



Energy Efficiency Program Customer Participation Study

Prepared for:

National Grid Rhode Island



FINAL REPORT

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DISCLAIMER

This report was prepared by Navigant Consulting, Inc. (Navigant) for National Grid. The work presented in this report represents Navigant's professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

EXECUTIVE SUMMARY

National Grid contracted Navigant Consulting, Inc. (Navigant, or the team) to assess customer participation in its Rhode Island residential and small business energy efficiency programs between 2009 and 2015. The team analyzed the following programs in this study, including both electric and gas accounts:

- EnergyWise Single Family
- Income Eligible Single Family
- EnergyWise Multifamily
- Income Eligible Multifamily
- Residential New Construction
- Small Business Direct Install

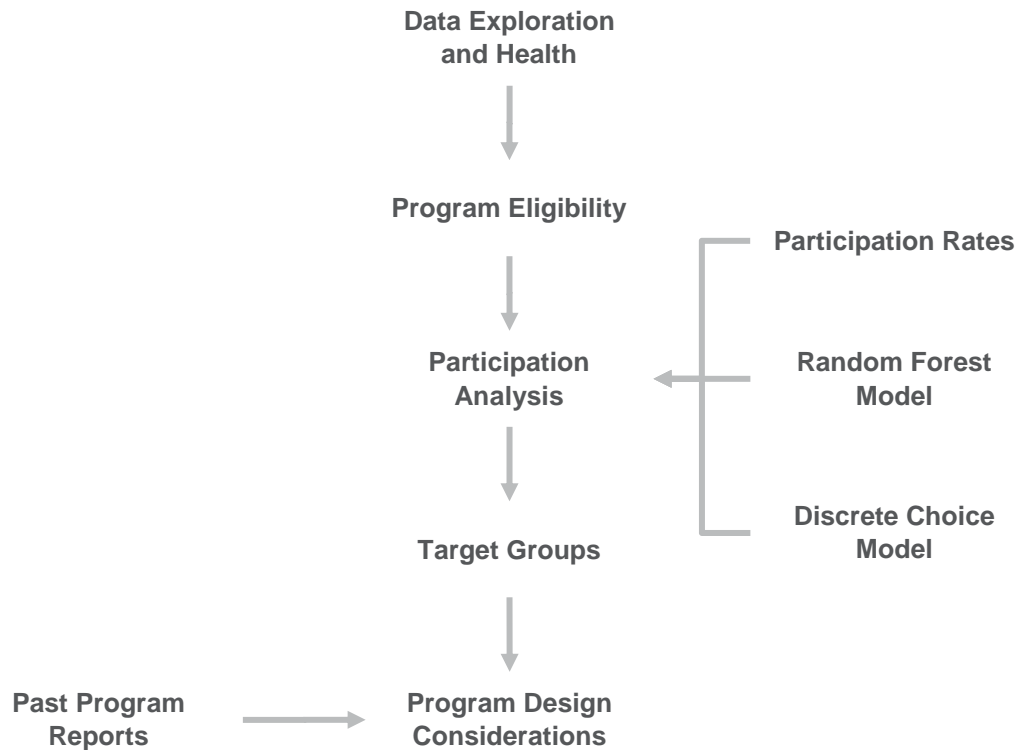
National Grid provided customer account data, participation data, and customer usage data, as well as third-party household, business, and property data. Using these data, Navigant investigated customer participation in each energy efficiency program with the following study objectives:

- Understand the characteristics of residential and small business customers that participate in energy efficiency programs
- Communicate information about program participants and nonparticipants to regulators and stakeholders
- Estimate the number of potential candidate accounts available for increasing participation
 - This analysis relied on energy usage and demographic data only and did not account for other factors such as budget constraints and customer behavior
 - Navigant did not estimate potential savings for these customers

Study Methodology and Summary

Navigant's general study methodology is shown in Figure ES-1.

Figure ES-1. Energy Efficiency Program Participation Analysis Methodology

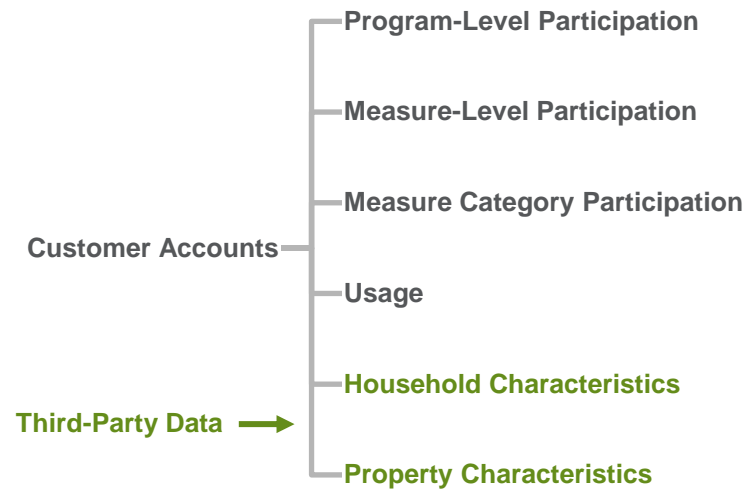


Source: Navigant analysis of National Grid data

Data Exploration and Health

Navigant used several data sources compiled and provided by National Grid as indicated in Figure ES-2. The team calculated participation rates (displayed in Table ES-5) relying only on National Grid account information and participation tracking data, which is linked via account number. However, further participation analysis relied on third-party household characteristic, business, and property data that National Grid matched to the account database snapshots. National Grid obtained household and business characteristic data from Infogroup and property data from Core Logic.

Figure ES-2. Links Between Data Received



Source: Navigant analysis of National Grid data

The process of matching customer accounts and third-party data is never perfect. However, based on Navigant's assessment of the overall data health (as provided in Table ES-1), the matching process employed by National Grid was relatively successful in obtaining key demographic characteristics at an account level for the company's Rhode Island accounts.

Table ES-1. Data Health for All Residential and C&I Electric and Gas Accounts

Description	Residential Electric	Residential Gas	C&I Electric	C&I Gas
Total Eligible Records in Account Database	435,777	242,101	24,896	17,892
Percentage with Household Characteristics (Residential) or Business Data (C&I)	69%	71%	72%	72%
Percentage with Property Data	84%	84%	78%	65%
Percentage with Usage Data	97%	97%	95%	95%

Source: Navigant analysis of National Grid data

Navigant also assessed the number of accounts found in participant lists in the customer account databases. The participant lists Navigant used are historical lists of participants who participated in energy efficiency programs from 2009 through 2015. The customer account databases are snapshots as of March 2017. As a result, not all historical participant accounts will be found in the account database snapshots. For each program, Table ES-2 lists the percentage of historical participant accounts that were matched with the residential or commercial and industrial (C&I) account database, as applicable.

Table ES-2. Percentage of Accounts in Participant Lists Matched with Customer Account Databases by Program

Program	Electric Participants	Gas Participants
EnergyWise Single Family	75%	78%
Income Eligible Single Family	65%	73%
EnergyWise Multifamily	41%	41%
Income Eligible Multifamily	55%	32%
Small Business Direct Install	60%	57%

Source: Navigant analysis of National Grid data

For multifamily programs the low match rate of participating accounts with the residential account database posed significant challenges to the team's analysis of multifamily programs. Many of the unmatched participant accounts were associated with inactive accounts as of March 2017, which could be ascribed to tenants moving in and out of multifamily buildings that previously participated in the program. As a result, many nonparticipant accounts in the residential account database may be associated with buildings that have participated in a multifamily energy efficiency program. This uncertainty makes the differences between participants and nonparticipants unclear and prohibited the team from analyzing these programs with confidence.

Program Eligibility

The participation rates calculated by Navigant depend on the number of eligible active accounts in the electric and gas databases. As part of this analysis, Navigant investigated the residential and C&I account database to determine the number of eligible accounts in each energy efficiency program. The team classified residential accounts as eligible for the program that corresponds to their income level (market rate or income eligible) as well as family category (single family or multifamily). The number of eligible accounts identified for each program are listed in Table ES-3.

Table ES-3. Eligible Accounts for Each Residential Program Identified in the Residential Database

Program	Residential Electric		Residential Gas	
	Accounts	Share	Accounts	Share
Total Accounts	435,777	100%	242,101	100%
EnergyWise Single Family	324,491	74%	186,940	77%
EnergyWise Multifamily	72,608	17%	36,923	15%
Income Eligible Single Family	27,902	6%	14,462	6%
Income Eligible Multifamily	10,776	2%	3,776	2%

Source: Navigant analysis of National Grid data

For the Small Business Direct Install program, the team determined eligible C&I accounts based on certain account type and usage criteria for the electric and gas programs. The number of eligible accounts for the electric and gas programs are listed in Table ES-4. In the C&I databases, many accounts had residential rates—specifically, 41% of electric accounts and 2% of gas accounts. Only those residential accounts associated with church properties are eligible for the Small Business Direct Install program.

Table ES-4. Eligible Accounts for the Small Business Direct Install Program Identified in the C&I Database

Eligibility	C&I Electric		C&I Gas	
	Accounts	Share	Accounts	Share
Total Accounts	51,904*	100%	22,049*	100%
Eligible	24,893	48%	17,892	81%
Ineligible	27,011	52%	4,157	19%

*21,139 accounts in the C&I electric database and 392 accounts in the C&I gas database were on residential rates.

Source: Navigant analysis of National Grid data

Participation Rates

Table ES-5 shows the additive and cumulative participation in each energy efficiency program for both electric and gas accounts. Additive participation represents the sum of unique participation within each year from 2009 through 2015. For example, if a customer participated in 2009 and 2013, that customer would be counted twice. Alternatively, cumulative participation represents the number of unique participating accounts over the entire analysis period from 2009 through 2015. For example, if a customer participated in the EnergyWise Single Family program in 2009 and again in 2015, that customer would only be counted once. Comparison of these rates provides a measure of the amount of repeat participation that has occurred historically, shown as the repeat rate. These results show that 11%-17% of participants in electric programs were repeat participants, while 2%-8% of participants in gas programs were repeat participants.

Table ES-5. Participation Rates for Each Program: 2009-2015

Program	Fuel	Participating Accounts		Eligible Accounts	Participation Rate*		Repeat Rate**
		Additive	Cumulative		Additive	Cumulative	
EnergyWise Single Family	Electric	49,104	44,052	324,491	15.1%	13.6%	11%
	Gas	10,979	10,182	186,940	5.9%	5.4%	8%
Income Eligible Single Family	Electric	16,092	13,947	27,902	57.7%	50.0%	15%
	Gas	2,040	1,983	14,462	14.1%	13.7%	3%
Small Business Direct Install	Electric	7,176	6,141	24,896	28.8%	24.7%	17%
	Gas	838	824	17,892	4.7%	4.6%	2%

*Calculated based on the total number of eligible accounts for each program

**Calculated as (Additive Participants – Cumulative Participants) / Cumulative Participants

Source: Navigant analysis of National Grid data

For the Residential New Construction program, the cumulative participation from 2009 through 2015 was 1,469 projects participating in the program specifically in new construction and 3,005 projects participating in the program including both new construction and renovation. Based on estimated single family new housing starts from Moody's Analytics, the participation rate based on single family new construction only was 28%.

Participation Analysis

Navigant assessed the demographic, property, and usage characteristics to characterize the most important variables that distinguish between historical participants and nonparticipants. Specifically, for each program where data was sufficient, the team developed random forest classification and discrete choice models. These models were used to identify the characteristics that most influence participation in energy efficiency programs.

Target Groups

Navigant used the participation analysis to select target groups of customers based on their likelihood of participating. In this context, the team assessed the likelihood of future nonparticipant participation based on their resemblance to past program participants in terms of the most important characteristics. Navigant also leveraged the relative influence determined by discrete choice models. The team considered characteristics that were associated with higher historical rates of participation to be indicative of more likely future participation. Similarly, Navigant considered characteristics that were associated with lower historical rates of participation to be indicative of less likely future participation.

As this analysis is based on past trends from 2009 through 2015, the characteristics of participants will evolve with the energy efficiency programs themselves—for example, as marketing efforts change over time. Additionally, this analysis did not account for factors such as budget constraints or customer behavior. For example, Navigant did not receive any data or conduct surveys regarding whether customers would be simply uninterested in energy efficiency programs regardless of demographic or property characteristics. The accuracy of this analysis is subject to the third-party demographic, business, and property data provided and the success of matching with National Grid's account records. Finally, Navigant was not able to find many historical participants within National Grid's account database snapshots as of March 2017. These non-matching participants could represent accounts that historically participated but were subsequently inactive as of when National Grid submitted the account databases.

Table ES-6 summarizes the targeting analysis for each program. The groups include the following:

- **Matched Past Participants, 2009-2015:** Customers who have participated in the program from 2009 through 2015. These customers could be targeted for installation of additional measures or for repeat audits, as electric customers are eligible for a repeat audit every 5 years.
- **Eligible Accounts Similar to Past Participants:** Customers who meet all of the following criteria: have not participated in the program; do not have any characteristics associated with lower historical participation rates; and have one or more characteristic associated with higher historical participation rates.
- **Other Eligible Accounts:** Customers who have not participated in the program and have one or more characteristic associated with lower historical participation rates; customers that do not have any characteristics associated with higher or lower historical participation rates; or customers that do not have sufficient demographic, property, or usage information to be classified.
- **Historical Participant Share of Other Eligible Accounts:** A portion of other eligible accounts that could be expected to participate based on historical participation rates.

Navigant also estimated the number of years potential participants remain by dividing the number of accounts in each target group by additive annual participation in 2015 in each program. These results are

listed in Table ES-7 and provide an estimate of how many years of participation remain if all potential participants in each group (Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Historical Participant Share of Other Eligible Accounts) were reached at the 2015 level of program participation. This estimate does not account for any repeat participation in future years.

Table ES-6. Summary of Targeting Analysis by Program

Description	EWSF Electric	EWSF Gas	IESF Electric	IESF Gas	SMB/DI Electric	SMB/DI Gas
Matched Past Participants, 2009-2015	33,225	7,973	9,108	1,438	3,739	471
Eligible Accounts Similar to Past Participants	124,837	72,478	6,609	4,238	5,257	4,254
Historical Participant Share of Other Eligible Accounts*	22,594	5,800	6,091	1,205	3,922	606
Other Eligible Accounts	143,835	100,689	6,094	7,581	11,978	12,561
Total Eligible Accounts	324,491	186,940	27,902	14,462	24,896	17,892

EWSF = EnergyWise Single Family, IESF = Income Eligible Single Family, SMB/DI = Small Business Direct Install

*Calculated based on historical cumulative participation rates for each program from 2009 through 2015

Source: Navigant analysis of National Grid data

Table ES-7. Summary of Years of 2015 Participation Remaining by Program

Description	EWSF Electric	EWSF Gas	IESF Electric	IESF Gas	SMB/DI Electric	SMB/DI Gas
2015 Participation (Accounts)	11,626	2,830	2,851	529	1,047	121
Matched Past Participants, 2009-2015 (Years)	3	3	3	3	4	4
Eligible Accounts Similar to Past Participants (Years)	11	26	2	8	5	35
Historical Participant Share of Other Eligible Accounts (Years)	2	2	2	2	4	5
Total (Years)	16	30	8	13	12	44

Note: The years are estimated by dividing the participation category by the 2015 participation.

EWSF = EnergyWise Single Family, IESF = Income Eligible Single Family, SMB/DI = Small Business Direct Install

*Total is the sum of the Matched Participants, Eligible Accounts Similar to Past Participants, and Historical Participant Share of Other Eligible Accounts.

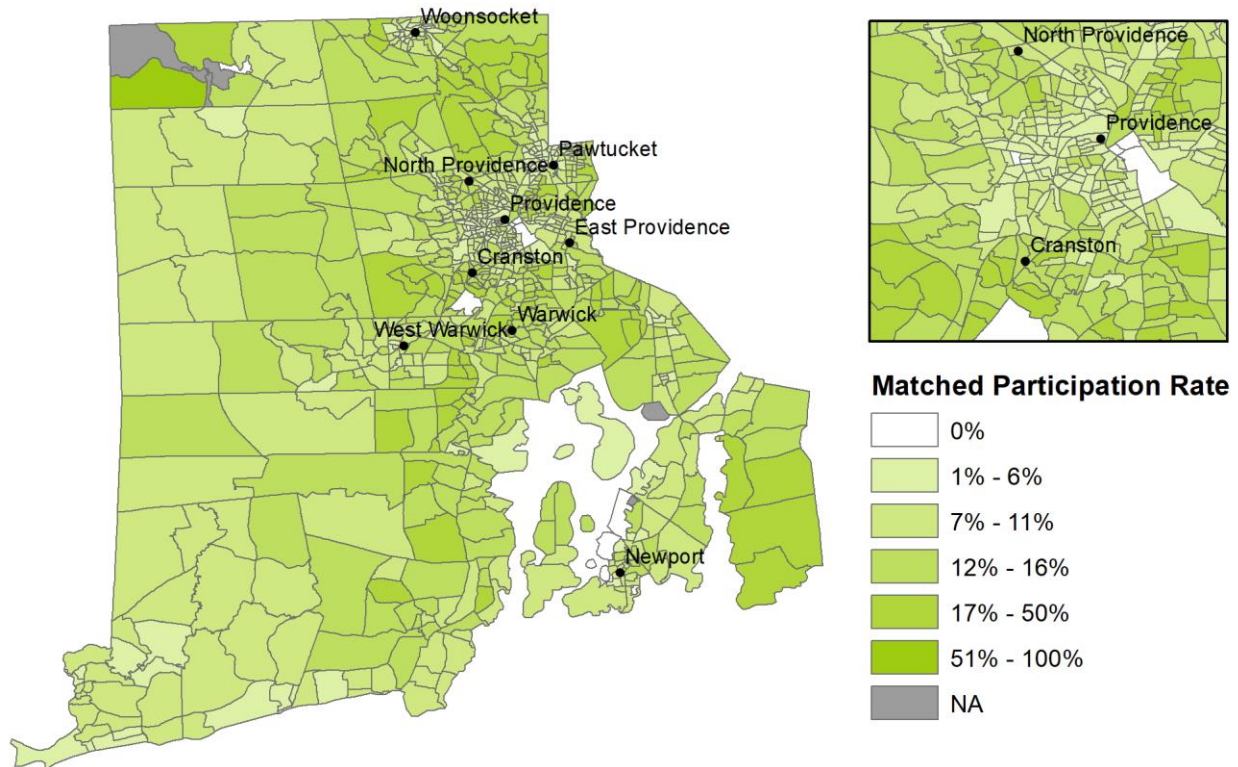
Source: Navigant analysis of National Grid data

Program Observations

Navigant found that participation in the EnergyWise Single Family Electric and Gas programs occurs throughout Rhode Island. Figure ES-3 shows the cumulative participation rate from 2009 through 2015 by census block group for the EnergyWise Single Family Electric program. In this map, the participation rate reflects the accounts that the team matched to the residential account database snapshot as of March 2017 for which geocoded data was available. There are higher concentrations of participation in the suburbs of Providence and in the southeastern-most part of the state and lower rates of participation in

the more rural western parts of Rhode Island. Similar patterns exist for the other programs and are shown in their respective sections.

Figure ES-3. EnergyWise Single Family Electric Cumulative Matched Participation Rate by Census Block Group: 2009-2015



Source: Navigant analysis of National Grid data

The team also looked at income equity in terms of participation rates in the Single Family programs. Navigant received household income ranges and size for accounts in the residential database. Where data were available, Navigant determined the area median income (AMI) range for each account based on the 2016 income limit criteria for low- and moderate-income households in Rhode Island.¹ Table ES-8 lists the participation rates of low- (0%-60% AMI) and moderate- (60%-100% AMI) income customers in either of the EnergyWise or Income Eligible Single Family programs. Table ES-8 also lists the total participation rate for the EnergyWise and Income Eligible Single Family programs, calculated based on all historical participants from 2009 to 2015. This number includes customers in all income ranges, as well as those who are missing income information. The participation rates of low-income customers are higher than those of all customers for electric accounts and slightly lower for gas accounts. The participation rates of moderate-income customers are slightly lower than the total participation rate for both gas and electric customers. Note that this analysis of income-related differences considered participation in the single family, whole home programs and does not consider upstream lighting, historically the largest program.

¹ FY2016 Rhode Island Income Limits for Low- and Moderate-Income Households.

http://www.rhodeislandhousing.org/filelibrary/FY16_HUD_Income_Limits_RI.pdf

Table ES-8. Low-/Moderate-Income Participation Rate Across EnergyWise (Market Rate) and Income Eligible Single Family Programs: 2009-2015

Fuel Type	Income Level	Participants	Eligible Accounts	Cumulative Participation Rate
Electric	Low-Income*	13,435	85,168	16%
	Moderate-Income**	5,252	50,514	10%
	All Accounts†	42,333	352,393	12%
Gas	Low-Income*	2,489	56,394	4%
	Moderate-Income**	1,480	32,939	4%
	All Accounts†	9,411	201,402	5%

*Determined based on the sum of the total number of accounts from the Income Eligible Single Family program and the number of accounts that fall below 60% AMI from the EnergyWise Single Family program.

** Determined based on the number of accounts between 60% and 100% AMI from the EnergyWise Single Family program.

† Determined based on the sum of the total number of accounts from the Income Eligible and EnergyWise Single Family programs. This number includes customers in all income ranges as well as those who are missing income information.

Source: Navigant analysis of National Grid data

Program Design Considerations

Based on a review of past program reports and the data analysis research, Navigant synthesized key findings from this analysis into actionable recommendations to address ways to increase participation for each program. Overall, Navigant acknowledges the robust and industry-leading program designs currently in place within Rhode Island's energy efficiency programs. National Grid's existing program designs are creative and are focused on quality of service, building science excellence, savings performance, and extensive investment in developing a cohort of highly credentialed trade allies to engage with program delivery. Additionally, the team took note of the existing levels of cross-program coordination and referrals, as well as the highly aggressive incentive levels already in place. To continue enrolling new customers—primarily those from customer sub-groups that are historically underrepresented—the following key summary observations and considerations are offered in Table ES-9.

Table ES-9. Program Design Considerations

Themes	Observations	Considerations
Marketing	Existing marketing efforts are robust, yet opportunity remains to be even more targeted.	<ul style="list-style-type: none"> • Increase target marketing. Devise marketing strategies that speak more directly to the underrepresented customer segments, addressing different channels in the sales cycle (e.g., customer, trade ally, supply houses, etc.). The marketing should use messaging that engages the desired customer base, even if the fundamental program design and rebate offerings remain essentially the same. Consider an array of different marketing and communication strategies and special additive incentive designs, specifically for the targeted customer group. This could include re-visiting the process of following up with customers that did not address the range of measures identified during the audit. • Promote value-added services and benefits. Try different marketing strategies that speak primarily to topics other than energy efficiency or comfort to break into new customer demographics—namely, those who have not traditionally participated in energy efficiency programs (e.g., market health and safety checks or other value-added services such as technology advisory with respect to Wi-Fi thermostats or smart home automation). Innovate with respect to these marketing strategies or services as a gateway to program participation.
Performance Goals	Performance goals, while in place for most lead vendors, could be tailored further to drive key desired results.	<ul style="list-style-type: none"> • Target performance awards. Expand on existing performance goals with trade allies and lead implementation contractors to reward goal attainment with targeted customer groups.
Incentives	Existing incentive levels, while aggressive, are still fixed per regulatory procedures and static throughout the annual program year.	<ul style="list-style-type: none"> • Introduce dynamic incentives. Request broader flexibility to adjust incentive levels as needed throughout the course of the year to maximize savings and reach target customer groups. Greater incentive flexibility would allow National Grid to be more dynamic in responding to market conditions. • Implement a bonus incentive for deep energy retrofits. National Grid could offer an extra incentive for customers who participate in the program and achieve dramatic energy savings reductions (e.g., >30%-40% energy savings).

Source: Navigant analysis of National Grid data

Because of the low match rates identified in Table ES-2, for future analyses of multifamily programs, Navigant recommends the following, subject to cost-effectiveness:

- **Create a flag across all residential and C&I databases identifying multifamily properties.** This flag would facilitate identifying eligible multifamily properties in future analyses.
- **Assign permanent, unique ID numbers for all facilities, buildings, and housing units in Rhode Island.** This could be a clean, geocoded full address, but a unique numerical ID would prevent complications from geocoding addresses that may arise from data entry errors. These IDs could be a single ID with components or a set of hierarchical IDs such that it is clear which housing units are within each building and which buildings belong to each facility. This would preserve the information that a building has previously contained participating accounts, such as when a tenant moves.

- **Track the number of housing units for each participating building.** Because this analysis relied on third-party data for the number of housing units matched to the account database, tracking this data would increase the accuracy of future analyses.
- **Maintain a flag variable for buildings that have at any point contained participating accounts.**
- **Preserve demographic/housing characteristics/property data matched to inactive accounts.** Paired with account open and close dates, this would enable the analysis team to consider accounts over a specified period of time rather than only snapshot in time. The analysis team could, for example, identify participating buildings based on the unique building ID number proposed above and obtain any inactive accounts closed in the last 3 years that were tied to those buildings, together with the matching demographic and housing/property data.

1. INTRODUCTION

This report presents the results of Navigant Consulting, Inc.'s (Navigant's, or the team's) assessment of Rhode Island energy efficiency program participation on behalf of National Grid. Navigant analyzed participation from 2009 through 2015 for each of the programs listed in Table 1.

Table 1. Programs Investigated

Sector	Program	Fuels
Residential	EnergyWise Single Family	Electric and Gas
	EnergyWise Multifamily	
	Residential New Construction	
Income Eligible	Income Eligible Single Family	
	Income Eligible Multifamily	
Commercial and Industrial (C&I)	Small Business Direct Install	

Source: Navigant analysis of National Grid data

The primary objectives of this study were to:

- Understand the characteristics of residential and small business customers that participate in energy efficiency programs
- Communicate information about program participants and nonparticipants to regulators and stakeholders
- Estimate the number of potential candidate accounts available for increasing participation
 - This analysis relied on energy usage and demographic data only
 - It did not account for other factors such as budget constraints, customer behavior, and potential savings

The basis of this analysis was a dataset provided by National Grid for each program. The dataset included account details; monthly energy usage; household, business, and property characteristics obtained from a third party; and participation in National Grid's energy efficiency programs from 2009 through 2015. Navigant investigated the effects of characteristics such as geography, usage, demographics, and property age on the likelihood of participation in each energy efficiency program. Through this analysis, the team identified key characteristics that influence participation and used these characteristics to identify target groups of customers who would be more likely to participate in the future.

2. GLOSSARY

Term	Definition
Annual Participation	Represents the unique accounts associated with an individual program in a given year. It removes all double counting within a given program within a given year. For example, if a customer participated in an EnergyWise program twice in 2015, they would only be counted once.
Additive Participation	The sum of annual program participation counts.
Candidate	An account, building, or property that is available for increasing participation and has not been determined to be less likely to participate based on usage, household, or business characteristics.
Cumulative Participation	Eliminates all double counting within a program across multiple years. For example, if a customer participated in the EnergyWise program in 2013 and then again in 2015, they would only be counted once. Therefore, the cumulative count may be less than the additive count since it removes customers that participate in the same program more than once.
Discrete Choice Model	A model that explains (or predicts/quantifies) choices between two or more distinct (or discrete) alternatives
Eligible Account	An account that could participate in a particular energy efficiency program. This includes both past participants (who could be eligible for additional measures) and customers who have not participated.
Measure Category	Collection of measures.
Multifamily Building	<p>For National Grid EnergyWise programs, multifamily buildings are defined as the following:</p> <ol style="list-style-type: none"> Buildings with five or more units (5+-unit buildings hereafter) Properties consisting of four or more 1-4-unit buildings that meet both of the following requirements: <ol style="list-style-type: none"> Are connected or neighboring to each other, or to a 5+-unit building Are owned by the same individual or firm <p>To simplify its analysis, Navigant did not apply the adjacency criterion in 2a in the analysis of this report.</p>
Nonparticipant (Non-P)	An account, housing unit, or building depending on the program that has not participated in the energy efficiency program.
Participant (P)	An account, housing unit, building, or facility (depending on the program) that has participated in the energy efficiency program. In Single Family programs, participants would be individual account holders. For Residential New Construction, a participant would be a project (renovation or new construction of a housing unit). For Multifamily programs, the participating facility (one or more multifamily buildings under the same ownership) as well as the number of housing units are of interest.
Participation Rate	The annual or cumulative fraction of program participants divided by the total number of eligible accounts.

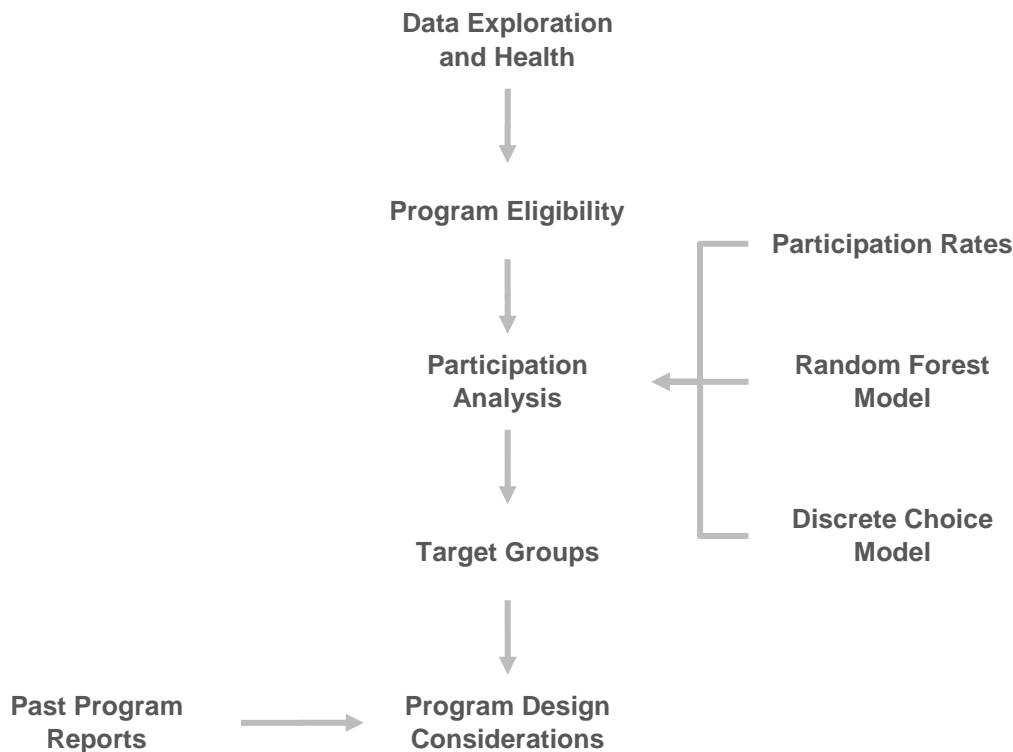
Term	Definition
Random Forest	An ensemble classification algorithm consisting of many individual decision trees where the output class is given by the mode of the output classes of all the individual decision tree predictions. Individual decision trees are trained to predict the output class using only a subset of all the data fields and by creating subsets of those fields that best split the data into the target classes. See Chapter 8 of Pattern Classification (2 nd Edition) by Richard Duda et al. for treatment of decision trees or https://en.wikipedia.org/wiki/Random_forest .

Source: Navigant analysis of National Grid data

3. GENERAL METHODOLOGY

Navigant utilized different methods to analyze each energy efficiency program, depending on the available data. Nevertheless, the team employed a similar methodological approach to each program, depicted in Figure 1.

Figure 1. Energy Efficiency Program Participation Analysis Methodology



Source: Navigant analysis of National Grid data

This methodological approach includes the following:

- Data Exploration and Health:** Navigant first explored the files provided by National Grid to understand all data available for a given program and merged together the various data received. The team evaluated the health (or quality) of the data received by determining the number of customer accounts matched to household, business, property, or usage data. Where possible, the team assessed the quality of household and property data by comparing them to other publicly available sources.
- Program Eligibility:** Navigant classified each account in the databases received from National Grid in terms of its eligibility for specific energy efficiency programs. For example, in the residential account databases, the team divided the eligible accounts among the single family and multifamily EnergyWise and Income Eligible programs.
- Participation Analysis:** For each program, the team calculated participation rates annually and by census-block group or ZIP code. When possible, Navigant used machine learning and

econometric techniques to identify key demographic or property characteristics most likely to influence customer participation in each program.

- **Target Groups:** Based on the results of the participation analysis, the team identified key groups of customers to target for increasing participation and estimated the number of remaining nonparticipants that could potentially be captured.
- **Program Design:** Based on a review of past program reports and the data analysis research, Navigant synthesized key findings into suggested actionable recommendations to address ways to increase program participation.

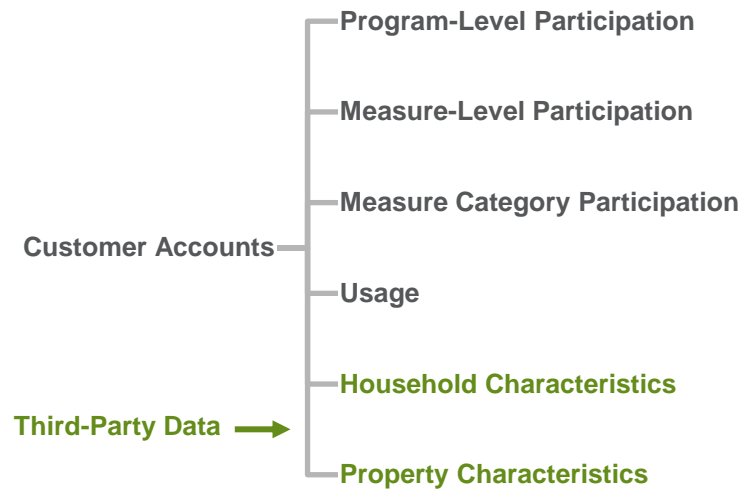
3.1 Data Exploration and Health

Navigant received various data from National Grid, including account details, participation tracking, usage, household, business, and property data. National Grid obtained household and business characteristics data from Infogroup and property data from Core Logic. The team first explored this data to understand the available characteristics and links between tables.

3.1.1 Residential Electric and Gas Programs

For residential electric and gas programs, Navigant received a variety of data tables linked as depicted in Figure 2. Each table links with the electric or gas customer account tables via unique account numbers.

Figure 2. Residential Data



Source: Navigant analysis of National Grid data

The team used unique account numbers to merge the following data tables provided by National Grid (depicted in Figure 2):

- **Customer Accounts:** Electric and gas accounts that list details such as account number, address, and rate code.
- **Usage:** Electric and gas account meter readings (kWh and/or therms) for a 24-month period through March 2017. The team normalized this data to monthly (30 day) periods for analysis.

- **Household Characteristics:** Demographic information such as income, ownership status, and length of residence for a subset of electric and gas accounts. National Grid obtained this data from Infogroup and matched it to National Grid's residential account database, prior to Navigant analysis, based on address, last name, and phone number.
- **Property Characteristics:** Property information, such as year the structure was built, property description (e.g., 1-Family/Single-Unit Residence), and number of housing units in the building. National Grid obtained this data from Core Logic and matched it to National Grid's account databases prior to Navigant analysis.
- **Measure-Level Participation:** Program tracking data, including the most recent date of participation for specific energy efficiency measures installed by electric and gas customers.

Navigant also received energy efficiency participation data:

- **Program-Level Participation:** List of participating accounts and payments by date made to participants in the EnergyWise or Income Eligible programs from 2009 through 2015. These lists do not contain information on the specific measures associated with each payment.
- **Measure Category Participation:** Participation by specific categories of measures. These categories are not as specific as the measure-level participation data. An example of such a table would be a list of EnergyWise Single Family home energy assessments for 2014 through 2016 along with invoice date.

For the Residential New Construction program, Navigant received the following:

- **Participation:** Lists of participants from 2009 through 2015. For each participant, the list includes information such as a ZIP code, project name, and date. Beginning in 2013, this information began including the energy efficiency tier achieved by each participant.
- **Housing Starts:** Data from Moody's Analytics that includes annual new single family and multifamily housing starts (units) for Rhode Island.

The different pieces of residential data provided by National Grid span different periods of time, as illustrated in Figure 3. Specifically, the account database, household, and property characteristics represent a snapshot in time as of March 2017. Conversely, the participation lists are a historical record of payments made to accounts from 2009 through 2015.² Likewise, electric and gas usage data spans the 24-month time period through March 2017. As a result, not all accounts in the participation lists will match with the account database provided by National Grid. For example, if a customer participated in 2009 but has since moved, that account may not be represented in the account database as of March 2017.

² 2016 participant data was not finalized when this study began.

Figure 3. Time Periods Covered by Residential National Grid Data

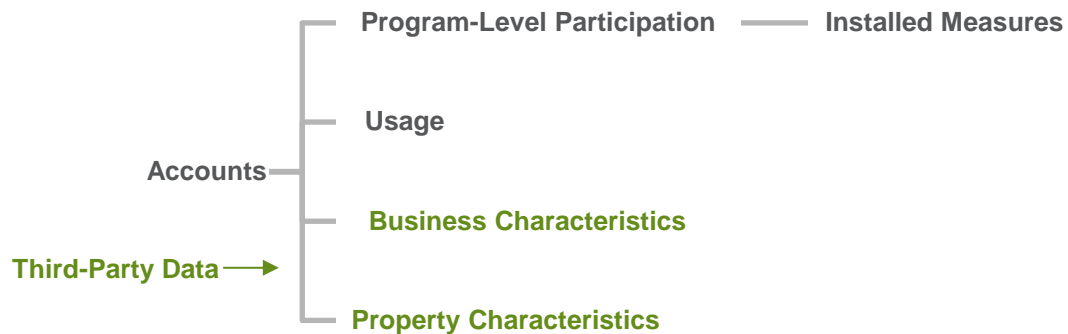


Source: Navigant analysis of National Grid Data

3.1.2 Small Business Direct Install

For the Small Business Direct Install program, Navigant received several data tables linked via unique account numbers, as depicted in Figure 4.

Figure 4. Small Business Data



Source: Navigant analysis of National Grid data

These data tables include the following:

- **Accounts:** Customer electric and gas account details, such as account numbers, address, and rate code.
- **Usage:** Electric and gas account meter readings (kWh, kW, and/or therms) for a 36-month period through March 2017.
- **Business Characteristics:** Business information, such as a six-digit North American Industry Classification System (NAICS) code, range of employees, and estimated sales volume for a subset of electric and gas accounts. National Grid obtained this information from Infogroup and matched it to National Grid's account database via address, name, and phone number.
- **Property Characteristics:** Property information, such as property description (e.g., retail building) and building square footage. National Grid obtained this information from Core Logic.

Navigant also received participation data for the Small Business Direct Install Electric and Gas programs:

- **Program-Level Participation:** List of participating accounts and payment dates to participants in the Small Business Direct Install program. Each payment is associated with an application number that links to the installed measure table.
- **Installed Measures:** Measures that were installed for each participant in the program-level participation data.

As was the case with the residential data, the different pieces of C&I data provided by National Grid span different periods of time, as illustrated in Figure 5. Specifically, the account database, business, and property characteristics represent a snapshot in time as of March 2017. Conversely, the participation lists are historical record of payments made to accounts from 2009 through 2015. Likewise, electric and gas usage data spans the 36-month period through March 2017. As a result, not all accounts in the participation lists will match with the account database provided by National Grid. For example, if a business participated in 2009 but has since closed or relocated, that account may not be represented in the account database as of March 2017.

Figure 5. Time Periods Covered by C&I National Grid Data



Source: Navigant analysis of National Grid Data

3.1.3 Account, Household, Property, and Usage Characteristics

The household, business, and property data provided by National Grid contain a variety of characteristics. Table 2 and Table 3 list the account, household, and property characteristics that the team used in this analysis.

Table 2. Residential Characteristics

Account	Household	Property	Usage
Address	Head of Household Age	Property Type	Average Monthly Usage (kWh or therms)
Rate Code	Household Income	Heating System Type*	
	Owner Marital Status	Year Built	
	Home Ownership	Building Area	
	Length of Residence	Number of Housing Units	
	Household Member Count		
	Number of Adults		
	Number of Children		

*The type of heating system in the home—e.g., forced air, radiant, heat pump. The household data did not include heating fuel information.

Source: Navigant analysis of National Grid data

Table 3. C&I Characteristics

Account	Business	Property	Usage
Address	NAICS Code/SIC Code/ Industry	Property Type	Average Monthly Usage (kWh or therms)
Rate Code	Estimated Annual Sales Volume	Building Area	Average Monthly Electric Demand (kW)
	Employee Size		
	Percent White Collar		

Source: Navigant analysis of National Grid data

Because National Grid obtained household, business, and property data from third parties, the definitions and categories did not necessarily align with the categorizations most relevant for this analysis. Therefore, the team re-categorized or re-binned some of these characteristics. For example, the residential customer household income data includes household income in increments of \$5,000 up to \$145,001 and above. To align with National Grid's definitions, Navigant re-classified residential customer income information using the income limits for different percentages of AMI for Rhode Island.³ Table 4 lists the income limits used to create the following categories: 0%-60% AMI, 60%-80% AMI, 80%-100% AMI, 100%-120% AMI, and 120% AMI and above.

³ FY2016 Rhode Island Income Limits for Low- and Moderate-Income Households.

http://www.rhodeislandhousing.org/filelibrary/FY16_HUD_Income_Limits_RI.pdf

Table 4. Rhode Island Income Limits by Household Size

Household Size	60% AMI	80% AMI	100% AMI	120% AMI
1	30,900	41,150	51,450	61,750
2	35,280	47,050	58,800	70,550
3	39,720	52,900	66,150	79,400
4	44,100	58,800	73,500	88,200
5	47,640	63,500	79,400	95,250
6	51,180	68,200	85,250	102,300
7	54,660	72,900	91,150	109,350
8	58,200	77,600	97,000	116,400

Source: Navigant analysis of National Grid data

Additionally, the data provided by National Grid included multiple sources of information regarding the number of housing units in each multifamily building:

- The number of housing units from property characteristics
- The number of housing units at an address from housing characteristics
- The number of accounts at each building from the account database

However, these sources of information may not be consistent for a given building. For example, the account database may contain only four accounts for a building, but property data indicates that the building has six units. This scenario may indicate that there are two housing units that are currently unoccupied. Therefore, the team derived a single estimate of the number of units at each building using the following method:

1. Use the number of units at a building as stated by property data, if available
2. If property data for a building is not available, use the greater of the number of units stated by the household characteristics table or the number of accounts at the building
3. Use the number of accounts at the building if no other information is available

3.1.4 Data Health

Navigant next assessed the overall health of the data received. First, the team determined the number of accounts that matched with one or more pieces of household, property, or usage data. Table 5 lists the total account records in the residential and C&I electric and gas databases, along with the percentage of accounts in each database that have a complete set of corresponding household characteristics (for residential accounts), business data (for C&I accounts), property data, and usage data.

Table 5. Data Health for All Residential and C&I Accounts

Description	Residential Electric	Residential Gas	C&I Electric	C&I Gas
Total Eligible Records in Account Database*	435,777	242,101	24,896	17,892
Percentage with Household Characteristics (Residential) or Business Data (C&I)	69%	71%	72%	72%
Percentage with Property Characteristics	84%	84%	78%	65%
Percentage with Usage Data	97%	97%	95%	95%

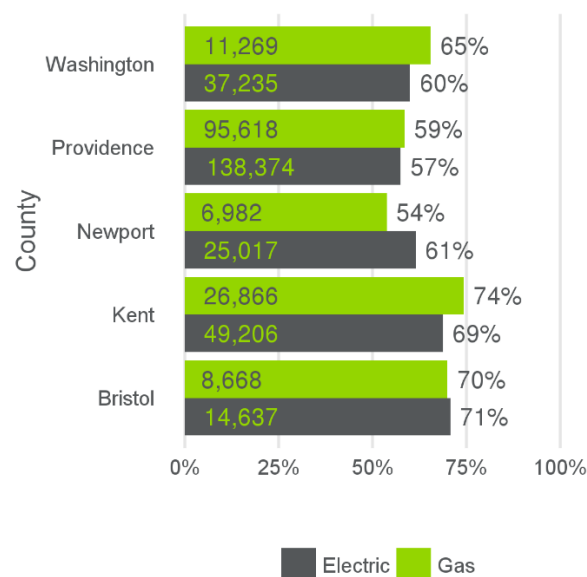
*For C&I accounts, Navigant analyzed data health only for accounts eligible for the Small Business Direct Install program.

Source: Navigant analysis of National Grid data

Although some of the accounts in the data that Navigant received were missing corresponding household or property characteristics or usage data, the share of National Grid accounts with complete data was in line with the team's expectations. The percentage of accounts that could be matched with residential and business characteristics data was close to 70% in all instances. This compared favorably with the experience of the Navigant team, which generally finds match rates of 60%-80%. The team typically recommends a more detailed assessment of the matching process and underlying data from the characteristic vendors and utility if the match rates are below 60%. Additional matching analysis was, therefore, unnecessary for this study.

As shown in Figure 6, the percentage of residential electric and gas accounts in each county with complete household and property information varied between 57% and 71% for electric accounts, and 54% and 74% for gas accounts. In other cases, accounts may have incomplete household or property information.

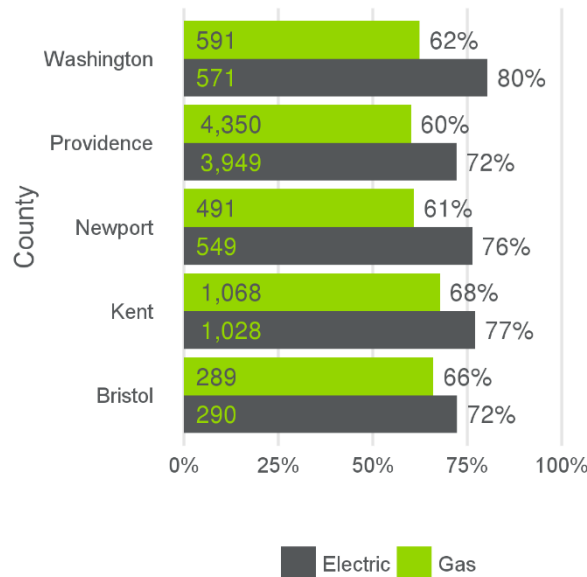
Figure 6. Percentage of Residential Accounts with Complete Household and Property Information by County



Source: Navigant analysis of National Grid data

Similarly, Figure 7 shows the percentage of eligible C&I electric and gas accounts in each county with complete business and property information, which ranged between 72% and 80% for electric accounts, and 60% and 68% for gas accounts. These results show that the match rate in each county was similar to the overall match rate. The team believes that this result shows that there are enough accounts in each geographic area to support this analysis.

Figure 7. Percentage of Eligible C&I Accounts with Complete Business and Property Information by County



Source: Navigant analysis of National Grid data

Navigant also assessed the number of accounts in participant lists that were found in the residential account databases. The participant lists Navigant used are historical lists of participants who participated in energy efficiency programs from 2009 through 2015. Conversely, the customer account databases are snapshots as of March 2017. As a result, not all historical participant accounts will be found in the account database snapshots. For each program, Table 6 lists the percentage of historical participant accounts that the team matched with the residential or C&I account database, as applicable.

Table 6. Percentage of Accounts in Participant Lists Matched with Customer Account Databases by Program

Program	Electric Participants	Gas Participants
EnergyWise Single Family	75%	78%
Income Eligible Single Family	65%	73%
EnergyWise Multifamily	41%	41%
Income Eligible Multifamily	55%	32%
Small Business Direct Install	60%	57%

Source: Navigant analysis of National Grid data

The low match rate of participating accounts with the residential account database posed challenges to the team's analysis of Multifamily programs. Specifically, the low match rates created uncertainty regarding correct identification of accounts in buildings that have previously participated in energy efficiency programs, as discussed further in Section 6.2.

3.2 Program Eligibility

Navigant analyzed the residential and C&I account database to determine the eligible number of accounts, housing units, and buildings eligible for each energy efficiency program. Specifically, the team classified each customer account in the residential account database as eligible for one of the following programs: EnergyWise Single Family, Income Eligible Single Family, EnergyWise Multifamily, or Income Eligible Multifamily.

In limited cases (<1,000) where a customer account participated in multiple programs in different years, the team classified the account according to the program in which the customer most recently participated; for example, if a customer participated in Income Eligible Single Family in 2009 and participated in EnergyWise Single Family in 2014, the customer would be assigned to EnergyWise Single Family. Navigant also analyzed each customer account in the C&I database to determine eligibility for the Small Business Direct Install program. Additional details regarding the methods used to determine program eligibility are contained within the discussion of each program.

3.3 Participation Rates

Navigant utilized the participation lists provided by National Grid to compute participation counts for 2009 through 2015. As described in Section 3.1.4, only a portion of all accounts in these participation lists were matched to account databases. For example, these non-matching participants could represent accounts that historically participated but were subsequently inactive as of when National Grid submitted the account databases. Therefore, Navigant calculated participation rates without merging the program tracking data into the main account database. Navigant computed three types of counts:

- **Annual:** Represents the unique accounts associated with an individual program in a given year. It removes all double counting within a given program and year. For example, if a customer participated in an EnergyWise program twice in 2015, they would only be counted once.
- **Additive:** The sum of annual program participation counts.
- **Cumulative:** Eliminates all double counting within a program across multiple years. For example, if a customer participated in the EnergyWise program in 2013 and then again in 2015, they would only be counted once. Therefore, the cumulative count may be less than the additive count since it removes customers that participate in the same program more than once.

Navigant also investigated the geographical distribution of participation, with the objective of understanding the range covered by National Grid's energy efficiency programs. The team leveraged available geocoded latitude and longitude data in the residential and C&I account databases provided by National Grid. The team then investigated geographical distributions of eligible accounts, matched participants (those found in the account database), and participation rate by census block group. Importantly, some accounts did not have usable latitude and longitude information. Specifically, geocoded information was not available for the Residential New Construction program; thus, this program was instead analyzed by ZIP code. In addition, Navigant provides tabulated participation rates by ZIP code (Appendix A).

Using data provided by National Grid, Navigant analyzed participation in specific measure categories within selected programs. National Grid provided a variety of measure participation dates, including measure category participation data for the weatherization, home energy assessment, and heat loan categories and measure-level participation data containing the most recent date of a specific measure's participation. National Grid and Navigant aggregated this data was aggregated into measure categories. These measure categories are detailed in Table 7. The team then determined participation counts for each category. Note that the team did not have data on audits to determine what measures customers were presented, or survey information to determine why a measure was or was not installed.

Table 7. Residential Measure Category Descriptions

Measure Category	Description of Measures Included
Home Energy Assessments/ Audits	The first step in residential programs; involves a professional energy audit of a home that results in recommendations of further measures to reduce energy use
Weatherization	Installation of measures such as air sealing and insulation to reduce air infiltration/exfiltration and reduce heating or cooling losses
Heat Loan	0% financing offered to EnergyWise participants to incentivize the installation of high efficiency improvements
Heat System	Replacement of the primary heating system for a residence, such as a furnace or boiler, with a higher efficiency version
Lighting and Showerheads	Measures such as LED bulbs or low-flow showerheads that are offered to customers during the home energy assessment
Smart Power Strips	Installation of smart power strips to reduce the standby power draw of home electronics
Thermostats	Installation of programmable thermostats
Domestic Hot Water	Installation of measures such as pipe insulation to reduce heat loss from pipes circulating or supplying domestic hot water
Appliances	Replacement of appliances, such as refrigerators, with energy efficient versions; also includes installation of timers on existing appliances

Source: Navigant analysis of National Grid data

Similarly, for the Small Business Direct Install program, National Grid and Navigant created measure categories from the measure-level participation data (described in Table 8 for the electric program and in Table 9 for the gas program).

Table 8. Description of Small Business Direct Install Electric Measure Categories

Measure Category	Description of Measures Included
CFL	Installation of CFLs
Custom Lighting	Installation of custom lighting systems
Custom Non-Lighting	Installation of custom non-lighting systems such as those involving motors or drives
Custom Process Related	Installation of measures related to processes such as compressed air systems
LED	Installation of LED lamps
Lighting Controls	Installation of controls such as occupancy sensors to control lighting
Other Custom Non-Lighting	Installation of measures such as custom HVAC or refrigeration systems
Prescriptive Non-Lighting	Installation of prescriptive measures such as fan controls
Prescriptive Motors and Drives	Installation of prescriptive motors and drives
Thermostats	Installation of programmable thermostats

Source: Navigant analysis of National Grid data

Table 9. Description of Small Business Direct Install Gas Measure Categories

Measure Category	Description of Measures Included
Domestic Hot Water	Installation of measures such as low-flow showerheads and aerators
Boiler Reset Control	Installation of a boiler reset control, which automatically regulates the temperature limit of a boiler based on outdoor temperature
Custom	Installation of custom measures
Insulation	Installation of duct insulation or pipe insulation
Pre-Rinse Spray Valve	Installation of the low-flow, pre-rinse spray valves used in C&I kitchens to rinse dishes prior to dishwashing
Thermostat	Installation of programmable thermostats

Source: Navigant analysis of National Grid data

3.4 Participation Analysis

Navigant undertook two data modeling efforts to understand the influence of demographic characteristics on participation. The models that Navigant developed were able to achieve approximately 60% accuracy in predicting participation in an energy efficiency program based only on demographic, property, and usage characteristics. Greater accuracy could be achieved by including additional information, such as measure incentive data and customer behavior data. Ultimately, the team utilized the results of this modeling to identify the most important demographic variables in predicting participation.

3.4.1 Random Forest Classification Modeling

To identify the most important characteristics of participants and nonparticipants, Navigant trained a random forest classification model.⁴ For this analysis, a random forest model was trained on a portion of the account-level data, with the task of predicting whether an account is a participant or a nonparticipant based on demographic, property, and usage characteristics. The model itself was not necessarily expected to be a very accurate predictor of participation relying solely on demographic and property variables in absence of incentive and customer data. Instead, the random forest model was employed to rank the importance of demographic and property variables in predicting participation; this is known as variable importance. In this way, the outputs from the random forest model were used to determine the most important characteristics associated with participation in the program. The random forest model includes relative importance estimates for each variable included in the model based on the decrease in model accuracy that results when a given variable is removed.

Importantly, the results presented for each program are the final iteration in a series of models that Navigant developed to maximize model accuracy and simplify reporting. Therefore, not all residential characteristics listed in Table 2 were included in the final model. Some variables were not predictive of participation at all and were removed from the final model. Other variables were highly correlated or duplicative. For the latter case, the model only used one of these variables as a predictor, as the other duplicative variable would add little additional predictive power.

Navigant used these variable importance results to focus its investigation of the differences in participation on key characteristics. An important variable of participation as indicated by the random forest model suggests that participants and nonparticipants can be distinguished based on that variable, whereas an unimportant variable in the model suggests that nonparticipants and participants cannot be readily differentiated using that variable. Navigant generally focused on the top five most important variables to find groups where participation is either strong or weak, suggesting areas for targeted marketing.

3.4.2 Discrete Choice Analysis

Building on the variable importance results derived from the random forest model, Navigant employed discrete choice analysis to further explore the distinguishing characteristics of participants.⁵ Similar to random forest models, this technique is used for the analysis of choice problems—in this application, the choice between participating or not participating in an energy efficiency program. The discrete choice model determines the relative influence of the important characteristic identified in the random forest classification modeling. The relative influence of a variable indicates how much more likely an account is to participate per unit increase or decrease in the variable (or in the case of a categorical variable, the increase in likelihood of participation when the variable takes one value as opposed to another). Navigant used a binary choice logit model for the analysis, with program participation as the dependent choice variable and grouped customer characteristics as the explanatory variables. The results of the random forest modeling, the conditional density analysis, and some model iteration were factors in determining the final model specification and variable groups of the discrete choice models.

⁴ See Chapter 8 of *Pattern Classification* (2nd Edition) by Richard Duda et al. for treatment of decision trees or https://en.wikipedia.org/wiki/Random_forest.

⁵ Train, Kenneth. *Discrete Choice Methods with Simulation*. Cambridge University Press, 2003.

Navigant used the discrete choice modeling results to understand the relative influence of the important variables identified by the random forest modeling and inform the selection of characteristics that positively influence program participation for the targeting analysis. Importantly, the variables included in the discrete choice model were limited by the availability of data. Other observable or unobservable customer characteristics or external variables may be equally influential on the choice to participate in energy efficiency programs. However, Navigant's aim was to understand how observable and available characteristics influence participation. Future data collection efforts could improve the robustness of the discrete choice modeling results.

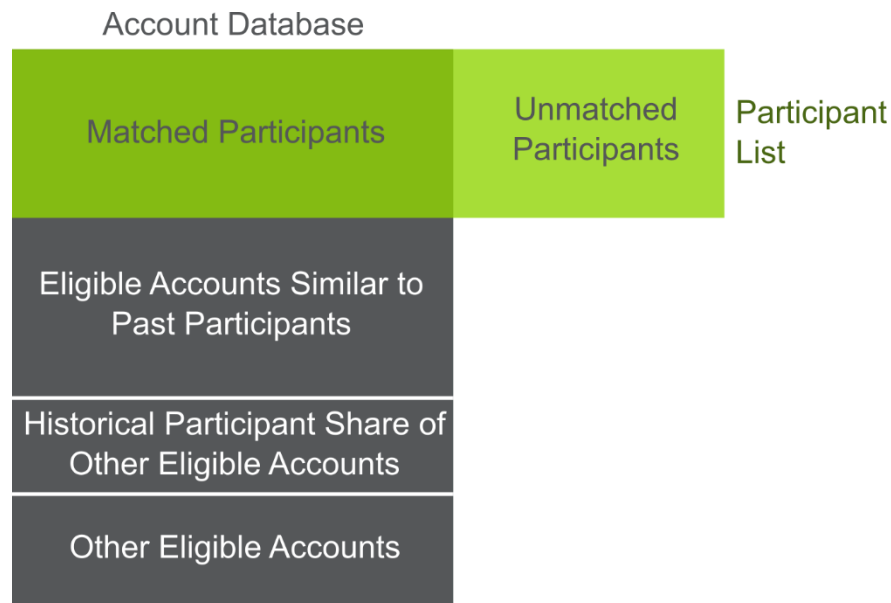
3.5 Target Groups

Navigant used the participation analysis to select target groups of customers based on their likelihood of participating. In this context, Navigant assessed the likelihood of future participation of nonparticipants based on their resemblance to past participants in terms of the most important characteristics. The team also leveraged the relative influence determined by the discrete choice model. Navigant considered characteristics that were associated with higher historical rates of participation to be indicative of more likely future participation. Similarly, the team considered characteristics that were associated with lower historical rates of participation to be indicative of less likely future participation. Navigant identified categories of customer targets depicted in Figure 8.

As this analysis based on past trends from 2009 through 2015, the characteristics of participants will evolve with the energy efficiency programs themselves—for example, as marketing efforts change over time. Additionally, this analysis did not account for factors such as budget constraints or customer behavior. For example, Navigant did not receive any data or conduct surveys regarding whether customers would be simply uninterested in energy efficiency programs regardless of demographic or property characteristics. The accuracy of this analysis is subject to the third-party demographic, business, and property data provided and the success of matching with National Grid's account records. Given these considerations, results from this analysis should be interpreted with caution.

Moreover, for each program there were some historical participants that were not found in the account database snapshot as of March 2017. These unmatched participants represent uncertainty regarding the estimated size of target groups for each program. For example, unmatched participants could be associated with inactive accounts; thus, some accounts identified as nonparticipants could be living in housing units that have previously participated in an energy efficiency program.

Figure 8. Categories of Customer Targets to Increase Participation



Source: Navigant analysis of National Grid data

These categories for each program are described as follows:

- Matched Past Participants, 2009-2015:** Customers who have participated in the program from 2009 through 2015. These customers could be targeted for installation additional measures or for repeat audits, as electric customers are eligible for a repeat audit every 5 years. Importantly, there were also unmatched participants not found in the March 2017 residential account database. These customers represent an uncertainty in the size of all target groups. For example, accounts identified as nonparticipants could be associated with housing units that have previously participated under a former resident.
- Eligible Accounts Similar to Past Participants:** Customers who have one or more characteristic of customers who have shown higher rates of participation (a preferred characteristic) and are considered more likely to participate in the future. This category excludes those who have any characteristics of customers who have shown historically lower rates of participation (a nonpreferred characteristic).
- Other Eligible Accounts:** Includes the remainder of nonparticipant accounts. These accounts have characteristics that are associated with lower historical participation rates or accounts with insufficient information to classify. Within the remaining nonparticipant category, Navigant identified a group of customers that are less likely to participate, which includes customers who have one or more nonpreferred characteristic. Also within this category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates but could potentially be reached through changes in program design.
- Historical Participant Share of Other Eligible Accounts:** Importantly, some historical participants have similar characteristics to those in the Other Eligible Accounts category. Therefore, Navigant estimated a share of the remaining nonparticipants that could potentially participate based on the cumulative historical participation rate for the program from 2009 through 2015.

3.6 Program Design

Based on a review of past program reports and the data analysis research, Navigant synthesized key findings from this analysis into actionable recommendations to address ways to increase participation for each program. A priority focus was on strategies to recruit participants who historically are underrepresented.

4. ENERGYWISE SINGLE FAMILY (ELECTRIC AND GAS)

EnergyWise is the gateway in-home program for all Rhode Islanders in single family residences that do not qualify for income-eligible services. The program is administered in three steps:

1. **Home energy assessment:** An auditor visually inspects the home and assesses the potential for cost-effective upgrades to improve energy efficiency, including improving insulation. The auditor also educates the customer on financing opportunities. This visit may also include direct installation of measures such as lighting and showerheads or smart power strips.
2. **Installation of measures:** A customer may choose to install some of the measures recommended during the home energy assessment and obtain rebates and/or a Heat Loan to cover part of the measure costs.
3. **Quality assurance:** Measures are inspected to verify correct installation.

4.1 Eligibility

All market rate customers in single family residences (1-4 units) are eligible to participate and can request a home energy assessment if they have not received one in the past 5 years. Even if a customer is ineligible for another home energy assessment, they would still be eligible to participate by installing additional measures recommended during their initial audit, as applicable.

Navigant identified program-eligible customers in the residential database using the following criteria:

1. Most recently participated in the EnergyWise Single Family Program
2. Number of units in the building is less than or equal to 4
 - a. For residential electric accounts, rate is A-16
 - b. For residential gas accounts, rate is 1012 (non-heating) or 1247 (heating)

Based on these eligibility criteria, Navigant identified 324,491 electric accounts eligible for the EnergyWise Single Family Electric program and 186,940 gas accounts eligible for the EnergyWise Single Family Gas program.

4.2 Electric Results

4.2.1 Program Participation Rates

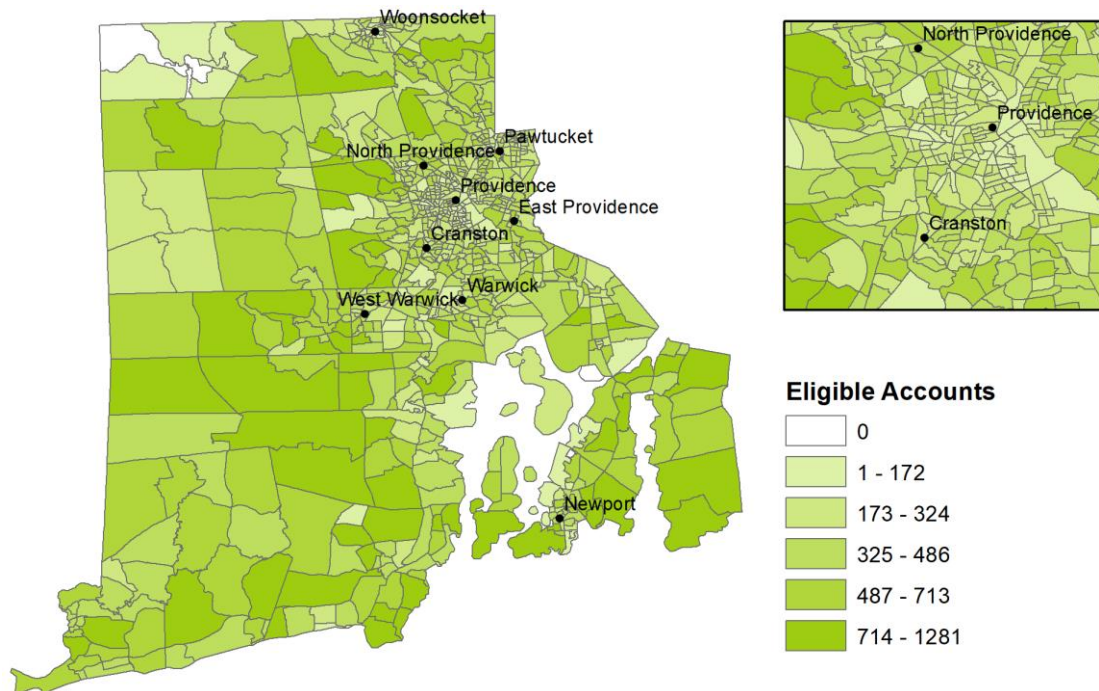
Table 10 contains the annual, additive, and cumulative program participation counts for the EnergyWise Single Family Electric program. The team estimated the number of nonparticipants and participation rates for each year assuming a constant number of 324,491 eligible accounts, as described in Section 4.1. The difference between the additive and cumulative participation from 2009 through 2015 is associated with repeat participants. For example, a customer could receive an audit in one year and install additional measures in a subsequent year.

Table 10. Annual Program Participation, EnergyWise Single Family Electric

Year	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
P	3,491	3,750	4,934	6,760	8,645	9,898	11,626	49,104	44,052
Non-P	321,000	320,741	319,557	317,731	315,846	314,593	312,865	275,387	280,439
Rate	1.1%	1.2%	1.5%	2.1%	2.7%	3.1%	3.6%	15.1%	13.6%

Source: Navigant analysis of National Grid data

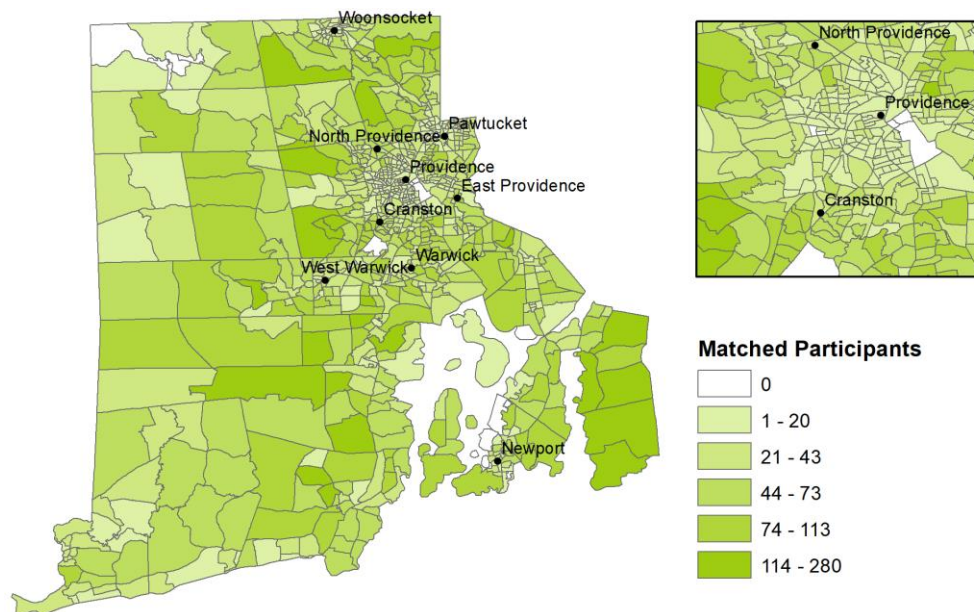
Figure 9 through Figure 11 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-1 in Appendix A. The results show participation in the EnergyWise Single Family Electric program throughout Rhode Island.

Figure 9. EnergyWise Single Family Electric Eligible Accounts by Census Block Group


Notes: Each listed interval includes both end points. Geocoded records were available for 32,086 (95%) of participants and 275,496 (95%) of nonparticipants.

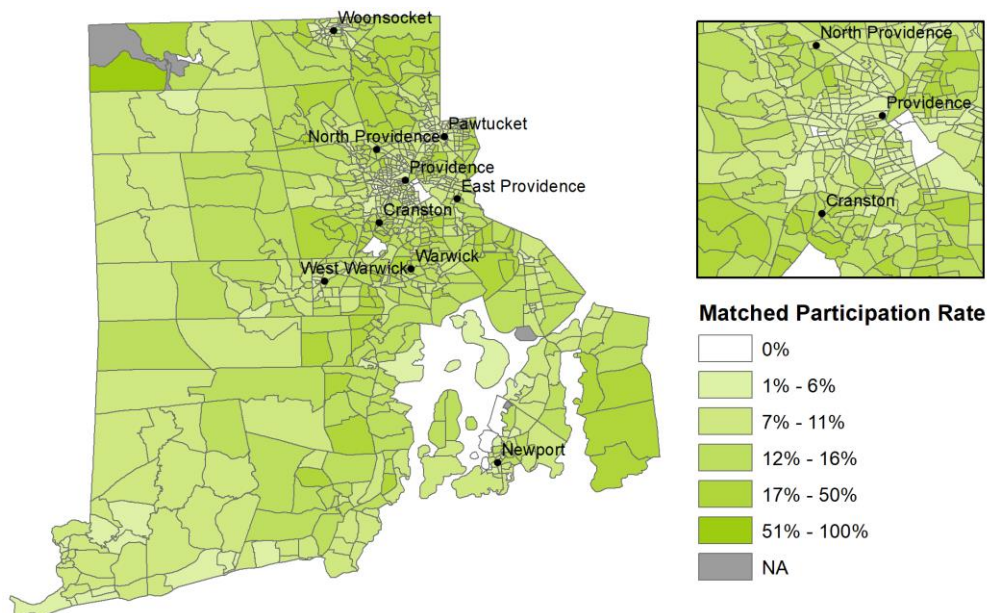
Source: Navigant analysis of National Grid data

Figure 10. EnergyWise Single Family Electric Cumulative Matched Participation Counts by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. Matched participants are the accounts of participants that are included in the March 2017 National Grid account database. 10,827 or 25% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 32,086 (95%) of participants and 275,496 (95%) of nonparticipants.
Source: Navigant analysis of National Grid data

Figure 11. EnergyWise Single Family Electric Cumulative Matched Participation Rate Census Block Group: 2009-2015



Notes: A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 10,827 or 25% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 32,086 (95%) of participants and 275,496 (95%) of nonparticipants.

Source: Navigant analysis of National Grid data

Navigant also calculated participation rates for participants matched with the account database, split by two variables that are important to National Grid—namely home ownership and the number of units in the building. As shown in Table 11, participation rates split by home ownership show that homeowners exhibit a higher historical participation rate than renters.

Table 11. Cumulative Matched Participation by Home Ownership, EWSF Electric: 2009-2015

Home Ownership	Eligible	Participants	Nonparticipants	Rate
Owner	211,901	27,305	184,596	13%
Renter	29,750	1,351	28,399	5%
Unknown	82,840	4,569	78,271	6%
Total	324,491	33,225	291,266	10%

Source: Navigant analysis of National Grid data

Similarly, Navigant calculated participation rates for all single family accounts split by the number of units in the building, shown in Table 12. These results are based on the estimated number of units for each account calculated, as described in Section 3.1.3. From 2009 through 2015, residents of 1-Family buildings exhibit a higher historical participation rate than those in 2-4-Family buildings.

Table 12. Cumulative Matched Participation by Number of Units, EWSF Electric: 2009-2015

Number of Units	Eligible	Participants	Nonparticipants	Rate
1-Family	247,635	29,510	218,125	12%
2-4-Family	76,625	3,484	73,141	5%
>4-Family*	231	231	N/A	100%
Total	324,491	33,225	291,266	10%

*National Grid's participation data contained some accounts associated with buildings with >4 units that participated in the EnergyWise Single Family program

Source: Navigant analysis of National Grid data

4.2.2 Important Characteristics of Participants and Nonparticipants

As described in Section 3.4, Navigant used a random forest classification model to investigate the influence of account type, demographic, and property variables on participation,⁶ and investigate the differences in these characteristics between participants and nonparticipants.

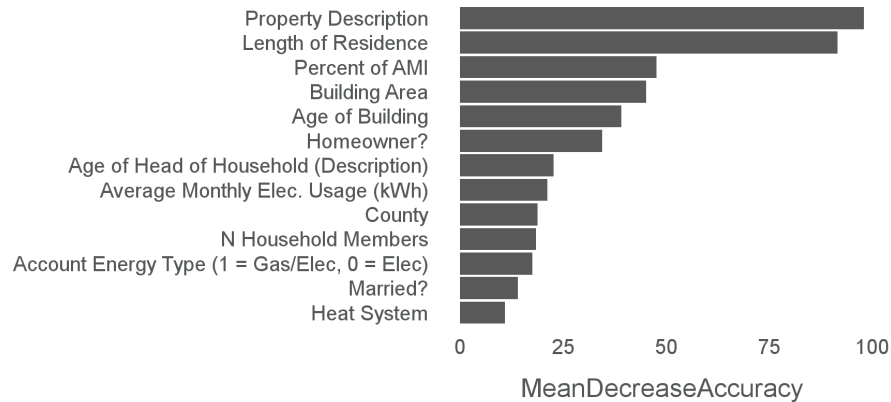
The variable importance estimates for the EnergyWise Single Family program are shown in Figure 12. These results show the relative importance of each characteristic in terms of the mean decrease in model accuracy, which represents the loss in predictive capability of the random forest model if that characteristic was removed. For example, in these results, property description (e.g., 1-Family, 2-5-Family)⁷ and length of residence were the most important variables, while heat system was the least important variable. These results show that if property description or length of residence was excluded from the model, the model would become much less accurate than if heat system was excluded.

⁶ Navigant built similar models for each program where possible.

⁷ Several property types had low sample sizes, so Navigant regrouped the property categories into "1-Family," "2-5-Family," "Apartment Building," "Condo," "Mobile Home," "Housing Authority," and "Other."

Therefore, property description and length of residence are much more important predictors of participation than heat system.

Figure 12. EnergyWise Single Family Electric Variable Importance

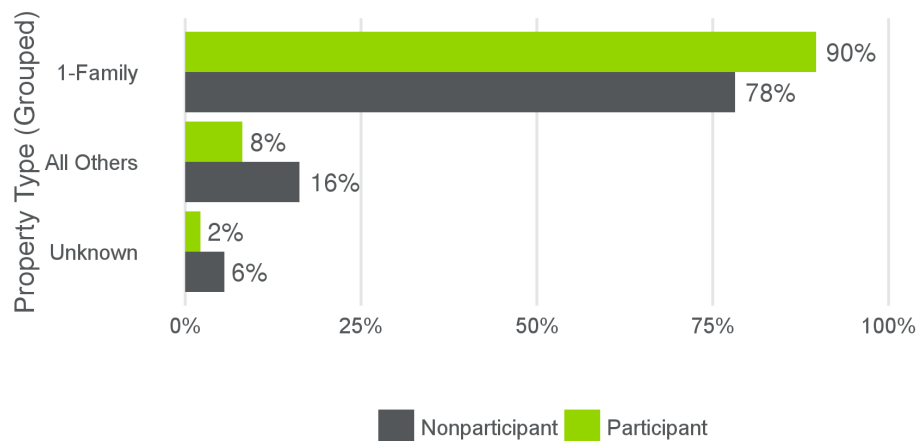


Source: Navigant analysis of National Grid data

The most important variables when predicting whether an account is a participant are the property type, length of residence for the inhabitant, household income level (measured as a percentage range of AMI), building area, and building age. In the following analysis of important variables, Navigant focused on accounts that were flagged as a homeowner, as renters do not necessarily have authority to upgrade or renovate their residence and, therefore, would not be ideal recipients of targeted marketing. As a result, Navigant focused on homeowners even though homeownership was the sixth most important variable. Additional analysis of renters is further discussed in Appendix E.

For EnergyWise Single Family electric accounts, the most important predictor of participation is the property type. As shown in Figure 13, participants in the EnergyWise Single Family program are more likely to live in single family dwellings (as opposed to, for example, a 2-4-unit building that is also eligible for the single family program) than nonparticipants.

Figure 13. Participation and Nonparticipation by Property Type for Homeowner Accounts Only

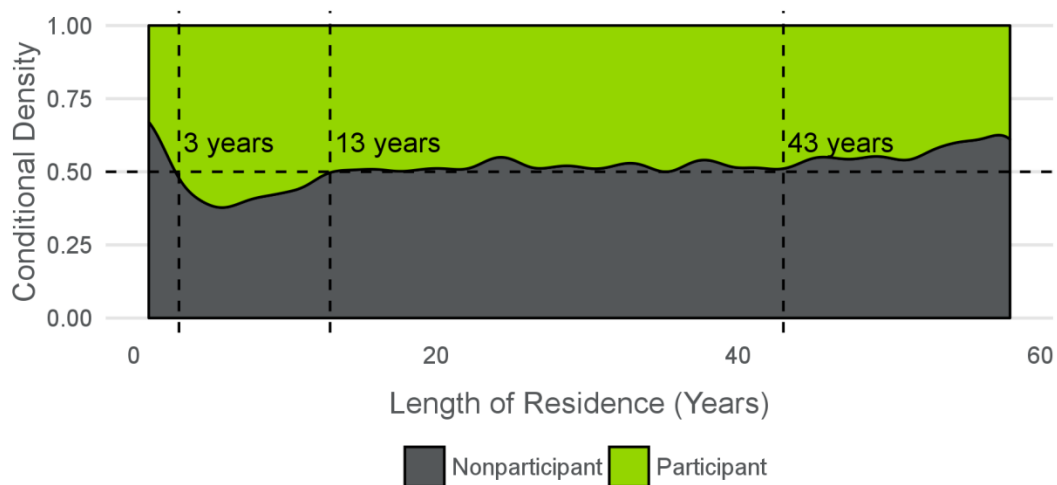


Source: Navigant analysis of National Grid data

The model also indicated length of residence in the building as a relatively strong predictor of participation. For continuous variables, conditional density plots (such as Figure 14) are presented to compare the distribution of the variable between nonparticipants and participants. If nonparticipants and participants shared the same distribution, the green participation and gray nonparticipation distributions in these plots would meet at the dashed 50% horizontal line over the entire range of the variable.

Ranges where the green shaded (Participant) area extends below the 50% line indicate that customers within that range of the variable are historically associated with higher participation. The converse is true for the ranges where the gray shaded (Nonparticipant) area extends above the participation line. In the case of length of residence in Figure 14, for example, there is a higher density of participants between 3 and 13 years of residence compared to nonparticipants, as indicated by the green participant distribution crossing over the dashed 50% line. Conversely, accounts for homeowners of less than 3 years or 43 or more years of residence are more likely to be nonparticipants.

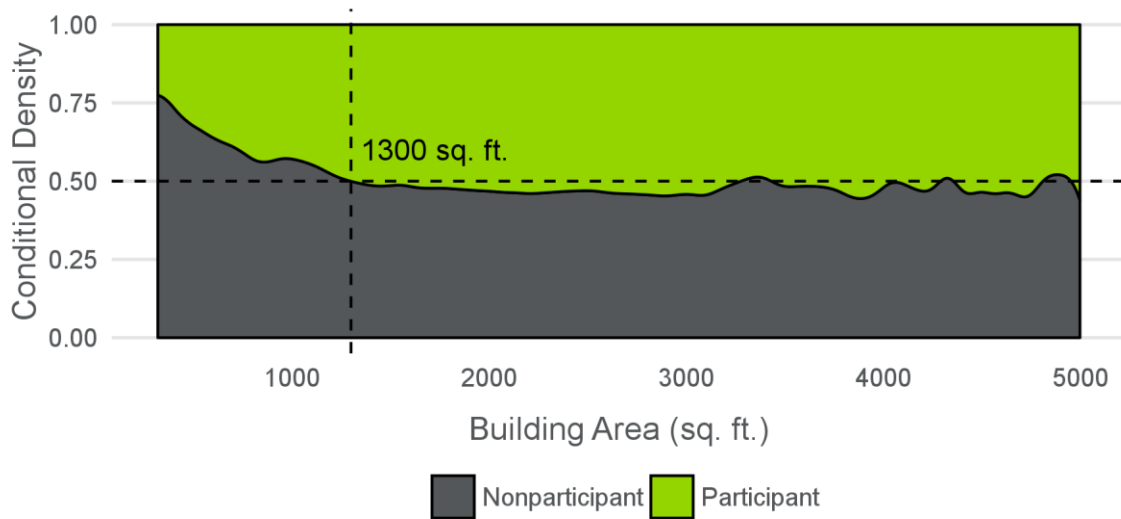
Figure 14. Conditional Density Plot of Length of Residence for Homeowner Accounts Only



Source: Navigant analysis of National Grid data

Building area was also a key feature identified in the random forest model for EnergyWise Single Family program electric accounts. As seen in Figure 15, homeowner accounts in buildings with less than 1,300 square feet were less likely to participate, but there are no clear ranges where these accounts were more likely to be participants.

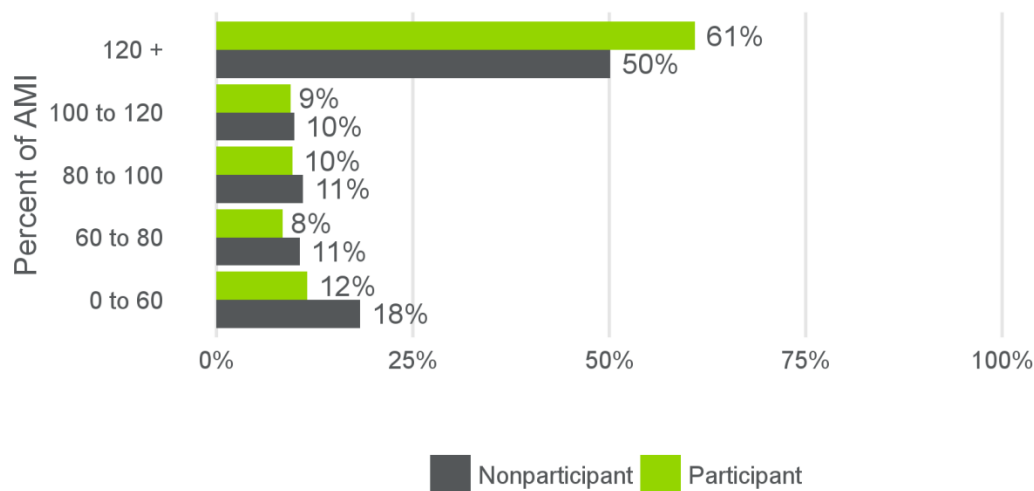
Figure 15. Conditional Density Plot of Building Area for Homeowner Accounts Only



Only building areas between 300 and 5,000 square feet (97% of available data) are shown.
Source: Navigant analysis of National Grid data

The fourth most important variable as indicated by the random forest model is percentage of AMI. The distribution of participants and nonparticipants among AMI bins is shown in Figure 16. Accounts with household income above 120% of AMI are more likely to participate, while accounts with household income less than 60% of AMI are less likely to participate in the EnergyWise Single Family program. The electricity rate code was used to determine eligibility for the program and, therefore, accounts with household income less than 60% of AMI may be considered only eligible for the market rate EnergyWise program despite low household income. These accounts (34,086 eligible homeowners in this income category) may instead be considered income eligible for future analysis.

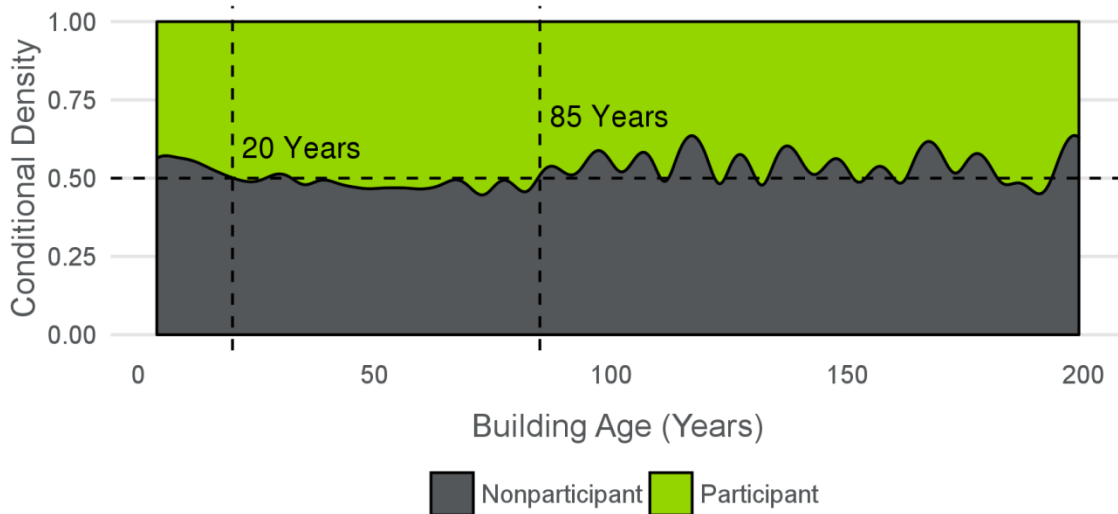
Figure 16. Distribution of Income Levels by Participation for Homeowner Accounts Only



Source: Navigant analysis of National Grid data

The random forest model identified building age as the fifth most important variable. As seen in Figure 17, there are less clear ranges where accounts are more likely to be participants or nonparticipants.

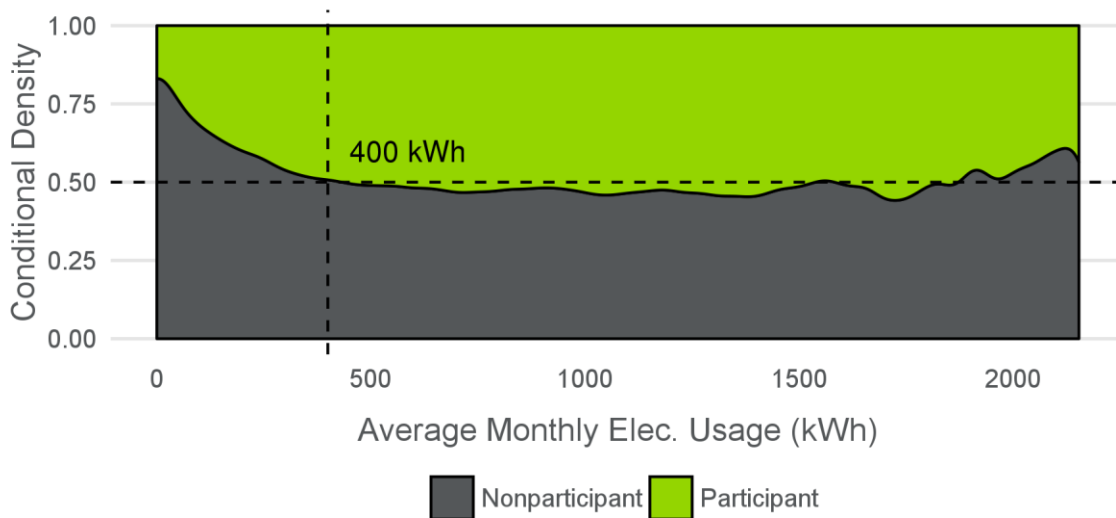
Figure 17. Conditional Density Plot of Building Age by Participation for Homeowner Accounts Only



Only building ages less than 200 years (91% of available data) are shown.
Source: Navigant analysis of National Grid data

Average monthly electricity usage (as determined from account usage data) was not identified as being among the most important variables for predicting participation. This result could be a result of correlation with building area, which was also identified as an important variable. Moreover, this analysis utilized usage data from 2015 to 2017, as described in Section 3.1.1, matched with participation from 2009 to 2015, which could have an impact on the predictive power of usage data. Energy use is nevertheless an important variable to consider when identifying accounts for targeted outreach. Figure 18 shows that the gray shaded nonparticipant area extends about the 50% line below 400 kWh average monthly usage. This result suggests based on historical participation rates, customers with average monthly usage below 400 kWh are less likely to participate.

Figure 18. Conditional Density Plot of Average Monthly Electricity Usage for Homeowner Accounts



Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B and Appendix C.

4.2.3 Discrete Choice Analysis

As described in Section 3.4, Navigant employed discrete choice analysis to further explore the distinguishing characteristics of participants. Similar to random forest models, this technique is used for analyzing choice problems—in this application, the choice between participating or not participating in an energy efficiency program.

Results from the discrete choice model are provided in Table 13. For each variable, the table presents the relative influence of the variable and whether the variable is statistically significant. The influence of each variable can be interpreted as the increase in the likelihood of participation for a customer with that characteristic relative to the base category or characteristic. The base variables are not included in the table as they are relative to the variables included in the model. For example, length of residence is grouped into four categories: 0-3 years, 3-13 years, 13-43 years, and 43+ years. The influence of the latter three categories is relative to 0-3 years of residence. From the results, the team finds that a customer with 0-3 years of residence is the least likely to participate, as the three other residence categories have a positive relative influence on participation.

Table 13. Discrete Choice Results for EWSF Electric

Variable	Relative Influence	Statistically Significant*
Age of Building (20-85 years)	▲▲▲	Yes
Age of Building (85+ years)	▲▲	Yes
Average Monthly kWh (400-1,500)	▲	Yes
Average Monthly kWh (1,500+)	▼	No
Homeowner	▲▲	Yes
Gas and Electric Account	▲▲	Yes
Percentage of AMI (60% to 80%)	▲	Yes
Percentage of AMI (80% to 100%)	▲	Yes
Percentage of AMI (100% to 120%)	▲▲	Yes
Percentage of AMI (120%+)	▲▲	Yes
Single Family Property	▲▲▲▲	Yes
Length of Residence (3-13 years)	▲▲▲▲	Yes
Length of Residence (13-43 years)	▲▲▲	Yes
Length of Residence (43+ years)	▲▲	Yes
Square Footage (1,300-3,000)	▲▲	Yes
Square Footage (3,000+)	▲▲▲	Yes

Key	▼	▲	▲▲	▲▲▲	▲▲▲▲
Relative Likelihood of Participation	-0 to -5%	0 to 5%	5 to 10%	10 to 15%	15 to 25%

*Statistically significant at the 95% level.

Source: Navigant analysis of National Grid data

Results from the discrete choice modeling align well with the variable importance analysis. Characteristics with large and significant relative influence include single family properties, buildings 20-85 years old, and residents of 3 to 13 years.

Conversely, the discrete choice analysis identified an account flagged as both a gas and electric customer as having a positive relative influence, while the random forest model identified this variable to relatively less important, as shown in Figure 12. Similarly, the discrete choice model identified building age >20 years as having a large relative influence, in contrast with the results shown in Figure 17, where the difference between participants and nonparticipants with respect to building age was less clear.

4.2.4 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts. For the same reasons discussed in Section 4.2.2, this analysis focused on homeowners, as renters were not considered a prime target audience.

In the Matched Past Participants, 2009-2015 category includes 33,225 participants. Of these participants, there were 16,398 matched participants who participated in the EnergyWise Single Family program from

2009 through 2013 that would be eligible for a repeat audit. There were also 10,827 unmatched participants not found in the March 2017 residential account database.

The Eligible Accounts Similar to Past Participants category is summarized in Table 14, which lists the characteristics of those accounts most similar to past participants. Also listed are the number of customers that have all preferred characteristics, which represents the group of nonparticipants that are most likely to participate.

Table 14. Characteristics of Eligible Accounts Similar to Past Participants, EWSF Electric

Customer Description	Accounts	Share*
Homeowners with one or more characteristic:		
• Property Type: 1-Family		
• Length of Residence: 3-13 years	124,837	38%
• AMI: 120+%		
• Building Age: 20-85 years		
Homeowners with all characteristics	9,829	5%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (324,491).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 15. Customers less likely to participate include renters or customers with an average monthly use less than 400 kWh. Customers with average monthly usage less than 400 kWh have less motivation to participate due to lower savings potential. Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates, but could potentially be reached through changes in program design. For these eligible accounts Navigant estimated a share that could potentially participate, based on the cumulative historical participation rate (13.6%) for the program from 2009 through 2015.

Table 15. Characteristics of Other Eligible Accounts, EWSF Electric

Customer Description	Accounts	Share*
Less likely to participate – one or more characteristic:		
• Home Ownership: Renter	115,150	35%
• Average Monthly Use: <400 kWh		
Unclassified nonparticipants	50,146	15%
Program design opportunity – one or more characteristic:		
• Building Area: <1,300 sq. ft.	1,113	0.3%
• Length of Residence: <3 years		
Total	166,429	51%
Historical Participant Share**	22,594	7%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (324,491).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of the targeting analysis is shown in Table 16.

Table 16. Summary of Target Customers, EWSF Electric

Category	Accounts	Share
Matched Past Participants, 2009-2015	33,225	10%
Eligible Accounts Similar to Past Participants	124,837	38%
Historical Participant Share of Other Eligible Accounts*	22,594	7%
Other Eligible Accounts	143,835	44%
Total Eligible Accounts	324,491	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015.

Source: Navigant analysis of National Grid data

4.2.5 Measure Category Participation Rates

Table 17 lists annual, additive, and cumulative participation counts in each measure category, as well as total program participation (as listed in Table 10). Table 18 lists the percentage of total program participants that participated in each measure category. The highest percentage of participation was in the appliances, lighting and showerheads, and smart power strips measure categories. The appliance category has a high percentage of participants—in this case because it includes the installation of timers. These measure categories have the highest participation because they consist of measures that are typically installed during the home energy assessment at no cost to the customer. Conversely, more involved energy efficiency measures with significant cost, such as weatherization, have a much lower participation rate (9.1% cumulative).

Table 17. Measure Category Participation Counts, EWSF Electric

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
Total Participation	3,491	3,750	4,934	6,760	8,645	9,898	11,626	49,104	44,052
Home Energy Assessment	N/A	N/A	N/A	N/A	N/A	8,641	9,996	18,637	18,635
Weatherization	136	244	452	534	717	898	1,110	4,091	4,023
Heat Loan	N/A	N/A	352	714	1,123	1,324	1,320	4,833	4,757
Appliances	1,675	2,260	3,261	5,005	6,681	7,993	9,427	36,302	35,845
Domestic Hot Water	108	91	79	8	50	42	48	426	426
Lighting and Showerheads	3,242	3,521	4,142	5,888	8,016	8,412	9,970	43,191	40,948
Smart Power Strips	N/A	N/A	N/A	2,228	6,834	7,750	9,570	26,382	26,309
Thermostats	51	60	47	44	100	306	249	857	852

An N/A value in this table indicates that participation data was not available for that year.

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 18. Measure Category Percentage of Total Program Participants, EWSF Electric

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive*	Cumulative*
Total Participation	3,491	3,750	4,934	6,760	8,645	9,898	11,626	49,104	44,052
Home Energy Assessment	N/A	N/A	N/A	N/A	N/A	87.3%	86.0%	86.7%	93.0%
Weatherization	3.9%	6.5%	9.2%	7.9%	8.3%	9.1%	9.5%	8.3%	9.1%
Heat Loan	N/A	N/A	7.1%	10.6%	13.0%	13.4%	11.4%	11.5%	12.6%
Appliances	48.0%	60.3%	66.1%	74.0%	77.3%	80.8%	81.1%	73.9%	81.4%
Domestic Hot Water	3.1%	2.4%	1.6%	0.1%	0.6%	0.4%	0.4%	0.9%	1.0%
Lighting and Showerheads	92.9%	93.9%	83.9%	87.1%	92.7%	85.0%	85.8%	88.0%	93.0%
Smart Power Strips	N/A	N/A	N/A	33.0%	79.1%	78.3%	82.3%	71.4%	79.1%
Thermostats	1.5%	1.6%	1.0%	0.7%	1.2%	3.1%	2.1%	1.7%	1.9%

An N/A value in this table indicates that participation data was not available for that year.

*Calculated based on the number of years for which data was available for a given measure category.

Source: Navigant analysis of National Grid Data

4.3 Gas Results

4.3.1 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the EnergyWise Single Family Gas program, listed in Table 19. The team determined the number of nonparticipants and participation rates assuming a constant number of 186,940 eligible accounts, calculated using the criteria described in Section 4.1. The difference between the additive and cumulative participation from 2009 through 2015 is associated with repeat participants.

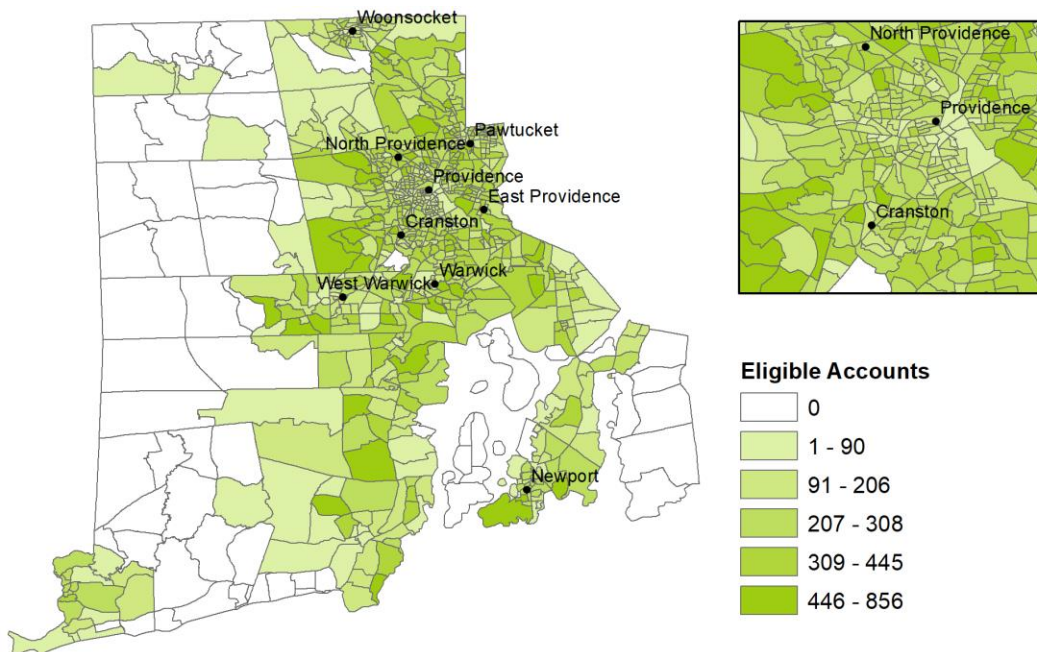
Table 19. Annual Program Participation, EWSF Gas

Year	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
P	442	705	906	1,413	1,946	2,737	2,830	10,979	10,182
Non-P	186,498	186,235	186,034	185,527	184,994	184,203	184,110	175,961	176,758
Rate	0.2%	0.4%	0.5%	0.8%	1.0%	1.5%	1.5%	5.9%	5.4%

Source: Navigant analysis of National Grid data

Figure 19 through Figure 21 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-1 in Appendix A. The results show that in each region where eligible accounts are available, there were generally some participants in the EnergyWise Single Family Gas program. There are some areas in the western regions of Rhode Island that did not have any participants or eligible accounts

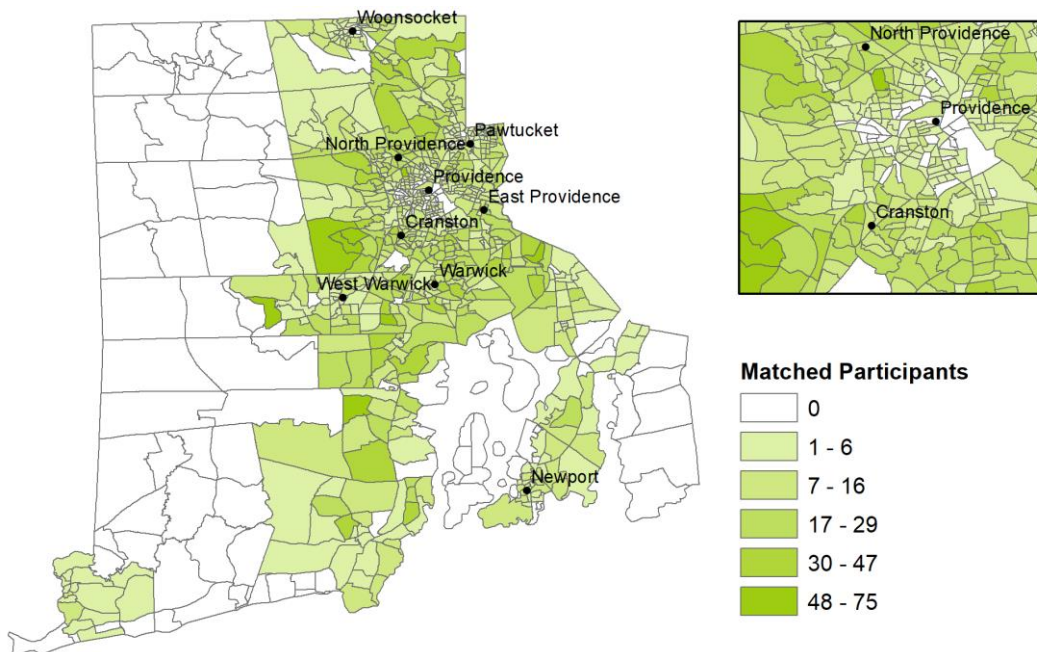
Figure 19. EnergyWise Single Family Gas Eligible Accounts by Census Block Group



Notes: Each listed interval includes both end points. 2,209 or 21% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 7,856 (99%) of participants and 172,814 (97%) of nonparticipants.

Source: Navigant analysis of National Grid data

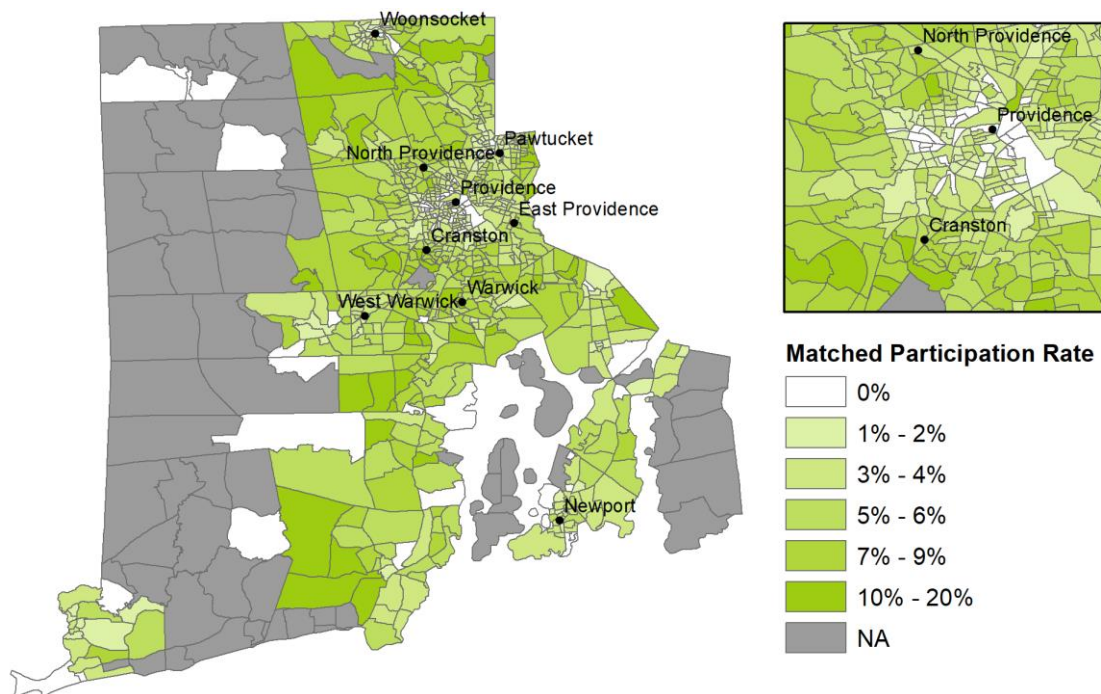
Figure 20. EnergyWise Single Family Gas Cumulative Matched Participation Counts by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. 2,209 or 21% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 7,856 (99%) of participants and 172,814 (97%) of nonparticipants.

Source: Navigant analysis of National Grid data

Figure 21. EnergyWise Single Family Gas Cumulative Matched Participation Rate by Census Block Group: 2009-2015



Notes: A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 2,209 or 21% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 7,856 (99%) of participants and 172,814 (97%) of nonparticipants.

Source: Navigant analysis of National Grid data

Navigant also calculated participation rates for participants matched with the account database, split by two variables that are important to National Grid, namely home ownership and number of units in the building. As shown in Table 20, participation rates split by home ownership show that homeowners exhibited higher historical participation rates.

Table 20. Cumulative Participation by Home Ownership, EWSF Gas: 2009-2015

Home Ownership	Eligible	Participants	Nonparticipants	Rate
Owner	118,715	6,757	111,958	6%
Renter	23,915	339	23,576	1%
Unknown	44,310	877	43,433	2%
Total	186,940	7,973	178,967	4%

Source: Navigant analysis of National Grid data

Similarly, Navigant calculated participation rates for all single family accounts split by the number of units in the building, shown in Table 21. These results are based on the estimated number of units for each account calculated as described in Section 3.1.3. From 2009 through 2015, residents of 1-Family buildings were more likely to participate than those in 2-4 Family buildings.

Table 21. Cumulative Participation by Number of Units, EWSF Gas: 2009-2015

Number of Units	Eligible	Participants	Nonparticipants	Rate
1-Family	130,064	7,180	122,884	6%
2-4 Family	56,838	755	56,083	1%
> 4 Family*	38	38	N/A	100%
Total	186,940	7,973	178,967	4%

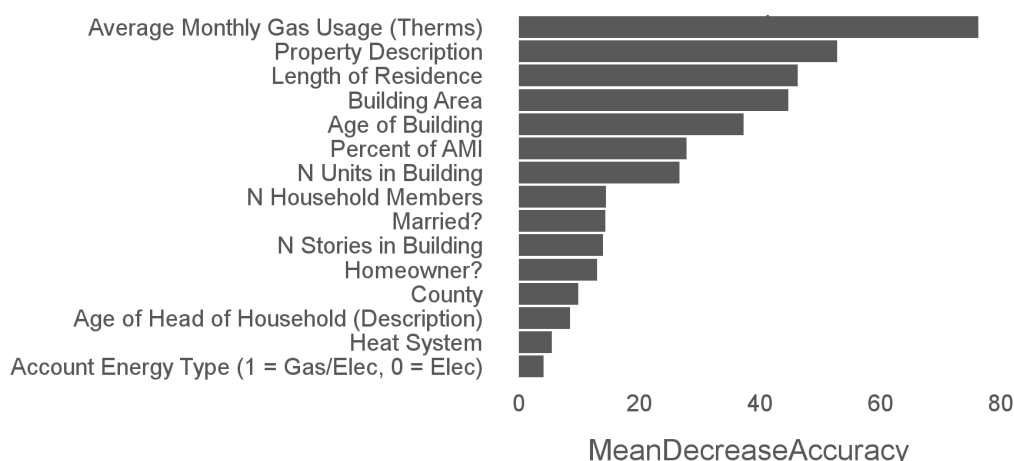
*National Grid's participation data contained some accounts associated with buildings with >4 units that participated in the EnergyWise Single Family program.

Source: Navigant analysis of National Grid data

4.3.2 Important Characteristics of Participants and Nonparticipants

The variable importance estimates for the EnergyWise Single Family program gas accounts are shown in Figure 22. Navigant focused on the top five most important variables for this analysis, again focusing on homeowners (similar to the electric program). Of the variables included in this model, the most important for predicting whether an account is a participant are average monthly gas usage, building type (property description), length of residence for the inhabitant, building area, and building age.

Figure 22. Variable Importance for EnergyWise Single Family Gas Accounts



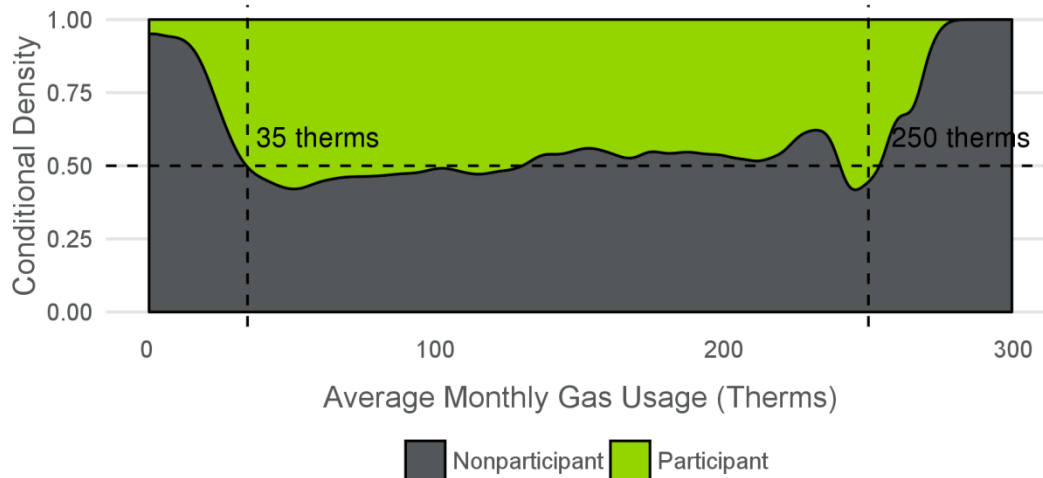
Source: Navigant analysis of National Grid data

In the following analysis of important variables, Navigant focused on accounts that were flagged as a homeowner, as renters do not necessarily have authority to upgrade or renovate their residence and, therefore, would not be ideal recipients of targeted marketing. As a result, Navigant focused on homeowners even though homeownership was the sixth most important variable. Additional analysis of renters is further discussed in Appendix E.

The random forest model indicates that the average monthly gas usage is most important in predicting participation in the EnergyWise Single Family program for gas accounts. This is clear from Figure 23, which shows that accounts with below 35 therms of gas usage and accounts with more than about 250 therms of usage are much more likely to be nonparticipants. Low usage means that account holders would be unlikely to perceive benefits from the program and, therefore, less likely to participate. However, it is unclear why these high usage accounts are generally not participating. These accounts should receive further investigation and potentially targeted outreach. Above 250 therms average usage per

month, accounts exhibited very little participation—but only 524 accounts with this usage were found out of 181,263 with available usage data.

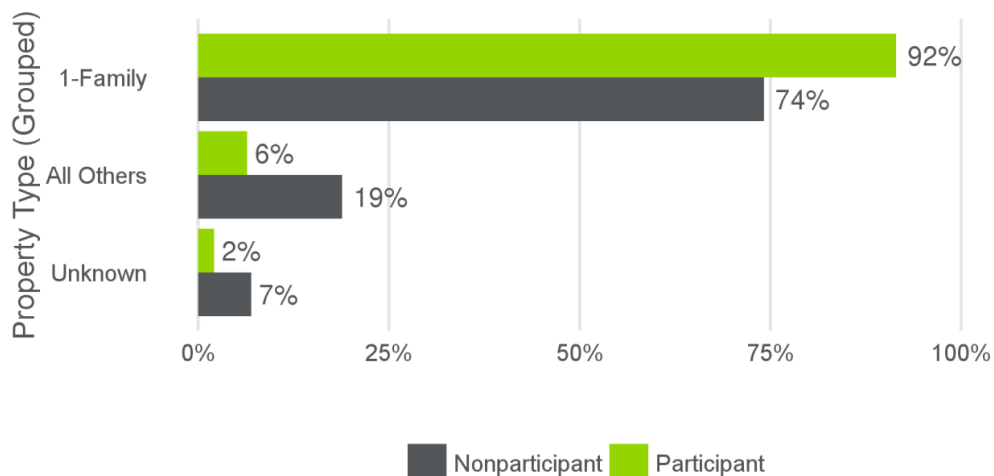
Figure 23. Conditional Density Plot of Average Monthly Gas Usage for Homeowner Accounts



Only accounts with average monthly usage less than 300 therms (99.9% of available data) are shown.
Source: Navigant analysis of National Grid data

Property description was the second most important variable in the random forest model. Figure 24 shows that participants in the EnergyWise Single Family Gas program are more likely to live in single family dwellings (as opposed to, for example, a 2-4-unit building that is eligible for the single family program) than nonparticipants. This result is similar to the EnergyWise Single Family Electric program.

Figure 24. Property Types for EnergyWise Single Family Gas Homeowner Accounts

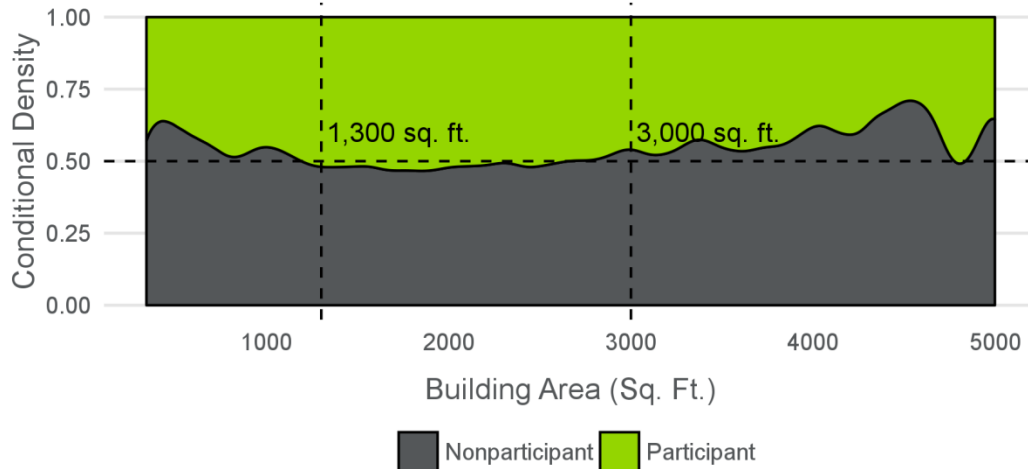


Source: Navigant analysis of National Grid data

Shown in Figure 25, building area is also an important factor in predicting participation for gas accounts in the EnergyWise Single Family program. When filtering only for homeowner accounts and accounts with

between 300 and 5,000 square feet, the differences in between participants and nonparticipants is not as stark as in other variables.

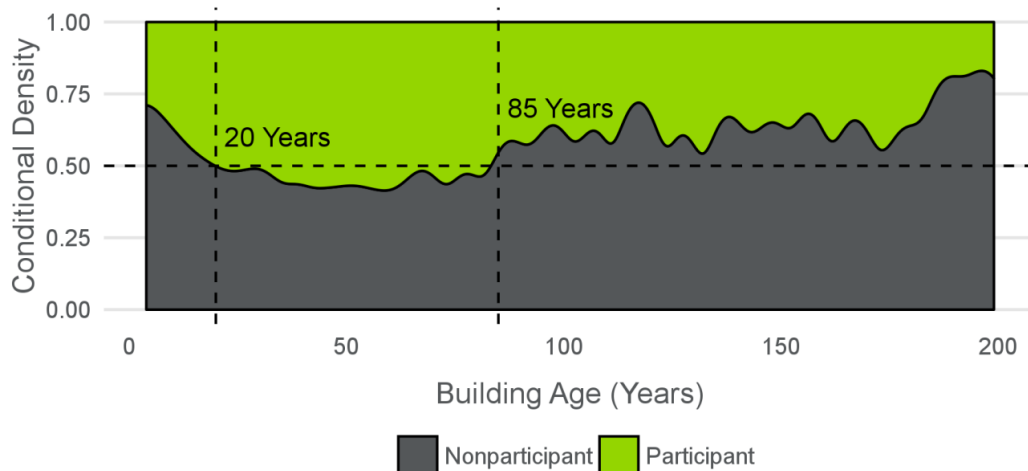
Figure 25. Conditional Density Plot of Building Area for Homeowner Accounts



Only accounts with building area between 300 and 5,000 square feet (98% of available data) are shown.
Source: Navigant analysis of National Grid data

Shown in Figure 26, building age was also an important variable in participation for these gas accounts. Gas accounts for buildings between 20 and 85 years old were more likely to be participants, and gas accounts for buildings outside that age range were much more likely to be nonparticipants. This makes intuitive sense: newer homes are less likely to be in need of envelope or heating system upgrades, while extensive retrofit for old buildings may be cost-prohibitive.

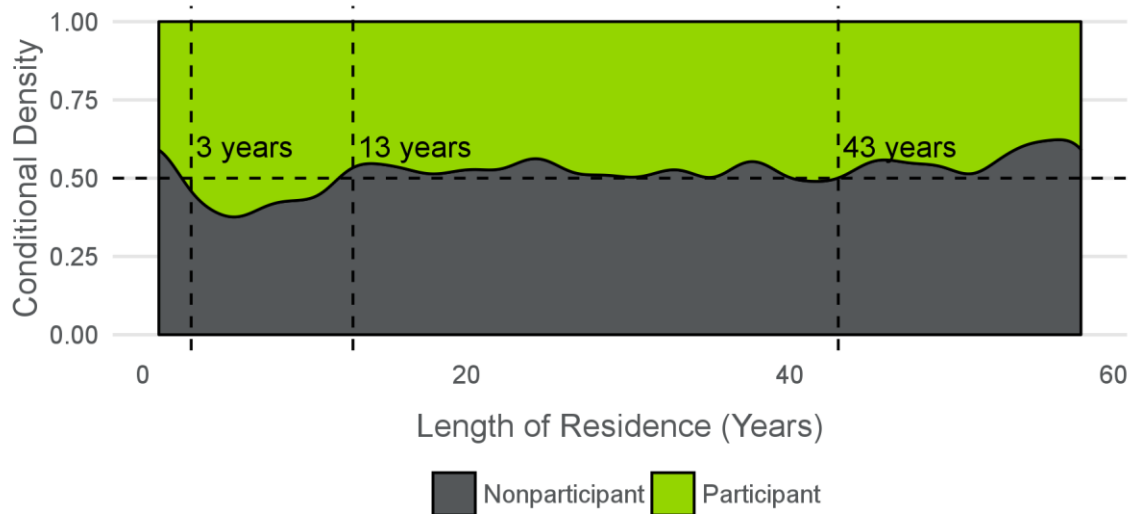
Figure 26. Conditional Density Plot of Building Age for Homeowner Accounts



Only accounts with building age less than 200 years (91% of available data) are shown.
Source: Navigant analysis of National Grid data

Similar to the electric accounts, the length of residence for the account is an important determinant of participation. For consistency with the electric account analysis, the 3- to 13-year residence window is shown in Figure 27 and used in the subsequent tables.

Figure 27. Conditional Density Plot of Length of Residence for Homeowner Accounts



Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B and Appendix C.

4.3.3 Discrete Choice Analysis

Results from the discrete choice model are provided in Table 22. For each variable, the table presents the relative influence of the variable and whether the variable is statistically significant. The influence of each variable can be interpreted as the increase in the likelihood of participation for a customer with that characteristic relative to the base category or characteristic. The base variables are not included in the table as they are relative to the variables included in the model. For example, age of building is grouped into three categories: 0-20 years, 20-85 years, and 85+ years. The influence of the latter two categories is relative to a building 0-20 years old. From the results, the team finds that a building 0-20 years old is the least likely to participate, as the two other building age categories have a positive relative influence on participation.

Table 22. Discrete Choice Results for EWSF Gas

Variable	Relative Influence	Statistically Significant*
Age of Building (20-85 years)	▲▲▲	Yes
Age of Building (85+ years)	▲▲	Yes
Average Monthly Therms (35-250)	▲▲▲▲	Yes
Average Monthly Therms (250+)	▼▼	No
Homeowner	▲▲	Yes
Gas and Electric Account	▲▲	Yes
Percentage of AMI (60% to 80%)	▲	No
Percentage of AMI (80% to 100%)	▲	Yes
Percentage of AMI (100% to 120%)	▲	No
Percentage of AMI (120% +)	▲▲	Yes
Single Family Property	▲▲▲▲	Yes
Length of Residence (3-13 years)	▲▲▲▲	Yes
Length of Residence (13-43 years)	▲▲	Yes
Length of Residence (43+ years)	▲▲	Yes
Square Footage (1300-3,000)	▲▲	Yes
Square Footage (3,000+)	▲▲	Yes

Key	▼▼	▼	▲	▲▲	▲▲▲	▲▲▲▲
Relative Likelihood of Participation	-5 to -10%	-0 to -5%	0 to 5%	5 to 10%	10 to 15%	15 to 25%

*Statistically significant at the 95% level.

Source: Navigant analysis of National Grid data

Similar to the electric program, results from the gas discrete choice modeling align well with the variable importance analysis. Characteristics with large and significant marginal effects include homes between 20 and 85 years old and residents of 3 to 13 years.

4.3.4 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts. For the same reasons discussed in Section 4.3.2, this analysis focused on homeowners, as renters were not considered a prime target audience.

The Matched Past Participants, 2009-2015 category includes 7,973 customers who participated from 2009 to 2015. There were also 2,209 unmatched participants not found in the March 2017 residential account database. The Eligible Accounts Similar to Past Participants category is summarized in Table 23, which lists the characteristics of those accounts most similar to past participants. Also listed are the number of customers that have all preferred characteristics, which represents nonparticipants most likely to participate.

Table 23. Characteristics of Eligible Accounts Similar to Past Participants, EWSF Gas

Customer Description	Accounts	Share*
Homeowners with one or more characteristic:		
• Property Type: 1-Family	72,478	39%
• Length of Residence: 3 to 13 years		
• Age of Building: 20 to 85 years		
Homeowners with all characteristics	10,884	6%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (186,940).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 24. These customers include renters, customers with an average monthly use less than 35 therms, residents of buildings less than 20 years old, and customers with non-heating accounts. Customers with average monthly usage less than 35 therms have less motivation to participate due to lower savings potential. Buildings less than 20 years old tend to have less need for upgrades such as improved insulation. Finally, customers with non-heating gas accounts tend to use their gas for activities like cooking and, therefore, have less motivation to participate.

Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates, but could potentially be reached through changes in program design. For the EnergyWise Single Family program, these customers are those who live in residences less than 1,300 square feet or greater than 3,000 square feet, and those who live in a building greater than or equal to 85 years old. For these eligible accounts, Navigant estimated a share that could potentially participate based on the cumulative historical participation rate (5.4%) for the program from 2009 through 2015.

Table 24. Characteristics of Other Eligible Accounts, EWSF Gas

Customer Description	Accounts	Share*
Less likely to participate – one or more characteristic:		
• Account Type: Non-Heating		
• Homeownership: Renter	57,537	31%
• Average Monthly Usage: <35 therms		
• Age of Building: < 20 years		
Unclassified nonparticipants	40,479	21%
Program design opportunity – one or more characteristic:		
• Building Area: <1,300 sq. ft. or >3,000 sq. ft.	8,473	5%
• Age of Building: ≥85 years		
Total	106,489	57%
Historical Participant Share**	5,800	3%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (186,490).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of this targeting analysis is shown in Table 25.

Table 25. Summary of Target Customers, EWSF Gas

Category	Accounts	Share
Matched Past Participants, 2009-2015	7,973	4%
Eligible Accounts Similar to Past Participants	72,478	39%
Historical Participant Share of Other Eligible Accounts*	5,800	3%
Other Eligible Accounts	100,689	54%
Total Eligible Accounts	186,940	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015.

Source: Navigant analysis of National Grid data

4.3.5 Measure Category Participation

Table 26 lists annual, additive, and cumulative participation counts in each category, as well as total program participation (as listed in Table 19). Table 27 lists the percentage of total program participants that participated in each measure category. These counts show that most of participants in the gas program participate in weatherization.

Table 26. Measure Category Participation Counts, EWSF Gas

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
Total Participation	442	705	906	1,413	1,946	2,737	2,830	10,979	10,182
Weatherization	437	343	647	1,015	1,606	1,994	1,715	9,607	7,481
Domestic Hot Water	N/A	361	424	348	72	39	175	2,127	2,124
Thermostats	N/A	N/A	N/A	42	451	786	1,018	2,299	2,295

An N/A value in this table indicates that participation data was not available for that year.

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 27. Measure Category Percentage of Total Participation, EWSF Gas

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive*	Cumulative*
Total Participation	442	705	906	1,413	1,946	2,737	2,830	10,979	10,182
Weatherization	98.9%	48.7%	71.4%	71.8%	82.5%	72.9%	60.6%	87.5%	73.5%
Domestic Hot Water	N/A	51.2%	46.8%	24.6%	3.7%	1.4%	6.2%	19.4%	20.9%
Thermostats	N/A	N/A	N/A	3.0%	23.2%	28.7%	36.0%	25.7%	26.5%

An N/A value in this table indicates that participation data was not available for that year.

*Calculated based on the number of years for which data was available for a given measure category.

Source: Navigant analysis of National Grid data

4.4 Program Design Considerations

The EnergyWise Single Family program is achieving high levels of participation with customers that have the following characteristics:

- Property Type: 1-Family
- Length of Residence: 3 to 13 years
- AMI: 120+%
- Building Age: 20 to 85 years

Analysis of the past performance and participant demographics indicates that to recruit new participants who are different than the customer profile of current participants, the following strategies may be helpful:

1. **Target Marketing/Recruitment:** Devise marketing strategies that speak more directly to the underrepresented customer segments. The marketing should use messaging that engages the desired customer base, even if the fundamental program design and rebate offerings remain essentially the same. For example, select opportunities for prize rewards (e.g., sporting tickets) could be the key enticement to generate new interest. This potential design change should be flexible and may include an array of different marketing and communication strategies and special additive incentive designs, specifically for each targeted customer group.
 - a. Use geofencing and other digital marketing tactics to present key segments with targeted promotional incentive offers to social media and advertising platforms via mobile phones

- b. Target customers living in historic homes (>85 years old)
 - c. Offer bonus incentives for customers that bundle multiple measures, including weatherization and mechanical systems
- 2. **Leverage Natural Gas Conversion Customers:** Potentially recruit EnergyWise participants among natural gas conversion customers through additional incentives and/or financing. Consider requiring EnergyWise participation (in some form) as an opt-out requirement rather than an opt-in for natural gas conversion customers.

5. INCOME ELIGIBLE SINGLE FAMILY (ELECTRIC AND GAS)

The Income Eligible Single Family program is similar to the market rate EnergyWise program, consisting of no-cost home energy assessments, installation of efficient measures, and quality assurance/quality control. This program identifies the opportunities for energy efficiency and will complete weatherization services and provide appliance and heating system replacement (for inefficient systems) at no charge to the customer.

5.1 Eligibility

Income eligible customers are those who are currently on the A-60 Electric Low-Income rate, the 1301 Low-Income Heat rate, and those customers who qualify for Low Income Home Energy Assistance program funds from the State (household income level falls below 60% of the AMI). Navigant identified eligible customers from the residential database using the following criteria:

1. Most recently participated in the Income Eligible Single Family program
2. Number of units in the building is less than or equal to 4
 - a. For residential electric accounts, rate is A-60
 - b. For residential gas accounts, rate is 1101 (Non-Heating) or 1301 (Heating)

Based on these eligibility criteria, Navigant identified 27,902 electric accounts eligible for the Income Eligible Single Family Electric program and 14,462 gas accounts eligible for the Income Eligible Single Family Gas program. As noted in Section 4.2.2, some customers in the 0%-60% AMI range were not included in the income eligible analysis, as they were not on a low-income rate. To further understand these customers, Navigant conducted additional analysis on the characteristics of participants and nonparticipants of income eligible customers identified using additional AMI criteria, discussed in Appendix D.

5.2 Electric Results

5.2.1 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the Income Eligible Single Family Electric program, listed in Table 28. The team determined the number of nonparticipants and participation rates assuming a constant number of 27,902 eligible accounts, calculated using the criteria described in Section 5.1. The difference between the additive and cumulative participation from 2009 through 2015 is associated with repeat participants. For example, a customer could receive an audit in one year and install additional measures in a subsequent year.

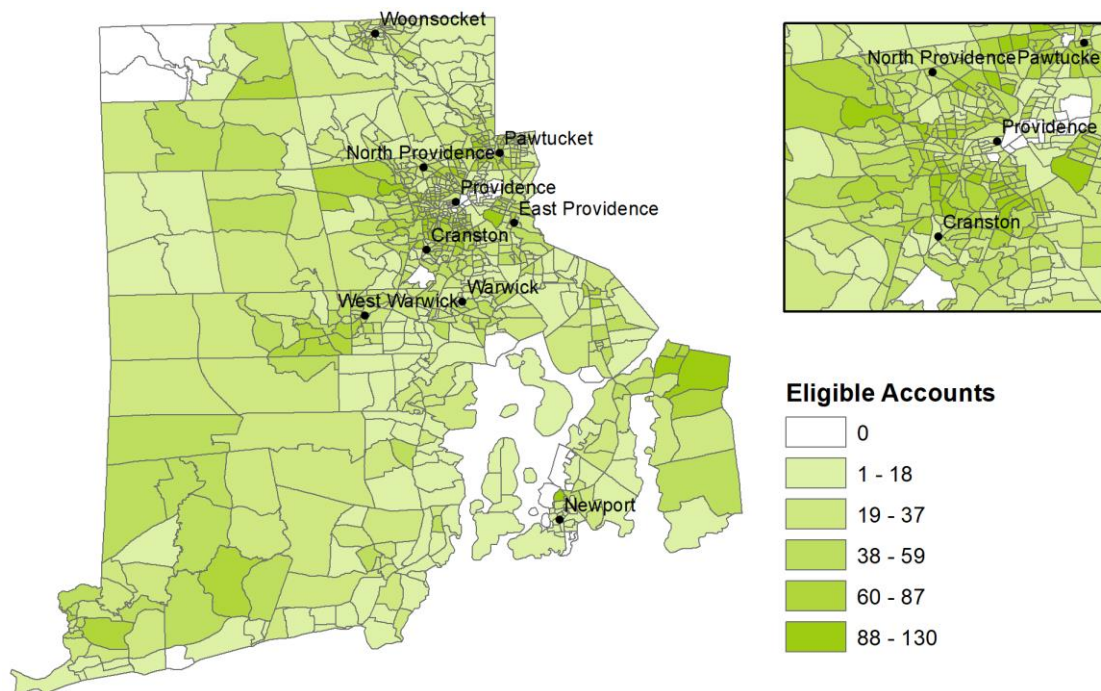
Table 28. Annual Program Participation, Income Eligible Single Family Electric

Year	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
P	1,448	1,662	1,777	2,654	2,646	3,054	2,851	16,092	13,947
Non-P	26,454	26,240	26,125	25,248	25,256	24,848	25,051	11,810	13,955
Rate	5.2%	6.0%	6.4%	9.5%	9.5%	10.9%	10.2%	57.7%	50.0%

Source: Navigant analysis of National Grid data

Figure 28 through Figure 30 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-1 in Appendix A. The results show that in each ZIP code where eligible accounts are available there were generally some participants in the Income Eligible Single Family Electric program.

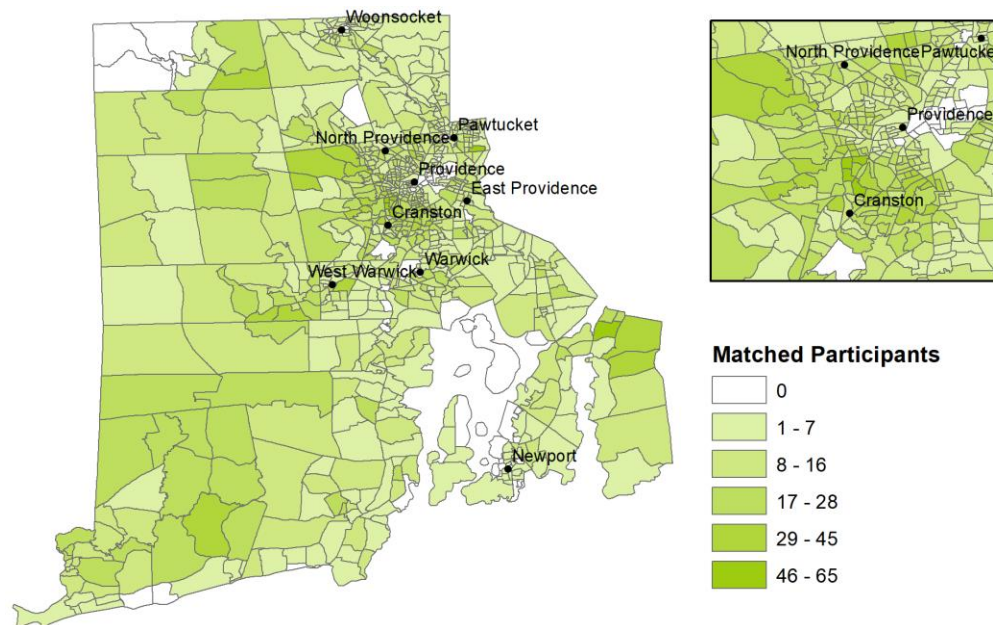
Figure 28. Income Eligible Single Family Eligible Accounts by Census Block Group



Notes: Each listed interval includes both end points. 4,839 or 35% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 8,821 (97%) of participants and 18,020 (96%) of nonparticipants.

Source: Navigant analysis of National Grid data

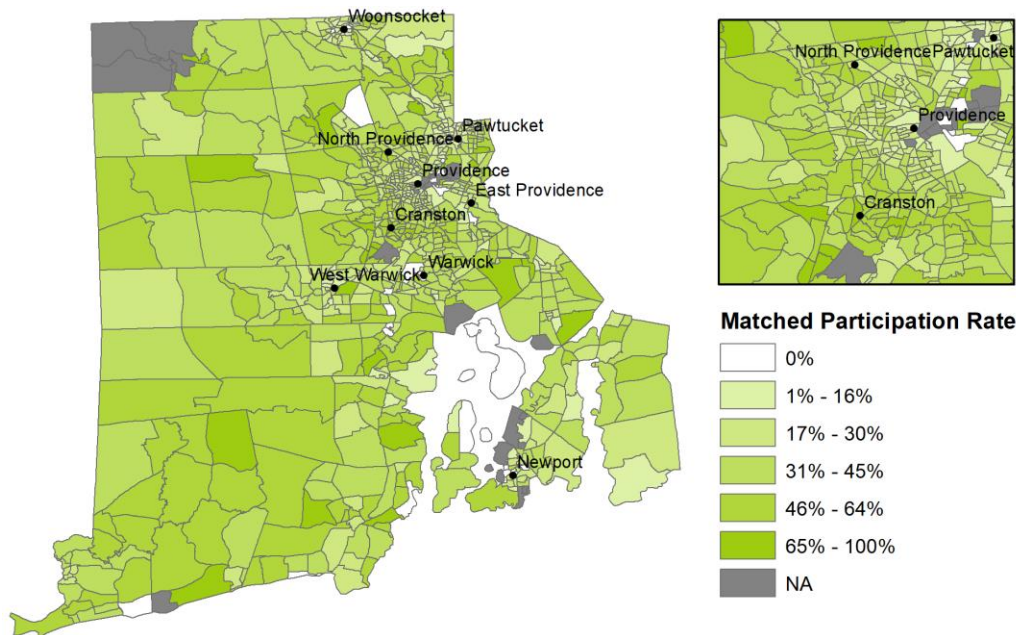
Figure 29. Income Eligible Single Family Cumulative Matched Participation Counts by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. 4,839 or 35% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 8,821 (97%) of participants and 18,020 (96%) of nonparticipants.

Source: Navigant analysis of National Grid data

Figure 30. Income Eligible Single Family Electric Cumulative Matched Participation Rate by Census Block Group: 2009-2015



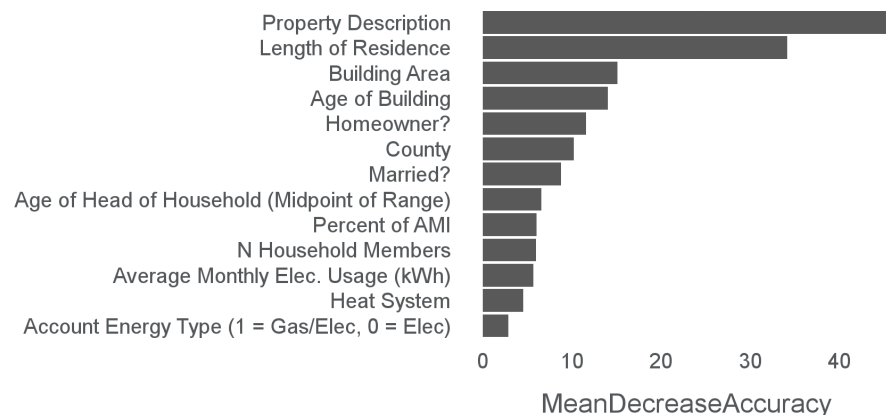
Notes: Geocoded records were available for 8,821 (97%) of participants and 18,020 (96%) of nonparticipants. A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 4,839 or 35% of historical participants were not found in the March 2017 database and are not included.

Source: Navigant analysis of National Grid data

5.2.2 Important Characteristics of Participants and Nonparticipants

The variable importance estimates for the Income Eligible Single Family program for electric accounts are shown in Figure 31. Of the variables included in this model, the most important ones for predicting whether an account is a participant are building type (property description), length of residence for the inhabitant, and building area. Property type and length of residence were the two most important predictors of participation for market rate electric accounts.

Figure 31. Variable Importance for Income Eligible Single Family Electric Accounts.

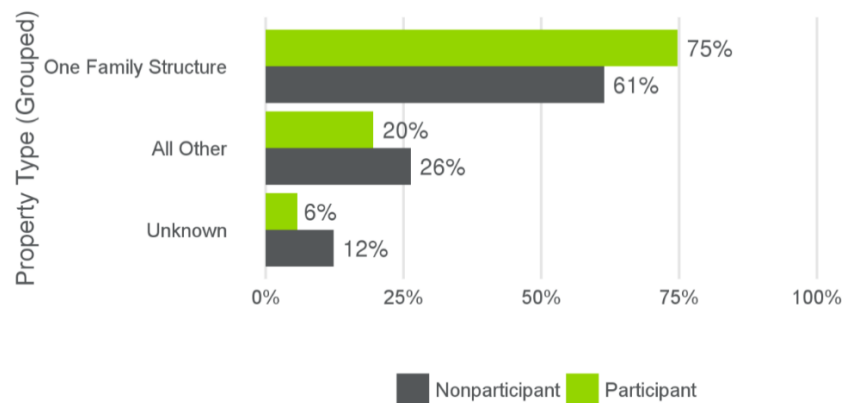


Source: Navigant analysis of National Grid data

In the following analysis of important variables, Navigant focused on accounts that were flagged as a homeowner, as renters do not necessarily have authority to upgrade or renovate their residence and, therefore, would not be ideal recipients of targeted marketing since. As a result, Navigant focused on homeowners even though homeownership was the sixth most important variable. Additional analysis of renters is further discussed in Appendix E.

For predicting participation of electric accounts in the Income Eligible Single Family program, the random forest model indicates that the property type is most important. Shown in Figure 32, homeowners in this program are more likely to live in a single family home as opposed to a house with two or more units or another building that is single family-eligible.

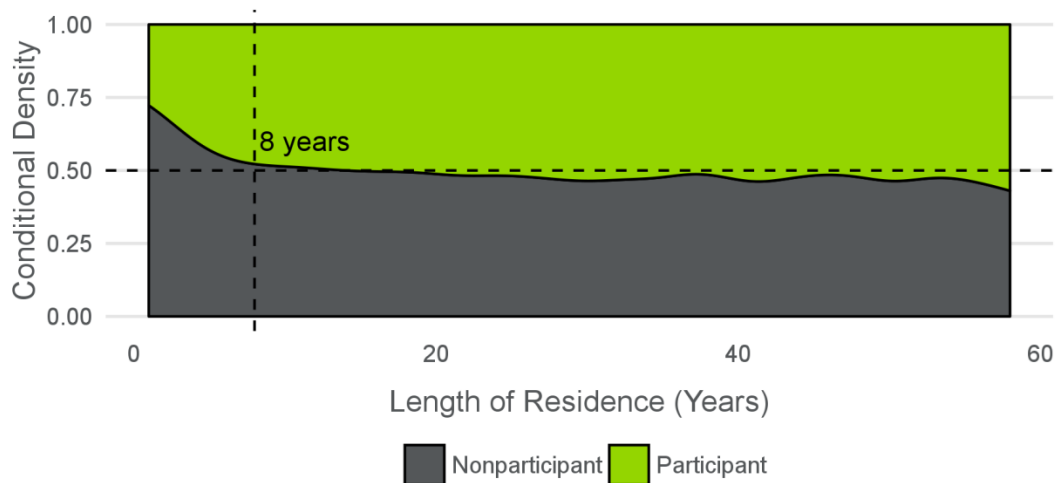
Figure 32. Property Types for Income Eligible Single Family Electric Homeowner Accounts



Source: Navigant analysis of National Grid data

Like the market rate programs, the length of residence is a critical feature in predicting whether an account is a participant. However, shown in Figure 33, the income eligible electric account analysis differs in that nonparticipants are increasingly concentrated starting at 8 years of residence and less; in the market rate programs, nonparticipants were concentrated under 3 years of residence, while participants were concentrated between 3 and 13 years of residence.

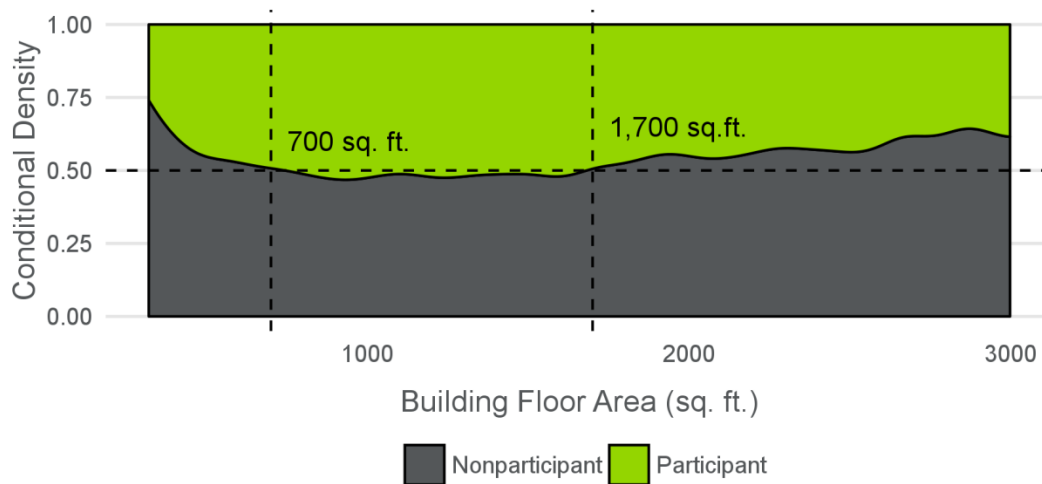
Figure 33. Conditional Density Plot of Length of Residence for Homeowner Accounts



Source: Navigant analysis of National Grid data

Again, similar to the market rate programs, building area is an important predictor of participation for income eligible electric accounts. However, the market rate electric account analysis found that nonparticipants were more likely to be found below a threshold of 1,300 square feet (see Section 4.2.2). In the income eligible case, the threshold appears to be closer to 700 square feet, shown in Figure 34.

Figure 34. Conditional Density Plot of Building Area for Homeowner Accounts

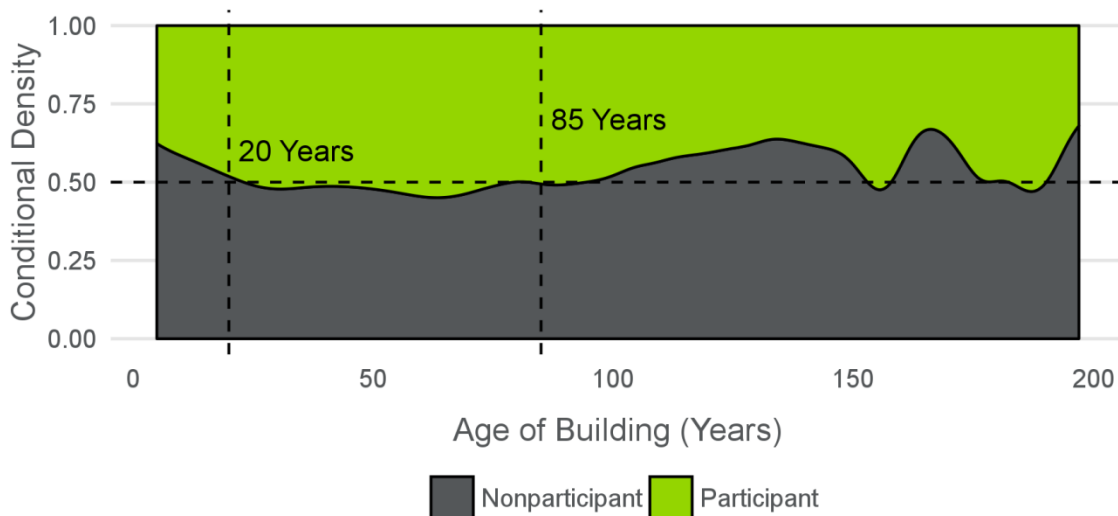


Only accounts with building area between 300 and 3,000 square feet (93% of available data) shown.

Source: Navigant analysis of National Grid data

The age of the building is also an important determinant of participation for income eligible electric accounts. Figure 35 shows similar thresholds—20 years and 85 years—as the market rate gas account analysis in Section 4.3.2. Again, these building ages (less than 25 years or greater than 85 years) are intuitive; buildings less than 20 years old are less likely to be ready for retrofits, while buildings older than 85 years would likely require significantly more investment for upgrades.

Figure 35. Conditional Density Plot of Age of Building for Homeowner Accounts



Only accounts with building age less than 200 years (88% of available data) shown.

Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B and Appendix C.

5.2.3 Discrete Choice Analysis

Results from the discrete choice model are in Table 29. For each variable, the table presents the relative influence of the variable and whether the variable is statistically significant. The influence of each variable can be interpreted as the increase in the likelihood of participation for a customer with that characteristic relative to the base category or characteristic. The base variables are not included in the table as they are relative to the variables included in the model. For example, age of building is grouped into three categories: 0-20 years, 20-85 years, and 85+ years. The influence of the latter two categories is relative to a building 0-20 years old. From the results, the team finds that a building 0-20 years old is the least likely to participate, as the two other building age categories have a positive relative influence on participation.

Table 29. Discrete Choice Results for IESF Electric

Variable	Relative Influence	Statistically Significant*
Age of Building (20-85 years)	▲▲	Yes
Age of Building (85+ years)	▲	No
Average Monthly kWh (600-2000)	▲	No
Average Monthly kWh (2000+)	▼▼	No
Homeowner	▲▲	Yes
Gas and Electric Account	▼	Yes
Percentage of AMI (60% to 80%)	▲	No
Percentage of AMI (80% to 100%)	▲	No
Percentage of AMI (100% to 120%)	▲	No
Percentage of AMI (120% +)	▼	No
Single Family Property	▲▲	Yes
Length of Residence (8+ years)	▲▲▲	Yes
Square Footage (700-1700)	▲▲	No
Square Footage (1700+)	▲	No

Key	▼▼	▼	▲	▲▲	▲▲▲	▲▲▲▲
Relative Likelihood of Participation	-5 to -10%	-0 to -5%	0 to 5%	5 to 10%	10 to 15%	15 to 25%

*Statistically significant at the 95% level.

Source: Navigant analysis of National Grid data

Results from the discrete choice modeling align well with the targeting analysis. Characteristics with large and significant marginal effects include homes between 20 and 85 years old and single family properties.

5.2.4 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts. For the same reasons discussed previously, this analysis focused on homeowners, as renters were not considered a prime target audience.

The Matched Past Participants, 2009-2015 category includes 9,108 customers who have participated from 2009 to 2015. Of these participants, 4,935 participated between 2009-2013 and would be eligible for a repeat audit. There were also 4,839 unmatched participants not found in the March 2017 residential account database. The Eligible Accounts Similar to Past Participants category is summarized in Table 30, which lists the characteristics of those accounts most similar to past participants. Also listed are the number of customers that have all preferred characteristics, which represents nonparticipants most likely to participate.

Table 30. Characteristics of Eligible Accounts Similar to Past Participants, IESF Electric

Customer Description	Accounts	Share*
Homeowners with one or more characteristic:		
• Property Type: 1-Family	6,609	24%
• Building Age: 20 to 85 years		
Homeowners with all characteristics	4,047	14%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (27,902).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 31. Customers less likely to participate include renters. Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates but could potentially be reached through changes in program design. Navigant estimated a share of these other eligible accounts that could potentially participate based on the cumulative historical participation rate (50.0%) for the program from 2009 through 2015.

Table 31. Characteristics of Other Eligible Accounts, IESF Electric

Customer Description	Accounts	Share*
Less likely to participate – one or more characteristic:		
• Home Ownership: Renter	4,390	16%
Unclassified nonparticipants	5,895	21%
Program design opportunity – one or more characteristic:		
• Building Area: <700 or > 1,700 sq. ft.	1,900	7%
• Length of Residence: < 8 years		
• Building Age: ≥ 85 years		
Total	12,185	44%
Historical Participant Share**	6,091	22%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (27,902).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of this targeting analysis is shown in Table 32.

Table 32. Summary of Target Customers, IESF Electric

Category	Accounts	Share
Matched Past Participants, 2009-2015	9,108	33%
Eligible Accounts Similar to Past Participants	6,609	24%
Historical Participant Share of Other Eligible Accounts*	6,091	22%
Other Eligible Accounts	6,094	22%
Total Eligible Accounts	27,902	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015.

Source: Navigant analysis of National Grid data

5.2.5 Measure Category Participation Rates

Table 33 shows the annual, additive, and cumulative participation counts in each measure category for which data was available, as well as total participation (as listed in Table 28). Table 34 provides the percentage of total program participants that participated in each measure category. These results show that the highest percentages of participants participate in simple measures such as lighting and showerheads that are installed at the time of the home energy assessment. However, these results also show a higher participation rate in weatherization (19.1% cumulative) compared with the EnergyWise Single Family Electric program, which is consistent with the fact that these upgrades would be subsidized for income eligible customers.

Table 33. Measure Category Participation Counts, IESF Electric

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
Total Participation	1,448	1,662	1,777	2,654	2,646	3,054	2,851	16,092	13,947
Home Energy Assessment	1,136	1,442	1,338	2,423	2,220	2,579	2,163	13,301	13,100
Lighting and Showerheads	1,139	1,431	1,322	2,422	2,206	2,537	2,123	13,180	13,080
Heat System	104	64	75	107	141	268	272	1,031	1,027
Weatherization	299	148	409	448	409	574	376	2,663	2,662
Appliances	477	661	763	709	1,216	1,495	1,732	7,053	6,881
Smart Power Strips	N/A	N/A	N/A	453	1,203	2,049	1,863	5,568	5,568
Domestic Hot Water	N/A	N/A	13	14	12	6	6	51	51

An N/A value in this table indicates that participation data was not available for that year.

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 34. Measure Category Percentage of Overall Program Participants, IESF Electric

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive*	Cumulative*
Total Participation	1,448	1,662	1,777	2,654	2,646	3,054	2,851	16,092	13,947
Home Energy Assessment	78.5%	86.8%	75.3%	91.3%	83.9%	84.4%	75.9%	82.7%	93.9%
Lighting and Showerheads	78.7%	86.1%	74.4%	91.3%	83.4%	83.1%	74.5%	81.9%	93.8%
Heat System	7.2%	3.9%	4.2%	4.0%	5.3%	8.8%	9.5%	6.4%	7.4%
Weatherization	20.6%	8.9%	23.0%	16.9%	15.5%	18.8%	13.2%	16.5%	19.1%
Appliances	32.9%	39.8%	42.9%	26.7%	46.0%	49.0%	60.8%	43.8%	49.3%
Smart Power Strips	N/A	N/A	N/A	17.1%	45.5%	67.1%	65.3%	49.7%	56.3%
Domestic Hot Water	N/A	N/A	0.7%	0.5%	0.5%	0.2%	0.2%	0.4%	0.5%

*Calculated based on the number of years for which data was available for a given measure category.

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

5.3 Gas Results

5.3.1 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the Income Eligible Single Family Gas program, listed in Table 35. The team determined the number of nonparticipants and participation rates assuming a constant number of 14,462 eligible accounts. The difference between the additive and cumulative participation from 2009 through 2015 is associated with repeat participants. The participation rate for the Income Eligible Single Family Gas program was found to be lower than the Income Eligible Single Family Electric program. One potential reason is most of customers participating in the electric program participated in the lighting and showerhead measure category as shown in Table 34, which are installed directly during the home energy assessment. Such direct install measures are not applicable in the gas program, which is reflected in that 90% of gas participants participated in weatherization, as shown in Table 41.

Table 35. Annual Program Participation, Income Eligible Single Family Gas

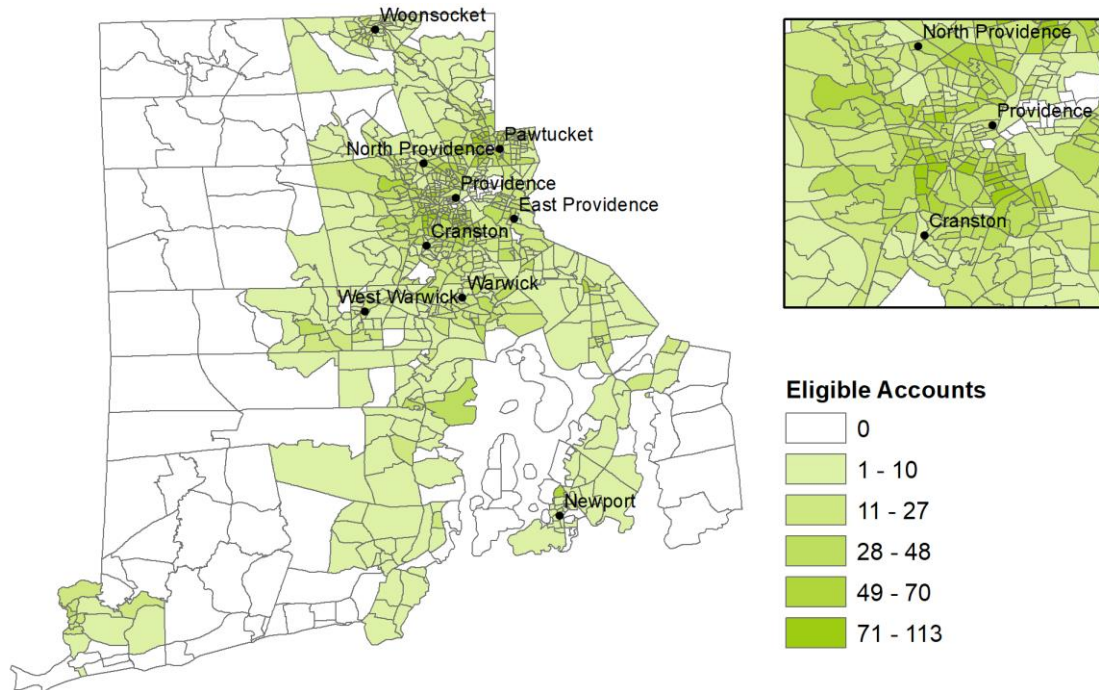
Year	2011	2012	2013	2014	2015	Additive	Cumulative
P	186	388	398	539	529	2,040	1,983
Non-P	14,276	14,074	14,064	13,923	13,933	12,422	12,479
Rate	1.3%	2.7%	2.8%	3.7%	3.7%	14.1%	13.7%

Source: Navigant analysis of National Grid data

Figure 36 through Figure 38 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-1 in Appendix A. These maps illustrate that

participants are generally concentrated around providence in Rhode Island. In the western regions, no income eligible gas accounts were found.

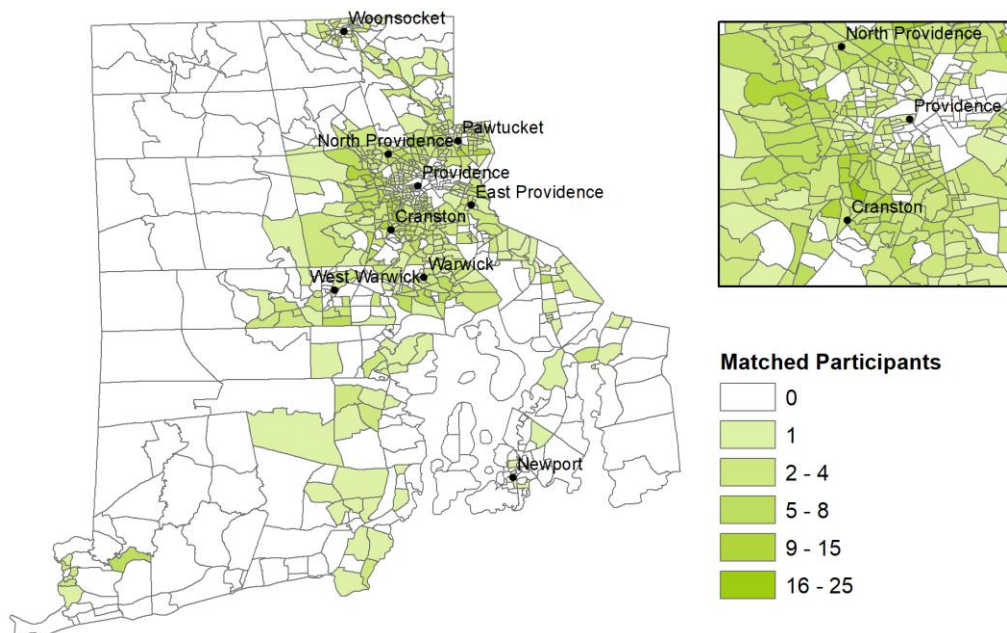
Figure 36. Income Eligible Single Family Gas Eligible Accounts by Census Block Group



Notes: Each listed interval includes both end points. 545 or 27% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 1,409 (98%) of participants and 12,599 (97%) of nonparticipants.

Source: Navigant analysis of National Grid data

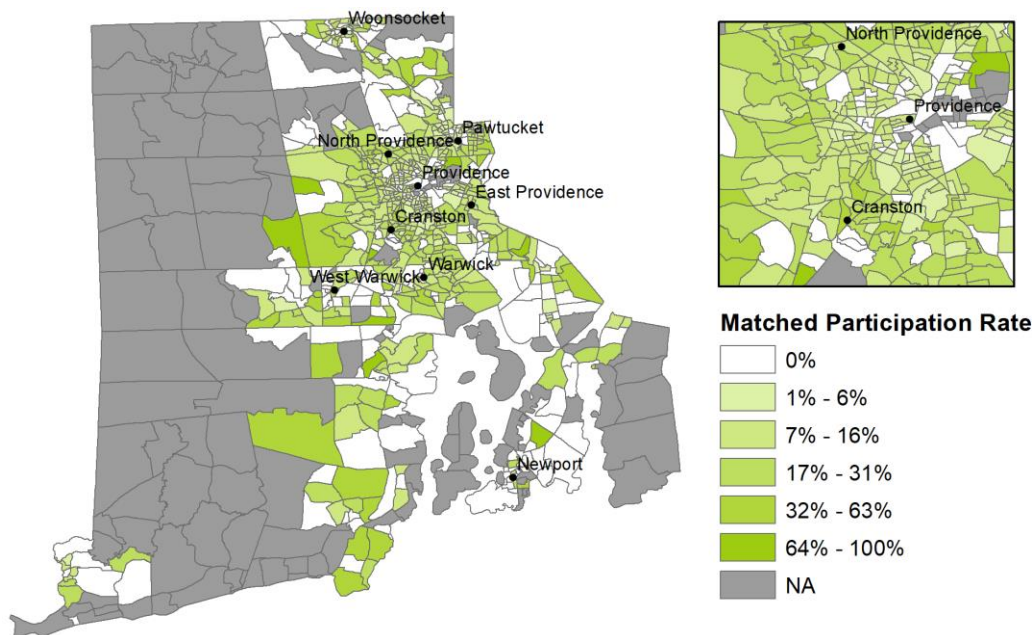
Figure 37. Income Eligible Single Family Gas Cumulative Matched Participation Counts by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. 545 or 27% of historical participants were not found in the March 2017 database and are not included. Geocoded records were available for 1,409 (98%) of participants and 12,599 (97%) of nonparticipants.

Source: Navigant analysis of National Grid data

Figure 38. Income Eligible Single Family Gas Cumulative Matched Participation Rate by Census Block Group: 2009-2015



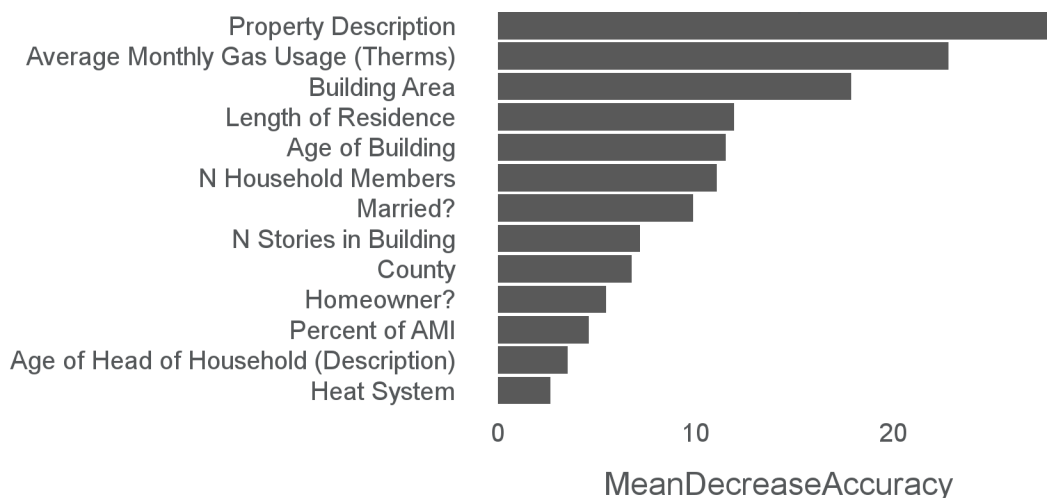
Notes: Geocoded records were available for 1,409 (98%) of participants and 12,599 (97%) of nonparticipants. A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 545 or 27% of historical participants were not found in the March 2017 database and are not included.

Source: Navigant analysis of National Grid data

5.3.2 Important Characteristics of Participants and Nonparticipants

Navigant developed a random forest classification model to identify the most important characteristics in predicting participation. The variable importance estimates for the Income Eligible Single Family program gas accounts are shown in Figure 39. Of the variables included in this model, the most important ones for predicting whether an account is a participant are building type (property description), average monthly gas usage (therms), and building area. The top variables are common with those found to be important in the market rate programs and the income eligible electric accounts.

Figure 39. Variable Importance for Income Eligible Single Family Gas Accounts

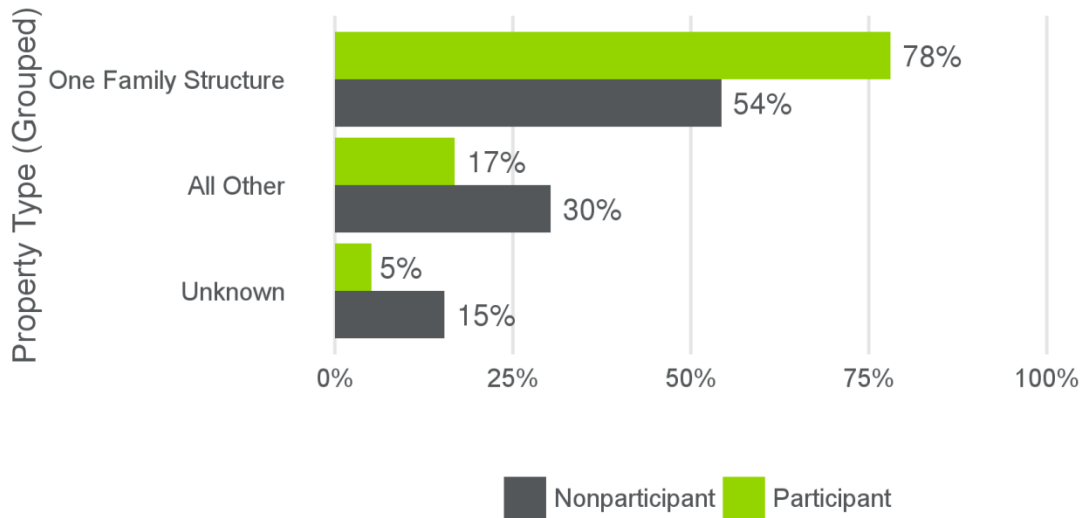


Source: Navigant analysis of National Grid data

In the following analysis of important variables, Navigant focused on accounts that were flagged as a homeowner, as renters do not necessarily have authority to upgrade or renovate their residence and, therefore, would not be ideal recipients of targeted marketing since. As a result, Navigant focused on homeowners even though homeownership was the sixth most important variable. Additional analysis of renters is further discussed in Appendix E.

Shown in Figure 40, as seen in the market rate programs and for income eligible single family electric accounts, property type is an important factor for whether an account participates, with accounts for single family buildings being more likely to participate.

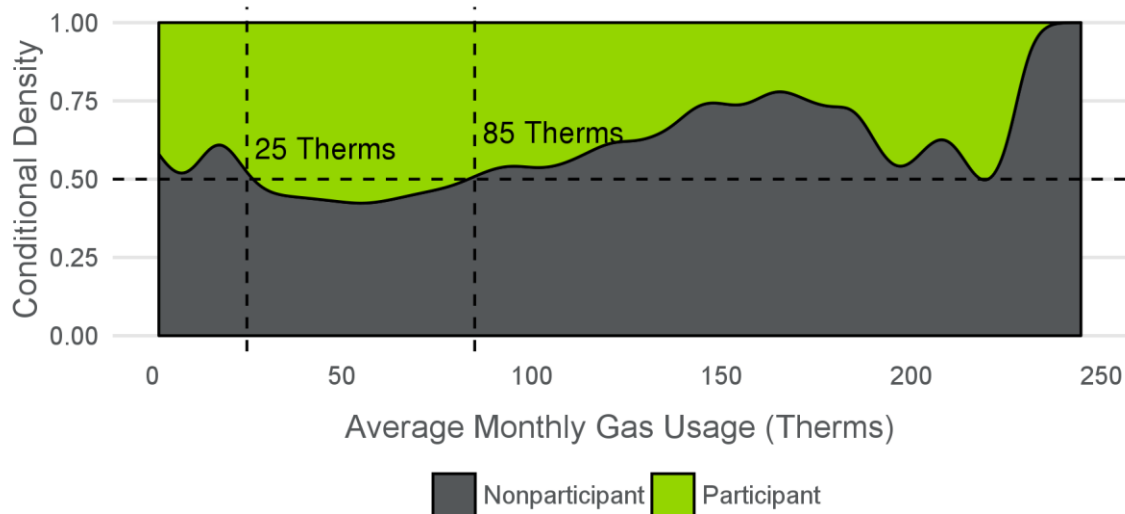
Figure 40. Property Types for Income Eligible Single Family Gas Homeowner Accounts



Source: Navigant analysis of National Grid data

Like gas accounts in the market rate program, average monthly gas usage outside of the range of 25 to 85 therms is associated with less participation. Shown in Figure 41, above 200 therms average monthly usage, accounts showed little participation; however, these accounts represent only 52 out of 14,085 accounts with available usage data.

Figure 41. Conditional Density Plot of Average Monthly Gas Usage for Homeowner Accounts

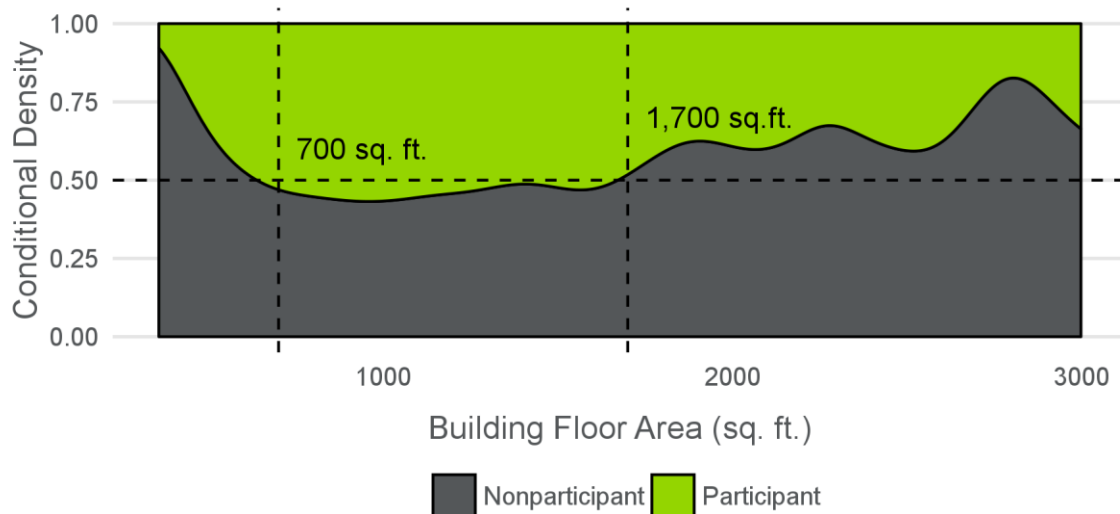


Only accounts with average monthly usage less than 250 therms (99.9% of available data) are shown.

Source: Navigant analysis of National Grid data

Shown in Figure 42, building area also shows similar trends to those found in the electric accounts, where less than 700 square feet or greater than 1,700 square feet in the building is correlated with lower participation.

Figure 42. Conditional Density Plot of Building Area for Homeowner Accounts

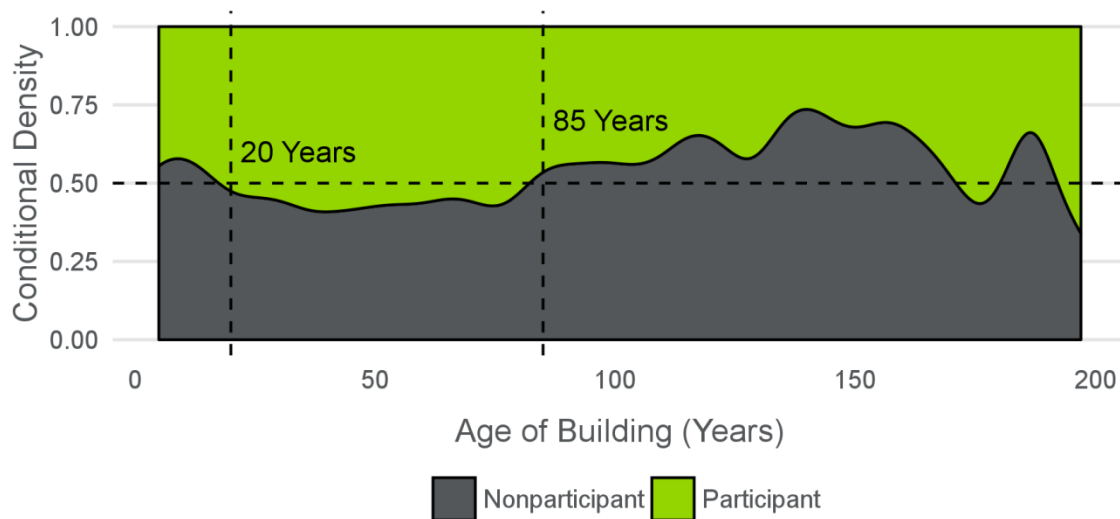


Only accounts with building area between 300 and 3,000 square feet (92% of available data) shown.

Source: Navigant analysis of National Grid data

Finally, the age of the building is again important, and the 20-year and 85-year thresholds are shown in Figure 43 to be consistent with single family income eligible electric accounts.

Figure 43. Conditional Density Plot of Building Age for Homeowner Accounts

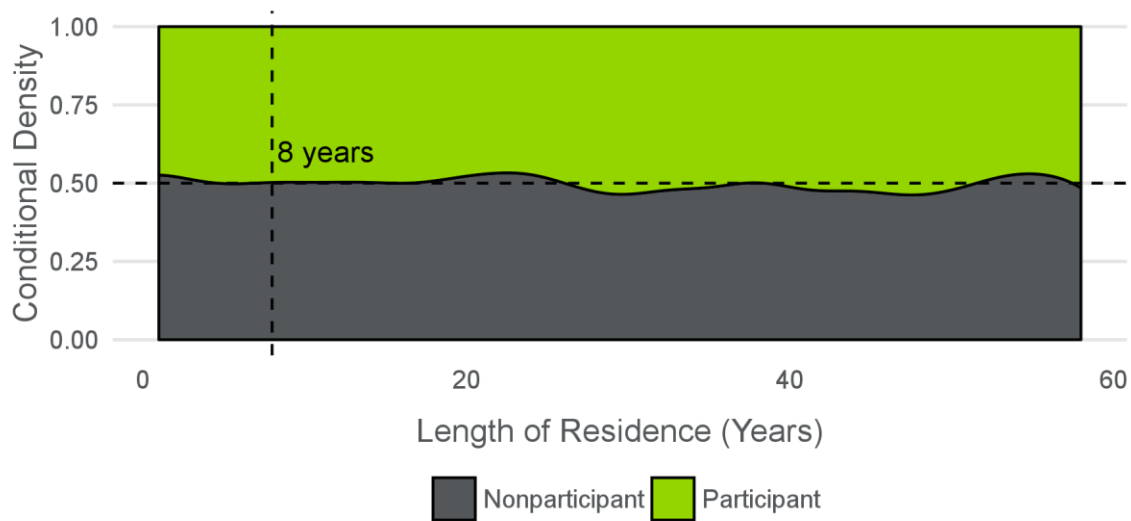


Only accounts with building age less than 200 years (84% of available data) are shown.

Source: Navigant analysis of National Grid data

Finally, although length of residence was found to be an important variable by the random forest model, Navigant did not find any clear contiguous regions of participation or nonparticipation, shown in Figure 44.

Figure 44. Conditional Density Plot of Length of Residence for Homeowner Accounts



Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B and Appendix C.

5.3.3 Discrete Choice Analysis

Results from the discrete choice model are in Table 36. For each variable, the table presents the relative influence of the variable and whether the variable is statistically significant. The influence of each variable can be interpreted as the increase in the likelihood of participation for a customer with that characteristic relative to the base category or characteristic. The base variables are not included in the table as they are relative to the variables included in the model. For example, age of building is grouped into three categories: 0-20 years, 20-85 years, and 85+ years. The influence of the latter two categories is relative to a building 0-20 years old. From the results, the team finds that a building 0-20 years old is the least likely to participate, as the two other building age categories have a positive relative influence on participation.

Table 36. Discrete Choice Results for IESF Gas

Variable	Relative Influence	Statistically Significant*
Age of Building (20-85 years)	▲▲▲	Yes
Age of Building (85+ years)	▲▲▲	Yes
Average Monthly Therms (25-85)	▲▲▲	No
Average Monthly Therms (85+)	▲	No
Homeowner	▲	No
Gas and Electric Account	▲▲▲	Yes
Percentage of AMI (60% to 80%)	▲▲	Yes
Percentage of AMI (80% to 100%)	▲	No
Percentage of AMI (100% to 120%)	▲▲	No
Percentage of AMI (120% +)	▲▲	Yes
Single Family Property	▲▲▲▲	Yes
Length of Residence (8+ years)	▲	No
Square Footage (700-1,700)	▲	No
Square Footage (1,700+)	▼	No

Key	▼	▲	▲▲	▲▲▲	▲▲▲▲
Relative Likelihood of Participation	-0 to -5%	0 to 5%	5 to 10%	10 to 15%	15 to 25%

*Statistically significant at the 95% level.

Source: Navigant analysis of National Grid data

Results from the discrete choice modeling align well with the targeting analysis. Characteristics with large and significant marginal effects include single family properties and homes between 20 and 85 years old.

5.3.4 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts. For the same reasons discussed previously, this analysis focused on homeowners, as renters were not considered a prime target audience.

The Matched Past Participants, 2009-2015 category includes 1,438 customers who have participated from 2009 to 2015. There were also 545 unmatched participants not found in the March 2017 residential account database. The Eligible Accounts Similar to Past Participants category is summarized in Table 37, which lists the characteristics of those accounts most similar to past participants. Listed are the number of customers that have one or more preferred characteristics. Also listed are those customers who have all preferred characteristics, which represents nonparticipants most likely to participate.

Table 37. Characteristics of Eligible Accounts Similar to Past Participants, IESF Gas

Customer Description	Accounts	Share*
Homeowners with one or more characteristic:		
• Property Type: 1-Family	4,238	29%
• Building Age: 20-85 years		
• Avg. Monthly Usage: 25-85 therms		
Homeowners with all characteristics	648	4%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (14,462).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 38. Customers less likely to participate include renters, customers with an average monthly use less than 25 therms, residents of buildings less than 20 years old, and customers with non-heating accounts. Customers with average monthly usage less than 25 therms have less motivation to participate due to lower savings potential. Buildings less than 20 years old tend to have less need for upgrades such as improved insulation. Finally, customers with non-heating gas accounts tend to use their gas for activities like cooking and, therefore, have less motivation to participate.

Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates, but could potentially be reached through changes in program design. Navigant estimated a share of the all other eligible accounts that could potentially participate based on the cumulative historical participation rate for the program (13.7%) from 2009 through 2015.

Table 38. Characteristics of Other Eligible Accounts, IESF Gas

Customer Description	Accounts	Share*
Less likely to participate – one or more characteristic:		
• Account Type: Non-Heating	4,181	29%
• Homeownership: Renter		
• Average Monthly Usage: <25 therms		
• Age of Building <20 years		
Unclassified nonparticipants	3,983	28%
Program design opportunity – one or more characteristic:		
• Building Area: <700 or > 1,700 Sq. Ft.	622	4%
• Building Age: ≥85 years		
• Average Monthly Usage: <25 or ≥85 therms		
Total	8,786	60%
Historical Participant Share**	1,205	8%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (14,462).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of this targeting analysis is shown in Table 39.

Table 39. Summary of Target Customers, IESF Gas

Category	Accounts	Share
Matched Past Participants, 2009-2015	1,438	10%
Eligible Accounts Similar to Past Participants	4,238	29%
Historical Participant Share of Other Eligible Accounts*	1,205	8%
Other Eligible Accounts	7,581	52%
Total Eligible Accounts	14,462	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015

Source: Navigant analysis of National Grid data

5.3.5 Measure Category Participation Rates

Table 40 shows the annual, additive, and cumulative participation counts in each measure category for which data was available, as well as total participation. Table 41 provides the percentage of total program participants that participated in each measure category. Similar to the EnergyWise Single Family Gas program, most of the participants install weatherization measures (90.3% cumulative).

Table 40. Measure Category Participation Counts, IESF Gas

Measure Category	2011	2012	2013	2014	2015	Additive	Cumulative
Total Participation	186	388	398	539	529	2,040	1,983
Heat System	21	31	71	121	157	401	401
Weatherization	169	374	356	476	418	1,793	1,791

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 41. Measure Category Percentage of Overall Program Participants, IESF Gas

Measure Category	2011	2012	2013	2014	2015	Additive	Cumulative
Total Participation	186	388	398	539	529	2,040	1,983
Heat System	11.3%	8.0%	17.8%	22.4%	29.7%	19.7%	20.2%
Weatherization	90.9%	96.4%	89.4%	88.3%	79.0%	87.9%	90.3%

Source: Navigant analysis of National Grid data

5.4 Program Design Considerations

To increase participation in the Income Eligible Single Family program, in particular with customer groups that historically are underrepresented, National Grid may consider applying the following strategies:

1. **Performance Bonuses for Community Action Programs (CAPs):** The program could use additional performance bonuses for CAPs to augment goal attainment incentives. For example, National Grid might develop more detailed performance goals and milestones—specifically for participating CAP agencies—to more actively engage with them on performance improvement goals. Performance targets could be customized to each CAP, building upon varying levels of current program engagement. National Grid may also want to consider offering a range of

performance goals that could include an array of program objectives such as: a) overall savings goal attainment, b) savings by fuel type, c) comprehensiveness of delivered services, etc.

2. **Geo-targeting for Underserved Locations:** Conduct detailed market research to identify and quantify program participation versus eligible market by geographic area. If confirmed that program participation is not proportional to eligible population, then implement participation bonuses for CAP agencies to accelerate participation in underserved areas.
3. **Aggressively Follow Up with Partial Participants:** Review the existing audit records and follow-up marketing approaches to those customers who did the initial audit, but never applied for the broader rebates identified as applicable. Consider contacting homeowners with limited time promotional offerings (e.g., bonus incentives) to encourage follow up, so they address the larger whole building energy efficiency opportunities (weatherization, HVAC).
4. **Non-CAP Delivery:** New program rules allow National Grid the flexibility to use non-CAP agencies for delivery of services if needed. National Grid should consider experimenting with non-CAP design and delivery of services to target populations that have not historically participated.

6. MULTIFAMILY PROGRAMS (ELECTRIC AND GAS)

The EnergyWise Multifamily program serves all customers, including those that are income eligible. Navigant analyzed market rate and income eligible customers, and results are presented separately. The multifamily program is administered in consultation with property owners or managers, who have the authority to make decisions for the whole property. The measures that are installed are typically customized based on a building's unique structure and occupancy status. Like the EnergyWise Single Family program, incentives are available for measures such as weatherization, heating and cooling systems, lighting, and appliances. The Income Eligible Multifamily program is administered as part of the EnergyWise Multifamily program and is operated similarly to the market rate program, in coordination with property owners and managers.

6.1 Eligibility

To simplify analysis using the data provided, Navigant did not apply the adjacency criterion that requires four or more 1-4-unit buildings under the same owner be adjacent or that any number of 1-4-unit buildings be adjacent to a 5+-unit building under the same owner. Rather, Navigant identified multifamily buildings in the residential database that meet any of the following criteria:

- Most recently participated in the EnergyWise Multifamily program
- The number of units in the building is greater than 4
- The number of units in the building is 1 to 4
 - Is part of a set of four or more 1-4-unit buildings with the same owner, determined from available ownership data
 - Has the same owner as a 5+-unit building

For multifamily buildings, a single electric account could represent a single housing unit, as in the case of submetered apartments in a building. Conversely, a single electric account could also represent multiple housing units; for example, in the case of a master metered building. For nonparticipants, a single electric or gas account would be considered market rate based on similar criteria to the EnergyWise Single Family program, specifically:

- Does not otherwise meet criteria for income eligibility
 - For residential electric accounts, rate is A-16
 - For residential gas accounts, rate is 1012 (non-Heating) or 1247 (heating)

The Income Eligible Multifamily sector is defined by properties that meet one of the following criteria:

- Owned by public housing authorities or community development corporations
- Receive affordable housing tax credits or any type of low-income funds/subsidies from the state or federal government
- Consist of building units where a majority of customers qualify as income eligible customers (receive utility service on the A-60 low income rate and/or have a household income of less than 60% of the AMI)

Navigant identified Income Eligible Multifamily buildings in the residential database as those that meet any of the following criteria:

- Most recently participated in the Income Eligible Multifamily program
- A majority of accounts are on a low-income rate code
 - For residential electric accounts, rate is A-60
 - For residential gas accounts, rate is 1101 (non-heating) or 1301 (heating)
- Property type is listed as Housing Authority
- Property owner contains a Housing Authority⁸

Accounts within a housing authority building were considered income eligible. Due to limitations of the residential data, there may be additional income eligible buildings that the team was unable to identify. Specifically, Navigant was unable to identify income eligible building accounts in the database if they were missing property data. Navigant was also unable to apply the criteria of affordable housing tax credits or low-income funds or subsidies to identify income eligible buildings because a comprehensive list matched to National Grid's databases was unavailable for this analysis.

Table 42 lists the accounts eligible for multifamily programs. Importantly, Navigant determined eligible accounts based on the residential database only.

Table 42. Eligible Multifamily Accounts in the Residential Database

Program	Fuel	Accounts
EnergyWise Multifamily	Electric	72,608
	Gas	36,923
Income Eligible Multifamily	Electric	10,776
	Gas	3,776

Source: Navigant analysis of National Grid data

6.2 Effect of Data Health

Navigant's assessment of the health of the account data for EnergyWise and Income Eligible Multifamily eligible customers revealed issues that inhibited a robust analysis of each program. Table 43 lists, for both EnergyWise and Income Eligible programs the following:

1. The total number of unique participants in electric and gas multifamily programs from 2009 to 2015, calculated from participation lists.
2. The total number of nonparticipants assuming a constant number of 72,608 eligible electric accounts and 23,127 eligible gas accounts, calculated from the residential database using the criteria described in Section 6.1.

⁸ Navigant also identified income eligible properties if the property owner contained variations of Housing Authority, namely "hsng auth" or "housing auth."

3. The percentage of these participant accounts that match with the residential account database. Unmatched accounts represent historical participants that were not found in the residential account database snapshot as of March 2017, as described in Section 3.1.1.

Table 43. Data Health for Multifamily Electric and Gas Programs

Program	Description	Electric Participants	Electric Nonparticipants	Gas Participants	Gas Nonparticipants
EnergyWise	Total Accounts in Participation Lists	24,500	N/A*	10,827	N/A*
	Percentage Matched with Account Database	41%	N/A	41%	N/A
	Total Records in Account Database	10,049	62,559	4,421	32,502
Income Eligible	Total Accounts in Participation Lists	7,384	N/A*	1,368	N/A*
	Percentage Matched with Account Database	55%	N/A	32%	N/A
	Total Records in Account Database	4,027	6,749	443	3,333

*Participation lists do not include nonparticipants.

Source: Navigant analysis of National Grid data

The low match rate of participating accounts with the residential account database posed significant challenges to the team's analysis. Many of the unmatched participant accounts were associated with inactive accounts as of March 2017, which could be ascribed to tenants moving in and out of multifamily buildings that previously participated in an energy efficiency program. As a result, many accounts in the residential account database that were characterized as nonparticipants may in fact be associated with buildings that have participated in a multifamily energy efficiency program. This uncertainty makes the differences between participants and nonparticipants unclear and prohibited the team from analyzing these programs with confidence.

For future analyses, Navigant recommends the following, subject to cost-effectiveness:

- **Create a flag across all residential and C&I databases identifying multifamily properties.** This flag would facilitate identifying eligible multifamily properties in future analyses.
- **Assign permanent, unique ID numbers for all facilities, buildings, and housing units in Rhode Island.** This could be a clean, geocoded full address, but a unique numerical ID would prevent complications from geocoding addresses that may arise from data entry errors. These IDs could be a single ID with components or a set of hierarchical IDs such that it is clear which housing units are within each building and which buildings belong to each facility. This would preserve the information that a building has previously contained participating accounts, such as when a tenant moves.
- **Track the number of housing units for each participating building.** Because this analysis relied on third-party data for number of housing units matched to the account database, tracking this data would increase the accuracy of future analyses.

- **Maintain a flag variable for buildings that have at any point contained participating accounts.**
- **Preserve demographic/housing characteristics/property data matched to inactive accounts.** Paired with account open and close dates, this would enable the analysis team to consider accounts over a specified period of time, rather than only snapshot in time. The analysis team could, for example, identify participating buildings based on the unique building ID number proposed above, and obtain any inactive accounts closed in the last 3 years that were tied to those buildings, together with the matching demographic and housing/property for those inactive accounts.

6.3 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the multifamily programs, listed in by account in Table 44 and by facility in Table 45. An account is a single electric or gas account in a multifamily building, while a facility is one or more buildings with the same owner. For example, a facility could be one 5+-unit building, or four or more 1-4-unit buildings with the same owner. For these counts, Navigant counted all participants in the historical participation lists. Due to difficulty encountered by the team matching participants to the account database, Navigant did not analyze the geographic distribution of participants. As a result, participation and participation rate maps are not included for multifamily programs.

For all programs, participation fluctuated from 2009 through 2015 but generally increased. This trend is most apparent in Table 45, as the number of facilities generally increased over the analysis period. Importantly, multifamily buildings could be master or individually metered; thus, each account listed could represent one or more housing unit.

Table 44. Annual Program Participation (Accounts) in Multifamily Programs: 2009-2015

Program	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
EnergyWise Electric	3,682	4,819	2,109	2,626	3,531	5,277	8,014	30,000	24,500
EnergyWise Gas	1,346	1,554	369	1,792	762	3,146	4,291	13,294	10,827
Income Eligible Electric	490	893	1,303	1,410	2,010	3,104	1,383	10,481	7,384
Income Eligible Gas	29	75	1	48	261	531	532	1,477	1,368

Source: Navigant analysis of National Grid data

Table 45. Annual Program Participation (Facilities) in Multifamily Programs: 2009-2015

Program	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
EnergyWise Electric	33	78	49	46	41	80	125	452	406
EnergyWise Gas	21	21	22	29	19	46	58	216	200
Income Eligible Electric	13	30	35	40	54	62	52	286	196
Income Eligible Gas	6	4	1	9	27	41	61	149	139

Source: Navigant analysis of National Grid data

Navigant also estimated participation rates assuming a constant number of eligible accounts found in the residential account database, listed in Table 42. The estimated participation rates are listed in Table 46. These estimates should be considered as upper limits, as there may be additional multifamily accounts

not identified in this analysis. Specifically, there may be additional multifamily buildings with non-residential accounts unidentified in this analysis and additional income eligible buildings.

Table 46. Annual Program Participation (Accounts) in Multifamily Programs: 2009-2015

Program	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
EnergyWise Electric	5.1%	6.6%	2.9%	3.6%	4.9%	7.3%	11.0%	41.3%	33.7%
EnergyWise Gas	3.6%	4.2%	1.0%	4.9%	2.1%	8.5%	11.6%	36.0%	29.3%
Income Eligible Electric	4.5%	8.3%	12.1%	13.1%	18.7%	28.8%	12.8%	97.3%	68.5%
Income Eligible Gas	0.8%	2.0%	0.0%	1.3%	6.9%	14.1%	14.1%	39.1%	36.2%

Source: Navigant analysis of National Grid data

7. RESIDENTIAL NEW CONSTRUCTION

The Residential New Construction and Renovation/Rehabilitation (RNC) program is a fuel-neutral program that provides comprehensive energy savings opportunities for single family and multifamily projects for both the market rate and income eligible markets. The program promotes the construction of high performing homes by offering the following resources to builders, tradesmen, designers, and code officials:

- Code compliance and technical trainings
- Energy modeling and design assistance
- In-field inspections
- Home Energy Rating System (HERS) Rating
- Optional ENERGY STAR Homes verification for projects seeking the US Environmental Protection Agency label
- Complimentary ENERGY STAR bulbs and WaterSense showerheads
- Financial incentives based on energy efficiency

The RNC program offers a tiered incentive structure, with higher incentives offered for buildings performing at a higher level relative to the energy code baseline. Each tier is based on the home's efficiency relative to the baseline home, as defined by the 2011 Baseline Study of Single Family Residential New Construction for the Rhode Island User Defined Reference Home 2011.⁹ RNC incentive amounts are tiered based on the building's performance relative to the baseline, with different amounts offered for single family and multifamily buildings. The program offered a similar tiered incentive structure for each year of this analysis, though the incentive amounts varied slightly year over year. In 2013, the RNC program expanded to include renovation, in addition to new construction projects, which were offered the same incentive amounts. In 2015, more granularity was added to multifamily incentive amounts, which are now dependent on the number of units in the building.

Table 47. Rhode Island RNC 2015 Performance Incentives

Tier Level	Percent More Efficient than Baseline	1-4-Unit Building	5-10-Unit Building	11-30-Unit Building	31-50-Unit Building	51+-Unit Building
Tier 1	15-24%	\$500	\$300	\$225	\$150	\$100
Tier 2	25%	\$1,500	\$1,000	\$750	\$500	\$330
Tier 3	45%	\$4,000	\$2,000	\$1,500	\$1,000	\$660
ENERGY STAR Verified (additional)	N/A	\$100	\$50	\$50	\$50	\$50

Source: RI Residential New Construction Project Application. <https://www1.nationalgridus.com/files/AddedPDF/POA/Application.pdf>

⁹ See: <http://www.rieermc.ri.gov/documents/evaluationstudies/2012/Final-RI-RNC-2011-Baseline-Report-sent-10-8-12.pdf>.

7.1 Program Participation Rates (Electric and Gas)

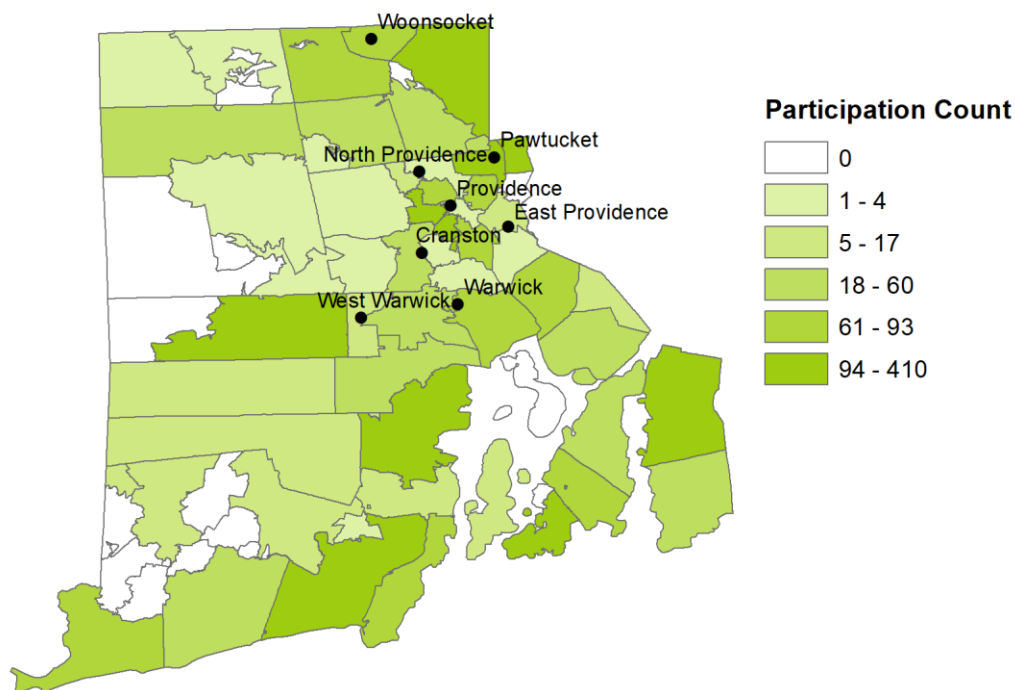
The following section summarizes RNC program activity from 2009 to 2015 by project type, size, fuel type, and location. The program completed an average of 429 projects per year between 2009 and 2015. Participation increased in 2013 when the program expanded eligibility to include renovation projects. Participation peaked in 2014 from the contribution of nearly 300 projects from two large multifamily renovation efforts. The program completed 3,005 new construction and renovation projects from 2009 to 2015, as shown in Table 48. Figure 45 illustrates cumulative participation from 2009 through 2015 in the Residential New Construction program by ZIP code. A list of participation counts by ZIP code can be found in Table A-2 in Appendix A.

Table 48. Overall Program Participation (New and Renovation): 2009-2015

Year	2009	2010	2011	2012	2013	2014	2015	Cumulative
P	363	341	384	429	473	602	413	3,005

Source: Navigant analysis of National Grid data

Figure 45. Residential New Construction Cumulative Participation Count by ZIP Code: 2009-2015



Source: Navigant analysis of National Grid data

7.1.1 2009-2015 New Construction Participation

Table 49 shows the distribution of single family and multifamily new construction projects (i.e., excluding renovation) from 2009 to 2015 by number of units. Single family projects are defined as having 1-4 units per building, and buildings larger than 5 units were categorized as multifamily. Most new construction

projects were single family (64%), with 5-30-unit buildings making up the majority of the remaining multifamily projects.

Table 49. New Construction Projects (Excluding Renovation) by Building Size: 2009-2015

Year	Building Size (No. of Units)					
	Single Family	Multifamily				
	1-4	5-10	11-30	31-50	51+	Total
2009	183	46	95	37	2	363
2010	205	22	35	74	5	341
2011	212	68	57	39	8	384
2012	246	55	109	0	19	429
2013	282	28	1	4	10	325
2014	140	17	0	7	14	178
2015	201	18	40	7	12	278
Cumulative	1,469	254	337	168	70	2,298

Source: Navigant analysis of National Grid data

As shown in Table 50, the program's share of the single family new construction market ranged from a low of 19% in 2014 to 35% in 2011. The program's average market share from 2009 to 2015 was 28%, which is on par with participation rates for mature programs in other markets.

Table 50. Single Family New Construction Market Share, 2009-2015

Year	Housing Starts	Participant Projects*	RNC Market Share**
2009	668	183	27%
2010	799	205	26%
2011	604	212	35%
2012	713	246	34%
2013	879	282	32%
2014	743	140	19%
2015	864	201	23%
Cumulative	5,270	1,469	28%

* Excludes renovation projects.

**Participation rate is based on number of new single and multifamily housing starts.

Source: Navigant analysis of Moody's Analytics and National Grid data

7.1.2 2013-2015 Renovation Participation

The RNC program opened to renovation projects in 2013. Table 51 shows the distribution of single family and multifamily renovation projects from 2013 to 2015 by number of units. In contrast to new construction, only 18% of renovation projects submitted were single family. Nearly 60% of the program's 700 renovation units were submitted from two large multifamily units in 2014. Navigant was unable to calculate the program's share of the multifamily new construction market because data for multifamily housing starts was not available at a unit level from Moody's Analytics.

Table 51. Renovation Participant Projects by Building Size: 2013-2015

Year	Building Size (No. of Units)					
	Single Family	Multifamily				
	1-4	5-10	11-30	31-50	51+	Total
2013	32	3	0	0	113	148
2014	58	52	27	0	287	424
2015	37	33	65	0	0	135
Cumulative	127	88	92	0	400	707

Source: Navigant analysis of National Grid data

7.1.3 Participation by Performance Tier

The RNC program offers a performance-based incentive structure, with higher incentives offered for higher levels of savings. Table 52 shows participation by project type (new versus renovation) and performance tier from 2013 to 2015. Tier II projects made up 53% of new homes completed, while 69% of renovation projects were completed at the Code Plus level. Data on project performance was unavailable for units completed prior to 2013.

Table 52. Participation by Performance Tier (Units): 2013-2015

Performance Tier	2013	2014	2015	Total
New Construction	325	178	278	781
Code Plus	76	59	25	160
Tier I	82	37	60	179
Tier II	154	75	187	416
Tier III	13	7	6	26
Renovations	148	424	135	707
Code Plus	116	360	13	489
Tier I	8	13	64	85
Tier II	20	49	55	124
Tier III	4	2	3	9
Total	473	602	413	1,488

Source: Navigant analysis of National Grid data

7.1.4 Participation by Fuel Type

Gas-heated homes made up nearly 85% of total projects completed to date, as shown in Table 53. Gas homes have consistently maintained 80%-90% of program participation, except in 2012, which saw a temporary increase in electric, propane, and fuel-oil heated homes.

Table 53. Participation by Heating Fuel Type (Units): 2009-2015

Year	Gas	Electric	Oil	Propane	Other	Total
2009	337	0	10	14	2	363
2010	278	51	4	4	4	341
2011	356	12	1	13	2	384
2012	272	85	21	49	2	429
2013	425	19	2	24	3	473
NEW	282	19	1	20	3	325
RENO	143	0	1	4	0	148
2014	523	50	5	22	2	602
NEW	139	14	2	21	2	178
RENO	384	36	3	1	0	424
2015	342	41	4	24	2	413
NEW	233	17	3	23	2	278
RENO	109	24	1	1	0	135
Total	2,533	258	47	150	17	3,005

Source: Navigant analysis of National Grid data

7.2 Program Design Considerations

The RNC program has evolved into a sophisticated, performance-based program that encourages continuous improvement in home building performance. This is evident in the trend toward more homes qualifying for Tier 2 and Tier 3 incentives.

- Incentive Design Flexibility:** While the program provides generous program services already, it could provide additional incentives (across all tier levels) to gain additional attention from builders and property developers.
 - Additional bonuses could be designed to encourage strategic electrification, (e.g., cold climate heat pumps or EV charging stations), or direct enrollment in demand response programs.
 - Consider requesting regulatory approval for greater flexibility to provide limited time bonus incentives to help the program achieve goals and/or provide an incentive bonus for first time program participating builders and development projects in historically underrepresented geographies.
- Facilitate Participation by First Time Program Builders:** For first time participating builders, waive the HERS rate charge if second or third home visits for ratings are required, such that the builder can address the performance issue and qualify for program incentives without incurring the additional costs of HERS ratings.
- Research Non-Participating Builders:** Conduct a detailed process evaluation, specifically focused on non-participating builders, to better understand the barriers to participation and strategies to increase program participation.

4. **Increase Direct Marketing to Customers:** While the program has appropriately prioritized marketing and program enrollment to the builder community, to broaden program awareness, consider additional marketing and awareness outreach directly to high target customer groups. This could include items such as higher profile website views of the program to customers and program awareness when builders/customers call to request new connection service orders.

8. SMALL BUSINESS DIRECT INSTALL (ELECTRIC AND GAS)

The Small Business Direct Install (SMB/DI) program provides direct installation of energy efficient lighting, non-lighting retrofit measures, and gas efficiency measures. For both programs, some accounts are ineligible for the program, including:

- Municipal accounts
- National accounts
- Multifamily or other residential buildings with C&I accounts
- Vacant properties

Additionally, only electric customers with average monthly demand of less than 200 kW are eligible to participate; however, there are no additional criteria related to consumption for gas customers.

Customers are provided turnkey services consisting of the following:

- An energy audit
- Direct installation of measures
- Company incentive contribution of 70% of total project cost
- On-bill repayment for customers' 30% share of the project costs, either over 24 months at 0% interest or a lump sum payment with a 15% discount, resulting in most customers' projects having a positive cash flow when they choose the 24-month repayment option¹⁰

8.1 Eligibility

The C&I databases received by Navigant included 30,157 electric accounts and 21,643 gas accounts. Navigant then identified accounts eligible for the SMB/DI electric and gas programs. Navigant excluded types of electric and gas accounts that are ineligible, including:

- Municipal accounts
- National accounts
- Multifamily or other residential buildings with C&I accounts
- Vacant properties

Additionally, for the electric program, there are additional eligibility criteria based on rate code and usage:

- Electric rate codes C-06, G1, and G2, or church properties on residential rates
- Monthly average demand <200 kW

Navigant calculated average monthly demand for C&I electric accounts from 36 months of electric usage data provided by National Grid. Based on these criteria, Navigant identified 24,896 electric accounts and 17,892 gas accounts eligible for the SMB/DI program.

¹⁰ National Grid Energy Efficiency Program Plan for 2015

8.2 Electric Results

8.2.1 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the SMB/DI program, listed in Table 54. Navigant determined the number of nonparticipants and participation rates assuming a constant number of 24,896 eligible accounts, calculated using the criteria described in Section 8.1.

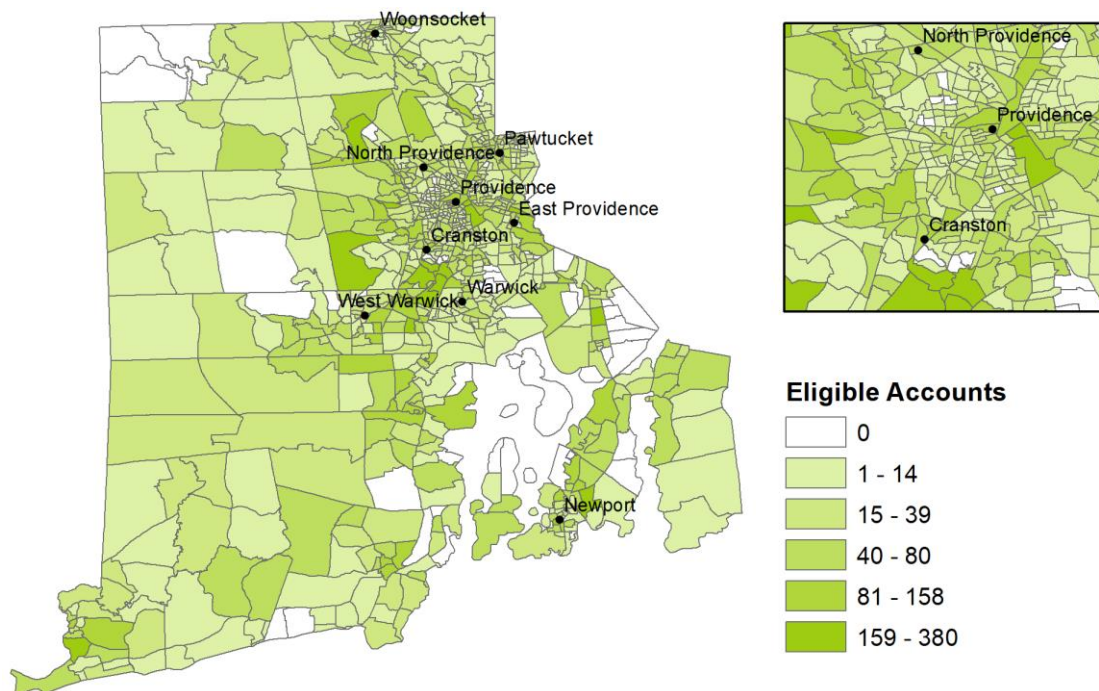
Table 54. Annual Program Participation, Small Business Direct Install Electric

Year	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
P	639	921	1,153	1,282	1,175	959	1,047	7,176	6,141
Non-P	24,257	23,975	23,743	23,614	23,721	23,937	23,849	17,720	18,755
Rate	2.6%	3.7%	4.6%	5.1%	4.7%	3.9%	4.2%	28.8%	24.7%

Source: Navigant analysis of National Grid data

Figure 46 through Figure 48 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-3 in Appendix A.

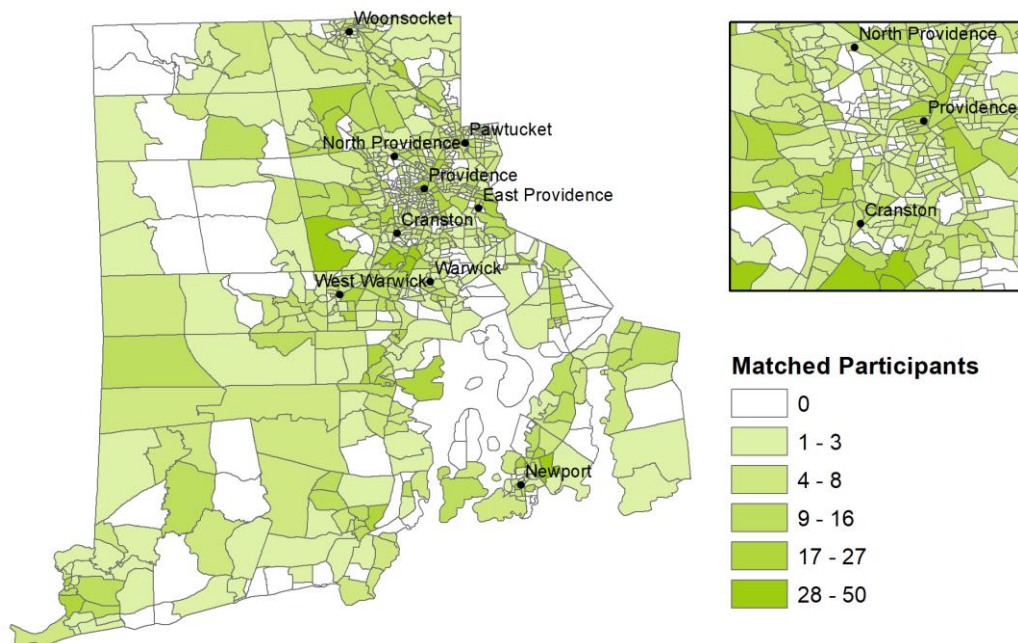
Figure 46. SMB/DI Electric Eligible Accounts by Census Block Group



Notes: Each listed interval includes both end points. 2,469 or 40% of historical participants were not found in the March 2017 database and are not included

Source: Navigant analysis of National Grid data

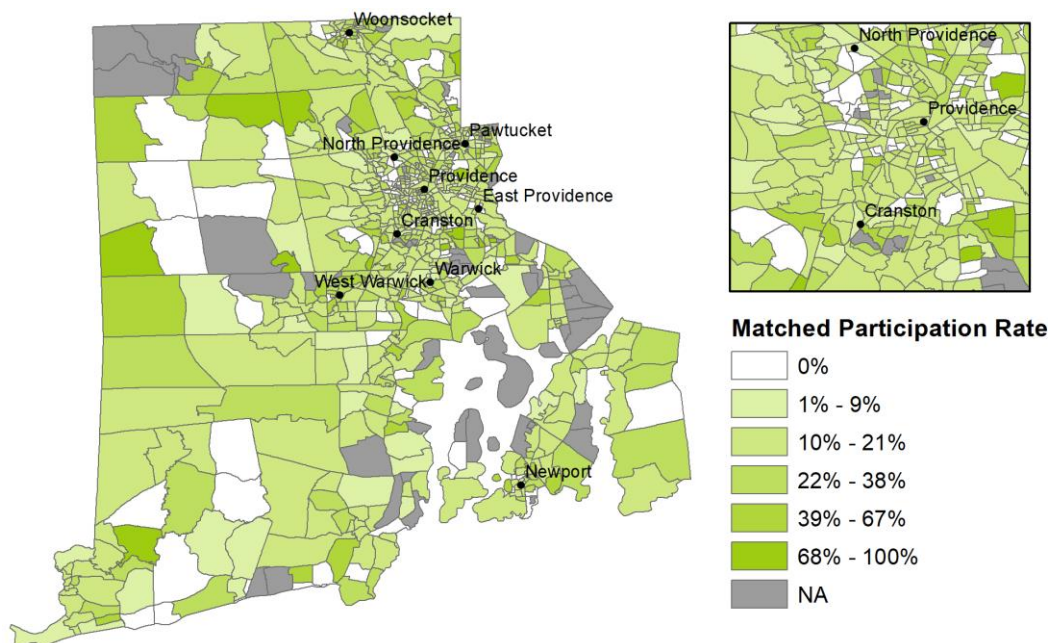
Figure 47. SMB/DI Electric Cumulative Matched Participation Count by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. 2,469 or 40% of historical participants were not found in the March 2017 database and are not included.

Source: Navigant analysis of National Grid data

Figure 48. SMB/DI Electric Cumulative Matched Participation Rate by Census Block Group: 2009-2015



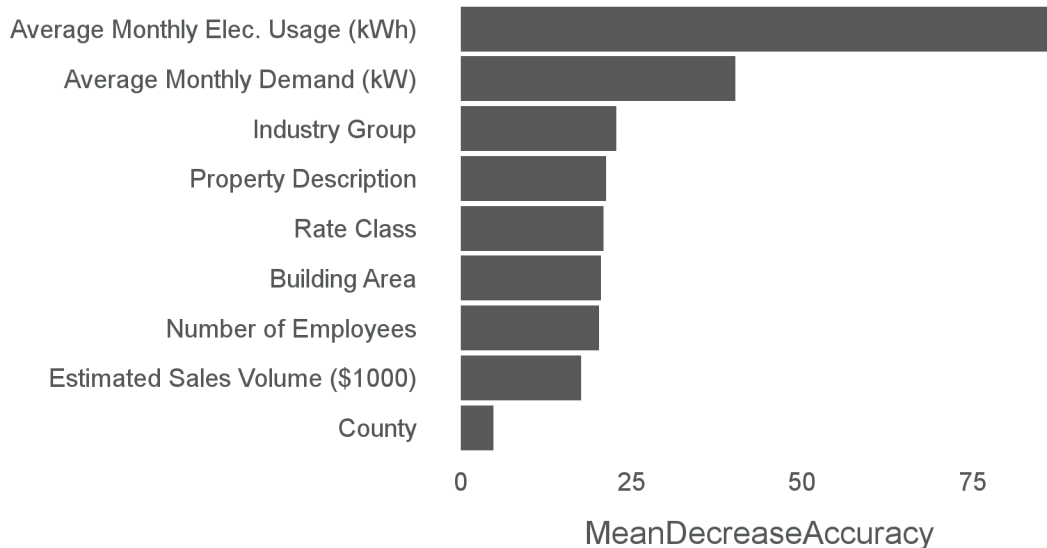
Notes: A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 2,469 or 40% of historical participants were not found in the March 2017 database and are not included

Source: Navigant analysis of National Grid data

8.2.2 Important Characteristics of Participants and Nonparticipants

Similar to other programs, Navigant developed a random forest classification model for eligible C&I accounts. The results of this model are shown in Figure 49.

Figure 49. Variable Importance Results, SMB/DI Electric



Source: Navigant analysis of National Grid data

Navigant further identified differences between participants and nonparticipants. This section presents the most important differences between participants and nonparticipants for the five most important variables. Navigant first investigated the rate class of electric customers. As shown in Table 55, large general service customers made up 49% of participants but only 17% of the nonparticipant population. Small general service customers represent 83% of the nonparticipant population and 49% of the participant population. These small general service customers represent a large pool of potential participants.

Table 55. Participation by Rate Class: 2009-2015

Rate Class	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
Electric General Service Small C&I	1,801	49%	17,564	83%
Electric General Service Large C&I with Demand	1,829	49%	3,216	15%
Electric C&I 200 kW Demand Service	42	1%	0	0%
Other*	67	2%	377	2%
Total	3,739	100%	21,157	100%

*Other includes Electric Residential, Electric Small C&I Unmetered, and Electric Residential Low Income

Source: Navigant analysis of National Grid data

Navigant analyzed 2009-2015 SMB/DI program participation by industry type, as seen in Table 56. The business characteristics in the C&I account databases include the North American Industry Classification

System (NAICS) code, which is used by federal agencies for the purposes of business classification.¹¹ To simplify analysis, Navigant created groupings of the first two digits of the NAICS code, which represent the highest level of industry classification. Participation has been well-distributed across industry types, with most industries participating in proportional to the size of their eligible population. The professional services industry group had the lowest participation rate, offering a potential pool of additional participants for targeting. The professional services industry group includes the following NAICS industries: information; finance and insurance; real estate and rental and leasing; professional, scientific, and technical services; management of companies and enterprises; and public administration.

Table 56. Electric Participation by Industry: 2009-2015

Industry	Participants		Nonparticipants	
	No.	Percentage	No	Percentage
Professional Services	442	12%	3,108	15%
Other Services	674	18%	2,916	14%
Manufacturing, Construction, Wholesale, Transportation, Warehousing	542	14%	2,631	12%
Health Care and Social Assistance	279	7%	1,786	8%
Educational Services	83	2%	354	2%
Retail Trade	655	18%	2,132	10%
Accommodation and Food Services	463	12%	1,378	7%
Unknown	601	16%	6,852	32%
Total	3,739	100%	21,157	100%

Source: Navigant analysis of National Grid data

For property description, the biggest difference between participant and nonparticipants was found to be for buildings with unknown information. Navigant did not find significant differences in historical participation rates for buildings with known property descriptions. This result suggests an area for exploration in future studies.

Table 57 shows the count of participants and nonparticipants by average monthly electric usage. Customers with an average monthly usage of less than 1,500 kWh represent 60% of the nonparticipant population but only 23% of the participation population.

¹¹ For more details, see <https://www.census.gov/eos/www/naics/>.

Table 57. Participation Rate by Average Monthly Electric Usage (kWh)

Average Monthly kWh	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
0-1,500	861	23%	12,611	60%
1,500-3,000	671	18%	3,080	15%
3,000-7,500	1,015	27%	2,726	13%
7,500-15,000	598	16%	955	5%
>15,000	544	15%	698	3%
Unknown	50	1%	1,087	5%
Total	3,739	100%	21,157	100%

Source: Navigant analysis of National Grid data

Table 58 shows the count of participants and nonparticipants by annual demand. Most customer records Navigant reviewed had an average monthly demand between 0 kW and 1 kW, which represents a large number of nonparticipants.

Table 58. Participation Rate by Average Monthly Demand (kW)

Average Monthly kW	Participants		Non-Participants	
	No.	Percentage	No.	Percentage
0	1,829	49%	16,869	80%
1-10	74	2%	478	2%
11-20	422	11%	859	4%
21-30	378	10%	634	3%
31-40	242	6%	339	2%
41-50	192	5%	233	1%
>50	552	15%	658	3%
Unknown	50	1%	1,087	5%
Total	3,739	100%	21,157	100%

Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B.

8.2.3 Discrete Choice Analysis

Results from the discrete choice model are in Table 59. For each variable, the table presents the relative influence of the variable and whether the variable is statistically significant. The influence of each variable can be interpreted as the increase in the likelihood of participation for a customer with that characteristic relative to the base category or characteristic. The base variables are not included in the table as they are relative to the variables included in the model. For example, square footage is grouped into three categories: 0-1,500 square feet, 1,500-15,000 square feet, and 15,000+ square feet. The influence of the latter two categories is relative to a building of 0-1,500 square feet. From the results, the team finds that a building of 0-1,500 square feet is less likely to participate than a building of 1,500-15,000 square feet, but more likely to participate than a building of greater than 15,000 square feet.

Table 59. Discrete Choice Results for SMB/DI (Electric)

Variable	Relative Influence	Statistically Significant*
Average Monthly kWh (1,500-3,000)	▲▲▲▲▲	Yes
Average Monthly kWh (3,000+)	▲▲▲▲▲	Yes
Industry (Accommodation/Food Services)	▲▲	Yes
Industry (Healthcare/Social Assistance)	▲	Yes
Industry (Mfg/Const/Whsle/Trans/Whous)	▲▲	Yes
Industry (Other Services)	▲▲▲▲	Yes
Industry (Retail)	▲▲▲▲	Yes
Rate Class (Large C&I w/ Demand)	▲▲▲	Yes
Square Footage (1,500-15,000)	▲▲	Yes
Square Footage (15,000+)	▼	No

Key	▼	▲	▲▲	▲▲▲	▲▲▲▲	▲▲▲▲▲
Relative Likelihood of Participation	-0 to -5%	0 to 5%	5 to 10%	10 to 15%	15 to 25%	25 to 35%

*Statistically significant at the 95% level.

Source: Navigant analysis of National Grid data

Results from the electric discrete choice modeling align well with the targeting analysis. Characteristics with large and significant marginal effects include businesses using over 3,000 kWh a month, businesses in the Large C&I with Demand rate class, and retail businesses.

8.2.4 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts.

The Matched Past Participants, 2009-2015 category includes 3,739 customers who have participated from 2009-2015. Of these participants, 2,396 participated between 2009-2013 and would be eligible for a repeat audit. There were also 2,469 unmatched participants not found in the March 2017 C&I account database. The Eligible Accounts Similar to Past Participants category is summarized in Table 60, and lists the characteristics of those customers most similar to past participants. Also listed are the number of customers that have all preferred characteristics, which represents nonparticipants most likely to participate.

Table 60. Characteristics of Eligible Accounts Similar to Past Participants, SMB/DI Electric

Customer Description	Accounts	Share*
One or more characteristic:		
• Rate Class: General Service Large C&I with Demand	5,257	21%
• Average Monthly Usage: >3,000 kWh		
• Industry: Retail trade or accommodation and food services		
All characteristics	670	3%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (24,896).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 61. Within this category, Navigant identified a group customers that are less likely to participate, which includes customers who have one or more nonpreferred characteristic. These customers include those with an average monthly usage less than 1,500 kWh, who would have less incentive to participate due to lower energy savings potential. Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates but could potentially be reached through changes in program design. Navigant estimated a share of the remaining nonparticipants that could potentially participate based on the cumulative historical participation rate for the program (24.7%) from 2009 through 2015.

Table 61. Characteristics of Other Eligible Accounts, SMB/DI Electric

Customer Description	Accounts	Share*
Less likely to participate – one or more characteristic:		
• Average Monthly Usage: <1,500 kWh	12,611	51%
Unclassified Nonparticipants	2,895	12%
Program design opportunity – one or more characteristic:		
• Industry: Professional services	394	2%
Total	15,900	64%
Historical Participant Share**	3,922	16%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (24,896).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of this targeting analysis is shown in Table 62.

Table 62. Summary of Target Customers, SMB/DI Electric

Category	Accounts	Share
Matched Past Participants, 2009-2015	3,739	15%
Eligible Accounts Similar to Past Participants	5,257	21%
Historical Participant Share of Other Eligible Accounts*	3,922	16%
Other Eligible Accounts	11,978	48%
Total Eligible Accounts	24,896	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015.

Source: Navigant analysis of National Grid data

8.2.5 Measure Category Participation Rates

Lighting measures made up nearly 90% of SMB/DI participation from 2009 to 2015, as shown in Table 63. Roughly 10% of participants received both lighting and at least one non-lighting measure. CFL volume has declined steadily since 2012, replaced by LEDs.

Table 63. Participation by Electric Measure Category: 2009-2015

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
Lighting									
CFL	556	852	1,039	1,139	623	518	273	5,000	4,667
LED	207	247	313	207	902	643	874	3,393	3,188
Lighting Controls	218	316	340	229	180	145	130	1,558	1,524
Exterior Lighting	96	89	346	344	3	158	213	1,249	1,221
Custom Lighting	106	90	102	113	112	123	182	828	762
Non-Lighting									
Prescriptive Non-Lighting	30	37	84	122	145	121	90	629	614
Prescriptive Motors & Drives	N/A	N/A	15	70	87	80	58	310	308
Custom Non-Lighting	27	34	29	N/A	23	15	2	130	127
Other Custom Non-Lighting	11	15	24	24	20	49	21	164	160
Custom Process	N/A	2	2	1	1	1	1	8	8
Thermostats	N/A	1	1	N/A	3	1	2	8	8

An N/A value in this table indicates that participation data was not available for that year.

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 64. Measure Category Percentage of Total Participation, SMB/DI Electric

Measure Category	2009	2010	2011	2012	2013	2014	2015	Additive*	Cumulative*
Lighting									
CFL	87%	93%	90%	89%	53%	54%	26%	70%	76%
LED	32%	27%	27%	16%	77%	67%	83%	47%	52%
Lighting Controls	34%	34%	29%	18%	15%	15%	12%	22%	25%
Exterior Lighting	15%	10%	30%	27%	0.3%	16%	20%	17%	20%
Custom Lighting	17%	10%	9%	9%	10%	13%	17%	12%	12%
Non-Lighting									
Prescriptive Non-Lighting	5%	4%	7%	10%	12%	13%	9%	9%	10%
Prescriptive Motors & Drives	N/A	N/A	1%	5%	7%	8%	6%	6%	6%
Custom Non-Lighting	4%	4%	3%	N/A	2%	2%	0.2%	2%	2%
Other Custom Non-Lighting	2%	2%	2%	2%	2%	5%	2%	2%	3%
Custom Process	N/A	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Thermostats	N/A	0.1%	0.1%	N/A	0.3%	0.1%	0.2%	0.2%	0.2%

An N/A value in this table indicates that participation data was not available for that year.

*Calculated based on years for which measure category participation data was available.

Source: Navigant analysis of National Grid data

8.3 Gas Results

8.3.1 Program Participation Rates

Navigant calculated annual, additive, and cumulative program participation counts for the SMB/DI Gas program, listed in Table 65. Navigant determined the number of nonparticipants and participation rates assuming a constant number of 17,892 eligible accounts, calculated using the criteria described in Section 8.1.

Table 65. Annual Program Participation, Small Business Direct Install Gas

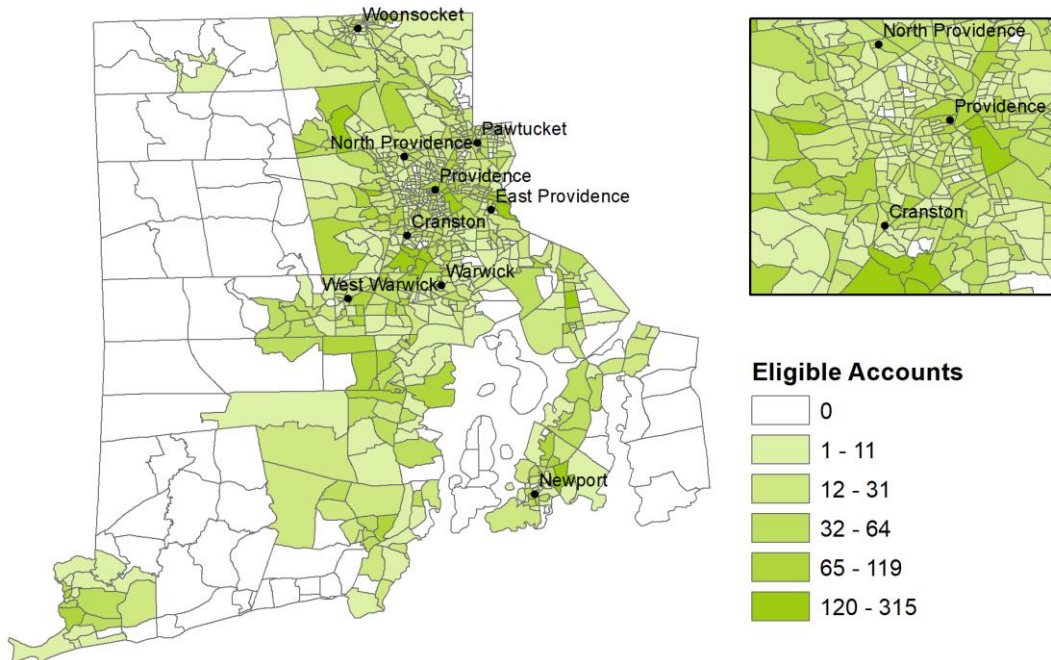
Year	2009	2010	2011	2012	2013	2014	2015	Additive	Cumulative
P	N/A	17	132	160	111	297	121	838	824
Non-P	17,892	17,875	17,760	17,732	17,781	17,595	17,771	17,054	17,068
Rate	N/A	0.1%	0.7%	0.9%	0.6%	1.7%	0.7%	4.7%	4.6%

An N/A value in this table indicates that participation data was not available for that year

Source: Navigant analysis of National Grid data

Figure 50 through Figure 52 illustrate the distribution of eligible accounts, participants, and participation rate from 2009 through 2015 by census block group in Rhode Island. Most participants were found near Providence in areas of higher population. Additionally, a list of participation counts and rates by ZIP code can be found in Table A-3 in Appendix A.

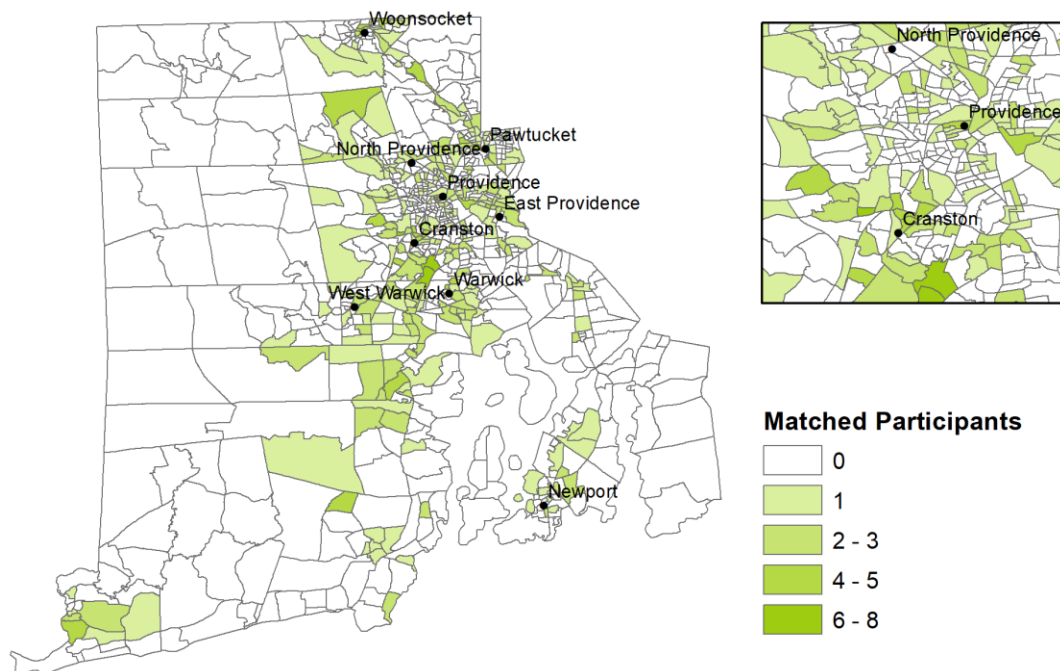
Figure 50. SMB/DI Gas Eligible Accounts by Census Block Group



Notes: Each listed interval includes both end points. 353 or 42% of historical participants were not found in the March 2017 database and are not included.

Source: Navigant analysis of National Grid data

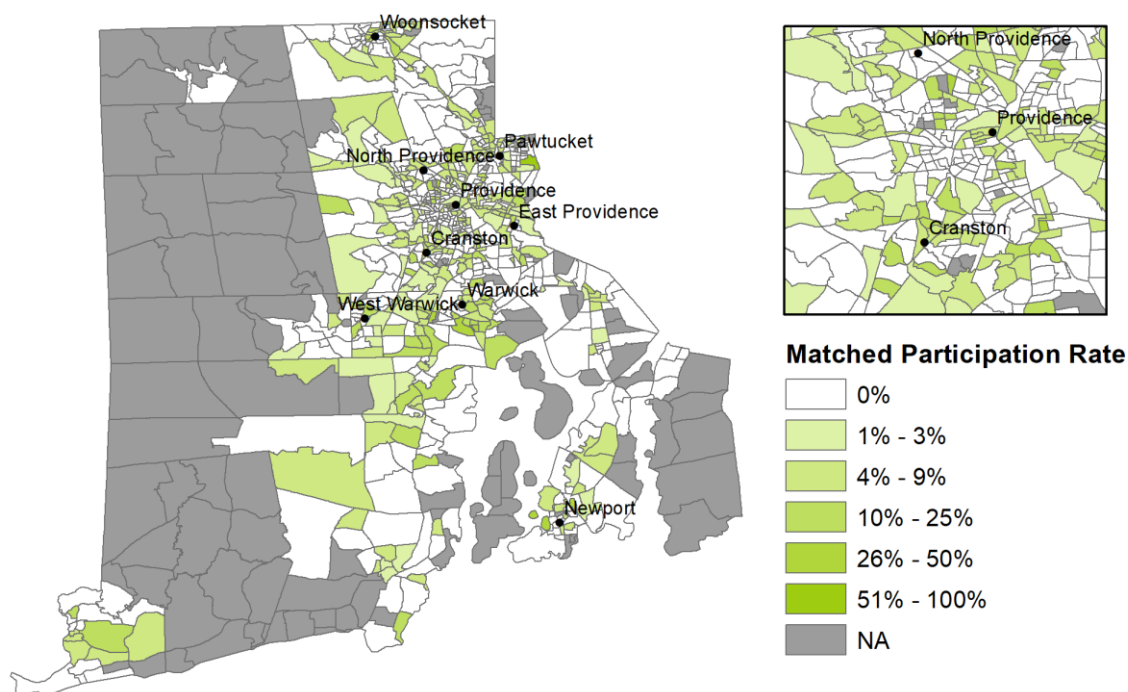
Figure 51. SMB/DI Gas Cumulative Matched Participation Count by Census Block Group: 2009-2015



Notes: Each listed interval includes both end points. 353 or 42% of historical participants were not found in the March 2017 database and are not included.

Source: Navigant analysis of National Grid data

Figure 52. SMB/DI Gas Program Cumulative Matched Participation Rate by Census Block Group: 2009-2015



Notes: A value of NA means that no eligible accounts were found, while 0% means that eligible accounts were found but none participated. Each listed interval includes both end points. 353 or 42% of historical participants were not found in the March 2017 database and are not included

Source: Navigant analysis of National Grid data

8.3.2 Important Characteristics of Participants and Nonparticipants

Due to the low number of matched participants with complete business and property information, Navigant was unable to develop analytical models for the SMB/DI Gas program. Nevertheless, Navigant analyzed differences in characteristics between nonparticipants and participants, aided by the results of analysis of the SMB/DI Electric program.

Table 66 shows lists participants and nonparticipants by rate class. As with electric customers, small general service gas customers made up roughly 50% of participants, though they make up nearly 80% of the nonparticipant population. These small general service customers represent a large pool of potential participants.

Table 66. Participation by Gas Rate Class: 2009-2015

Rate Class	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
C&I Small	249	53%	13,639	78%
C&I Medium	209	44%	3,299	19%
C&I Large	13	3%	481	3%
Res Non Heat*			2	0%
Total	471	100%	17,421	100%

*Accounts associated with church properties.

Source: Navigant analysis of National Grid data

Navigant also investigated differences in participants and nonparticipants in terms of industry, shown in Table 67. Navigant created groupings of the first two digits of the NAICS code, which represent the highest level of industry classification. The accommodation and food services industries made up only 15% of electric participation, though 51% of gas participants, despite representing only 10% of the nonparticipant population. The professional services industry had the lowest gas participation rate, offering a potential pool of additional participants for targeting. The professional services industry group includes the following NAICS industries: information; finance and insurance; real estate and rental and leasing; professional, scientific, and technical services; management of companies and enterprises; and public administration.

Table 67. Gas Participation by Industry: 2009-2015

Industry	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
Accommodation and Food Services	197	42%	1,140	7%
Other Services	71	15%	2,639	15%
Health Care and Social Assistance	30	6%	1,326	8%
Educational Services	3	1%	513	3%
Manufacturing, Construction, Wholesale, Transportation, Warehousing	32	7%	2,231	13%
Professional Services*	25	5%	2,477	14%
Retail Trade	23	5%	1,884	11%
Unknown	90	19%	5,211	30%
Total	471	100%	17,421	100%

*Professional services includes the following NAICS industries: information; finance and insurance; real estate and rental and leasing; professional, scientific, and technical services; and management of companies and enterprises.

Source: Navigant analysis of National Grid data

Table 68 compares participation rates in terms of estimated sales volume. Small businesses with sales volume between \$0 and \$500,000 were more likely to participate than larger businesses, accounting for 50% of participants from 2009 through 2015.

Table 68. Participation Rate by Estimated Sales Volume (\$1,000): 2009-2015

Estimated Sales Volume (\$1,000)	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
0 to 500	234	50%	6,659	38%
500 to 1,500	85	18%	2,749	16%
1,500 to 2,500	28	6%	944	5%
2,500+	38	8%	2,094	12%
Unknown	86	18%	4,975	29%
Total	471	100%	17,421	100%

Source: Navigant analysis of National Grid data

Table 69 shows the count of participants and nonparticipants by average monthly gas usage. Customers with an average monthly usage of less than 200 therms represent 60% of the nonparticipant population but only 28% of the participation population.

Table 69. Participation Rate by Average Monthly Gas Usage (Therms): 2009-2015

Average Monthly Therms	Participants		Nonparticipants	
	No.	Percentage	No.	Percentage
<50	29	6%	3,945	23%
50-199	103	22%	6,353	36%
200-349	91	19%	2,001	11%
350-649	95	20%	1,781	10%
650-1,399	91	19%	1,360	8%
>1,400	56	12%	1,081	6%
Unknown	6	1%	900	5%
Total	471	100%	17,421	100%

Source: Navigant analysis of National Grid data

A summary of the characteristics of participants and non-participants is included in Appendix B.

8.3.3 Target Groups

As described in Section 3.4, Navigant identified four main target group categories: Matched Past Participants, 2009-2015, Eligible Accounts Similar to Past Participants, Other Eligible Accounts, and Historical Participant Share of Other Eligible Accounts.

The Matched Past Participants, 2009-2015 category includes 471 customers who have participated from 2009-2015 and were found in the C&I account database. There were also 353 unmatched participants not found in the March 2017 C&I account database. The Eligible Accounts Similar to Past Participants category is summarized in Table 70, and lists the characteristics of those customers most similar to past participants. Also listed are the number of customers that have all preferred characteristics, which represents nonparticipants most likely to participate.

Table 70. Characteristics of Nonparticipants More Likely to Participate, SMB/DI Gas

Customer Description	Accounts	Share*
One or more characteristic:		
• Rate Class: Gas C&I Medium	4,254	24%
• Industry: Accommodation and food services		
• Estimated Sales Volume: <\$500,000		
All characteristics	278	2%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (17,892).

Source: Navigant analysis of National Grid data

The Other Eligible Accounts category is summarized in Table 71. Within this category, Navigant identified a group customers that are less likely to participate, which includes customers who have one or more nonpreferred characteristic. These customers include those with an average monthly usage less than 1,500 kWh, who would have less incentive to participate due to lower energy savings potential. Also within the Other Eligible Accounts category, Navigant identified some customers with nonpreferred characteristics as representing a program design opportunity. These customers have characteristics that have historically been associated with lower participation rates but could potentially be reached through changes in program design. Navigant estimated a share of the remaining nonparticipants that could potentially participate based on the cumulative historical participation rate (4.6%) for the program from 2009 through 2015.

Table 71. Characteristics of Nonparticipants Less Likely to Participate, SMB/DI Gas

Customer Description	Accounts	Share
Less likely to participate – one or more characteristic:		
• Average Monthly Usage: <200 therms	10,298	58%
Unclassified nonparticipants	1,920	11%
Program design opportunity – one or more characteristic:		
• Rate Class: Gas C&I Small	949	5%
Total	13,167	74%
Historical Participant Share**	606	3%

*Share is the number of accounts indicated divided by the total number of eligible accounts in the program (17,892).

**Based on historical participation rate for the program.

Source: Navigant analysis of National Grid data

A summary of this targeting analysis is shown in Table 72.

Table 72. Summary of Target Customers, SMB/DI Gas

Category	Accounts	Share
Matched Past Participants, 2009-2015	471	3%
Eligible Accounts Similar to Past Participants	4,254	24%
Historical Participant Share of Other Eligible Accounts*	606	3%
Other Eligible Accounts	12,561	70%
Total Eligible Accounts	17,892	100%

*Calculated based on the historical cumulative participation rate of the program from 2009 through 2015

Source: Navigant analysis of National Grid data

8.3.4 Measure Category Participation Rates

Pre-rinse spray valves made up over 50% of 2009-2015 SMB/DI gas measure participation, as shown in Table 73.

Table 73. Participation by Gas Measure Category: 2010-2015

Measure Category	2010	2011	2012	2013	2014	2015	Additive	Cumulative
Pre-Rinse Spray Valve	8	47	104	64	247	70	540	535
DHW	3	68	26	12	81	17	207	206
Thermostat	7	66	45	40	13	20	191	189
Custom	N/A	N/A	N/A	N/A	31	27	58	58
Boiler Reset Control	0	1	5	7	5	6	24	24
Insulation	4	3	4	4	0	1	16	16

An N/A value in this table indicates that participation data was not available for that year

Measure category counts do not necessarily represent all participants, as complete measure category information was not available for all programs.

Source: Navigant analysis of National Grid data

Table 74. Measure Category Percentage of Total Participation, SMB/DI Gas

Measure Category	2010	2011	2012	2013	2014	2015	Additive*	Cumulative*
Pre-Rinse Spray Valve	47%	36%	65%	58%	83%	58%	64%	65%
DHW	18%	52%	16%	11%	27%	14%	25%	25%
Thermostat	41%	50%	28%	36%	4%	17%	23%	23%
Custom	N/A	N/A	N/A	N/A	10%	22%	14%	14%
Boiler Reset Control	N/A	1%	3%	6%	2%	5%	3%	3%
Insulation	24%	2%	3%	4%	N/A	1%	3%	3%

An N/A value in this table indicates that participation data was not available for that year

*Calculated based on years for which measure category participation data was available

Source: Navigant analysis of National Grid data

8.4 Program Design Considerations

The SMB/DI program could consider the following tactics to increase program participation with historically underrepresented customer groups. The considerations include the following:

1. **Geo-targeting for Underserved Locations or Business Types:** Conduct additional market research to identify and quantify program participation versus eligible market (both by geography and business type). If confirmed that program participation is not proportional to eligible population, then implement participation bonuses to the lead vendor for goal attainment in the target geographic or market segments that historically are underrepresented.
2. **Performance Incentives for Regional Program Administrator:** Consider developing more aggressive performance milestones and awards tied to goal attainment. Include varying goals/performance payments targeted to the number of participants, types of participants (targeting historically underrepresented customer groups), and depth of savings opportunities achieved.
3. **Immediate Direct Install:** At the time of the initial customer visit/recruitment phase, consider some immediate direct install of observed opportunities (e.g., smart strips, vending misers). Claim these immediate savings while setting the stage for the follow-up visit.
4. **Provide Value-Added Services to Engage Different Customers and Improve Recruitment and Enrollment:** Research and identify common small business management items and provide this information or toolkit to customers as a reward for program participation. Information transfer can include multiple formats, print, podcasts, pre-recorded webinars, or in-person seminars. Experiment on what type of presentation and material style is most accessible to the target customer groups. Specific services should be tailored to the business type. National Grid should convey to the customer that it wants their business to succeed and that it has the tools and resources to help manage small businesses. This might include items such as:
 - a. Strategies for inventory optimization
 - b. Strategies for marketing
 - c. Strategies for broader financing and loan refinancing
 - d. Strategies tailored to specific business type

APPENDIX A. DETAILED PARTICIPATION BY ZIP CODE

To provide additional detail regarding the geographic distribution of participants in Rhode Island, Navigant tabulated participants and accounts by ZIP code in this appendix.

Figure A-1. Rhode Island ZIP Codes

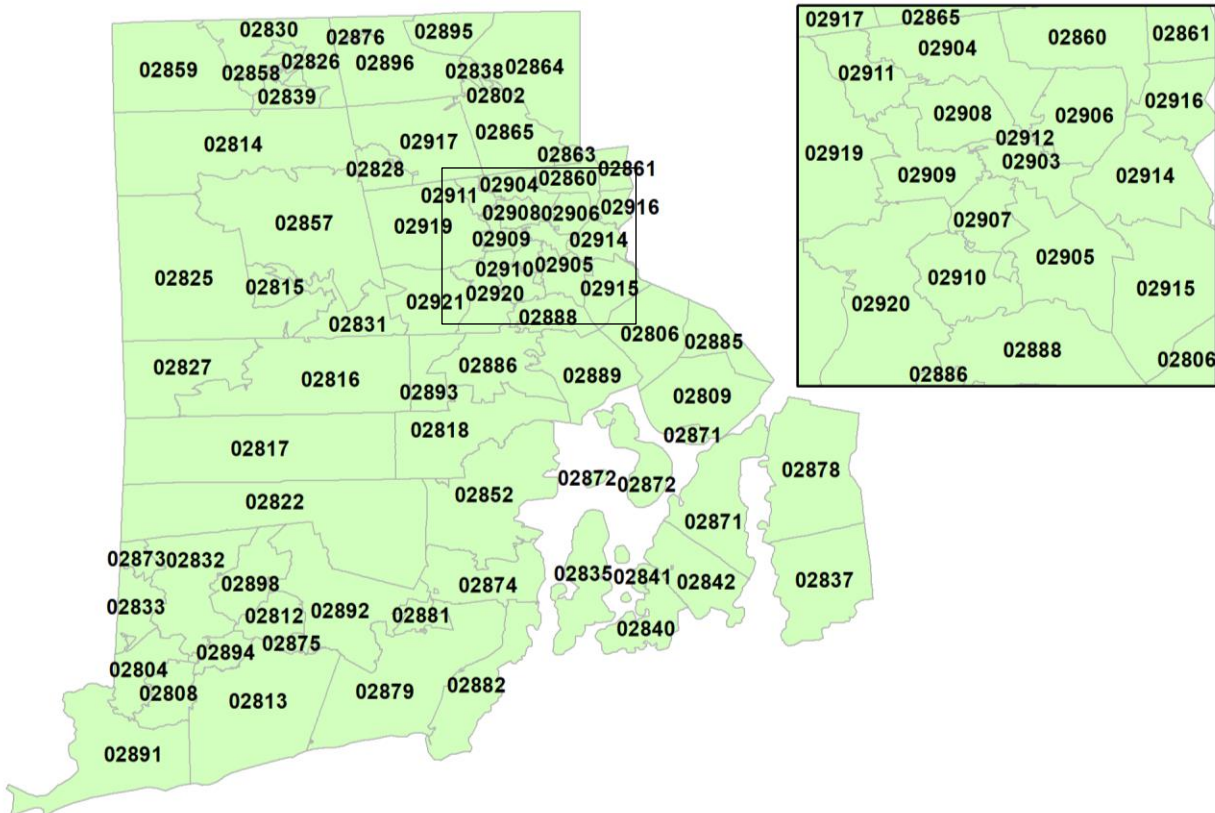


Table A-1. Residential Cumulative Matched Participation by ZIP Code: 2009-2015

ZIP	EWSF Electric			IESF Electric			EWSF Gas			IESF Gas		
	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate
02802	17	162	10%	2	10	20%	-	14	0%			
02804	58	1,031	6%	39	79	49%	-	19	0%	-	1	0%
02806	1,009	5,927	17%	71	188	38%	339	4,507	8%	9	83	11%
02808	53	1,188	4%	37	90	41%	3	215	1%	5	18	28%
02809	744	7,289	10%	113	443	26%	122	3,676	3%	8	162	5%
02812	49	510	10%	20	27	74%						
02813	272	4,158	7%	104	196	53%						
02814	228	2,846	8%	74	203	36%						
02815	5	100	5%	-	4	0%						
02816	1,068	10,712	10%	279	778	36%	173	3,635	5%	18	136	13%

ZIP	EWSF Electric			IESF Electric			EWSF Gas			IESF Gas		
	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate
02817	212	2,252	9%	54	108	50%	-	304	0%	-	1	0%
02818	956	6,365	15%	47	127	37%	231	3,328	7%	4	38	11%
02822	228	2,124	11%	48	96	50%	7	201	3%	1	3	33%
02825	145	1,854	8%	45	92	49%						
02826	36	389	9%	9	18	50%						
02827	65	797	8%	10	35	29%						
02828	331	2,154	15%	42	94	45%	53	713	7%	2	17	12%
02830	96	848	11%	25	47	53%	-	5	0%			
02831	161	1,318	12%	25	71	35%	10	103	10%	1	3	33%
02832	153	2,056	7%	66	124	53%						
02833	19	304	6%	5	14	36%						
02835	310	2,822	11%	14	39	36%						
02836	6	81	7%	1	2	50%						
02837	433	2,220	20%	17	65	26%						
02838	83	1,013	8%	8	60	13%	21	762	3%	2	26	8%
02839	65	668	10%	40	80	50%						
02840	716	9,016	8%	49	326	15%	140	5,511	3%	5	135	4%
02841												
02842	525	5,452	10%	48	174	28%	53	2,131	2%	1	23	4%
02852	1,003	8,013	13%	154	393	39%	302	5,098	6%	18	180	10%
02857	392	3,091	13%	77	148	52%	-	8	0%			
02858	10	195	5%	3	9	33%						
02859	1	15	7%	2	6	33%	-	45	0%			
02860	650	11,315	6%	376	1,951	19%	230	10,290	2%	117	1,541	8%
02861	831	8,707	10%	313	1,024	31%	320	7,627	4%	79	623	13%
02863	148	4,036	4%	112	754	15%	33	3,595	1%	33	642	5%
02864	1,449	10,845	13%	131	486	27%	339	6,223	5%	21	254	8%
02865	916	5,618	16%	82	230	36%	309	4,290	7%	14	109	13%
02871	613	6,597	9%	86	258	33%	57	1,544	4%	3	26	12%
02872	9	419	2%	-	2	0%						
02873	7	119	6%	1	6	17%						
02874	309	2,263	14%	19	53	36%	50	550	9%	1	4	25%
02875	18	160	11%	6	15	40%						
02876	62	513	12%	9	27	33%	2	51	4%			
02878	787	5,988	13%	217	547	40%	17	694	2%	3	30	10%
02879	973	9,441	10%	150	336	45%	99	1,894	5%	6	33	18%
02881	103	713	14%	5	12	42%	10	253	4%	1	4	25%
02882	723	7,695	9%	91	206	44%	138	2,780	5%	7	46	15%
02885	313	3,702	8%	100	372	27%	46	2,111	2%	10	183	5%
02886	1,209	8,815	14%	215	573	38%	418	6,193	7%	34	276	12%
02888	1,024	6,746	15%	170	461	37%	343	5,066	7%	38	212	18%
02889	1,085	9,356	12%	272	799	34%	417	7,706	5%	67	467	14%
02891	645	9,766	7%	204	595	34%	68	3,026	2%	13	168	8%
02892	164	1,419	12%	41	64	64%	7	41	17%			

ZIP	EWSF Electric			IESF Electric			EWSF Gas			IESF Gas		
	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate	P	Accts	Rate
02893	766	8,751	9%	184	794	23%	125	3,453	4%	21	212	10%
02894	22	260	8%	14	30	47%						
02895	772	10,506	7%	224	1,057	21%	205	7,840	3%	51	535	10%
02896	540	3,444	16%	59	164	36%	53	788	7%	1	27	4%
02898	37	528	7%	20	37	54%						
02903	57	1,409	4%	16	79	20%	20	1,183	2%	3	55	5%
02904	677	7,605	9%	315	987	32%	271	6,589	4%	69	563	12%
02905	598	5,880	10%	433	1,189	36%	175	5,249	3%	82	863	10%
02906	1,127	8,769	13%	52	213	24%	343	8,045	4%	15	126	12%
02907	254	4,770	5%	427	1,453	29%	81	4,339	2%	63	1,207	5%
02908	708	9,626	7%	422	1,537	27%	272	8,671	3%	64	1,085	6%
02909	381	8,968	4%	600	1,896	32%	108	8,204	1%	110	1,470	7%
02910	761	6,868	11%	526	1,030	51%	270	5,765	5%	109	607	18%
02911	531	4,492	12%	174	459	38%	199	3,671	5%	48	277	17%
02912	3	7	43%				1	6	17%			
02914	469	6,280	7%	200	791	25%	154	5,231	3%	31	440	7%
02915	593	5,620	11%	146	454	32%	200	4,097	5%	23	197	12%
02916	378	2,877	13%	61	181	34%	110	2,070	5%	8	62	13%
02917	445	3,847	12%	80	183	44%	72	1,574	5%	10	52	19%
02919	939	8,698	11%	406	992	41%	275	5,248	5%	92	440	21%
02920	1,341	10,232	13%	660	1,354	49%	427	7,709	6%	118	768	15%
02921	658	3,851	17%	54	105	51%	275	2,999	9%	7	32	22%
Total	33,544	324,491	10%	9,201	27,902	33%	7,993	186,940	4%	1,446	14,462	10%
Mean	447	4,327	10%	124	377	36%	143	3,338	4%	30	295	12%
SD	391	3,564	5%	151	468	13%	133	2,854	3%	36	387	8%

Source: Navigant analysis of National Grid data

Table A-2. Residential New Construction Participation by ZIP Code: 2009-2015

ZIP	Projects	ZIP	Projects
02806	65	02885	17
02809	32	02886	32
02813	49	02888	4
02814	19	02889	71
02816	395	02891	93
02817	7	02892	5
02818	18	02893	10
02822	8	02895	78
02828	2	02896	89
02830	1	02903	4
02831	1	02904	4
02832	7	02905	73
02835	16	02906	62

ZIP	Projects	ZIP	Projects
02837	22	02907	410
02840	205	02908	87
02842	67	02909	237
02852	232	02910	1
02857	1	02911	16
02859	1	02914	6
02860	118	02915	1
02861	153	02917	48
02863	38	02919	4
02864	358	02920	52
02865	41	02921	3
02871	60		
02873	12		
02874	5		
02878	110		
02879	237		
02881	4		
02882	72		
Total		3,763	
Mean		68	
SD		99	

Source: Navigant analysis of National Grid data

Table A-3. C&I Cumulative Matched Participation by ZIP Code: 2009-2015

ZIP	SMB/DI Electric			SMB/DI Gas		
	P	Accts	Rate	P	Accts	Rate
02804	7	55	13%	-	4	0%
02806	29	241	12%	2	188	1%
02808	3	9	33%	1	6	17%
02809	74	487	15%	4	399	1%
02812	-	1	0%			
02813	9	131	7%			
02814	23	94	24%			
02816	59	449	13%	3	307	1%
02817	24	123	20%	2	44	5%
02818	83	534	16%	10	494	2%
02822	16	80	20%	1	14	7%
02825	4	30	13%			
02826	1	9	11%			
02827	4	9	44%			
02828	30	174	17%	4	145	3%
02830	5	27	19%	-	1	0%
02831	3	14	21%			
02832	6	49	12%			

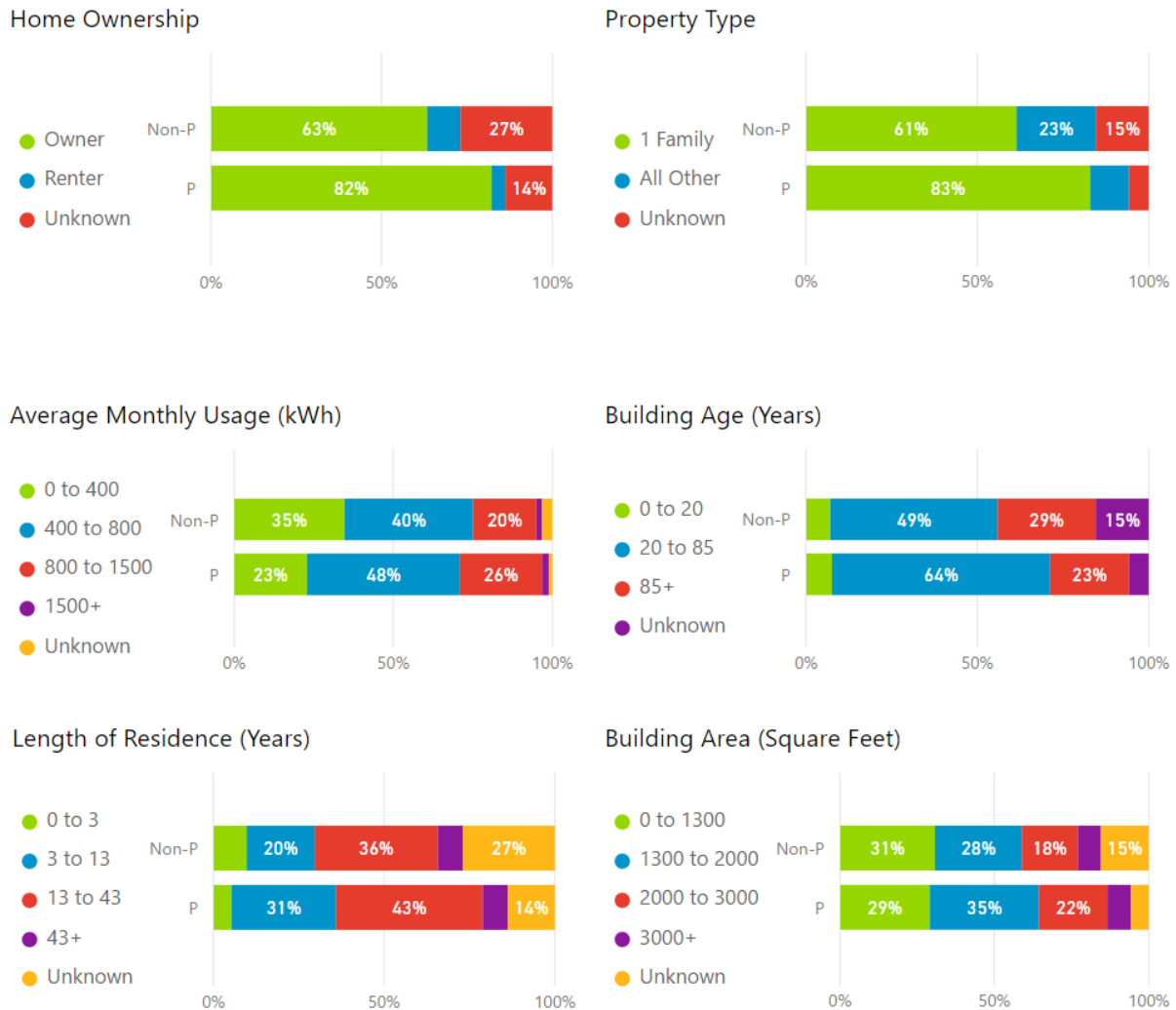
ZIP	SMB/DI Electric			SMB/DI Gas		
	P	Accts	Rate	P	Accts	Rate
02835	13	127	10%			
02837	5	26	19%			
02838	3	37	8%	1	37	3%
02839	4	17	24%	-	2	0%
02840	127	776	16%	7	541	1%
02842	119	736	16%	8	427	2%
02852	97	728	13%	15	523	3%
02857	8	63	13%			
02858	-	7	0%			
02860	162	1,173	14%	21	883	2%
02861	77	399	19%	8	314	3%
02863	37	272	14%	10	260	4%
02864	83	449	18%	14	354	4%
02865	70	372	19%	5	328	2%
02871	51	357	14%	2	185	1%
02873	-	4	0%			
02874	3	20	15%	-	8	0%
02876	-	5	0%	-	4	0%
02878	56	296	19%	-	81	0%
02879	89	577	15%	5	307	2%
02881	14	71	20%	4	78	5%
02882	41	246	17%	5	142	4%
02885	54	320	17%	8	263	3%
02886	221	1,618	14%	28	1,109	3%
02888	112	812	14%	20	632	3%
02889	67	442	15%	27	354	8%
02891	107	813	13%	13	459	3%
02892	5	63	8%	-	30	0%
02893	90	493	18%	8	375	2%
02894	2	7	29%			
02895	150	697	22%	28	581	5%
02896	26	186	14%	2	130	2%
02898	12	46	26%			
02903	97	979	10%	15	722	2%
02904	145	837	17%	17	664	3%
02905	92	603	15%	14	483	3%
02906	63	584	11%	13	511	3%
02907	73	501	15%	5	488	1%
02908	84	490	17%	16	426	4%
02909	72	686	10%	7	537	1%
02910	98	601	16%	25	488	5%
02911	29	244	12%	4	169	2%
02912	1	9	11%	-	68	0%
02914	124	892	14%	24	723	3%

ZIP	SMB/DI Electric			SMB/DI Gas		
	P	Accts	Rate	P	Accts	Rate
02915	61	363	17%	8	257	3%
02916	37	180	21%	3	153	2%
02917	77	538	14%	5	394	1%
02919	158	1,154	14%	15	694	2%
02920	206	1,284	16%	33	947	3%
02921	37	180	21%	1	133	1%
Total	3,739	24,896	15%	471	17,892	3%
Mean	55	366	16%	9	325	3%
SD	54	367	7%	9	271	3%

Source: Navigant analysis of National Grid data

APPENDIX B. CHARACTERISTICS OF PARTICIPANTS AND NON-PARTICIPANTS BY PROGRAM

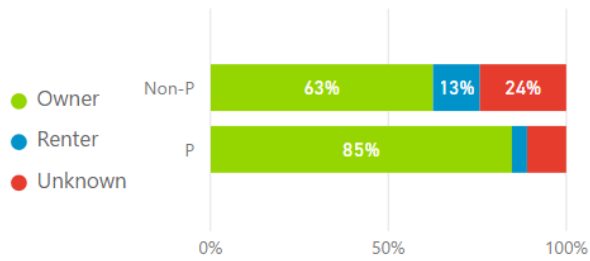
Figure B-1. EnergyWise Single Family Electric



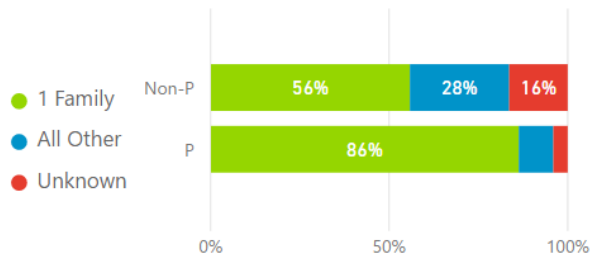
Source: Navigant analysis of National Grid Data.

Figure B-2. EnergyWise Single Family Gas

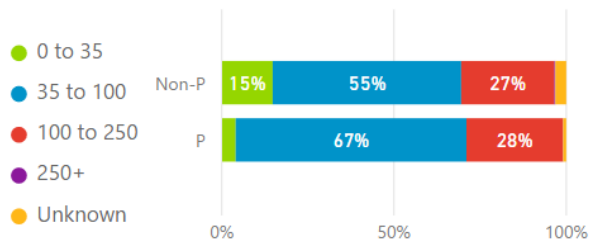
Home Ownership



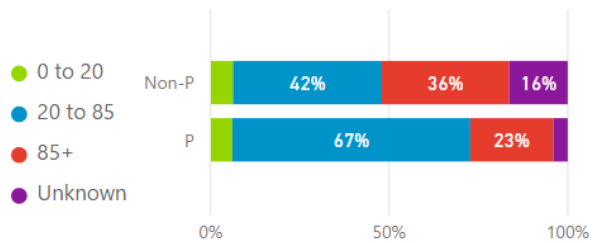
Property Type



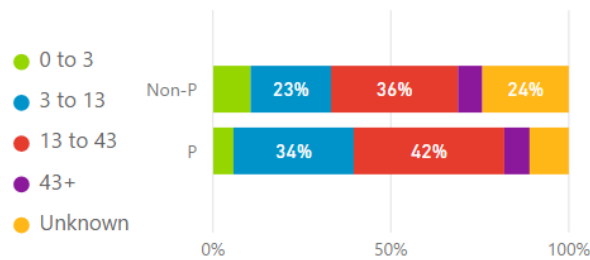
Average Monthly Usage (Therms)



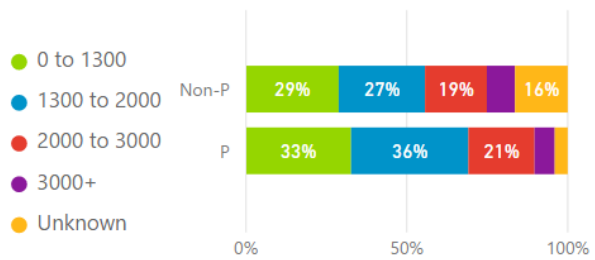
Building Age (Years)



Length of Residence (Years)



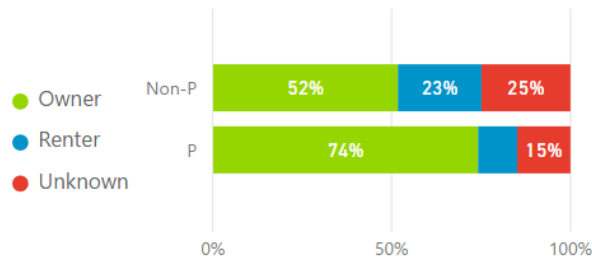
Building Area (Square Feet)



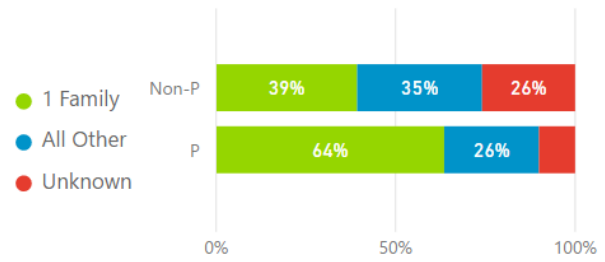
Source: Navigant analysis of National Grid Data.

Figure B-3. Income Eligible Single Family Electric

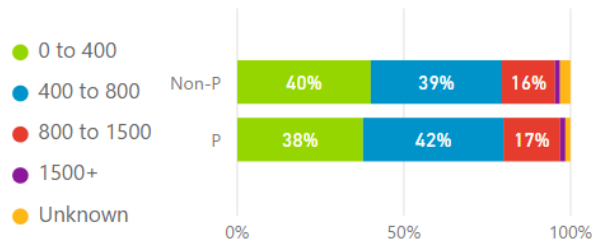
Home Ownership



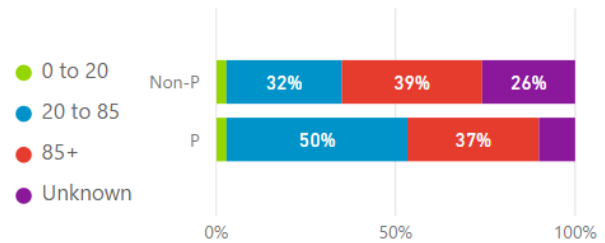
Property Type



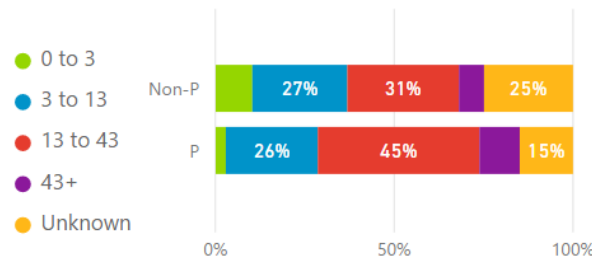
Average Monthly Usage (kWh)



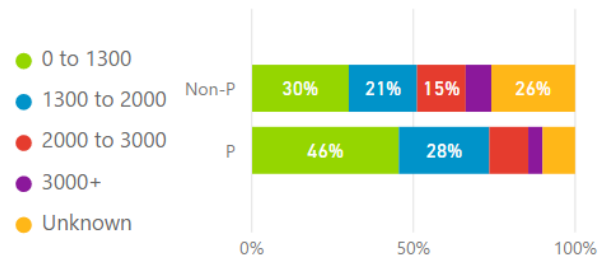
Building Age (Years)



Length of Residence (Years)



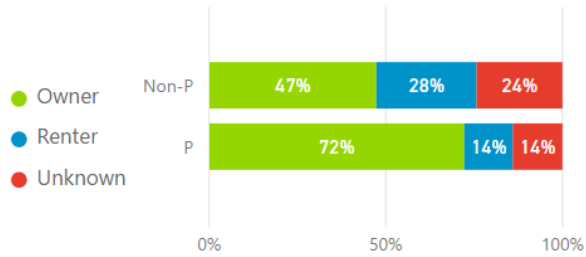
Building Area (Square Feet)



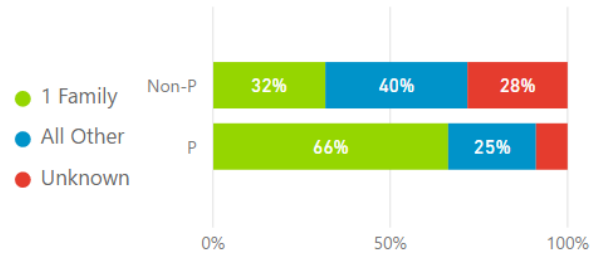
Source: Navigant analysis of National Grid Data.

Figure B-4. Income Eligible Single Family Gas

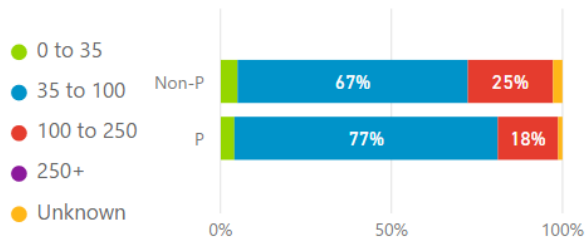
Home Ownership



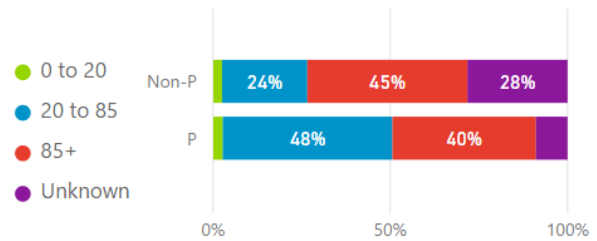
Property Type



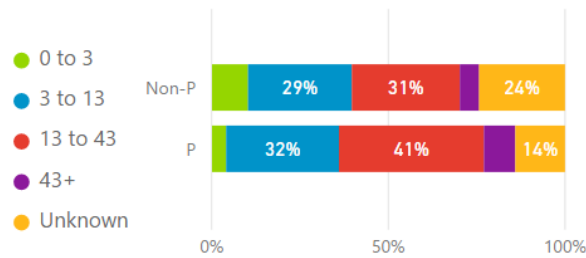
Average Monthly Usage (Therms)



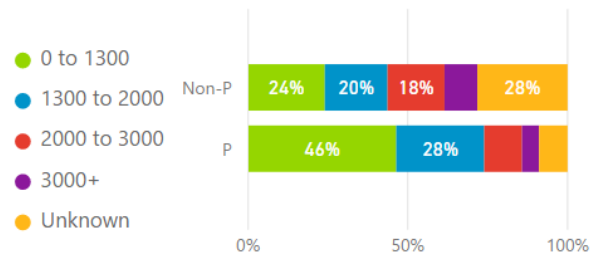
Building Age (Years)



Length of Residence (Years)



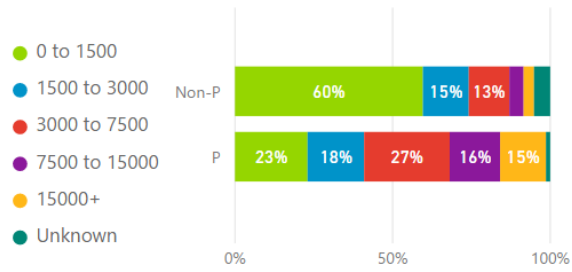
Building Area (Square Feet)



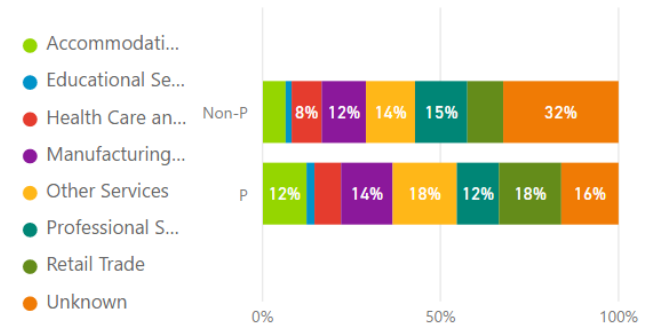
Source: Navigant analysis of National Grid Data.

Figure B-5. Small Business Direct Install Electric

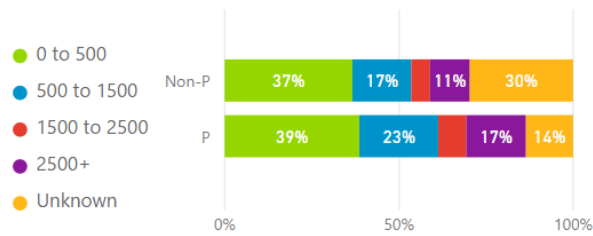
Average Monthly Usage (kWh)



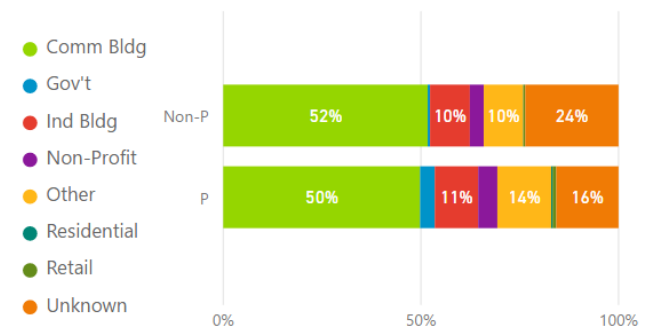
Industry Group



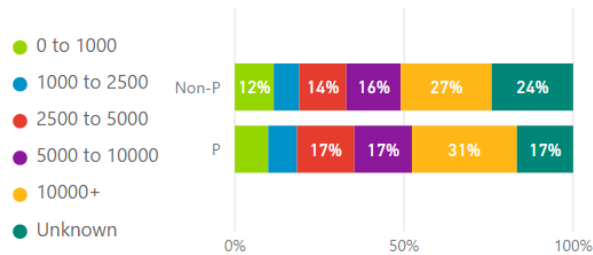
Estimated Sales Volume (\$1000)



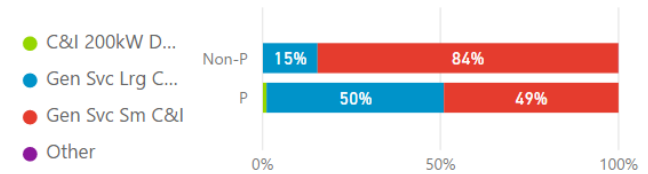
Property Type



Building Area (Square Feet)



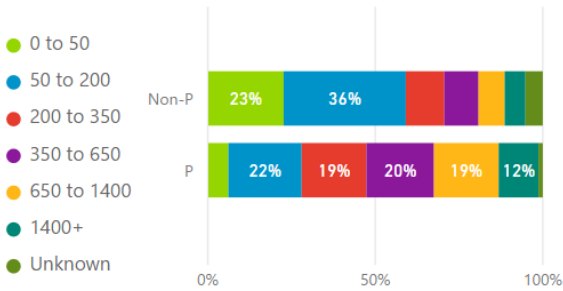
Rate Class



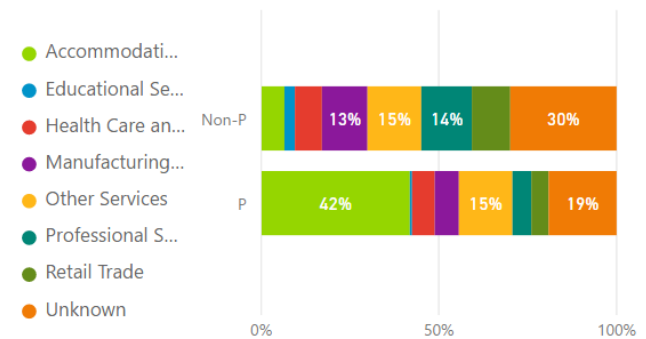
Source: Navigant analysis of National Grid Data.

Figure B-6. Small Business Direct Install Gas

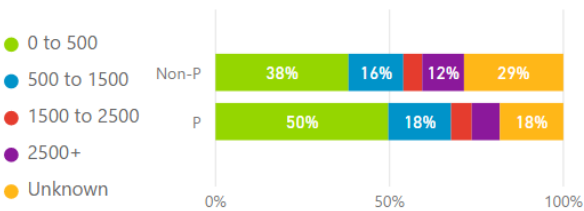
Average Monthly Usage (Therms)



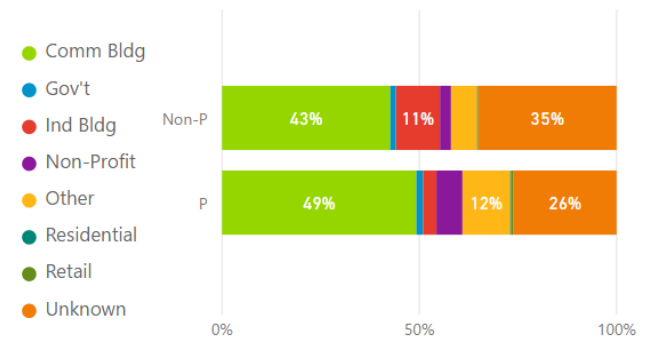
Industry Group



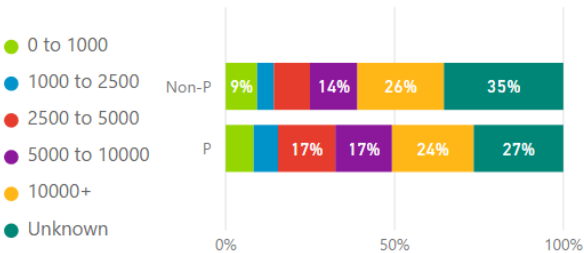
Estimated Sales Volume (\$1000)



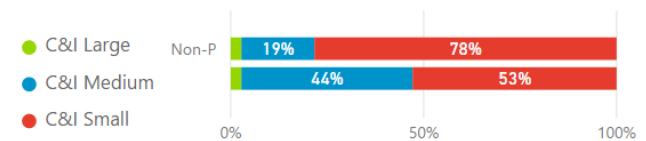
Property Type



Building Area (Square Feet)



Rate Class



Source: Navigant analysis of National Grid Data.

APPENDIX C. TABULATED CHARACTERISTICS OF PARTICIPANTS AND NON-PARTICIPANTS BY RESIDENTIAL PROGRAM

C.1 EnergyWise Single Family Electric

Table C-1. Characterization by Property Type, EnergyWise Single Family Electric

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	27,545	83%	179,087	61%
2-5-Family	2,658	8%	47,797	16%
Apt Bldg.	68	0%	1,875	1%
Condo	192	1%	6,022	2%
Mobile Home	120	0%	1,660	1%
Other	736	2%	9,777	3%
Unknown	1,906	6%	45,048	15%
Total	33,225	100%	291,266	100%

Source: Navigant analysis of National Grid data

Table C-2. Characterization by Length of Residence, EnergyWise Single Family Electric

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 3	1,772	5%	28,451	10%
3 to 13	10,158	31%	58,006	20%
13 to 43	14,297	43%	105,115	36%
43+	2,429	7%	21,423	7%
Unknown	4,569	14%	78,271	27%
Total	33,225	100%	291,266	100%

Source: Navigant analysis of National Grid data

Table C-3. Characterization by Building Area, EnergyWise Single Family Electric

Building Area (sq. ft.)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 1,300	9,659	29%	89,777	31%
1,300 to 2,000	11,744	35%	81,761	28%
2,000 to 3,000	7,412	22%	52,818	18%
3,000+	2,504	8%	21,862	8%
Unknown	1,906	6%	45,048	15%
Total	33,225	100%	291,266	100%

Source: Navigant analysis of National Grid data

Table C-4. Characterization by Building Age, EnergyWise Single Family Electric

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	2,521	8%	20,715	7%
20 to 85	21,157	64%	142,007	49%
85+	7,641	23%	83,496	29%
Unknown	1,906	6%	45,048	15%
Total	33,225	100%	291,266	100%

Source: Navigant analysis of National Grid data

Table C-5. Characterization by Average Monthly Usage, EnergyWise Single Family Electric

Average Monthly Usage (kWh)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 400	7,613	23%	101,050	35%
400 to 800	15,968	48%	117,739	40%
800 to 1,500	8,567	26%	57,936	20%
1,500+	707	2%	5,211	2%
Unknown	370	1%	9,330	3%
Total	33,225	100%	291,266	100%

Source: Navigant analysis of National Grid data

C.2 EnergyWise Single Family Gas

Table C-6. Characterization by Property Type, EnergyWise Single Family Gas

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	6,882	86%	99,914	56%
2-5-Family	614	8%	38,845	22%
Apt Bldg.	17	0%	1,403	1%
Condo	47	1%	4,884	3%
Mobile Home	4	0%	441	0%
Other	88	1%	4,173	2%
Unknown	321	4%	29,307	16%
Total	7,973	100%	178,967	100%

Source: Navigant analysis of National Grid data

Table C-7. Characterization by Length of Residence, EnergyWise Single Family Gas

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 3	460	6%	18,923	11%
3 to 13	2,695	34%	40,472	23%
13 to 43	3,374	42%	63,848	36%
43+	567	7%	12,291	7%
Unknown	877	11%	43,433	24%
Total	7,973	100%	178,967	100%

Source: Navigant analysis of National Grid data

Table C-8. Characterization by Building Area, EnergyWise Single Family Gas

Building Area (sq. ft.)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 1,300	2,605	33%	51,612	29%
1,300 to 2,000	2,907	36%	48,003	27%
2,000 to 3,000	1,639	21%	34,394	19%
3,000+	501	6%	15,651	9%
Unknown	321	4%	29,307	16%
Total	7,973	100%	178,967	100%

Source: Navigant analysis of National Grid data

Table C-9. Characterization by Building Age, EnergyWise Single Family Gas

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	484	6%	11,282	6%
20 to 85	5,314	67%	74,585	42%
85+	1,854	23%	63,793	36%
Unknown	321	4%	29,307	16%
Total	7,973	100%	178,967	100%

Source: Navigant analysis of National Grid data

Table C-10. Characterization by Average Monthly Usage, EnergyWise Single Family Gas

Average Monthly Usage (Therms)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 35	324	4%	26,488	15%
35 to 100	5,340	67%	97,939	55%
100 to 250	2,237	28%	48,411	27%
250+	2	0%	522	0%
Unknown	70	1%	5,607	3%
Total	7,973	100%	178,967	100%

Source: Navigant analysis of National Grid data

C.3 Income Eligible Single Family Electric

Table C-11. Characterization by Property Type, Income Eligible Single Family Electric

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	5,787	64%	7,384	39%
2-5-Family	1,723	19%	5,505	29%
Apt Bldg.	58	1%	208	1%
Condo	119	1%	127	1%
Housing Authority	3	0%	6	0%
Mobile Home	293	3%	249	1%
Other	209	2%	446	2%
Unknown	916	10%	4,869	26%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

Table C-12. Characterization by Length of Residence, Income Eligible Single Family Electric

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 8	1,472	16%	4,992	27%
8 to 20	2,556	28%	4,144	22%
20 to 40	2,490	27%	3,407	18%
40+	1,234	14%	1,577	8%
Unknown	1,356	15%	4,674	25%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

Table C-13. Characterization by Building Area, Income Eligible Single Family Electric

Building Area (sq. ft.)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 700	366	4%	780	4%
700 to 1,700	5,582	61%	7,434	40%
1,700 to 3,000	1,842	20%	4,223	22%
3,000+	402	4%	1,488	8%
Unknown	916	10%	4,869	26%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

Table C-14. Characterization by Building Age, Income Eligible Single Family Electric

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	264	3%	540	3%
20 to 85	4,589	50%	6,031	32%
85+	3,339	37%	7,354	39%
Unknown	916	10%	4,869	26%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

Table C-15. Characterization by Average Monthly Usage, Income Eligible Single Family Electric

Average Monthly Usage (kWh)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 400	3,442	38%	7,535	40%
400 to 800	3,834	42%	7,395	39%
800 to 1,500	1,550	17%	2,994	16%
1,500+	144	2%	284	2%
Unknown	138	2%	586	3%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

C.4 Income Eligible Single Family Gas

Table C-16. Characterization by Property Type, Income Eligible Single Family Gas

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	954	66%	4,131	32%
2-5-Family	315	22%	4,662	36%
Apt Bldg.	6	0%	134	1%
Condo	15	1%	103	1%
Housing Authority	1	0%	6	0%
Mobile Home	3	0%	49	0%
Other	16	1%	262	2%
Unknown	128	9%	3,677	28%
Total	1,438	100%	13,024	100%

Source: Navigant analysis of National Grid data

Table C-17. Characterization by Length of Residence, Income Eligible Single Family Gas

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 8	309	21%	3,664	28%
8 to 20	427	30%	3,049	23%
20 to 40	351	24%	2,275	17%
40+	149	10%	871	7%
Unknown	202	14%	3,165	24%
Total	1,438	100%	13,024	100%

Source: Navigant analysis of National Grid data

Table C-18. Characterization by Building Area, Income Eligible Single Family Gas

Building Area (sq. f.t)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 700	33	2%	413	3%
700 to 1,700	928	65%	4,283	33%
1700 to 3,000	272	19%	3,313	25%
3,000+	77	5%	1,338	10%
Unknown	128	9%	3,677	28%
Total	1,438	100%	13,024	100%

Source: Navigant analysis of National Grid data

Table C-19. Characterization by Building Age, Income Eligible Single Family Gas

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	40	3%	337	3%
20 to 85	688	48%	3,132	24%
85+	582	40%	5,878	45%
Unknown	128	9%	3,677	28%
Total	100%	13,024	100%	100%

Source: Navigant analysis of National Grid data

Table C-20. Characterization by Average Monthly Usage, Income Eligible Single Family Gas

Average Monthly Usage (Therms)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 25	19	1%	247	2%
25 to 85	971	68%	7,214	55%
85 to 250	430	30%	5,202	40%
250+	0	0%	2	0%
Unknown	18	1%	359	3%
Total	9,108	100%	18,794	100%

Source: Navigant analysis of National Grid data

APPENDIX D. SINGLE FAMILY INCOME ELIGIBLE ANALYSIS BY AMI

Navigant further investigated income eligible customers utilizing an alternate set of criteria for eligibility that considers area median income (AMI criteria). For this analysis, Navigant considered customers with household income between 0-60% AMI to be income eligible, regardless of participation or rate code. For this analysis, Navigant used the following criteria to identify income eligible customers:

1. Participated in an income eligible program in 2009-2015; or
2. Is on a low income rate:
 - a. For residential electric accounts, rate is A-60, or
 - b. For residential gas accounts, rate is 1101 (Non-Heating) or 1301 (Heating); or
3. Has a household income in the 0-60% AMI range.

In this analysis, customers were considered participants if they participated in either of the EnergyWise or Income Eligible Single Family programs.

D.1 Electric Results

Table D-1 lists the cumulative matched participation in income eligible electric programs compared with all accounts. The 85,168 income eligible accounts were determined by considering AMI in addition to prior participation and rate code. Importantly, 88,870 out of 352,393 single family accounts (25%) were missing household income information. Some of these accounts with unknown income information could also be considered income eligible, but were not included in this analysis. Among the 13,435 participants identified as income eligible, 9,108 participated in the Income Eligible program, while 4,327 participated in the EnergyWise program. The participation rate among income eligible accounts in either of the EnergyWise or Income Eligible Electric programs is higher than the rate for all accounts. The AMI criteria identified more income eligible accounts, specifically 85,168 compared with 27,902 identified using the criteria in Section 5.1. This difference represents a large number of customers that could also be on a low income rate but are not currently.

Table D-1. Cumulative Matched Participation in Single Family Electric Programs by Income Eligibility: 2009-2015

Income Level	Participants*	Eligible Accounts**	Rate*
Income Eligible**	13,435	85,168	16%
All Single Family Accounts	42,333	352,393	12%

*The cumulative matched participant rate is calculated based on participants matched to the customer account database snapshot as of March 2017, who participated in either of the EnergyWise or Income Single Family programs.

**Income eligible accounts were identified by considering AMI in addition to prior participation and rate code.

Source: Navigant analysis of National Grid data

Navigant characterized participants and nonparticipants for income eligible customers, listed in Table D-2 through Table D-6. Based on the random forest modeling results for single family electric programs, Navigant focused on the same important variables discussed in Sections 4.2.2 and 5.2.2, namely: property type, length of residence, building area, building age, and average monthly usage. These

variables were consistently important across both EnergyWise and Income Eligible programs. In the following tables, the intervals listed are inclusive of the highest value. For example, an interval of 3 to 13 years would include 13 years, but not 3 years.

Table D-2 lists the number and percentage of participants and nonparticipants split by property type. Consistent with the income eligible analysis in Section 5.2.2, this result shows that customers in 1 family structures show a higher rate of historical participation than those in other properties.

Table D-2. Characterization by Property Type, Income Eligible Single Family Electric

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	8,664	64%	29,679	41%
2-5-Family	2,619	19%	22,357	31%
Apt Bldg.	80	1%	736	1%
Condo	150	1%	1,046	1%
Housing Authority	3	0%	4	0%
Mobile Home	337	3%	770	1%
Other	318	2%	1,974	3%
Unknown	1,264	9%	15,167	21%
Total	13,435	100%	71,733	100%

Source: Navigant analysis of National Grid data

Table D-3 lists the number and percentage of participants and nonparticipants split by length of residence. This result shows that customers who have lived in their residence for 3 or less years have shown lower rates of participation, compared with other customers. Conversely, the set of income eligible customers that showed the highest rate of participation were those who have lived in their residence for more than 13 years and less than 43 years. Overall, this result is consistent with the income eligible analysis in Section 5.2.2, as shown in Figure 33, where customers with a length of residence less than 8 years were less likely to participate.

Table D-3. Characterization by Length of Residence, Income Eligible Single Family Electric

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 3	682	5%	11,649	16%
3 to 13	3,928	29%	21,909	31%
13 to 43	5,849	44%	25,912	36%
43+	1,546	12%	7,591	11%
Unknown	1,430	11%	4,672	7%
Total	13,435	100%	71,733	100%

Source: Navigant analysis of National Grid data

Table D-4 lists the number and percentage of participants and nonparticipants split by building area. This result shows that customers in residences less than 2000 square feet have shown a higher historical rate of participation, compared with those in larger buildings. This result is consistent with the results found in Sections 4.2.2 and 5.2.2.

Table D-4. Characterization by Building Area, Income Eligible Single Family Electric

Building Area (sq. ft.)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 1,300	5,868	44%	21,793	30%
1,300 to 2,000	3,916	29%	16,752	23%
2,000 to 3,000	1,720	13%	11,988	17%
3,000+	667	5%	6,033	8%
Unknown	1,264	9%	15,167	21%
Total	13,435	100%	71,733	100%

Source: Navigant analysis of National Grid data

Table D-5 lists the number and percentage of participants and nonparticipants split by building age. This result shows that customers in buildings between 20 and 85 years of age have shown a higher rate of participation. This result is consistent with the results of Sections 4.2.2 and 5.2.2.

Table D-5. Characterization by Building Age, Income Eligible Single Family Electric

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	402	3%	2,297	3%
20 to 85	6,792	51%	24,049	34%
85+	4,977	37%	30,220	42%
Unknown	1,264	9%	15,167	21%
Total	13,435	100%	71,733	100%

Source: Navigant analysis of National Grid data

Table D-6 lists the number and percentage of participants and nonparticipants split by average monthly usage. This result shows that customers with average monthly usage less than 400 kWh have shown a lower rate of participation compared with those with usage between 400 and 800 kWh. Customers with average monthly usage less than 1500 kWh represent 97% of all participants.

Table D-6. Characterization by Average Monthly Usage, Income Eligible Single Family Electric

Average Monthly Usage (kWh)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 400	5,096	38%	31,796	44%
400 to 800	5,748	43%	27,200	38%
800 to 1,500	2,203	16%	9,503	13%
1,500+	186	1%	790	1%
Unknown	202	2%	2,444	3%
Total	13,435	100%	71,733	100%

Source: Navigant analysis of National Grid data

Overall, the characteristics of participants and nonparticipants of income eligible customers using AMI are generally consistent with the mixture of customers that may have household income between 0 and 60% AMI, but who participated in either the Income eligible or EnergyWise programs. Since this analysis is based on a mixture of EnergyWise and Income Eligible participants, Navigant did not analyze target groups for these customers.

D.2 Gas Results

Table D-7 lists the cumulative matched participation in income eligible gas programs compared with all accounts. The 56,451 income eligible accounts were determined by considering AMI in addition to prior participation and rate code. Importantly, 47,677 out of 201,402 single family accounts (24%) were missing household income information. Some of these accounts with unknown income information could also be considered income eligible, but were not included in this analysis. Among the 2,548 participants identified as income eligible, 1,438 participated in the Income Eligible program, while 1,110 participated in the EnergyWise program. The participation rate among income eligible accounts in either of the EnergyWise or Income Eligible Electric programs is similar to the rate for all accounts. The AMI criteria identified more income eligible accounts, specifically 56,451 compared with 14,462 identified using the criteria in Section 5.1. This difference represents a large number of customers that could also be on a low income rate but are not currently.

Table D-7. Cumulative Matched Participation in Single Family Gas Programs by Income Eligibility: 2009-2015

Income Level	Participants*	Eligible Accounts**	Rate*
Income Eligible**	2,548	56,451	5%
All Single Family Accounts	9,411	201,402	5%

*The cumulative matched participant rate is calculated based on participants matched to the customer account database snapshot as of March 2017, who participated in either of the EnergyWise or Income Single Family programs.

**Income eligible accounts were identified by considering AMI in addition to prior participation and rate code.

Source: Navigant analysis of National Grid data

Similar to the electric program, Navigant characterized participants and nonparticipants for income eligible customers in gas programs, listed in Table D-8 through Table D-12. Based on the random forest modeling results for single family gas programs, Navigant focused on the same important variables discussed in the analysis of single family programs in Sections 4.3.2 and 5.3.2, namely: property type, length of residence, building area, building age, and average monthly usage. These variables were consistently important across both EnergyWise and Income Eligible programs. In the following tables, the

intervals listed are inclusive of the highest value. For example, an interval of 3 to 13 years would include 13 years, but not 3 years.

Table D-8 lists the number and percentage of participants and nonparticipants split by property type. This result is consistent with the analysis discussed in Sections 4.3.2 and 5.3.2, and shows that customers in 1 family structures show a higher rate of historical participation than those in other properties.

Table D-8. Characterization of Property Type, Income Eligible Single Family Gas

Property Description	P		Non-P	
	No.	Percentage	No.	Percentage
1-Family	1,740	68%	18,744	35%
2-5-Family	532	21%	19,280	36%
Apt Bldg.	10	0%	541	1%
Condo	20	1%	849	2%
Housing Authority	1	0%	4	0%
Mobile Home	5	0%	302	1%
Other	30	1%	1,276	2%
Unknown	210	8%	12,907	24%
Total	2,548	100%	53,903	100%

Source: Navigant analysis of National Grid data

Table D-9 lists the number and percentage of participants and nonparticipants split by length of residence. This result shows that customers who have lived in their residence for 3 or less years have shown lower rates of participation, compared with other customers. Conversely, the set of income eligible customers that showed the highest rate of participation were those who have lived in their residence for more than 13 years. This result is consistent with the results of the EnergyWise Single Family Gas program, shown in Figure 27.

Table D-9. Characterization of Length of Residence, Income Eligible Single Family Gas

Length of Residence (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 3	164	6%	8,917	17%
3 to 13	869	34%	17,862	33%
13 to 43	1,044	41%	19,109	35%
43+	254	10%	4,852	9%
Unknown	217	9%	3,163	6%
Total	2,548	100%	53,903	100%

Source: Navigant analysis of National Grid data

Table D-10 lists the number and percentage of participants and nonparticipants split by building area. This result shows that customers in residences less than 2,000 square feet have shown a higher historical rate of participation, compared with those in larger buildings. This result is consistent with the results of Sections 4.3.2 and 5.3.2.

Table D-10. Characterization of Building Area, Income Eligible Single Family Gas

Building Area (sq. ft.)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 1,300	1,155	45%	14,113	26%
1,300 to 2,000	752	30%	11,627	22%
2,000 to 3,000	305	12%	9,854	18%
3,000+	126	5%	5,402	10%
Unknown	210	8%	12,907	24%
Total	2,548	100%	53,903	100%

Source: Navigant analysis of National Grid data

Table D-11 lists the number and percentage of participants and nonparticipants split by building age. This result shows that customers in buildings between 20 and 85 years of age have shown a higher rate of participation. This result is consistent with the results of other Single Family programs discussed in Sections 4.3.2 and 5.3.2.

Table D-11. Characterization of Building Age, Income Eligible Single Family Gas

Building Age (Years)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 20	65	3%	1,541	3%
20 to 85	1,281	50%	14,086	26%
85+	992	39%	25,369	47%
Unknown	210	8%	12,907	24%
Total	2,548	100%	53,903	100%

Source: Navigant analysis of National Grid data

Table D-12 lists the number and percentage of participants and nonparticipants split by average monthly usage. This result shows that customers with average monthly usage less than 35 therms have shown a lower rate of participation compared with those with usage between 35 and 100 therms. Customers with average monthly usage less than 250 therms represent 99% of all participants. This results is consistent with the results of other Single Family programs discussed in Sections 4.3.2 and 5.3.2.

Table D-12. Average Monthly Usage, Income Eligible Single Family Gas

Average Monthly Usage (Therms)	P		Non-P	
	No.	Percentage	No.	Percentage
0 to 35	132	5%	8,002	15%
35 to 100	1,943	76%	32,297	60%
100 to 250	437	17%	11,722	22%
250+	0	0%	95	0%
Unknown	36	1%	1,787	3%
Total	2,548	100%	53,903	100%

Source: Navigant analysis of National Grid data

Overall, the characteristics of participants and nonparticipants of income eligible customers using AMI are generally consistent with the mixture of customers that may have household income between 0 and 60% AMI, but who participated in either the Income Eligible or EnergyWise programs. Since this analysis is based on a mixture of EnergyWise and Income Eligible participants, Navigant did not analyze target groups for these customers.

APPENDIX E. SINGLE FAMILY RENTER ANALYSIS

This appendix complements Navigant's analysis of homeowners in single family programs. Navigant characterized the participation of renters in terms of the key demographic variables identified in its analysis of single family programs. In this analysis, the criteria used to identify income eligible customers is the rate code base criteria described in Section 5.1. Since the historical participation rate of renters was relatively low, and due to the challenges of limited data on renters, Navigant did not analyze target groups for renters.

E.1 Electric Results

Table E-1 lists the cumulative match participation in electric single family programs by homeownership. For both income eligible and market rate (EnergyWise) programs, homeowners exhibited a higher rate of historical participation. Importantly, many participants were had unknown homeownership information (4,568 in the EnergyWise program, and 1,356 in the Income Eligible program). Many of these customers with unknown information could be renters, which could change the results of this analysis.

Table E-1. Cumulative Matched Participation in Electric Programs by Homeownership: 2009-2015

Income Level	Homeownership	P	Eligible Accounts	Rate
Income Eligible	Owner	6,757	16,487	41%
	Renter	995	5,385	18%
	Unknown	1,356	6,030	22%
	Total	9,108	27,902	33%
EnergyWise	Owner	27,305	211,901	13%
	Renter	1,351	29,750	5%
	Unknown	4,569	82,840	6%
	Total	33,225	324,491	10%

*The cumulative matched participant rate is calculated based on participants matched to the customer account database snapshot as of March 2017.

Source: Navigant analysis of National Grid data

Navigant characterized participants and nonparticipants for renters, listed in Table E-2 through Table E-6. Navigant focused on the same important variables discussed in Sections 4.2.2 and 5.2.2, namely: property type, length of residence, building area, building age, and average monthly usage. In this tables, the intervals listed are inclusive of the highest value. For example, an interval of 3 to 13 years would include 13 years, but not 3 years.

Table E-2 lists the number and percentage of participants and nonparticipants split by property type. This result shows that customers in 1-family structures show a higher rate of historical participation than those in other properties. Nevertheless, the largest portion of participant renters live in 2-5-family properties, 47% and 49% of EnergyWise and income eligible participants, respectively.

Table E-2. Characterization of Property Type for Renters, Single Family Electric Programs

Property Description	EnergyWise	Income Eligible
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	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
1-Family	375	28%	4,781	17%	188	19%	408	9%
2-5-Family	634	47%	12,213	43%	486	49%	1,934	44%
Apt Bldg.	15	1%	527	2%	23	2%	81	2%
Condo	8	1%	491	2%	11	1%	17	0%
Mobile Home	7	1%	54	0%	1	0%	4	0%
Other	76	6%	1,109	4%	34	3%	9	0%
Unknown	236	17%	9,224	32%	212	21%	1,825	42%
Total	1,351	100%	28,399	100%	995	100%	4,390	100%

Source: Navigant analysis of National Grid data

Table E-3 lists the number and percentage of participants and nonparticipants split by length of residence. This result shows that customers who have lived in their residence for 13 or less years have shown higher rates of participation, compared with customers who have lived in their residence for more than 13 years. These customers represent 91% and 85% of EnergyWise and income eligible participants, respectively.

Table E-3. Characterization of Length of Residence for Renters, Single Family Electric Programs

Length of Residence	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 3	463	34%	12,280	43%	176	18%	1,465	33%
3 to 13	767	57%	13,255	47%	669	67%	2,377	54%
13 to 43	111	8%	2,651	9%	142	14%	520	12%
43+	10	1%	213	1%	8	1%	28	1%
Total	1,351	100%	28,399	100%	995	100%	4,390	100%

Source: Navigant analysis of National Grid data

Table E-4 lists the number and percentage of participants and nonparticipants split by building area. Among renters, participants were generally evenly distributed among building area; the largest portion of participants live in buildings between 2000 and 3000 square feet (27% and 24% of EnergyWise and income eligible participants, respectively).

Table E-4. Characterization of Building Area for Renters, Single Family Electric Programs

Building Area	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 1,300	239	18%	4,128	15%	178	18%	468	11%
1,300 to 2,000	317	23%	5,122	18%	229	23%	614	14%
2,000 to 3,000	359	27%	6,232	22%	241	24%	918	21%
3,000+	200	15%	3,693	13%	135	14%	565	13%
Unknown	236	17%	9,224	32%	212	21%	1,825	42%
Total	1,351	100%	28,399	100%	995	100%	4,390	100%

Source: Navigant analysis of National Grid data

Table E-5 lists the number and percentage of participants and nonparticipants split by building age. This result shows that most of participant renters live in buildings greater than 85 years of age, in contrast with homeowners (see Sections 4 and 5).

Table E-5. Characterization of Building Age for Renters, Single Family Electric Programs

Building Age	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 20	32	2%	754	3%	37	4%	94	2%
20 to 85	346	26%	4,731	17%	187	19%	461	11%
85+	737	55%	13,690	48%	559	56%	2,010	46%
Unknown	236	17%	9,224	32%	212	21%	1,825	42%
Total	1,351	100%	28,399	100%	995	100%	4,390	100%

Source: Navigant analysis of National Grid data

Table E-6 lists the number and percentage of participants and nonparticipants split by average monthly usage. This result shows that customers with average monthly usage less than 400 kWh have shown a lower rate of participation compared with those with usage greater than 400 kWh. Customers with average monthly usage less than 1500 kWh represent 96% of all EnergyWise participants and 97% of all income eligible participants.

Table E-6. Characterization of Average Monthly Usage for Renters, Single Family Electric Programs

Average Monthly Usage (kWh)	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 400	562	42%	14,299	50%	387	39%	1,917	44%
400 to 800	524	39%	9,180	32%	416	42%	1,705	39%
800 to 1,500	202	15%	3,095	11%	161	16%	579	13%
1,500+	18	1%	301	1%	9	1%	33	1%
Unknown	45	3%	1,524	5%	22	2%	156	4%
Total	1,351	100%	28,399	100%	995	100%	4,390	100%

Source: Navigant analysis of National Grid data

E.2 Gas Results

Table E-7 lists the cumulative match participation in gas single family programs by homeownership. For both income eligible and market rate (EnergyWise) programs, homeowners exhibited a higher rate of historical participation. Importantly, many participants were missing homeownership information, more than those identified as renters. As a result, the following analysis of renters should be viewed considering this fact.

Table E-7. Cumulative Matched Participation in Single Family Gas Programs by Homeownership: 2009-2015

Income Level	Homeownership	P	Eligible Accounts	Rate
Income Eligible	Owner	1,038	7,199	14%
	Renter	198	3,896	5%
	Unknown	202	3,367	6%
	Total	1,438	14,462	10%
EnergyWise	Owner	6,757	118,715	6%
	Renter	339	23,915	1%
	Unknown	877	44,310	2%
	Total	7,973	186,940	10%

*The cumulative matched participant rate is calculated based on participants matched to the customer account database snapshot as of March 2017.

Source: Navigant analysis of National Grid data

Similar to the electric program, Navigant characterized participants and nonparticipants for single family gas programs, listed in Table E-8 through Table E-12. Navigant focused on the same important variables discussed in the analysis of single family programs in Sections 4.3.2 and 5.3.2, namely: property type, length of residence, building area, building age, and average monthly usage. In this tables, the intervals listed are inclusive of the highest value. For example, an interval of 3 to 13 years would include 13 years, but not 3 years.

Table E-8 lists the number and percentage of participants and nonparticipants split by property type. This result shows that customers in 1 family structures show a higher rate of historical participation than those in other properties. Nevertheless, the largest portion of participant renters live in 2-5 family properties, 45% and 54% of EnergyWise and income eligible participants, respectively.

Table E-8. Characterization of Property Type for Renters, Single Family Gas Programs

Property Description	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
1-Family	108	32%	3,063	13%	47	24%	278	8%
2-5-Family	151	45%	10,774	46%	106	54%	1,722	47%
Apt Bldg.	4	1%	384	2%	4	2%	56	2%
Condo	2	1%	397	2%	1	1%	10	0%
Housing Authority	0	0%	0	0%	0	0%	4	0.1%
Mobile Home	0	0%	8	0%	0	0%	3	0.1%
Other	16	5%	706	3%	1	1%	93	3%
Unknown	58	17%	8,244	35%	39	20%	1,532	41%
Total	339	100%	23,576	100%	198	100%	3,698	100%

Source: Navigant analysis of National Grid data

Table E-9 lists the number and percentage of participants and nonparticipants split by length of residence. This result shows that customers who have lived in their residence for 13 or less years have shown higher rates of participation, compared with customers who have lived in their residence for more than 13 years. These customers represent 92% and 92% of EnergyWise and income eligible participants, respectively.

Table E-9. Characterization of Length of Residence for Renters, Single Family Gas Programs

Length of Residence	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 3	122	36%	9,656	41%	43	22%	1,124	30%
3 to 13	190	56%	11,382	48%	139	70%	2,082	56%
13 to 43	24	7%	2,356	10%	16	8%	471	13%
43+	3	1%	182	1%	0	0%	21	1%
Total	339	100%	23,576	100%	198	100%	3,698	100%

Source: Navigant analysis of National Grid data

Table E-10 lists the number and percentage of participants and nonparticipants split by building area. Among renters, participants were generally evenly distributed among building area; the largest portion of participants live in buildings between 1300 and 2000 square feet (28% and 26% of EnergyWise and income eligible participants, respectively).

Table E-10. Characterization of Building Area, Single Family Gas Programs

Building Area	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 1,300	60	18%	2,760	12%	31	16%	313	8%
1,300 to 2,000	94	28%	3,985	17%	52	26%	477	13%
2,000 to 3,000	75	22%	5,276	22%	48	24%	815	22%
3,000+	52	15%	3,311	14%	28	14%	561	15%
Unknown	58	17%	8,244	35%	39	20%	1,532	41%
Total	339	100%	23,576	100%	198	100%	3,698	100%

Source: Navigant analysis of National Grid data

Table E-11 lists the number and percentage of participants and nonparticipants split by building age. This result shows that most of participant renters live in buildings greater than 85 years of age, in contrast with homeowners (see Sections 4 and 5). These customers represent 56% and 66% of participants in the EnergyWise and income eligible programs, respectively.

Table E-11. Characterization of Building Age, Single Family Gas Programs

Building Age (Years)	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 20	6	2%	581	2%	3	2%	69	2%
20 to 85	86	25%	2,891	12%	25	13%	316	9%
85+	189	56%	11,860	50%	131	66%	1,781	48%
Unknown	58	17%	8,244	35%	39	20%	1,532	41%
Total	339	100%	23,576	100%	198	100%	3,698	100%

Source: Navigant analysis of National Grid data

Table E-12 lists the number and percentage of participants and nonparticipants split by average monthly usage. This result shows that customers with average monthly usage less than 35 therms have shown a slightly lower rate of participation compared with those with usage between 35 and 250 therms. These customers together represent 98% of all EnergyWise participants and 97% of all income eligible participants.

Table E-12. Average Monthly Usage (Therms)

Average Monthly Usage (Therms)	EnergyWise				Income Eligible			
	P		Non-P		P		Non-P	
	#	%	#	%	#	%	#	%
0 to 35	46	14%	4,082	17%	10	5%	238	6%
35 to 100	221	65%	13,465	57%	143	72%	2,456	66%
100 to 250	64	19%	4,778	20%	39	20%	892	24%
250+	0	0%	76	0%	0	0%	0	0%
Unknown	8	2%	1,175	5%	6	3%	112	3%
Total	339	100%	23,576	100%	198	100%	3,698	100%

Source: Navigant analysis of National Grid data