DNV·GL

2013 - 2015 Residential Customer Profile Report

Massachusetts Program Administrators and Energy Efficiency Advisory Council

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Table of Contents

1 EXECUTIVE SUMMARY 8

KEY FINDINGS 9

Profile Analysis Recommendations 11

1.1.1 Build on the demographic and geographic analyses to better understand how within and across PA differences affect engagement in the PAs' energy efficiency programs 11

1.1.2 Leverage the contribution ratio statistic to capture non-data elements including implementation, strategy, and other stakeholder anecdotal experiences in the Residential Customer Profile report in a rigorous, transparent and mathematically robust way 12

1.1.3 Conduct any time series analyses at the location level rather than the account level for a more robust picture of participation and savings though time. 12

1.1.4 Leverage the building vintage, style and use code from the tax data to further segment participant and customer populations 13

1.1.5 Leverage the combination of the tax data, the PAs' energy use information, and American Community Survey block group data to identify and quantify where opportunities for energy optimization efforts may exist 14

2 INTRODUCTION 15

2.1 Objectives 15

2.2 Organization 15

2.3 Methodology in brief 16

2.4 Primary analysis functions 17

3 ELECTRIC AND GAS COMBINED SUMMARIES 19

3.1 Time Series Summary Data 20

3.2 Merge success rates 24

3.3 2013 – 2015 unique participation and savings 27

3.3.1 Participation Rates and Savings by Year and PA 32

3.4 Preliminary savings by program 34

3.5 Preliminary savings by initiative 37

4 DEMOGRAPHIC ANALYSIS – BACKGROUND 45

4.1 Electric demographic analysis 47

4.2 Gas demographic analysis 53

5 ELECTRIC MARKET ANALYSIS 57

5.1 Participation and savings 57

5.2 By PA summary 62

5.2.1 Participation and savings 62

5.3 Electric Geographic Weighted Regression Analysis 64

5.4 Electric Hot Spot and Cluster / Outlier Analysis 68

5.5 End uses 71

6 GAS MARKET ANALYSIS 72

6.1 Participation and savings 72

6.2 By PA summary 76

6.2.1 Participation and savings 76

6.3 Gas Hot Spot and Cluster / Outlier Analysis 78
6.4 End uses 81

7 APPENDICES 82
7.1 Appendix A. Methodology 82
7.1.1 Merging billing and energy efficiency tracking data 82
7.2 Appendix B. Additional PA-specific Tables 86
7.2.1 Electric 86
7.2.2 Gas 99
7.3 Appendix C. Demographic Analysis tables by individual year 117
7.3.1 Electric Demographic analysis by year 117
7.3.2 Gas Demographic analysis by year 121
7.4 Appendix D. Geographic Analysis by individual year 125
7.4.1 Electric Geographic analysis by year 125
7.4.2 Gas Geographic analysis by year 131

List of Tables

Table 3-1. Time series universe of unique billing records - unique accounts 21
Table 3-2. Time series universe of billing consumption 21
Table 3-3. Time series universe of unique energy efficiency program participants (excluding behavioral) ... 23
Table 3-4. Time series universe of energy efficiency program savings (including behavioral) 24
Table 3-5. Time series universe of energy efficiency program savings (excluding behavioral) 24
Table 3-6. Merge success rates of the 2013 through 2015 EE participation with billing (upstream and behavioral excluded) 26
Table 3-7. Unique 2013-2015 account participation rates and population savings achieved by electric PA .. 27
Table 3-8. Unique 2013-2015 account participation rates and population savings achieved by gas PA 27
Table 3-9. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2015) 32
Table 3-10. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2014) 32
Table 3-11. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2013) 32
Table 3-12. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2015) 33
Table 3-13. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2014) 33
Table 3-14. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2013) 33
Table 3-15. 2013-2015 Energy efficiency participant projects and population savings by fuel, program, and year (excluding behavioral) 34
Table 3-16 2013-2015 Energy efficiency participant projects and population savings by fuel, PA, program, and year (excluding behavioral) 35
Table 3-17. Electric cross initiative participant movement by unique account, 2014-2015 39
Table 3-18. Gas cross initiative participant movement by unique account, 2014-2015 41
Table 3-19 Electric Residential Products Tracking Statistics by PA and Initiative (2013-2015) 42
Table 3-20 Electric Residential Whole House Tracking Statistics by PA and Initiative (2013-2015) 42
Table 3-21 Electric Low-Income Whole House Tracking Statistics by PA and Initiative (2013-2015) 43
Table 3-22 Gas Residential Products Tracking Statistics by PA and Initiative (2013-2015) 43
Table 3-23 Gas Residential Whole House Tracking Statistics by PA and Initiative (2013-2015) 44
Table 3-24 Gas Low-Income Whole House Tracking Statistics by PA and Initiative (2013-2015) 44
Table 4-1. Two variable examples of quintiles in a five-block-group population 46
Table 4-2. ACS quintile analysis: ratio of population below 200% of poverty index – unique 2014 & 2015 electric participation rate and savings rate (excludes upstream and behavioral data) 48

Table 4-3. ACS quintile analysis: ratio of renter occupied households – unique 2014 & 2015 electric participation rate and savings rate (excludes upstream and behavioral data) 51
Table 4-4. ACS quintile analysis: ratio of population below 200% of poverty index – unique 2014 & 2015 gas participation rate and savings rate (excludes behavioral data) 54
Table 4-5. ACS quintile analysis: ratio of renter occupied households – unique 2014 & 2015 gas participation rate and savings rate (excludes upstream and behavioral data) 55
Table 5-1. Field name descriptions for tables in Section 5, electric market analysis 58
Table 5-2. All PAs' kWh breakouts, excluding unlinked energy efficiency tracking data (2013-2015) 58
Table 5-3. ACS analysis variables used in global OLS input model for the GWR analysis 64
Table 5-4. Population summary statistics – electric end uses, including upstream lighting (2015) 71
Table 5-5. Population summary statistics – electric end uses, including upstream lighting (2014) 71
Table 6-1. All PAs' therm breakouts, excluding unlinked energy efficiency tracking data (2013-2015) 73
Table 6-2. Population summary statistics – gas end uses (2015) 81
Table 6-3. Population summary statistics – gas end uses (2014) 81
Table 7-1. Cape Light Compact Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 82
Table 7-2. Eversource Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 82
Table 7-3. National Grid Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 83
Table 7-4. Unitil Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 83
Table 7-5. Berkshire Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 84
Table 7-6. Columbia Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 84
Table 7-7 Eversource Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 85
Table 7-8. Liberty Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 85
Table 7-9. National Grid Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 85
Table 7-10. Unitil Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative 86
Table 7-11. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2015) 86
Table 7-12. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2014) 87
Table 7-13. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2013) 87
Table 7-14. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2015) 90
Table 7-15. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2014) 90
Table 7-16. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2013) 90
Table 7-17. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2015) 93
Table 7-18. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2014) 93
Table 7-19. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2013) 93
Table 7-20. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2015) 96
Table 7-21. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2014) 96
Table 7-22. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2013) 96
Table 7-23. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2015) 99
Table 7-24. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2014) 99
Table 7-25. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2013) 99
Table 7-26. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2015) 102
Table 7-27. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2014) 102
Table 7-28. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2013) 102
Table 7-29. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2015) 105
Table 7-30. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2014) 105

Table 7-31. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2013) ... 105
Table 7-32. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2015) 108
Table 7-33. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2014) 108
Table 7-34. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2013) 108
Table 7-35. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2015) 111
Table 7-36. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2014) 111
Table 7-37. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2013) 111
Table 7-38. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2015) 114
Table 7-39. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2014) 114
Table 7-40. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2013) 114
Table 7-41. Basic quintile analysis: ratio of population below 200% of poverty index– 2015 electric participation and average block group building vintage 117
Table 7-42. Basic quintile analysis: ratio of population above 200% of poverty index– 2014 electric participation and average block group building vintage 118
Table 7-43. Basic quintile analysis: ratio of renter occupied homes – 2015 electric participation and average block group building vintage 119
Table 7-44. Basic quintile analysis: ratio of renter occupied homes – 2014 electric participation and average block group building vintage 120
Table 7-45. Basic quintile analysis: ratio of population above 200% of poverty index– 2015 gas participation and average block group building vintage 121
Table 7-46. Basic quintile analysis: ratio of population above 200% of poverty index– 2014 gas participation and average block group building vintage 122
Table 7-47. Basic quintile analysis: ratio of renter occupied homes – 2015 gas participation and average block group building vintage 123
Table 7-48. Basic quintile analysis: ratio of renter occupied homes – 2014 gas participation and average block group building vintage 124

List of Figures

Figure 2-1. Visualization of the analysis cube leveraged in the 2013-2015 Residential Customer Profile report 17
Figure 3-1. Combined PA served electric and gas participant savings achieved, 2015 (MMBtu, exclusive of non-PA delivered fuels) 28
Figure 3-2. Combined PA served electric and gas participant savings achieved, 2014 (MMBtu, exclusive of non-PA delivered fuels) 29
Figure 3-3. Combined PA served electric and gas participant savings achieved for the combined 2014 and 2015 program years (MMBtu, exclusive of non-PA delivered fuels) 30
Figure 3-4 Percent savings and percent projects by program and year, electric 35
Figure 3-5 Percent savings and percent projects by program and year, gas 35
Figure 3-6. Electric cross initiative participant movement, 2014-2015 37
Figure 3-7. Gas cross initiative participant movement, 2014-2015 39
Figure 4-1. Block group contribution ratio by poverty index – unique 2014 & 2015 electric population (excludes upstream and behavioral data) 48
Figure 4-2 Block group contribution ratio by ratio of renter occupied households – unique 2014 & 2015 electric population (excludes upstream and behavioral data) 50
Figure 4-3. Block group contribution ratio by poverty index – unique 2014 & 2015 gas population (excludes behavioral data) 53
Figure 4-4. Block group contribution ratio by ratio of renter occupied households – unique 2014 & 2015 electric population (excludes upstream and behavioral data) 55
Figure 5-1. Map of MA electric PA service territories 56
Figure 5-2. Electric customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013-2015) 58
Figure 5-3. Combined 2014 & 2015 unique electric account participation by census block group 59
Figure 5-4. Combined 2014 & 2015 unique electric account savings by census block group 60
Figure 5-5. Historical account participation rates, electric 61
Figure 5-6 Historical population savings rates, electric 62

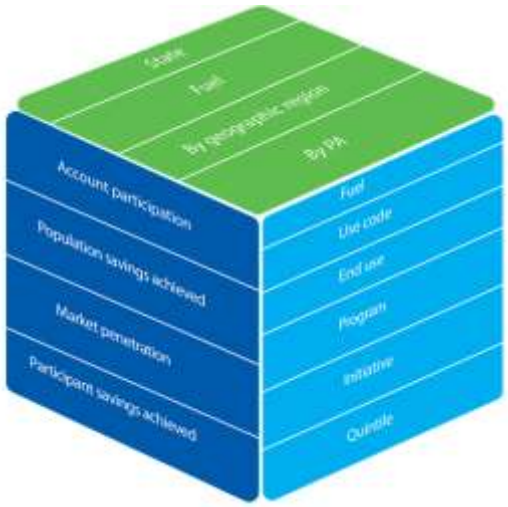
Figure 5-7. Example GWR result using the MA Electric 2014 and 2015 combined participation data 65
Figure 5-8. 2014 and 2015 combined electric participation rate Geographic Weighted Regression (GWR) localized R-squared using nearest 30 block groups 66
Figure 5-9. 2014 and 2015 combined block group electric participation rate hot spot analysis using a five-mile search radius 68
Figure 5-10. 2014 and 2015 combined block group electric participation rate hot spot analysis using a one-mile search radius 68
Figure 5-11. 2014 and 2015 combined block group electric participation rate cluster / outlier analysis using a one-mile search radius 69
Figure 6-1. Map of MA electric PA service territories 71
Figure 6-2. Gas customer population summary by use code, excluding unlinked energy efficiency 72
Figure 6-3. Combined 2014 & 2015 unique gas account participation by census block group 73
Figure 6-4. Combined 2014 & 2015 unique gas account savings by census block group 74
Figure 6-5. Historical account participation rates, gas 75
Figure 6-6. Historical population savings rates, gas 76
Figure 6-7. 2014 and 2015 combined block group gas participation rate hot spot analysis using a five-mile search radius 78
Figure 6-8. 2014 and 2015 combined block group gas participation rate hot spot analysis using a one-mile search radius 78
Figure 6-9. 2014 and 2015 combined block group gas participation rate cluster / outlier analysis using a one-mile search radius 79
Figure 7-1. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 87
Figure 7-2. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 87
Figure 7-3. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 88
Figure 7-4. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 90
Figure 7-5. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 90
Figure 7-6. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 91
Figure 7-7. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 93
Figure 7-8. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 93
Figure 7-9. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 94
Figure 7-10. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 96
Figure 7-11. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 96
Figure 7-12. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 97
Figure 7-13. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 99
Figure 7-14. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 99
Figure 7-15. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 100
Figure 7-16. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 102
Figure 7-17. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 102
Figure 7-18. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 103

Figure 7-19. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 105
Figure 7-20. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 105
Figure 7-21. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 106
Figure 7-22. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 108
Figure 7-23. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 108
Figure 7-24. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 109
Figure 7-25. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 111
Figure 7-26. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 111
Figure 7-27. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 112
Figure 7-28. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015) 114
Figure 7-29. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014) 114
Figure 7-30. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013) 115
Figure 7-31. Block group contribution ratio by poverty index – unique 2015 electric population 116
Figure 7-32. Block group contribution ratio by poverty index – unique 2014 electric population 117
Figure 7-33. Block group contribution ratio by ratio of renter occupied homes – unique 2015 electric population..... 118
Figure 7-34. Block group contribution ratio by ratio of renter occupied homes – unique 2014 electric population..... 119
Figure 7-35. Block group contribution ratio by poverty index – unique 2015 gas population 120
Figure 7-36. Block group contribution ratio by poverty index – unique 2014 gas population 121
Figure 7-37. Block group contribution ratio by ratio of renter occupied homes – unique 2015 gas population 122
Figure 7-38. Block group contribution ratio by ratio of renter occupied homes – unique 2014 gas population 123
Figure 7-39. 2015 Electric residential account participation by census block group (excluding behavioral and upstream data)..... 124
Figure 7-40. 2014 Electric residential account participation by census block group (excluding behavioral and upstream data)..... 125
Figure 7-41. 2015 Electric residential savings ratios by census block group 125
Figure 7-42. 2014 Electric residential savings ratios by census block group 126
Figure 7-43. 2015 Home Energy Services residential electric account participation by census block group 126
Figure 7-44. 2014 Home Energy Services residential electric account participation by census block group 127
Figure 7-45. 2015 Home Energy Services residential electric savings ratio by census block group 127
Figure 7-46. 2014 Home Energy Services residential electric savings ratio by census block group 128
Figure 7-47. 2015 Behavioral residential electric savings ratio by census block group..... 128
Figure 7-48. 2014 Behavioral residential electric savings ratio by census block group..... 129
Figure 7-49. 2015 Gas residential account participation by census block group (excluding behavioral)..... 130
Figure 7-50. 2014 Gas residential account participation by census block group (excluding behavioral)..... 130
Figure 7-51. 2015 Gas residential savings ratios by census block group..... 131
Figure 7-52. 2014 Gas residential savings ratios by census block group..... 131
Figure 7-53. 2015 Home Energy Services residential gas account participation by census block group..... 132
Figure 7-54. 2015 Home Energy Services residential gas account participation by census block group..... 132
Figure 7-55. 2015 Home Energy Services residential gas savings ratios by census block group..... 133
Figure 7-56. 2014 Home Energy Services residential gas savings ratios by census block group..... 133
Figure 7-57. 2015 Behavioral residential gas savings ratio by census block group 134

Figure 7-58. 2014 Behavioral residential gas savings ratio by census block group 134

1 EXECUTIVE SUMMARY

The 2013 – 2015 Residential Customer Profile report provides a "snap-shot in time" data retrospective though tables, charts, and geographic analysis of the Massachusetts Program Administrators residential and low-income energy efficiency program activities for the 2013-2015 term period. The analysis and reporting of the statewide data allow the PAs and the Energy Efficiency Advisory Council (EEAC) Consultants to accurately quantify and report on the trends and time series evolution of energy efficiency in the Massachusetts residential landscape. Results are presented at a series of different analysis grains (shown in the data cube to the right) including program administrator, fuel, geography, to provide stakeholders with a robust and detailed series of data insights into the savings, participation, and other reporting metrics for the nation's top ranked state for energy efficiency per the American Council for an Energy-Efficient Economy.



The data presented in the Residential Customer Profile report is compiled from the individual program administrator's customer information, billing, and tracking databases and is augmented by third party Massachusetts demographic data from the US Census Bureau's American Community Survey (ACS) and building characteristics data from the Massachusetts Level 3 Tax Assessor Data and the City of Boston Tax Assessor Data. The bulk of the analysis is conducted at the account level, though some analysis sections like the demographic profiles aggregate accounts up to a geographic block group reporting level.[1]

This report is intended to provide a high-level overview of the trends, successes, and opportunities in the Massachusetts residential and low-income energy efficiency sectors. The analysis is not intended to be, and should not be misconstrued as, an attempt to audit or provide regulatory assessments on program tracking, billing, or customer information. The executive summary consists of two interrelated pieces:

1. **Key findings and implications** for the 2013-2015 Residential Customer Profile report summarize the most noteworthy findings as identified in the data and through stakeholder feedback. This includes the historical and non-data supporting context behind these trends and possible underlying drivers. The key finding is presented in the blue box with the supporting sections in the report identified in the lower right-hand corner of the box. The implications in brief are presented as bullets under each box.
2. **Profile analysis recommendations** identify areas where the report can be improved for future years either by adding new material in the underlying data provided by the PAs, modifying the existing analyses, or adding new analyses based on stakeholder feedback and data trends. Supporting context behind the recommendations is offered to the PAs and EEAC teams for consideration in crafting a course of action.[2]

[1] The majority of the PAs provide a direct account number, however for PAs that used combinations of premise and customer number to represent an account DNV GL created the account number from the customer and premise field for a like-to-like comparison in this report.

[2] DNV GL's understanding though collaboration with the PAs and EEAC teams on prior Customer Profiles is that anything in the recommendations section of the report requires a response from the PAs via the annual reporting cycle and so should be specific in nature, discreet in scope, and have clear suggested course of action. Interesting findings with speculative implications or unclear courses of action should either be included as a key finding or flagged as potential future research.

KEY FINDINGS

The block group level geographic assessments using the ACS and tax data confirmed that both across and within individual PAs, there are geographic differences in program participation and savings.

(*Section 5.3, 5.4, 6.3, 7.3, 7.4*)

- Core areas of the largest towns displayed statistically significant clustering of lower participation rates than suburban areas for both gas and electric. Although the way that multifamily data is captured at the facility level likely factors into this, a better understanding of additional drivers may help identify approaches to further increase participation in these areas.
- Individual outliers were observed in these clusters identifying potential areas where there may be transferable strategies or lessons applicable to the larger cold spots.

Block group savings ratios were relative consistent across all poverty index quintiles; participation rates and contribution ratios were more variable.

(*Section 4.1, 4.2, 5.4, 6.3, 7.3, 7.4*)

- It is **not** possible due to ecological fallacy to state, "Low income accounts have lower participation and savings." A review of individual block groups identified substantial variations within quintile populations.
- It is critical to differentiate between the quantitative "lower" and more qualitative or relative statements of performance. In the absence of defined stakeholder expectations on low or high, it is not possible to make these types of statements about performance.
- PA low income programs have been serving low income households since the late 1990s. In each of these years, program expenditures for low-income households have been proportionally higher than expenditures for non-low-income households. The lower participation and savings statistics reflect the fact that program costs for reaching and serving the low income population are higher than they are for the rest of the residential sector.

Block group savings ratios were relative consistent across all renter quintiles. Participation rates declined but were likely impacted by both the data grain availible for the analysis and some large multifamily customers being represented on C&I rate codes.

(*Section 5.3, 5.4, 6.3, 7.3, 7.4*)

- It is **not** possible due to ecological fallacy to state, "Renter accounts have lower participation and savings." A review of individual block groups identified substantial variations within quintile populations.
- Rental accounts may have a lower consumption base (e.g., on a central system), which could reduce the amount of energy efficiency savings they can capture individually. The misalignment between how some PA IT systems record data (facility level) vs. the ACS data (household level) also decreases the apparent participation rate.
- In recognition of the need to increase the participation and savings rates for renters and moderate income households, the PAs developed new targeted initiatives in mid-2015. The study captures a period before those initiatives were fully in effect.

Geographic hot spots and clusters show more spatial clustering than a random distribution would produce.

(*Section 5.3, 5.4, 6.3*)

- The geographic clustering suggests underlying drivers of lower participation rates in high population areas are unlikely to be an artifact of any one fuel or PA, and appear to be something systemic in these geographies.
- These may represent potential outreach areas where community stakeholders can help increase participation; while high participation areas may represent opportunities to identify successful program marketing and outreach efforts.

Over the 2013-2015 term period 14.5% of unique electric accounts and 10.8% of unique gas accounts participated in a PA program offering.

(*Sections 3.3, 4, 5, 6, 7.2, 7.3*)

- With over 1 in 10 unique accounts participating across both gas and electric the PAs have a base of strong program participation and success stories that can be leveraged to continue to be a national leader in the energy efficiency sector.
- The savings from the upstream lighting programs (and in some instances PA multifamily data) cannot be linked to individual accounts. The scale of these savings represents both a success story for the MA PAs, as well as a challenge for accurately assessing participation rates. It is likely that the actual electric account participation rate exceeds the 14.5% presented in the key finding box.

Gross electric population level savings for the individual years generally vary between 2% to 4% of consumption for that year; gross gas population level savings vary between 0.5% and 1.5%.

(*Section 3.3.1*)

- Savings rates remained relatively consistent within each year.
- Any future analysis may want to include a view of surviving savings based on the measure lifetime savings to provide additional insight into what the impact of measure are relative to what consumption would have been in their absence.

The electric residential products program had a declining share of savings over the three year term; but still contributed the largest share of savings due to the upstream lighting offering.

(*Section 3.4, 3.5*)

- The upstream lighting offering continues to have a very large impact on the PA's electric savings. However, the success of this channel and its impact in shifting the market landscape also suggests that while lighting is likely to continue to contribute savings in future years there is strategic value for the PAs to continue to diversify their sources of electrical savings.

The Home Energy Services core initiative contributed heavily to account participation and savings in the Whole House Program.

(*Section 3.5, 7.4*)

- The HES core initiative represents an important engagement avenue for the PAs across all geographies. However in large cities the participation in the HES offering was lower than in other areas of the state.
- Future work to better quantify expectations on savings and participation rates for different geographic regions would greatly improve the ability to assess if an area is over or under preforming on savings and participation relative to what the demographic characteristics would suggest.

Profile Analysis Recommendations

The Residential Customer Profile project focuses on the collection of PA data, construction of the tracking and billing databases, and analysis using attribute filters. Additional value and insight can be gained by using this study's high-level findings as a basis to identify critical research questions for deeper analysis. The following recommendations identify opportunities to build on the findings of this report and, with guidance from the PAs and EEAC, to go deeper into the data and explore the underlying drivers of the report's identified trends.

1.1.1 Build on the demographic and geographic analyses to better understand how within and across PA differences affect engagement in the PAs' energy efficiency programs

The customer populations, and engagement in energy efficiency programs is not homogenous across the MA landscape and there are significant geographic differences in participation and savings. The Residential Customer Profile integrated a large body of data (US Census and MA Tax Assessor) and new analyses (hot spot, cluster, and GWR) that attempted to better quantify differences and their potential underlying drivers. These analyses and their complimentary graphics can support stakeholders understanding of discreet geographic areas interest.

The demographic analysis sections (4.1, 4.2, and 7.3) illustrate that at the block group level, there are differences in participation and savings. In order to avoid errors of ecological fallacy, as discussed in the report, the study cannot definitively state how individual accounts and locations within the block groups were being affected relative to variables like ownership and building age. However, we can say that there appear to be population level correlations between certain block group characteristics such as rental homes and income, though a detailed review of the sub-populations did show that individual block groups could be highly variable. An understanding of the underlying demographic and building characteristics as they relate to participation and savings in PA energy efficiency offerings could yield powerful new analytic insights for the PAs, EEAC, and other stakeholders quantifying not only where and how much energy was saved, but also if this is aligned with what would have been anticipated based on the demographic and building characteristics.

DNV GL's integration of the tax data in the 2013-2015 Residential Customer Profile data provides a future robust set of variables for sub-block group location specific analysis; some of this material is reflected in the modified quintile analyses and is already being leveraged by both the PAs and their Evaluation Contractors. This information can be used for more granular segmentation and a better understanding of what types of customers participated in the past year's energy efficiency programs. It can also inform how successes in one geographic area might be applied to other PAs and parts of the state. This understanding could subsequently be leveraged to feed a more forward-looking analysis portion in the Residential Customer Profile report that translates past success to potential actions for future implementation and strategy investment. DNV GL recognizes that this additional analysis approach would be a substantial evolution of the Residential Customer Profile report, and is one that has the potential to compliment the PAs' investments in their MassSaveData platform.

1.1.2 Leverage the contribution ratio statistic to capture non-data elements including implementation, strategy, and other stakeholder anecdotal experiences in the Residential Customer Profile report in a rigorous, transparent and mathematically robust way

The Residential Customer Profile analysis shows that there are proportional differences in how much unique groups of customers contribute to the overall savings relative to their contribution to overall consumption. However, in the absence of a baseline it is not possible to assess if these differences are unexpected or to arrive at qualitative conclusions (e.g. statements like "good" or "bad") about the implications of these differences. The contribution ratio can be leveraged to capture non-data elements (for example a PA implementation team knowing they coordinated with a local stakeholder to target a specific group of customers within a town) in a quick and simple but also transparent way to develop baseline expectations using stakeholder knowledge to inform more qualitative conclusions.

The contribution ratio statistic is presented in greater detail in section 2.4. An inherent limitation in this statistic is the common assumption that a result of 1.0 – indicating that a group's share of contribution to savings is commensurate with share of contribution to consumption – represents the desired baseline state. Anecdotal feedback from stakeholders, as well as time series data illustrates that this type of perfectly correlated relationship rarely occurs, but in absence of additional information it is challenging to make assessments leading to an appropriate baseline. Massachusetts is fortunate to have access to a robust and knowledgeable stakeholder population engaged in the customer profile report process and their insights should be captured, along with the newly integrated demographic data and locational data, to support establishing these transparent and mathematically robust baselines for more qualitative findings.

The contribution ratio also represents an opportunity to apply a Bayesian statistics[3] approach, supported by the current data in the Residential Customer Profile report and on the MassSaveData website, to develop a series of participant groupings baselines based on probability curves. This approach would consider the non-data expertise discussed in the preceding paragraphs as well as leverage this historical contribution ratio data to build out a series of mathematically robust baselines to inform discussion on the relative performance of the different customer groups and geographies.

1.1.3 Conduct any time series analyses at the location level rather than the account level for a more robust picture of participation and savings though time.

The 2013 – 2015 Residential Customer Profile report was the first effort to look at PA participation and savings though time. A challenge encountered was that while the account level data grain provides excellent within year insights due to the ability to link tracking data to billing data, accounts can change over time causing potential disconnects, particularly for mobile populations like renters, multifamily, or low income households, in the calculated participation and savings rates.[4] When the energy efficiency investments by landlords or prior occupants are tied to the account number the time series analysis risks that an account level view shows no participation or savings at a building due to closed accounts despite that building having received new systems in the preceding years. This does not discount or explain the

[3] In simplified terms, Bayesian statistics leverages our prior beliefs and knowledge to inform a probability distribution that something will occur, and then provides us with a mechanism to systemically update that distribution as new data is accumulated.

[4] These changes can occur from both external events such as move-ins and move-outs, as well as internal changes like IT systems updates where historical account to new account number crosswalk may be incomplete or inaccessible.

challenges the PAs face in any given year securing participation and savings from some of these sectors, but is something to consider improving on for time series analyses going forward.

Beyond presenting a more informative picture of how much of a PAs building population has been engaged in a PA program a location level analysis may also help provide sub-program insights into what types of measures have already been installed in the building as well as if there are certain measures that "move-out" with the occupant when the account closes.[5] Finally, the time series integration of locational data could leverage details from the integrated tax data on when homes were last sold or reappraised to understand which households may have new decision makers in them representing an opportunity to reengage the location for new energy efficiency offerings.[6]

1.1.4 Leverage the building vintage, style and use code from the tax data to further segment participant and customer populations

The 2013 – 2015 Residential Customer Profile report includes a high level break out of individual PA's account population and savings by one of five use codes presenting the first look at differences in the underlying PA building populations and their savings and participation though time. These tables quantified the differences in absolute numbers of the PA populations while also providing a way to assess the PAs relative numbers against each other. The underlying data can be leveraged to go even deeper and further segment the PA populations which when combined with the geographic details would also allow for very explicit targeting of specific ages and types of homes in discreet regions of the PA territories by the PAs and other stakeholders.

Over the course of the profile report DNV GL acquired the tax assessor data including building age, square footage, detailed use code, and sales information for all 351 cities in Massachusetts. This data was integrated into the PA customer systems at both the standardization location ID level as well as sub-location property codes when possible (e.g. linking a specific condo unit with a specific account). Through iterative improvements in the tax to account integration logic models more than 90% of the customer population can now be associated with a corresponding tax location key.

With this new data integrated it is possible not only to conduct the type of geographic micro-targeting outlined above, but also to use sub-populations of higher savings or performing clusters of buildings as a source of insight into lessons that may be applicable to increase participation and savings in the larger population. This data will also support analysis into more specific hypotheses about sub-populations of homes such as quantifying if older homes in a specific town are not as energy efficient as similar homes in other towns. This type of analysis would increase the value of the report by bridging historical performance and placing in the context of future opportunities for continued energy efficiency success.

[5] e.g. do they bring the programable thermostat with them, or just the Wi-Fi ones?

[6] This may be particularly true for PAs that can access historical home energy audit data to see what recommendations were not installed by the prior home occupant.

1.1.5 Leverage the combination of the tax data, the PAs' energy use information, and American Community Survey block group data to identify and quantify where opportunities for energy optimization efforts[7] may exist

The Residential Customer Profile focuses on the gas and electric PAs' accomplishments. However, the integration of additional data provides a foundation for broader analyses into where delivered fuel use is high (e.g. oil, propane, and others) and where electric weather sensitivity is low or high, suggesting delivered fuels for heat or electric heating as a possible supplementary heating fuel respectively. This information can be used by the PAs to prioritize geographic areas for energy optimization outreach efforts and GHG reductions. The tax data integrated though the Residential Customer Profile report may also be a useful training set, allowing the PAs to leverage building age, style, and square footage combined with the weather sensitivity data as a proxy for the amount of GHG reductions that could be obtainable though energy optimization outreach initiatives. At the broader scope there may also be non-energy elements to energy optimization that local stakeholder groups may be able to leverage.

Integration of a proxy estimate for delivered fuel will also address a current limitation in the Residential Customer Profile report. Some PAs have historically reported on delivered fuel savings in their tracking data, and with the adoption of the standardized BCR IDs this should be possible across all PAs in future years regardless of if the data is captured in their underlying systems. This 2013 – 2015 Customer Profile Report did not leverage the delivered fuel savings in the analyses as they caused an overstatement of the savings ratios in the absence of data on the underlying delivered fuel consumption.

[7] DNV GL understands that the term energy optimization encompasses strategic electrification and fuel switching.

2 INTRODUCTION

The 2013–2015 Residential Customer Profile report provides a series of selected data tables, charts, and maps illustrating the participation, savings, and geographic dynamics of the Program Administrators (PAs) 2013 through 2015 residential energy efficiency programs. The analysis and reporting of the statewide data allow the PAs and the Energy Efficiency Advisory Council (EEAC) Consultants to:

- Accurately quantify and report on trends and time series evolution in the Massachusetts residential landscape
- Develop narratives about these trends and their implications for a variety of stakeholder interests

All data is presented in accordance with the Department of Public Utilities (DPU) rules to protect individual customer confidentiality. Additional PA data summaries, reports including the Commercial and Industrial Customer Profile reports for 2011 – 2016, and the most recent quarterly filed net and impact adjusted PA data can be found online at www.MassSaveData.com and on the MA EEAC website at www.ma-eeac.org.

2.1 Objectives

The objective of the Residential Customer Profile project is to integrate the Massachusetts PAs' 2014 and 2015 customer, consumption and energy efficiency tracking data with the previously captured 2013 data into the Residential Evaluation Database and to analyze this data in order to identify, quantify, and report on the evolving trends in the residential energy efficiency landscape.

The objectives of the MA Residential Evaluation Database are:

- To provide a standardized, time-series, statewide view of the PAs' tracking and billing data
- To maintain customer-level data confidentiality
- To support a diverse and robust array of drill-downs and roll-ups of PA data, focusing on various attributes that provide unique insight into PA residential efficiency accomplishments
- To minimize data requests on the PA teams in support of ongoing evaluation work
- Track customer participation in PA research to minimize the requests on any given customer and maintain a "do not contact" list on behalf of the PAs to support ongoing evaluation projects.

The Residential Customer Profile report serves as the vehicle to aggregate and summarize the account- and project-level details contained in the MA Residential Evaluation Database, in accordance with the PAs' and EEAC Consultants' goal of:

Generating cross-PA views of the data at as granular a level as feasible without compromising customer or project data confidentiality.[8]

2.2 Organization

The report presents a series of the key tables, charts, and metric using the following structure:

- **Introduction (section 1)** provides a high-level overview and key concepts that orient the reader to the material in the residential report, including primary analysis equations, definitions, and high-level methodological details.

[8] This principle was originally articulated in the 2012 C&I Customer Profile report and is consistent with the DPU 14.140 ruling specifying the actual aggregation thresholds for any data summaries.

- **Electric and gas combined summary (section 3)** provides high level summaries of the population, consumption, program participation, and savings of electric and gas accounts for 2013-2015 by year, PA, geography, customer size, and program type.
- **Demographic analysis (section 4)** provides a series of quintile analyses on participation, savings, and consumption for the combined 2014 and 2015 reporting years for the ratio of census block group households below 200% of the poverty index, the median block group home age, and the ratio of renter occupied homes in each block group.
- **Electric (Section 5) and Gas (Section 1)** present a series of increasingly granular data charts, tables and maps showing the population and participant level savings, participation rates, and geographic distribution of combined 2014 and 2015 block group savings and participation.
- **Appendices (section 7)** present additional detailed data summaries within individual PAs and provide break outs for individual reporting years' data. Additional supporting methodological details are also provided.

2.3 Methodology in brief

DNV GL began the project by requesting the previously compiled 2010-2013 Residential Evaluation database and the raw PA data for the 2014 and 2015 reporting years. Specifically, DNV GL requested:

- Energy efficiency tracking data – including upstream, behavioral, and HES Lead Vendor Data – pertaining to the customers, projects, equipment, and vendors associated with the energy efficiency measures.
- Billing data including customer's contact and location information and the consumption for those customers for each billed period in 2014 and 2015.

The data DNV GL received from the PAs contained a wide variety of file types and formats. We thoroughly reviewed the data and coordinated with the PAs to identify additional files to fill in data gaps. Although the Residential Customer Profile is presented as a static report, DNV GL continues to refine, update, and load additional data into the MA PAs' Residential Evaluation Database as new material becomes available; each year's Customer Profile presents a snapshot of the current MA Residential Evaluation Database. As PAs identify new attributes that yield better insight into the data, DNV GL incorporates them into the Residential Evaluation Database and retroactively applies them to the time series data.

It is important to recognize that for all PAs the underlying purpose of their billing systems and tracking systems are to accurately account for energy consumed so the PA can be appropriate compensated, and to accurately track measures installed so the savings can be reported in aggregate and the consumers rebated for their purchases. The MA PA's use of their billing and tracking datasets in the Residential Customer Profile, and integration of these systems with other locational and third-party datasets for deeper analysis of their MA engagements represents a level of data analysis and precision that many PA systems were not originally built to handle and have required PA teams find effective work arounds for. These underlying IT systems continue to be upgraded and improved to support these new levels of analysis. Not all residential tracking accounts will link up to corresponding billing data; the Appendix includes merge success rates by initiative for each PA. Causes of unlinked data included:

- Missing accounts in the billing or energy efficiency tracking data provided by the PAs
- Incomplete billing data or mis-assigned accounts in the PA's tracking system

- One-too-many relationships between measures installed and billed accounts; multifamily data may be reported by some PAs at the building level, e.g. "32 thermostats in 25 apartments in building A"
    - Master-metered accounts in residential multifamily units are another case of this, where the account may actually join correctly but since they would represent only one line of data they would under-represent the participation rates.
- New construction accounts that did not have a record in the previous year's data
- Accounts that did not contain all necessary IDs for merging, in particular in the 2013 data compiled by a previous vendor
- Line item corrections in the underlying PA data systems

The account population is not static over time. The opening and closing of accounts causes year-over-year variation in match rates. The success rate values help determine how much of a given year's energy efficiency tracking data is used for each PA in the different analyses in this report. Nevertheless, variation from year to year is expected, and a lower number in any given year should not be construed as "worse."

DNV GL included unlinked accounts in population-level analyses that did not require billing and energy efficiency tracking data to be merged. Including the unlinked accounts in these analyses allows us to demonstrate the magnitude of participation and savings achieved, regardless of whether an account could be linked to billing data in a given year. It is appropriate to include these accounts in the population-level statistics because only active PA customers are allowed to participate in the PAs' efficiency offerings. Consequently, unlinked accounts listed in the energy efficiency tracking data were active customers in the billing data at the time of their participation. This approach allows for the possibility of two different savings numbers, depending on whether the table is using the unlinked population level "all records provided" or participant level of "only linked records".

For the building type analyses DNV GL leveraged the MA Residential tax data that has been integrated into the Evaluation Database to categorize the billed locations and individual accounts where possible. The use codes were aggregated to distinguish between multifamily, single family, other, and unknown building uses. The detailed use codes can be found at http://www.mass.gov/dor/docs/dls/bla/classificationcodebook.pdf.

Within the energy efficiency tracking data there are varying degrees of detail around what was specifically installed for each project. As part of the process for incorporating the 2014 and 2015 energy efficiency tracking data into the MA Residential Evaluation Database, each unique end use description provided by the PAs has been cross-walked to a standardized set of values derived from the MA Technical Reference Manual (TRM). The Residential Customer Profile report focuses on high-level classifications of the energy efficiency tracking data using the field end use impacted. Fees and associated service type measures have currently been split into the "other" category.

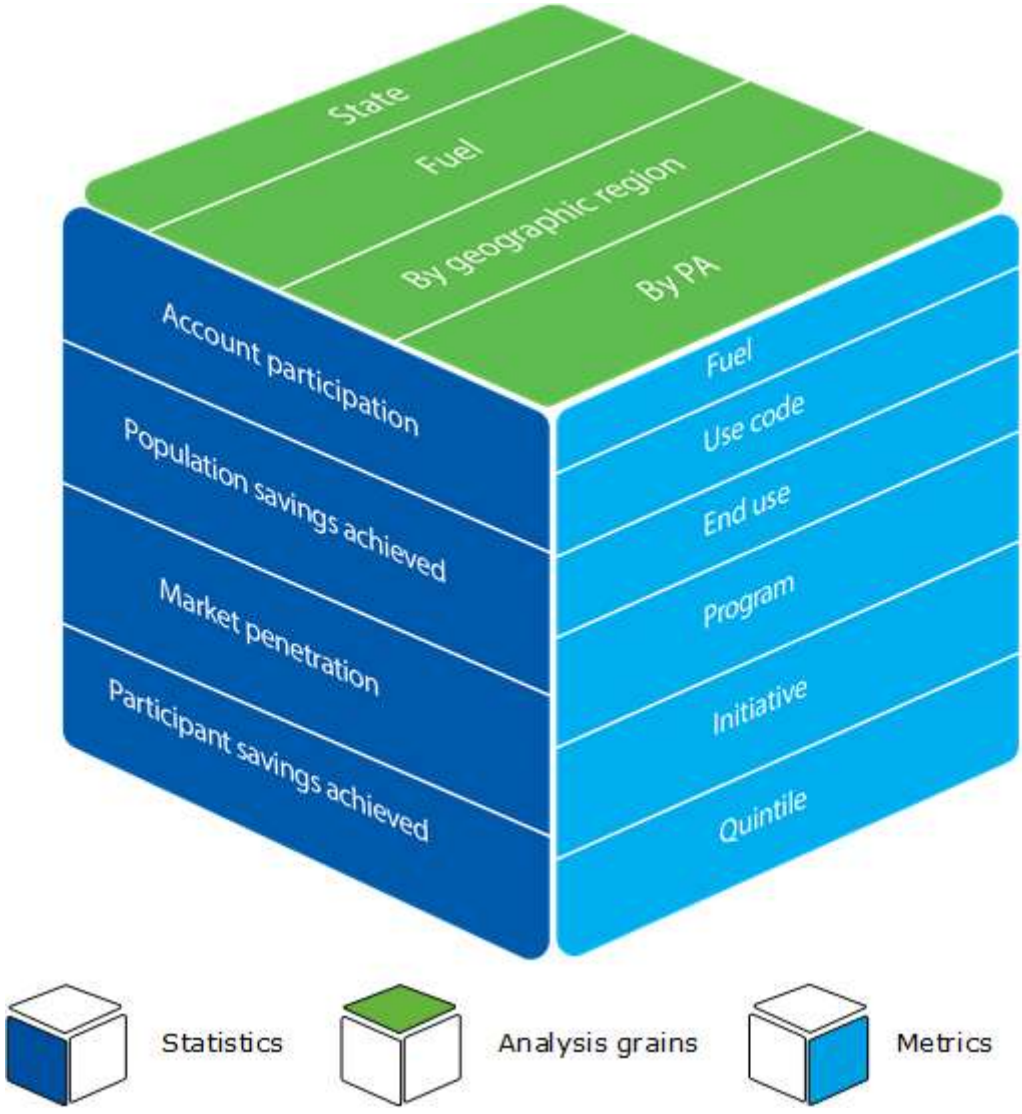
2.4 Primary analysis functions

DNV GL uses an analysis cube presented in Figure 2-1 as the basis for the Residential Customer Profile analysis. This cube provides the stakeholder teams with a quick visual way to assess if a specific statistic for a metric of interest can be calculated at the respective analysis grain in an expedient manner under the current data structure. The three faces of the cube are defined as:

- **Analysis grains:** the different reporting levels in which the data can be summarized.

- **Metrics:** the categorical bins that are used to subset out the analysis grains and provide the detailed views into the data. There is some interchangeability between analysis grains and metrics, such that it is possible to leverage an analysis grain as a metric (e.g., reporting on a statistic by PA and year) for certain sections of the report.
- **Statistics:** the equations and standardized terminology that DNV GL uses in both the Residential and C&I Customer Profile projects. Additional details are provided for each statistic following the data cube presentation.

Figure 2-1. Visualization of the analysis cube leveraged in the 2013-2015 Residential Customer Profile report



DNV GL has analyzed the PAs' tracking and billing data at the unique account level. For PAs that did not directly provide an account number, DNV GL used the combination of the premise number and the customer number as representative of an account number. Unless otherwise noted, all savings values used in the

analyses are in gross annual kWh or gross annual therm savings. The statistics are defined and calculated as:

- **Account participation.** This statistic identifies the ratio of accounts within the analysis population that participated in energy efficiency programs. It can answer questions such as, "What percentage of single family accounts participated in an efficiency program for each PA?" In some instances, PA multifamily data may link only at the master meter level and in these instances would under represent the actual multifamily participation (e.g. 10 units) by capturing only the single master meter account number.

$$\frac{(Number\ of\ Participating\ Accounts\ within\ Analysis\ Population)}{(Number\ of\ Accounts\ within\ Analysis\ Population)}$$

- **Population savings achieved.** This statistic looks at the consumption of efficiency participants within a specific analysis population relative to the consumption of the total analysis population. It can answer questions such as, "What percentage of single family consumption for each PA participated in an efficiency program in 2015?"

$$\frac{(Sum\ of\ Savings\ for\ Participating\ Accounts\ within\ Analysis\ Population)}{(Sum\ of\ Consumption\ of\ all\ Accounts\ within\ Analysis\ Population)}$$

- **Participant savings achieved.** This statistic looks at the gross annual energy savings from participant accounts relative to the consumption for those participants only. It can answer questions such as, "How much energy did participating single family accounts save relative to their consumption?"

$$\frac{(Sum\ of\ Savings\ for\ Participating\ Accounts\ within\ Analysis\ Population)}{(Sum\ of\ Consumption\ of\ Participating\ Accounts\ Only\ within\ Analysis\ Population)}$$

- **Contribution ratio.** This metric measures the proportional savings contribution to total savings for a specific analysis bin relative to the proportional consumption contribution to total consumption. This lens provides a more normalized view of a bin's savings relative to its consumption by incorporating population-level weights.

$$\frac{\left(\frac{Savings\ for\ analysis\ bin}{Total\ savings\ for\ all\ analysis\ bins}\right)}{\left(\frac{Consumption\ for\ analysis\ bin}{Total\ Consumption\ for\ all\ analysis\ bins}\right)}$$

3 ELECTRIC AND GAS COMBINED SUMMARIES

This section provides high level summaries of the population, consumption, program participation, and savings of electric and gas accounts for 2013-2015. The section presents these summaries by year, PA, geography, customer size, and program type.

The section is organized as follows:

- Section 3.1 – Presents the overall number of accounts and consumption history
- Section 3.2 – Presents the success rates merging the tracking and billing data
- Section 3.3 – Presents the overall PA level participation and savings
- Section 3.3.1 – Presents the savings broken out by the PA program
- Section 3.5 – Presents the savings broken out by the PA core initiative

As noted earlier in the report, this analysis focuses on the account level. To try to keep the comparisons across PAs as consistent a data grain as possible, DNV GL used the PA-provided account number when one could be identified. For PAs that did not provide an account number, DNV GL used the combination of the customer number and the premise number as a proxy for account.[9]

3.1 Time Series Summary Data

Table 3-1 shows the number of accounts for each PA in each year and Table 3-2 provides the total consumption for each PA in each year. The 2013 data was compiled for a previous study, and DNV GL has leveraged the existing data wherever possible. A known challenge in the 2013 data is an inconsistent mapping of account numbers in the underlying data, coupled with inconsistent formatting relative to the 2014 and 2015 data. DNV GL attempted to crosswalk and standardize the 2013 data wherever possible to ensure similar grains of data for all time series analyses. However, discrepancies still remain between 2013 and the 2014 through 2015 time series data that cause variations in year-over-year counts.

DNV GL also noted variations for some PAs between 2014 and 2015. In conversations with the PAs we were alerted to three items that could affect this:

1) Several PAs instituted changes in their IT system in 2014 that affected account numbers; crosswalks were provided and have been leveraged wherever possible.

2) The time series record is dependent on receiving a consistently defined extract from the PA source systems year over year. DNV GL understands that there may be inconsistencies in what data is extracted by IT team over the time period and that may have a human element beyond the PAs or direct control.[10]

3) Within the energy efficiency tracking data, there is some material that is captured by third party vendors and provided to the PAs and it is possible that data is either mis-keyed or not captured at all by certain vendors. An example would be a rebate form where the vendor has their receipts, address, and savings information but may not have captured an account number for the address – this is a problem noted for multifamily in particular.

After several iterations of data cleaning and comparison with PA team, the 2013 – 2015 time series consumption and account numbers were deemed sufficiently within tolerance to accurately reflect the PAs' residential billing populations.

[9] This was done as DNV GL confirmed that multiple customer could exist at a single premise, and customers could have many premises associated with their customer number; the combination of the two yielded a unique ID within the PA and Fuel.

[10] An example is if a request is made to an offshore data management firm for all "residential data" and multifamily common area is included one year, but not another. A second example is if the same data is extracted, but only includes "active" accounts on the date of the extract rather than all accounts active over the course of the year. In these instances, the time series data can be updated as root causes for discrepancies are identified and resolved.

Table 3-1. Time series universe of unique billing records - unique accounts

Fuel	PA	Unique Accounts			Total number of unique accounts 2013-2015
		2015	2014	2013	
Electric	Cape Light Compact	189,085	188,763	180,206	222,061
	Eversource	1,034,366	1,000,134	1,003,553	1,329,330
	National Grid	1,357,853	1,350,992	1,088,372	1,577,323
	Unitil	30,574	30,147	30,392	41,627
	Total	**2,611,878**	**2,570,036**	**2,302,523**	**3,170,341**
Gas	Columbia	325,615	322,231	310,950	443,182
	Eversource	287,088	251,024	303,948	393,854
	National Grid	938,407	931,260	761,384	1,076,364
	Small Gas PAs	**99,000**	**97,156**	**95,791**	**131,747**
	Berkshire	31,057	34,307	33,660	45,009
	Liberty	50,150	49,635	46,420	63,943
	Unitil	17,793	13,214	15,711	22,795
	Total	**1,650,110**	**1,601,671**	**1,472,073**	**2,045,147**

Table 3-2. Time series universe of billing consumption

Fuel	PA	Total Consumption			Total consumption 2013-2015
		2015	2014	2013	
Electric (kWh)	Cape Light Compact	1,115,063,940	1,096,360,972	1,074,481,240	3,285,906,152
	Eversource	6,991,739,560	6,194,367,872	6,384,393,321	19,570,500,752
	National Grid	8,600,988,265	8,736,070,482	8,290,812,031	25,627,870,778
	Unitil	166,346,556	174,265,619	177,936,705	518,548,880
	Total	**16,874,138,321**	**16,201,064,945**	**15,927,623,297**	**49,002,826,562**
Gas (Therms)	Columbia	239,134,065	271,467,647	233,828,048	744,429,760
	Eversource	240,789,667	209,194,828	176,772,931	626,757,426
	National Grid	708,313,212	714,260,536	587,006,382	2,009,580,130
	Small Gas PAs	**78,831,887**	**78,273,767**	**69,923,868**	**227,029,523**
	Berkshire	31,208,897	32,174,936	27,053,255	90,437,088
	Liberty	37,052,132	36,904,128	33,085,256	107,041,517
	Unitil	10,570,858	9,194,703	9,785,357	29,550,918
	Total	**1,267,068,831**	**1,273,196,778**	**1,067,531,229**	**3,607,796,839**

Table 3-3 shows the number of unique participants[11] for each PA in each year, while Table 3-4 and Table 3-5 show the savings inclusive and exclusive of behavioral programs respectively for each PA in each year.

[11] If an account participated in multiple programs in a year they are only counted once in this table.

This analysis provides an important baseline for assessing multi-year participation, and for beginning to identify time series trends in how participants engage in efficiency programs. The larger differences between the 2013 tracking data and the 2014 though 2015 data are due in part to the previously mentioned inconsistencies in the underlying 2013 database, however continued growth of the PA energy efficiency programs also plays a role in the increase over time.

Upstream store sales data contributes a sizeable amount of savings to the PA totals, but as it is only captured at the store level it cannot be linked to any individual accounts. This dynamic is likely to have the following effects on the results presented in this section:

- Participation rates are likely to be understated relative to reality as households that only participated in an energy efficiency program via an in-store purchase will not be captured.
- A straight mathematical average of savings per account would be overstated as the savings reflects the upstream data, but not the accurate number of corresponding accounts; caution should be exercised for any population level tables dividing savings by accounts. This caveat would not apply to non-upstream participant level tables.
- Beyond upstream, participants through multifamily programs that were captured at a master meter level would not be captured individually in the participant count; only the master metered record would be reflected.

Unitil's tracking data presented a special case and was affected in some limited instances by two items:

1) an occasional absence of material needed to generate the billing account number, and

2) unadjusted gross savings in the underlying tracking data.

The limited instances where account numbers were not available stemmed from incomplete data needed for the DNV GL requested fields from Unitil's raw databases. A deeper look into the root cause and underlying raw data identified that the incomplete information was not captured in the Unitil system when the data was originally requested and entered into the system by Unitil. The impact of this missing data is twofold. First, as the bulk of the profile report is at the account level, when DNV GL generates the unique number of accounts in the data system for Unitil all missing instances are counted as a single unique account – e.g. 10 customers actually installed measures but without the identification fields we have them show up as a single account labelled "missing". The result of these missing accounts is an under-representation of participation rates for Unitil (e.g. showing 3% participation when it is actually 5%) and the second impact is that since the unique number of accounts is lower the per account savings ratios can be higher than the other PAs. This occurs despite the total savings to consumption ratios being largely consistent with the other PAs. When either of these situations occurs, DNV GL has footnoted the tables and charts for readers. DNV GL is coordinating with Unitil to leverage logic models to try and backfill this data, and a changeover to a new tracking system that enforces field population suggests that the root cause of this missing data has already been addressed by the Unitil team.

The second impact of unadjusted gross savings stems from Unitil's IT system limitation that once tracking data has been keyed in and gross savings populated, it cannot be edited in Unitil's underlying database and is instead aggregated and trued up in the BCR reporting filings. Since the underlying data has accurately captured the measure and the quantity, so long as a measure crosswalk to BCR category is known by the team filling in the BCR for Unitil this aggregate level adjustment will return a correct final population level savings number and at the aggregate level is not an issue. This relies on the PA analyst filling out the BCR

model to correctly map out the measures using their institutional knowledge of the relationship and a formal written index that could be leveraged for the 2013-2015 Residential Customer Profile report did not exist for incorporation. The result is DNV GL is using the unadjusted gross savings from the Unitil tracking systems in this analysis and so the savings and incentive numbers may not directly line up with the final BCR savings. In the majority of situations there is minimal or no impact on savings, but in instances where a measure had the deemed savings changed during the reporting year the original savings could over or understate the final adjusted gross savings in the BCR filings. The PAs' adoption of standardized BCR IDs starting in 2016 suggests that this will not be a factor going forward, though DNV GL recognizes that not all PAs will have the direct ID mapped in their internal systems and there will likely still be a need to coordinate to ensure that the measures within individual initiatives are mapped to the appropriate BCR ID. DNV GL is coordinating with Unitil to adjust the historical data for future time series reporting.

Finally, DNV GL did not include the behavioral savings in these population level tables. This was done to ensure that the savings reported reflected initiatives that required active customer participation decisions; the combination of the behavioral program not being offered in all service territories and the passive engagement resulted in challenges for apples-to-apples comparisons between the PAs in this report. To provide an accurate sense of scale however, DNV GL has included the behavioral initiative savings in Table 3-4.

Table 3-3. Time series universe of unique energy efficiency program participants (excluding behavioral)

Fuel	PA	Unique Energy Efficiency Program Participants			Total number of unique participants 2013-2015
		2015	2014	2013	
Electric	Cape Light Compact	13,782	13,700	10,166	31,915
	Eversource	78,390	80,960	63,581	199,164
	National Grid	70,200	81,550	99,024	226,607
	Unitil	1,097	742	498	2,190
	Total	**163,469**	**176,952**	**173,269**	**459,876**
Gas	Columbia	13,473	12,292	12,655	36,141
	Eversource	14,263	12,603	14,545	37,414
	National Grid	48,330	50,996	55,333	137,607
	Small Gas PAs	**3,479**	**3,156**	**3,393**	**9,179**
	Berkshire	1,774	2,132	2,073	5,460
	Liberty	1,375	742	1,193	3,014
	Unitil	330	282	127	705
	Total	**79,545**	**79,047**	**85,926**	**220,341**

Table 3-4. Time series universe of energy efficiency program savings (including behavioral)

Fuel	PA	Annual Energy Efficiency Program Savings			Total Energy Efficiency Program Savings 2013-2015
		2015	2014	2013	
Electric (kWh)	Cape Light Compact	22,307,932	23,538,306	19,752,399	65,598,637
	Eversource	280,895,862	321,383,280	251,469,423	853,748,565
	National Grid	345,762,940	407,607,064	333,981,937	1,087,351,941
	Unitil	4,035,786	3,416,622	3,085,875	10,538,283
	Total	**653,002,520**	**755,945,272**	**608,289,634**	**2,017,237,426**
Gas (Therms)	Columbia	2,522,227	2,056,692	1,918,418	6,497,337
	Eversource	3,783,433	3,476,038	2,939,353	10,198,824
	National Grid	11,938,361	12,784,337	10,956,343	35,679,041
	Small Gas PAs	**620,353**	**547,550**	**511,196**	**1,679,099**
	Berkshire	320,645	267,599	291,776	880,020
	Liberty	206,158	185,882	148,360	540,400
	Unitil	93,550	94,068	71,060	258,677
	Total	**18,864,374**	**18,864,617**	**16,325,310**	**54,054,301**

Table 3-5. Time series universe of energy efficiency program savings (excluding behavioral)

Fuel	PA	Annual Energy Efficiency Program Savings			Total Energy Efficiency Program Savings 2013-2015
		2015	2014	2013	
Electric (kWh)	Cape Light Compact	22,307,932	23,538,306	19,752,399	65,598,637
	Eversource	241,491,862	281,877,280	225,147,423	748,516,565
	National Grid	261,872,940	319,718,064	262,863,937	844,454,941
	Unitil	4,035,786	3,416,622	3,085,875	10,538,283
	Total	**529,708,521**	**628,550,272**	**510,849,634**	**1,669,108,427**
Gas (Therms)	Columbia	2,522,227	2,056,692	1,918,418	6,497,337
	Eversource	2,391,415	2,380,788	2,245,010	7,017,212
	National Grid	6,880,526	7,478,607	6,308,242	20,667,374
	Small Gas PAs	**540,259**	**547,550**	**511,196**	**1,599,004**
	Berkshire	240,551	267,599	291,776	799,927
	Liberty	206,158	185,882	148,360	540,400
	Unitil	93,550	94,068	71,060	258,677
	Total	**12,334,426**	**12,463,636**	**10,982,865**	**35,780,928**

3.2 Merge success rates

Table 3-6 shows the merge success rates of the 2013 through 2015 energy efficiency participation and billing data without the upstream EE participation data or the behavioral program data. Upstream has been left out due to the absence of account numbers in this data; behavioral has been left out as the opt-out nature of that program would cause the calculated participation ratio to be substantially higher for PAs that ran a behavioral program.

The merge success rate tables provide the context to understand what percent of each PAs energy efficiency tracking data has been successfully linked to a billing record and are intended to provide a baseline for stakeholder confidence when assessing how comprehensive the underlying data is for observed trends or hypotheses. When looking at the merge success rate tables, it is important to remember that PAs with small populations can show large variation in merge success rates even though most accounts merge. For example, if a PA only has 10 participants each year, a match of 8 in year 1 would show a success rate of 80%, but a match of 9 in year 2 would be 90%.

DNV GL worked to format account numbers in the 2013 data to align with the formats used in 2014 and 2015. However, because of inconsistencies in how account, customer, and premise numbers were recorded in the underlying 2013 Evaluation database, DNV GL was unable to standardize all account numbers for all 2013 observations. For this reason, tracking to billing merge rates are lower in 2013 than 2014 and 2015

Table 3-6. Merge success rates of the 2013 through 2015 EE participation with billing (upstream and behavioral excluded)[12]

Fuel	PA	2015			2014			2013		
		No. of Tracking Accounts	No. Accounts Merged to Billing	Merge Success Rate	No. of Tracking Accounts	No. Accounts Merged to Billing	Merge Success Rate	No. of Tracking Accounts	No. Accounts Merged to Billing	Merge Success Rate
Electric	Cape Light Compact	13,782	12,789	93%	13,700	13,334	97%	10,165	9,186	90%
	Eversource	78,389	71,472	91%	80,958	73,312	91%	63,580	49,941	79%
	National Grid	70,199	68,880	98%	81,549	80,727	99%	99,023	65,786	66%
	Unitil	1,096	983	90%	741	644	87%	497	465	94%
	Electric Total	**163,466**	**154,124**	**94%**	**176,948**	**168,017**	**95%**	**173,265**	**125,378**	**72%**
Gas	Columbia	13,473	12,660	94%	12,292	7,607	62%	12,655	12,306	97%
	National Grid	48,330	46,431	96%	50,996	49,289	97%	55,333	42,393	77%
	Eversource	14,263	13,554	95%	12,603	11,381	90%	14,545	14,033	96%
	Small Gas PAs	**3,478**	**3,168**	**91%**	**3,155**	**2,868**	**91%**	**3,393**	**2,318**	**68%**
	Berkshire Gas Co.	1,774	1,478	83%	2,132	1,900	89%	2,073	1,769	85%
	Liberty Utilities	1,374	1,372	100%	741	740	100%	1,193	450	38%
	Unitil Gas	330	318	96%	282	228	81%	127	99	78%
	Gas Total	**79,544**	**75,813**	**95%**	**79,046**	**71,145**	**90%**	**85,926**	**71,050**	**83%**
Grand Total		**243,010**	**229,937**	**95%**	**255,994**	**239,162**	**93%**	**259,191**	**196,428**	**76%**

[1] Columbia's 62% merge rate in 2014 resulted from a change in tracking systems midway through the year.

[12] Occasionally the counts may display a difference of 1 from other tables. This is an artifact of how the analysis platform handles blanks and Null cells in the underlying data when generating distinct counts. DNV GL verified that this difference has no effect on the overall table outcomes.

3.3 2013 – 2015 unique participation and savings

Table 3-7 through Table 3-8 show basic summary information for the combined 2013 through 2015 energy efficiency tracking data used throughout this report. Additional charts based on these tables are presented in Sections 5.2.1 and 6.2.1; additional tables for individual years can be found in section 7.2. These tables include upstream savings that account for a large degree of portfolio savings but that are not reflected in the "accounts participating in EE" counts. As with the earlier population tables, behavioral savings are not captured so that the savings reported reflected initiatives requiring active customer participation decisions.

Table 3-7. Unique 2013-2015 account participation rates and population savings achieved by electric PA[13]

PA	Billing Accounts	Population kWh Usage	Accounts Participating in EE	Gross Participant kWh Savings	Account Participation	Population Savings Achieved
Cape Light Compact	222,061	3,285,906,152	31,915	65,598,637	14.4%	2.0%
Eversource	1,329,330	19,570,500,752	199,164	748,516,565	15.0%	3.8%
National Grid	1,577,323	25,627,870,778	226,607	844,454,941	14.4%	3.3%
Unitil	41,627	518,548,880	2,190	10,538,283	See footnote	2.0%
Total	**3,170,341**	**49,002,826,562**	**459,876**	**1,669,108,427**	**14.5%**	**3.4%**

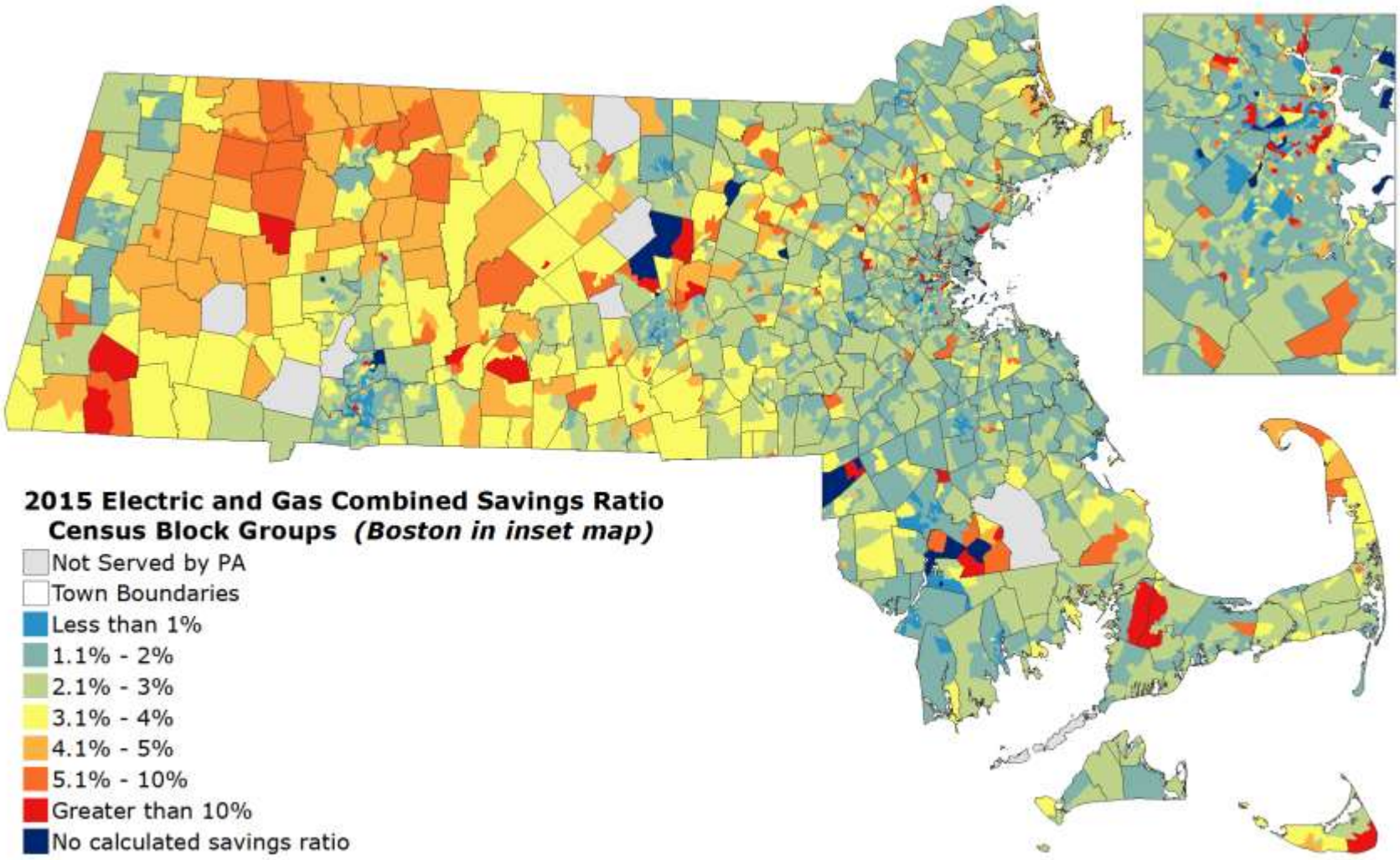
Table 3-8. Unique 2013-2015 account participation rates and population savings achieved by gas PA

PA	Billing Accounts	Population Therms Usage	Tracking Accounts	Gross Participant Therms Savings	Account Participation	Population Savings Achieved
Columbia	443,182	744,429,760	36,141	6,497,337	8.2%	0.9%
Eversource	393,854	626,757,426	37,414	7,017,212	9.5%	1.1%
National Grid	1,076,364	2,009,580,130	137,607	20,667,374	12.8%	1.0%
Small Gas PAs	**131,747**	**227,029,523**	**9,179**	**1,599,004**	**7.0%**	**0.7%**
Berkshire	45,009	90,437,088	5,460	799,927	12.1%	0.9%
Liberty	63,943	107,041,517	3,014	540,400	4.7%	0.5%
Unitil Gas	22,795	29,550,918	705	258,677	3.1%	0.9%
Total	**2,045,147**	**3,607,796,839**	**220,341**	**35,780,928**	**10.8%**	**1.0%**

[13] Unitil's account participation is lower than other PAs, this is a result of a series of Unitil tracking data not including account numbers or the associated customer and premise numbers in the raw data. These accounts, and their savings, are captured in the report and tables but the absence of the account numbers means that all records are aggregated to a single "blank" account number line. This is why Unitil's savings are consistent with the other PAs, but its participation rate, if calculated it is 5.3%, appears lower than the other PAs.

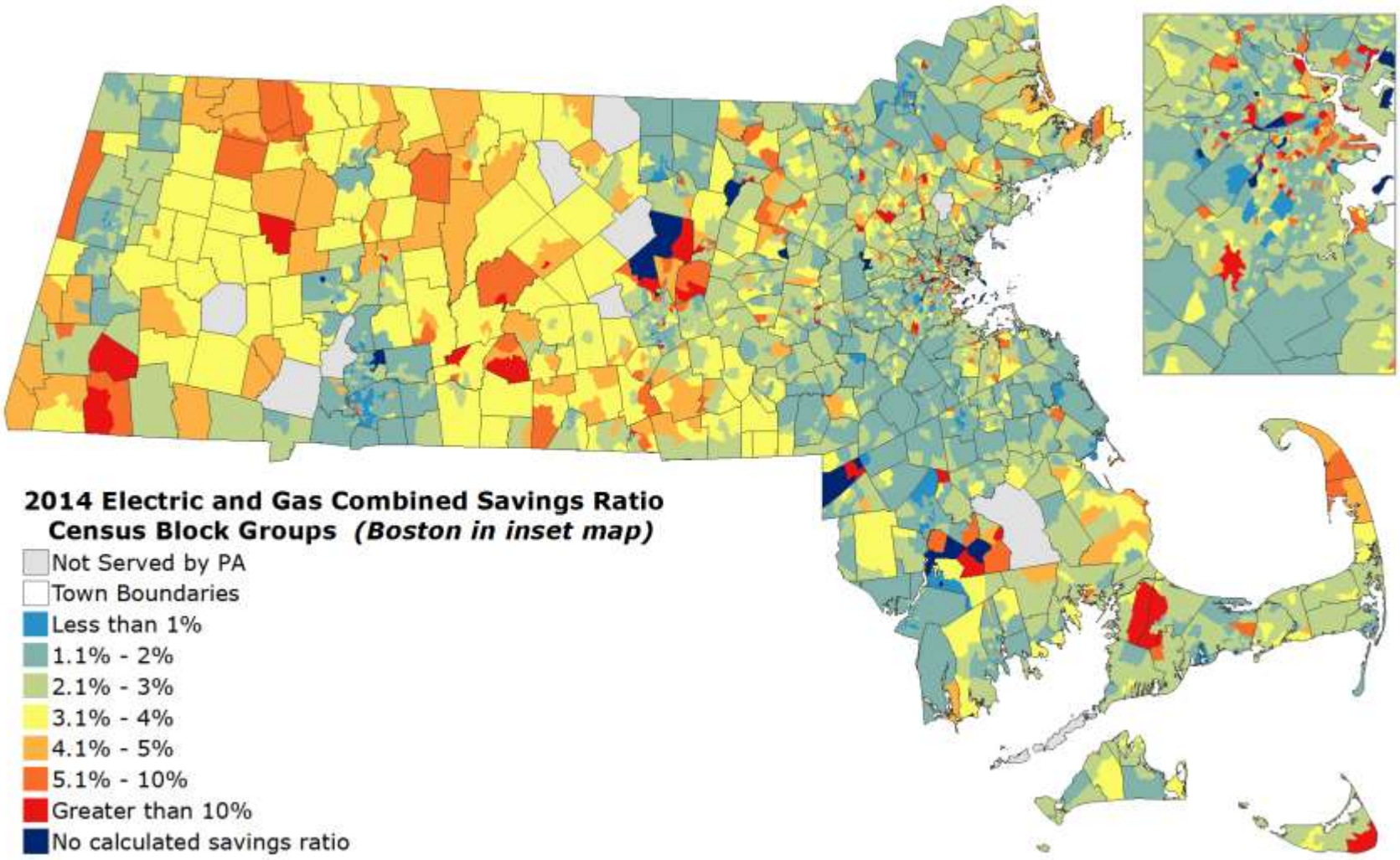
Figure 3-1, and Figure 3-2 provide a combined block group level view of the population savings achieved by MMBTU. These tables include upstream lighting and behavioral program savings; for records where no account identifiers were available, such as some PA's multifamily programs and the new construction program, DNV GL used the facility address to identify where savings should be allocated on the map. Delivered fuel towns, particularly in the western portion of the state, have consistently higher population savings achieved ratios; this is reflective of a limitation of the MMBTU consumption from delivered fuels being an unknown value and not reflected in the Residential Evaluation Database. The implication is that it would be incorrect to assess delivered fuel towns energy savings relative to PA served towns and conclude that the PA served towns are saving less energy; the absence of the delivered fuel data is the primary driver behind this visual outcome.

Figure 3-1. Combined PA served electric and gas participant savings achieved, 2015[14] (MMBtu, exclusive of non-PA delivered fuels)



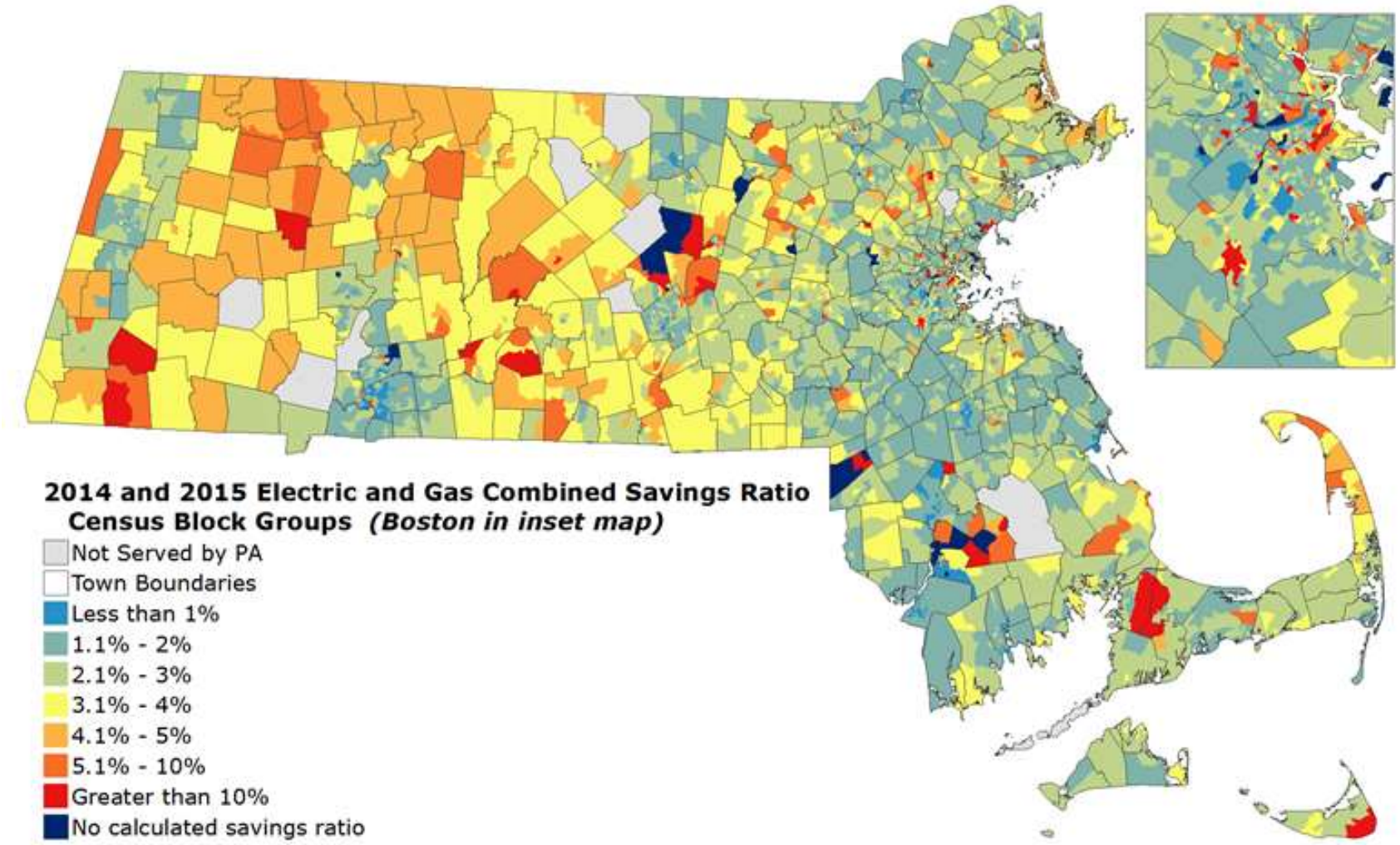
[14] Savings maps include the modeled block group level upstream lighting savings and the behavioral program savings. The upstream lighting distribution model was developed by the NMR Group at the Census Tract spatial grain using the 2016 Program year's data. The Residential Customer Profile report uses the census block group spatial grain. To generate an approximation of the lighting distribution for the 2014 and 2015 program years DNV GL leveraged the upstream lighting model parameters provided by NMR but applied at the block group level. For the full details of the NMR model please review http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Distribution-Model-Report-2.pdf.

Figure 3-2. Combined PA served electric and gas participant savings achieved, 2014[15] (MMBtu, exclusive of non-PA delivered fuels)



[15] Savings maps include the modeled block group level upstream lighting savings and the behavioral program savings. The upstream lighting distribution model was developed by the NMR Group at the Census Tract spatial grain using the 2016 Program year's data. The Residential Customer Profile report uses the census block group spatial grain. To generate an approximation of the lighting distribution for the 2014 and 2015 program years DNV GL leveraged the upstream lighting model parameters provided by NMR but applied at the block group level. For the full details of the NMR model please review http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Distribution-Model-Report-2.pdf.

Figure 3-3. Combined PA served electric and gas participant savings achieved for the combined 2014 and 2015 program years[16] (MMBtu, exclusive of non-PA delivered fuels)



[16] Savings maps include the modeled block group level upstream lighting savings and the behavioral program savings. The upstream lighting distribution model was developed by the NMR Group at the Census Tract spatial grain using the 2016 Program year's data. The Residential Customer Profile report uses the census block group spatial grain. To generate an approximation of the lighting distribution for the 2014 and 2015 program years DNV GL leveraged the upstream lighting model parameters provided by NMR but applied at the block group level. For the full details of the NMR model please review http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Distribution-Model-Report-2.pdf.

3.3.1 Participation Rates and Savings by Year and PA

As noted earlier in the report, Unitil's tracking data was affected in some limited instances by two items: an occasional absence of material needed to generate the billing account number, and unadjusted gross savings in the underlying tracking data. For this reason, DNC GL has not calculated the account participation rate for Unitil.

Table 3-9. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2015)

PA	Billing Accounts	Population kWh Usage	Accounts Participating in EE	Gross Participant kWh Savings	Account Participation	Population Savings Achieved
Cape Light Compact	189,085	1,115,063,940	13,782	22,307,932	7.3%	2.0%
Eversource	1,034,366	6,991,739,560	78,390	241,491,862	7.6%	3.5%
National Grid	1,357,853	8,600,988,265	70,200	261,872,940	5.2%	3.0%
Unitil	30,574	166,346,556	1,097	4,035,786	See note	2.4%
Total	**2,611,878**	**16,874,138,321**	**163,469**	**529,708,521**	**6.3%**	**3.1%**

Table 3-10. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2014)

PA	Billing Accounts	Population kWh Usage	Tracking Accounts	Gross Participant kWh Savings	Account Participation	Population Savings Achieved
Cape Light Compact	188,763	1,096,360,972	13,700	23,538,306	7.3%	2.1%
Eversource	1,000,134	6,194,367,872	80,960	281,877,280	8.1%	4.6%
National Grid	1,350,992	8,736,070,482	81,550	319,718,064	6.0%	3.7%
Unitil	30,147	174,265,619	742	3,416,622	See note	2.0%
Total	**2,570,036**	**16,201,064,945**	**176,952**	**628,550,272**	**6.9%**	**3.9%**

Table 3-11. Account participation rates and population savings achieved by PA, electric - including unlinked energy efficiency tracking data (2013)

PA	Billing Accounts	Population kWh Usage	Tracking Accounts	Gross Participant kWh Savings	Account Participation	Population Savings Achieved
Cape Light Compact	180,206	1,074,481,240	10,166	19,752,399	5.6%	1.8%
Eversource	1,003,553	6,384,393,321	63,581	225,147,423	6.3%	3.5%
National Grid	1,088,372	8,290,812,031	99,024	262,863,937	9.1%	3.2%
Unitil	30,392	177,936,705	498	3,085,875	See note	1.7%
Total	**2,302,523**	**15,927,623,297**	**173,269**	**510,849,634**	**7.5%**	**3.2%**

Table 3-12. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2015)

PA	Billing Accounts	Population Therms Usage	Tracking Accounts	Gross Participant Therms Savings	Account Participation	Population Savings Achieved
Columbia	325,615	239,134,065	13,473	2,522,227	4.1%	1.1%
Eversource	287,088	240,789,667	14,263	2,391,415	5.0%	1.0%
National Grid	938,407	708,313,212	48,330	6,880,526	5.2%	1.0%
Small Gas PAs	**99,000**	**78,831,887**	**3,478**	**524,529**	**3.5%**	**0.7%**
Berkshire	31,057	31,208,897	1,774	240,551	5.7%	0.8%
Liberty	50,150	37,052,132	1,374	190,428	2.7%	0.5%
Unitil Gas	17,793	10,570,858	330	93,550	See note	0.9%
Total	**1,650,110**	**1,267,068,831**	**79,544**	**12,318,696**	**4.8%**	**1.0%**

Table 3-13. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2014)

PA	Billing Accounts	Population Therms Usage	Tracking Accounts	Gross Participant Therms Savings	Account Participation	Population Savings Achieved
Columbia	322,231	271,467,647	12,292	2,056,692	3.8%	0.8%
Eversource	251,024	209,194,828	12,603	2,380,788	5.0%	1.1%
National Grid	931,260	714,260,536	50,996	7,478,607	5.5%	1.0%
Small Gas PAs	**97,156**	**78,273,767**	**3,155**	**547,550**	**3.2%**	**0.7%**
Berkshire	34,307	32,174,936	2,132	267,599	6.2%	0.8%
Liberty	49,635	36,904,128	741	185,882	1.5%	0.5%
Unitil Gas	13,214	9,194,703	282	94,068	See note	1.0%
Total	**1,601,671**	**1,273,196,778**	**79,046**	**12,463,636**	**4.9%**	**1.0%**

Table 3-14. Account participation rates and population savings achieved by PA, gas - including unlinked energy efficiency tracking data (2013)

PA	Billing Accounts	Population Therms Usage	Tracking Accounts	Gross Participant Therms Savings	Account Participation	Population Savings Achieved
Columbia	310,950	233,828,048	12,655	1,918,418	4.1%	0.8%
Eversource	303,948	176,772,931	14,545	2,245,010	4.8%	1.3%
National Grid	761,384	587,006,382	55,333	6,308,242	7.3%	1.1%
Small Gas PAs	**95,791**	**69,923,868**	**3,393**	**511,196**	**3.5%**	**0.7%**
Berkshire	33,660	27,053,255	2,073	291,776	6.2%	1.1%
Liberty	46,420	33,085,256	1,193	148,360	2.6%	0.4%
Unitil Gas	15,711	9,785,357	127	71,060	See note	0.7%
Total	**1,472,073**	**1,067,531,229**	**85,926**	**10,982,865**	**5.8%**	**1.0%**

3.4 Preliminary savings by program

Table 3-15 and Table 3-16 show the 2013-2015 energy efficiency participant population project and savings statistics (excluding behavioral programs) for electric and gas PAs by sector and program as standardized in the PA energy efficiency tracking data. For consistency across PAs, DNV GL defined a project as the unique combination of account and program when an account and program was provided within a year. When there was no account number, such as new construction DNV GL leveraged the project ID and in the absence of that the combination of data that best represented a unique engagement for an account within a program. Electric PA data is reported in kWh, gas in therms.

DNV GL verified a sizeable increase in one PA's low income program savings between 2013 and 2014; this resulted in a large increase in the total savings reported for the low income whole house program despite the apparent decrease in the number of participating accounts from 2013. DNV GL suspects that some of the difference in the 2013 data may be the result of legacy items within the historical database, but we were unable to verify this or identify a pathway to reconcile these numbers without tracing back to the raw 2013 data.

Table 3-15. 2013-2015 Energy efficiency participant projects and population savings by fuel, program, and year (excluding behavioral)

Fuel	Program	Projects				Savings			
		2013	2014	2015	2013-2015	2013	2014	2015	2013-2015
Electric	Residential Whole House	106,206	107,985	108,676	322,867	80,972,438	135,702,280	159,754,548	376,429,266
	Residential Products	42,844	57,952	44,612	145,408	400,529,158	448,691,043	324,786,239	1,174,006,440
	Low-Income Whole House	22,613	18,183	16,680	57,476	29,348,038	44,156,949	45,167,735	118,672,721
	Total	**171,663**	**184,120**	**169,968**	**525,751**	**510,849,634**	**628,550,272**	**529,708,521**	**1,669,108,427**
Gas	Residential Whole House	68,462	49,873	52,650	170,985	4,450,279	6,340,222	6,728,690	17,519,191
	Residential Products	26,520	29,974	28,016	84,510	4,384,270	3,491,526	3,290,609	11,166,405
	Low-Income Whole House	4,092	2,702	2,678	9,472	1,569,336	2,631,888	2,315,128	6,516,352
	Total	**99,074**	**82,549**	**83,344**	**264,967**	**10,403,885**	**12,463,636**	**12,334,426**	**35,201,948**

Table 3-16 2013-2015 Energy efficiency participant projects and population savings by fuel, PA, program, and year (excluding behavioral)

Fuel	PA	Low-Income Whole House				Residential Whole House				Residential Products			
		Projects	Savings	Percent Projects	Percent Savings	Projects[1]	Savings	Percent Projects	Percent Savings	Projects	Savings	Percent Projects	Percent Savings
Electric	Cape Light Compact	3,220	5,089,349	9%	8%	17,366	24,610,841	50%	38%	13,911	35,898,447	40%	55%
	Eversource	28,638	64,960,009	12%	9%	141,472	165,027,194	61%	22%	62,539	518,529,362	27%	69%
	National Grid	25,568	47,804,666	10%	6%	162,212	184,771,403	63%	22%	68,446	611,878,872	27%	72%
	Unitil	50	818,698	2%	8%	1,817	2,019,828	76%	19%	512	7,699,758	22%	73%
	Total	**57,476**	**118,672,721**	**15%**	**7%**	**322,867**	**376,429,266**	**61%**	**23%**	**145,408**	**1,174,006,440**	**28%**	**70%**
Gas	Columbia	1,939	1,039,458	5%	16%	22,392	3,391,809	56%	53%	15,327	2,014,089	39%	31%
	Eversource	1,681	1,443,154	4%	21%	28,020	3,866,193	65%	55%	13,605	1,684,219	31%	24%
	National Grid	5,261	3,725,297	3%	18%	114,497	9,535,945	67%	47%	51,824	6,905,416	30%	34%
	Small Gas PAs	**591**	**308,443**	**6%**	**19%**	**6,076**	**725,244**	**60%**	**45%**	**3,527**	**562,681**	**35%**	**35%**
	Berkshire	419	147,869	7%	19%	3,608	334,776	58%	42%	2,244	315,994	36%	40%
	Liberty	152	68,300	4%	13%	1,954	287,641	58%	53%	1,283	183,110	38%	34%
	Unitil Gas	20	92,274	3%	36%	514	102,827	68%	40%	227	63,577	30%	25%
	Total	**9,472**	**6,516,352**	**4%**	**19%**	**170,985**	**17,519,191**	**65%**	**50%**	**84,510**	**11,166,405**	**32%**	**32%**

Figure 3-4 Percent savings and percent projects by program and year, electric

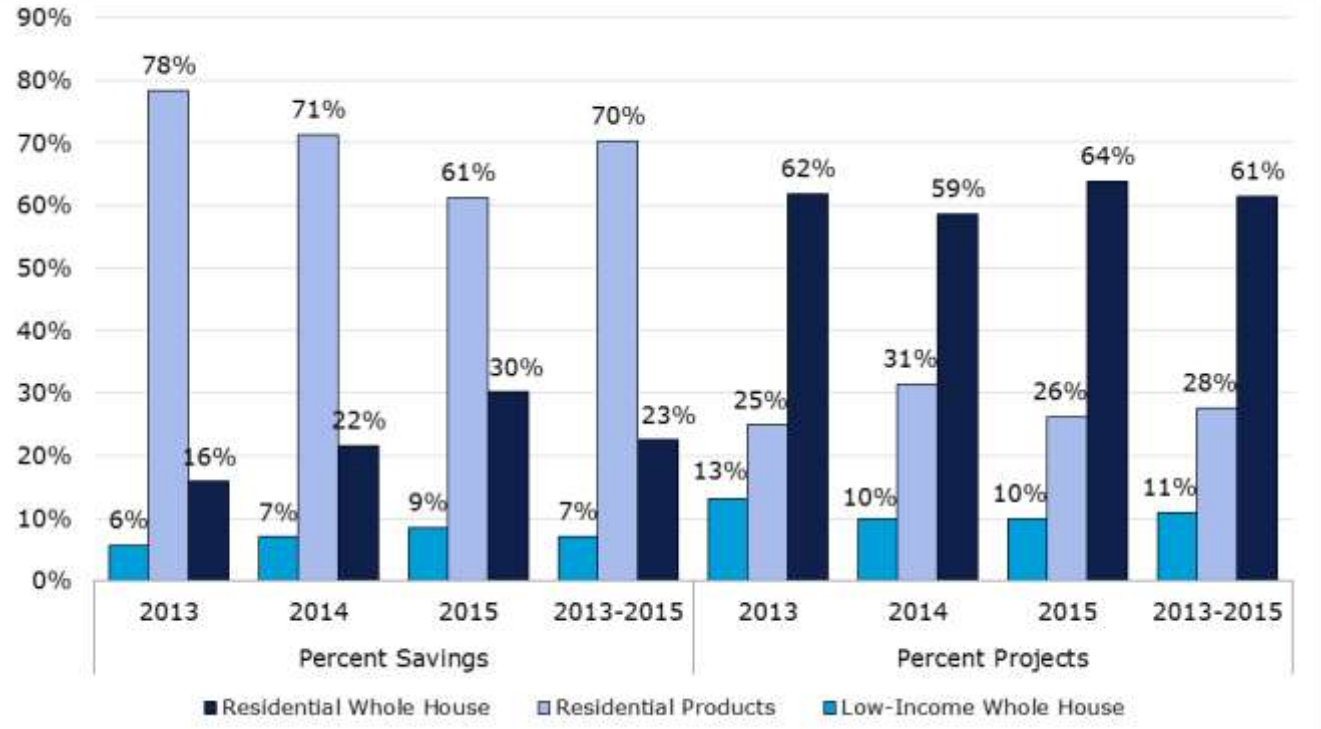
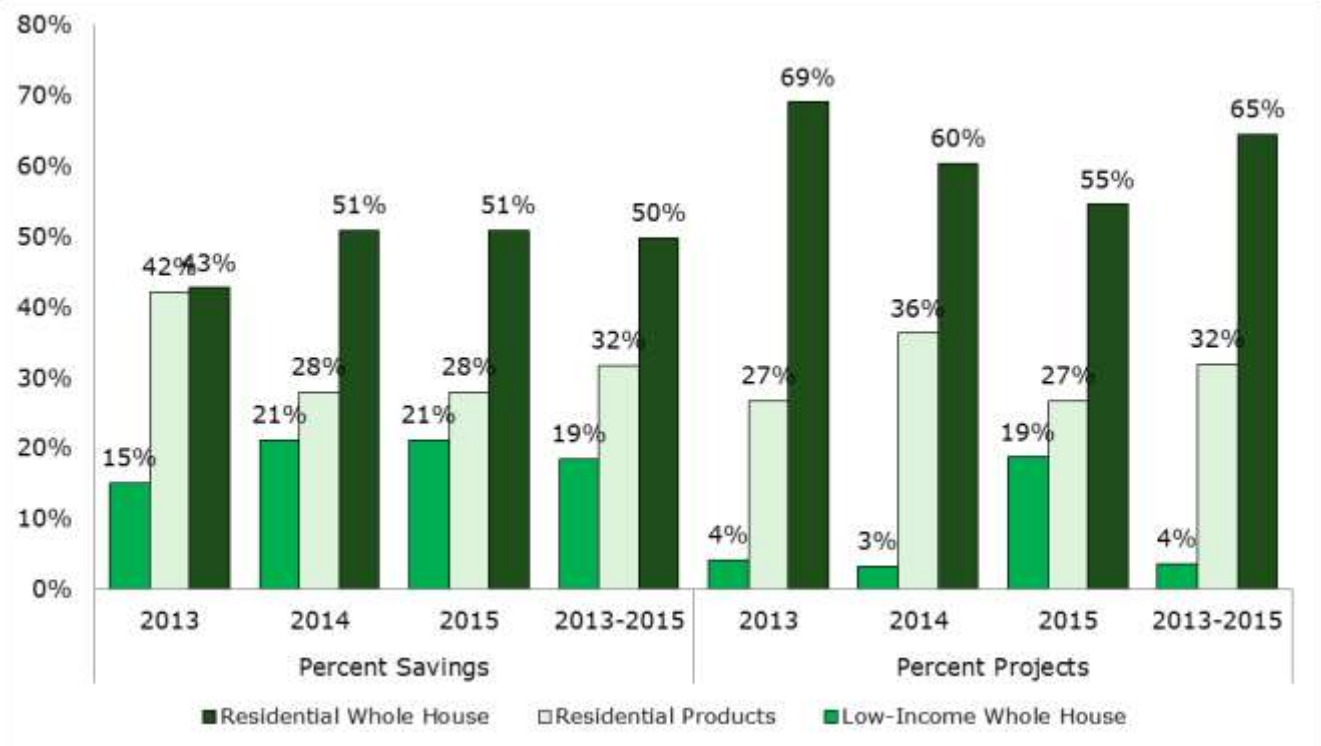


Figure 3-5 Percent savings and percent projects by program and year, gas



3.5 Preliminary savings by initiative

This section presents the number of projects and estimated savings achieved by PA within each initiative as well as the lead to lag initiative for multi-initiative participants. Appendix 7.3 provides the geographical distribution of the behavioral and HES initiative savings and participation by block group.

Figure 3-6 covers the combined electric and gas data for the 2014 and 2015 analysis period; due to the inconsistencies in the account keys for 2013 DNV GL was unable to include that year in this chart. The left hand column shows the lead initiative a participant engaged in with the next subsequent engagement in the right column. Each account could only have one lead program, and one lag program for this graphic so it is possible that participants with and across the years actually had multiple lag programs beyond what is captured in Figure 3-6. The thickness of the line connecting the two initiatives represents the number of participants in the initiative pairing with a thicker line indicating a greater number of participants. The lead and lag program were determined by reporting date in the PA tracking systems. This figure contains cross initiative participation within 2014 and 2015.

Several data elements impact this graphic. First, the lack of account numbers within the New Construction initiative, as well as facility level participation only for National Grid's multifamily data, understate the cross-initiative flow, as the individual accounts cannot be tracked; a change in the analysis grain to the facility level for future reports is likely to alleviate (but not resolve, due to the one-to-many relationship between accounts and addresses) this data element. Upstream lighting participation is also unable to be captured, as there is no account- or address-level information available for that delivery channel. However, it is possible that people bought upstream lighting bulbs at a retail location and also participated in a non-upstream program. Finally, it is possible that temporal lags may affect individual records; however, the overarching trends are unlikely to be adversely affected.

Figure 3-6. Electric cross initiative participant movement, 2014-2015

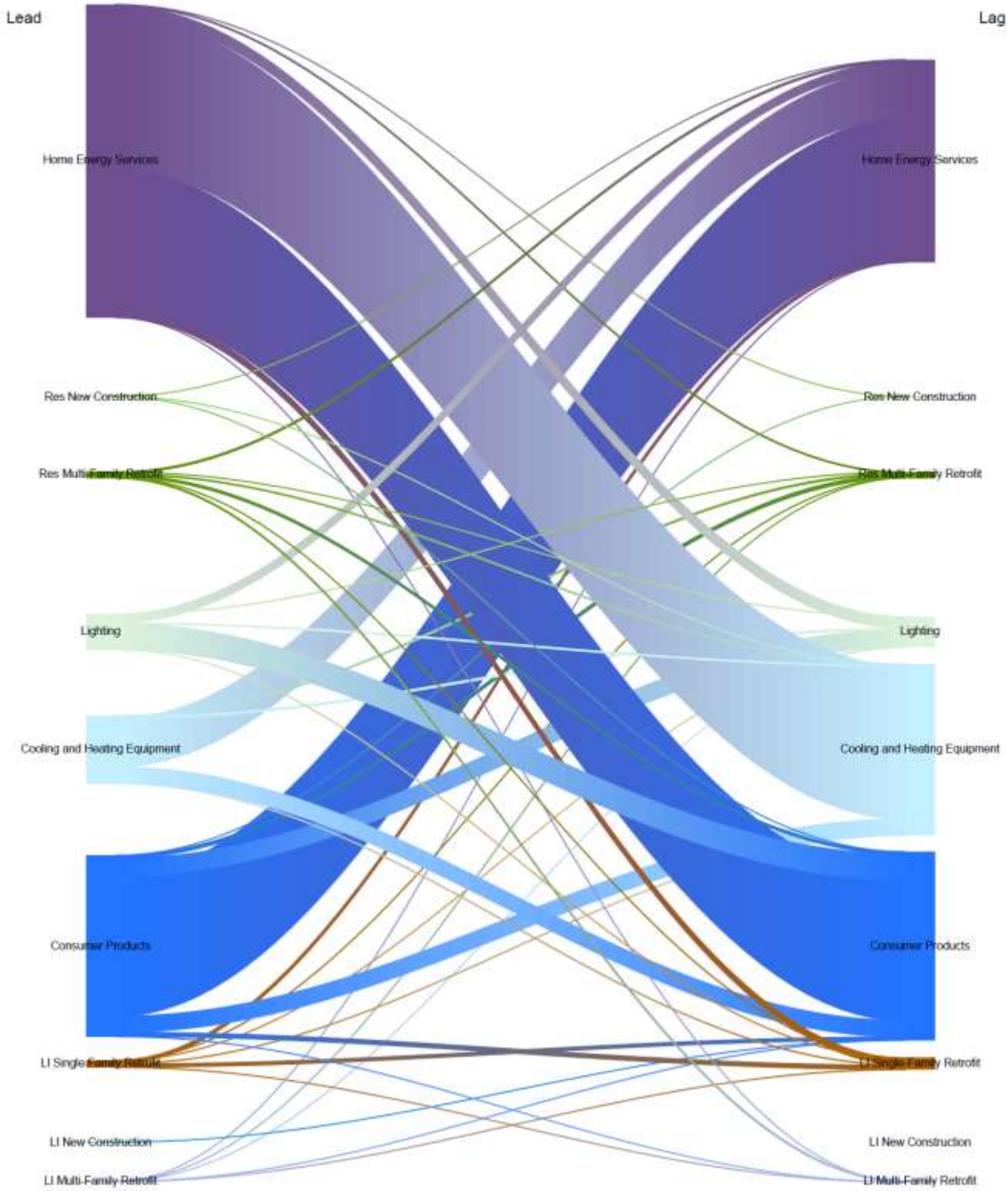


Table 3-17. Electric cross initiative participant movement by unique account, 2014-2015

First Initiative	Second Initiative	Unique Accounts
Low-Income Multi-Family Retrofit	Low-Income Single Family Retrofit	less than 15
	Residential Consumer Products	less than 15
	Residential Home Energy Services	less than 15
	Residential Lighting	less than 15
	Residential Multi-Family Retrofit	less than 15
Low-Income New Construction	Residential Consumer Products	less than 15
	Low-Income Multi-Family Retrofit	less than 15
	Residential Consumer Products	130
	Residential Cooling & Heating Equipment	less than 15
	Residential Home Energy Services	142
	Residential Lighting	less than 15
	Residential Multi-Family Retrofit	less than 15
Residential Consumer Products	Low-Income Multi-Family Retrofit	less than 15
	Low-Income Single Family Retrofit	172
	Residential Cooling & Heating Equipment	688
	Residential Home Energy Services	6,072
	Residential Lighting	755
	Residential Multi-Family Retrofit	139
	Residential New Construction	less than 15
Residential Cooling & Heating Equipment	Low-Income Single Family Retrofit	less than 15
	Residential Consumer Products	703
	Residential Home Energy Services	2,087
	Residential Lighting	62
	Residential Multi-Family Retrofit	60
Residential Home Energy Services	Low-Income Multi-Family Retrofit	less than 15
	Low-Income Single Family Retrofit	288
	Residential Consumer Products	6,093
	Residential Cooling & Heating Equipment	6,624
	Residential Lighting	486
	Residential Multi-Family Retrofit	41
	Residential New Construction	less than 15
Residential Lighting	Low-Income Single Family Retrofit	less than 15
	Residential Consumer Products	1,116
	Residential Cooling & Heating Equipment	40
	Residential Home Energy Services	375
	Residential Multi-Family Retrofit	less than 15
Residential Multi-Family Retrofit	Low-Income Multi-Family Retrofit	54
	Low-Income Single Family Retrofit	less than 15
	Residential Consumer Products	97
	Residential Cooling & Heating Equipment	38
	Residential Home Energy Services	72
	Residential Lighting	less than 15
Residential New Construction	Residential Consumer Products	less than 15
	Residential Cooling & Heating Equipment	less than 15
	Residential Home Energy Services	less than 15

Figure 3-7. Gas cross initiative participant movement, 2014-2015

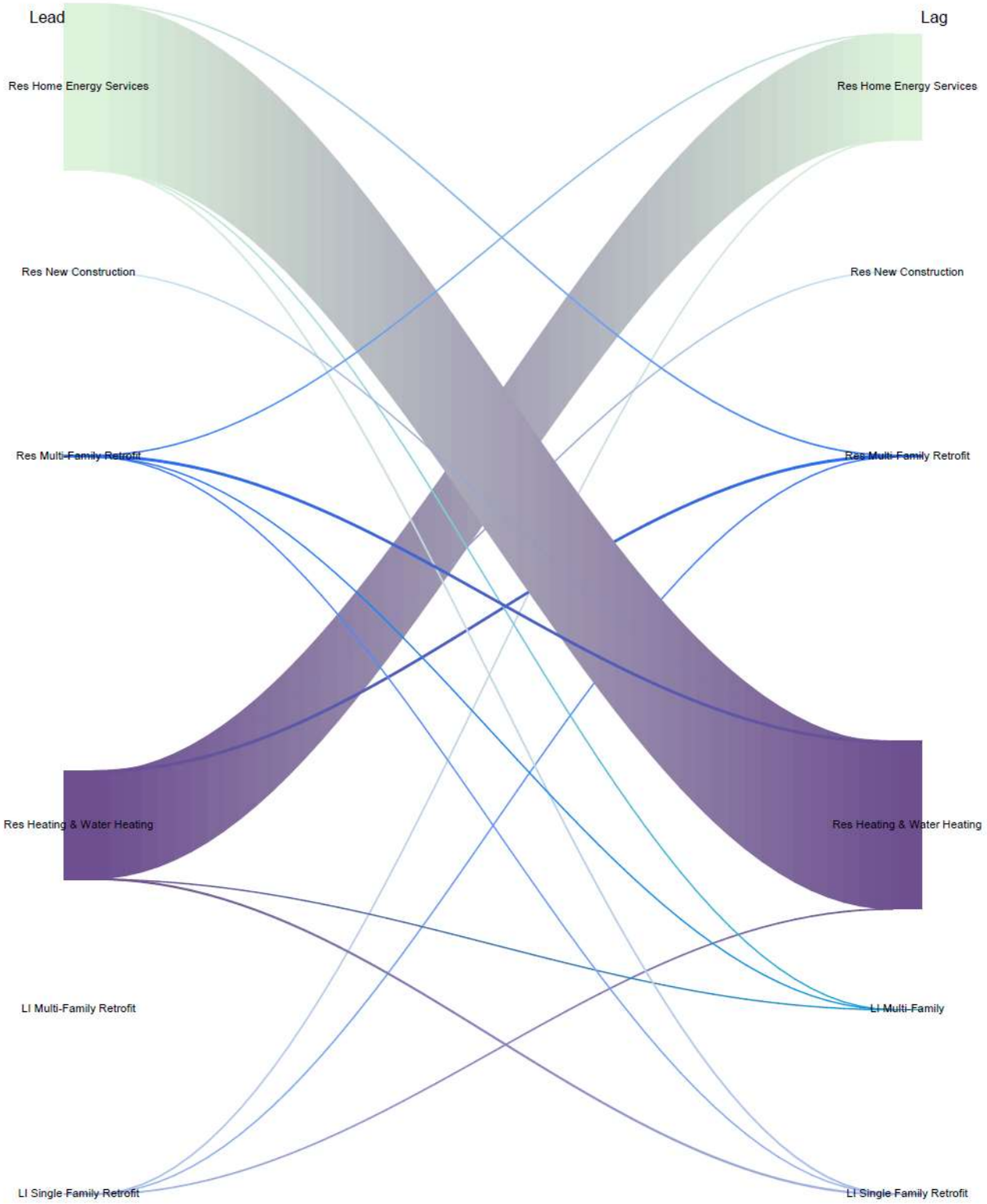


Table 3-18. Gas cross initiative participant movement by unique account, 2014-2015

First Initiative	Second Initiative	Unique Accounts
Low-Income Single Family Retrofit	Residential Heating & Water Heating	less than 15
	Residential Home Energy Services	less than 15
	Residential Multi-Family Retrofit	less than 15
Residential Heating & Water Heating	Low-Income Multi-Family Retrofit	less than 15
	Low-Income Single Family Retrofit	23
	Residential Home Energy Services	3,007
	Residential Multi-Family Retrofit	47
	Residential New Construction	less than 15
Residential Home Energy Services	Low-Income Multi-Family Retrofit	less than 15
	Low-Income Single Family Retrofit	16
	Residential Heating & Water Heating	4,717
	Residential Multi-Family Retrofit	less than 15
Residential Multi-Family Retrofit	Low-Income Multi-Family Retrofit	less than 15
	Low-Income Single Family Retrofit	less than 15
	Residential Heating & Water Heating	46
	Residential Home Energy Services	less than 15
Residential New Construction	Residential Heating & Water Heating	less than 15

Table 3-19 through Table 3-23 display project counts, and savings estimates by fuel, PA, and initiative from 2013-2015.

The savings per project for Cape Light Compact are higher than Eversource and National Grid in the Residential Lighting data presented in Table 3-19. DNV GL verified that the upstream sales data had repeating project IDs in the raw data throughout the course of the year for Cape Light Compact (e.g. the store with account X always has project ID 1). This was a less granular reporting view than the same material for Eversource and National Grid, which used a different project number for each reporting period. As a crosscheck on the underlying data, DNV GL multiplied the total number of projects by 12 months and divided the total reporting savings to reflect a consistent data grain as Eversource and National Grid; this back of the envelope math returned an average savings per project of 1,867 kWh, which is consistent with the other PAs.

Table 3-19 Electric Residential Products Tracking Statistics by PA and Initiative (2013-2015) [17]

PA	Residential Consumer Products			Residential Cooling & Heating Equipment			Residential Lighting		
	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project
Cape Light Compact	7,711	3,145,184	408	6,103	5,835,992	956	1,194	26,754,418	see footnote
Eversource	43,150	25,249,380	585	18,891	13,882,060	735	182,766	477,018,364	2,610
National Grid	45,678	31,671,244	693	21,892	18,687,095	854	289,196	560,905,624	1,940
Unitil	281	687,471	2,447	173	336,512	1,945	909	6,675,775	see footnote
Total	**96,820**	**60,753,279**	**627**	**47,059**	**38,741,659**	**823**	**474,065**	**1,071,354,182**	**2,260**

Table 3-20 Electric Residential Whole House Tracking Statistics by PA and Initiative (2013-2015) [18]

PA	Residential Multi-Family Retrofit			Residential Home Energy Services			Residential New Construction		
	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project
Cape Light Compact	1,243	2,710,898	2,181	15,900	20,658,837	1,299	389	1,403,959	3,609
Eversource	18,429	31,876,240	1,730	123,086	119,336,916	970	3,844	15,673,736	4,077
National Grid	26,151	42,313,407	1,618	136,071	133,736,843	983	3,788	9,332,374	2,464
Unitil	16	422,855	26,428	1,787	1,208,887	676	28	388,086	see footnote
Total	**45,839**	**77,323,399**	**1,687**	**276,844**	**274,941,484**	**993**	**8,049**	**26,798,154**	**3,329**

DNV GL and National Grid identified missing data in the new construction datasets provided to National Grid used in Table 3-21. The missing data affected the bottom right quarter of the supplied dataset which is where income flags exist for each line item, as well as and some of the information to derive savings. Subsequent repulls of the data confirmed that the data was not available and DNV GL was instructed to continue using the material that was available. The effect of this in this table is that the savings and project found for National Grid Low Income New Construction is likely to be understated.

[17] Unitil's data is affected by the footnote 13 on page 13

[18] Unitil's data is affected by the footnote 13 on page 13

Table 3-21 Electric Low-Income Whole House Tracking Statistics by PA and Initiative (2013-2015)[19]

PA	Low-Income Multi-Family Retrofit			Low-Income Single Family Retrofit			Low-Income New Construction		
	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project	Projects	Savings (kWh)	Savings per Project
Cape Light Compact	728	1,088,013	1,495	2,398	3,879,007	1,618	188	122,329	651
Eversource	13,051	45,488,998	3,485	15,592	18,624,108	1,194	434	1,366,763	3,149
National Grid	6,350	33,371,058	5,255	19,218	14,379,723	748	157	57,572	367
Unitil	10	470,312	47,031	49	338,866	6,916	4	9,519	See footnote
Total	**20,139**	**80,418,381**	**3,993**	**37,257**	**37,221,704**	**999**	**783**	**1,556,184**	**1,987**

Table 3-22 illustrates the gas residential products tracking statistics by PA and Initiative for 2013 – 2015. National Grid's projects and savings were larger than the other PAs. DNV GL verified that these numbers are consistent with reported data; National Grid's gas population is larger than the other PAs which is the driver of this scale, and the savings per project suggests that although a much larger population the average participant savings is consistent with the other gas PAs.

Table 3-22 Gas Residential Products Tracking Statistics by PA and Initiative (2013-2015)

PA	Residential Heating & Water Heating		
	Projects	Savings (Therms)	Savings per Project
Columbia	15,327	2,014,089	131
Eversource	13,605	1,684,219	124
National Grid	51,824	6,905,416	133
Small Gas PAs	**3,754**	**562,681**	**150**
Berkshire	2,244	315,994	141
Liberty	1,283	183,110	143
Unitil Gas	227	63,577	280
Total	**84,510**	**11,166,405**	**132**

[19] Unitil's data is affected by the footnote 13 on page 13

Table 3-23 Gas Residential Whole House Tracking Statistics by PA and Initiative (2013-2015)

PA	Residential Multi-Family Retrofit			Residential Home Energy Services			Residential New Construction		
	Projects	Savings (Therms)	Savings per Project	Projects	Savings (Therms)	Savings per Project	Projects	Savings (Therms)	Savings per Project
Columbia	3,347	477,291	143	19,046	2,597,537	136	879	368,963	420
Eversource	2,818	485,652	172	25,208	2,881,813	114	1,680	522,374	311
National Grid	10,592	1,297,970	123	103,912	7,047,096	68	3,503	1,691,595	483
Small Gas PAs	**138**	**22,759**	**92**	**5,849**	**626,803**	**107**	**96**	**78,318**	**438**
Berkshire	129	11,915	92	3,413	298,983	88	69	25,165	365
Liberty	NA	10,245	NA	1,952	241,151	124	NA	37,594	NA
Unitil Gas	7	599	86	484	86,670	179	24	15,559	648
Total	**16,895**	**2,283,672**	**135**	**154,015**	**13,153,249**	**85**	**6,158**	**2,661,250**	**432**

N/A: Liberty provided Residential Multi-Family Retrofit and Residential New Construction data as aggregated data. This resulted in all data being represented as a single project line for Liberty and the savings per project equaling the total savings. This is an artifact of the data grain provided and DNV GL has chosen to capture these fields for Liberty as NA in order to avoid confusion for stakeholders.

Table 3-24 Gas Low-Income Whole House Tracking Statistics by PA and Initiative (2013-2015)[20]

PA	Low-Income Multi-Family Retrofit			Low-Income Single Family Retrofit		
	Projects	Savings (Therms)	Savings per Project	Projects	Savings (Therms)	Savings per Project
Columbia	324	626,007	1,932	1,615	413,451	256
Eversource	308	1,058,682	3,437	1,373	384,472	280
National Grid	1,018	2,959,149	2,907	4,243	766,148	181
Small Gas PAs	**199**	**156,220**	**see footnote**	**504**	**152,223**	**302**
Berkshire	188	90,422	481	231	57,447	249
Liberty	NA	12,487	NA	152	55,813	367
Unitil Gas	10	53,311	5,331	121	38,963	322
Total	**1,849**	**4,800,058**	**2,596**	**7,735**	**1,716,294**	**222**

N/A: Liberty provided Low-Income Multi-Family Retrofit data as aggregate observations. This resulted in all data being represented as a single project line for Liberty and the savings per project equaling the total savings. This is an artifact of the data grain provided and DNV GL has chosen to capture these fields for Liberty as NA in order to avoid confusion for stakeholders.

[20] Unitil's data is affected by the footnote 13 on page 13

4 DEMOGRAPHIC ANALYSIS – BACKGROUND

With the approval of the PAs and EEAC Consultants, DNV GL modified and updated the quintile analysis developed in the 2013 Residential Customer Profile. The quintile analysis provides a snapshot of account—or in select instances where account is not available, location-level—participation and participant savings, which vary geographically based on a ranking variable of interest from the US Census American Community Survey (ACS) database. This analysis can show whether specific ratios of ACS variables appear to be correlated with block group-level savings trends or participation ratios; **however, a critical distinguishing factor of this analysis is that the block group quintile variable <u>may not</u> be correlated with the participating PA accounts** and ACS analysis does not provide account level granularity due to ACS data only being available at the block group level. The extension of the block group characteristic as a descriptive variable of the individual participating accounts is known as the "ecological fallacy" and is discussed in greater detail in the 2013 Residential Customer Profile report.[21] When consuming the data from the following tables all conclusions should be considered at the block group- not the individual account - level and taken as potentially useful indicators of how ratios of certain variables at the block group level are correlated at the block group level with participation; due to the ecological fallacy, characteristics from the block group are not necessarily transferable to an individual account or sub-population of accounts within the block group.[22]

The assignment of the PA billing data to a corresponding block group was done at the point level using the following steps. Presented under these steps are high-level bullets of the potential caveats and implications.

3. The raw PA billing and tracking locations were geocoded using the MA Emergency 911 Database (e911) and US Census TIGER line index (TIGER) to generate a latitude and longitude coordinate that could be spatially intersected with the ACS block group polygons.[23]

    a. The requirement for point-level precision for the initial round of intersects means that there can be PA records with completed physical site data that either cannot be located within the acceptable accuracy criteria[24] by the geocoding index used (e911 or TIGER) or that there can be information that could be located at a less granular level, like zip code or city, that could not be confidently assigned an ACS variable in this first pass.

    b. Due to the higher quality of the location information in the billing data, DNV GL used the account level link between billing and energy efficiency tracking data as the primary means to assign consistent locational information to the energy efficiency tracking data and minimize the opportunity for spatial misalignments (step 3). In instances where tracking data either did not have an account-level link but contained location data or was missing the account altogether but contained location data, DNV GL used the location in the tracking data to spatially allocate the savings. The analytical effect of this choice is that there are limited instances where savings in a block group may not be linked to a corresponding billing record, which would result in a

[21] Per the 2013 Residential Customer Profile report: "The ecological inference fallacy might lead a reader to believe that the block groups in Quintile 1 with a high participation rate in a certain program all share the same demographic characteristics as aggregated for the category. However, there may be substantial variation in these characteristics for the block groups within a category and for the households within a block group." http://ma-eeac.org/wordpress/wp-content/uploads/Residential-Customer-Profile-Study2.pdf

[22] This correlation does not imply a causal effect and may be spurious at the individual account level.

[23] Future geocodes are anticipated to leverage the MA e911 database and potentially third party mapping services such as the google maps API to resolve records that could not be geocoded using the TIGER index.

[24] For both the e911 and TIGER geocoders this was set to 85.

potentially higher numerator for the savings ratio calculations,[25] and a potentially lower denominator for the participation ratios, with a resulting higher participation ratio.

4. The point-level data were intersected with the ACS block groups to assign a block group ID to each record.

    a. Some accounts provided a physical location that could be geocoded but that was outside of MA. These likely reflect misalignment in the source systems between a billing address and a physical address; when the intersection with the ACS block groups is run, these accounts do not receive an ACS assignment and fall out of the analysis.

5. Ratios of the select analysis variables such as "percent occupied housing" and "percent of households below poverty" were calculated for each block group and then assigned a quintile relative to the state block group population.[26] Table 4-1 presents a simplified example showing how the same block group can be assigned to different quintiles for different variables depending on the independent variable being considered (Variable A or Variable B). In this example the variables are sorted from smallest to largest and the corresponding quintile assigned.

Table 4-1. Two variable examples of quintiles in a five-block-group population

Block Group	Participation Rate	Variable A	Variable A Quintile	Variable B	Variable B Quintile
A	10%	1	1	15	5
B	12%	3	2	10	4
C	9%	7	3	2	5
D	9%	15	4	4	3
E	5%	25	5	3	2

    a. A Very small subset (usually high single digits to low double digits out of over 4,000 block groups) of the ACS block groups did not contain data from the US Census Department for some of the analysis variables due to privacy rules in the ACS data. In these instances, we discarded the affected block groups for any quintile analysis and dropped the PA accounts contained in them from that particular table.

    b. Some analysis variables had large populations in the top or bottom quintile that caused a roll-up of one or more analysis bins into a single "quintile." An example would be both the fourth (in part) and fifth interval (in its entirety) having block groups with a ratio of 100%. Rather than arbitrarily split the 100% block groups into two bins, we aggregated the fifth bin into the fourth. The effect of this is that some quintile tables will have fewer than five rows of data.

[25] An example is a multifamily building reporting savings and partial consumption under the residential sector, but also having additional consumption captured under a C&I rate code that would not be captured in this report. DNV GL understands that the instances of this occurring are likely to be small, but within the individual block groups that are impacted, there can be potentially substantial shifts in savings ratios as a result.

[26] This was a change from the 2013 Residential Customer Profile where the quintiles were assigned by rank-ordering the block group participation ratios. Using this logic, a block group should always remain in the same quintile within a fuel and year regardless of which ACS variable was being assessed. Based on a working group call with the PAs and EEAC teams the decision was made to let the block group quintile shift in line with the ACS variable being assessed (e.g. the explanatory variable); block participation under this logic would become in effect the dependent variable whereas in 2013 it was used as an explanatory variable.

6. We then generated the quintile block groups for each of the ACS variables presented in the remainder of this section. We present the quintile range along with the bin's total billing and tracking locations, as well as the of the descriptive statistics for the block group population within that quintile.[27]

7. All ACS Block Group maps were generated at the block group level using the aggregated numbers for the point-level data that was associated with the block group.

    a. In the event that there was a block group with no identified billing data, this would appear in the map as a white area with "no data identified." This could happen for certain gas activity maps where towns are not served by a distribution pipeline, or for block groups that are not residential (an example would be Logan International Airport in Boston).

8. DNV GL leveraged the integrated MA DOR tax data to identify multifamily accounts in an effort to provide more detailed insight into a population that the PAs and EEAC had indicated through the working groups was historically a tougher market to gain insight into, and needed to be better understood.

    a. There are limitations with this first attempt to include multifamily as a specific grain in the quintile tables, most notably that the data presented here is only for accounts that could be successfully linked to tax data and that some of the PA tracking systems captured the multifamily information at the building or master metered level, rather than account level. DNV GL understands that new PA tracking systems coming online for future years' data may alleviate some of the latter challenge, and coordination work between the DNV GL data management team and the Evaluation Contractors will provide even greater insight into the multifamily populations in future years.

4.1 Electric demographic analysis

The demographic analysis presents the total number of linked and street-level geocoded billing and tracking accounts and summary statistics for a selection of block group variables. Based on guidance of the PAs and EEAC team, **these analyses do not include the modeled upstream[28] or behavioral data[29]** due to the design of these two delivery channels and the effect that the aggregated data would have on the participation and savings ratios in the quintiles.

A condensed version of the quintile analysis is presented in the following section, with supporting scatterplots to provide insights within the quintile bins. The quintile tables summarize all the individual block groups within each quintile population on the scatterplot. The scatterplot illustrates the variability within individual quintiles as well as the existence of outlier points, and also serves as a useful illustration that the variability can be negligible between individual points that are right at the breakpoint between individual quintiles.[30]

[27] This number may not equal the ratio of all accounts in the bin divided by all tracking accounts in the bin; this is because the bin population average may not be the same as the average of all the individual block group participations within that bin – they are similar but distinctly different ratios.

[28] While it is possible to allocate savings, upstream participation data is not captured at the individual account level and the number of participants in a block group cannot be allocated as a result.

[29] Behavioral data was excluded due to the passive enrollment of which accounts are control or participant and the fact that not all PAs ran a behavioral program. The inclusion of the behavioral data would cause the participation rates to appear substantially higher.

[30] This is a result of forcing the data into 5 equally sized bins for analysis. Alternate categorization approaches, such as k-means clusters, geometric intervals, or standard deviations from the population mean, would yield different summary results by changing the individual points included in any given category. These may be more appropriate for different types of analysis questions. K-means may be useful for understanding if there are any natural groupings in the data along both axes, while standard deviations may be useful in understanding how outlier groups perform.

Due to an absence of account numbers in the residential new construction program and some PAs' tracking data—particularly the National Grid multifamily records—the number of tracking accounts may be understated, as DNV GL only had the facility-level data. The impact of this is that for select block groups where there are larger numbers of multifamily data, participation rates may look lower than they are in reality, as the individual accounts will be captured from the billing data in the denominator, but the facility would only be reflected once in the numerator. Several PAs also discovered that their 2013 – 2015 tracking data did not accurately reflect sub-unit participation within locations; this is due to the way that the data is captured in the PA systems. DNV GL is coordinating with the PAs to update historical data when possible, and future Customer Profile reports may be able to better reflect multifamily locations' sub-unit participation. Caution should be used when interpreting the participation rates, particularly around the renter quintile table, as a result of this data artifact. Since the facility address is used to geographically locate the savings, this does not impact the savings ratios.

Table 4-2 presents the quintile analysis for households identified in the ACS data as below 200% of the poverty index for the combined 2014 and 2015 reporting years.[31] Figure 4-1 presents a scatterplot of the individual block groups' contribution ratios[32] relative to the block groups' poverty index; to facilitate trend assessment, extreme outlier block groups are excluded from this scatterplot.

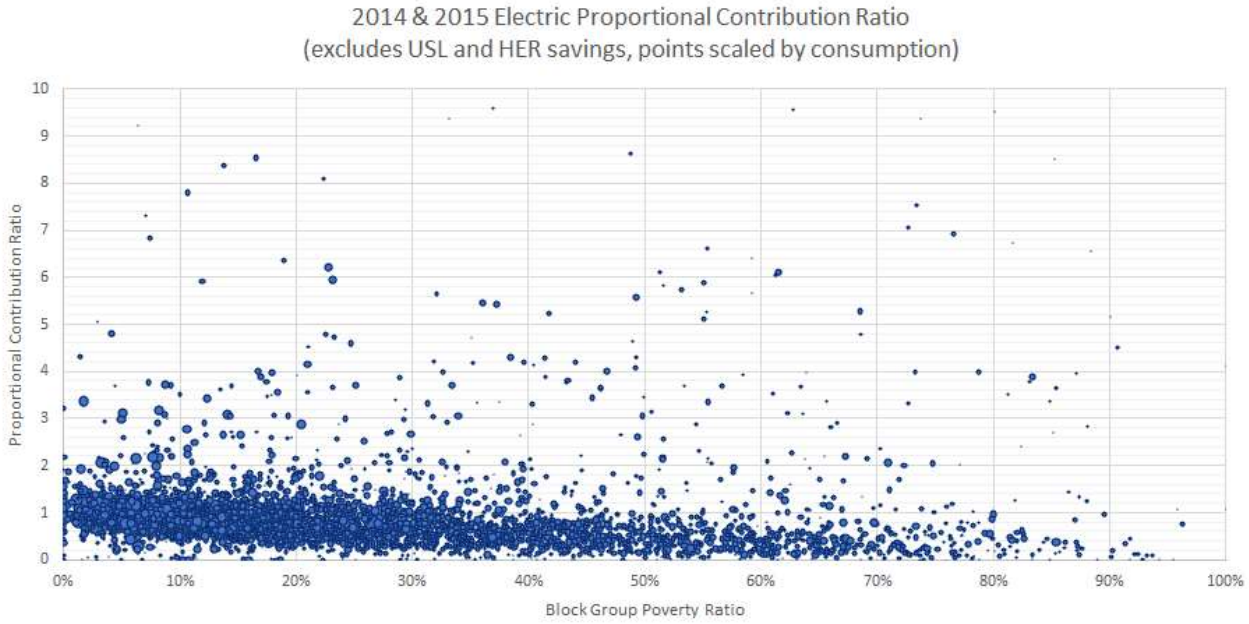
Table 4-2. ACS quintile analysis: ratio of population below 200% of poverty index – unique 2014 & 2015 electric participation rate and savings rate (excludes upstream and behavioral data)

	Unique Billing Records	2014 and 2015 Electric MMBTU Consumption	Unique Tracking Records	2014 and 2015 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Poverty Range
1 - Low Poverty Ratio	519,937	26,974,160	86,094	388,222	1.44%	16.56%	Zero to 9.3
2	600,430	25,273,675	78,815	346,480	1.37%	13.13%	9.3 to 16.9
3	612,815	22,911,872	68,185	296,352	1.29%	11.13%	16.9 to 27.0
4	608,946	18,942,969	52,476	226,557	1.20%	8.62%	27.0 to 43.2
5 - High Poverty Ratio	518,030	13,749,316	30,598	205,315	1.49%	5.91%	43.2 to 100
Grand Total	**2,860,158**	**107,851,992**	**316,168**	**1,462,926**	**1.36%**	**11.05%**	

[31] The ACS data provides categorical bins indicating the number of households represented at different ratios of household income to the poverty level. This is not a DNV GL calculated value.

[32] Defined in section 2.4 as the proportion share of block group statewide savings divided by the share of block group proportional consumption. A value of 1 indicates that the block group share of statewide savings was equal to the block group share of statewide consumption.

Figure 4-1. Block group contribution ratio by poverty index – unique 2014 & 2015 electric population (excludes upstream and behavioral data)



To facilitate consumption of the data presented in the table, we offer several observations, as well as the following caveats. The consumption from the accounts presented in the billing data does not include any C&I metered consumption (such as common spaces or central systems) for the location or block group, which can have the impact of depressing overall consumption. A review of the data suggests this happens in very limited circumstances for a small set of block groups. On the tracking side, some PAs were only able to provide facility-level details, with the result that the tracking account numbers may be understated in some block groups, although the savings would be reflected accurately due to the location level geocodes. Finally, it is important to clarify that the observations presented are in response to the interesting trends in the data and may be something that merits greater in-depth analysis; this report does not investigate the drivers and implications behind how these trends occur or make subjective statements on the trends.

- Within the quintiles, individual block groups demonstrated variability in their proportional contribution ratio that may not be apparent at the aggregated quintile level. This suggests that caution should be exercised when equivocating aggregated quintile results to be indicative of any individual block group within the quintile group rather than as a representative snapshot of the quintile population.

- In quintile 5, where generally more than half the homes in the ACS blocks are identified as above 200% of the poverty limit, the average block group experienced overall participation rates of 6% of the unique accounts identified from 2014-2015. Quintile 1, with a similar number of unique accounts but representing block groups with substantially fewer households above 200% of poverty line, experienced unique account participation rates more than double the fifth quintile. On deeper review of the data, DNV GL suspects it is possible that a correlation between higher poverty quintiles and multifamily locations, combined with the National Grid multifamily data being reported at the facility level, under-reports the participation rate for block groups where there are larger concentrations of multifamily households.

- The accounts in quintile 1 contributed lower levels of consumption than other quintiles – speculatively this may be indicative of smaller households (potentially in terms of people or physical space) with less energy consumption, it might also be indicative that households in this grouping may not have the same level of energy consuming products or systems as households in the other quintiles, or even that these customers have gas accounts. We cannot state definitively from this data. We can, however, offer that the savings ratios by quintile were relative consistent across the quintile bins.

- The individual block group's contribution ratio tended to decrease as the proportion of block group households below 200% of the poverty limit increased, although as a population, the quintile with the highest block group poverty ratios had the highest contribution ratio. This indicates that generally, the block groups with higher proportions of households below the poverty level did not contribute to the overall savings at the same level that they did to the overall consumption. However, when they did participate, they had instances of contribution ratios well in excess of 1.0, indicating a substantially higher share of statewide savings than statewide consumption. While some of this may be an artifact of C&I data, anecdotal evidence and a review of the data suggests large multifamily housing projects that are addressed at the facility level and generate substantial savings are a key driver of this outcome. Finally, it is important to reiterate that while individual block groups may have higher or lower ratios, these do not (in absence of additional data on an expected CR baseline from the demographic and building population mix) necessarily indicate that they are under- or over-contributing.

    - DNV GL believes that there are options that could allow different stakeholders to provide their expert opinions on what any given group is likely to contribute on proportional savings relative to proportional consumption in a mathematically transparent and robust manner that would leverage experts inherent biases to present a more informed baseline contribution ratio.[33] However, we also recognize that this may be a degree of coordination and complexity that exceeds the purpose of the Customer Profile report. Ultimately a more transparent and explicit means of determining a baseline expectation for any given contribution ratio (e.g. is a CR of 0.61 is "low" or is it relatively aligned with what stakeholders anticipated for a low-income population) is likely to both increase the usefulness of the CR statistic as well as stimulate discussion between stakeholders on the underlying biases that are driving their estimates.

The ecological fallacy means we cannot make the statement that lower income homes participate at lower rates, or that income is inversely related to participation and savings. This is a particularly important caveat for bullet number 4 above. For the sake of illustrating the distinction, it is theoretically possible that in each block group, only low-income households participated, and this is being masked by the aggregate level data.

Table 4-3 provides the quintile analysis for the proportion of homes within a block group occupied by renters for the combined 2014 and 2015 reporting years. Figure 4-2 presents a scatterplot of the individual block groups' contribution ratio relative to the block groups' poverty index; extreme outlier block groups have not been included in this scatterplot to facilitate trend assessment.[34] DNV GL has presented the number of unique tracking and billing accounts in the block group. Caution should be exercised with the tracking accounts in particular, as some PAs only capture the multifamily facility-level savings rather than individual account data or sub-unit participation data. In the event that multifamily households and renter-occupied

[33] A common challenge with the contribution ratio is the inherent assumption that 1.0 is the "goal". While this is intuitively an attractive number as it indicates savings and consumption are aligned, it is also unlikely based on a myriad of demographic, building, and physiographic variables that 1.0 represents the target contribution ratio. The contribution ratio may represent an opportunity to engage stakeholders in a more Bayesian approach to assessing under or over represented block groups.

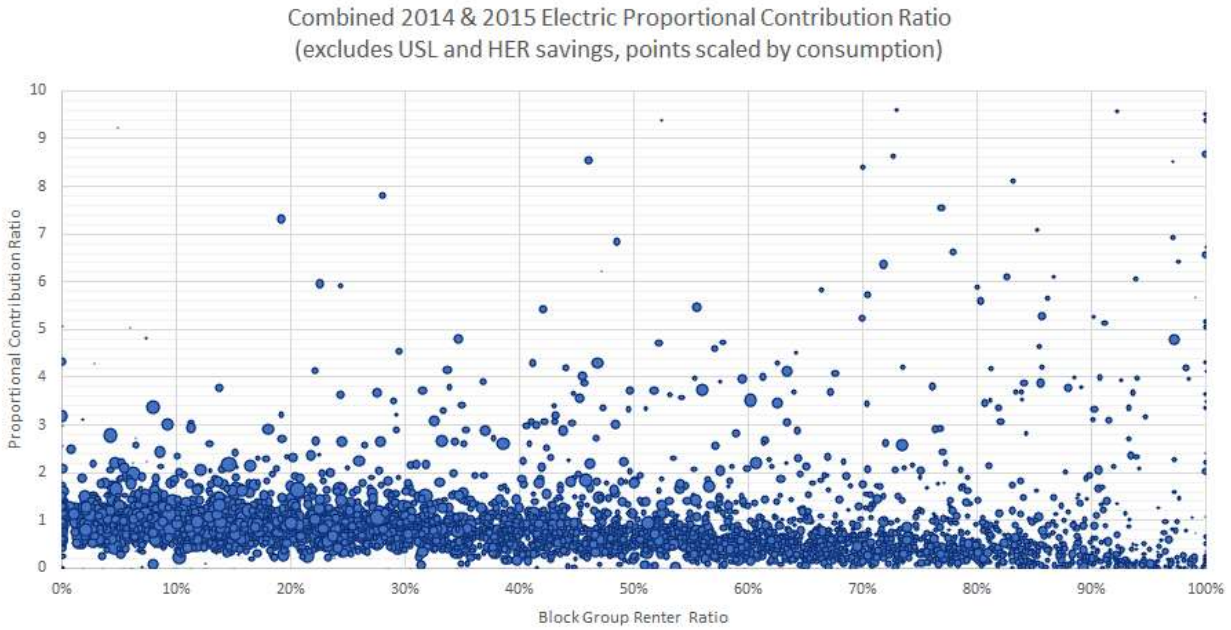
[34] DNV GL identified 29 out of 4,413 block groups as exceeding a CR of 10.

households are correlated (e.g., if home is multifamily, it is also more likely to be a rental) then the number of participating accounts would be under-represented, leading to artificially lower participation rates. Finally, it is important to note that some multifamily buildings may be a mixture of Residential and C&I data. While this report uses multiple logic models to try and capture as much of the location-level consumption and savings data as possible across the two sectors, it remains a possibility that in some instances the data picture will be incomplete.

Table 4-3. ACS quintile analysis: ratio of renter occupied households – unique 2014 & 2015 electric participation rate and savings rate (excludes upstream and behavioral data)

	Unique Billing Records	2014 and 2015 Electric MMBTU Consumption	Unique Tracking Records	2014 and 2015 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Renter Range
1 - Low Renter Ratio	504,442	27,549,392	89,446	389,738	1.41%	17.73%	Zero to 10.2
2	599,074	27,160,454	84,545	361,362	1.33%	14.11%	10.2 to 24.7
3	586,632	21,725,560	66,419	289,427	1.33%	11.32%	24.7 to 44.7
4	603,827	17,850,879	46,746	221,567	1.24%	7.74%	44.7 to 66.6
5 - High Renter Ratio	566,183	13,565,707	29,012	200,831	1.48%	5.12%	66.6 to 100
Grand Total	**2,860,158**	**107,851,992**	**316,168**	**1,462,926**	**1.36%**	**11.05%**	

Figure 4-2 Block group contribution ratio by ratio of renter occupied households – unique 2014 & 2015 electric population (excludes upstream and behavioral data)



- The quintile savings ratio remained relatively constant across block groups; as the proportion of renter occupied homes increased, the raw consumption and savings totals decreased, which may be indicative of generally smaller accounts.

- The quintile participation rates declined as the ratio of rental homes increased. This may be due to a combination of multiple factors including the known limitation of tracking data being captured only at the facility level for National Grid. Speculatively, the lumpy nature of multifamily accounts and the

economies of scale involved in treating as many accounts at a given location as possible at once may also cause natural spikes in individual block groups contribution ratios, as seen in the scatterplot.

- The energy efficiency tracking data does not capture upstream lighting sales, which are reported at the point of sales (store) level. It is possible that renters may be more willing to install measures that they can bring with them when they move, in particular lighting, which would lower their electric bill but not represent the same type of sunk investment from the renter that an HVAC or building shell measure would. This potential dynamic could result in block groups with higher proportions of renters having higher actual participation than is reflected in these aggregate tables due to the grain at which the data is captured by the vendor.

- The scatterplot illustrated greater variability in the contribution ratio for block groups and quintiles with higher proportions of renters. This may indicate that there is a sub-quintile dynamic occurring that the current analysis grain does not shed light on (an example could be a specific city having high block group participation in this quintile), and deeper geographic analysis into potential regional variations within this group may yield greater insight into what is occurring.

4.2 Gas demographic analysis

This demographic analysis presents the total number of linked and street level geocoded billing and tracking accounts and summary statistics for a selection of block group variables. **These analyses do not currently include behavioral data.**[35] These variables are anticipated to form many of the inputs into the geographic weighted regression analysis; additional variables may be added in the draft report as the exploratory data analysis identifies additional potential explanatory variables.

A condensed version of the quintile analysis is presented in the following section, with supporting scatterplots to provide insights within the quintile bins. The quintile tables summarize all the individual block groups within each quintile population on the scatterplot. The scatterplot illustrates the variability within individual quintiles as well as the existence of outlier points, and also serves as a useful illustration that variability can be negligible between individual points that are right at the breakpoint between individual quintiles. Block groups that do not have gas accounts present are not included in this analysis. Within individual census block groups not all households may have access to gas service, and it possible that the ACS variable being considered in the table may not actually be part of the gas service network. As an example, it is possible that all the low-income housing identified in the ACS data is in the northwest corner of a block group, but the gas network only exists in the southeast corner of the block group. In this instance, the block group would show 0% low income participation in the gas data; however, in reality there are no low-income homes that are part of the gas service network and the true value is not 0% but rather "not applicable." The effect of this is that the ecological fallacy extends to both the billing, and tracking, populations; unlike electric where the it primarily affects tracking as all households in a block group are likely to have electric service. The trends presented in tables Table 4-4 through Table 4-5 should be considered with caution in this light. Disaggregating the ACS data within the individual block groups is not feasible in this analysis due to the underlying grain that the ACS data is captured at.

Table 4-4 (page 53) presents the quintile analysis for households identified in the ACS data as below 200% of the poverty index. A similar trend to electric is present, where block groups with higher proportions of households below 200% of the poverty index had lower participation and savings then the other gas quintiles.

- The block group savings rates were relatively consistent across the first 4 poverty quintiles, with a slight decline in the 5th quintile. A deeper look at the data though the block group scatterplot (Figure 4-3) illustrates that there are outlier block groups in all quintiles, including the highest poverty quintile.

- The average block group participation declines from the lowest to highest poverty quintile; however, caution should be exercised in interpreting this trend due to several factors. Some low-income housing—notably Housing Authorities—may be served under a C&I rate code rather than Residential. The participation for these customers would likely be captured under the building's account and not reflect the individual units, causing an underrepresentation of participation when compared to the ACS household-level data. Second, several PAs' data only captures multifamily information at the location grain and cannot be tied to individual accounts; in these cases, the entire building is counted as "one participant" for the block group analysis. There is a large body of research that has found a correlation between multifamily housing and lower income households. Although it could not be confirmed directly in the ACS data, the relative stability of the savings rate against the declining participation rate suggests

[35] Behavioral data was excluded due to the passive enrollment of which accounts are control or participant and the fact that not all PAs ran a behavioral program. The inclusion of the behavioral data would cause the participation rates to appear substantially higher.

that there are likely additional dynamics—including the two discussed in this bullet—at play and that a lower participation rate alone is not necessarily indicative of lower service or savings for the higher poverty block groups.

Table 4-4. ACS quintile analysis: ratio of population below 200% of poverty index – unique 2014 & 2015 gas participation rate and savings rate (excludes behavioral data)

	Unique Billing Records	2014 and 2015 Gas MMBTU Consumption	Unique Tracking Records	2014 and 2015 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Average Save Ratio	Quintile Poverty Range
1 - Low Poverty Ratio	310,468	57,589,120	39,177	574,801	1.00%	12.62%	Zero to 8.76
2	353,835	53,040,373	34,727	495,657	0.93%	9.81%	8.76 to 16.1
3	375,083	50,405,497	31,277	482,349	0.96%	8.34%	16.1 to 25.8
4	375,145	46,282,463	24,263	416,274	0.90%	6.47%	25.8 to 42.3
5 - High Poverty Ratio	342,090	40,552,981	12,344	289,191	0.71%	3.61%	42.3 to 100
Grand Total	**1,756,621**	**247,870,434**	**141,788**	**2,258,271**	**0.91%**	**8.07%**	

Figure 4-3. Block group contribution ratio by poverty index – unique 2014 & 2015 gas population (excludes behavioral data)

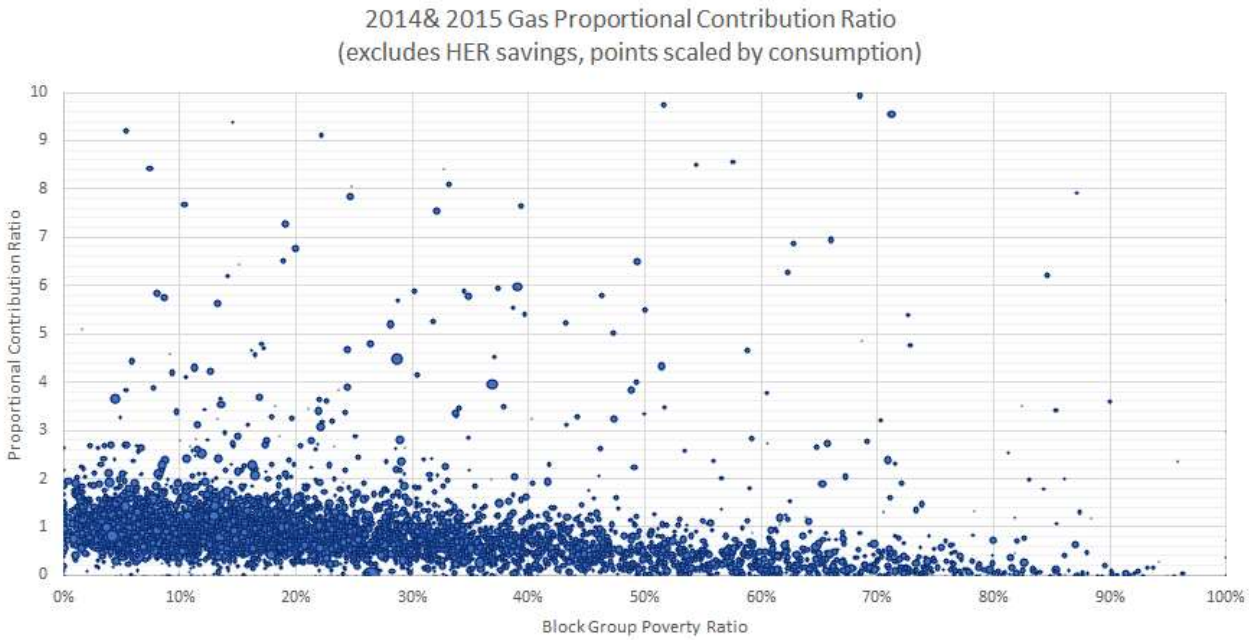


Table 4-5 provides the quintile analysis for proportion of homes within a block group occupied by renters. A very similar trend to the poverty index quintile analysis is present: as the proportion of renter-occupied homes increases, the average participation and savings ratios for those block groups declines.

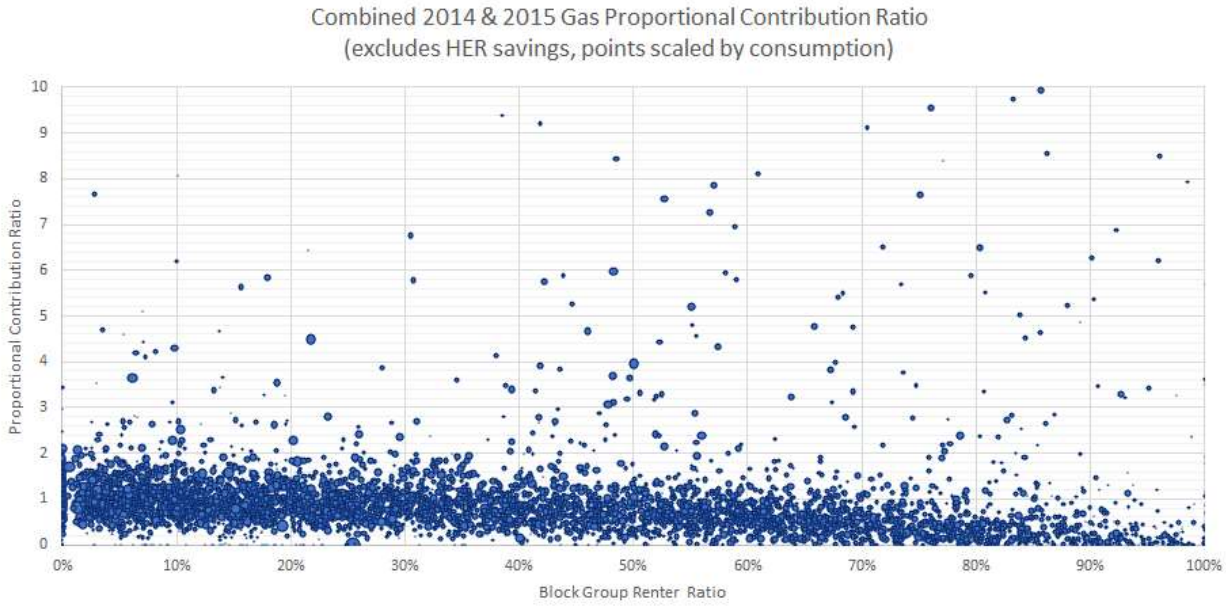
- The block group scatterplot for proportion of renter-occupied homes (Figure 4-4) provides additional insight into sub-quintile dynamics; the preponderance of outliers in the fourth and fifth quintile is higher for the renter occupied households than it is in the prior poverty index. This suggest that there is an additional dynamic happening; speculatively, at least some of this is likely to be influenced by Boston and the surrounding towns where there is still a high proportion of renter-occupied housing, but there may be more of a disconnect between the renters and the poverty index due to local market conditions, student housing, and area-adjusted incomes than there would be in other cities in the state. A second factor may be condominium complexes, which were observed in the data and may qualify as "renter-occupied" housing in the ACS data but present a different population than something like a Housing Authority occupied rental units.

- As was noted for the poverty index discussion, the capture of multifamily participants, which are likely to be correlated to some degree with rental occupancy, at the location grain in the PA IT systems is also a factor. Some of the largest multifamily properties that are likely to be renter-occupied may be severed under a commercial rate, and counted as a single participant which would drive the number of tracking records down. This may be a partially explaining factor in why the fifth quintile has almost half the number of unique tracking records as other quintiles while still having a relatively comparable savings ratio.

Table 4-5. ACS quintile analysis: ratio of renter occupied households – unique 2014 & 2015 gas participation rate and savings rate (excludes upstream and behavioral data)

	Unique Billing Records	2014 and 2015 Gas MMBTU Consumption	Unique Tracking Records	2014 and 2015 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Participation Ratio	Quintile Renter Range
1 - Low Renter Ratio	287,006	54,728,562	37,182	547,201	1.00%	12.96%	Zero to 10.0
2	340,962	54,295,848	35,418	498,436	0.92%	10.39%	10.0 to 24.9
3	366,674	51,836,726	31,003	481,324	0.93%	8.46%	24.9 to 44.5
4	404,049	48,063,364	25,162	424,556	0.88%	6.23%	44.5 to 66.1
5 - High Renter Ratio	357,992	38,550,935	13,033	296,578	0.77%	3.64%	66.1 to 100
Grand Total	**1,756,683**	**247,475,434**	**141,798**	**2,248,097**	**0.91%**	**8.07%**	

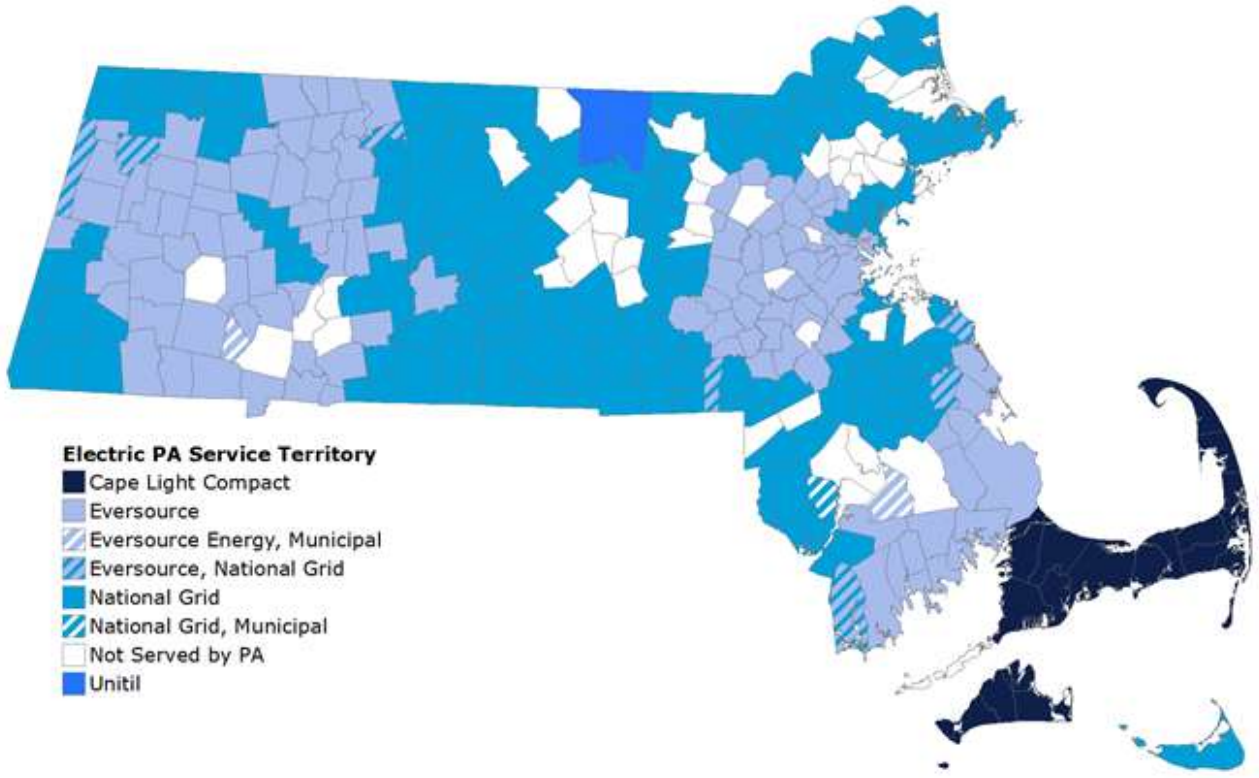
Figure 4-4. Block group contribution ratio by ratio of renter occupied households – unique 2014 & 2015 electric population (excludes upstream and behavioral data)



5 ELECTRIC MARKET ANALYSIS

This section describes the electric market in Massachusetts, broken up by PA service territory (Figure 5-1).

Figure 5-1. Map of MA electric PA service territories



5.1 Participation and savings

This section contains detailed energy consumption and savings breakdowns for all PAs in aggregate, and for individual PAs. Table 5-1 (page 57) shows the field headers, descriptions, and calculations for all tables presented in this section.

Table 5-2 (page 57) shows key variable breakouts statewide, separated by use code (building type) for all accounts that could be linked up successfully with the MA Department of Revenue tax assessor dataset. This dataset was used given the standardized nature of the use codes contained in it, which allowed for consistency in building classification across PAs and geographies. PA-specific versions of this table can be found in Appendix B. Additional PA-specific Tables. These charts contain only energy efficiency tracking data that can be successfully merged to billing data; this decreases total overall savings from what is presented in other sections of the report.

Table 5-1. Field name descriptions for tables in Section 5, electric market analysis

Field Name	Description
# Accounts (YYYY)	Count of the unique accounts identified in the residential evaluation database
kWh Usage (YYYY)	Sum of the kWh usage for the unique accounts for the identified year
Participant kWh Usage (YYYY)	Sum of the kWh usage for match participant accounts only
Annual kWh Savings (YYYY)	Sum of gross annual kWh savings for the matched participant tracking accounts
# Participants (YYYY)	Count of the unique number of matched tracking accounts that participated in an energy efficiency program as identified in the residential evaluation database
Incentive $ (YYYY)	Sum of the incentive dollars for the matched tracking accounts as identified in the residential database

Table 5-2. All PAs' kWh breakouts, excluding unlinked energy efficiency tracking data (2013-2015)

Use Code	Data					
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	Incentive $
Single Family Detached	1,103,464	24,839,613,491	2,271,684,982	235,775,932	225,396	154,144,473
Duplex/Condo	535,633	6,588,924,827	322,590,815	38,661,700	47,368	21,288,651
Multi-Family	182,853	1,287,822,083	30,040,154	5,265,985	6,412	3,478,780
Mobile/Land/Other	129,352	2,029,615,903	105,124,449	12,283,266	12,017	7,588,594
Unknown	1,219,039	14,256,850,257	840,375,510	105,033,257	115,985	68,698,255
TOTAL	**3,170,341**	**49,002,826,562**	**3,569,815,910**	**397,020,141**	**407,178**	**$255,198,754**

Figure 5-2 summarizes the participation, savings, consumption, and population distribution for the population and participants by use code. It also reports on the total GWh saved by the matched participants. The results for individual PAs are presented in Appendix B. Additional PA-specific Tables.

Figure 5-2. Electric customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013-2015)

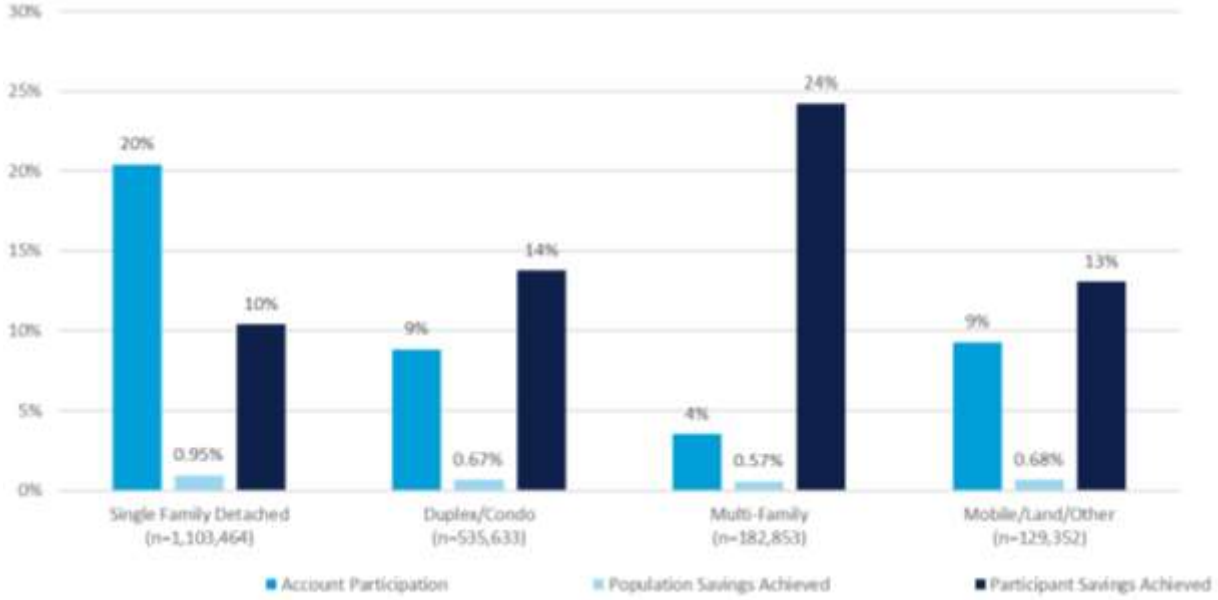
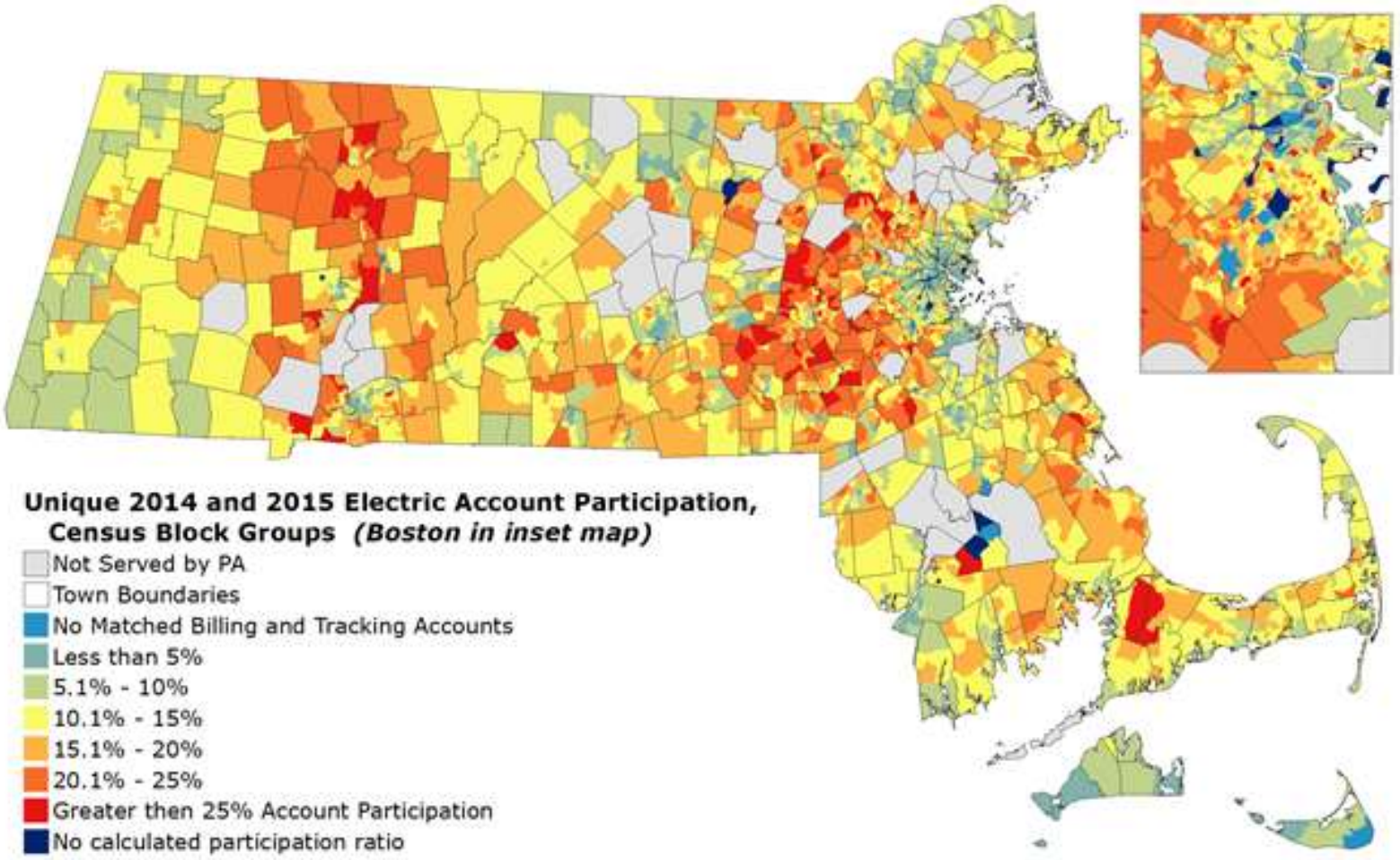


Figure 5-3 and Figure 5-4 provide individual year's savings and participation dynamics across Massachusetts and allow for comparisons across block groups and towns. Participation maps do not include upstream store data as it is not possible to identify the individual, or aggregate, number of participants due to the data grain; DNV GL has included the behavioral only maps in section 7.4. Behavioral program participants are also not included in the participation map due to the opt-out nature of that program and the fact that not all PAs run a behavioral program. Inclusion of the behavioral data would result in many block groups having very high participation ratios.

Savings maps include the upstream data, and the behavioral data. The 2014 and 2015 upstream sales data was allocated out to individual block groups per the model and methodology detailed in Massachusetts Lighting Distribution Modeling (TXC44) report.[36] Behavioral data was linked to the corresponding geocoded customer data so it could be placed into the appropriate block group; any behavioral data that could not be successfully linked to a billing account would not be reflected in the savings maps.

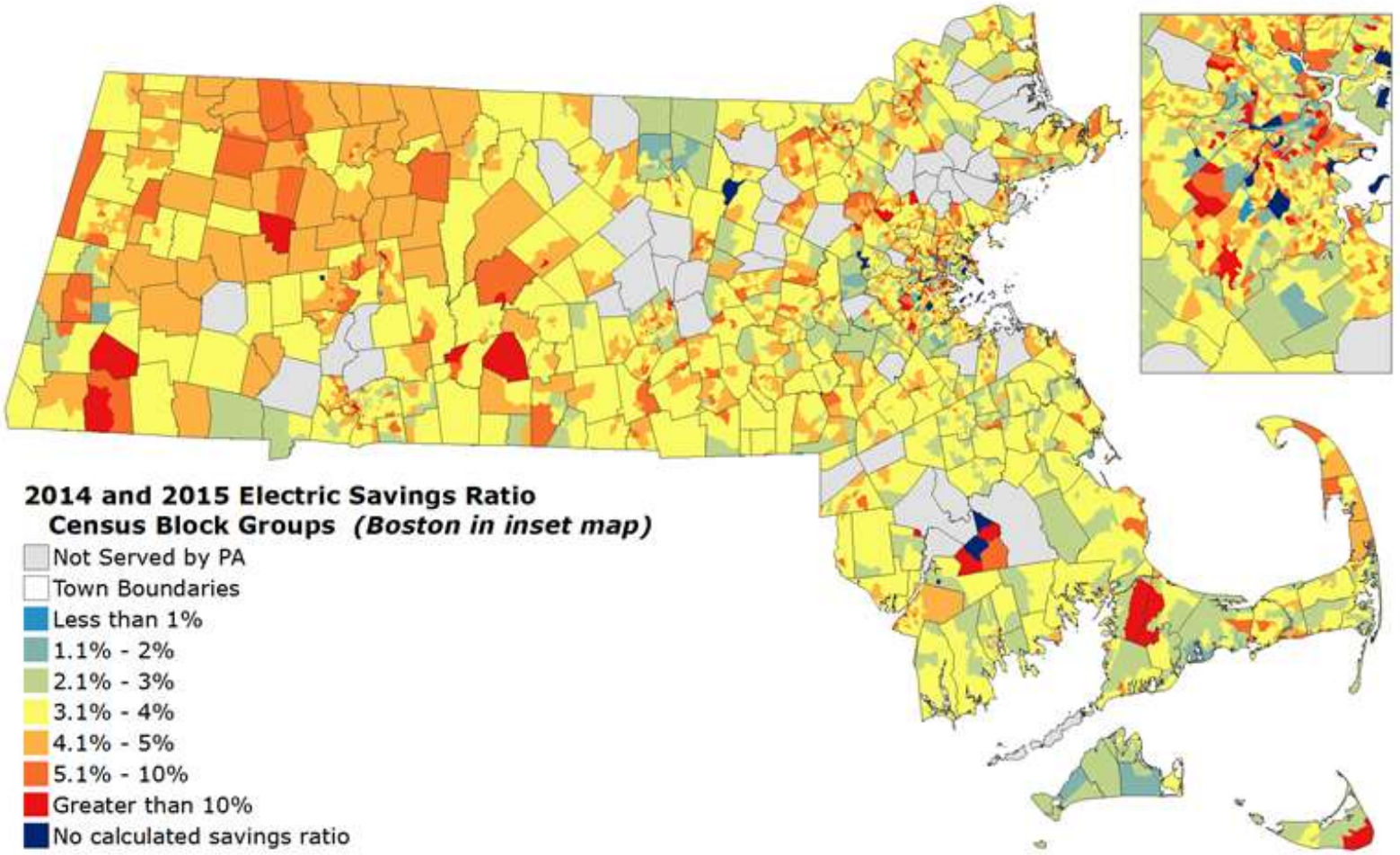
[36] http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Distribution-Model-Report-2.pdf.

Figure 5-3. Combined 2014 & 2015 unique electric account participation by census block group[37]



[37] Participation maps do not include behavioral or upstream accounts.

Figure 5-4. Combined 2014 & 2015 unique electric account savings by census block group



5.2 By PA summary

5.2.1 Participation and savings

Figure 5-5 shows historical electric account participation rates, including upstream data. The large increase in participation, beginning in 2013, is largely due to the upstream lighting program. National Grid's 2013 data had a higher participation rate than the other PAs both within that year and across time; the combination of these two data points suggest that the National Grid 2013 participation rate may be overstated in this chart, however DNV GL could not confirm from the previous Evaluation Database. We were able to verify the 2014 and 2015 numbers against the raw data.

As noted earlier in the report Unitil's tracking data was affected in some limited instances by two items: an occasional absence of material needed to generate the billing account number, and unadjusted gross savings in the underlying tracking data.

Figure 5-5. Historical account participation rates, electric

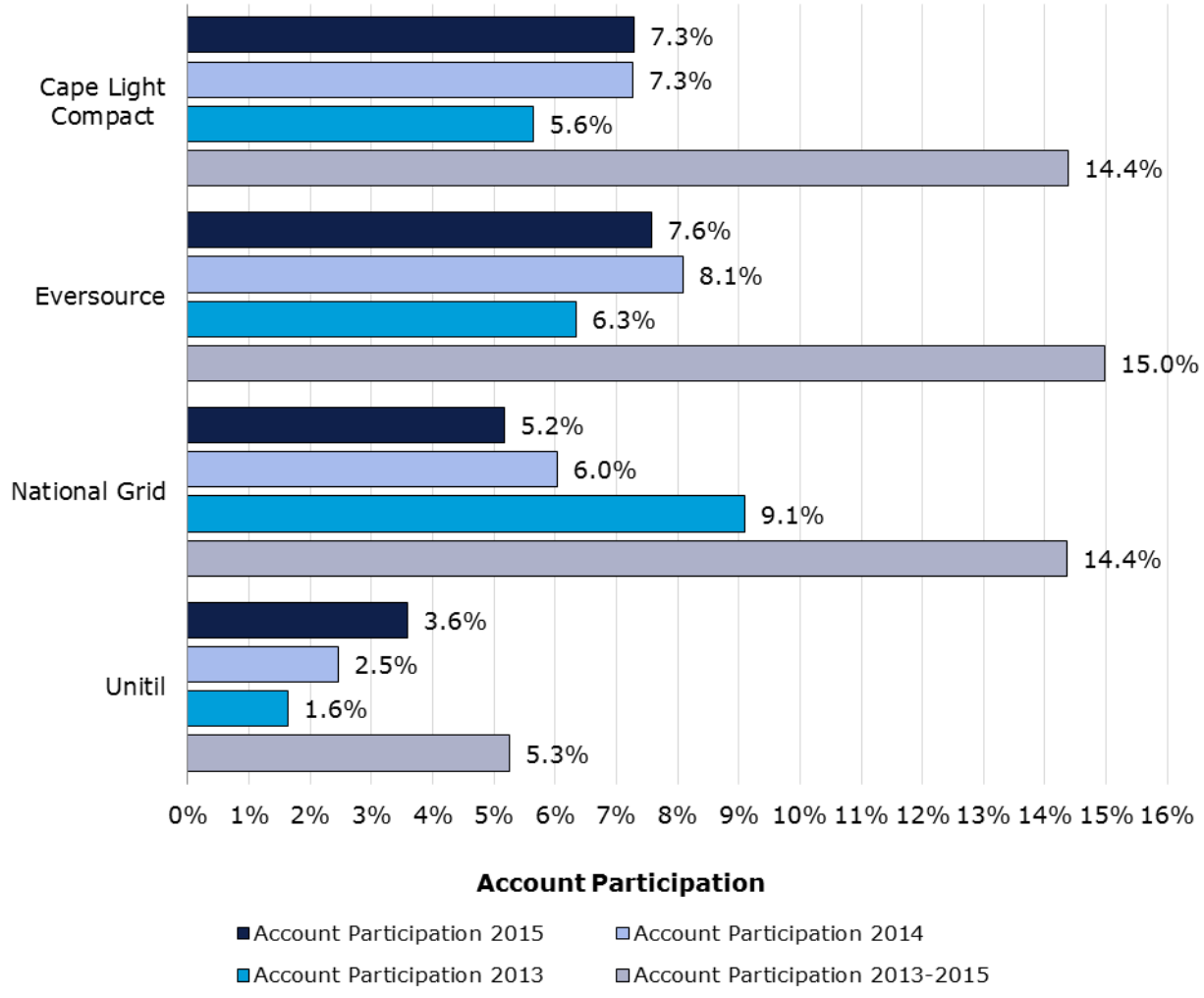
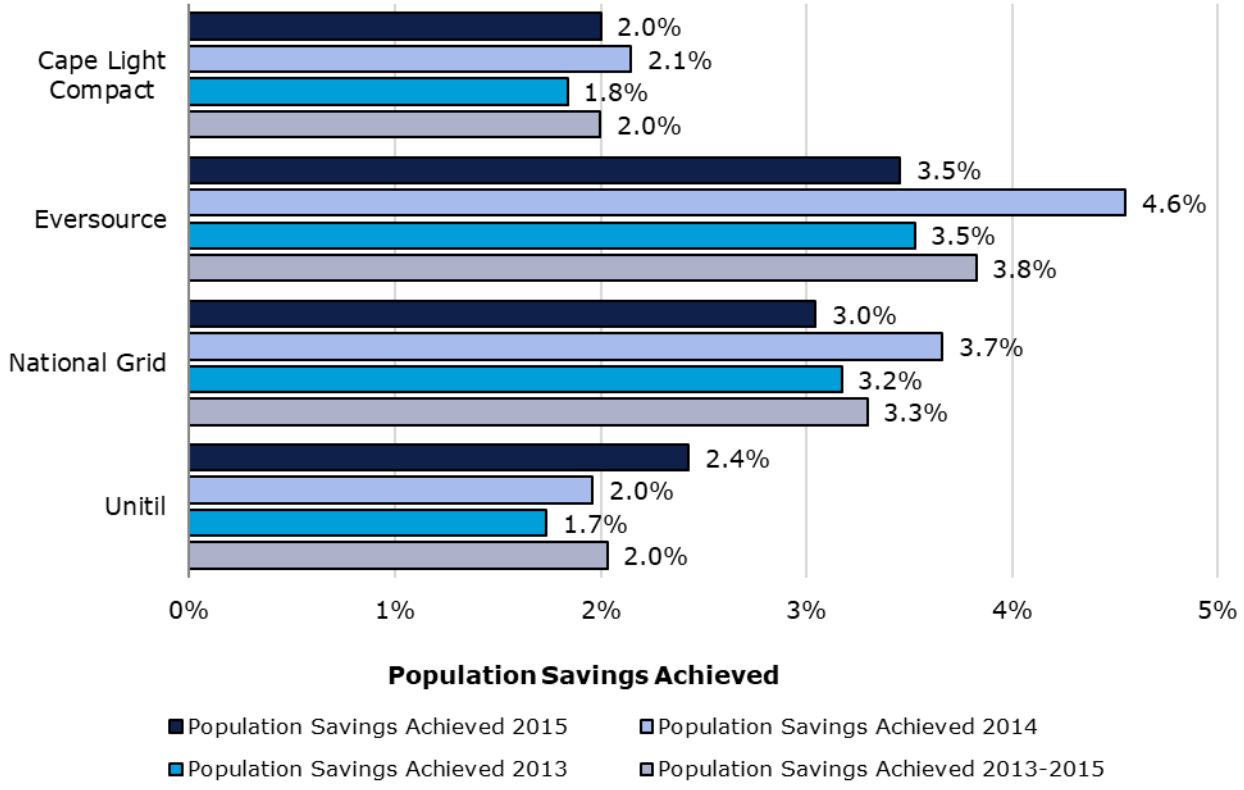


Figure 5-6 shows historical electric population savings rates.

Figure 5-6 Historical population savings rates, electric



5.3 Electric Geographic Weighted Regression Analysis

In addition to the modified quintile analysis leveraging the MA tax assessor data, DNV GL also attempted to assess if a geographic weighted regression analysis (GWR) could be specified and run to predict and explain block group level participation. The GWR uses a series of localized regressions incorporating nearby geographic features – in this analysis the census block groups – into a regression equation for participation rates of each individual block group. This takes into account geographic proximity between block groups and the idea that local neighborhoods are more similar than distant ones in a way that a global least squared (OLS) linear model does not facilitate as cleanly. The electric participation GWR model leveraged several of the ACS variables from the demographic analysis in section 4 as well as the additional ACS variables selected from a literature review and presented in Table 5-3. The analysis kernel was allowed to float so that the nearest 30 block groups were captured and used for each individual block group's regression analysis the GWR.

Table 5-3. ACS analysis variables used in global OLS input model for the GWR analysis

Variable
Percent of household in the block group speaking English only
Percent of household in the block group over 200% of poverty line
Percent of households in the block group that are not multifamily
Percent of households in the block group with no one under 18 years of age
Percent of households in the block group with no one over 60 years of age

DNV GL conducted this analysis using the electric 2014 and 2015 combined participation data, excluding behavioral and upstream data.[38] The upstream participation numbers were not included as they had been derived based on the number of households reported in each block group using the ACS data. Inclusion of these numbers would result in a perfect correlation between participation numbers and households. DNV GL did not include the behavioral data given the passive opt-in nature of the program design would increase the participation rates for most block groups where a behavioral program was being run. Finally, for this analysis effort, we used a natural log transformation to get the data into a normal-like distribution so we could take advantage of displaying results in terms of standard deviations to facilitate cross PA assessments.

Unfortunately, we were unable to specify a GWR model that passed all the prerequisite checks for a reliable model result. Specifically, we were unable to achieve a statistically insignificant Jarque-Bera statistic which indicated spatial autocorrelation of the results and that the model may be missing additional explanatory variables that would improve the results and reduce potential local bias. In particular the model performance degraded in Boston, Burlington, Pembroke, Dalton, Wayland, the Cape and Martha's Vineyard. The implication of this result is that the model performs well in many cases, but due to specific underlying variables we could not isolate in this report, the model performs less well in the areas specified above. Speculatively, examples of possible causes could be availability of local contractors to perform home energy audits, population density per area or household, urban or rural designations, seasonal second homes, and/or non-linear relationships within the analysis variables.

[38] DNV GL did not run the GWR on the gas data due to a concern that gas accounts would represent a subset of all customers within a block group and it may not be appropriate to make determinations on the gas account participation and savings relying on block group level variables. During the 13-15 Residential Customer Profile report, DNV GL worked to integrate the Massachusetts level 3 tax data with individual accounts; this integration opens the possibility of a future GWR using the tax data at the account level for gas records, as well as further enhancements to the electric GWR analysis.

Despite the inability to specify a GWR that passed the full battery of checks, the results from the assessment were largely positive. The GWR returned a model R-squared adjusted of .81 versus the .52 of the OLS linear model; the GWR model explained around 81% of the participation while the global OLS model only explained around 52%. This result suggests that all else equal, geography is an important factor in understanding participation in energy efficiency programs in Massachusetts and one that would bear greater scrutiny for trends, patterns, and identification of potentially over-performing areas with possible lessons to apply on similar characterized under-performing areas.

For transparency and informational purposes, DNV GL has included the GWR results for participation in Figure 5-7. **Due to the model bias, Figure 5-7 should be taken as illustrative of what the GWR analysis hoped to show at a statistically significant level; given the model bias the statistical significance indicated in the legend for each the individual block groups should be considered informative rather than statistically significant.** DNV GL chose to include a second map (Figure 5-8) with the local R-squared results for each the block group. The local R-squared result indicates how well each block group's GWR performed and provides important insight into the geographic areas any future GWR efforts will need to better understand and account for to ultimately create an unbiased model. Boston, Worcester, and Springfield as well as the Cape and South Shore will benefit from future model refinement; and the population differences of these areas are suggestive that more than one additional variable is likely to have explanatory power.

DNV GL believes that with the integration of location level tax data and the positive preliminary results from the GWR; future years Customer Profile reports would benefit from a focus to further specify the model. To facilitate any future work on application of a GWR model for Massachusetts DNV GL conducted two additional analyses that were not originally specified in the work plan, but that we believe will – in the absence of a GWR result that passed all statistical checks – provide guidance and focus for any future GWR efforts. These are a hot spot analysis on participation and a cluster / outlier analysis. We ran this for both electric and gas block group participation for the combined 2014 and 2015 time period.

Figure 5-7. Example GWR result using the MA Electric 2014 and 2015 combined participation data

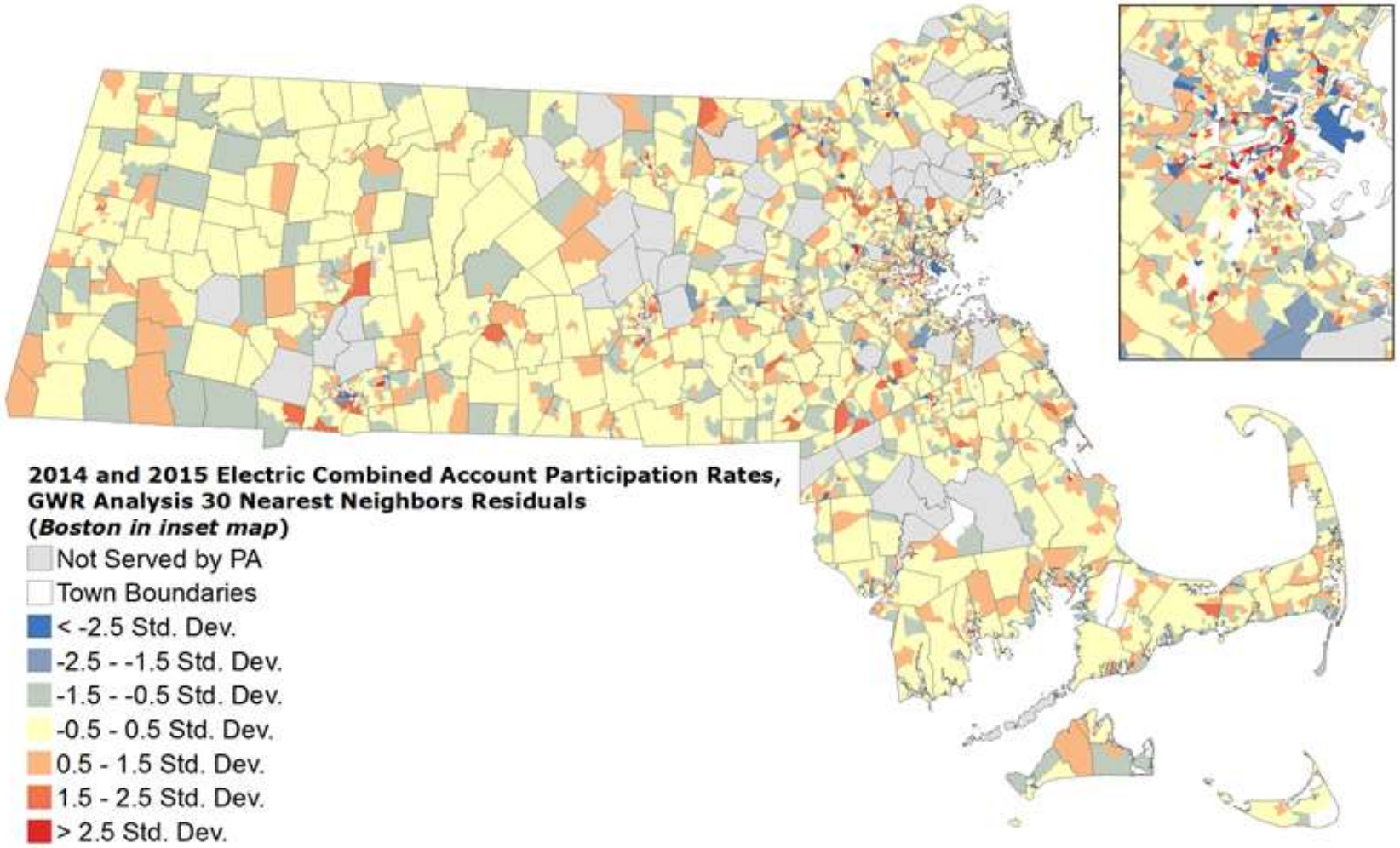
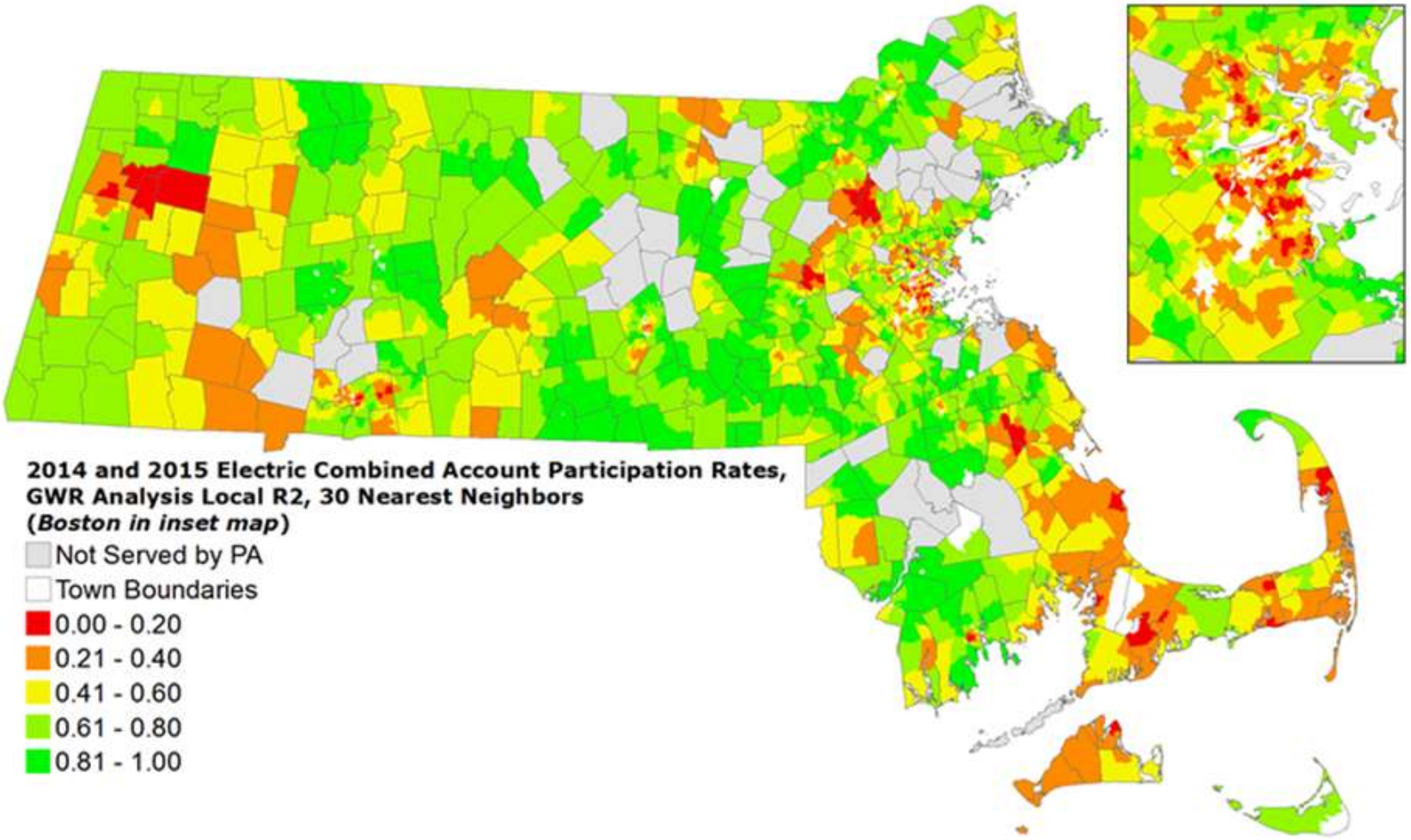


Figure 5-8. 2014 and 2015 combined electric participation rate Geographic Weighted Regression (GWR) localized R-squared using nearest 30 block groups



5.4 Electric Hot Spot and Cluster / Outlier Analysis

DNV GL conducted a hot spot analysis on the electric census block group participation at both the five mile and one-mile search radius. The hot spot analysis identifies where the participation rates for the block groups are more prominent than a random spatial distribution would suggest within the given search radius; the hot spot analysis does not indicate why this clustering is occurring.

At the five mile search radius – shown in Figure 5-9 - statistically significant hot spots were identified outside of Boston, along the South Shore region, along the I-91 corridor and in Pittsfield; statistically significant cold spots included Boston proper and the neighboring towns as well as several of the larger cities in the state. This suggests that there is some dynamic for block groups in the larger cities that may adversely affect participation rates in residential energy efficiency. It is important to recognize that lower participation rates relative to other areas of the state may not in themselves be indicative of sub-optimal energy efficiency program performance. It is entirely possible that despite the block group cold spots on participation, these block group participation rates may actually be outperforming relative to what their demographic characteristics would predict.

At the one-mile search radius, the weaker hot spots observed in along the South Shore were no longer statistically significant while the hot spots in western MA were reduced though the core areas continued to persist (Figure 5-10). The outlying Boston suburbs continued to have hot spots indicating that even with the generally higher participation rates in that region, specific areas at the finer spatial grain were higher than random spatial clustering would suggest. These areas may serve as a valuable opportunity to better understand what motivates participation and how it could translate to other regions of the state. The core areas of the cold spots in Boston and other large cities persisted in the one-mile search radius, indicating that even at this finer spatial grain these cities had participation concentrations at the block group level that were more pronounced than a random spatial distribution would suggest.

Figure 5-9. 2014 and 2015 combined block group electric participation rate hot spot analysis using a five-mile search radius

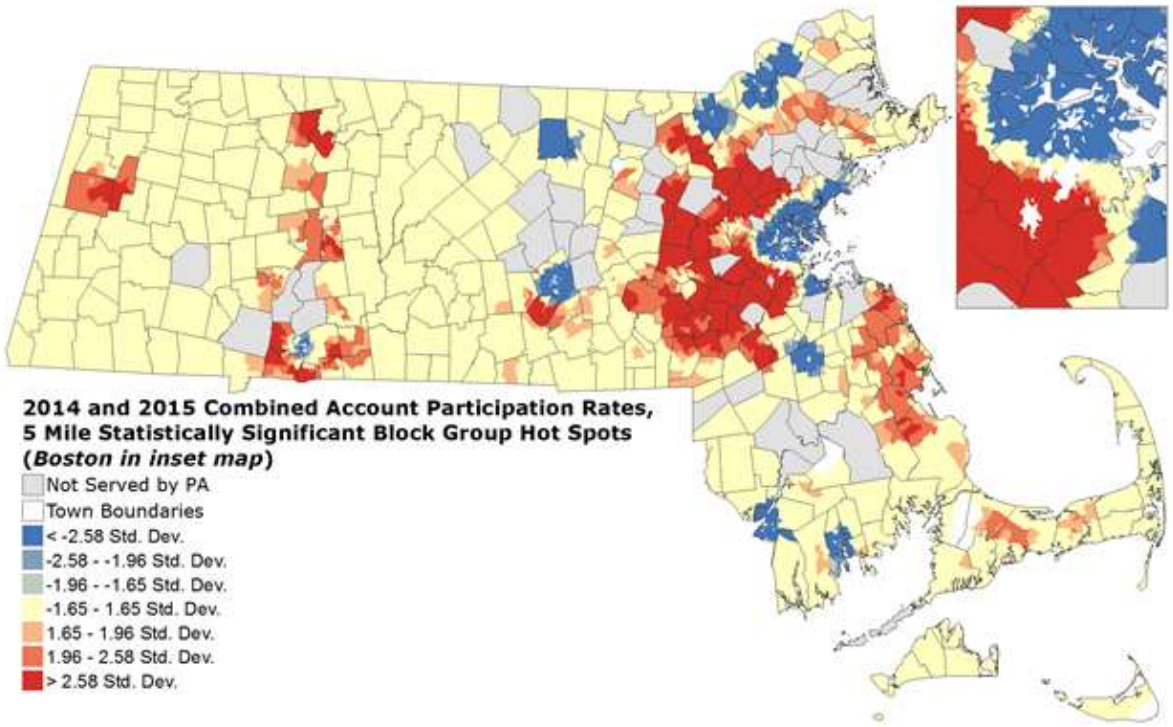
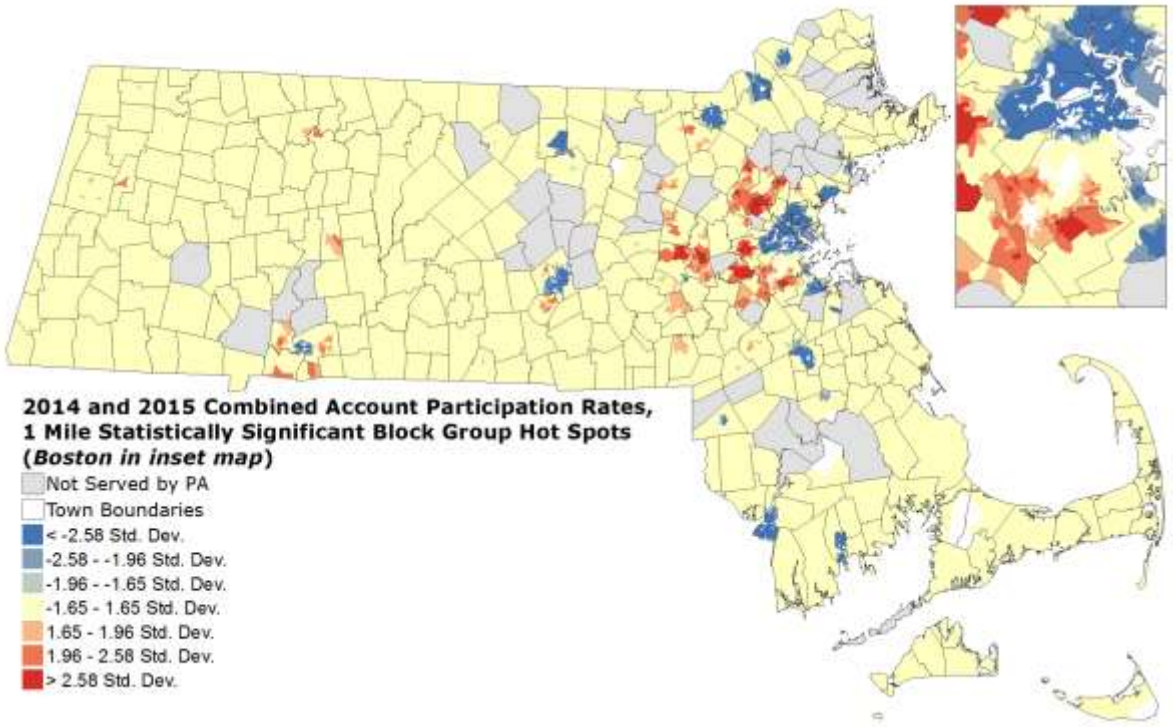


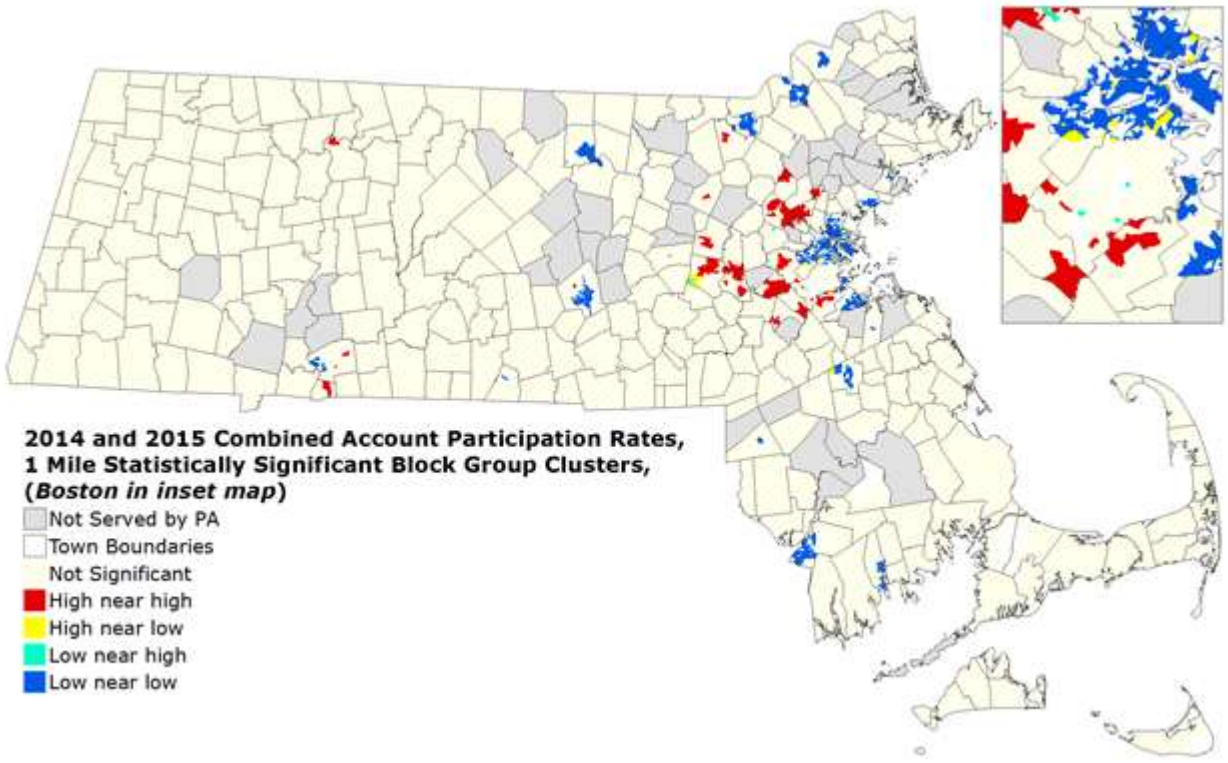
Figure 5-10. 2014 and 2015 combined block group electric participation rate hot spot analysis using a one-mile search radius



A potential challenge with hot and cold spot analyses are that while they provide an excellent screening tool for identifying neighborhoods of interest, they can mask the important outlier stories within those neighborhoods. These stories are the "cold" block groups within a larger hot sport that could represent an opportunity for geo-targeting to increase participation, and the "hot" block groups within large cold spots that could offer localized insight into what types of programs and approaches are resonating with the customer base.

DNV GL focused on conducting a one mile cluster and outlier analysis (Figure 5-11) as a complement to Figure 5-10.[39] Although the picture presented by this analysis is largely consistent with the prior hot spot analysis, DNV GL identified several important outliers. Chelsea presented a more nuanced picture with a relatively even mixture of hot and cool block groups despite being in a statistically significant cold spot. Within the larger Boston cold spot, the landscape is also not as homogenous as the hot spot analysis alone would suggest; several individual block groups of statistically higher participation than random spatial distribution would suggest exist. These block groups may offer valuable insight into methods and avenues to potentially increase the participation in the neighboring lower block groups.

Figure 5-11. 2014 and 2015 combined block group electric participation rate cluster / outlier analysis using a one-mile search radius



[39] DNV GL chose to forego inclusion of the five mile cluster and outlier analysis after a review of the results indicated that the trend was consistent with the other material in this section but did not yield the same focused insight in the Boston metro area as the 1 mile cluster and outlier analysis did.

5.5 End uses

Table 5-4 and Table 5-5 show the project and savings statistics by end use for electric accounts in 2015 and 2014, respectively. A project is defined for these tables as the unique combination of fuel, PA, account ID, and project ID within each end use.

Table 5-4. Population summary statistics – electric end uses, including upstream lighting (2015)

End Use	2015 Projects	2015 Population kWh Savings	2015 Total Incentives Paid	Percent of 2015 Projects	Percent of 2015 Savings	Percent of 2015 Incentives	Percent of Savings/Percent of Projects
Behavioral Measures[40]	12,192	888,651	$256,875	3.3%	0.2%	0.1%	0.05
Envelope	20,499	8,299,528	$39,860,236	5.5%	1.6%	22.9%	0.28
Hot Water	24,346	7,353,455	$3,731,104	6.6%	1.4%	2.1%	0.21
HVAC	42,487	17,617,178	$23,085,776	11.5%	3.3%	13.3%	0.29
Lighting	107,637	458,950,726	$88,578,566	29.0%	86.6%	50.8%	2.99
Process	109,678	18,225,814	$5,084,576	29.6%	3.4%	2.9%	0.12
Refrigeration	17,324	14,899,271	$7,375,098	4.7%	2.8%	4.2%	0.60
Other	24,057	992,631	$3,159,093	6.5%	0.2%	1.8%	0.03
Unknown/Missing	12,702	2,481,266	$3,067,927	3.4%	0.5%	1.8%	0.14
Grand Total	**370,922**	**529,708,521**	**$174,199,252**	**100%**	**100%**	**100%**	**N/A**

Table 5-5. Population summary statistics – electric end uses, including upstream lighting (2014)

Broad End Uses	2014 Projects	2014 Population kWh Savings	2014 Total Incentives Paid	Percent of 2014 Projects	Percent of 2014 Savings	Percent of 2014 Incentives	Percent of Savings/Percent of Projects
Behavioral Measures[41]	13,586	102,754	$227,105	3.6%	0.0%	0.1%	0.00
Envelope	19,685	9,967,992	$31,498,862	5.2%	1.6%	20.5%	0.31
Hot Water	20,005	6,802,962	$2,870,949	5.3%	1.1%	1.9%	0.20
HVAC	44,166	17,632,504	$23,901,355	11.7%	2.8%	15.6%	0.24
Lighting	110,106	557,305,929	$79,421,832	29.1%	88.7%	51.7%	3.05
Process	95,896	13,559,641	$4,197,946	25.3%	2.2%	2.7%	0.09
Refrigeration	33,521	20,683,888	$7,511,731	8.9%	3.3%	4.9%	0.37
Other	25,677	1,878,015	$3,273,978	6.8%	0.3%	2.1%	0.04
Unknown/Missing	16,027	616,587	$584,781	4.2%	0.1%	0.4%	0.02
Grand Total	**378,669**	**628,550,272**	**$153,488,540**	**100%**	**100%**	**100%**	**N/A**

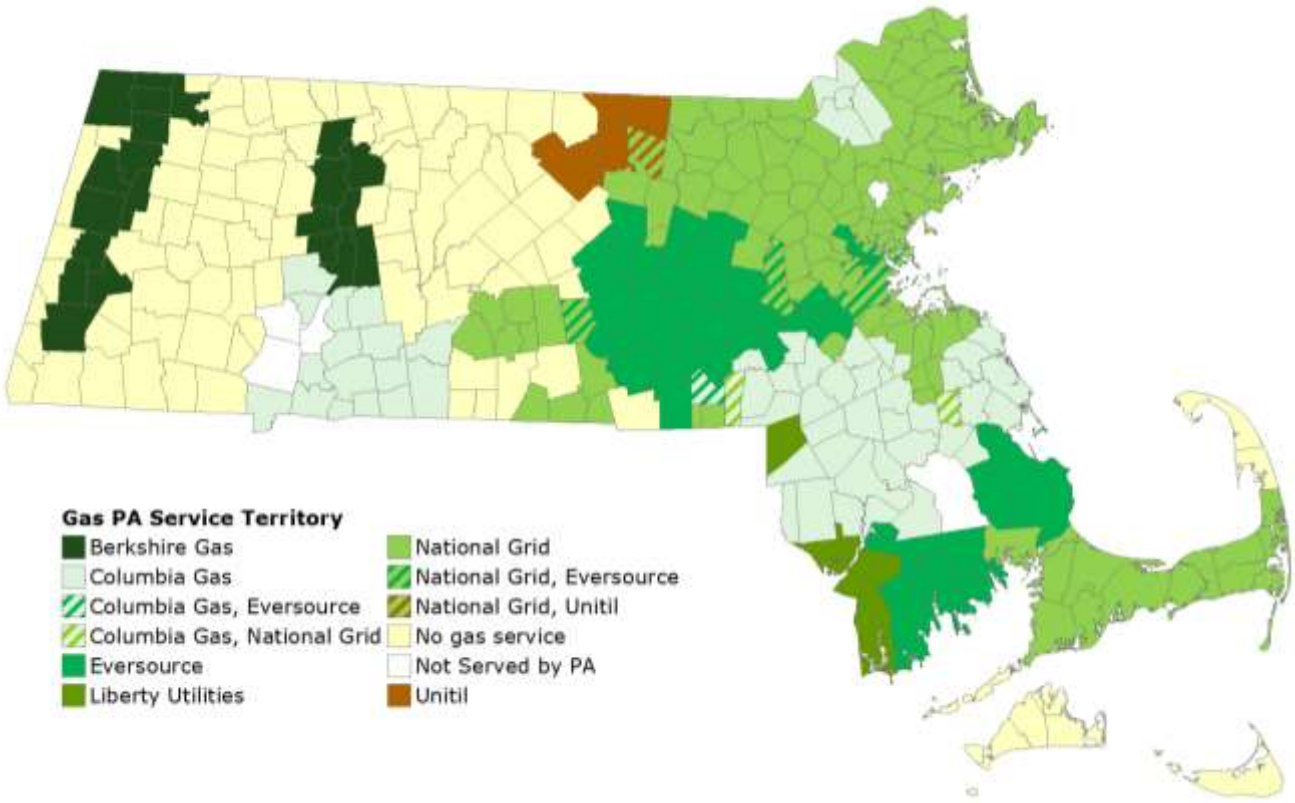
[40] Behavioral measures include things like the TLC kits. They do not include the Behavioral Program.

[41] Behavioral measures include things like the TLC kits. They do not include the Behavioral Program.

6 GAS MARKET ANALYSIS

This section describes the gas market in Massachusetts, broken up by PA service territory (Figure 6-1).

Figure 6-1. Map of MA electric PA service territories



6.1 Participation and savings

This section contains detailed therm breakdowns for all PAs in aggregate, and for individual PAs.

Table 6-1 shows key variable breakouts statewide, separated by therm size range. PA-specific versions of this table can be found in section 7.2 Notice that this table, and in all tables that are PA-specific, small consumers appear to have unrealistically high annual therms savings, relative to their average consumption. We have identified a few likely sources of this misleading result. We found that several customers had negative annual consumption, as well as customers who only had partial years of billing data available. Moving forward, we will break the negative consumers into the unassigned category, and will identify a methodology to either normalize savings or extrapolate usage for consumers with partially complete billing data.

Table 6-1. All PAs' therm breakouts, excluding unlinked energy efficiency tracking data (2013-2015)

Use	Data					
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	Incentive $
Single Family Detached	663,244	1,587,670,047	130,857,357	14,890,199	109,806	$100,828,674
Duplex/Condo	402,085	579,576,873	24,585,551	3,171,980	29,308	$23,367,483
Multi-Family	88,407	77,793,321	1,441,116	295,818	2,305	$2,510,860
Mobile/Land/Other	67,935	96,058,153	4,178,432	565,473	4,458	$4,250,317
Unknown	823,476	1,266,698,446	46,979,166	6,167,412	52,614	$59,398,619
TOTAL	**2,045,147**	**3,607,796,839**	**208,041,621**	**25,090,882**	**198,491**	**$190,355,954**

Figure 6-2 summarizes the consumption (therms) analysis in a single snapshot; results for individual PAs are presented in section 7.2.

Figure 6-2. Gas customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013-2015)

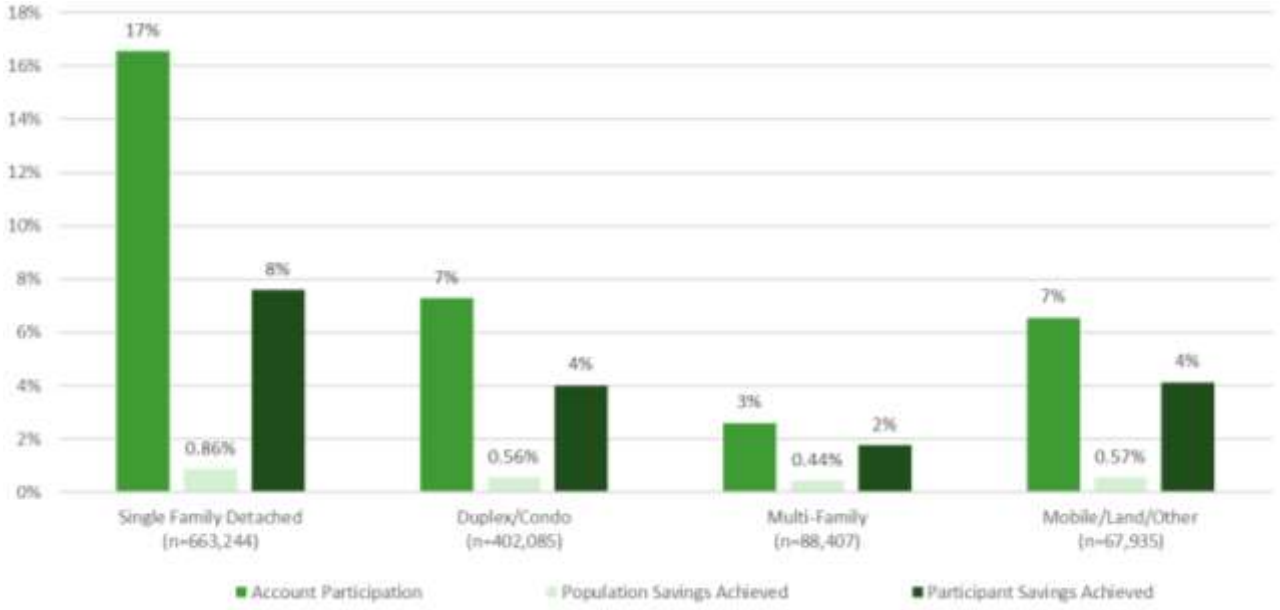
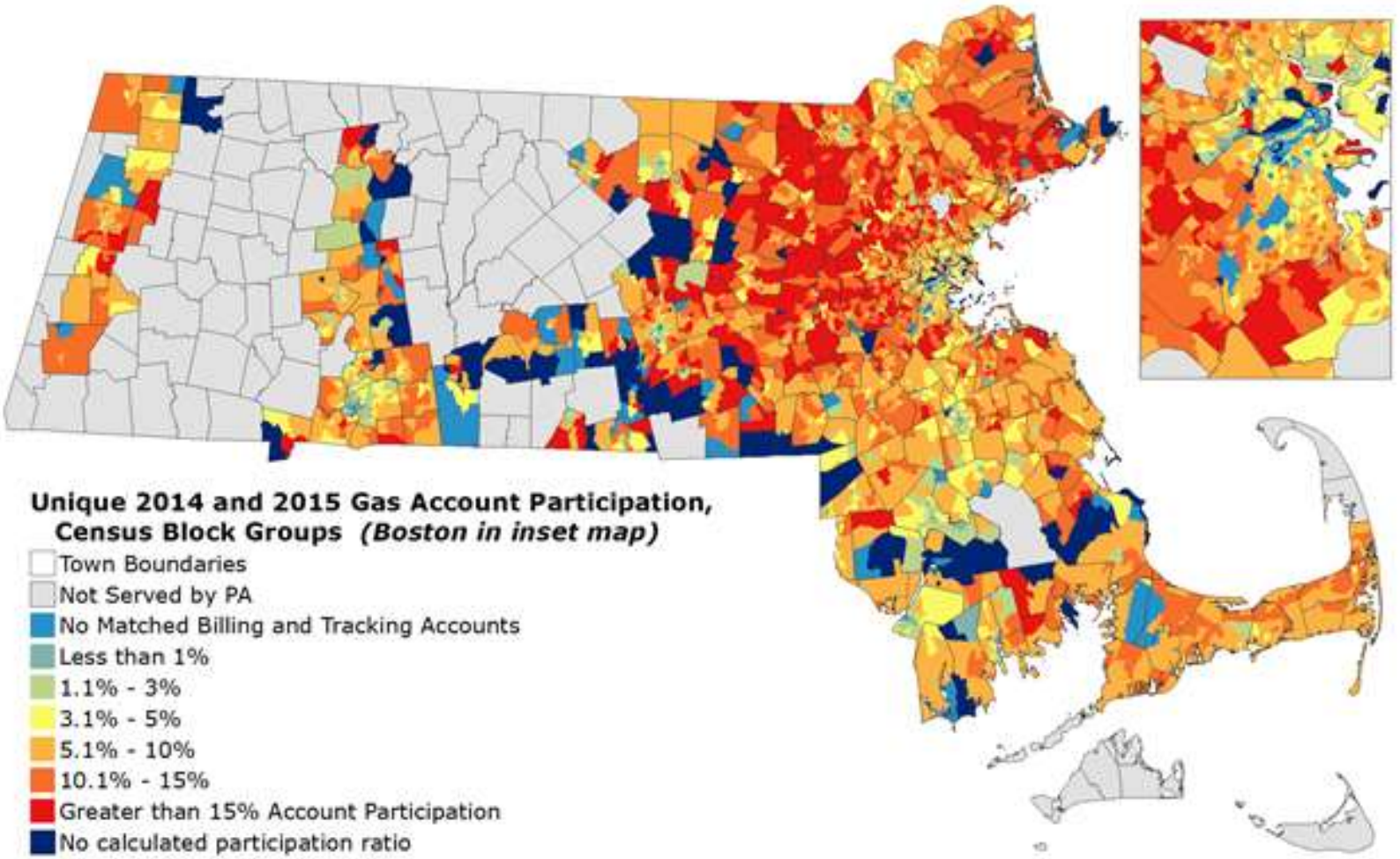


Figure 6-3 and Figure 6-4 provide the 2014 through 2015 savings and participation dynamics across Massachusetts and allowing for comparisons across block groups and towns. Participation maps do not include behavioral program participants due to the opt-out nature of that program and the fact that not all PAs run a behavioral program. Inclusion of the behavioral data would result in many block groups having very high participation ratios.

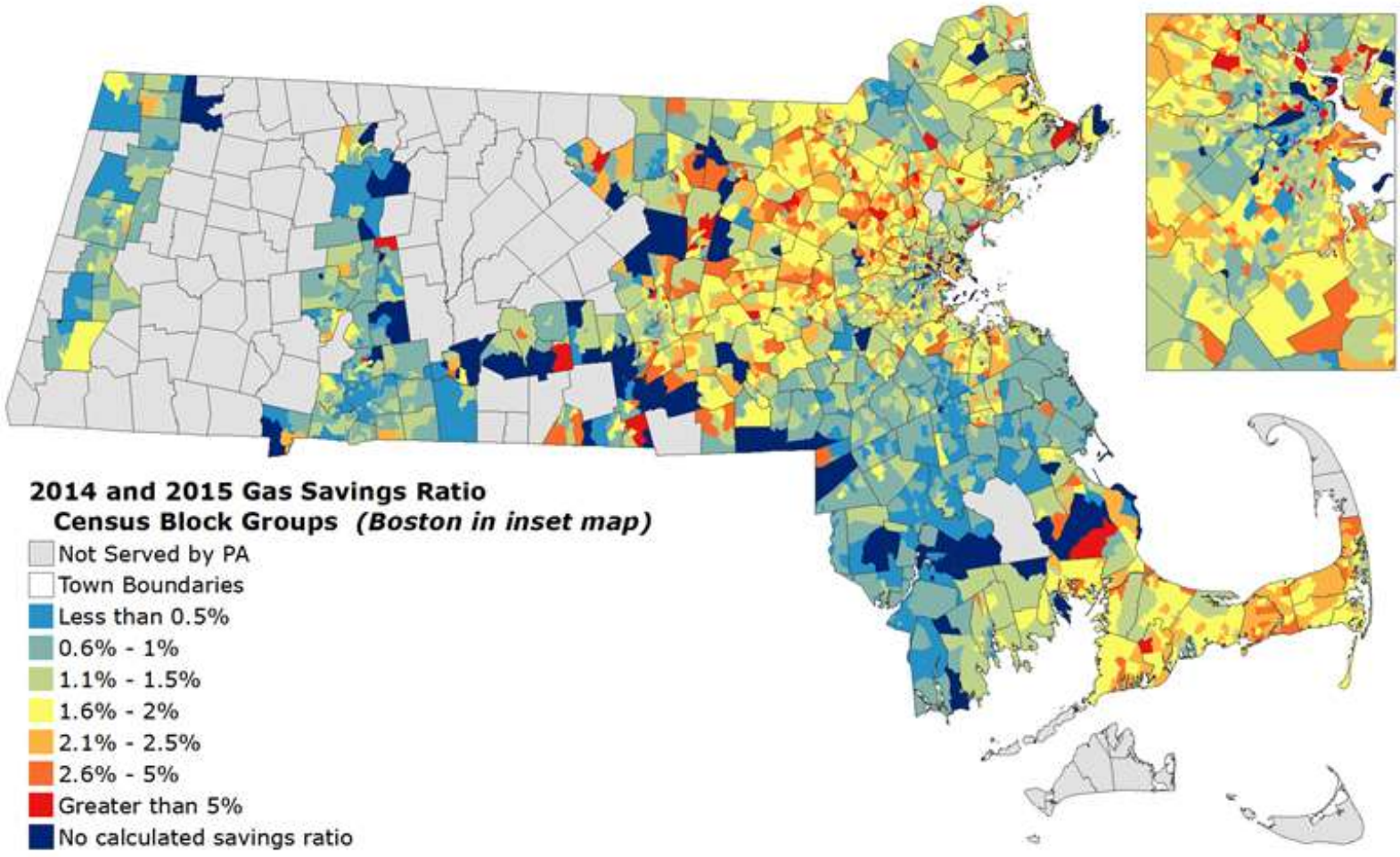
Savings maps include the behavioral data. Behavioral data was linked to the corresponding geocoded customer data so it could be placed into the appropriate block group; any behavioral data that could not be successfully linked to a billing account would not be reflected in the savings maps.

Figure 6-3. Combined 2014 & 2015 unique gas account participation by census block group[42]



[42] Participation maps do not include behavioral or upstream accounts.

Figure 6-4. Combined 2014 & 2015 unique gas account savings by census block group



6.2 By PA summary

6.2.1 Participation and savings

Figure 6-5 shows historical gas account participation rates, including upstream data while Figure 6-6 shows historical gas population savings rates.

Figure 6-5. Historical account participation rates, gas

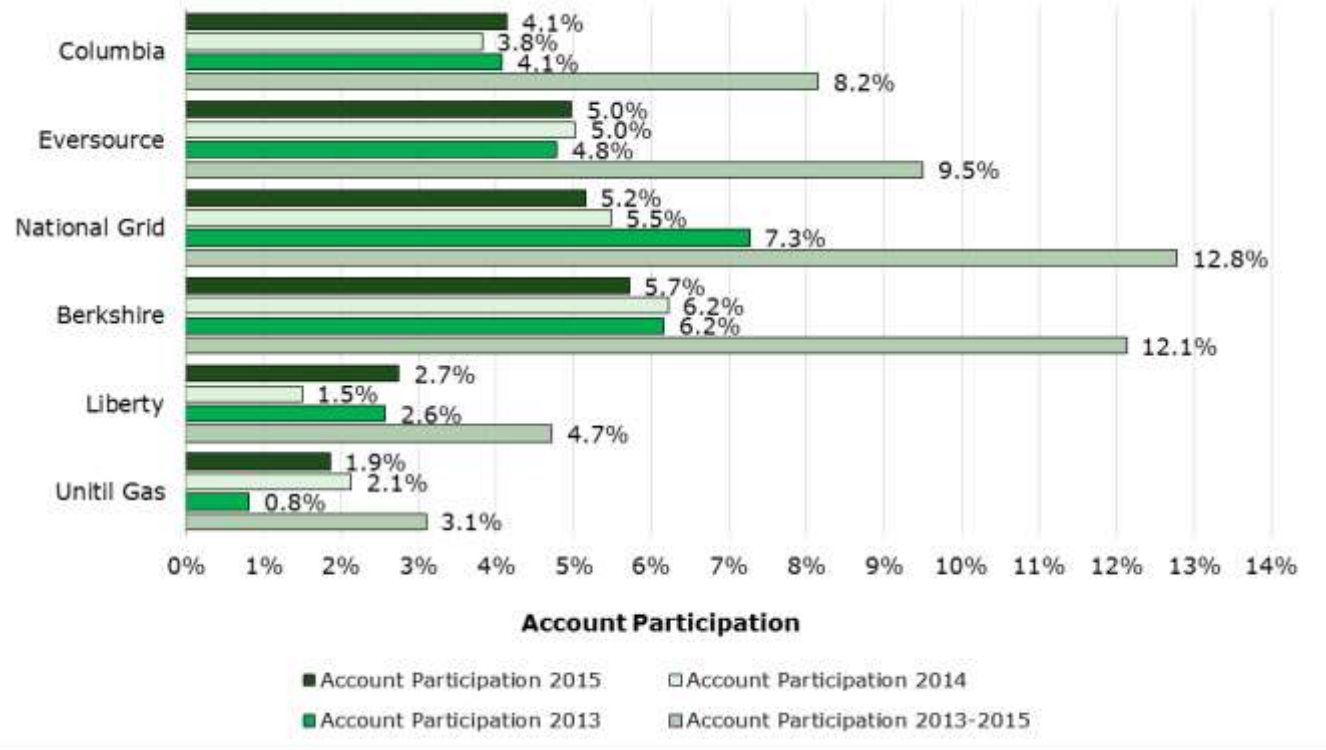
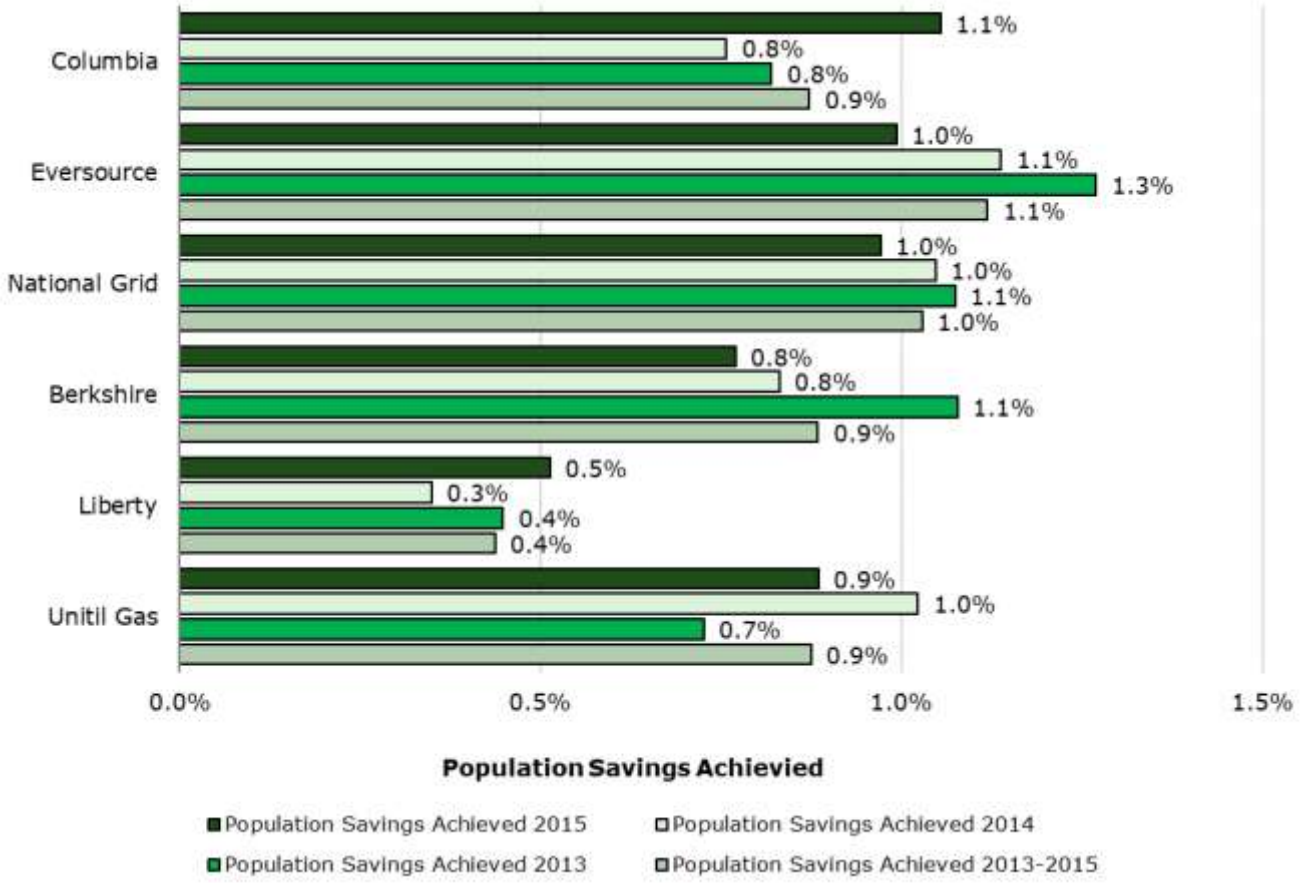


Figure 6-6. Historical population savings rates, gas



6.3 Gas Hot Spot and Cluster / Outlier Analysis

DNV GL conducted a hot spot analysis on the gas census block group participation at both the five mile and one-mile search radius. The hot spot analysis identifies where the participation rates for the block groups are more prominent than a random spatial distribution would suggest within the given search radius; the hot spot analysis does not indicate why this clustering is occurring.

At the five-mile search radius statistically significant hot spots were identified to the north and west of Boston, along with a smaller hotspot to the southeast of Boston (Figure 6-7). Boston and several of the other large population centers in the state were identified as statistically significant cold spots for participation. This trend was consistent with the electric hot spot analysis, which suggests that the underlying drivers of lower participation rates in larger population areas are less likely to be an artifact of any one fuel or PA, and are more likely to be something systemic to these population centers causing lower participation rates. As we previously noted in the electric section it is important to recognize that lower participation rates relative to other areas of the state may not in itself be indicative of sub-optimal program performance and that it is entirely possible that these block group may actually be outperforming relative to what their demographic characteristics would predict for participation.

The one-mile search radius (Figure 6-8) provides a more detailed view into the areas with persistently different participation rates even within the regional hot and cold spots. The outlying Boston suburbs continued to have hot spots indicating that even with the generally higher participation rates in that region, specific areas were higher than random spatial clustering would suggest. This is particularly of note along the Route 9 corridor to the west of Boston as well as the Mattapan and Milton areas to the south of Boston. Burlington and Arlington to the north of the city are another area of statistically higher participation. As with the electric section the core areas of the cold spots in Boston and other large cities persisted indicating that even at the smaller search radius these cities had participation concentrations at the block group level that were more pronounced than a random spatial distribution would suggest. One particularly interesting difference that may merit additional analysis is the difference between Chelmsford (hot spot) and Lowell (cold spot). With the integration of the tax data during the 2013-2015 Residential Customer Profile cycle this could be an excellent area for further build out of a GWR model to better understand if the participation rates – despite their differences – are relatively consistent with what the demographic variables would suggest. A deeper understanding to differences like these is a critical component to qualifying if an area is underperforming relative to what would be expected given current program offerings; or if the area could potentially be better served with modifications to program designs.

Figure 6-7. 2014 and 2015 combined block group gas participation rate hot spot analysis using a five-mile search radius

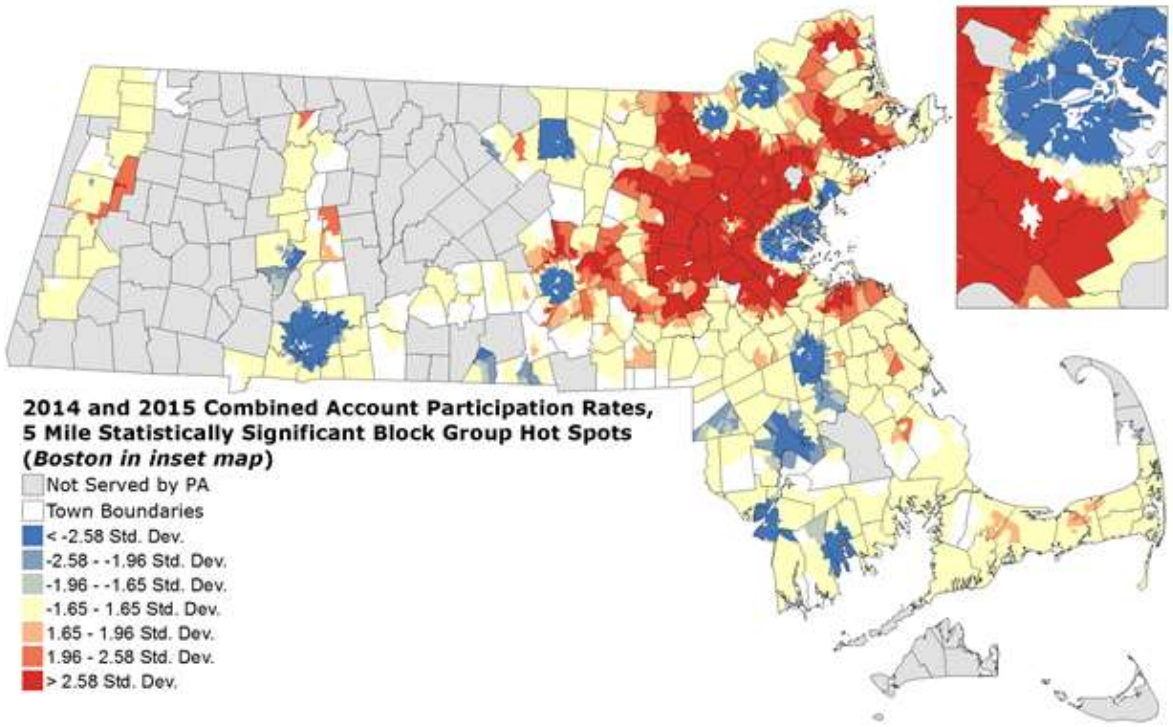
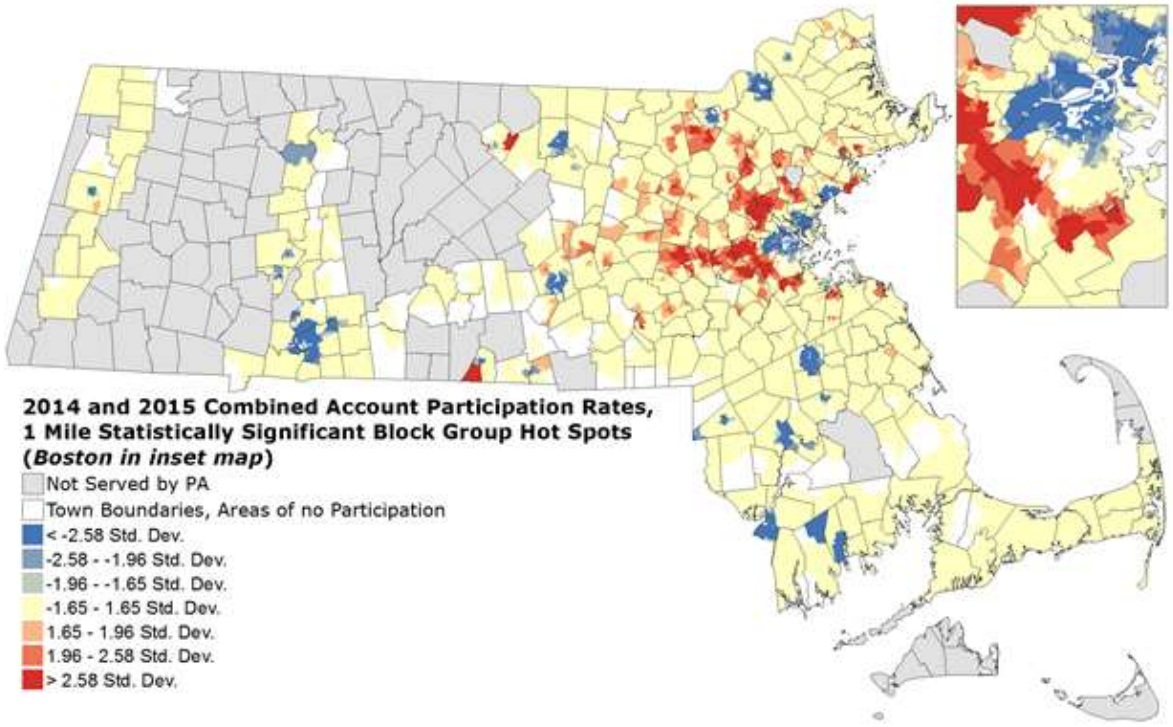


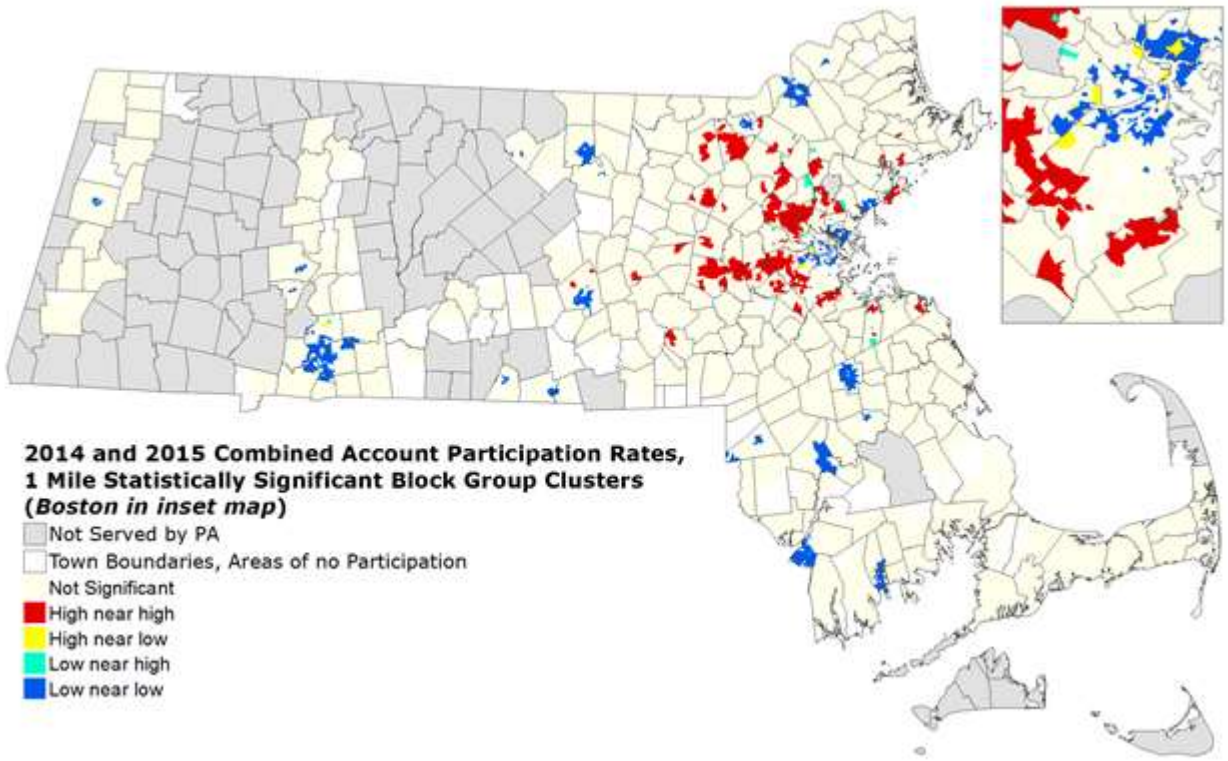
Figure 6-8. 2014 and 2015 combined block group gas participation rate hot spot analysis using a one-mile search radius



As noted in the corresponding electric section, a potential challenge with hot and cold spot analyses are that while they provide an excellent screening tool for identifying neighborhoods of interest, they can mask the important outlier stories within those neighborhoods. These stories are the "cold" block groups within a larger hot sport that could represent an opportunity for geo-targeting to increase participation, and the "hot" block groups within large cold spots that could offer localized insight into what types of programs and approaches are resonating with the customer base.

DNV GL focused on conducting a one mile cluster and outlier analysis (Figure 6-9) as a complement to Figure 6-8.[43] Although the picture presented by this analysis is largely consistent with the prior hot spot analysis, DNV GL identified several important outliers. The hot spot to the northeastern part of Boston yielded several areas where there were individual block groups of low participation in the high participation hot spots. A google maps review of these block groups indicated that they were generally more commercial or industrial than other areas within the towns. The cluster and outlier analysis results for the Boston region cold spot presented a much more fractured landscape than the larger cold spot suggested, and presented a center of mass more towards Everett and Chelsea than downtown Boston; in fact, downtown Boston has several individual block groups that were high participation as well as a comparatively large number of block groups that were statistically insignificant from the rest of the landscape. In western MA, Springfield had a sizable number of block groups that were statistically low participation areas.

Figure 6-9. 2014 and 2015 combined block group gas participation rate cluster / outlier analysis using a one-mile search radius



[43] DNV GL chose to forego inclusion of the five mile cluster and outlier analysis after a review of the results indicated that the trend was consistent with the other material in this section but did not yield the same focused insight in the Boston metro area as the one mile cluster and outlier analysis did.

6.4 End uses

Table 6-2 and Table 6-3 show the project and savings statistics by end use for gas accounts in 2015 and 2014, respectively.[44]

Table 6-2. Population summary statistics – gas end uses (2015)

End Use	2015 Projects[1]	2015 Population therm Savings	2015 Total Incentives Paid	Percent of 2015 Projects	Percent of 2015 Savings	Percent of 2015 Incentives	Percent of Savings/Percent of Projects
Envelope	19,994	4,498,545	$45,253,017	15.2%	36.5%	43.0%	2.39
HVAC	41,390	5,154,917	$37,449,653	31.6%	41.8%	35.6%	1.32
Hot Water	27,797	1,700,032	$10,883,564	21.2%	13.8%	10.3%	0.65
Lighting	550	2,659	$96,578	0.4%	0.0%	0.1%	0.05
Process	-	-	$0	0.0%	0.0%	0.0%	-
Other	17,747	152,595	$6,348,080	13.5%	1.2%	6.0%	0.09
Unknown/Missing	23,640	825,679	$5,251,671	18.0%	6.7%	5.0%	See footnote
Grand Total	**131,118**	**12,334,426**	**$105,282,564**	**100%**	**100%**	**100%**	**N/A**

The bulk of the unknown or missing end use projects do not have savings associated with them and represent fees or line item costs. For those that did have savings, but that could not be satisfactorily classed based on the data available to DNV GL we moved them into "unknown". A line item review of this data suggests that the bulk of the savings are likely weatherization measures and if one wanted to combine the savings into the enumerated end uses would be most appropriate under "Envelope".

Table 6-3. Population summary statistics – gas end uses (2014)

End Use	2014 Projects	2014 Population therm Savings	2014 Total Incentives Paid	Percent of 2014 Projects	Percent of 2014 Savings	Percent of 2014 Incentives	Percent of Savings/Percent of Projects
Envelope	17,310	3,956,896	$37,151,601	13.6%	31.7%	39.2%	2.34
HVAC	46,069	5,948,179	$38,804,871	36.1%	47.7%	40.9%	1.32
Hot Water	22,566	1,544,186	$10,583,711	17.7%	12.4%	11.2%	0.70
Lighting	1,421	1,111	$256,789	1.1%	0.0%	0.3%	0.01
Process	638	-	$16,032	0.5%	0.0%	0.0%	-
Other	9,943	201,425	$2,882,079	7.8%	1.6%	3.0%	0.21
Unknown/Missing	29,539	811,839	$5,174,033	23.2%	6.5%	5.5%	See footnote
Grand Total	**127,486**	**12,463,636**	**$94,869,116**	**100%**	**100%**	**100%**	**N/A**

The bulk of the unknown or missing end use projects do not have savings associated with them and represent fees or line item costs. For those that did have savings, but that could not be satisfactorily classed based on the data available to DNV GL we moved them into "unknown". A line item review of this data suggests that the bulk of the savings are likely weatherization measures and if one wanted to combine the savings into the enumerated end uses would be most appropriate under "Envelope".

[44] The gas savings suppressed in this table have been confirmed by the PA which provided the data.

7 APPENDICES

7.1 Appendix A. Methodology

7.1.1 Merging billing and energy efficiency tracking data

Table 7-1. Cape Light Compact Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	237	230	97%	267	254	95%
Low-Income New Construction	45	33	73%	52	50	96%
Low-Income Single Family Retrofit	797	795	100%	789	787	100%
Residential Consumer Products	1,980	1,933	98%	3,007	2,987	99%
Residential Cooling & Heating Equipment	2,675	2,033	76%	2,135	2,087	98%
Residential Home Energy Services	8,119	7,965	98%	7,615	7,498	98%
Residential Lighting	174	116	67%	250	128	51%
Residential Multi-Family Retrofit	757	727	96%	442	419	95%
Residential New Construction	141	96	68%	172	138	80%
Total	**14,925**	**13,928**	**93%**	**14,729**	**14,348**	**97%**

The lower merge rate for the residential lighting initiative is a result of store level sale material being captured in the PA data with the store name reflected as the account number (e.g. "HOMEDEPOT23") which would not have a corresponding link in the PA billing data.

Table 7-2. Eversource Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	3,299	2,425	74%	5,636	4,394	78%
Low-Income New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income Single Family Retrofit	5,993	5,726	96%	5,061	4,784	95%
Residential Consumer Products	14,212	13,213	93%	17,783	16,373	92%
Residential Cooling & Heating Equipment	6,897	6,512	94%	6,733	6,313	94%
Residential Home Energy Services	45,428	42,192	93%	42,689	39,763	93%
Residential Lighting	1,139	1,072	94%	1,174	1,108	94%
Residential Multi-Family Retrofit	6,299	5,057	80%	6,442	4,997	78%
Residential New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Total	**83,271**	**76,197**	**92%**	**85,520**	**77,732**	**91%**

N/A: Account id was not provided for the Low-Income New Construction or Residential New Construction initiatives.

Table 7-3. National Grid Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income Single Family Retrofit	6,276	6,259	100%	6,392	6,367	100%
Residential Consumer Products	11,498	11,348	99%	19,539	19,197	98%
Residential Cooling & Heating Equipment	6,006	5,924	99%	7,689	7,605	99%
Residential Home Energy Services	49,025	47,957	98%	51,873	51,508	99%
Residential Lighting	1,499	1,490	99%	1,583	1,573	99%
Residential Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Residential New Construction	N/A	M/A	N/A	N/A	N/A	N/A
Total	**74,308**	**72,978**	**98%**	**87,080**	**86,250**	**99%**

N/A: Account number was not provided for the Low-Income New Construction and Residential New Construction initiatives. National Grid provided Residential Multi-Family Retrofit and Low-Income Multi-Family Retrofit data at the facility level.

Table 7-4. Unitil Electric Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income New Construction	N/A	N/A	N/A	-[1]	-[1]	-[1]
Low-Income Single Family Retrofit	42	41	98%	6	5	83%
Residential Consumer Products	99	17	17%	129	74	57%
Residential Cooling & Heating Equipment	68	60	88%	26	24	92%
Residential Home Energy Services	842	820	97%	581	540	93%
Residential Lighting	56	53	95%	13	12	92%
Residential Multi-Family Retrofit	N/A	N/A	N/A	-[1]	-[1]	-[1]
Residential New Construction	18	17	94%	5	3	60%
Total	**1,129**	**1,008**	**89%**	**761**	**658**	**86%**

N/A: Account number was not provided for the Low-Income Multi-Family Retrofit, Low-Income New Construction, or Residential Multi-Family Retrofit initiatives.
[1] Unitil did not claim savings in this initiative in 2014.

Table 7-5. Berkshire Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	31	-	0%	107	97	91%
Low-Income Single Family Retrofit	71	65	92%	65	62	95%
Residential Heating & Water Heating	659	563	85%	787	689	88%
Residential Home Energy Services	1,058	907	86%	1,170	1,060	91%
Residential Multi-Family Retrofit	18	8	44%	70	64	91%
Residential New Construction	29	18	62%	39	30	77%
Total	**1,866**	**1,561**	**84%**	**2,238**	**2,002**	**89%**

DNV GL attempted to do individual matches on both the account and the premise numbers for the 31 Low-Income Multi-Family Retrofit records in the 2015 tracking data but could not identify any corresponding records in the billing data. Given that this is multifamily it is possible that the billing data is either captured under a different account number or was captured in the C&I data for 2015.

Table 7-6. Columbia Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	72	29	40%	82	1	1%
Low-Income Single Family Retrofit	506	502	99%	522	162	31%
Residential Heating & Water Heating	5,057	4,356	86%	4,836	4,276	88%
Residential Home Energy Services	6,581	6,531	99%	5,817	2,743	47%
Residential Multi-Family Retrofit	1,468	1,455	99%	935	317	34%
Residential New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Total	**13,685**	**12,873**	**94%**	**12,193**	**7,499**	**62%**

N/A: Account number was not provided for the Residential New Construction initiative; Columbia also notified DNV GL that they had an internal IT change over midway through 2014 which may influence the low merge rate. DNV GL attempted to do individual matches on the customer numbers in the tracking data but was unable to isolate matches.

Table 7-7 Eversource Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	145	99	68%	120	20	17%
Low-Income Single Family Retrofit	457	444	97%	393	368	94%
Residential Heating & Water Heating	4,443	4,231	95%	4,860	4,409	91%
Residential Home Energy Services	8,590	8,252	96%	6,979	6,403	92%
Residential Multi-Family Retrofit	1,263	1,154	91%	839	750	89%
Residential New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Total	**14,899**	**14,180**	**95%**	**13,192**	**11,950**	**91%**

N/A: Account number was not provided for the Residential New Construction initiative.

Table 7-8. Liberty Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	-[1]	-[1]	-[1]	N/A	N/A	N/A
Low-Income Single Family Retrofit	86	85	99%	N/A	N/A	N/A
Residential Heating & Water Heating	406	404	100%	283	282	100%
Residential Home Energy Services	936	935	100%	471	470	100%
Residential Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Residential New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Total	**1,430**	**1,424**	**100%**	**758**	**752**	**99%**

[1]Liberty did not claim savings in this initiative for 2015.
N/A: Account number was not provided for the Low-Income Multi-Family Retrofit and Low-Income Single Family Retrofit in 2014. Account number was not provided for the Residential Multi-Family Retrofit and Residential New Construction initiatives in 2014 or 2015.

Table 7-9. National Grid Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income Single Family Retrofit	1,288	1,265	98%	1,399	1,366	98%
Residential Heating & Water Heating	17,189	16,816	98%	18,875	18,445	98%
Residential Home Energy Services	32,320	30,817	95%	33,187	31,932	96%
Residential Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Residential New Construction	N/A	N/A	N/A	N/A	N/A	N/A
Total	**50,800**	**48,898**	**96%**	**53,464**	**51,743**	**97%**

N/A: Account number was not provided for the Residential New Construction initiatives. National Grid provided Residential Multi-Family Retrofit and Low-Income Multi-Family Retrofit data at the facility level.

Table 7-10. Unitil Gas Merge success rates of 2015 EE participation with 2015 billing (upstream excluded) by initiative

Initiative	Number of Accounts in 2015 Tracking	Number of Unique Accounts Successfully Merged to 2015 Billing	Merge Success Rate 2015	Number of Accounts in 2014 Tracking	Number of Unique Accounts Successfully Merged to 2014 Billing	Merge Success Rate 2014
Low-Income Multi-Family Retrofit	N/A	N/A	N/A	N/A	N/A	N/A
Low-Income Single Family Retrofit	13	11	85%	N/A	N/A	N/A
Residential Heating & Water Heating	138	134	97%	87	75	86%
Residential Home Energy Services	174	166	95%	196	158	81%
Residential Multi-Family Retrofit	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
Residential New Construction	17	16	94%	4	2	50%
Total	**343**	**327**	**95%**	**291**	**235**	**81%**

N/A: Account number was not provided for the Low-Income Multi-Family Retrofit in 2014 and 2015 and was not provided for the Low-Income Single Family Retrofit initiative in 2014.
[1] Unitil gas did not claim savings in this initiative for 2014 or 2015.

7.2 Appendix B. Additional PA-specific Tables

The following tables in this section provide tables that present PA-specific by years, formatted to match tables and charts that we present in the body of the report.

7.2.1 Electric

This following tables present a summary of key variables for each PA, in alphabetical order by PA.

7.2.1.1 Cape Light Compact

Table 7-11. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	76,895	477,773,154	40,359,815	6,450,794	5,740	8,867	$4,191,547
Duplex/Condo	12,986	60,186,607	5,002,066	1,074,248	794	1,446	$725,128
Multi-Family	1,179	3,666,089	81,617	16,410	23	34	$9,457
Mobile/Land/Other	9,002	53,966,193	3,032,314	476,733	412	592	$353,782
Unknown	89,023	519,471,897	39,378,925	6,430,770	5,820	9,092	$4,010,001
TOTAL	**189,085**	**1,115,063,940**	**87,854,737**	**14,448,955**	**12,789**	**20,031**	**$9,289,914**

Table 7-12. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	76,867	474,078,906	41,419,162	5,742,780	6,154	10,120	$1,032,575
Duplex/Condo	13,038	60,950,987	3,970,972	830,324	685	994	$280,077
Multi-Family	1,195	3,889,768	79,274	9,276	21	26	$300
Mobile/Land/Other	8,995	52,801,120	2,453,960	470,708	417	625	$50,908
Unknown	88,668	504,640,191	38,894,417	5,511,366	6,057	9,658	$980,351
TOTAL	**188,763**	**1,096,360,972**	**86,817,785**	**12,564,454**	**13,334**	**21,423**	**$2,344,211**

Table 7-13. Cape Light Compact use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	70,385	457,728,873	28,477,885	3,705,191	4,116	10,120	$4,844,063
Duplex/Condo	11,470	57,534,986	2,637,216	442,271	442	994	$312,132
Multi-Family	892	3,263,214	78,915	6,230	21	26	$10,474
Mobile/Land/Other	7,769	48,584,446	2,212,306	343,508	313	625	$399,347
Unknown	89,690	507,369,721	27,914,778	3,814,761	4,294	9,658	$4,680,612
TOTAL	**180,206**	**1,074,481,240**	**61,321,100**	**8,311,961**	**9,186**	**21,423**	**$10,246,628**

Figure 7-1. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

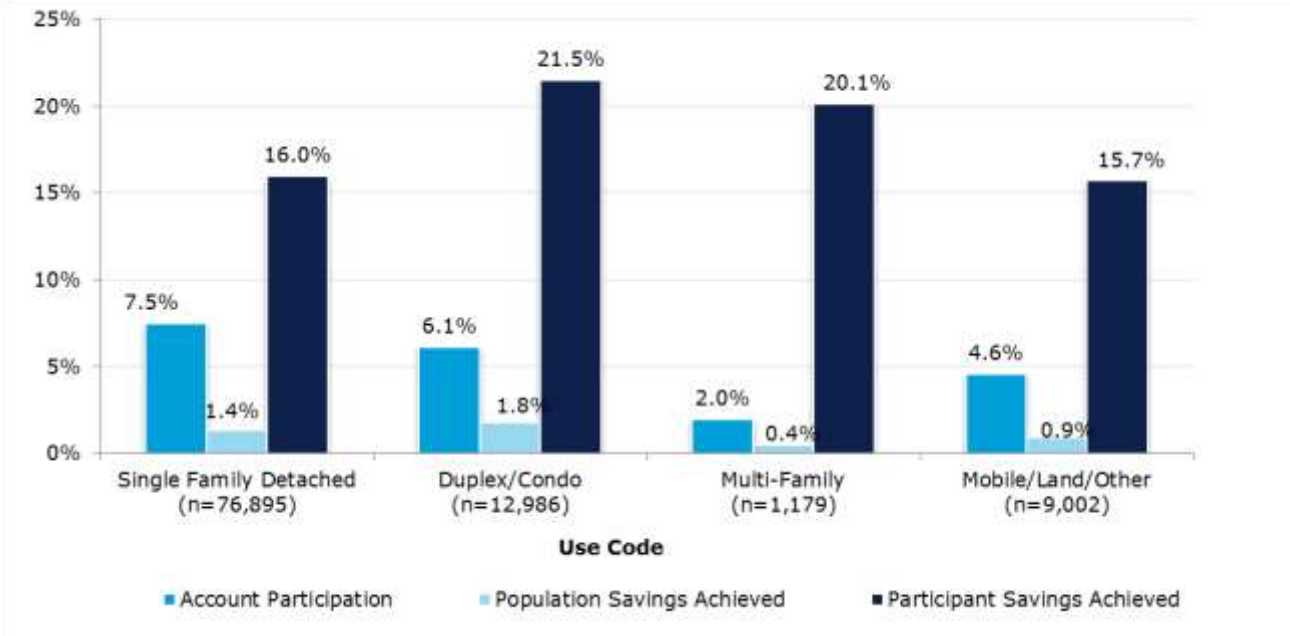


Figure 7-2. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

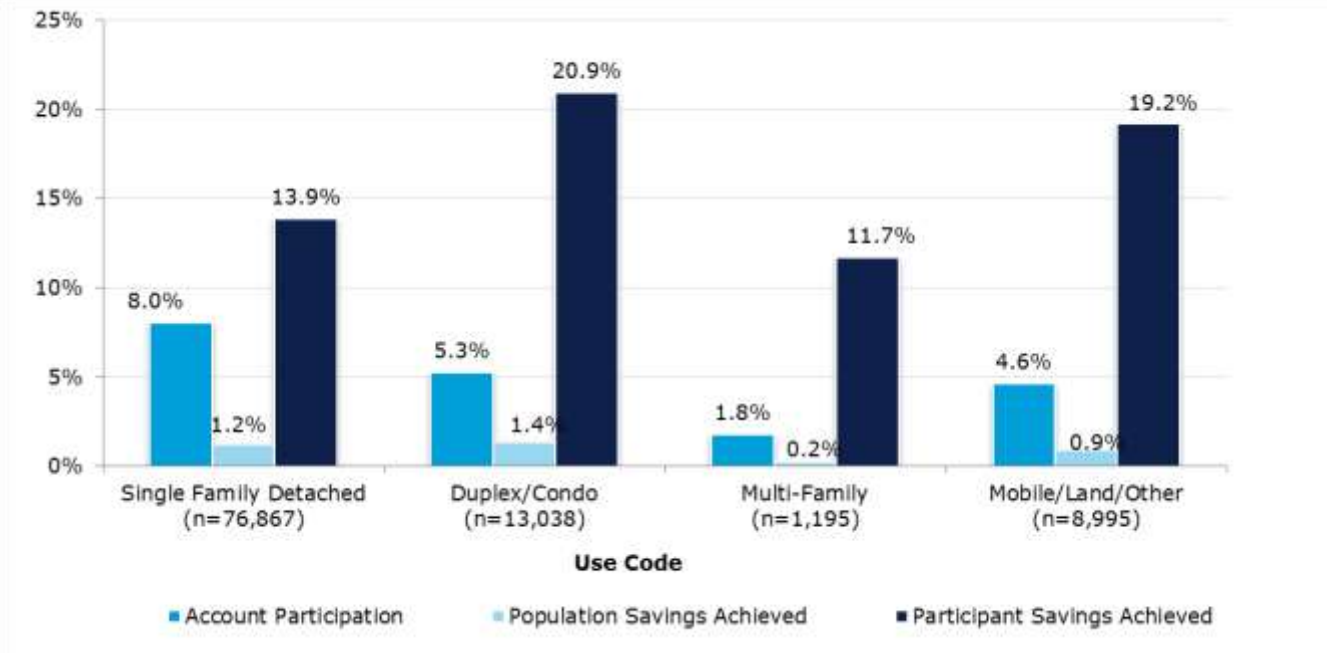
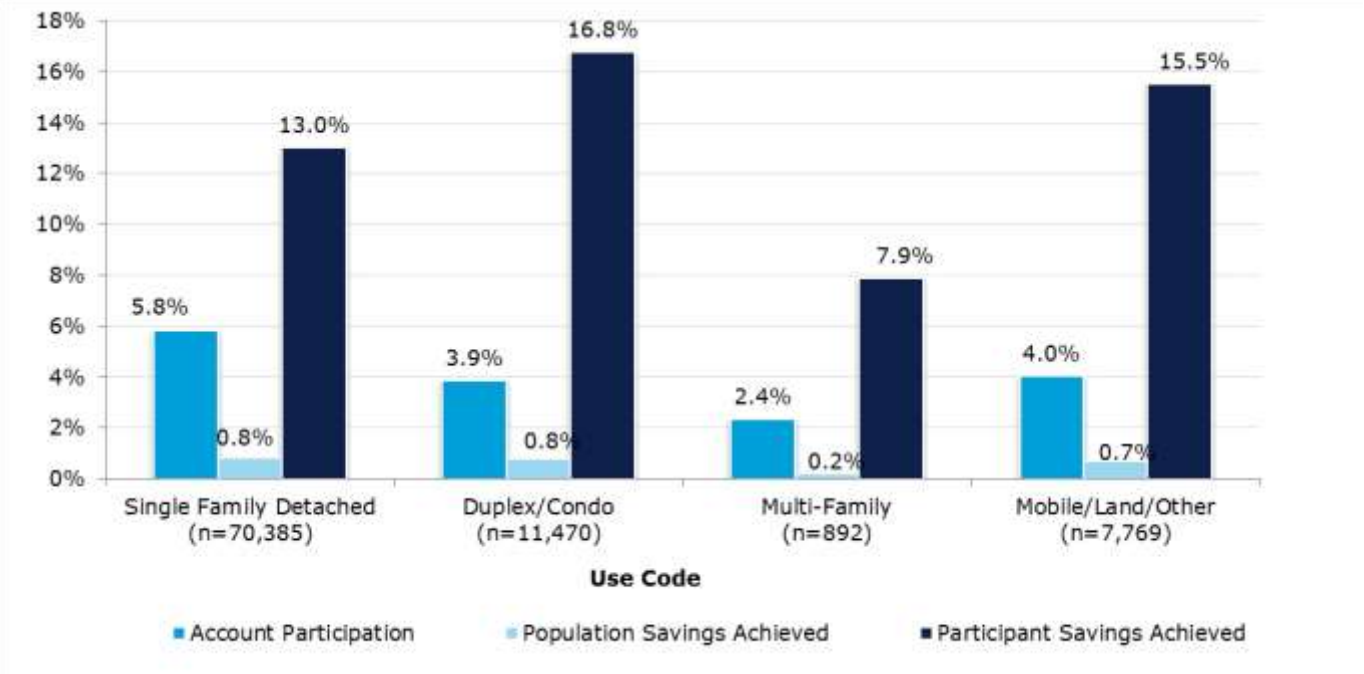


Figure 7-3. Cape Light Compact customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.1.2 Eversource

Table 7-14. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	345,552	3,034,865,342	355,276,889	43,794,643	38,788	47,277	$25,059,325
Duplex/Condo	151,720	841,741,034	51,363,250	7,026,263	7,723	8,479	$3,713,896
Multi-Family	41,651	168,890,108	3,115,308	731,345	726	744	$574,528
Mobile/Land/Other	29,707	209,952,789	13,773,451	1,759,095	1,682	1,904	$994,916
Unknown	465,736	2,736,290,286	154,889,601	22,124,590	22,553	25,478	$14,506,280
TOTAL	**1,034,366**	**6,991,739,560**	**578,418,499**	**75,435,937**	**71,472**	**83,882**	**$44,848,946**

Table 7-15. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	336,843	2,885,220,126	320,813,318	32,616,541	36,836	46,224	$19,392,327
Duplex/Condo	145,043	719,845,879	46,097,325	6,506,054	7,767	8,874	$3,467,232
Multi-Family	38,358	126,142,393	5,031,508	874,862	1,248	1,338	$585,399
Mobile/Land/Other	27,384	187,398,390	12,941,164	1,701,394	1,801	2,105	$1,050,175
Unknown	452,506	2,275,761,084	159,450,424	20,986,869	25,660	30,213	$13,311,261
TOTAL	**1,000,134**	**6,194,367,872**	**544,333,739**	**62,685,719**	**73,312**	**88,754**	**$37,806,394**

Table 7-16. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	334,029	2,955,410,729	199,473,784	18,248,977	23,063	46,224	$14,208,854
Duplex/Condo	126,386	663,563,089	30,807,338	3,937,612	5,193	8,874	$2,634,424
Multi-Family	29,175	115,791,023	5,155,298	1,295,762	951	1,338	$995,488
Mobile/Land/Other	24,633	197,742,664	7,273,675	778,324	817	2,105	$582,224
Unknown	489,330	2,451,885,816	121,707,689	16,487,652	19,917	30,213	$11,352,917
TOTAL	**1,003,553**	**6,384,393,321**	**364,417,784**	**40,748,326**	**49,941**	**88,754**	**$29,773,907**

Figure 7-4. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

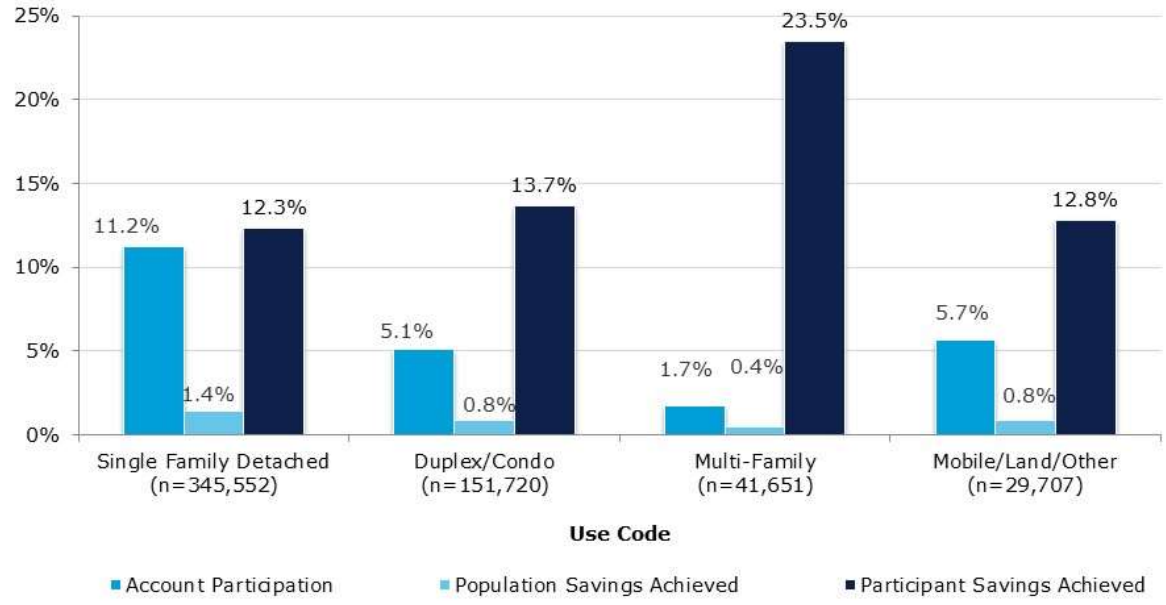


Figure 7-5. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

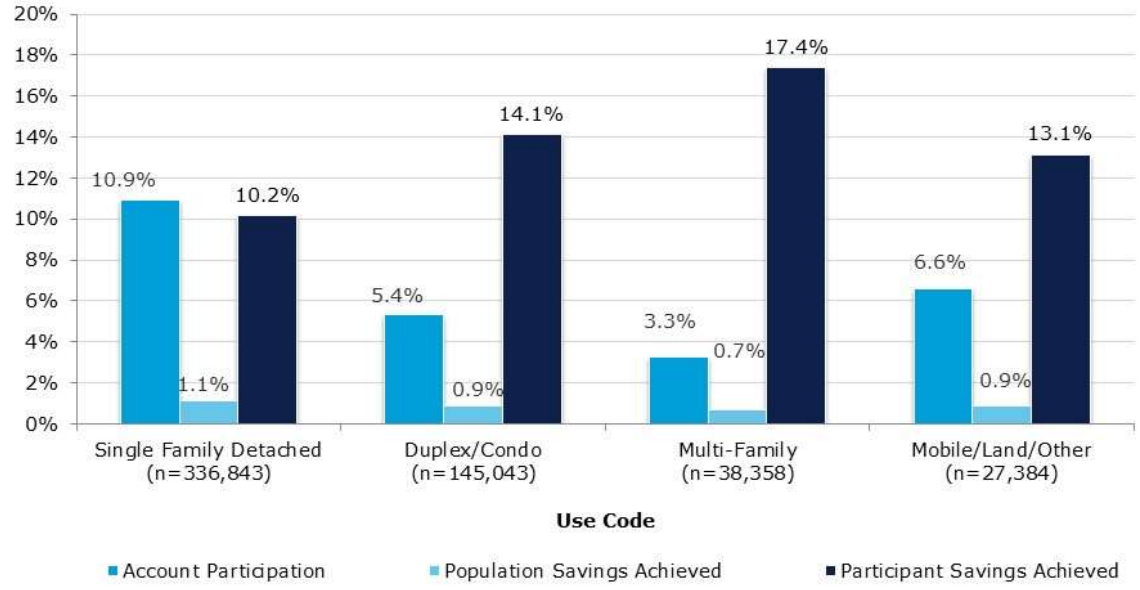
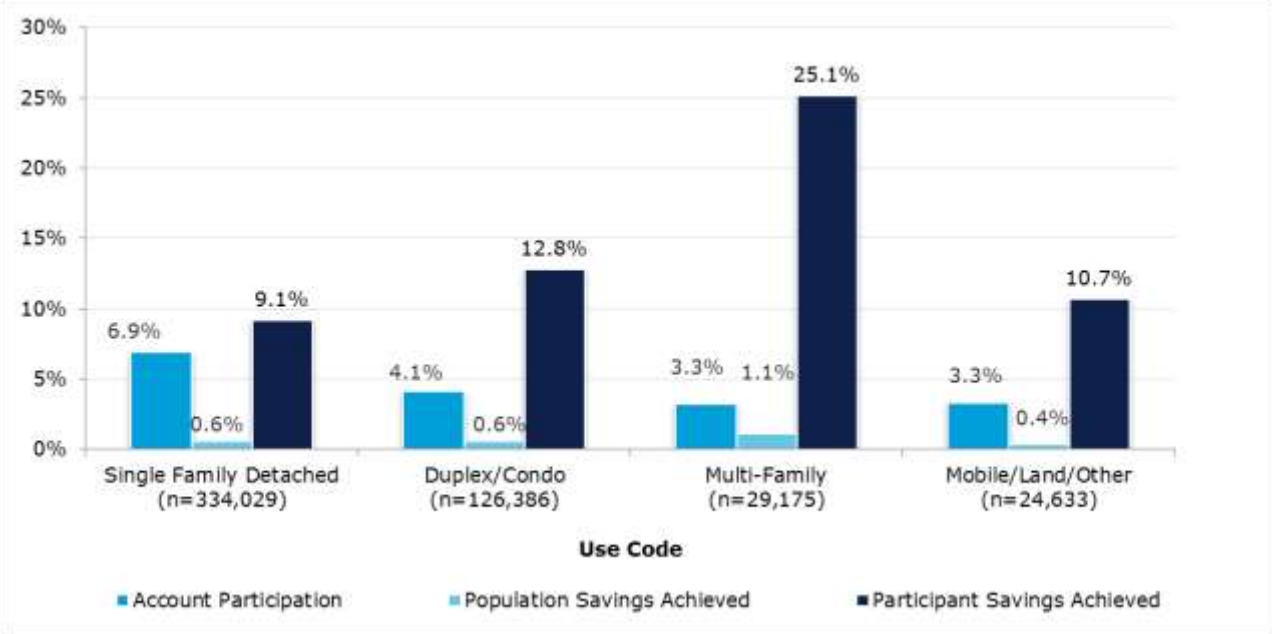


Figure 7-6. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.1.3 National Grid

Table 7-17. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	578,968	4,700,497,438	425,380,474	50,967,509	47,197	59,190	$30,232,809
Duplex/Condo	278,387	1,402,190,539	51,909,709	6,293,113	7,961	9,044	$3,261,028
Multi-Family	94,373	304,841,027	3,692,511	452,957	634	680	$255,062
Mobile/Land/Other	70,318	428,826,512	20,067,357	2,551,606	2,279	2,834	$1,381,032
Unknown	335,807	1,764,632,749	89,943,785	10,775,107	10,809	13,276	$6,328,797
TOTAL	**1,357,853**	**8,600,988,265**	**590,993,836**	**71,040,292**	**68,880**	**85,024**	**$41,458,728**

Table 7-18. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	577,312	4,810,770,267	500,255,403	49,935,119	55,092	70,866	$31,691,074
Duplex/Condo	278,151	1,418,406,349	63,696,353	6,944,657	9,925	11,449	$3,629,208
Multi-Family	93,863	303,282,062	3,731,596	451,369	632	676	$221,756
Mobile/Land/Other	68,344	428,255,334	22,008,356	2,309,211	2,593	3,183	$1,352,978
Unknown	333,322	1,775,356,470	102,430,087	10,453,641	12,485	15,439	$6,525,829
TOTAL	**1,350,992**	**8,736,070,482**	**692,121,795**	**70,093,996**	**80,727**	**101,613**	**$43,420,845**

Table 7-19. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	521,844	4,757,526,328	348,318,601	23,310,643	37,021	70,866	$21,656,424
Duplex/Condo	212,269	1,273,770,551	65,863,327	5,513,698	9,611	11,449	$3,106,510
Multi-Family	57,554	235,573,945	9,022,296	1,421,607	2,067	676	$817,899
Mobile/Land/Other	53,251	403,261,249	20,896,493	1,842,289	2,571	3,183	$1,362,448
Unknown	243,454	1,620,679,958	103,692,971	8,207,779	14,516	15,439	$6,619,750
TOTAL	**1,088,372**	**8,290,812,031**	**547,793,688**	**40,296,017**	**65,786**	**101,613**	**$33,563,029**

Figure 7-7. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

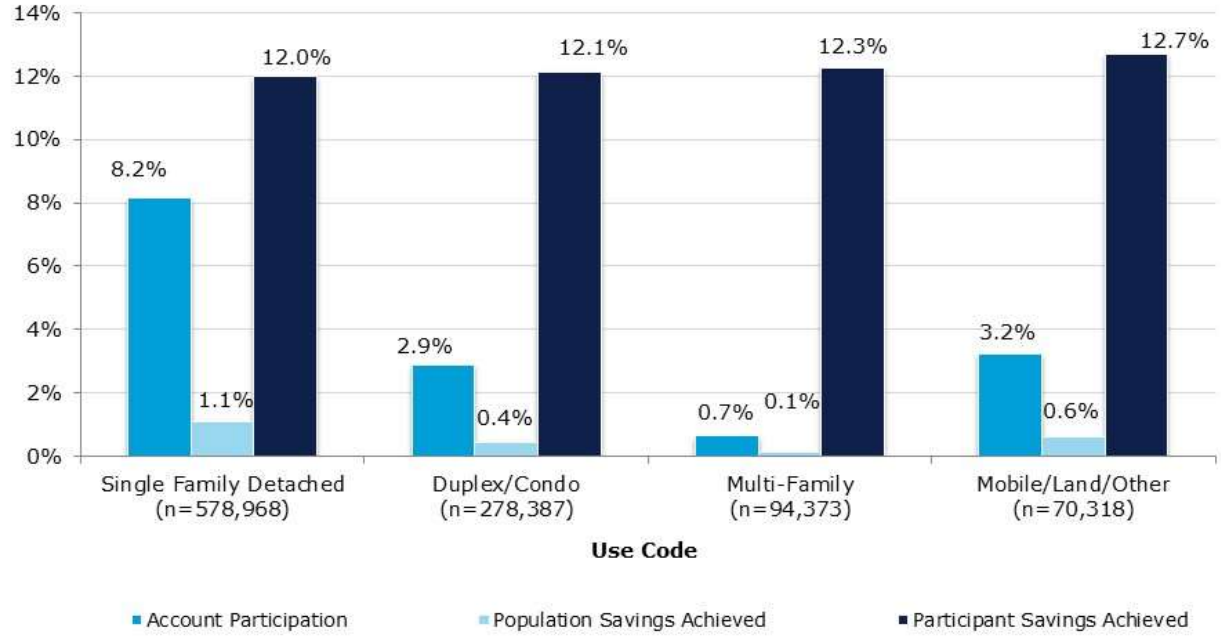


Figure 7-8. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

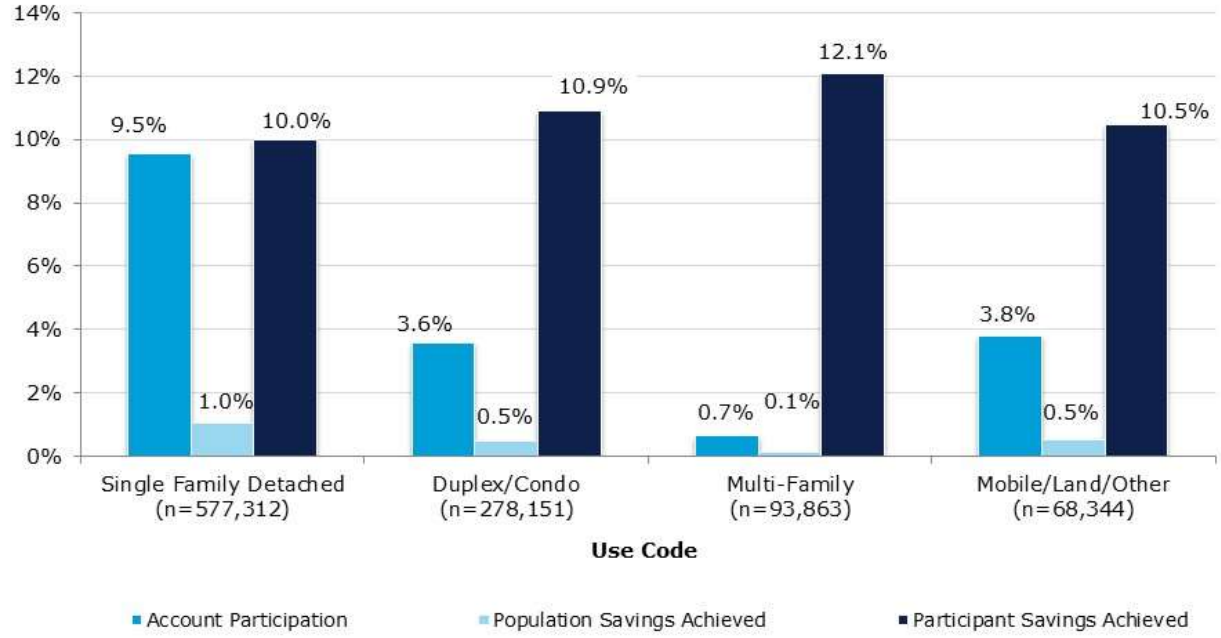
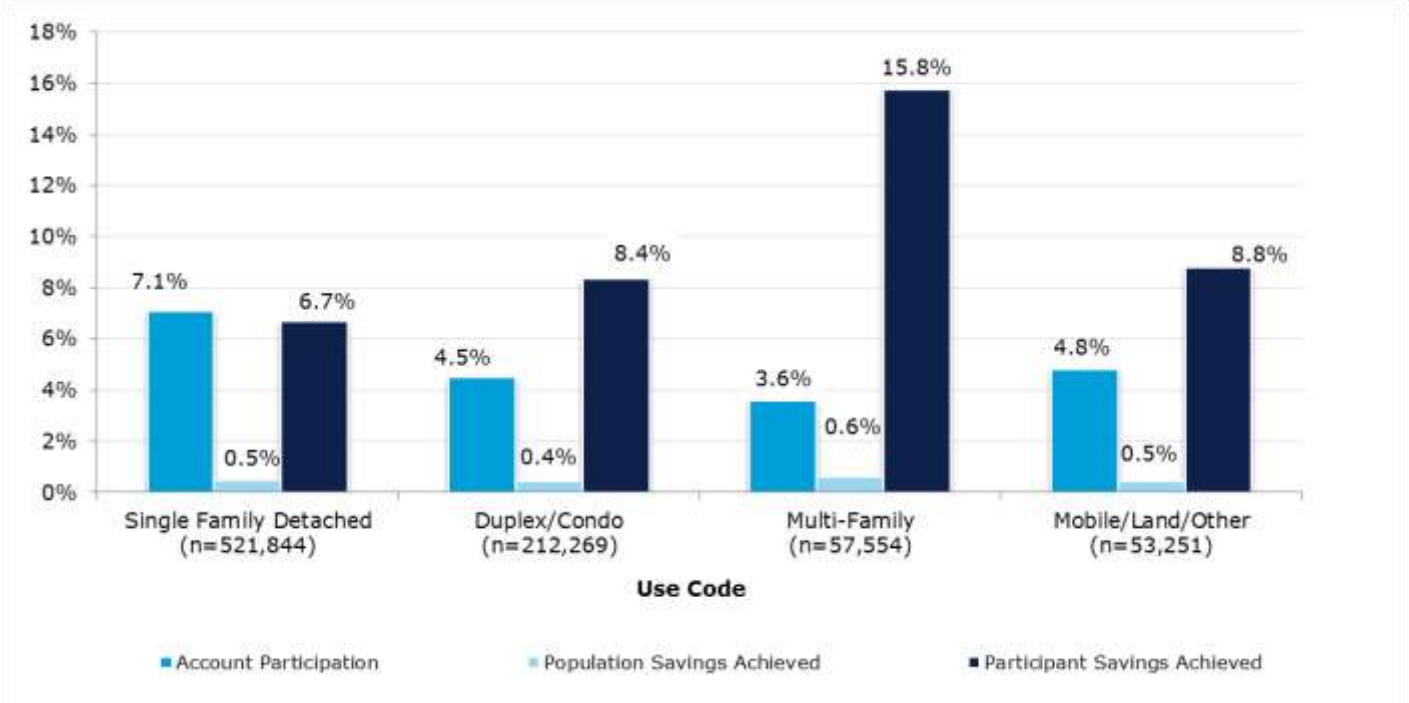


Figure 7-9. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.1.4 Unitil

Table 7-20. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	13,277	90,954,623	5,485,831	623,970	739	995	$816,019
Duplex/Condo	7,045	31,214,704	517,563	40,279	76	90	$71,012
Multi-Family	3,920	14,692,583	201,239	26,131	28	35	$21,245
Mobile/Land/Other							
Unknown	6,332	29,484,646	945,113	146,554	140	194	$168,872
TOTAL	**30,574**	**166,346,556**	**7,149,746**	**836,934**	**983**	**1,314**	**$1,077,147**

Table 7-21. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	13,072	96,639,998	3,593,813	186,726	456	523	$665,487
Duplex/Condo	7,099	31,565,136	469,975	21,851	77	87	$64,143
Multi-Family	3,624	14,361,405	143,143	9,754	19	22	$16,385
Mobile/Land/Other							
Unknown	6,352	31,699,080	621,865	30,514	92	104	$113,622
TOTAL	**30,147**	**174,265,619**	**4,828,796**	**248,844**	**644**	**736**	**$859,637**

Table 7-22. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	kWh Usage	Participant kWh Usage	Annual kWh Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	12,673	98,147,708	2,830,893	193,039	334	523	$353,970
Duplex/Condo	5,539	27,954,966	263,123	31,331	45	87	$23,864
Multi-Family	2,696	12,255,672	172,822	20,682	21	22	$31,571
Mobile/Land/Other							
Unknown	9,484	39,578,359	497,567	63,655	65	104	$99,963
TOTAL	**30,392**	**177,936,705**	**3,764,405**	**308,707**	**465**	**736**	**$509,368**

Figure 7-10. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

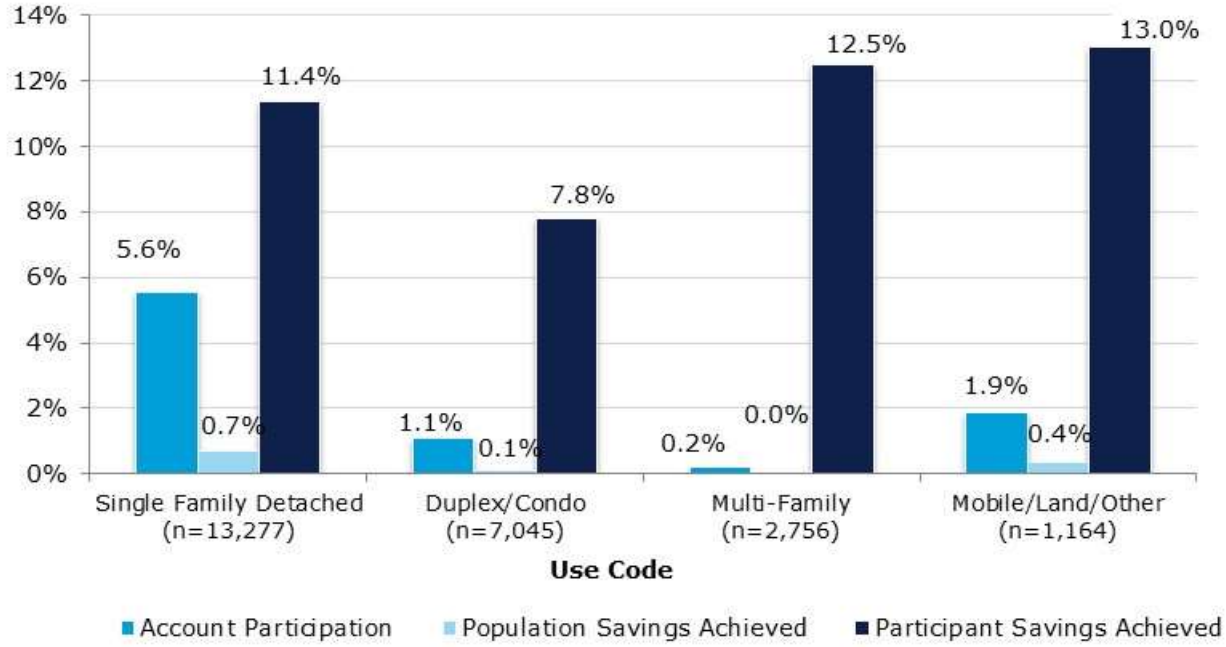


Figure 7-11. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

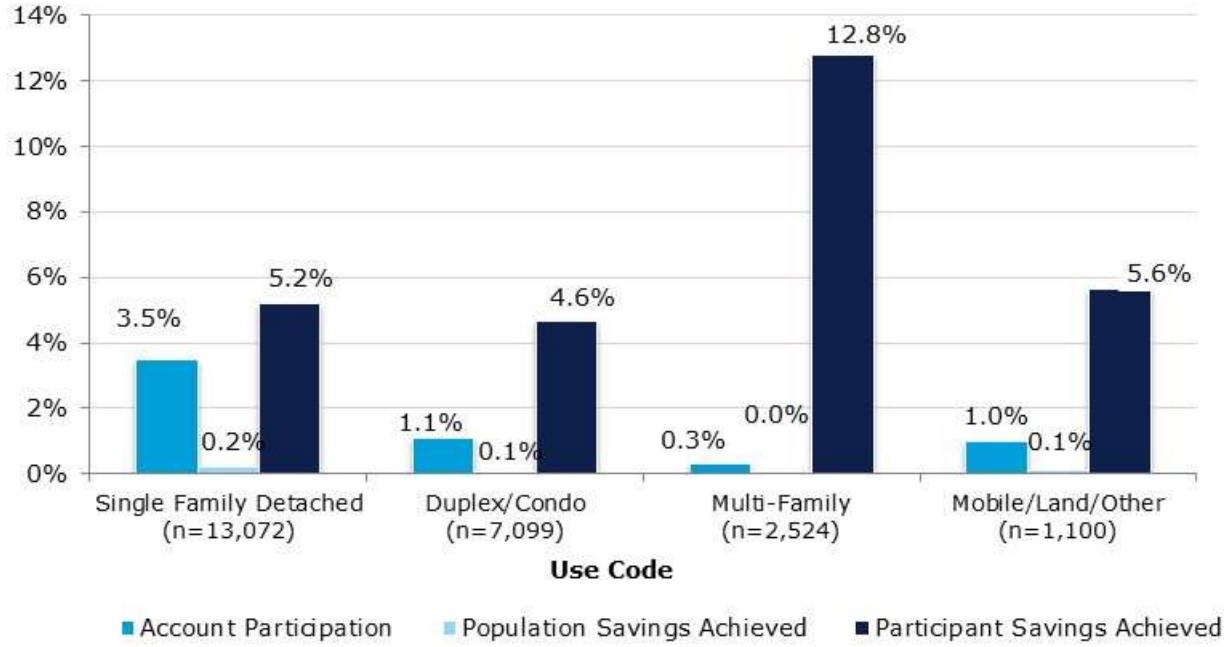
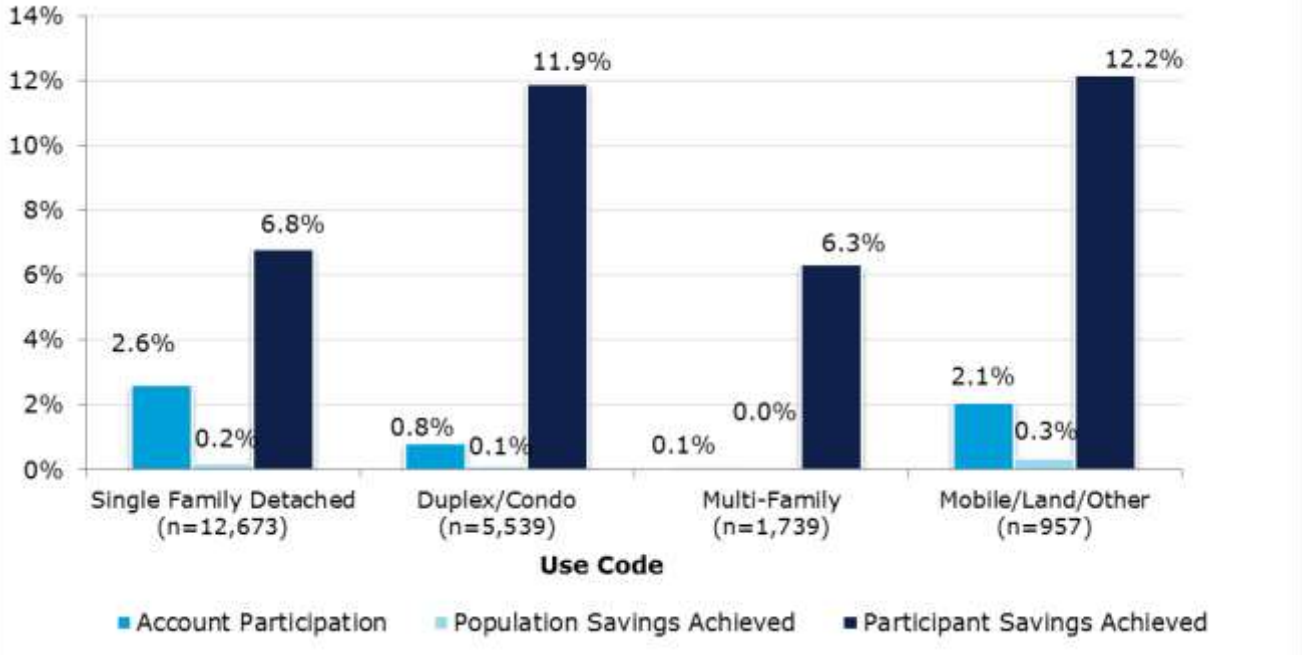


Figure 7-12. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.2 Gas

This section presents a summary of key variables for each PA, in alphabetical order by PA.

7.2.2.1 Berkshire

Table 7-23. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	15,526	17,524,057	1,171,183	126,851	1,060	1,060	$1,233,737
Duplex/Condo	5,681	5,125,373	170,326	18,867	161	161	$198,376
Multi-Family	3,225	2,890,597	85,313	10,591	77	77	74,653
Mobile/Land/Other							
Unknown	6,625	5,668,870	170,064	25,746	180	180	$243,313
TOTAL	**31,057**	**31,208,897**	**1,596,886**	**182,055**	**1,478**	**1,478**	**$1,750,079**

Table 7-24. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	16,990	18,025,738	1,365,192	156,068	1,217	1,567	$1,102,563
Duplex/Condo	6,506	5,326,688	223,739	23,653	233	290	$179,621
Multi-Family	3,559	3,006,229	106,946	12,841	90	130	84,048
Mobile/Land/Other							
Unknown	7,252	5,816,281	283,968	37,933	360	421	$364,989
TOTAL	**34,307**	**32,174,936**	**1,979,845**	**230,495**	**1,900**	**2,408**	**$1,731,221**

Table 7-25. Berkshire gas use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	15,619	14,962,295	1,423,877	144,199	1,091	1,567	$1,077,808
Duplex/Condo	5,315	3,789,000	182,544	35,185	215	290	$251,425
Multi-Family	2,775	2,091,809	81,920	11,078	108	130	94,273
Mobile/Land/Other							
Unknown	9,951	6,210,151	247,498	42,130	355	421	$302,265
TOTAL	**33,660**	**27,053,255**	**1,935,839**	**232,592**	**1,769**	**2,408**	**$1,725,772**

Figure 7-13. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

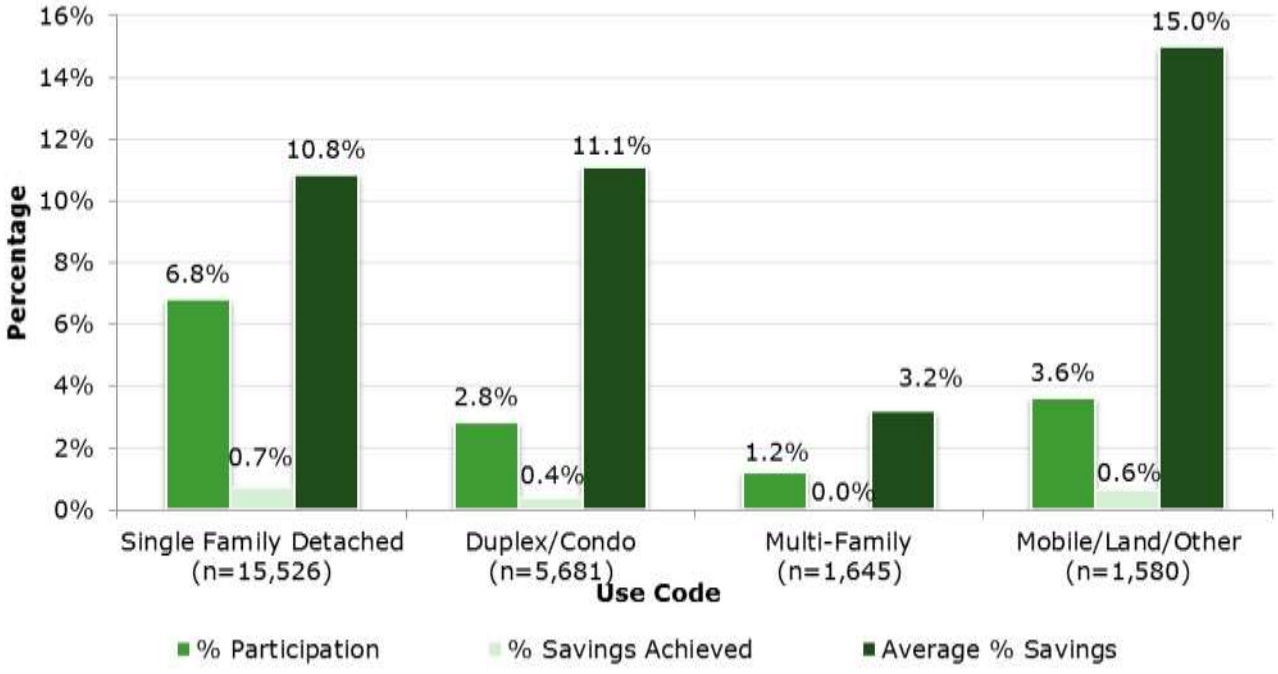


Figure 7-14. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

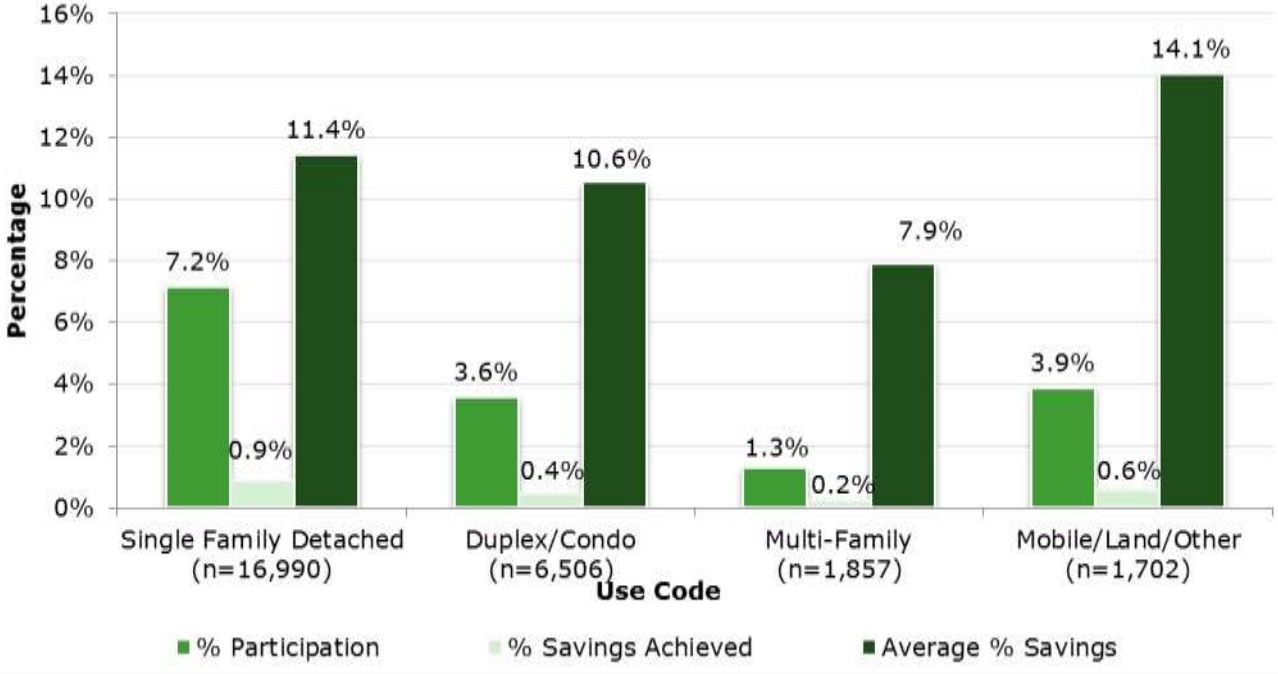
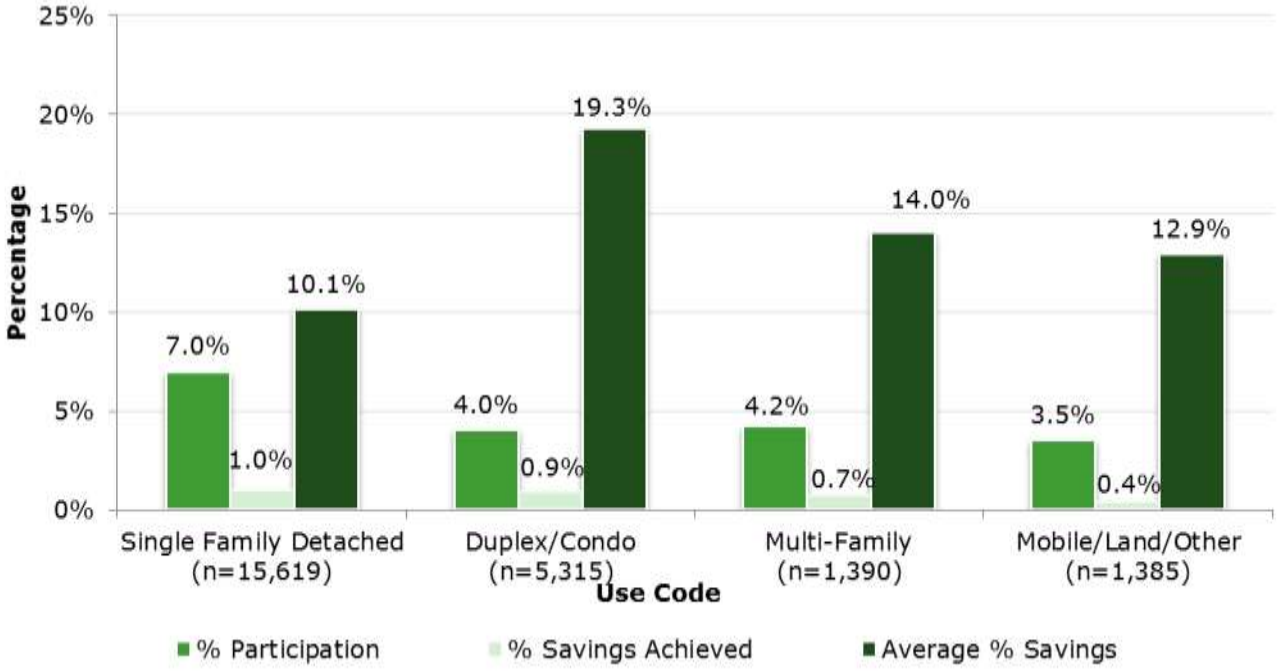


Figure 7-15. Berkshire customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.2.2 Columbia

Table 7-26. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	145,764	126,432,104	7,085,358	1,262,348	7,687	9,324	$9,932,493
Duplex/Condo	53,804	33,118,186	1,187,104	270,731	1,828	1,957	$2,349,199
Multi-Family	11,184	4,363,640	37,472	8,083	69	74	$58,609
Mobile/Land/Other	8,610	5,998,330	184,793	31,759	209	247	$248,550
Unknown	106,253	69,221,805	2,262,778	487,661	2,867	3,429	$4,073,446
TOTAL	**325,615**	**239,134,065**	**10,757,505**	**2,060,582**	**12,660**	**15,031**	**$16,662,296**

Table 7-27. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	145,271	144,402,814	5,071,171	785,727	5,086	5,501	$5,415,879
Duplex/Condo	54,066	37,951,198	473,068	83,134	633	656	$583,990
Multi-Family	11,229	5,033,985	64,522	10,756	89	89	$72,905
Mobile/Land/Other	8,407	6,766,795	125,466	18,202	124	134	$139,749
Unknown	103,258	77,312,855	1,414,293	256,103	1,675	1,754	$1,750,614
TOTAL	**322,231**	**271,467,647**	**7,148,520**	**1,153,922**	**7,607**	**8,134**	**$7,963,136**

Table 7-28. Columbia use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	150,793	138,119,593	7,836,322	1,067,986	8,495	5,501	$7,328,749
Duplex/Condo	50,246	31,832,653	879,639	147,259	1,220	656	$1,189,958
Multi-Family	9,106	3,749,685	49,255	14,297	98	89	$80,557
Mobile/Land/Other	7,006	5,011,176	199,827	33,587	246	134	$266,975
Unknown	93,799	55,114,941	1,641,207	261,919	2,247	1,754	$1,757,549
TOTAL	**310,950**	**233,828,048**	**10,606,250**	**1,525,048**	**12,306**	**8,134**	**$10,623,787**

Figure 7-16. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

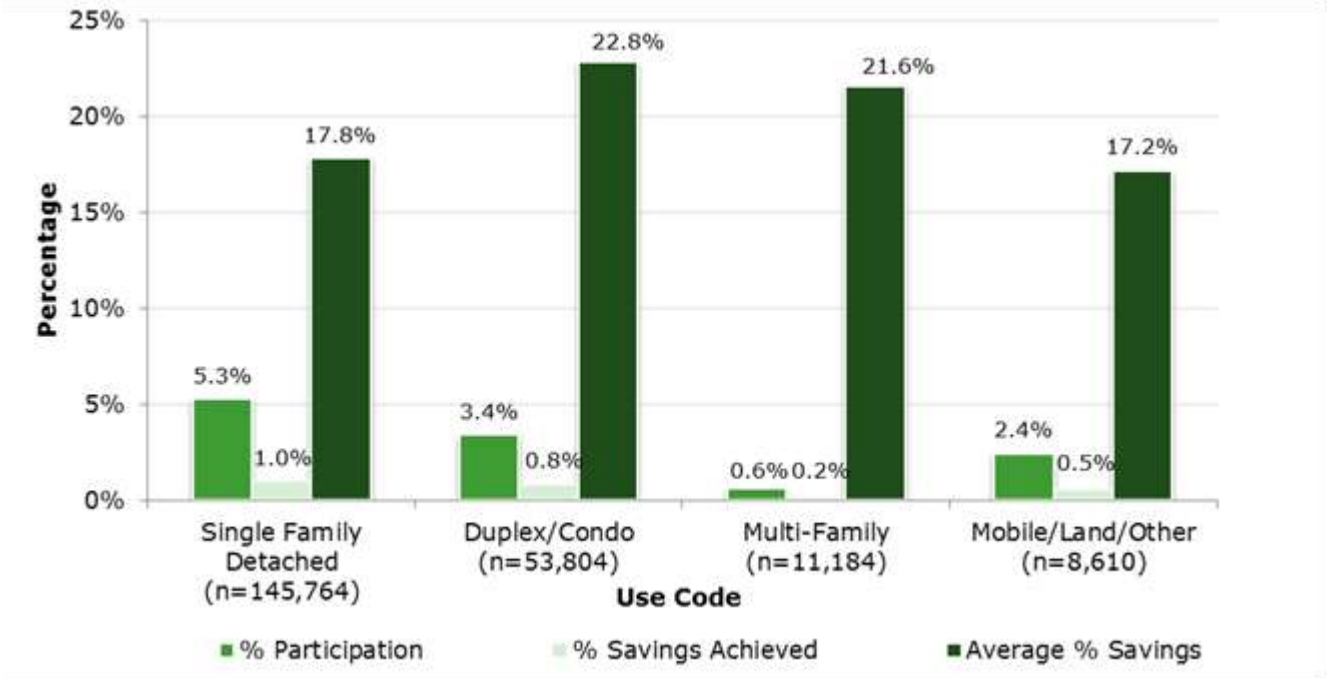


Figure 7-17. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

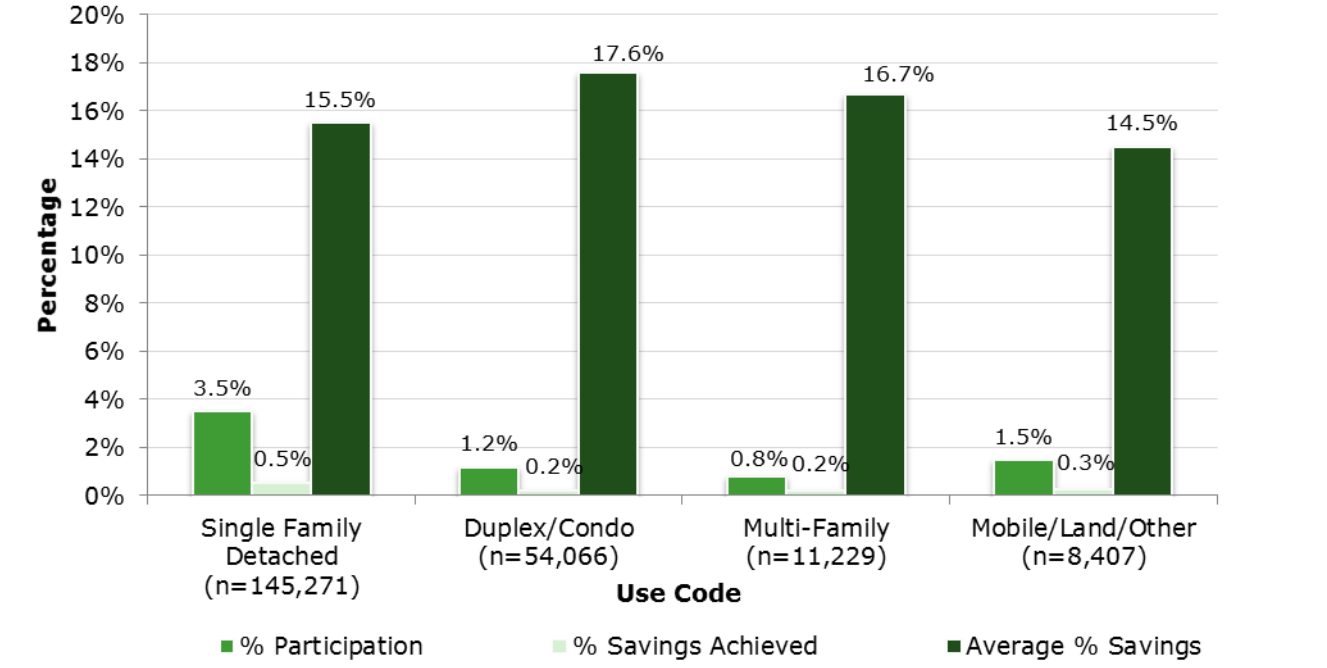
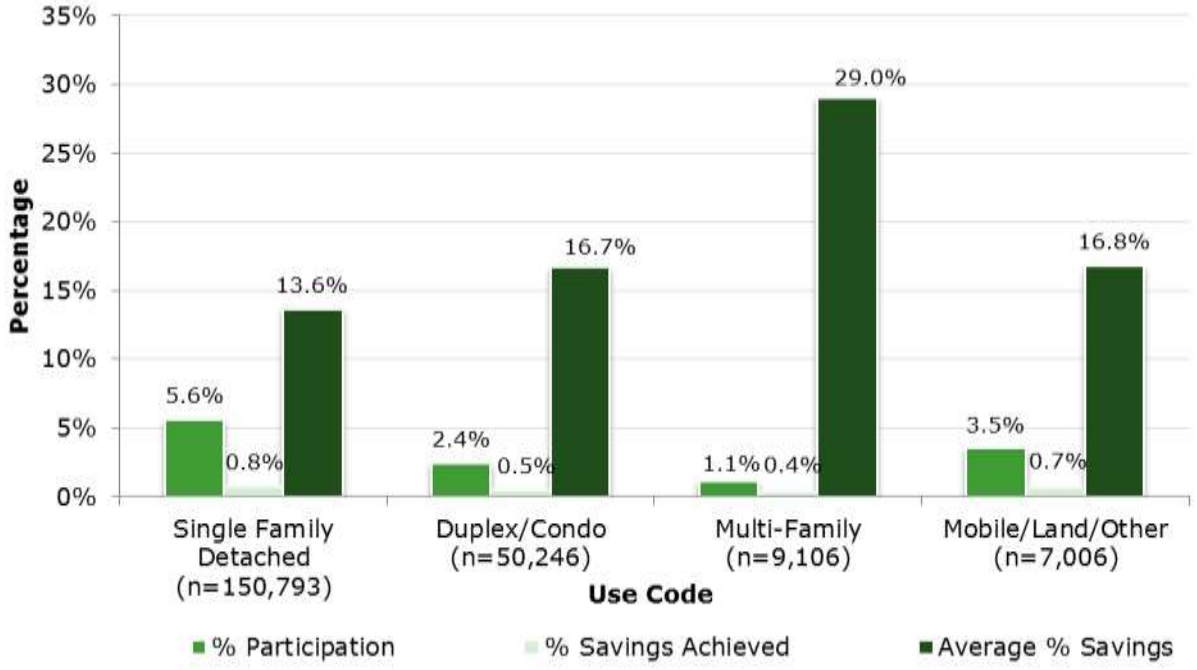


Figure 7-18. Columbia customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.2.3 Eversource

Table 7-29. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	98,220	105,675,077	8,624,181	1,014,404	7,464	9,020	$8,860,490
Duplex/Condo	85,996	62,611,968	2,114,788	281,392	2,639	3,040	$2,336,147
Multi-Family	16,699	9,345,430	97,630	17,985	160	170	$156,360
Mobile/Land/Other	11,406	8,159,057	322,079	40,149	350	407	$324,499
Unknown	74,767	54,998,135	2,521,234	319,780	2,941	3,707	$3,067,630
TOTAL	**287,088**	**240,789,667**	**13,679,912**	**1,673,709**	**13,554**	**16,344**	**$14,745,126**

Table 7-30. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	90,996	98,485,569	6,968,185	904,457	6,266	7,924	$7,019,853
Duplex/Condo	72,860	50,077,264	1,781,400	246,417	2,337	2,703	$2,024,763
Multi-Family	13,433	6,736,919	104,778	63,797	143	168	$120,847
Mobile/Land/Other	9,067	6,895,970	307,566	42,276	317	404	$311,724
Unknown	64,668	46,999,106	2,164,033	300,706	2,318	2,754	$2,381,622
TOTAL	**251,024**	**209,194,828**	**11,325,962**	**1,557,653**	**11,381**	**13,953**	**$11,858,809**

Note that Table 7-30, the annual kWh savings for multi-family buildings in 2014 is estimated at 62,811 kWh, and the participant usage is 95,601 kWh. These estimates produce an unrealistic average customer annual savings estimate of 66%. This unlikely result is also visible in Figure 7-20, below.

Table 7-31. Eversource use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	93,141	73,797,042	6,320,617	1,049,283	7,750	7,924	$5,517,079
Duplex/Condo	62,084	34,212,552	1,455,827	251,127	2,281	2,703	$1,412,097
Multi-Family	10,474	4,964,453	87,577	38,148	120	168	$425,654
Mobile/Land/Other	16,857	11,609,367	249,389	98,353	296	404	$1,062,268
Unknown	121,392	52,189,517	2,210,825	555,567	3,586	2,754	$3,323,947
TOTAL	**303,948**	**176,772,931**	**10,324,235**	**1,992,477**	**14,033**	**13,953**	**$11,741,045**

Figure 7-19. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

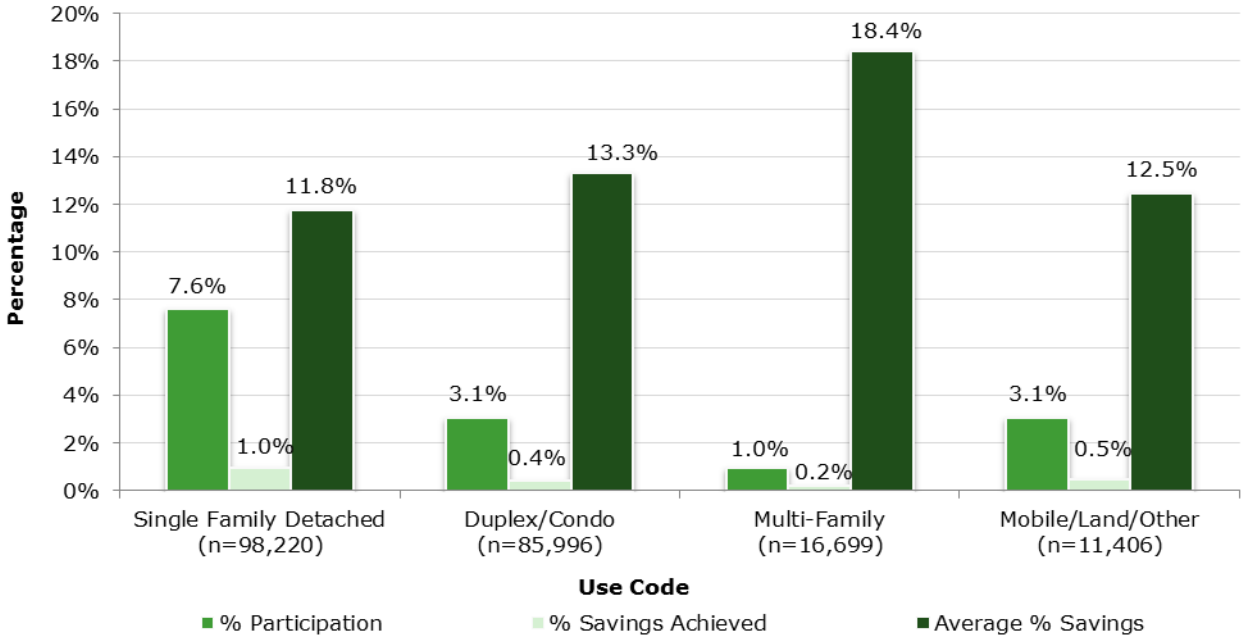


Figure 7-20. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

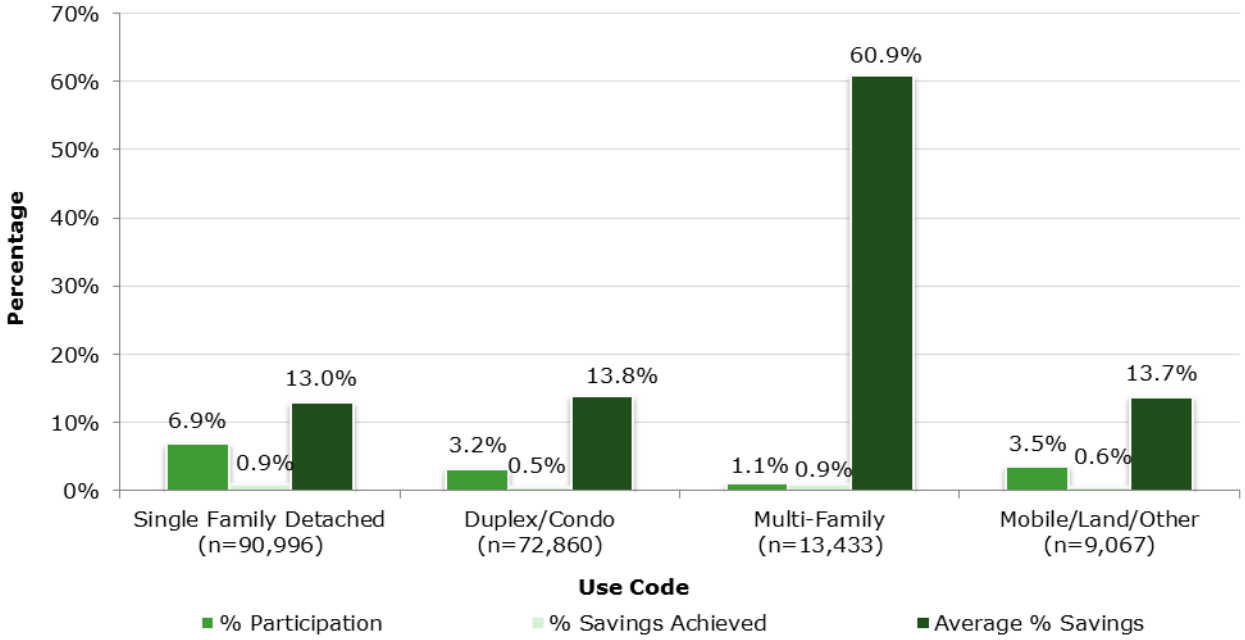
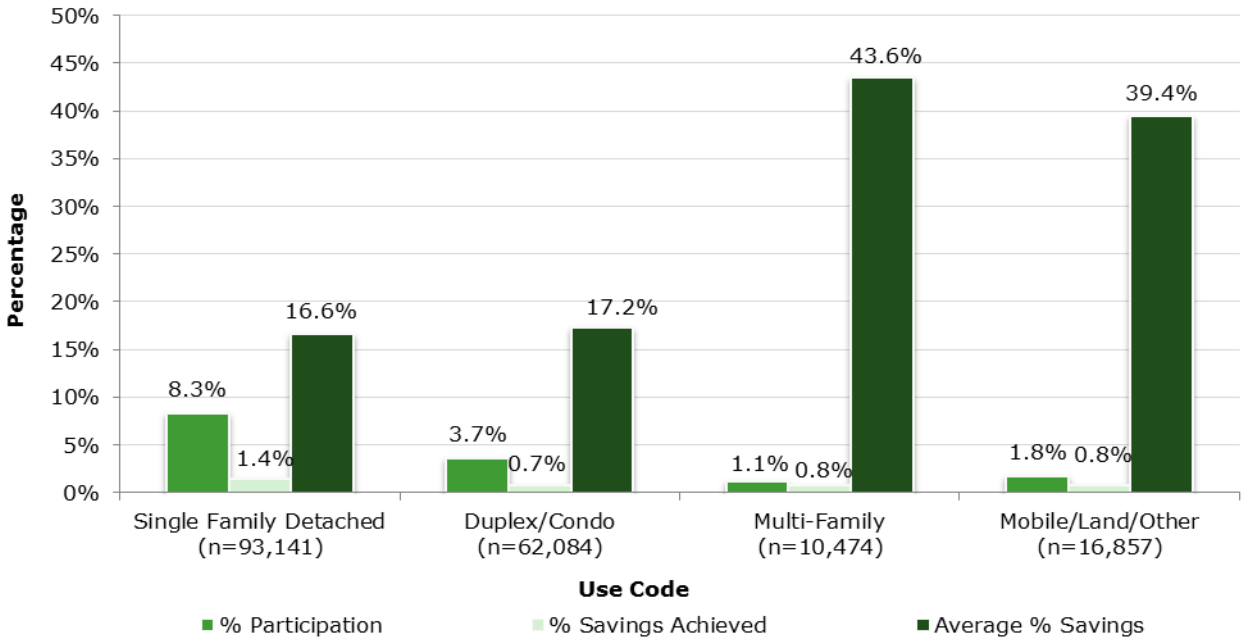


Figure 7-21. Eversource customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



As discussed above, it is unlikely that multi-family customers achieved 66% annual energy savings per household on average. However, this calculation matches the underlying data as seen in Table 7-30. DNV GL will continue to investigate the use code classifications and data that feed into this calculation, and we anticipate revisions in any future profile.

7.2.2.4 National Grid

Table 7-32. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	323,908	330,862,381	30,205,599	2,739,895	26,911	39,602	$22,084,076
Duplex/Condo	184,450	117,484,893	4,903,938	564,217	5,973	7,982	$4,253,735
Multi-Family	34,955	14,096,471	219,556	30,420	277	352	$257,548
Mobile/Land/Other	26,972	17,903,936	878,697	95,233	963	1,334	$704,297
Unknown	368,122	227,965,531	10,600,612	1,243,153	12,307	16,665	$10,446,418
TOTAL	**938,407**	**708,313,212**	**46,808,402**	**4,672,918**	**46,431**	**65,935**	**$37,746,074**

Table 7-33. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	321,416	333,876,435	30,854,632	2,945,602	27,266	40,055	$21,720,824
Duplex/Condo	183,716	119,402,534	5,546,090	620,525	6,514	8,424	$4,454,746
Multi-Family	33,940	14,327,644	248,530	36,373	335	403	$271,239
Mobile/Land/Other	26,021	17,802,979	951,518	99,607	1,032	1,405	$679,670
Unknown	366,167	228,850,944	12,565,943	1,442,463	14,142	19,117	$10,938,796
TOTAL	**931,260**	**714,260,536**	**50,166,713**	**5,144,569**	**49,289**	**69,404**	**$38,065,275**

Table 7-34. National Grid use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	292,722	289,713,296	21,956,408	2,410,400	21,281	40,055	$15,488,536
Duplex/Condo	148,423	94,103,958	5,367,368	573,936	7,004	8,424	$3,817,631
Multi-Family	23,882	10,069,341	396,162	62,402	742	403	$555,944
Mobile/Land/Other	19,747	14,151,012	720,527	74,413	858	1,405	$509,222
Unknown	276,610	178,968,775	10,380,139	1,127,326	12,508	19,117	$11,262,966
TOTAL	**761,384**	**587,006,382**	**38,820,604**	**4,248,477**	**42,393**	**69,404**	**$31,634,299**

Figure 7-22. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

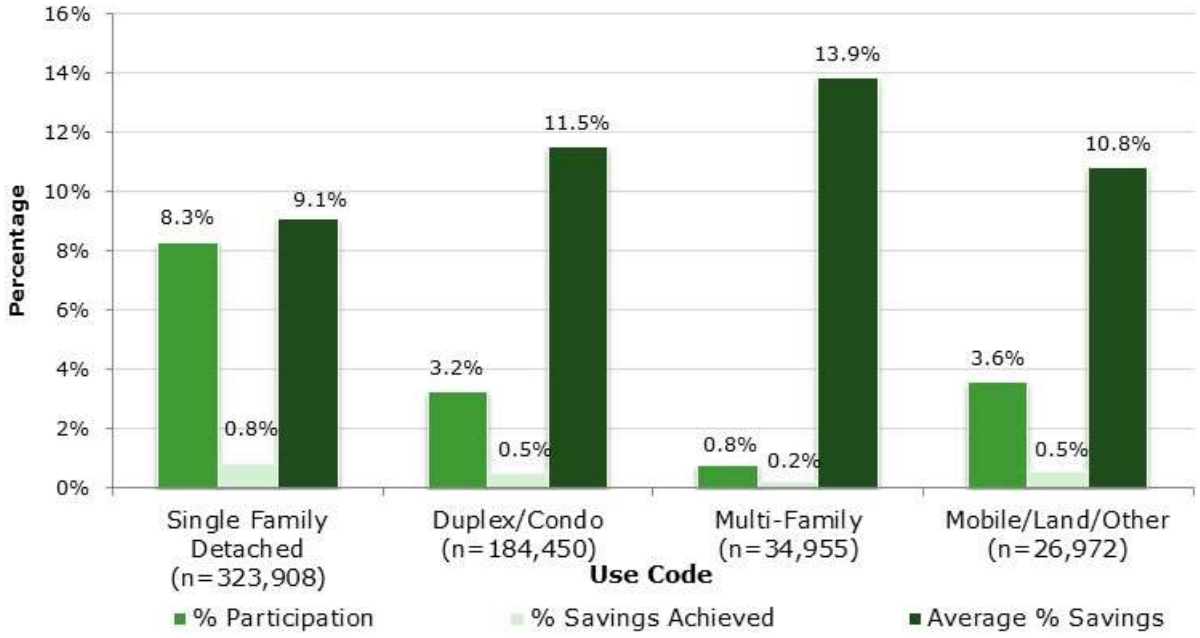


Figure 7-23. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

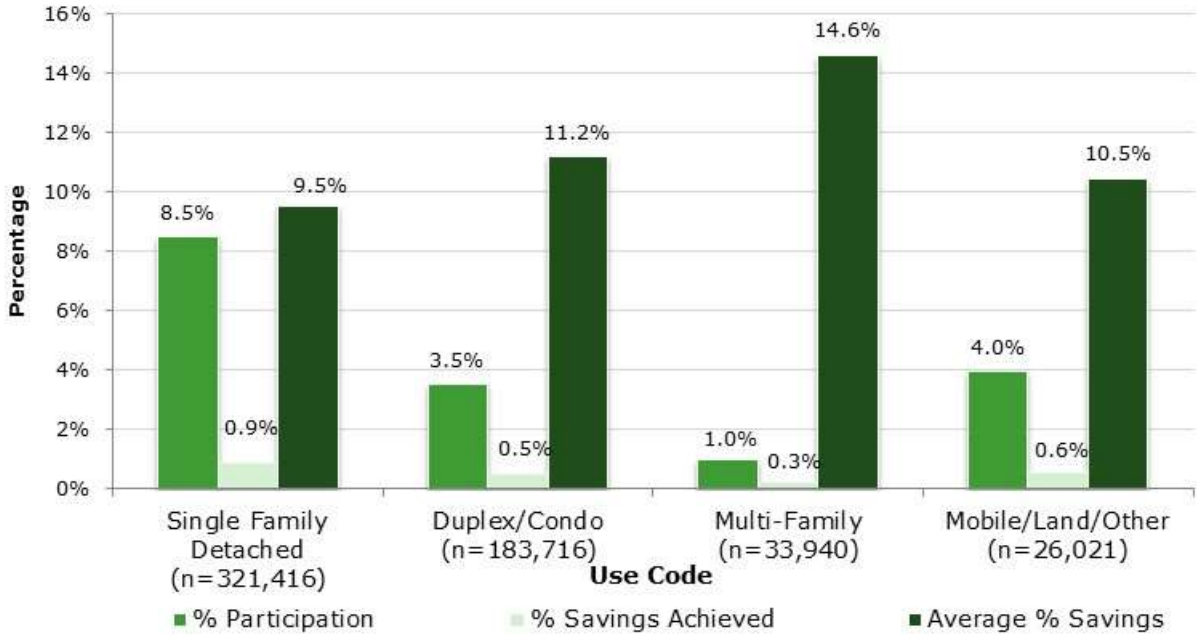
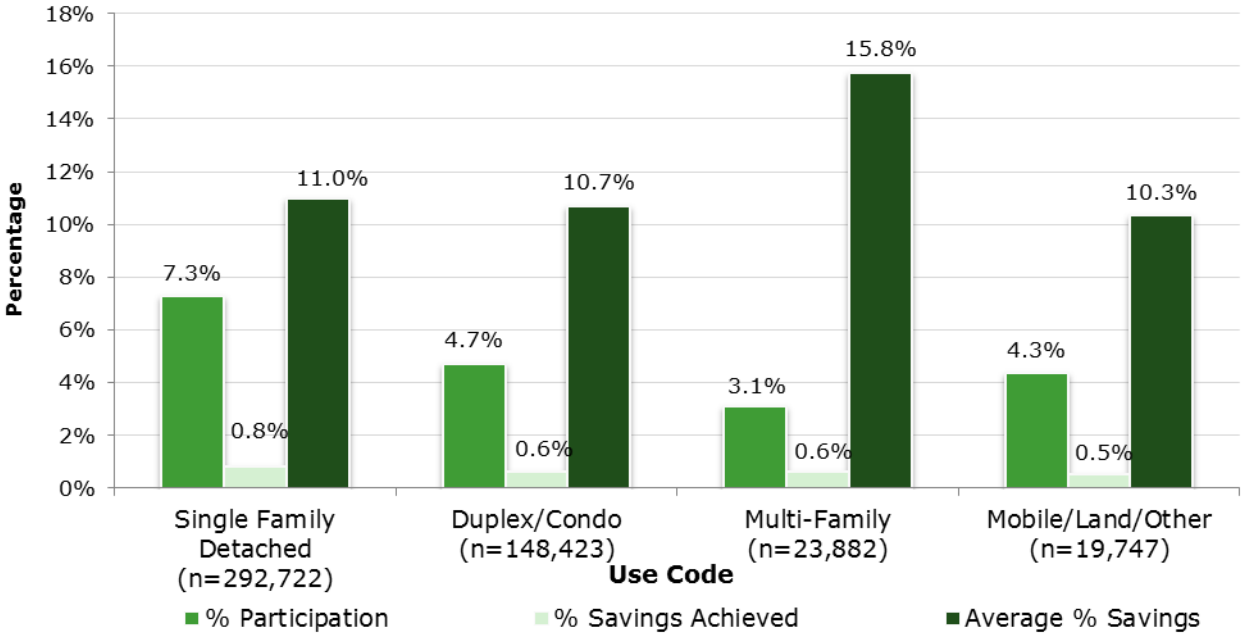


Figure 7-24. National Grid customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.2.5 Liberty

Table 7-35. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	8,910	7,705,561	865,692	111,482	902	902	$1,211,398
Duplex/Condo	6,324	3,331,538	132,776	21,899	167	167	$257,281
Multi-Family	3,691	1,526,040	12,423	1,105	18	18	$13,057
Mobile/Land/Other	841	551,327	21,125	1,970	23	23	$27,587
Unknown	30,384	23,937,667	238,145	25,955	262	262	$285,489
TOTAL	**50,150**	**37,052,132**	**1,270,160**	**162,411**	**1,372**	**1,372**	**$1,794,811**

Table 7-36. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	8,406	7,259,675	482,381	68,192	515	526	$342,500
Duplex/Condo	5,790	2,994,539	49,791	10,310	62	62	$29,963
Multi-Family	3,353	1,310,831	*	*	*	*	*
Mobile/Land/Other	774	511,686	11,884	795	15	15	$1,917
Unknown	31,312	24,827,398	127,985	15,010	141	145	$73,338
TOTAL	**49,635**	**36,904,128**	**679,319**	**95,216**	**740**	**755**	**$453,370**

Table 7-37. Liberty use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	6,780	5,720,345	248,490	30,391	284	515	$188,867
Duplex/Condo	3,453	1,888,577	30,269	4,771	42	62	$43,169
Multi-Family	1,525	716,357	*	*	*	*	*
Mobile/Land/Other	489	360,568	*	*	*	*	*
Unknown	34,173	24,399,410	72,191	11,185	107	141	$63,961
TOTAL	**46,420**	**33,085,256**	**364,896**	**47,785**	**450**	**740**	**$310,339**

Figure 7-25. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

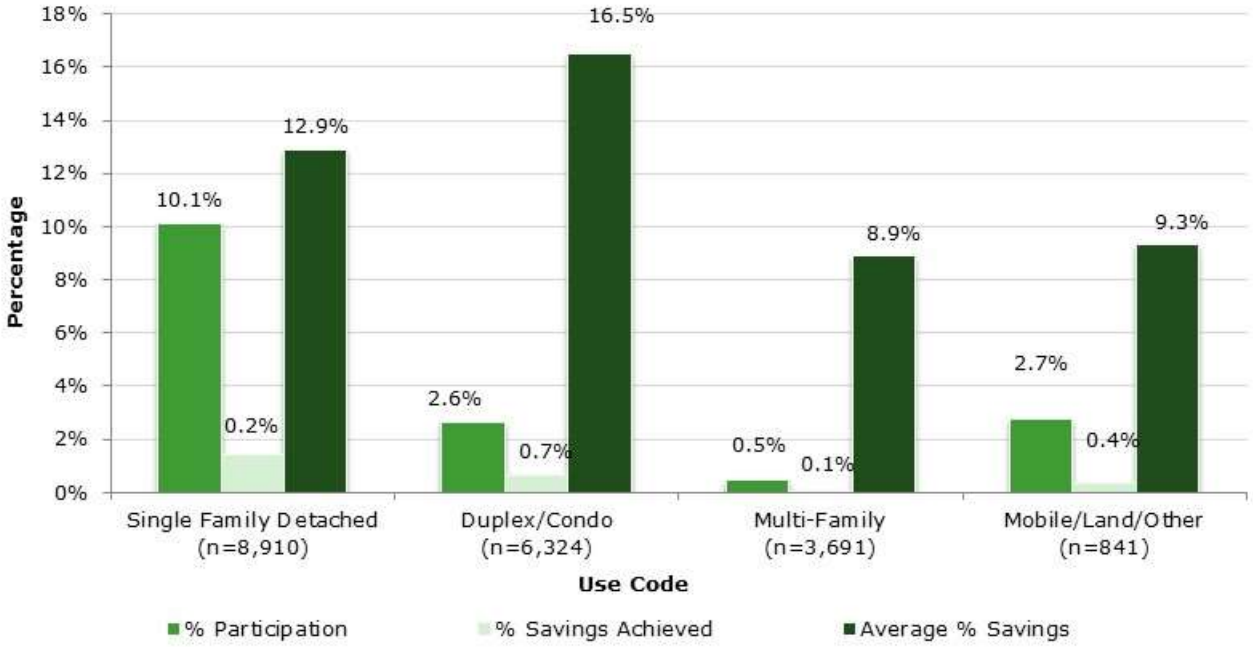


Figure 7-26. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

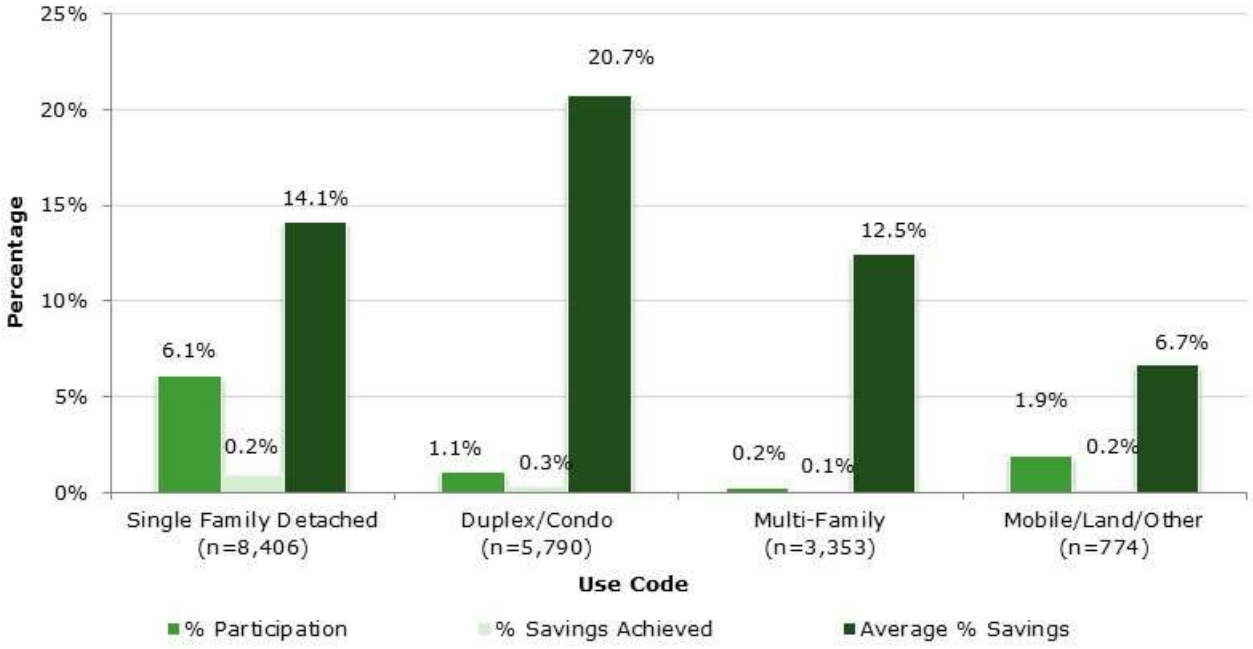
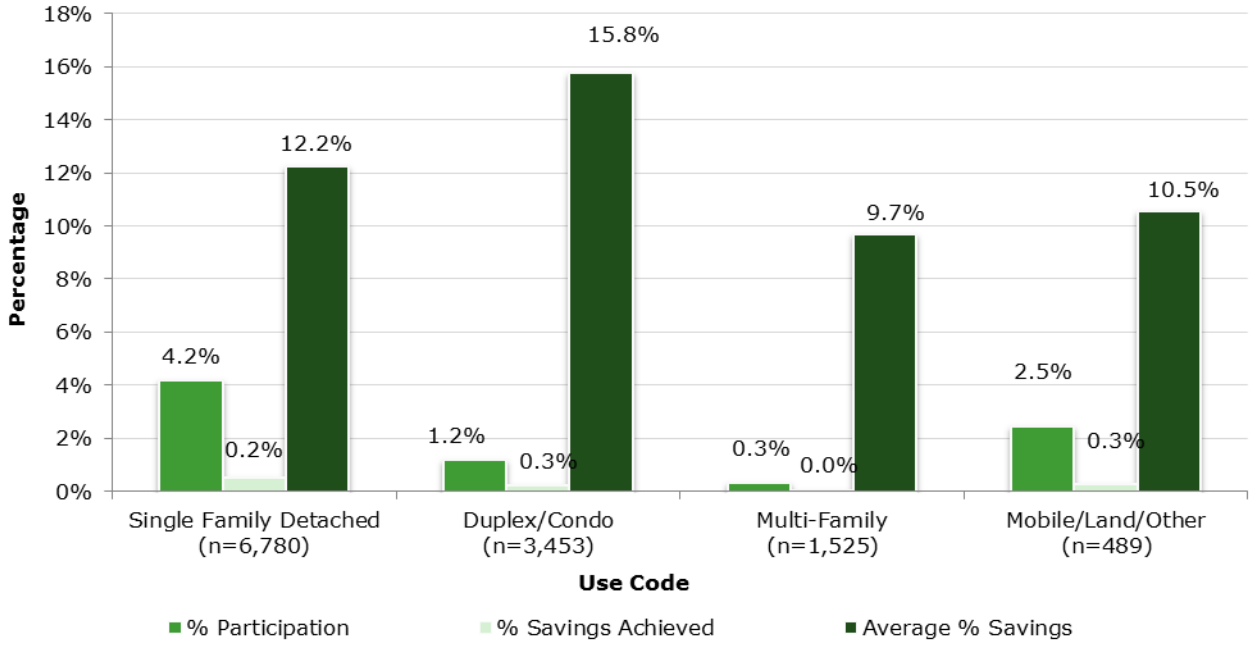


Figure 7-27. Liberty customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.2.2.6 Unitil

Table 7-38. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2015)

Use Code	Data						
	# Accounts	Therms Usage	Participant Therms Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	5,947	4,520,198	174,506	33,461	198	229	$281,372
Duplex/Condo	5,969	3,235,470	29,252	7,878	50	54	$55,201
Multi-Family	2,515	1,102,281	16,709	3,282	19	21	$25,990.96
Mobile/Land/Other							
Unknown	3,362	1,712,909	40,872	8,678	51	54	$60,920
TOTAL	**17,793**	**10,570,858**	**261,339**	**53,298**	**318**	**358**	**$423,484**

Table 7-39. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2014)

Use Code	Data						
	# Accounts	Therms Usage	Participant kWh Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	5,164	4,299,787	131,856	29,993	139	151	$271,257
Duplex/Condo	4,213	2,650,659	42,741	7,462	49	54	$92,529
Multi-Family	1,502	838,209	16,445	1,442	10	13	$12,056.72
Mobile/Land/Other							
Unknown	2,335	1,406,048	27,396	4,363	30	32	$48,698
TOTAL	**13,214**	**9,194,703**	**218,438**	**43,260**	**228**	**250**	**$424,541**

Table 7-40. Unitil use code breakouts, excluding unlinked energy efficiency tracking data (2013)

Use Code	Data						
	# Accounts	Therms Usage	Participant kWh Usage	Annual Therms Savings	# Participants	# Applications / Projects	Incentive $
Single Family Detached	5,070	4,407,674	71,708	9,461	65	65	$146,030
Duplex/Condo	3,414	2,272,475	14,891	3,217	19	19	$42,312
Multi-Family	1,122	720,210	213	-	1	1	$875.00
Mobile/Land/Other							
Unknown	6,105	2,384,998	*	*	*	*	*
TOTAL	**15,711**	**9,785,357**	**96,795**	**14,412**	**99**	**99**	**$221,422**

Figure 7-28. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2015)

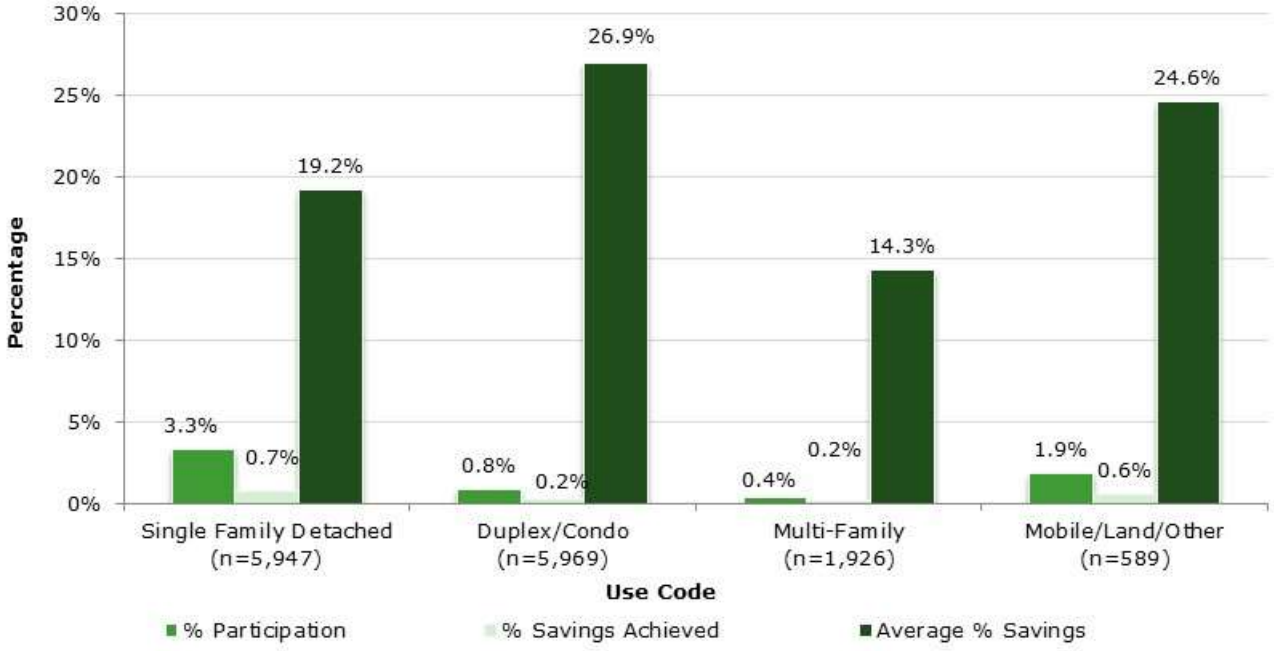


Figure 7-29. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2014)

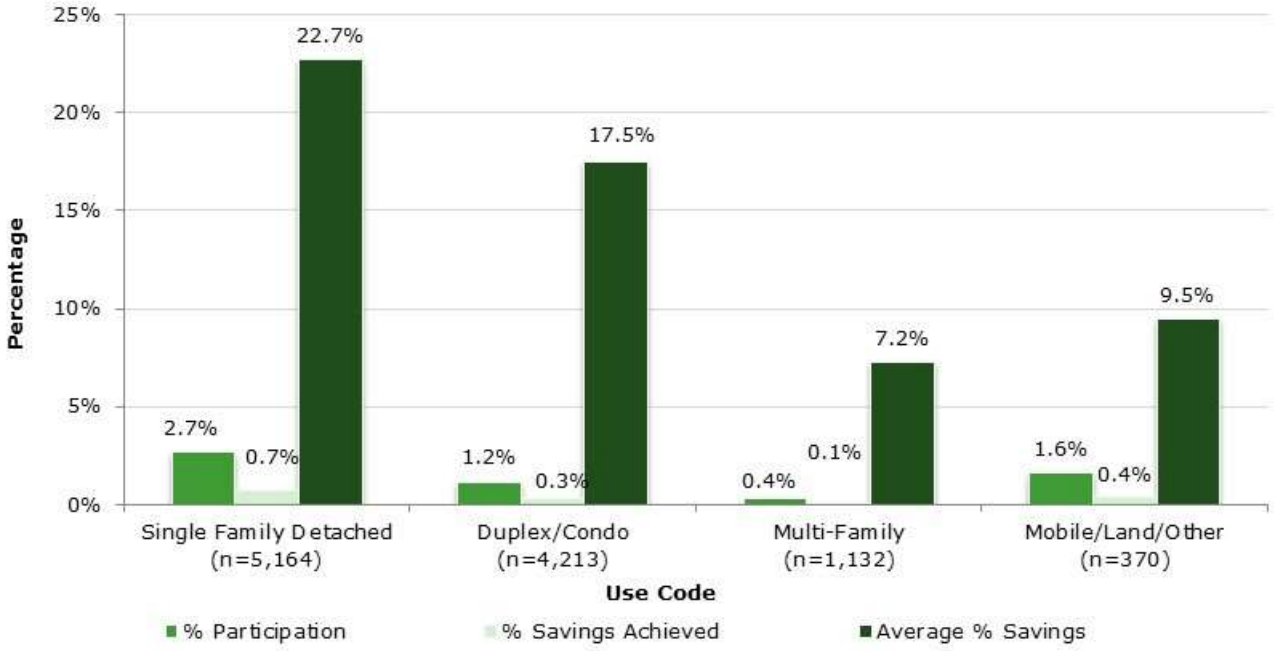
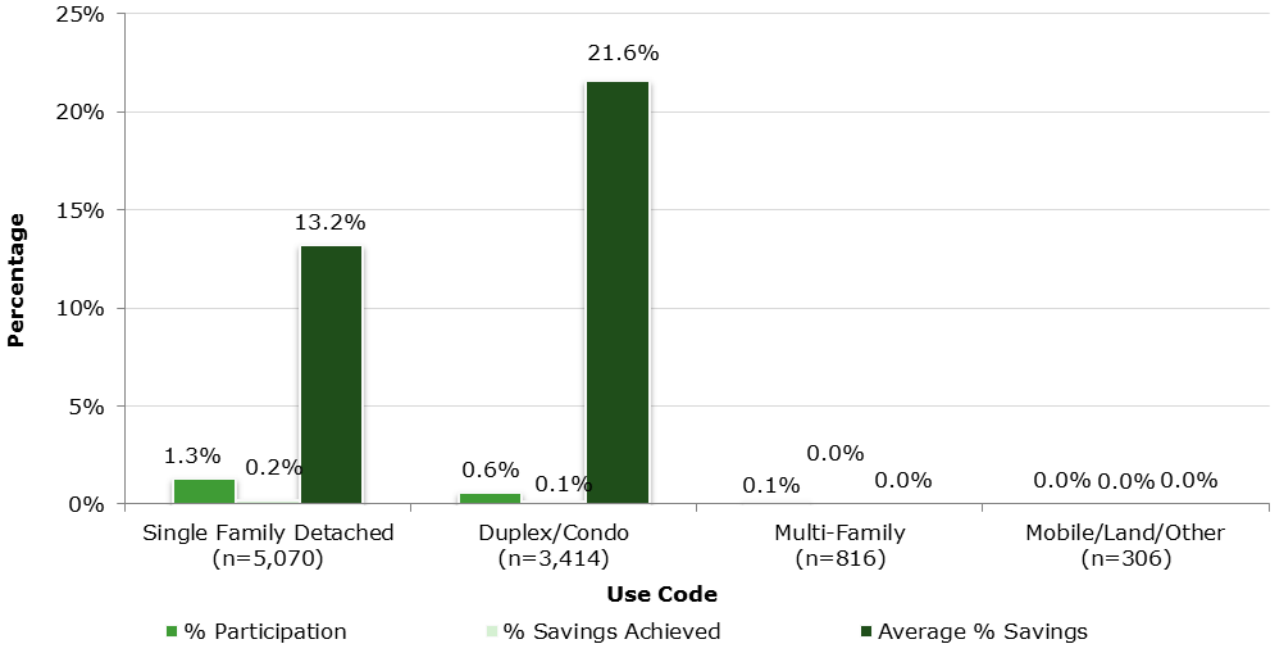


Figure 7-30. Unitil customer population summary by use code, excluding unlinked energy efficiency tracking data and unknown use code (2013)



7.3 Appendix C. Demographic Analysis tables by individual year

This section presents the individual year demographic

nalysis quintile tables for electric and gas. These tables can provide more granular insight into changes in the quintiles for each year's corresponding billing and energy efficiency tracking data and facilitate deeper dives into how changes in program offerings and strategies may have influenced specific quintiles. Please review Section 4 for key methodology and calculation details.

7.3.1 Electric Demographic analysis by year

Table 7-41. Basic quintile analysis: ratio of population below 200% of poverty index– 2015 electric participation and average block group building vintage

	Unique Billing Accounts	2015 Electric MMBTU Consumption	Unique Tracking Accounts	2015 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Poverty Range
1 - Low Poverty Ratio	470,604	13,752,024	41,981	210,082	1.53%	8.92%	Zero to 9.3
2	527,066	12,882,292	37,666	181,497	1.41%	7.15%	9.3 to 16.9
3	529,226	11,689,599	32,305	155,986	1.33%	6.10%	16.9 to 27.0
4	509,562	9,735,902	23,232	115,078	1.18%	4.56%	27.0 to 43.2
5 - High Poverty Ratio	419,606	7,162,803	13,058	106,421	1.49%	3.11%	43.2 to 100
Grand Total	**2,456,064**	**55,222,620**	**148,242**	**769,063**	**1.39%**	**6.04%**	

Figure 7-31. Block group contribution ratio by poverty index – unique 2015 electric population

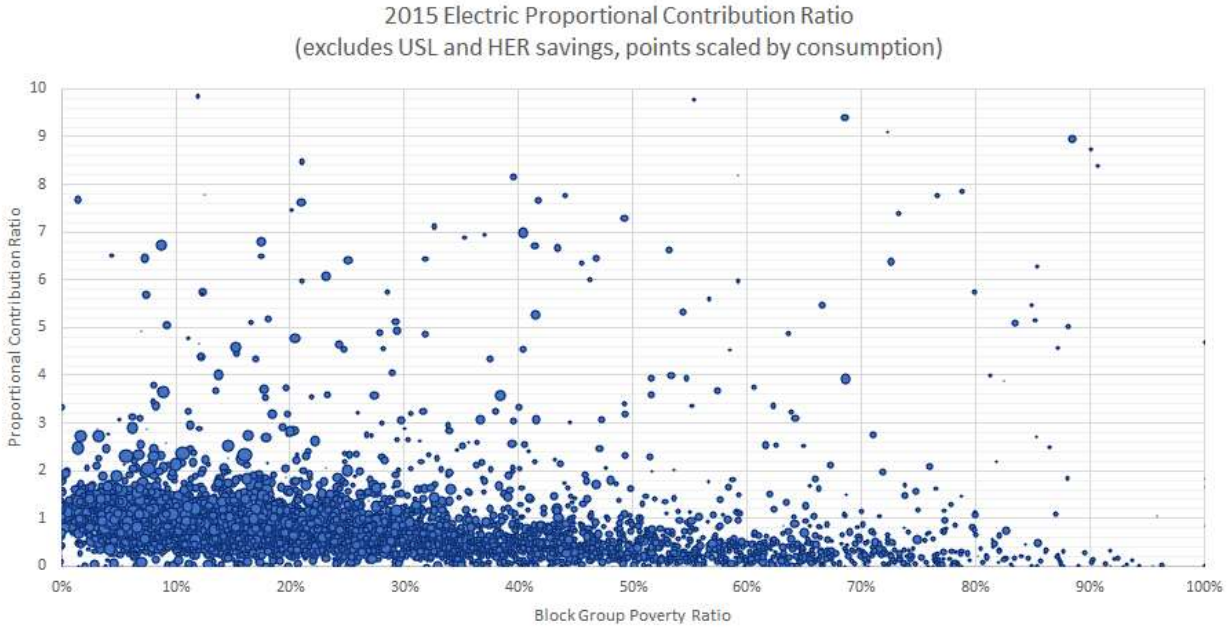


Table 7-42. Basic quintile analysis: ratio of population above 200% of poverty index– 2014 electric participation and average block group building vintage

	Unique Billing Accounts	2014 Electric MMBTU Consumption	Unique Tracking Accounts	2014 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Poverty Range
1 - Low Poverty Ratio	465,662	13,248,398	44920	178,307	1.35%	9.65%	Zero to 9.3
2	518,805	12,365,202	40258	164,764	1.33%	7.76%	9.3 to 16.9
3	524,730	11,222,273	34954	140,366	1.25%	6.66%	16.9 to 27.0
4	505,423	9,207,067	27348	111,479	1.21%	5.41%	27.0 to 43.2
5 - High Poverty Ratio	413,478	6,586,513	14643	98,894	1.50%	3.54%	43.2 to 100
Grand Total	**2,428,098**	**52,629,453**	**162123**	**693,810**	**1.32%**	**6.68%**	

Figure 7-32. Block group contribution ratio by poverty index – unique 2014 electric population

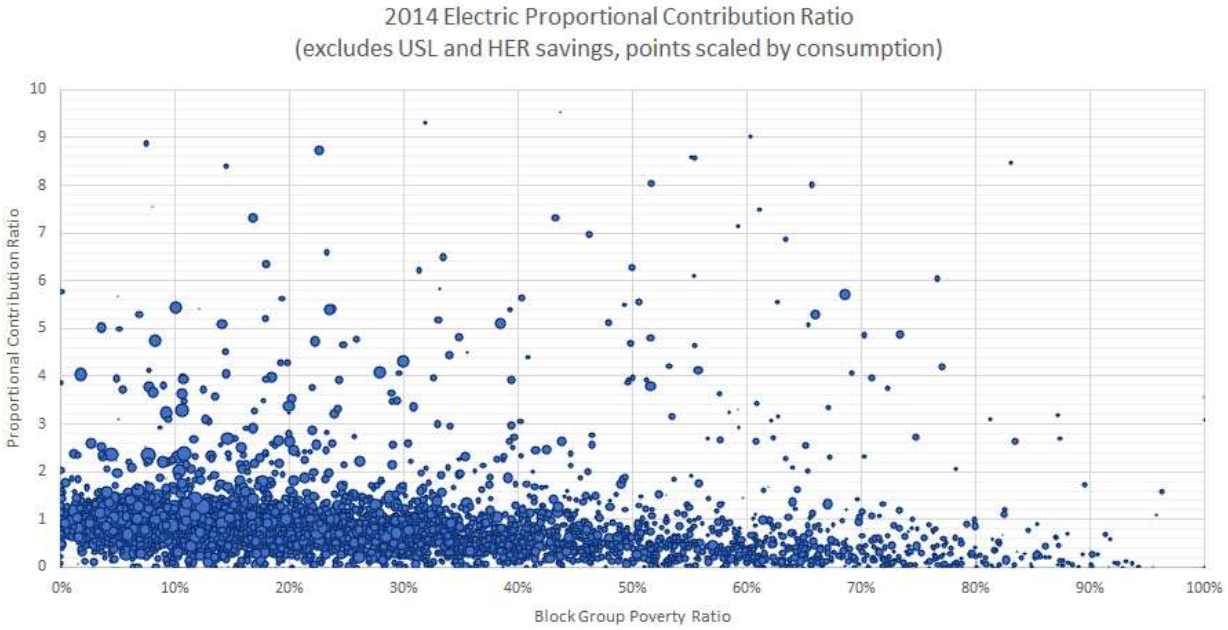


Table 7-43. Basic quintile analysis: ratio of renter occupied homes – 2015 electric participation and average block group building vintage

	Unique Billing Accounts	2015 Electric MMBTU Consumption	Unique Tracking Accounts	2015 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Ratio Range
1 - Low Renter Ratio	463,474	13,943,721	44,582	209,145	1.50%	9.62%	Zero to 10.2
2	536,671	13,743,520	40,890	189,427	1.38%	7.62%	10.2 to 24.7
3	506,538	11,122,726	30,636	153,383	1.38%	6.05%	24.7 to 44.7
4	498,663	9,471,907	20,377	112,037	1.18%	4.09%	44.7 to 66.7
5 - High Renter Ratio	449,115	7,617,579	11,551	112,513	1.48%	2.57%	66.7 to 100
Grand Total	**2,454,461**	**55,899,454**	**148,036**	**776,505**	**1.39%**	**6.03%**	

Figure 7-33. Block group contribution ratio by ratio of renter occupied homes – unique 2015 electric population

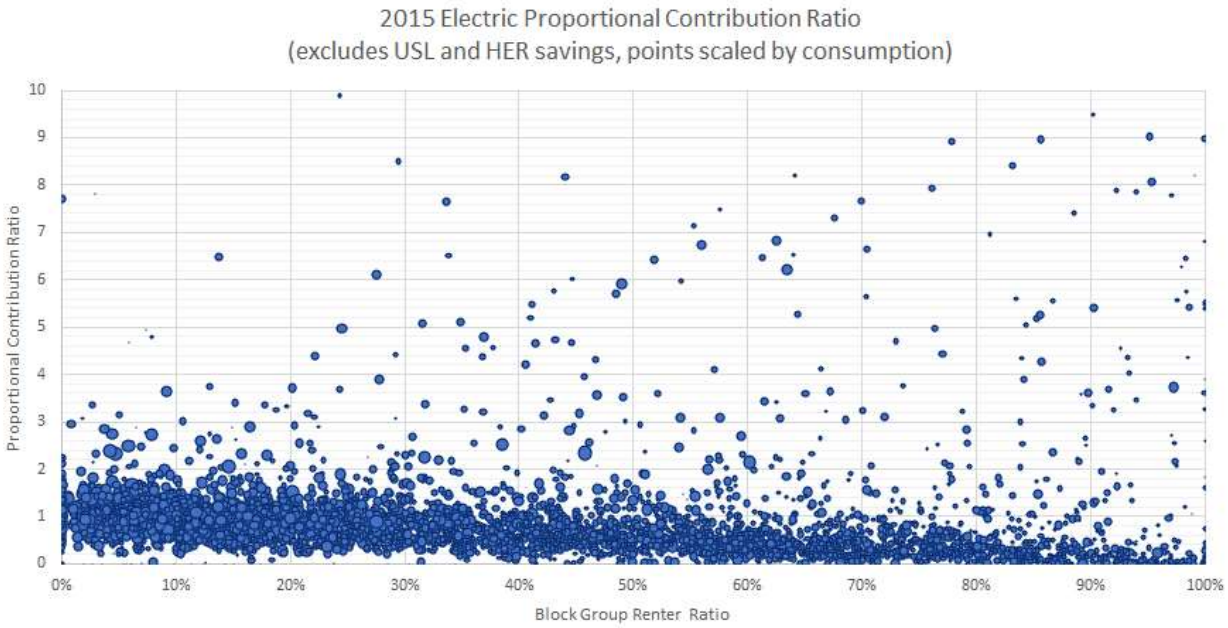
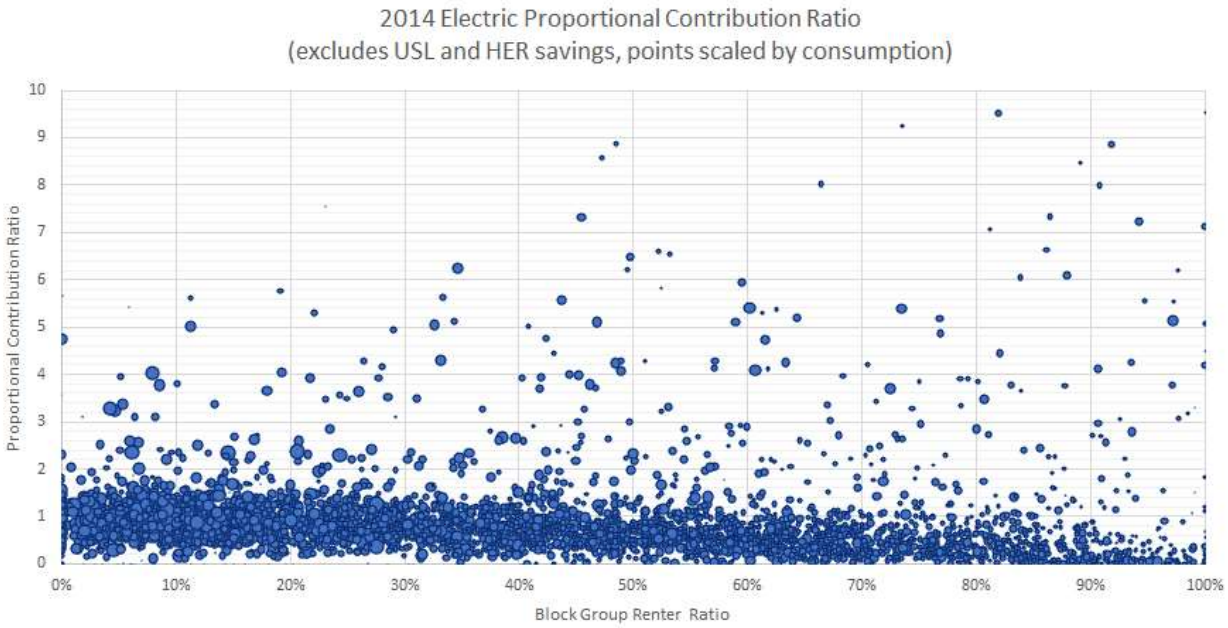


Table 7-44. Basic quintile analysis: ratio of renter occupied homes – 2014 electric participation and average block group building vintage

	Unique Billing Accounts	2014 Electric MMBTU Consumption	Unique Tracking Accounts	2014 Electric MMBTU Savings (No USL or HER)	Quintile Population Average Save Ratio (No USL or HER)	Quintile Population Participation Ratio	Quintile Ratio Range
1 - Low Renter Ratio	459,377	13,637,260	46,459	181,357	1.33%	10.11%	Zero to 10.2
2	532,808	13,472,736	43,845	172,334	1.28%	8.23%	10.2 to 24.7
3	501,518	10,788,156	34,423	137,996	1.28%	6.86%	24.7 to 44.7
4	492,149	8,767,272	23,505	115,723	1.32%	4.78%	44.7 to 66.6
5 - High Renter Ratio	441,845	6,719,459	13,843	96,907	1.44%	3.13%	66.6 to 100
Grand Total	**2,427,697**	**53,384,883**	**162,075**	**704,318**	**1.32%**	**6.68%**	

Figure 7-34. Block group contribution ratio by ratio of renter occupied homes – unique 2014 electric population



7.3.2 Gas Demographic analysis by year

Table 7-45. Basic quintile analysis: ratio of population above 200% of poverty index– 2015 gas participation and average block group building vintage

	Unique Billing Accounts	2015 Gas MMBTU Consumption	Unique Tracking Accounts	2015 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Participation Ratio	Quintile Ratio Range
1 - Low Poverty Ratio	285,570	28,663,393	21,118	297,778	1.04%	7.40%	Zero to 8.76
2	316,330	26,575,008	18,508	258,977	0.97%	5.85%	8.76 to 16.1
3	330,882	25,356,098	15,855	248,516	0.98%	4.79%	16.1 to 25.8
4	325,460	23,608,760	11,629	195,014	0.83%	3.57%	25.8 to 42.5
5 - High Poverty Ratio	274,055	21,144,238	5,480	157,351	0.74%	2.00%	42.5 to 100
Grand Total	**1,532,297**	**125,347,496**	**72,590**	**1,157,635**	**0.92%**	**4.74%**	

Figure 7-35. Block group contribution ratio by poverty index – unique 2015 gas population

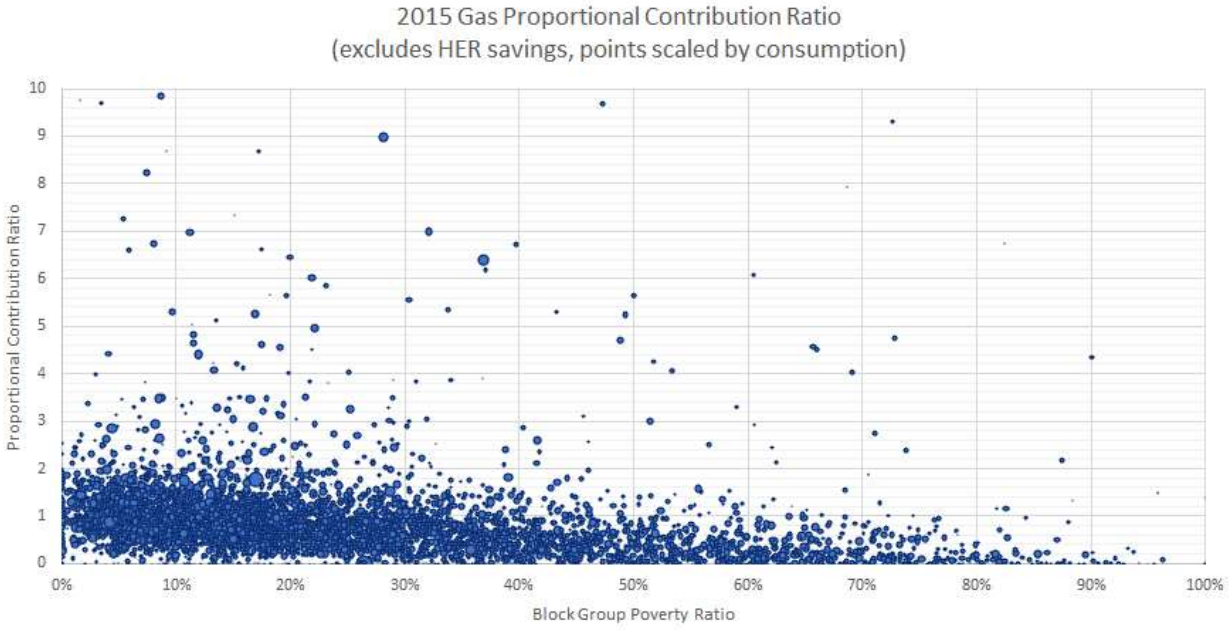


Table 7-46. Basic quintile analysis: ratio of population above 200% of poverty index– 2014 gas participation and average block group building vintage

	Unique Billing Accounts	2014 Gas MMBTU Consumption	Unique Tracking Accounts	2014 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Average Save Ratio (All)	Quintile Poverty Range
1 - Low Poverty Ratio	277,224	29,052,690	19,550	277,612	0.96%	7.05%	Zero to 8.77
2	306,264	26,679,186	16,449	236,595	0.89%	5.37%	8.77 to 16.1
3	319,713	25,454,257	15,362	235,824	0.93%	4.80%	16.1 to 25.8
4	312,053	23,391,804	11,963	220,001	0.94%	3.83%	25.8 to 42.5
5 - High Poverty Ratio	256,785	21,029,953	5,704	157,922	0.75%	2.22%	42.5 to 100
Grand Total	**1,472,039**	**125,607,891**	**69,028**	**1,127,954**	**0.90%**	**4.69%**	

Figure 7-36. Block group contribution ratio by poverty index – unique 2014 gas population

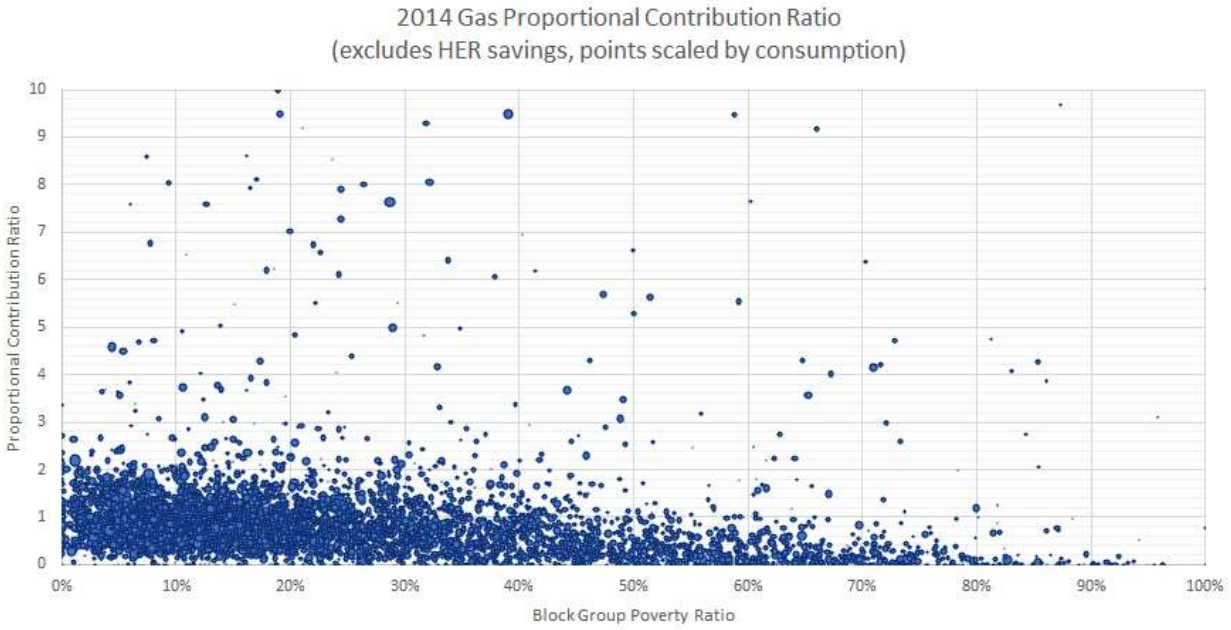


Table 7-47. Basic quintile analysis: ratio of renter occupied homes – 2015 gas participation and average block group building vintage

	Unique Billing Accounts	2015 Gas MMBTU Consumption	Unique Tracking Accounts	2015 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Participation Ratio	Quintile Ratio Range
1 - Low Renter Ratio	265,493	27,087,334	20,609	290,547	1.07%	7.76%	Zero to 10.0
2	306,181	27,114,103	18,621	256,444	0.95%	6.08%	10.0 to 24.9
3	326,364	26,080,243	15,814	227,510	0.87%	4.85%	24.9 to 44.7
4	346,375	24,704,704	11,877	216,157	0.87%	3.43%	44.7 to 66.2
5 - High Renter Ratio	287,884	20,361,112	5,669	166,978	0.82%	1.97%	66.2 to 100
Grand Total	**1,532,297**	**125,347,496**	**72,590**	**1,157,635**	**0.92%**	**4.74%**	

Figure 7-37. Block group contribution ratio by ratio of renter occupied homes – unique 2015 gas population

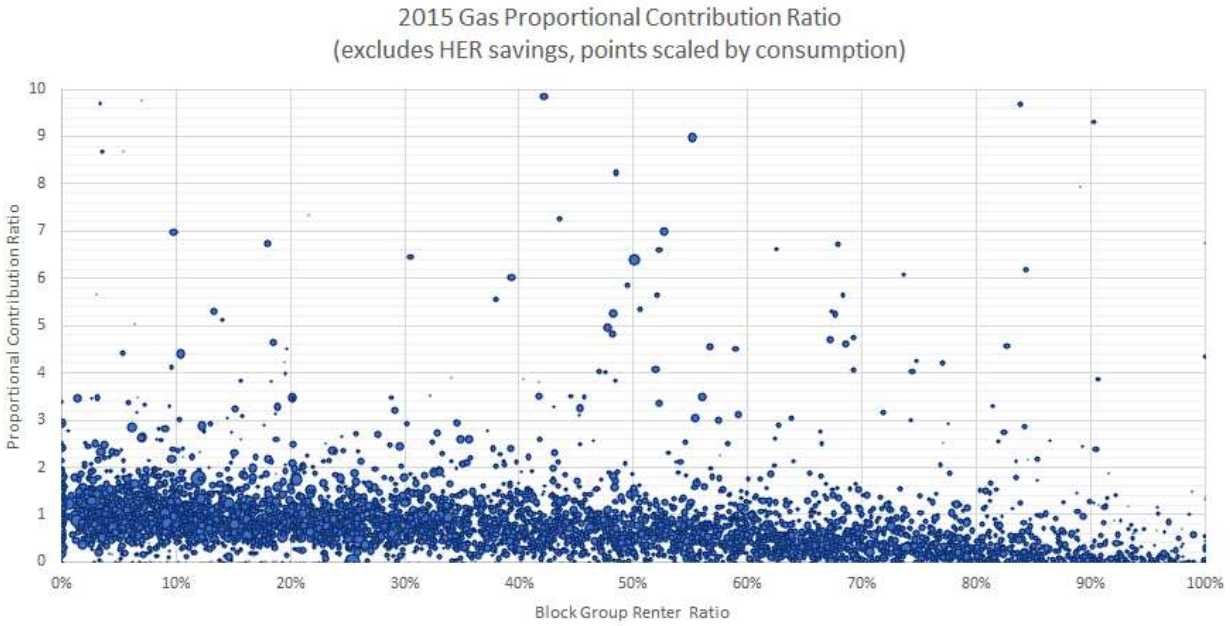
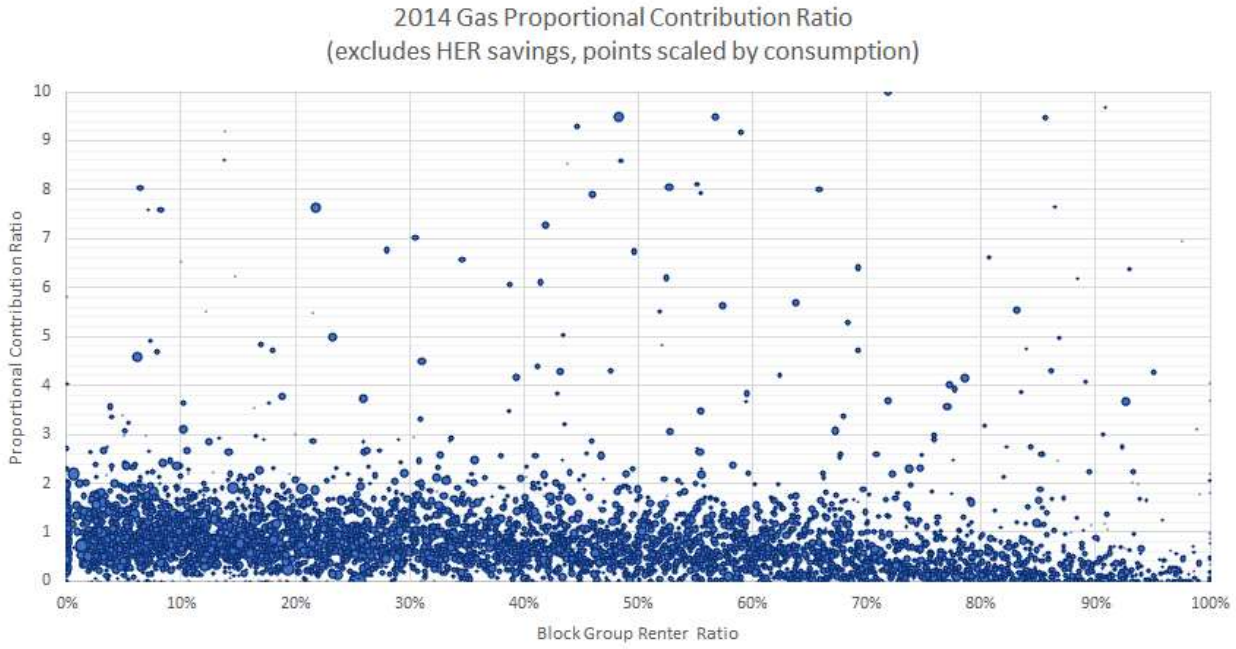


Table 7-48. Basic quintile analysis: ratio of renter occupied homes – 2014 gas participation and average block group building vintage

	Unique Billing Accounts	2014 Gas MMBTU Consumption	Unique Tracking Accounts	2014 Gas MMBTU Savings (No HER)	Quintile Population Average Save Ratio (No HER)	Quintile Population Participation Ratio	Quintile Ratio Range
1 - Low Renter Ratio	258,945	27,754,658	17,830	257,301	0.93%	6.89%	Zero to 10.0
2	298,894	27,414,418	17,201	242,721	0.89%	5.75%	10.0 to 24.9
3	314,441	26,165,760	15,235	253,931	0.97%	4.85%	24.9 to 44.7
4	331,549	24,418,458	12,618	208,863	0.86%	3.81%	44.7 to 66.2
5 - High Renter Ratio	268,210	19,854,597	6,144	165,137	0.83%	2.29%	66.2 to 100
Grand Total	**1,472,039**	**125,607,891**	**69,028**	**1,127,954**	**0.90%**	**4.69%**	

Figure 7-38. Block group contribution ratio by ratio of renter occupied homes – unique 2014 gas population



7.4 Appendix D. Geographic Analysis by individual year

This section presents the individual year's geographic analysis outputs for electric and gas. These maps can provide more granular insight into geographic changes within each year's billing and energy efficiency tracking data and facilitate deeper dives into how changes in program offerings and strategies may have influenced where energy efficiency measures were undertaken.

7.4.1 Electric Geographic analysis by year

Figure 7-39. 2015 Electric residential account participation by census block group (excluding behavioral and upstream data)

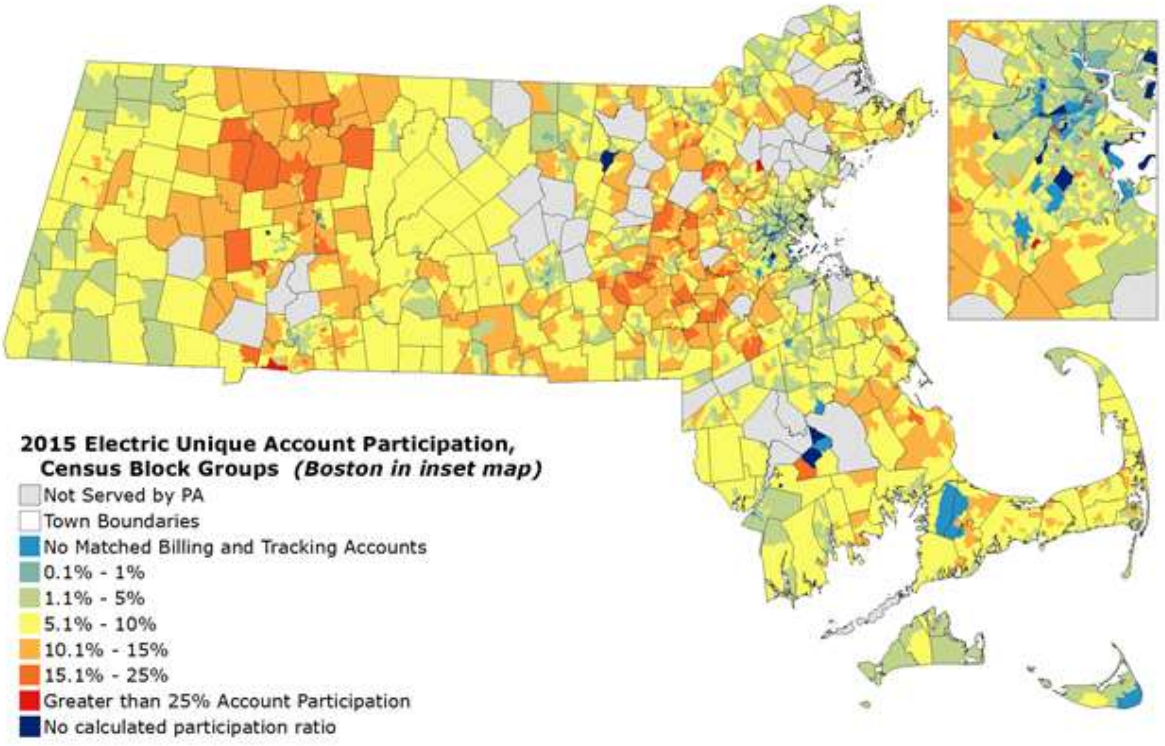


Figure 7-40. 2014 Electric residential account participation by census block group (excluding behavioral and upstream data)

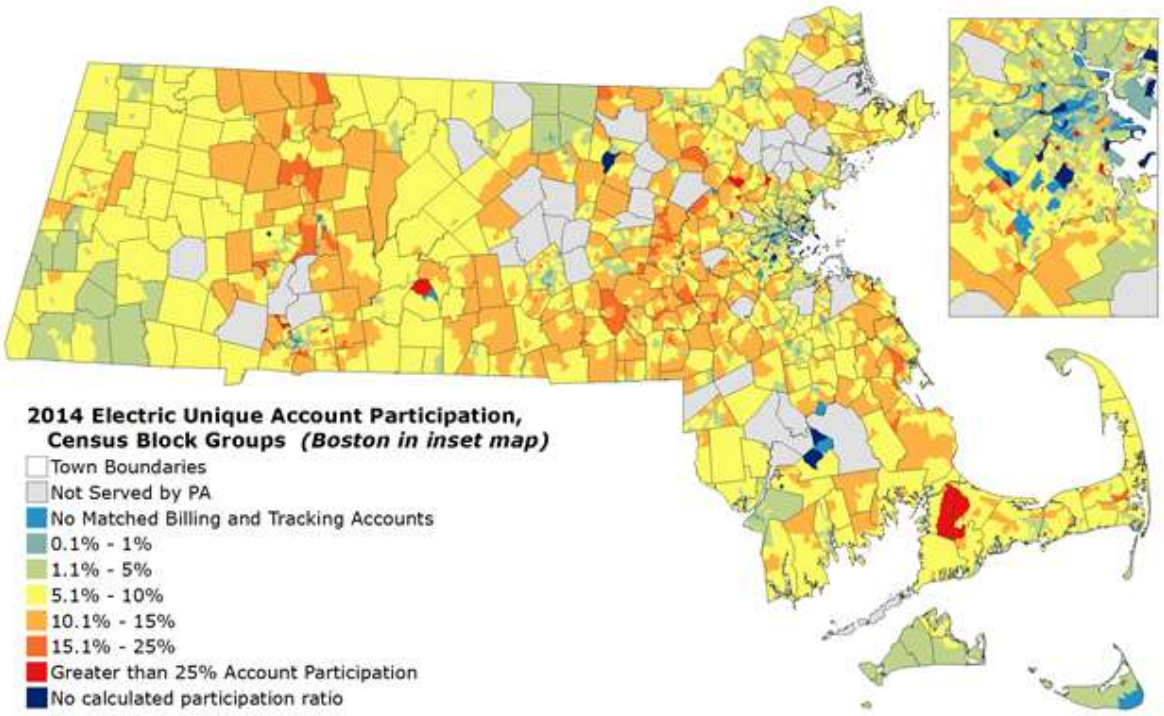


Figure 7-41. 2015 Electric residential savings ratios by census block group

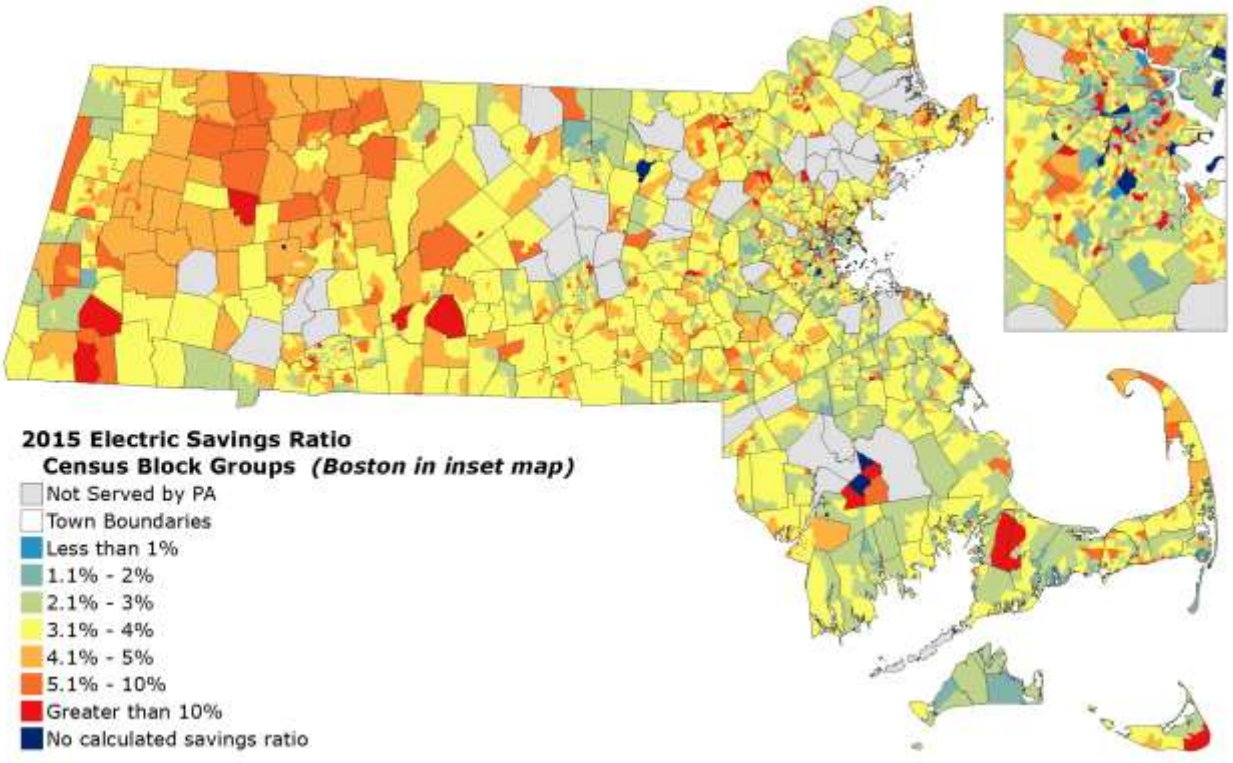


Figure 7-42. 2014 Electric residential savings ratios by census block group

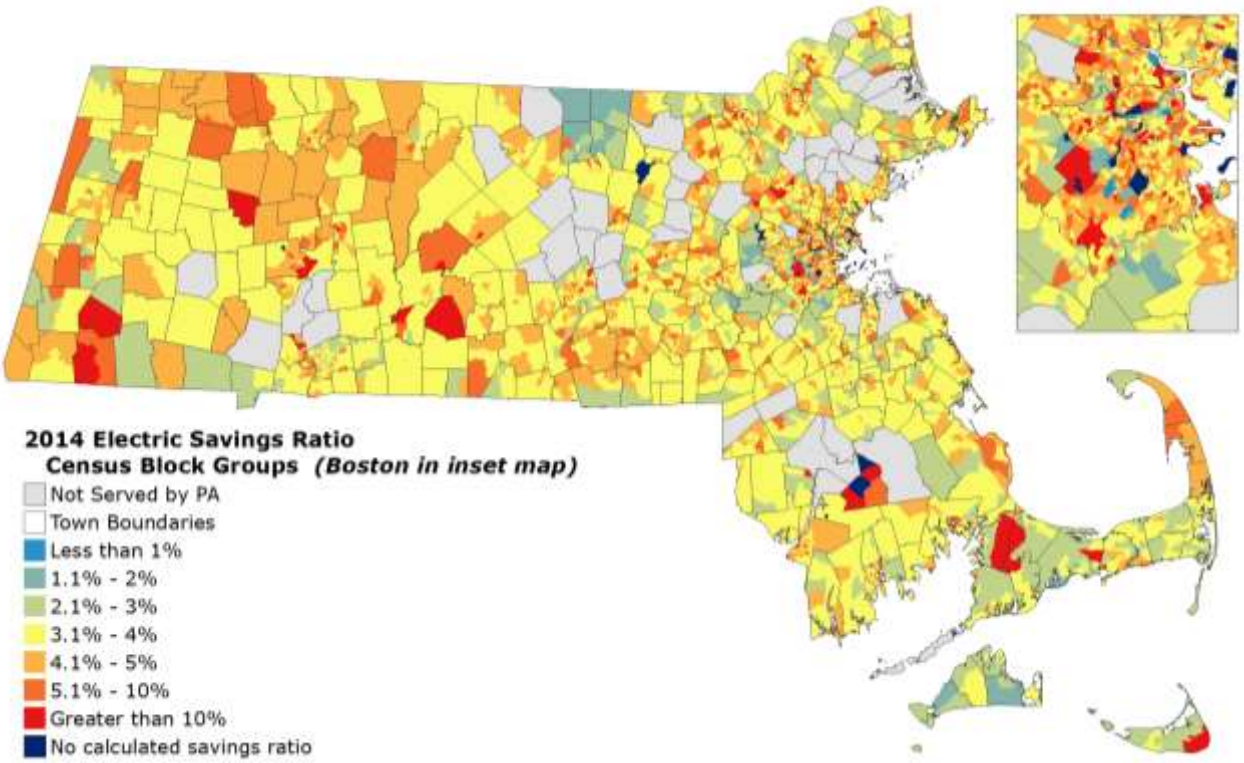


Figure 7-43. 2015 Home Energy Services residential electric account participation by census block group

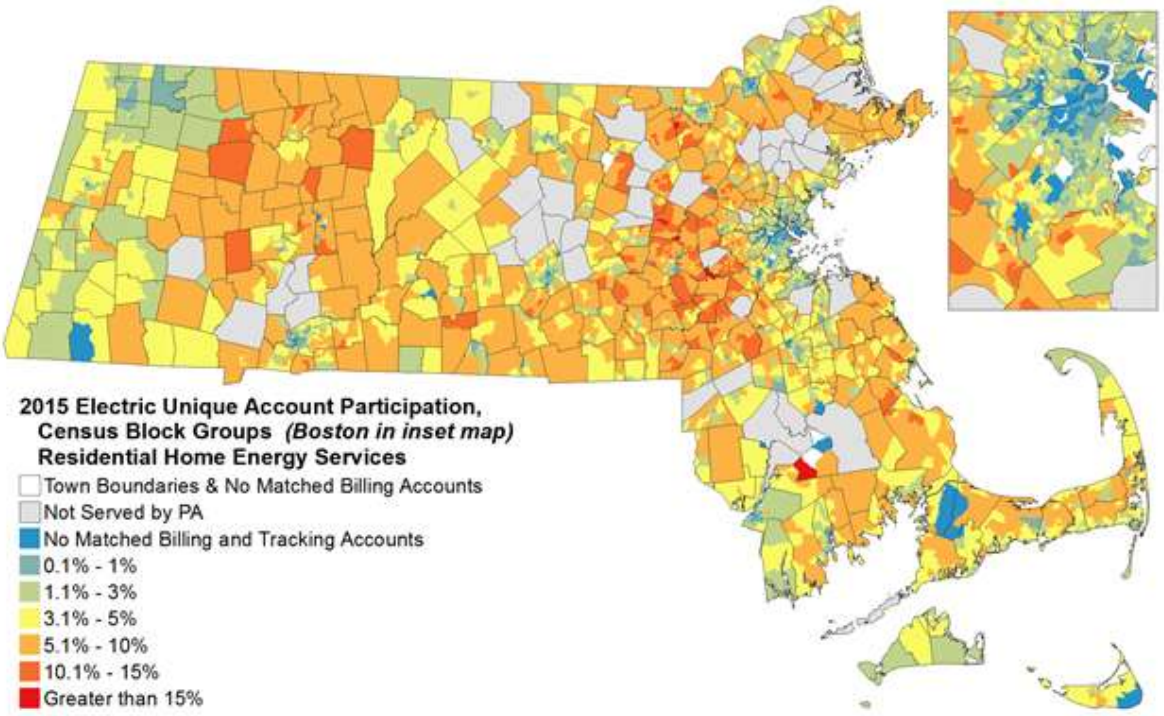


Figure 7-44. 2014 Home Energy Services residential electric account participation by census block group

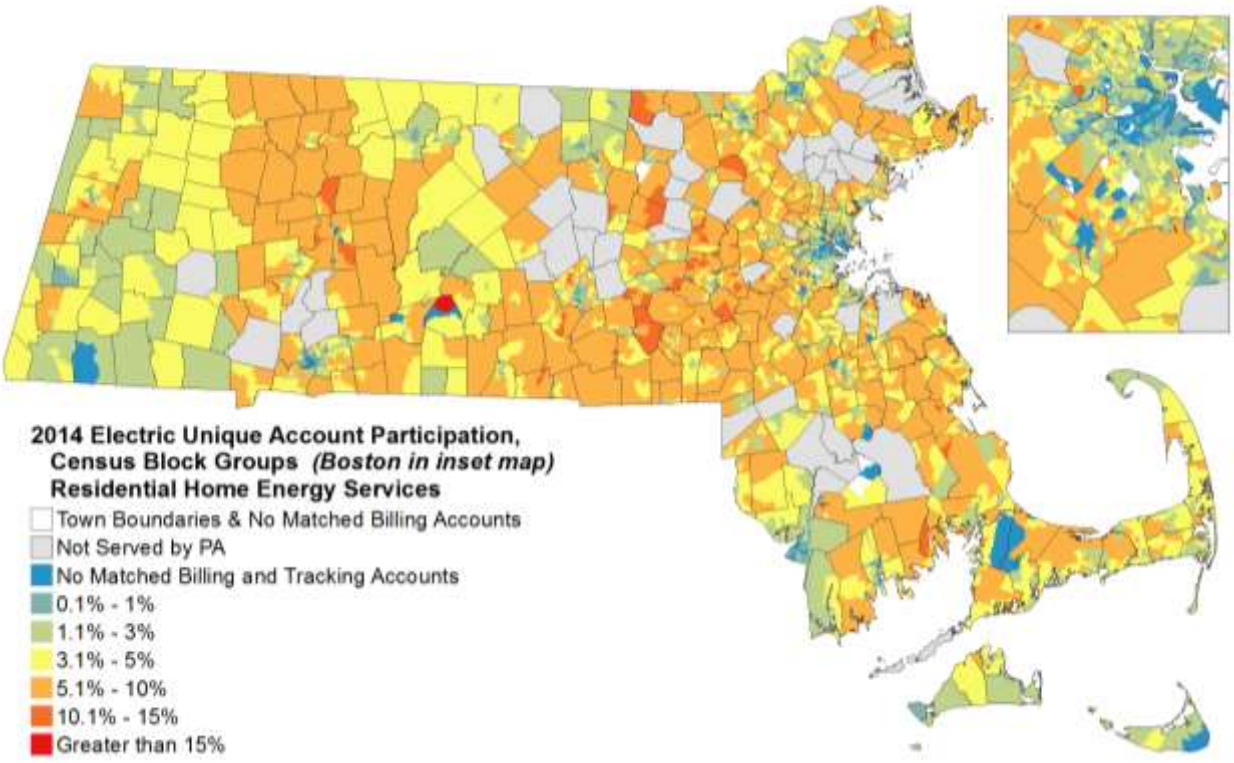


Figure 7-45. 2015 Home Energy Services residential electric savings ratio by census block group

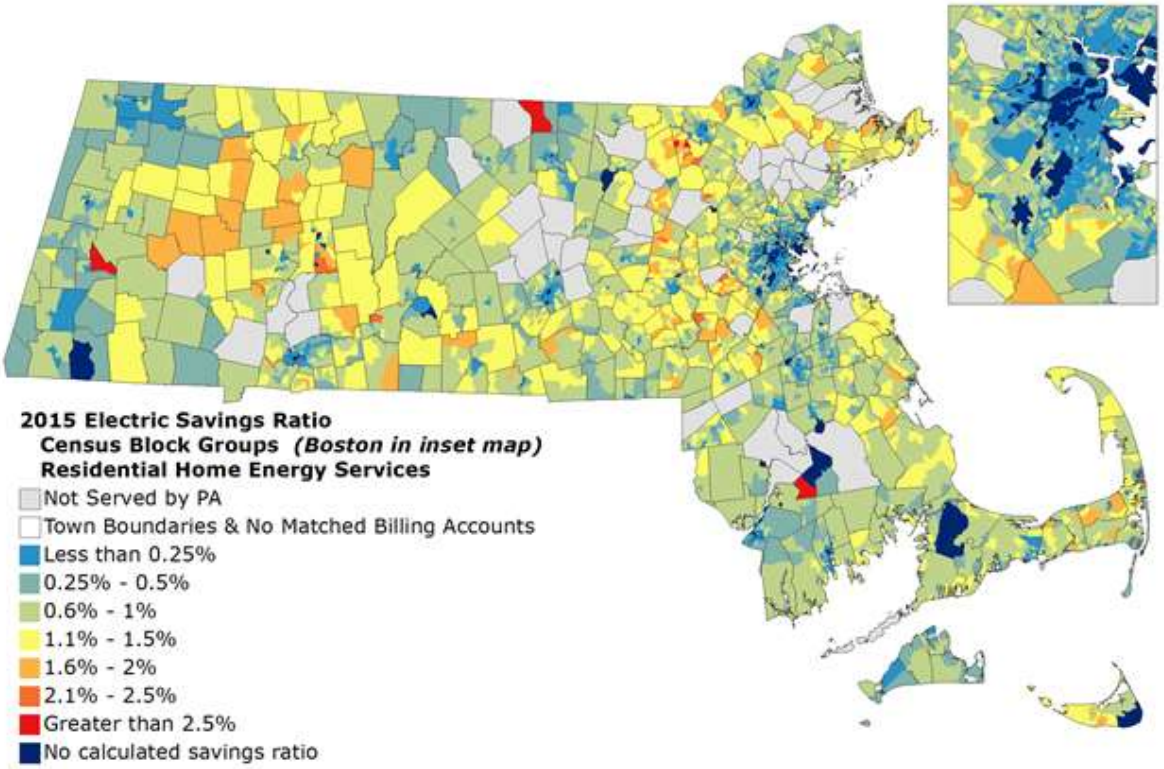


Figure 7-46. 2014 Home Energy Services residential electric savings ratio by census block group

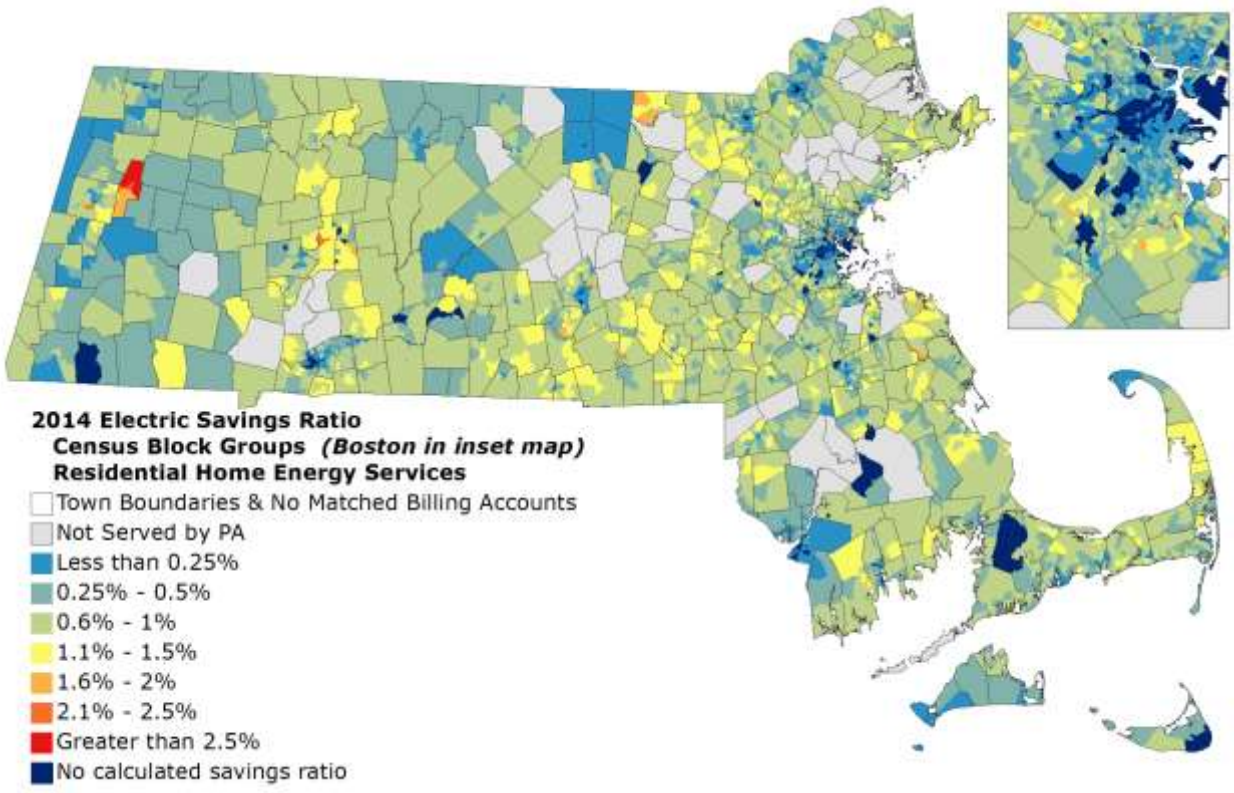


Figure 7-47. 2015 Behavioral residential electric savings ratio by census block group

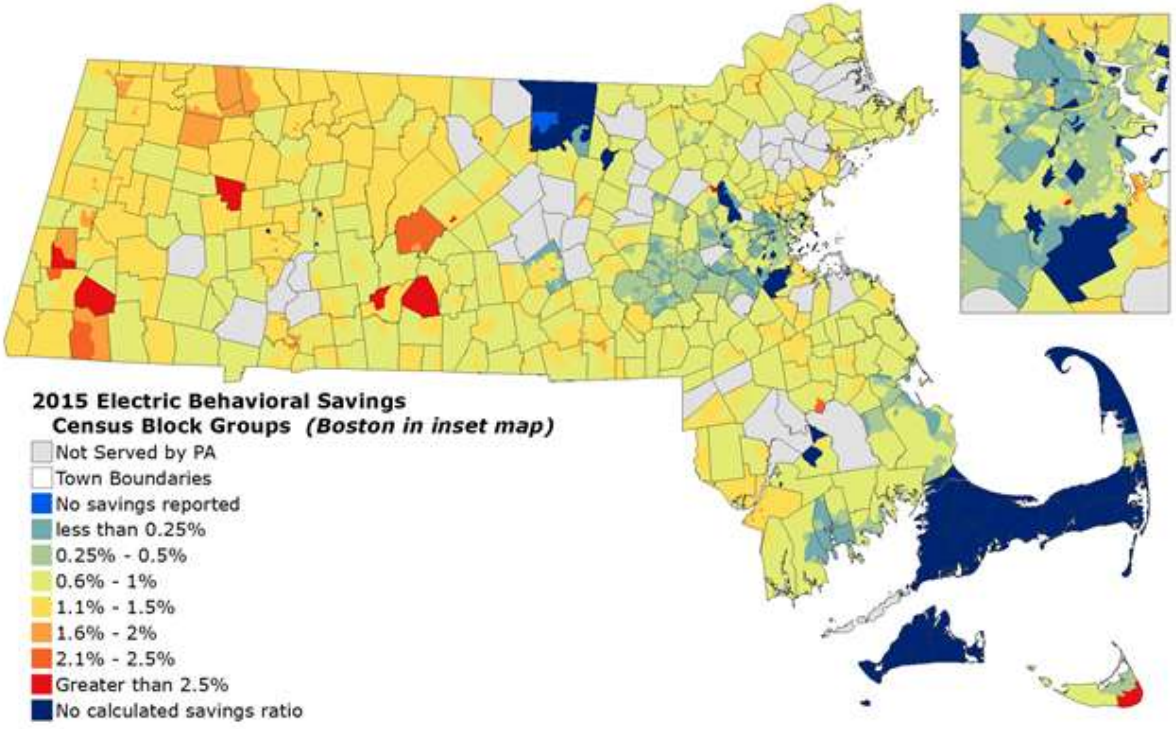
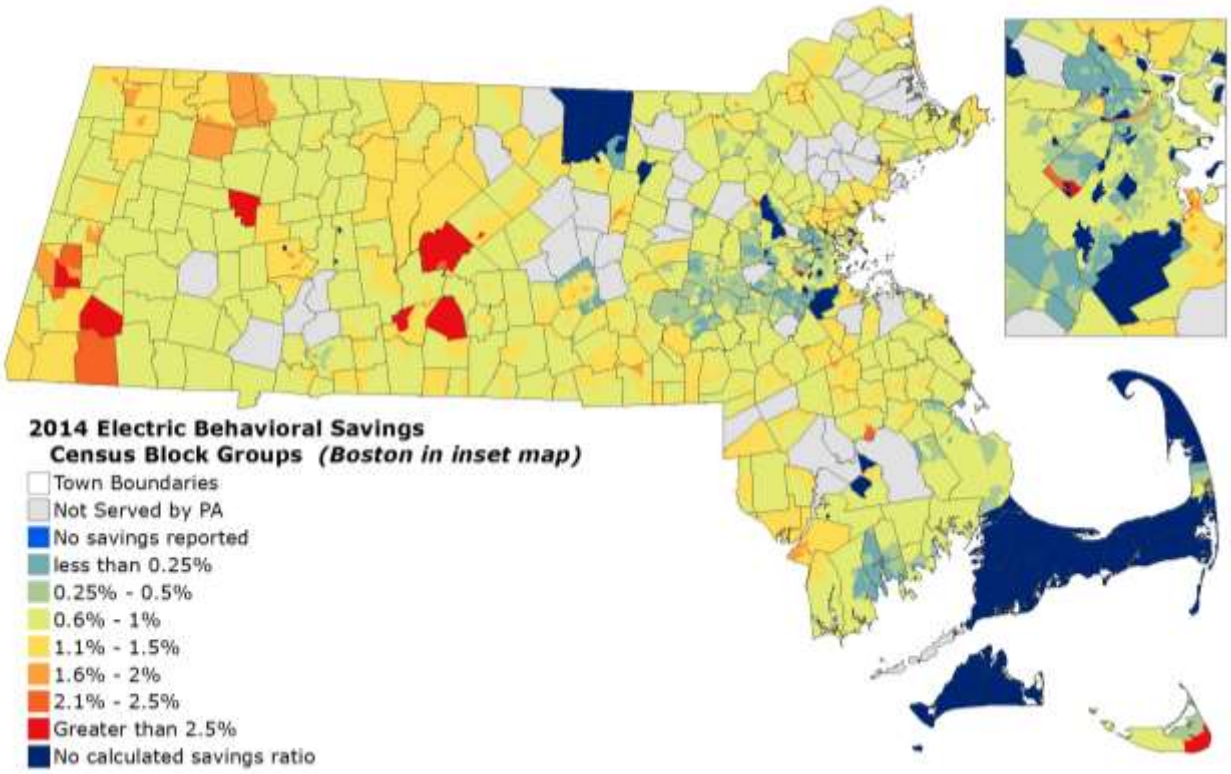


Figure 7-48. 2014 Behavioral residential electric savings ratio by census block group



7.4.2 Gas Geographic analysis by year

Figure 7-49. 2015 Gas residential account participation by census block group (excluding behavioral)

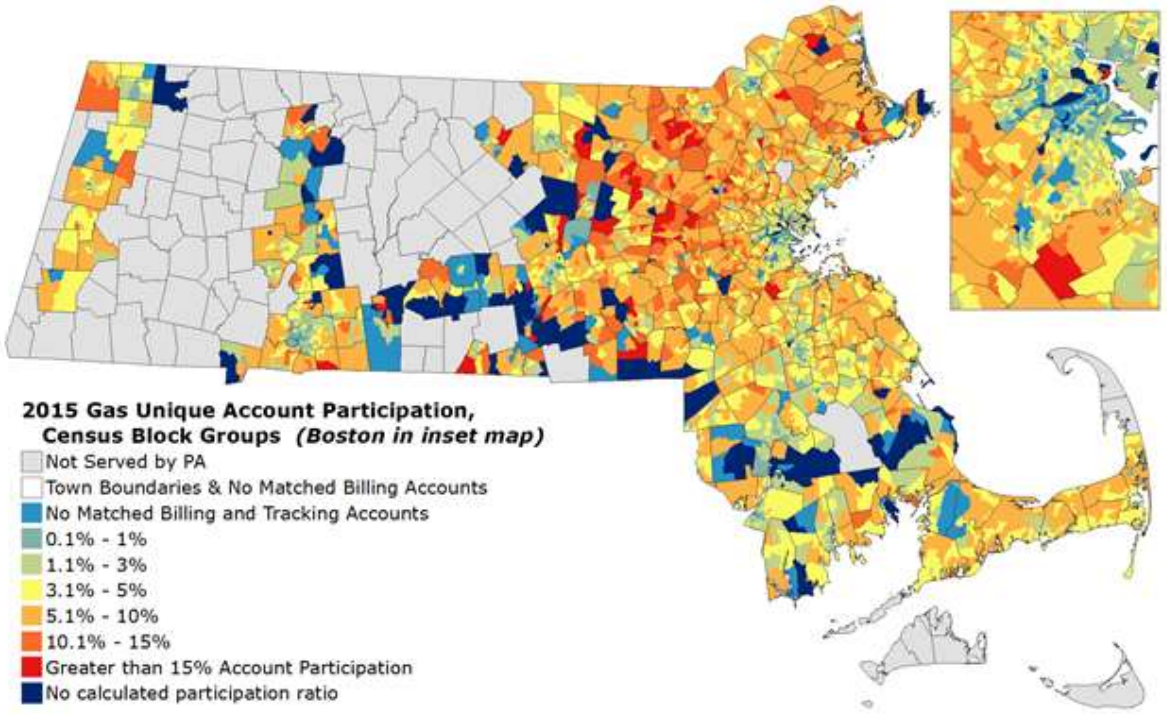


Figure 7-50. 2014 Gas residential account participation by census block group (excluding behavioral)

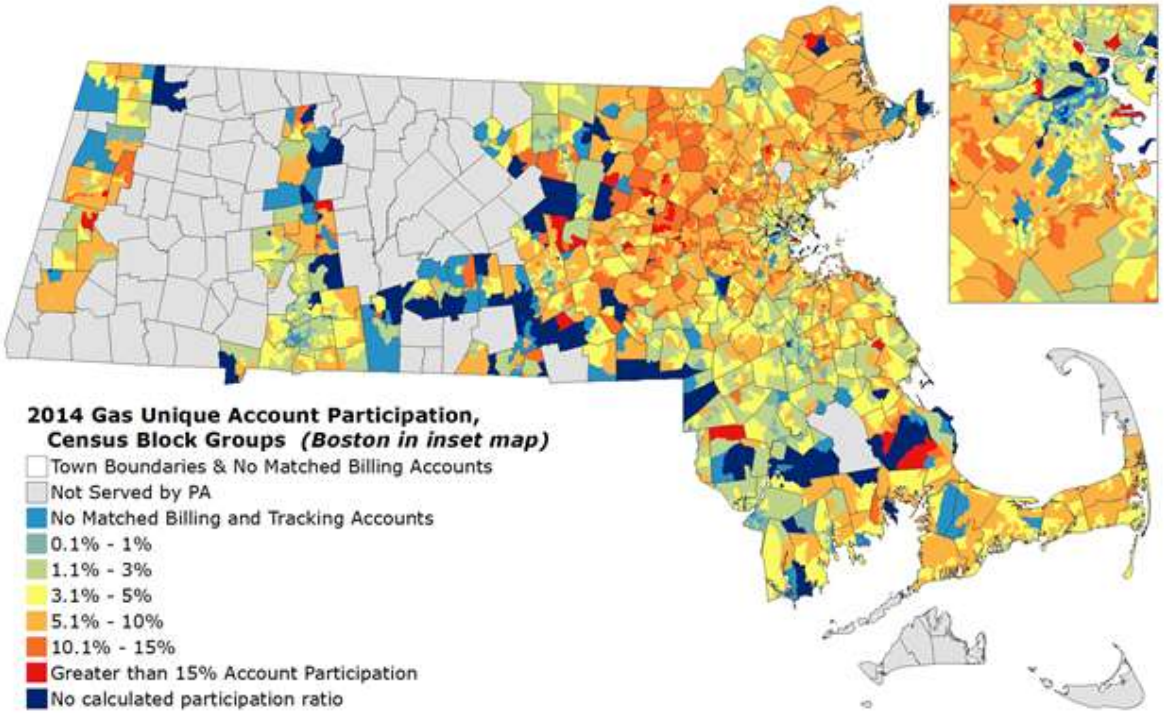


Figure 7-51. 2015 Gas residential savings ratios by census block group

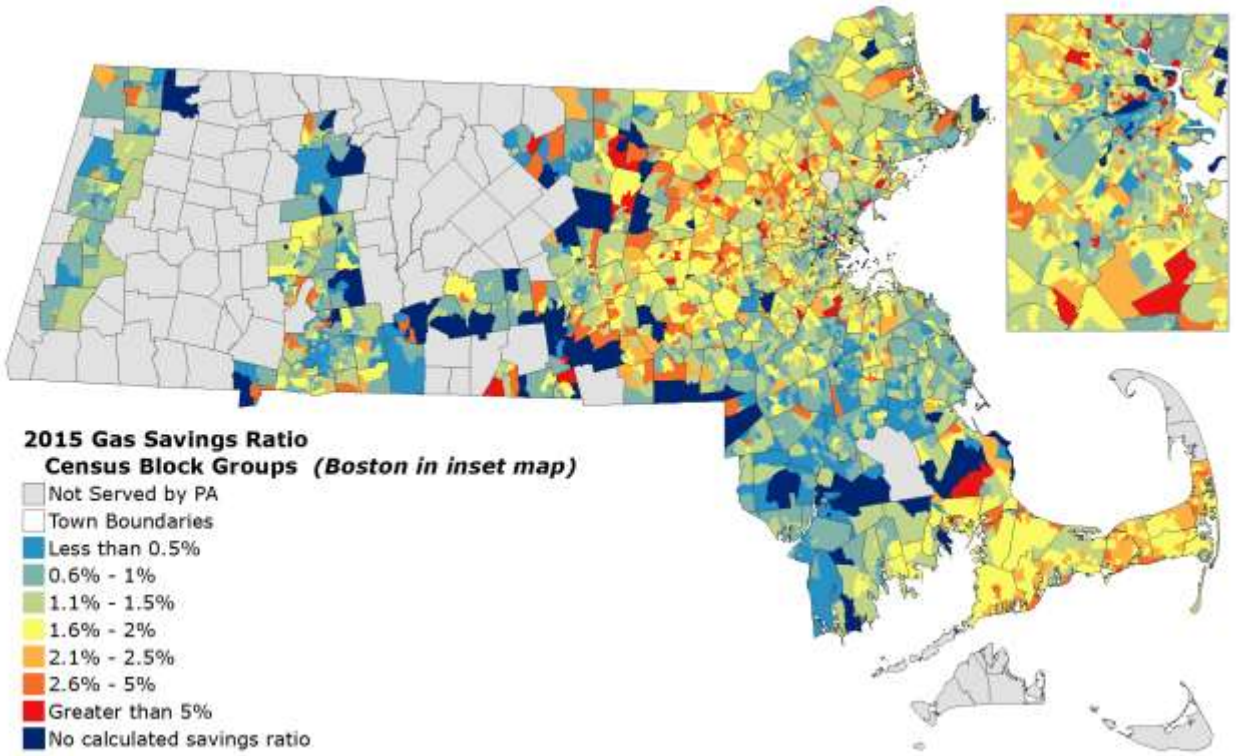


Figure 7-52. 2014 Gas residential savings ratios by census block group

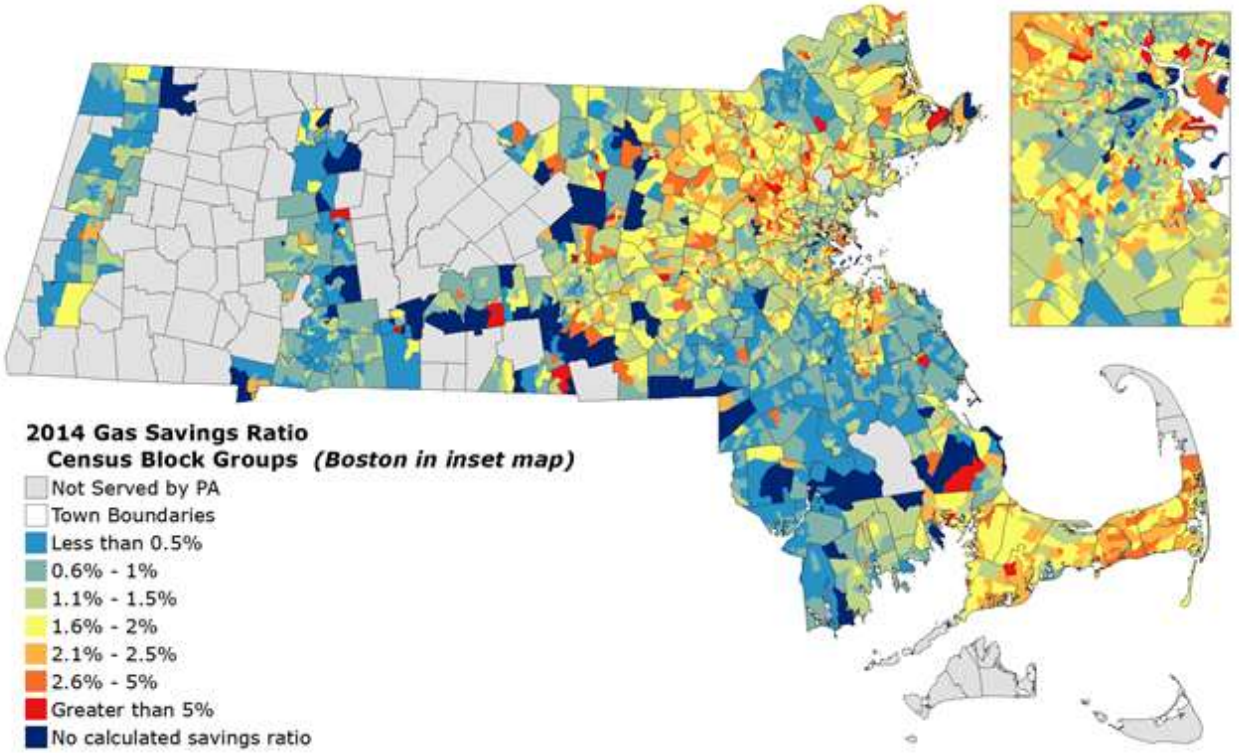


Figure 7-53. 2015 Home Energy Services residential gas account participation by census block group

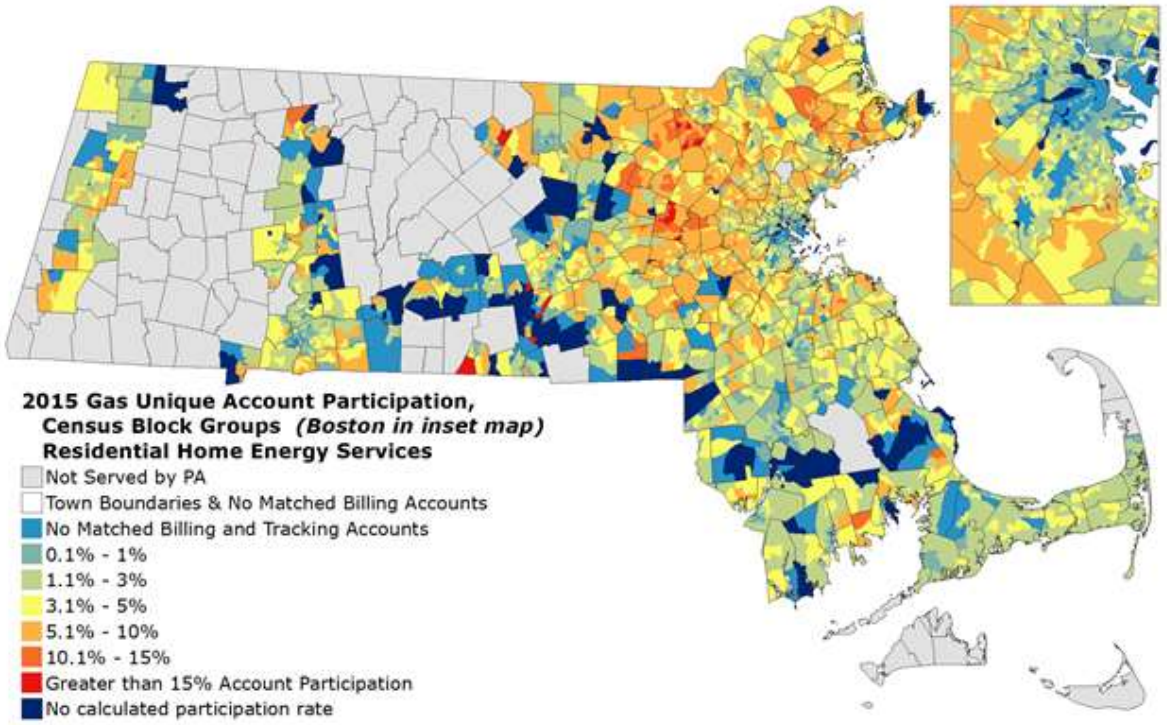


Figure 7-54. 2015 Home Energy Services residential gas account participation by census block group

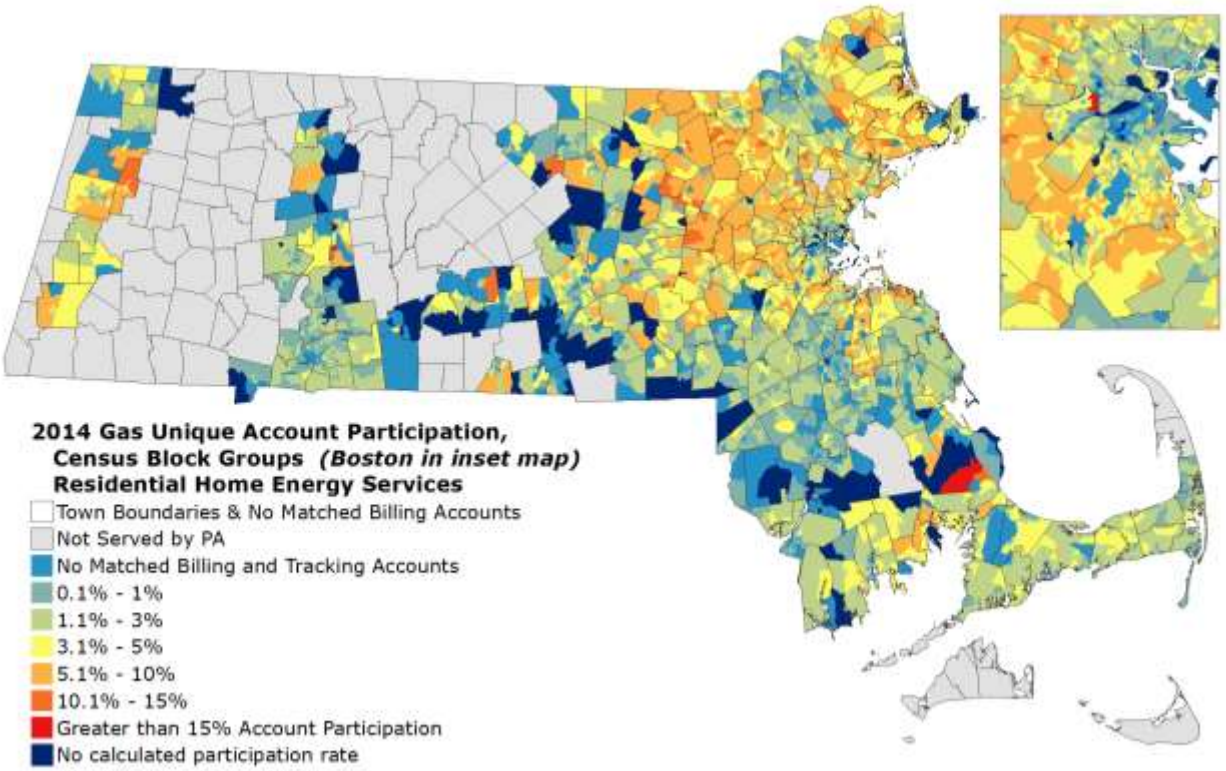


Figure 7-55. 2015 Home Energy Services residential gas savings ratios by census block group

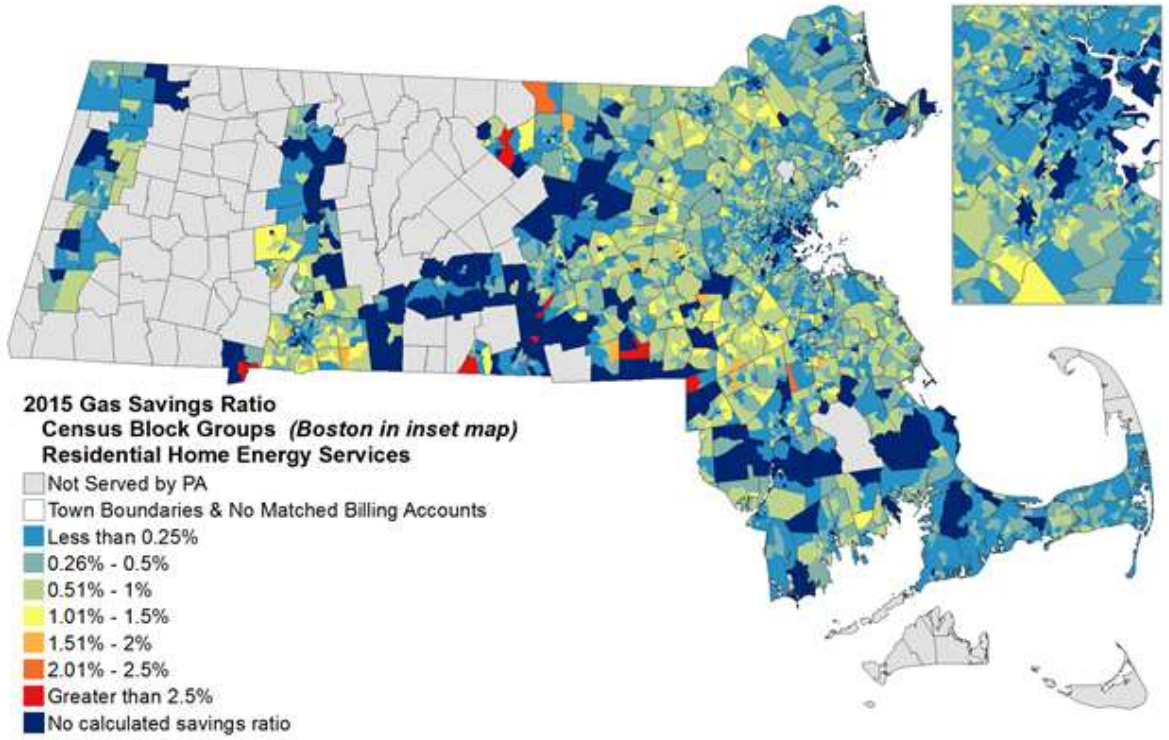


Figure 7-56. 2014 Home Energy Services residential gas savings ratios by census block group

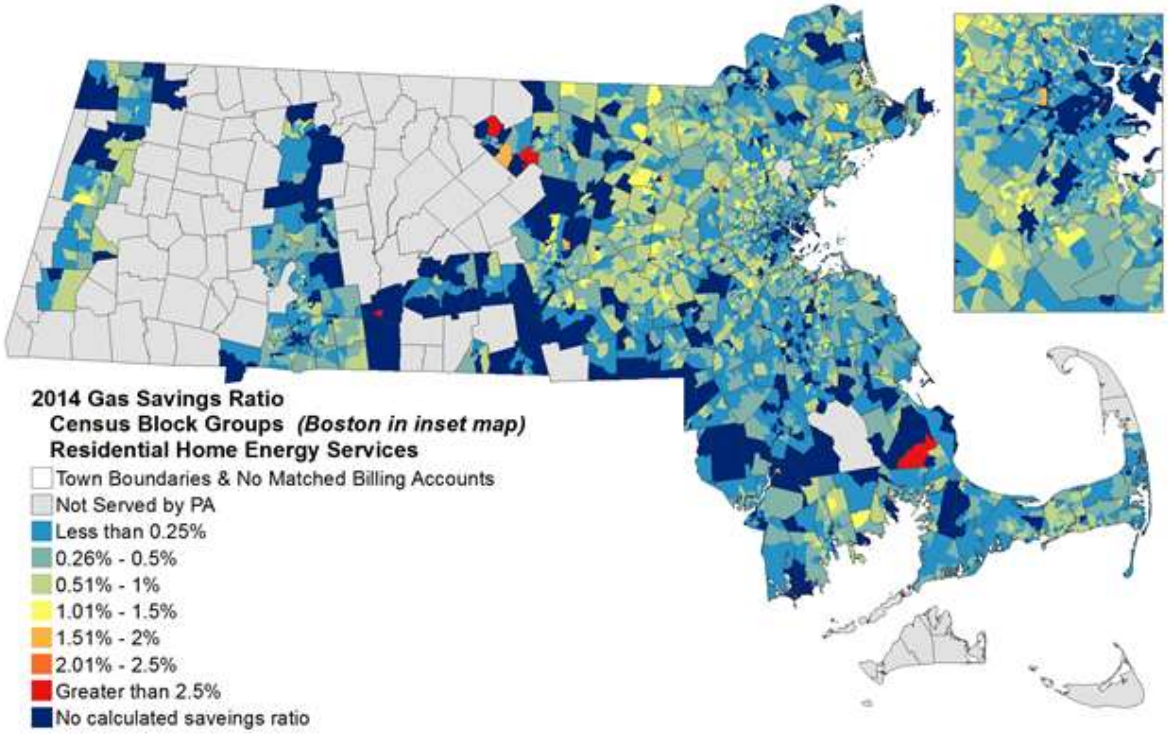


Figure 7-57. 2015 Behavioral residential gas savings ratio by census block group

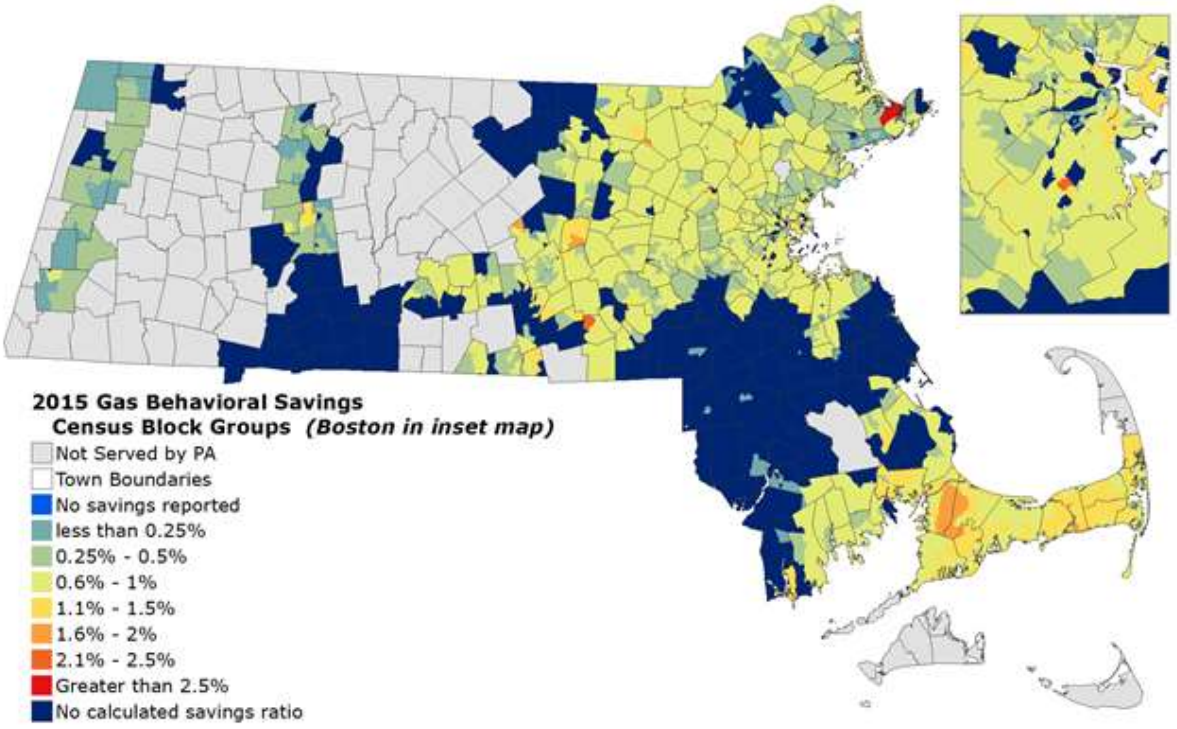
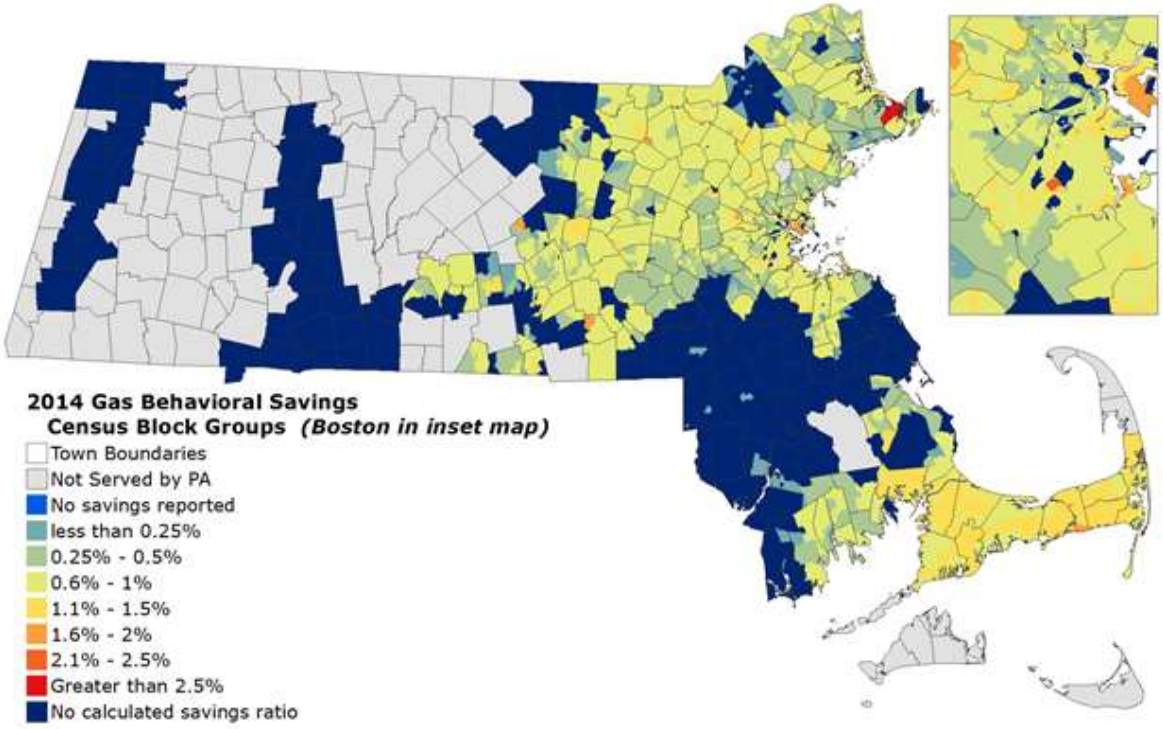



Figure 7-58. 2014 Behavioral residential gas savings ratio by census block group