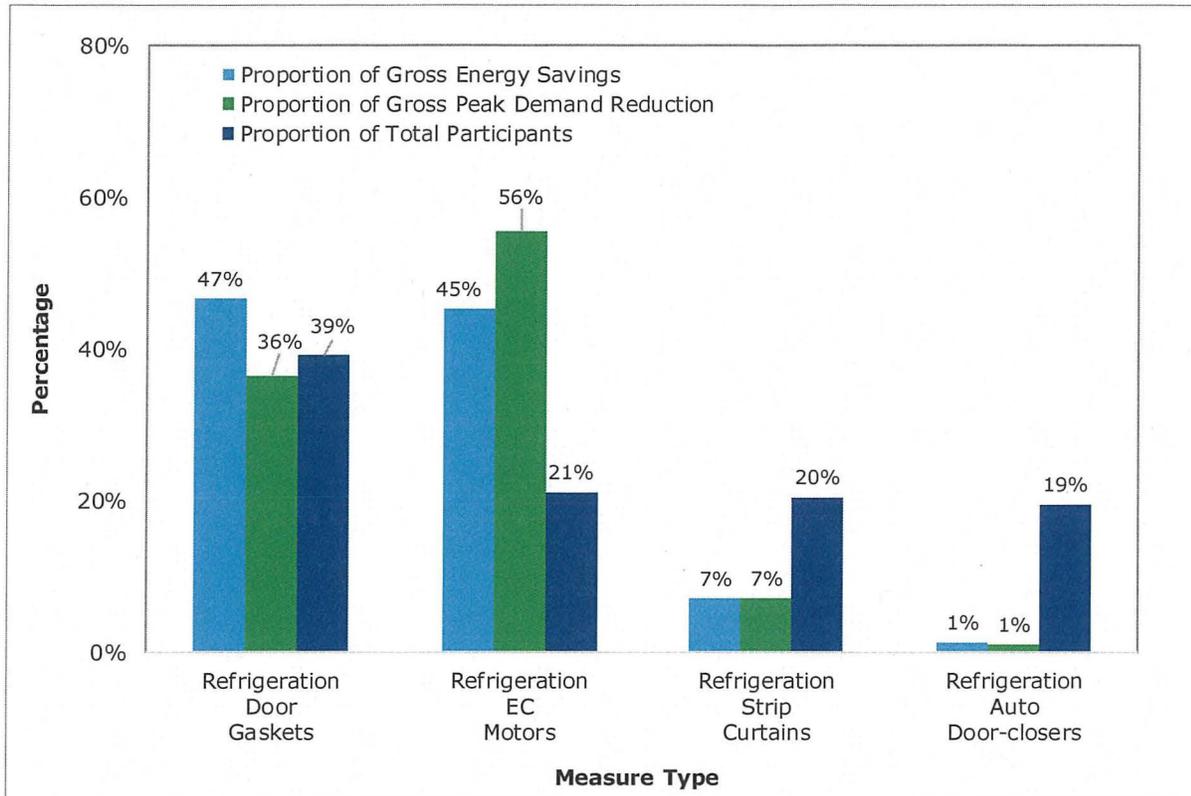


More than 90% of the annual energy savings were realized by providing refrigeration door gaskets and electronically commutated motors at refrigeration compressors, as shown in Figure 5-24.

**Figure 5-24. NC Non-residential Energy Audit Performance Indicators by Measure (2014-2017)**



### 5.3 Non-residential Lighting Systems & Controls – Virginia and North Carolina

The Non-residential Lighting Systems & Controls Program provides non-residential customers with rebate incentives to retrofit their existing inefficient lighting system with a more cost-effective, energy efficient lighting system. The program provides rebates for the following types of measures:

- T8 with electronic ballast
- High-performance T8
- T5 with electronic ballast
- CFLs
- LEDs
- Occupancy sensors

This program is implemented through a contractor network, so customers must contact a participating contractor to be eligible for the rebate. All Dominion Energy non-residential customers who are not exempt by statute or special contract, or who have not opted-out, are eligible. Customers are not considered participants 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 Dominion Energy has 90 days to process it.

The SCC approved the DSM Phase III programs in Virginia on April 29, 2014 (Case No. PUE-2013-00072). In North Carolina, this program was approved on October 27, 2014 (Docket No. E-22, Sub 508). Upon approval, the Company worked to finalize data systems, build contractor networks, and finalize implementation details in both states.

In 2017, a smaller percentage of Virginia program participants received rebates compared to their contractors (25%) when compared to 2016 (39%). In North Carolina, 17% of participants assigned rebates to their contractors, which was an increase from 14% in 2016.

Table 5-9 provides the breakdown of rebate assignment by state for 2017.

In 2017, a smaller percentage of Virginia program participants received rebates compared to their contractors (25%) when compared to 2016 (39%). In North Carolina, 17% of participants assigned rebates to their contractors, which was an increase from 14% in 2016.

**Table 5-9. Percent of 2017 Non-residential Lighting Systems & Controls Participants Who Assigned Rebates Directly to Contractors**

State	Percent of Rebates Given to Customers	Percent of Rebates Given to Contractors
VA	75%	25%
NC	83%	17%
<b>Total</b>	<b>100%</b>	<b>42%</b>

### 5.3.1 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 gross energy savings and peak demand reduction using STEP Manual calculations.

Table 5-10 outlines Dominion Energy's initial program planning assumptions that were used to design the program. DNV GL uses the planned NTG factor in its deemed savings calculations until it can be verified through EM&V.

**Table 5-10. Non-residential Lighting Systems and Controls Program Planning Assumptions System-wide**

Item	Description
Target Market	Non-residential
NTG Factor	70%
Measure Life	9 years
Average Energy Savings (kWh) per Participant per Year	18,259 kWh per participant per year
Average Peak Demand Reduction (kW) per Participant	5.2 kW
Average Rebate (US \$) per Participant	\$2,957

### 5.3.2 Assessment of Program Progress Towards Plan

Table 5-11 on the subsequent pages summarize key indicators of progress from May 1, 2014 through December 31, 2017 in Virginia.

Detailed program indicators by year and month are provided for Virginia in Appendix A.9 and for North Carolina in Appendix B.9.

A total of 868 customers participated in the program in Virginia in 2017, which was about 56% of planned. This was a decrease from the 1,203 customers that participated in Virginia in 2016.

The program did exceed its planned Virginia net energy savings target in 2017 with a total of 49,717,225 kWh/year (149.7% of planned), and its planned Virginia net peak demand target with a total 8,371 kW (152.6% of planned). The program is exceeding its savings target by a wide margin with even fewer than planned numbers of participants, which suggests larger projects are being processed through the program than originally anticipated. The same or greater savings achieved by fewer projects or applications contributes to the overall cost efficiency of the program.

### 5.3.2.1 Key Virginia Program Data

**Table 5-11. VA Non-residential Lighting Systems & Controls Program Performance Indicators (2014-2017)**

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016 <sup>60</sup>	2017	
Operations and Management Costs (\$)	Direct Rebate					
	Direct Implementation					
	Direct EM&V					
	Indirect Other (Administrative)	\$39,157	\$191,137	\$214,891	\$351,449	\$796,634
Total Costs (\$)	Total					
	Planned					
	Variance					
	Cumulative % of Planned	43%	123%	132%	169.5%	125.7%
Participants	Total (Gross)	118	1,241	1,203	868	3,430
	Planned (Gross)	688	1,504	1,531	1,553	5,276
	Variance	-570	-263	-328	-685	-1,846
	Cumulative % of planned (Gross)	17%	83%	79%	56%	65%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	4,749,693	50,828,062	65,876,985	71,024,607	192,479,347
	Realization Rate Adjustment (100%)	0	0	0	0	0

<sup>60</sup> The 2016 total gross deemed savings values reported in this table differs from values in the May 1, 2017 EM&V report, and have been refiled with the Commission. The adjustments totaled 14,862,478 kWh/year and 168 kW for 2016 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017, in section 9.1.1. The adjustment was to waste heat factors (WHFe and WHFd) applied to lighting fixtures installed in 2016, where the program participant building HVAC systems was assumed to be heat pump heating and cooling systems, rather than the previous assumption of AC cool and non-electric heat systems. This adjustment was made in response to requests by the North Carolina Public Staff Utilities Commission Re: Docket No. E-22, Sub 545, on October 23, 2017. It is reflected in STEP Manual version 8.0.0 in this EM&V report.

Category	Item	Virginia					Program Total (2014-2017)
		2014	2015	2016 <sup>60</sup>	2017		
	Adjusted Gross Savings	4,749,693	50,828,062	65,876,985	71,024,607	192,479,347	
	Net-to-Gross Adjustment (70%) <sup>61</sup>	-1,424,908	-15,248,419	-19,763,096	-21,307,382	-57,743,804	
	Net Adjusted Savings	3,324,785	35,579,643	46,113,890	49,717,225	134,735,543	
	Planned Savings (Net)	12,317,239	27,461,536	24,119,220	33,214,031	97,112,026	
	Cum. % Toward Planned Savings (Net)	27%	130%	191%	150%	139%	
	Avg. Savings per Participant (Gross)	40,252	40,957	54,761	81,826	56,116	
	Avg. Savings per Participant (Net)	28,176	28,670	38,332	57,278	39,281	
Installed Demand Reduction	Total Gross Deemed Demand	998	10,674	15,380	11,958	39,011	
	Realization Rate Adjustment (100%)	0	0	0	0	0	
	Adjusted Gross Demand	998	10,674	15,380	11,958	39,011	
	Net-to-Gross Adjustment (70%) <sup>62</sup>	-300	-3,202	-4,614	-3,587	-11,703	
	Net Adjusted Demand	699	7,472	10,766	8,371	27,308	
	Planned Demand (Net)	3,229	7,670	4,089	5,486	20,475	
	Cum. % Toward Planned Demand (Net)	22%	97%	263%	153%	133%	
	Avg. Demand per Participant (Gross)	8	9	13	14	11	
	Avg. Demand per Participant (Net)	6	6	9	10	8	
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$332	\$154	\$179	\$405	\$232	

<sup>61</sup> The program implementation vendor has listed the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" See section 3.1.3 Net Savings Estimation for a description of net-to-gross estimation.

<sup>62</sup> Ibid.

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016 <sup>60</sup>	2017	
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.008	\$0.004	\$0.003	\$0.005	\$0.004
	Cum. \$Admin. per Cum. kW (Gross)	\$39	\$18	\$14	\$29	\$20
	Cum. \$EM&V per Cum. Total Costs (\$)	5%	2%	2%	1%	2%
	Cum. \$Rebate per Cum. Participant (Gross)					

Extraordinarily Sensitive Information Redacted

### 5.3.2.2 Key North Carolina Program Data

In North Carolina, the program did not meet its planned participation in 2017 (Table 5-12). Twenty-three customers participated, which is about 22% of planned, a decrease from the 43 customers that participated in 2016.

The program met 55% its planned net energy savings target in 2017 at 1,216,685 kWh/year, and met 64% of its planned net peak demand reduction target at 234 kW. The average gross annualized energy savings per participant in 2017 (75,570 kWh/year) was slightly lower than 2016 (77,524 kWh/year). Similarly, average gross demand savings per participant in 2017 was slightly lower than 2016 at 15 kW and 17 kW, respectively.

Therefore, the reduction in percentage of net energy and demand savings compared to planned number can be attributed to the participation of fewer than planned number of participants.

**Table 5-12. NC Lighting Systems & Controls Program Performance Indicators (2015-2017)**

Category	Item	North Carolina			
		2015	2016 <sup>63</sup>	2017	Program Total (2015-2017)
Operations and Management Costs (\$)	Direct Rebate				
	Direct Implementation				
	Direct EM&V				
	Indirect Other (Administrative)	\$3,511	\$11,956	\$9,940	\$25,407
Total Costs (\$)	Total				
	Planned				
	Variance				
	Cumulative % of Planned	34%	109%	73%	72%
Participants	Total (Gross)	13	43	23	79
	Planned (Gross)	96	102	104	302
	Variance	-83	-59	-81	-223
	Cumulative % of planned (Gross)	14%	42%	22%	26%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	564,326	3,333,527	1,738,121	5,635,974
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Savings	564,326	3,333,527	1,738,121	5,635,974

<sup>63</sup> The 2016 total gross deemed savings values reported in this table differs from values in the May 1, 2017 EM&V report, and have been refiled with the Commission. The adjustments totaled -481,137 kWh/year and 26 kW for 2016 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017, in section 9.1.1. The adjustment was to waste heat factors (WHFe and WHFd) applied to lighting fixtures installed in 2016, where the program participant building HVAC systems was assumed to be heat pump heating and cooling systems, rather than the previous assumption of AC cool and non-electric heat systems. This adjustment was made in response to requests by the North Carolina Public Staff Utilities Commission Re: Docket No. E-22, Sub 545, on October 23, 2017. It is reflected in STEP Manual version 8.0.0 in this EM&V report.

Category	Item	North Carolina			
		2015	2016 <sup>63</sup>	2017	Program Total (2015-2017)
	Net-to-Gross Adjustment (70%) <sup>64</sup>	-169,298	-1,000,058	-521,436	-1,690,792
	Net Adjusted Savings	395,028	2,333,469	1,216,685	3,945,182
	Planned Savings (Net)	1,752,864	1,619,973	2,220,165	5,593,002
	Cum. % Toward Planned Savings (Net)	23%	144%	55%	71%
	Avg. Savings per Participant (Gross)	43,410	77,524	75,570	71,341
	Avg. Savings per Participant (Net)	30,387	54,267	52,899	49,939
Installed Demand Reduction	Total Gross Deemed Demand	105	743	335	1,182
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Demand	105	743	335	1,182
	Net-to-Gross Adjustment (70%) <sup>65</sup>	-31	-223	-100	-355
	Net Adjusted Demand	73	520	234	828
	Planned Demand (Net)	490	275	367	1,132
	Cum. % Toward Planned Demand (Net)	15%	189%	64%	73%
	Avg. Demand per Participant (Gross)	8	17	15	15
	Avg. Demand per Participant (Net)	6	12	10	10
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$270	\$278	\$432	\$322
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.006	\$0.004	\$0.006	\$0.006
	Cum. \$Admin. per Cum. kW (Gross)	\$34	\$16	\$30	\$21
	Cum. \$EM&V per Cum. Total Costs (\$)	6%	2%	3%	3%
	Cum. \$Rebate per Cum. Participant (Gross)				

### 5.3.2.3 Additional Virginia Program Data

Figure 5-25 illustrates gross energy savings, gross peak demand reduction, and units installed by lighting measure type as a percentage of the total in Virginia in 2017. The most common lighting measure types installed as part of this program were LEDs, which accounted for over 90% of the installations and the

<sup>64</sup> The program implementation vendor has listed the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" See section 3.1.3 Net Savings Estimation for a description of net-to-gross estimation.

<sup>65</sup>Ibid.

largest amount of gross energy and peak demand savings. Occupancy sensors accounted for 7% of the lighting measure types installed.

T8/T5s lamps accounted for only 1% of the lighting measure types installed.

This is a continuation of the 2016 trend, where T8/T5s had dropped to 5%, when in 2015, it was 16% and in 2014, they were 22% of the total fixtures installed. The number of CFLs being installed as part of this program are less than 1% of the total units installed. Note that T8s in the T8/T5 category refer to T8s with electronic ballasts and high performance T8s. T8s became the baseline lighting option in 2014, as required by the Energy Independence and Security Act (EISA) of 2007.

**Figure 5-25. VA Non-residential Lighting Systems & Controls Program Performance Indicators by Lamp Type as % of Total (2017)**

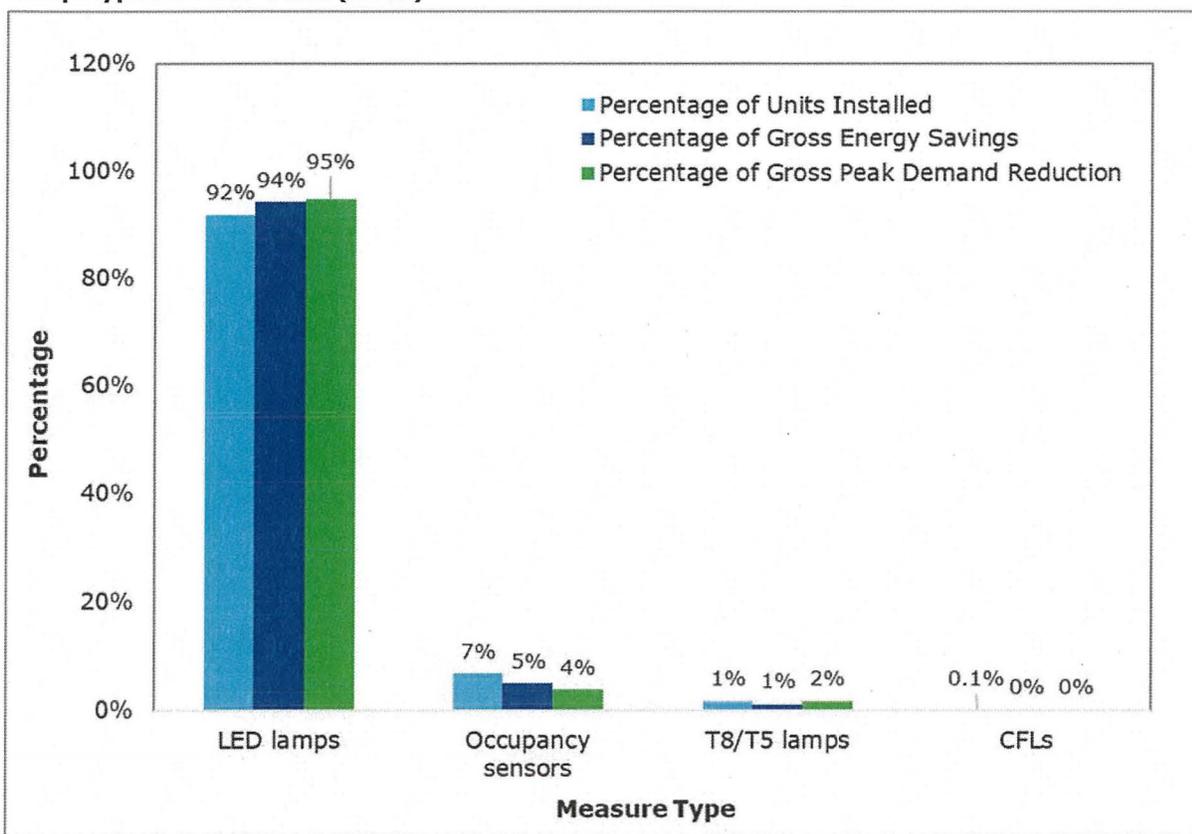


Figure 5-26 shows the continued upward trend of LEDs in the program between 2016 and 2017. Occupancy sensors accounted for 7% of the lighting measure types installed, which was an increase from 2016, when they accounted for 4%.

Installations of other lighting types, especially T8/T5 and CFLs, have decreased as a percentage of total year-over-year.

**Figure 5-26. VA Non-residential Lighting Systems & Controls Program Percentage of Measures Installed by Program Year**

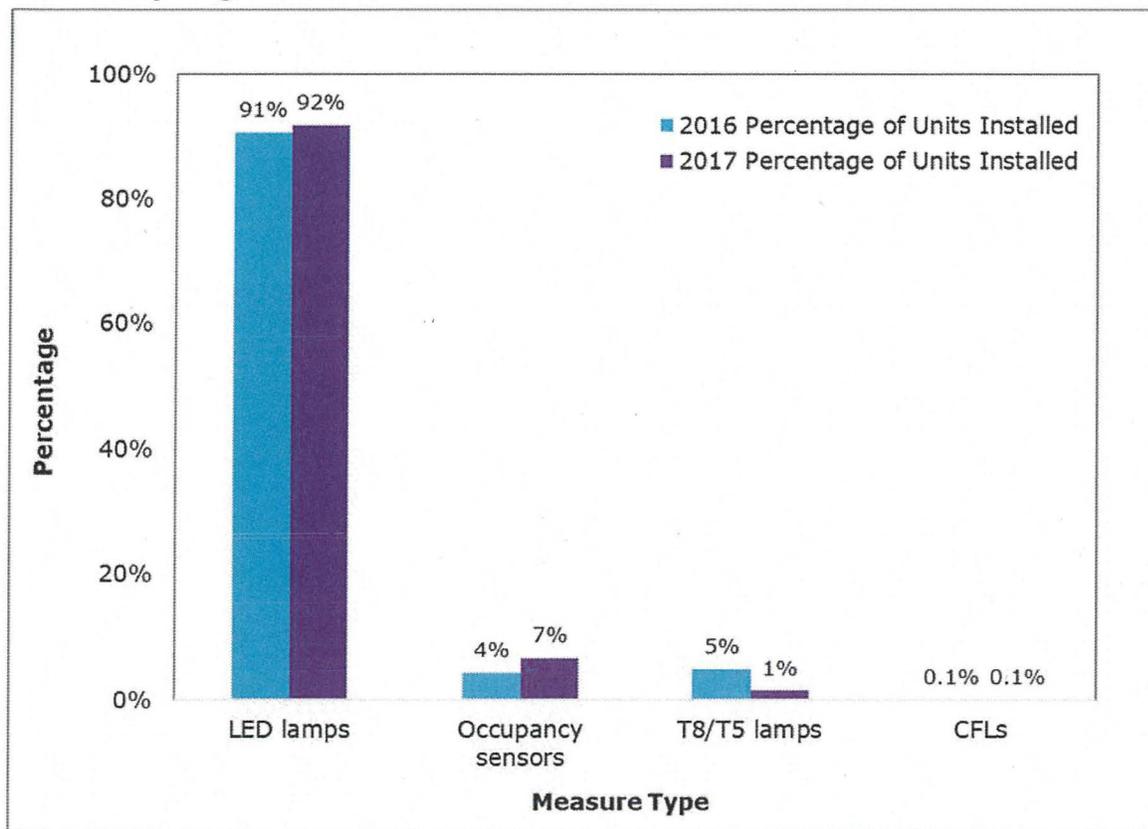


Figure 5-27 shows the Virginia gross energy savings, gross peak demand reduction, and participation by building type as a percentage of total. The most common building type with respect to units installed was office, making up 19% of the total lights installed. However, food building type had the greatest energy with 21% of total gross energy savings.

**Figure 5-27. VA Non-residential Lighting Systems & Controls Program Performance Indicators by Building Type as % of Total (2017)**

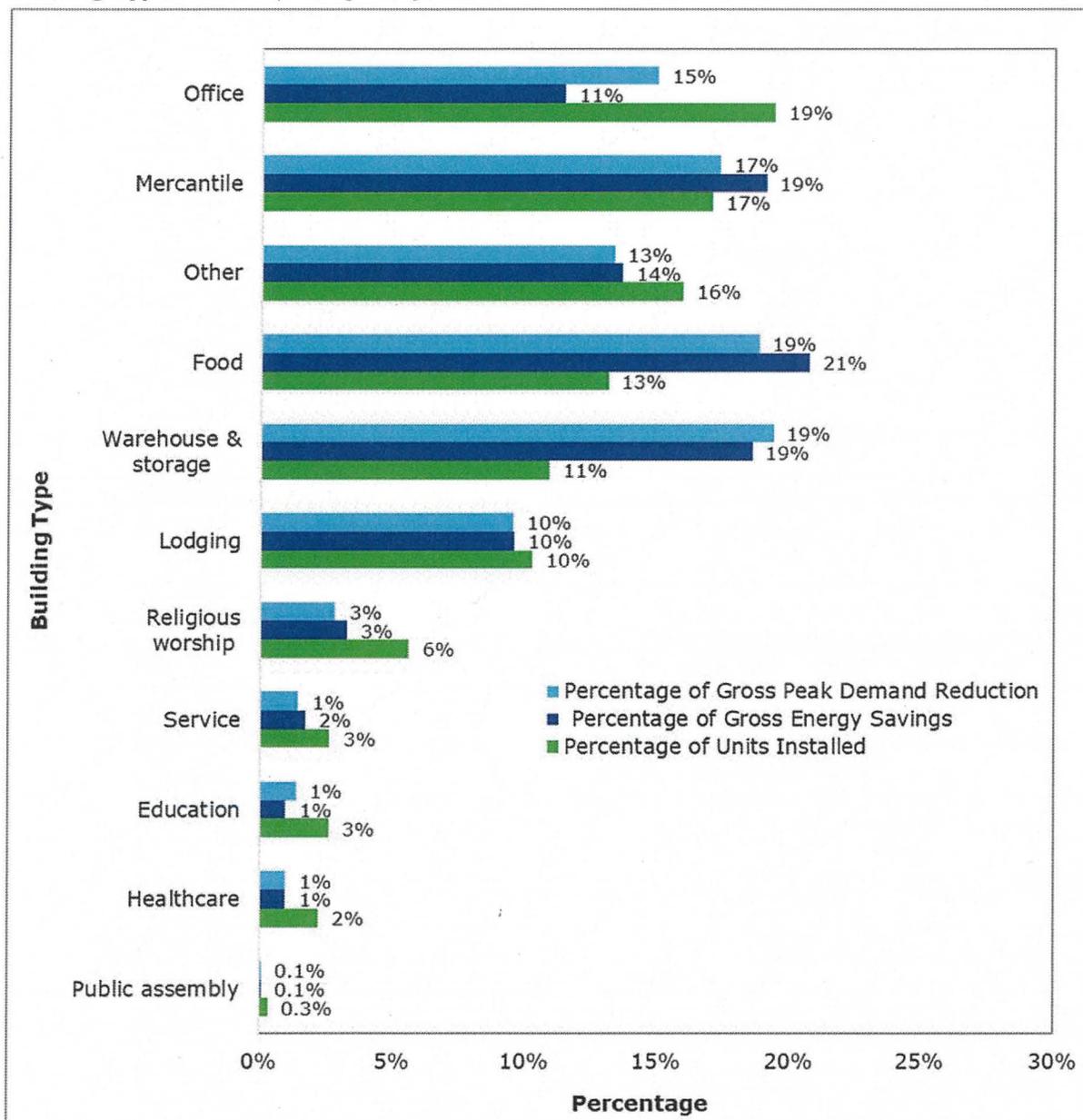
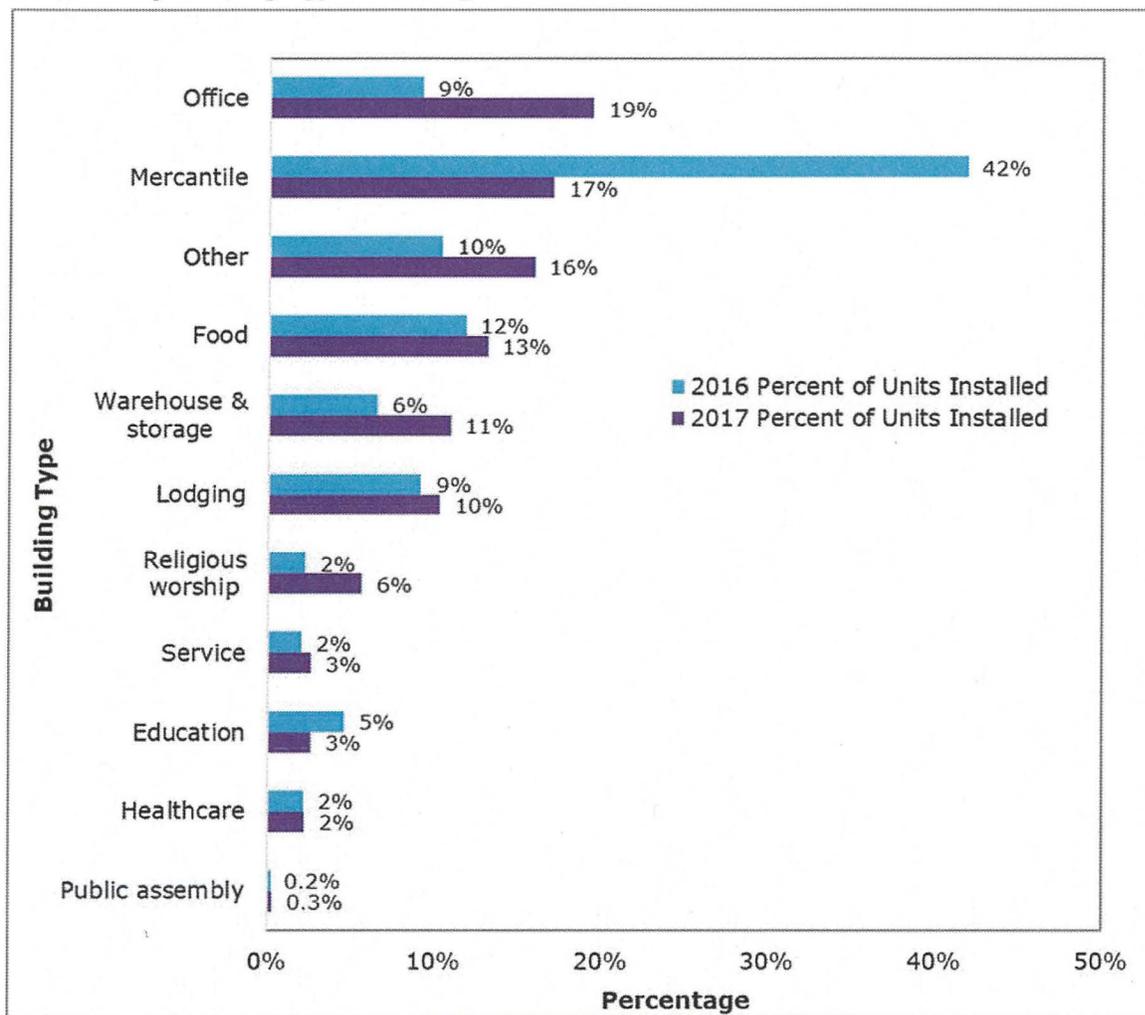


Figure 5-28 shows the shift in building type participation between 2016 and 2017 reported data. In 2016, mercantile had the largest number of installations at 42%, and public assembly had the least number of installations. Public assembly building type saw a similar trend of being the least installed lighting measure units, but the largest number of installations in 2017 were in office buildings.

**Figure 5-28. VA Non-residential Lighting Systems & Controls Program Percentage of Measures Installed by Building Type and Program Year**

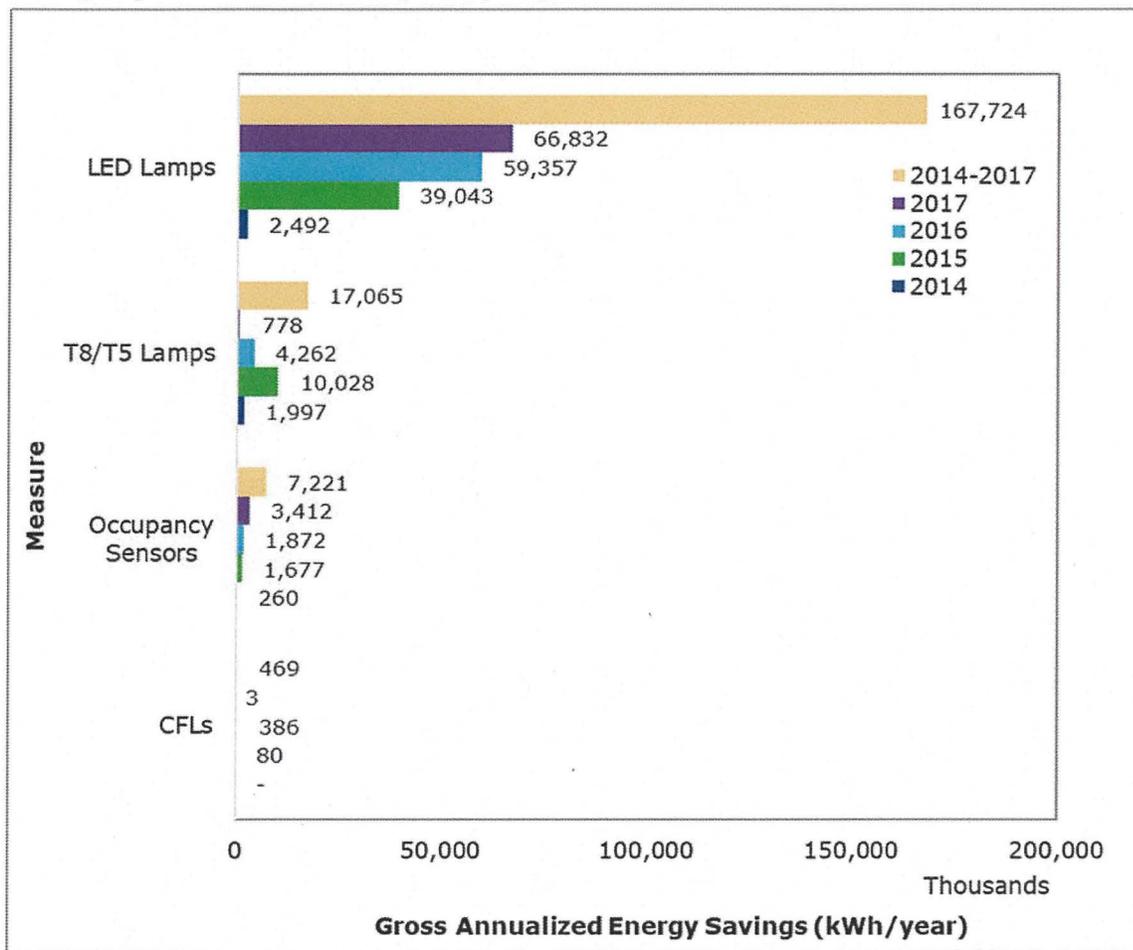


The remaining section of this report shows program progress from inception in 2014 to the end of this reporting year (2017).

Figure 5-29 through Figure 5-31 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. These figures show that the first program year (shown in dark blue) has low participation, and as a result the total gross energy savings for each measure type and in the first year were lower compared to subsequent program years.

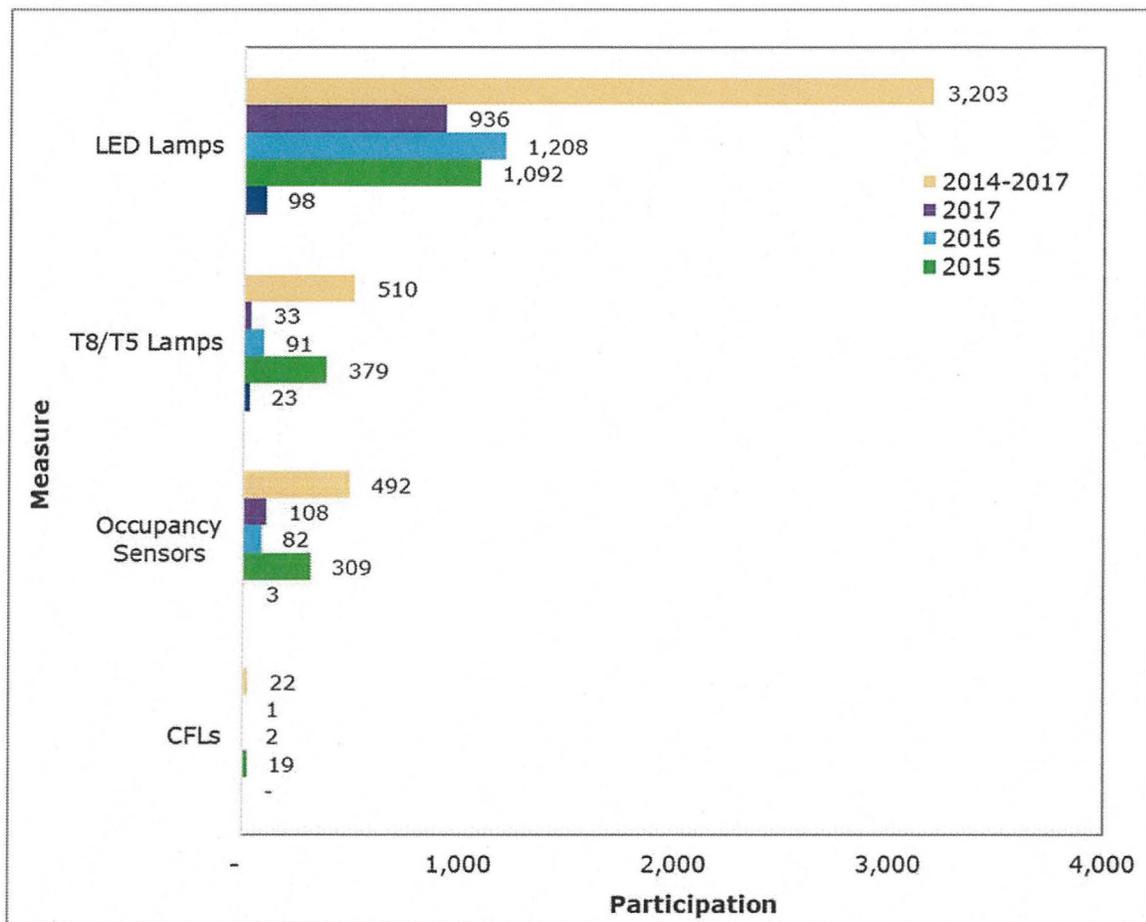
In the following year (2015), program participation increased. The LED measure produces the highest number of savings for the program life thus far, followed by T8/T5 lamps and occupancy sensors (Figure 5-29).

**Figure 5-29. VA Non-residential Lighting Systems & Controls Program Gross Annualized Energy Savings by Measure and Year (kWh/year)**



The most frequently-adopted measures were installation of LED lamps, T8/T5 lamps and occupancy sensors (Figure 5-30). This is likely due to the fact that these are the latest technologies available in the market and over the year the consumer awareness about EE has also increased.

**Figure 5-30. VA Non-residential Lighting Systems & Controls Program Participation by Measure and Year**



The installation of LED lamps and T8 lamps had the highest gross annualized savings per participant, followed closely by CFLs, shown in Figure 5-31. The installation of LED lamps continues growth year-over-year, however, for T8/T5 lamps, CFLs and occupancy sensors, trend varies year-by year most likely due to customer behavior.

**Figure 5-31. VA Non-residential Lighting Systems & Controls Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Measure and Year**

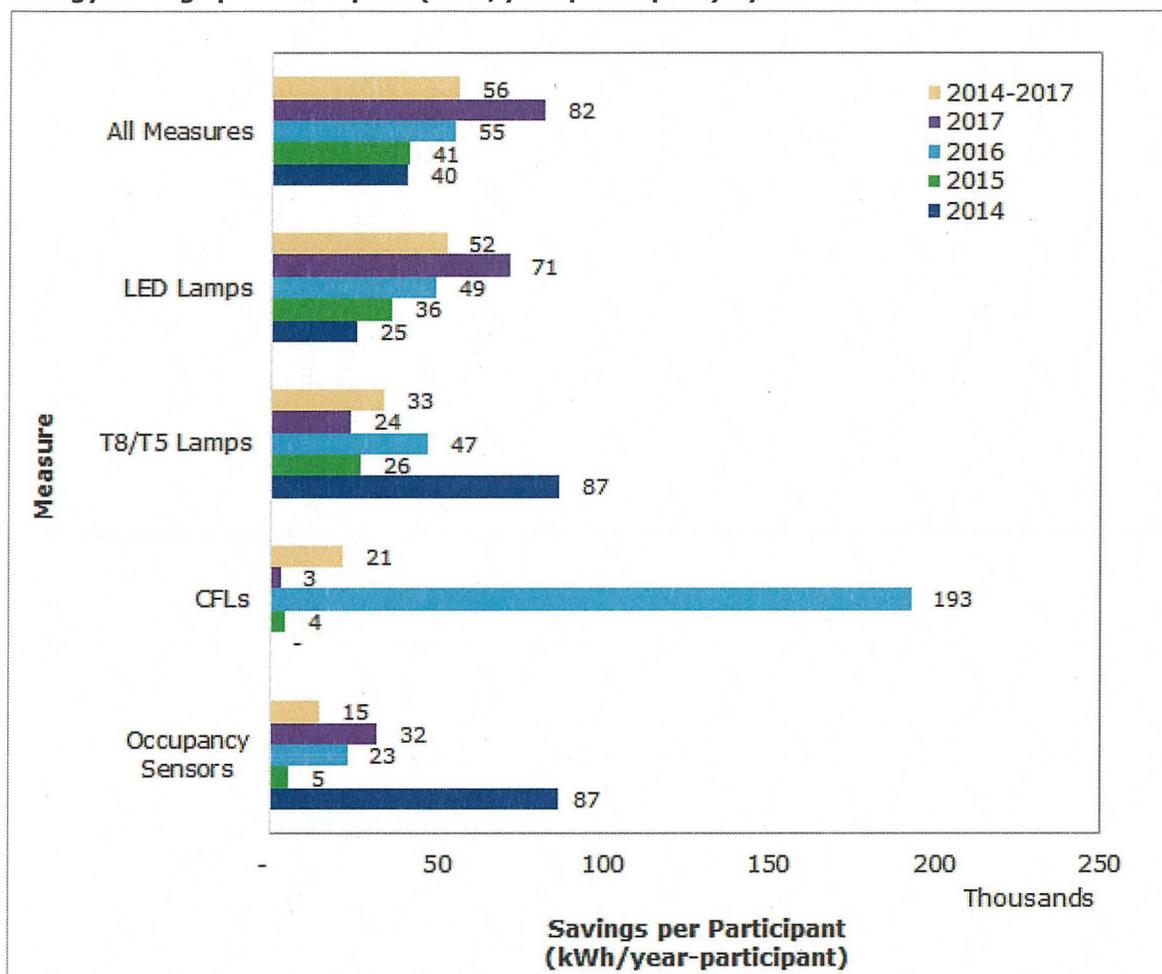
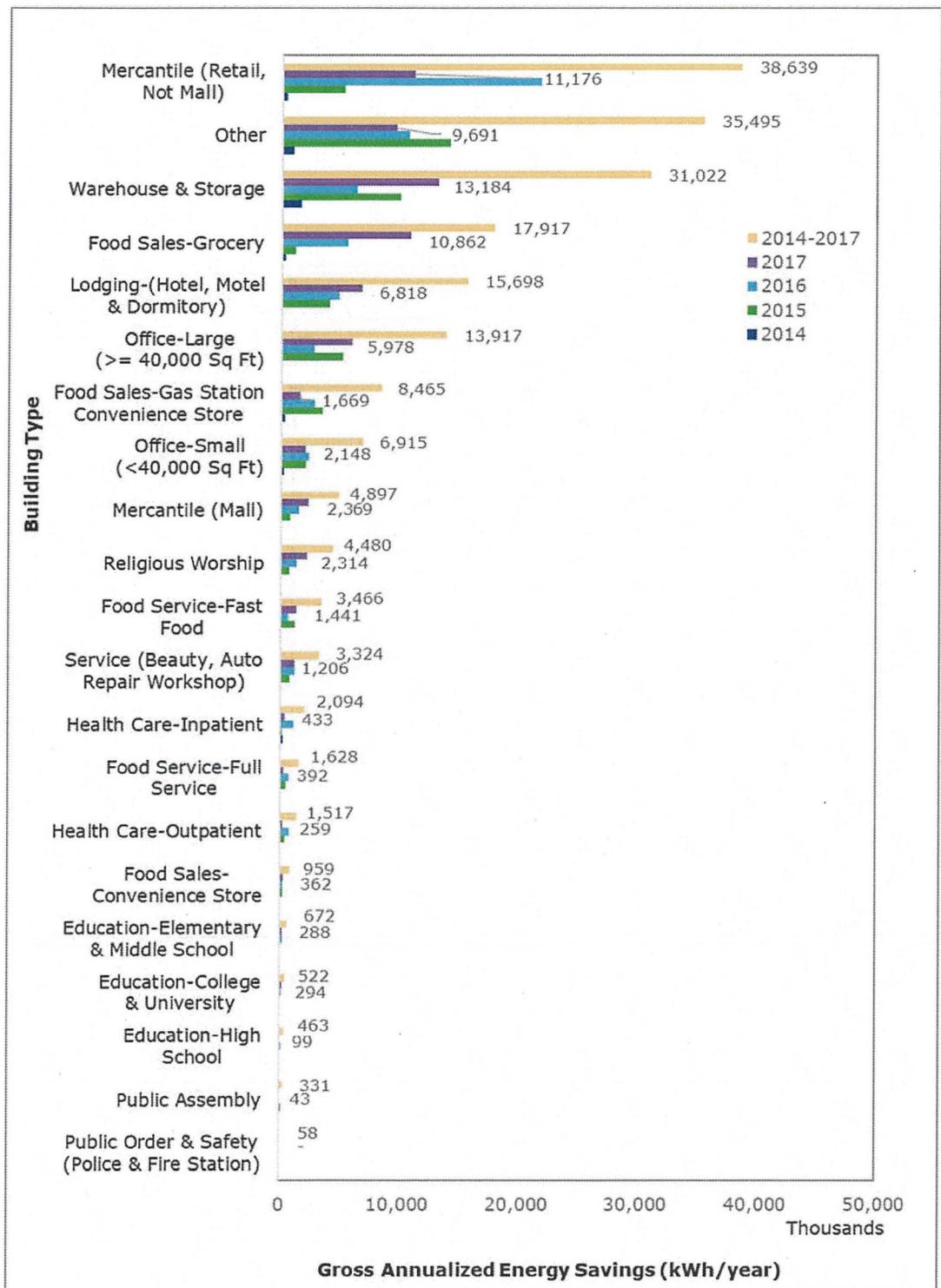




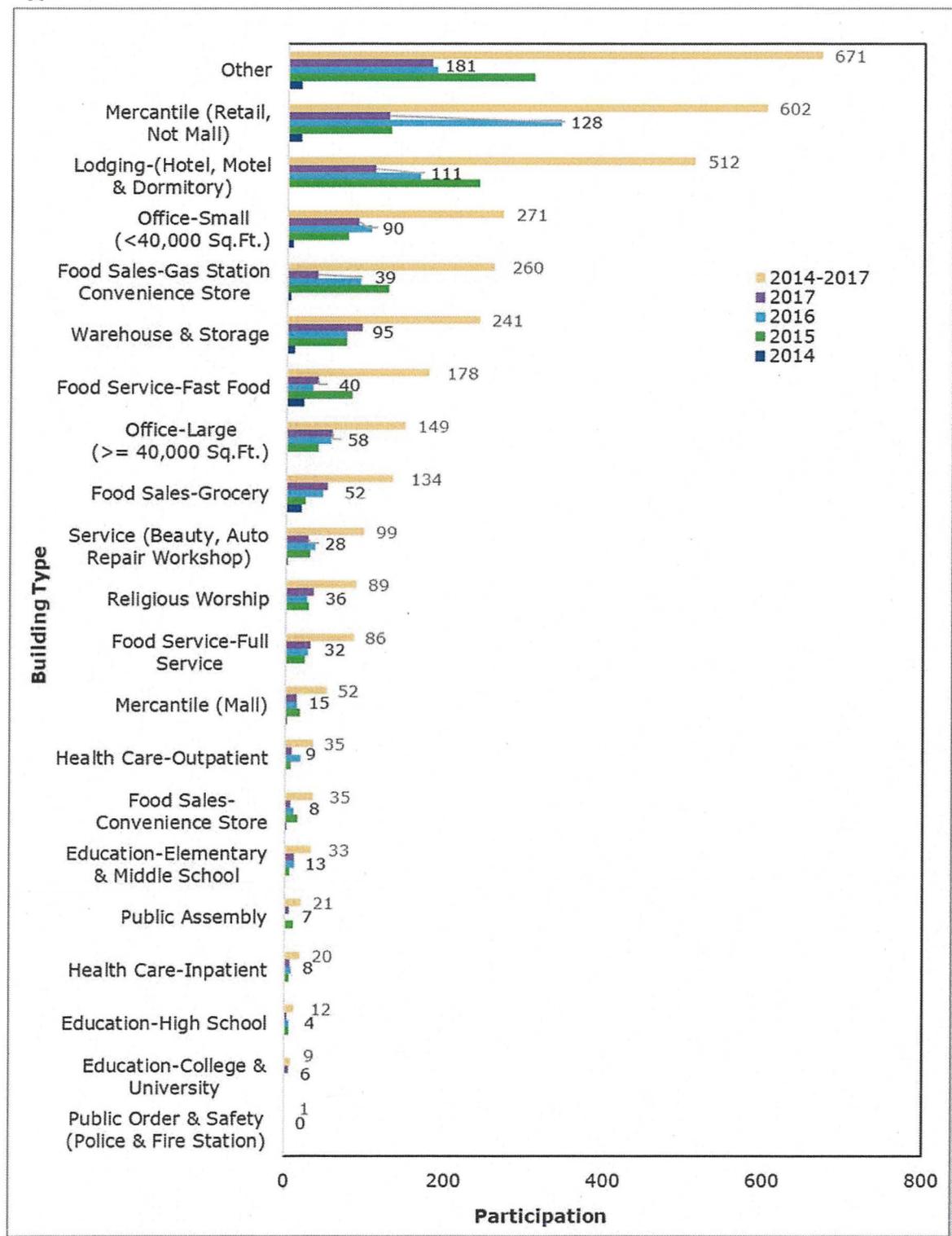
Figure 5-32 through Figure 5-34 show gross annualized energy savings, participation, and average annualized energy savings per participant (for participants who installed the measure in that year) by building type and program year.

For all the program years (2014 through 2017), the vast majority of program participants (Figure 5-34) were the “other” building category followed by mercantile buildings, but the gross annualized energy savings (Figure 5-32) were highest in mercantile buildings followed by the other building category. This implies the energy savings claimed per participant for mercantile buildings is much higher than the other building category. It might be useful to verify whether any of these sites, categorized as “Other” building type should actually have been categorized as one of the designated building type categories used by the program. DNV GL will consider this for future reports.

**Figure 5-32. VA Non-residential Lighting Systems & Controls Program Gross Annualized Energy Savings by Building Type and Year (kWh/year)**



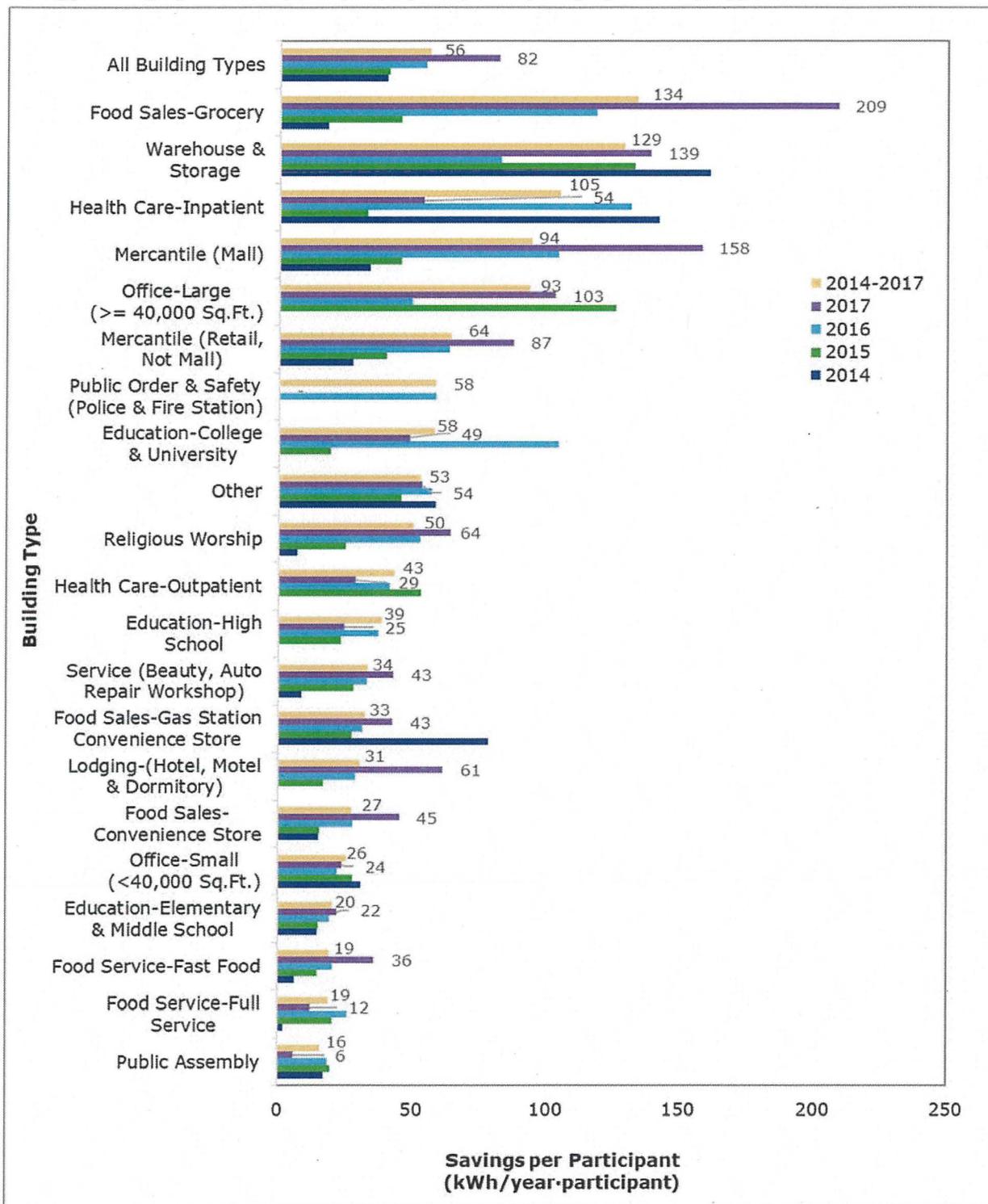
**Figure 5-33. VA Non-residential Lighting Systems & Controls Program Participation by Building Type and Year**





Average gross energy savings per participant by building type (Figure 5-34) show that the savings per participant for all years combined (2014-2017) varies significantly for all building types. This may be attributed to food sales – grocery, warehouse and storage being generally larger than other building types (food service – fast food and full service and public assembly) and having longer operating hours, therefore having greater opportunities for savings.

**Figure 5-34. VA Non-residential Lighting Systems & Controls Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Building Type and Year**



### 5.3.2.4 Additional North Carolina Program Data

Figure 5-35 illustrates gross energy savings, gross peak demand, and units installed by lighting measure type as a percentage of the total in North Carolina. Similar to Virginia, LEDs dominate the total number of installs, energy savings, and peak demand reduction, with over 89% in all three categories. Also, the smaller market share of T8/T5 and occupancy sensors is just as noticeable in North Carolina as it is in Virginia for this program. The gross energy and demand savings for T8/T5 lamps is very high due to the fact that only one customer participated and installed 518 high performance T8 lamps.

Note also that T8s in the T8/T5 category refer to T8s with electronic ballasts and high performance T8s. T8s became the baseline lighting option in 2014 as required in the Energy Independence and Security Act (EISA) of 2007.

**Figure 5-35. NC Non-residential Lighting Systems & Controls Program Performance Indicators by Lamp Type as % of Total (2017)**

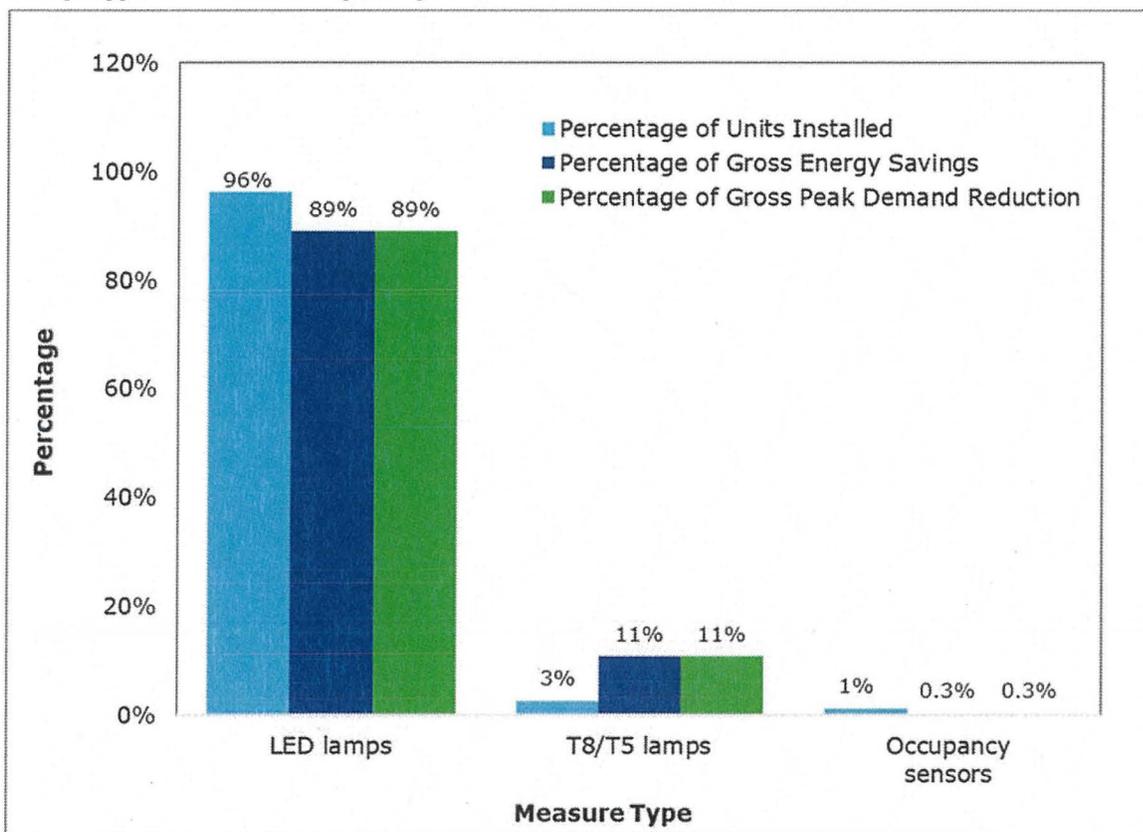
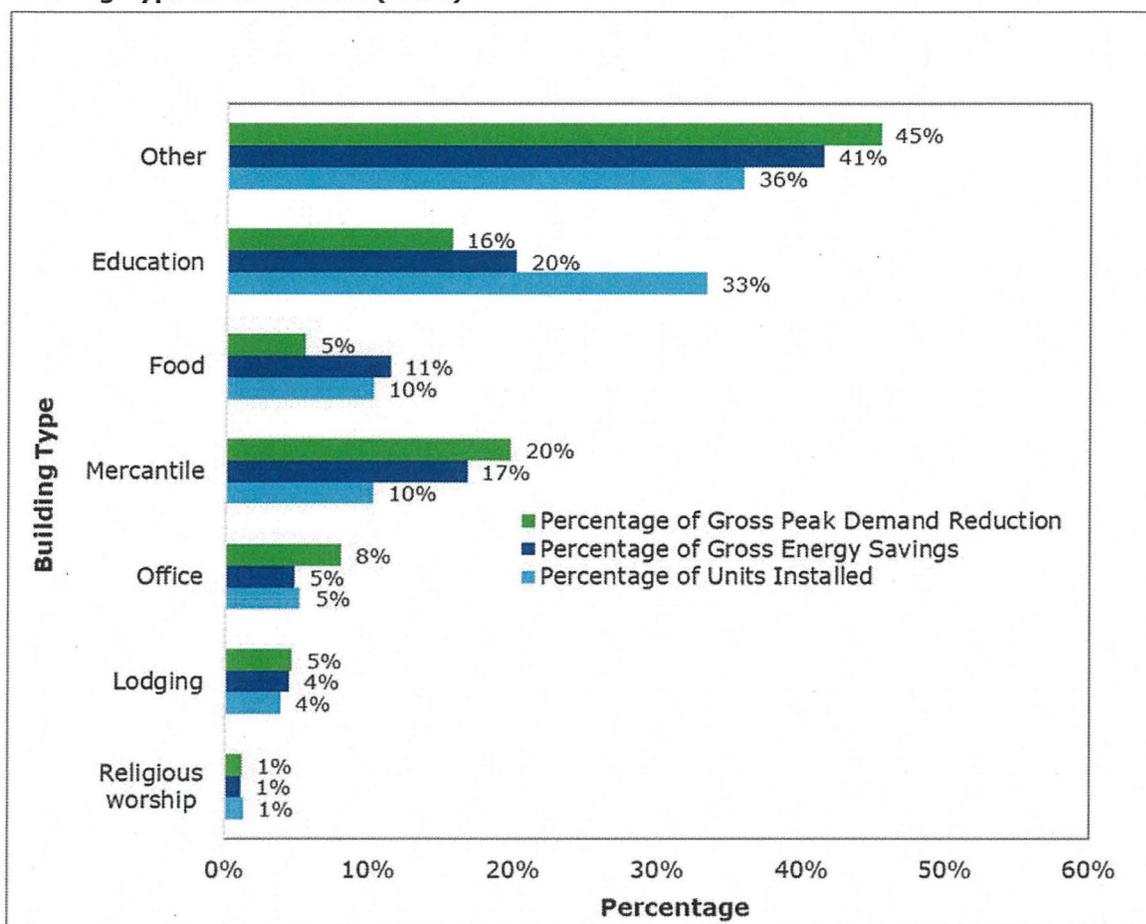


Figure 5-36 shows the North Carolina gross energy savings, gross peak demand savings, and participation by building type as a percentage of total. In 2017, the most common building type is the other category,<sup>66</sup> making up 36% of the lights installed, 41% of total gross energy savings, and 45% of peak demand reduction.

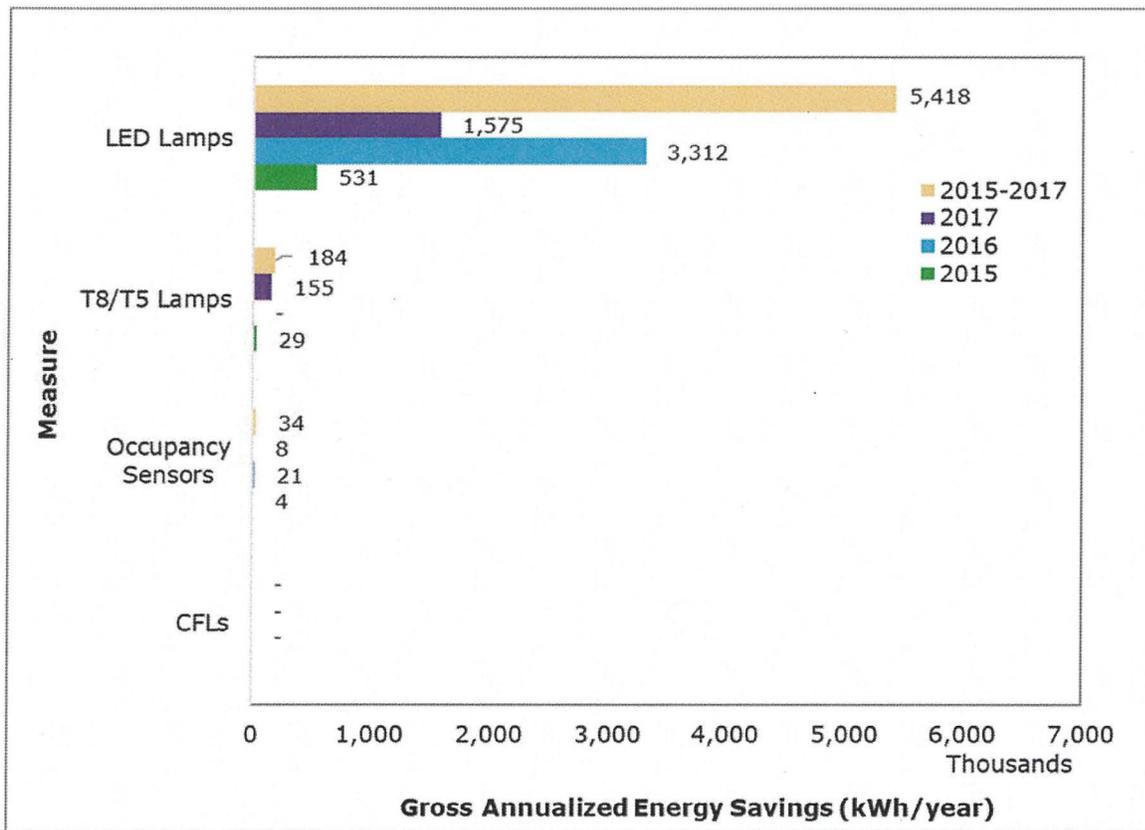
**Figure 5-36. NC Non-residential Lighting Systems & Controls Program Performance Indicators by Building Type as % of Total (2017)**



The remaining section of this report shows program progress from inception in 2015 to the end of this reporting year (2017). Figure 5-37 and Figure 5-39 shows gross annualized energy savings and participant (for participants who installed the measure in that year) by measure type and program year in North Carolina respectively. The installation of LED lamps contributed highest to the program gross annualized savings and as expected was the measure that was installed the most by participants.

<sup>66</sup> Other building types like gyms, lumber company, yacht service providers.

Figure 5-37. NC Non-residential Lighting Systems & Controls Program Gross Annualized Energy Savings (kWh/year) by Measure and Year



**Figure 5-38. NC Non-residential Lighting Systems & Controls Program Participation by Measure and Year**

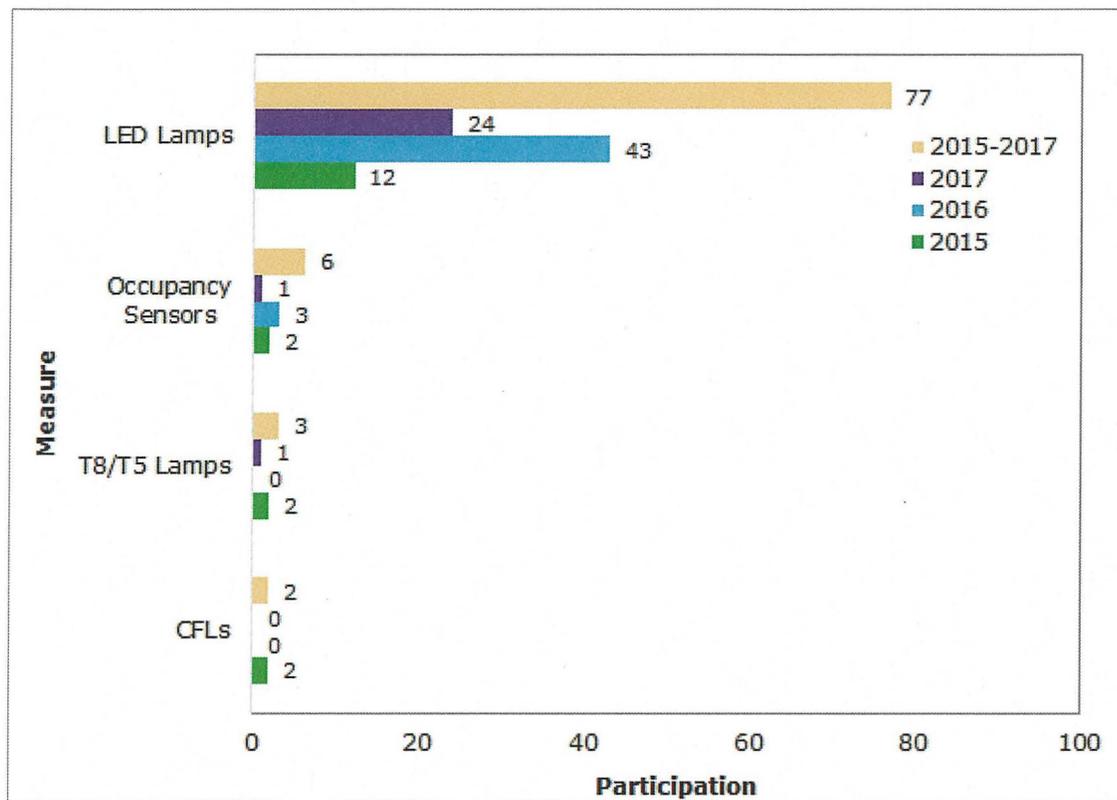


Figure 5-39 shows gross annualized energy savings per participant (for participants who installed the measure in that year) for each program year in North Carolina. The savings per participant for T8/T5 lamps are highest in 2017 due to the fact that only one customer participated and installed 518 high-performance T8 lamps (Figure 5-39).

**Figure 5-39. NC Non-residential Lighting Systems & Controls Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Measure and Year**

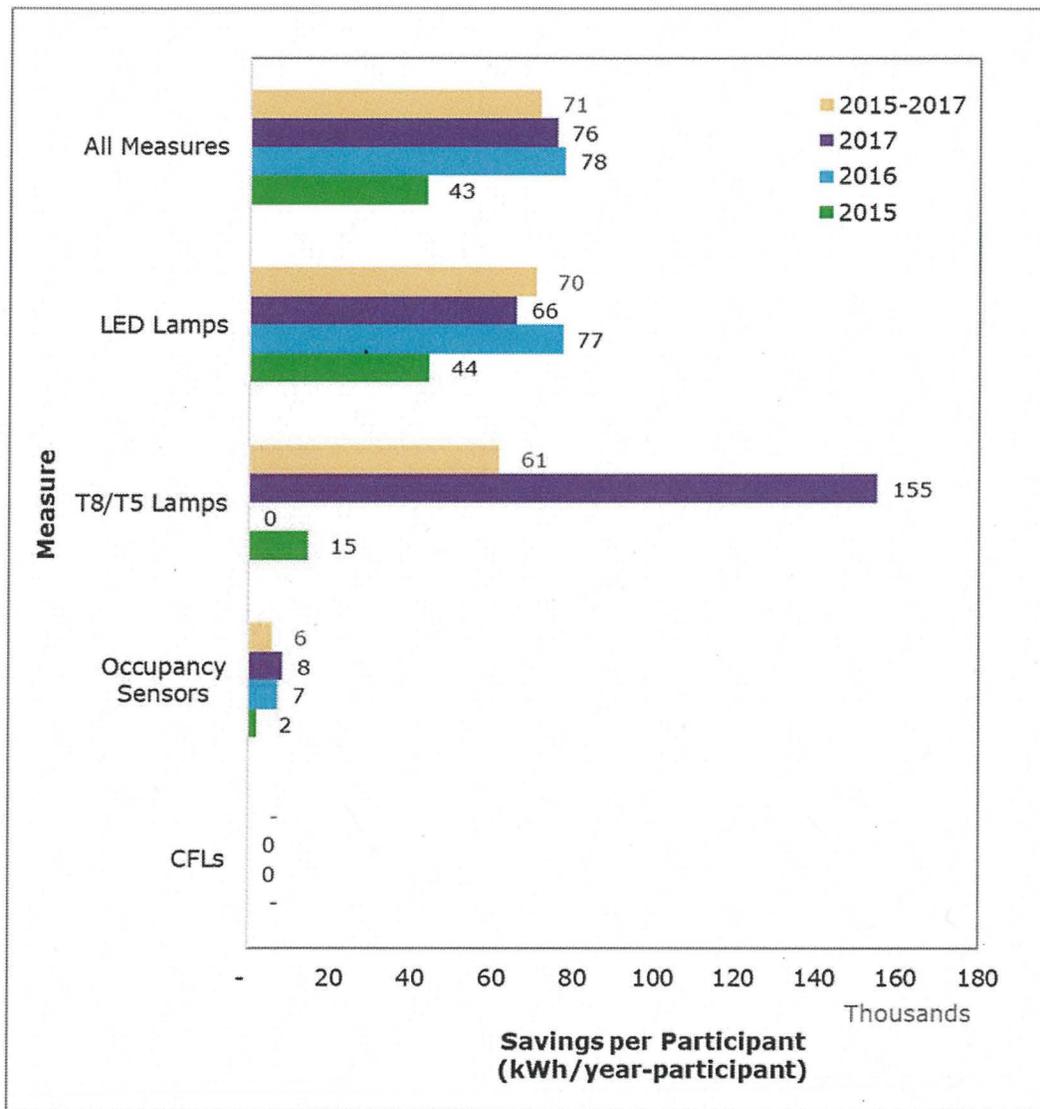
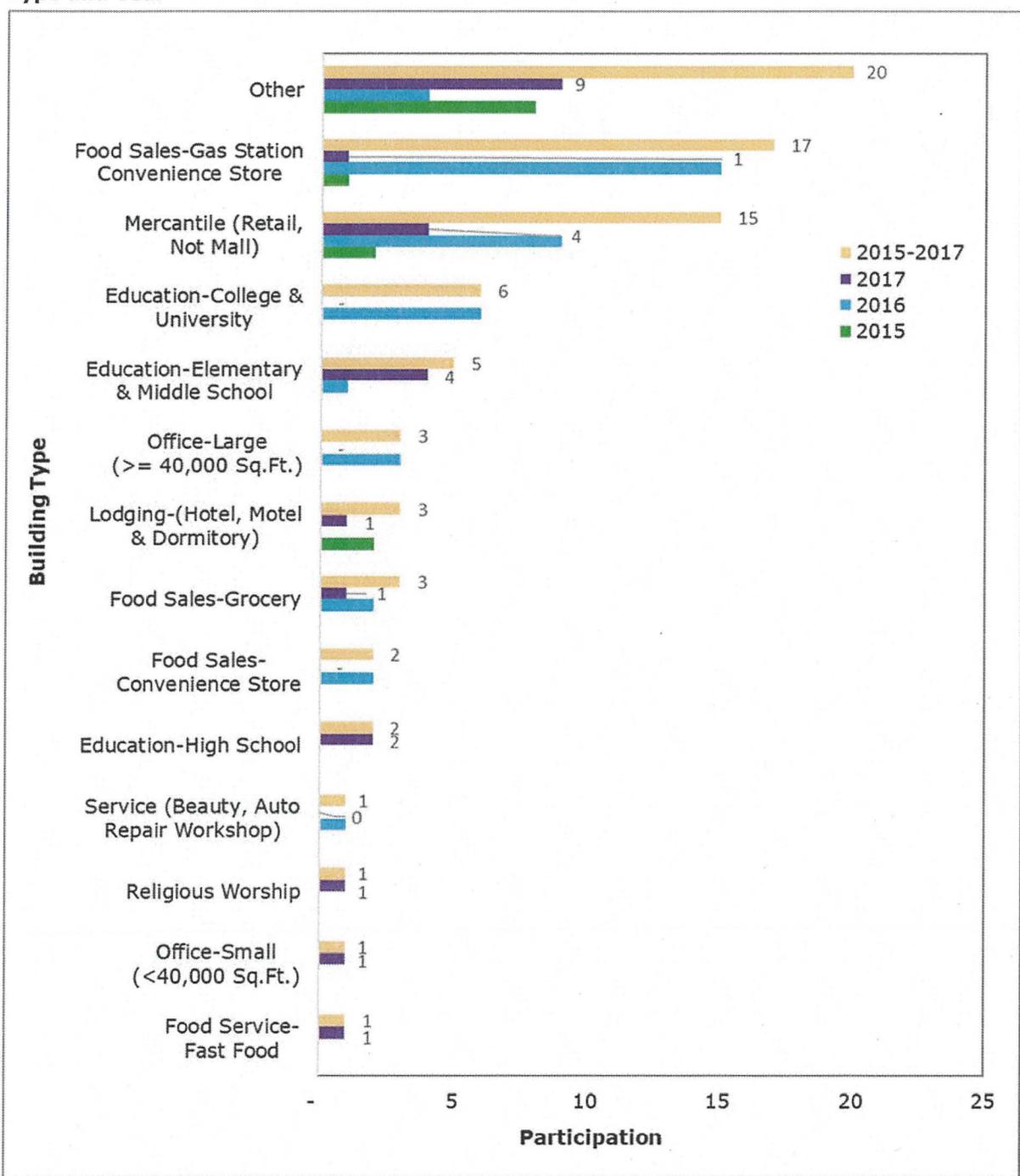


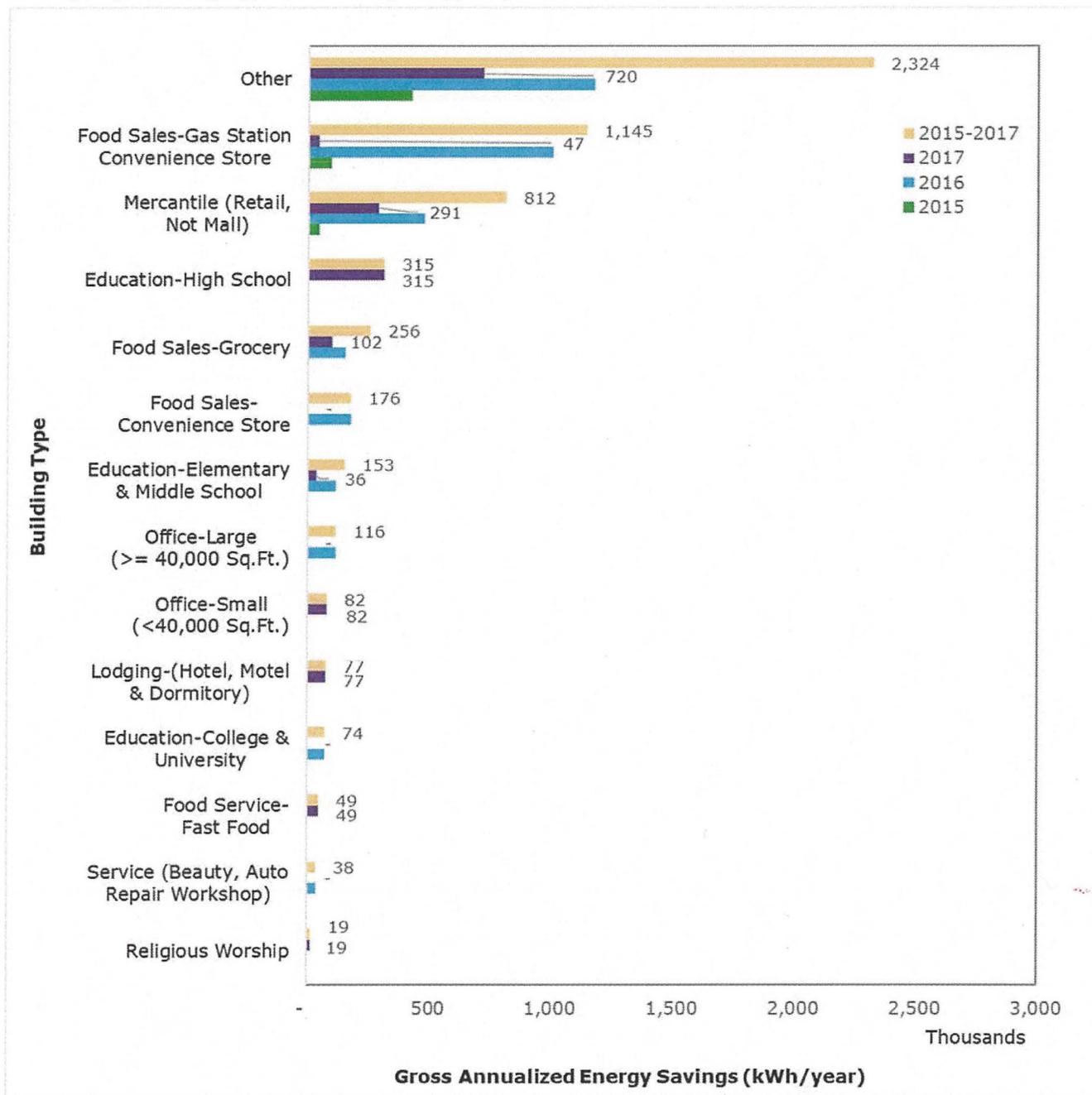


Figure 5-40 through Figure 5-42 shows participation, gross annualized energy savings, and average annualized energy savings per participant (for participants who installed the measure in that year) by building type and program year. They show that in both the years (2015 and 2016), the vast majority of program participants (Figure 5-40) and gross annualized energy savings (Figure 5-41) are in the other building category, followed by food sales – gas station convenience stores.

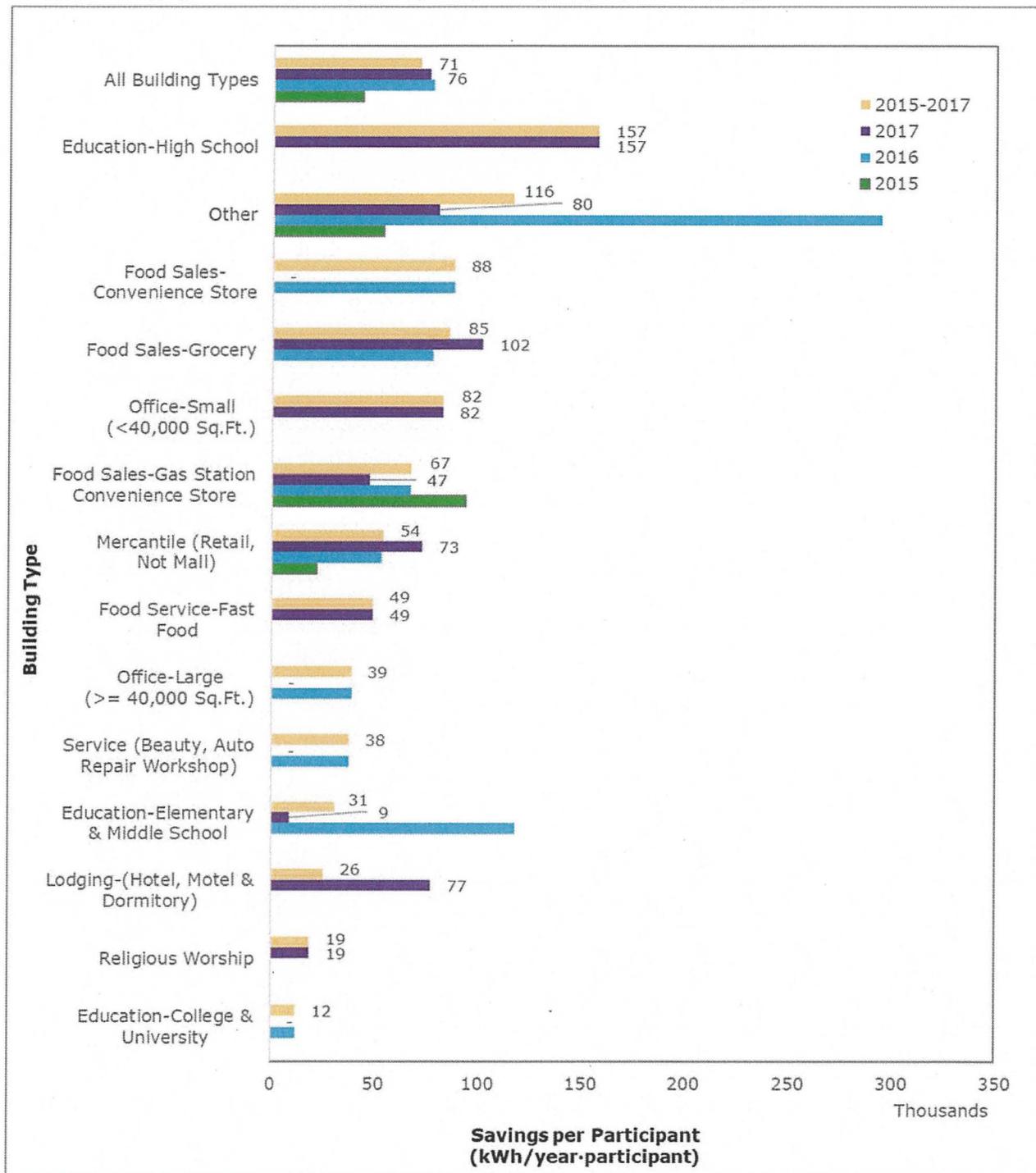
**Figure 5-40. NC Non-residential Lighting Systems & Controls Program Participation by Building Type and Year**



**Figure 5-41. NC Non-residential Lighting Systems & Controls Program Gross Annualized Energy Savings by Building Type and Year (kWh/year)**



**Figure 5-42. NC Non-residential Lighting Systems & Controls Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Building Type and Year**



## 5.4 Non-residential Heating and Cooling Efficiency – Virginia and North Carolina

The Non-residential Heating and Cooling Efficiency Program provides incentives to qualifying non-residential customers to upgrade existing heating or cooling equipment or install new energy efficient technologies. The category of eligible non-residential customers excludes those who are exempt by statute or contract or have opted-out. Measures eligible to receive a rebate in 2017 included:

- Unitary and split AC units
- Air-source/ground-source heat pump units
- Packaged terminal AC and heat pump
- Variable refrigerant flow
- Water- and air-cooled chillers
- Variable frequency drive applications
- Economizers

This program is implemented through a contractor network, so customers must contact a participating contractor to be eligible for the rebate. Customers are not considered participants until a completed application form has been processed and a rebate has been issued. This process can take several months since customers have 45 days to submit their rebate application, and the Company has 90 days to process it.

The SCC approved the DSM Phase III programs on April 29, 2014 (Case No. PUE-2013-00072). The NCUC approved the DSM Phase III programs on October 27, 2014 (Docket No. E-22, Sub 507). Upon approval, the Company worked to finalize data systems, build contractor networks, and finalize implementation details. Following program initiation activities, customer enrollment in the programs began in the fall of 2014. This program is heavily reliant upon a contractor network to implement the programs.

Following experience from DSM Phase II programs, this program allows for customer assignment of rebate to vendor. See Table 5-13 for a breakdown by state.

**Table 5-13. Proportion of 2017 Non-residential Heating and Cooling Efficiency Participant Rebate Recipients**

State	Percent of Rebates Given to Customers	Percent of Rebates Given to Vendors
VA	94%	6%
NC	75%	25%
<b>Overall</b>	<b>94%</b>	<b>6%</b>

### 5.4.1 Methods for the Current Reporting Period

DNV GL developed an EM&V Plan for this program that is included in Appendix K. For the current period, the approach included reviewing the tracking data and then estimating gross energy savings and peak demand reduction using STEP Manual calculations.

Table 5-14 outlines Dominion Energy's initial program planning assumptions used to design the program. DNV GL uses the planned NTG factor in its deemed savings calculations until it can be verified through EM&V.

**Table 5-14. Non-residential Heating and Cooling Efficiency Program Customer Participation Planning Assumptions System-wide**

Item	Description
Target Market	Non-residential customers
NTG Factor	70%
Measure Life	15 years
Average Energy Savings (kWh) per Participant per Year	12,641 kWh per participant per year
Average Peak Demand Reduction (kW) per Participant	3.2 kW per participant per year
Average Rebate (US \$) per Participant	\$1,653 per participant

## 5.4.2 Assessment of Program Progress Towards Plan

The next two subsections provide the tables summarizing the key indicators of the Non-residential Heating and Cooling Efficiency program progress in Virginia and North Carolina. The two subsections thereafter provide charts to show the types of participant buildings involved and the types of measures implemented.

### 5.4.2.1 Key Virginia Program Data

Table 5-15 summarizes key indicators of progress for Virginia from May 1, 2014 through December 31, 2017. Detailed program indicators by year and month are provided for Virginia in Appendix A.10.

In Virginia, the gross number of participants increased from 89 in 2016 to 103 in 2017. The net annual energy savings decreased somewhat year-over-year from 9,553,114 kWh/year to 5,270,047 kWh/year (14% of planned). See section 5.4.2.3 for additional breakdowns of program participants and energy savings, for additional insights on the difference between the types of measures and/or participants between the two years. One additional reason not discussed in section 5.4.2.3 is the update to the deemed savings calculation for measures in this program, which resulted in a large reduction in the full load hours assumption for all building types. The net peak demand reduction decreased year-over-year from 1,459.0 kW to 1,353.3 kW (9% of planned). Total annual program costs in 2017 increased year-over-year to 95% of planned.

On a per-participant basis, the average gross annual energy savings decreased by 52% from 153,341 kWh in 2016 to 73,094 kWh in 2017 (12,641 kWh planned). The average gross peak demand reduction per participant decreased somewhat from 23.4 kW to 18.8 kW (3.2 kW planned). The average rebate per participant increased.

Cumulatively, since the program's inception in 2014 and through the end of 2017, the program has achieved a total of 23,633,941 kWh/year of net annual energy savings (31% of planned) and a total of 5,113.3 kW of net demand reduction (22% of planned) through a total of 312 participants (12% of planned). Total program costs over the life of the program have been 70% of planned.

**Table 5-15. VA Non-residential Heating and Cooling Efficiency Program Performance Indicators (2014-2017)**

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016 <sup>67</sup>	2017	
Operations and Management Costs (\$)	Direct Rebate					
	Direct Implementation					
	Direct EM&V					
	Indirect Other (Administrative)	\$14,267	\$38,982	\$41,094	\$69,115	\$163,457
Total Costs (\$)	Total					
	Planned					
	Variance					
	Cumulative % of Planned	30%	72%	75%	95%	70%
Participants	Total (Gross)	6	114	89	103	312
	Planned (Gross)	261	746	782	797	2,586
	Variance	-255	-632	-693	-694	-2,274
	Cumulative % of planned (Gross)	2%	15%	11%	13%	12%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	1,456,991	11,129,837	13,647,306	7,528,638	33,762,773
	Realization Rate Adjustment (100%)	0	0	0	0	0
	Adjusted Gross Savings	1,456,991	11,129,837	13,647,306	7,528,638	33,762,773
	Net-to-Gross Adjustment (70%) <sup>68</sup>	-437,097	-3,338,951	-4,094,192	-2,258,592	-10,128,832

<sup>67</sup> The 2016 total gross deemed savings values reported in this table differs from values in the May 1, 2017 EM&V report, and have been refiled with the Commission. The adjustments totaled -154,576 kWh/year and 0 kW for 2016 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017, in section 10. The adjustment was made to full load heating hours (FLH<sub>heat</sub>) in Tables 90 and 91 to be consistent with those in the Mid-Atlantic TRM v 6, in response to requests by the North Carolina Public Staff Utilities Commission Re: Docket No. E-22, Sub 545, on October 23, 2017. This affected multiple non-residential HVAC measures (e.g. heat pumps, variable refrigerant flow, mini split systems) that reference Table 90 and 91, in multiple non-residential programs. This adjustment is reflected in STEP Manual version 8.0.0 in this EM&V report. Another adjustment was made to correct the full load cooling hours in North Carolina for this program. The code that calculated this savings did not match the STEP Manual v 7.0.0.

<sup>68</sup> The program implementation vendor has listed the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" See section 3.1.3 Net Savings Estimation for a description of net-to-gross estimation.

Category	Item	Virginia					Program Total (2014-2017)
		2014	2015	2016 <sup>67</sup>	2017		
	Net Adjusted Savings	1,019,894	7,790,886	9,553,114	5,270,047	23,633,941	
	Planned Savings (Net)	3,299,301	9,430,186	24,119,220	38,355,947	75,204,654	
	Cum. % Toward Planned Savings (Net)	31%	83%	40%	14%	31%	
	Avg. Savings per Participant (Gross)	242,832	97,630	153,341	73,094	108,214	
	Avg. Savings per Participant (Net)	169,982	68,341	107,338	51,166	75,750	
Installed Demand Reduction	Total Gross Deemed Demand	510.1	2,777.0	2,084.3	1,933.3	7,304.7	
	Realization Rate Adjustment (100%)	0.0	0.0	0.0	0.0	0.0	
	Adjusted Gross Demand	510.1	2,777.0	2,084.3	1,933.3	7,304.7	
	Net-to-Gross Adjustment (70%) <sup>69</sup>	-153.0	-833.1	-625.3	-580.0	-2,191.4	
	Net Adjusted Demand	357.1	1,943.9	1,459.0	1,353.3	5,113.3	
	Planned Demand (Net)	835.2	2,387.2	4,089.6	15,592.6	22,904.6	
	Cum. % Toward Planned Demand (Net)	43%	81%	36%	9%	22%	
	Avg. Demand per Participant (Gross)	85.0	24.4	23.4	18.8	23.4	
	Avg. Demand per Participant (Net)	59.5	17.1	16.4	13.1	16.4	
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$2,378	\$342	\$462	\$671	\$524	
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.01	\$0.00	\$0.00	\$0.01	\$0.00	
	Cum. \$Admin. per Cum. kW (Gross)	\$28	\$14	\$20	\$36	\$22	

<sup>69</sup> Ibid.



Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016 <sup>67</sup>	2017	
	Cum. \$EM&V per Cum. Total Costs (\$)	6%	6%	9%	8%	7%
	Cum. \$Rebate per Cum. Participant (Gross)					

Extraordinarily Sensitive Information Redacted

OFFICIAL COPY

May 01 2018

### 5.4.2.2 Key North Carolina Program Data

Table 5-16 summarizes key indicators of progress for North Carolina from May 1, 2014 through December 31, 2017. Detailed program indicators by year and month are provided for North Carolina in Appendix B.10.

In North Carolina, the gross number of participants decreased from six in 2016 to three in 2017. The net annual energy savings also decreased from 202,650 kWh/year in 2016 to 58,080 kWh in 2017 (2% of planned). The net peak demand reduction also decreased from 65.3 kW to -28.5 kW (-3% of planned).<sup>70</sup> Total annual program costs in 2017 increased somewhat year-over-year to 49% of planned.

On a per-participant basis, the average gross annual energy savings decreased from 48,250 kWh/year in 2016 to 27,657 kWh/year in 2017 (12,641 kWh/year planned). The average gross peak demand reduction per participant decreased from 15.5 kW to -13.6 kW (3.2 kW planned). The average rebate per participant doubled from \$3,404 in 2016 to \$6,996 in 2017.

Cumulatively, since the program's inception in 2015 and through the end of 2017, the program has achieved a total of 324,531 kWh/year of net annual energy savings (7% of planned) and a total of 55.6 kW of net demand reduction (4% of planned) through a total of 12 participants (8% of planned). Total program costs over the life of the program have been 42% of planned.

**Table 5-16. NC Non-residential Heating and Cooling Efficiency Program Performance Indicators (2015-2017)**

Category	Item	North Carolina			
		2015	2016 <sup>71</sup>	2017	Program Total (2015-2017)
Operations and Management Costs (\$)	Direct Rebate				
	Direct Implementation				
	Direct EM&V				
	Indirect Other (Administrative)	\$1,360	\$1,610	\$2,353	\$5,323
Total Costs (\$)	Total				
	Planned				
	Variance				
	Cumulative % of Planned	32%	44%	49%	42%
Participants	Total (Gross)	3	6	3	12
	Planned (Gross)	48	52	53	153
	Variance	-45	-46	-50	-141
	Cumulative % of planned (Gross)	6%	12%	6%	8%

<sup>70</sup> This is due to what appears to be a data entry error in record ID M077556228; an inquiry was submitted for clarification on March 6, 2018.

<sup>71</sup> The 2016 total gross deemed savings values reported in this table differs from values in the May 1, 2017 EM&V report, and have been refiled with the Commission. The adjustments totaled -22,904 kWh/year and 0 kW for 2016 reported savings. The adjustments account for corrections to STEP Manual version 7.0.0 issued on May 1, 2017, in section 10. The adjustment was made to full load heating hours (FLH<sub>heat</sub>) in Tables 90 and 91 to be consistent with those in the Mid-Atlantic TRM v 6, in response to requests by the North Carolina Public Staff Utilities Commission Re: Docket No. E-22, Sub 545, on October 23, 2017. This affected multiple non-residential HVAC measures (e.g. heat pumps, variable refrigerant flow, mini split systems) that reference Table 90 and 91, in multiple non-residential programs. This adjustment is reflected in STEP Manual version 8.0.0 in this EM&V report.

Category	Item	North Carolina			Program Total (2015-2017)
		2015	2016 <sup>71</sup>	2017	
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	91,144	289,500	82,971	463,615
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Savings	91,144	289,500	82,971	463,615
	Net-to-Gross Adjustment (70%)	-27,343	-86,850	-24,891	-139,085
	Net Adjusted Savings	63,801	202,650	58,080	324,531
	Planned Savings (Net)	606,768	1,619,973	2,563,872	4,790,614
	Cum. % Toward Planned Savings (Net)	11%	13%	2%	7%
	Avg. Savings per Participant (Gross)	30,381	48,250	27,657	38,635
Avg. Savings per Participant (Net)	21,267	33,775	19,360	27,044	
Installed Demand Reduction	Total Gross Deemed Demand	26.9	93.2	-40.7	79.4
	Realization Rate Adjustment (100%)	0.0	0.0	0.0	0.0
	Adjusted Gross Demand	26.9	93.2	-40.7	79.4
	Net-to-Gross Adjustment (70%)	-8.1	-28.0	12.2	-23.8
	Net Adjusted Demand	18.8	65.3	-28.5	55.6
	Planned Demand (Net)	154.2	274.7	1,042.3	1,471.1
	Cum. % Toward Planned Demand (Net)	12%	24%	-3%	4%
	Avg. Demand per Participant (Gross)	9.0	15.5	-13.6	6.6
Avg. Demand per Participant (Net)	6.3	10.9	-9.5	4.6	
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$453	\$268	\$784	\$444
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.01	\$0.01	\$0.03	\$0.01
	Cum. \$Admin. per Cum. kW (Gross)	\$51	\$17	-\$58	\$67
	Cum. \$EM&V per Cum. Total Costs (\$)	14%	15%	15%	14%
	Cum. \$Rebate per Cum. Participant (Gross)				



### 5.4.2.3 Additional Virginia Program Data

This section provides a series of charts to show the program performance over the life of the program in Virginia, by year, by measure type, and by building type. In Figure 5-43, the average energy savings per participant (gross annualized) are shown for each measure category, by year and overall. In 2017 and over the life of the program, chillers have yielded the highest average savings per participant, followed by variable frequency drives (VFDs).

**Figure 5-43. VA Non-residential Heating and Cooling Efficiency Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Measure**

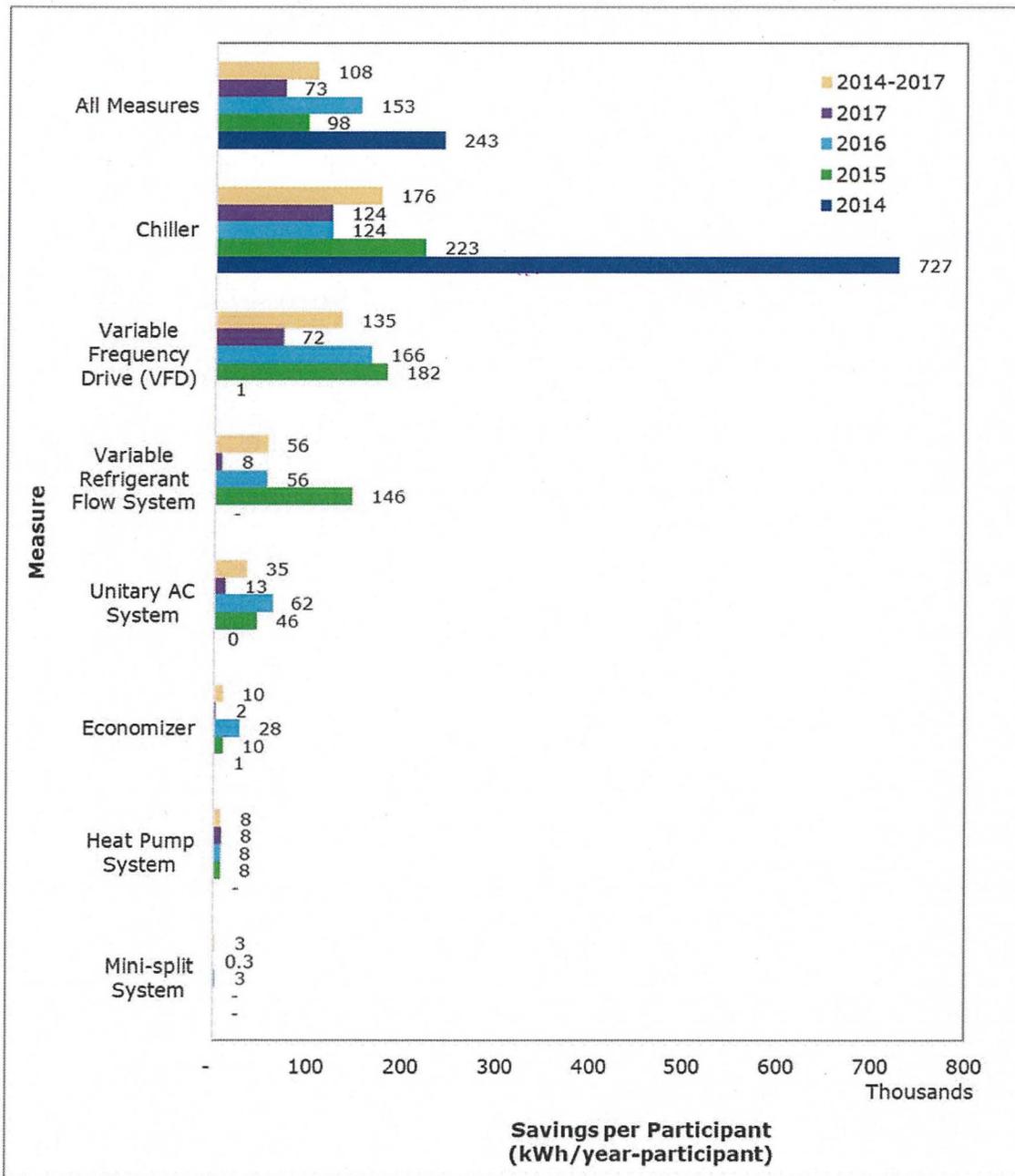
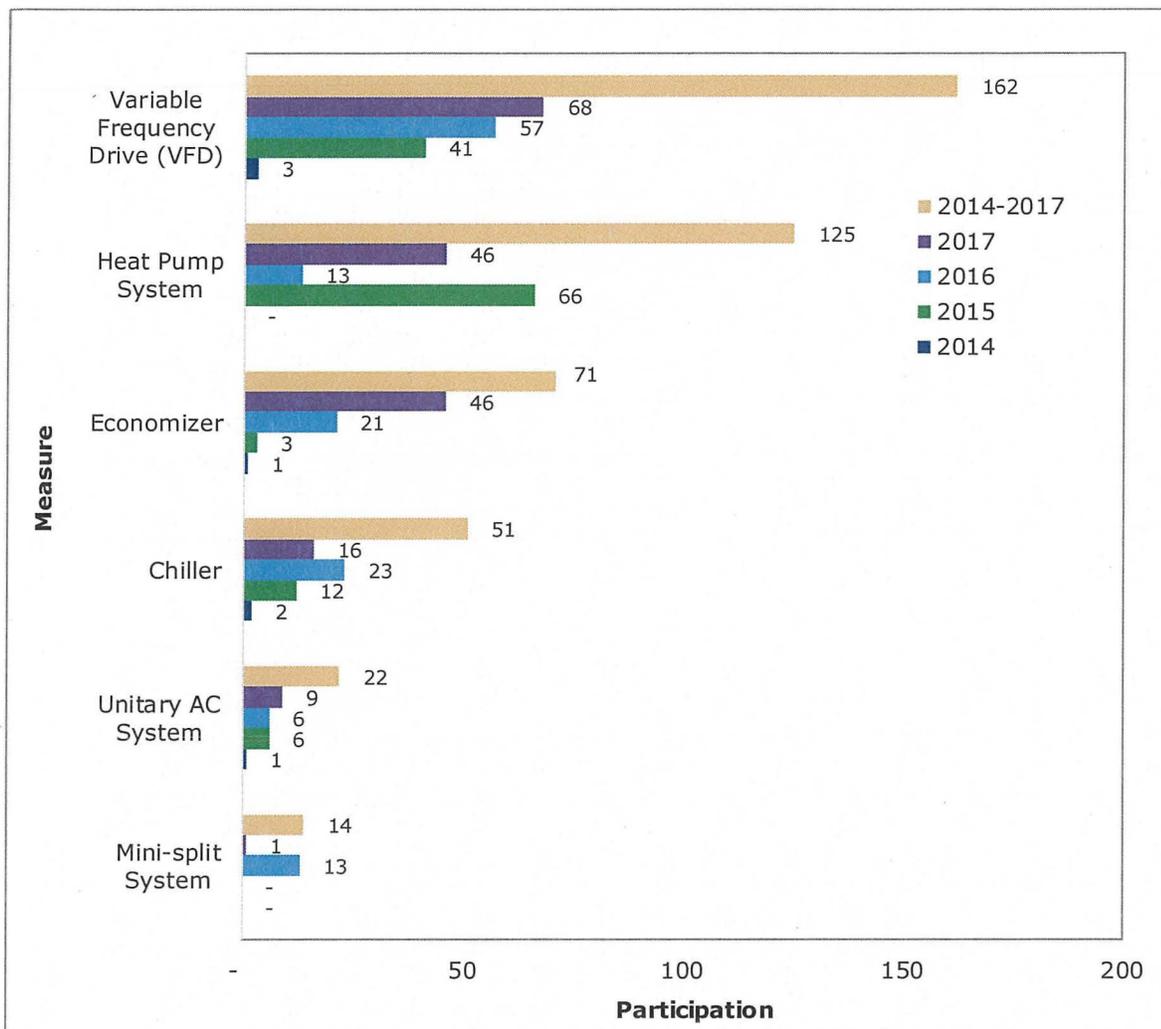


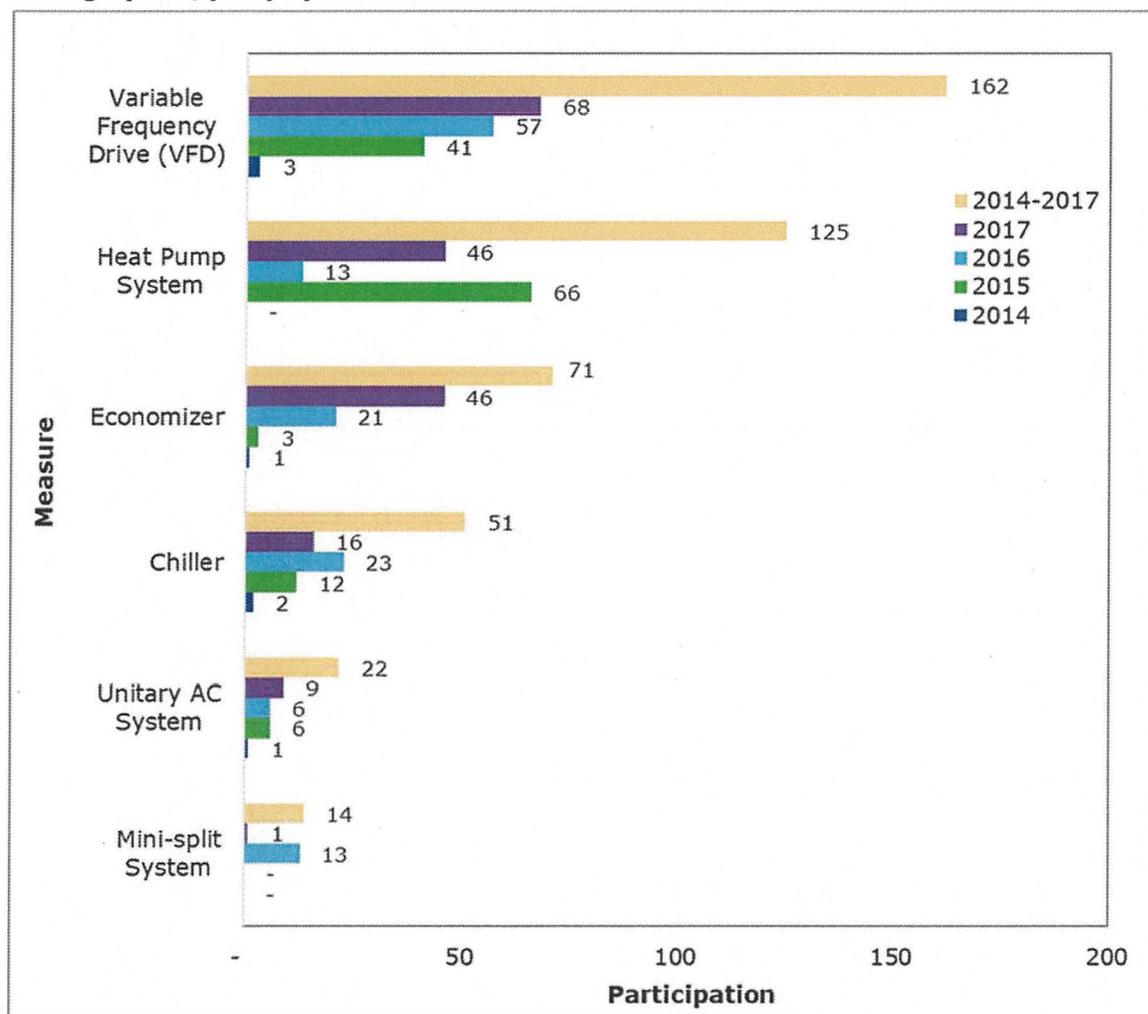
Figure 5-44 shows the number of new participants that install the various measures offered through the program. They are shown for each year and overall. Upon viewing this figure and the one immediately prior, we see that variable frequency drives (VFDs) have been installed by the most participants since the program's inception, but yielded fewer average savings per participant than chiller upgrades.

**Figure 5-44. VA Non-residential Heating and Cooling Efficiency Program Participation by Measure and Year**



In Figure 5-45, the gross annualized savings for each program year are presented by measure category. To date, the VFD measure has yielded the most savings and is following by the chiller upgrade measure.

**Figure 5-45. VA Non-residential Heating and Cooling Efficiency Program Gross Annualized Energy Savings (kWh/year) by Measure and Year**

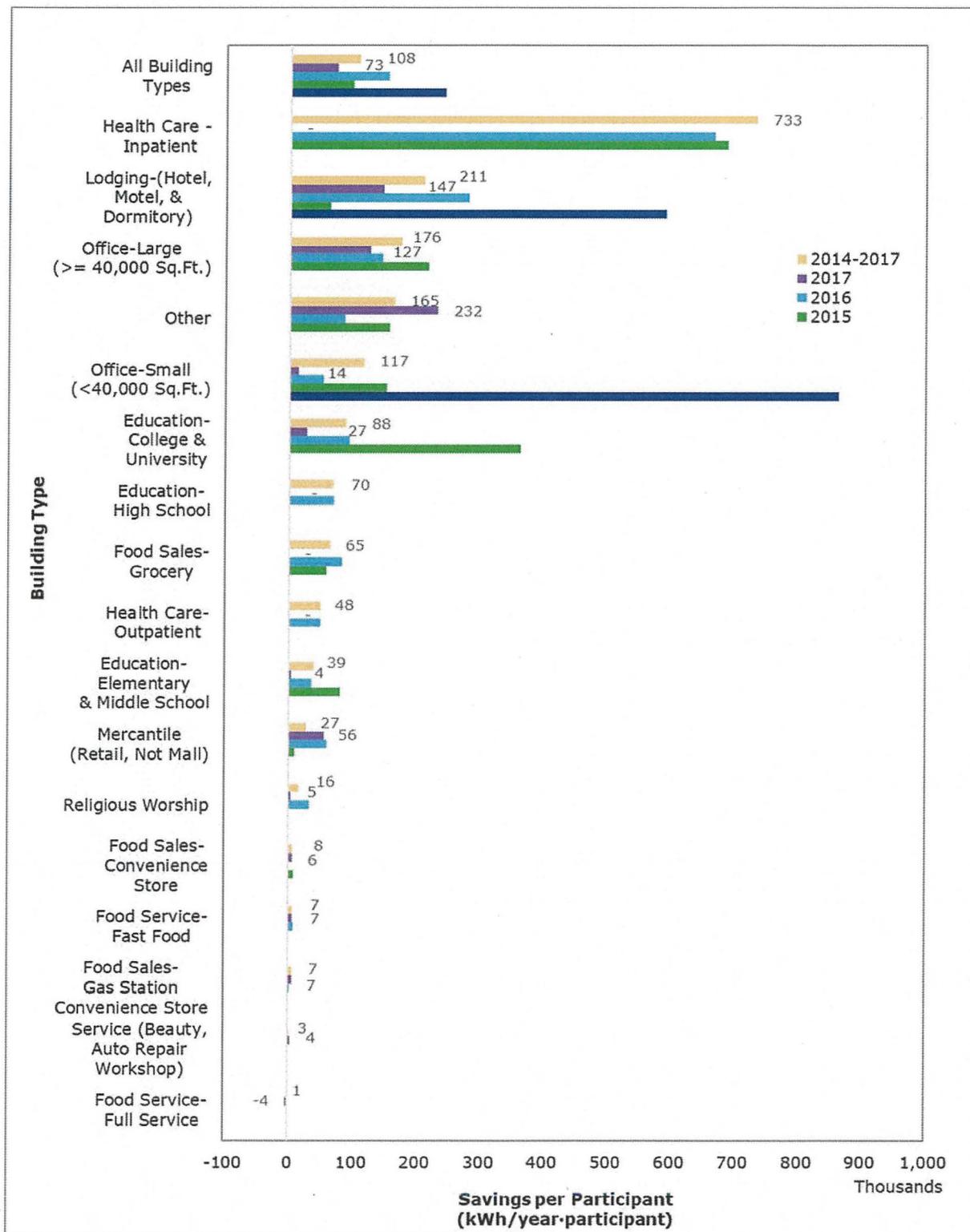


In Figure 5-46, Figure 5-47, and Figure 5-48, the same sequence of three figures are provided, but they are segmented by building type rather than measure category. In the first, the highest average per-participant energy savings (gross, annualized) was yielded at hospitals (inpatient health care facilities) and followed by lodging. In general, food services facilities yielded lower average per-participant energy savings.

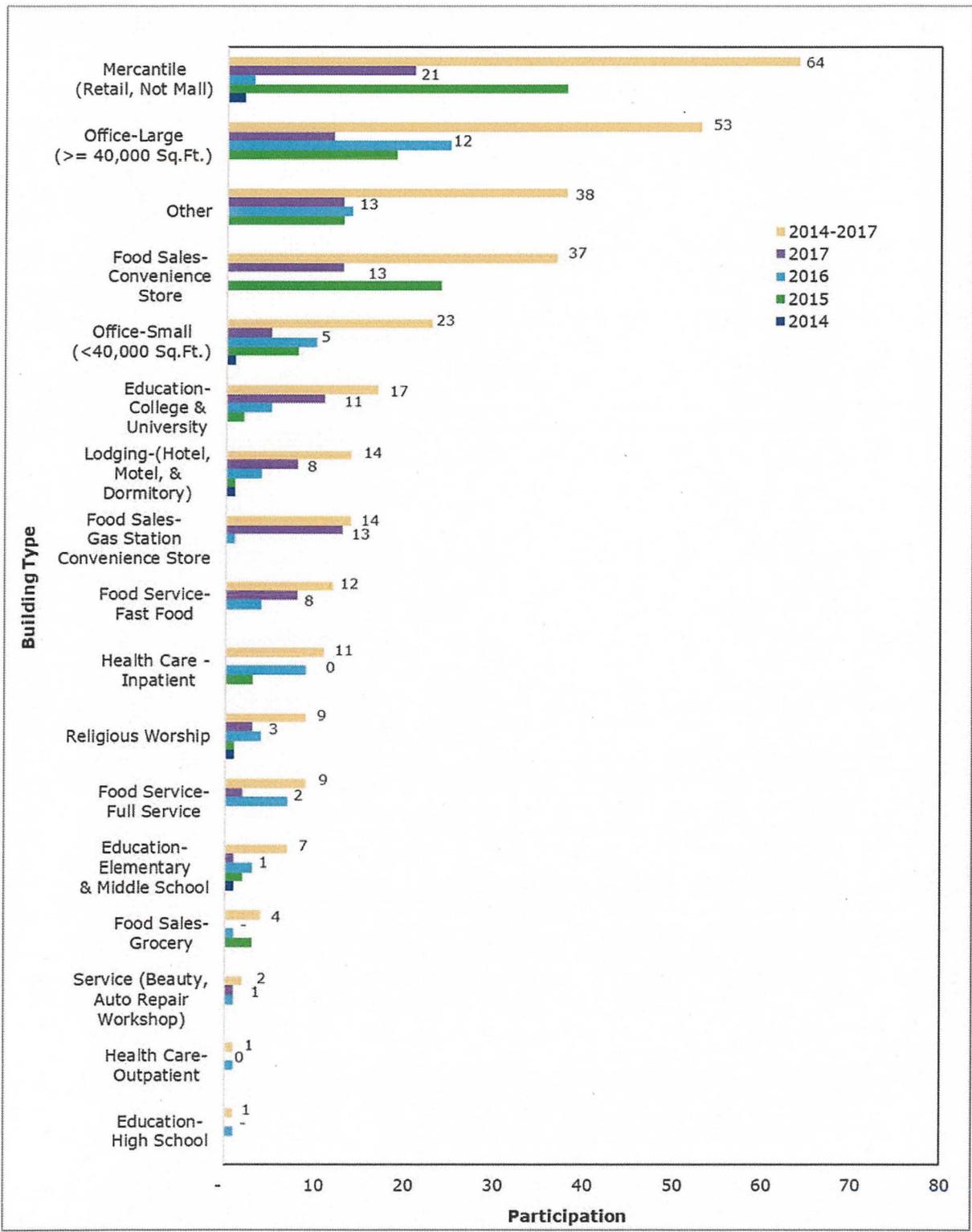


In Figure 5-47, the building type with the leading number of participants is mercantile (retail, not mall) and followed by large offices. In Figure 5-48, the most gross, annualized, and cumulative savings have been yielded at large office buildings and followed by hospitals (inpatient health care facilities). The "Other" building type was used to describe the third-largest number of participant facilities. Since this is a rather high ranking, it might be useful to verify whether any of these sites should actually have been categorized as one of the designated building type categories used by the program. DNV GL will consider this for future reports.

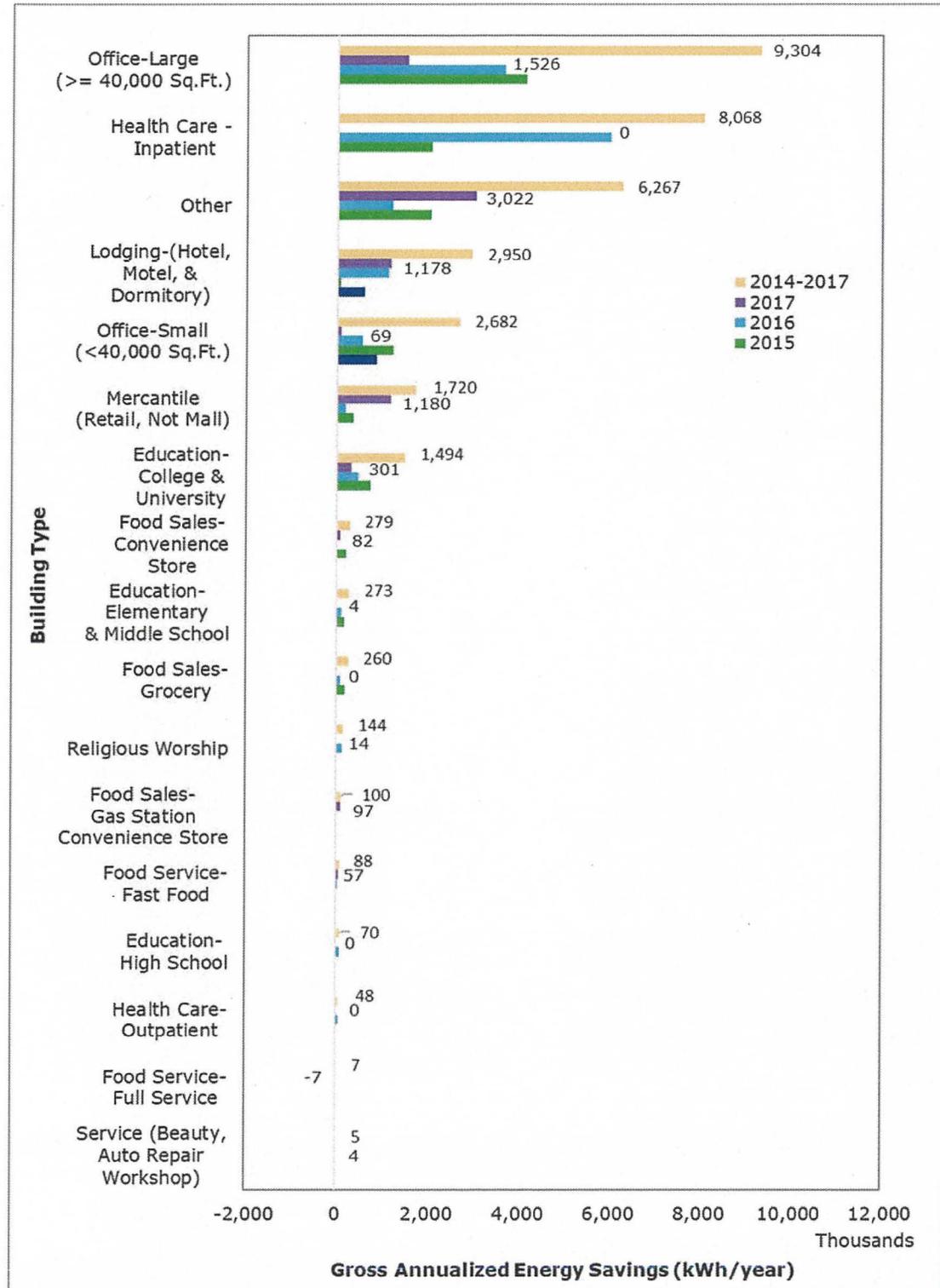
**Figure 5-46. VA Non-residential Heating and Cooling Efficiency Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Building Type and Year**



**Figure 5-47. VA Non-residential Heating and Cooling Efficiency Program Participation by Building Type and Year**



**Figure 5-48. VA Non-residential Heating and Cooling Efficiency Program Gross Annualized Energy Savings (kWh/year) by Building Type and Year**



### 5.4.2.4 Additional North Carolina Program Data

This section provides a series of charts to show the program performance over the life of the program in North Carolina, by year, by measure type and by building type. In Figure 5-49, the average energy savings per participant (gross annualized) are shown for each measure category, by year and overall. In 2017, VFDs have yielded the highest average savings per participant, followed by heat pump system upgrades.

**Figure 5-49. NC Non-residential Heating and Cooling Efficiency Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Measure and Year**

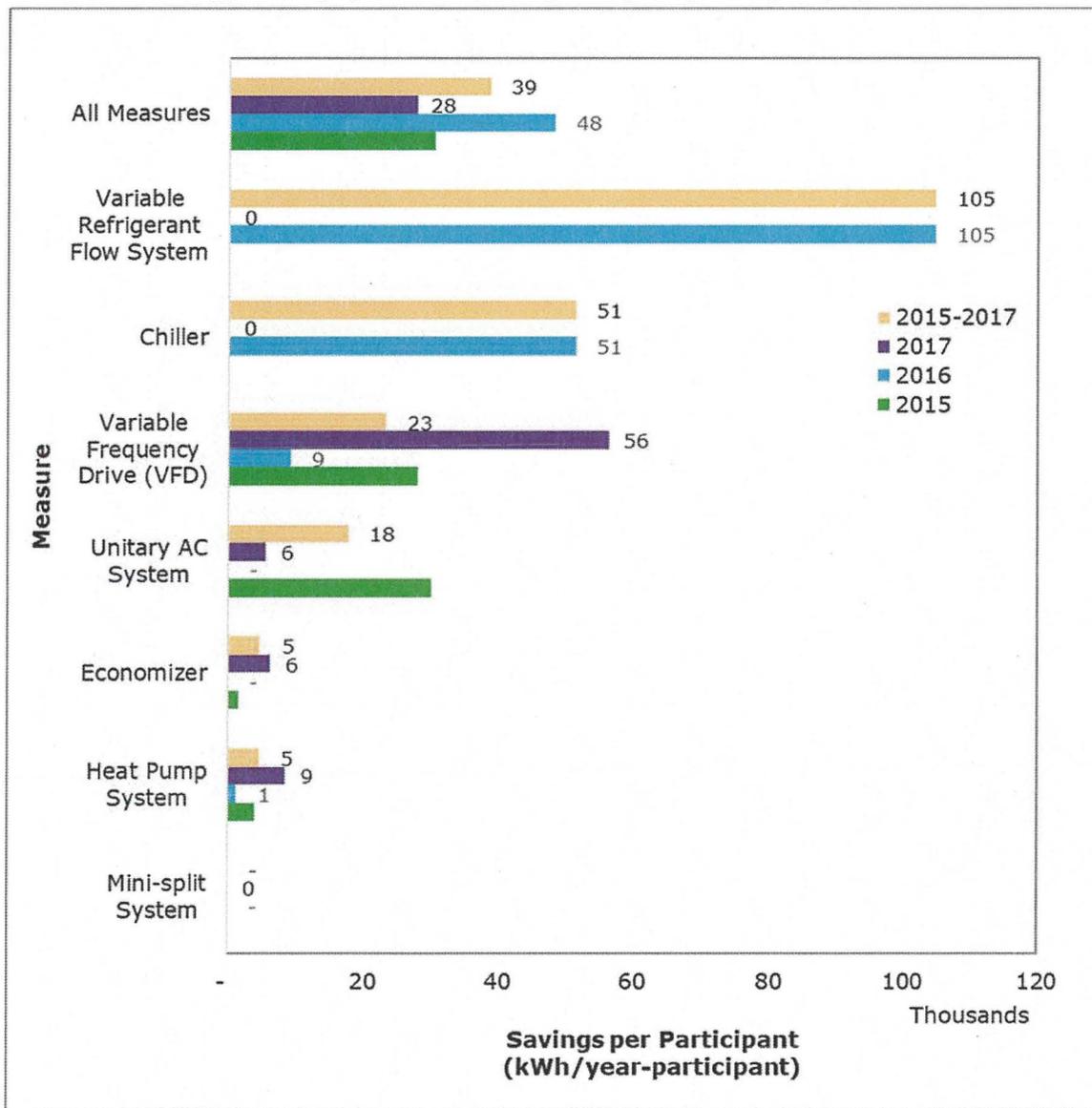
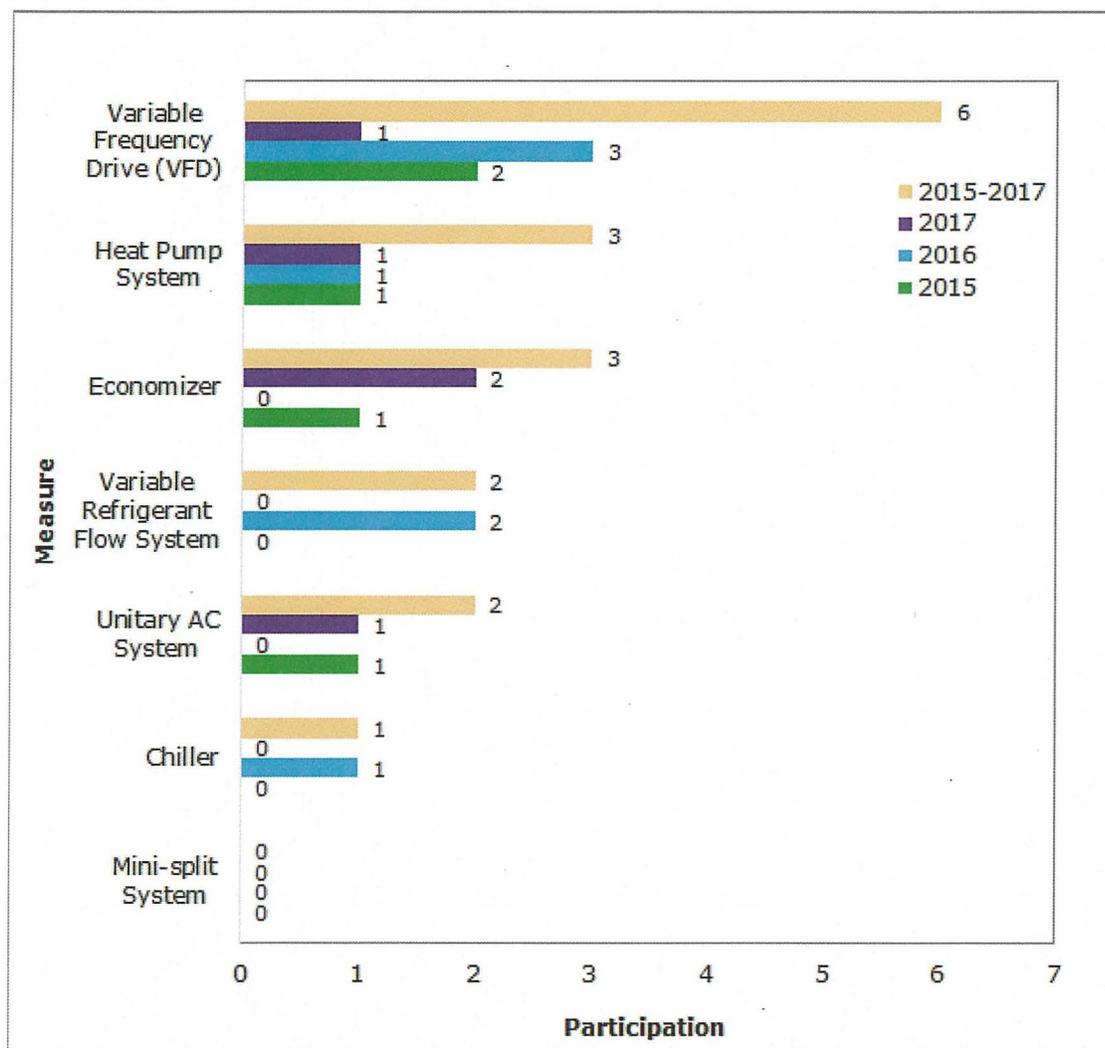


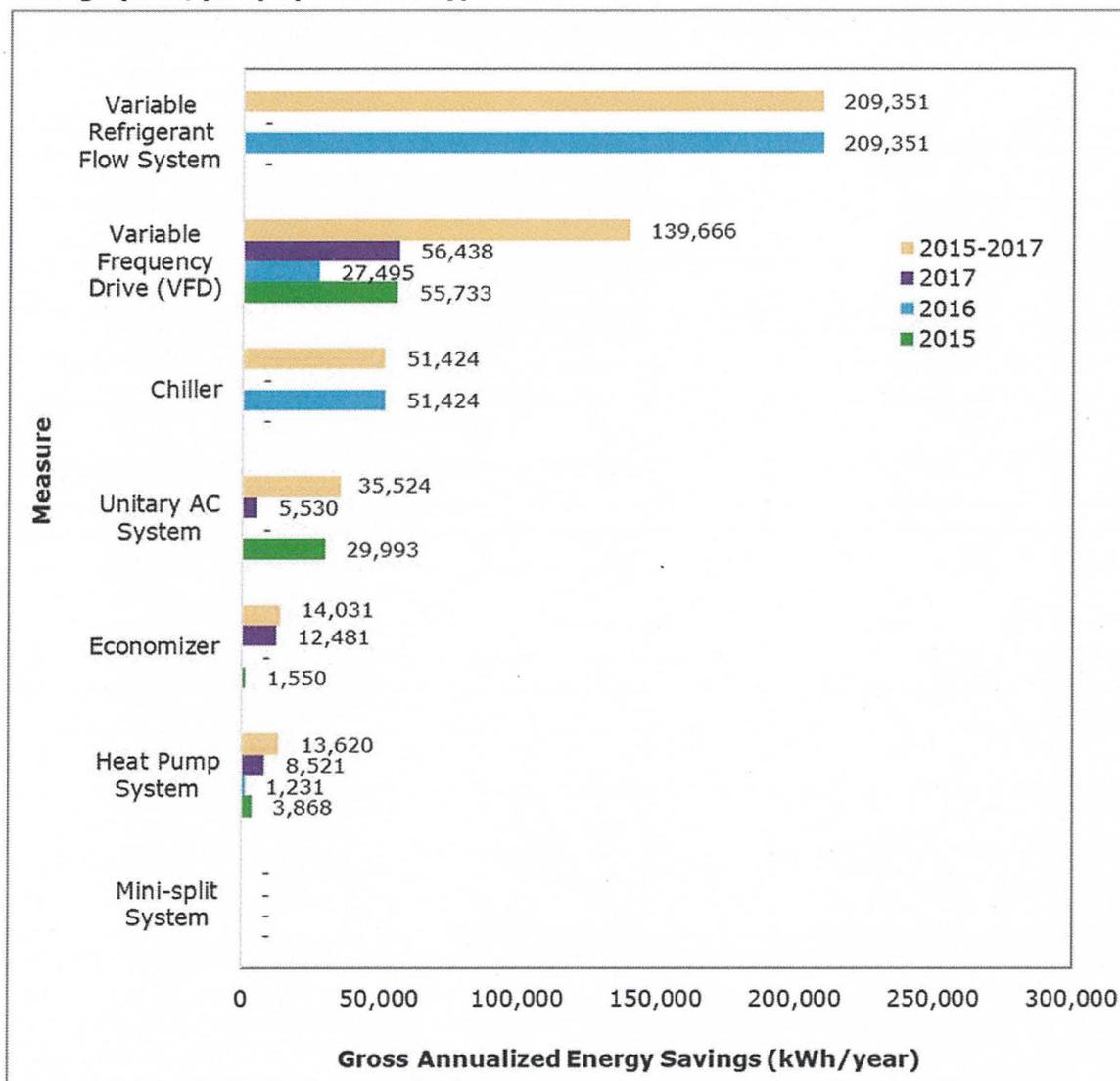
Figure 5-50 shows the number of new participants that install the various EE measures offered through the program. They are shown for each year and overall. Although the number of participants is low, VFDs and heat pump system upgrades have had the most participants to date.

**Figure 5-50. NC Non-residential Heating and Cooling Efficiency Program Participation by Measure and Year**



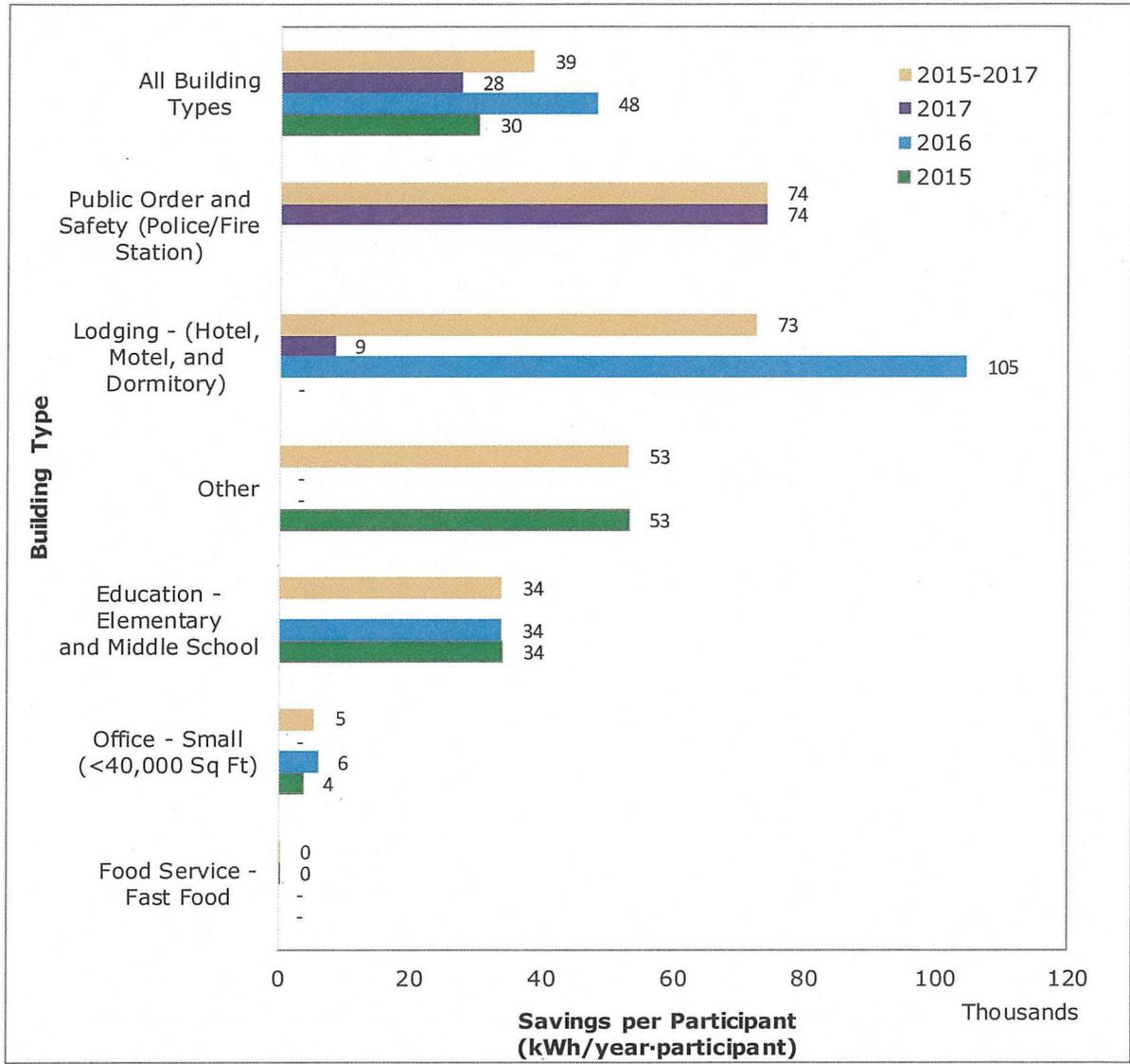
In Figure 5-51, the gross annualized savings for each program year are presented by measure category. In 2017, VFDs led the annual savings and were followed by economizers. Since program inception in North Carolina, the variable refrigeration flow (VRF) system measure has yielded the most savings (all in 2016) and is followed by the VFD measure.

**Figure 5-51. NC Non-residential Heating and Cooling Efficiency Program Gross Annualized Energy Savings (kWh/year) by Measure Type**



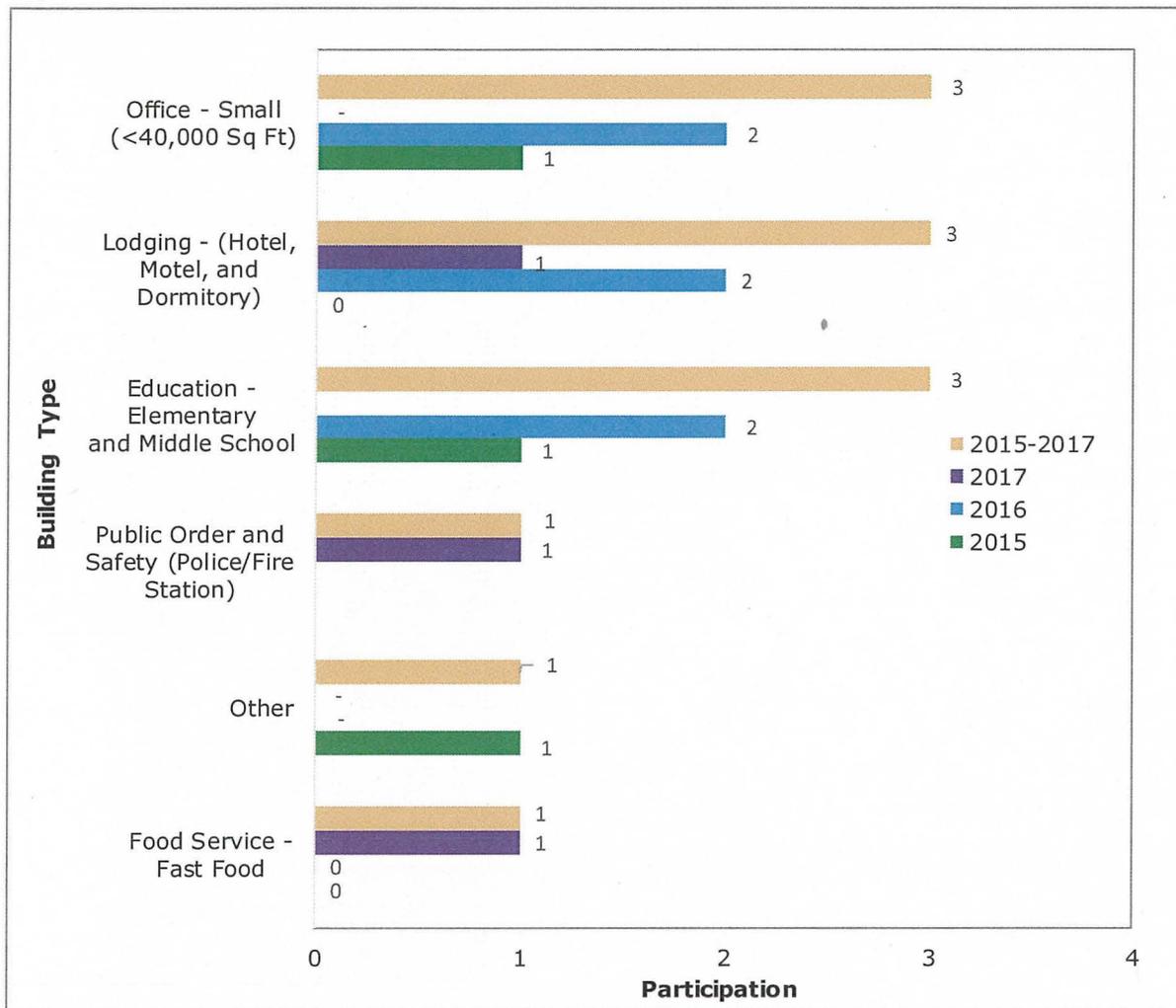
In 2017 as well as over the life of the program in North Carolina, the highest average energy savings per participant (gross, annualized) were yielded at police and fire stations.

**Figure 5-52. NC Non-residential Heating and Cooling Efficiency Program Average Gross Annualized Energy Savings per Participant (kWh/year-participant) by Building Type and Year**



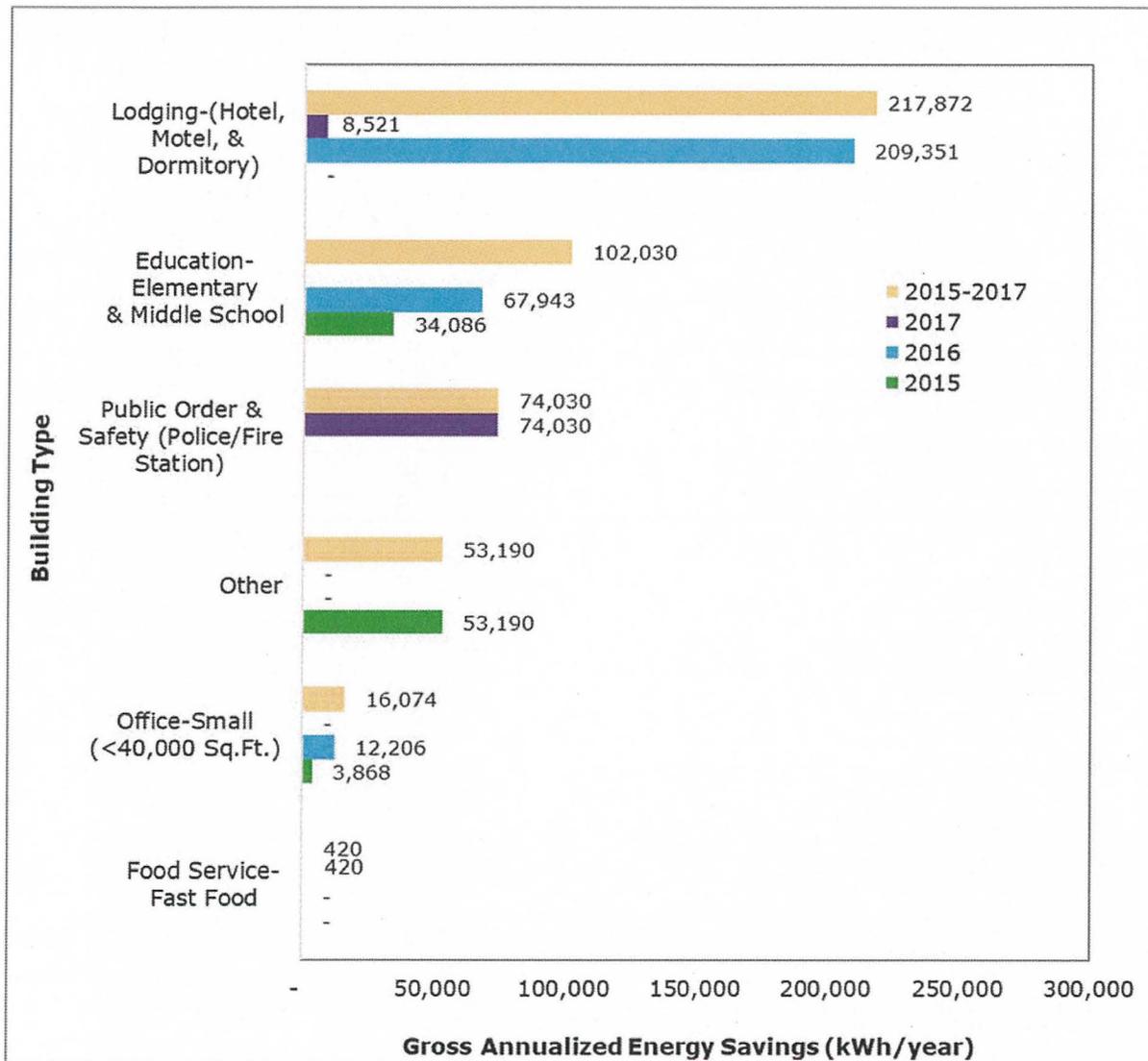
According to Figure 5-53, the leading building types, since program inception, include small offices, lodging, and early education facilities.

**Figure 5-53. NC Non-residential Heating and Cooling Efficiency Program Participation by Building Type and Year**



According to Figure 5-54, the leading building type to realize energy savings in 2017 was police and fire stations. Since the beginning of the program, however, lodging facilities have yielded the most savings.

**Figure 5-54. NC Non-residential Heating and Cooling Efficiency Program Gross Annualized Energy Savings (kWh/year) by Building Type and Year**



## 5.5 Non-residential Window Film – Virginia & North Carolina

The Non-residential Window Film Program was approved by the SCC for five years in April 2014. The program was launched in Virginia in May 2014 and North Carolina in January 2015. The Program provides an incentive to non-residential customers to install solar reduction window film in order to reduce energy consumption and peak demand during the cooling season. All non-residential customers in Virginia and North Carolina, not exempt by statute or contract, and who have not opted-out, are eligible.



This program is implemented through a contractor network, therefore customers must contact a participating contractor to be eligible for the rebate. Customers are not considered participants until a completed application form is processed and a rebate is issued. This process can take several months, because customers have 45 days to submit their rebate application and the Company has 90 days to process it.

### 5.5.1 Methods for the Current Reporting Period

Table 5-17 outlines Dominion Energy's initial program planning assumptions that were used to design the program.

**Table 5-17. Non-residential Window Film Program Planning Assumptions**

Item	Description
Target Market	Non-residential customers
NTG Factor	80%
Measure Life	10 years
Average Energy Savings (kWh) per Participant	18 kWh per participant per year
Average Peak Demand Reduction (kW) per Participant	0.004 kW per participant per year
Average Rebate (US \$) per Participant	\$0.91 per sq. ft.

## 5.5.2 Assessment of Program Progress Towards Plan

The next section describes the Program's progress towards planned spending, participants, square feet of installed window film, energy savings and peak demand reductions.

### 5.5.2.1 Key Virginia Program Data

Table 5-18 features the key program indicators, from program implementation in 2014 through 2017, describing program progress toward planned O&M costs, participants, square feet of installed window film, energy savings and peak demand reduction; all of which the program fell short of 2017 goals at 29%, 17%, 9% and 3%, respectively. From program implementation through 2017, the program spent 32% of planned spending, enrolled 13% of planned participants, achieved 15% of planned energy savings and 4% of planned peak demand reduction.

**Table 5-18. VA Non-residential Window Film Program Performance Indicators (2014-2017)**

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016	2017	
Operations and Management Costs (\$)	Direct Rebate					
	Direct Implementation					
	Direct EM&V					
	Indirect Other (Administrative)	\$11,980	\$12,457	\$13,085	\$21,659	\$59,181
Total Costs (\$)	Total					
	Planned					
	Variance					
	Cumulative % of Planned	54%	32%	25%	29%	32%
Participants	Total Participants	3	22	70	59	154
	Total Square Feet	53,021	97,121	57,228	231,634	439,004
	Planned Square Feet	133,086	681,000	1,148,077	1,371,237	3,333,400
	Variance	-80,065	-583,879	-1,090,849	-1,139,603	-2,894,396
	Cum % Toward Planned Total	40%	14%	5%	17%	13%
Square feet	Total Square Feet	53,021	97,121	57,228	231,634	439,004
	North Facing	11,663	23,535	13,931	48,150	97,279
	East Facing	14,597	24,260	8,105	61,663	108,625
	West Facing	15,090	22,836	15,826	62,196	115,948
	South Facing	11,671	26,490	19,366	59,625	117,152
Installed Energy	Total Gross Deemed Savings	1,152,476	3,077,815	464,794	1,734,665	6,429,750

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016	2017	
Savings (kWh/year)	Realization Rate Adjustment (100%)	0	0	0	0	0
	Adjusted Gross Savings	1,152,476	3,077,815	464,794	1,734,665	6,429,750
	Net-to-Gross Adjustment (80%) <sup>72</sup>	-230,495	-615,563	-92,959	-346,933	-1,285,950
	Net Adjusted Savings	921,980	2,462,252	371,835	1,387,732	5,143,800
	Planned Savings (Net)	2,395,548	12,258	15,842,639	15,209,376	33,459,821
	Cum. % Toward Planned Savings (Net)	38%	20087%	2%	9%	15%
	Avg. Savings per Participant (Gross)	384,159	139,901	6,640	29,401	41,752
	Avg. Savings per Square Foot (Gross)	22	32	8	7	15
	Avg. Savings per Participant (Net)	307,327	111,921	5,312	23,521	33,401
	Avg. Savings per Square Foot (Net)	17	25	6	6	12
Installed Demand Reduction	Total Gross Deemed Demand	233	627	140	471	1,471
	Realization Rate Adjustment (100%)	0	0	0	0	0
	Adjusted Gross Demand	233	627	140	471	1,471
	Net-to-Gross Adjustment (80%) <sup>73</sup>	-47	-125	-28	-94	-294
	Net Adjusted Demand	187	501	112	377	1,177
	Planned Demand (Net)	532	2	14,497	13,693	28,725
	Cum. % Toward Planned Demand (Net)	35%	20885%	1%	3%	4%
	Avg. Demand per Participant (Gross)	78	28	2	8	10
	Avg. Demand Reduction per Square Foot (Gross)	0.004	0.006	0.002	0.002	0.003
	Avg. Demand per Participant (Net)	62	23	2	6	8

<sup>72</sup> The program implementation vendor has listed the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" See section 3.1.3 Net Savings Estimation for a description of net-to-gross estimation.

<sup>73</sup> Ibid.

Category	Item	Virginia				Program Total (2014-2017)
		2014	2015	2016	2017	
	Avg. Demand Reduction per Square Foot (Net)	0.004	0.005	0.002	0.002	0.003
Program Performance	Cum. \$Admin. per Cum. Participant (Gross)	\$3,993	\$566	\$187	\$367	\$384
	Cum. \$Admin. per Cum. kWh/year (Gross)	\$0.01	\$0.00	\$0.03	\$0.01	\$0.01
	Cum. \$Admin. per Cum. kW (Gross)	\$51	\$20	\$93.7	\$45.9	\$40
	Cum. \$EM&V per Cum. Total Costs (\$)	22%	17%	26%	16%	20%
	Cum. \$Rebate per Cum. Participant (Gross)					

### 5.5.2.2 Key North Carolina Program Data

No North Carolina customers have participated in the program through 2017.

**Table 5-19. NC Window Film Program Performance Indicators (2015-2017)**

Category	Item	North Carolina			Program Total (2015-2017)
		2015	2016	2017	
Operations and Management Costs (\$)	Direct Rebate				
	Direct Implementation				
	Direct EM&V				
	Indirect Other (Administrative)	\$851	\$799	\$870	\$2,520
Total Costs (\$)	Total				
	Planned				
	Variance				
	Cumulative % of Planned	30%	23%	17%	23%
Participants	Total Participants	0	0	0	0
	Total Square Feet	0	0	0	0
	Planned Square Feet	48,000	76,742	91,659	216,401
	Variance	-48,000	-76,742	-91,659	-216,401
	Cum % Toward Planned Total	0%	0%	0%	0%
Square feet	Total Square Feet	0	0	0	0
	North Facing	0	0	0	0
	East Facing	0	0	0	0
	West Facing	0	0	0	0
	South Facing	0	0	0	0
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	0	0	0
	Realization Rate Adjustment (100%)	0	0	0	0
	Adjusted Gross Savings	0	0	0	0
	Net-to-Gross Adjustment (80%)	0	0	0	0
	Net Adjusted Savings	0	0	0	0
	Planned Savings (Net)	864	1,064,075	1,016,658	2,081,597
	Cum. % Toward Planned Savings (Net)	0%	0%	0%	0%