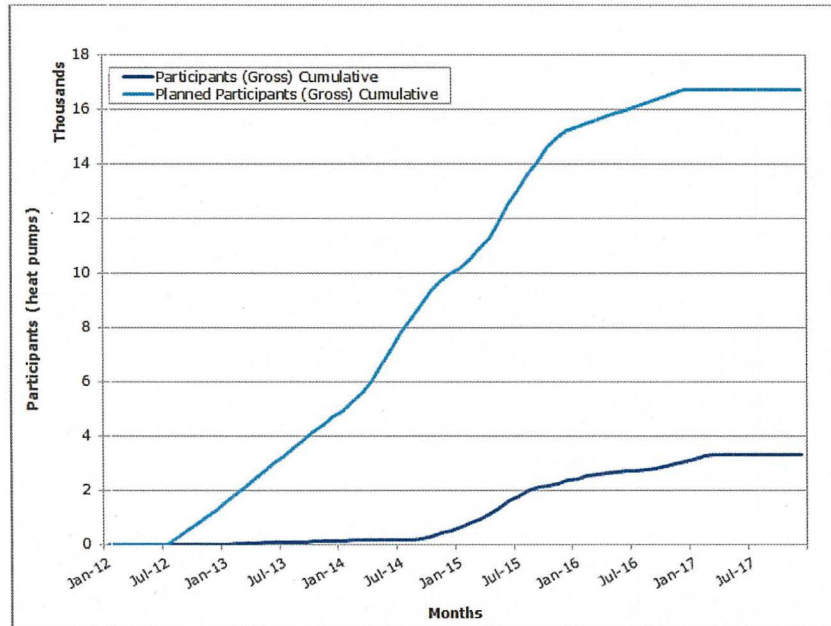
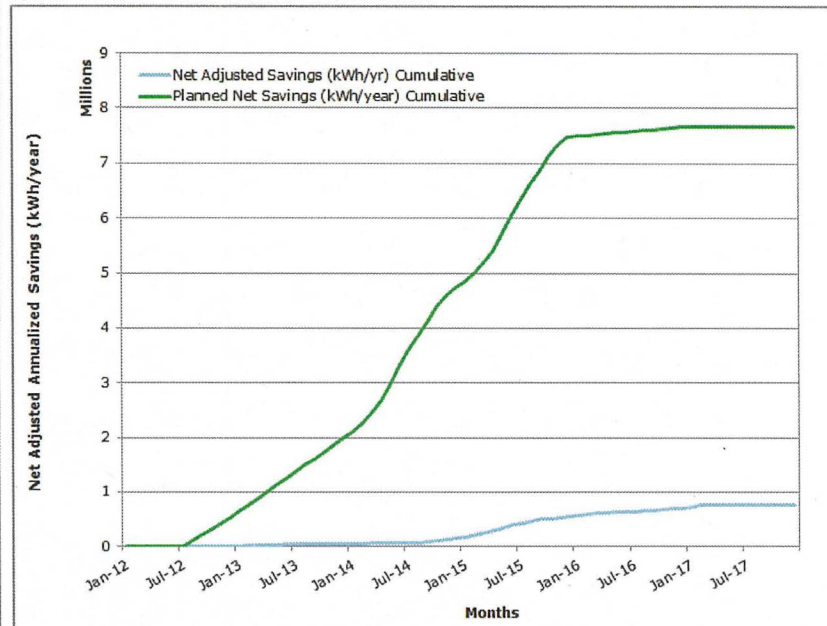


**Figure 4-23. VA Residential Duct Sealing Cumulative Participation Compared to Planned and Over Time**



**Figure 4-24. VA Residential Duct Sealing Cumulative Net Adjusted Annualized Savings (kWh/year) Compared to Planned and Over Time**



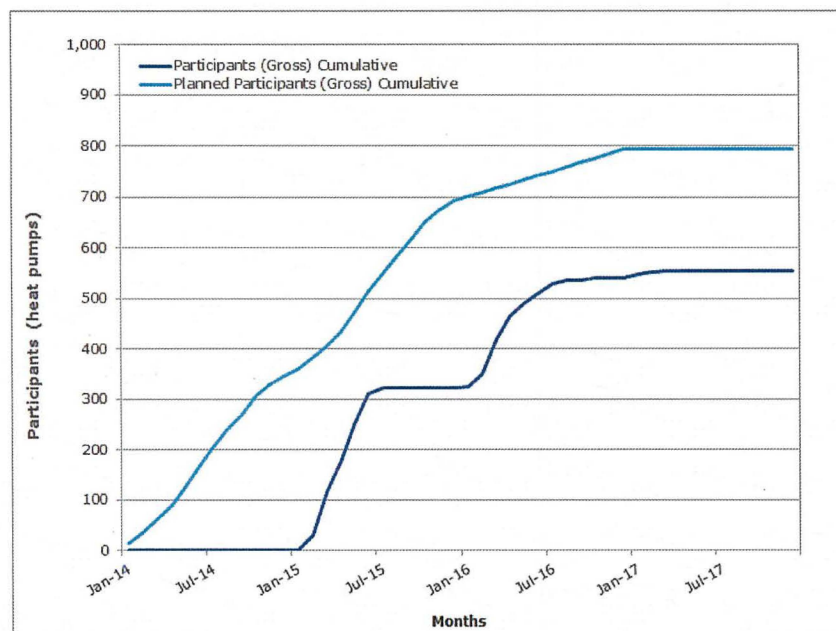
**Table 4-11. NC Residential Duct Sealing Program Performance Indicators (2014–2017)**

Category	Item	North Carolina				
		2014	2015	2016	2017	Program Total (2014-2017)
Operations and Management Costs (\$)	Direct Rebate					
	Direct Implementation					
	Direct EM&V					
	Indirect Other (Administrative)	\$951	\$3,700	\$4,363	\$690	\$9,704
Total Costs (\$)	Total					
	Planned					
	Variance					
	Cumulative % of Planned	18%	93%	121%	96%	78%
Participants	Total (Gross)	0	323	217	14	554
	Planned (Gross)	346	346	101	0	793
	Variance	-346	-23	116	14	-239
	Cumulative % of planned (Gross)	0%	93%	215%	N/A	70%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	201,495	129,136	8,003	338,633
	Realization Rate Adjustment (49%)	0	-101,956	-65,343	-4,049	-171,348
	Adjusted Gross Savings	0	99,538	63,793	3,953	167,285
	Net-to-Gross Adjustment (80%)	0	-19,908	-12,759	-791	-33,457
	Net Adjusted Savings	0	79,631	51,034	3,163	133,828
	Planned Savings (Net)	181,304	181,304	12,013	0	374,621
	Cum. % Toward Planned Savings (Net)	0%	44%	425%	N/A	36%
	Avg. Savings per Participant (Gross)	0	624	595	572	611
	Avg. Savings per Participant (Net)	0	247	235	226	242

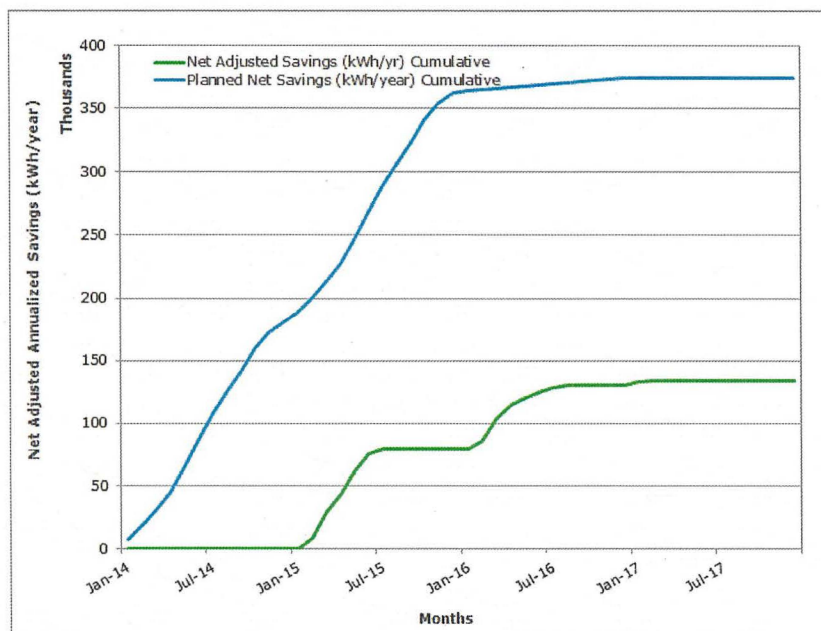


Category	Item	North Carolina				
		2014	2015	2016	2017	Program Total (2014-2017)
Installed Demand Reduction (kW)	Total Gross Deemed Demand	0	148	95	6	249
	Realization Rate Adjustment (43%)	0	-85	-55	-3	-143
	Adjusted Gross Demand	0	63	40	2	106
	Net-to-Gross Adjustment (80%)	0	-13	-8	0	-21
	Net Adjusted Demand	0	50	32	2	85
	Planned Demand (Net)	114	114	4	0	232
	Cum. % Toward Planned Demand (Net)	0%	44%	802%	N/A	36%
	Avg. Demand per Participant (Gross)	0	0.46	0.44	0.42	0.45
	Avg. Demand per Participant (Net)	0	0.16	0.15	0.14	0.15
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	0	\$11	\$20	\$49	\$18
	Cum. \$Admin. per Cum. kWh/year (Gross)	0	\$0.02	\$0.03	\$0.09	\$0.03
	Cum. \$Admin. per Cum. kW (Gross)	0	\$25	\$46	\$117	\$39
	Cum. \$EM&V per Cum. Total Costs (\$)	41%	5%	5%	25%	9%
	Cum. \$Rebate per Cum. Participant (Gross)					

**Figure 4-25. NC Residential Duct Sealing Cumulative Participation Compared to Planned and Over Time**



**Figure 4-26. NC Residential Duct Sealing Cumulative Net Adjusted Annualized Savings (kWh/year) Compared to Planned and Over Time**





Over the program life, there were a total of 3,299 Virginia participants and 554 North Carolina participants. These participants achieved 764,592 kWh/year of net annualized energy savings in Virginia, and 133,828 kWh/year in North Carolina. On average, the program produced slightly less than 250 kWh/year of net annualized energy savings per customers in both states. The program did not meet program goals in participation, net annualized energy savings, or net peak demand reductions in either state.

In Virginia, the program did not spend its planned budget over the program life (at 58% of plan). It did come closer to its spending goal in North Carolina, at 78% of plan. In Virginia, the program performance indicator, rebate amount per participant remained steady over time and averaged \$125 per participant. The same was true in North Carolina.

All other program performance indicators (administrative cost per participant, per gross kWh/year, per gross kW, EM&V cost as a percentage of total program cost) fluctuated over time, but began to stabilize by the third program year.

#### **4.3.2.2 Additional Virginia Program Participant Data**

Figure 4-27 shows the distribution of gross energy savings, peak demand reduction, and number of duct systems sealed by the heat pump system capacity in Virginia, over the program life. Systems with 3-ton capacities had the greatest percentage of gross energy and peak demand savings (32% for energy and 31% for demand). Systems ranging from 2.0 ton–3.0 ton accounted for roughly 83% of the number of duct systems sealed and approximately 81% of gross energy savings and approximately 80% of the peak demand reductions.

**Figure 4-27. VA Residential Duct Sealing Program Performance Indicators by System Capacity as % of Total (2012 - 2017)**

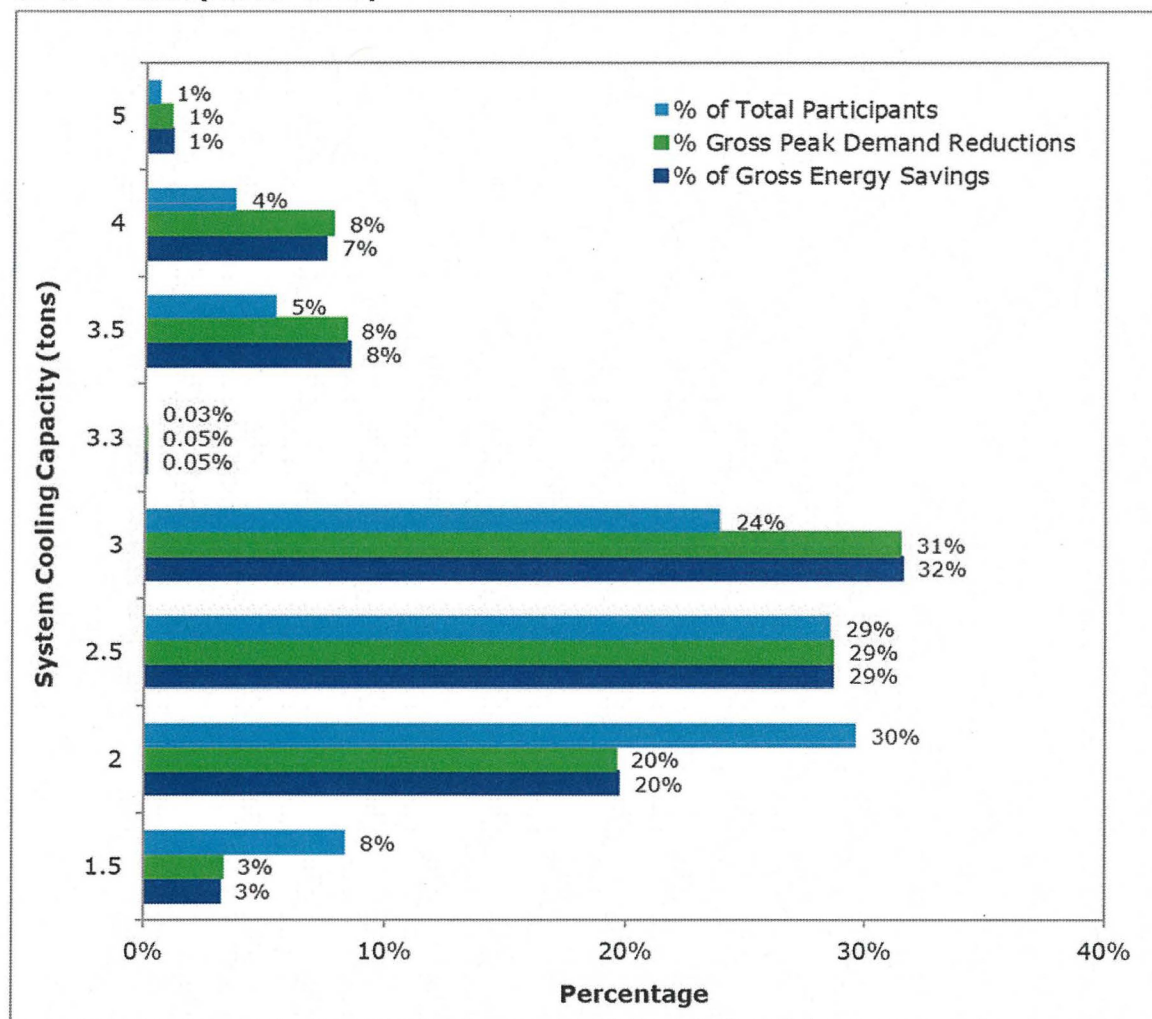
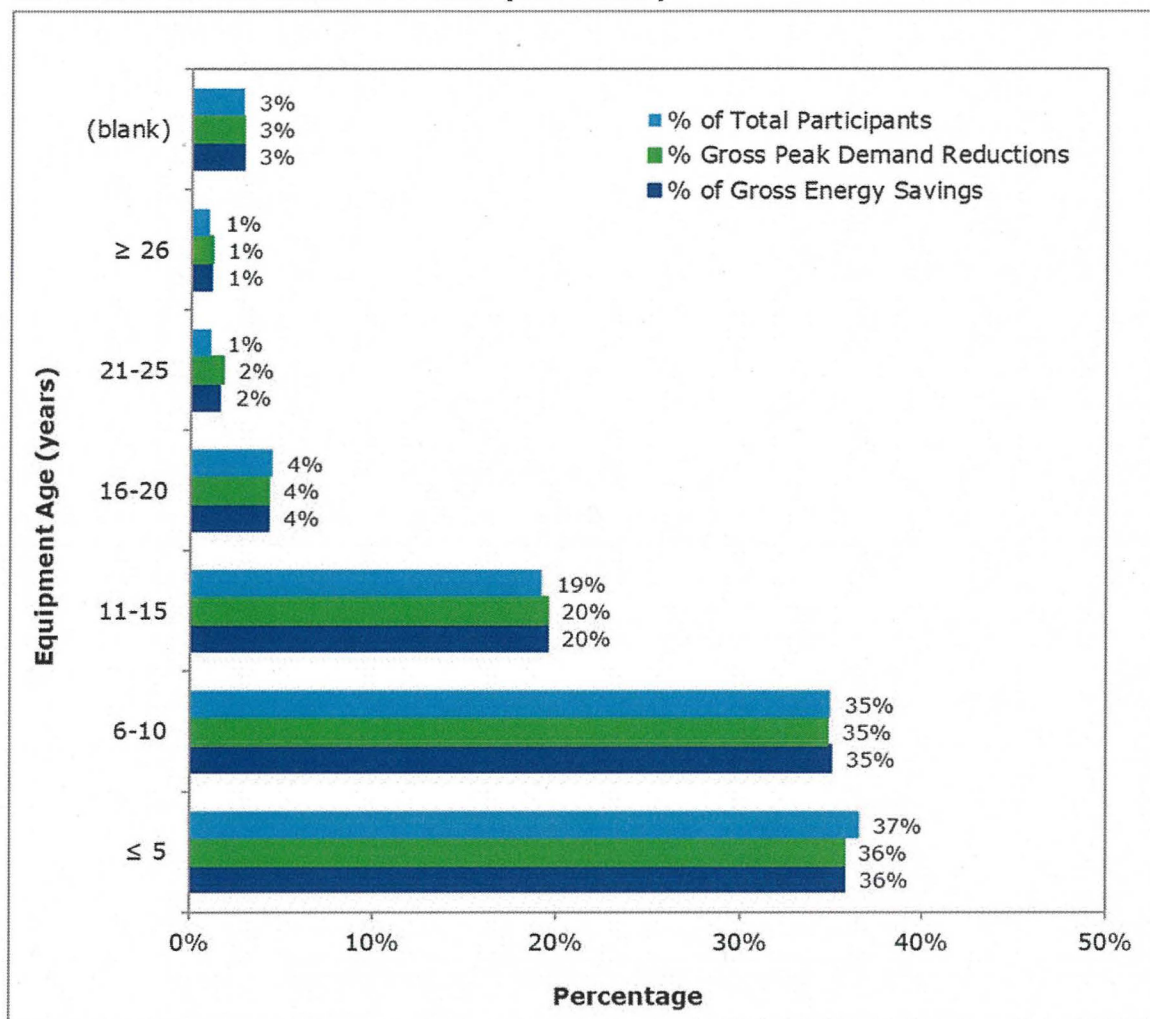


Figure 4-28 shows that of the systems that were sealed, the majority (approximately 91%) were less than or equal to 15 years old. About one-third (36%) of that savings were from systems that were less than or equal to 5 years old. The next third (35%) of that savings were from systems 6 years old through 10 years old. And the last portion (20%) were from systems 11 years old through 15 years old. There was a small number of savings achieved from sealing much older systems, which may indicate that older systems may simply be replaced with new ones.

About 97% of all participating HVAC systems and 97% of achieved savings were from single-family dwellings.



Figure 4-28. VA Residential Duct Testing Program Performance Indicators by Equipment Age, at the Time of the Service as % of Total (2012-2017)




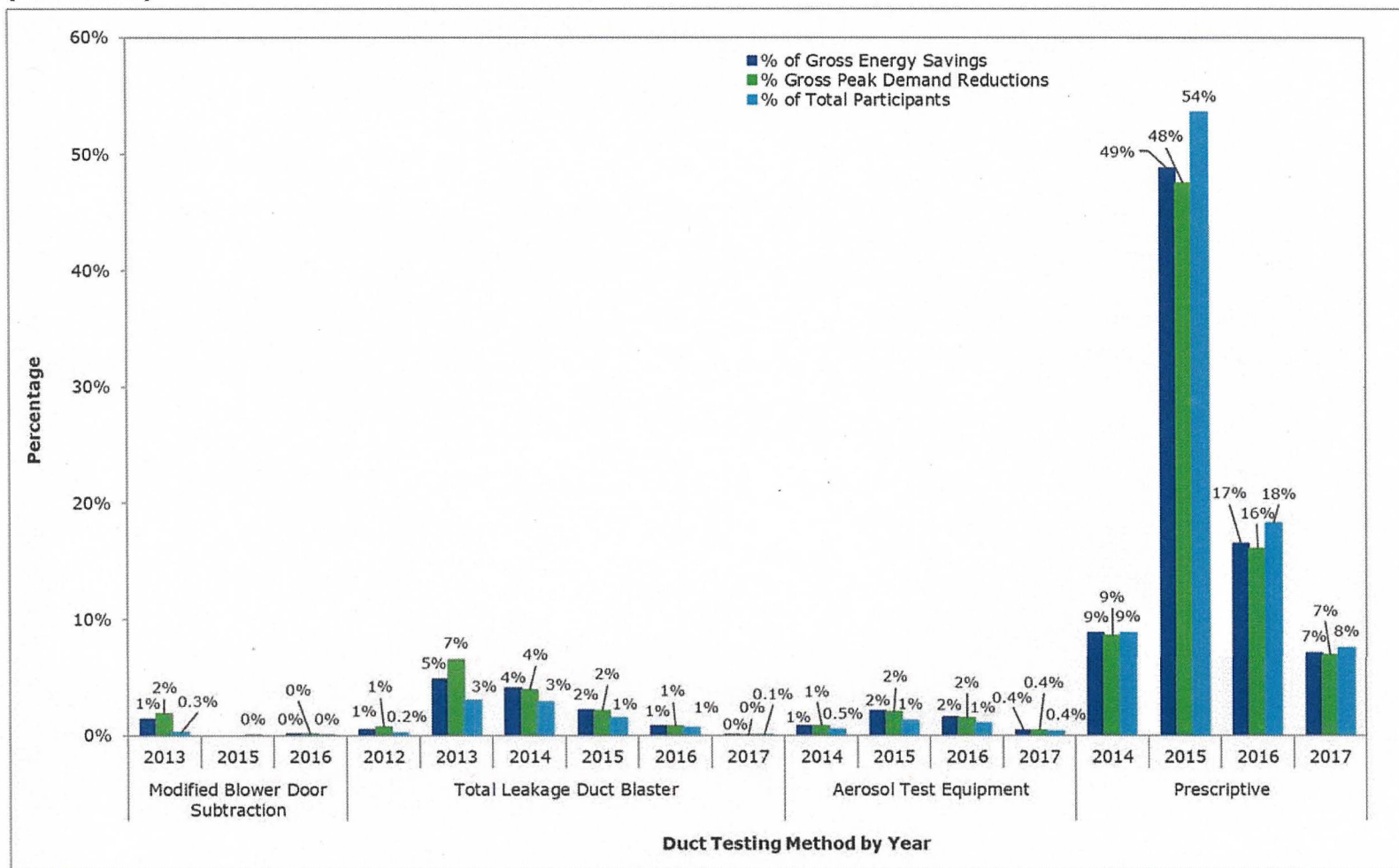


Figure 4-29 shows that over the life of the program, the most commonly selected path to participate in the program was the prescriptive path, accounting for approximately 89% of all the systems that were sealed. Dominion Energy began offering the prescriptive option in 2014 in an attempt to increase program participation after slow enrollment. This option allows contractors to use the duct sealing and repair checklist provided on the rebate application form in lieu of duct leakage testing.

The figure shows that this move was successful in increasing overall program enrollment. Participation and energy savings through this path were significantly larger than all other methods starting from the first year it was introduced. Since 2014, the majority of participants have continued to enroll in the program through the prescriptive path. While there were still participants and contractors who continued to participate in the program through the other testing methods, after this prescriptive option was made available, they were much less.



Figure 4-29. VA Residential Duct Testing Program Performance Indicator by Eligibility Path or Testing Method as % of Total (2012-2017)



#### 4.3.2.3 Additional North Carolina Program Participant Data

Figure 4-30 shows the distribution of gross energy savings, peak demand reduction, and number of duct systems sealed by the heat pump system capacity in North Carolina over the program life (2014–2017). Systems ranging from 2.0 ton–4 ton accounted for the majority of the gross energy savings and peak demand reduction (86%), and were the majority of the units sealed (85%). Similar to Virginia, systems with 3-ton capacity had the greatest percentage of gross energy savings and peak demand reduction (27% for both).

**Figure 4-30. NC Residential Duct Sealing Program Performance Indicators by System Capacity as % of Total (2014–2017)**

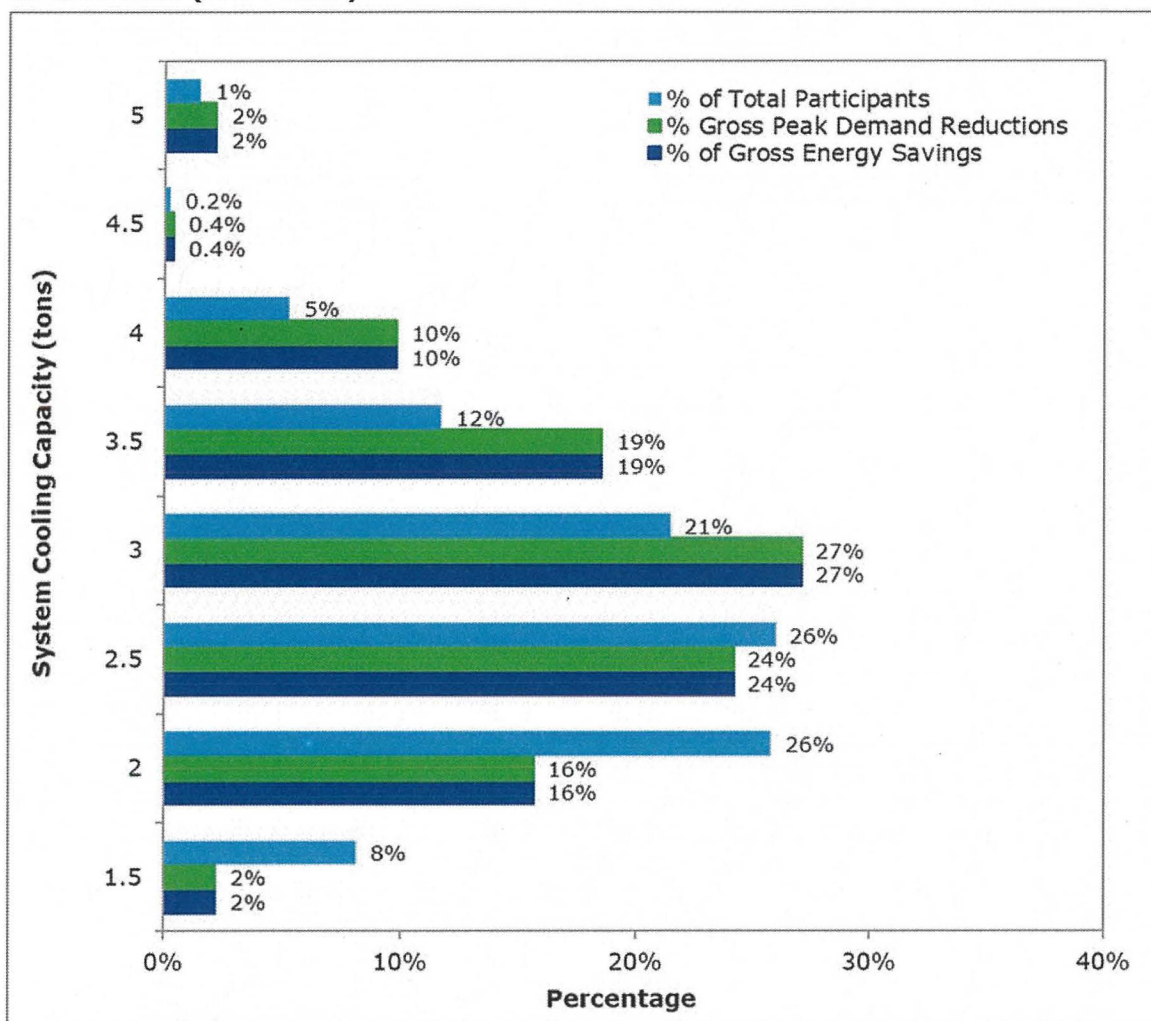




Figure 4-31 on the next page shows similar results to those in Virginia, relating to the distribution of energy savings and participation across equipment ages. About 91% of the energy savings were from equipment that were less than or equal to 15 years old. Systems that were less than or equal to 5 years old represented almost half of the savings from that group (38%).

About 99% of all participating HVAC systems, and 99% of the achieved savings were from single-family dwellings.

**Figure 4-31. NC Residential Duct Testing Program Performance Indicators by Equipment Age at the Time of the Service as a % of Total (2014-2017)**

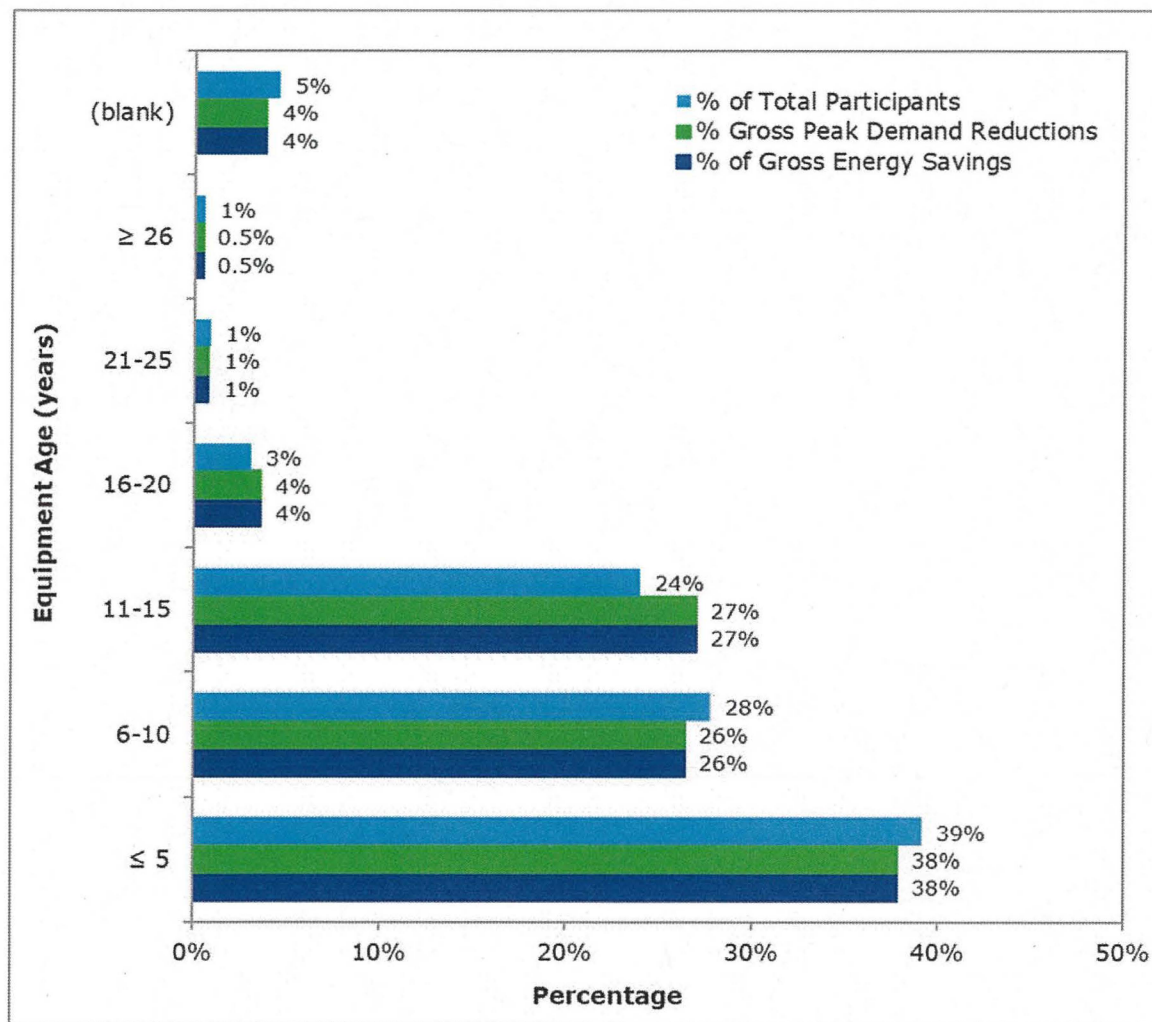
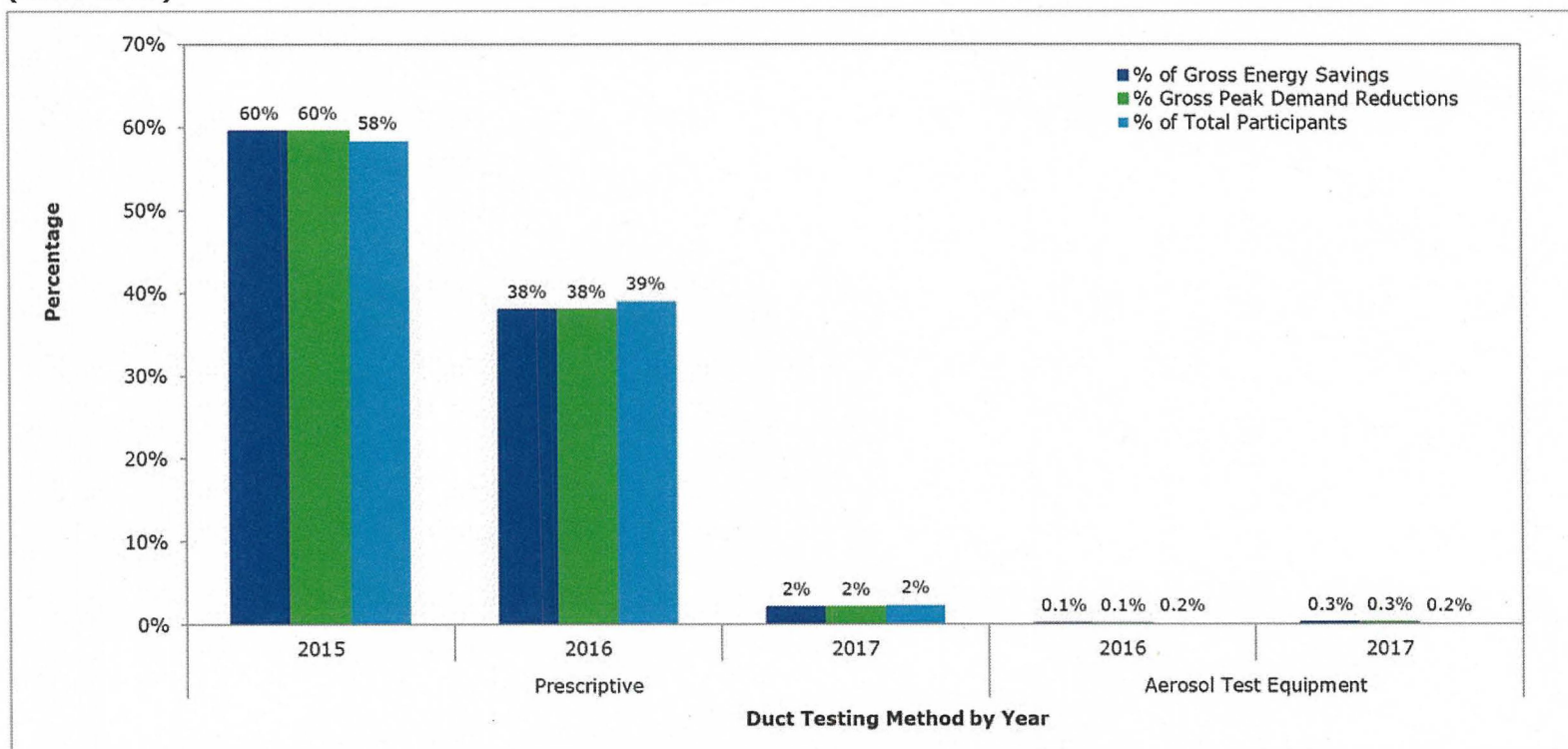




Figure 4-32 shows similar results to those in Virginia. The program started enrolling participants in 2015, and the prescriptive path was available to participants from the launch. Almost all participants, with the exception of one, entered the program through that path.

Figure 4-32. NC Residential Duct Sealing Program Performance Indicators by Eligibility Path or Testing Method as % of Total (2014-2017)





## 4.4 Residential Home Energy Check-up – Virginia and North Carolina



The Residential Home Energy Check-Up Program provides owners and occupants of single-family homes and townhomes with an easy and low-cost home energy audit. This includes a walk-through audit of customer homes, direct install measures, and recommendations for additional home energy improvements. Customers receive the recommendations in a personalized report

showing the projected energy and cost savings from implementing the options identified during the check-up.

Residential customers with single-family residences or townhomes that are at least five years old are eligible for this program. Customers living in apartments are not eligible to participate in this program. To be eligible, the audit and installation of measures must have been performed after August 1, 2012 in Virginia and after January 1, 2014 in North Carolina.

Customers must contact a participating contractor to receive the home energy check-up. Customers are not considered to have fully participated in the program until a completed application form is processed and a rebate is issued. This process can take several months, as customers have 45 days to submit their rebate application, and the Company has 90 days to process it.

The eligible improvements are primarily EE measures that impact electricity consumption, and may include, but are not limited to:

- Domestic hot water (DHW)-heater tank wrap
- DHW-heater temperature adjustment
- DHW-pipe insulation
- Kitchen and bathroom aerator
- Low-flow showerhead
- Central AC, heat pump, or window-unit filter change
- CFL bulb replacement
- Smart strip plug
- Door sweep and/or door weatherization
- Refrigerator temperature increase

Starting in June 2013, the Residential Home Energy Check-Up Program allowed customers to assign rebates to contractors. Since that time, the majority (more than 85% each year) of participating households consistently assigned their rebates to their contractors in both states.

All North Carolina participants assigned their rebates to the contractors throughout the program life. This modification in rebate assignment was intended to help the program increase the customer enrollment, which was at its highest in 2014 through 2016 in Virginia. Enrollment was most active in North Carolina in 2015.

In 2016, Dominion Energy announced the program closed to new participants in both states. To be eligible for a rebate, the service must have been completed by a participating contractor by December 24, 2016 and rebate applications received by February 7, 2017. This report section shows those final enrollments in 2017. The rebate form submission and processing time all together can add up to 135 days before a participant is registered in the tracking and reporting system. This report section shows those final enrollments in 2017 that were serviced in the last months of 2016.

#### 4.4.1 Methods for the Current Reporting Period

For the current period, the approach included reviewing the tracking data and then estimating gross energy savings and peak demand reductions using STEP Manual calculations with the realization rate estimated from the 2014 billing analysis.

Table 4-12 outlines Dominion Energy's initial program planning assumptions that were used to design the program.

**Table 4-12. Residential Home Energy Check-Up Program Planning Assumptions System-wide**

Item	Description
Target Market	Residential customers
NTG Factor	80%
Measure Life	10 years
Average Energy Savings (kWh) per Participant per Year	1,017 kWh per participant per year
Average Peak Demand Reduction (kW) per Participant	0.18 kW per participant per year
Average Rebate (US \$) per Participant	\$230 per participant

#### 4.4.2 Assessment of Program Progress Towards Plan

The next section describes the program's progress towards planned participants, energy savings, and peak demand reductions.

##### 4.4.2.1 Key Virginia Program Data

The following table (Table 4-13) summarize key indicators of progress from August 1, 2012 to December 31, 2017 for Virginia. Detailed monthly program indicators for Virginia appear in Appendix A.4.



**Table 4-13. VA Residential Home Energy Check-Up Program Performance Indicators (2012–2017)**

Category	Item	Virginia						Program Total (2012-2017)
		2012	2013	2014	2015	2016	2017 <sup>36</sup>	
Operations and Management Costs (\$)	Direct Rebate							
	Direct Implementation							
	Direct EM&V							
	Indirect Other (Administrative)	\$45,900	\$107,979	\$302,076	\$142,892	\$152,251	\$27,969	\$779,066
Total Costs (\$)	Total							
	Planned							
	Variance							
	Cumulative % of Planned	67%	99%	506%	326%	343%	75%	269%
Participants	Total (Gross)	31	1,569	19,702	13,860	15,252	1,500	51,914
	Planned (Gross)	602	1,605	2,427	2,427	2,427	-	9,488
	Variance	-571	-36	17,275	11,433	12,825	1,500	42,426
	Cumulative % of planned (Gross)	5%	98%	812%	571%	628%	N/A	547%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	24,484	1,156,888	10,573,042	6,834,001	6,803,477	827,576	26,219,469
	Realization Rate Adjustment (154%) <sup>37</sup>	13,099	618,935	5,656,578	3,656,191	3,639,860	442,753	14,027,416
	Adjusted Gross Savings	37,583	1,775,823	16,229,620	10,490,192	10,443,338	1,270,330	40,246,885
	Net-to-Gross Adjustment (82%) <sup>38</sup>	-7,517	-355,165	-3,245,924	-1,898,725	-1,890,244	-229,930	-7,627,504

<sup>36</sup> The 2017 total gross deemed savings values reported in this table include adjustments of -24,556.1 kWh/year and -1.64 kW made to the January 2017 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017. Specifically, the correction was in section 2.1.5 for "Low-Flow Showerhead" measures, to the "ΔT" variable, which is a measure of the change in temperature of the water used for shower and temperature entering the house (ΔT = Tshower - Tin house). STEP Manual 7.0.0 reported the value as 44.9°F, but has been corrected to 44.1°F. This correction is reflected in STEP Manual version 8.0.0 in this EM&V report.

<sup>37</sup> The realization rate for installed energy savings was updated to 154% based on the 2015 Impact Evaluation and Customer Satisfaction Report.

<sup>38</sup> NTG adjustment for 2012-2014 was 80% per the program planning assumptions. Starting in 2015, the NTG adjustment was updated to 81.9% based on the 2015 Net-to-Gross Characterization Study.



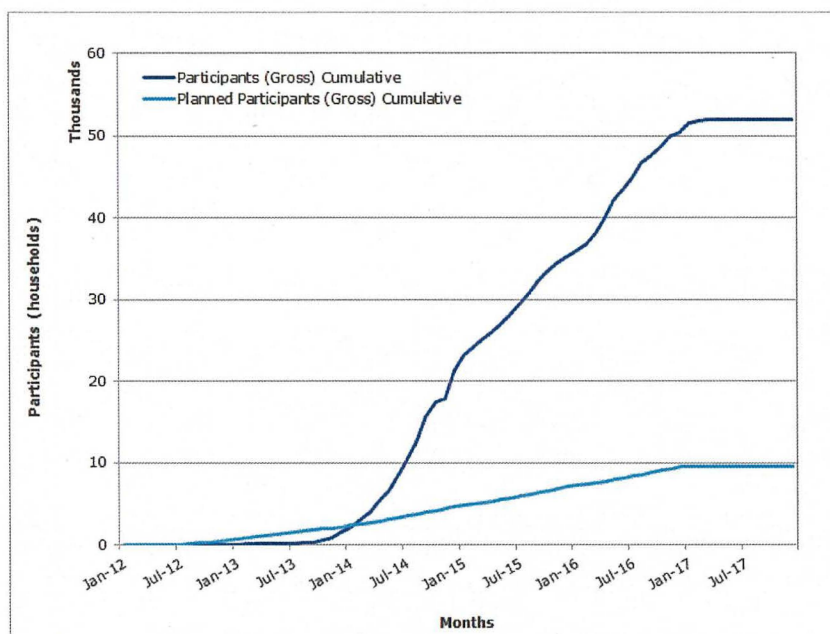
Category	Item	Virginia						Program Total (2012-2017)
		2012	2013	2014	2015	2016	2017 <sup>36</sup>	
	Net Adjusted Savings	30,066	1,420,658	12,983,696	8,591,467	8,553,094	1,040,400	32,619,381
	Planned Savings (Net)	492,000	1,306,356	2,468,259	2,468,259	4,593,678	-	11,328,552
	Cum. % Toward Planned Savings (Net)	6%	109%	526%	348%	186%	N/A	288%
	Avg. Savings per Participant (Gross)	790	737	537	493	446	552	505
	Avg. Savings per Participant (Net)	970	905	659	620	561	694	628
Installed Demand Reduction	Total Gross Deemed Demand	3	140	1,106	695	693	76	2,713
	Realization Rate Adjustment (154%) <sup>39</sup>	2	75	592	372	371	41	1,452
	Adjusted Gross Demand	5	215	1,698	1,066	1,064	117	4,165
	Net-to-Gross Adjustment (82%) <sup>40</sup>	-1	-43	-340	-193	-193	-21	-790
	Net Adjusted Demand	4	172	1,358	873	871	96	3,374
	Planned Demand (Net)	85	225	437	437	1,002	-	2,186
	Cum. % Toward Planned Demand (Net)	4%	76%	311%	200%	87%	N/A	154%
	Avg. Demand per Participant (Gross)	0.10	0.09	0.06	0.05	0.05	0.05	0.05
	Avg. Demand per Participant (Net)	0.1	0.1	0.1	0.06	0.06	0.06	0.07
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$1,481	\$69	\$15	\$10	\$10	\$19	\$15
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$2	\$0	\$0.03	\$0.02	\$0	\$0	\$0
	Cum. \$Admin. per Cum. kW (Gross)	\$14,840	\$771	\$273	\$206	\$220	\$366	\$287

<sup>39</sup> The realization rate for installed demand reductions was updated to 154% based on the 2015 Impact Evaluation and Customer Satisfaction Report.

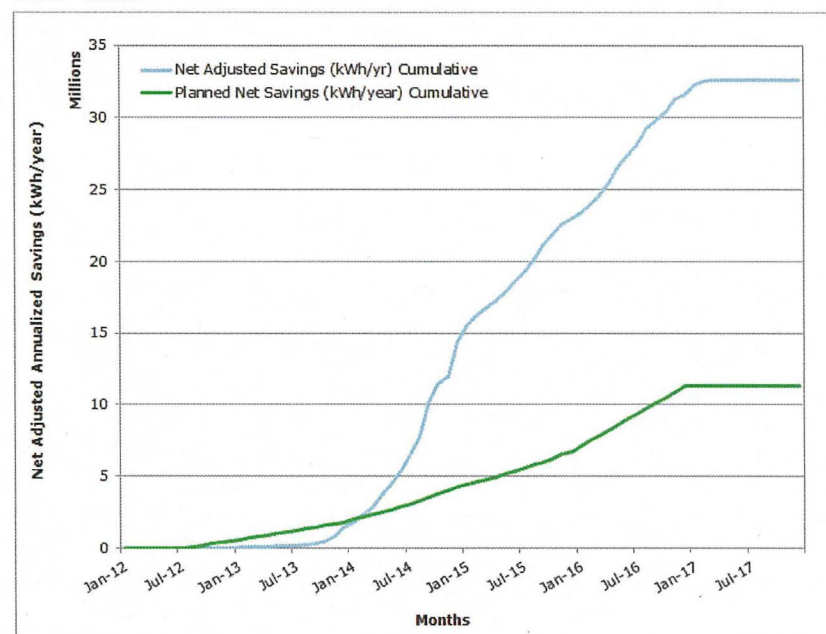
<sup>40</sup> NTG adjustment for 2012-2014 was 80% per the program planning assumptions. Starting in 2015, the NTG adjustment was updated to 81.9% based on the 2015 Net-to-Gross Characterization Study.

Category	Item	Virginia						Program Total (2012-2017)
		2012	2013	2014	2015	2016	2017 <sup>36</sup>	
	Cum. \$EM&V per Cum. Total Costs (\$)	4.9%	9.7%	0.8%	2.6%	3.2%	12.0%	3.0%
	Cum. \$Rebate per Cum. Participant (Gross)							

**Figure 4-33. VA Residential Home Energy Check-Up Cumulative Participation Compared to Planned and Over Time**



**Figure 4-34. VA Residential Home Energy Check-Up Cumulative Net Adjusted Annualized Savings (kWh/year) Compared to Planned and Over Time**





From 2012 to 2017, Virginia program participants saved an average of net 628 kWh/year, which is more than half of what was initially planned (1,017 kWh/year), shown previously in Table 4-12. The difference in yearly kWh averages is due to the type of measures and number of the measures installed in households in a given year.

The overall program costs per participant over the life span of the program steadily decreased over time, potentially due to the increasing economies of scale. The exception is 2017, however as described above, these participants were serviced in 2016, but appeared in the 2017 EM&V results because of the normal time required to process rebates. Rebate cost per participants was at \$217 in 2017 and overall program life time rebate cost per participant was \$215.

In Virginia, there were 1,500 participants in 2017. These enrollments were the residual participants who installed measures in 2016. Overall, all participation and program activity was highest from 2014 through 2016 until the program's retirement. By the end of the program, program participation exceeded plans by fivefold as shown in Figure 4-33, which may be attributed to greater-than-planned program spending starting in 2014. Dominion Energy has the authority to allocate funds across the programs within a single DSM Phase (Phase II in this case), based on participation and progress towards goals.

Net adjusted annualized savings (kWh/year) in Virginia exceeded the final program plans by almost threefold, as shown in Figure 4-34. Peak demand reduction (kW/Year) also exceeded plans at 154% of the total cumulative program goals.

#### **4.4.2.2 Key North Carolina Program Data**

The following tables (Table 4-14) summarize key indicators of progress from February 1, 2015 to December 31, 2017 for North Carolina. Detailed monthly program indicators for North Carolina in Appendix B.4.



**Table 4-14. NC Residential Home Energy Check-Up Program Performance Indicators (2014–2017)**

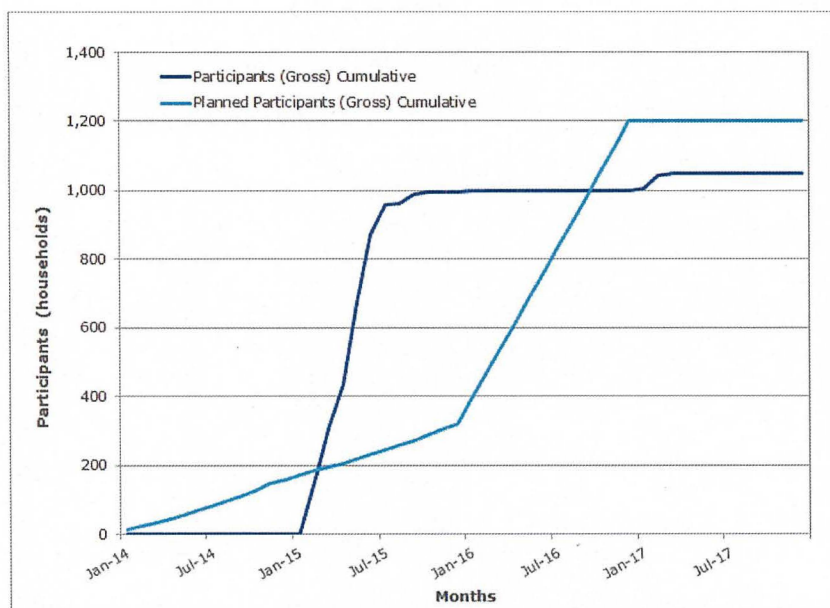
Category	Item	North Carolina				Program Total (2014-2017)
		2014	2015	2016	2017 <sup>41</sup>	
Operations and Management Costs (\$)	Direct Rebate					
	Direct Implementation					
	Direct EM&V					
	Indirect Other (Administrative)	\$654	\$11,982	\$658	\$1,086	\$14,380
Total Costs (\$)	Total					
	Planned					
	Variance					
	Cumulative % of Planned	17%	379%	44%	46%	123%
Participants	Total (Gross)	0	996	4	49	1,049
	Planned (Gross)	160	160	881	-	1,201
	Variance	-160	836	-877	49	-152
	Cumulative % of planned (Gross)	0%	623%	0%	N/A	87%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	593,172	1,495	35,049	629,716
	Realization Rate Adjustment (154%)	0	317,347	800	18,751	336,898
	Adjusted Gross Savings	0	910,520	2,294	53,800	966,614
	Net-to-Gross Adjustment (82%)	0	-164,804	-415	-9,738	-174,957
	Net Adjusted Savings	0	745,716	1,879	44,062	791,657
	Planned Savings (Net)	162,720	162,720	308,536	-	633,976
	Cum. % Toward Planned Savings (Net)	0%	458%	1%	N/A	125%
	Avg. Savings per Participant (Gross)		596	374	715	600
	Avg. Savings per Participant (Net)		749	470	899	755

<sup>41</sup> The 2017 total gross deemed savings values reported in this table include adjustments of -2.1 kWh/year and -0.00044 kW made to the January 2017 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017. Specifically, the correction was in section 2.1.5 for "Low-Flow Showerhead" measures, to the "ΔT" variable, which is a measure of the change in temperature of the water used for shower and temperature entering the house ( $\Delta T = T_{\text{shower}} - T_{\text{in house}}$ ). STEP Manual 7.0.0 reported the value as 44.9°F, but has been corrected to 44.1°F. This correction is reflected in STEP Manual version 8.0.0 in this EM&V report.

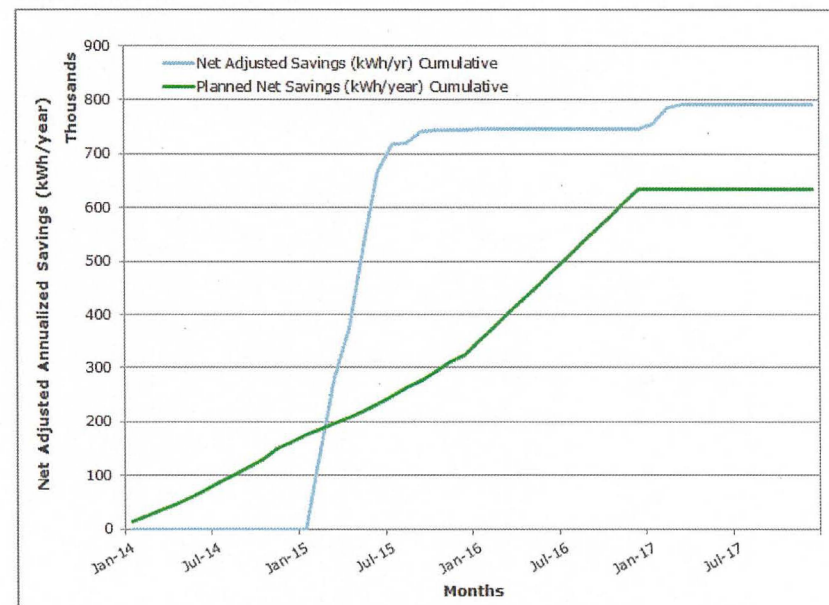
Category	Item	North Carolina				Program Total (2014-2017)
		2014	2015	2016	2017 <sup>41</sup>	
Installed Demand Reduction (kW)	Total Gross Deemed Demand	0	52	0.17	2.45	55
	Realization Rate Adjustment (154%)	0	28	0.09	1.31	29
	Adjusted Gross Demand	0	80	0.25	3.76	84
	Net-to-Gross Adjustment (82%)	0	-14	-0.05	-0.68	-15
	Net Adjusted Demand	0	65	0.21	3.08	69
	Planned Demand (Net)	29	29	67	-	125
	Cum. % Toward Planned Demand (Net)	0%	227%	1%	N/A	55%
	Avg. Demand per Participant (Gross)		0.05	0.04	0.05	0.05
	Avg. Demand per Participant (Net)		0.07	0.05	0.06	0.07
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	N/A	\$12	\$165	\$22	\$14
	Cum. \$Admin. per Cum. kWh/year (Gross)	N/A	\$0.02	\$0.44	\$0.03	\$0.02
	Cum. \$Admin. per Cum. kW (Gross)	N/A	\$230	\$3,983	\$443	\$263
	Cum. \$EM&V per Cum. Total Costs (\$)	24.8%	2.3%	50.0%	20.2%	6.7%
	Cum. \$Rebate per Cum. Participant (Gross)					



**Figure 4-35. NC Residential Home Energy Check-Up Cumulative Participation Compared to Planned and Over Time**



**Figure 4-36. NC Residential Home Energy Check-Up Cumulative Net Adjusted Annualized Savings (kWh/year) Compared to Planned and Over Time**





In 2017, per participant, average net savings were 899 kWh/year and average peak demand reduction was 0.06 kW. All of the 2017 program enrollments were serviced in 2016. The difference in yearly kWh averages is associated with the types of measures and number of measures installed in households each year.

Over the entire program life in both states, an average program participant in North Carolina saved 755 kWh/year, slightly higher than the average per-participant savings in Virginia (628 kWh/year). The reason for this difference is described further in the following sections.

Program spending program performance indicators (program costs, administrative costs per participants, per gross kWh/year saved, and per gross kW reduced) fluctuated from year to year. These indicators are driven by program enrollment, as demonstrated by the 2016 cost peak due to low participant enrollment. Overall, the rebate per participant was at \$193 in 2017 and entire program lifecycle rebate per participant cost was \$220.

In North Carolina, program enrollment and activity was highest in 2015 as shown in Figure 4-35. There were 49 enrollments in 2017. Program-level spending is allocated at 94% for Virginia and 6% for North Carolina. The Company manages its program design and implementation using this allocation scheme.

Figure 4-36 shows how North Carolina program new participant enrollment quickly slowed down by midyear 2015. The cumulative figure shows the slowed down enrollment as the curve flattens through the end of 2016. At the time of the program retirement (March 2017), it achieved and exceeded its planned net energy savings goals at 125% of goals. It reached 87% of the total planned participation goals, and reached 55% of total program goals for peak demand reduction by the end of 2017.

#### **4.4.2.3 Additional Virginia Program Participant Data**

Based on Virginia tracking data (illustrated in Figure 4-37), about 60% of the gross annualized energy savings were a result of measures installed in homes that were approximately 20 to 49 years old at the time the measures were installed. Another 23% of the gross annualized energy savings were from measures installed in homes approximately 50 to 79 years old. Overall, Virginia's program savings were achieved from older houses than those in North Carolina.

**Figure 4-37. VA Residential Home Energy Check-Up Program Participant Approximate Home Age as % of Gross Annualized Energy Savings (kWh/year), Over Time**

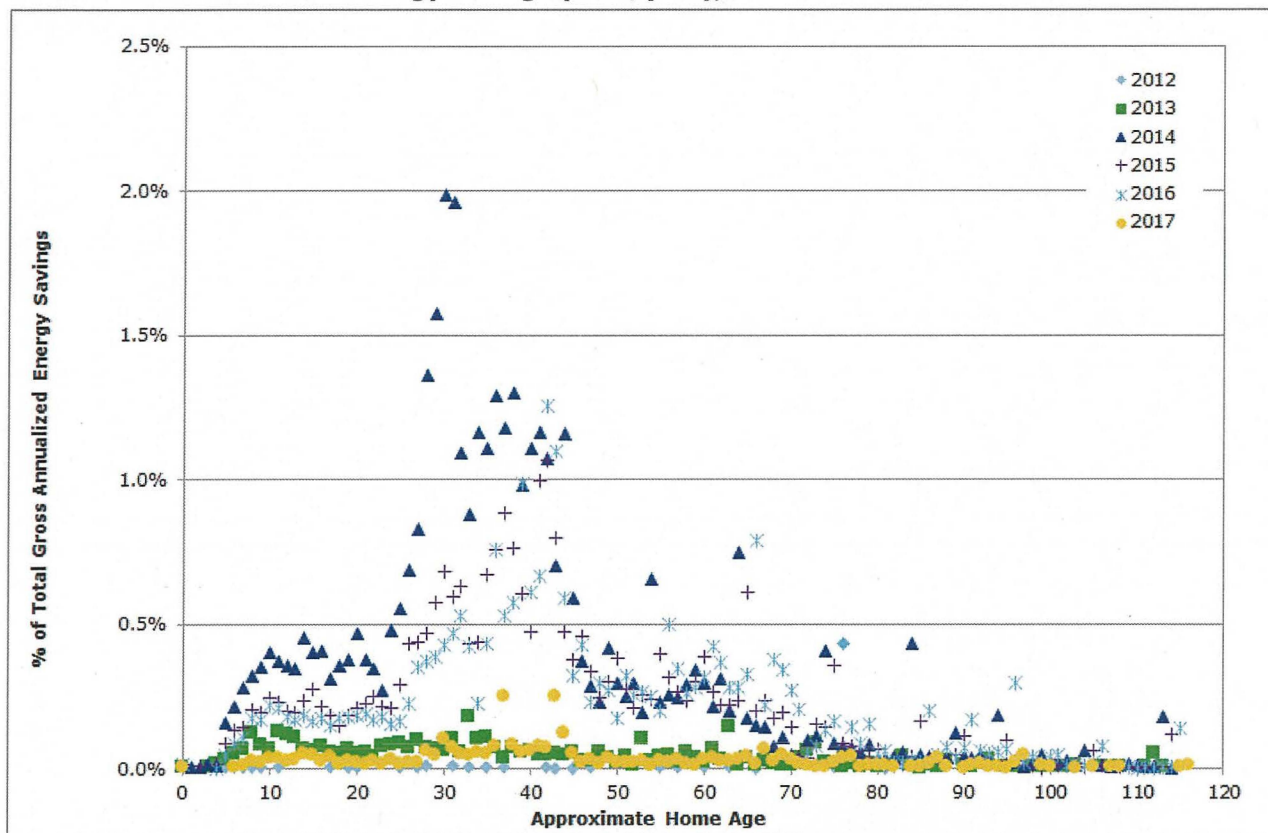


Figure 4-38 shows the gross energy savings, gross peak demand reduction, measures, and number of participants by the measure type installed in Virginia over the entire program life, 2012 to 2017. CFL retrofits accounted for the largest share (46%) of total gross energy savings and 47% of total gross peak demand reduction. DHW faucet aerators, which included kitchen and bath faucet aerators as well as low-flow showerheads, was the second-largest measure category for savings, accounting for 18% total gross energy

savings and 12% total gross peak demand reduction. DHW pipe insulation was 15% of energy savings and 17% of peak demand reduction.

All other measure categories combined accounted for relatively smaller contributions to overall program savings, about 21% of the gross energy savings combined.

**Figure 4-38. VA Residential Home Energy Check-Up Program Performance Indicators by Measure Type as % of Total (2012-2017)**

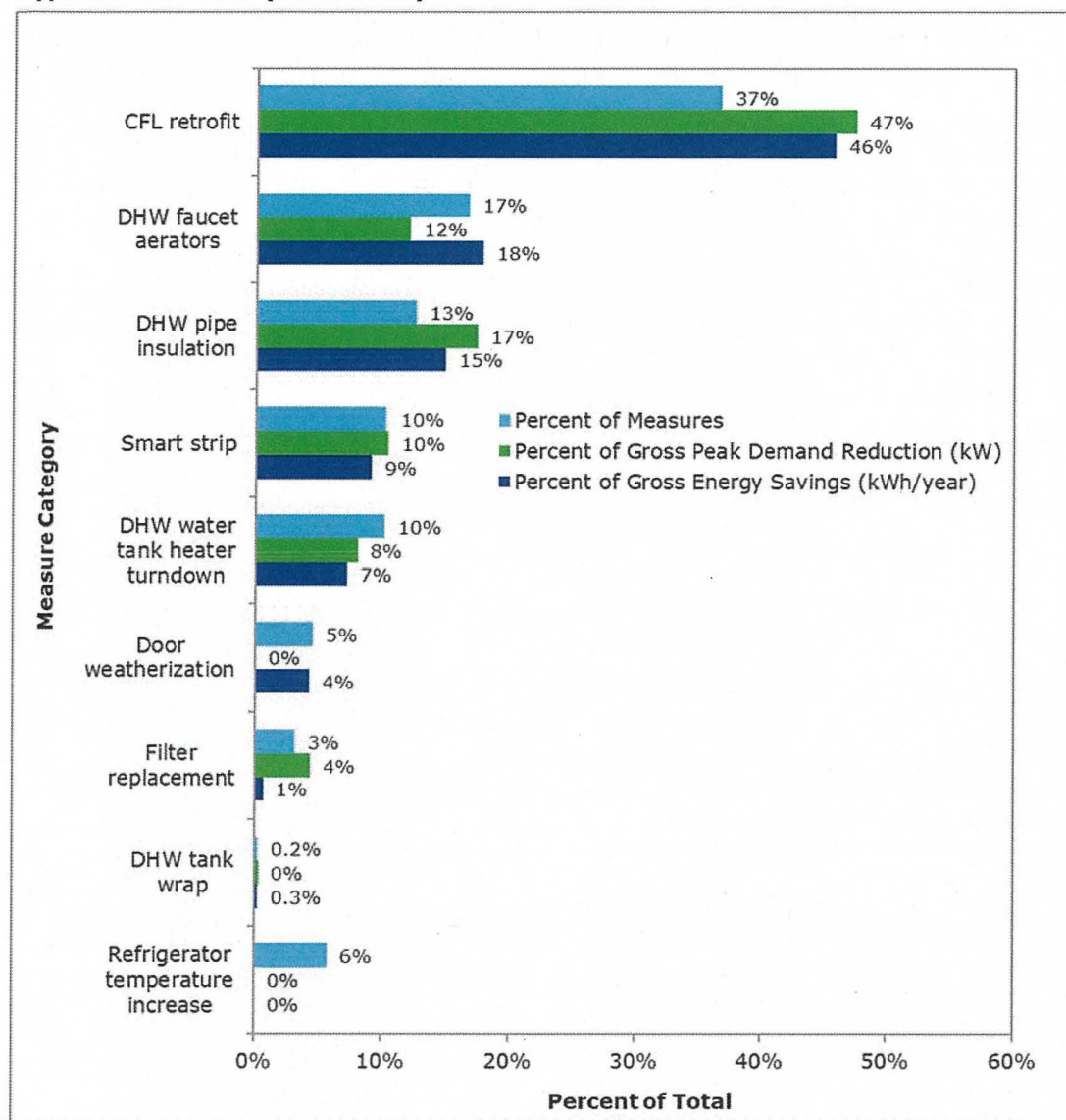
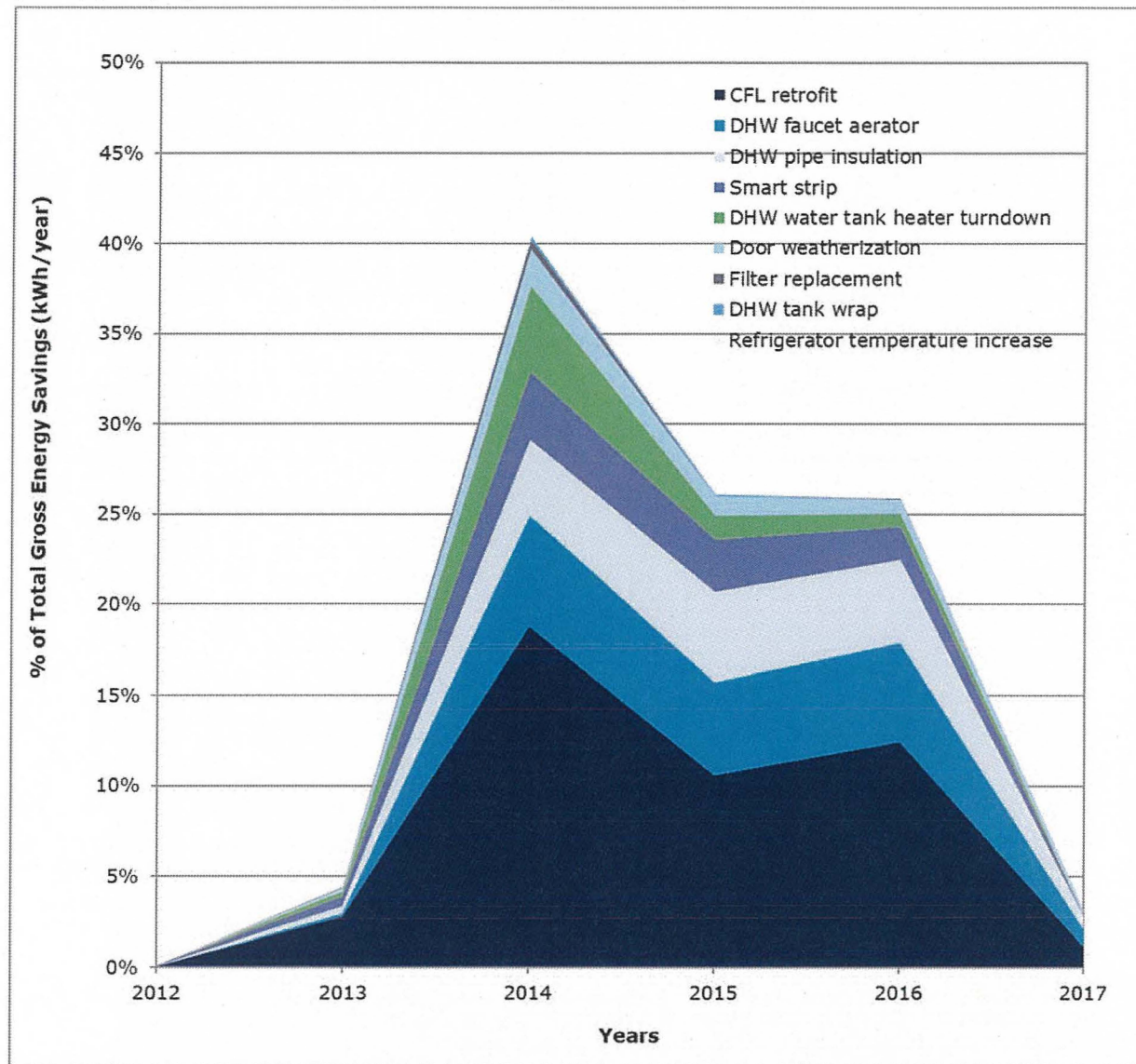


Figure 4-39 shows that over the life of the program, CFL retrofit measures have consistently been the highest contributor to program savings. The same is true of the DHW faucet aerators and DHW pipe insulation, which have consistently been the next two highest contributors to program savings.



Figure 4-39. VA Residential Home Energy Check-Up Program Gross Annualized Energy Savings (kWh/year) By Measure Type, as a % of Program Total, Over Time



#### 4.4.2.4 Additional North Carolina Program Participant Data

Savings from the North Carolina program were achieved from homes that were much newer, on average, than those participating in the Virginia program. This may be the result of different program participants in Virginia and North Carolina.

In Virginia, the Company serves across the entire state and participation is also spread across the state. However, in North Carolina, the Company serves a small portion of the northern section of the state, a less diverse participant group than in Virginia. Based on North Carolina tracking data (illustrated in Figure 4-40), slightly more than 40% of the gross annualized energy savings was a result of measures installed in homes that were approximately 5 to 19 years old at the time the measures were installed. About 39% of the gross annualized energy savings were from measures installed in homes approximately 20 to 49 years old.

**Figure 4-40. NC Residential Home Energy Check-Up Program Approximate Home Age as % of Gross Annualized Energy Savings (kWh/year), Over Time**

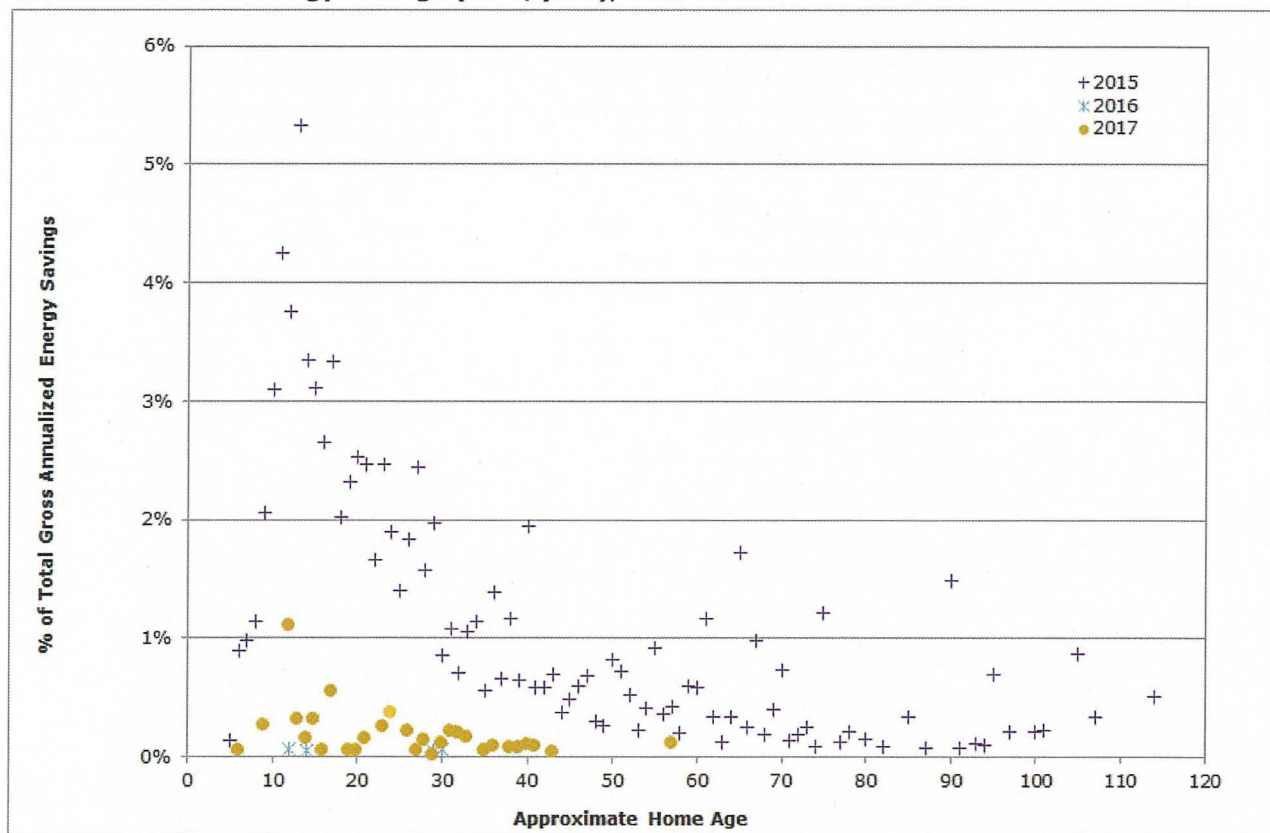


Figure 4-41 shows the gross energy savings, gross peak demand reduction, measures, and number of participants by the measure type installed in North Carolina over the entire program life, 2014 to 2017. Like in Virginia, CFL retrofits were the largest contributor to program savings. CFL retrofits accounted for 45% of total gross energy savings and 49% of total gross peak demand reduction. The DHW faucet aerator measure was the second largest measure category for savings, accounting for 42% total gross energy savings and

36% total gross peak demand reduction. Smart strips accounted for 7% of energy savings and 9% of peak demand reduction. The remaining measures combined accounted for about 6% of the total program savings.

**Figure 4-41. NC Residential Home Energy Check-Up Program Performance Indicators by Measure Type as % of Total (2014-2017)**

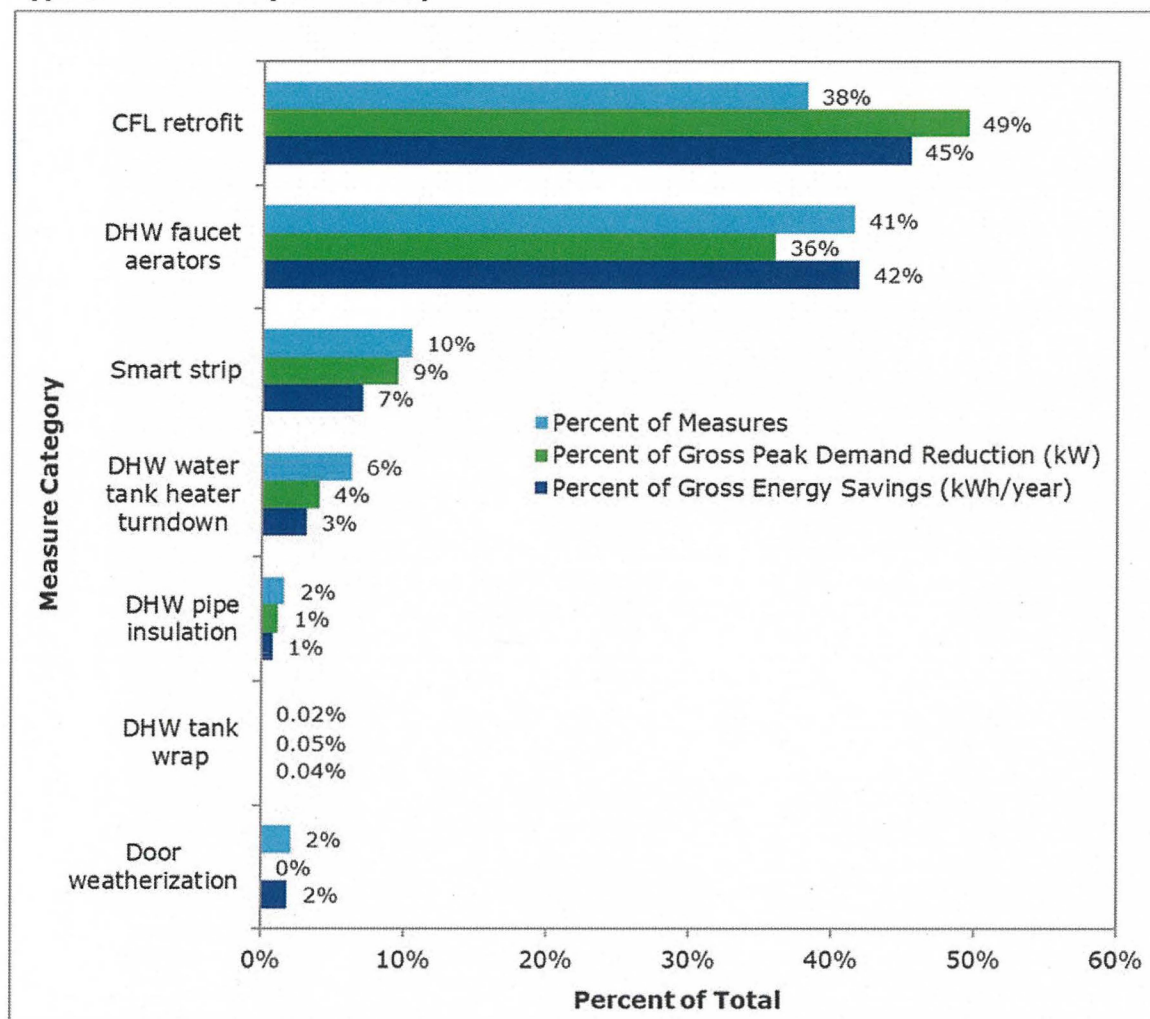
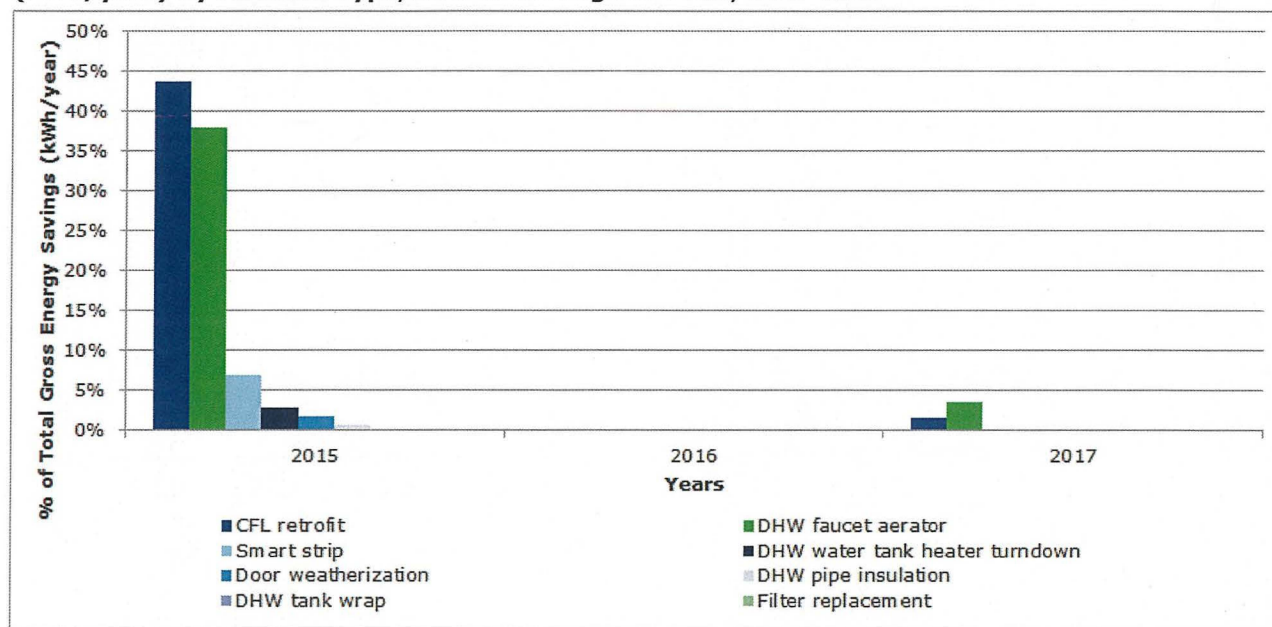




Figure 4-42 shows that this program activities were highest in 2015, which is consistent with results from other tables and figures in this section.

**Figure 4-42. NC Residential Home Energy Check-Up Program Gross Annualized Energy Savings (kWh/year) By Measure Type, as a % of Program Total, Over Time**



## 4.5 Residential Income and Age Qualifying Home Improvement – Virginia and North Carolina

The Residential Income and Age Qualifying Home Improvement Program provides direct-install EE improvements to eligible age- and income-qualifying homeowners to reduce electric usage in Dominion Energy's service territory. In Virginia, the Department of Housing and Community Development determines qualification guidelines, which include an income requirement of 60% or less of the state median income, or for those aged 60 or older, 120% of the state medium income or less. The Program is available to income-qualifying customers who live in single-family, multifamily, manufactured, and mobile homes. To participate in the Program, Dominion Energy customers can contact Dominion Energy-approved weatherization service providers. These weatherization service providers also go door-to-door in some areas of the Dominion Energy service territory to promote the Program. The energy-saving products may include:

- ENERGY STAR® qualified LED light bulbs (screw base)
- Energy-saving showerhead(s)
- High-efficiency faucet aerators
- Pipe wrap insulation for hot water pipes
- Added attic insulation

The official start dates were May 1, 2015 for the Virginia Program and January 1, 2016 for the North Carolina Program. The participation tracking did not begin until July of the program start year in both states because of the lag between enrollment and becoming a tracked participant, which may take several months. This program was designed to expire in Virginia in early 2018. On November 6, 2017, the program was suspended by the NCUC in Docket No. E-22, Sub 523 at Dominion Energy's request. On October 3, 2017, the Company requested a program extension (Case No. PUR-2017-00129) and is awaiting the SCC's decision. Dominion's EE program portfolio is designed to be managed and operated as a consolidated, system-wide basis in both Virginia and North Carolina, to minimize program costs and optimize deployment. Since the program will expire in Virginia in early 2018, Dominion Energy requested the suspension and program renewal at a future date pending program approval in Virginia in the previously mentioned case. The assessment of this program used the algorithms and assumptions specified in the STEP Manual (Appendix F).

In Virginia, the program achieved 155% of its participation goal and 254% of its energy savings goal in the end of 2017. North Carolina achieved 51% of its participation goal and 172% of its energy savings goal by the end of 2017.

### 4.5.1 Methods for the Current Reporting Period

DNV GL developed an EM&V Plan for this program, which is included in Appendix J. For the current period, the approach included reviewing the tracking data and then estimating energy savings and peak demand reduction using STEP Manual calculations. Table 4-15 outlines Dominion Energy's initial program planning assumptions that were used to design the program.

**Table 4-15. Residential Income and Age Qualifying Home Improvement Program Planning Assumptions System-wide**

Item	Description
Target Market	Income and age-qualifying residential customers
NTG Factor	80%
Measure Life	14 years
Average Energy Savings (kWh) per Participant per Year	873 kWh per participant per year
Average Coincident Peak Demand Reduction (kW) per Participant	0.21 kW per participant per year
Average Rebate (US \$) per Participant	n/a



## 4.5.2 Assessment of Program Progress Towards Plan

The next section describes the program's progress towards planned participants, energy savings, and peak demand reductions.

### 4.5.2.1 Key Virginia Program Data

The following table (Table 4-16) summarizes key indicators of progress from May 1, 2015 to December 31, 2017 for Virginia. Detailed program indicators by year and month are provided for Virginia in Appendix A.5.

**Table 4-16. VA Residential Income and Age Qualifying Home Improvement Program Performance Indicators (2015–2017)**

Category	Item	Virginia			
		2015	2016	2017 <sup>42</sup>	Program Total (2015-2017)
Operations and Management Costs (\$)	Direct Rebate				
	Direct Implementation				
	Direct EM&V				
	Indirect Other (Administrative)	\$48,256	\$191,950	\$199,872	\$440,079
Total Costs (\$)	Total				
	Planned				
	Variance				
	Cumulative % of Planned	68%	108%	109%	99%
Participants	Total (Gross)	1,523	8,403	5,970	15,896
	Planned (Gross)	1,849	3,843	3,846	9,538
	Variance	-326	4,560	2,124	6,358
	Cumulative % of planned (Gross)	82%	219%	155%	167%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	984,230	3,575,492	2,431,737	6,991,460
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Savings	984,230	3,575,492	2,431,737	6,991,460
	Net-to-Gross Adjustment (80%)	-196,846	-715,098	-486,347	-1,398,292
	Net Adjusted Savings	787,384	2,860,394	1,945,390	5,593,168
	Planned Savings (Net)	1,810,380	998,136	765,945	3,574,461
	Cum. % Toward Planned Savings (Net)	44%	287%	254%	156%
	Avg. Savings per Participant (Gross)	646	426	407	440

<sup>42</sup> The 2017 total gross deemed savings values reported in this table include adjustments of -12,182.94 kWh/year and -1.10 kW made to the January 2017 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017. Specifically, the correction was in section 2.1.5 for "Low-Flow Showerhead" measures, to the "ΔT" variable, which is a measure of the change in temperature of the water used for shower and temperature entering the house ( $\Delta T = T_{\text{shower}} - T_{\text{in house}}$ ). STEP Manual 7.0.0 reported the value as 44.9°F, but has been corrected to 44.1°F. This correction is reflected in STEP Manual version 8.0.0 in this EM&V report.

Category	Item	Virginia			
		2015	2016	2017 <sup>42</sup>	Program Total (2015-2017)
	Avg. Savings per Participant (Net)	517	340	326	352
Installed Demand Reduction	Total Gross Deemed Demand	80	398	228	706
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Demand	80	398	228	706
	Net-to-Gross Adjustment (80%)	-16	-80	-46	-141
	Net Adjusted Demand	64	318	182	565
	Planned Demand (Net)	415	218	170	803
	Cum. % Toward Planned Demand (Net)	16%	146%	107%	70%
	Avg. Peak Demand per Participant (Gross)	0.05	0.05	0.04	0.04
	Avg. Demand per Participant (Net)	0.04	0.04	0.03	0.04
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$32	\$23	\$33	\$28
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0	\$0	\$0	\$0
	Cum. \$Admin. per Cum. kW (Gross)	\$601	\$482	\$876	\$623
	Cum. \$EM&V per Cum. Total Costs (\$)	1%	1%	2%	2%
	Cum. \$Rebate per Cum. Participant (Gross)				

Participant enrollment began in October 2015, therefore participation rate, net annualized energy savings (kWh/year), and net demand reduction (kW) were lower than the planned expectations in the first year of the program operation. This was due both to program approval timing (typically summer of the first program year) and the ramp-up required in a program's first year. All three categories of program performance indicators exceeded the planned expectations in 2016 and 2017. In 2017, total enrollment was 5,970. The 2017 enrollment is at 155% of planned expectations for the year. The program performed above the planned expectation in the last two consecutive years. Overall, since program inception, participant enrollment stands at 167%.

Total annual net energy savings in 2017 were 1,945,390 kWh/year, which was 254% of planned, and annual demand reduction was 228 kW, 107% of planned. Average annual net savings per participant was 326 kWh/year, which is less than initially assumed, and average peak demand reduction per participant was 0.03 kW. The gross energy savings and peak demand reduction per participants (for participants from 2015 through 2017) were at 440 kWh/year and 0.04 kW. The gross savings calculation applied the realization rate of 100% as well as the assumed NTG ratio of 80%. Therefore, the gross savings are higher than the net savings. Both rates are part of the initial program planning assumptions. As discussed in the text



summarizing Figure 4-47 below, the majority of Virginia program participants and their associated gross energy savings are from multi-family properties. In general, multi-family properties have less opportunities for attic insulation and other measures when compared to single-family properties, which may contribute to the lower than initially assumed savings per participant.

The higher percentage of energy savings to planned number can be attributable to the type of measures and number of the measure units that get installed in large number of households in a given year. Percentages of measure quantity installed, annualized gross energy savings, and peak demand reduction percentages are discussed in the following sections.

Total 2017 program cost was at 109%, higher than what was planned. The total cumulative costs for the lifetime of the program (2015 to 2017) was 99% of plan. The average rebate per participant in 2017 increased to \$644. This is slightly higher than the 2016 average rebate of \$612.

#### 4.5.2.2 Key North Carolina Program Data

The following table (Table 4-17) summarizes key indicators of progress from January 1, 2016 to December 31, 2017 for North Carolina. Detailed program indicators by year and month are provided for North Carolina in Appendix B.5.

**Table 4-17. NC Residential Income and Age Qualifying Home Improvement Program Performance Indicators (2016–2017)**

Category	Item	North Carolina		
		2016	2017 <sup>43</sup>	Program Total (2016-2017)
Operations and Management Costs (\$)	Direct Rebate			
	Direct Implementation			
	Direct EM&V			
	Indirect Other (Administrative)	\$8,999	\$12,899	\$21,897
Total Costs (\$)	Total			
	Planned			
	Variance			
	Cumulative % of Planned	75%	107%	89%
Participants	Total (Gross)	157	130	287
	Planned (Gross)	257	254	511
	Variance	-100	-124	-224
	Cumulative % of planned (Gross)	61%	51%	56%
	Total Gross Deemed Savings	106,379	109,794	216,174

<sup>43</sup> The 2017 total gross deemed savings values reported in this table include adjustments of -306.89 kWh/year and -0.03 kW made to the January 2017 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017. Specifically, the correction was in section 2.1.5 for "Low-Flow Showerhead" measures, to the "ΔT" variable, which is a measure of the change in temperature of the water used for shower and temperature entering the house ( $\Delta T = T_{\text{shower}} - T_{\text{in house}}$ ). STEP Manual 7.0.0 reported the value as 44.9°F, but has been corrected to 44.1°F. This correction is reflected in STEP Manual version 8.0.0 in this EM&V report.



Category	Item	North Carolina		
		2016	2017 <sup>43</sup>	Program Total (2016-2017)
Installed Energy Savings (kWh/year)	Realization Rate Adjustment (100%)	0	0	0
	Adjusted Gross Savings	106,379	109,794	216,174
	Net-to-Gross Adjustment (80%)	-21,276	-21,959	-43,235
	Net Adjusted Savings	85,103	87,835	172,939
	Planned Savings (Net)	67,040	51,199	118,239
	Cum. % Toward Planned Savings (Net)	127%	172%	146%
	Avg. Savings per Participant (Gross)	678	845	753
	Avg. Savings per Participant (Net)	542	676	603
Installed Demand Reduction	Total Gross Deemed Demand	11	9	20
	Realization Rate Adjustment (100%)	0	0	0
	Adjusted Gross Demand	11	9	20
	Net-to-Gross Adjustment (80%)	-2	-2	-4
	Net Adjusted Demand	8	7	16
	Planned Demand (Net)	15	11	26
	Cum. % Toward Planned Demand (Net)	57%	64%	60%
	Avg. Peak Demand per Participant (Gross)	0.07	0.07	0.07
	Avg. Demand per Participant (Net)	0.05	0.06	0.06
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$57	\$99	\$157
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.08	\$0	\$0
	Cum. \$Admin. per Cum. kW (Gross)	\$847	\$1,415	\$2,263
	Cum. \$EM&V per Cum. Total Costs (\$)	2%	2%	4%
	Cum. \$Rebate per Cum. Participant (Gross)			

North Carolina had 130 participants in 2017, which was approximately 51% of plan. The net annualized energy savings for 2017 was at 87,835 kWh/year, which was 172% of planned. The annual average net savings per participant was at 676 kWh/year. The higher percentage of net energy savings to planned number can be attributable to the type of measures and number of the measure units that get installed in large number of households in a given year. Percentages of measure quantity installed, energy savings, and peak demand reduction percentages are discussed in the following sections. The program achieved 64% of its peak demand reduction goal by the end of 2017. The average net peak reduction was 0.06 kW for 2017.

The total 2017 program cost was 107% of planned. The total cumulative costs for 2015 to 2017 is 89% of planned. The average rebate per participant in 2017 increased to \$1,939. This is higher than the 2016 average rebate of \$1,442.

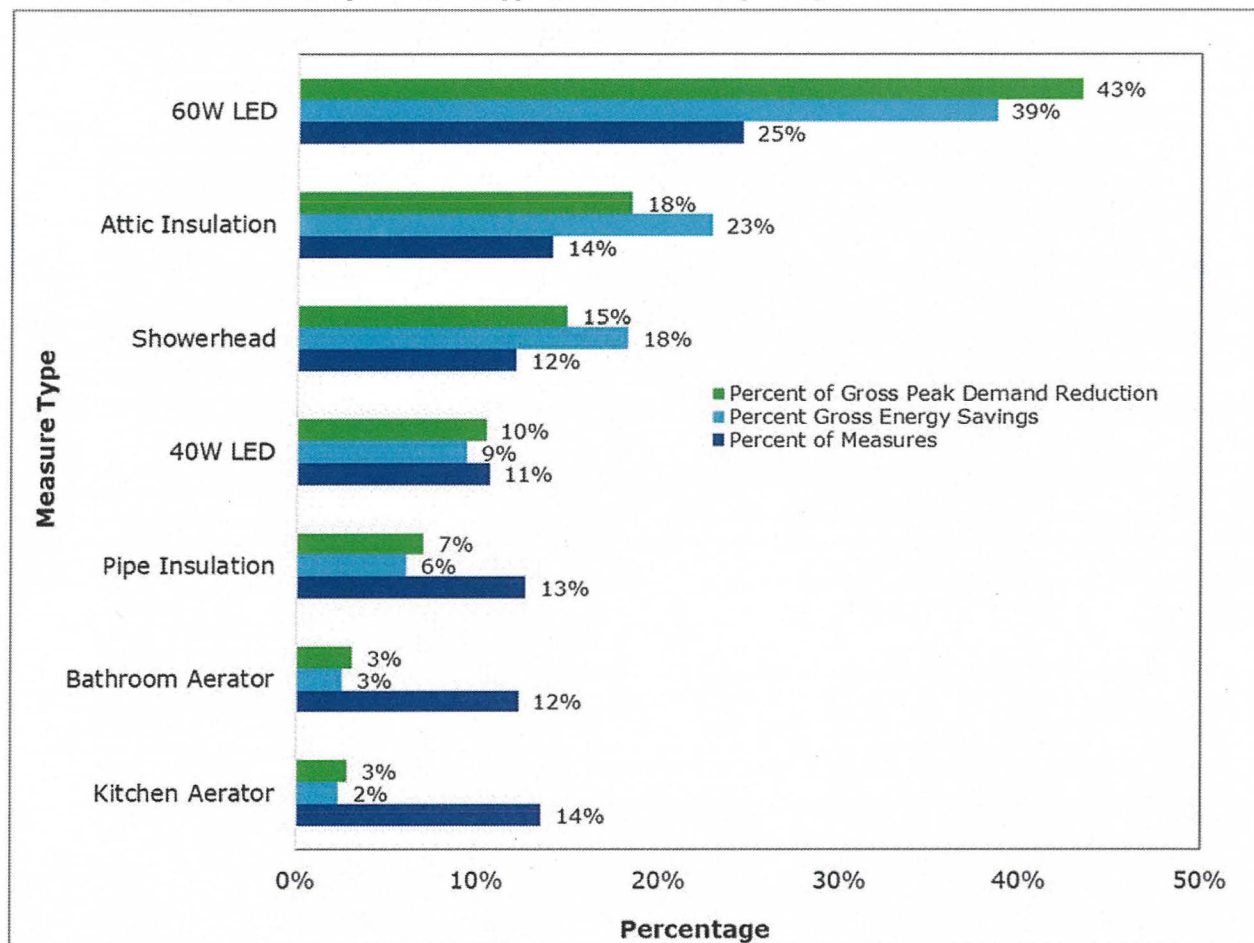
#### **4.5.2.3 Additional Virginia Program Participant Data**

Figure 4-43 shows the gross energy savings, gross peak demand reduction, and number of installed measures by the measure type installed in Virginia in 2017.

Approximately 39% of total gross annualized energy savings and 43% of total gross peak demand reduction were from installing LEDs that replace 60 W incandescent light lamps. Attic insulation was the second largest measure category for savings, accounting for 23% total gross annualized energy savings and 18% total gross peak demand reduction. Showerhead aerators accounted for 18% of annualized energy savings and 15% of peak demand reduction.

The other four measures were LED replacement of 40 W incandescent light lamps, pipe insulation, bathroom aerators, and kitchen aerators, all of which contributed less than 10% each to total program annualized energy savings and demand reduction. The lighting measure LED replacement for 60 W incandescent lamp accounted for the highest percent of total measure installed approximately at 25%. The other measures in this program accounted for between approximately 10% to 20%, each of the total measure installed.

**Figure 4-43. VA Residential Income and Age Qualifying Home Improvement Program Performance Indicators by Measure Type as % of Total (2017)**



The remaining section of this report discusses program progress from inception in 2015 to the end of this reporting year (2017).

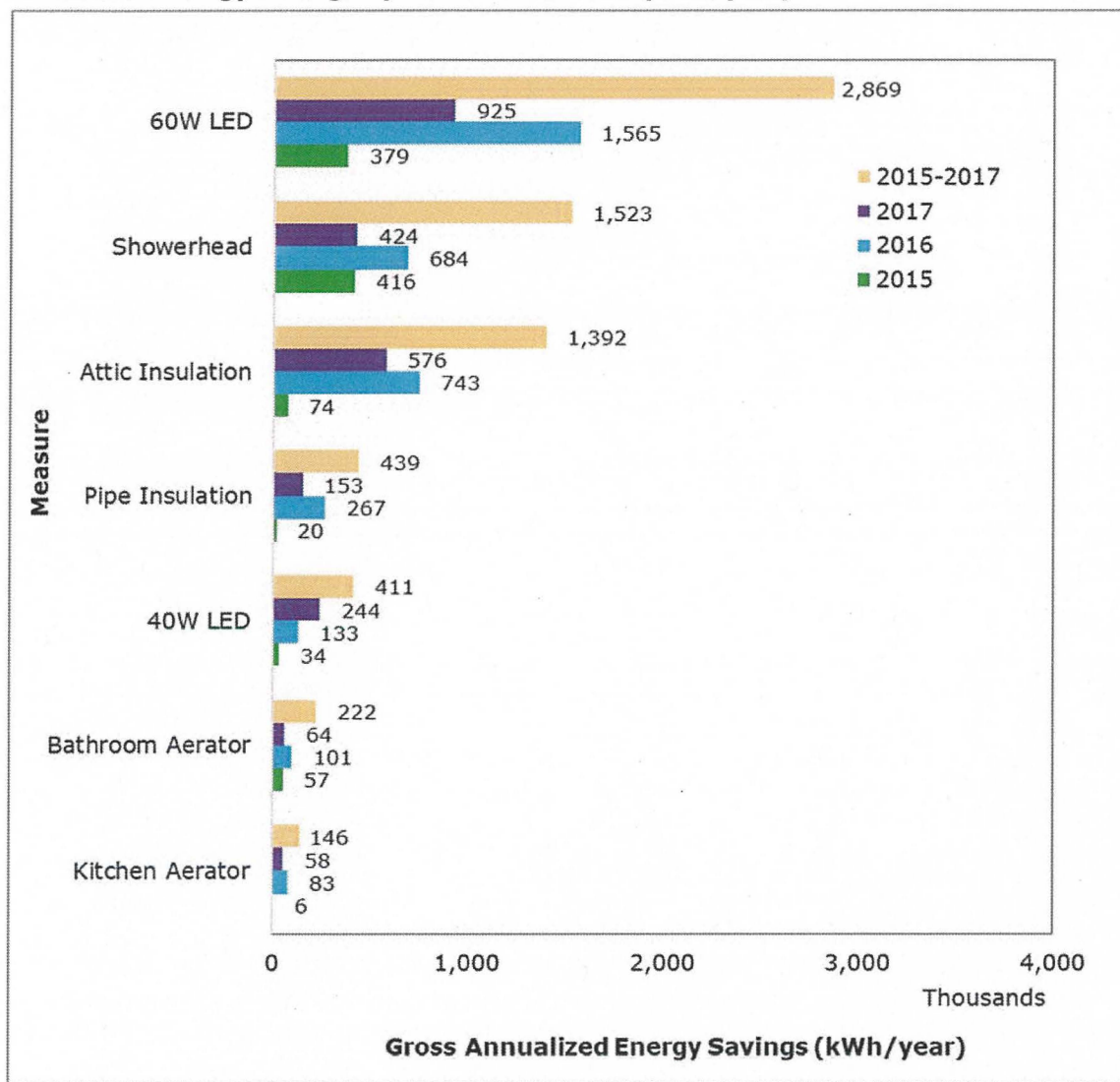
Figure 4-44 through Figure 4-46 show the Virginia program's gross annualized energy savings, participation, and average annualized energy savings per participant (for participants who installed the measure in the respective year) by measure type and program year.

The first program year (in green) had low participation and low total gross energy savings. In the following year (in blue), program participation increased.

LED replacement of 60 W incandescent measure produced the highest of energy savings for the program life thus far, followed by showerheads, and attic insulation (Figure 4-44).

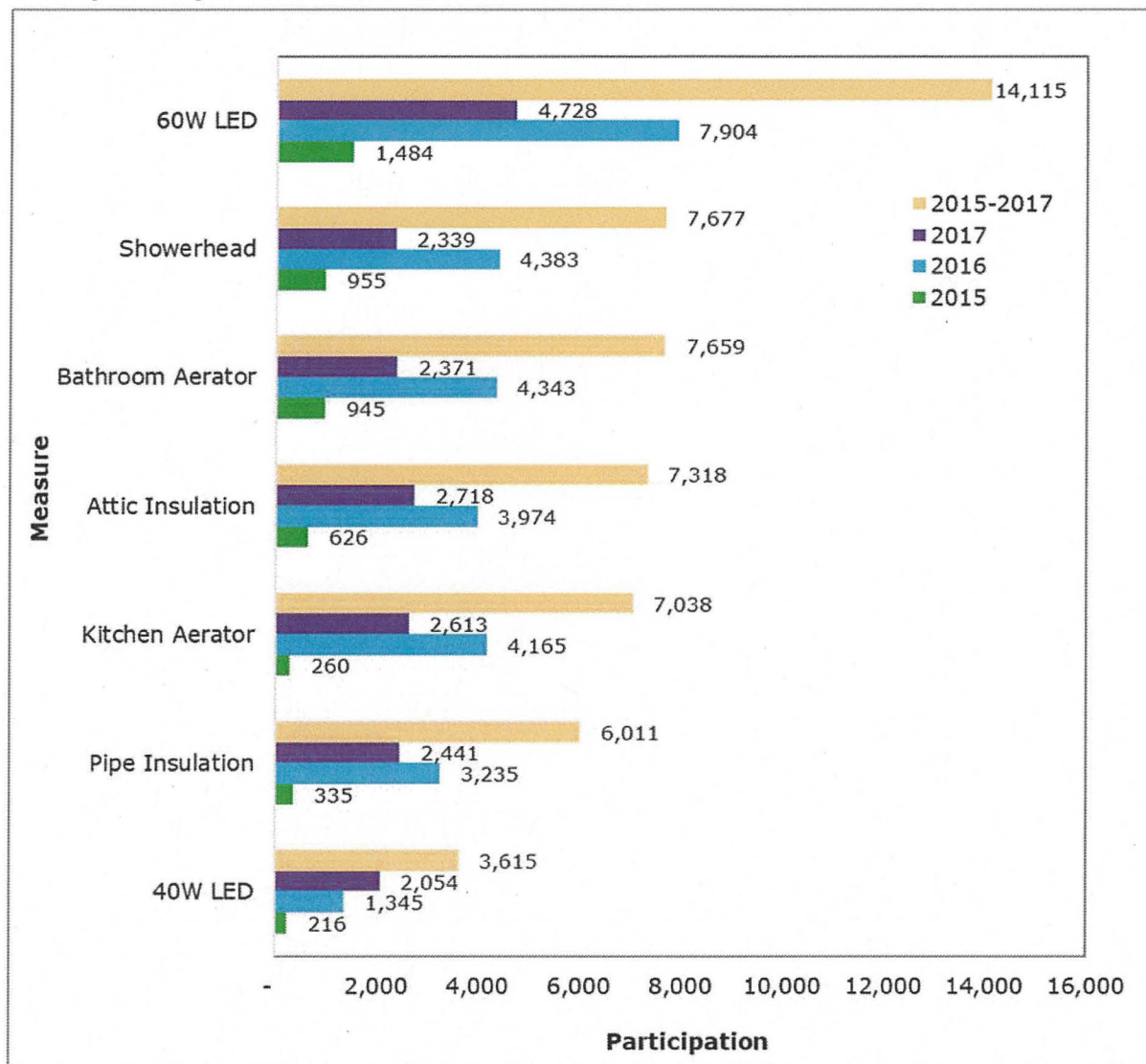


**Figure 4-44. VA Residential Income and Age Qualifying Home Improvement Program Gross Annualized Energy Savings by Measure and Year (kWh/year)**



The most frequently adopted measures were LED replacement of 60 W incandescent lamps, showerheads, and the two aerator measures (Figure 4-45). This is likely due to the fact that they are the easiest to install of the program's eligible measures.

**Figure 4-45. VA Residential Income and Age Qualifying Home Improvement Program Participation by Measure and Year**



The LED replacement of 60 W incandescent and the low-flow showerheads were the measures that had the highest gross annualized savings per participant, followed closely by attic insulation (Figure 4-46). However,

the average savings for both these top measures (LEDs and showerheads), has been decreasing, while the average savings for attic insulation has been increasing.

**Figure 4-46. VA Residential Income and Age Qualifying Home Improvement Program Average Gross Annualized Energy Savings per Participant (kWh/year participant) by Measure and Year**

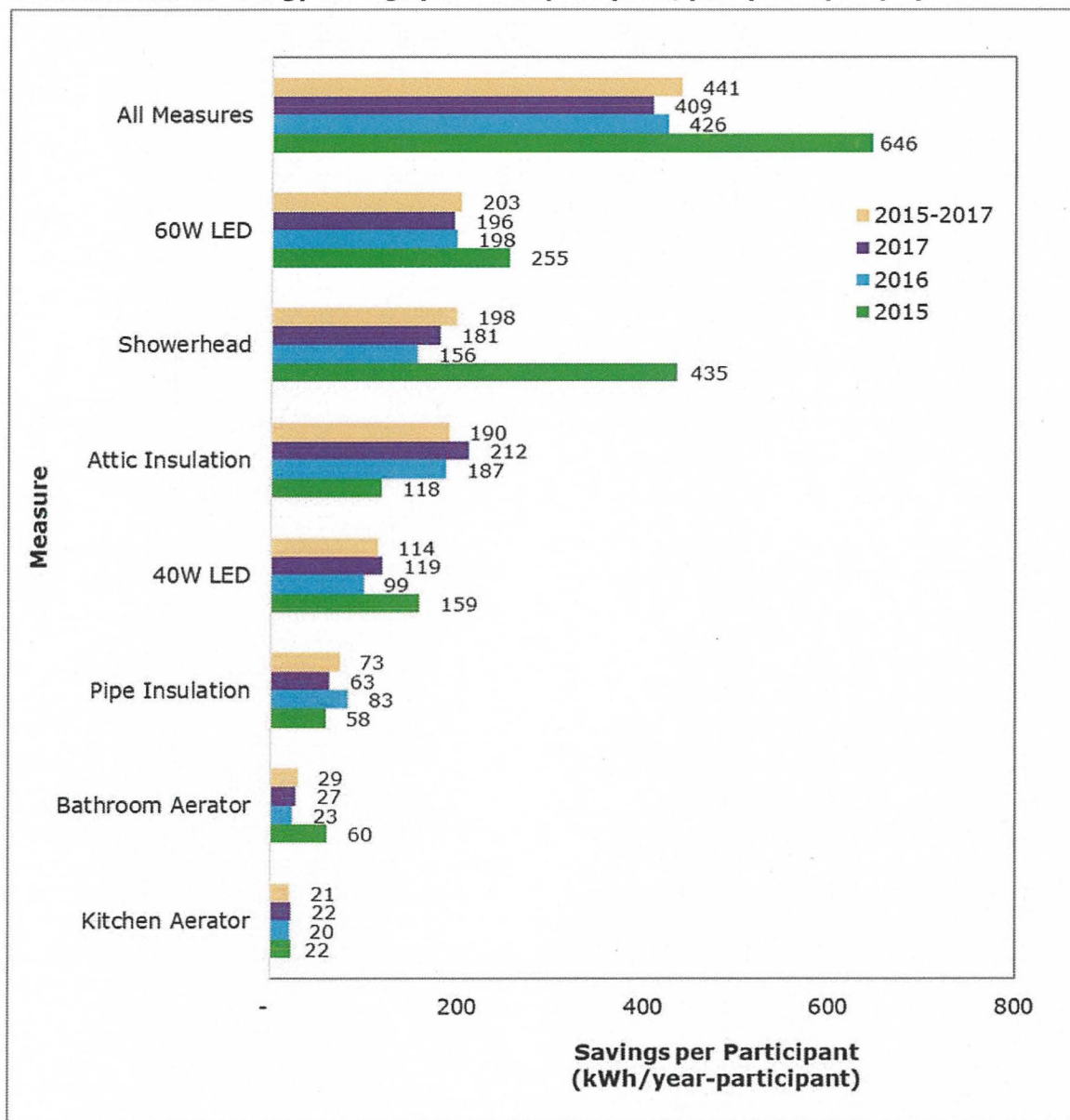
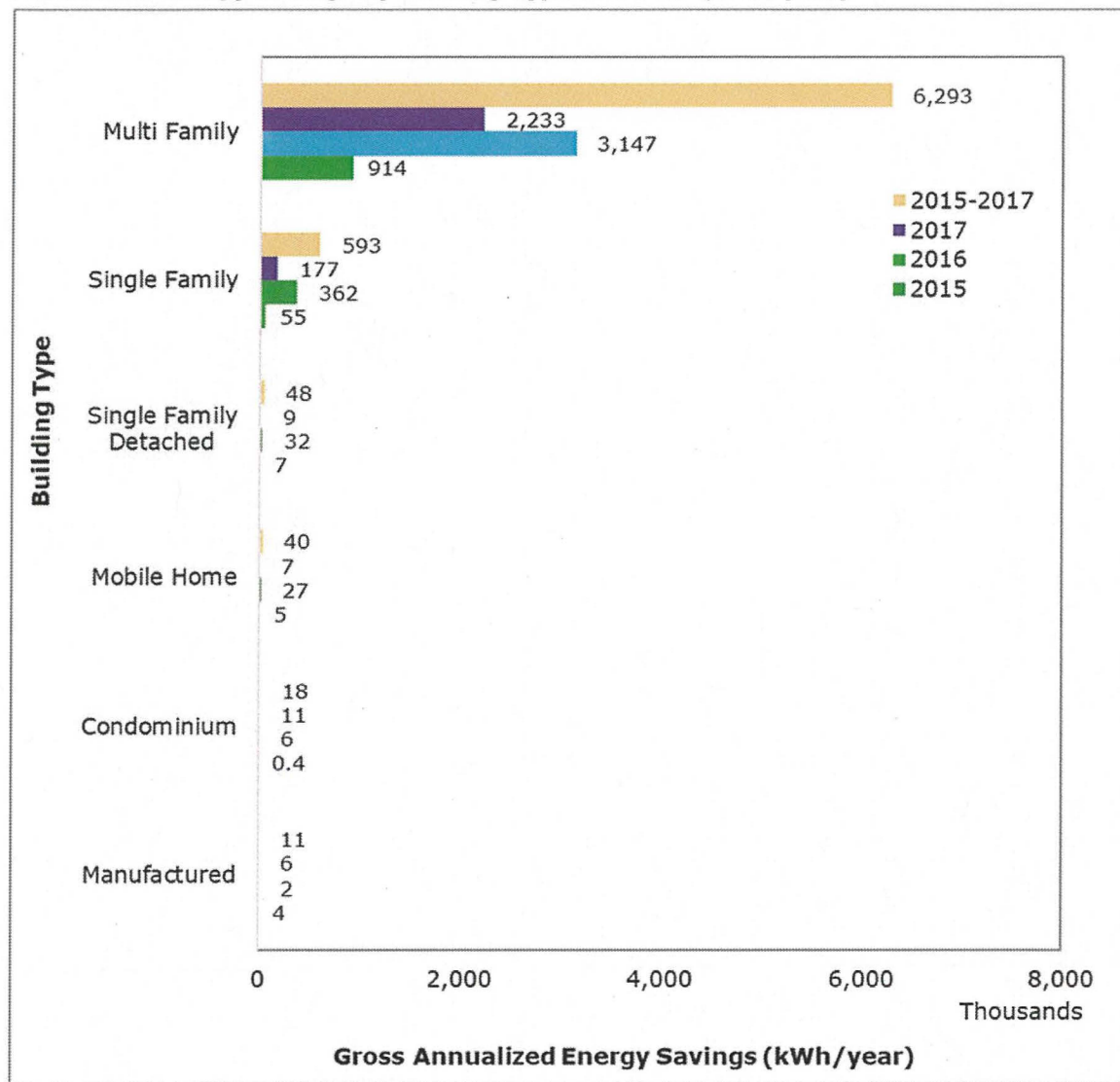


Figure 4-47 through Figure 4-49 show gross annualized energy savings, participation, and average annualized energy savings per participant (for participants who installed the measure in that year) by

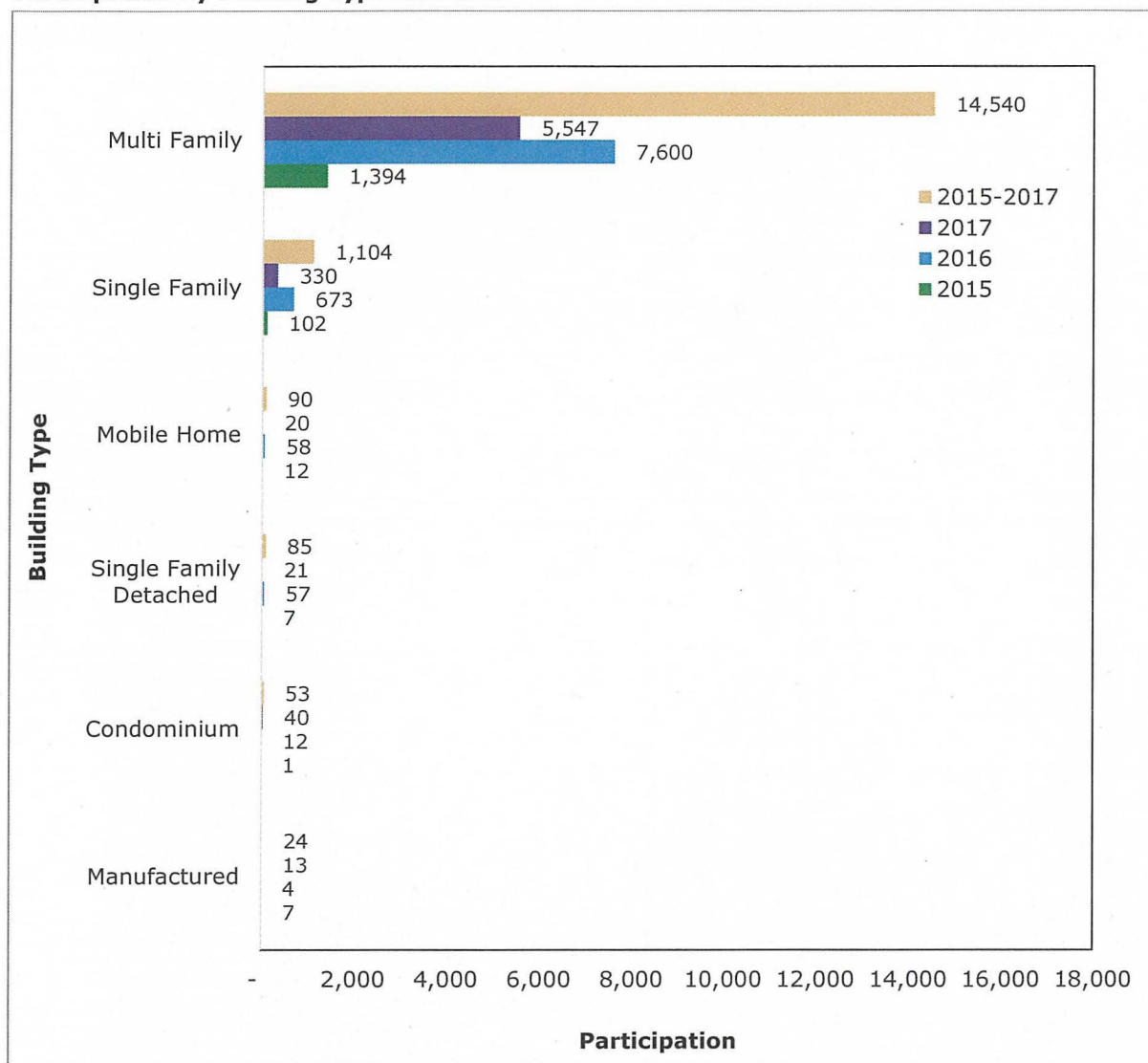


building type and program year. They show that, in all years, the vast majority of program participants (Figure 4-48) and gross annualized energy savings are in multi-family buildings.

**Figure 4-47. VA Residential Income and Age Qualifying Home Improvement Program Gross Annualized Energy Savings by Building Type and Year (kWh/year)**



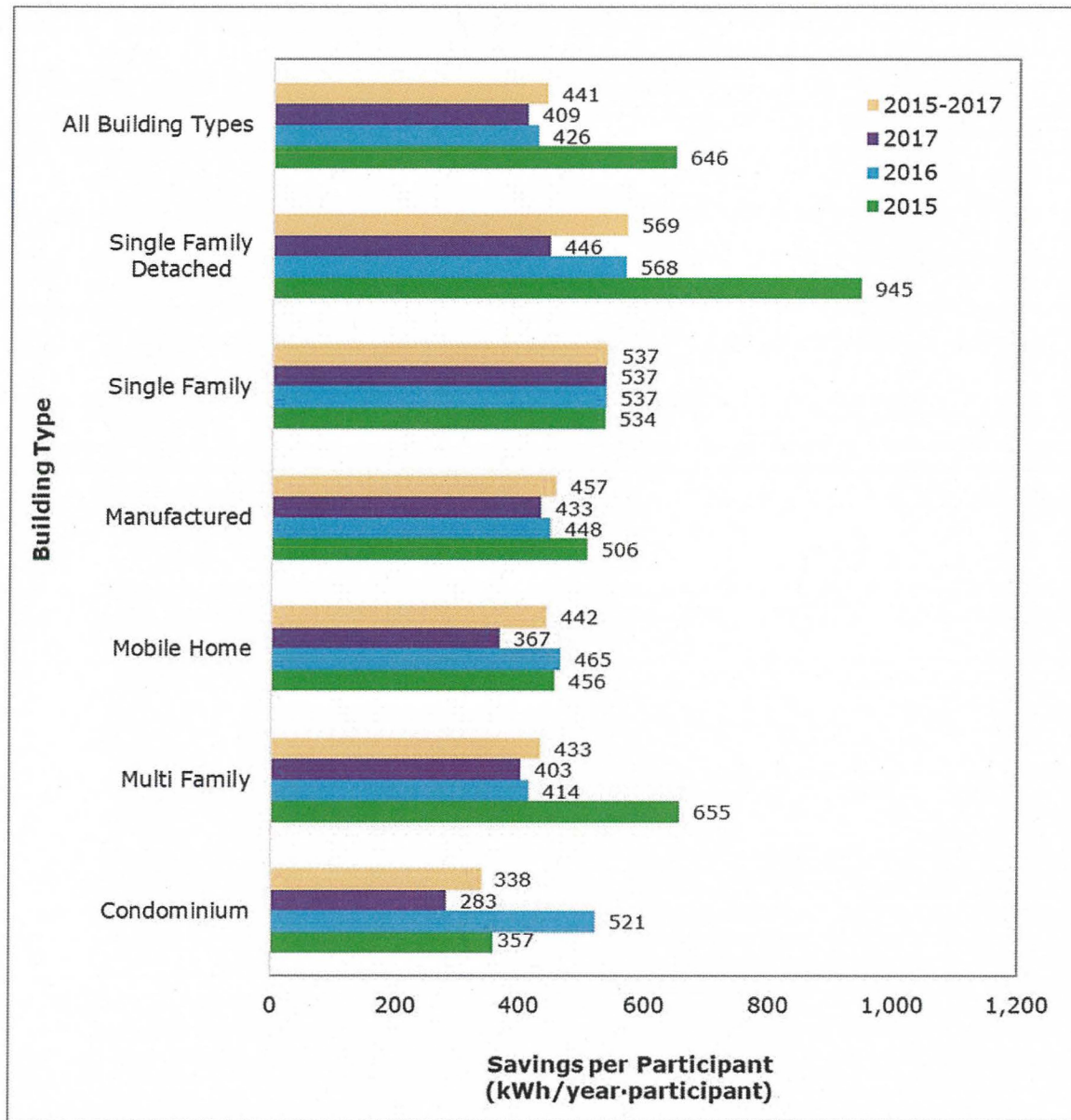
**Figure 4-48. VA Residential Income and Age Qualifying Home Improvement Program Participation by Building Type and Year**



The average gross energy savings per participant by building type shown in Figure 4-49 indicates that the savings per participant for all years combined (2015-2017) were within a close range for all building types other than single family and single-family detached housing types. The savings per participant for single family and single-family detached building types for all years combined (2015-2017) were between approximately 500 kWh/year-participant and 600 kWh/year-participant.

Other building type savings were between approximately 400 kWh/year-participant and 500 kWh/year-participant. The higher average savings for single-family type may be attributed to the single-family dwellings having generally larger space area than the other building types (condominium, manufactured, mobile, and multi-family homes), and therefore have greater opportunities for savings.

**Figure 4-49. VA Residential Income and Age Qualifying Home Improvement Program Average Gross Annualized Energy Savings per Participant (kWh/year participant) by Building Type and Year**



#### 4.5.2.4 Additional North Carolina Program Participant Data

Figure 4-50 shows the gross energy savings, gross peak demand reduction, and number of installed measures by the measure type installed in North Carolina in 2017. Attic insulation accounted for 44% of total gross energy savings and 42% of total gross peak demand reduction. LED replacement of 60 W incandescent lamps was the second largest measure category for savings, accounting for 30% of total gross energy savings and 32% of total gross peak demand reduction. Showerhead aerators accounted for 14% of



energy savings and 11% of peak demand reduction. The energy savings and demand reduction of pipe insulation were 8% and 10%, respectively. The other three measures were bathroom aerators, kitchen aerators, and LED replacement of 40 W incandescent lamps, each of which contributed less than 5% to the program totals of gross energy savings and gross peak demand reduction.

Attic insulation and LED replacement of 60 W incandescent measures each represented 22% of the total installed measures. Showerhead, pipe insulation, bathroom aerator, and kitchen aerator each accounted for between 10% to 15% of all installed measures. LED replacement of 40 W incandescent lamps represented less than 1% of the total.

**Figure 4-50. NC Residential Income and Age Qualifying Home Improvement Program Performance Indicators by Measure Type as % of Total (2017)**

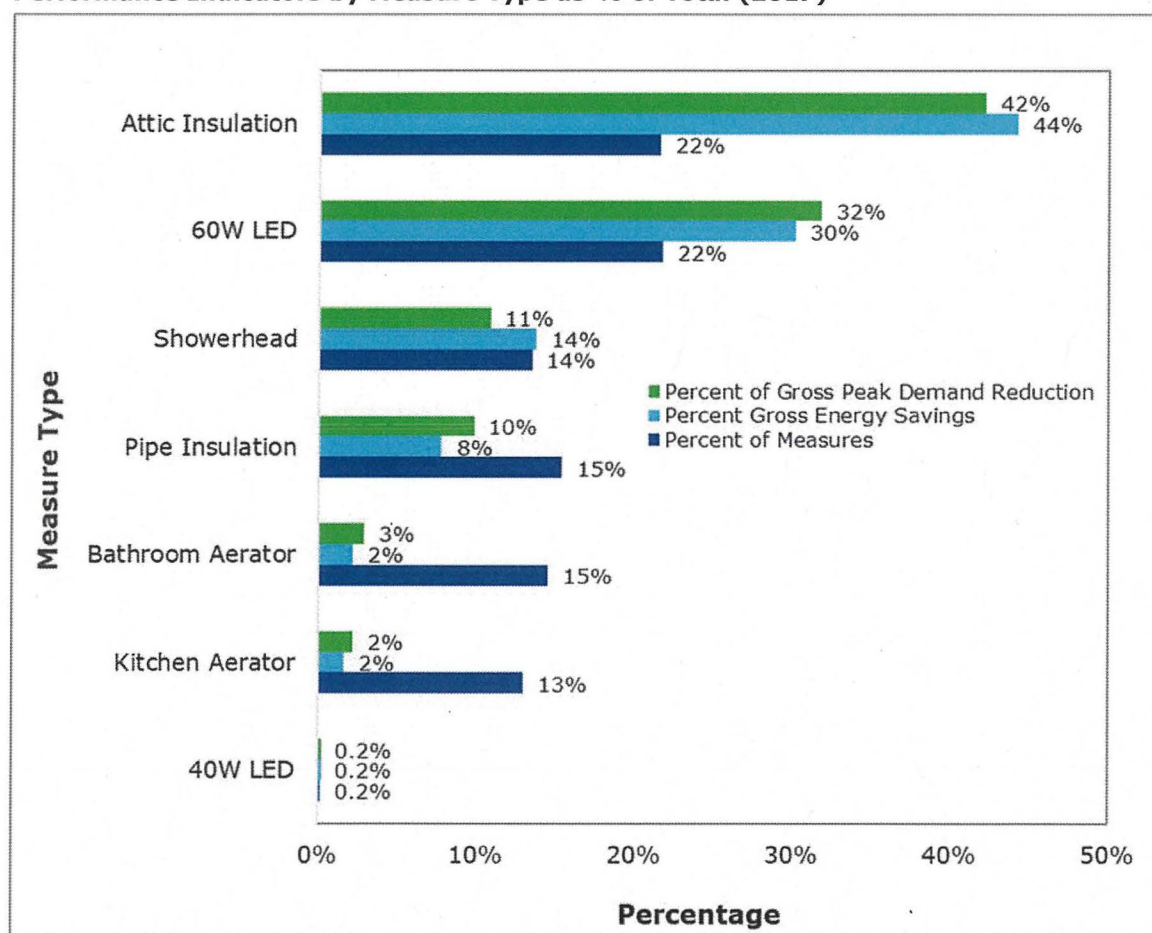
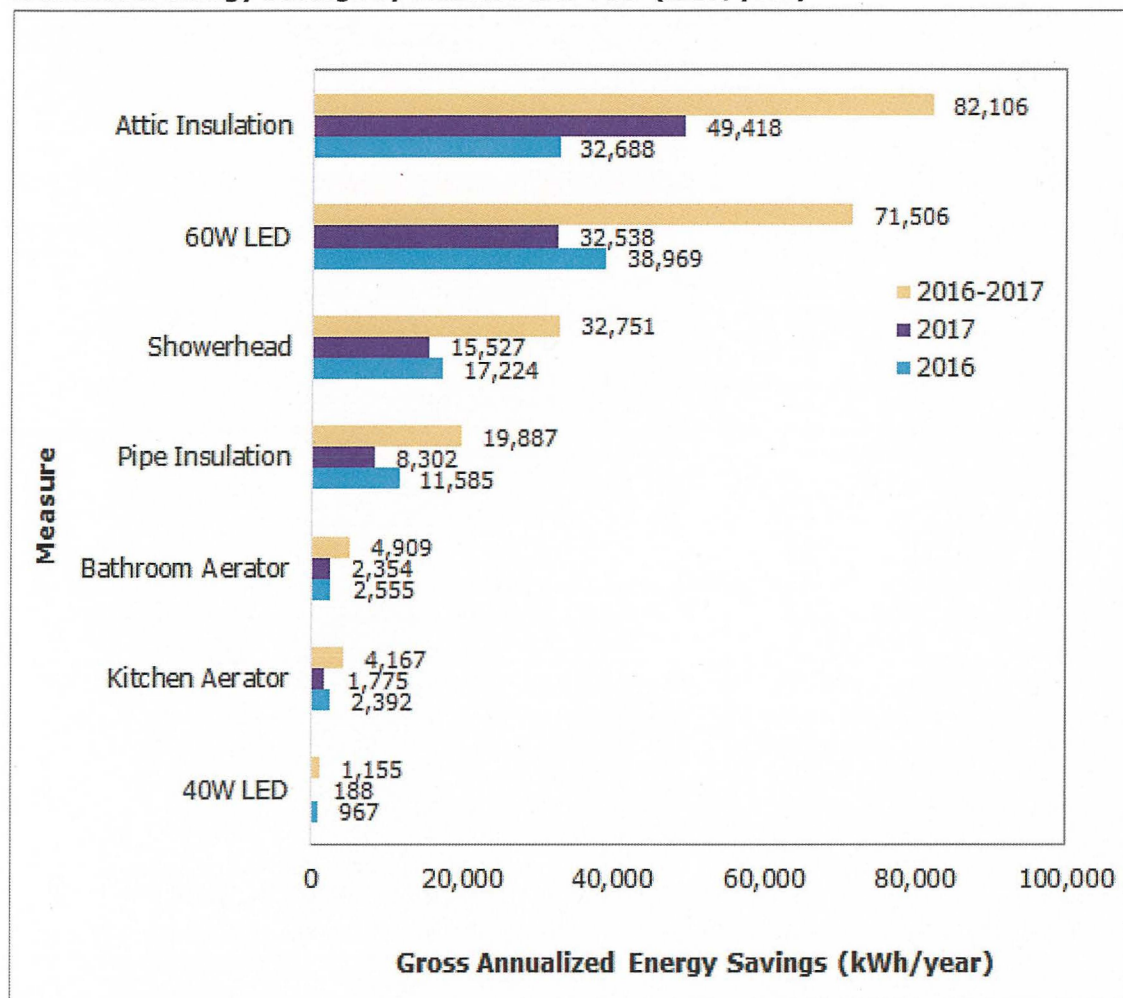


Figure 4-51 through Figure 4-56 show participation and average annualized energy savings per participant (for participants who installed the measure in that year) by building type and program year in North Carolina.

Except for the LED replacement of 40 W incandescent lamps, most measures were adopted by more than 65% of all participants. The two measures that contributed greatest to program gross annualized savings

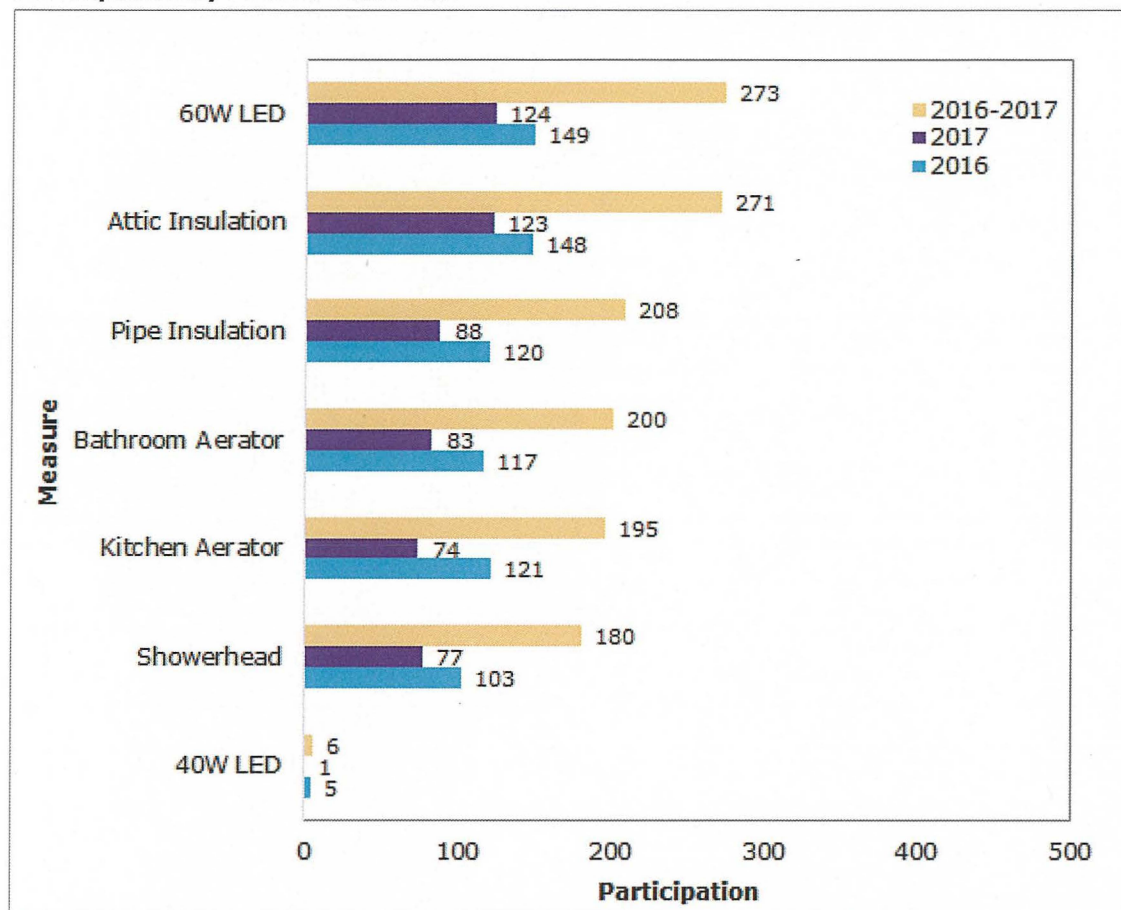
(LED replacement of 60 W incandescent lamps and attic insulation) were also the measures that were installed the most by participants and had the highest average savings per participant.

**Figure 4-51. NC Residential Income and Age Qualifying Home Improvement Program Gross Annualized Energy Savings by Measure and Year (kWh/year)**

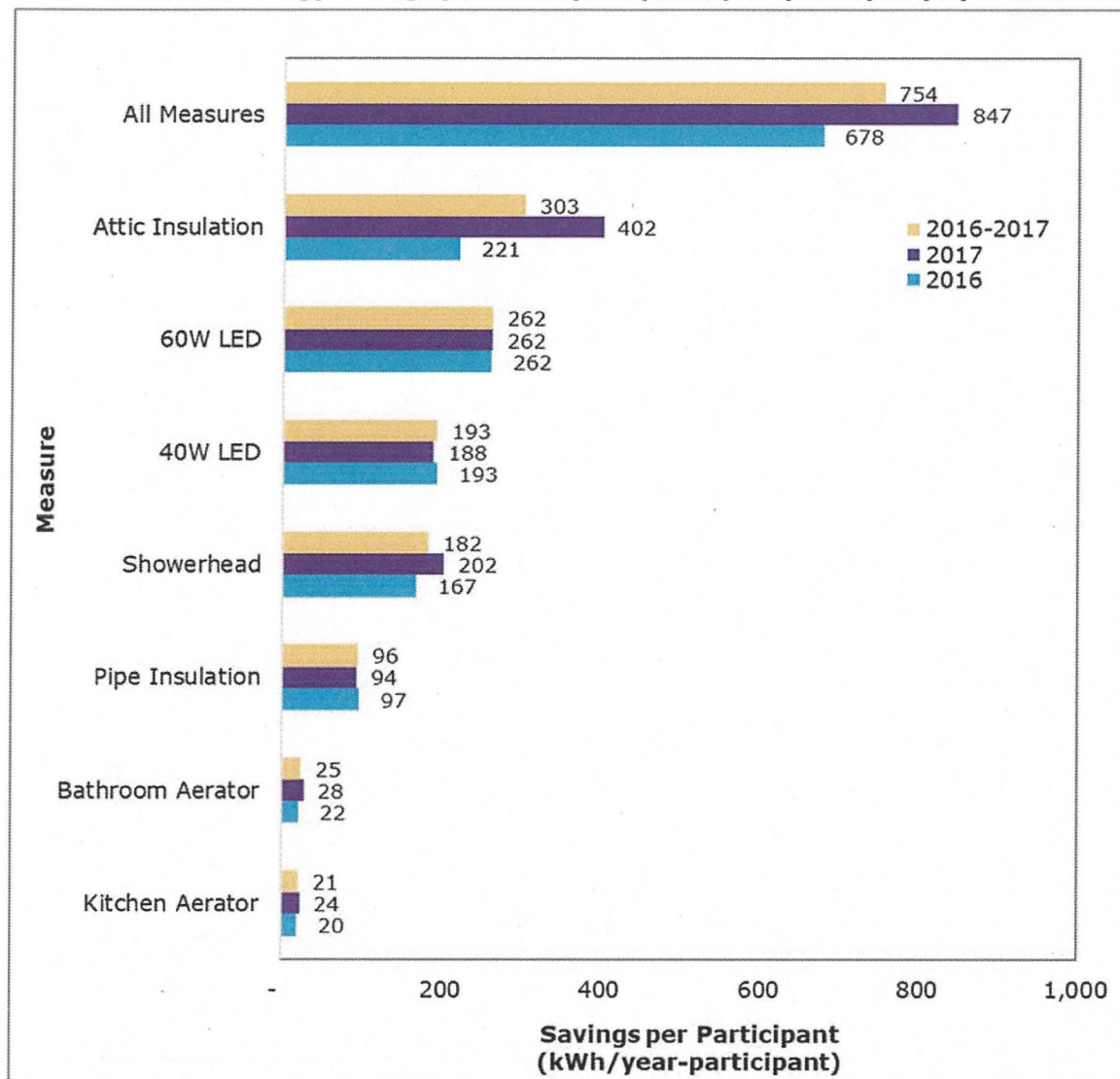




**Figure 4-52. NC Residential Income and Age Qualifying Home Improvement Program Participation by Measure and Year**



**Figure 4-53. NC Residential Income and Age Qualifying Home Improvement Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Measure and Year**



The differences between the Virginia and North Carolina program achievements may be explained by differences in the participant dwelling type. Whereas in Virginia the participant dwelling types were largely multi-family, in North Carolina the program had more single family and single-family detached participants, as shown in Figure 4-54 and Figure 4-55 on the following pages. Most of the participants in North Carolina lived in single family or single-family detached homes, where as in Virginia majority participants were from multifamily homes.