Massachusetts Residential Baseline Study

2017 Saturation and Characterization Results

April 12, 2018

Prepared for:

Prepared by:

NAVIGANT

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1 Terminology and Context

1.1 Terminology

- **Data Sources:** All saturation results were derived from data for all major residential appliances collected through an online survey and trued-up using data collected through onsite validations. All characterization results presented here were derived from nameplate information collected onsite and looked up for each unit in the onsite sample.
- **Saturation vs. Characterization:** Saturation results refers to the values pertaining to the proportion and quantity of the appliances. Characterization results refers to specific qualities, such as size, age and efficiency of the equipment.
- **"Adjusted":** Saturation results were adjusted based on onsite validation results. Onsite adjustments to saturations were calculated by comparing the saturation of a given measure claimed in the surveys to the onsite results for the same sites. For example, in an onsite population of 100, 50 claimed to have widget A in the survey and the field technicians found 45 onsite. In this example, the onsite adjustment is equal to 45 divided by 50, or 0.9.
- **"Weighted":** Saturation results were weighted to represent the Massachusetts statewide population demographics. All summarized results derived from the online survey were post-weighted to ensure that they are representative of the Massachusetts population. The results were post-weighted by education level (college graduate vs. non-college graduate) and language (English speaker vs. non-English speaker). More information about the specific weights and weight choices were included in the memo and spreadsheet delivered on July 16, 2017.
- **"Proportion":** Proportion of homes in bin with end use, calculated by dividing the count of homes with the end use present by the total number of homes in the relevant bin.
- **"Average Quantity":** Average quantity of end use across homes in bin, calculated by dividing the total quantity of the end use across homes in the relevant bin by the total number of homes in the bin.

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1.2 Sample Disposition

- **Sample Disposition:** The following table shows the survey completes and onsite validation completes in each bin.

Bin Variable	Survey Completes	Onsite Sample
All Participants	6,673	300
Age		
Age 20-29	521	28
Age 30-59	3,684	170
Age 60+	2,468	102
Building Type		
Multi-family	940	47
Single Family Attached	1,721	80
Single Family Detached	4,012	173
Education Level		
College Degree	4,634	235
No College Degree	2,039	65
Heating Fuel		
Electric Heat	444	28
Gas Heat	2,773	154
Gas Plus Electric	463	22
Oil Heat	1,052	53
Oil Plus Electric	215	15
Other Heat	128	3
Other Plus Electric	30	1
Shared Heat	959	18
Shared Plus Electric	66	2
Income		
Low Income	1,070	75
Not Low Income	5,603	225
Language		
English Is Primary Language	6,147	253
English Not Primary Language	526	47
Occupancy Type		
Owner	5,183	227
Renter	1,490	73
Program Participation		
Non-participant	4,263	229
Participant	2,410	71

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1.3 Comparison to the 2009 Massachusetts Residential Appliance Saturation Survey (RASS)

- The following is a comparison of the proportion of homes that have key end uses between the 2009 Massachusetts Residential Appliance Saturation Survey (RASS) and the 2017 Baseline Study. Results are presented across all homes as well as for single-family detached homes. There are a few key differences between the two studies that make comparison difficult. First, the 2017 study was post-weighted by education level and primary language spoken to correct for the demographics of the survey respondents not being representative of the statewide population, while the 2009 RASS does not mention weighting. Second, the 2017 Baseline Study adjusted the results for all end uses based on onsite verification work, while the 2009 RASS only adjusted results for certain end uses. Finally, the definitions of the different end uses were not always consistent between the two studies. However, despite these differences in methodology this comparison may still be indicative of high-level trends, though caution should be used in interpreting the results.

End Use	All Homes		Single Family Detached		Notes
	2009 RASS Saturation	2017 Baseline Study Saturation	2009 RASS Saturation	2017 Baseline Study Saturation	
HVAC - Heating					
Any Space Heating System	99%	97%	99%	99%	
Natural Gas Heat	53%	64%	47%	61%	
Oil Heat	36%	24%	44%	31%	
Electric Heat	8%	9%	4%	5%	
HVAC - Cooling					
Any Space Cooling System	81%	83%	81%	79%	
Central Cooling System	29%	35%	30%	40%	Includes central AC/HP and ductless mini-split AC/HP
Room or Window Air Conditioner	64%	48%	60%	47%	
Domestic Hot Water					
Any DHW System	98%	100%	97%	100%	
Natural Gas DHW	57%	37%	55%	42%	Includes tank-type and tankless water heaters
Oil DHW	24%	3%	30%	5%	Includes tank-type and tankless water heaters
Electric DHW	16%	16%	14%	18%	Assuming the RASS numbers include electric resistance and heat pump DHW
Laundry					
Clothes Washer (Private Use)	86%	72%	94%	90%	
Clothes Dryer (Private Use)	83%	73%	93%	92%	Includes electric, natural gas, and propane clothes dryers
Kitchen Appliances					
Microwave	95%	92%	97%	94%	
Dishwasher	71%	69%	77%	78%	
Primary Refrigerator	100%	99%	100%	100%	
Freezer	13%	20%	17%	24%	
Secondary Refrigerator	28%	36%	35%	45%	2017 Baseline Study numbers include mini-fridges and wine coolers (31% of total)
Miscellaneous					
Dehumidifier	50%	34%	65%	48%	
Pond/well/pool pump	23%	12%	32%	20%	2017 Baseline Study numbers do not include pond pumps (data not collected)

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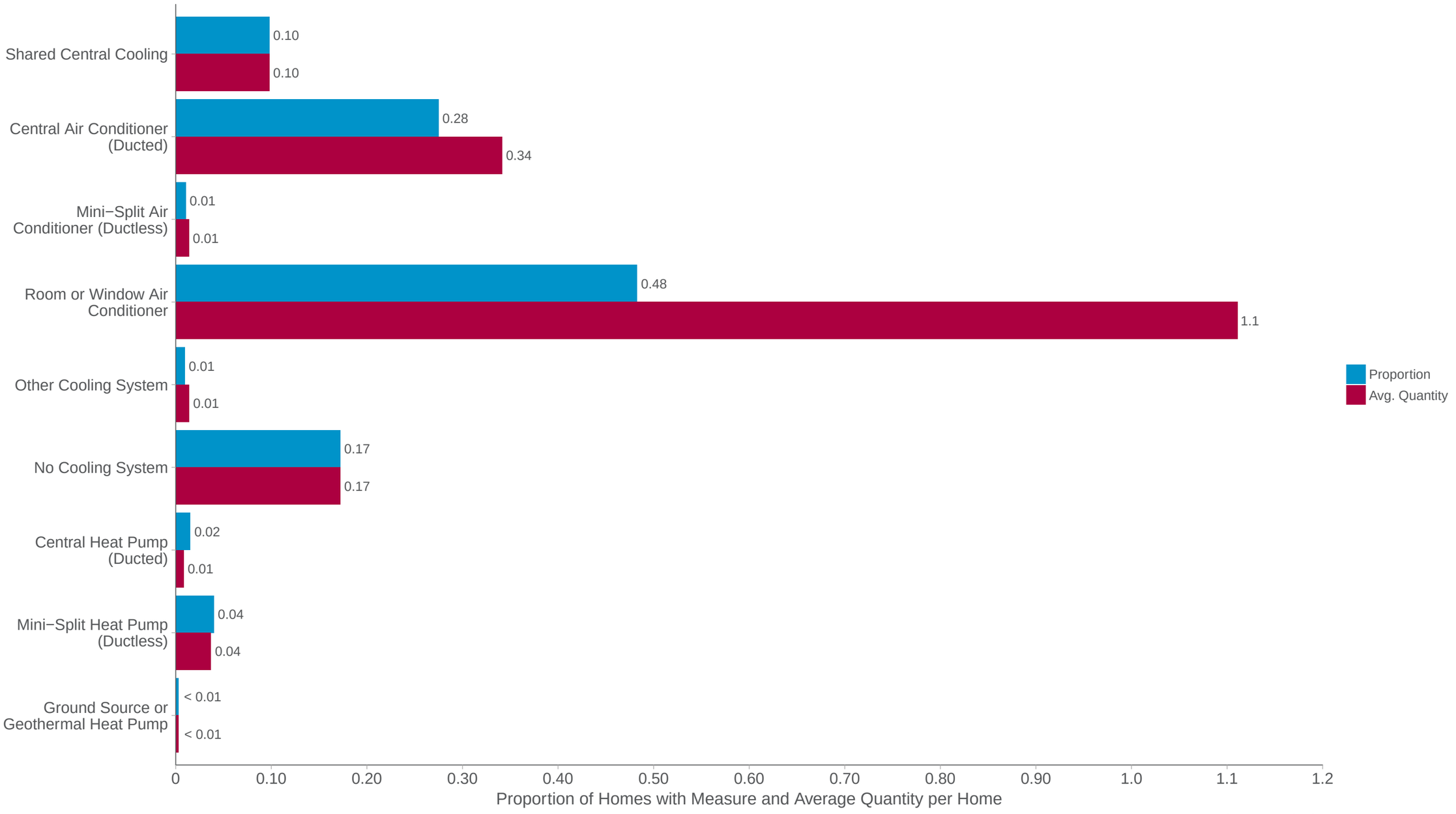
2 HVAC - Cooling

2.1 Adjusted and Weighted Proportion and Average Quantity of Cooling Systems



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

Note: Because some homes have multiple HVAC systems, totals may add up to more than 1.0.

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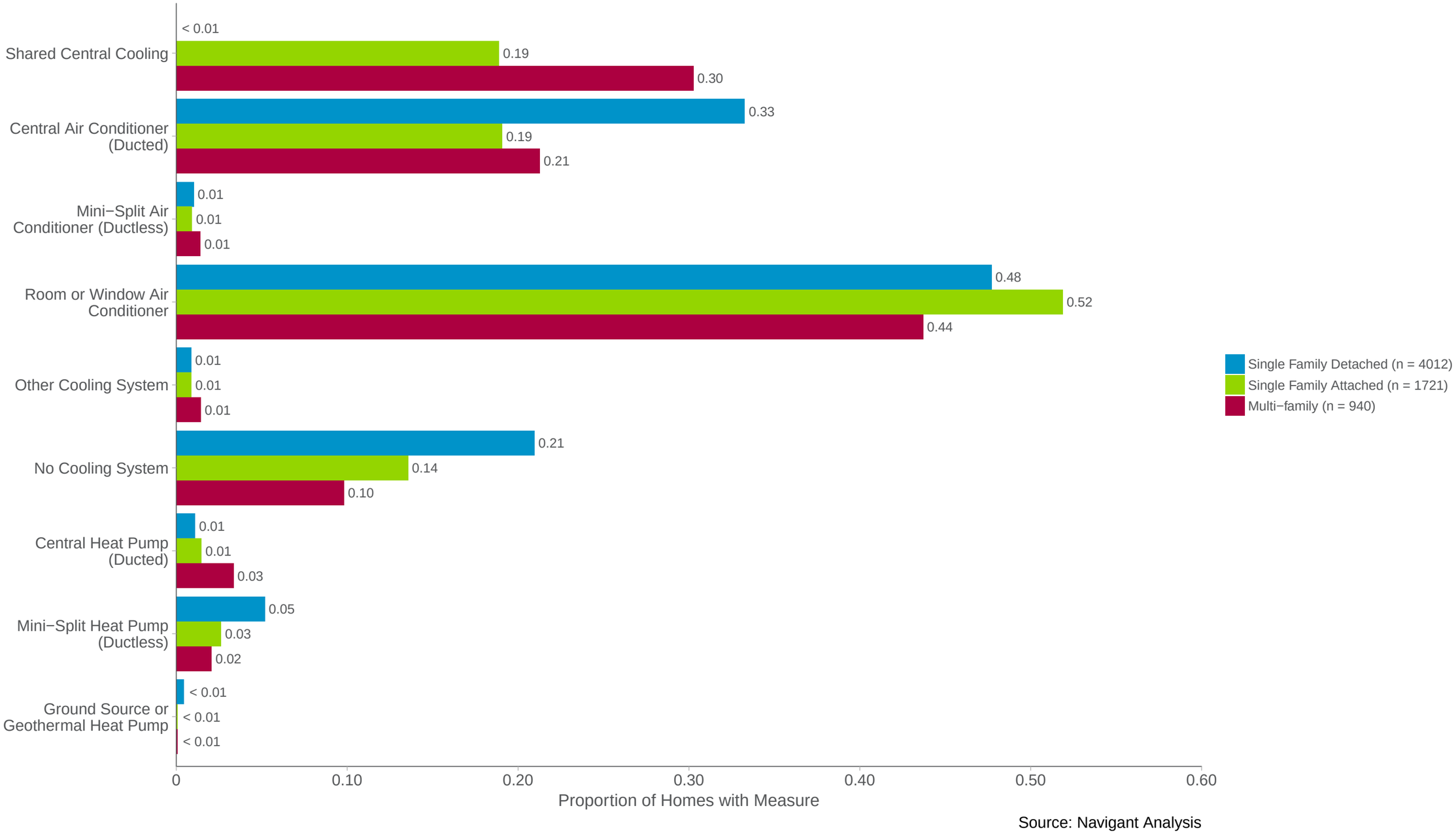
2.2 Adjusted and Weighted Proportion of Cooling Systems by Building Type



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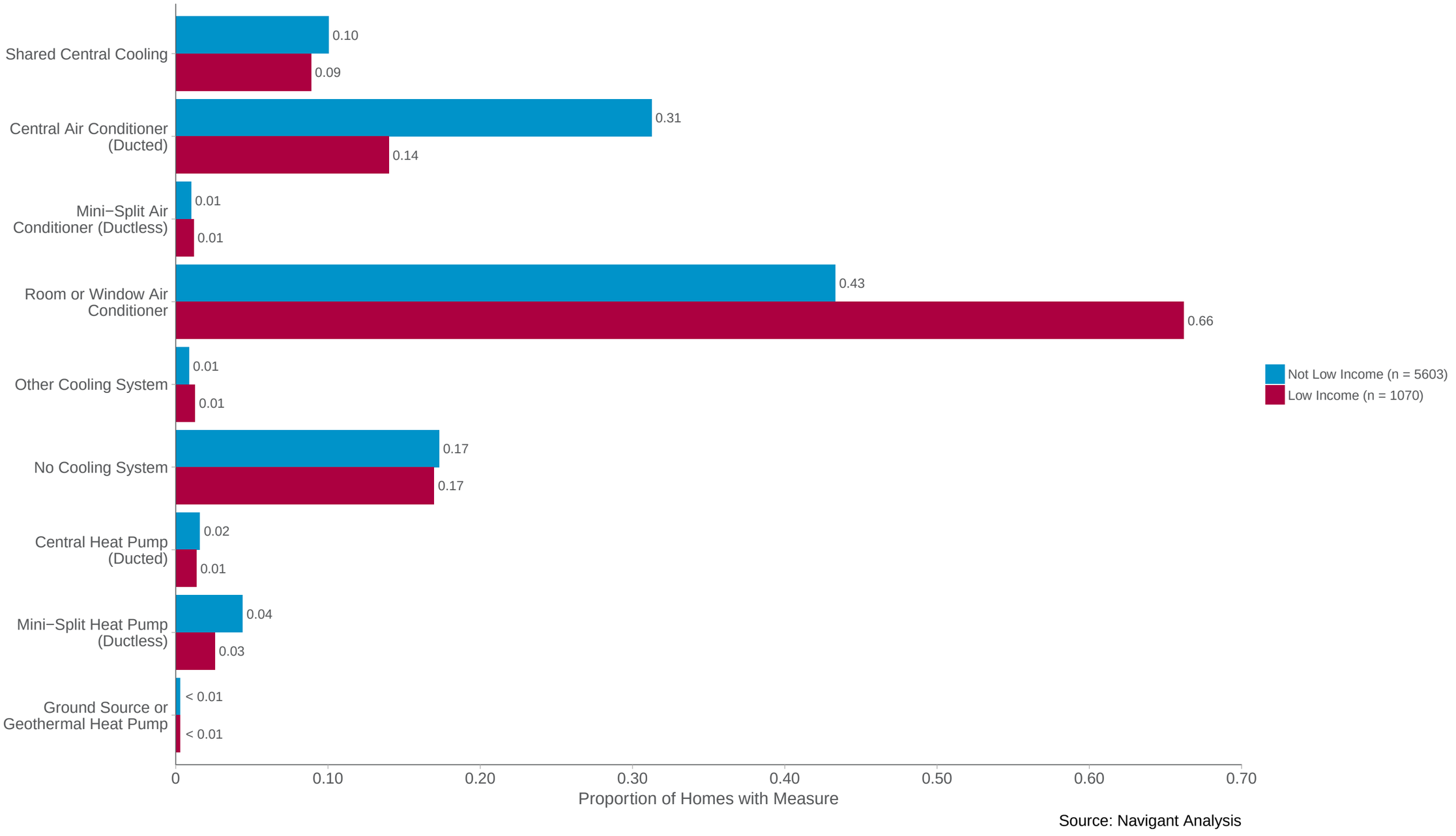
2.3 Adjusted and Weighted Proportion of Cooling Systems by Income



Source: Navigant Analysis

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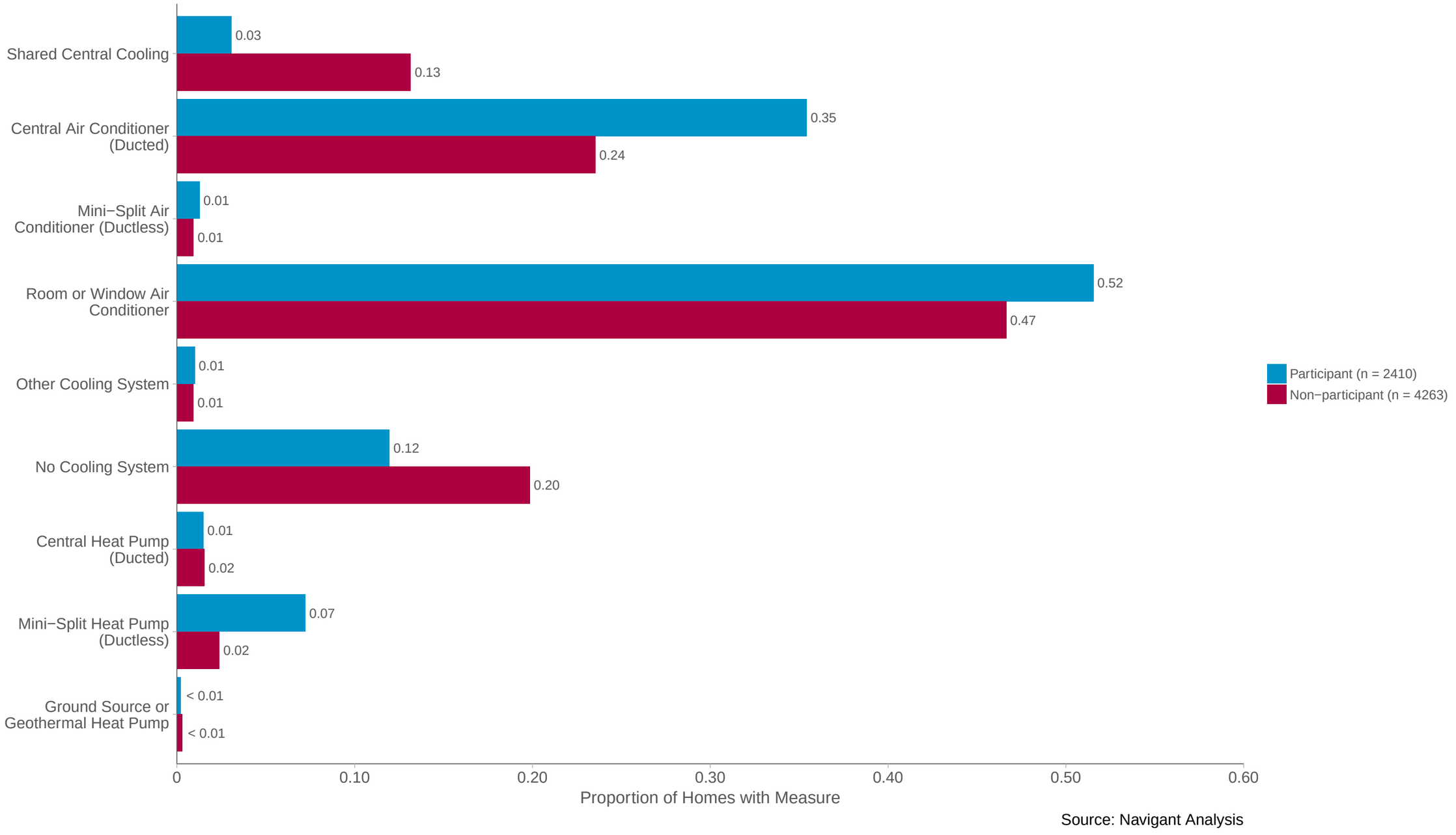
2.4 Adjusted and Weighted Proportion of Cooling Systems by Participation



Source: Navigant Analysis

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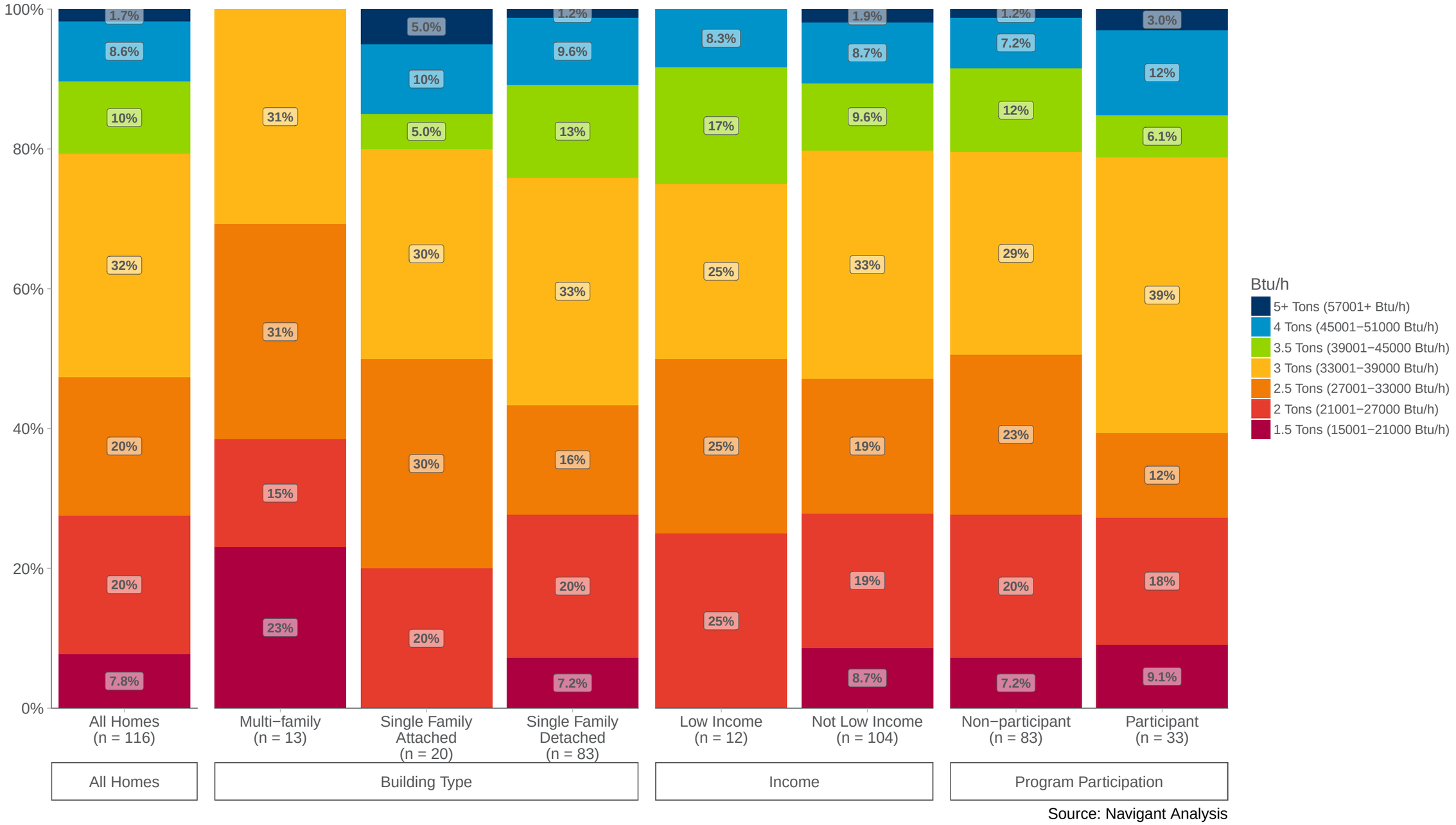
2.5 Central Air Conditioner Cooling Capacity by Various Demographics



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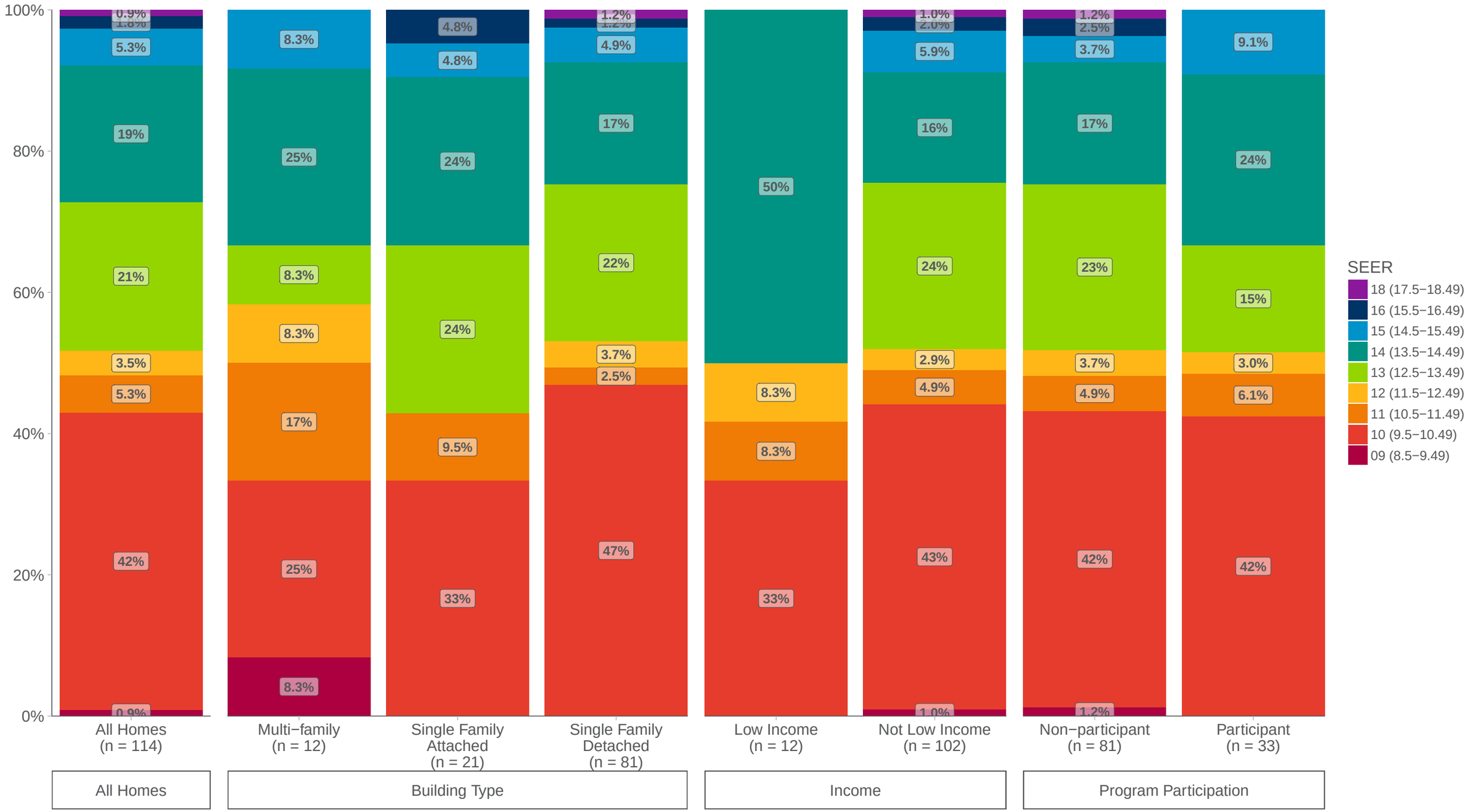
2.6 Central Air Conditioner SEER by Various Demographics



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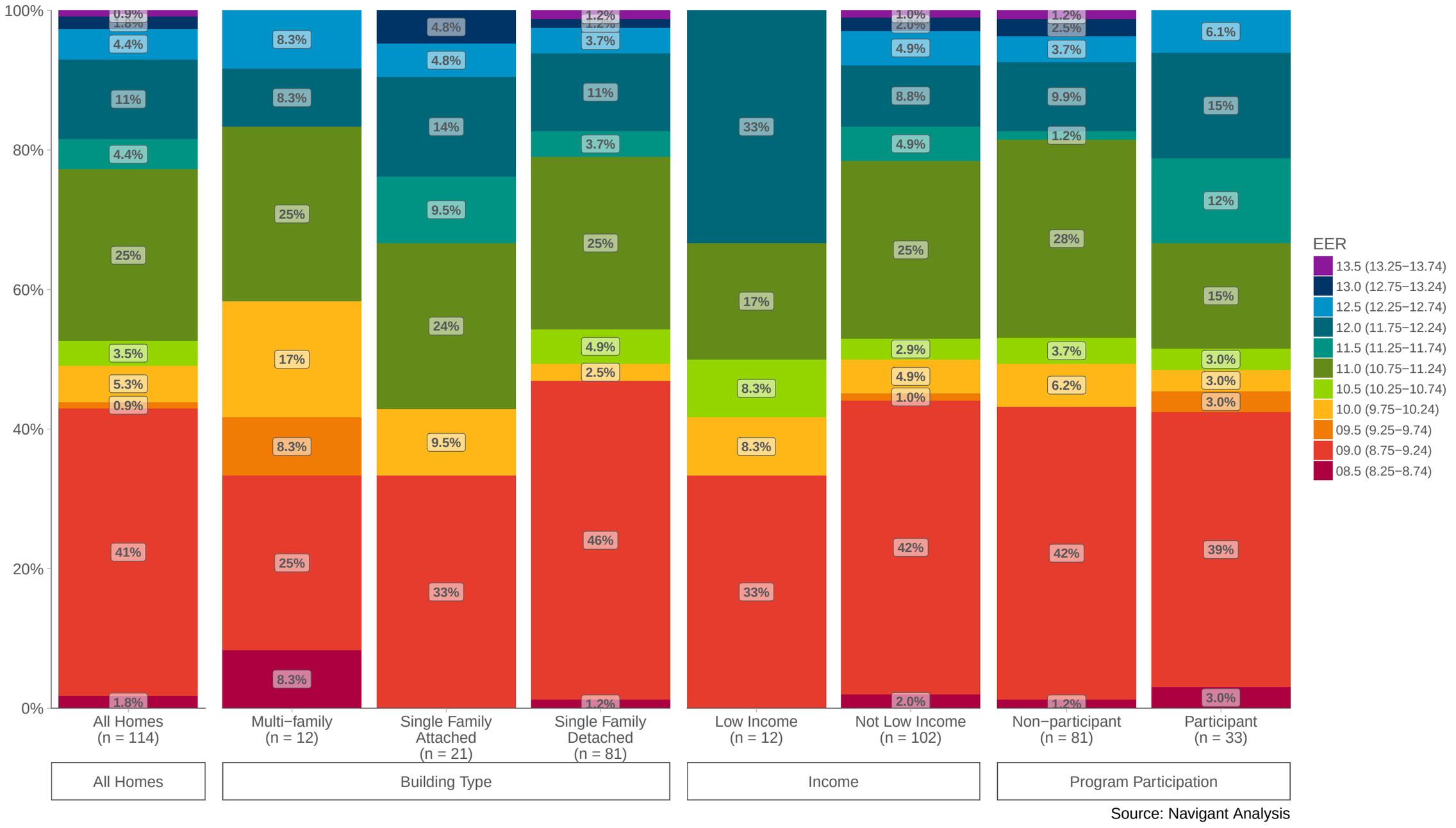
2.7 Central Air Conditioner EER by Various Demographics



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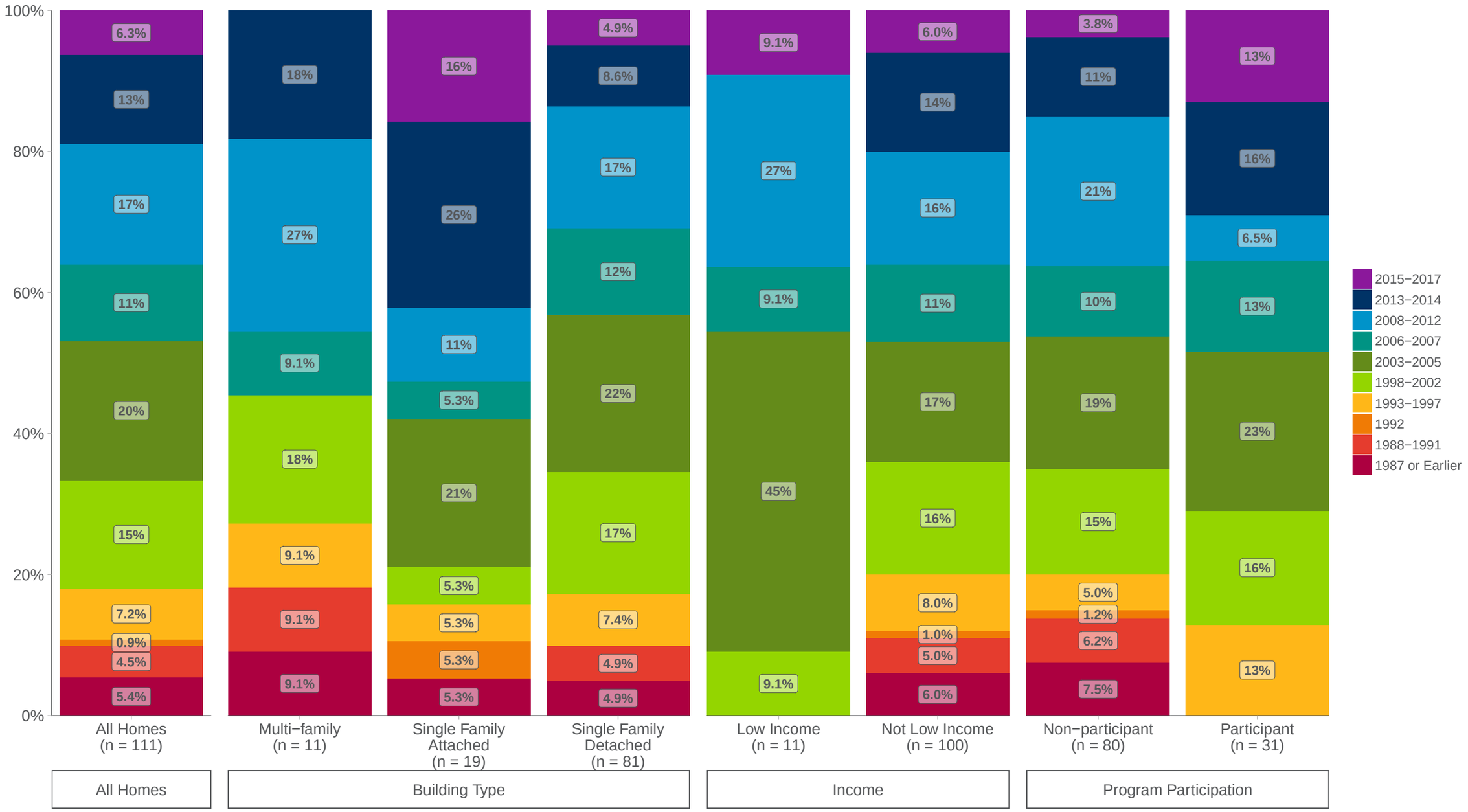
2.8 Central Air Conditioner Year of Manufacture by Various Demographics



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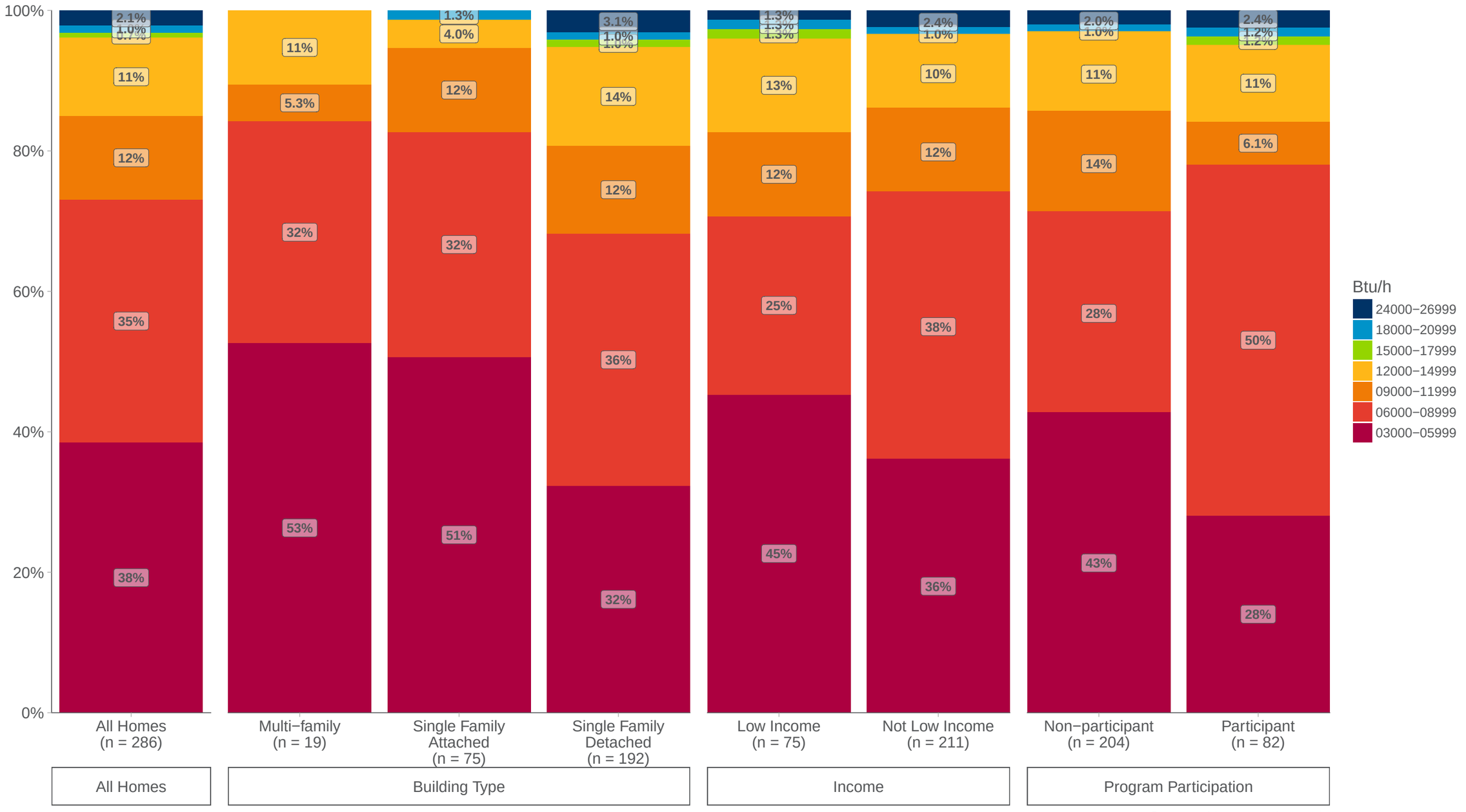
2.9 Room or Window Air Conditioner Cooling Capacity by Various Demographics



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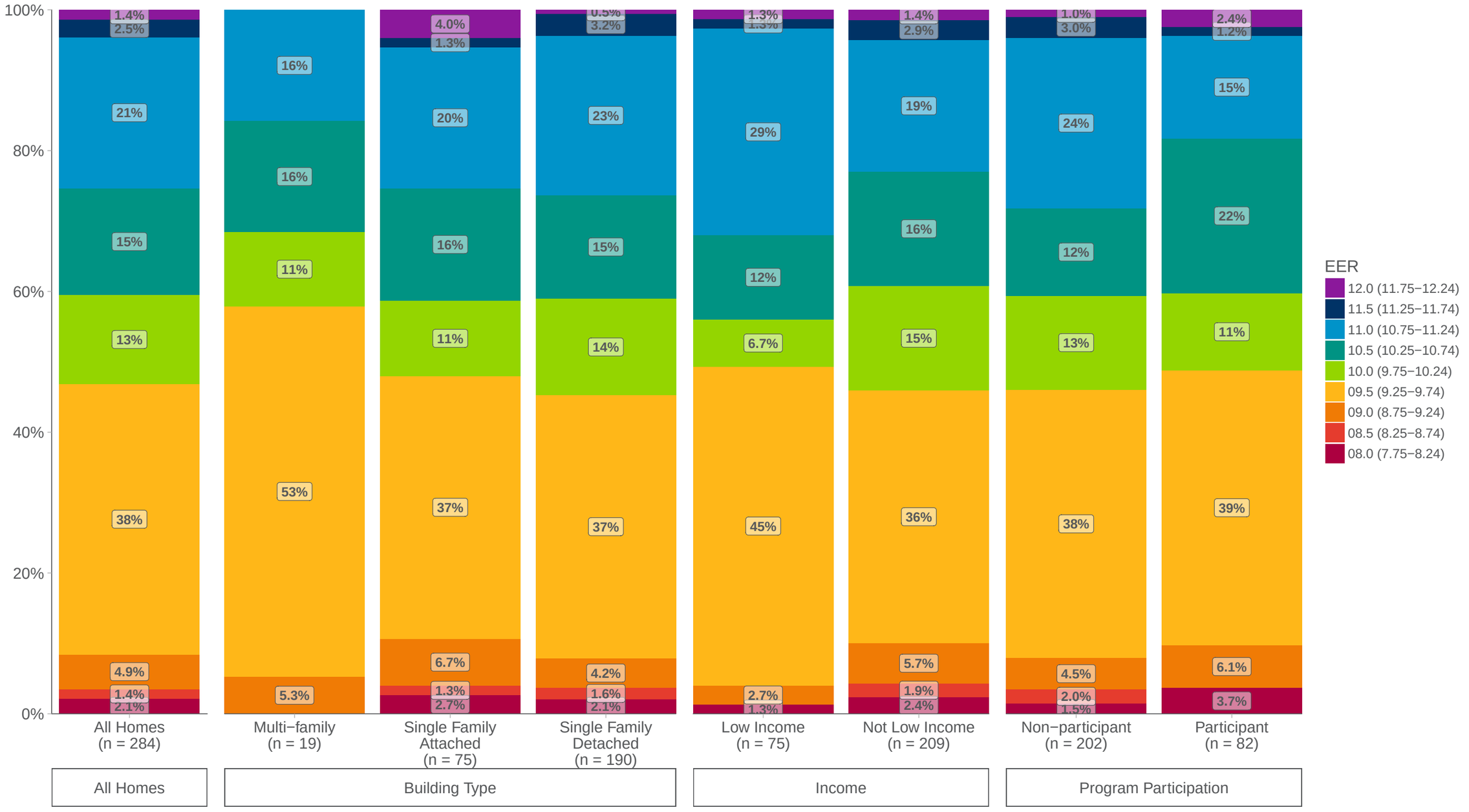
2.10 Room or Window Air Conditioner EER by Various Demographics



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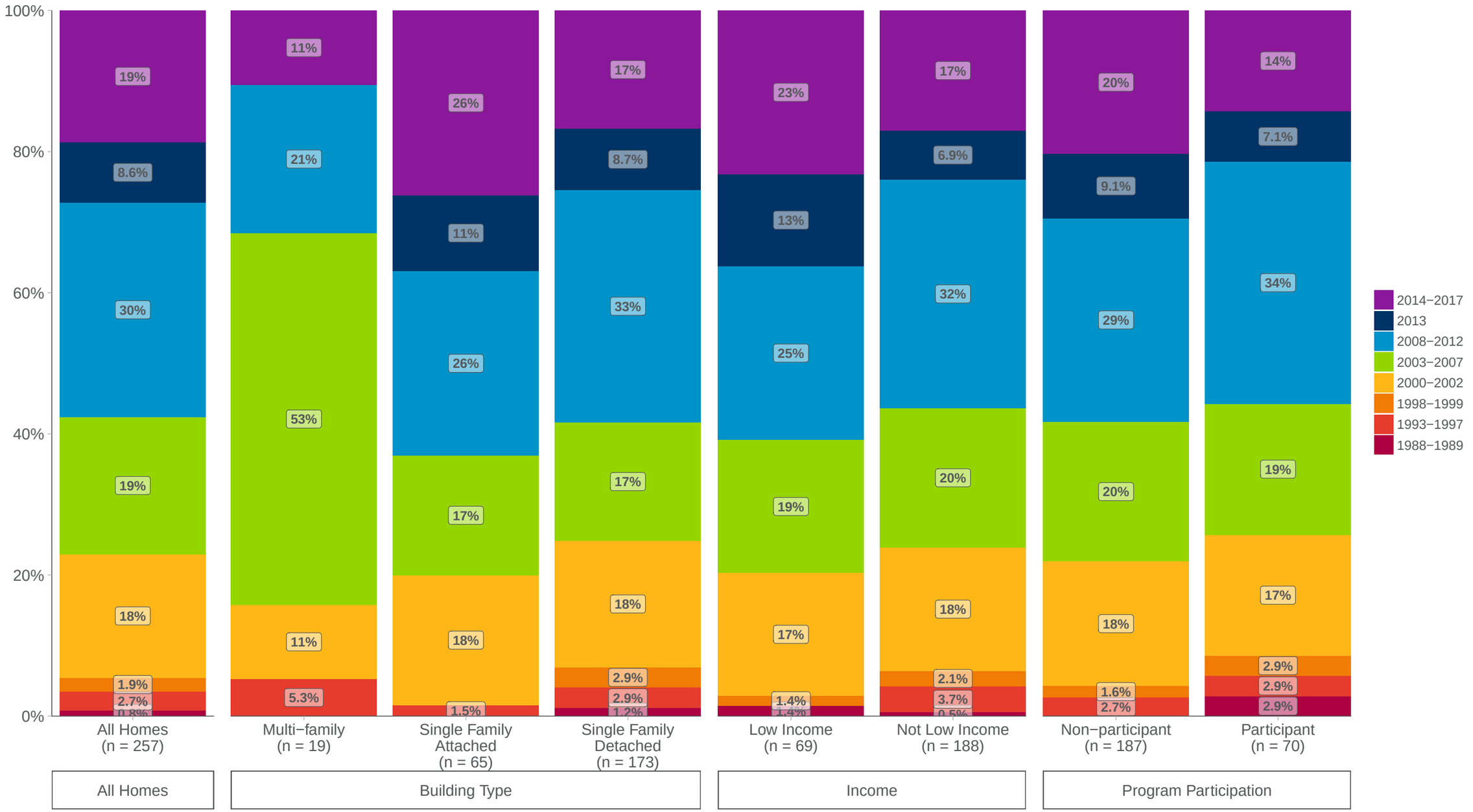
2.11 Room or Window Air Conditioner Year of Manufacture by Various Demographics



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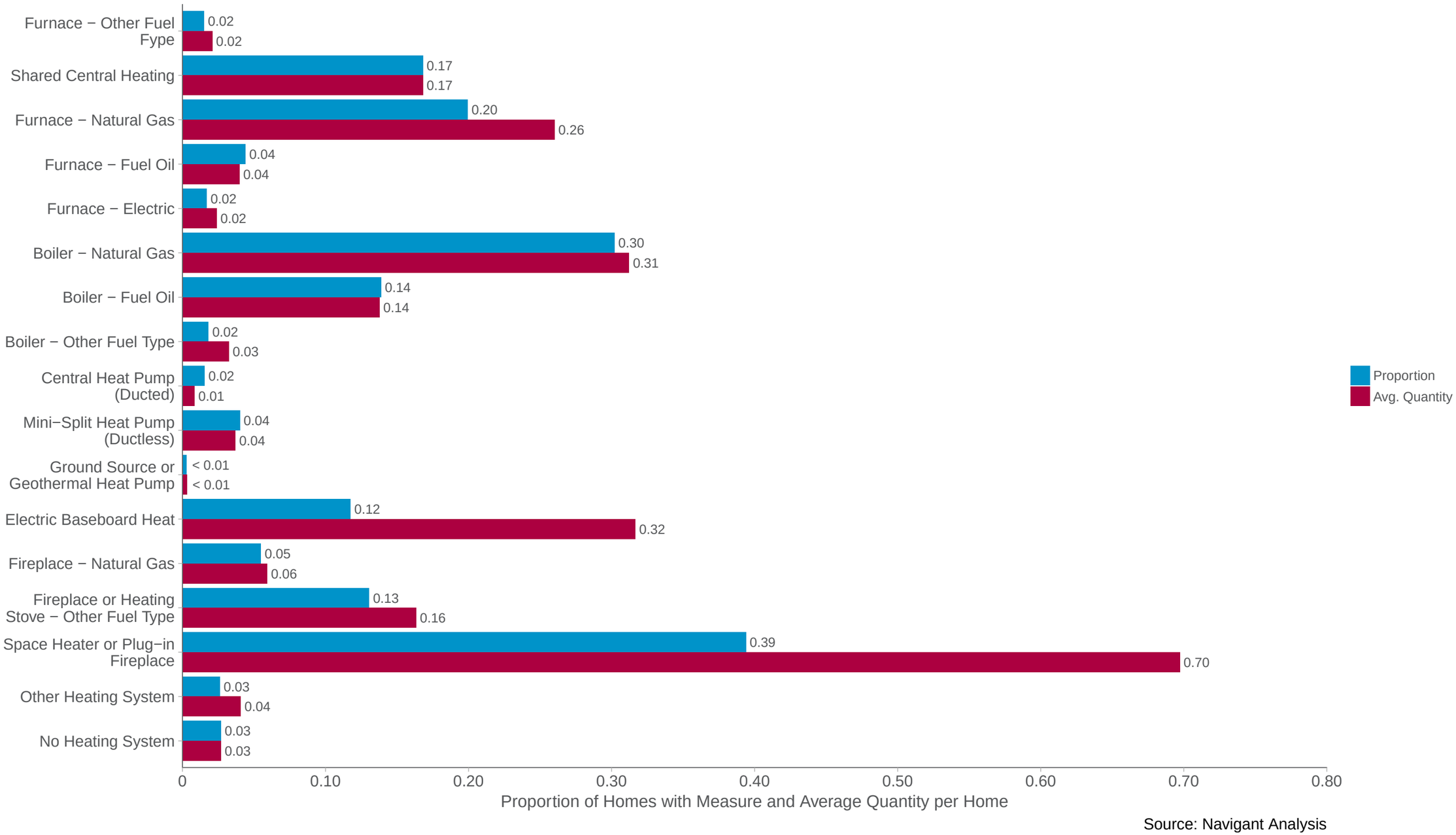
3 HVAC - Heating

3.1 Adjusted and Weighted Proportion and Average Quantity of Heating Systems



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

Note: Because some homes have multiple HVAC systems, totals may add up to more than 1.0.

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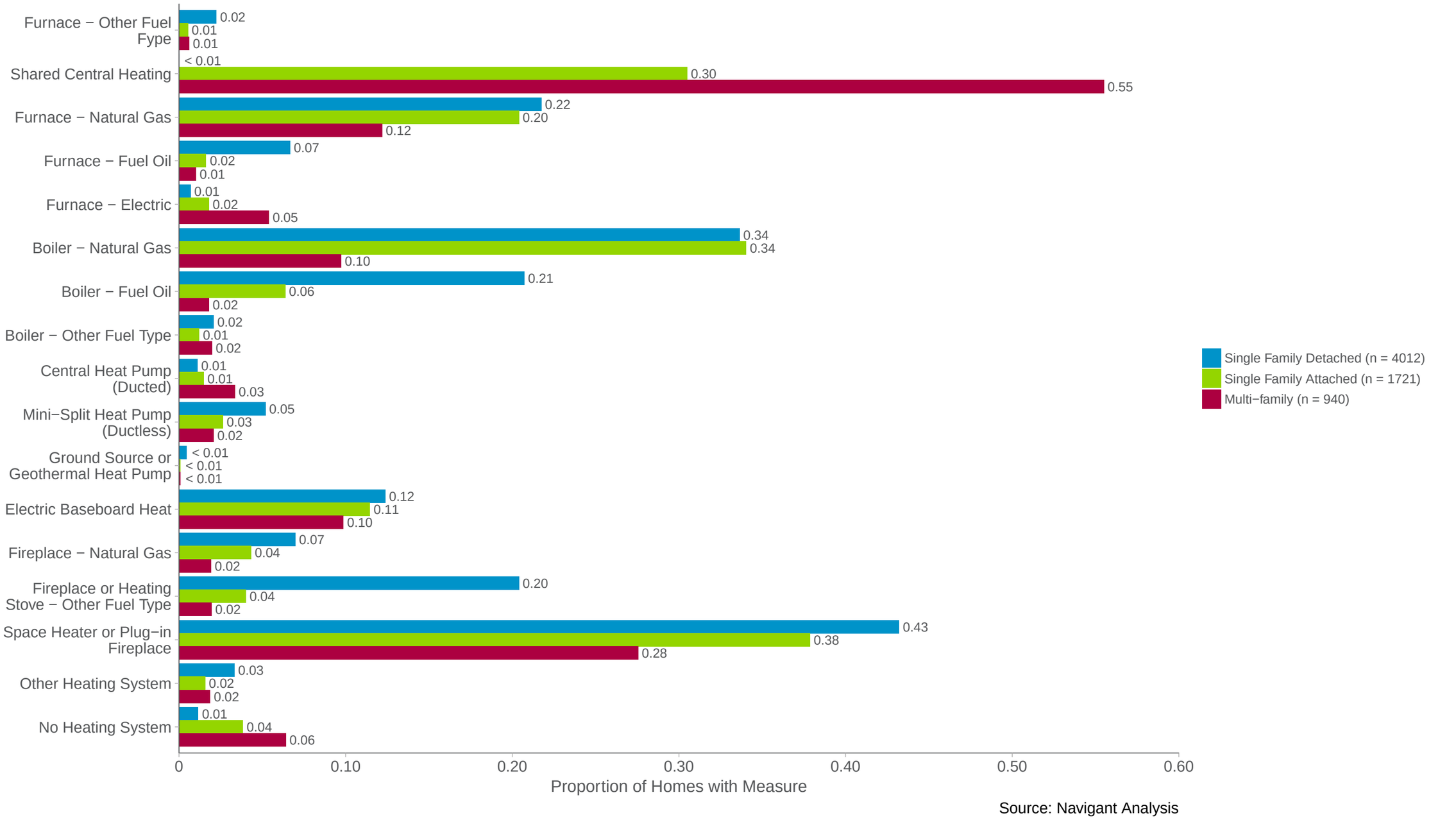
3.2 Adjusted and Weighted Proportion of Heating Systems by Building Type



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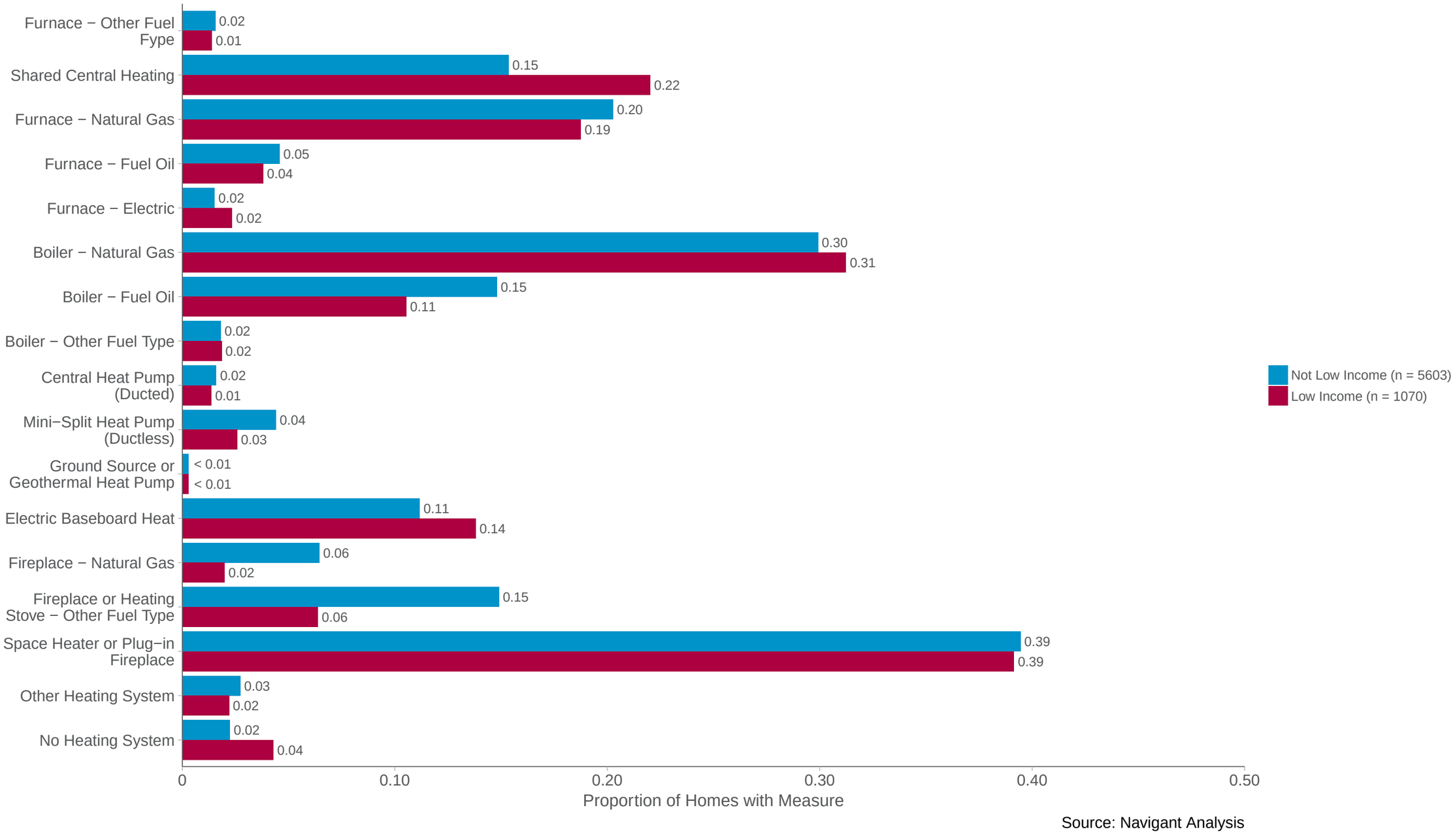
3.3 Adjusted and Weighted Proportion of Heating Systems by Income



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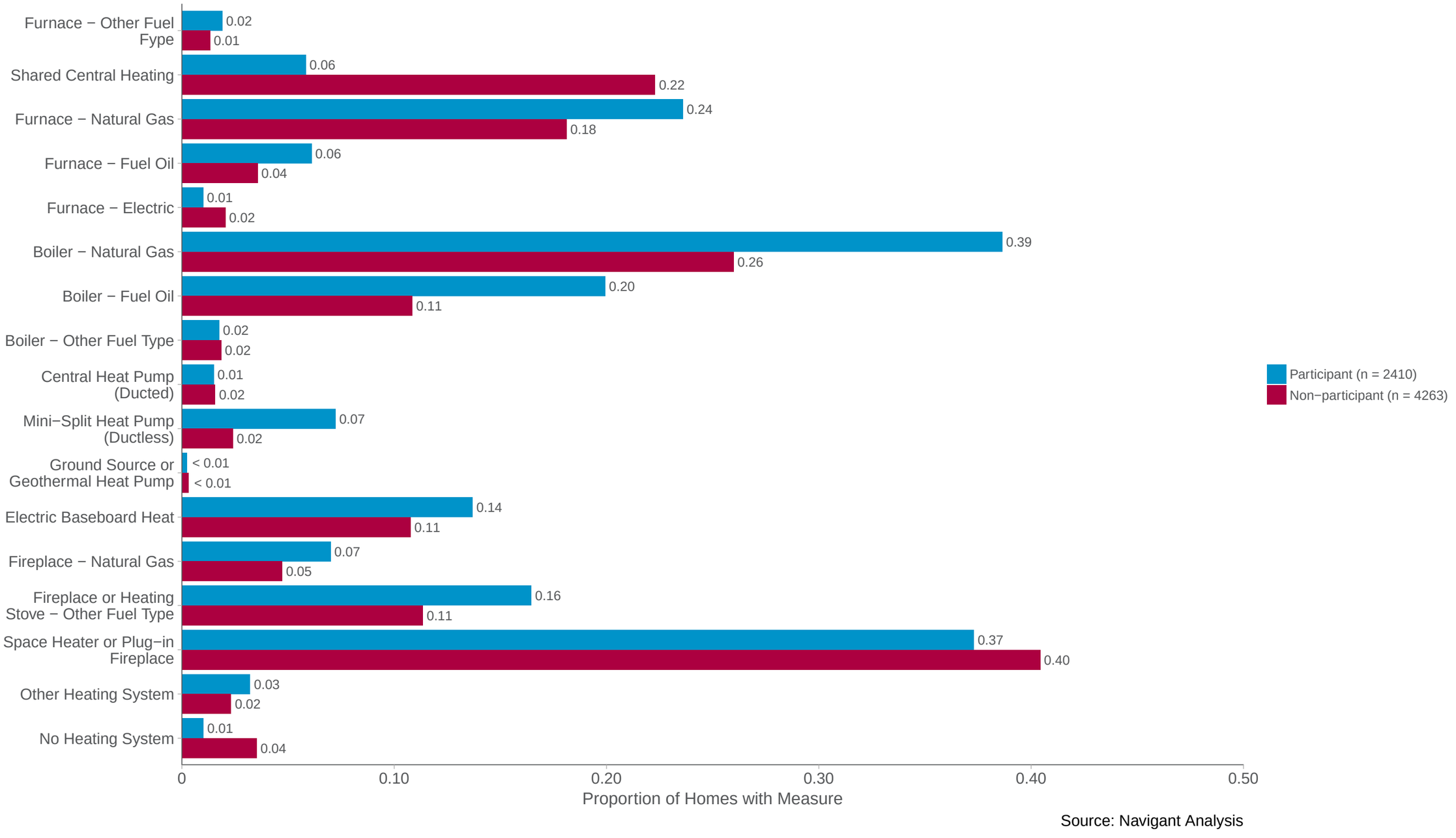
3.4 Adjusted and Weighted Proportion of Heating Systems by Participation



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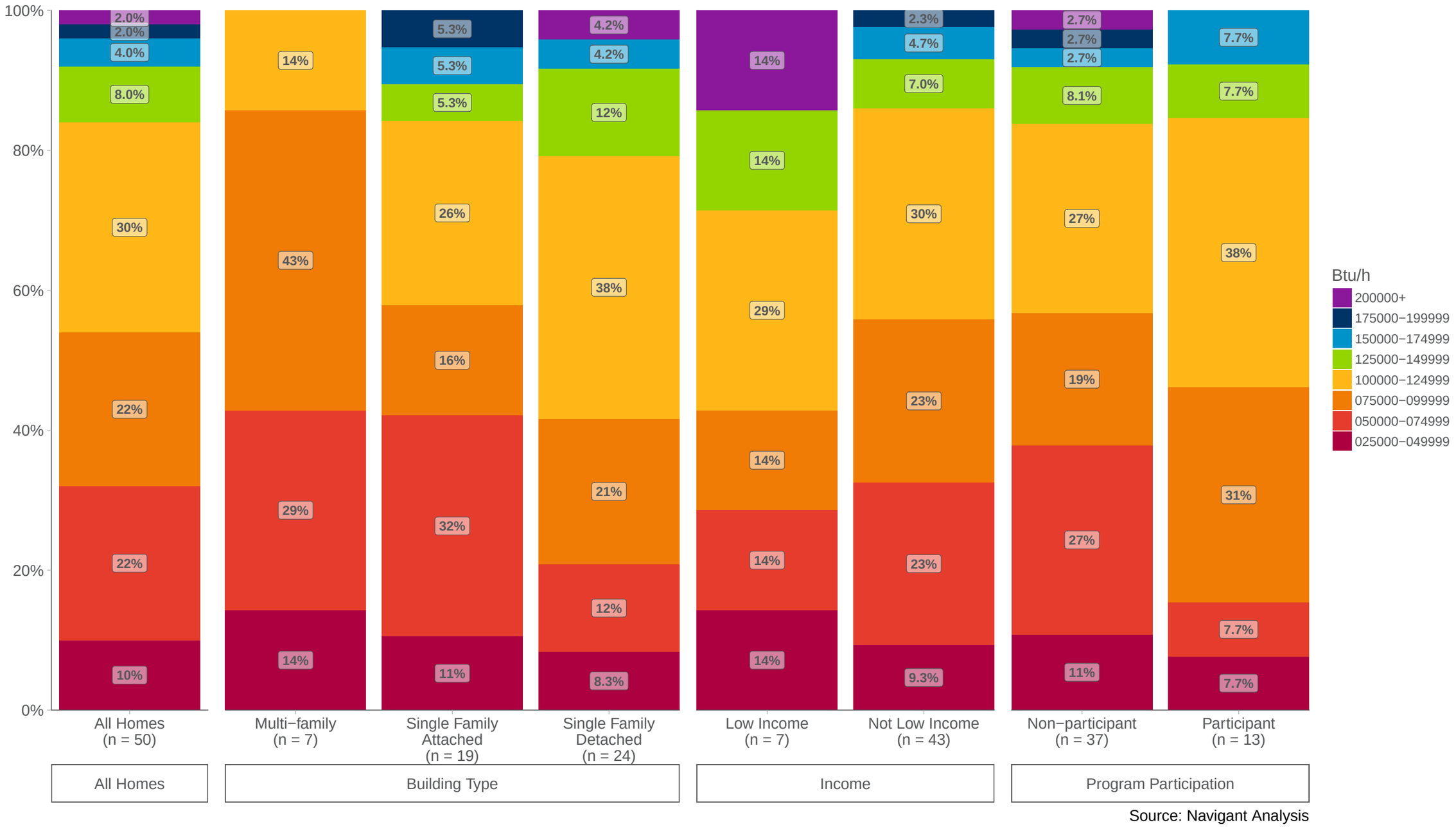
3.5 Natural Gas Furnace Input Rate by Various Demographics



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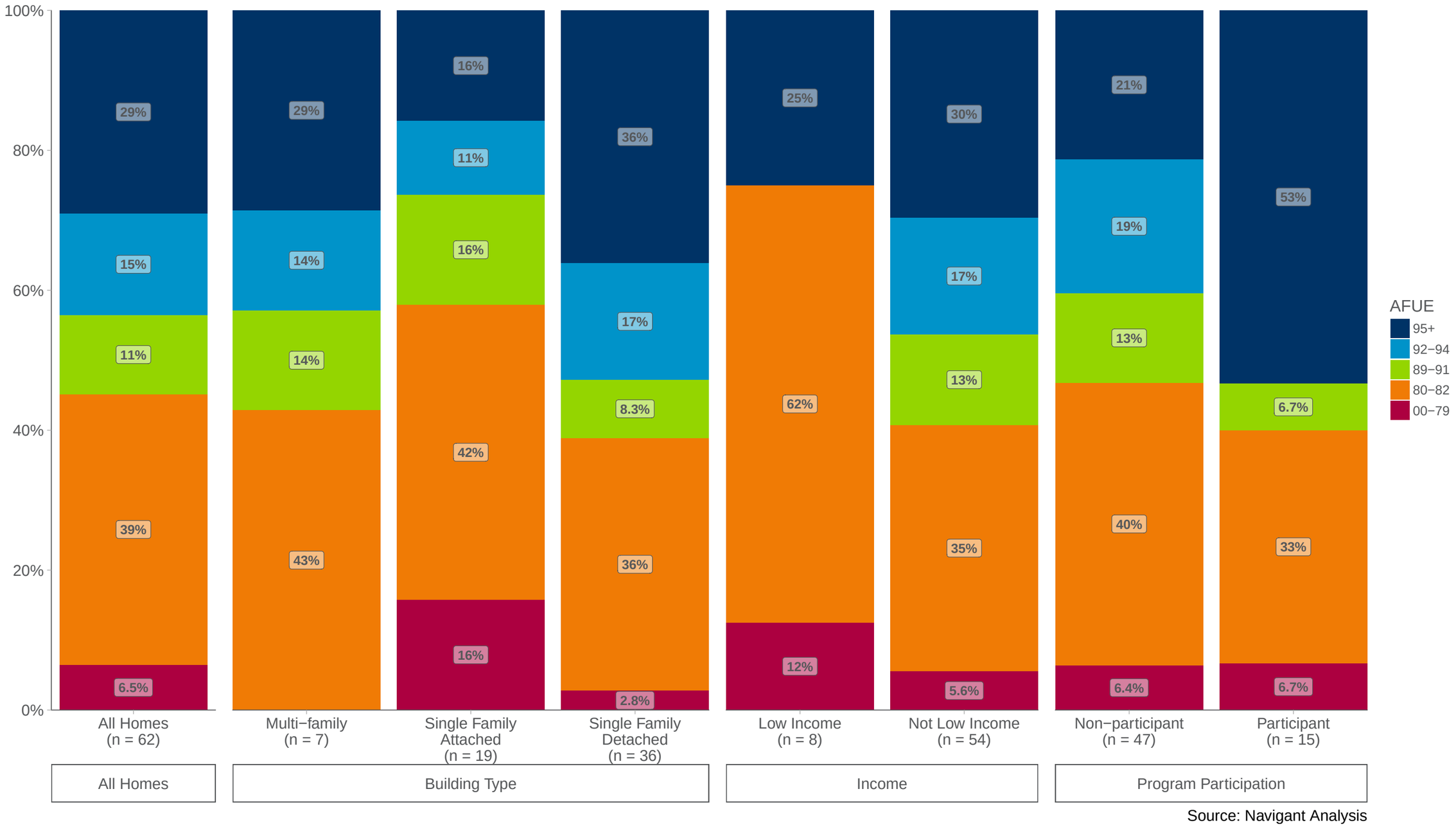
3.6 Natural Gas Furnace AFUE by Various Demographics



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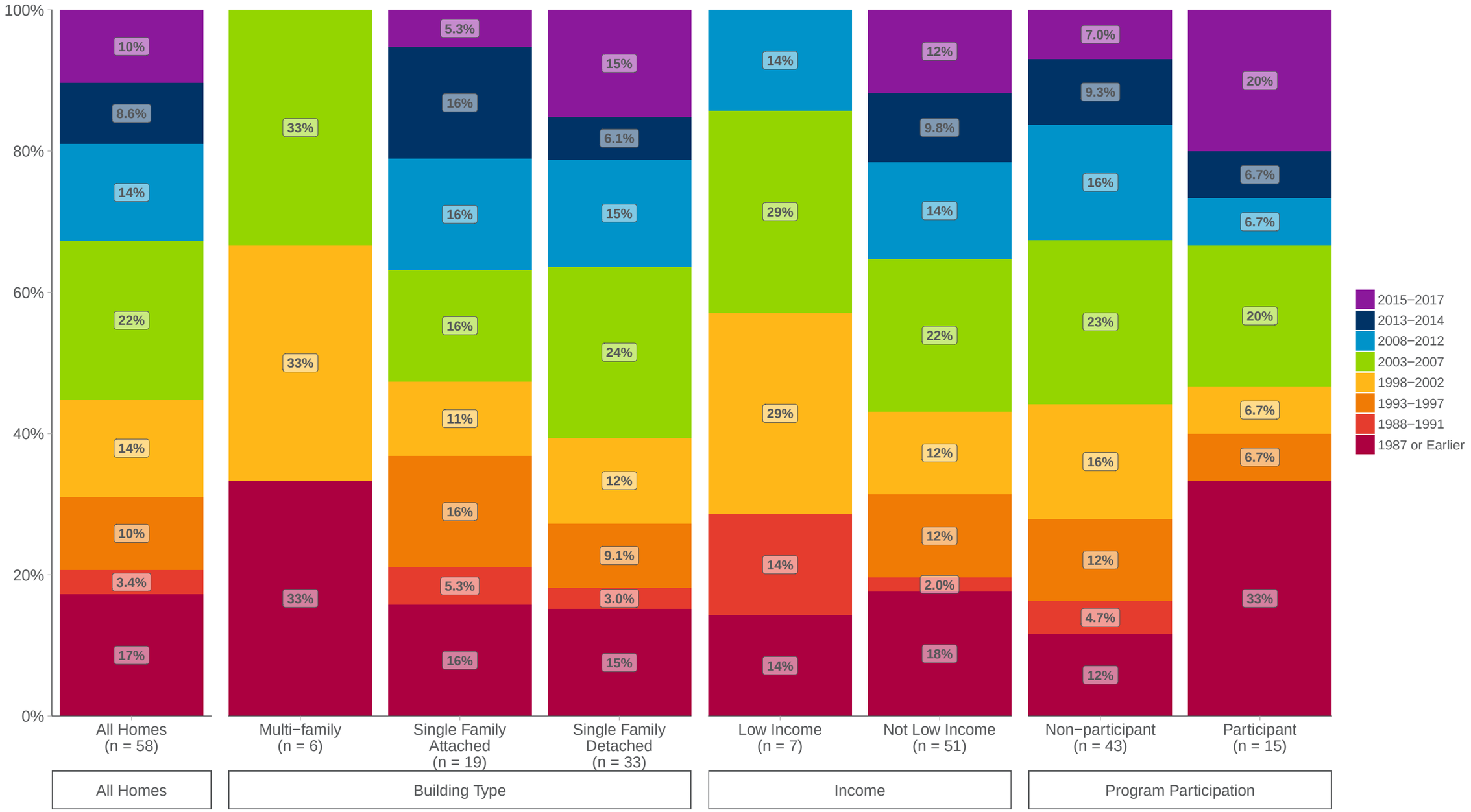
3.7 Natural Gas Furnace Year of Manufacture by Various Demographics



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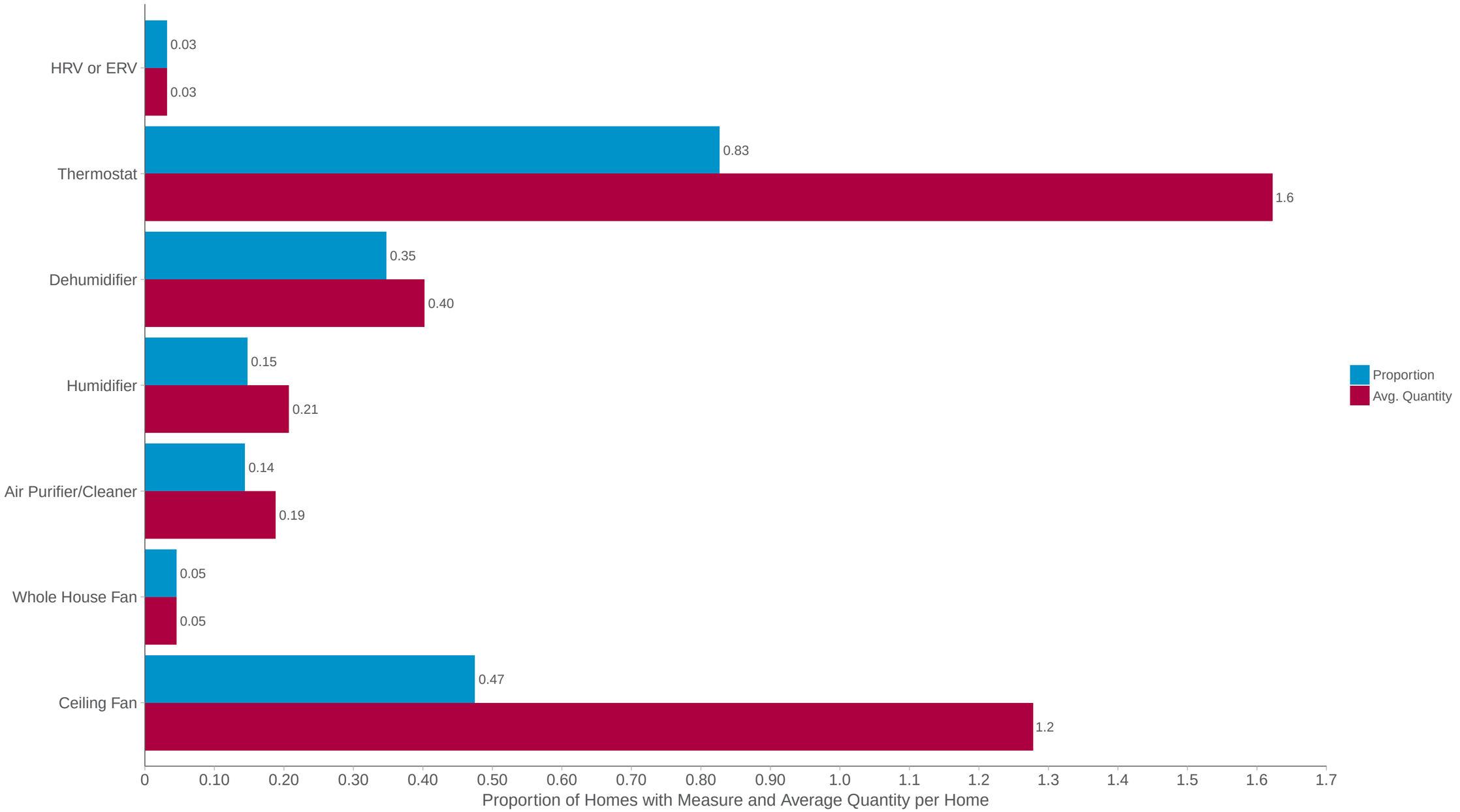
4 HVAC - Other

4.1 Adjusted and Weighted Proportion and Average Quantity of Other HVAC Systems



Source: Navigant Analysis

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Note: Because some homes have multiple HVAC systems, totals may add up to more than 1.0.

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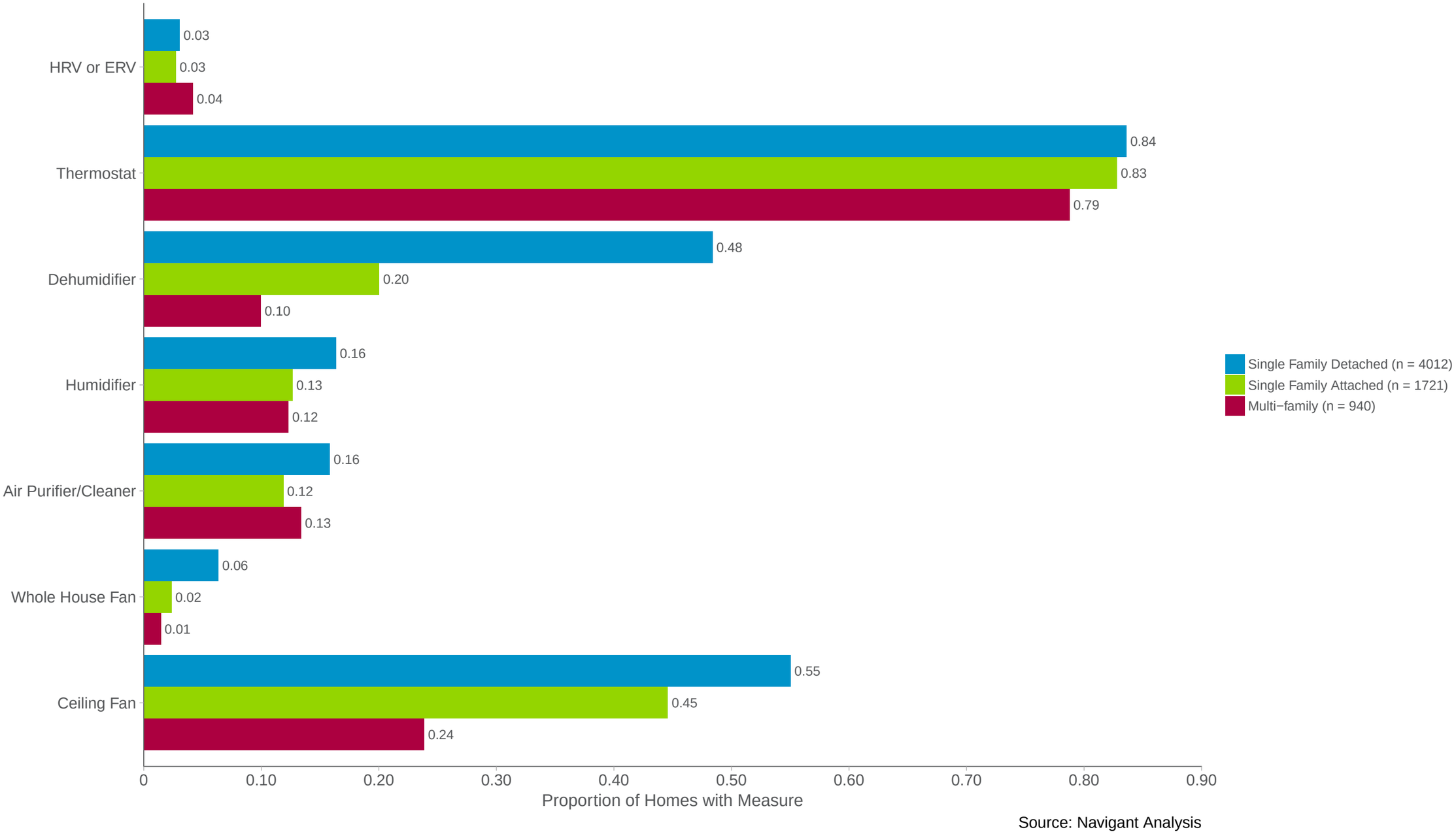
4.2 Adjusted and Weighted Proportion of Other HVAC Systems by Building Type



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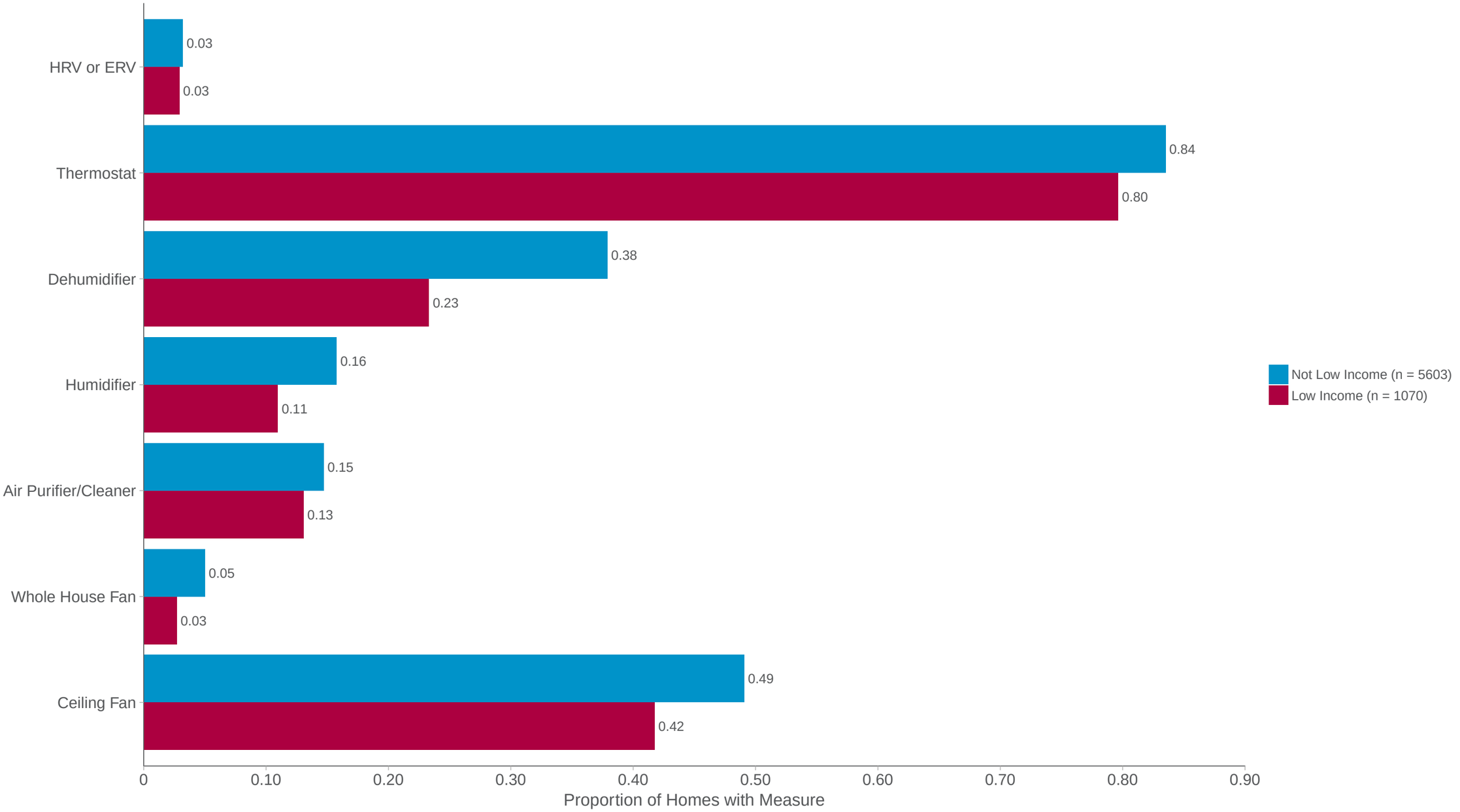
4.3 Adjusted and Weighted Proportion of Other HVAC Systems by Income



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Note: Because some homes have multiple HVAC systems, totals may add up to more than 1.0.

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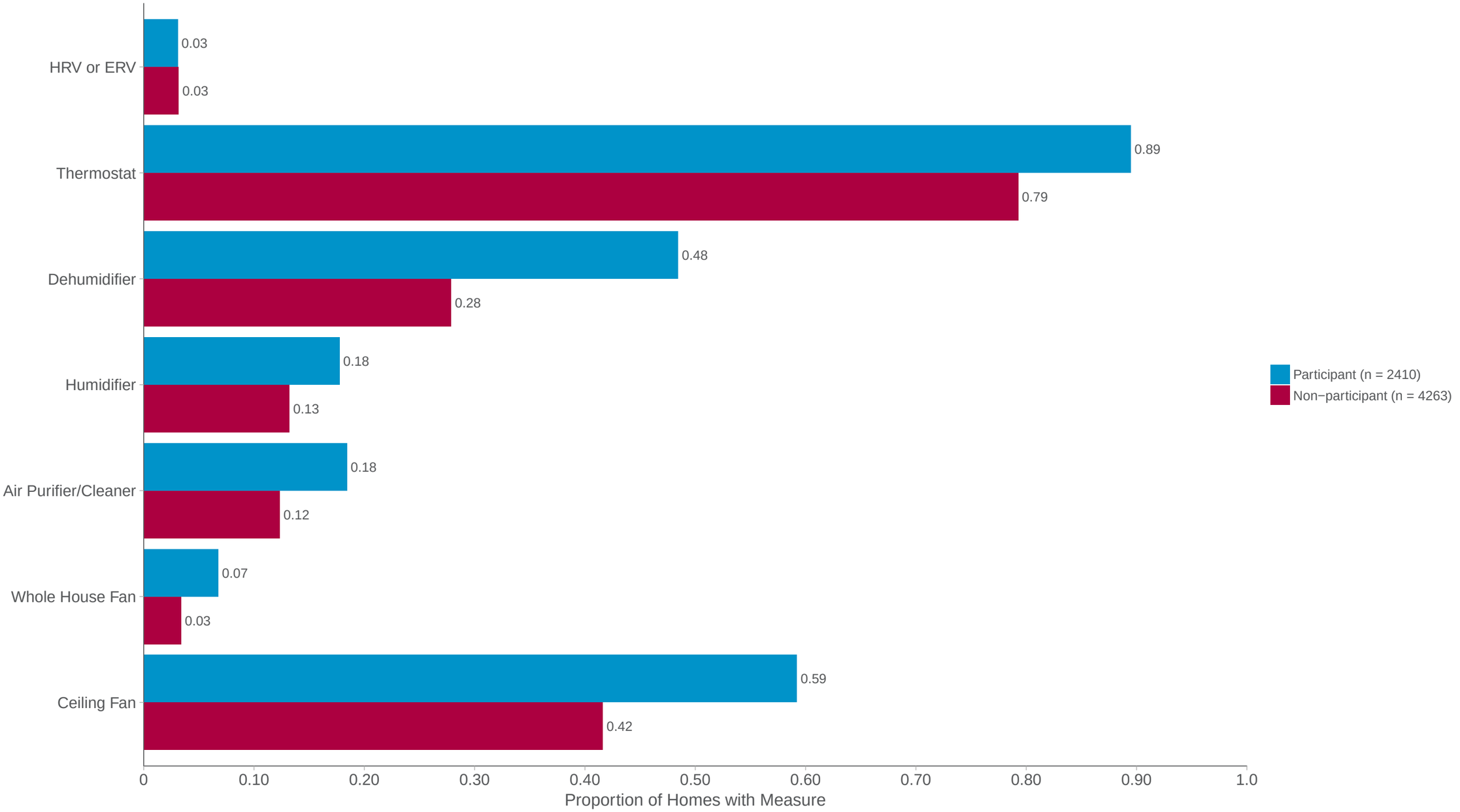
4.4 Adjusted and Weighted Proportion of Other HVAC Systems by Participation



Source: Navigant Analysis

Note: Because some homes have multiple HVAC systems, totals may add up to more than 1.0.

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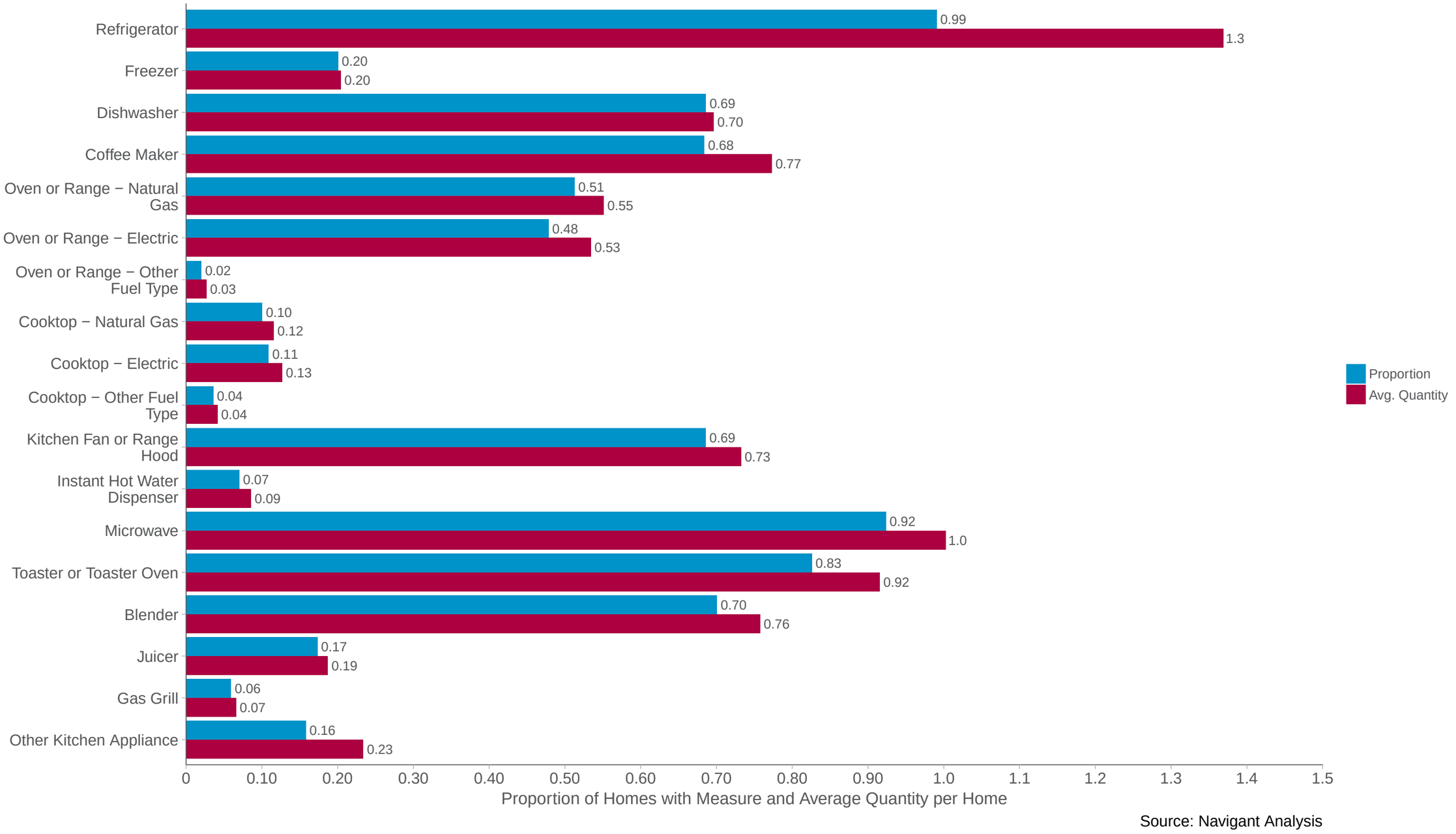
5 Kitchen Appliances

5.1 Adjusted and Weighted Proportion and Average Quantity of Kitchen Appliances



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

Note: The refrigerator category includes mini-fridges and wine coolers. Of the secondary refrigerators, 69% were full-size refrigerators (comparable to the refrigerators category in the 2009 RASS), while the remaining 31% were mini-fridges and wine coolers.

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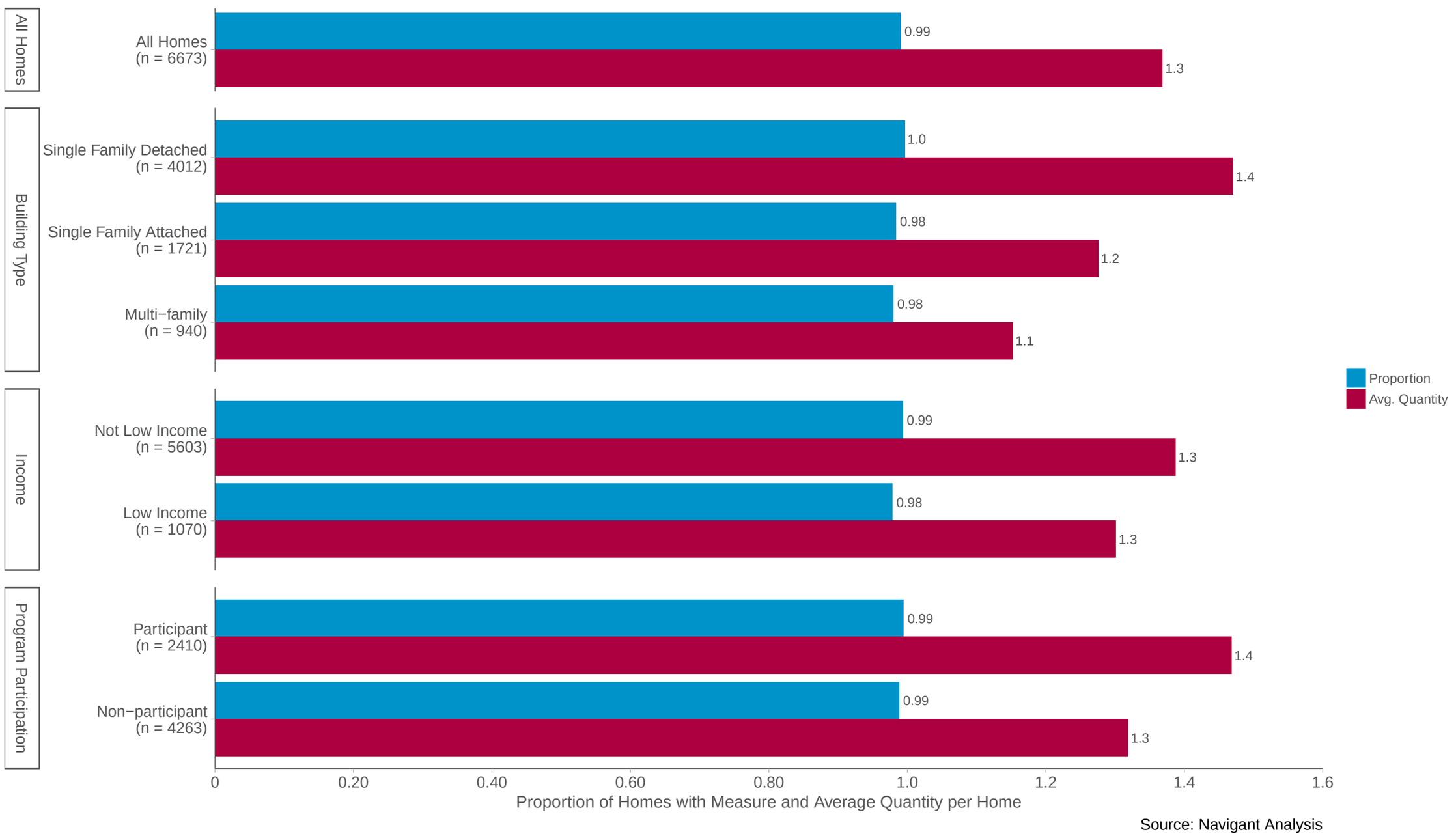
5.2 Adjusted and Weighted Proportion and Average Quantity of Refrigerators by Various Demographics



Source: Navigant Analysis

Note: The refrigerator category includes mini-fridges and wine coolers. Of the secondary refrigerators, 69% were full-size refrigerators (comparable to the refrigerators category in the 2009 RASS), while the remaining 31% were mini-fridges and wine coolers.

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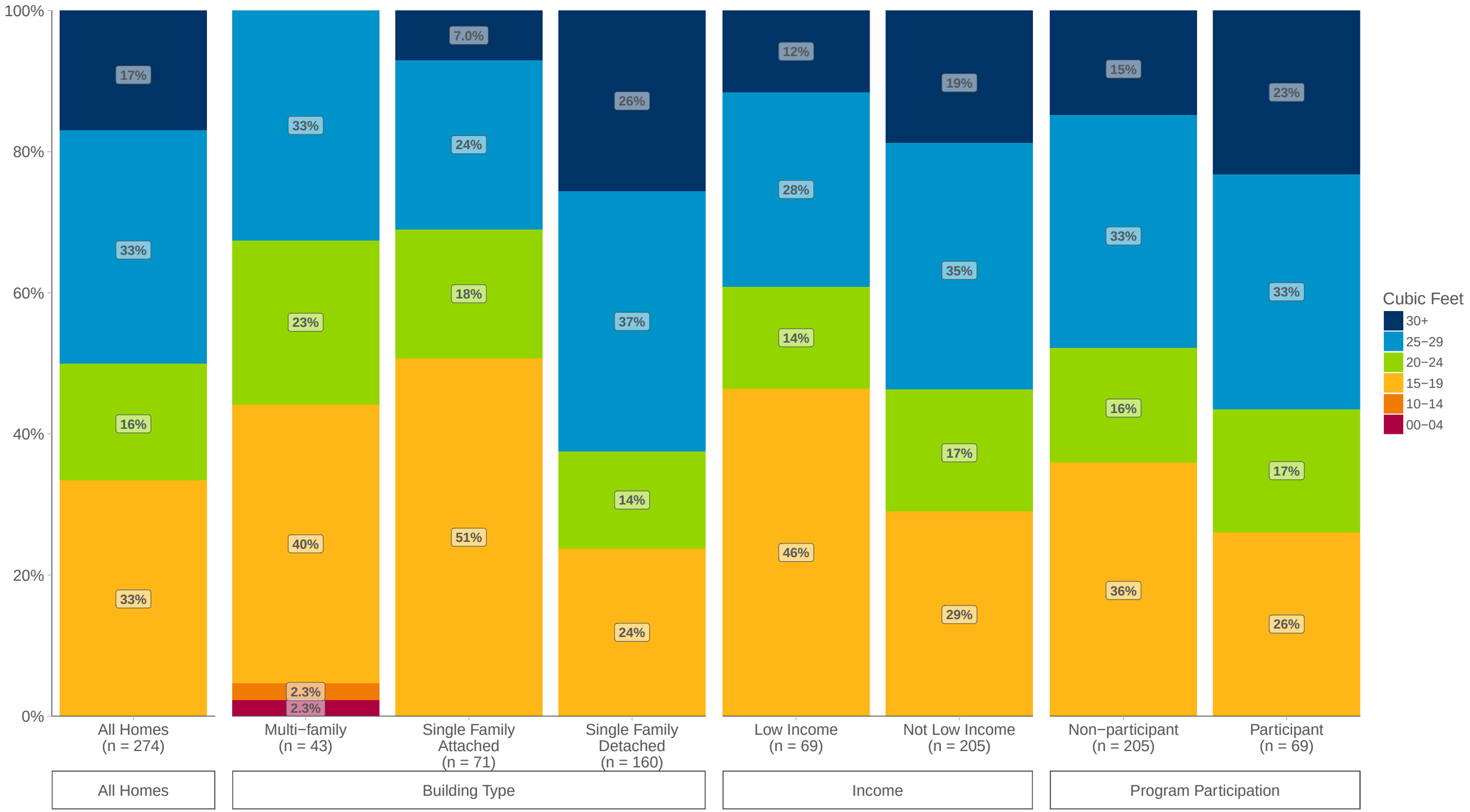
5.3 Primary Refrigerator Total Adjusted Volume by Various Demographics



Source: Navigant Analysis

Note: Total Adjusted Volume is defined by DOE as fresh volume + 1.63 * freezer volume.

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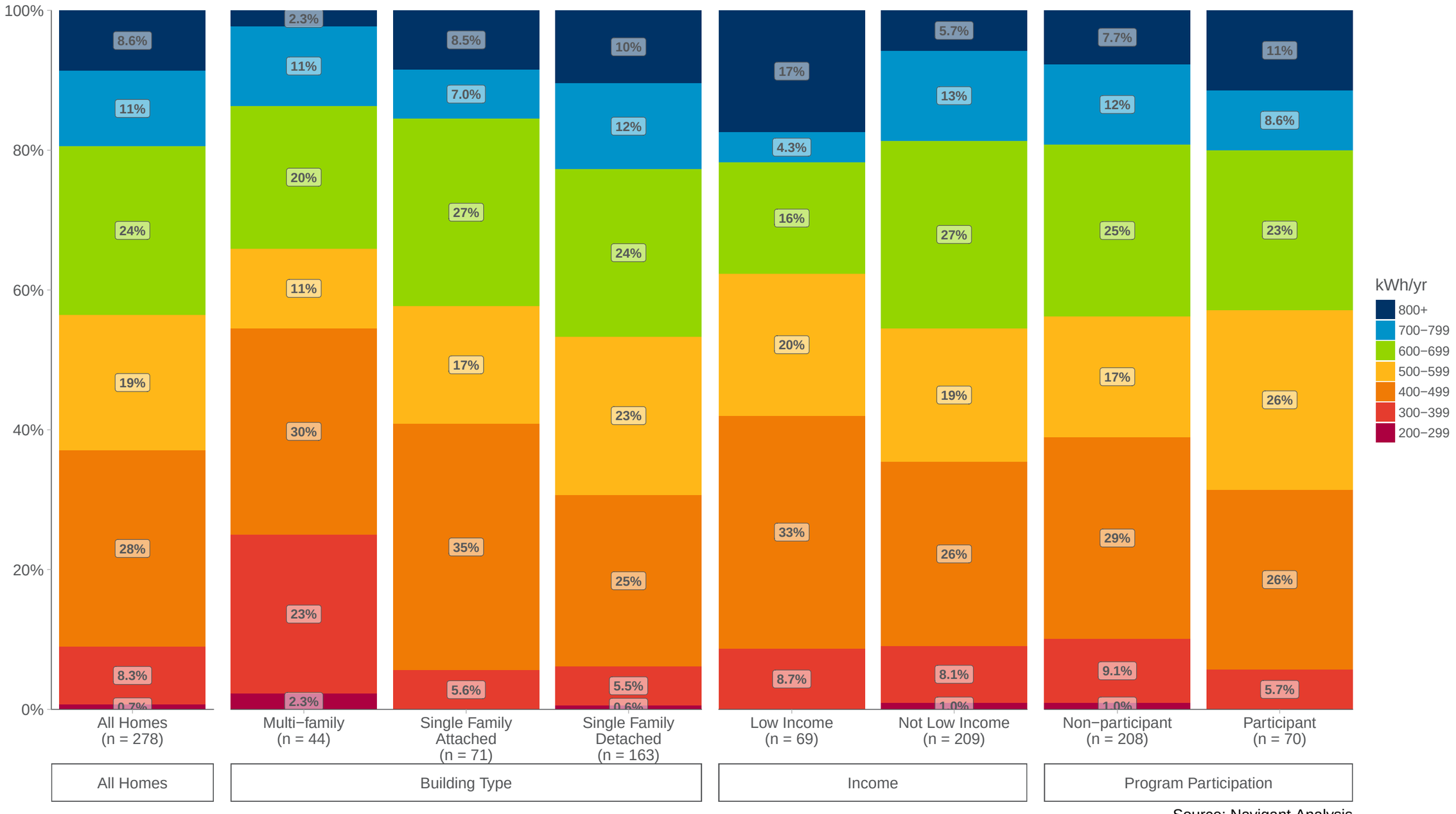
5.4 Primary Refrigerator DOE-Estimated Annual Energy Use by Various Demographics



Source: Navigant Analysis

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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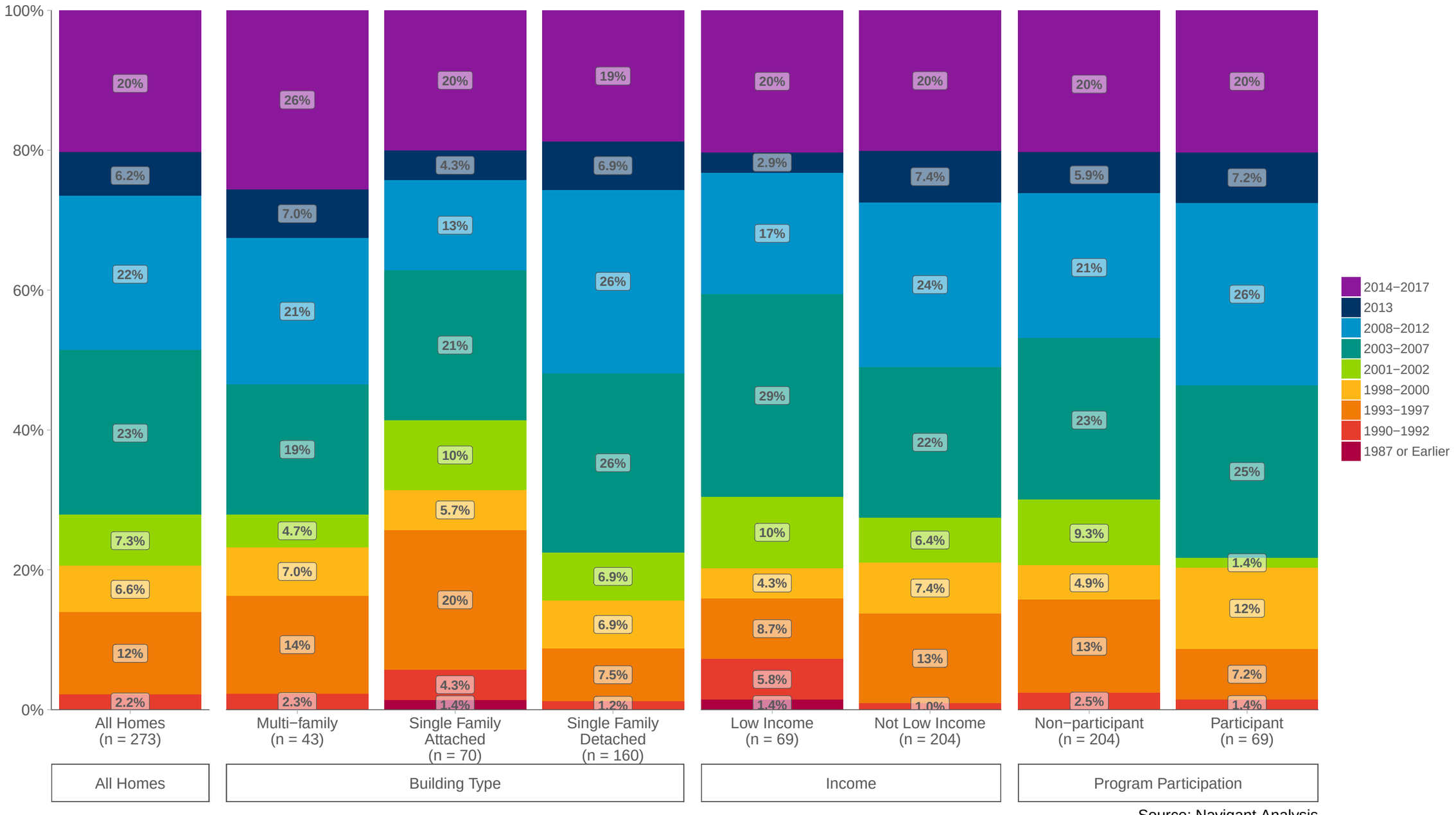
5.5 Primary Refrigerator Year of Manufacture by Various Demographics



Source: Navigant Analysis

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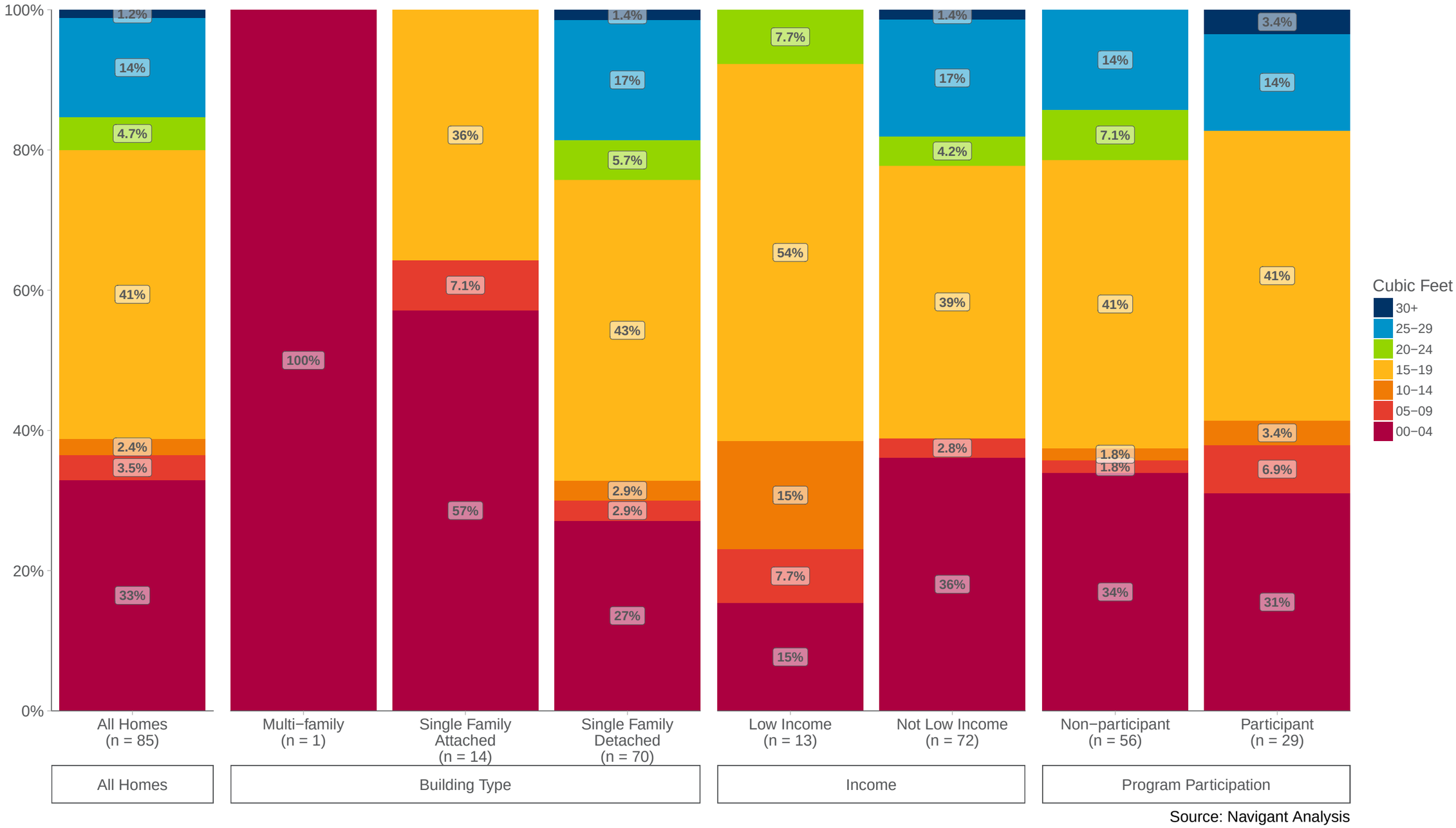
5.6 Secondary Refrigerator Total Adjusted Volume by Various Demographics



Source: Navigant Analysis

Note: Total Adjusted Volume is defined by DOE as fresh volume + 1.63 * freezer volume.

Note: The refrigerator category includes mini-fridges and wine coolers. Of the secondary refrigerators, 69% were full-size refrigerators (comparable to the refrigerators category in the 2009 RASS), while the remaining 31% were mini-fridges and wine coolers.

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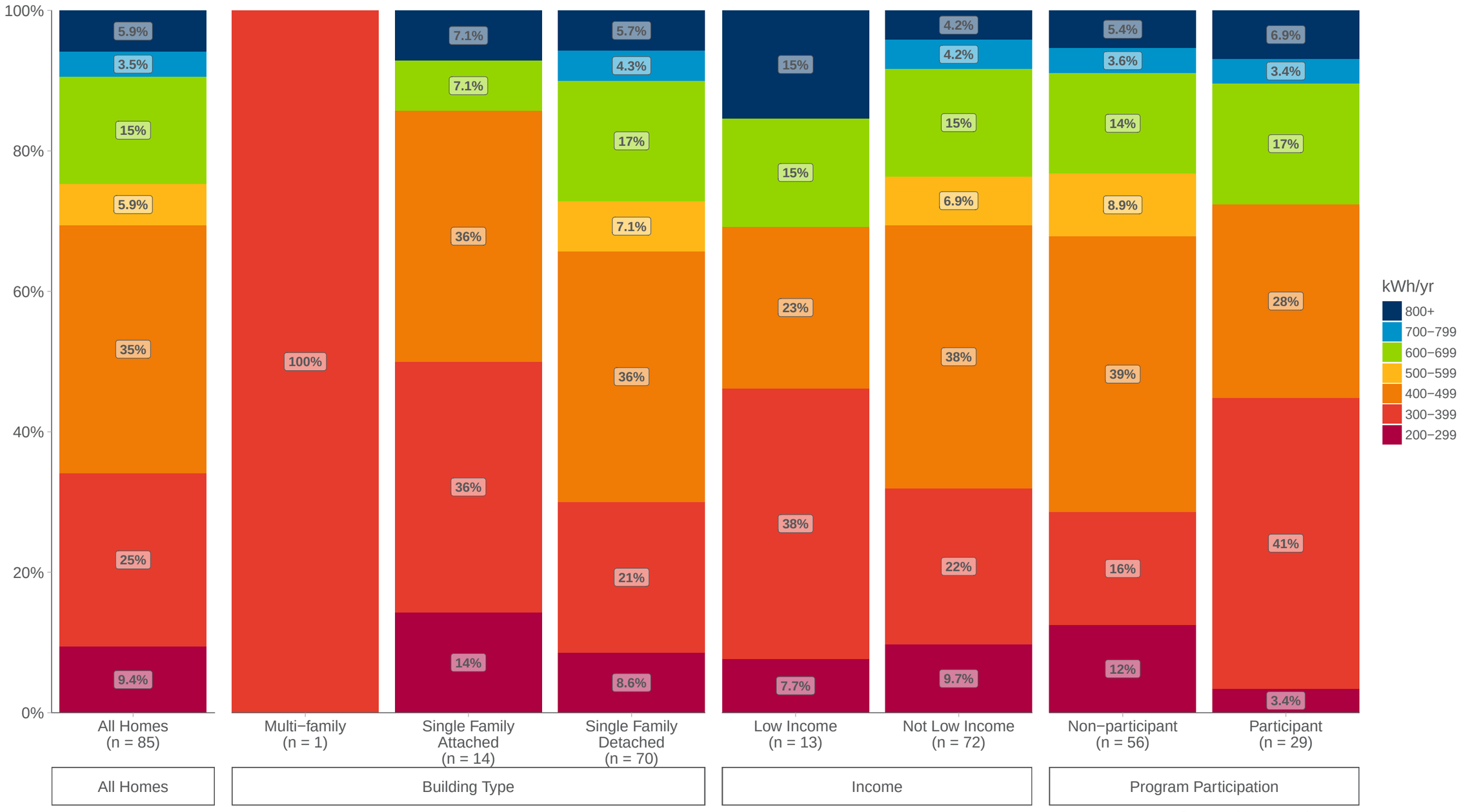
5.7 Secondary Refrigerator DOE-Estimated Annual Energy Use by Various Demographics



Source: Navigant Analysis

Note: The refrigerator category includes mini-fridges and wine coolers. Of the secondary refrigerators, 69% were full-size refrigerators (comparable to the refrigerators category in the 2009 RASS), while the remaining 31% were mini-fridges and wine coolers.

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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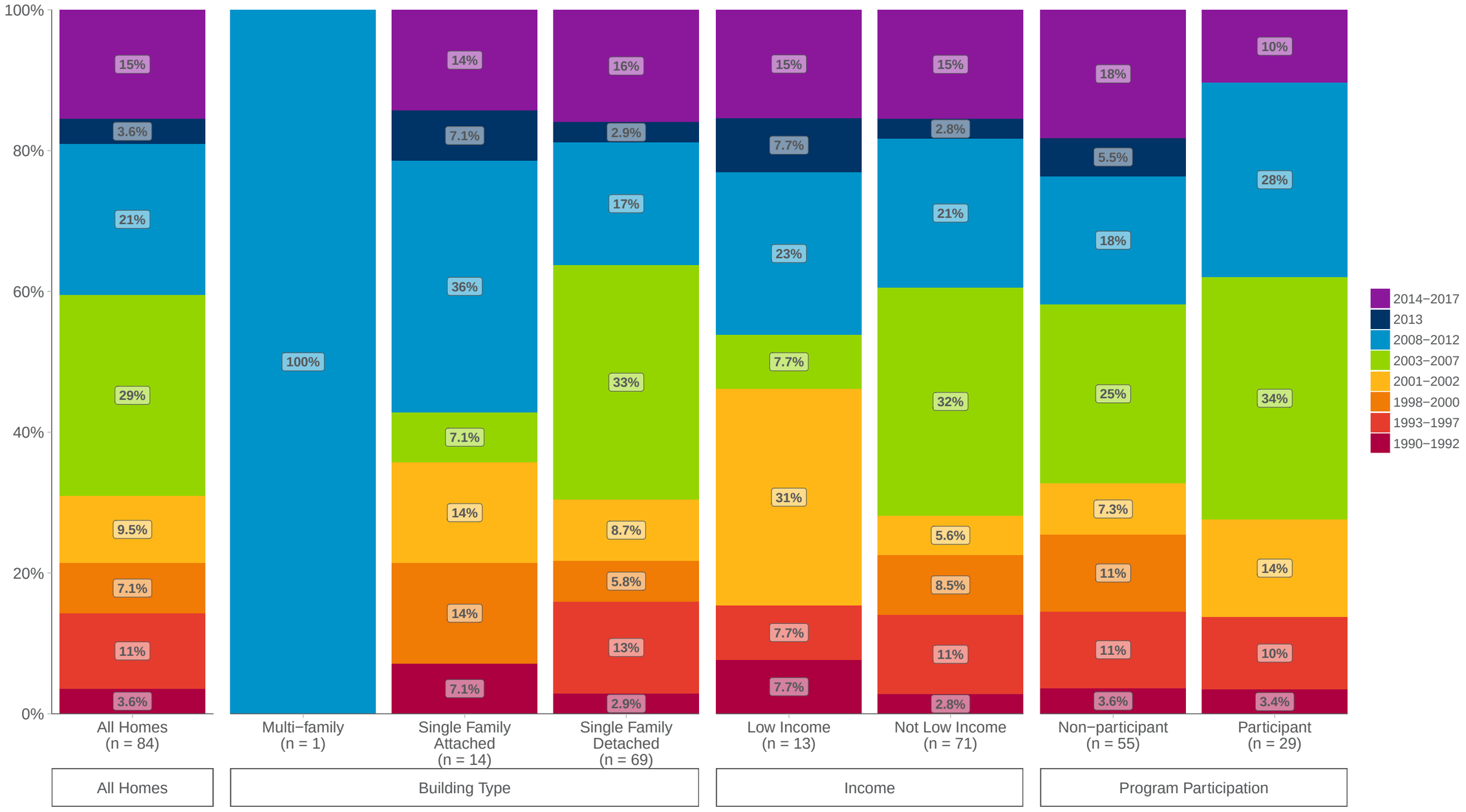
5.8 Secondary Refrigerator Year of Manufacture by Various Demographics



Source: Navigant Analysis

Note: The refrigerator category includes mini-fridges and wine coolers. Of the secondary refrigerators, 69% were full-size refrigerators (comparable to the refrigerators category in the 2009 RASS), while the remaining 31% were mini-fridges and wine coolers.

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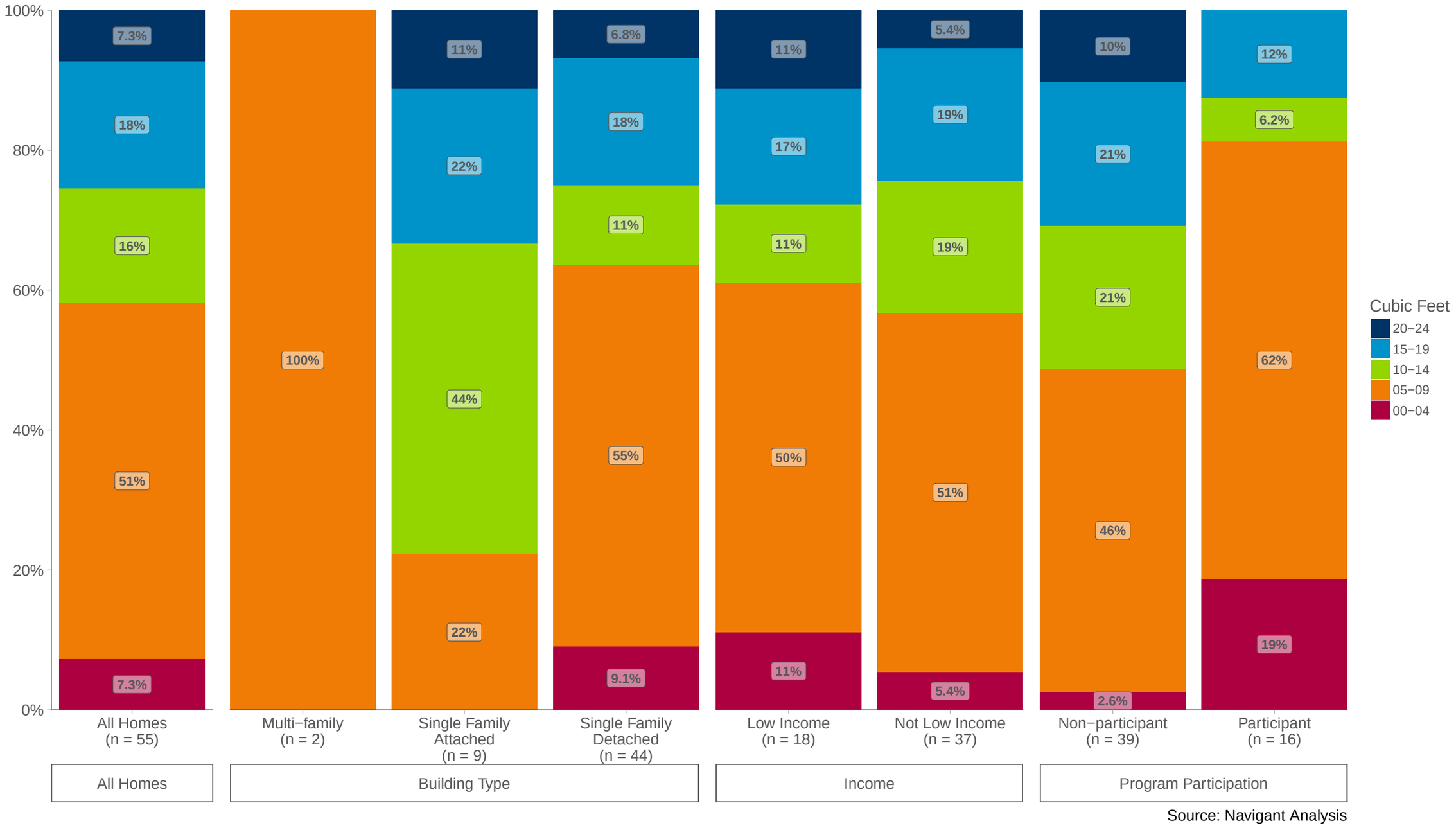
5.9 Volume of Freezers by Various Demographics



Source: Navigant Analysis

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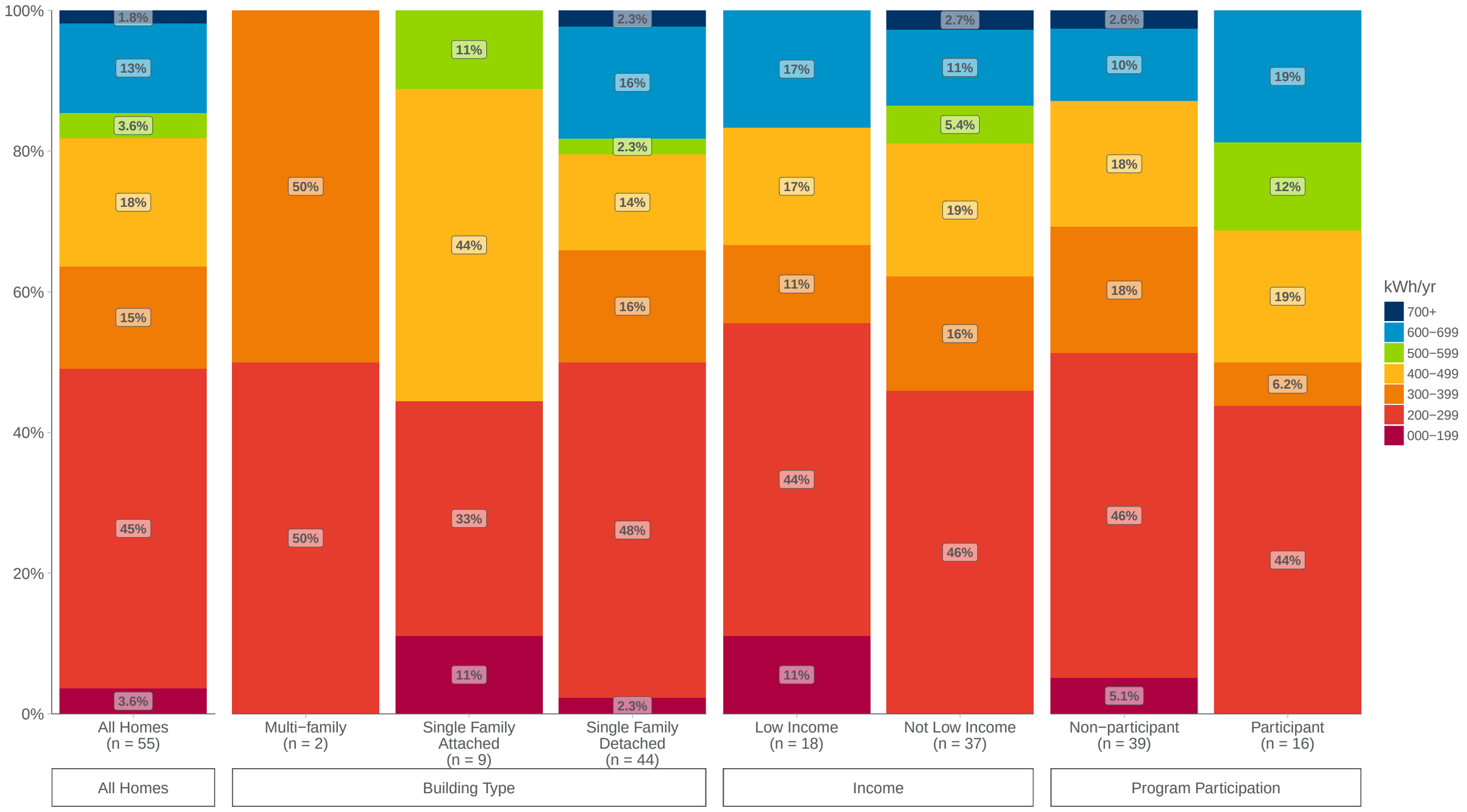
5.10 Freezer DOE-Estimated Annual Energy Use by Various Demographics



Source: Navigant Analysis

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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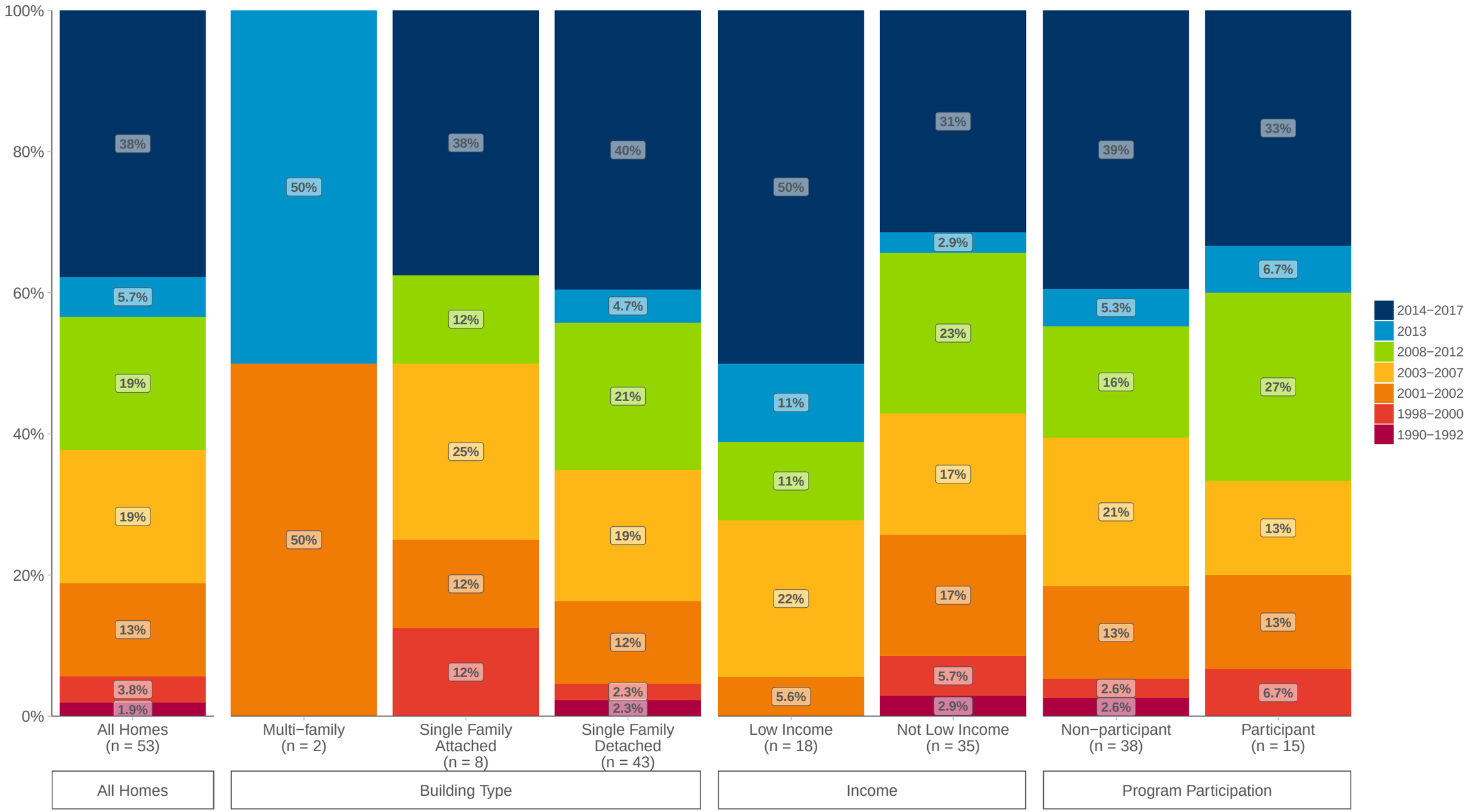
5.11 Freezer Year of Manufacture by Various Demographics



Source: Navigant Analysis

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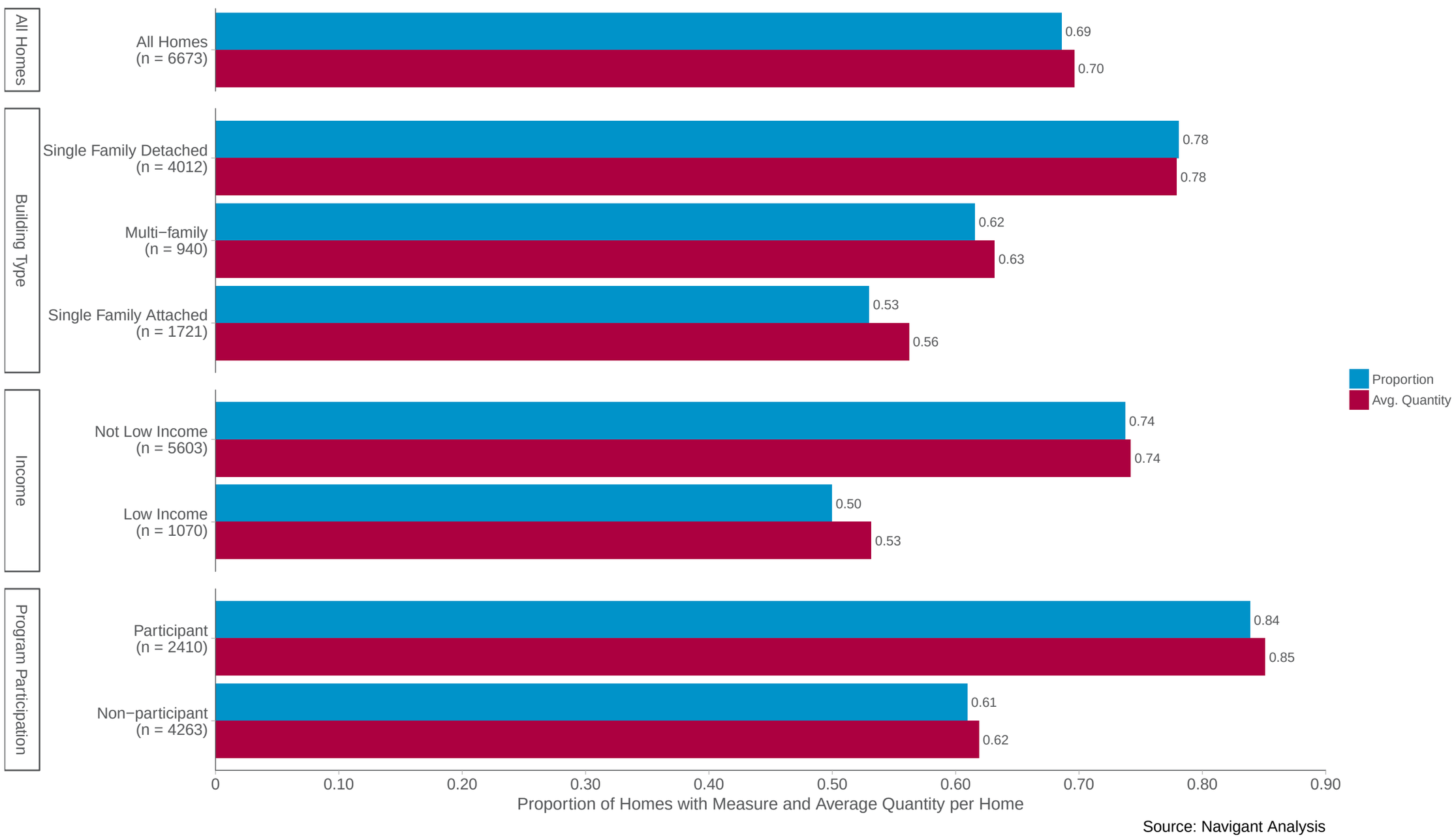
5.12 Adjusted and Weighted Proportion and Average Quantity of Dishwashers by Various Demographics



Source: Navigant Analysis

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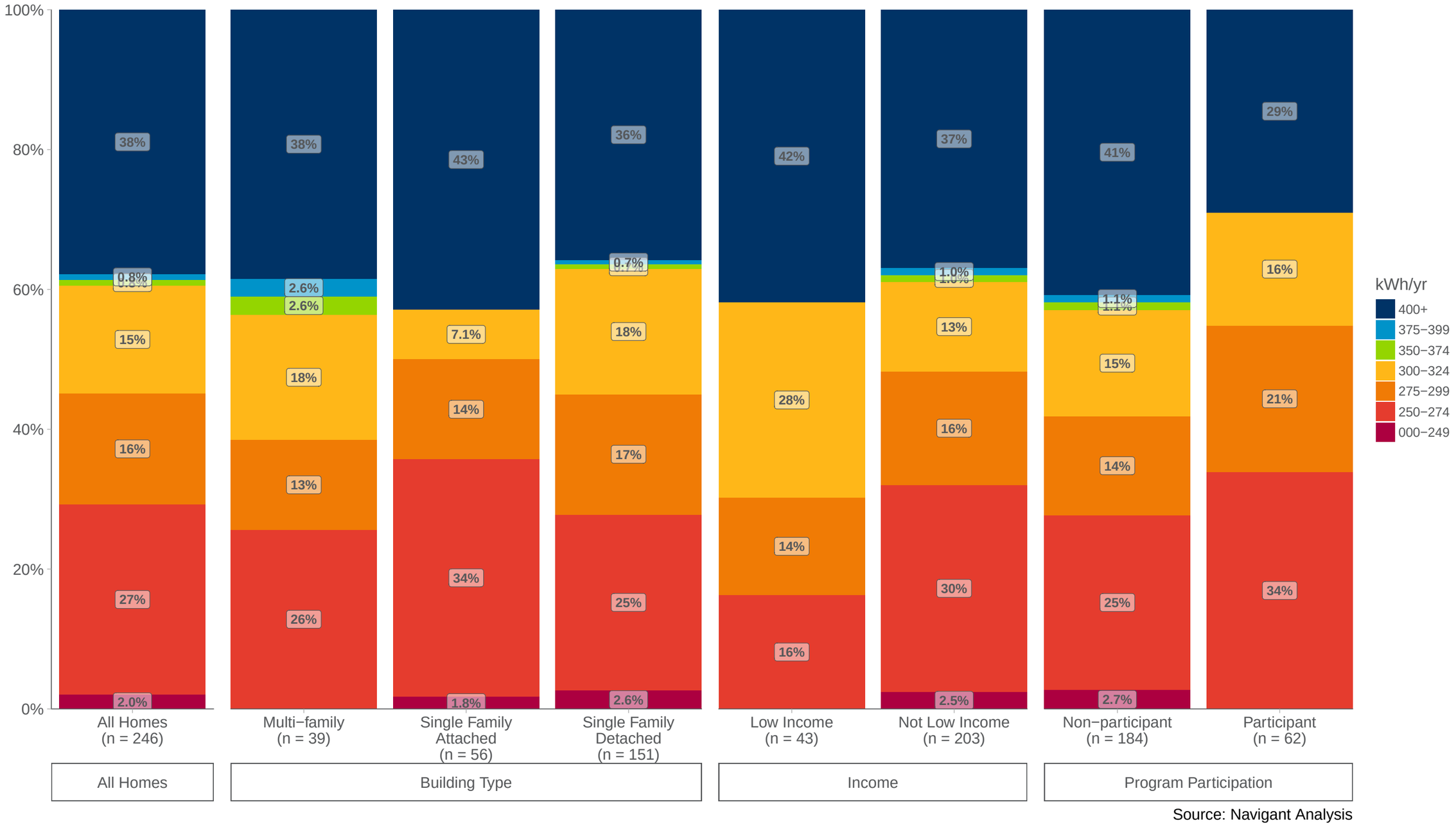
5.13 Dishwasher DOE-Estimated Annual Energy Use by Various Demographics



Source: Navigant Analysis

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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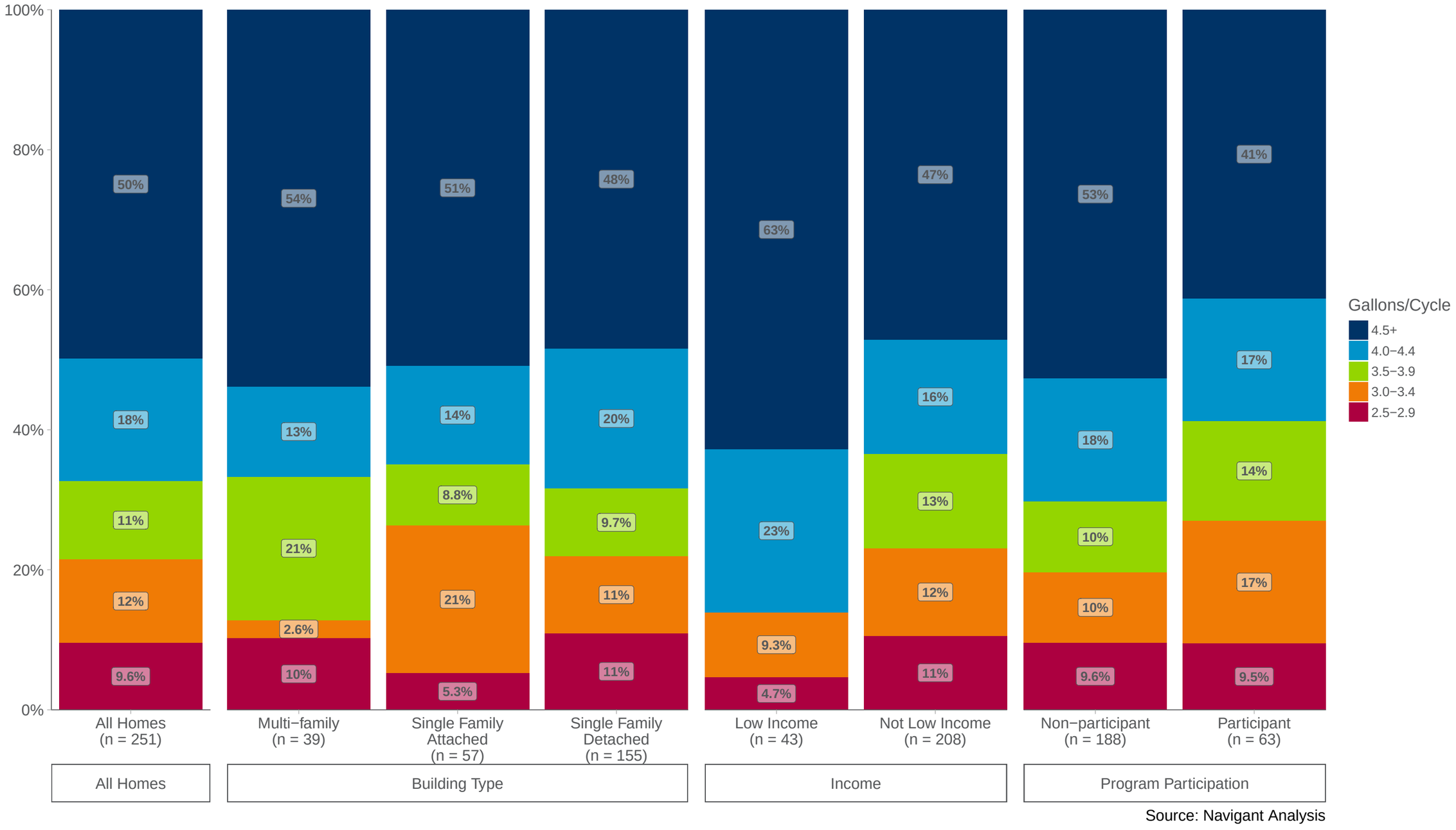
5.14 Dishwasher DOE-Estimated Water Consumption by Various Demographics



Source: Navigant Analysis

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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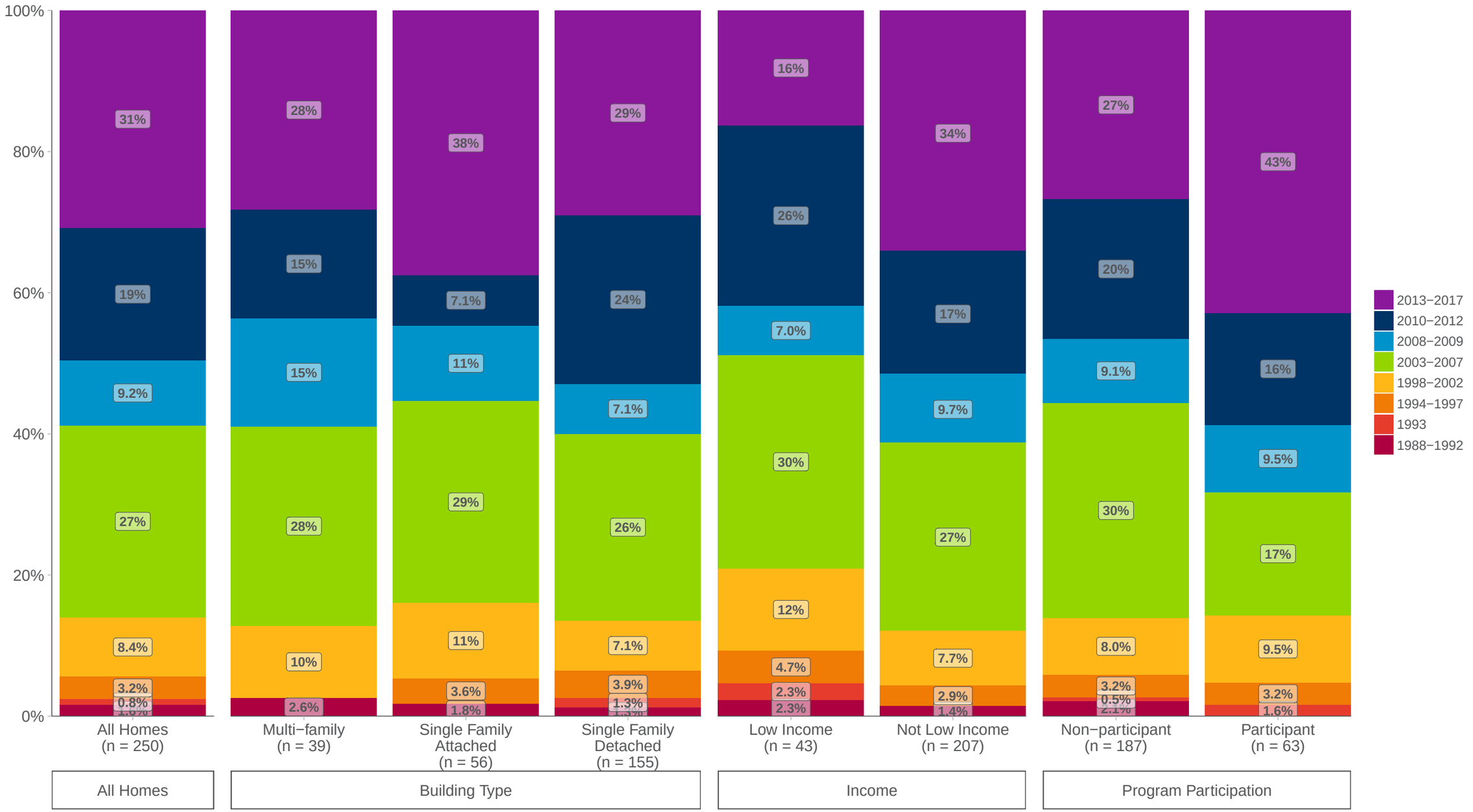
5.15 Dishwasher Year of Manufacture by Various Demographics



Source: Navigant Analysis

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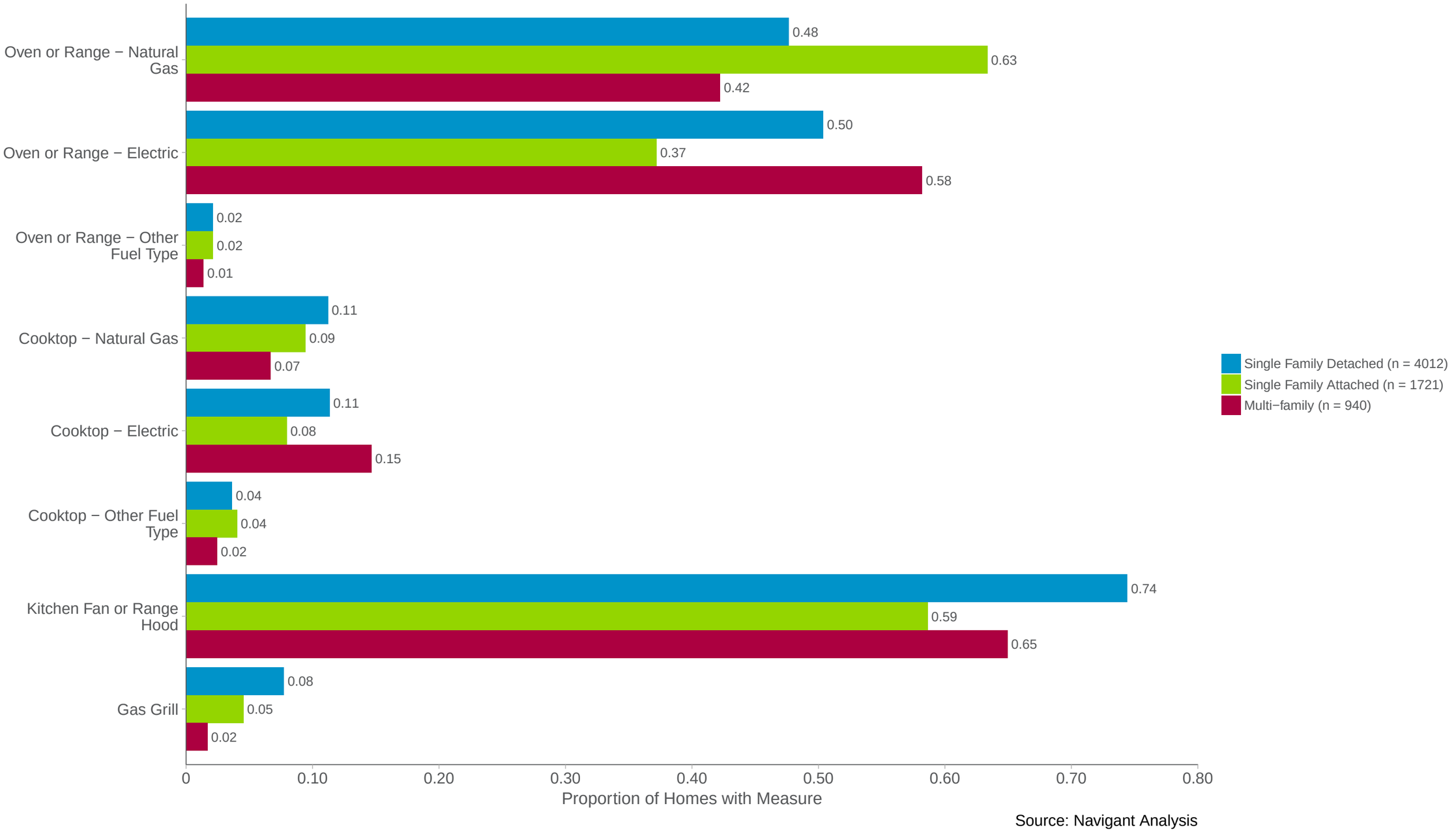
5.16 Adjusted and Weighted Proportion of Cooktops and Ranges by Building Type



Source: Navigant Analysis

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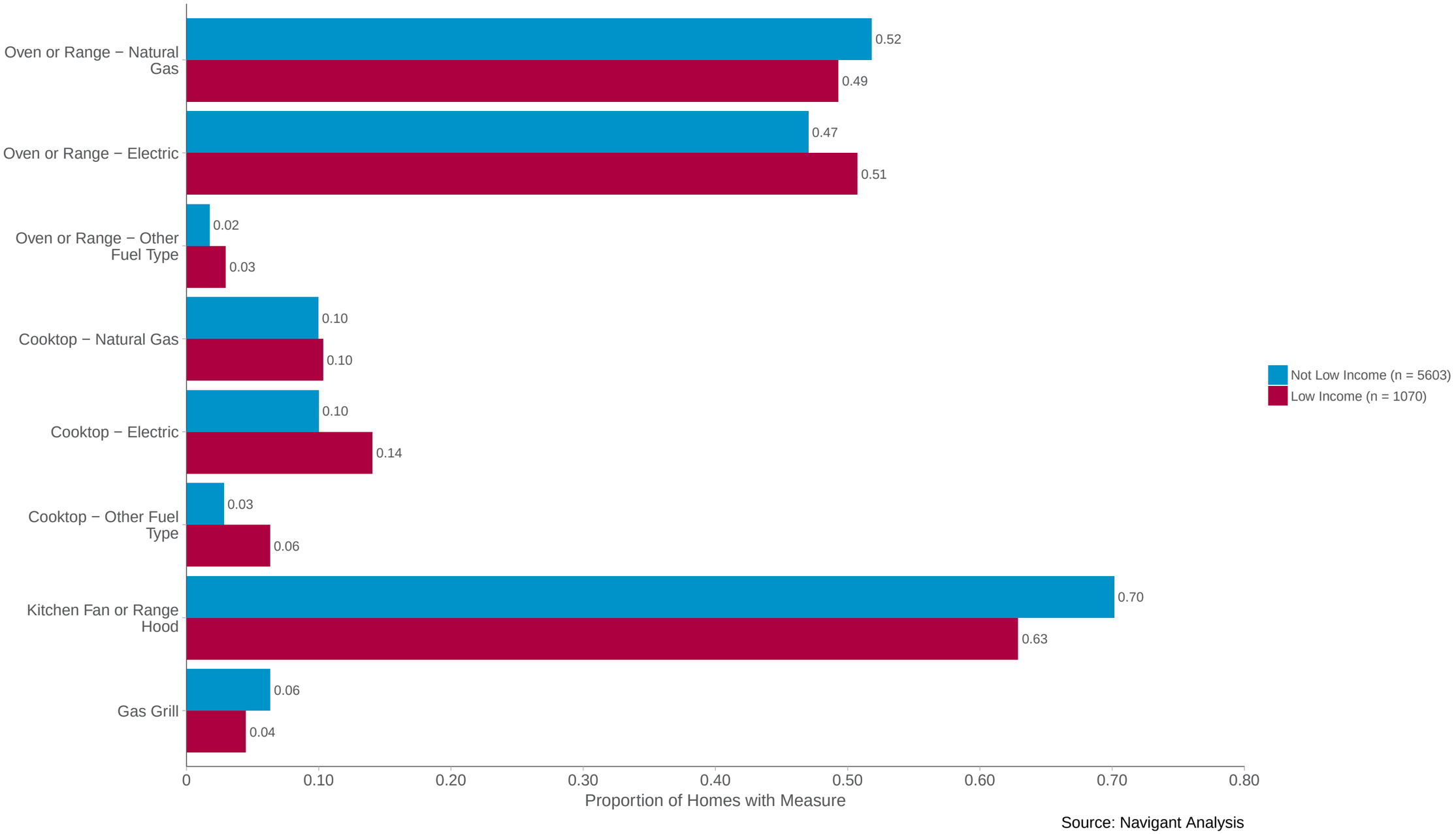
5.17 Adjusted and Weighted Proportion of Cooktops and Ranges by Income



Source: Navigant Analysis

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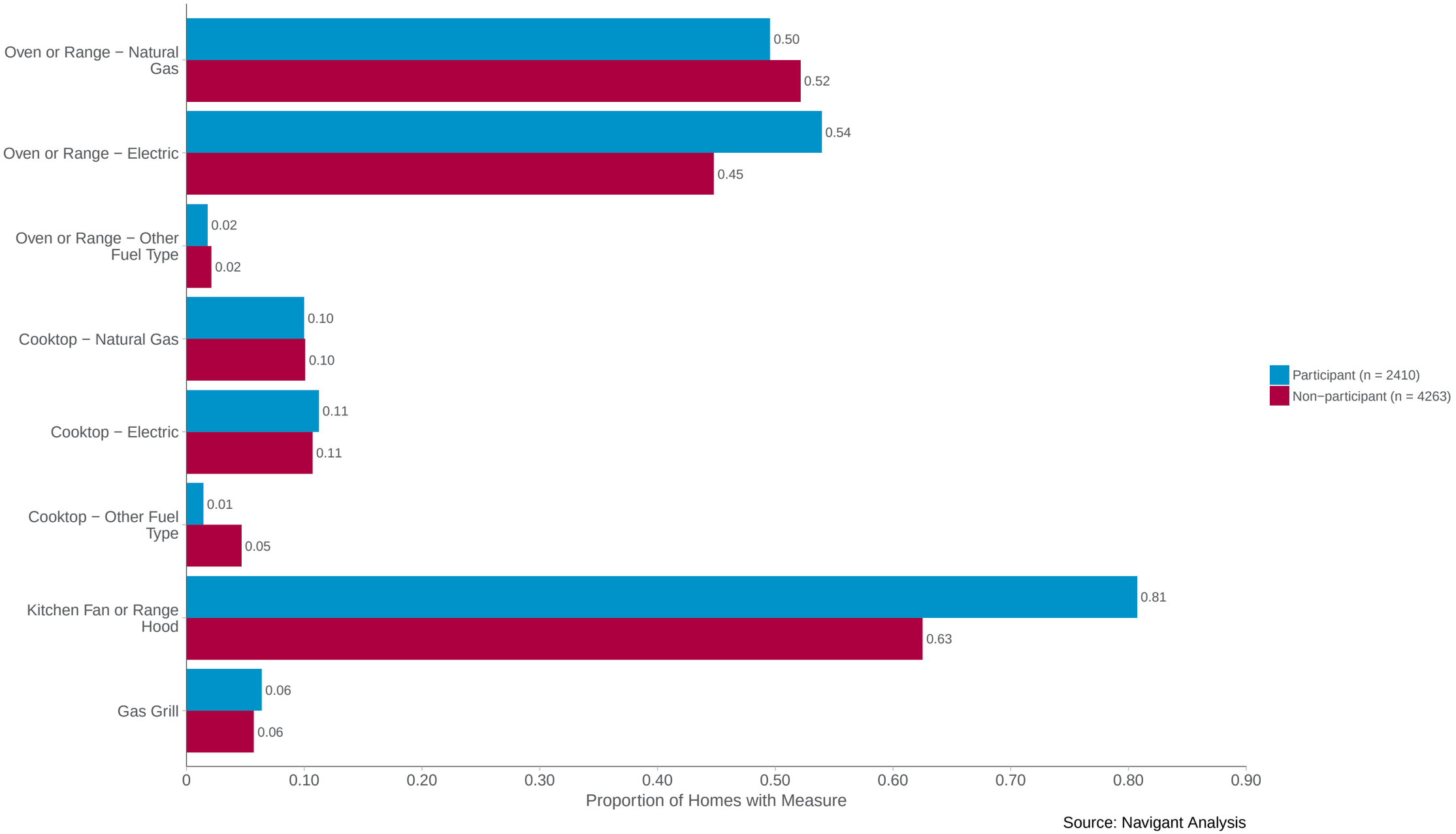
5.18 Adjusted and Weighted Proportion of Cooktops and Ranges by Participation



Source: Navigant Analysis

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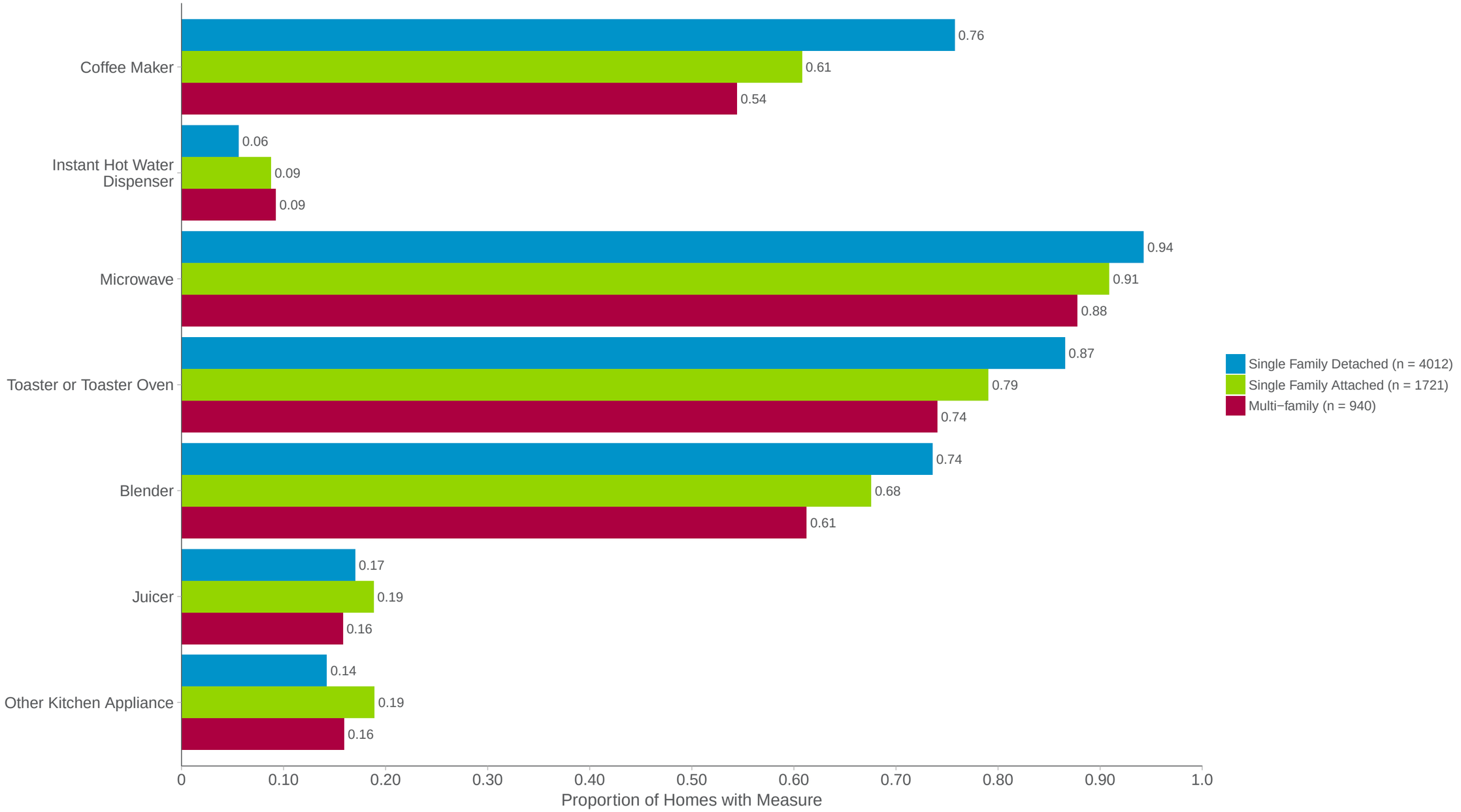
5.19 Adjusted and Weighted Proportion of Miscellaneous Kitchen Appliances by Building Type



Source: Navigant Analysis

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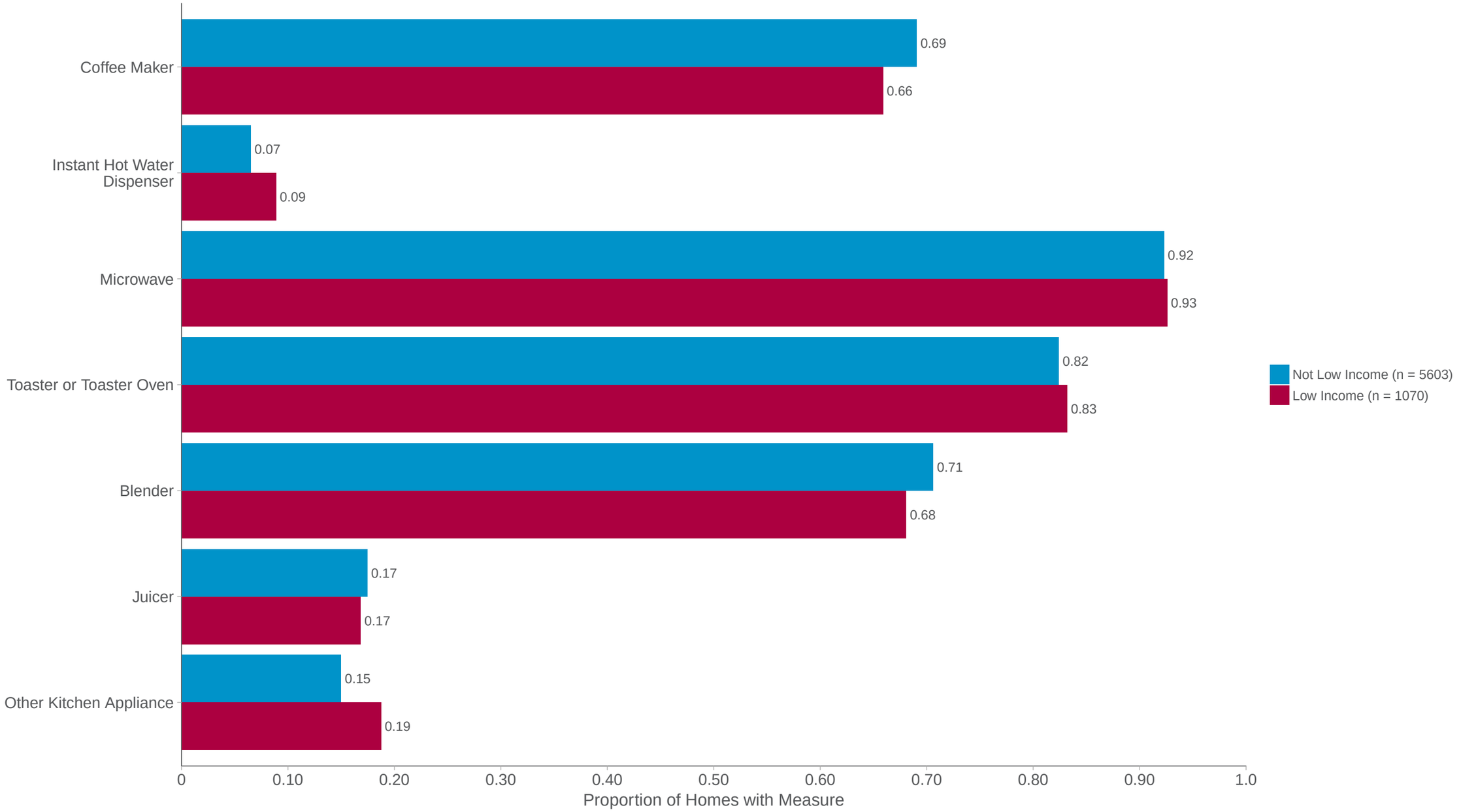
5.20 Adjusted and Weighted Proportion of Miscellaneous Kitchen Appliances by Income



Source: Navigant Analysis

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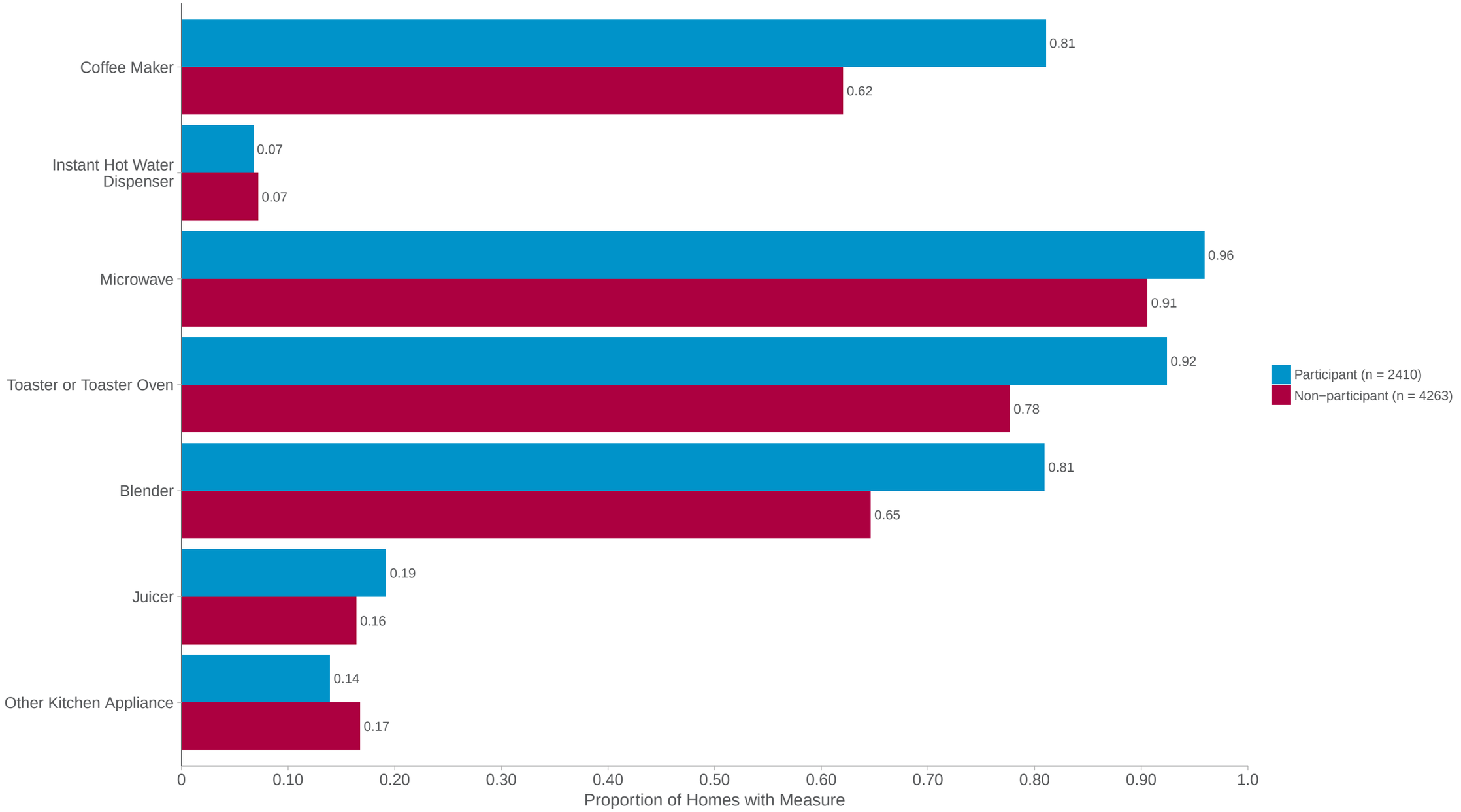
5.21 Adjusted and Weighted Proportion of Miscellaneous Kitchen Appliances by Participation



Source: Navigant Analysis

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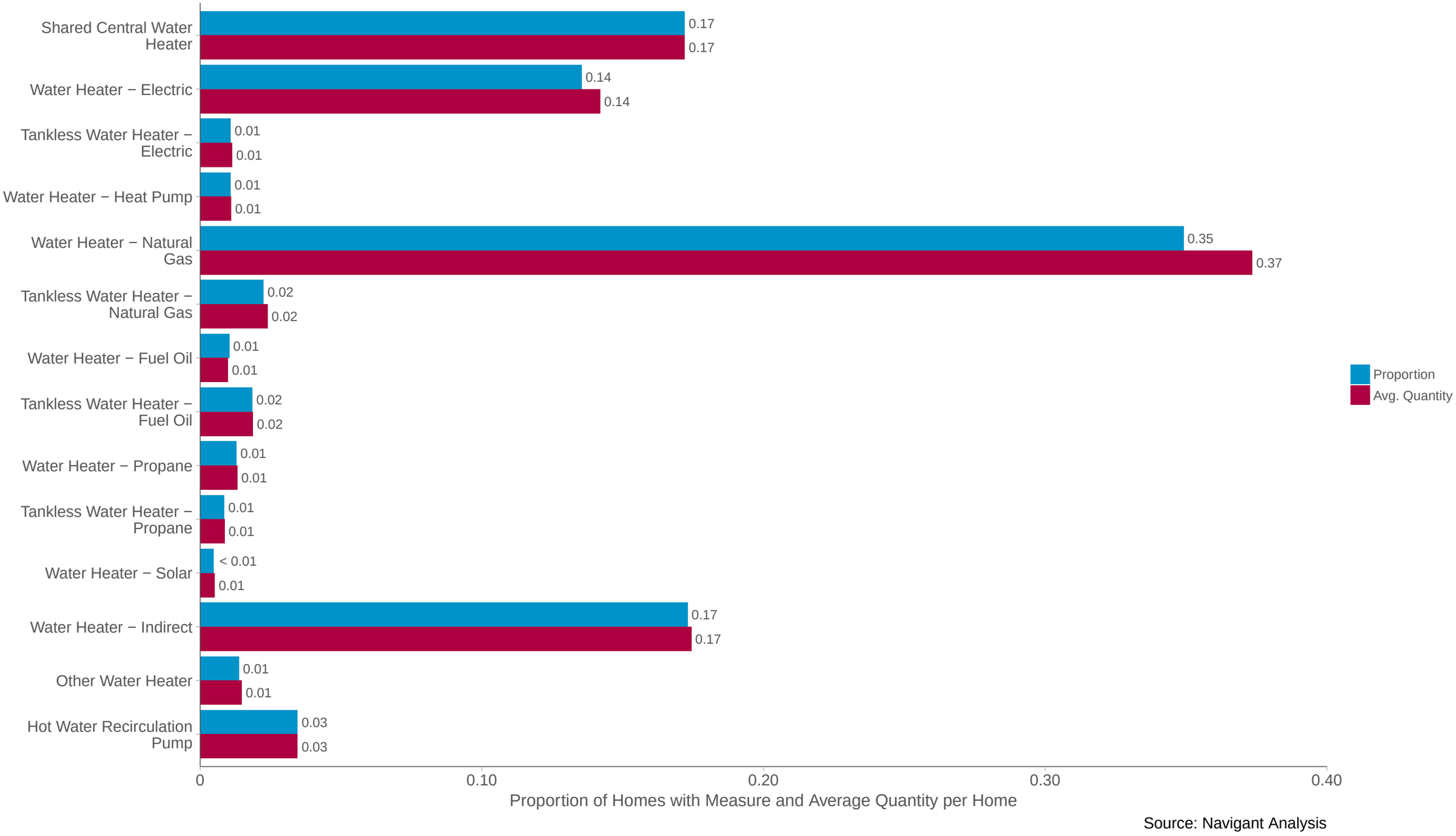
6 Domestic Hot Water

6.1 Adjusted and Weighted Proportion and Average Quantity of Water Heaters



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

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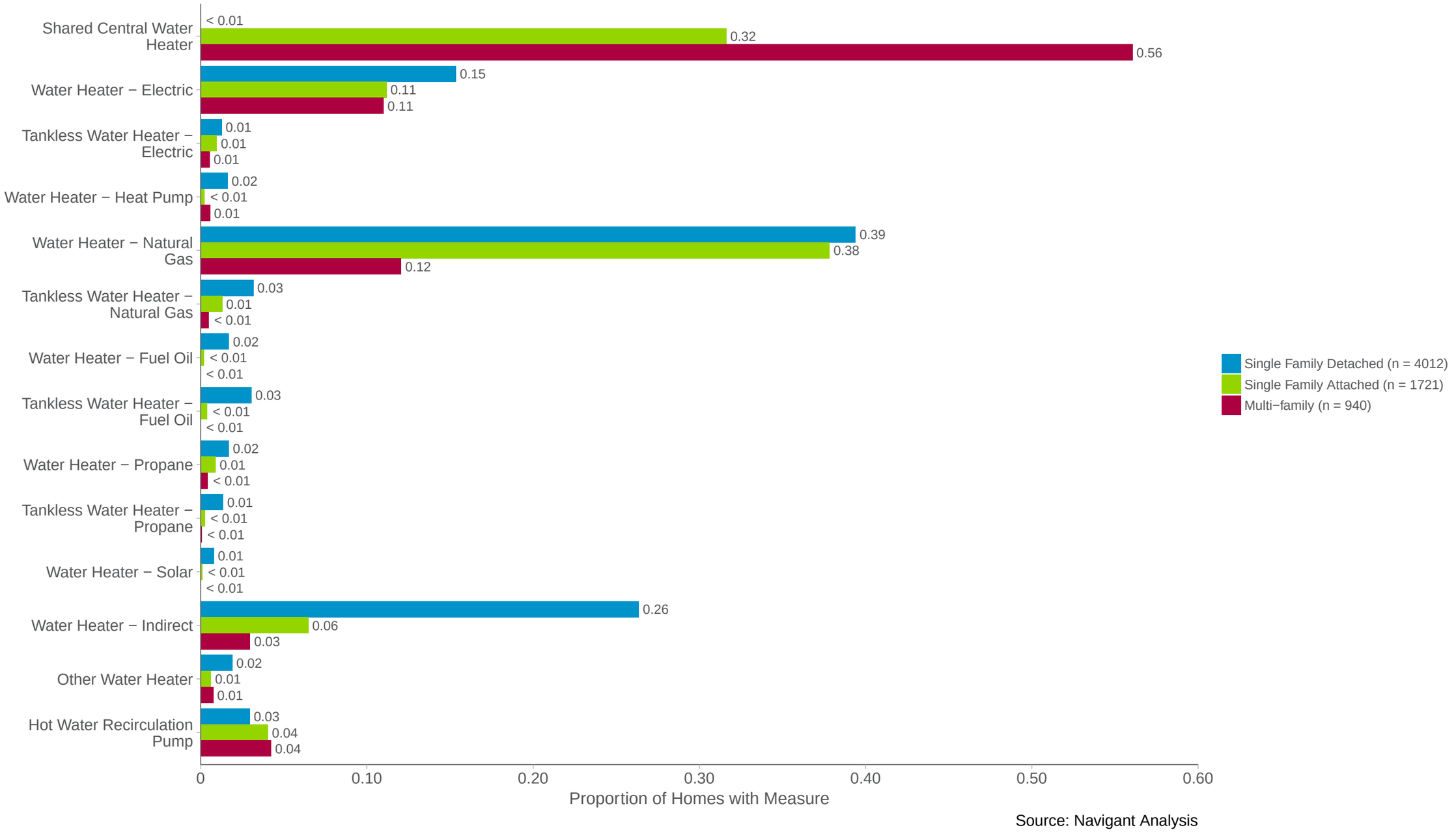
6.2 Adjusted and Weighted Proportion of Water Heaters by Building Type



Source: Navigant Analysis

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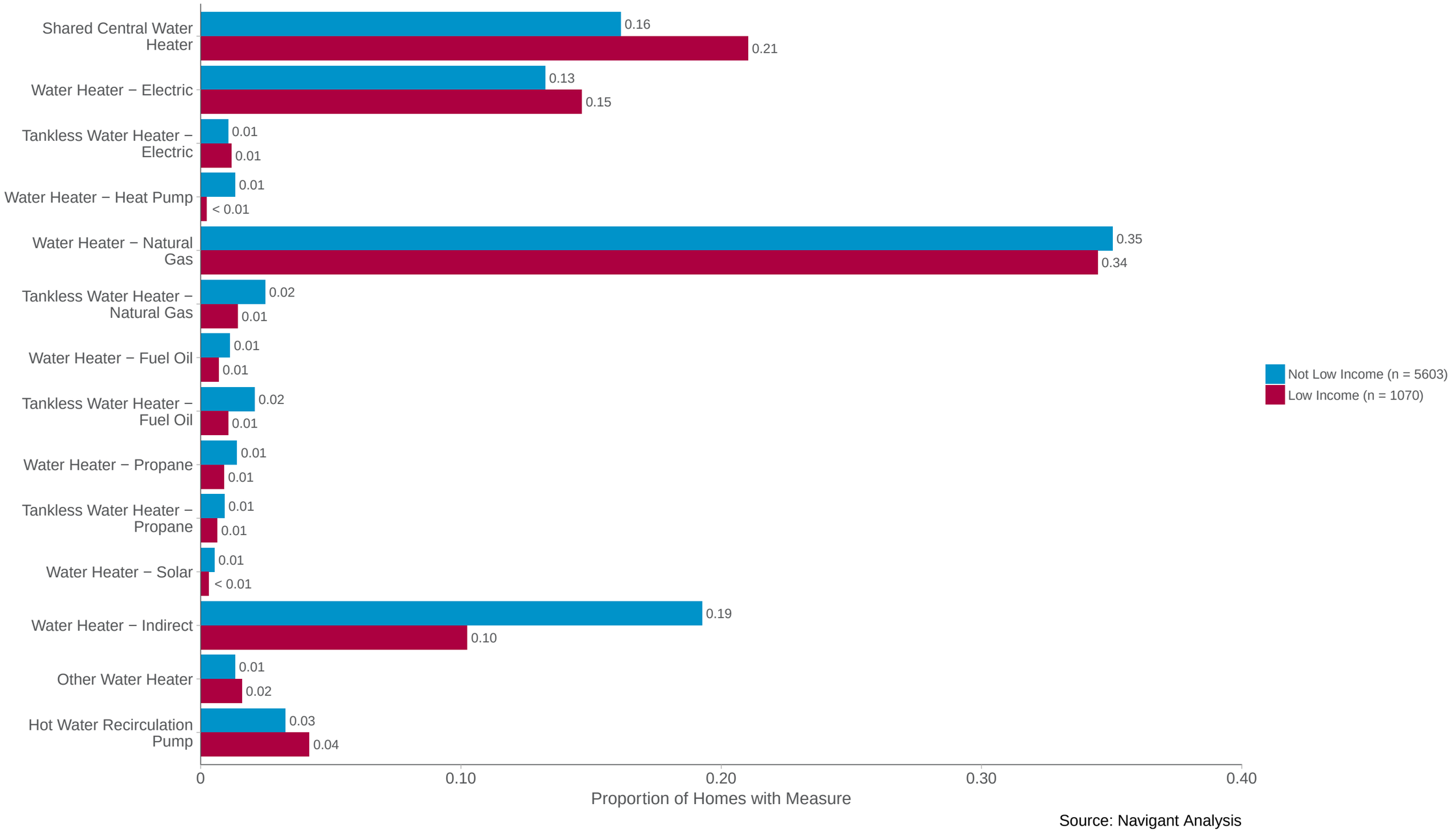
6.3 Adjusted and Weighted Proportion of Water Heaters by Income



Source: Navigant Analysis

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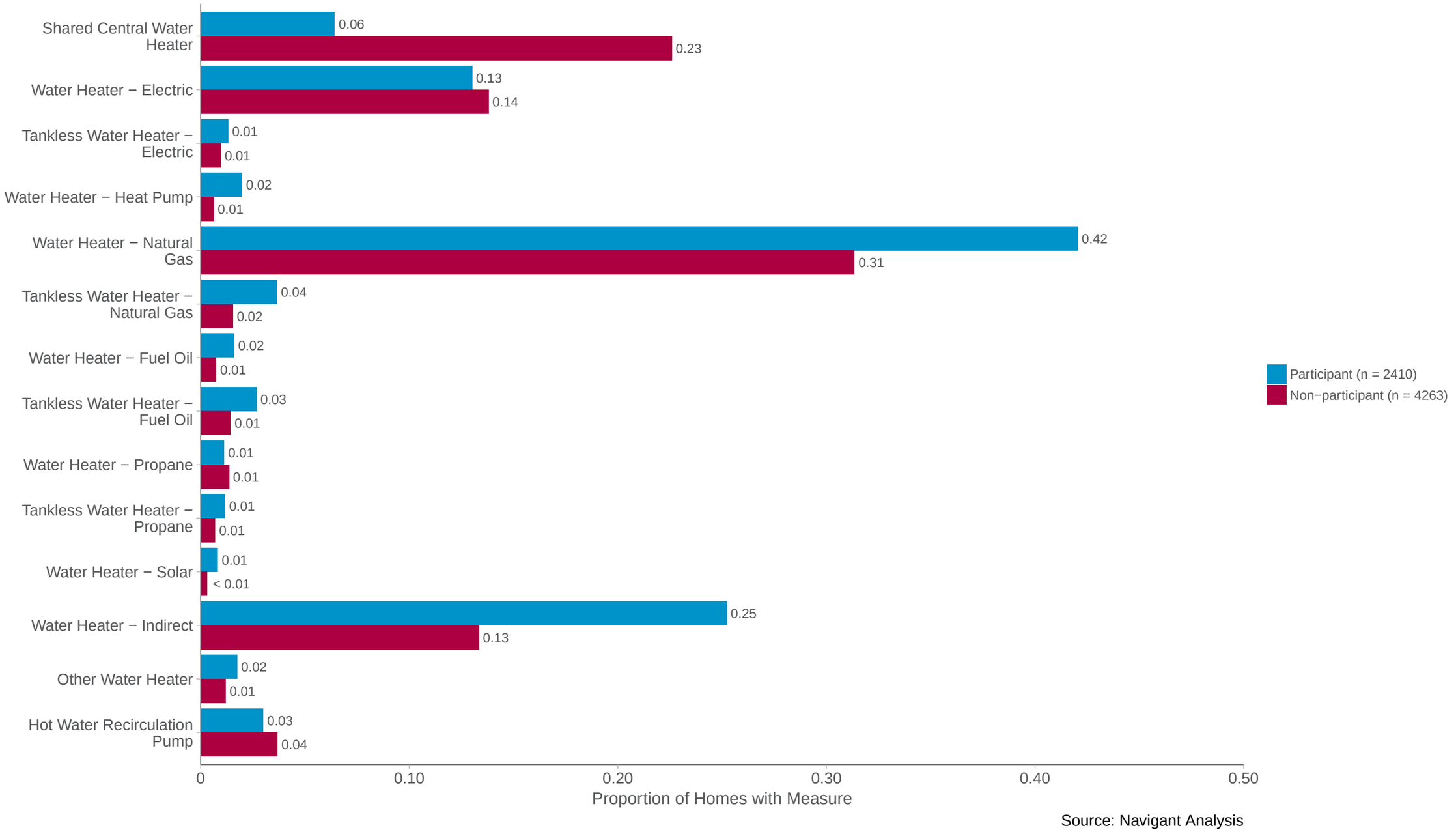
6.4 Adjusted and Weighted Proportion of Water Heaters by Participation



Source: Navigant Analysis

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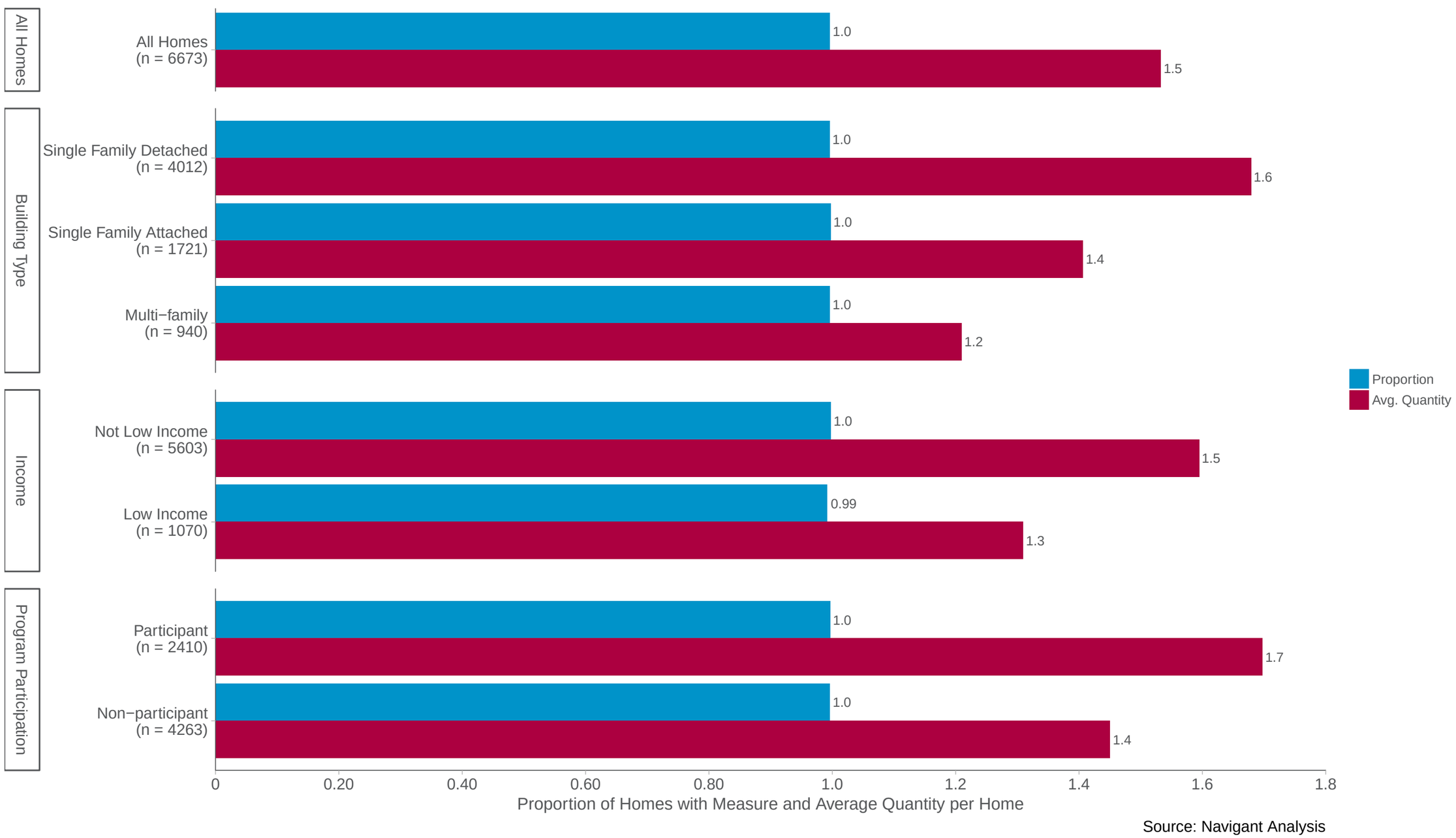
6.5 Adjusted and Weighted Proportion and Average Quantity of Showerheads by Various Demographics



Source: Navigant Analysis

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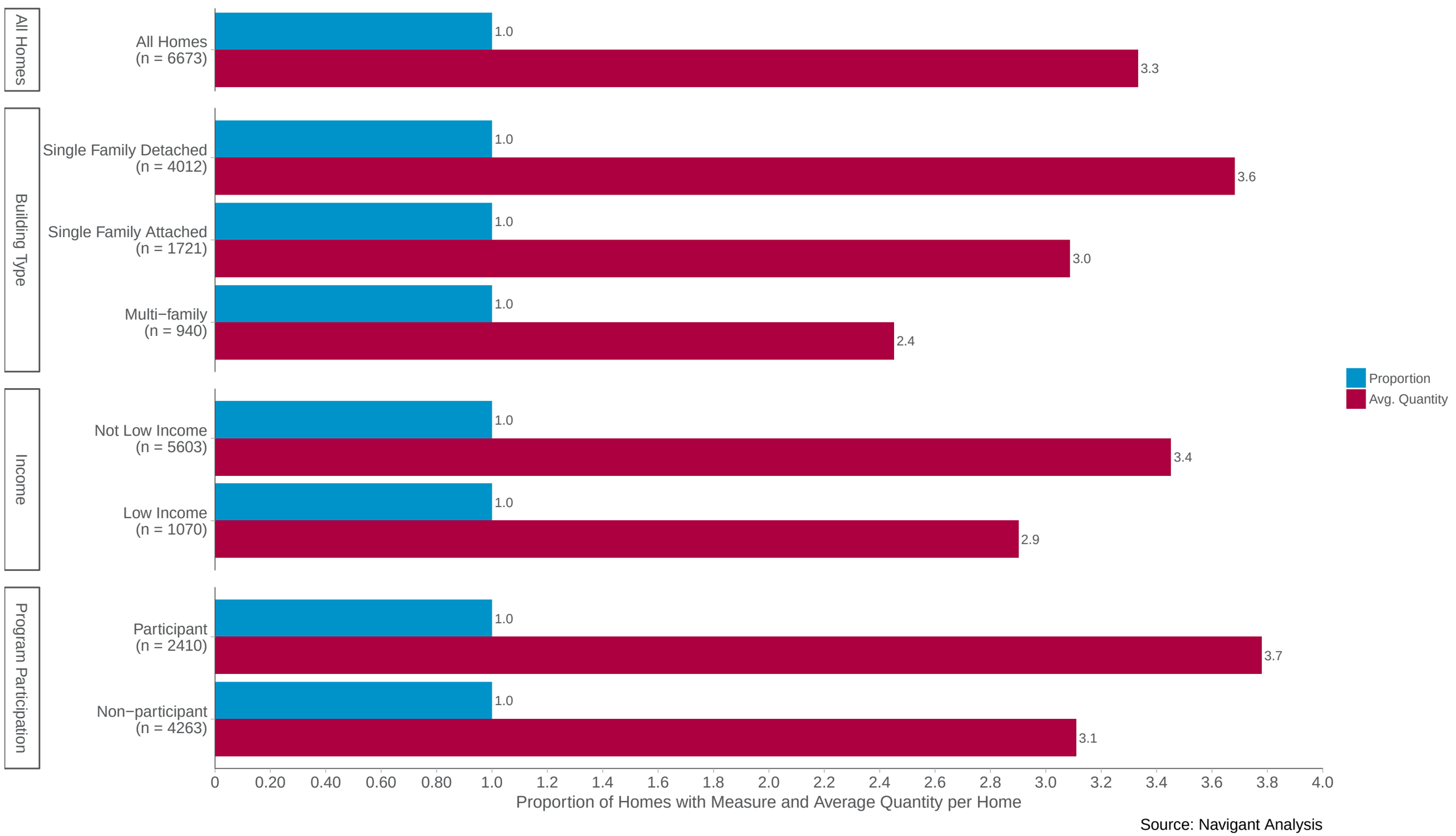
6.6 Adjusted and Weighted Proportion and Average Quantity of Sink Faucets by Various Demographics



Source: Navigant Analysis

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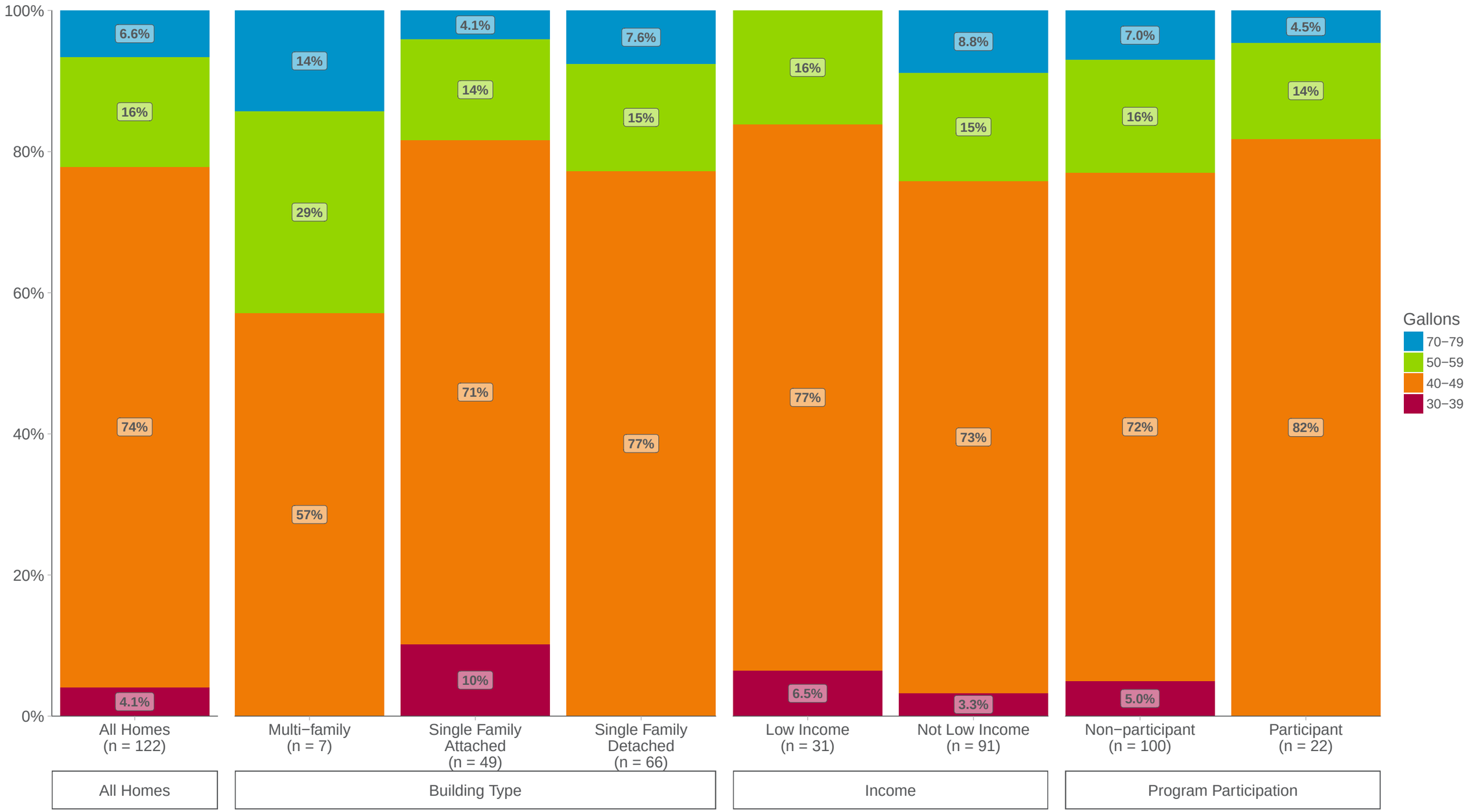
6.7 Natural Gas Water Heater Volume by Various Demographics



Source: Navigant Analysis

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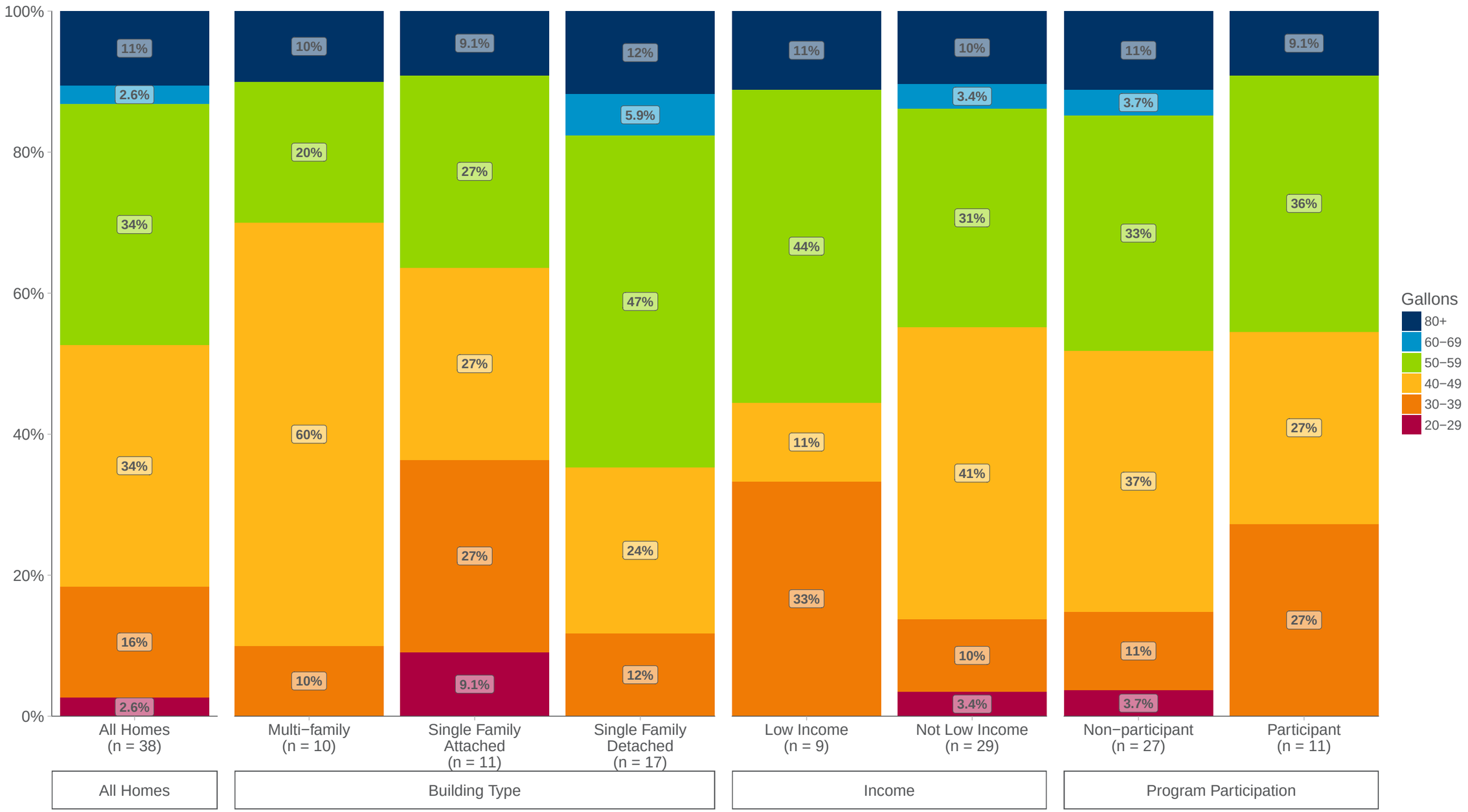
6.8 Electric Water Heater Volume by Various Demographics



Source: Navigant Analysis

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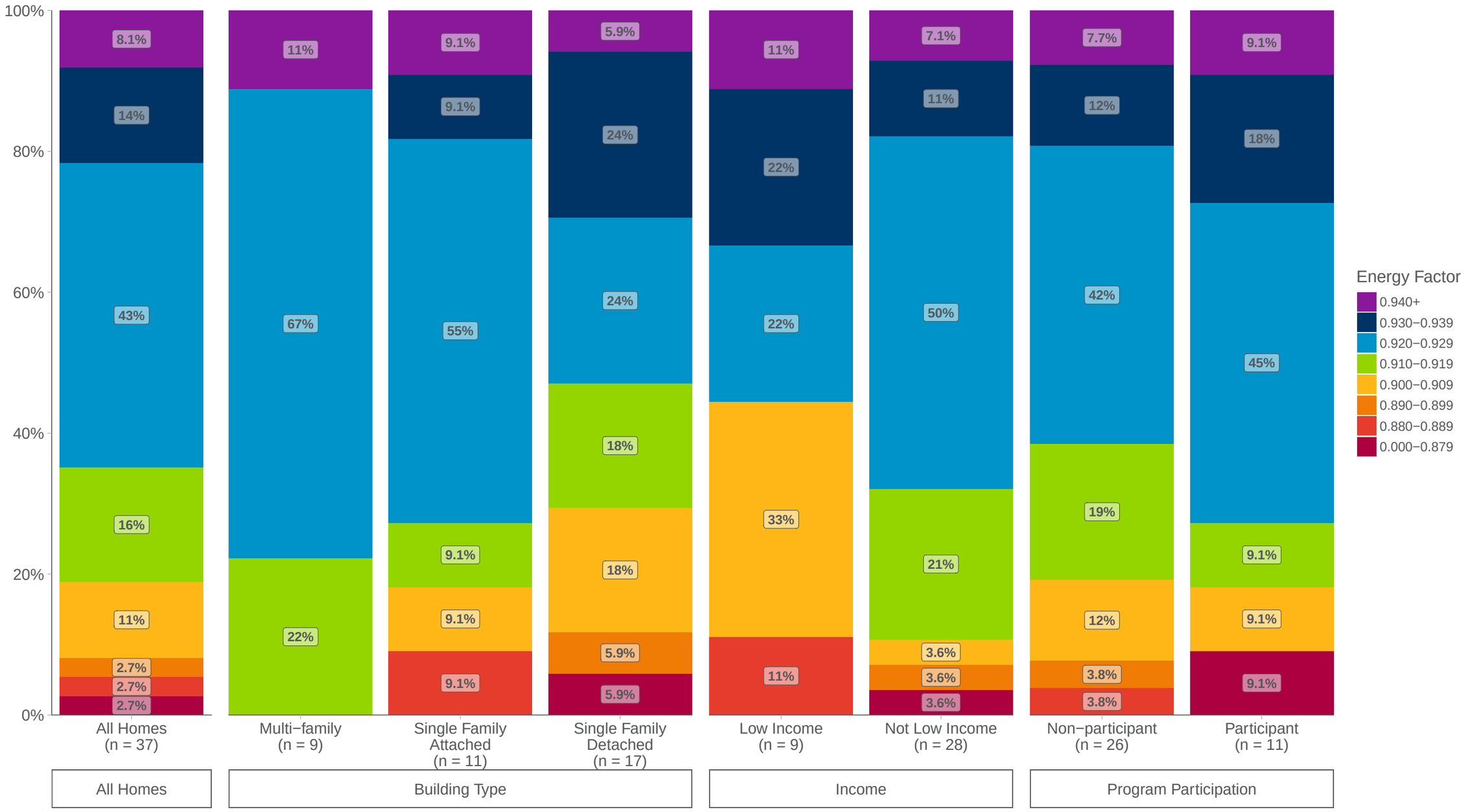
6.9 Electric Water Heater Energy Factor by Various Demographics



Source: Navigant Analysis

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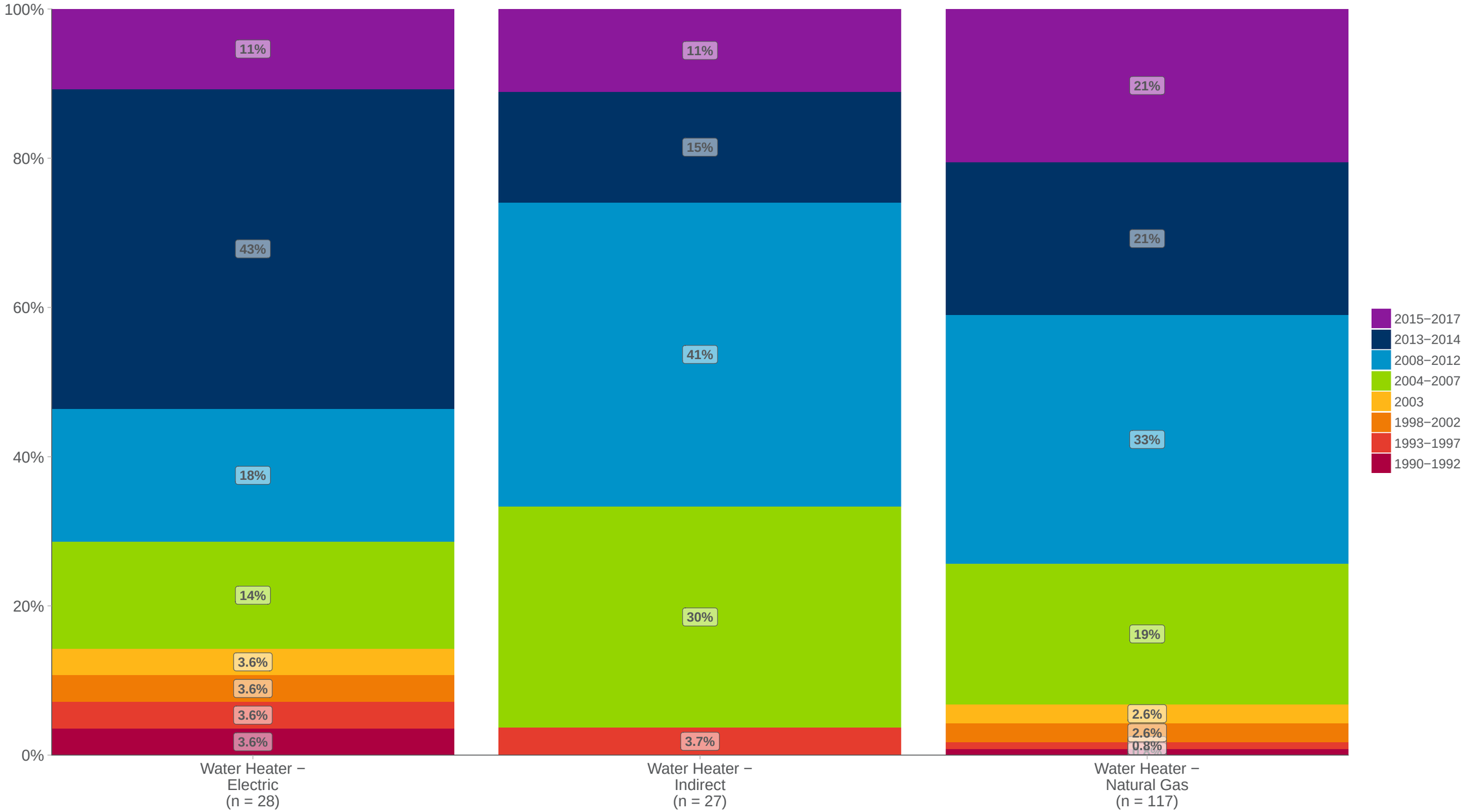
6.10 Water Heater Year of Manufacture



Source: Navigant Analysis

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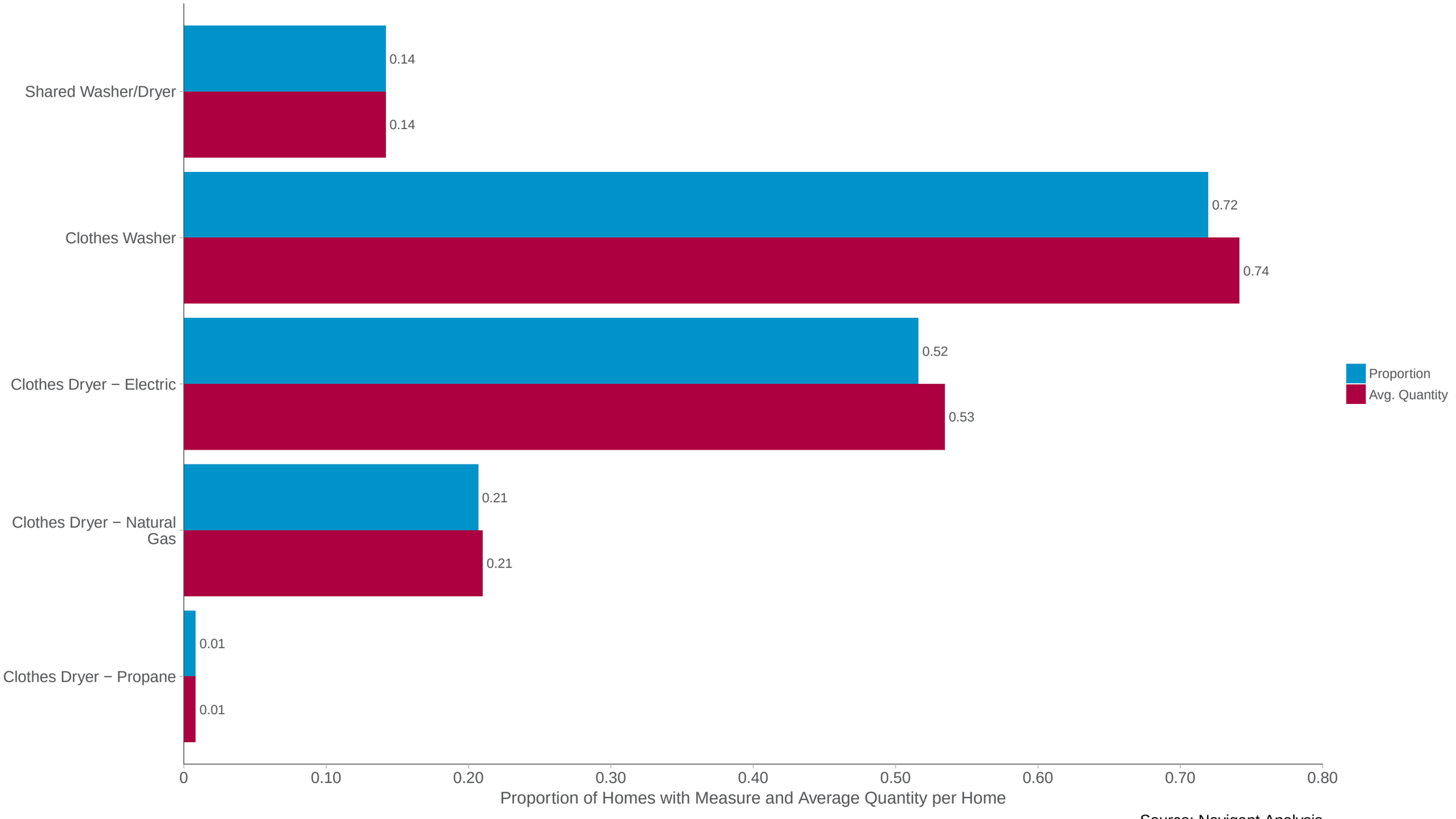
7 Laundry

7.1 Adjusted and Weighted Proportion and Average Quantity of Laundry Appliances



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

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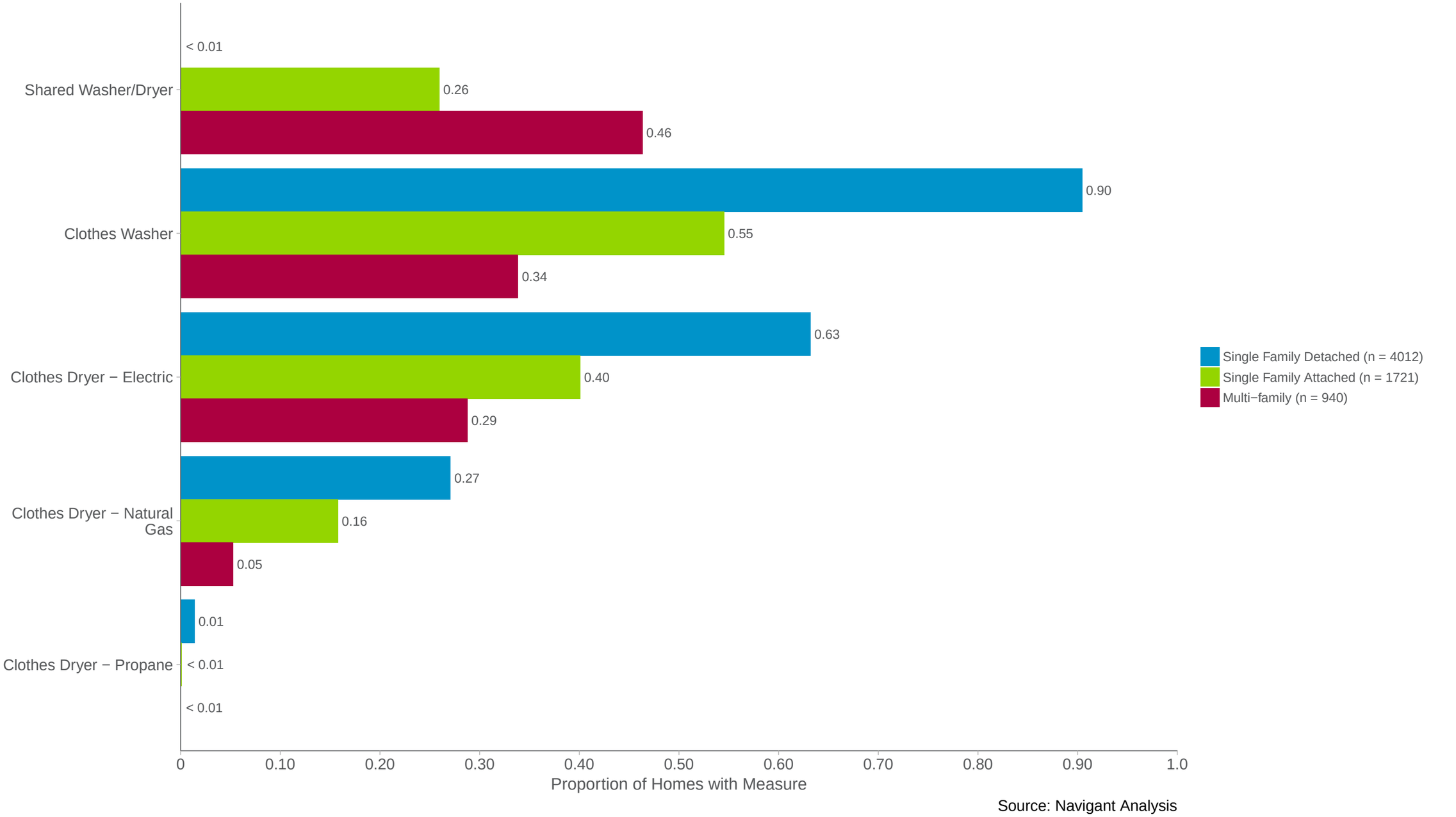
7.2 Adjusted and Weighted Proportion of Laundry Appliances by Building Type



Source: Navigant Analysis

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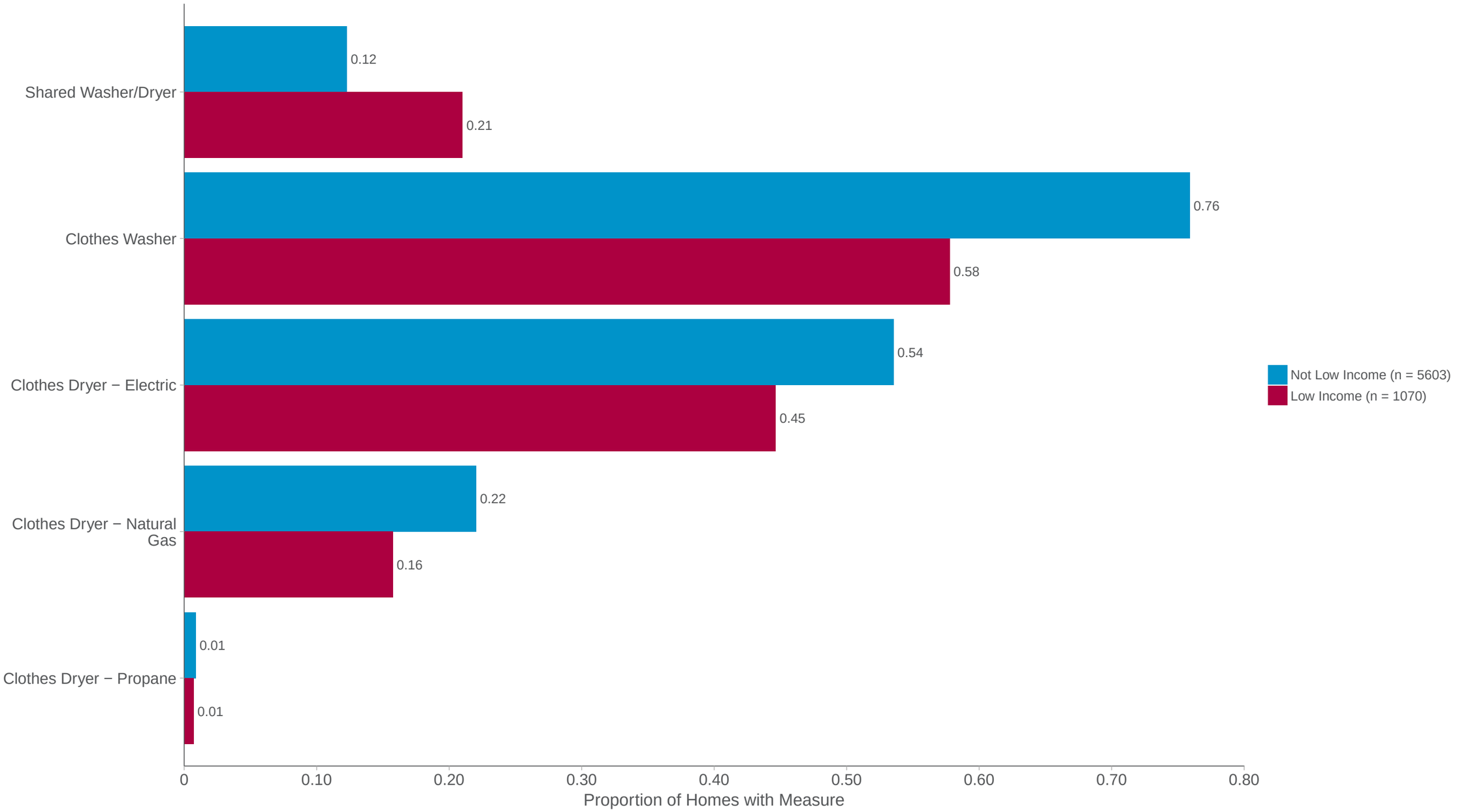
7.3 Adjusted and Weighted Proportion of Laundry Appliances by Income



Source: Navigant Analysis

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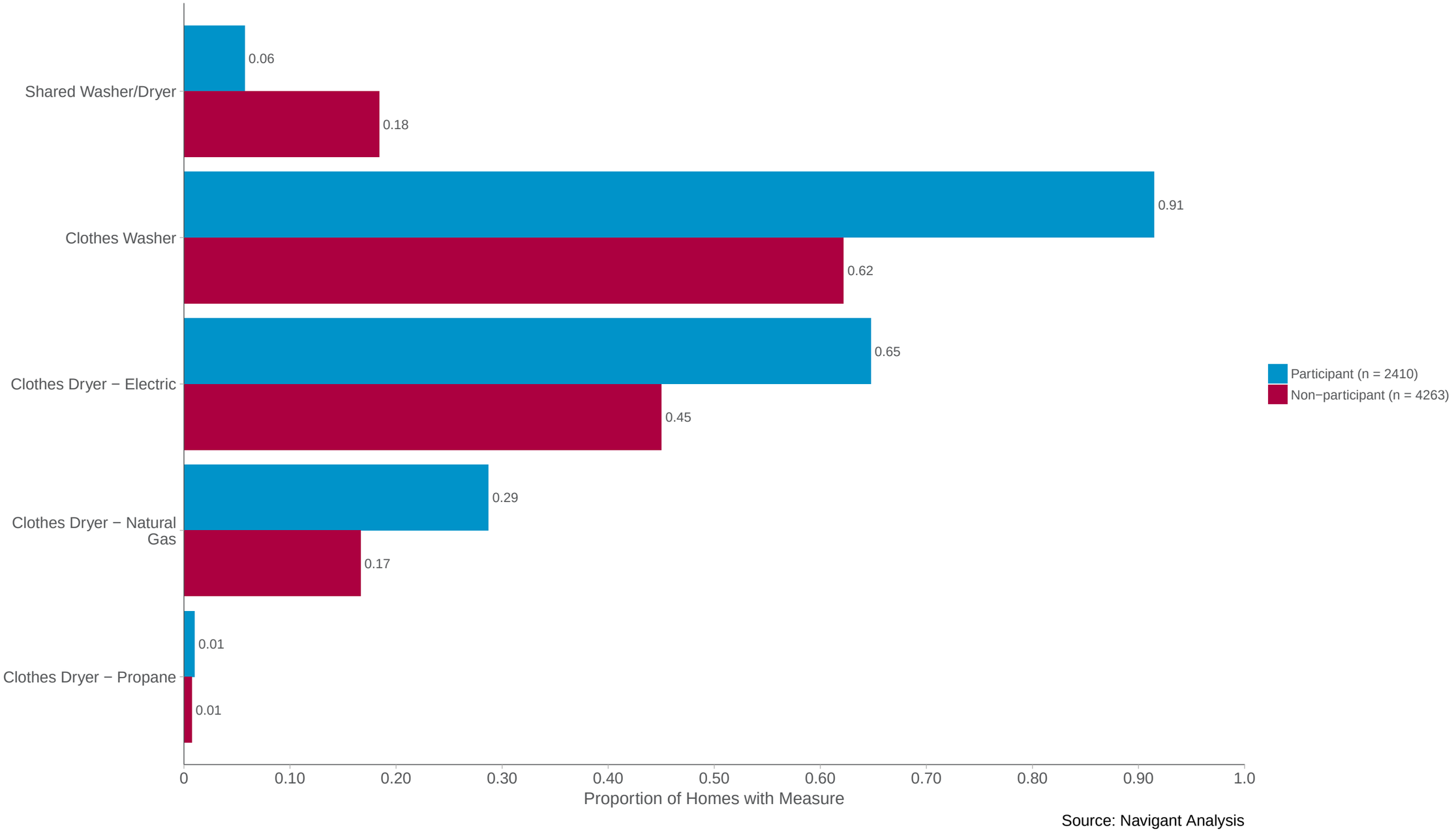
7.4 Adjusted and Weighted Proportion of Laundry Appliances by Participation



Source: Navigant Analysis

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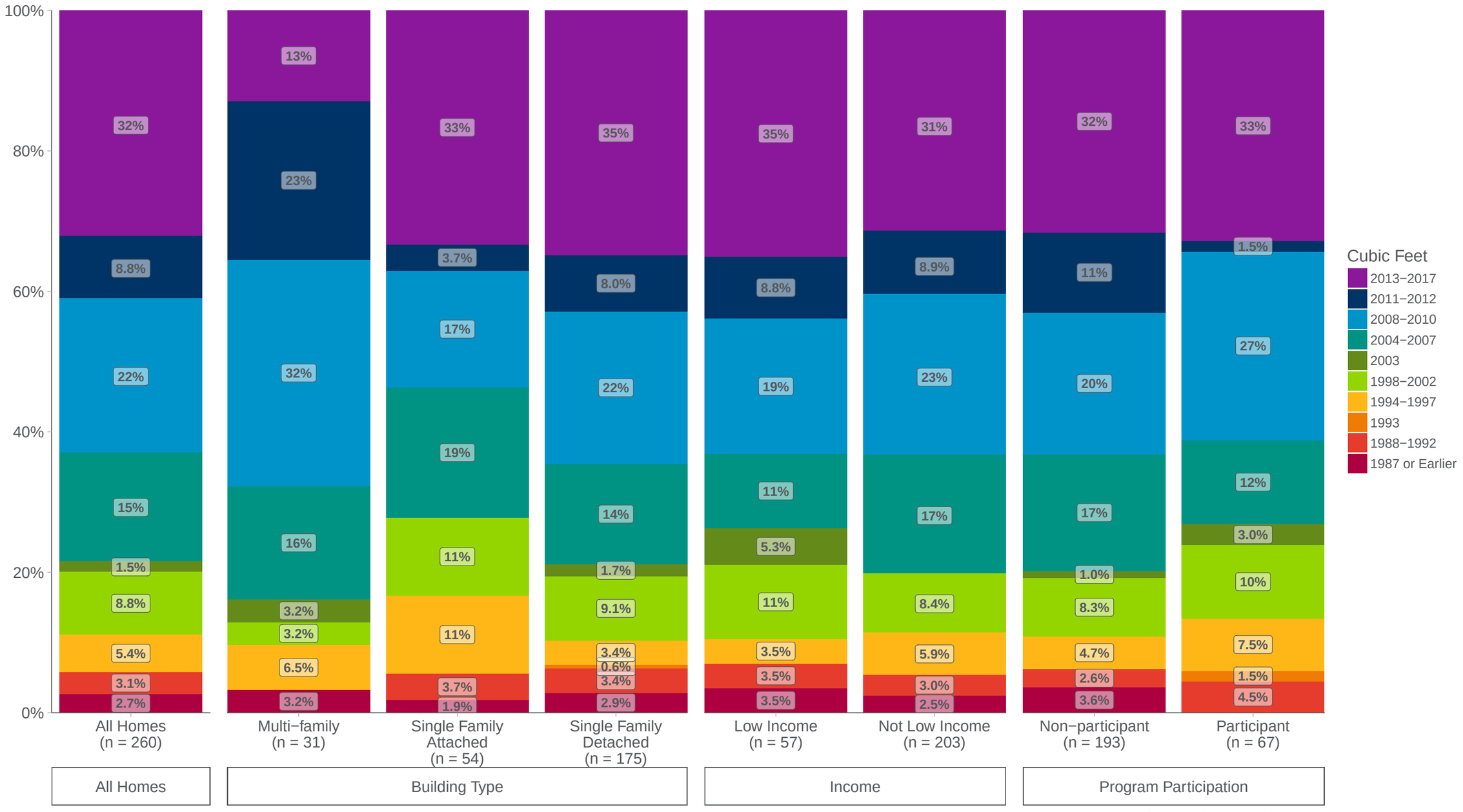
7.5 Clothes Washer Capacity by Various Demographics



Source: Navigant Analysis

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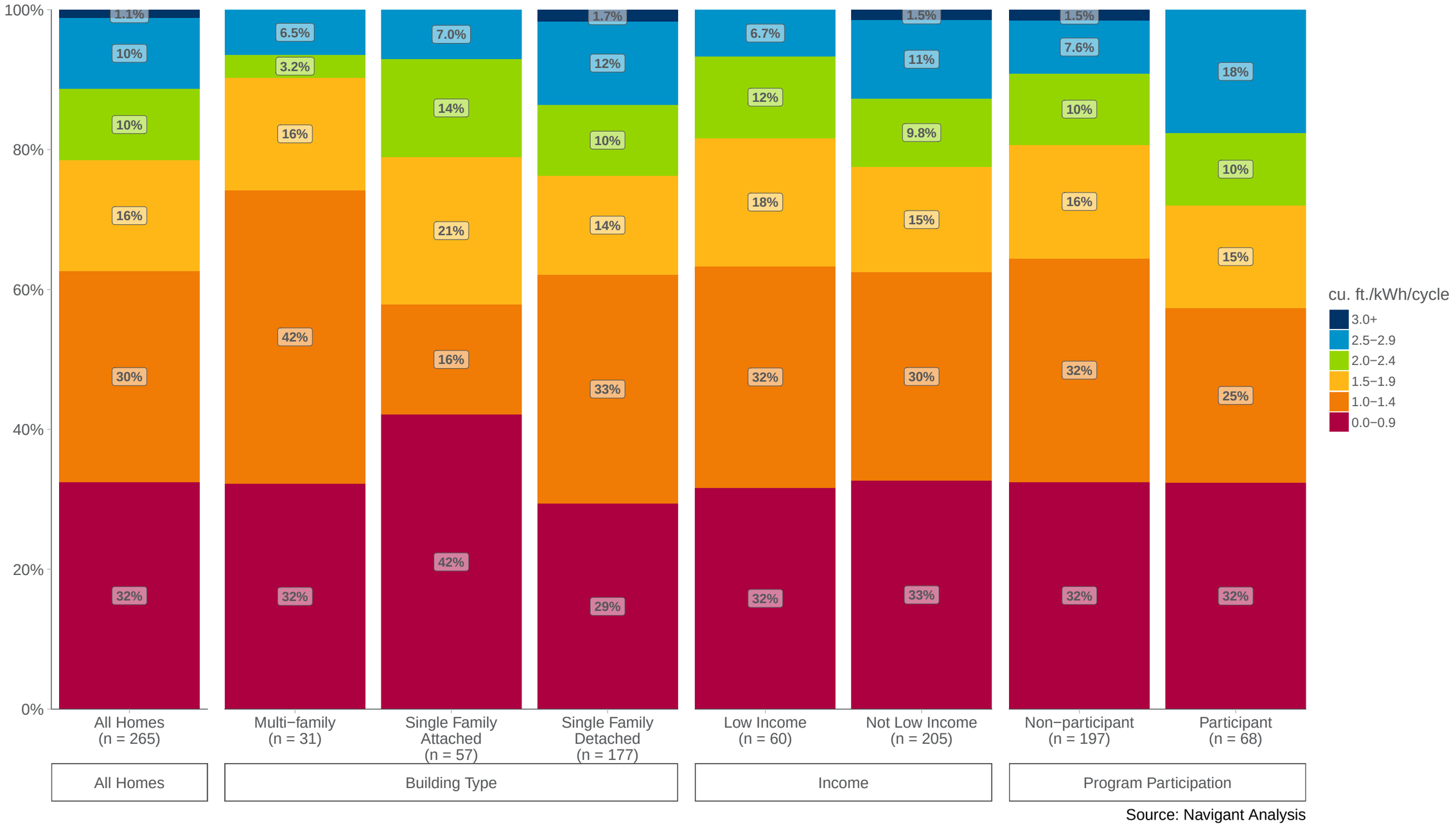
7.6 Clothes Washer Integrated Modified Energy Factor by Various Demographics



Source: Navigant Analysis

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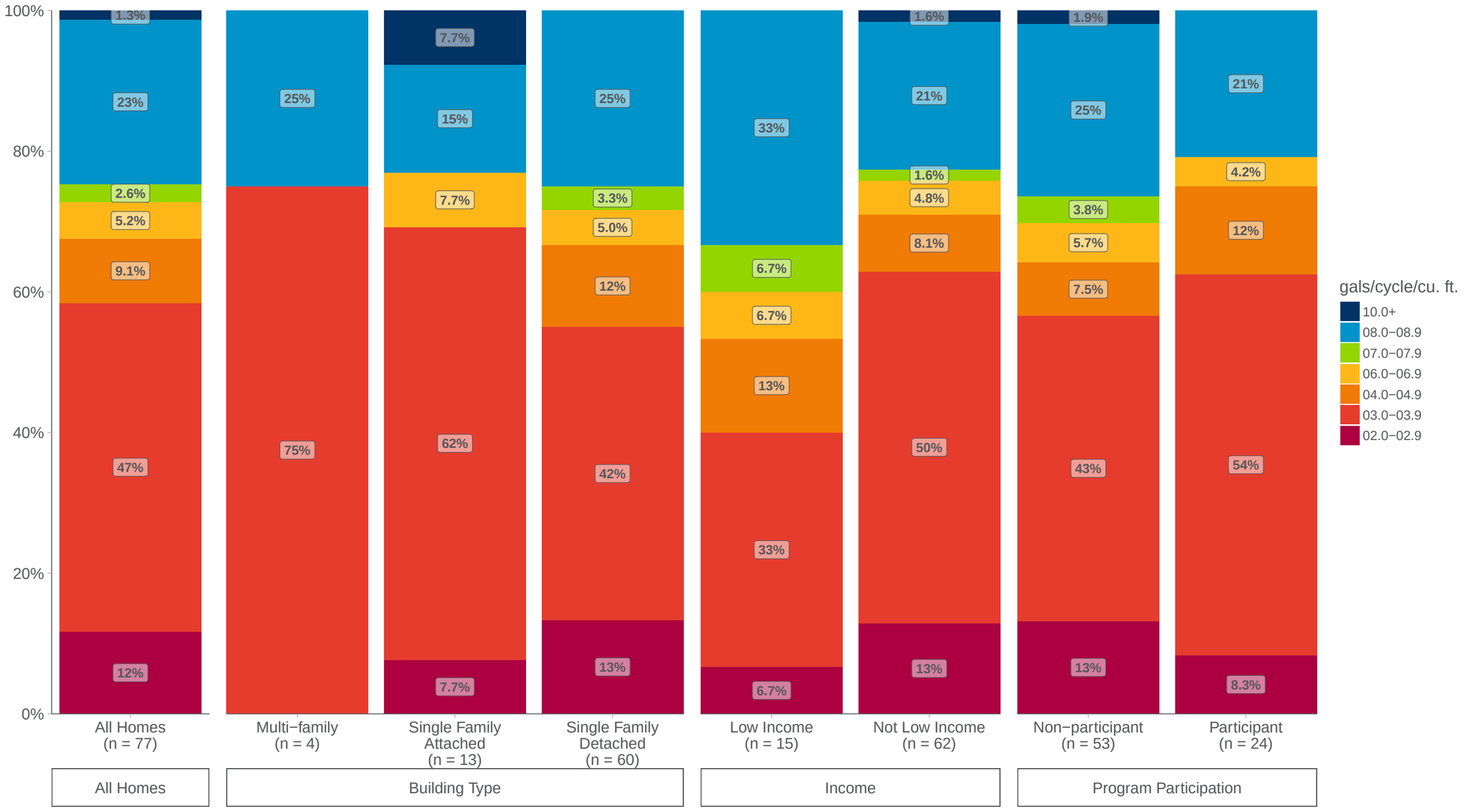
7.7 Clothes Washer Integrated Water Factor by Various Demographics



Source: Navigant Analysis

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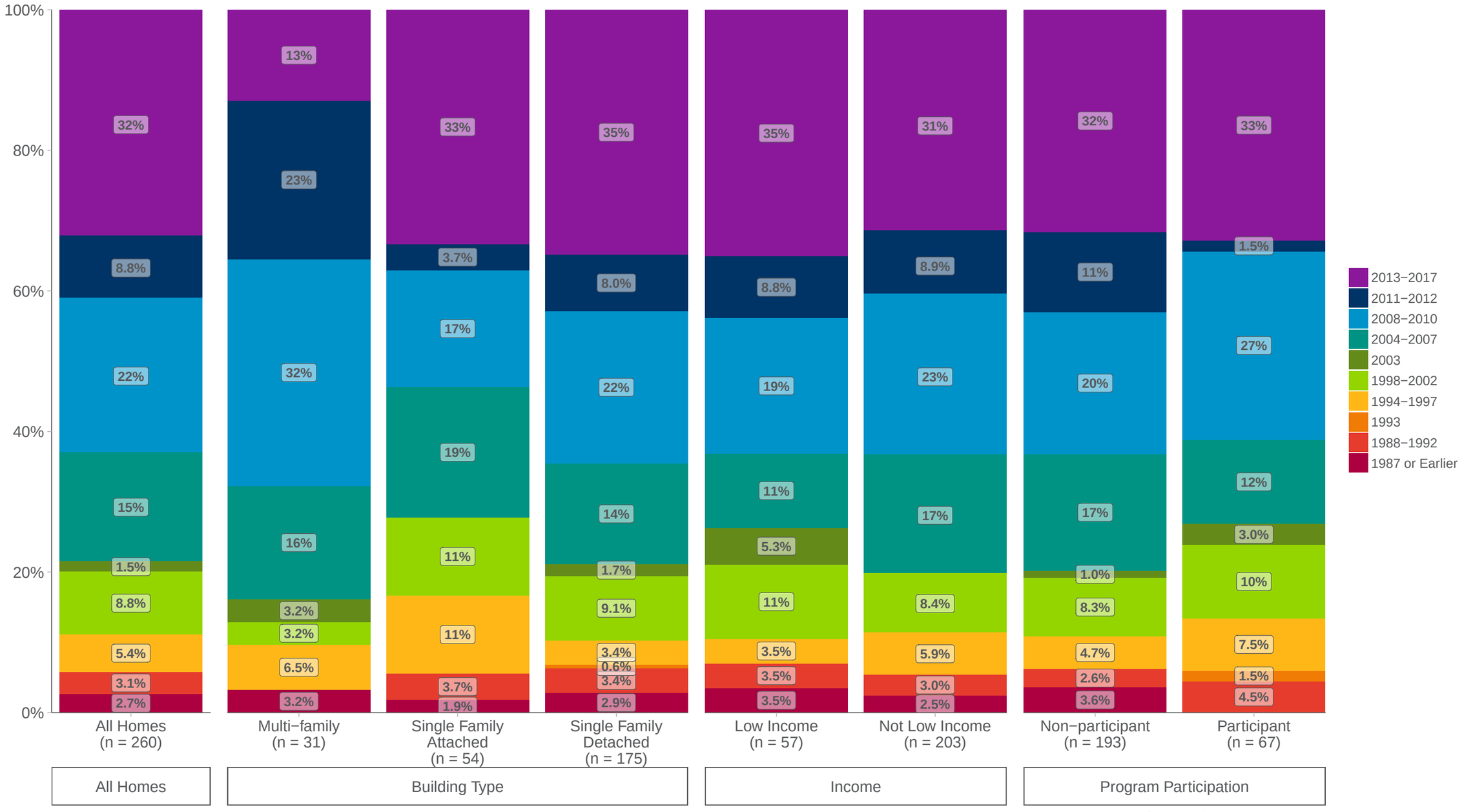
7.8 Clothes Washer Year of Manufacture by Various Demographics



Source: Navigant Analysis

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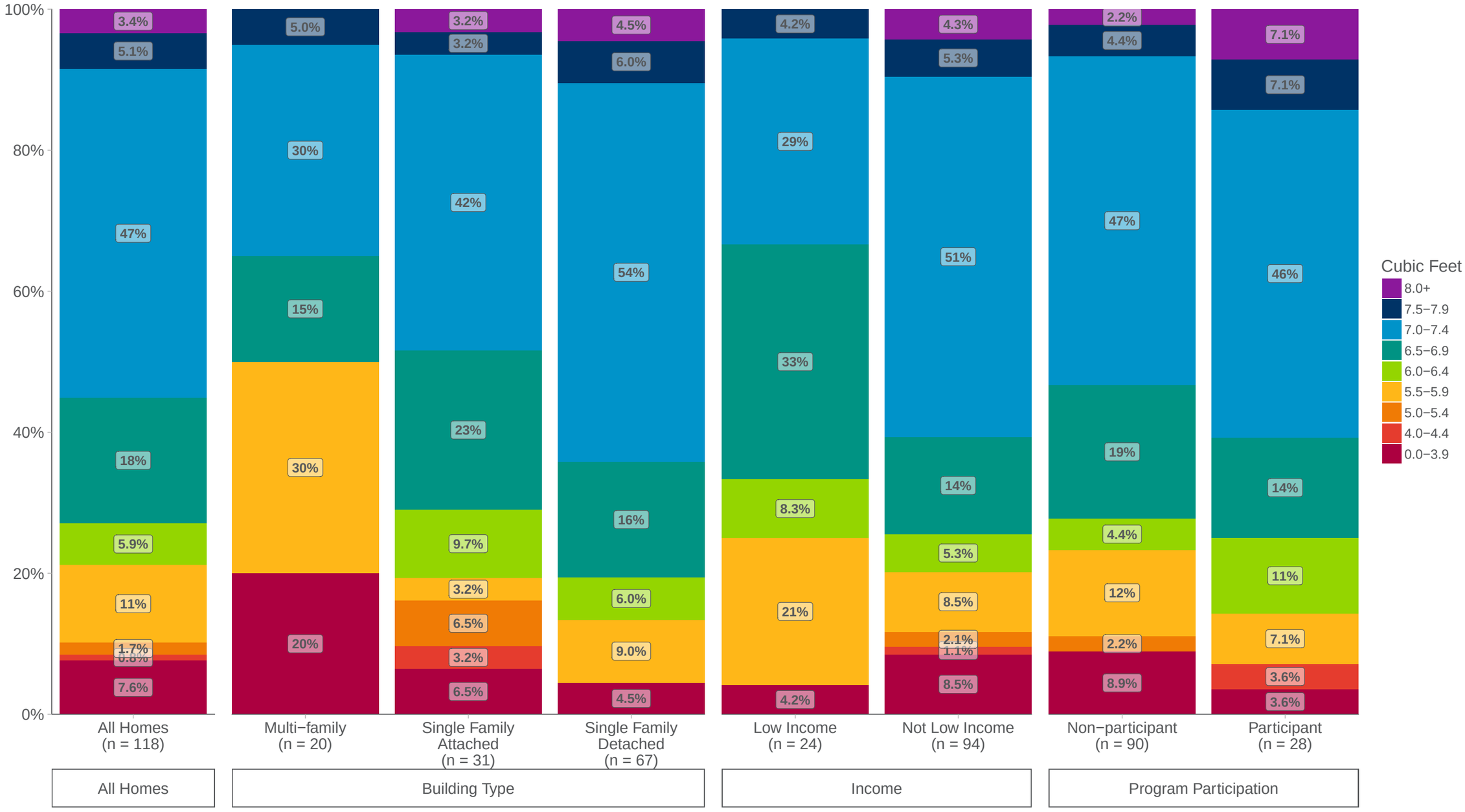
7.9 Electric Clothes Dryer Capacity by Various Demographics



Source: Navigant Analysis

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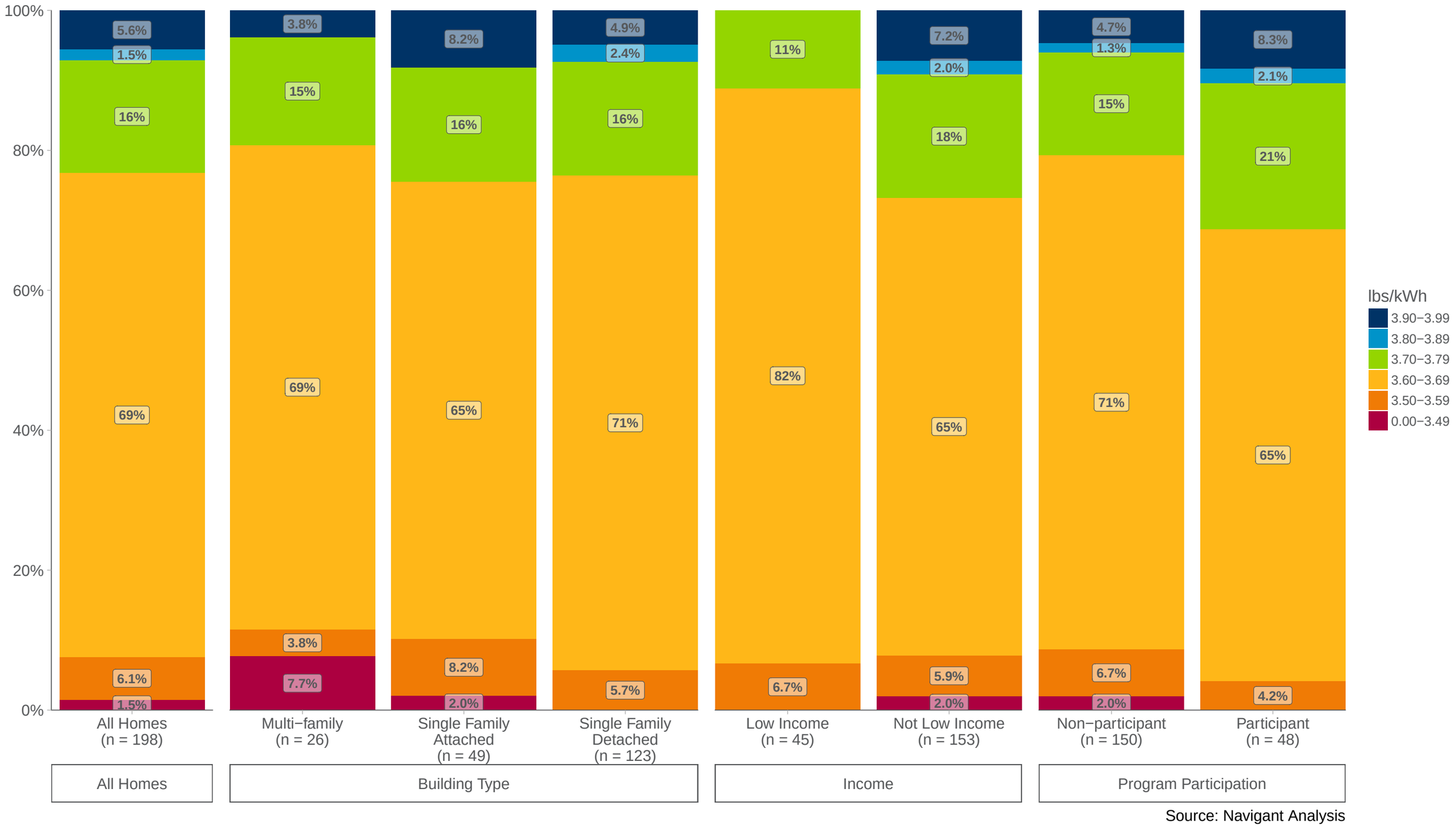
7.10 Electric Clothes Dryer Combined Energy Factor by Various Demographics



Source: Navigant Analysis

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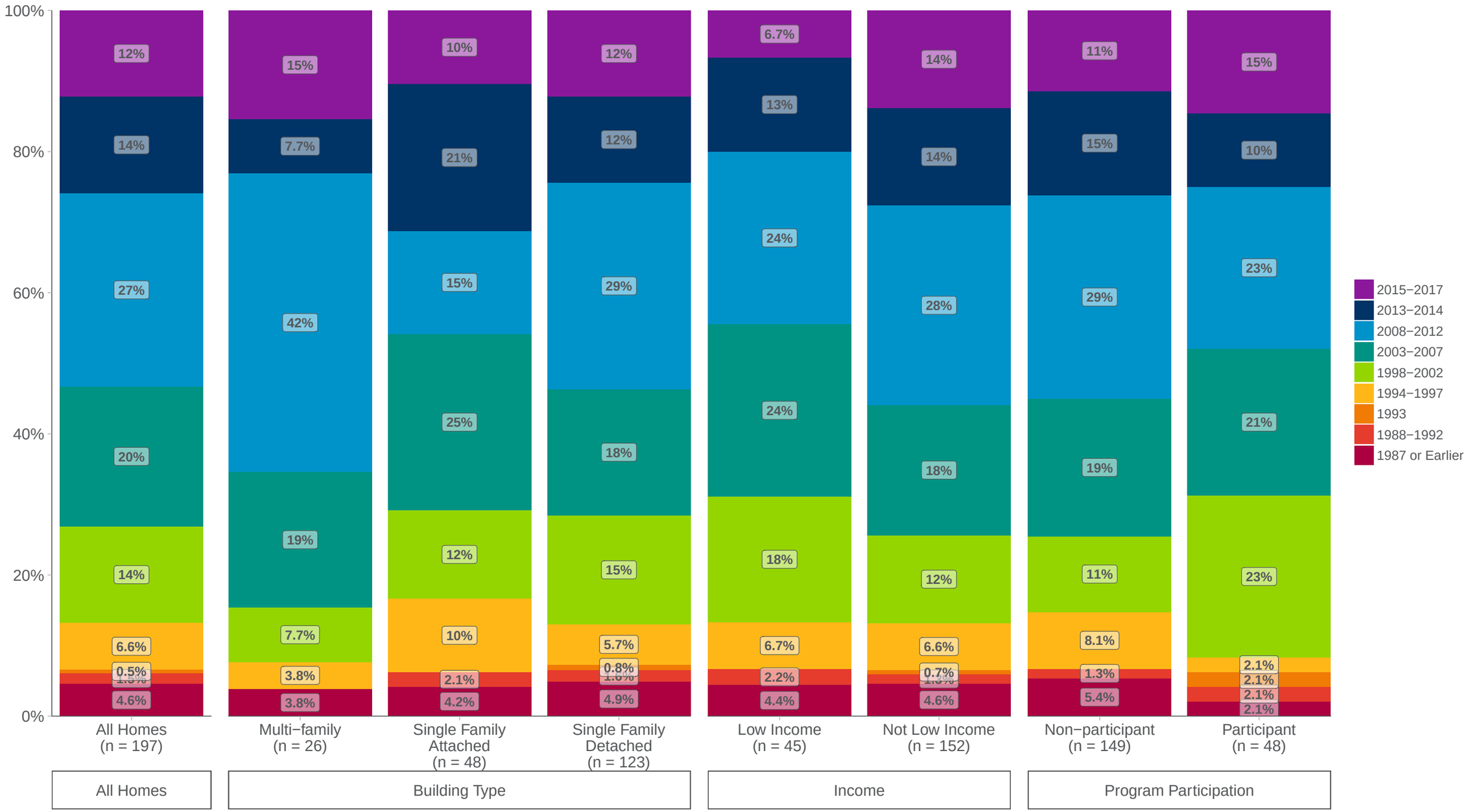
7.11 Electric Clothes Dryer Year of Manufacture by Various Demographics



Source: Navigant Analysis

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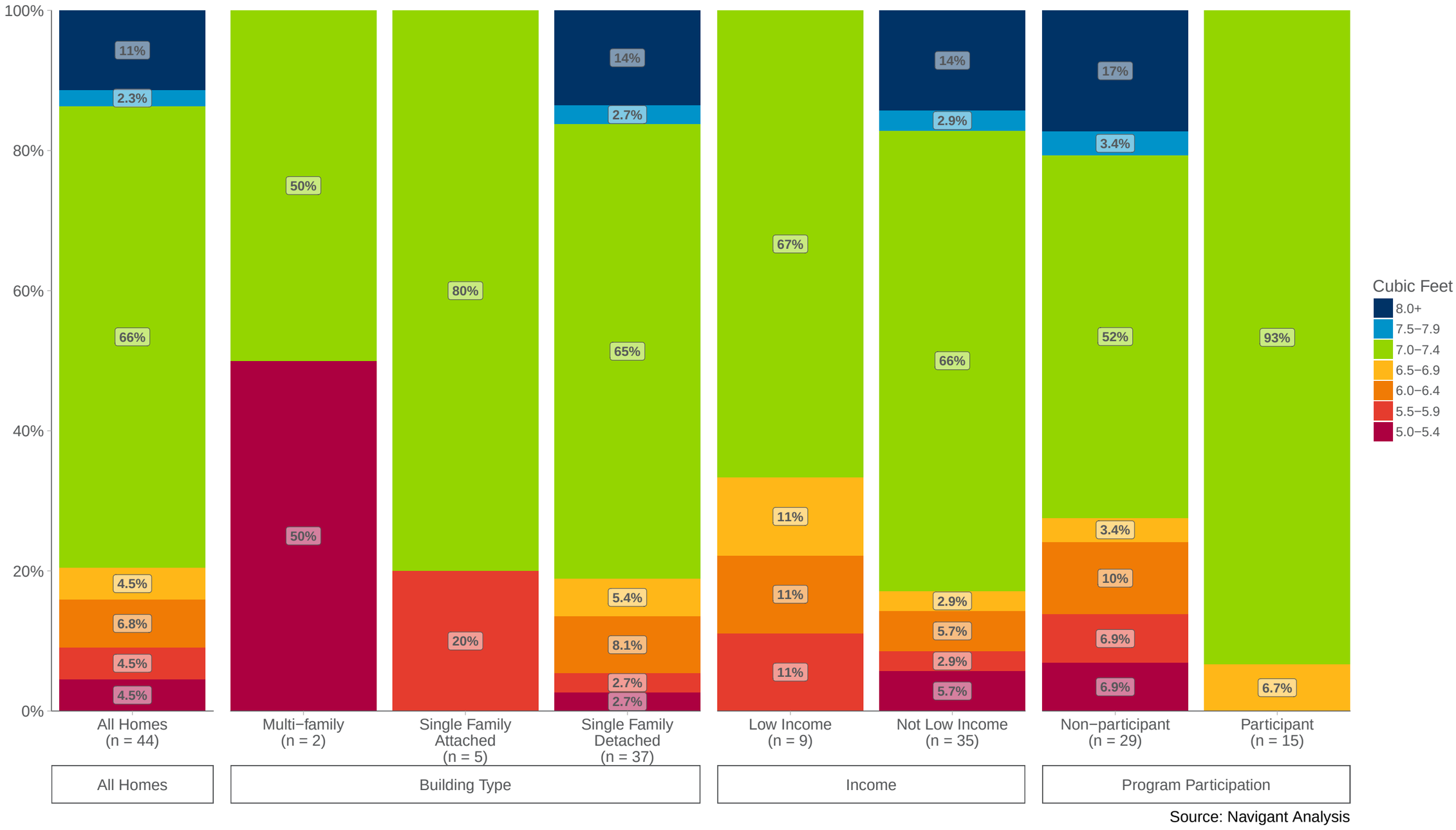
7.12 Natural Gas Clothes Dryer Capacity by Various Demographics



Source: Navigant Analysis

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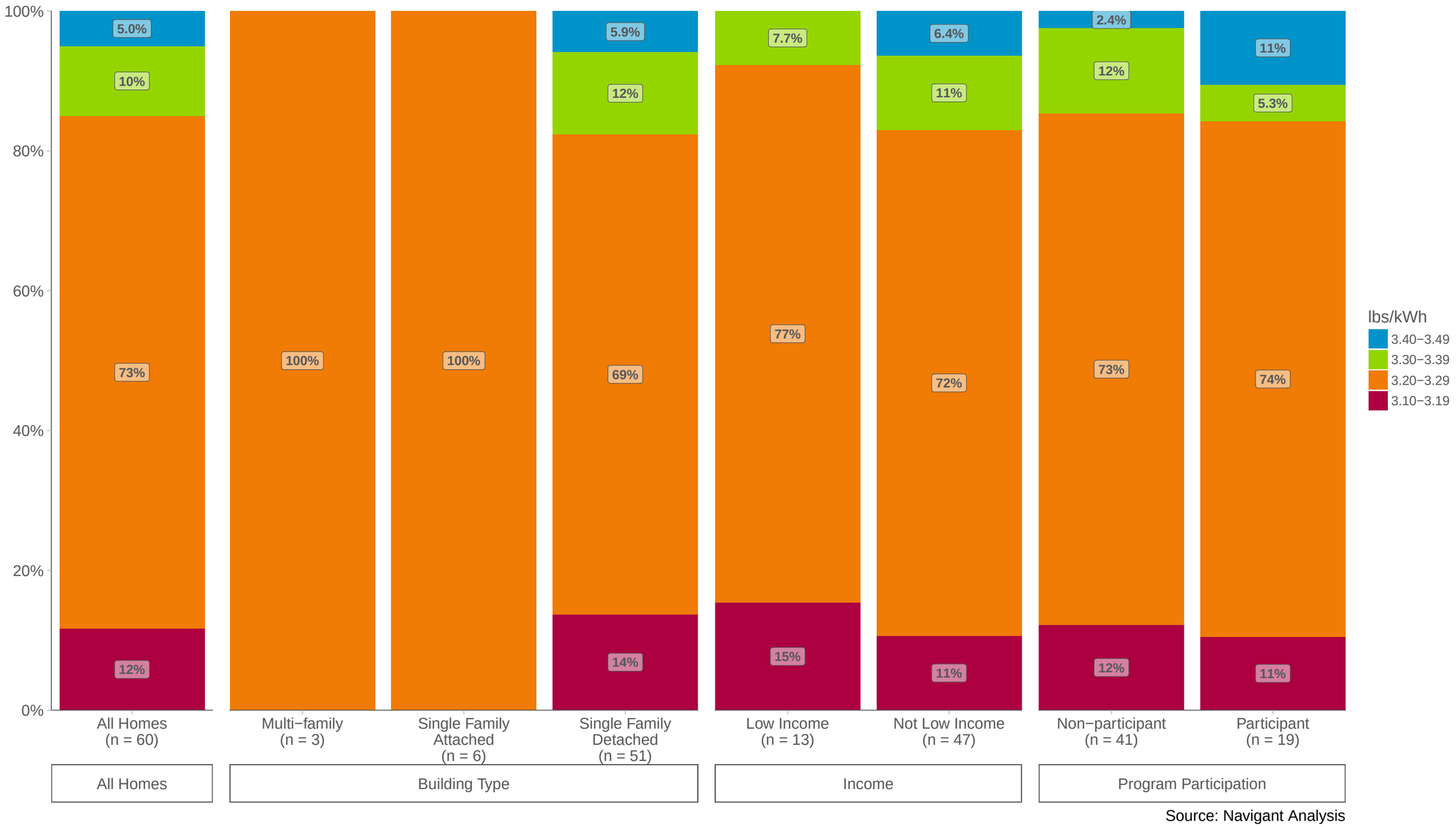
7.13 Natural Gas Clothes Dryer Combined Energy Factor by Various Demographics



Source: Navigant Analysis

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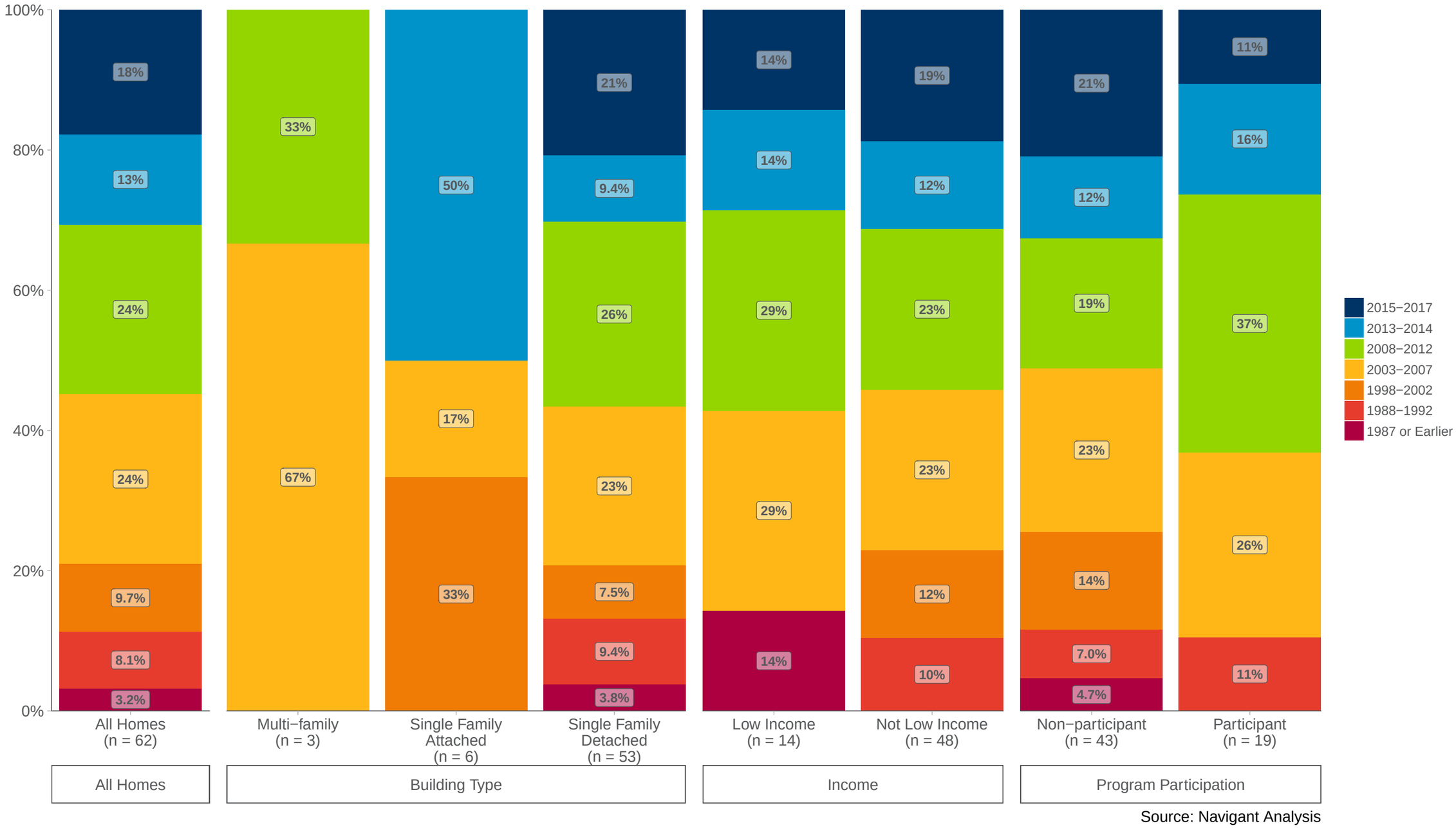
7.14 Natural Gas Clothes Dryer Year of Manufacture by Various Demographics



Source: Navigant Analysis

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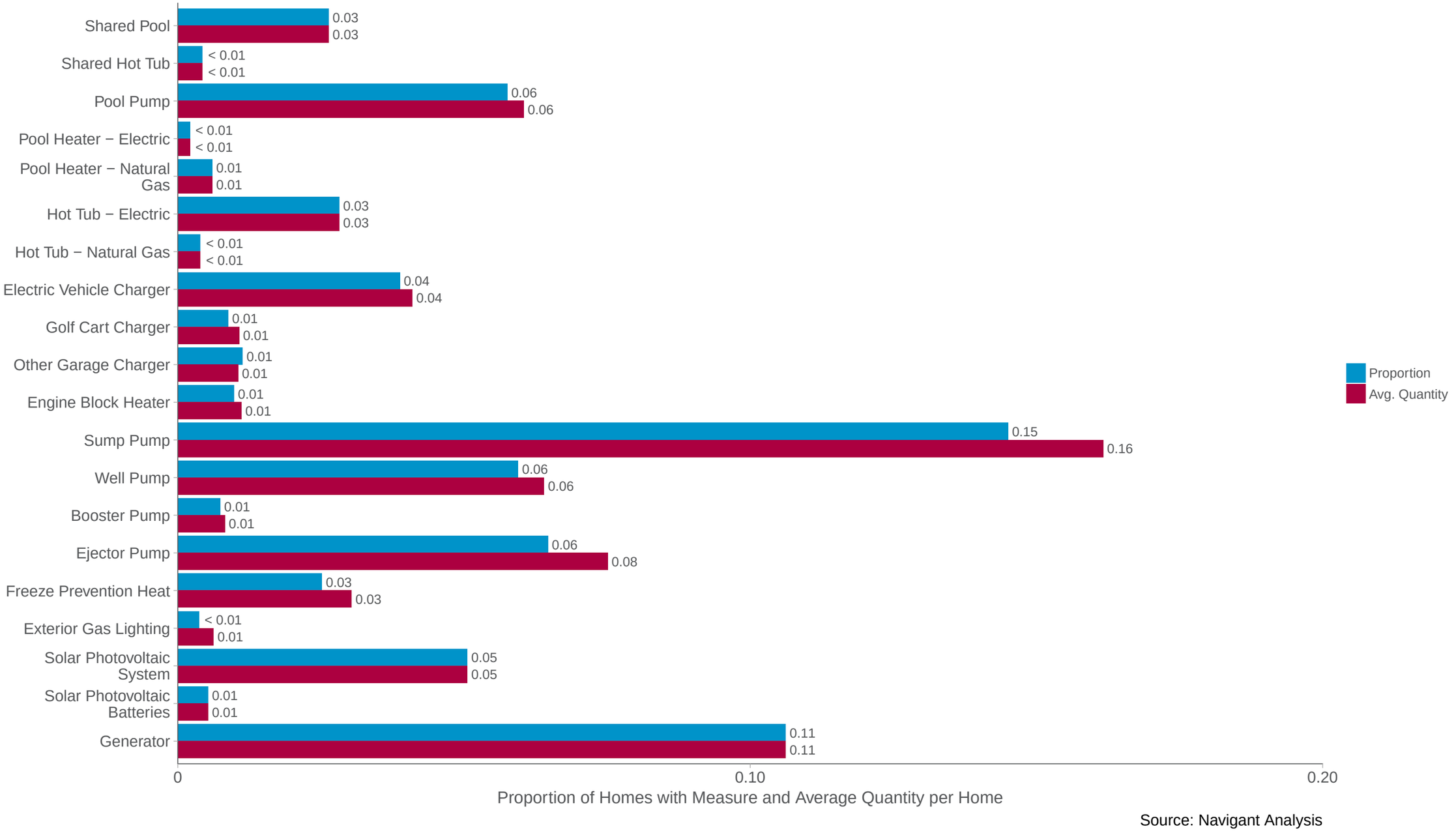
8 Outdoor/Garage

8.1 Adjusted and Weighted Proportion and Average Quantity of Outdoor and Garage Appliances



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

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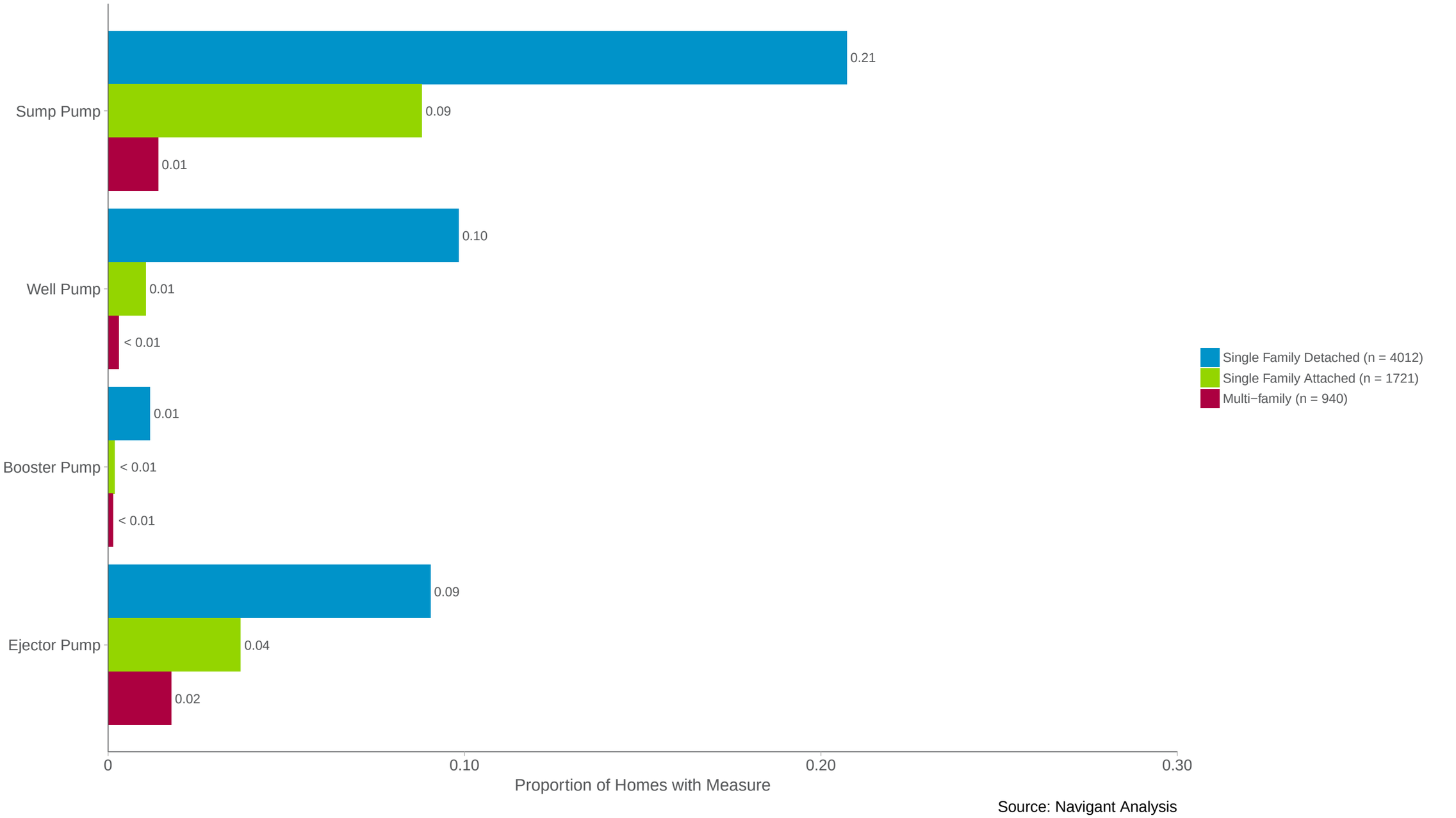
8.2 Adjusted and Weighted Proportion of Pumps by Building Type



Source: Navigant Analysis

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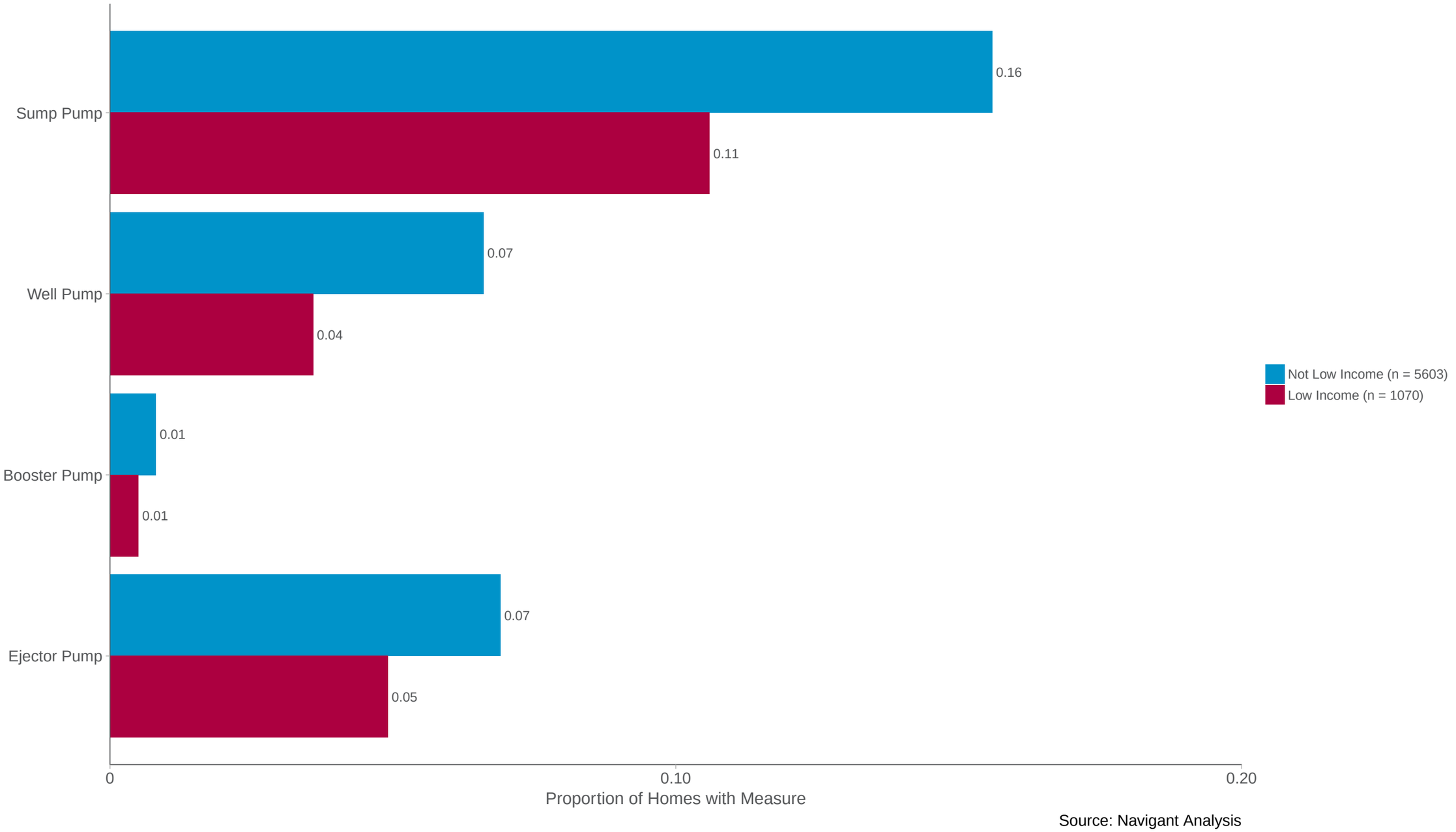
8.3 Adjusted and Weighted Proportion of Pumps by Income



Source: Navigant Analysis

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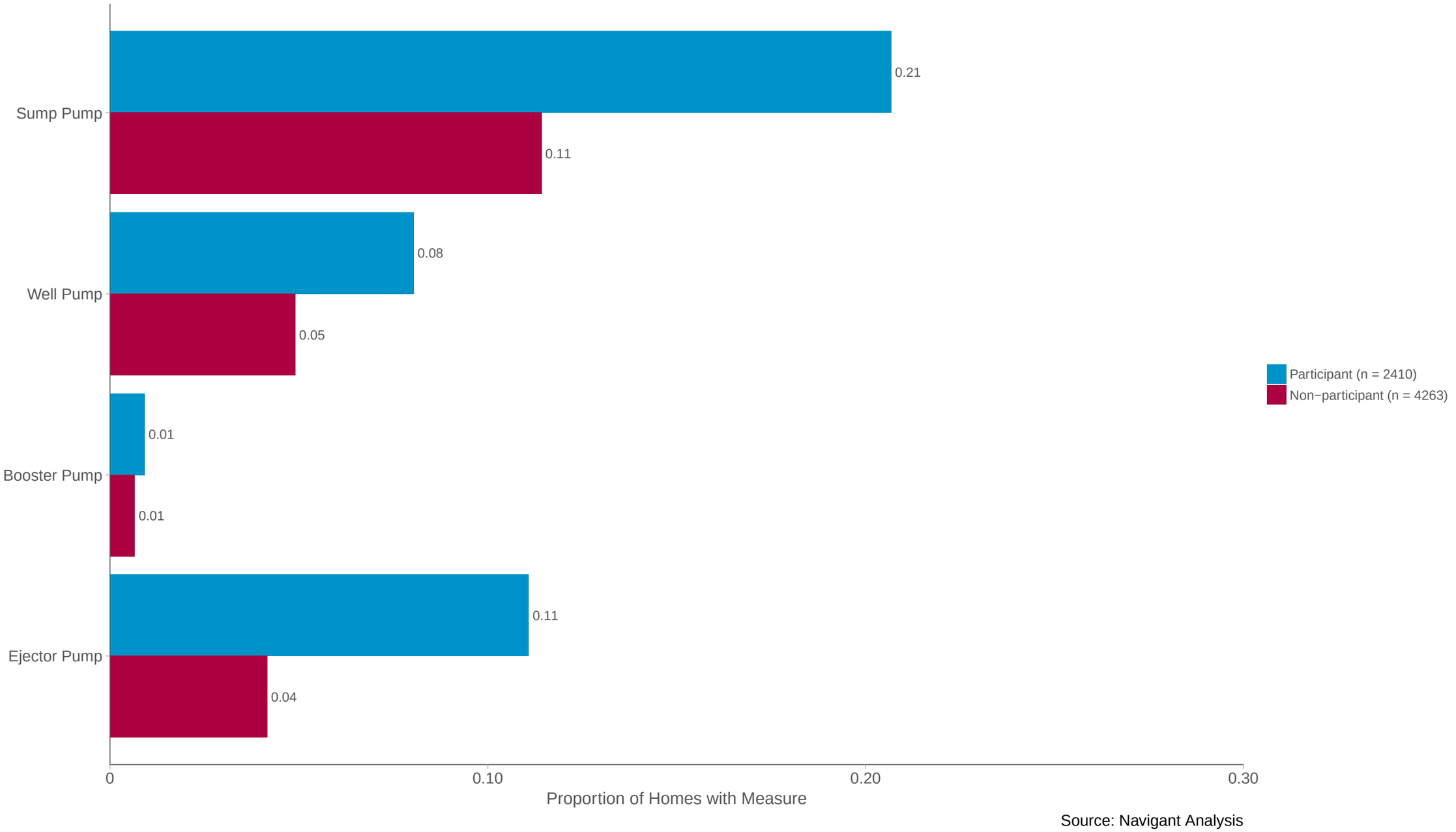
8.4 Adjusted and Weighted Proportion of Pumps by Participation



Source: Navigant Analysis

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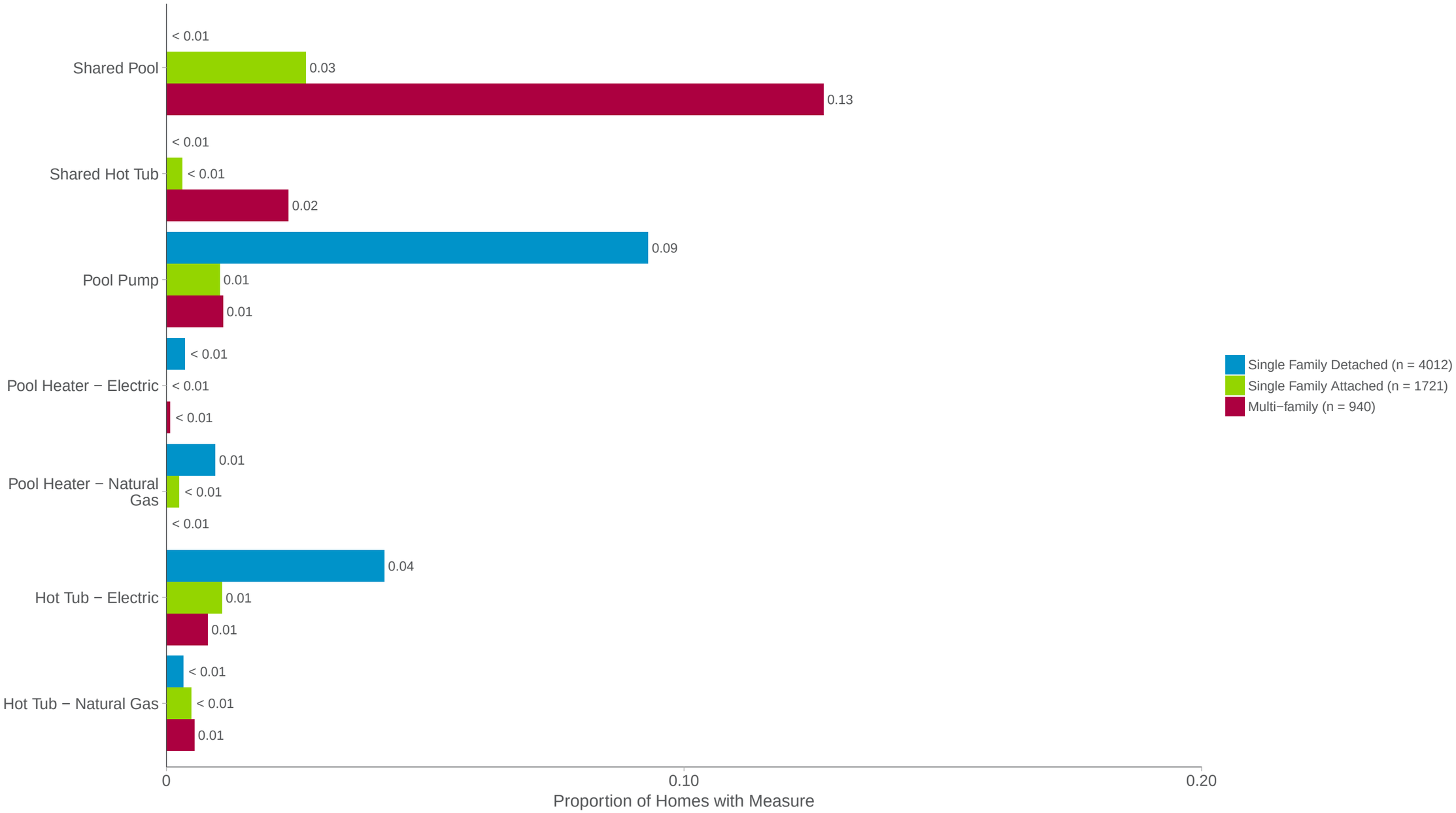
8.5 Adjusted and Weighted Proportion of Pools and Hot Tubs by Building Type



Source: Navigant Analysis

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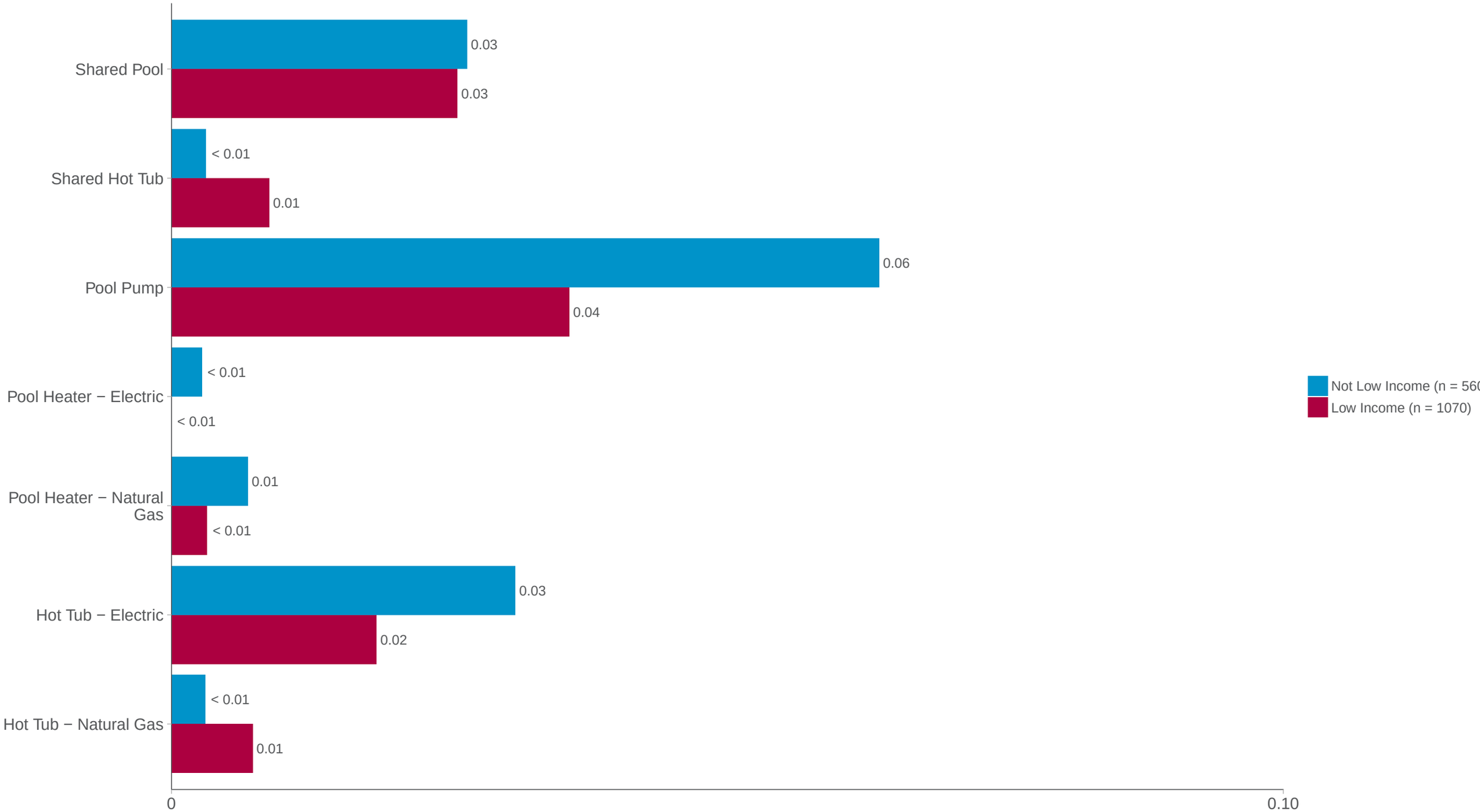
8.6 Adjusted and Weighted Proportion of Pools and Hot Tubs by Income



Source: Navigant Analysis

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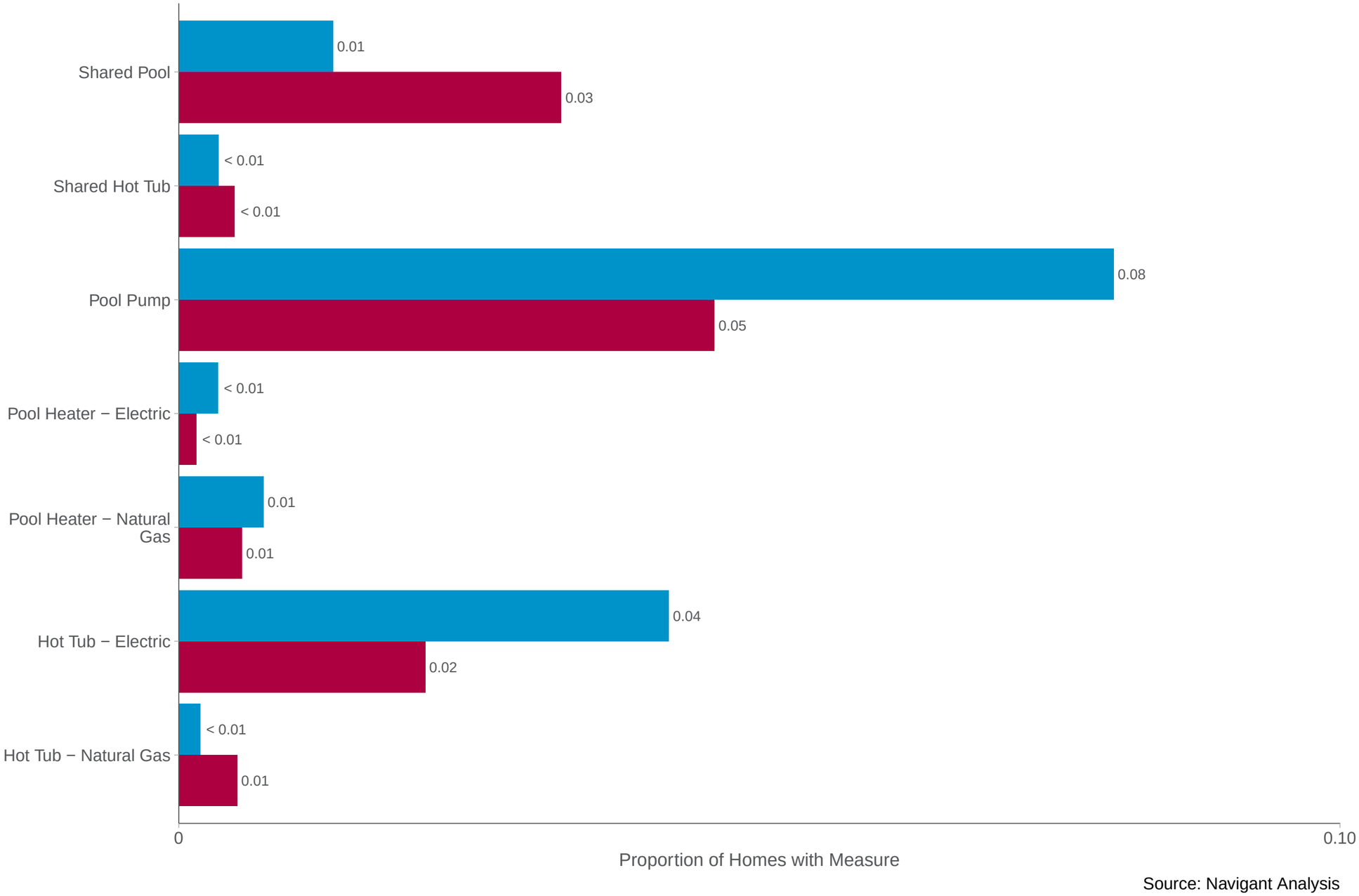
8.7 Adjusted and Weighted Proportion of Pools and Hot Tubs by Participation



Source: Navigant Analysis

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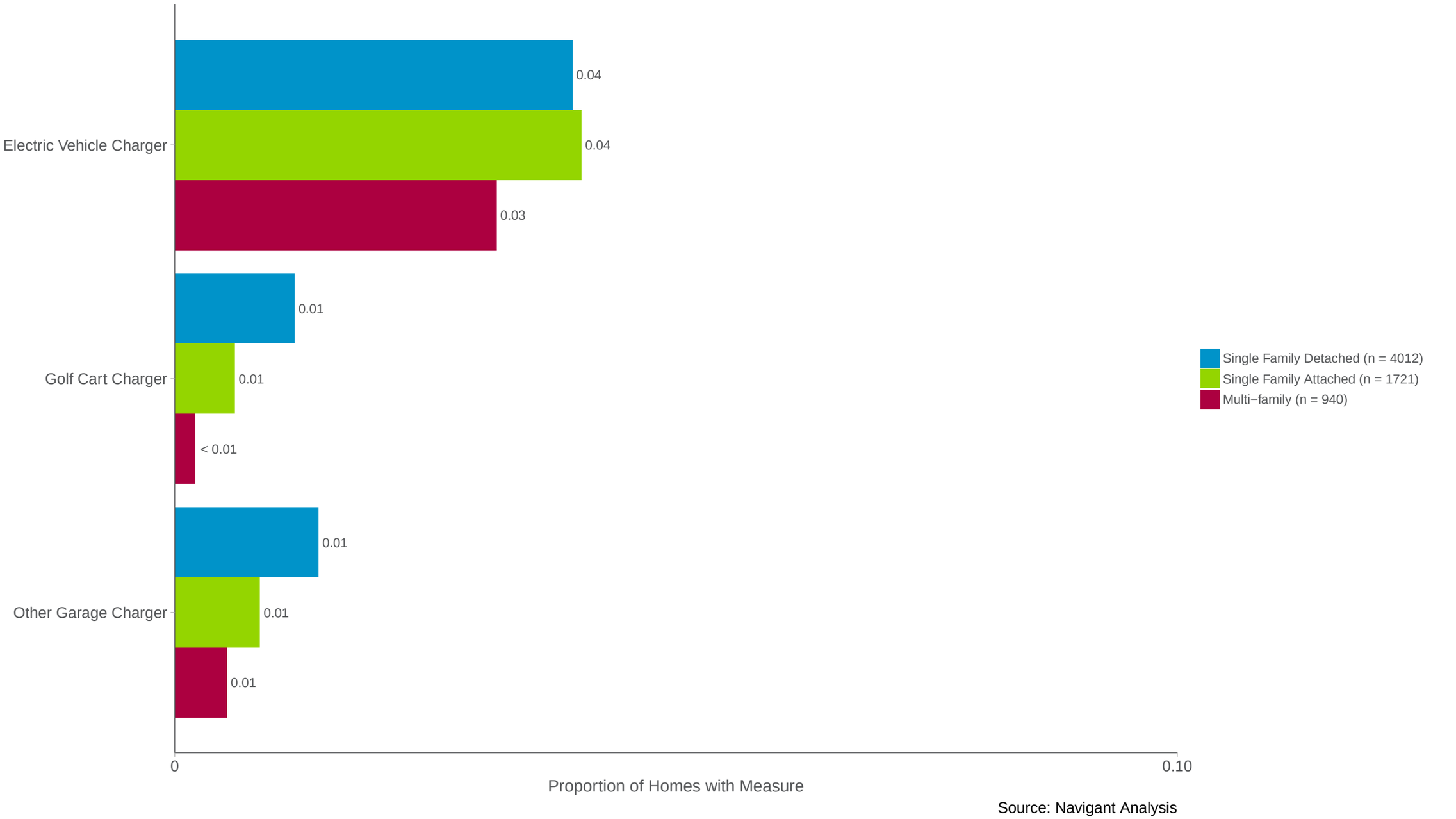
8.8 Adjusted and Weighted Proportion of Chargers by Building Type



Source: Navigant Analysis

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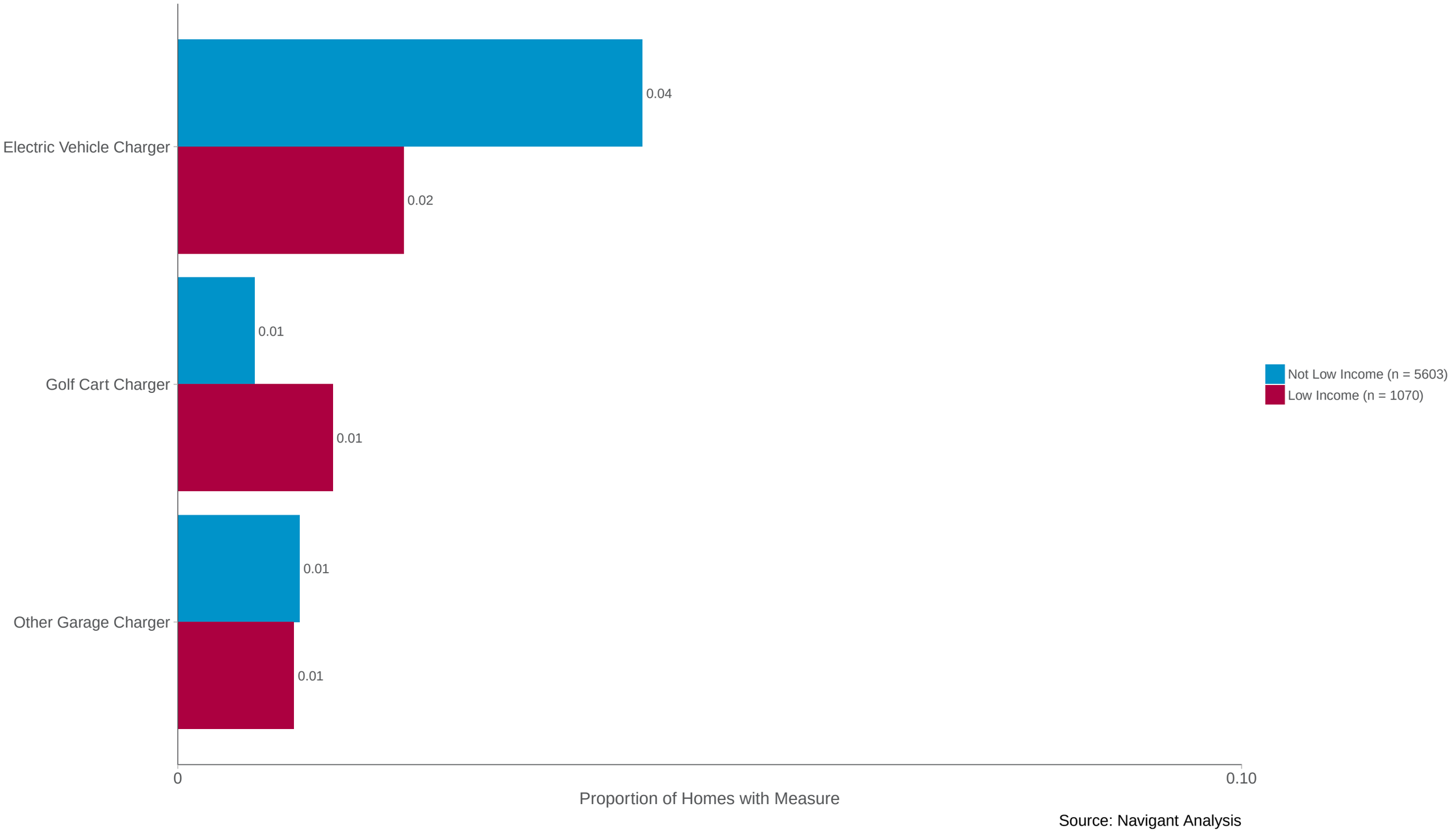
8.9 Adjusted and Weighted Proportion of Chargers by Income



Source: Navigant Analysis

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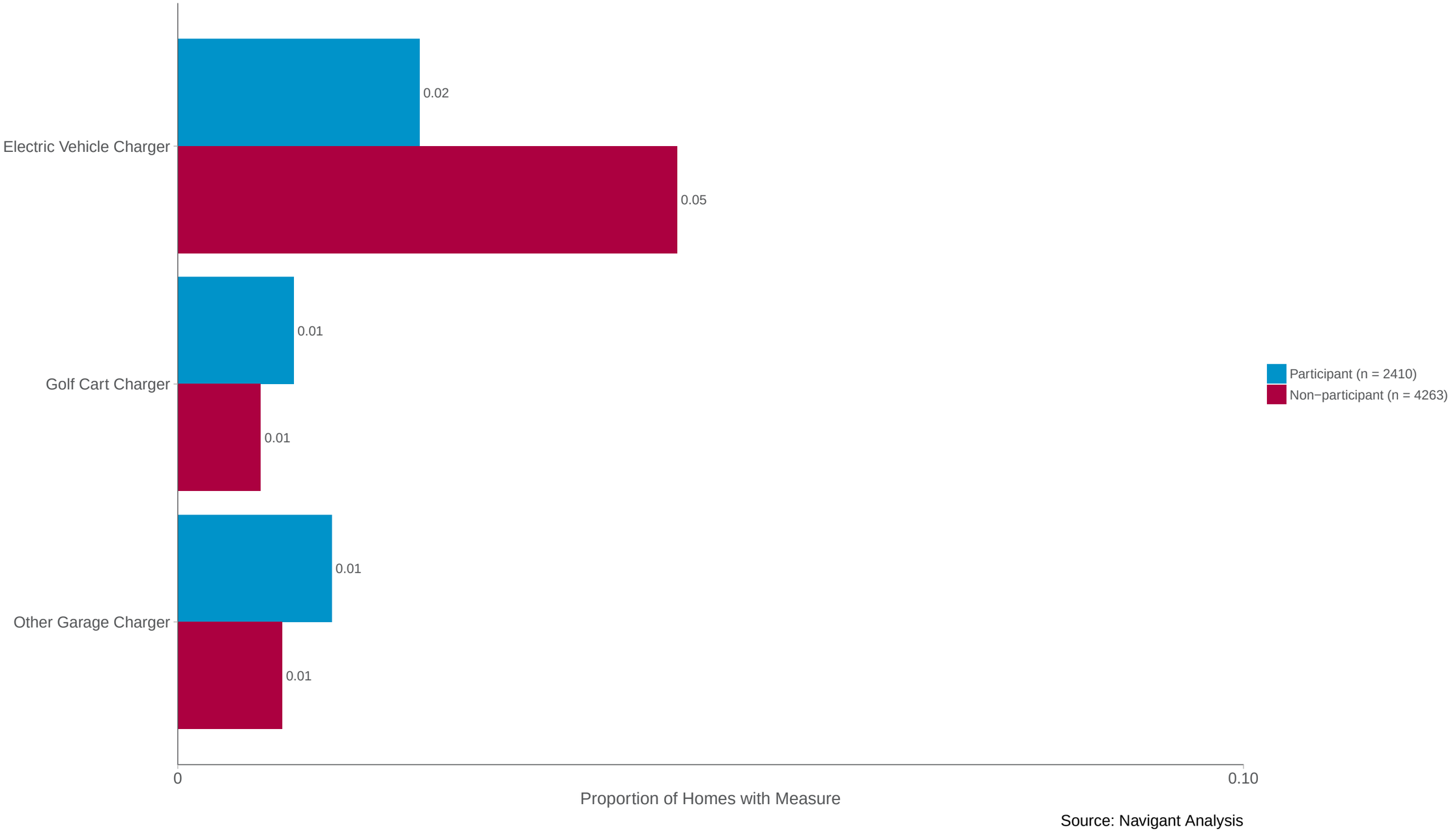
8.10 Adjusted and Weighted Proportion of Chargers by Participation



Source: Navigant Analysis

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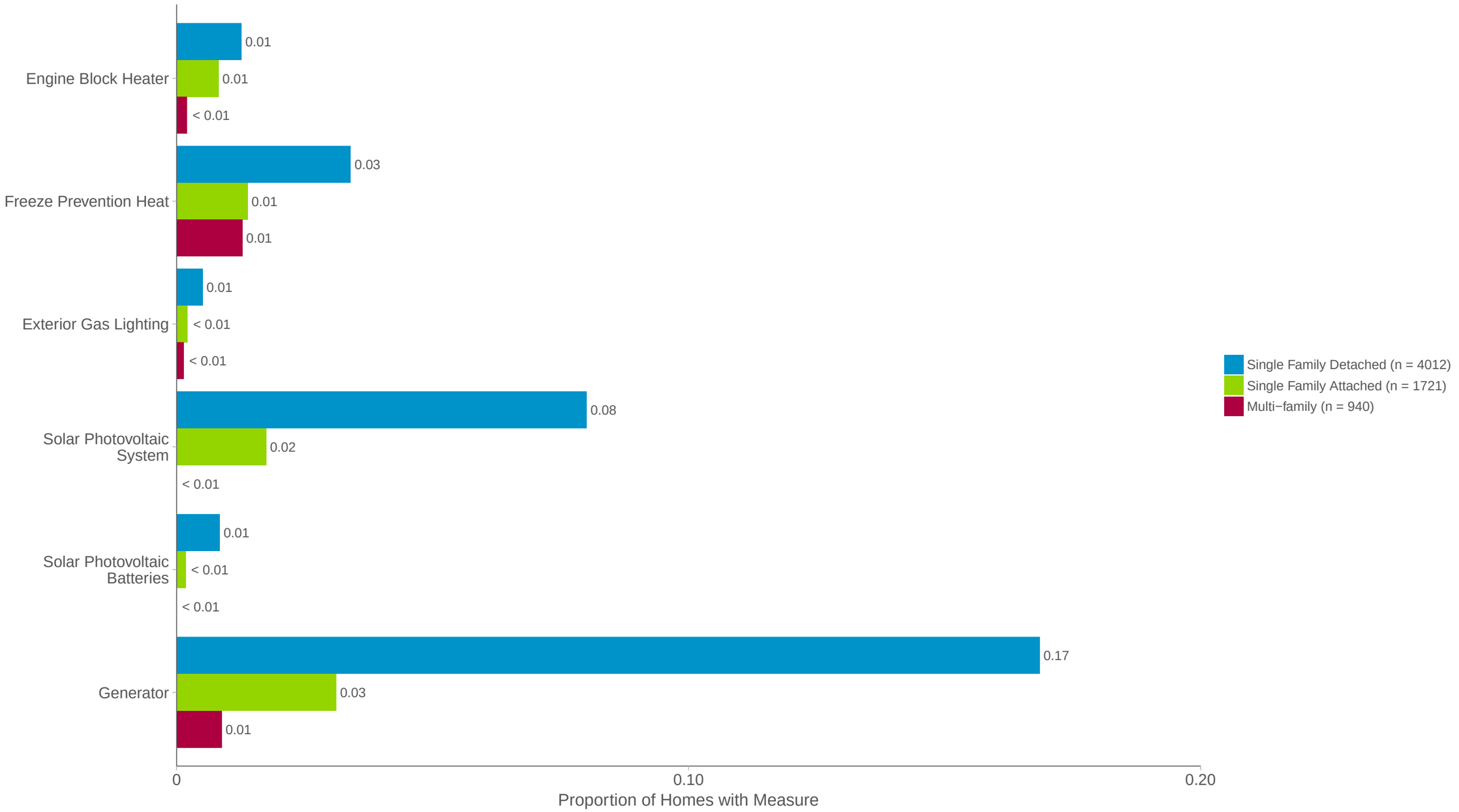
8.11 Adjusted and Weighted Proportion of Miscellaneous Exterior Measures by Building Type



Source: Navigant Analysis

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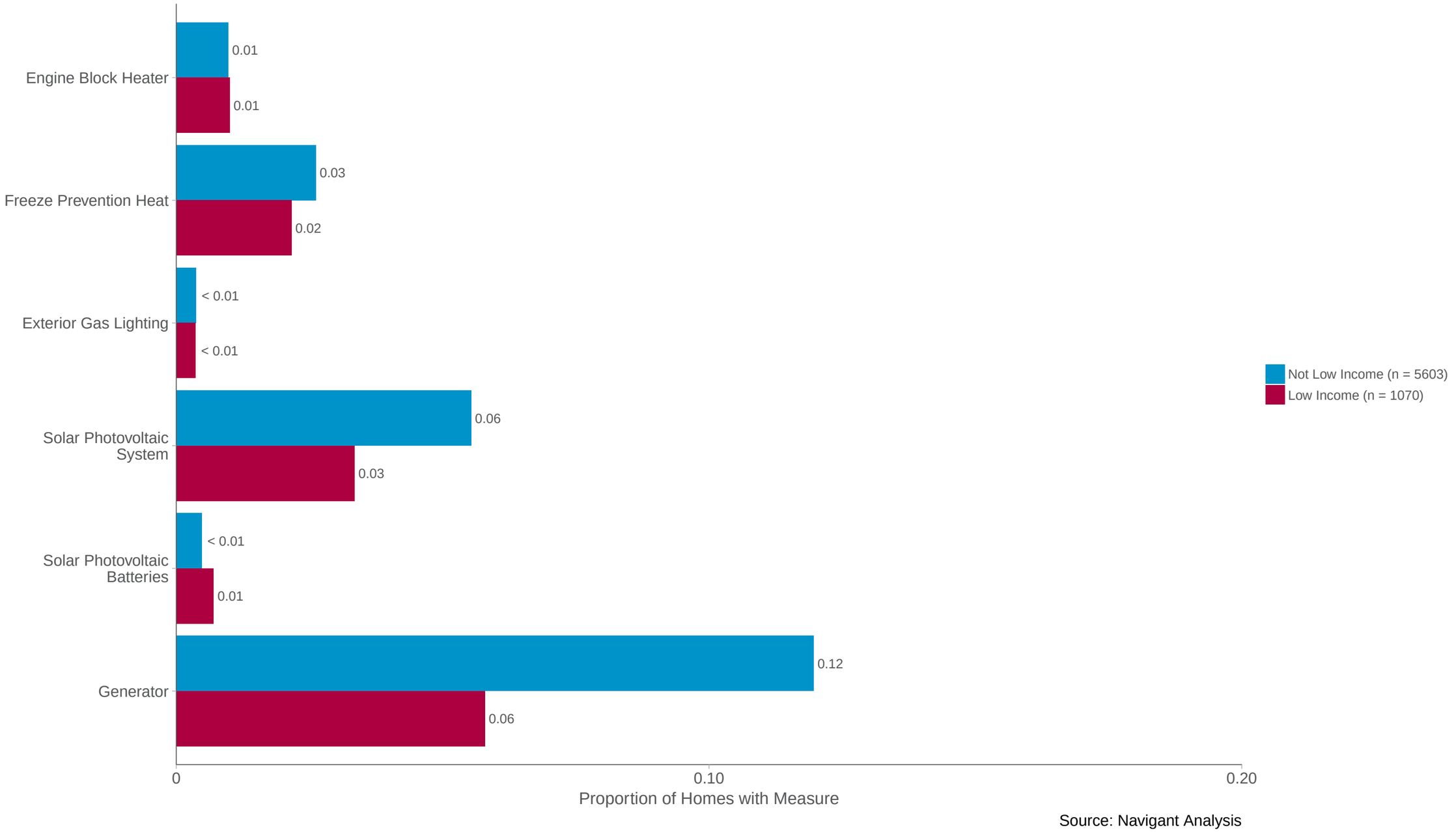
8.12 Adjusted and Weighted Proportion of Miscellaneous Exterior Measures by Income



Source: Navigant Analysis

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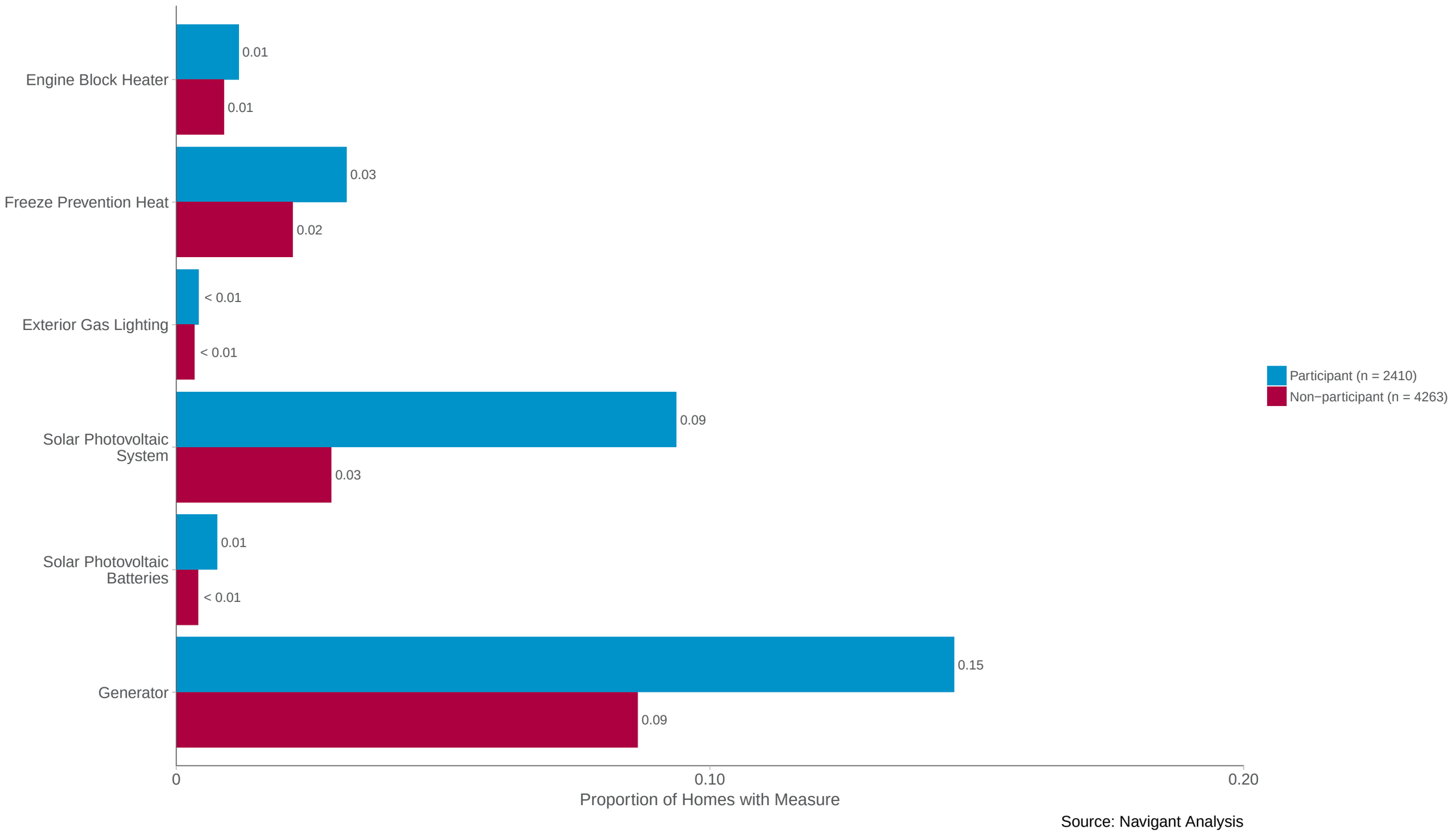
8.13 Adjusted and Weighted Proportion of Miscellaneous Exterior Measures by Participation



Source: Navigant Analysis

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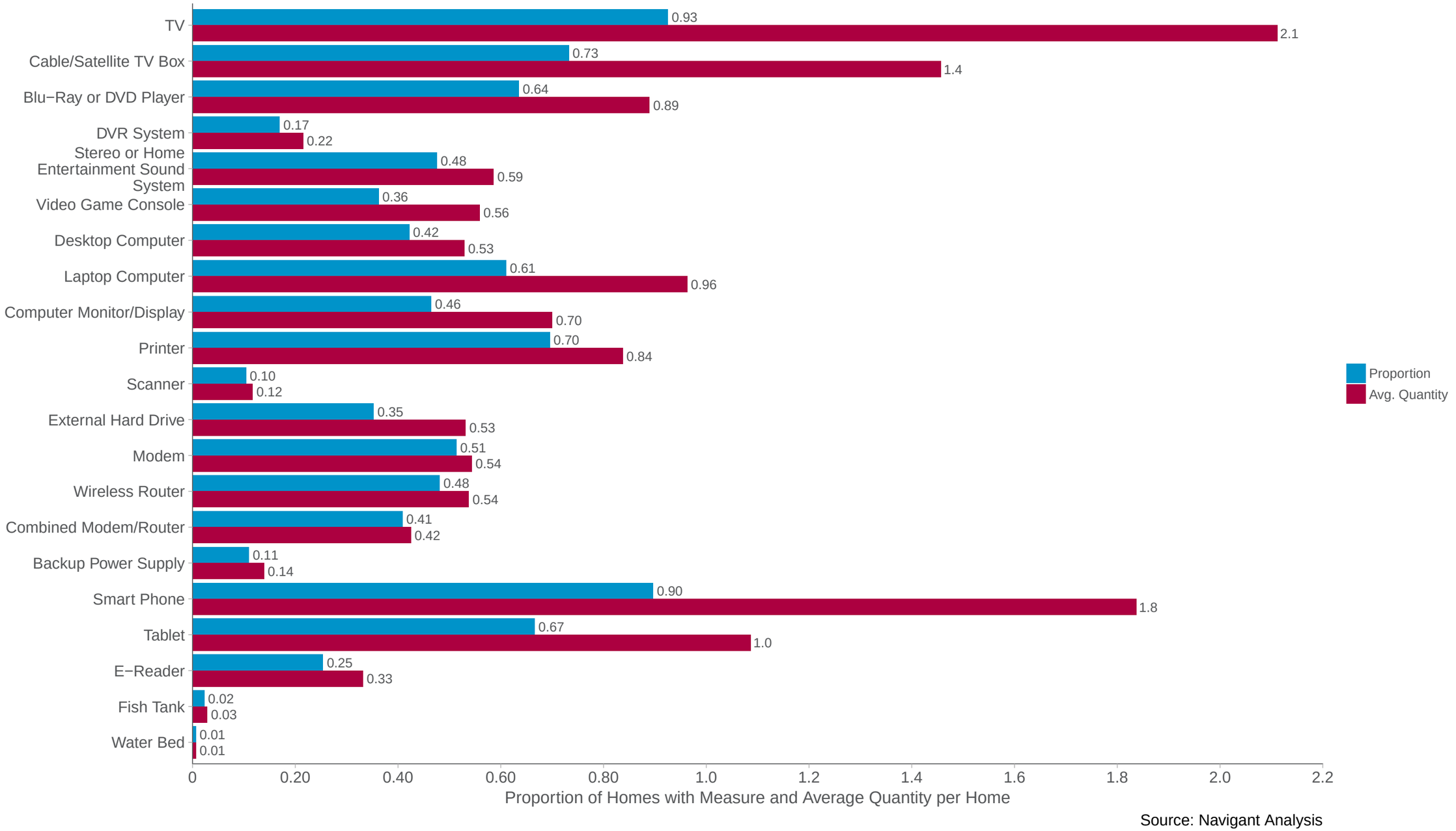
9 Electronics/Miscellaneous

9.1 Adjusted and Weighted Proportion and Average Quantity of Electronic Devices



Source: Navigant Analysis

Note: Saturation results were derived using data from all survey respondents (n = 6673).

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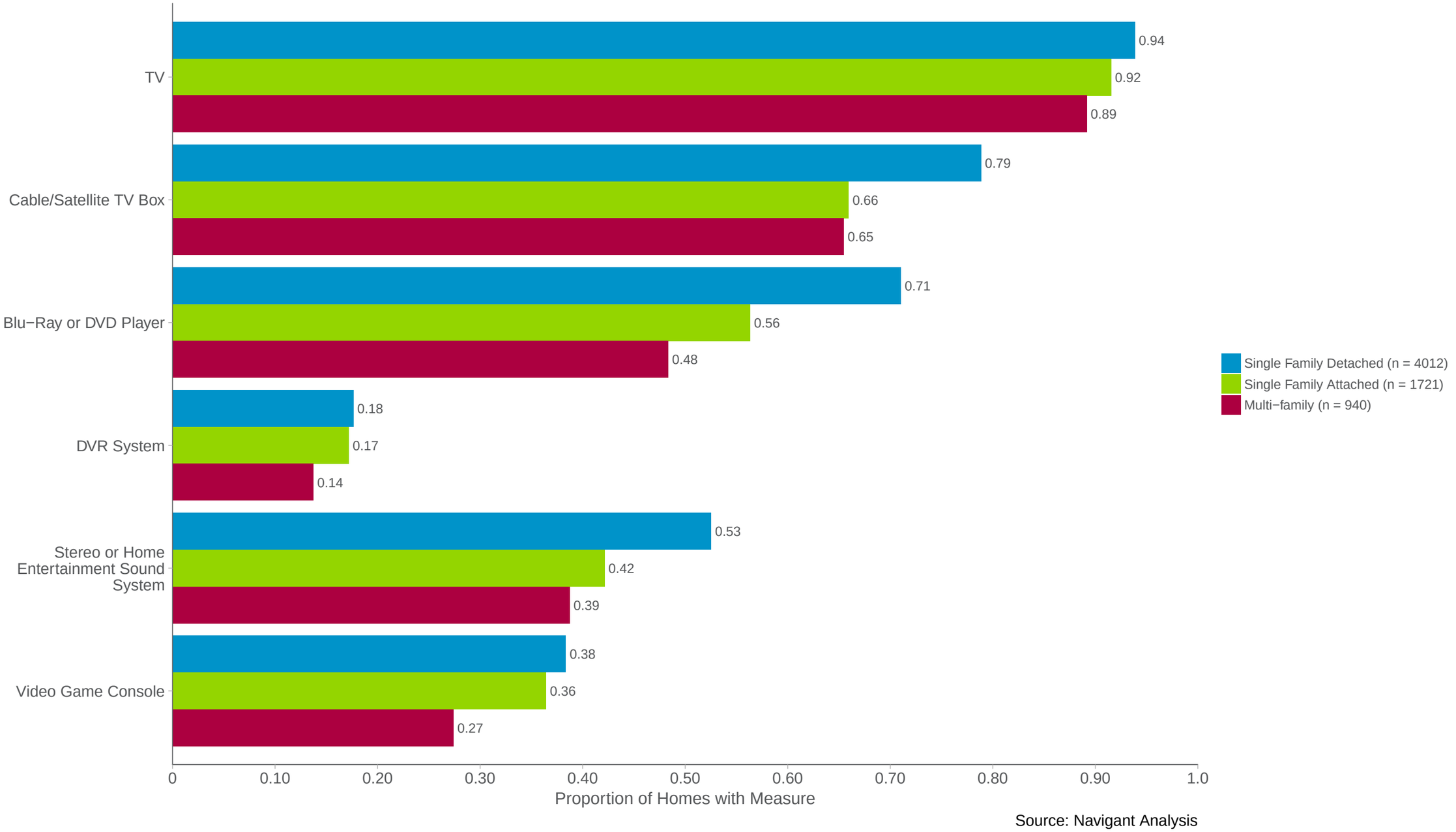
9.2 Adjusted and Weighted Proportion of Home Entertainment Equipment by Building Type



Source: Navigant Analysis

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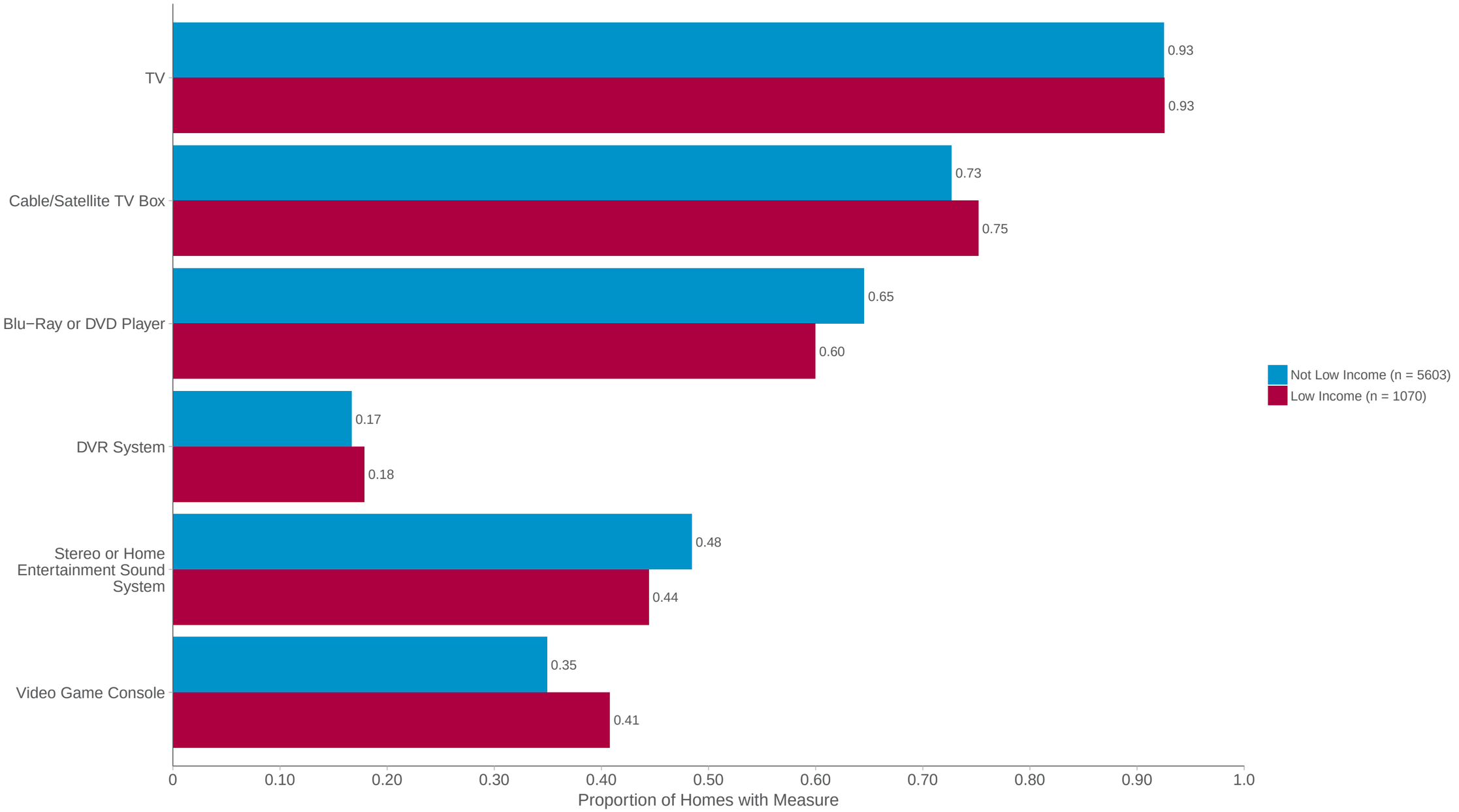
9.3 Adjusted and Weighted Proportion of Home Entertainment Equipment by Income



Source: Navigant Analysis

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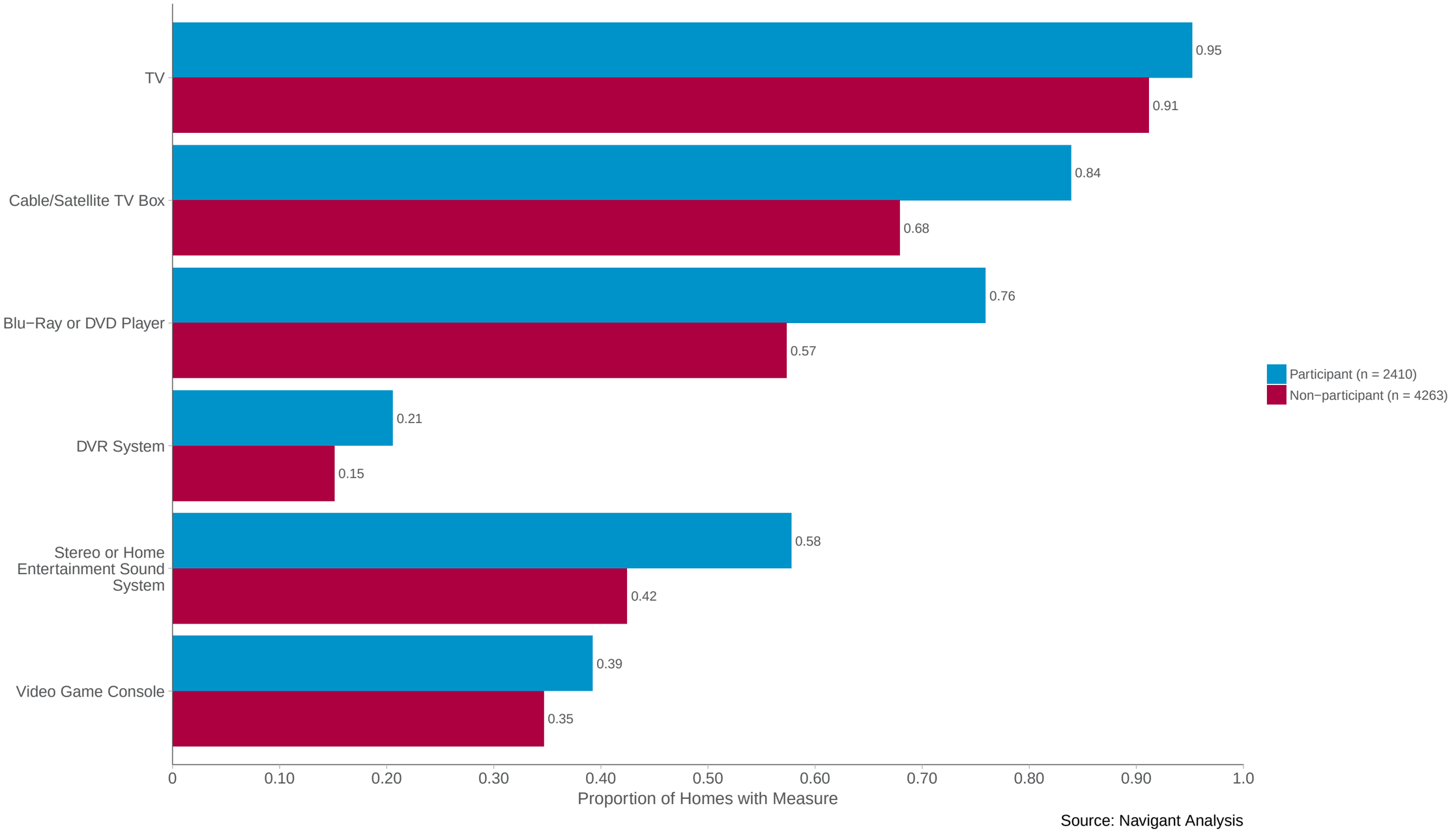
9.4 Adjusted and Weighted Proportion of Home Entertainment Equipment by Participation



Source: Navigant Analysis

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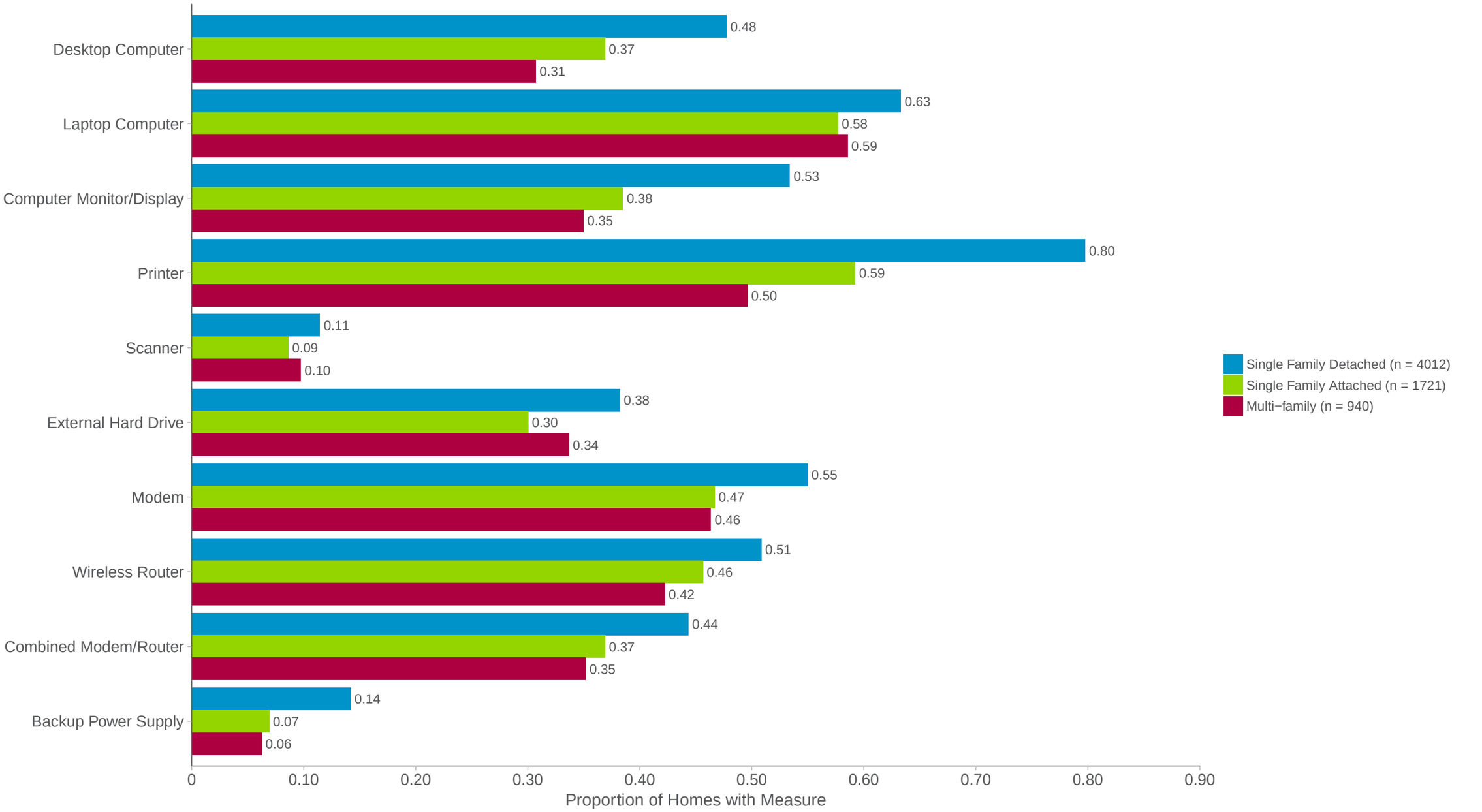
9.5 Adjusted and Weighted Proportion of Office Equipment by Building Type



Source: Navigant Analysis

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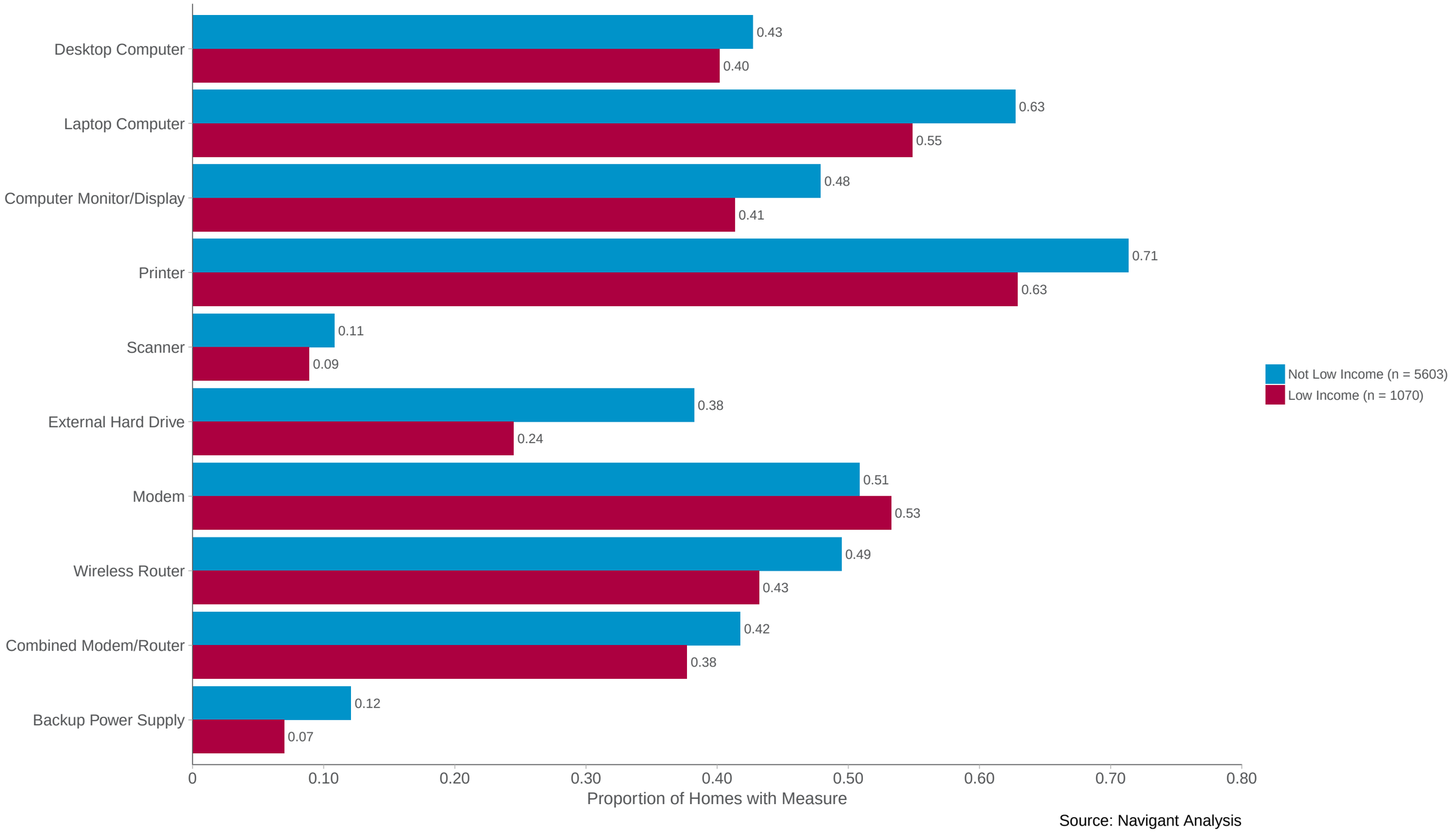
9.6 Adjusted and Weighted Proportion of Office Equipment by Income



Source: Navigant Analysis

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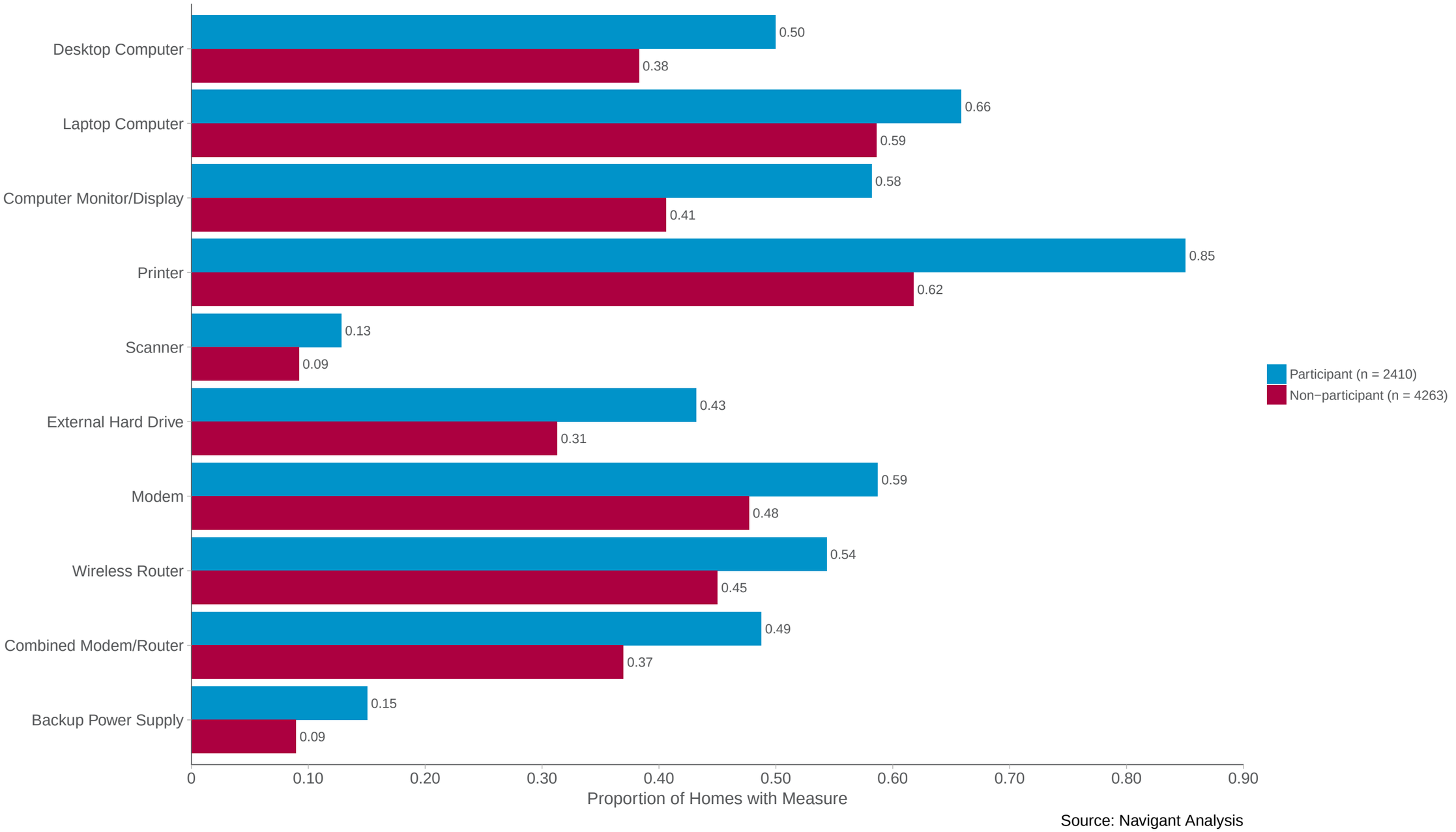
9.7 Adjusted and Weighted Proportion of Office Equipment by Participation



Source: Navigant Analysis

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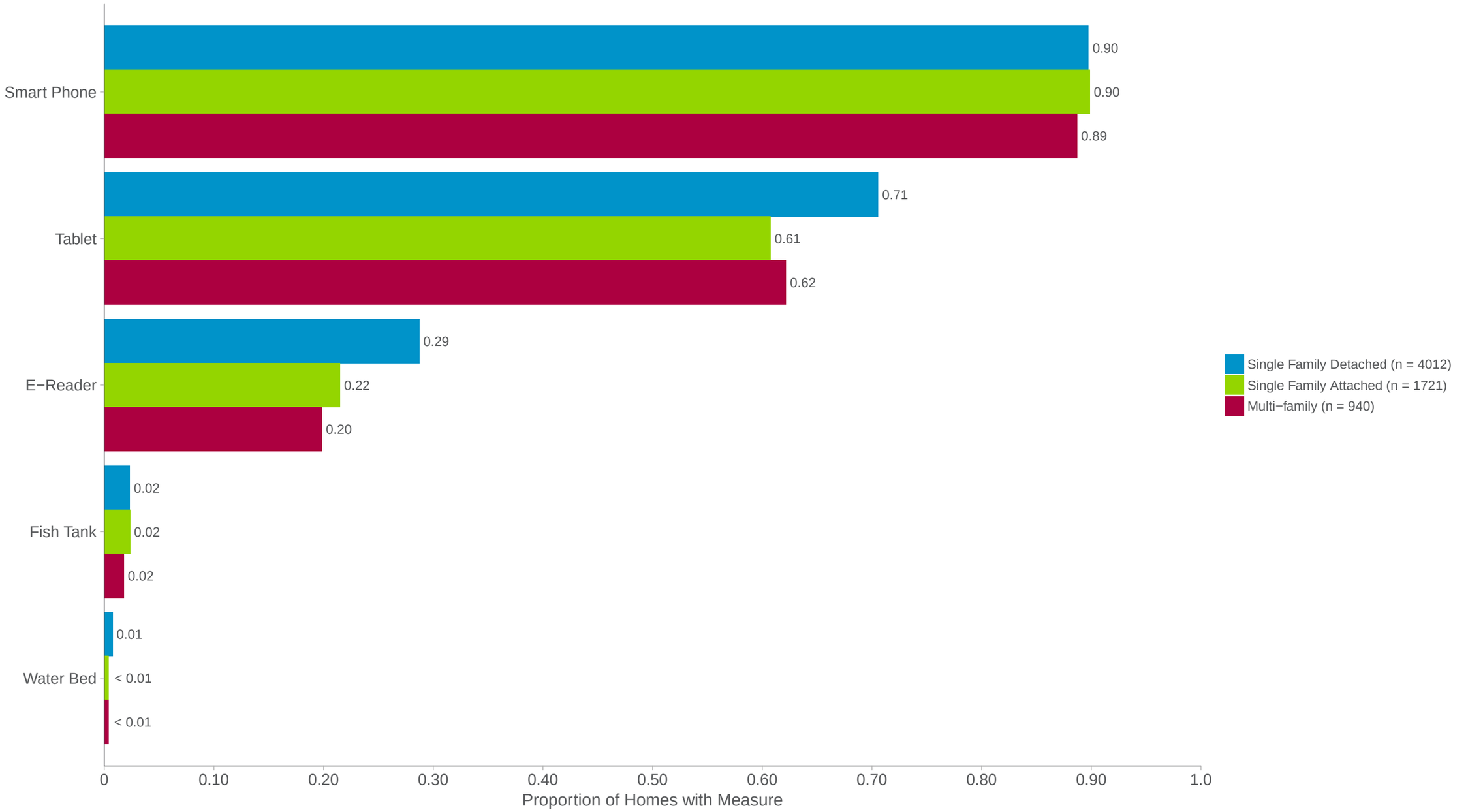
9.8 Adjusted and Weighted Proportion of Other Electronics/Miscellaneous Equipment by Building Type



Source: Navigant Analysis

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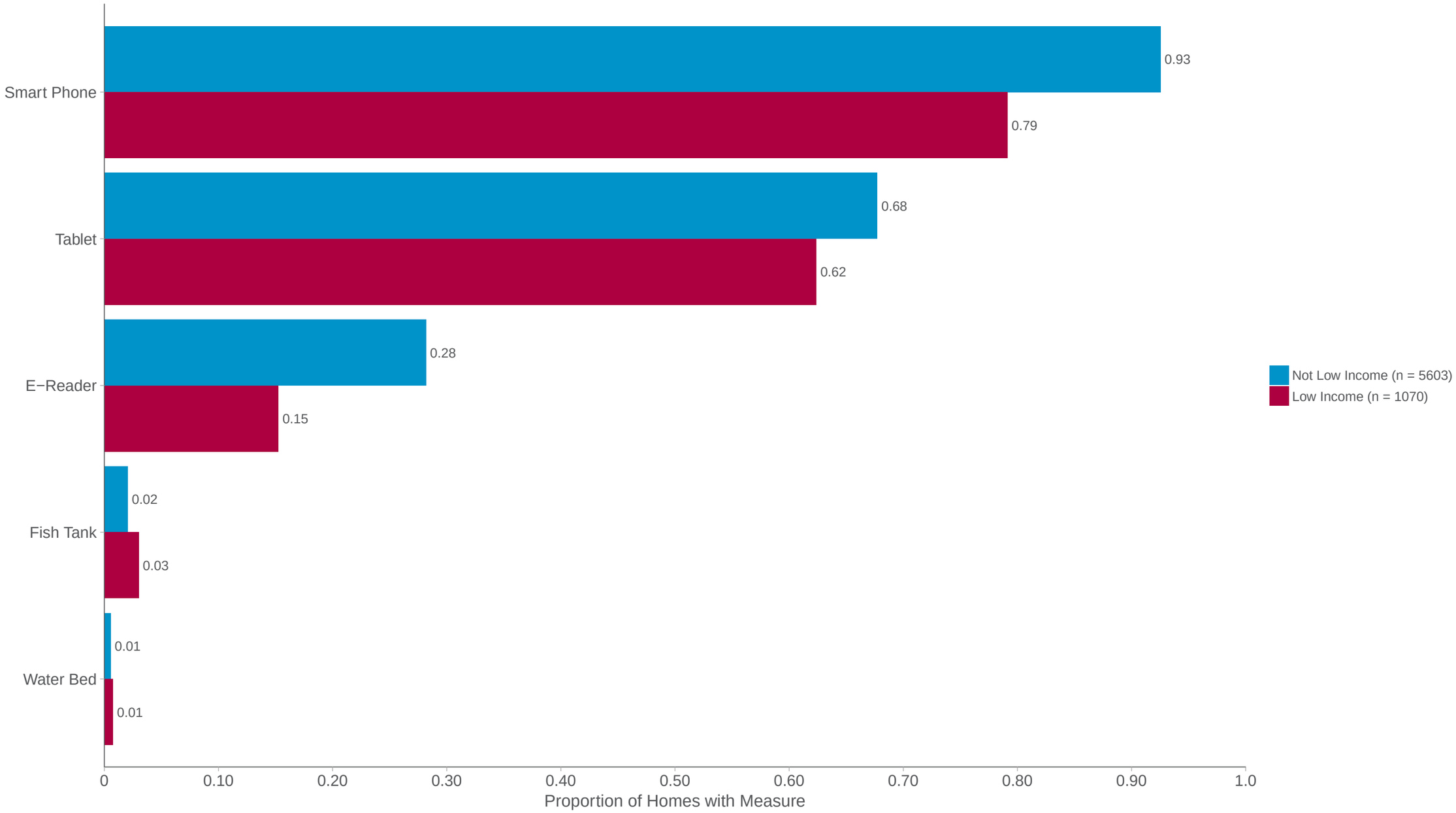
9.9 Adjusted and Weighted Proportion of Other Electronics/Miscellaneous Equipment by Income



Source: Navigant Analysis

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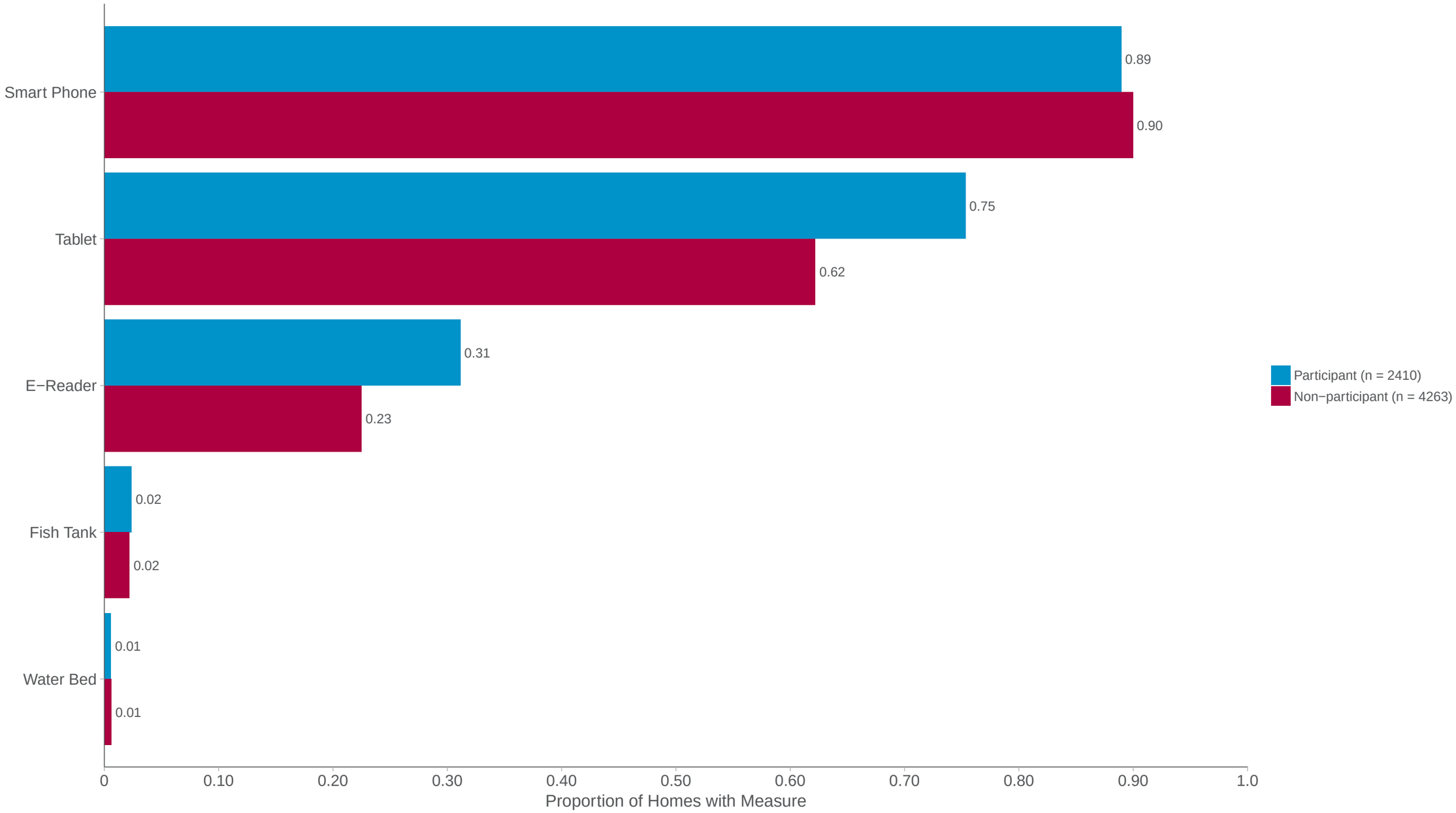
9.10 Adjusted and Weighted Proportion of Other Electronics/Miscellaneous Equipment by Participation



Source: Navigant Analysis

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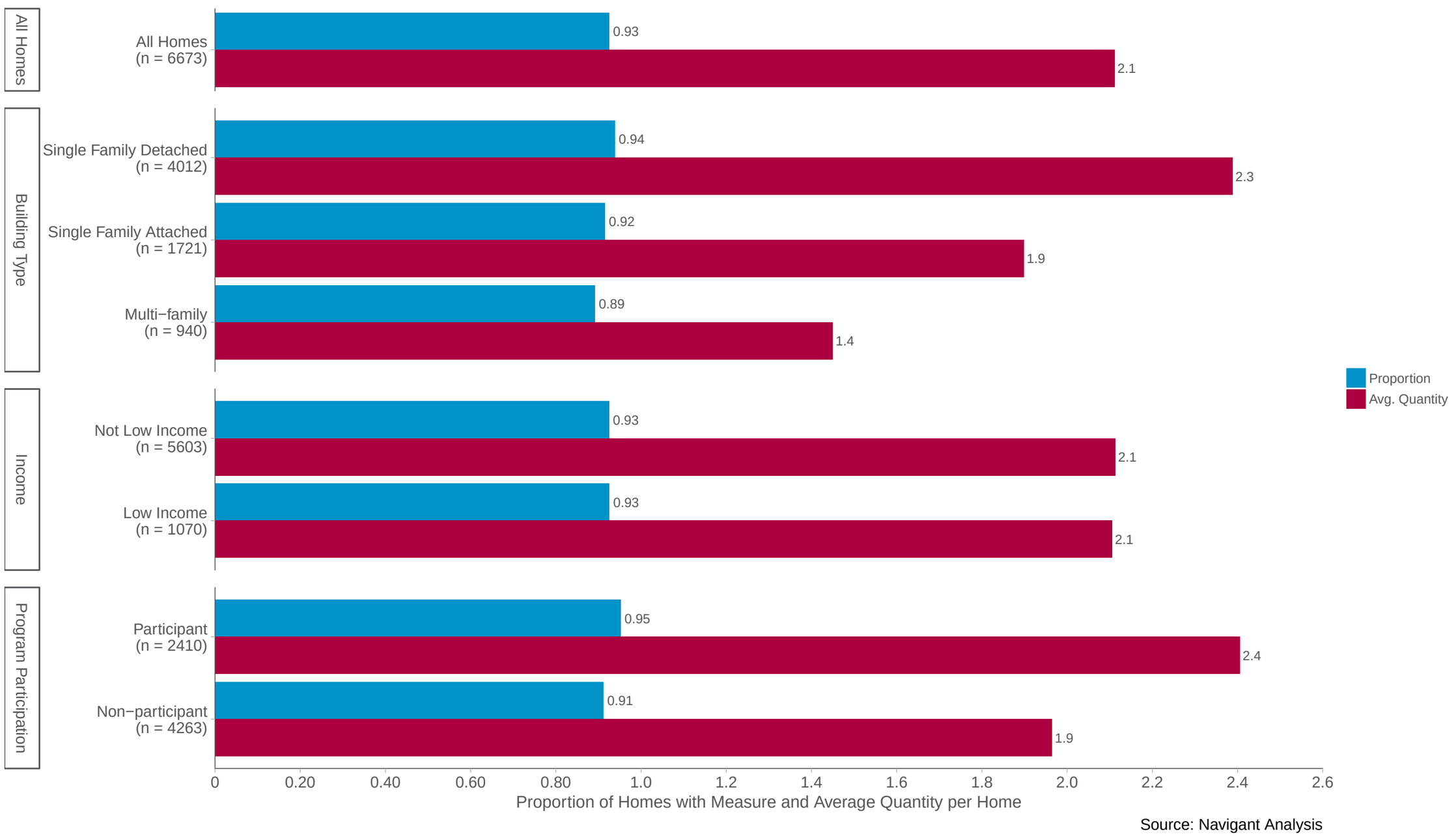
9.11 Adjusted and Weighted Proportion and Average Quantity of TVs by Various Demographics



Source: Navigant Analysis

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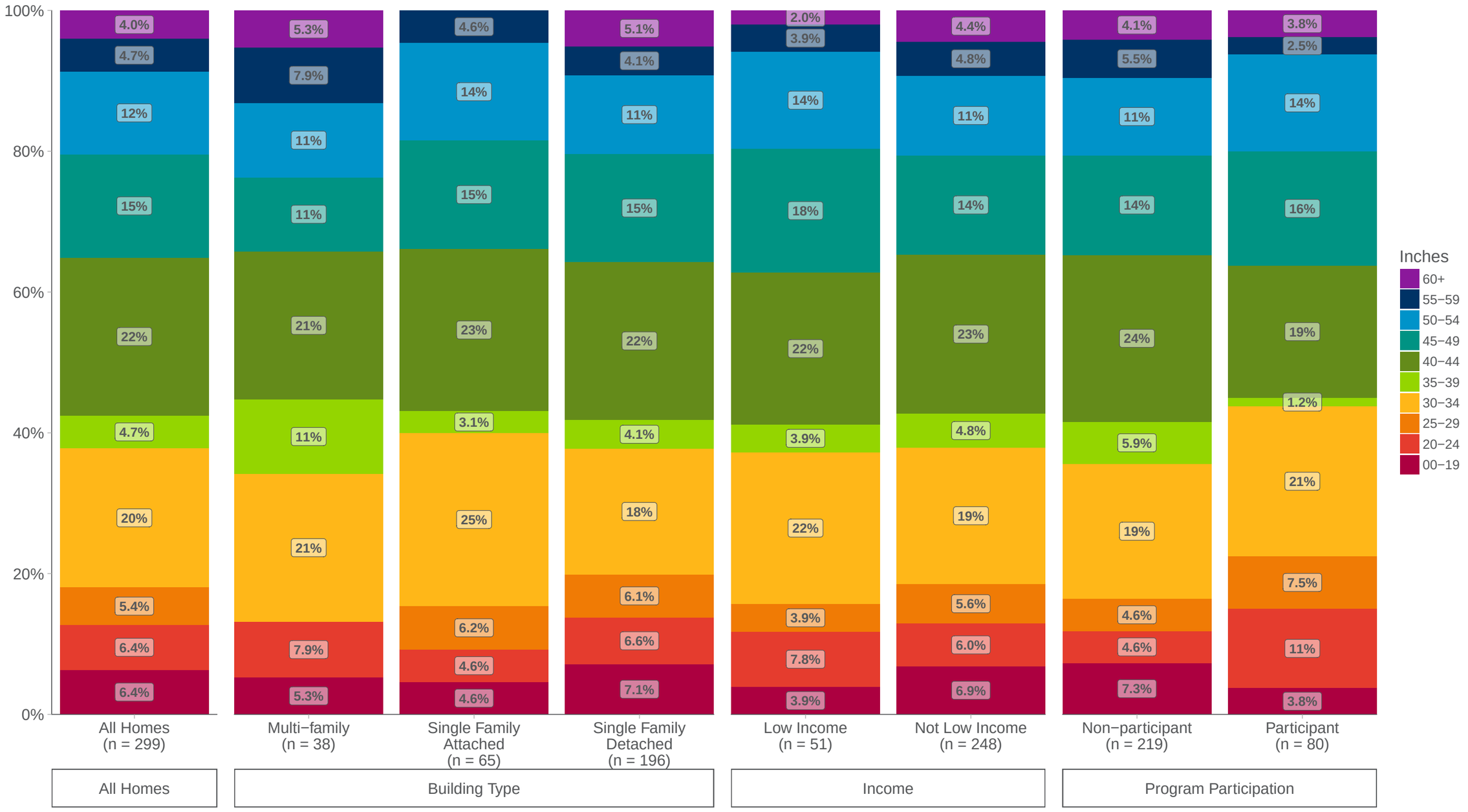
9.12 TV Screen Size by Various Demographics



Source: Navigant Analysis

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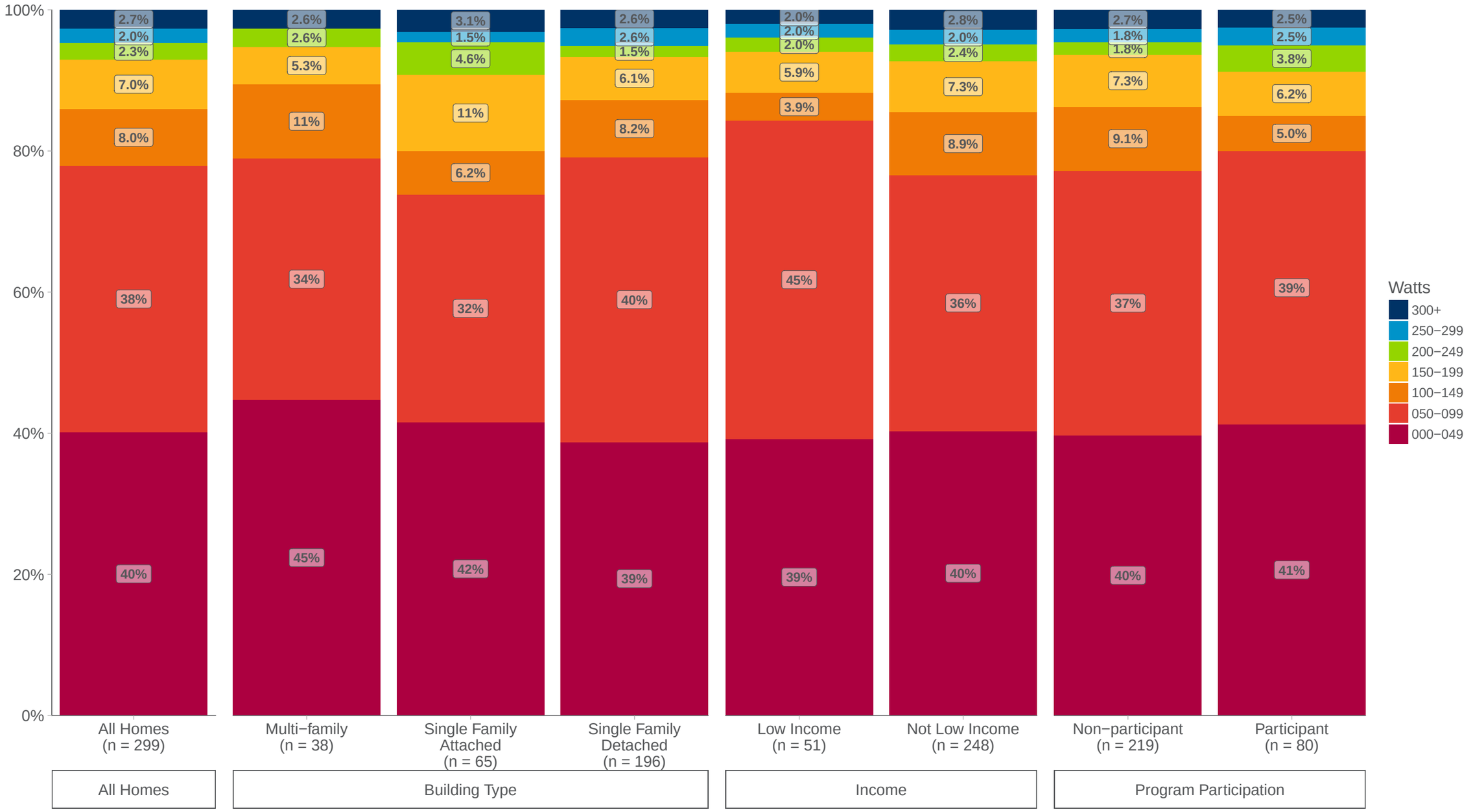
9.13 DOE-Estimated TV Power by Various Demographics



Source: Navigant Analysis

Note: DOE-estimated annual energy use, water consumption, and power based on appliance standards test procedure results reported by manufacturer.

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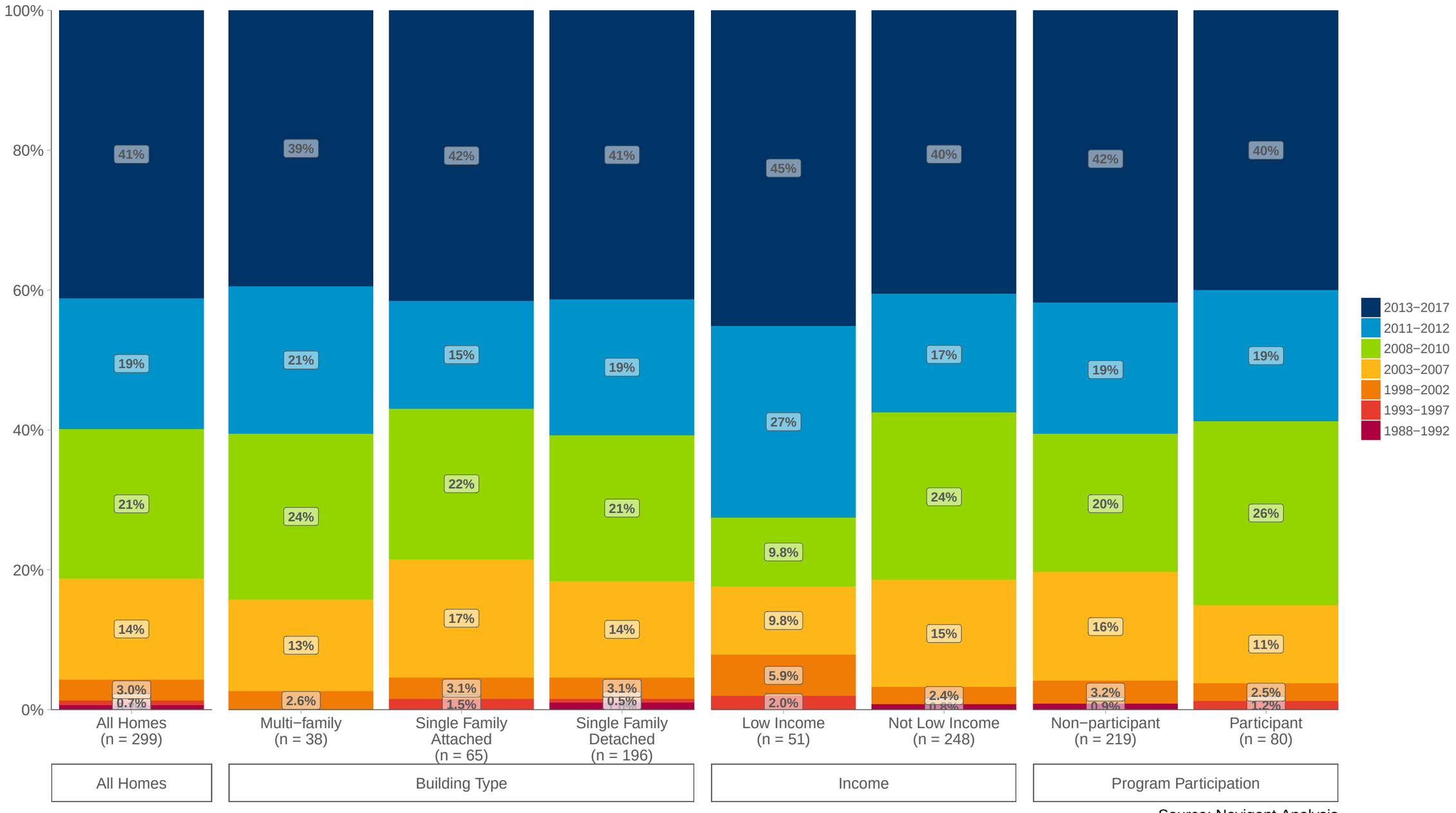
9.14 TV Year of Manufacture by Various Demographics



Source: Navigant Analysis

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