how often did you contact Duke Energy or program staff with questions?

[Do not read list] [SINGLE RESPONSE]

Never

Once

2 or 3 times

4 times or more

98. Don't know

99. Refused

[ASK IF 0 = 2-4]

How did you contact them?

[Do not read list] [MULTIPLE RESPONSE]

Phone

Email

Fax

Letter

In person

98. Don't know

99. Refused

[ASK IF 0 =2-4]

Using that same scale, how satisfied were you with these communications? [INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means “very dissatisfied,” 5 means “neither satisfied nor dissatisfied,” and 10 means “very satisfied.”]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
97.	N/A
98.	Don’t Know
99.	Refused

[ASK IF 0<5 (Somewhat to Very Dissatisfied)]

Why were you dissatisfied? _____

[ASK ALL]

Have you experienced any savings on your electric bill since the [**LAST PROJECT**] project?

[SINGLE RESPONSE]

Yes

No

Too soon to tell

98. Don't know

99. Refused

[ASK IF 0= Yes (if noticed savings)]

How satisfied are you with any savings you noticed on your electric bill since the [**LAST PROJECT**] project? [INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know
99.	Refused

[ASK ALL]

How satisfied are you with your [**LAST PROJECT**] project? [INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."]

[INTERVIEWER NOTE: IF RESPONDENT SAYS 'TOO SOON TO TELL,' THEN FOLLOW UP WITH: "So would you say you are "Neither satisfied nor dissatisfied?" or you just don't know yet AND PROBE TO CODE]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know
99.	Refused

[ASK IF 0<5 (Somewhat to Very Dissatisfied)]

Why aren't you satisfied?

[RECORD VERBATIM] _____

98. Don't know

99. Refused

[ASK ALL]

[ASK IF LAST PROJECT <> ROOM AC] How satisfied are you with the interaction with the contractors who worked on the [**LAST PROJECT**] project? [INTERVIEWER NOTE: REPEAT SCALE IF NECESSARY: Please use a 0 to 10 scale where 0 means "very dissatisfied," 5 means "neither satisfied nor dissatisfied," and 10 means "very satisfied."]

[SINGLE RESPONSE]

0.	0. Very dissatisfied
1.	1.
2.	2
3.	3
4.	4
5.	5. Neither satisfied nor dissatisfied
6.	6.
7.	7.
8.	8.
9.	9.
10.	10. Very satisfied
98.	Don't Know
99.	Refused

[ASK IF Q17< 5 (Somewhat to Very Dissatisfied)]

Why aren't you satisfied?

[RECORD VERBATIM] _____

98. Don't know

99. Refused

[ASK ALL]

Finally, if you were rating your overall satisfaction with the Duke Energy Progress Home Energy Improvement Rebate Program, would you say you were Very Satisfied, Somewhat Satisfied, Neither Satisfied nor Dissatisfied, Somewhat Dissatisfied, or Very Dissatisfied? [SINGLE RESPONSE]

1.	1. Very dissatisfied
2.	2. Somewhat dissatisfied
3.	3. Neither satisfied nor dissatisfied
4.	4. Somewhat satisfied
5.	5. Very satisfied
98.	Don't Know
99.	Refused

[ASK IF 0 < 5]

Why do you give it that rating? _____

[ASK ALL]

Do you have any suggestions to improve Duke Energy's Home Energy Improvement Program?

[YES, RECORD VERBATIM] _____

No

98. Don't know

99. Refused

Demographics/Property Characteristics

Finally, I just need to ask you some questions about the residence where the rebated work was done.

[ASK ALL]

[ASK ALL]

Do you live at this residence where the work was performed?

Yes

No

99. Refused

[ASK ALL]

Do you manage renters or condo owners that live at this residence?

Yes

No

96. Other, please specify: [OPEN-ENDED RESPONSE]

99. Refused

[ASK IF 0=NO]

Do you own or rent this residence?

[SINGLE RESPONSE]

Own

Rent

98. Don't know

99. Refused

[ASK IF 0=Rent]

Do you pay your own electric bill or is it included in your rent? [*DO NOT READ*]

[Single RESPONSE]

Pay own bill

Included in rent

98. Don't know

99. Refused

[ASK IF 0=YES]

Do you personally own this residence, or do you work for the firm that does?

Yes

No

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Don't know

99. Refused

[ASK ALL]

Approximately when was this residence first built? [*DO NOT READ*]

[SINGLE RESPONSE]

Before 1960

1960-1969

1970-1979

1980-1989

1990-1999

2000-2005

2006 or later

98. Don't know

99. Refused

[ASK ALL]

Excluding unfinished basements, how many square feet is the residence?

NUMERICAL OPEN END [RANGE 0-99,999]_____

98. Don't know

99. Refused

[ASK IF 0=Don’t Know or Refused]

Would you estimate the residence is about: [*READ LIST*]

[SINGLE RESPONSE]

less than 1,000 sqft

1,001-2,000 sqft

2,001-3,000 sqft

3,001-4,000 sqft

4,001-5,000 sqft

Greater than 5,000 sqft

98. Don't know

99. Refused

[ASK ALL]

Does the primary heating system at the residence run on electricity, natural gas, or something else?? [*DO NOT READ*]

[SINGLE RESPONSE]

Electricity

Natural Gas (not propane)

Liquid propane gas

Fuel Oil

Wood

Other, specify:_____

98. Don't know

99. Refused

[ASK ALL]

I'm going to read a list of options. Please stop me when I reach the range that includes your annual household income. [*READ LIST*]

[SINGLE RESPONSE]

1. Less than $25,000

2. $25,000 to less than $50,000

3. $50,000 to less than $75,000

4. $75,000 to less than $100,000

5. $100,000 to less than $150,000

6. $150,000 or more

98. Don’t know

99. Refused

That is all of the questions I have for you today. Thank you very much for your time.

Appendix E Housing Characteristics and Demographics

Overall, about one-third of participants (60% of single and 67% of multifamily participants) reported their residence was built between 1980 and 2005 (Table 6-5). Participant survey responses were reflective of the housing stock in North and South Carolina[1], with 69% of housing being constructed between 1980 and 2009.

Table 6-5 Year Property Was Built, by Sector

Year built	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Before 1960	12%	0%	9%
1960-1969	8%	0%	6%
1970-1979	13%	20%	15%
1980-1989	21%	27%	23%
1990-1999	19%	13%	17%
2000-2005	20%	27%	22%
2006 or later	7%	13%	9%
Total	**100%**	**100%**	**100%**

About two-thirds of participants (72% of single and 63% of multifamily participants) reported electricity was the primary fuel source for heating at the residence where they performed rebated work (Table 6-6). Similar to building age, The Evaluation Team found the primary fuel source participants used for heating in our sample was consistent with the population in DEP territory (65% of households using electricity as their primary heating fuel; RECS 2009)

Table 6-6 Fuel Source for Primary Heating System, by Sector

Heating Fuel Source	Single Family (N=75)	Multifamily (N=30)	Total (N=105)
Electricity	72%	63%	70%
Natural Gas (not propane)	21%	27%	23%
Both electricity and gas (dual system)	4%	3%	4%
Liquid propane gas	1%	0%	1%
Wood	1%	0%	1%
Other	0%	7%	2%
Total	**100%**	**100%**	**100%**

[1] The Evaluation Team compared survey data with 2009 Residential Energy Consumption Survey (RECS) data. RECS is a nationally representative sample of housing units. Since it is a sample of housing units, it is not possible to differentiate between single and multifamily housing by year built, heating fuel source, or building square footage. The Evaluation Team provided these comparisons for an approximate estimate of how well HEIP participants represent the overall population of North and South Carolina.

About two-fifths (43%) of single-family participants reported the residence being between 2,001 to 3,000 square feet (Table 6-7). Comparatively, most (82%) of multifamily participants reported the residence being between 2,000 square feet or less. On average, single-family participants reported a residence size of 2,373 square feet and multifamily reported a residence size of 1,381 square feet.[2] The average size of single-family participants' residences was significantly larger, compared to the average size in the population in DEP territory (1,574 square feet, on average; RECS 2009).

Table 6-7 Residence Size (Excluding Unfinished Basements), by Sector

Residence Size (square feet)	Single Family (N=75)	Multifamily (N=27)*	Total (N=102)*
Less than 1,000	0%	19%	5%
1,001-2,000	41%	63%	47%
2,001-3,000	43%	7%	33%
3,001-4,000	9%	0%	6%
4,001-5,000	7%	0%	5%
Don't know	0%	11%	3%
Total	**100%**	**100%**	**100%**

* The Evaluation Team excluded three multifamily responses of over 3,000 square feet from this analysis.

About two-thirds (62%) of single-family participants who owned their home reported an annual household income of $75,000 or more, suggesting higher income households are more likely to participate in HEIP (Table 6-8).[3] The Evaluation Team also compared single-family participant income survey responses to the income in the population in DEP's territory from the 2014 American Community Survey (ACS)). The analysis revealed that significantly more single-family HEIP participants had annual household incomes of $75,000 or more compared to the annual income for owner-occupied housing units in North and South Carolina (62% compared to 37%, respectively).[4]

[2] The Evaluation Team asked single and multifamily participants how many square feet the residence where the rebated work was completed. However, some responses (those over 3,000 square feet) to exceed the size of what would be expect for a multifamily residence. Likely multifamily participants who provided these responses were referring to the total size of the multifamily building, rather than the unit. The Evaluation Team excluded three multifamily respondents who provided response over 3,000 square feet from this analysis.

[3] The Evaluation Team also asked multifamily participants their annual household income. However, since The Evaluation Team spoke multifamily owners and property managers, as well as renters, this information may not accurately represent the multifamily sector, in general. The Evaluation Team excluded this information from the report.

[4] Please note that the actual income distribution for single-family homeowners in North and South Carolina may be slightly different, as the ACS data includes condominium and row house owners. The Evaluation Team was unable to specify housing type along with state and housing tenure when extracting 2014 ACS data.

Table 6-8 Annual Household Income, Single Family Only

Annual Household Income	Single-Family Participants (N=59)*	Owner Occupied Housing Units in North and South Carolina (2014 ACS)
Less than $50,000	14%	43%
$50,000 to less than $75,000	24%	20%
$75,000 to less than $100,000	25%	14%
$100,000 to less than $150,000	25%	14%
$150,000 or more	12%	9%
Total	**100%**	**100%**

* The Evaluation Team excluded 15 single-family participants who refused to answer this question and two who reported renting the home from this analysis.

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CERTIFICATE OF SERVICE

I certify that Duke Energy Progress, LLC's 2014 EM&V report has been served by electronic mail (e-mail), hand-delivery or by depositing a copy in the United States Mail, first class postage prepaid, properly addressed to the parties of record.

This the 11th day of July 2016.

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