Evaluation, Measurement, and Verification Report for Virginia Electric and Power Company (Dominion Energy)

CASE NO. PUR-2021-00247 (VIRGINIA)
DOCKET NO. E-22, SUB 645 (NORTH CAROLINA)

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7 ENERGY EFFICIENCY – NON-RESIDENTIAL TARGETED SECTORS

7.1 Non-Residential Multifamily Program – Virginia

7.1.1 Program description

The Multifamily Program is available in Virginia and it provides property owners and managers with an on-site energy assessment of both common areas and tenant units. Following the assessment, participants receive a report detailing energy-saving improvements for individual units and common areas of the building. The Program also installs some energy efficient measures during the assessment.

The Program contains both residential and non-residential components. Measures installed in residential units are reported in Section 3.5, the residential component of the Program. Measures installed in common areas, and on behalf of on-residential accounts, are reported in the Program's non-residential component here in this section.

The Program had minimal participation in 2022, seeing only five participants. According to the Program's Manager, the program is actively doing outreach and property managers are showing interest in the program but, with a few exceptions, they have not yet been committing to projects.

Table 7-1 lists the energy efficient measures that are eligible for the non-residential component of this Program.

Table 7-1. Measures offered through Non-Residential Multifamily Program

End use	Measure
Domestic Hot Water	¾″ Water Heater (WH) Pipe Insulation
	½″ WH Pipe Insulation
	WH Turndown 10 degrees
	Fixed Showerhead (1.5 Gallons Per Minute (GPM) max)
	Handheld Showerhead (1.5 GPM max)
	Kitchen Swivel Aerator (1.5 GPM max)
	Bathroom Aerator (1.5 GPM max)
Lighting	Decorative LED
	LED Globe
	LED Downlight
Refrigeration	Refrigerator Coil Brush
	Refrigerator Thermometer
Major Measures	Tune-Up on Heat Pump System and/or Central AC
	Packaged Terminal Heat Pump and/or Central AC Upgrade
	Smart Thermostat on Heat Pump and/or Central AC, Replacing a Manual and/or Programmable Thermostat
	Air Sealing
	Duct Sealing
	Attic Insulation

End use	Measure
	Drill & Fill Wall Insulation
ENERGY STAR Appliances	Refrigerator
	Room/Wall AC Unit
	Clothes Washer
	Clothes Dryer

Participating customers must contact a participating contractor to receive the assessment. 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 Dominion Energy has 90 days to process it.

The Virginia SCC approved this Program, as part of the DSM Phase VIII programs, on July 30, 2020, (PUR-2019-00201) for a five-year period of January 1, 2021, through December 31, 2025. The Program officially launched on January 15, 2021.[193]

7.1.2 Methods for the current reporting period

DNV developed an EM&V Plan for this Program, which appears in Appendix E. For the current period, the approach included reviewing the tracking data and then estimating net energy savings and demand reduction using the DE TRM calculations located in Appendix F. Table 7-2 outlines Dominion Energy's initial Program planning assumptions.

Table 7-2. Non-Residential Multifamily Housing Program planning assumptions system-wide

Assumption	Value
Target Market	Property Managers
NTG Factor	90%
Measure Life (years)	9.11
Gross Average Annual Savings per Participant (kWh/year)	1,901.51
Gross Average Summer Demand Reduction Per Participant (kW)	0.31
Gross Average Winter Demand Reduction Per Participant (kW)	0.22
Net Average Annual Energy Savings per Participant (kWh/year)	1,710.46
Net Average Summer Demand Reduction Per Participant (kW)	0.28
Net Average Winter Demand Reduction Per Participant (kW)	0.20
Average Rebate per Participant (US$)	$164.29

7.1.3 Assessment of program progress toward plan

The next section describes the Program's progress toward planned participants, energy savings, and demand reduction.

7.1.3.1 Key Virginia program data

Table 7-3 provides performance indicator data for 2022 in Virginia. Shaded cells are considered extraordinarily sensitive information. Appendix O.25 provides detailed program indicators by month and year, program performance by measure, and a comparison of program savings with usage by rate schedule and Appendix Q shows cumulative gross and net savings.

[193] Residential Multifamily Program Terms and Conditions, https://www.dominionenergy.com/-/media/pdfs/virginia/save-energy/multifamily/dsm-viii-nonresidential-multifamily-tcs--final.pdf. Accessed March 9, 2023.

Table 7-3. Non-Residential Multifamily Housing Program performance indicators (2020-2022)[194]

Category	Item	2020	2021	2022	Program total (2020–2022)
Operations and Management Costs ($)	[redacted]				
	[redacted]				
	[redacted]				
	Indirect Other (Administrative)	$1,213	$9,453	$7,265	$17,930
Total Costs ($)	Total[195]	$28,431	$201,595	$173,987	$404,013
	Planned	$0	$394,826	$504,682	$899,508
	Variance	$28,431	-$193,231	-$330,695	-$495,496
	Annual % of Planned	N/A	51%	34%	45%
Participants	Total (Gross)	0	0	5	5
	Planned (Gross)	0	1,100	1,725	2,825
	Variance	0	-1,100	-1,720	-2,820
	Annual % of Planned (Gross)	N/A	0%	0%	0%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	0	165,606	165,606
	Realization Rate	N/A	N/A	100%	100%
	Realization Rate Adjustment	0	0	0	0
	Adjusted Gross Savings	0	0	165,606	165,606
	Net-to-Gross Ratio[196]	N/A	N/A	90%	90%
	Net-to-Gross Adjustment	0	0	-16,561	-16,561
	Net Adjusted Savings	0	0	149,045	149,045
	Planned Savings (Net)	0	1,881,505	2,950,541	4,832,046
	Annual % Toward Planned Savings (Net)	N/A	0%	5.05%	3.08%
	Avg. Savings per Participant (Gross)	N/A	N/A	33,121	33,121
	Avg. Savings per Participant (Net)	N/A	N/A	29,809	29,809
Installed Summer Demand Reduction	Total Gross Deemed Demand	0.0	0.0	18.2	18.2
	Realization Rate	N/A	N/A	100%	100%
	Realization Rate Adjustment	0.0	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	18.2	18.2

[194] The sum of the individual annual values may differ from the total value due to rounding.

[195] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include Dominion Energy's margins.

[196] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 100% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Section 3.1.3 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2020	2021	2022	Program total (2020–2022)
(kW)	Net-to-Gross Ratio[197]	N/A	N/A	90%	90%
	Net-to-Gross Adjustment	0.0	0.0	-1.8	-1.8
	Net Adjusted Demand	0.0	0.0	16.4	16.4
	Planned Demand (Net)	0.0	302.9	475.0	777.8
	Annual % Toward Planned Reduction (Net)	N/A	0%	3.46%	2.11%
	Avg. Demand per Participant (Gross)	N/A	N/A	3.6	3.6
	Avg. Demand per Participant (Net)	N/A	N/A	3.3	3.3
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	-	0.0	18.3	18.3
	Realization Rate	-	N/A	100%	100%
	Realization Rate Adjustment	-	0.0	0.0	0.0
	Adjusted Gross Demand	-	0.0	18.3	18.3
	Net-to-Gross Ratio[198]	-	N/A	90%	90%
	Net-to-Gross Adjustment	-	0.0	-1.8	-1.8
	Net Adjusted Demand	-	0.0	16.5	16.5
	Planned Demand (Net)	-	217.8	341.6	559.4
	Annual % Toward Planned Reduction (Net)	-	0%	4.82%	2.94%
	Avg. Demand per Participant (Gross)	-	N/A	3.7	3.7
	Avg. Demand per Participant (Net)	-	N/A	3.3	3.3
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	N/A	$3,586	$3,586
	Cml Annual $Admin. per kWh/year (Gross)	N/A	N/A	$0	$0
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	$983	$983
	Cml Annual $EM&V per Total Costs ($)	94.0%	39.7%	40.1%	40.1%
	Cml Annual $Rebate per Participant (Gross)	N/A	N/A	$671	$671

7.1.3.2 Additional Virginia program data

Figure 7-1 and Figure 7-2 show the Program's participation and gross annualized energy savings, respectively, by measure type and year in Virginia. Other detailed Program participation and savings at the measure level appear in Appendix O.25.

Note that in these charts, participation is the count of new unique customers in the "all measures" presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the Program in previous years. This differs from the participation count from the Key Virginia program data section above, where participants are only counted once (the first time they receive a rebate). After the first time the

[197] Ibid.
[198] Ibid.

participant enrolls in the Program, future applications are not counted as new participants, although their savings are counted.

In 2022, LED lamps were the only measures installed by participants, as shown in Figure 7-1. These lighting measures were installed in common areas such as exit signs and stairwells.

Figure 7-1. Non-Residential Multifamily Housing Program participation by measure and year

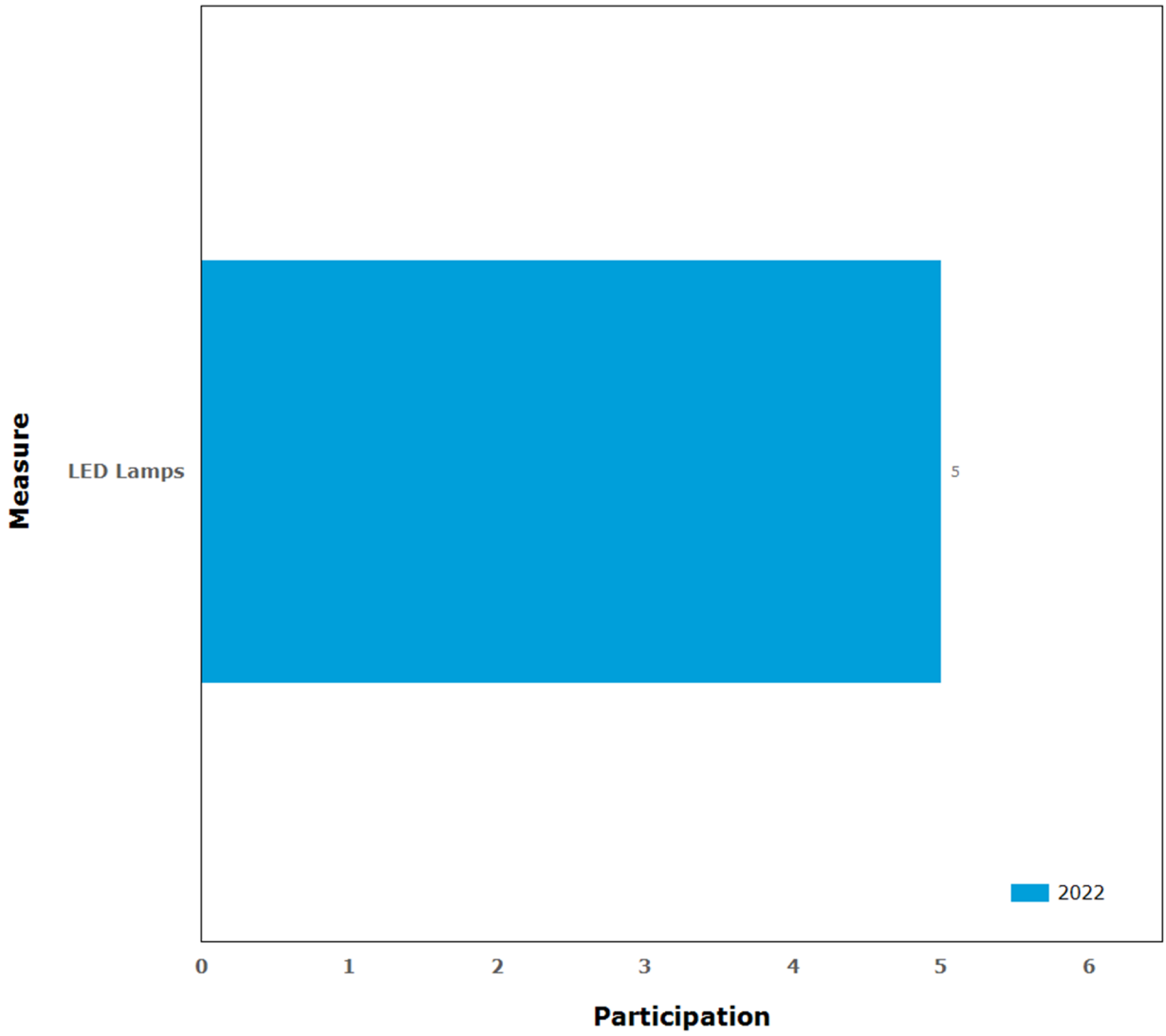
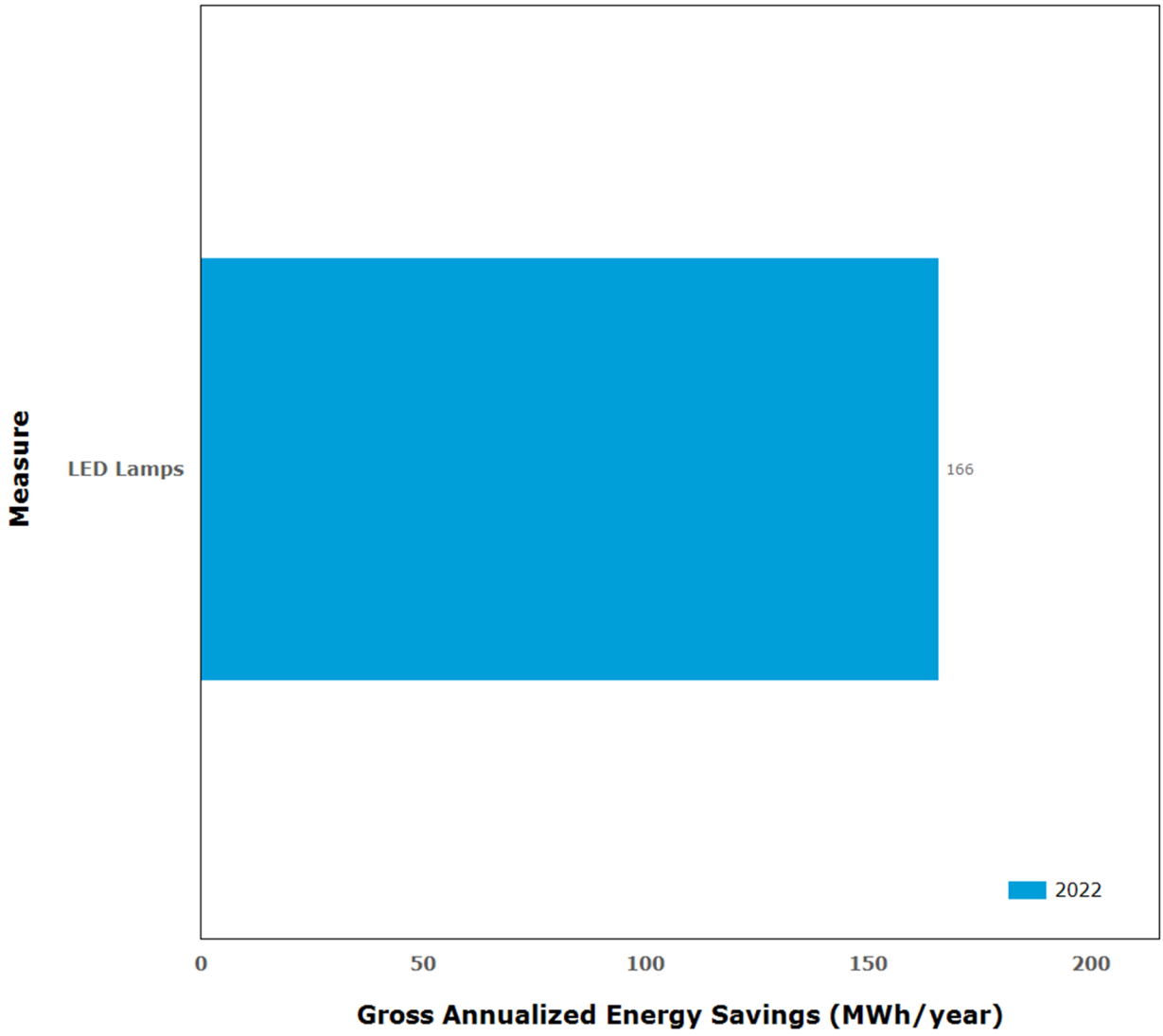


Figure 7-2 shows that the LED lamps installed results in 166 MWh of savings per year.

Figure 7-2. Virginia Non-Residential Multifamily Housing Program gross annualized energy savings by measure and year (MWh/year)



7.2 Non-Residential New Construction Program – Virginia and North Carolina

7.2.1 Program description

The Non-Residential New Construction Program offers design recommendations and rebates to qualifying facility owners for installing energy efficient measures. The program applies to non-residential customers for new construction or extensive renovation projects. Some of the measures offered include:

- High performance interior lighting designs
- Efficient chillers, air-source heat pumps, and other cooling equipment
- Efficient HVAC system controls
- Demand controlled ventilation
- LED exterior lighting
- Plug load management systems
- Chiller controls

This program is implemented through program representatives. The customer's design team or contractor will work with program representatives to determine the best energy efficiency options for consideration. The contractor or design firm applies to Dominion Energy for qualification of installed energy efficiency measures. Sites are inspected to verify the installed measures and other project details.

All Dominion Energy non-residential customers are eligible to participate except those who are exempt by statute, special contract, or have opted out. Customers are not considered participants until a completed rebate application form is processed and a rebate is issued. This rebate application 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 Virginia SCC approved this program, as part of the DSM Phase VIII programs, on July 30, 2020 (PUR-2019-00201) for a five-year period of January 1, 2021, through December 31, 2025. The program officially launched in Virginia on January 15, 2021.[199] The North Carolina Utilities Commission approved this program on February 9, 2021 (Docket No. E-22 Sub 591). The program officially launched in North Carolina on April 15, 2021.[200]

This program has seen no participation through 2022.The nature of this program requires that the program engage potential participants during the design phase. The long lead-time required to design and construct non-residential new construction buildings may be one contributing factor to the lack of participation through 2022. However, there are projects in the pipeline and expected to be completed in early 2023.

7.2.2 Methods for the current reporting period

For the current period, there were no participants. Therefore, no EM&V activities were performed in 2022.

[199] Non-Residential New Construction Program Terms and Conditions, https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/virginia/save-energy/va-terms-conditions-non-res-new-construction.pdf, Accessed March 3, 2023.

[200] Non-Residential New Construction Program Terms and Conditions, https://domsavings.com/wp-content/uploads/2021/05/TCs-DSM-VIII-NR-New-Construction-DENC-Final.pdf, Accessed March 3, 2023.

Table 7-4 outlines Dominion Energy's initial program planning assumptions that were used to design the program. DNV uses the planned NTG factor in its net savings calculations until it can be verified through EM&V.

Table 7-4. Non-Residential New Construction Program (Phase VII) planning assumptions system-wide

Assumption	Description
Target Market	Non-residential customers
NTG Factor	90%
Measure Life (years)	20.0
Gross Average Annual Energy Savings per Participant (kWh/year)	54,259
Gross Average Summer Coincident Peak Demand Reduction (kW) per Participant	14.49
Gross Average Winter Coincident Peak Demand Reduction (kW) per Participant	16.37
Net Average Annual Energy Savings per Participant (kWh/year)	48,833
Net Average Summer Coincident Peak Demand Reduction (kW) per Participant	13.04
Net Average Winter Coincident Peak Demand Reduction (kW) per Participant	14.74
Average Rebate (US$) per Participant	$18,754

7.2.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

7.2.3.1 Key Virginia program data

Table 7-5 provides performance indicator data annually and from program inception through 2022. Shaded cells are considered extraordinarily sensitive information. Detailed incremental program indicators by year and month are provided in Appendix O.26, along with program performance by measure and a comparison of program savings with usage by rate schedule. Cumulative gross and net savings are provided in Appendix Q.

Table 7-5. Virginia Non-Residential New Construction Program performance indicators (2020–2022)[201]

Category	Item	2020	2021	2022	Program total (2020-2022)
Operations and Management Costs ($)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect Other (Administrative)	$1,179	$28,316	$19,946	$49,441
Total Costs ($)	Total[202]	$27,624	$603,899	$477,704	$1,109,227
	Planned	$0	$1,139,214	$1,153,721	$2,292,936
	Variance	$27,624	-$535,315	-$676,017	-$1,183,709
	Annual % of Planned	N/A	53%	41%	48%

[201] The sum of the individual annual values may differ from the total value due to rounding.

[202] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2020	2021	2022	Program total (2020-2022)
Participants	Total (Gross)	0	0	0	0
	Planned (Gross)	0	19	47	66
	Variance	0	-19	-47	-66
	Annual % of Planned (Gross)	N/A	0%	0%	0%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	0	0	0
	Realization Rate	N/A	N/A	N/A	N/A
	Realization Rate Adjustment	0	0	0	0
	Adjusted Gross Savings	0	0	0	0
	Net-to-Gross Ratio	N/A	N/A	N/A	N/A
	Net-to-Gross Adjustment	0	0	0	0
	Net Adjusted Savings	0	0	0	0
	Planned Savings (Net)	0	927,828	2,295,154	3,222,983
	Annual % Toward Planned Savings (Net)	N/A	0%	0%	0%
	Avg. Savings per Participant (Gross)	N/A	N/A	N/A	N/A
	Avg. Savings per Participant (Net)	N/A	N/A	N/A	N/A
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0	0.0
	Planned Demand (Net)	0.0	247.8	612.9	860.6
	Annual % Toward Planned Reduction (Net)	N/A	0%	0%	0%
	Avg. Demand per Participant (Gross)	N/A	N/A	N/A	N/A
	Avg. Demand per Participant (Net)	N/A	N/A	N/A	N/A
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	-	0.0	0.0	0.0
	Realization Rate	-	N/A	N/A	N/A
	Realization Rate Adjustment	-	0.0	0.0	0.0
	Adjusted Gross Demand	-	0.0	0.0	0.0
	Net-to-Gross Ratio	-	N/A	N/A	N/A
	Net-to-Gross Adjustment	-	0.0	0.0	0.0
	Net Adjusted Demand	-	0.0	0.0	0.0
	Planned Demand (Net)	-	280.0	692.7	972.7
	Annual % Toward Planned Reduction (Net)	-	0%	0%	0%
	Avg. Demand per Participant (Gross)	-	N/A	N/A	N/A

Category	Item	2020	2021	2022	Program total (2020-2022)
	Avg. Demand per Participant (Net)	-	N/A	N/A	N/A
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	N/A	N/A	N/A
	Cml Annual $Admin. per kWh/year (Gross)	N/A	N/A	N/A	N/A
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A	N/A
	Cml Annual $EM&V per Total Costs ($)	85.1%	11.8%	8.5%	8.5%
	Cml Annual $Rebate per Participant (Gross)	N/A	N/A	N/A	N/A

7.2.3.2 Key North Carolina program data

Table 7-6 provides performance indicator data for the year. Shaded cells are considered extraordinarily sensitive information. Detailed incremental program indicators by year and month are provided in Appendix P.16, along with program performance by measure and a comparison of program savings with usage by rate schedule. Cumulative gross and net savings are provided in Appendix Q.

Table 7-6. North Carolina Non-Residential New Construction Program performance indicators (2022)

Category	Item	2021	2022	Program total (2020-2022)
Operations and Management Costs ($)				
	Indirect Other (Administrative)	$1,270	$1,293	$2,563
Total Costs ($)	Total[203]	$27,089	$30,963	$58,052
	Planned	$70,887	$73,614	$144,501
	Variance	-$43,798	-$42,651	-$86,449
	Annual % of Planned	38%	42%	40%
Participants	Total (Gross)	0	0	0
	Planned (Gross)	1	3	4
	Variance	-1	-3	-4
	Annual % of Planned (Gross)	0%	0%	0%
Installed Energy Savings	Total Gross Deemed Savings	0	0	0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment (100%)	0	0	0

[203] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2021	2022	Program total (2020-2022)
(kWh/year)	Adjusted Gross Savings	0	0	0
	Net-to-Gross Ratio	N/A	N/A	N/A
	Net-to-Gross Adjustment	0	0	0
	Net Adjusted Savings	0	0	0
	Planned Savings (Net)	48,833	146,499	195,332
	Annual % Toward Planned Savings (Net)	0%	0%	0%
	Avg. Savings per Participant (Gross)	N/A	N/A	N/A
	Avg. Savings per Participant (Net)	N/A	N/A	N/A
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0
	Planned Demand (Net)	13.0	39.1	52.2
	Annual % Toward Planned Reduction (Net)	0%	0%	0%
	Avg. Demand per Participant (Gross)	N/A	N/A	N/A
	Avg. Demand per Participant (Net)	N/A	N/A	N/A
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0
	Planned Demand (Net)	14.7	44.2	59.0
	Annual % Toward Planned Reduction (Net)	0%	0%	0%
	Avg. Demand per Participant (Gross)	N/A	N/A	N/A
	Avg. Demand per Participant (Net)	N/A	N/A	N/A
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	N/A	N/A
	Cml Annual $Admin. per kWh/year (Gross)	N/A	N/A	N/A
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A
	Cml Annual $EM&V per Total Costs ($)	4.6%	4.3%	4.3%
	Cml Annual $Rebate per Participant (Gross)	N/A	N/A	N/A

7.2.3.3 Additional Virginia program data

No Virginia customers have participated in the program through 2022.

7.2.3.4 Additional North Carolina program data

No North Carolina customers have participated in the program through 2022.

7.3 Non-Residential Small Business Improvement Enhanced Program – Virginia and North Carolina

7.3.1 Program description

The Non-Residential Small Business Improvement Enhanced Program is the next iteration of the DSM Phase V Non-Residential Small Business Improvement Program. It offers non-residential small businesses the opportunity to receive an on-site energy assessment, or audit, by a participating contractor in Dominion Energy's Small Business contractor network. Eligible participants are non-residential customers with privately-owned businesses in five or fewer locations who have not exceeded the monthly demand of 100 kilowatts more than three times in the past 12 months. The customer must be responsible for the electric bill and must be the owner of the facility or reasonably able to secure permission to complete the measures.

After an energy assessment, the customer receives a personalized report showing the projected energy and cost savings anticipated from the implementation of energy efficiency measure options identified during the audit. Once a qualifying customer provides documentation that at least one of the recommended energy efficiency improvements has been made, a portion of the audit value is refunded based on the measures installed.

Since the program is implemented through a contractor network, customers must contact a participating contractor to receive the energy audit. Customers are not considered participants until a completed application form is processed and a rebate issued. Work must be completed within six months of the audit to qualify for a rebate.

The program measures are primarily energy efficiency measures designed to decrease energy consumption through the replacement of less efficient equipment, installation of new equipment that exceeds current code efficiency standards, or recommissioning of existing equipment. Measures eligible to receive a rebate through the program are shown in Table 7-7.

The Virginia State Corporation Commission (SCC) approved this program, as part of the DSM Phase VIII programs, on July 30, 2020 (Case No. PUR-2019-00201) for a five-year period. The program officially launched on January 15, 2021.[204] The North Carolina Utilities Commission approved this program on February 9, 2021 (Docket No. E-22, SUB 596). The program officially launched on April 15, 2021.[205] Upon approval, the Company worked to finalize data systems, build contractor networks, and finalize implementation details. The program continued both conventional (bill inserts, brochures, trade shows, etc.) and web-based (search engine marketing, pop-up ads, etc.) marketing approaches. A new online platform for commercial customers called Manage Your Account (MYA) is operational. The platform includes advertising for resources to save money on facility heating and cooling.

DNV conducted an impact evaluation of the lighting measures in this program, as part of a multi-program non-residential lighting study, because lighting accounts for roughly 90% of the gross annualized savings in the previous DSM Phase V Small Business Improvement Program and this program. The program years studied were from program inception through year-end 2021. The studies were conducted in response to the SCC final order for Case No. PUR-2020-00156, filed on

[204] Virginia Small Business Improvement Enhanced Program Terms and Conditions, https://domsavings.com/wp-content/uploads/2022/10/DSMVIII-DEV-NR-SBIE-Terms-and-Conditions-Final-09262022.pdf Accessed April 13, 2023.

[205] North Carolina Small Business Improvement Enhanced Program Terms and Conditions, https://domsavings.com/wp-content/uploads/2022/10/DSMVIII-DENC-NR-SBIE-Terms-and-Conditions-Final-10042022.pdf Accessed April 13, 2023.

October 27, 2021. The Small Business Improvement Enhanced Program underwent gross impact, net-to-gross, persistence, and baseline studies. The gross impact study included:

- Physical and virtual site verifications of measure installation
- Metering of annual hours of use (HOU) via lighting loggers

The net-to-gross study included studies of free ridership and spillover. The detailed impact evaluation report can be found in Appendix K.

Table 7-7. Measures offered through Small Business Improvement Program

End use	Measure
Building envelope	Window film
Domestic hot water	VFD on hot water pump
Plug-load	Vending miser
Lighting	T5/T8 LED or fluorescent lamps/ballasts
	LED Lamp/fixture
	LED Exit signs
	Occupancy sensors
	De-lamping
Refrigeration	Anti-sweat heater controls
	Door closer (cooler and freezer)
	Strip curtain (cooler and freezer)
	Evaporator Fan Electronically Commutated Motor (ECM)
	Evaporator fan motor controls
	Variable frequency drives
	Night cover
HVAC	Unitary/split AC & HP upgrade
	Dual enthalpy air-side economizer
	Programmable thermostat
HVAC, recommissioning	Duct testing & sealing
	Unitary/split AC & HP tune-up
	Refrigerant charge correction

7.3.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program, which is included in Appendix E. For the current period, the approach included reviewing the tracking data, then estimating gross energy and demand savings using the DE TRM calculations located in Appendix F.

Table 7-8 outlines Dominion Energy's initial program planning assumptions used to design the program. DNV uses the planned NTG factor in its net savings calculations until it can be verified through EM&V.

Table 7-8. Non-Residential Small Business Improvement Enhanced Program (Phase VII) planning assumptions system-wide

Assumption	Description
Target Market	Non-residential customers
NTG Factor	93%
Measure Life (years)	11.0
Gross average annual energy savings per participant (kWh/year)	15,602
Gross average summer coincident peak demand reduction (kW) per participant	4.91
Gross average winter coincident peak demand reduction (kW) per participant	3.16
Net average annual energy savings per participant (kWh/year)	14,510
Net average summer coincident peak demand reduction (kW) per participant	4.57
Net average winter coincident peak demand reduction (kW) per participant	2.94
Average rebate (US$) per participant	$3,161

7.3.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

7.3.3.1 Key Virginia program data

Table 7-9 provides performance indicator data for 2022. Shaded cells are considered extraordinarily sensitive information. Appendix O.27 provides detailed incremental program indicators by year and month, program performance by measure, and a comparison of program savings with usage by rate schedule. Appendix Q shows cumulative gross and net savings.

Table 7-9. Virginia Non-Residential Small Business Improvement Enhanced Program performance indicators (2020–2022)[206]

Category	Item	2020	2021	2022	Program total (2020-2022)
Operations and management costs ($)					
	Indirect other (administrative)	$2,402	$114,584	$143,863	$260,849
Total costs ($)	Total[207]	$56,290	$2,443,713	$3,445,530	$5,945,533
	Planned	$0	$3,564,498	$3,652,065	$7,216,563
	Variance	$56,290	-$1,120,785	-$206,535	-$1,271,030
	Annual % of planned	N/A	69%	94%	82%
Participants	Total (Gross)	0	307	591	898

[206] The sum of the individual annual values may differ from the total value due to rounding.

[207] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2020	2021	2022	Program total (2020-2022)
	Planned (Gross)	0	634	634	1,268
	Variance	0	-327	-43	-370
	Annual % of planned (Gross)	N/A	48%	93%	71%
Installed energy savings (kWh/year)	Total gross deemed savings	0	2,429,201	5,119,684	7,548,885
	Realization rate	N/A	119%	119%	119%
	Realization rate adjustment	0	456,770	966,932	1,423,702
	Adjusted gross savings	0	2,885,972	6,086,616	8,972,588
	Net-to-gross rate weighted by measure[208]	N/A	74%	74%	74%
	Net-to-gross adjustment	0	-754,710	-1,596,051	-2,350,761
	Net adjusted savings	0	2,131,262	4,490,565	6,621,826
	Planned savings (Net)	0	9,199,251	9,199,251	18,398,502
	Annual % toward planned savings (Net)	N/A	23.2%	48.8%	36.0%
	Avg. savings per participant (Gross)	N/A	7,913	8,663	8,406
	Avg. savings per participant (Net)	N/A	6,942	7,598	7,374
Installed summer demand reduction (kW)	Total gross deemed demand	0.0	448.9	1,076.5	1,525.4
	Realization rate	N/A	100%	100%	100%
	Realization rate adjustment	0.0	0.0	0.0	0.0
	Adjusted gross demand	0.0	448.9	1,076.5	1,525.4
	Net-to-gross rate weighted by measure[208]	N/A	79%	77%	78%
	Net-to-gross adjustment	0.0	-94.5	-243.3	-337.8
	Net adjusted demand	0.0	354.54	833.2	1,187.7
	Planned demand (Net)	0.0	2,895.0	2,895.0	5,790.0
	Annual % toward Planned reduction (Net)	N/A	12.2%	28.8%	20.5%
	Avg. demand per participant (Gross)	N/A	1.5	1.8	1.7
	Avg. demand per participant (Net)	N/A	1.2	1.4	1.3
Installed winter	Total gross deemed demand	-	327.7	629.6	957.3
	Realization rate	-	100%	100%	100%

[208] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 98% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Appendix D Methodologies, Section 3.1.6 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2020	2021	2022	Program total (2020-2022)
demand reduction (kW)	Realization rate adjustment	-	0.0	0.0	0.0
	Adjusted gross demand	-	327.7	629.6	957.3
	Net-to-gross rate weighted by measure[208]	-	77%	76%	76%
	Net-to-gross adjustment	-	-75.1	-151.2	-226.3
	Net adjusted demand	-	252.6	478.4	731.0
	Planned demand (Net)	-	1,863.3	1,863.3	3,726.6
	Annual % toward planned reduction (Net)	-	13.6%	25.7%	19.6%
	Avg. demand per participant (Gross)	-	1.1	1.1	1.1
	Avg. demand per participant (Net)	-	0.8	0.8	0.8
Program performance	Cml annual $admin. per participant (Gross)	N/A	$381	$290	$290
	Cml annual $admin. per kWh/year (Gross)	N/A	$0.05	$0.03	$0.03
	Cml annual $admin. per kw (Gross)	N/A	$261	$171	$171
	Cml Annual $EM&V per total costs ($)	83.7%	8.7%	6.6%	6.6%
	Cml annual $rebate per participant (Gross)	N/A	$3,184	$3,244	$3,244

7.3.3.2 Key North Carolina program data

Table 7-10 provides performance indicator data for the year. Shaded cells are considered extraordinarily sensitive information. Appendix P.17 provides detailed incremental program indicators by year and month, program performance by measure, and a comparison of program savings with usage by rate schedule. Appendix Q shows cumulative gross and net savings.

Table 7-10. North Carolina Non-Residential Small Business Improvement Enhanced Program performance indicators (2021–2022)[209]

Category	Item	2021	2022	Program total (2021–2022)
Operations and management costs ($)	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect other (administrative)	$3,866	$6,068	$9,933

[209] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2021	2022	Program total (2021–2022)
Total costs ($)	Total[210]	$82,440	$145,320	$227,760
	Planned	$221,797	$233,024	$454,821
	Variance	-$139,357	-$87,704	-$227,061
	Annual % of planned	37%	62%	50%
Participants	Total (Gross)	8	8	16
	Planned (Gross)	41	41	82
	Variance	-33	-33	-66
	Annual % of planned (Gross)	20%	20%	20%
Installed energy savings (kWh/year)	Total gross deemed savings	157,603	315,960	473,563
	Realization rate	120%	120%	120%
	Realization rate adjustment	31,908	64,325	96,232
	Adjusted gross savings	189,510	380,285	569,795
	Net-to-gross rate weighted by measure[211]	73%	73%	73%
	Net-to-gross adjustment	-51,874	-104,453	-156,327
	Net adjusted savings	137,636	275,832	413,468
	Planned savings (Net)	594,904	594,904	1,189,809
	Annual % toward planned savings (Net)	23.1%	46.4%	34.8%
	Avg. savings per participant (Gross)	19,700	39,495	29,598
	Avg. savings per participant (Net)	17,205	34,479	25,842
Installed summer demand reduction (kW)	Total gross deemed demand	30.3	66.8	97.0
	Realization rate	100%	100%	100%
	Realization rate adjustment (100%)	0.0	0.0	0.0
	Adjusted gross demand	30.3	66.8	97.0
	Net-to-gross rate weighted by measure[211]	73%	73%	73%
	Net-to-gross adjustment	-8.3	-17.9	-26.1
	Net adjusted demand	22.0	48.9	70.9
	Planned demand (Net)	187.2	187.2	374.4
	Annual % toward planned reduction (Net)	11.7%	26.1%	18.9%
	Avg. demand per participant (Gross)	3.8	8.3	6.1
	Avg. demand per participant (Net)	2.7	6.1	4.4
Installed	Total gross deemed demand	15.5	28.0	43.5

[210] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

[211] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 98% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Appendix D Methodologies, section 3.1.6 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2021	2022	Program total (2021–2022)
winter demand reduction (kW)	Realization rate	100%	100%	100%
	Realization rate adjustment (100%)	0.0	0.0	0.0
	Adjusted gross demand	15.5	28.0	43.5
	Net-to-gross rate weighted by measure[211]	73%	73%	73%
	Net-to-gross adjustment	-4.1	-7.6	-11.7
	Net adjusted demand	11.4	20.4	31.8
	Planned demand (Net)	120.5	120.5	241.0
	Annual % toward planned reduction (Net)	9.48%	16.9%	13.2%
	Avg. demand per participant (Gross)	1.9	3.5	2.7
	Avg. demand per participant (Net)	1.4	2.6	2.0
Program performance	Cml annual $admin. per participant (Gross)	$483	$621	$621
	Cml annual $admin. per kWh/year (Gross)	$0.02	$0.02	$0.02
	Cml annual $admin. per kW (Gross)	$128	$102	$102
	Cml annual $EM&V per total costs ($)	2.7%	5.7%	5.7%
	Cml annual $rebate per participant (Gross)	$2,911	$5,072	$5,072

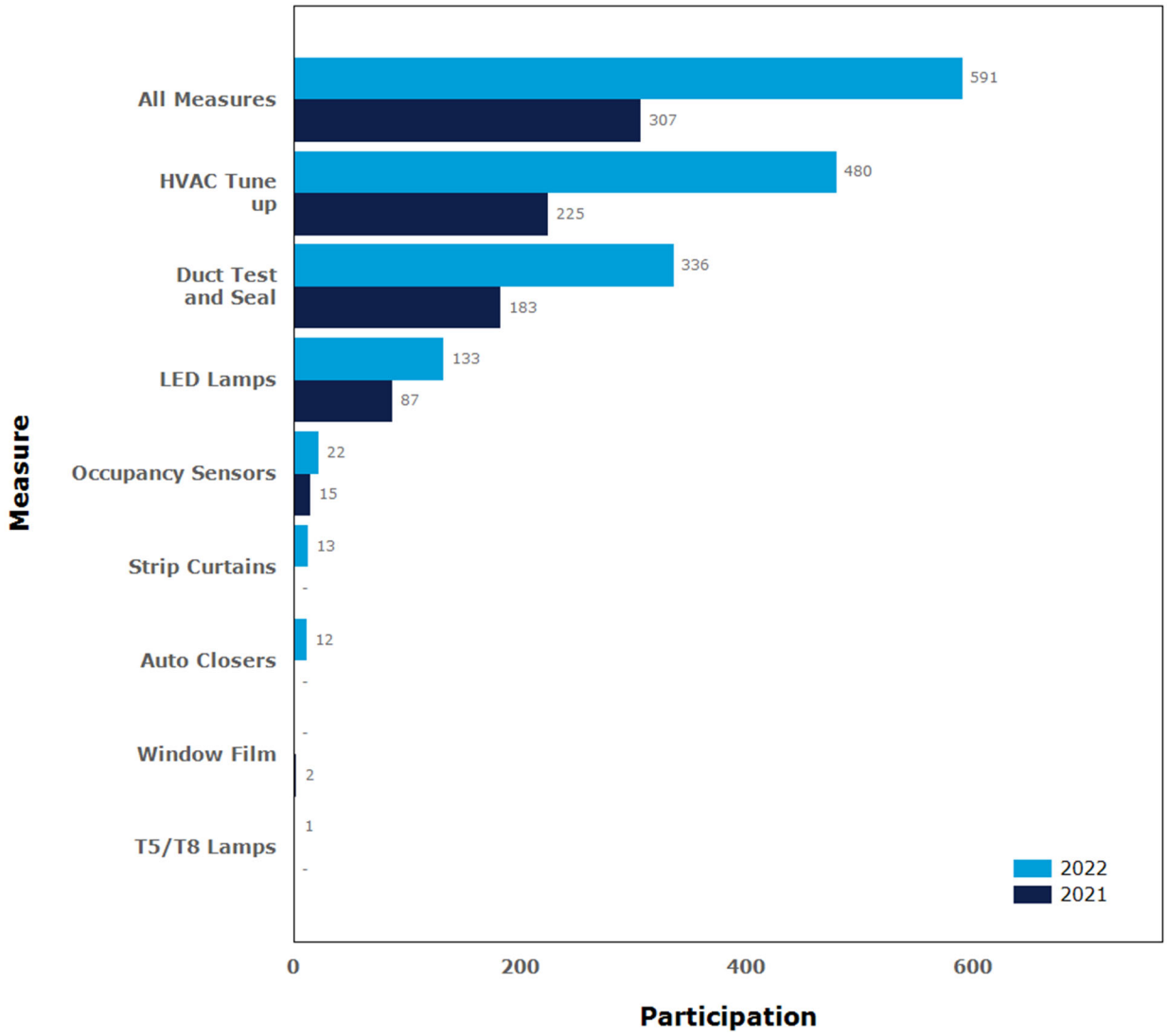
7.3.3.3 Additional Virginia program data

Figure 7-3 through Figure 7-7 show the program's participation and gross annualized energy savings by measure type. Other detailed program participation and savings at the measure level are provided in Appendix O.27.

Note that participation in these charts is the count of new unique customers in the "all measures" presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the program in previous years. This differs from the participation count presented in the Key Virginia Program Data and Key North Carolina Program Data sections above, where a participant is only counted once, the first time they receive a rebate. After the first time the participant enrolls in a program, future applications are not counted as a new participant, though their savings are counted.

In 2022, the most frequently implemented measure was "HVAC tune-up," used by 81% of program participants, as shown in Figure 7-3. "Duct test and seal" was the next most implemented measure, used by 57% of program participants.

Figure 7-3. Virginia Small Business Improvement Enhanced Program participation by measure and year



The gross savings by measure were in almost the opposite order of the participation. LEDs again accounted for the majority of gross annualized energy savings (90%) in 2022, as shown in Figure 7-4. Figure 7-5 shows that the program achieved all-

time net savings of approximately 88% of all time gross savings. More details regarding the results of the 2022 evaluation of the program's lighting measures are included in Appendix K.

Figure 7-4. Virginia Non-Residential Small Business Improvement Enhanced Program gross annualized energy savings by measure and year (MWh/year)

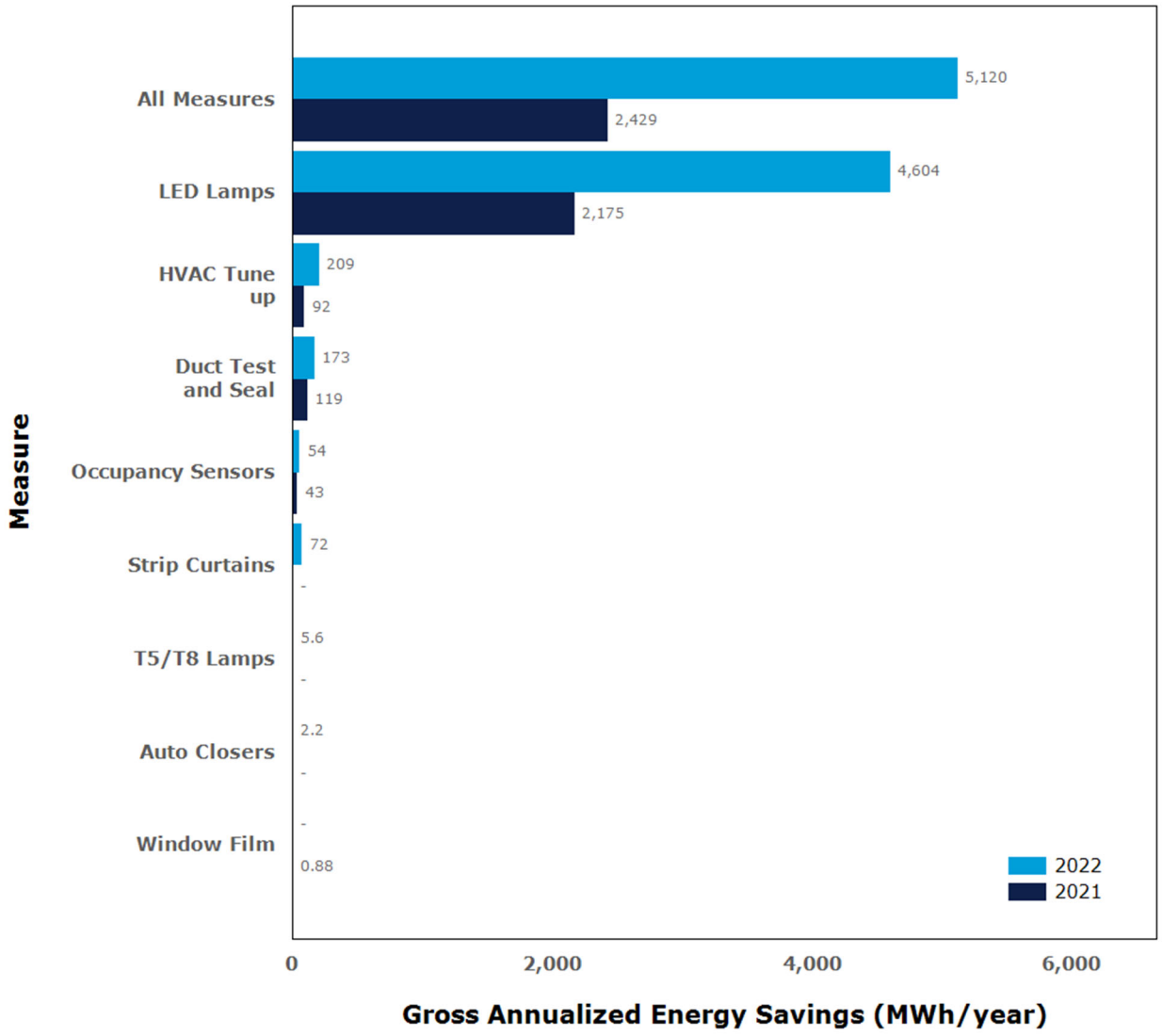


Figure 7-5. Virginia Non-Residential Small Business Improvement Enhanced Program net annualized energy savings by measure and year (MWh/year)

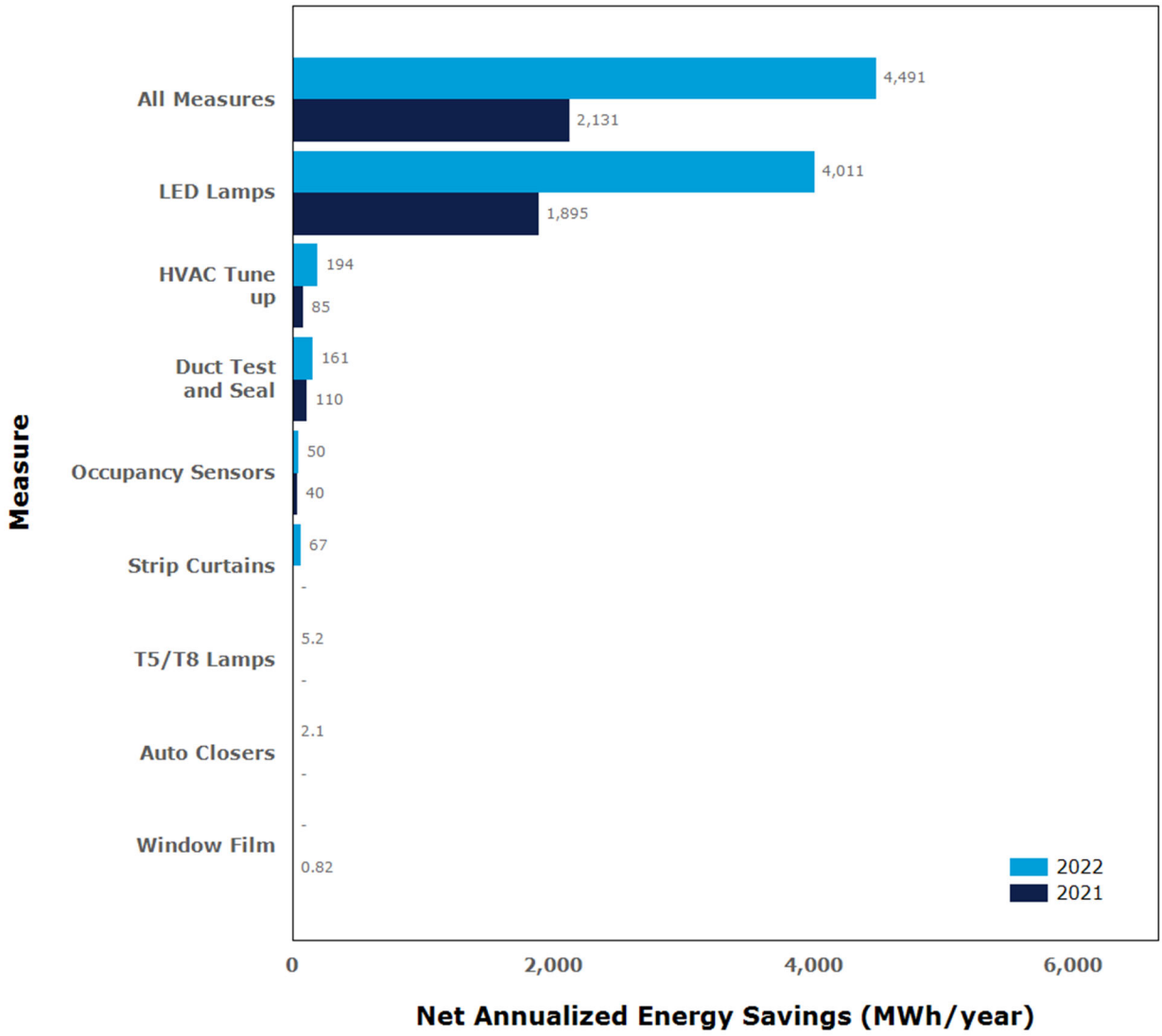


Figure 7-6 through Figure 7-7 show participation and gross annualized energy savings by building type.

In 2022, “mercantile (retail, not mall)” overtook “religious worship” (second most participants) as the building type with the most program participants. The third and fourth most frequent building types are “office (small, <40 ksf),” and “service (beauty, auto repair workshop),” respectively as shown in Figure 7-6.

Figure 7-6. Virginia Non-Residential Small Business Improvement Enhanced Program participation by building type and year

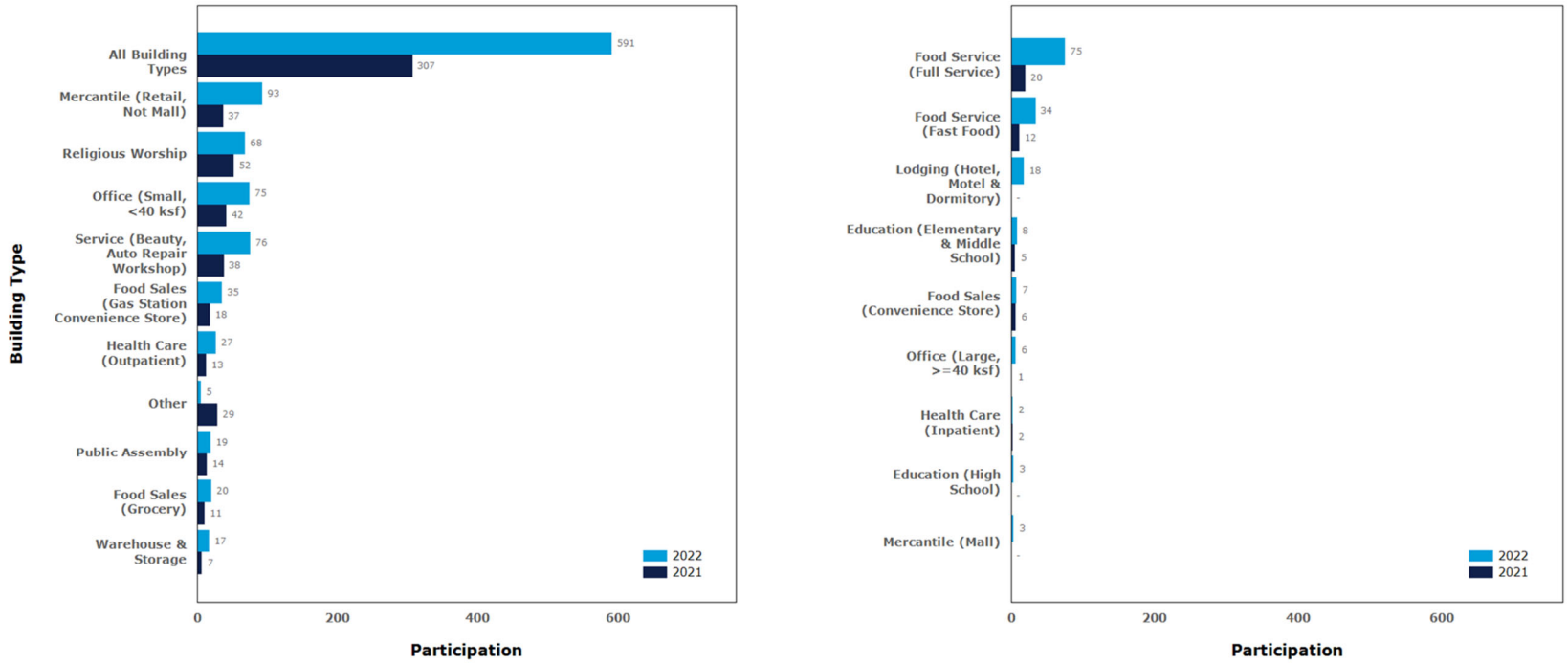


Figure 7-7 shows that “mercantile (retail, not mall)” building types accounted for the greatest proportion of gross savings (30%). Building types “service (beauty, auto repair workshop)” and “office (small, <40 ksf)” are the next two largest building types accounting for 33% of gross savings combined. Figure 7-8 shows that the aforementioned building types also account for the greatest proportion of net savings in the same order.

Figure 7-7. Virginia Non-Residential Small Business Improvement Enhanced Program gross annualized energy savings by building type and year (MWh/year)

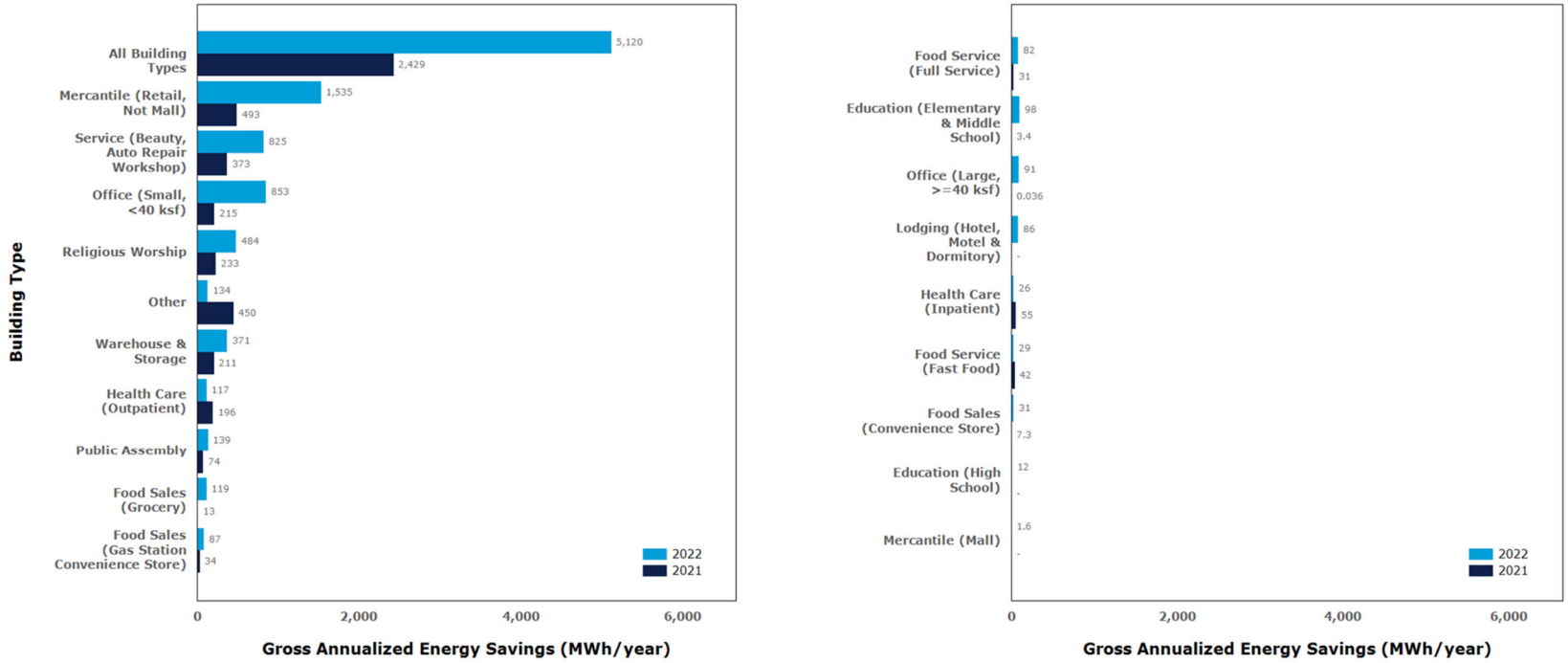
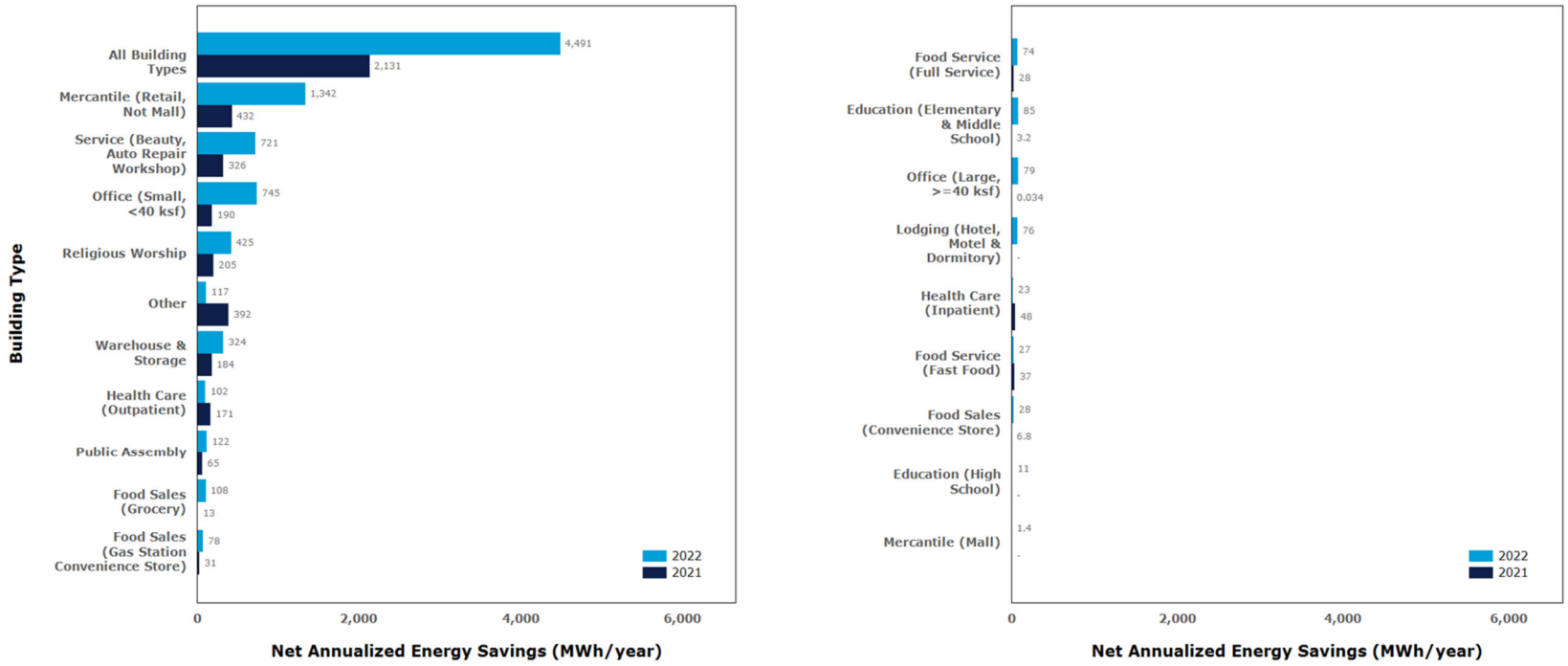


Figure 7-8. Virginia Non-Residential Small Business Improvement Enhanced Program net annualized energy savings by building type and year (MWh/year)



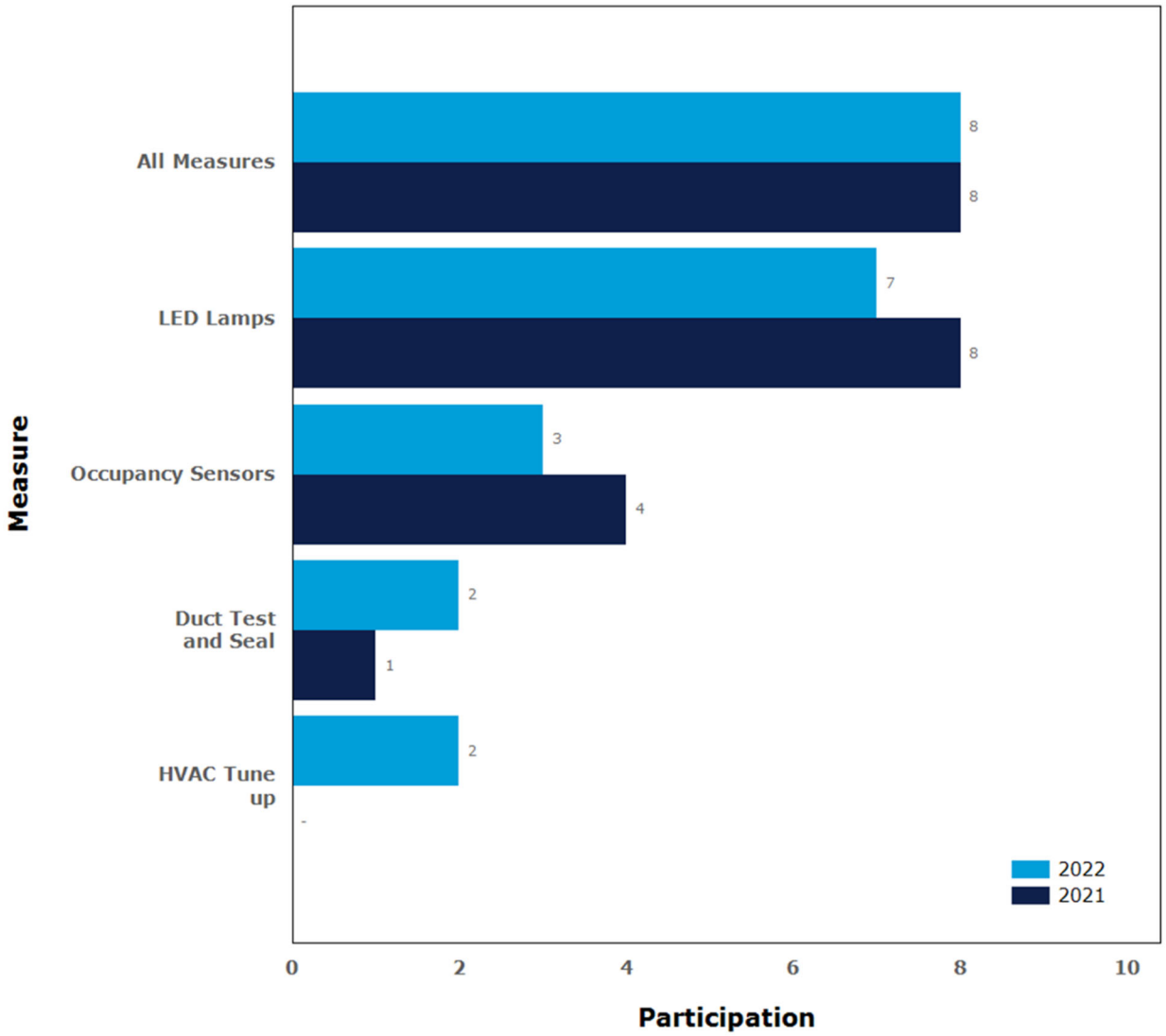
7.3.3.4 Additional North Carolina program data

Figure 7-9 through Figure 7-10 show the program's participation and gross annualized energy savings by measure type.

Note that participation in these charts is the count of new unique customers in the "all measures" presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the program in previous years. This differs from the participation count presented in the Key Virginia Program Data and Key North Carolina Program Data sections above, where a participant is only counted once, the first time they receive a rebate. After the first time the participant enrolls in a program, future applications are not counted as a new participant, though their savings are counted. Other detailed program participation and savings at the measure level are provided in Appendix P.17.

In 2022, a new measure (HVAC Tune up) was implemented by participants. Other measures include LED lamps, occupancy sensor, and duct test and seal. LED lamps continued to account for most installations (88%), as shown in Figure 7-9.

Figure 7-9. North Carolina Non-Residential Small Business Improvement Enhanced Program participation by measure and year



LED lamps continued to account for most gross savings in 2022 (97%), as shown in Figure 7-10. The program achieved overall net savings of approximately 87% of overall gross savings, with LEDs also being the leading measure in net savings, Figure 7-11. More details regarding the results of the 2022 evaluation of the non-residential lighting measures in this program are included in Appendix K.

Figure 7-10. North Carolina Non-Residential Small Business Improvement Enhanced Program gross annualized energy savings (MWh/year) by measure and year

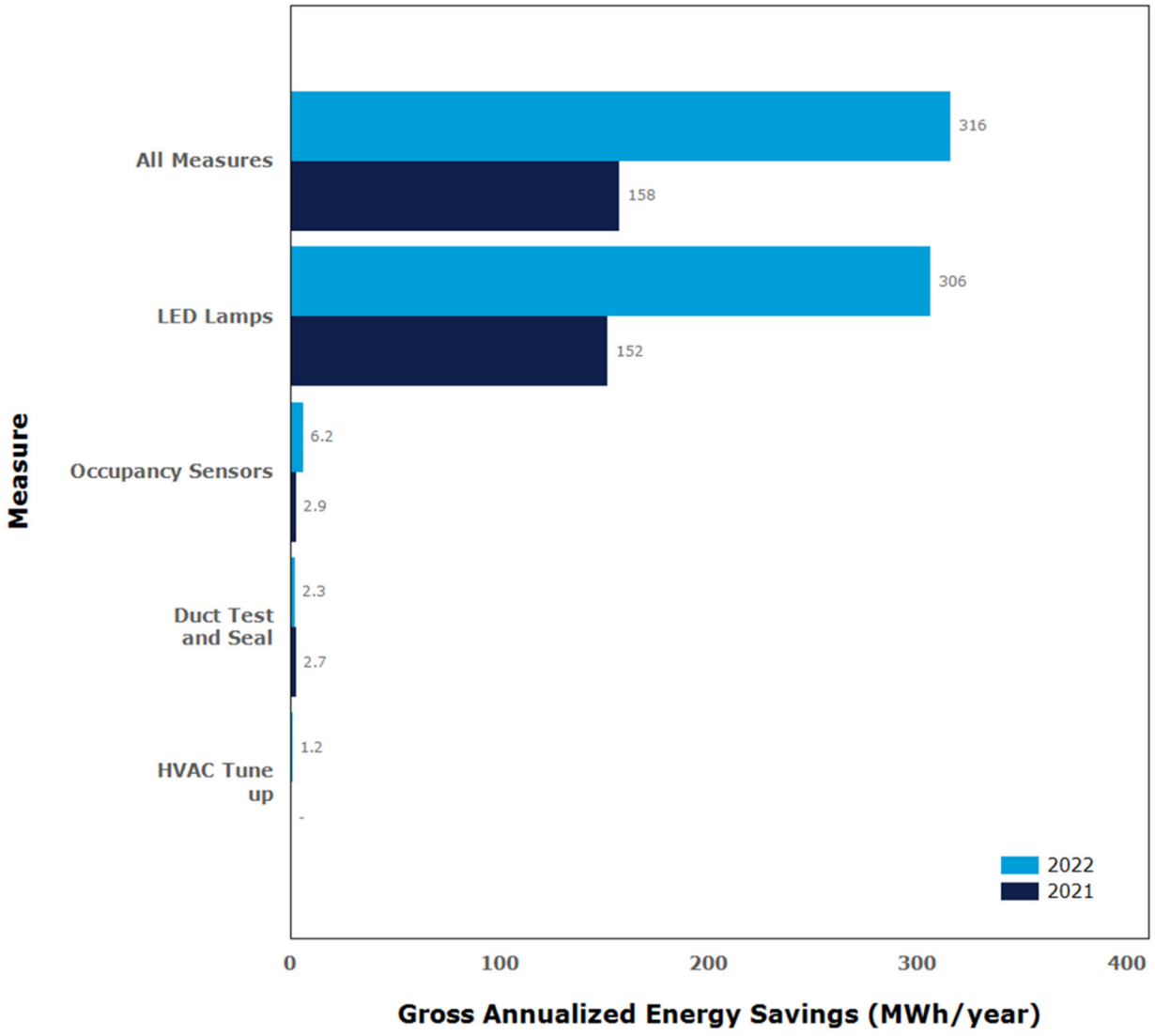


Figure 7-11. North Carolina Non-Residential Small Business Improvement Enhanced Program net annualized energy savings (MWh/year) by measure and year

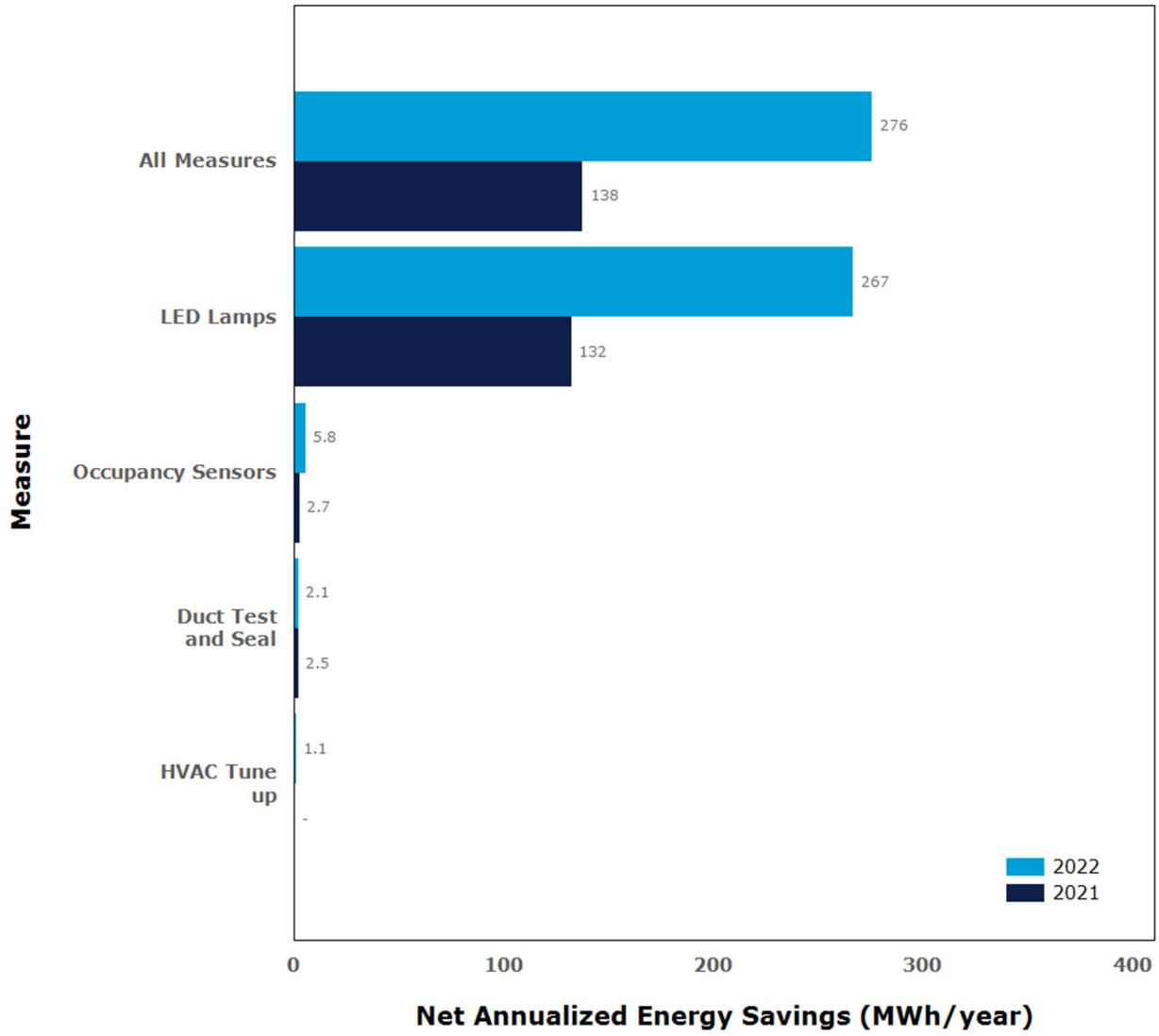


Figure 7-12 and Figure 7-13 show the program's participation and gross annualized energy savings by building type. In 2022, a plurality of participants (25%) were "public assembly" building types.

Figure 7-12. North Carolina Non-Residential Small Business Improvement Enhanced Program participation by building type and year

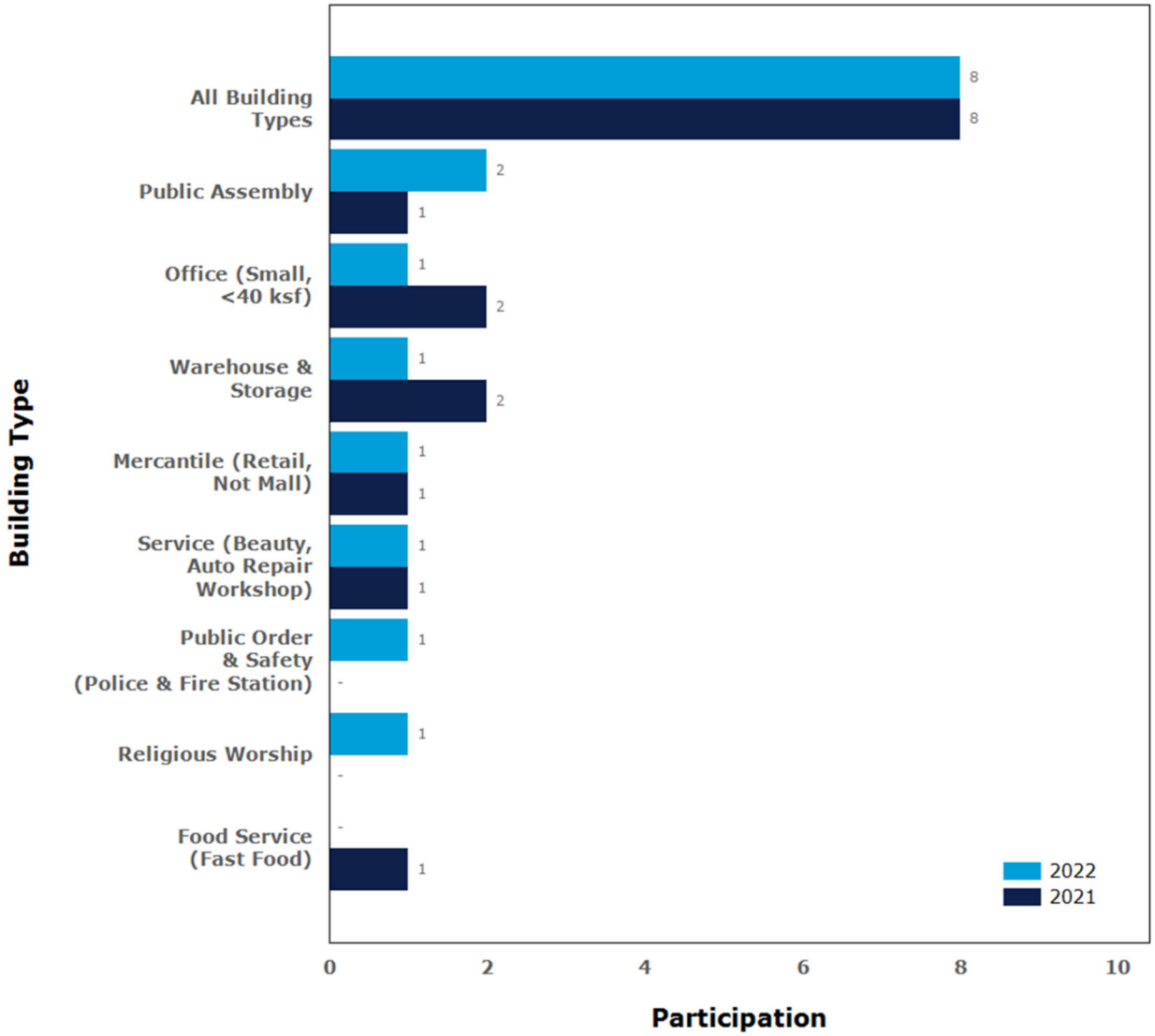


Figure 7-13 shows that “warehouse & storage” (32%) overtook “service (beauty, auto repair, workshop)” (24%) as the lead building type in 2022. The third most was “public assembly” with 23% of gross savings. Figure 7-14 shows that the aforementioned building types also account for the greatest proportion of net savings in the same order.

Figure 7-13. North Carolina Non-Residential Small Business Improvement Enhanced Program gross annualized energy savings by building type and year (MWh/year)

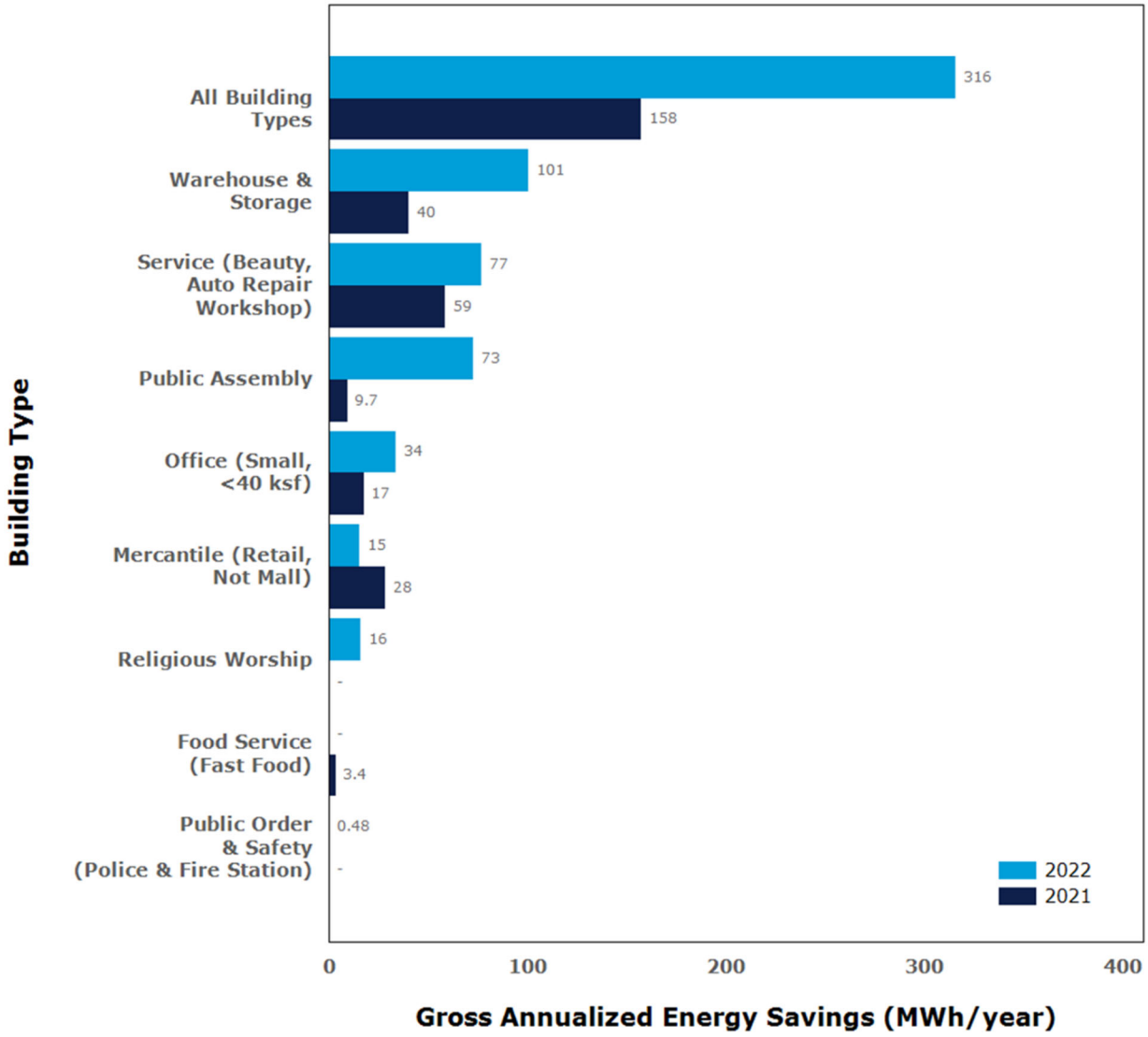
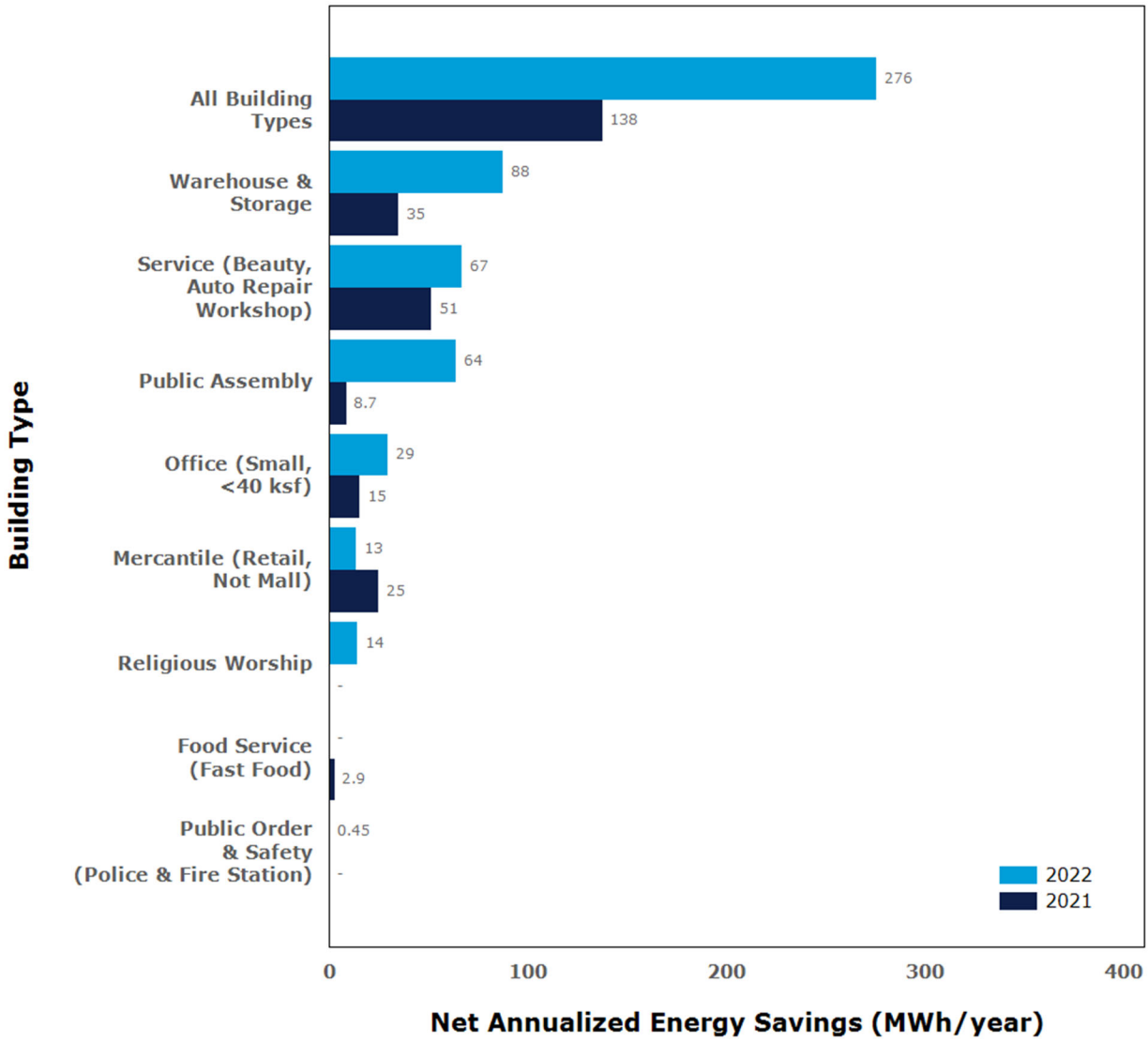


Figure 7-14. North Carolina Non-Residential Small Business Improvement Enhanced Program net annualized energy savings by building type and year (MWh/year)



7.4 Non-Residential Agriculture Program – Virginia

7.4.1 Program description

The Non-Residential Agriculture Program provides incentives to qualifying non-residential customers to help agribusiness replace aging, inefficient equipment and systems with high-efficiency agriculture equipment, lighting, irrigation, and more. Eligible for program rebates are Dominion Energy non-residential agriculture customers in Virginia who are on a non-residential rate schedule, are not exempt by statute or under a special contract,[212] are responsible for the electric bill, and are the owners of the facilities or are reasonably able to secure permission to complete installation of the energy-efficient measures.

The measures eligible to receive rebates include:

- Ventilation and circulation fans
- High-volume, low-speed fans
- Dairy lighting controls
- Horticulture and poultry LEDs
- T5/T8 lamps
- Automatic milker take-offs
- Dairy plate coolers
- Grain storage aerators fan controls
- Low-pressure irrigation systems
- VFDs for:
  - Dust collection system fans
  - Irrigation pumps
  - Tobacco curing fans
  - Greenhouse ventilation and poultry house fans
  - Dairy vacuum pumps

This program is implemented through a contractor network and so customers must use participating contractors to be eligible for the rebate. Before beginning work, every project must finish and submit an initial assessment. Once the project has been evaluated, the company will send the customer an application that confirms the review and includes information about the rebate incentives offered. However, it's important to note that project eligibility and incentive amounts cannot be guaranteed until the project is completed. Customers must submit the rebate application within 45 days of the date of service and ensure that all rebate requirements are met. Failure to provide any required information will delay application processing and may result in non-payment. After receiving all necessary information, the company will process rebates within 90 days.

The Virginia SCC approved this program, as part of the DSM Phase IX programs, on September 7, 2021 (Case No. PUR-2020-00274) for a five-year period of January 1, 2022, through December 31, 2026. The program officially launched on June 1, 2022.[213] Upon approval, the Company worked to finalize data systems, build contractor networks, and finalize implementation details. Implementation vendors indicated that many agriculture customers are still under the residential rates, and therefore they cannot participate in the Non-residential Agriculture program – a contributing factor to the

[212] Program participant must be a Dominion Energy Virginia non-residential customer ("Customer") who is not exempt by statute, not under special contract, and has not elected to opt-out of paying the DSM rider. Non-Residential Prescriptive Program Terms and Conditions (dominionenergy.com). Accessed March 13,2023.

[213] Virginia Non-Residential Agriculture Program Terms and Conditions. https://domsavings.com/wp-content/uploads/2022/09/DSM-IX-DEV-NR-Agriculture-Terms-and-Conditions-Final-09062022.pdf. Accessed March 13, 2023.

program's low participation level. However, the savings achieved by the few participants far exceeded the original plans for 2022. This is because the program's primary measure so far -- stacked indoor horticulture LED lighting -- resulted in higher energy savings than the program initially expected for this measure.

7.4.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program, which appears in Appendix E For the upcoming period, the approach will include reviewing the tracking data and then estimating gross energy savings and demand reduction using the DE TRM calculations located in Appendix F.

Table 7-11 outlines Dominion Energy's initial program planning assumptions used to design the program. DNV uses the planned NTG factor in its net savings calculations until it can be verified through EM&V.

Table 7-11. Non-Residential Heating and Cooling Efficiency Program (Phase VII) planning assumptions system-wide

Assumption	Value
Target Market	Non-Residential customers
NTG Factor	97%
Measure Life (years)	14.37
Gross Average Annual Energy Savings per Participant (kWh/year)	12,787
Gross Average Summer Coincident Peak Demand Reduction per Participant (kW)	1.67
Gross Average Winter Coincident Peak Demand Reduction per Participant (kW)	3.41
Net Average Annual Energy Savings per Participant (kWh/year)	12,403
Net Average Summer Coincident Peak Demand Reduction (kW) per Participant	1.62
Net Average Winter Coincident Peak Demand Reduction (kW) per Participant	3.30
Average Rebate (US$) per Participant	$1,654

7.4.3 Assessment of program progress toward plan

The next subsection provides the tables summarizing the key indicators of the Non-Residential Agriculture program progress in Virginia.

7.4.3.1 Key Virginia program data

The performance indicator data for each year and from program inception through 2022 appear in **Table 7-12**. The shaded cells in the table are considered extraordinarily sensitive information. Appendix O.28 contains detailed program indicators by year and month, along with information about program performance by measure and a comparison of program savings with

usage by rate schedule. Appendix Q shows the cumulative gross and net savings.

Table 7-12. Virginia Non-Residential Agriculture Program performance indicators (2021–2022)[214]

Category	Item	2021	2022	Program total (2021–2022)
Operations and Management Costs ($)	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect Other (Administrative)	$974	$19,669	$20,643
Total Costs ($)	Total[215]	$20,770	$471,081	$491,851
	Planned	$0	$909,217	$909,217
	Variance	$20,770	-$438,137	-$417,367
	Annual % of Planned	N/A	52%	54%
Participants	Total (Gross)	0	3	3
	Planned (Gross)	0	151	151
	Variance	0	-148	-148
	Annual % of Planned (Gross)	N/A	2%	2%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	4,980,594	4,980,594
	Realization Rate	N/A	100%	100%
	Realization Rate Adjustment	0	0	0
	Adjusted Gross Savings	0	4,980,594	4,980,594
	Net-To-Gross Ratio[216]	N/A	97%	97%
	Net-to-Gross Adjustment	0	-149,418	-149,418
	Net Adjusted Savings	0	4,831,176	4,831,176
	Planned Savings (Net)	0	1,872,912	1,872,912
	Annual % Toward Planned Savings (Net)	N/A	258%	258%
	Avg. Savings per Participant (Gross)	N/A	1,660,198	1,660,198
	Avg. Savings per Participant (Net)	N/A	1,610,392	1,610,392
Installed Summer Demand Reduction	Total Gross Deemed Demand	0.0	793.3	793.3
	Realization Rate	N/A	100%	100%
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	793.3	793.3

[214] The sum of the individual annual values may differ from the total value due to rounding.

[215] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

[216] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 100% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Appendix G Methodologies, Section 3.1.6 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2021	2022	Program total (2021–2022)
(kW)	Net-To-Gross Rate Ratio[217]	N/A	97%	97%
	Net-to-Gross Adjustment	0.0	-23.8	-23.8
	Net Adjusted Demand	0.0	769.5	769.5
	Planned Demand (Net)	0.0	244.7	244.7
	Annual % Toward Planned Demand (Net)	N/A	314%	314%
	Avg. Peak Demand per Participant (Gross)	N/A	264.4	264.4
	Avg. Demand per Participant (Net)	N/A	256.5	256.5
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0
	Net-To-Gross Rate Ratio[218]	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0
	Planned Demand (Net)	0.0	498.9	498.9
	Annual % Toward Planned Demand (Net)	N/A	0%	0%
	Avg. Peak Demand per Participant (Gross)	N/A	0.0	0.0
	Avg. Demand per Participant (Net)	N/A	0.0	0.0
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	$6,881	$6,881
	Cml Annual $Admin. per kWh/year (Gross)	N/A	$0.00	$0.00
	Cml Annual $Admin. per kW (Gross)	N/A	$26	$26
	Cml Annual $EM&V per Total Costs ($)	74.6%	18.5%	18.5%
	Cml Annual $Rebate per Participant (Gross)	N/A	$16,668	$16,668

7.4.3.2 Additional Virginia program data

One measure has been implemented under this program, Horticulture LED. Two participants were "Horticulture" building type and one was categorized as "Other" building type. The gross annualized energy savings for the "Other" building type is 4,780 MWh/year, while for the Horticulture building type is 201 MWh/year. The Horticulture LEDs were installed in vertical agriculture facilities with large amounts of lighting.

[217] Ibid.
[218] Ibid.

8 ENERGY EFFICIENCY – NON-RESIDENTIAL AUTOMATION & CONTROLS

8.1 Non-Residential Office Program – Virginia and North Carolina

8.1.1 Program description

This program provides qualifying non-residential customers with incentives for the installation of energy efficiency improvements, consisting of recommissioning measures at small office facilities. Measures eligible to receive a rebate include:

- Reduce lighting schedule
- HVAC unit scheduling
- Temperature setback
- Condensing water temp reset
- Discharge air temperature reset
- Static pressure reset
- VAV minimum flow reduction
- Dual enthalpy economizer

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 are eligible except those who are exempt by statute, special contract, or have opted out. 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 Virginia SCC approved this program, as part of the DSM Phase VII programs, on May 2, 2019, (Case No. PUR-2018-00168) for a five-year period of July 1, 2019, through June 30, 2024. The program officially launched on January 1, 2020.[219] The North Carolina Utilities Commission approved this program on November 13, 2019 (Docket No. E-22, SUB 572). The program officially launched on January 1, 2020.[220] In 2022 the DSM Phase IX the Non-Residential Building Optimization Program was launched. This program offers all of the measures offered in the Non-Residential Office Program with some additional measures. To read more about the Building Optimization Program, please see Section 8.2.

A major change in program delivery happened in fall 2021 when the program was opened to customers with over 500 kW of demand, in the SCC's Final Order in Case No. PUR-2020-00274 on September 1, 2021. Since the restriction was lifted the program has large office participants.

In 2022, there were 16 participants in Virginia and no participants in North Carolina. This is down from 59 participants in 2021. However, the annual energy savings increased in 2022 due to larger facilities participating and more measures being implemented. This was the first time the program had discharge air temperature rest, schedule lighting, static pressure reset, reduce VAV box minimum, and dual enthalpy economizer measures.

[219] Virginia Non-Residential Office Program Terms and Conditions, https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/virginia/save-energy/va-non-res-office-terms-conditions.pdf Accessed March 12, 2023.

[220] North Carolina Non-Residential Office Program Terms and Conditions, https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/north-carolina---electric/save-energy/nc-non-res-office-terms-conditions.pdf Accessed March 12, 2023.

8.1.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program, which is included in Appendix E. For the current period, the approach included reviewing the tracking data, then estimating gross energy and demand savings using the DE TRM calculations located in Appendix F.

Table 8-1. Non-Residential Office Program planning assumptions system-wide

Assumption	Value
Target Market	Non-residential customers
NTG Factor	90%
Measure Life (years)	7
Gross Average Annual Energy Savings per Participant (kWh/year)	65,104
Gross Average Summer Coincident Peak Demand Reduction per Participant (kW)	6.57
Gross Average Winter Coincident Peak Demand Reduction per Participant (kW)	34.56
Net Average Annual Energy Savings per Participant (kWh/year)	58,594
Net Average Summer Coincident Peak Demand Reduction (kW) per Participant	5.91
Net Average Winter Coincident Peak Demand Reduction (kW) per Participant	31.11
Average Rebate (US$) per Participant	$6,649

8.1.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

8.1.3.1 Key Virginia program data

Key data highlights for enrollment, energy savings, demand reduction and program costs for Virginia appear below. Following this summary, Table 8-2 provides performance indicator data annually and from program inception through 2022. Shaded cells are considered extraordinarily sensitive information. Appendix O.29, and show detailed program indicators, program performance by measure, and a comparison of program savings with usage by rate schedule. Appendix Q shows cumulative gross and net savings by year and month.

Table 8-2. Virginia Non-Residential Office Program performance indicators (2019–2022)[221]

Category	Item	2019	2020	2021	2022	Program total (2019–2022)
Operations and Management Costs ($)						
	Indirect Other (Administrative)	$13,706	$21,271	$37,706	$19,957	$92,641

[221] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2019	2020	2021	2022	Program total (2019–2022)
Total Costs ($)	Total[222]	$405,507	$408,837	$804,161	$477,980	$2,096,486
	Planned	$832,726	$1,140,867	$1,141,410	$1,165,496	$4,280,498
	Variance	-$427,218	-$732,030	-$337,249	-$687,516	-$2,184,013
	Annual % of Planned	49%	36%	70%	41%	49%
Participants	Total (Gross)	0	6	59	16	81
	Planned (Gross)	42	79	79	79	279
	Variance	-42	-73	-20	-63	-198
	Annual % of Planned (Gross)	0%	8%	75%	20%	29%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	131,417	1,203,577	4,217,101	5,552,095
	Realization Rate	N/A	100%	100%	100%	100%
	Realization Rate Adjustment	0	0	0	0	0
	Adjusted Gross Savings	0	131,417	1,203,577	4,217,101	5,552,095
	Net-to-Gross Ratio[223]	N/A	90%	90%	90%	90%
	Net-to-Gross Adjustment	0	-13,142	-120,358	-421,710	-555,209
	Net Adjusted Savings	0	118,275	1,083,219	3,795,391	4,996,885
	Planned Savings (Net)	2,460,940	4,628,911	4,628,911	4,628,911	16,347,674
	Annual % Toward Planned Savings (Net)	0%	2.56%	23.4%	82%	30.6%
	Avg. Savings per Participant (Gross)	N/A	21,903	20,400	263,569	68,544
	Avg. Savings per Participant (Net)	N/A	19,713	18,360	237,212	61,690

[222] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

[223] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 99% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Appendix G Methodologies, section 3.1.6 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2019	2020	2021	2022	Program total (2019–2022)
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0	68.6	68.6
	Realization Rate	N/A	N/A	N/A	100%	100%
	Realization Rate Adjustment	0.0	0.0	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0	68.6	68.6
	Net-to-Gross Ratio	N/A	N/A	N/A	90%	90%
	Net-to-Gross Adjustment[223]	0.0	0.0	0.0	-6.9	-6.9
	Net Adjusted Demand	0.0	0.0	0.0	61.7	61.7
	Planned Demand (Net)	248	467	467	467	1,649
	Annual % Toward Planned Demand (Net)	0%	0%	0%	13.2%	3.74%
	Avg. Peak Demand per Participant (Gross)	N/A	0.0	0.0	4.3	0.8
	Avg. Demand per Participant (Net)	N/A	0.0	0.0	3.9	0.8
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	-	-	0.0	41.1	41.1
	Realization Rate	-	-	N/A	100%	100%
	Realization Rate Adjustment	-	-	0.0	0.0	0.0
	Adjusted Gross Demand	-	-	0.0	41.1	41.1
	Net-to-Gross Ratio	-	-	N/A	90%	90%
	Net-to-Gross Adjustment[223]	-	-	0.0	-4.1	-4.1
	Net Adjusted Demand	-	-	0.0	37.0	37.0
	Planned Demand (Net)	-	-	2,458	2,458	4,915
	Annual % Toward Planned Demand (Net)	-	-	0%	1.50%	0.75%
	Avg. Peak Demand per Participant (Gross)	-	-	0.0	4.6	0.6
	Avg. Demand per Participant (Net)	-	-	0.0	4.1	0.5
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	$5,829	$1,118	$1,144	$1,144
	Cml Annual $Admin. per kWh/year (Gross)	N/A	$0	$0.05	$0.02	$0.02
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A	$1,351	$1,351
	Cml Annual $EM&V per Total Costs ($)	25.8%	30.9%	24.3%	24.2%	24.2%
	Cml Annual $Rebate per Participant (Gross)	N/A	$2,944	$3,921	$4,611	$4,611

8.1.3.2 Key North Carolina program data

Key data highlights for enrollment, energy savings, demand reduction and program costs for North Carolina appear below. Following this summary, Table 8-3 provides performance indicator data for the year. Shaded cells are considered extraordinarily sensitive information. Appendix P.18 shows detailed program indicators, program performance by measure, and a comparison of program savings with usage by rate schedule. Appendix Q shows cumulative gross and net savings by year and month.

Table 8-3. North Carolina Non-Residential Office Program performance indicators (2020–2022)[224]

Category	Item	2020	2021	2022	Program total (2020–2022)
Operations and Management Costs ($)					
	Indirect Other (Administrative)	$0	$1,783	$775	$2,558
Total Costs ($)	Total[225]	$21,142	$38,028	$18,553	$77,723
	Planned	$72,457	$71,023	$74,366	$217,846
	Variance	-$51,316	-$32,995	-$55,812	-$140,123
	Annual % of Planned	29%	54%	25%	36%
Participants	Total (Gross)	0	2	0	2
	Planned (Gross)	5	5	5	15
	Variance	-5	-3	-5	-13
	Annual % of Planned (Gross)	0%	40%	0%	13%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	43,444	0	43,444
	Realization Rate	N/A	100%	N/A	100%
	Realization Rate Adjustment	0	0	0	0
	Adjusted Gross Savings	0	43,444	0	43,444
	Net-to-Gross Ratio	N/A	90%	N/A	90%
	Net-to-Gross Adjustment[226]	0	-4,344	0	-4,344
	Net Adjusted Savings	0	39,100	0	39,100
	Planned Savings (Net)	292,969	292,969	292,969	878,907
	Annual % Toward Planned Savings (Net)	0%	13.3%	0%	4.45%
	Avg. Savings per Participant (Gross)	N/A	21,722	N/A	21,722

[224] The sum of the individual annual values may differ from the total value due to rounding.

[225] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

[226] On the rebate application form the program implementation vendor included the question, "Did the rebate incentive offered by Dominion Energy have any influence in your decision to have the work performed?" Of the participants who responded (from program inception to the end of this reporting period), the implementation vendor has calculated that 99% answered yes at the time they filled out the rebate application. This is not a substitute for a net-to-gross analysis conducted by an independent evaluator. See Appendix G Methodologies, section 3.1.6 Net Savings Estimation for a description of net-to-gross estimation approaches.

Category	Item	2020	2021	2022	Program total (2020–2022)
	Avg. Savings per Participant (Net)	N/A	19,550	N/A	19,550
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A	N/A
	Net-to-Gross Adjustment[226]	0.0	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0	0.0
	Planned Demand (Net)	29.6	29.6	29.6	88.7
	Annual % Toward Planned Demand (Net)	0%	0%	0%	0%
	Avg. Peak Demand per Participant (Gross)	N/A	0.0	N/A	0.0
	Avg. Demand per Participant (Net)	N/A	0.0	N/A	0.0
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	-	0.0	0.0	0.0
	Realization Rate	-	N/A	N/A	N/A
	Realization Rate Adjustment	-	0.0	0.0	0.0
	Adjusted Gross Demand	-	0.0	0.0	0.0
	Net-to-Gross Ratio	-	N/A	N/A	N/A
	Net-to-Gross Adjustment[226]	-	0.0	0.0	0.0
	Net Adjusted Demand	-	0.0	0.0	0.0
	Planned Demand (Net)	-	155.5	155.5	311.1
	Annual % Toward Planned Demand (Net)	-	0%	0%	0%
	Avg. Peak Demand per Participant (Gross)	-	0.0	0.0	0.0
	Avg. Demand per Participant (Net)	-	0.0	0.0	0.0
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	$892	$1,279	$1,279
	Cml Annual $Admin. per kWh/year (Gross)	N/A	$0.04	$0.06	$0.06
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A	N/A
	Cml Annual $EM&V per Total Costs ($)	39.8%	29.2%	31.5%	31.5%
	Cml Annual $Rebate per Participant (Gross)	N/A	$4,079	$4,079	$4,079

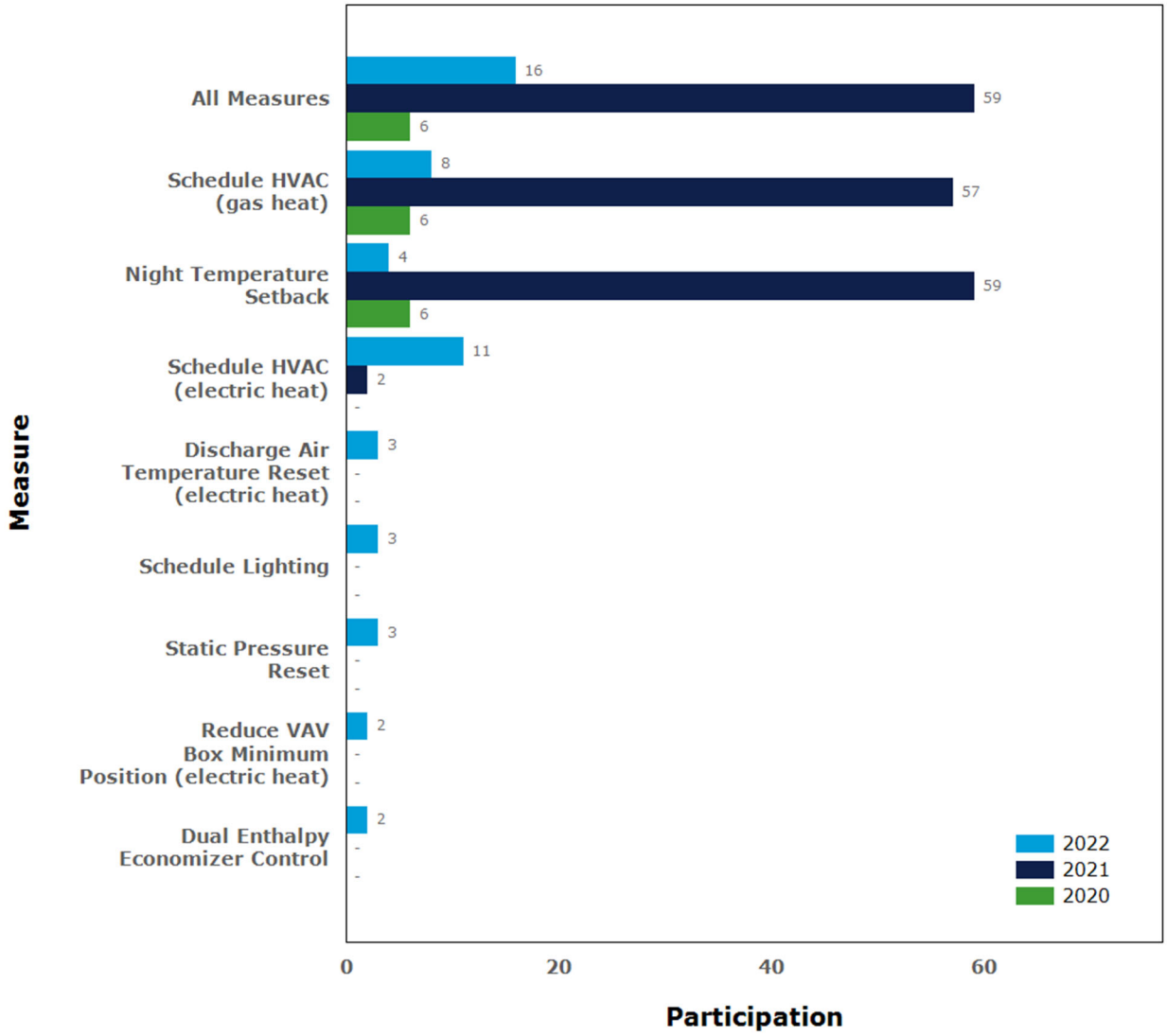
8.1.3.3 Additional Virginia program data

Additional program data regarding participation and overall program savings for Virginia are provided below.

Note that participation in these charts is the count of new unique customers in the “all measures” presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the program in previous years. This differs from participation count presented in the Key Virginia program data and Key North Carolina program data sections above, where a participant is only counted once, the first time they receive a rebate. After the first time the participant enrolls in a program, future applications are not counted as a new participant, though their savings are counted. Other detailed program participation and savings at the measure level are provided in Appendix O.29.

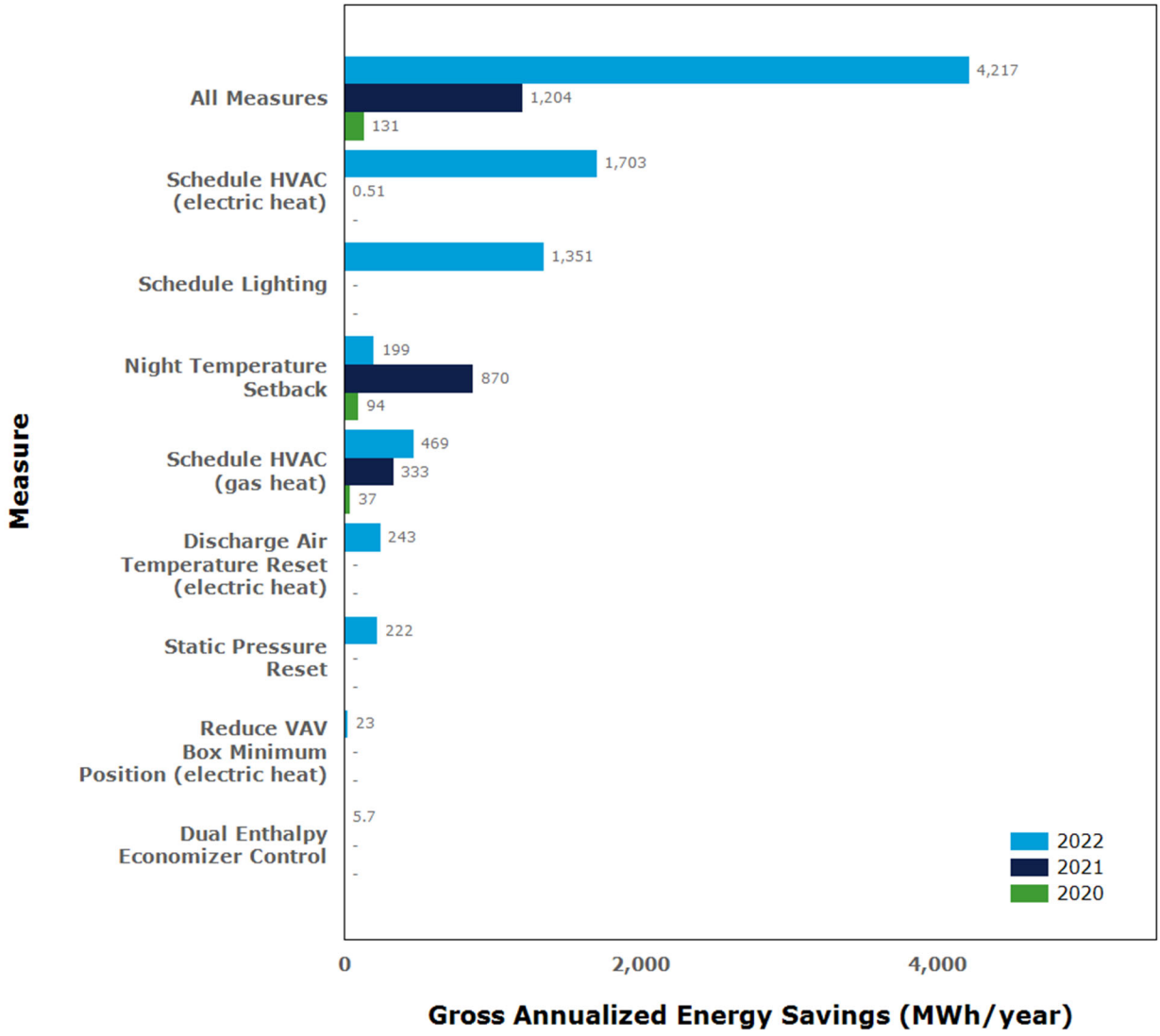
Figure 8-1 shows that there were 18 participants in 2022. This is a decrease from 59 participants in 2021. However, annual savings increased in 2022 from 2021. Several measures offered through this program were implemented for the first time in 2022.

Figure 8-1. Virginia Non-Residential Office Program participation by measure and year



The program achieved gross annualized energy savings of 4,217 MWh/year in 2022, as shown in Figure 8-2. The schedule HVAC measure comprises about 40% of the total savings in 2022 followed by 32% of 2022 savings for the schedule lighting measure. The increase in savings in 2022 is partially due to an increase in the number of measures implemented. Though this can partially be attributed to larger facilities participating in 2022 compared to the previous years.

Figure 8-2. Virginia Non-Residential Office Program gross annualized energy savings (MWh/year) by measure and year



In 2022, large office participants entered the program for the first time. The total number of participants decreased from 59 participants in 2021 down to 16 in in 2022. Figure 8-3 shows the participation by building type. Figure 8-4 shows that savings increased from 1,204 MWh/year in 2021 to 4,217 MWh/year in 2022. This increase in savings is driven by an increase in project size.

Figure 8-3. Virginia Non-Residential Office Program participants by building type and year

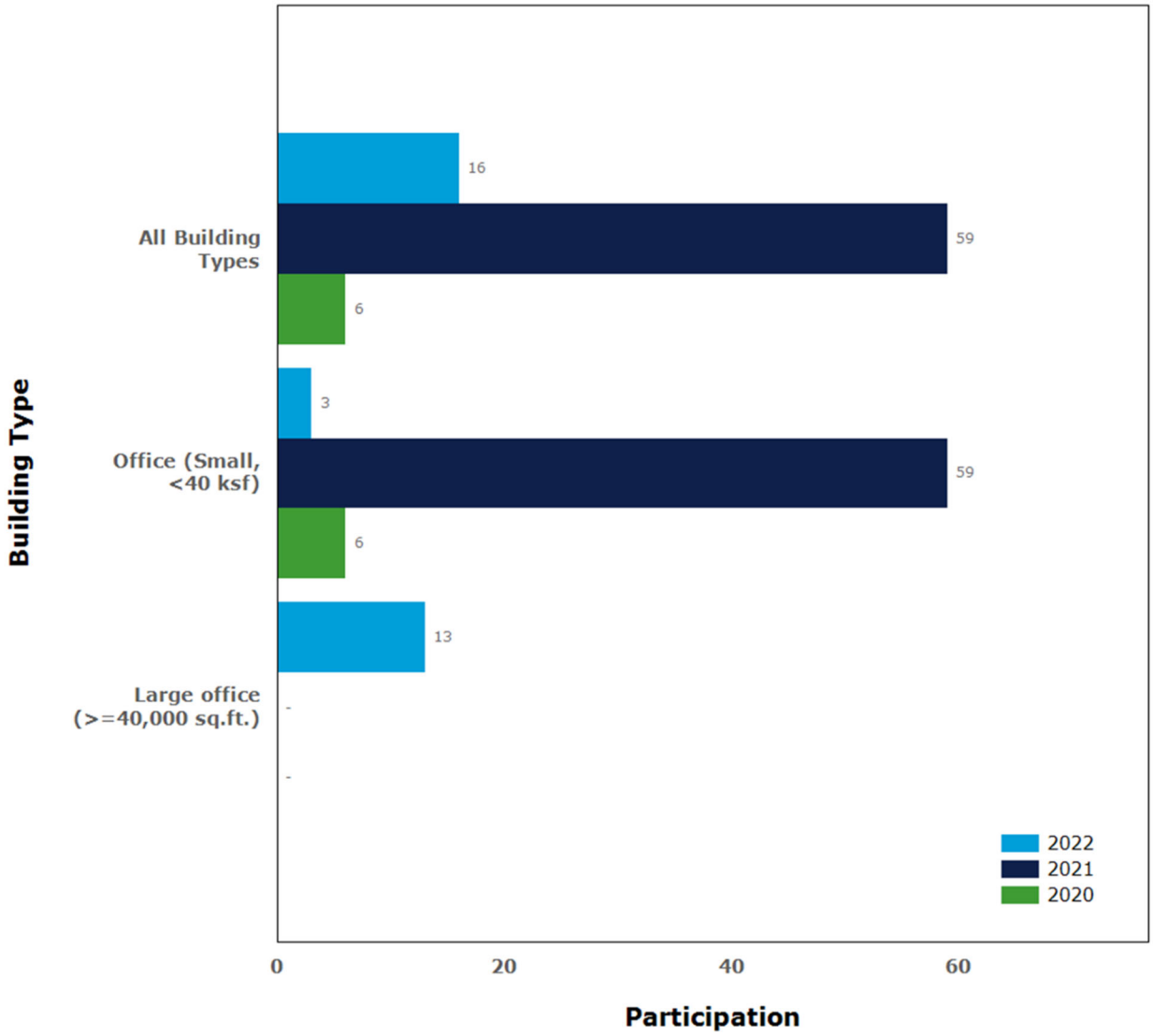
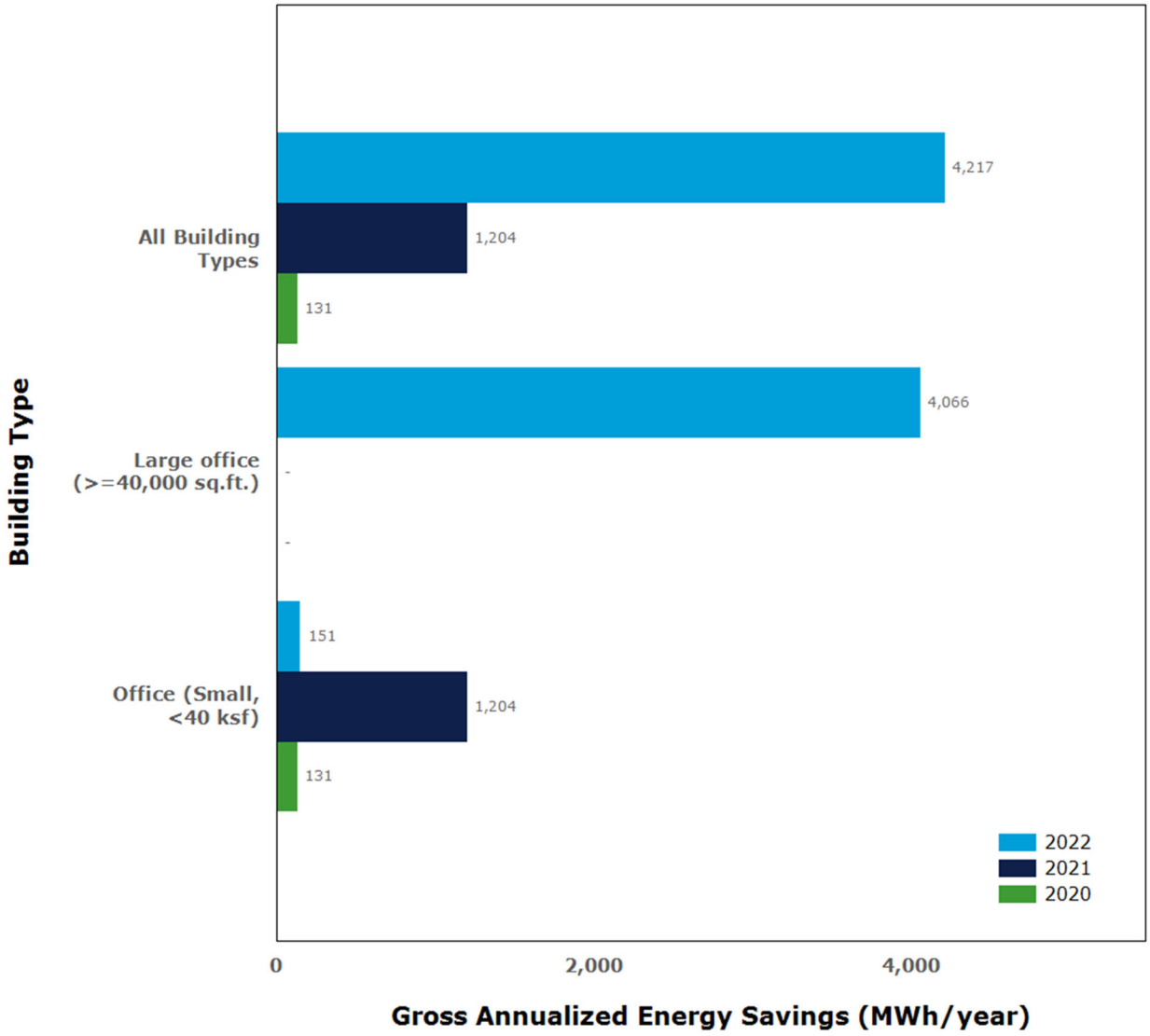


Figure 8-4. Virginia Non-Residential Office Program gross annualized energy savings (MWh/year) by building type and year



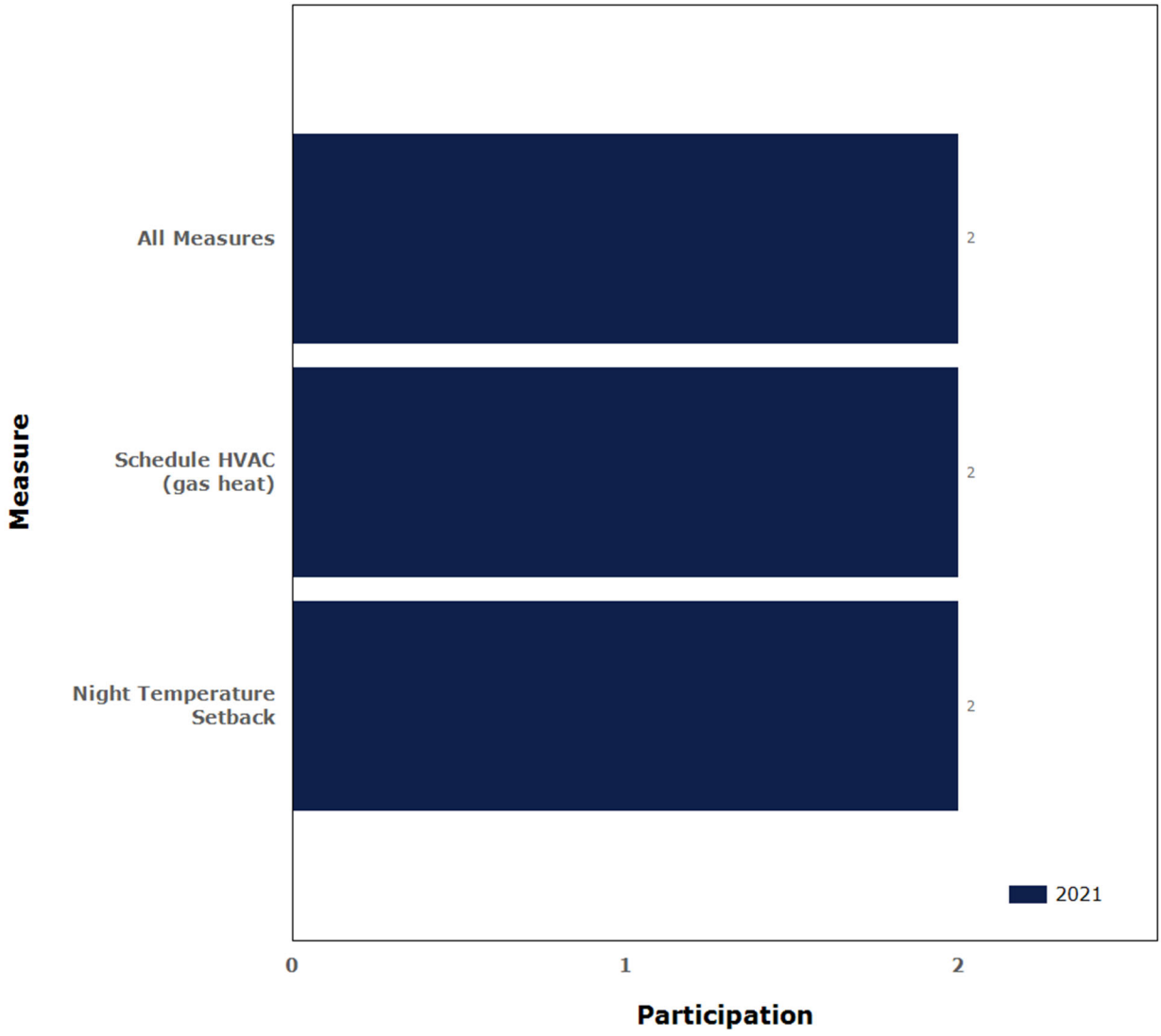
8.1.3.4 Additional North Carolina program data

Additional program data regarding participation and overall program savings for North Carolina are provided below.

Note that participation in these charts is the count of new unique customers in the “all measures” presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the program in previous years. This differs from participation count presented in the Key Virginia program data and Key North Carolina program data sections above, where a participant is only counted once, the first time they receive a rebate. After the first time the participant enrolls in a program, future applications are not counted as a new participant, though their savings are counted. Other detailed program participation and savings at the measure level are provided in Appendix P.18.

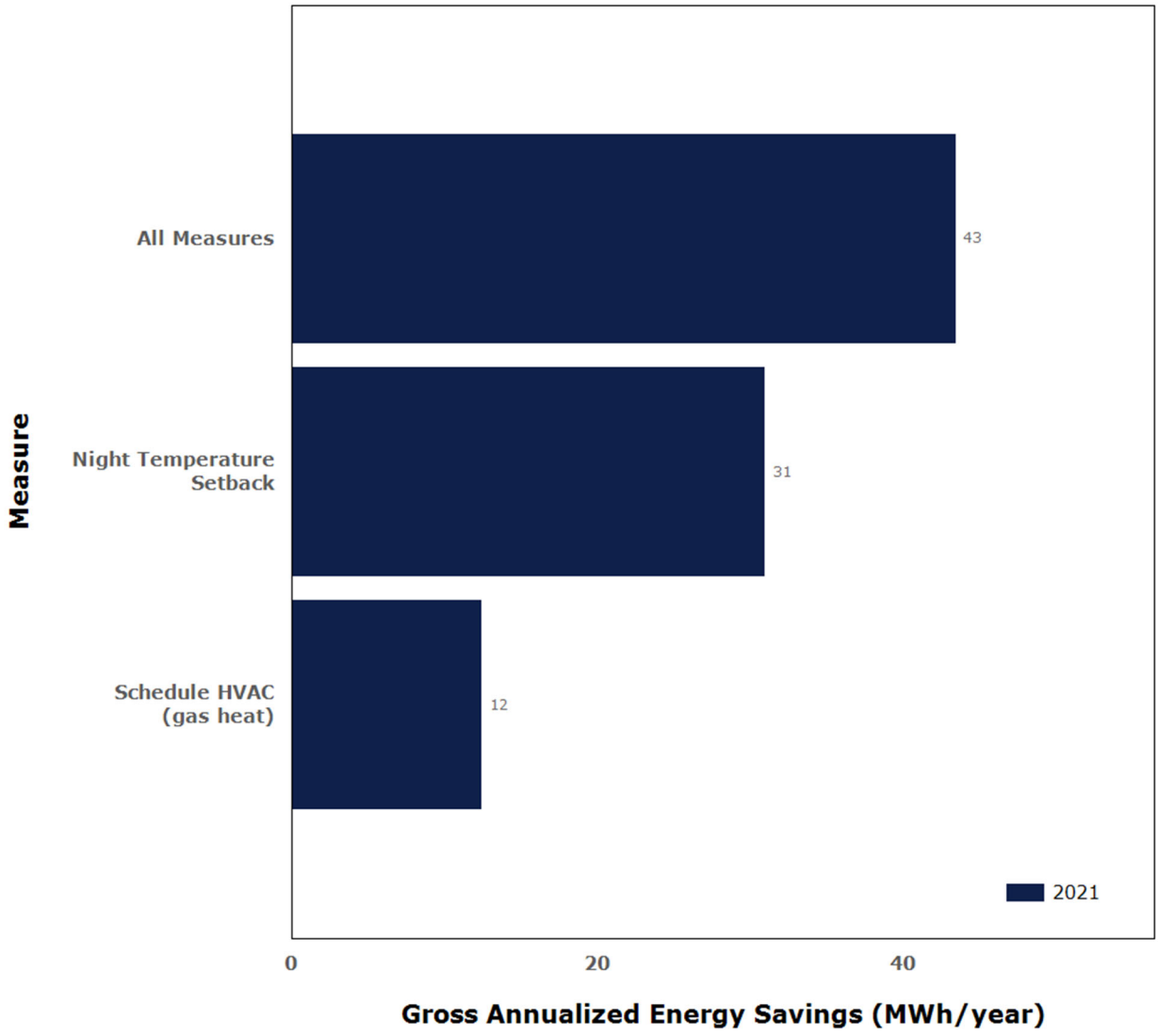
Figure 8-5 shows that 2021 was the first year there was participation in North Carolina. Schedule HVAC and night temperature setback were implemented. There were no participants in 2022.

Figure 8-5. North Carolina Non-Residential Office Program participation by measure and year



The program achieved gross annualized energy savings of 43 MWh/year in 2021, as shown in Figure 8-6. Night temperature setback generated the vast majority of savings, accounting for approximately 72% of 2021 savings. There are no participants in 2022.

Figure 8-6. North Carolina Non-Residential Office Program gross annualized energy savings (MWh/year) by measure and year



8.2 Non-Residential Building Optimization Program – Virginia and North Carolina

8.2.1 Program description

This program expands upon the existing Non-Residential Office Program, providing qualifying non-residential customers with incentives for the installation of energy-efficient improvements. The program includes recommissioning measures for various types of facilities. Measures eligible to receive a rebate include:

- Schedule lighting
- Schedule HVAC
- Temperature setback
- Discharge air temperature reset
- Static pressure reset
- Dual enthalpy economizer
- Condensing water temperature reset
- Variable air volume box minimum
- Coil cleaning
- Pump pressure reduction
- Schedule non-HVAC equipment
- Temperature setup
- Custom retrocommissioning measure
- Outdoor air reduction
- Chilled water reset

This program is implemented through a contractor network and, to be eligible for the rebate, customers must contact a participating contractor. All Dominion Energy non-residential customers are eligible, except for those exempted by statute, special contract, or who have opted out. Customers are considered participants only after a completed application form is processed and a rebate is issued. This process may take several months, as customers have 45 days to submit their rebate application, and Dominion Energy has 90 days to process it.

The Virginia SCC approved this program, as part of the DSM Phase IX programs, on September 7, 2021 (Case No. PUR-2020-00274) for a five-year period of January 1, 2022 through December 31, 2026. The program officially launched in Virginia on January 1, 2022.[227] The North Carolina Utilities Commission approved this program on April 14, 2022 (Docket No. E-22, SUB 614 – 621). The program officially launched in North Carolina on June 1, 2022.[228] Upon approval, the Company worked to finalize data systems, build contractor networks, and finalize implementation details.

During the first year of the program two customers applied for 10 different measures. Despite the COVID-19 pandemic, the program experienced limited impact.

8.2.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program which is included in Appendix E. For the current period, the approach included reviewing the tracking data and estimating gross energy and demand savings using the DE TRM calculations

[227] Virginia Non-Residential Building Optimization Program Terms and Conditions, https://www.dominionenergy.com/-/media/pdfs/virginia/save-energy/building-optimization/nr-building-optimization-terms-conditions.pdf Accessed February 22, 2023.

[228] Schedule CBOT Non-Residential Building Optimization Program, https://www.dominionenergy.com/-/media/pdfs/north-carolina---electric/business-rates/schedule-cbot.pdf Accessed February 22, 2022.

located in Appendix F. Table 8-4 outlines Dominion Energy's initial program planning assumptions that were used to design the program.

Table 8-4. Non-Residential Building Optimization Program (Phase IX) Planning Assumptions System-wide

Assumption	Value
Target Market	Non-residential customers
NTG Factor	90%
Measure Life (years)	7
Gross Average Annual Energy Savings per Participant (kWh/year)	182,885
Gross Average Summer Coincident Peak Demand Reduction per Participant (kW)	18.45
Gross Average Winter Coincident Peak Demand Reduction per Participant (kW)	97.09
Net Average Annual Energy Savings per Participant (kWh/year)	164,596
Net Average Summer Coincident Peak Demand Reduction (kW) per Participant	16.61
Net Average Winter Coincident Peak Demand Reduction (kW) per Participant	87.38
Average Rebate (US$) per Participant	$14,864

8.2.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction. Table 8-5 provides performance indicator data annually and from program inception through 2022. Shaded cells are considered extraordinarily sensitive information. Appendix O.30 shows detailed program indicators by year and month. Appendix Q shows cumulative gross and net savings.

8.2.3.1 Key Virginia program data

Table 8-5. Virginia Non-Residential Building Optimization Program performance indicators (2021-2022)

Category	Item	2021	2022	Program total (2021–2022)
Operations and Management Costs ($)	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect Other (Administrative)	$328	$21,019	$21,347
Total Costs ($)	Total[229]	$6,996	$503,402	$510,398
	Planned	$0	$1,100,849	$1,100,849
	Variance	$6,996	-$597,447	-$590,451
	Annual % of Planned	N/A	46%	46%

[229] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2021	2022	Program total (2021–2022)
Participants	Total (Gross)	0	2	2
	Planned (Gross)	0	28	28
	Variance	0	-26	-26
	Annual % of Planned (Gross)	N/A	7%	7%
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0	1,783,034	1,783,034
	Realization Rate	N/A	100%	100%
	Realization Rate Adjustment	0	0	0
	Adjusted Gross Savings	0	1,783,034	1,783,034
	Net-to-Gross Ratio	N/A	90%	90%
	Net-to-Gross Adjustment	0	-178,303	-178,303
	Net Adjusted Savings	0	1,604,731	1,604,731
	Planned Savings (Net)	0	4,608,702	4,608,702
	Annual % Toward Planned Savings (Net)	N/A	34.8%	34.8%
	Avg. Savings per Participant (Gross)	N/A	891,517	891,517
	Avg. Savings per Participant (Net)	N/A	802,365	802,365
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0
	Planned Demand (Net)	0.0	465.0	465.0
	Annual % Toward Planned Demand (Net)	N/A	0%	0%
	Avg. Peak Demand per Participant (Gross)	N/A	0.0	0.0
	Avg. Demand per Participant (Net)	N/A	0.0	0.0
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	0.0	0.0	0.0
	Realization Rate	N/A	N/A	N/A
	Realization Rate Adjustment	0.0	0.0	0.0
	Adjusted Gross Demand	0.0	0.0	0.0
	Net-to-Gross Ratio	N/A	N/A	N/A
	Net-to-Gross Adjustment	0.0	0.0	0.0
	Net Adjusted Demand	0.0	0.0	0.0
	Planned Demand (Net)	0.0	2,446.8	2,446.8
	Annual % Toward Planned Demand (Net)	N/A	0%	0%
	Avg. Peak Demand per Participant (Gross)	N/A	0.0	0.0
	Avg. Demand per Participant (Net)	N/A	0.0	0.0

Category	Item	2021	2022	Program total (2021–2022)
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	$10,673	$10,673
	Cml Annual $Admin. per kWh/year (Gross)	N/A	$0.01	$0.01
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A
	Cml Annual $EM&V per Total Costs ($)	35.2%	15.8%	15.8%
	Cml Annual $Rebate per Participant (Gross)	N/A	$39,890	$39,890

8.2.3.2 Key North Carolina program data

Key data highlights for enrollment, energy savings, demand reduction and program costs for North Carolina appear below. Following this summary, Table 8-6 provides performance indicator data for the year. Shaded cells are considered extraordinarily sensitive information. Appendix P.19 provides detailed program indicators by year and month and a comparison of program savings with usage by rate schedule. Appendix Q shows cumulative gross and net savings.

Table 8-6. North Carolina Non-Residential Building Optimization Program performance indicators (2022)

Category	Item	2022
Operations and Management Costs ($)	[redacted]	[redacted]
	[redacted]	[redacted]
	[redacted]	[redacted]
	Indirect Other (Administrative)	$402
Total Costs ($)	Total[230]	$9,639
	Planned	$28,217
	Variance	-$18,577
	Annual % of Planned	34%
Participants	Total (Gross)	0
	Planned (Gross)	2
	Variance	-2
	Annual % of Planned (Gross)	0%

[230] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2022
Installed Energy Savings (kWh/year)	Total Gross Deemed Savings	0
	Realization Rate	N/A
	Realization Rate Adjustment	0
	Adjusted Gross Savings	0
	Net-to-Gross Ratio	N/A
	Net-to-Gross Adjustment	0
	Net Adjusted Savings	0
	Planned Savings (Net)	329,193
	Annual % Toward Planned Savings (Net)	0%
	Avg. Savings per Participant (Gross)	N/A
	Avg. Savings per Participant (Net)	N/A
Installed Summer Demand Reduction (kW)	Total Gross Deemed Demand	0.0
	Realization Rate	N/A
	Realization Rate Adjustment	0.0
	Adjusted Gross Demand	0.0
	Net-to-Gross Ratio	N/A
	Net-to-Gross Adjustment	0.0
	Net Adjusted Demand	0.0
	Planned Demand (Net)	33.2
	Annual % Toward Planned Demand (Net)	0%
	Avg. Peak Demand per Participant (Gross)	N/A
	Avg. Demand per Participant (Net)	N/A
Installed Winter Demand Reduction (kW)	Total Gross Deemed Demand	0.0
	Realization Rate	N/A
	Realization Rate Adjustment	0.0
	Adjusted Gross Demand	0.0
	Net-to-Gross Ratio	N/A
	Net-to-Gross Adjustment Net-to-Gross Adjustment	0.0
	Net Adjusted Demand	0.0
	Planned Demand (Net)	174.8
	Annual % Toward Planned Demand (Net)	0%
	Avg. Peak Demand per Participant (Gross)	N/A
	Avg. Demand per Participant (Net)	N/A

Category	Item	2022
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A
	Cml Annual $Admin. per kWh/year (Gross)	N/A
	Cml Annual $Admin. per kW (Gross)	N/A
	Cml Annual $EM&V per Total Costs ($)	22.8%
	Cml Annual $Rebate per Participant (Gross)	N/A

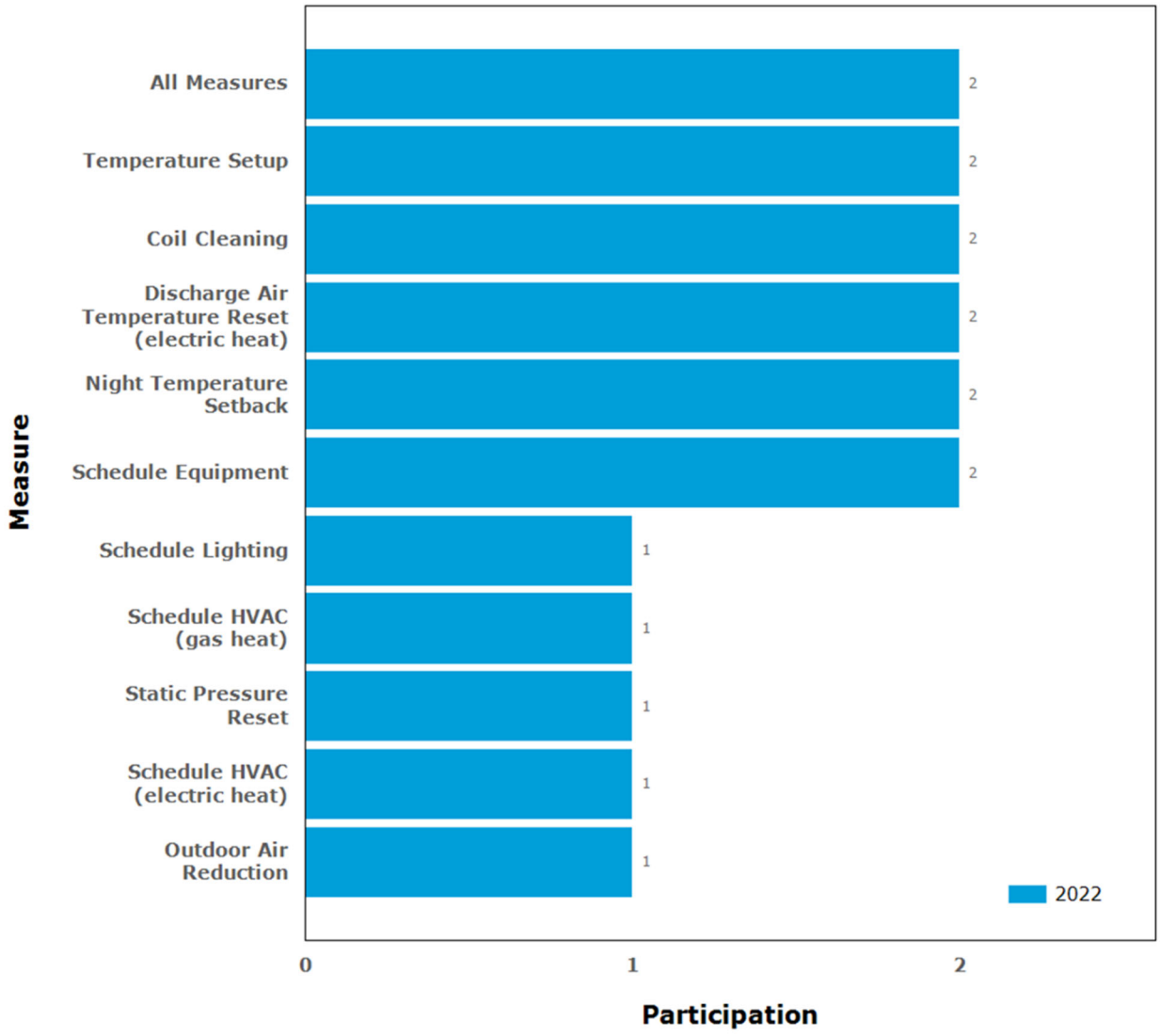
8.2.3.3 Additional Virginia program data

Additional program data regarding participation and overall program savings for Virginia are provided below.

Note that participation in these charts is the count of new unique customers in the “all measures” presentation of the results. The results by specific measure names count all participants who installed measures in that year, regardless of whether they participated in the program in previous years. This differs from participation count presented in the Key Virginia Program Data and Key North Carolina Program Data sections above, where a participant is only counted once, the first time they receive a rebate. After the first time the participant enrolls in a program, future applications are not counted as a new participant, though their savings are counted. Other detailed program participation and savings at the measure level are provided in Appendix O.30.

Figure 8-7 shows that 10 measures were implemented in 2022, including measures for both HVAC and lighting equipment.

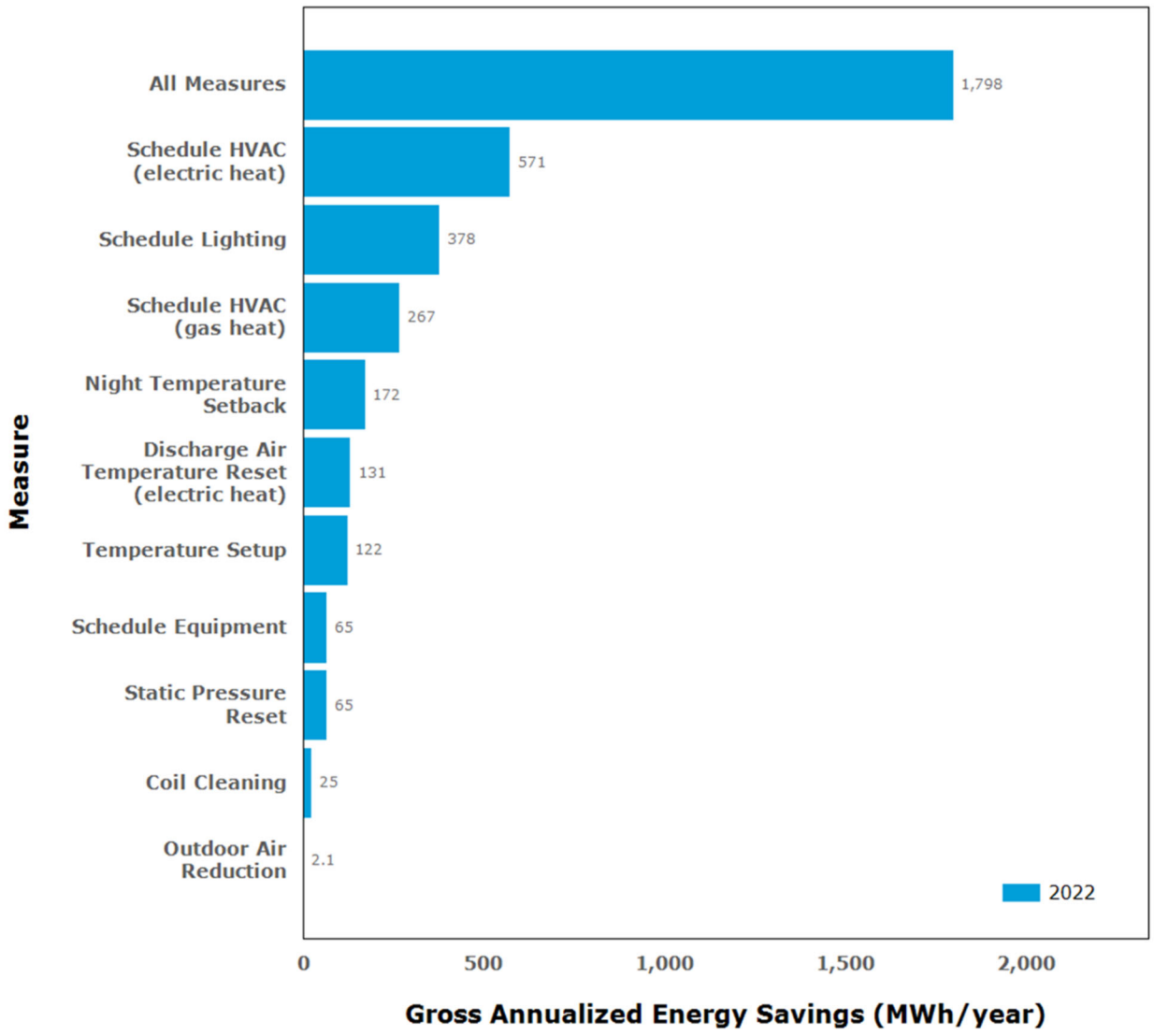
Figure 8-7. Virginia Non-Residential Building Optimization Program participation by measure and year



The program achieved gross annualized energy savings of 1,798 MWh/year in 2022, as shown in Figure 8-8. Schedule HVAC for both gas heating and electric heating makes up 47% of the total savings in 2022 and schedule lighting makes up

21% of the total savings. The building type information was not gathered for the participants, Therefore, there is not a figure showing the breakdown by building types.

Figure 8-8. Virginia Non-Residential Building Optimization Program gross annualized energy savings (MWh/year) by measure and year



8.2.3.4 Additional North Carolina program data

No North Carolina customers have participated in the program in 2022 or before.

8.3 Non-Residential Building Automation and Controls Program – Virginia and North Carolina

8.3.1 Program description

The Non-Residential Building Automation and Controls program provides businesses with energy savings through increased efficiency via the use of system automation and controls. This includes incentives to install new automation systems or to replace antiquated systems when deemed necessary.

Non-residential customers must be the owner of the facility, responsible for their own electric bill, and have not opted out of the DSM rider. Customers are allowed to receive a rebate for each location where they operate, but they cannot claim a rebate if they received another rebate for the same measure at the same location.

The Non-Residential Building Automation and Controls program is available to customers with diverse or custom facilities that meet the above qualifying conditions. This program:

- Recommends design improvements including adding new or upgrading existing control features that are tailored for their facility(ies)
- Provides savings estimates to help the customer better understand the long-term benefits of their new systems
- Offers financial incentives to offset the cost of installing the recommended design improvements.

This program is promoted and marketed by contractors who specialize in the design, installation, and maintenance of fully functional building automation systems and can provide the customer with comprehensive automation solutions. Equipment product lines include brands such as Carrier, Schneider Electric, Johnson Controls, Siemens, and Trane.

The Virginia SCC approved the Non-Residential Building Automation and Controls program as part of the DSM Phase IX programs on September 7, 2021 (Case No. PUR – 2020 – 00274) for the five-year period of January 1, 2022, through December 31, 2026. The program officially launched in Virginia on January 1, 2022. The North Carolina Utilities Commission approved the Non-Residential Building Automation and Controls program as part of the DSM Phase IX programs on May 10, 2022 (Docket No. E-22, SUB 614). The program officially launched in North Carolina on August 1, 2022.

Due to long measure installation lead times, the Non-Residential Building Automation and Controls program had no participants in 2022 even though the project was officially launched at the beginning of the year.

8.3.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program, which is included in Appendix E. For the current period, the approach included reviewing the tracking data, then estimating gross energy and demand savings using the DE TRM calculations located in Appendix F. Table 8-7 outlines Dominion Energy's initial program planning assumptions, which were used to design the program.

Table 8-7. Non-Residential Building Automation and Controls (Phase IX) planning assumptions system-wide

Assumption	Value
Target market	Non-Residential customers
NTG factor	90%
Measure life (years)	20
Average annual energy savings per participant (kWh/year)	149,999
Gross average summer coincident peak demand reduction (kW) per participant	15.13
Gross average winter coincident peak demand reduction (kW) per participant	79.64
Net average annual energy savings per participant (kWh/year)	134,999
Net average summer coincident peak demand reduction (kW) per participant	13.62
Net average winter coincident peak demand reduction (kW) per participant	71.67
Average rebate (US$) per participant	$7,500

8.3.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

8.3.3.1 Key Virginia program data

Key data highlights for enrollment, energy savings, demand reduction, and program costs for Virginia appear below. Following this summary, Table 8-8 provides performance indicator data annually and from program inception. Shaded cells are considered extraordinarily sensitive information. Appendix O.31 provides detailed program indicators by year and month, cumulative gross and net savings, program performance by measure, and a comparison of program savings with usage by rate schedule.

Table 8-8. Virginia Non-Residential Building Automation and Controls (Phase IX) program performance indicators (2021–2022)[231]

Category	Item	2021	2022	Program total (2021–2022)
Operations and management costs ($)	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect other (administrative)	$315	$17,764	$18,079
Total costs ($)	Total[232]	$6,714	$425,457	$432,171
	Planned	$0	$961,106	$961,106
	Variance	$6,714	-$535,649	-$528,934
	Annual % of planned	N/A	44%	45%

[231] The sum of the individual annual values may differ from the total value due to rounding.

[232] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2021	2022	Program total (2021–2022)
Participants	Total (Gross)	0	0	0
	Planned (Gross)	0	28	28
	Variance	0	-28	-28
	Annual % of planned (gross)	N/A	0%	0%
Installed energy savings (kWh/year)	Total gross deemed savings	0	0	0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0	0	0
	Adjusted gross savings	0	0	0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0	0	0
	Net adjusted savings	0	0	0
	Planned savings (Net)	0	3,779,975	3,779,975
	Annual % toward planned savings (Net)	N/A	0%	0%
	Avg. savings per participant (Gross)	N/A	N/A	N/A
	Avg. savings per participant (Net)	N/A	N/A	N/A
Installed summer demand reduction (kW)	Total gross deemed demand	0.0	0.0	0.0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0.0	0.0	0.0
	Adjusted gross demand	0.0	0.0	0.0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0.0	0.0	0.0
	Net adjusted demand	0.0	0.0	0.0
	Planned demand (Net)	0.0	381.4	381.4
	Annual % toward planned demand (Net)	N/A	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A	N/A
Installed winter demand reduction (kW)	Total gross deemed demand	0.0	0.0	0.0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0.0	0.0	0.0
	Adjusted gross demand	0.0	0.0	0.0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0.0	0.0	0.0
	Net adjusted demand	0.0	0.0	0.0
	Planned demand (Net)	0.0	2,006.8	2,006.8
	Annual % toward planned demand (Net)	0%	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A	N/A

Category	Item	2021	2022	Program total (2021–2022)
Program performance	Cml Annual $Admin. per participant (Gross)	N/A	N/A	N/A
	Cml Annual $Admin. per kWh/year (Gross)	N/A	N/A	N/A
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A
	Cml Annual $EM&V per total costs ($)	32.6%	6.6%	6.6%
	Cml Annual $Rebate per participant (Gross)	N/A	N/A	N/A

8.3.3.2 Key North Carolina program data

Key data highlights for enrollment, energy savings, demand reduction, and program costs for North Carolina appear below. Following this summary, Table 8-9 provides performance indicator data annually and from program inception. Shaded cells are considered extraordinarily sensitive information.

Appendix P.20 provides detailed program indicators by year and month, cumulative gross and net savings, program performance by measure, and a comparison of program savings with usage by rate schedule.

Table 8-9. North Carolina Non-Residential Building Automation and Controls (Phase IX) program performance indicators (2022) [233]

Category	Item	2022	Program total (2022)
Operations and management costs ($)	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	Indirect other (administrative)	$388	$388
Total costs ($)	Total[234]	$9,301	$9,301
	Planned	$24,635	$24,635
	Variance	-$15,334	-$15,334
	Annual % of planned	38%	38%
Participants	Total (Gross)	0	0
	Planned (Gross)	2	2
	Variance	-2	-2
	Annual % of planned (Gross)	0%	0%

[233] The sum of the individual annual values may differ from the total value due to rounding.

[234] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2022	Program total (2022)
Installed energy savings (kWh/year)	Total gross deemed savings	0	0
	Realization rate	N/A	N/A
	Realization rate adjustment	0	0
	Adjusted gross savings	0	0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0	0
	Net adjusted savings	0	0
	Planned savings (Net)	269,998	269,998
	Annual % toward planned savings (Net)	0%	0%
	Avg. Savings per participant (Gross)	N/A	N/A
	Avg. Savings per participant (Net)	N/A	N/A
Installed summer demand reduction (kW)	Total gross deemed demand	0.0	0.0
	Realization rate	N/A	N/A
	Realization rate adjustment	0.0	0.0
	Adjusted gross demand	0.0	0.0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0.0	0.0
	Net adjusted demand	0.0	0.0
	Planned demand (Net)	27.2	27.2
	Annual % toward planned demand (Net)	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A
Installed winter demand reduction (kW)	Total gross deemed demand	0.0	0.0
	Realization rate	N/A	N/A
	Realization rate adjustment	0.0	0.0
	Adjusted gross demand	0.0	0.0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0.0	0.0
	Net adjusted demand	0.0	0.0
	Planned demand (Net)	143.3	143.3
	Annual % toward planned demand (Net)	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A

Category	Item	2022	Program total (2022)
Program performance	Cml Annual $Admin. per participant (Gross)	N/A	N/A
	Cml Annual $Admin. per kWh/year (Gross)	N/A	N/A
	Cml Annual $Admin. per kW (Gross)	N/A	N/A
	Cml Annual $EM&V per total costs ($)	4.5%	4.5%
	Cml Annual $rebate per participant (Gross)	N/A	N/A

8.3.3.3 Additional Virginia program data

No Virginia customers participated in the program in 2022.

8.3.3.4 Additional North Carolina program data

No North Carolina customers participated in the program in 2022.

8.4 Non-Residential Engagement Program – Virginia and North Carolina

8.4.1 Program description

The Non-Residential Engagement program is intended to educate commercial building operators on best practices to optimize their buildings' energy performance.

To be eligible for this program, the customer must be a non-residential customer and must not have opted-out of the Demand Side Management/Energy Efficiency Riders.

The program provides educational and technical resources to qualifying facility management staff via a customer engagement online portal. The portal presents the information as a series of challenges and allows the customer to earn points and compete against other facility teams from other buildings.

The challenges include but are not limited to the following:

- Review outside air damper operation
- Minimize the introduction of outside air
- Review of supply fan operation and minimum flow setpoints
- Review of airside economizer operation and performance
- Review of air-handler supply air temperature sequences and setpoints
- Review of HVAC schedules and zone temperature setbacks
- Review lighting schedules and alignment with occupancy and use
- Review lighting levels
- Review condenser water setpoint and sequencing
- Review chilled water temperature setpoint and sequencing
- Review off-peak heating loads and lockouts
- Review AHU static pressure setpoints and sequencing
- VAV box sequencing

The program provides customers access to the engagement portal and vendor expertise at no cost to the customer.

As the Non-Residential Engagement program was not approved until 2022 and customers are required to complete a full twelve-month enrollment in the customer engagement online portal, there were no participants in 2022.

The SCC approved the Non-Residential Engagement program as part of the DSM Phase IX programs on September 7, 2021 (Case No. PUR – 2020 – 00274) for the five-year period of January 1, 2022, through December 31, 2026. The

program officially launched in Virginia on April 10, 2023. The North Carolina Utilities Commission approved the Non-Residential Engagement program as part of the DSM Phase IX programs on May 10, 2022 (Docket No. E-22, SUB 616).[235]

8.4.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program which is included in Appendix E. For the current period, the approach included reviewing the tracking data, then estimating gross energy and demand savings using the DE TRM calculations located in Appendix F. Table 8-10 outlines Dominion Energy's initial program planning assumptions, which were used to design the program.

Table 8-10. Non-Residential Engagement (Phase IX) planning assumptions system-wide

Assumption	Value
Target market	Non-Residential customers
NTG factor	90%
Measure life (years)	7
Average annual energy savings per participant (kWh/year)	81,802
Gross average summer coincident peak demand reduction (kW) per participant	8.25
Gross average winter coincident peak demand reduction (kW) per participant	43.43
Net average annual energy savings per participant (kWh/year)	73,622
Net average summer coincident peak demand reduction (kW) per participant	7.43
Net average winter coincident peak demand reduction (kW) per participant	39.09
Average rebate (US$) per participant	$9,900

8.4.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

8.4.3.1 Key Virginia program data

Key data highlights for enrollment, energy savings, demand reduction, and program costs for Virginia appear below. Following this summary, Table 8-11 provides performance indicator data annually and from program inception. Shaded cells are considered extraordinarily sensitive information. Appendix O.32 provides detailed program indicators by year and month.

Table 8-11. Virginia Non-Residential Engagement Program performance indicators (2021–2022)[236]

Category	Item	2021	2022	Program total (2021–2022)
Operations and management costs ($)				
	Indirect other (administrative)	$380	$25,032	$25,412

[235] Non-Residential Customer Engagement program website. Accessed April 11, 2023. https://domsavings.com/building-automation-controls/building-engagement-virginia/
[236] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2021	2022	Program total (2021–2022)
Total costs ($)	Total	$8,109	$599,509	$607,618
	Planned	$0	$1,536,746	$1,536,746
	Variance	$8,109	-$937,237	-$929,128
	Annual % of planned	N/A	39%	40%
Participants	Total (Gross)	0	0	0
	Planned (Gross)	0	54	54
	Variance	0	-54	-54
	Annual % of planned (Gross)	N/A	0%	0%
Installed energy savings (kWh/year)	Total gross deemed savings	0	0	0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0	0	0
	Adjusted gross savings	0	0	0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0	0	0
	Net adjusted savings	0	0	0
	Planned savings (Net)	0	3,975,577	3,975,577
	Annual % toward planned savings (Net)	N/A	0%	0%
	Avg. savings per participant (Gross)	N/A	N/A	N/A
	Avg. savings per participant (Net)	N/A	N/A	N/A
Installed summer demand reduction (kW)	Total gross deemed demand	0.0	0.0	0.0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0.0	0.0	0.0
	Adjusted gross demand	0.0	0.0	0.0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0.0	0.0	0.0
	Net adjusted demand	0.0	0.0	0.0
	Planned demand (Net)	0.0	401.0	410.0
	Annual % toward planned demand (Net)	N/A	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A	N/A

Category	Item	2021	2022	Program total (2021–2022)
Installed winter demand reduction (kW)	Total gross deemed demand	0.0	0.0	0.0
	Realization rate	N/A	N/A	N/A
	Realization rate adjustment	0.0	0.0	0.0
	Adjusted gross demand	0.0	0.0	0.0
	Net-to-gross ratio	N/A	N/A	N/A
	Net-to-gross adjustment	0.0	0.0	0.0
	Net adjusted demand	0.0	0.0	0.0
	Planned demand (Net)	0.0	2,110.7	2,110.7
	Annual % toward planned demand (Net)	0%	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A	N/A
Program performance	Cml annual $admin. per participant (Gross)	N/A	N/A	N/A
	Cml annual $admin. per kWh/year (Gross)	N/A	N/A	N/A
	Cml annual $admin. per kW (Gross)	N/A	N/A	N/A
	Cml annual $EM&V per total costs ($)	43.4%	7.7%	7.7%
	Cml annual $rebate per participant (Gross)	N/A	N/A	N/A

8.4.3.2 Key North Carolina program data

Key data highlights for enrollment, energy savings, demand reduction, and program costs for North Carolina appear below. Following this summary, Table 8-12 provides performance indicator data annually and from program inception. Shaded cells are considered extraordinarily sensitive information.

Appendix P.21 provides detailed program indicators by year and month.

Table 8-12. North Carolina Non-Residential Engagement (Phase IX) Program performance indicators (2022)[237]

Category	Item	2022	Program total (2022)
Operations and management costs ($)	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]
	Indirect other (administrative)	$627	$627
Total costs ($)	Total	$15,022	$15,022
	Planned	$55,717	$55,717
	Variance	-$40,695	-$40,695
	Annual % of planned	27%	27%

[237] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2022	Program total (2022)
Participants	Total (Gross)	0	0
	Planned (Gross)	3	3
	Variance	-3	-3
	Annual % of planned (Gross)	0%	0%
Installed energy savings (kWh/year)	Total gross deemed savings	0	0
	Realization rate	N/A	N/A
	Realization rate adjustment	0	0
	Adjusted gross savings	0	0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0	0
	Net adjusted savings	0	0
	Planned savings (Net)	220,865	220,865
	Annual % toward planned savings (Net)	0%	0%
	Avg. savings per participant (Gross)	N/A	N/A
	Avg. savings per participant (Net)	N/A	N/A
Installed summer demand reduction (kW)	Total gross deemed demand	0.0	0.0
	Realization rate	N/A	N/A
	Realization rate adjustment	0.0	0.0
	Adjusted gross demand	0.0	0.0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0.0	0.0
	Net adjusted demand	0.0	0.0
	Planned demand (Net)	22.3	22.3
	Annual % toward planned demand (Net)	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A
Installed winter demand reduction (kW)	Total gross deemed demand	0.0	0.0
	Realization rate	N/A	N/A
	Realization rate adjustment	0.0	0.0
	Adjusted gross demand	0.0	0.0
	Net-to-gross ratio	N/A	N/A
	Net-to-gross adjustment	0.0	0.0
	Net adjusted demand	0.0	0.0
	Planned demand (Net)	117.3	117.3
	Annual % toward planned demand (Net)	0%	0%
	Avg. peak demand per participant (Gross)	N/A	N/A
	Avg. demand per participant (Net)	N/A	N/A

Category	Item	2022	Program total (2022)
Program performance	Cml annual $admin. per participant (Gross)	N/A	N/A
	Cml annual $admin. per kWh/year (Gross)	N/A	N/A
	Cml annual $admin. per kW (Gross)	N/A	N/A
	Cml annual $EM&V per total costs ($)	4.4%	4.4%
	Cml annual $rebate per participant (Gross)	N/A	N/A

8.4.3.3 Additional Virginia Program data

No Virginia customers participated in the program in 2022.

8.4.3.4 Additional North Carolina Program data

No North Carolina customers participated in the program in 2022.

9 PEAK SHAVING

9.1 Residential Smart Cooling Rewards – Virginia and North Carolina

9.1.1 Program description

The Residential Smart Cooling Rewards Program was implemented in Virginia and in North Carolina to provide a supply resource by shaving summer peak electric demand by curtailing air-conditioner load. It served residential customers living in owner-occupied single-family homes, townhouses, or condominiums with central air conditioners or heat pumps. The Smart Cooling Rewards Program closed at the end of 2022, and over its 13-year life, enrolled 166,461 customers. At its peak in June 2016, the program provided 104,783 kW of summer demand reduction potential. Over the course of the program there were 278 events called representing 855 event hours.

9.1.2 Program performance

The annual Impact Evaluation of 2022 Dispatch Events can be found in Appendix L and is summarized below. Demand reduction impacts were realized from approximately 59,400 customers (and 62,400 air conditioning unts). The objectives of the evaluation are to estimate the average kW impacts of demand reduction for each event hour during the event and by event-hour in varying temperature and humidity conditions including Dominion Energy's summer peak planning conditions.

9.1.2.1 Key findings

- Ex post impacts over the 67 event hours in 2022 ranged from 0.30 kW to 0.64 kW per participant. The lowest average event impact occurred on June 30 and the highest on August 4 and August 10.
- The proportion of program participants with AMI data increased from 10% in 2020 to 27% in 2021 and to 63% in 2022 due to the accelerated deployment of AMI meters in Dominion Energy's service territory. Most of the expansion in AMI meters occurred in the Eastern and Central Divisions.

In 2022, the evaluated load impact for weather conditions observed during Dominion Energy's peak day conditions was 0.49 kW per participant.

9.1.3 Assessment of program progress toward plan

Table 9-2 and Table 9-3 summarize the annual progress toward plan for key AC Cycling performance indicators in Virginia and North Carolina, respectively. The shaded cells are considered extraordinarily sensitive information. Appendix O.33 (Virginia) and Appendix P.22 (North Carolina) provide detailed indicators by year and month. Appendix Q shows the cumulative net reduction (kW) by year and month.

The 2022 kW peak shaving potential of 26,958 kW for Virginia and 1,148 kW for North Carolina represent 89% and 59% of the planned targets respectively. Virginia participation was 96% of the planned goal and North Carolina's participation was 64% of planned goal. Consequently, program expenditures were also below plan. The program expenditures, number of participants, and load reduction impact estimates are compared to Dominion Energy's corresponding planning numbers in Table 9-1.

Table 9-1. AC Cycling Program planning assumptions

Assumption	Value
Target Market	Owner-occupied SF-family home, townhouse, or condominium
Measure Life (years)	15 years
Average Number of AC Switches/Premise	1.13

9.1.3.1 Cumulative indicators over time vs. planned — Virginia and North Carolina

Table 9-2. Virginia Residential AC Cycling Program performance indicators (2010–2022)[238]

Category	Item	2021	2022	Program total (2010–2022)
Operations and Management Costs ($)	[redacted]			
	[redacted]			
	[redacted]			
	Indirect Other (Administrative)	$228,463	$188,298	$5,183,132
Capital ($)	Direct Implementation	$25,725	$4,200	$19,201,348
Total Costs ($)	Total	$4,898,125	$4,513,936	$91,980,606
	Planned	$5,734,278	$5,278,587	$123,032,545
	Variance	-$836,152	-$764,651	-$31,051,939
	Cumulative % of Planned	85%	86%	75%
Participants	Total (Cumulative @ End of Month)	156,210	160,172	160,172
	Removals (Uninstalled)/ Deactivations	-95,733	-105,604	-105,604
	Net Participation	60,477	54,568	54,568
	Planned	66,977	57,105	57,105
	Variance	-6,499	-2,537	-2,537
	Cum% toward planned total (Net basis)	90%	96%	96%
	Removal (Uninstalled) /Deactivation Rate	-1.12%	-1.45%	-1.45%
	Connected Load kW	199,450	179,418	179,418
	Ex Ante Estimated kW	0.53	0.49	0.49
	Connected Load Per Participant (kW)	3.30	3.29	3.29
kW Potential	Peak Shaving Potential kW - Gross Participants	83,320.7	79,137.1	79,137.1
	Removed (Uninstalled) / Deactivated Peak Shaving Potential kW	-51,062.9	-52,176.4	-52,176.4
	Dispatchable Peak Shaving Potential – Net Total kW	32,254.5	26,958.0	26,958.0
	Planned Demand	35,721	30,437	30,437
	% Toward Planned Total	90%	89%	89%

[238] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2021	2022	Program total (2010–2022)
Program Performance	$Admin. per Participant (Gross)	$32	$32	$32
	$Admin. per kW (Gross)	$60	$65	$65
	$EM&V per Total Costs ($)	2%	2%	2%
	$Rebate per Participant (Gross)	$206	$213	$213

Table 9-3. North Carolina Residential AC Cycling Program performance indicators (2011–2022)[239]

Category	Item	2021	2022	Program total (2011–2022)
Operations and Management Costs ($)	[redacted]			
	[redacted]			
	[redacted]			
	Indirect Other (Administrative)	$9,310	$8,312	$155,748
Capital ($)	Direct Implementation	$150	$75	$862,499
Total Costs ($)	Total	$198,710	$199,147	$3,787,247
	Planned	$288,782	$278,967	$6,262,647
	Variance	-$90,071	-$79,820	-$2,475,400
	Cumulative % of Planned	69%	71%	60%
Participants	Total (Cumulative @ End of Month)	6,287	6,289	6,289
	Removals (Uninstalled)/ Deactivations	-3,807	-3,965	-3,965
	Net Participation	2,480	2,324	2,324
	Planned	4,275	3,645	3,645
	Variance	-1,795	-1,321	-1,321
	Cum % toward planned total (Net basis)	58%	64%	64%
	Removal (Uninstalled) /Deactivation Rate	-1.01%	-0.55%	-0.55%
	Connected Load kW	10,160	9,357	9,357
	Ex Ante Estimated kW	0.53	0.49	0.49
	Connected Load Per Participant (kW)	4.10	4.03	4.03
kW Potential	Peak Shaving Potential kW - Gross Participants	3,353.4	3,107.2	3,107.2
	Removed (Uninstalled) / Deactivated Peak Shaving Potential kW	-2,030.6	-1,959.0	-1,959.0
	Dispatchable Peak Shaving Potential – Net Total kW	1,323	1,148	1,148

[239] The sum of the individual annual values may differ from the total value due to rounding.

Category	Item	2021	2022	Program total (2011–2022)
	Planned Demand	2,280	1,943	1,943
	% Toward Planned Total	58%	59%	59%
Program Performance	$Admin. per Participant (Gross)	$23	$25	$25
	$Admin. per kW (Gross)	$44	$50	$50
	$EM&V per Total Costs ($)	3%	3%	3%
	$Rebate per Participant (Gross)	$202	$215	$215

Table 9-4. Disposition from cumulative and net participants, and peak shaving potential (kW) (through December 31, 2022)

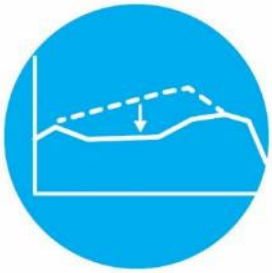
Reduction factor to participants/savings	Participants		Peak shaving potential (kW)	
	Virginia	North Carolina	Virginia	North Carolina
Cumulative Total	160,172	6,289	79,137	3,107
Reduction for Disenrollment	-106,604	-3,965	-52,179	-1,959
Net Total	54,568	2,324	26,958	1,148

9.2 Non-Residential Distributed Generation Program – Virginia

9.2.1 Program description

The DSM Phase II Non-Residential Distributed Generation (DG) program provides qualifying customers with an incentive to curtail load by operating backup generation upon request. Large non-residential customers with least 200 kW of demand are eligible to participate.[240] Each customer site commits to a targeted level of dispatchable power (kW) to be available to the Company to 120 hours per year. Load must be available/dispatchable on 30 minutes' notice. Dispatched power production is measured at each site for each event. The Company has the right to adjust the incentive amount based on evaluated performance if a site's dispatched load is less than 95% of its enrolled load.

The Virginia State Corporation Commission approved the Non-Residential Distributed Generation Pilot on January 17, 2008. The DG Pilot subsequently achieved program status on April 30, 2012, and the pilot officially ended at the end of 2014. In September 2021, the DG program was extended for an additional two years through May 31, 2024.[241] Twenty-one sites were enrolled in 2022, which is consistent with prior years. The fully enrolled program capacity is 5,880 kW.



9.2.2 Methods for the current reporting period

An impact evaluation is conducted annually and the amount of generated load by participant per event-hour interval is measured on-site. Total and average dispatched generation, per event-hour, is aggregated and reported for daily, monthly, seasonal (winter/summer), and yearly intervals. The evaluation methodology is defined in the DE TRM located in Appendix F and has remained consistent over the program's history. A summary of impact results for 2022 are provided in Section 9.2.4 and the detailed impact report can be found in Appendix M.

9.2.3 Computation of demand reduction

The key performance indicator for the Non-Residential DG program is measured kW generated during dispatch events. Site-level realization rates are created by comparing measured generation (kW) to the dispatched power production (kW). Realization rates are calculated for each participant site by event-hour and aggregated to the event, seasonal, and annual level.

9.2.4 Impact analysis of 2022 dispatch events

The Non-Residential DG Program is evaluated annually using metered power production data to verify event based dispatched load. The objectives for the Non-Residential DG impact evaluation are:

1. To compute aggregate kW of load curtailment for one-hour intervals on each event day
2. To compute realization rates comparing dispatched load to generated load reduction
3. To describe trends across event intervals of program performance to planned assumptions

From January 1, 2022, through December 31, 2022, the program achieved an overall realization rate of 104% and exceeded its planned realization rate of 95%. Figure 9-1 shows the summer and winter realization rates by year since 2014. Monthly realization rates ranged from 57% (December) to 116% (July).

240 A participant is defined by its enrolled capacity, and one participant equals 1,000 kW of enrolled generation. The level of incentive corresponds with the kW of enrolled generation capacity and a customer with greater than 1,000 kW of enrolled capacity is counted as more than one participant.

241 Case No. PUR-2020-00274, Commonwealth of Virginia, State Corporation Commission, Petition of Dominion Energy Virginia for approval of its 2020 DSM Update, Final Order September 2021

Figure 9-1. Non-Residential DG annual and seasonal realization rates, 2014–2022

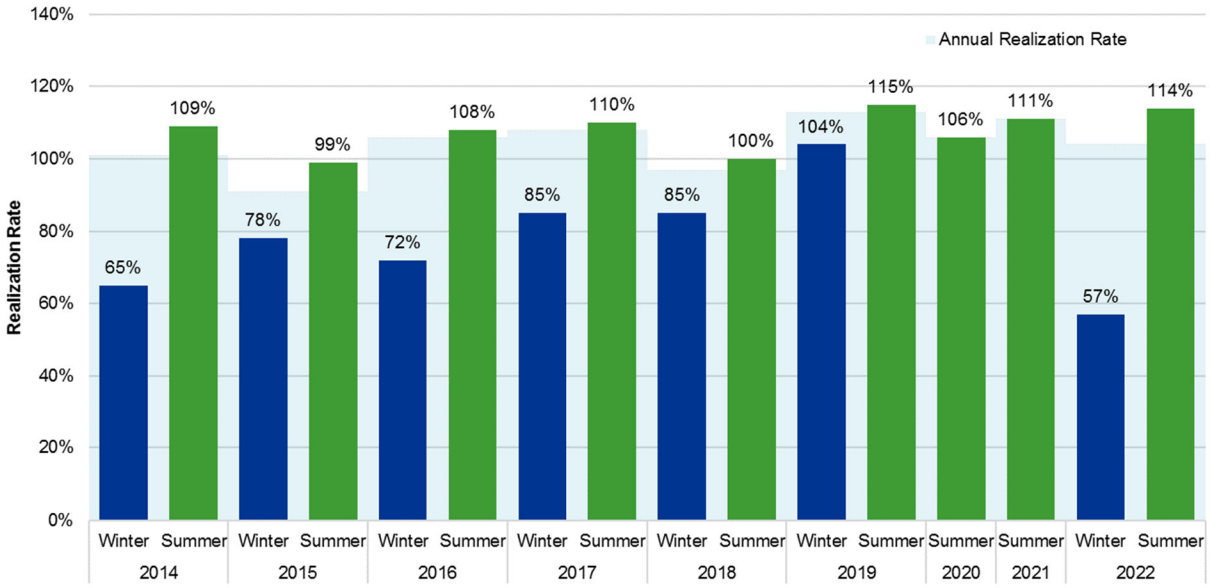


Table 32-5 shows 2022 program performance by kW and month. The total and average dispatched generation for the 2022 event intervals ranged from 3,040 kW to 5,880 over 30 events. Twenty-eight of 28 summer event days (100%) met or exceeded the 95% target average. The highest-performing summer event days occurred on July 24 and August 9, generating 128% of the dispatched load on each of those days. The lowest-performing summer event occurred on June 15, generating 105% of the dispatched load on that day, which still exceeds the 95% target average. Both winter events occurred in December, generating 57% of the dispatched load on those days, which do not achieve the 95% target rate.

Table 32-5. DG Program performance for 2022 events by kW and month

2022	Planned (MW)	Enrolled (MW)	Net kW planned	Net kW enrolled	Event days	Average dispatched (kW)	Average generation (kW)	Average realization rate
May	7.13	5.88	7,130	5,880	2	5,500	6,102	111%
June	7.13	5.88	7,130	5,880	6	5,297	5,900	111%
July	7.13	5.88	7,130	5,880	13	4,609	5,342	116%
August	7.13	5.88	7,130	5,880	7	3,640	4,103	113%
September	No Events							
October	No Events							
November	No Events							
December	7.13	5.88	7,130	5,880	2	5,782	3,284	57%

Table 32-6 outlines the DG program planning assumptions.

Table 32-6. Non-Residential DG Program planning assumptions

Assumption	Value
Target Market	Non-Residential customers with at least 200 kW of backup generation.
Participant Definition	1 participant equals 1,000 kW of enrolled generation. For example, a site with 1,250 kW of generation has a participant value of 1.25.
NTG Factor	100%
Measure Life (years)	N/A

9.2.5 Assessment of program progress toward plan

Table 32-7 summarizes the annual progress toward plan for key program performance indicators in Virginia for the most recent years through the end of 2022. The shaded cells are considered extraordinarily sensitive information. Appendix O.34 provides detailed indicators by month and year. Appendix Q shows cumulative net kW reduction by year and month.

Table 32-7. Virginia Non-Residential Distributed Generation Program performance indicators (2012–2022)[242]

Category	Item	2019	2020	2021	2022	Program total (2012–2022)
Operations and Management Costs ($)						
	Indirect Other (Administrative)	$26,331	$30,369	$28,515	$25,892	$366,473
Total Costs ($)	Total[243]	$589,631	$570,747	$608,132	$620,104	$6,905,228
	Planned	$909,830	$1,014,629	$1,015,757	1,152,161	$14,231,816
	Variance	-$320,199	-$443,882	-$407,626	-$532,057	$7,326,588
	Cumulative % of Planned	65%	56%	60%	54%	49%
Participants	Total (Cumulative @ End of Month)	6.13	6.13	5.97	5.88	5.88
	Planned	7.6	9.0	7.1	7.1	7.1
	Variance	-1.5	-2.9	-1.2	-1.2	-1.2
	% Toward Planned Total (Net basis)	80.7%	67.9%	83.7%	82.5%	82.5%
kW Potential	Total (Cumulative @ End of Month)	6,130	6,130	5,970	5,880	5,880

[242] The sum of the individual annual values may differ from the total value due to rounding.

[243] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

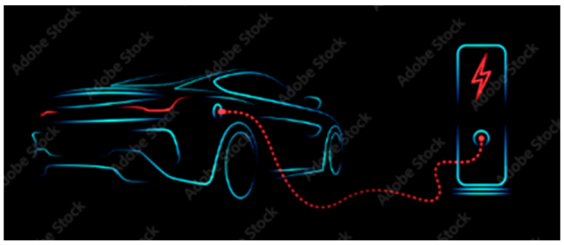
Category	Item	2019	2020	2021	2022	Program total (2012–2022)
	Realization Rate	113%	106%	111%	104%	104%
	Net kW	6,927	6,498	6,627	6,115	6,115
	Planned	7,592	9,025	7,130	7,130	7,130
	% Toward Planned Total (Net basis)	91.24%	72.00%	92.95%	85.77%	85.77%
	Avg. per Net Participant (Net kW)	1,130	1,060	1,110	1,039.97	924.61
Program Performance	Cml Annual $Admin. per Participant (Gross)	$45,954	$50,908	$57,049	$62,325	$62,325
	Cml Annual $Admin. per kW (Gross)	$46	$51	$57	$62	$62
	Cml Annual $EM&V per Total Costs ($)	13.4%	13.2%	13.4%	13.3%	13.3%
	Cml Annual $Rebate per Participant (Gross)	$651,772	$728,973	$828,578	$927,835	$927,835

9.3 Residential Electric Vehicle Rewards Program – Virginia

9.3.1 Program description

The Electric Vehicle Rewards Program provides annual on-bill incentives to residential customers for allowing Dominion to adjust the charging schedule or speed of the charger during periods of high electricity demand. Participants receive an annual rebate for ongoing participation.

Demand response events are called by the Company during times of peak system demand throughout the year to reduce the electric vehicle charging load while encouraging customers to charge their vehicles during off-peak hours. Events can be for up to a four-hour period, with a maximum of 45 demand response events per year (and a maximum of 15 events per month). Customers may opt out of any demand response event. To date, the Company has called one demand response event, on August 30, 2022, with 397 chargers dispatched.



To participate in this program, a customer must own or purchase an eligible Level 2 charger. Dominion provides a separate rebate to participants for the purchase of eligible Level 2 chargers. The charger incentive rebate program is described in Section 2.5. Participant counts in this section include participants in that charger incentive rebate program who are also enrolled in the Electric Vehicle Rewards Program.

The Virginia SCC approved this program, as part of the DSM Phase VIII programs, on July 30, 2020, (PUR-2019-00201) for a five-year period of January 1, 2021, through December 31, 2025. The program officially launched on March 1, 2021.[244]

In 2022, EV program participation was impacted by difficulties in the launch and integration of the demand response program. While only two chargers are currently eligible for participation due to difficulties in integration with the program implementer's system, Dominion plans to add two more chargers to the list of those eligible in 2023.

9.3.2 Methods for the current reporting period

DNV developed an EM&V Plan for this program, which is included in Appendix E. Table 9-8 outlines Dominion Energy's initial program planning assumptions. DNV uses the planned NTG factor in its net savings calculations until it is verified through EM&V.

Table 9-8. Residential Electric Vehicle Rewards Program planning assumptions system-wide

Assumption	Description
Target Market	Residential customers
NTG Factor	93%
Measure Life (years)	10
Gross Average Annual Energy Savings per Participant (kWh/year)	0
Net Average Annual Energy Savings per Participant (kWh/year)	0
Net Average Coincident Peak Demand Reduction per Participant (kW)	1.00
Average Rebate (US$) per Participant per Year	$40.00

[244] Residential Electric Vehicle Program Terms and Conditions, https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/virginia/save-energy/ev/evse-eedr-tcs-final.pdf. Accessed March 28, 2022.

9.3.3 Assessment of program progress toward plan

The next section describes the program's progress toward planned participants, energy savings, and demand reduction.

9.3.3.1 Key Virginia program data

Table 9-9 provides performance indicator data annually and cumulatively from program inception through 2022. Shaded cells are considered extraordinarily sensitive information. Appendix O.35 provides detailed program indicators by year and month, program performance by measure, and a comparison of program savings with usage by rate schedule. Appendix Q provides cumulative gross and net savings.

Table 9-9. Virginia Residential Electric Vehicle Rewards Program performance indicator data (2020–2022)

Category	Item	2020	2021	2022	Program total (2020–2022)
Operations and Management Costs ($)					
	Indirect Other (Administrative)	$599	$8,557	$7,472	$16,628
Total Costs ($)	Total[245]	$14,036	$182,492	$178,959	$375,487
	Planned	$0	$299,301	$315,959	$615,260
	Variance	$14,036	-$116,809	-$137,000	-$239,773
	Annual % of Planned	N/A	61%	57%	61%
Participants	Total (Cumulative @ End of Month)	0	0	686	686
	Removals (Uninstalled) / Deactivations	0	0	0	0
	Opt-outs	0	0	0	0
	Adjusted Participants (Cml)	0	0	686	686
	Net Participation (Cml)	0	0	686	686
	Planned (Cml)	0	652	831	831
	Variance (Cml)	0	-652	-145	-145
	Cum % toward planned total (Net basis)	N/A	0%	82.6%	82.6%
	Ex Ante Estimated kW	0	0	0	0
Summer kW Potential	Summer Peak Shaving Potential kW – Gross Participants	0	0	0	0
	Removed (Uninstalled) / Deactivated Summer Peak Shaving Potential kW	0	0	0	0
	Dispatchable Summer Peak Shaving Potential –Total kW	0	0	0	0

[245] Program expenditures include operations and maintenance, capital spending, and common costs. Operations and maintenance spending are separated by direct rebate, direct implementation, direct EM&V, other indirect or administrative spending. The expenditures reported in this document do not include the Company's margins.

Category	Item	2020	2021	2022	Program total (2020–2022)
	Planned Summer Demand (Cml)	0	652	831	831
	Cml % Toward Planned Total	N/A	0%	0%	0%
Program Performance	Cml Annual $Admin. per Participant (Gross)	N/A	N/A	$24	$24
	Cml Annual $Admin. per kW (Gross)	N/A	N/A	N/A	N/A
	Cml Annual $EM&V per Total Costs ($)	45.0%	15.8%	12.8%	12.8%
	Cml Annual $Rebate per Participant (Gross)	N/A	N/A	$0	$0

9.4 Residential Smart Thermostat Rewards Program – Virginia and North Carolina

9.4.1 Program description

The Residential Thermostat Smart Thermostat Rewards Program℠ was implemented to provide the Company a supply resource by shaving peak electric demand.

The SCC approved the Residential Smart Thermostat Rewards Program as part of the DSM Phase VII programs on May 2, 2019 (Case No. PUR-2018-00168). Following additional review, the program was refiled in Virginia at the end of 2019 and re-approved on July 30, 2020, as part of the DSM Phase VIII programs (Case No.PUR-2019-00201). As a result, the planned implementation schedule was delayed a year. The program officially launched on January 15, 2021 and began enrolling participants in March 2021.[246]

Demand response events are called by the Company during times of peak system demand throughout the year and thermostats of participating customers are gradually adjusted to achieve a specified amount of load reduction while maintaining reasonable customer comfort. Customers can opt out of specific events if they choose to do so. Demand response events may last up to four hours with a maximum of 45 events per year. When an energy event is called, the Company will automatically adjust the run-time of the qualifying smart thermostat. Customers can opt out of any single demand response event by adjusting their thermostat or through the mobile app, but the customer must participate in 75% of event hours to receive the on-bill credit.

Residential customers living in an owner-occupied single-family home, townhouse, condominium, or manufactured home with central air conditioners or heat pumps who are not already participating in the Company's DSM Phase I Smart Cooling Rewards Program or on a time-of-use rate are eligible to enroll. Enrolled customers also receive a "Connected Savings Energy Scorecard" report based on their individual HVAC runtime data and temperature setpoint patterns.

In the fall of 2022, the annual impact evaluation was conducted for the 25 summer events. In 2022, the evaluated load impact was 0.94 kW per participant at Dominion's summer peak planning period. By the first event on May 20, 2022, the 7,387 customers were enrolled in the program, almost twice the enrollment in 2021. The program continued to experience strong growth and over the summer grew 18% to 8,742 participants. Average event-level ex post impacts range from 0.55 to 1.01 kW.

9.4.2 Program performance

The Residential Smart Thermostat Rewards Program called 25 events in 2022 for a total of 73 controlled hours. Approximately 9,400 accounts were controlled in the summer of 2022.

[246] Residential Smart Thermostat Rewards Program Terms and Conditions https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/virginia/save-energy/smart-thermostat-rewards-terms-conditions-va.pdf Accessed April 27, 2023.

The 2022 kW peak shaving potential for was 0.94 kW for both Virginia and North Carolina. Program expenditures, number of participants, and load reduction impact estimates are compared to Dominion's corresponding planning numbers in Table 5-8, Table 5-9, and Table 5-10. The annual impact evaluation of the 2022 season is included in Appendix N.

9.4.3 Impact analysis of 2022 events

This section summarizes key findings of the 2022 impact analysis:

- In 2022, the evaluated load impact was 0.94 kW per participant at Dominion Energy's summer peak planning which is the second year this program produced levels of residential demand response potential not seen since the very early years of the Residential Smart Cooling Rewards (or Residential AC Cycling) program.
- By the first event on May 20, 2022, the program had 7,387 active participants, almost twice that of 2021. The program experienced strong growth and grew 18% over the summer. By the end of August there were 8,742 participants.
- Average event-level ex post impacts range from 0.55 to 1.01 kW.
- First-hour load reduction is consistently higher than subsequent hours, with load reduction dropping with each additional hour. This pattern is present in all events and is explained by a combination of pre-cooling and customer overrides.

9.4.4 Assessment of program progress toward plan

Table 9-10 and Table 9-11 summarize the annual progress toward plan for key DR performance indicators in Virginia and North Carolina, respectively. The shaded cells are considered extraordinarily sensitive information. Appendix O.36 and Appendix P.24 show detailed indicators by year and month. Appendix Q show cumulative net reduction (kW) by year.

Table 9-10. Residential Smart Thermostat Rewards Program planning assumptions

Assumption	Description
Target Market	Single-family detached, attached, and manufactured home with a heat pump or a central air conditioning system
NTG Factor	95%
Measure Life (years)	10
Gross Average Annual Energy Savings per Participant (kWh/year)	0
Net Average Annual Energy Savings per Participant (kWh/year)	0
Net Average Coincident Peak Demand Reduction per Participant (kW)	1.59
Average Rebate per Participant per Year (USD)	$18.00

9.4.4.1 Cumulative Indicators over Time vs. Planned — Virginia and North Carolina

Table 9-11. Virginia Residential Smart Thermostat Rewards Program performance indicators (2020–2022)

Category	Item	2020	2021	2022	Program Total (2020-2022)
Operations and Management Costs ($)					
	Indirect Other (Administrative)	$4,128	$33,978	$47,737	$85,843

Category	Item	2020	2021	2022	Program Total (2020-2022)
Capital ($)	Direct Implementation	$0	$0	$0	$0
Total Costs ($)	Total	$96,743	$724,644	$1,143,292	$1,964,679
	Planned	$0	$1,892,494	$1,914,911	$3,807,405
	Variance	$96,743	-$1,167,850	-$771,619	-$1,842,726
	Cumulative % of Planned	N/A	38%	60%	52%
Participants	Total (Cumulative @ End of Month)	0	6,329	13,084	13,084
	Removals (Uninstalled)/ Deactivations	0	982	2,474	2,474
	Net Participation	0	5,347	10,610	10,610
	Planned	0	6,400	19,433	19,433
	Variance	0	-1,053	-8,823	-8,823
	Cum% toward planned total (Net basis)	N/A	83.5%	54.6%	54.6%
	Removal (Uninstalled) /Deactivation Rate	N/A	3.23%	1.58%	2.33%
	Ex Ante Estimated kW	-	1.07	0.94	0.94
kW Potential	Peak Shaving Potential kW - Gross Participants	0	6,740	12,299	12,299
	Removed (Uninstalled) / Deactivated Peak Shaving Potential kW	0	1,046	2,326	2,326
	Dispatchable Peak Shaving Potential – Net Total kW	0	5,695	9,973	9,973
	Planned Demand	0	10,176	30,898	30,898
	% Toward Planned Total	N/A	55.96%	32.28%	32.28%
Program Performance	Cum. Annual $Admin. per Participant (Gross)	N/A	$6	$7	$7
	Cum. Annual $Admin. per kW (Gross)	N/A	$6	$7	$7
	Cum. Annual $EM&V per Total Costs ($)	26.7%	13.2%	16.4%	16.4%
	Cum. Annual $Rebate per Participant (Gross)	N/A	$21	$25	$25

Table 9-12. North Carolina Residential Smart Thermostat Rewards Program performance indicators (2021–2022)

Category	Item	2021	2022	Program Total (2020–2022)
Operations and Management Costs ($)	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	[redacted]	[redacted]
	Indirect Other (Administrative)	$860	$1,864	$2,724

Category	Item	2021	2022	Program Total (2020–2022)
Capital ($)	Direct Implementation	$0	$0	$0
Total Costs ($)	Total	$18,350	$44,643	$62,993
	Planned	$95,307	$101,201	$196,508
	Variance	-$76,957	-$56,558	-$133,515
	Cumulative % of Planned	19%	44%	32%
Participants	Total (Cumulative @ End of Month)	86	243	243
	Removals (Uninstalled)/ Deactivations	15	45	45
	Net Participation	71	198	198
	Planned	408	1,240	1,240
	Variance	-337	-1,042	-1,042
	Cum % toward planned total (Net basis)	17.4%	16.0%	16.0%
	Removal (Uninstalled) /Deactivation Rate	5.31%	1.99%	3.10%
	Ex Ante Estimated kW	1.07	0.94	0.94
kW Potential	Peak Shaving Potential kW - Gross Participants	92	228	228
	Removed (Uninstalled) / Deactivated Peak Shaving Potential kW	16	42	42
	Dispatchable Peak Shaving Potential – Net Total kW	76	186	186
	Planned Demand	649	1,972	1,972
	% Toward Planned Total	11.66%	9.44%	9.44%
Program Performance	Cum. Annual $Admin. per Participant (Gross)	$10	$11	$11
	Cum. Annual $Admin. per kW (Gross)	$9	$12	$10
	Cum. Annual $EM&V per Total Costs ($)	9.0%	19.5%	19.5%
	Cum. Annual $Rebate per Participant (Gross)	$18	$21	$21

Table 9-13. Disposition from cumulative and net participants, and peak shaving potential (kW) (through December 31, 2022)

Reduction Factor to Participants/Savings	Participants		Peak Shaving Potential (kW)	
	Virginia	North Carolina	Virginia	North Carolina
Cumulative Total	13,084	243	12,299	228
Reduction for Disenrollment	2,474	45	2,326	42
Net Total	**10,610**	**198**	**9,973**	**186**

APPENDIX C. GLOSSARY OF TERMS

Below is a list of selected key terms used in energy efficiency impact evaluation. All terms below are from the Glossary of Terms (Version 1.0): A Project of the Regional Evaluation, Measurement and Verification Forum, Mar. 2009. Prepared by Paul Horowitz of PAH Associates for the Northeast Energy Efficiency Partnerships.

Assumed Error Ratio – The strength of the association between the actual value and the estimated value. It is the primary driver of the sample size required to satisfy a given confidence interval.

Coincidence Factor - The ratio, expressed as a numerical value or as a percentage, of the simultaneous maximum demand within a specified period of a group of electrical appliances or consumers within a specified period, to the sum of their individual maximum demands within the same period.

Confidence - An indication of how close, expressed as a probability, the true value of the quantity in question is within a specified distance to the estimate of the value. Confidence is the likelihood that the evaluation has captured the true value of a variable within a certain estimated range. Also, see Precision.

Deemed Savings - An estimate of energy or demand savings for a single unit of an installed energy efficiency measure that (a) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and (b) is applicable to the situation being evaluated. Individual parameters or calculation methods can also be deemed.

Energy Efficiency Measure - An installed piece of equipment or system, or modification of equipment, systems, or operations on end-use customer facilities that reduces the total amount of electrical energy and capacity that would otherwise have been needed to deliver an equivalent or improved level of end-use service.

Evaluation, Measurement and Verification (EM&V) - A subset of program impact evaluation that is associated with the documentation of energy savings at individual sites or projects using one or more methods that can involve measurements, engineering calculations, statistical analyses, and/or computer simulation modeling.

***Ex Ante* Savings Estimate** - Forecasted savings used for program and portfolio planning purposes.

***Ex Post* Savings Estimate** - Savings estimate reported by an evaluator after the energy impact evaluation has been completed.

Free Driver - A program non-participant who has adopted a particular efficiency measure or practice as a result of the evaluated program. Also, see Spillover.

Free-Rider - A program participant who would have implemented the program measure or practice in the absence of the program. Free-riders can be (1) total, in which the participant's activity would have completely replicated the program measure; (2) partial, in which the participant's activity would have partially replicated the program measure; or (3) deferred, in which the participant's activity would have completely replicated the program measure, but at a future time than the program's timeframe.

Free-Ridership Rate - The percent of savings attributable to free-riders.

Gross Savings - The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Impact Evaluation - An evaluation of the program-specific measures directly induced quantitative changes (*e.g.*, kWh, kW) attributable to an energy efficiency program.

Load Shapes - Representations such as graphs, tables, and databases that show the time-of-use pattern of customer or equipment energy use. These are typically shown over a 24 hour or whole year (8760 hours) period.

Model Based Statistical Sampling - MBSS™ methodology is used to develop efficient sample designs and to assess the likely statistical precision.

Net Savings - The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of free drivers, free-riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand.

Peak Demand - The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Peak Load - The highest electrical demand within a particular period of time. Daily electric peaks on weekdays typically occur in late afternoon and early evening. Annual peaks typically occur on hot summer days.

Precision - The indication of the closeness of agreement among repeated measurements of the same physical quantity. It is also used to represent the degree to which an estimated result in social science (e.g. energy savings) would be replicated with repeated studies.

Prescriptive Program - An energy efficiency program focused on measures that are one-for-one replacements of the existing equipment and for which fixed customer incentives can be developed based on the anticipated similar savings that will accrue from their installation.

Program Participant - A consumer that received a service offered through an efficiency program in a given program year. The term "service" can be one or more of a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information, or other services, items, or conditions.

Realization Rate - The term is used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (*e.g.*, initial estimates of project savings) to savings (1) adjusted for data errors, (2) that incorporate evaluated or verified results of the tracked savings, and (3) that account for free-ridership and/or spillover.

Representative Sample - A sample that has approximately the same distribution of characteristics as the population from which it was drawn.

Sampling Error - The error that is caused by observing a sample and not the entire population.

Spillover - Reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program.

Standard Error - A measure of the variability in a data sample, how far a "typical" data point is from the mean of a sample. In a large sample, about 2/3 of observations lie within one standard error of the mean, and 95% of observations lie within two standard errors.

Stratified Ratio Estimation - A sampling method that combines a stratified sample design with a ratio estimator to reduce the coefficient of variation by using the correlation of a known measure for the unit (*e.g.*, expected energy savings) to stratify the population and allocate sample from strata for optimal sampling.

Verification - An independent assessment of the reliability (considering completeness and accuracy) of claimed energy savings

DNV

EVALUATION, MEASUREMENT, AND VERIFICATION REPORT FOR VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION ENERGY)

Appendix D
Methodologies, and Detailed Avoided Emission, Non-Energy Impacts, and Bill Savings Results

Date: June 15, 2023

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1 EXECUTIVE SUMMARY

Dominion Energy is required to utilize the services of a third party to perform evaluation, measurement, and verification services to review the utility's total customer bill savings that the programs and portfolios produce per the Virginia Clean Economy Act Code Section 56-596.2 C. This report details the process that DNV used to review Dominion Energy's total bill savings, non-energy impacts, avoided emissions, and avoided costs for their energy efficiency programs that were active in Virginia in 2022.

For total bill savings, DNV calculates the annual bill impacts by program and rate schedule for the programs that were active in Virginia in 2022. DNV used an algorithm that incorporated the participant population from program tracking data, pre-participation billing data, and the unitized rate class hourly load shapes from the Dominion Energy Load Research team matched with each of the participant customers based on rate schedule. The estimated post-participation load shape was calculated as the pre-participation load minus the savings for each hour with a savings shape and a pre-participation load shape for each customer. The difference between the pre-participation and post-participation billing parameters was the difference due to the program, and the bill impact is the rate components applied to those differences, across all billing parameters, with and without the program. The total bill savings were calculated at roughly 34.5 and 0.5 million dollars per year resulting from the Company's programs in Virginia and North Carolina, respectively, that were active in 2022.

For non-energy impacts (NEIs), DNV calculates annual operations and maintenance (O&M) related non-energy impacts utilizing an engineering cost-estimating approach and DNV's proprietary "Life Cycle Cost" tool. It relies upon an engineering life cycle cost-based approach to inventory O&M cost data and to estimate the cost change impacts of Dominion Energy's select energy-efficiency measures and projects in Virginia for programs that were active in 2022. The total annualized net present value of the life cycle NEIs for upgraded lighting, HVAC, and drive/motor, from the programs that were available in Virginia in 2022, totaled an estimated $17.8 million per year.

For avoided emissions, DNV calculated impacts by applying the hourly emissions rates to the hourly demand side management (DSM) savings for each EE program that was active in Virginia in 2022, splitting the overall Dominion Energy emissions savings by state based on each state's annual 2021 usage savings percentage. The parameters included the 2022 emissions levels from the WattTime.org, using the PJM DC-area historical emissions data, and the hourly 2021 DSM cumulative energy savings from load shapes already developed by the program to determine the hourly DSM kWh energy savings to produce the emissions impacts, in metric tons of CO_2 units.

Overall, emissions impacts (in metric tons CO_2 avoided) were a total of 344,873 metric tons of CO_2 emissions avoided from the Virginia programs that were active in 2022 (inclusive of those participants from the program start through 2022). They contributed 97.8% of all Dominion Energy system-wide emissions impacts from the DSM program savings that persist in 2022. Impacts were distributed fairly evenly across the year, reflecting the large savings impacts of lighting measures (from programs such as the Non-Residential Lighting Systems & Controls and Residential Efficient Products Marketplace programs), some heating-oriented (winter seasonal, such as the Residential Income and Age Qualifying Home Improvement Program) and some cooling-oriented (summer-seasonal, such as from the Non-Residential Prescriptive Program).

For the benefit-cost analyses, DNV reviewed the Company's new LMT software system that models and calculates cost-effectiveness tests for Dominion Energy DSM programs.

These activities are meant to fulfill the requirements of the Virginia Clean Economy Act, Code Section 56-596.2 C, which states:

"B. Utilities shall utilize the services of a third party to perform evaluation, measurement, and verification services to determine a utility's total annual savings as required by this subsection, as well as the annual and lifecycle net and gross energy and capacity savings, related emissions reductions, and other quantifiable benefits of each program; total customer

bill savings that the programs and portfolios produce; and utility spending on each program, including any associated administrative costs. The third-party evaluator shall include and review each utility's avoided costs and cost-benefit analyses. The findings and reports of such third parties shall be concurrently provided to both the Commission and the utility, and the Commission shall make each such final annual report easily and publicly accessible online. Such stakeholder process shall include the participation of representatives from each utility, relevant directors, deputy directors, and staff members of the State Corporation Commission who participate in approval and oversight of utility efficiency programs, the office of Consumer Counsel of the Attorney General, the Department of Mines, Minerals and Energy, energy efficiency program implementers, energy efficiency providers, residential and small business customers, and any other interested stakeholder who the independent monitor deems appropriate for inclusion in such process. The independent monitor shall convene meetings of the participants in the stakeholder process not less frequently than twice in each calendar year during the period beginning July 1, 2019 and ending July 1, 2028. The independent monitor shall report on the status of the energy efficiency stakeholder process, including(i) (a) the objectives established by the stakeholder group during this process related to programs to be proposed, (ii) (b) recommendations related to programs to be proposed that result from the stakeholder process, and (iii) (c) the status of those recommendations, in addition to the petitions filed and the determination thereon, to the Governor, the State Corporation Commission, and the Chairmen of the House Committee on Labor and Commerce and Senate Committee on Commerce and Labor Committees on July 1, 2019, and annually thereafter through July 1, 2028."

2 LIST OF PROGRAM ACRONYMS

Program Acronym and Phase	Program Name
AC (Phase I)	Residential Smart Cooling Rewards
DG (Phase II)	Non-Residential Distributed Generation
CNRP (Phase VI)	Non-Residential Prescriptive
RAR2 (Phase VII)	Residential Appliance Recycling
REEC (Phase VII)	Residential Efficient Products Marketplace
RTHO (Phase VII)	Residential Home Energy Assessment
RCEB (Phase VIII)	Residential Customer Engagement
REVEE (Phase VIII)	Residential Electric Vehicle Energy Efficiency and Demand Response
RHRF (Phase VIII)	Residential Retrofit
RHVC (Phase VIII)	Residential HVAC Health and Safety
RKTS (Phase VIII)	Residential Kits
RMHP (Phase VIII)	Residential Manufactured Housing
RMFP (Phase VIII)	Residential Multifamily
RNCR (Phase VIII)	Residential New Construction
RTEE/RTEB (Phase VIII)	Residential Thermostat Purchase and WeatherSmart℠
CHV3 (Phase VII)	Non-Residential Heating and Cooling Efficiency
CLT3 (Phase VII)	Non-Residential Lighting System & Controls
CSW2 (Phase VII)	Non-Residential Window Film
CTSM (Phase VII)	Non-Residential Small Manufacturing
CTSO (Phase VII)	Non-Residential Office
CEEP (Phase VIII)	Non-Residential Midstream Energy Efficiency Products
CMFP (Phase VIII)	Non-Residential Multifamily
CNCR (Phase VIII)	Non-Residential New Construction
SBI2 (Phase VIII)	Non-Residential Small Business Improvement Enhanced
RTDR (Phase VIII)	Residential Thermostat Rewards
REVDR (Phase VIII)	Residential Electric Vehicle Rewards
CAGR (Phase IX)	Non-Residential Agriculture
CBAS (Phase IX)	Non-Residential Building Automation
CBOT (Phase IX)	Non-Residential Building Optimization
CENG (Phase IX)	Non-Residential Customer Engagement
CNR2 (Phase IX)	Non-Residential Prescriptive Enhanced
EAL4 (Phase IX)	Residential Income and Age Qualifying Home Improvement Enhanced
EALS (Phase IX)	Residential and Non-Residential Solar (HB 2789)
RSMH (Phase IX)	Residential Smart Home
RVAU (Phase IX)	Residential Virtual Audit

Program Acronym and Phase	Program Name
RWDR (Phase IX)	Residential Water Savings Demand Response
RWEE (Phase IX)	Residential Water Savings

3 GROSS AND NET ENERGY SAVINGS AND DEMAND REDUCTION IMPACTS

3.1 Calculating the value of resources saved

In the life of a Dominion Energy DSM program, there are three stages of savings estimates that the Company provides the Commission:

1. Planning. Program design forecasted savings estimates that are derived from program designers and/or implementers. These are generalized savings estimates on a per-participant basis, forecasted, and submitted to the Commission in the initial program approval filing.
2. Tracking. Participant-specific deemed savings currently calculated by DNV, using deemed savings calculations documented in the Dominion Energy TRM, for actual program participants using a combination of customer-specific inputs (from customer applications collected either directly from customers or installation vendor while onsite) and DNV assigned deemed factors. The Dominion Energy TRM is independently produced by DNV and updated annually. These savings have been referred to as “deemed savings” estimates.
3. Evaluated. Net savings calculated by DNV based on primary impact evaluation data and analysis.

All programs and measures begin with a stage 1 (planning) estimate. For most measures, a tracking value or calculation is then developed and used for ongoing tracking and annual reporting if there is no primary evaluation conducted (stage 2). For measures with stage 3 evaluation conducted, the evaluated savings are reported for that year, and the evaluation results are used to update the tracking calculations going forward. For some measures (e.g., Demand Response), stage 3 evaluation is conducted from the outset and are the only reported savings provided.

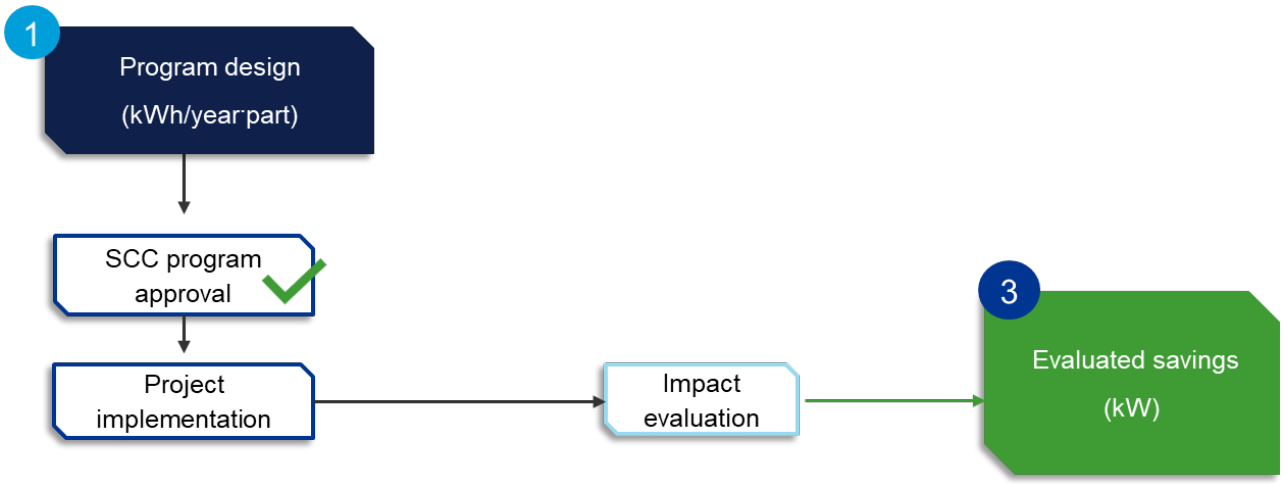
In this process, DNV has produced the savings for stages 2 and 3 throughout the life of each of the Company’s DSM portfolios to date and is under contract to continue to do so through 2024 via the DSM Phase X programs. The tracked (stage 2) savings are not based on primary evaluation analysis, but are calculated using a combination of the customer-specific information and deemed factors listed below:

- The utility’s customer-specific information collected from customer application data, where available and reliable (e.g., equipment size, equipment type), collected either from the customer or installation vendor
- Virginia-specific information (e.g., Virginia building code requirements)
- Information from other sources that are adjusted to be both utility- and Virginia-specific, where applicable (e.g., for weather specific to the Company’s territory)
- Adjustment factors from prior evaluations.

3.1.1 Savings estimation for DR programs

The evaluation approach differs slightly depending on the type of program (EE or peak shaving/DR). For DR programs, DNV has historically and will continue to analyze customer-specific load data for an affected group of participant premises in comparison with a control group (non-participants from the Company’s customer population), on an annual basis. Figure 3-1 illustrated the evaluation process for demand response programs. These estimates are fully customer- and utility-specific and do not rely on any deemed factors from outside sources.

Figure 3-1. Overall evaluation process for demand response programs



Generally, this approach for evaluating EE and DR programs is consistent with industry best practices for EM&V of these types of programs.

3.1.2 Savings estimation for EE programs

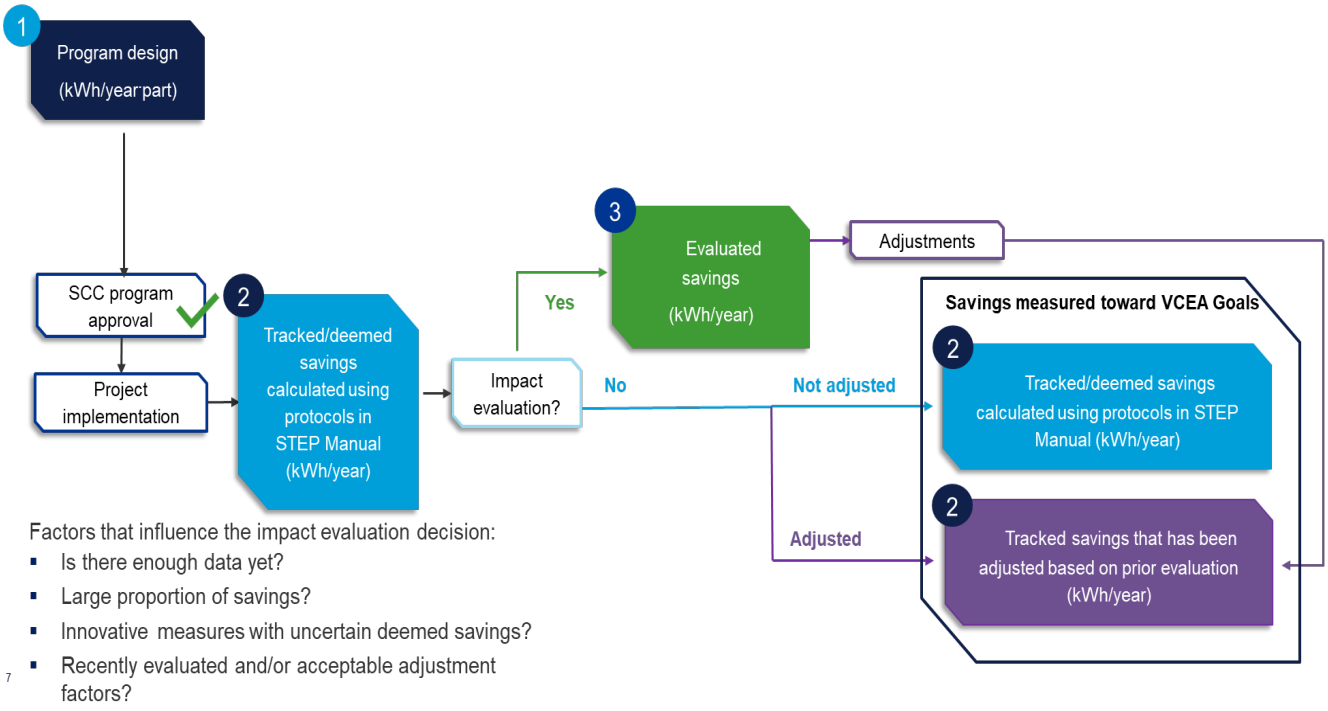
The three broadly recognized categories of EM&V methods are:

- Deemed savings
- Measurement and verification
- Consumption data analysis with a comparison group.

DNV uses deemed savings methods for tracked savings (Stage 2) to determine and report deemed participant-specific savings when a program is initially launched. This process ensures that program progress can be reported on an annual basis for the Commission's use, even before there is sufficient program participation to conduct an impact evaluation that will yield meaningful results.

Then, when there is enough participation in the program to reliably produce statistically valid results, or roughly two to three years after program launch, DNV will conduct primary impact evaluations of the programs that will yield the most value from the evaluation information. The impact evaluation will include primary data collection and analysis (or either direct EM&V and/or a comparison group impact analysis). This process is illustrated in Figure 3-2 for energy efficiency programs. If a program will go through a primary data collection evaluation (Stage 3), those evaluations will collect customer-specific data that will be used in combination with other variables to estimate savings.

Figure 3-2. Overall evaluation process for energy efficiency programs



For measures with particularly uncertain deemed savings estimates, DNV may conduct impact evaluations (i.e., primary data collection and analysis) after the first year and annually, assuming the program budget is sufficient to warrant that level of evaluation.

DNV will follow the directive in the Final Order in SCC Case No. PUR-2020-00156, specifically Attachment A to identify the programs that will receive primary impact evaluation (stage 3 savings estimates) in a given year. Not all programs will be evaluated through a primary impact evaluation, as it will not be cost-effective to do so. For the DSM Phase I through X programs, these impact evaluation approaches are described in greater detail in their program EM&V plans listed in Appendix E.

Programs selected for evaluation in each year will be prioritized based on several factors, including but not limited to the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

If a program will go through a primary data collection evaluation (Stage 3), those evaluations will collect customer-specific data that will be used in combination with other variables to estimate savings. A high-level summary of the primary data collection evaluation methods that will be used for each program is listed in Table 3-1.

Currently, tracking savings estimates (Stage 2), and primary impact evaluations (Stage 3) are guided by these objectives:

- Follow the “value of information” framework to identify the programs that should receive primary impact evaluations (e.g., programs with the largest proportion of the portfolio’s savings, programs with savings estimates with the greatest uncertainty, programs with potential for future growth)
- Optimize the cost of measurement

- Produce savings that are not overly conservative or high, to achieve the Virginia State Corporation Commission's guidance to determine actual savings estimates
- Keep the process as simple as it needs to be, and do not overcomplicate the calculations and issues to gain a false sense of accuracy
- Provide transparency in our deemed savings methodology in the Dominion Energy TRM, and our evaluations
- Specify the impact evaluation approaches that will be taken in our EM&V plans, before program launch, to allow for flexibility in the plan as the program may not be adopted by the market the way it was originally planned

In addition to the impact evaluation method, Table 3-1 indicates whether a net-to-gross survey is required. While other methods of determining a net-to-gross ratio are available, our proposed net-to-gross method for the current programs is based on surveys of customers, vendors, distributors, or manufacturers, as applicable. For some programs, a net-to-gross adjustment is not needed because the impact evaluation method provides net savings directly. This is the case, for example, for the load analysis conducted for the Residential Smart Cooling Rewards, as well as for the energy consumption analysis for the Residential Customer Engagement Program.

Table 3-1. Primary impact evaluation methods to measure net energy and demands savings

DSM Phase	Program	Impact Evaluation Method	Net-to-Gross Surveys Required?	Preference Order for Collection of EM&V Data (1, 2, 3)
I	Residential Smart Cooling Rewards	Whole premise hourly load analysis	No	1 – customer specific
II	Non-Residential Distributed Generation	Whole premise hourly load analysis	No	1 – customer specific
VI	Non-Residential Prescriptive Program	Measurement and verification (metering)	Yes	1 – customer specific
VII	Non-Residential Heating and Cooling Efficiency Program	Measurement and verification (metering)	Yes	1 – customer specific
	Non-Residential Lighting Systems & Controls Program	Measurement and verification (metering)	Yes	1 – customer specific
	Non-Residential Office Program	Measurement and verification (metering)	Yes	1 – customer specific
	Non-Residential Small Manufacturing Program	Measurement and verification (metering)	Yes	1 – customer specific
	Non-Residential Window Film Program Measures	Measure verification with deemed calculation	Yes	1 – customer specific
	Residential Appliance Recycling Program	Measurement and verification (metering)	Yes	1 – customer specific
	Residential Efficient Products Marketplace Program	Measure verification with deemed calculation	Yes	1 – customer specific
	Residential Home Energy Assessment Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
VIII	Non-Residential Heating & Cooling Efficiency	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Non-Residential Midstream Energy Efficiency Products	Measurement and verification (metering)	Yes	1 – customer specific

DSM Phase	Program	Impact Evaluation Method	Net-to-Gross Surveys Required?	Preference Order for Collection of EM&V Data (1, 2, 3)
	Non-Residential Multifamily Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Non-Residential New Construction Program	Measurement and verification (metering)	Yes	1 – customer specific
	Non-Residential Small Business Improvement Enhanced Program	Measurement and verification (metering)	Yes	1 – customer specific
	Residential Customer Engagement Program	Whole premise monthly consumption analysis	No	1 – customer specific
	Residential Electric Vehicle Rewards	Whole premise hourly load analysis	No	1 – customer specific
	Residential Electric Vehicle Energy Efficiency and Demand Response Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Energy Efficiency Kits Program	Measure verification with deemed calculation	Yes	1 – customer specific
	Residential HVAC Health and Safety	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Home Retrofit Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Manufactured Housing Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Multifamily Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential New Construction Program	Measurement and verification (metering)	Yes	1 – customer specific
	Residential Smart Thermostat Purchase and WeatherSmart Program	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Thermostat Rewards	Whole premise hourly load analysis	No	1 – customer specific
IX	Non-Residential Agriculture	Measure verification with deemed calculation	Yes	1 – customer specific
	Non-Residential Building Automation	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Non-Residential Building Optimization	Measurement and verification	Yes	1 – customer specific
	Non-Residential Customer Engagement	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Non-Residential Prescriptive Enhanced	Measure verification with deemed calculation	Yes	1 – customer specific

DSM Phase	Program	Impact Evaluation Method	Net-to-Gross Surveys Required?	Preference Order for Collection of EM&V Data (1, 2, 3)
	Residential Income and Age Qualifying Home Improvement Enhanced	Whole premise monthly consumption analysis	No	1 – customer specific
	Residential and Non-Residential Solar (HB 2789)	Whole premise monthly consumption analysis	No	1 – customer specific
	Residential Smart Home	Whole premise monthly consumption analysis	Yes	1 – customer specific
	Residential Virtual Audit	Measure verification with deemed calculation	Yes	1 – customer specific
	Residential Water Savings Demand Response	Whole premise hourly load analysis	No	1 – customer specific
	Residential Water Savings	Whole premise monthly consumption analysis	Yes	1 – customer specific

3.1.3 Gross savings

Gross savings are calculated using deemed calculations documented in the Dominion Energy Technical Reference Manual (DE TRM, Appendix F, formerly the Standard Tracking and Engineering Protocol Manual or the STEP Manual). It has been included as an appendix to the annual EM&V report since 2010. The Dominion Energy TRM contains the deemed engineering equations used to calculate kilowatt and kilowatt-hour savings for each of the measures and programs that the Company implements in Virginia and North Carolina for a given program year. It is updated annually.

In the absence of a TRM that is issued by regulators in Virginia or North Carolina and that applies to all utility programs in each state, DNV derives deemed savings equations from the Mid-Atlantic Technical Reference Manual (Mid-Atlantic TRM).[1] The Mid-Atlantic TRM is used in states that border Virginia and elsewhere in the Mid-Atlantic region of the United States (e.g., Maryland, District of Columbia, Delaware). For program measures that are not available in the Mid-Atlantic TRM, DNV assesses recent TRMs in the region, and nationally, if necessary, to identify the most appropriate source or sources for deriving the deemed savings equations and/or inputs.

Each TRM contains the sources for every deemed savings equation and input, including titles, version numbers, publication dates, and page numbers of all source documents, as appropriate.

As much as practicable, DNV currently produces kilowatt and kilowatt-hour savings estimates using utility-specific program participant data as inputs to the equations described above.

To gather utility-specific program data, DNV provides the Company with a list of the EM&V data variables and other data requirements that are necessary for estimating deemed savings, and for documenting the measure baseline. DNV develops this list, keeping in mind when it may be impractical to collect specific data variables (e.g., equipment nameplate may be sun-bleached and illegible). The Company's program managers, analysts, and information technology ("IT") staff ensure that the program data is generated, and the Company's IT staff defines the information management system needed to ensure delivery of the data to DNV monthly.

[1] Mid-Atlantic Technical Reference Manual (TRM) V10, https://neep.org/mid-atlantic-technical-reference-manual-trm-v10.

When utility-specific data are unavailable or impracticable to collect, DNV uses proxy utility-specific program participant data to assign assumed inputs derived from Virginia-specific data or data from non-Virginia jurisdictions, and with appropriate citation to the source documents.

DNV applies the combination of program-generated utility-specific data, and other default inputs to the deemed equations documented in the TRM to calculate the kilowatt and kilowatt-hour savings for each implemented measure and aggregates it at the measure level, where appropriate, and reports it in the annual EM&V report for each program, without adjustment for free-ridership values. DNV reports the savings after adjustments for free-ridership based on either the initial program design assumed free-ridership value or evaluated free-ridership value determined through EM&V. We will continue to report savings in this manner.

The protocols are limited to calculating per-unit annual energy savings and demand reductions at the measure level. The measure-level savings are aggregated up to the program level and reported through this document. The protocols do not include the calculation of the value of resources saved. To calculate the value of the resource savings for reporting and other purposes, the energy savings reported in this document can then be increased by the amount of the transmission and distribution (T&D) losses to reflect the energy savings at the system level. Energy savings at the system level can be multiplied by the appropriate avoided costs to calculate the value of the benefits.

System savings = Savings at measure x T&D loss factor

Value of resources saved = System savings x System avoided costs

The duration of expected savings of installed measures is specified in terms of the average expected measure life in years by the program. They are discussed in more detail in Section 3.1.7, Life cycle or lifetime savings below.

3.1.4 Transmission and distribution system losses

These protocols calculate gross annual energy savings at the measure level, which should be increased by transmission and distribution (T&D) system losses to determine gross annual energy savings at the system level. The T&D loss factor multiplied by the savings calculated from the protocols will result in savings at the supply level.

The T&D electric loss factor is approximately 1.05 as a system-wide average (for both energy and demand), to be applied to savings at the customer meter. This loss factor was provided to DNV by Dominion Energy. It was developed internally for Dominion Energy's programs as part of its IRP process.

3.1.5 Adjusted gross savings

As indicated in Section 3.1.3, once an impact evaluation (Stage 3 analysis) is conducted, the tracked or deemed savings (Stage 2 results) that are produced using the TRM can then be adjusted based on those results. The adjustment factor is called a "gross realization rate" or "realization rate." Until an impact evaluation is conducted, the realization for any program is assigned a default of 100%. Table 3-2 lists the realization rates by program for all the Company's DSM programs that have undergone impact evaluations and produced realization rates.

Table 3-2. Impact study realization rates and sources by program, for programs that have undergone in-depth evaluation

DSM Phase	Program	Year	Gross Energy Savings		Demand Reduction		Source	
			Realization Rate	Relative precision at 90%	Realization Rate	Relative precision at 90%	Case	Appendix
Energy Efficiency Residential Programs								
I	Residential Low Income	2012	47%				PUE-2010-00084. April 1, 2012	E-1. Low Income Program Billing Analysis Report
		2013	75%				PUE-2011-00093. April 1, 2013	E-1. Low Income Program Billing Analysis Report
		2014	62%				PUE-2012-00100. April 1, 2014	F-1. Low Income Program Billing Analysis Report
II	Residential Duct Sealing	2015	49%	23%	43%	23%	PUE-2013-00072. April 1, 2015	J-1. Residential Duct Sealing Program Load Shape and Net Savings Analysis Evaluation Report
II	Residential Heat Pump Tune-Up	2015	99%	33%			PUE-2013-00072. April 1, 2015	I-1. Residential Heat Pump Tune-up Program Load Shape and Net Savings Analysis Evaluation Report
II	Residential Heat Pump Upgrade	2012-2014	107%	10.2%	83%	11.8%	PUE-2013-00072. April 1, 2015	H-1. Residential Heat Pump Upgrade Program Load Shape and Net Savings Analysis Evaluation Report
		2015 and beyond	78%	7.5%	89%	2.2%	PUE-2014-00071. April 1, 2016	G-2. Residential Heat Pump Upgrade Program Load Shape and Impact Analysis

DSM Phase	Program		Year	Gross Energy Savings		Demand Reduction		Source	
				Realization Rate	Relative precision at 90%	Realization Rate	Relative precision at 90%	Case	Appendix
II	Residential Home Energy Check-up		2015	154%				PUE-2013-00072. April 1, 2015	G-1. Residential Home Energy Check-up Program Impact Evaluation and Customer Satisfaction Report
VII	Residential Efficient Products Marketplace		2021	100%				PUR-2019-00201. May 14, 2021	J.1. Impact Evaluation of the Residential Efficient Products Marketplace Program
VII	Residential Home Energy Assessment		2022	40%	26%			PUR-2021-00247. May 15, 2022	H. Residential Home Energy Assessment Impact Evaluation
Energy Efficiency-Non-Residential Programs									
I	Commercial lighting	Peak (Jun-Sep)	2011	179%	6.1%	98%	1.4%	PUE-2010-00084. October 1, 2011	B-1. Commercial Lighting Program. Load Shape and Net Savings Analysis Evaluation Report
		Off-peak (Oct-May)		177%	6.4%	98%	1.4%		
I	Commercial HVAC	Peak (Jun-Sep)	2012	35%	19%	169%	17%	PUE-2010-00084. April 1, 2012	C-1. Commercial HVAC Program. Load Shape and Net Savings Analysis Evaluation Report
		Off-peak (Oct-May)		63%	20%	97%	19.3%		
II	Non-Residential Duct Testing and Sealing		2015	87%	10%	94%	6%	PUE-2013-00072. April 1, 2015	L-1. Non-Residential Duct Sealing and Testing Program Load Shape and Net Savings Analysis Evaluation Report
II	Non-Residential Energy Audit	Walk-in door closer	2015	89.8%	6.10%	91.2%	5.5%	PUE-2013-00072. April 1, 2015	K-1. Non-Residential Energy Audit Program Load Shape and Net Savings Analysis Evaluation Report
		Smart strips		70%	8.30%				
		Electric commutated motors		78.6%	<1.0%	78.6%	<1.0%		

DSM Phase	Program		Year	Gross Energy Savings		Demand Reduction		Source	
				Realization Rate	Relative precision at 90%	Realization Rate	Relative precision at 90%	Case	Appendix
		LED display case lighting		97.5%	<1.0%	97.5%	<1.0%		
		Occupancy sensor		93.1%	<1.0%	51.2%	<1.0%		
		Door gaskets		99.2%	4%	99.2%	4%		
		Strip curtains		36.1%	22.1%	35.3%	21.9%		
VI	Non-Residential Prescriptive	AC tune-up	2021	117%	14%	99%	0%	PUR-2019-00201. May 14, 2021	X.1. Impact Evaluation of the Non-Residential Prescriptive Program
		Auto closer		89%	20%	77%	52%		
		Condenser coil cleaning		41%	58%	62%	115%		
		Convection oven		100%		100%			
		Door gasket		107%	6%	107%	6%		
		Duct test and seal		80%	31%	77%	21%		
		ECM at evaporator fan		100%		100%			
		Electric fryer		100%		100%			
		Evaporator fan control		100%		100%			
		Freezer and refrigerator		116%	22%	116%	22%		
		Griddle		100%		100%			
		Hot food holder		100%		100%			
		Ice maker		100%		100%			
		Low no sweat door film		100%		100%			
		Night cover		100%		100%			
		Steam cooker		100%		100%			
		Strip curtains		151%	58%	151%	58%		

DSM Phase	Program		Year	Gross Energy Savings		Demand Reduction		Source	
				Realization Rate	Relative precision at 90%	Realization Rate	Relative precision at 90%	Case	Appendix
		VSD at kitchen exhaust fan		186%		93%			
VII	Non-Residential Lighting Systems & Controls	Peak (Jun-Sep)	2022	123.7%	7.7%	101.5%	15.4%	PUR-2021-00247. May 15, 2022	K. Non-Residential Lighting End-Use Baseline, Gross Impact, Net-to-Gross, and Persistence Study
		Off-peak (Oct-May)		123.7%	7.7%	99.3%	7.9%		
VIII	Small Business Improvement Enhanced	Peak (Jun-Sep)	2022	121.4%	8.5%	99.4%	11.5%	PUR-2021-00247. May 15, 2022	K. Non-Residential Lighting End-Use Baseline, Gross Impact, Net-to-Gross, and Persistence Study
		Off-peak (Oct-May)		121.4%	8.5%	99.5%	5.9%		
Peak Shaving Programs									
II	Non-Residential Distributed Generation		2013			102%			M. Impact Evaluation of 2022 Dispatch Events
			2014			101%			
			2015			93%			
			2016			106%			
			2017			108%			
			2018			97%			
			2019			113%			
			2020			106%			
			2021			111%			
			2022			104%			

3.1.6 Net savings estimation

The TRM protocols are designed to estimate gross savings program impacts, or more specifically, the total amount of annual energy savings and demand reductions related to program activity. However, the amount of energy savings and demand reductions that can be attributed to the program is not the same as the estimated gross savings. This is because any given program's design can have intended and unintended outcomes. The amount of energy savings and demand reductions that can be attributed to the program is referred to as net savings, which is the magnitude of the impact of the program's intended outcomes. The most common unintended outcomes of an energy efficiency (EE) or peak shaving program can be characterized as any combination of the following:

- **Free-ridership:** program participants who consume the incentive but were not influenced by the program through which the measure is delivered, thereby reducing gross savings.
- **Participant "like" spillover:** past program participants who subsequently install those same program-eligible EE measures, but do not consume the incentive, having been already influenced by the program through which the measure is delivered, thereby increasing gross savings.
- **Participant "unlike" spillover:** past program participants who subsequently install other EE measures not offered through the program, but who have been influenced by the original program, thereby increasing gross savings.
- **Non-participant spillover:** program non-participants who were influenced by the program through which the measure is delivered and implement the measure without consuming the program incentive, potentially increasing gross savings. The influence may happen upstream at the design or specification stage without the customer's input or knowledge. This is also commonly referred to as "free drivers."
- **Leakage:** program non-participants who receive the measure and consume the incentive but install the measure outside of Dominion Energy's service territory, thereby reducing gross savings.
- **Snapback:** program participants who receive the measure and consume the incentive but alter behavior in such a way that the participants' or non-participants' energy and demand are higher than the baseline for the given measure.

Table 3-3 summarizes unintended outcomes that are considered in DNV's net-to-gross studies.

Table 3-3. Status of unintended outcomes considered in DNV impact evaluations

Unintended outcome category	Status of impact evaluations
Free-ridership	Included in all previous impact evaluations
Participant "Like" spillover	Included only in the previous Non-Residential Energy Audit program impact evaluation
Participant "Unlike" spillover	Not included at this time
Non-participant spillover	Not included at this time
Leakage	Not included at this time
Snapback	Not included at this time

The combination of all adjustments described above is typically referred to as the net-to-gross (NTG) factor. The NTG factor is summarized by program in Table 3-4. In this report, default NTG ratios are the ex ante values specified by Dominion Energy. These values will be updated over time as NTG is measured for each program. NTG factors typically change as programs mature and extend beyond the early adopters to the mass market.

NTG factors may be estimated in several ways. The energy efficiency evaluation industry discussions around various approaches are described in "Chapter 21, Estimating Net Savings – Common Practices," from the Uniform Methods Project for the U.S. Department of Energy and the "Energy Efficiency Program Impact Evaluation Guide."[2]

Table 3-4. Net-to-Gross ratios and sources by program

DSM phase	Program	Year(s)	Net-to-gross ratio	Source
Energy efficiency-residential programs				
I	Residential Lighting	2010-2012	65%	Dominion Energy program design assumption
I	Residential Low Income	2010-2015	94%	KEMA, April 2011 for Dominion Energy
II	Residential Duct Sealing	2012-2017	80%	Dominion Energy program design assumption
II	Residential Heat Pump Tune-Up	2012-2017	90%	Dominion Energy program design assumption
II	Residential Heat Pump Upgrade	2012-2014	85%	
		2015-2017	45%	DNV, April 2016 for Dominion Energy
II	Residential Home Energy Check-up	2012-2017	82%	DNV, April 2016 for Dominion Energy
IV	Residential Appliance Recycling	2015-2018	77%	Dominion Energy program design assumption
IV	Residential Income and Age Qualifying Home Improvement	2015-2020	100%	
		2021-2022	80%	DNV, May 2022 for Dominion Energy
V	Residential Retail LED Lighting	2017-2019	85%	Dominion Energy program design assumption
VII	Residential Appliance Recycling	2019-Ongoing	60%	Dominion Energy program design assumption
VII	Residential Efficient Products Marketplace	2019-Ongoing	Varies by measure	DNV, May 2022 for Dominion Energy DNV, May 2021 for Dominion Energy
VII	Residential Home Energy Assessment	2019-Ongoing	100%	DNV, May 2022 for Dominion Energy
VIII	Residential Customer Engagement	2021-Ongoing	100%	DNV, May 2022 for Dominion Energy
VIII	Residential Electric Vehicle Energy Efficiency and Demand Response	2021-Ongoing	80%	Dominion Energy program design assumption
VIII	Residential Energy Efficiency Kits	2021-Ongoing	60%	Dominion Energy program design assumption
VIII	Residential HVAC Health and Safety	2021-Ongoing	80%	Dominion Energy program design assumption
VIII	Residential Home Retrofit	2021-Ongoing	90%	Dominion Energy program design assumption
VIII	Residential Manufactured Housing	2021-Ongoing	90%	Dominion Energy program design assumption
VIII	Residential New Construction	2021-Ongoing	87%	Dominion Energy program design assumption

2 Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578. http://www.nrel.gov/docs/fy17osti/68578.pdf; State and Local Energy Efficiency (EPA) Action Network (SEE Action), Energy Efficiency Program Impact Evaluation Guide Evaluation, Measurement, and Verification Working Group December 2012, https://www.energy.gov/sites/default/files/2013/11/f5/emv_ee_program_impact_guide.pdf.

DSM phase	Program	Year(s)	Net-to-gross ratio	Source
VIII	Residential Multifamily	2021-Ongoing	90%	Dominion Energy program design assumption
VIII	Residential Smart Thermostat (Energy Efficiency)	2021-Ongoing	80%	Dominion Energy program design assumption
VIII	Residential Smart Thermostat (Behavioral)	2021-Ongoing	95%	Dominion Energy program design assumption
IX	Residential Income and Age Qualifying Home Improvement Enhanced	2021-Ongoing	80%	Dominion Energy program design assumption
IX	Residential and Non-Residential Solar (HB 2789)	2022-Ongoing	80%	Dominion Energy program design assumption
IX	Residential Smart Home	2022-Ongoing	85%	Dominion Energy program design assumption
IX	Residential Virtual Audit	2022-Ongoing	60%	Dominion Energy program design assumption
IX	Residential Water Savings	2022-Ongoing	90%	Dominion Energy program design assumption
Energy efficiency-non-residential programs				
I	Commercial Lighting	2010-2014	50%	KEMA, October 2011 Commercial Lighting Program: Load Shape and Net Savings Analysis Evaluation Report
I	Commercial HVAC	2010-2014	45%	KEMA, April 2012 Commercial HVAC Program: Load Shape and Net Savings Analysis Evaluation Report
II	Non-Residential Duct Testing and Sealing	2012-2017	97%	DNV, April 2015 for Dominion Virginia Power
II	Non-Residential Energy Audit	2012-2017	Varies by measure	DNV, April 2015 for Dominion Virginia Power
III	Non-Residential Heating and Cooling	2014-2020	70%	Dominion Energy program design assumption
III	Non-Residential Lighting Systems & Controls	2014-2020	70%	Dominion Energy program design assumption
III	Non-Residential Window Film	2014-2020	80%	Dominion Energy program design assumption
V	Non-Residential Small Business Improvement	2016-2021	93%	Dominion Energy program design assumption
VI	Non-Residential Prescriptive	2017-2022	Varies by measure	DNV, May 14, 2021 for Dominion Energy
VII	Non-Residential Heating and Cooling	2019-Ongoing	70%	Dominion Energy program design assumption
VII	Non-Residential Lighting Systems & Controls	2019-Ongoing	45%	DNV, May 15, 2022 for Dominion Energy
VII	Non-Residential Window Film	2019-Ongoing	80%	Dominion Energy program design assumption
VII	Non-Residential Small Manufacturing	2021-Ongoing	90%	Dominion Energy program design assumption
VII	Non-Residential Office	2019-Ongoing	90%	Dominion Energy program design assumption
VIII	Non-Residential Midstream Energy Efficiency Products	2021-Ongoing	90%	Dominion Energy program design assumption
VIII	Non-Residential New Construction	2021-Ongoing	90%	Dominion Energy program design assumption
VIII	Non-Residential Small Business Improvement Enhanced	2021-Ongoing	Varies by measure	DNV, May 15, 2022 for Dominion Energy
VIII	Non-Residential Multifamily	2021-Ongoing	90%	Dominion Energy program design assumption

DSM phase	Program	Year(s)	Net-to-gross ratio	Source
IX	Non-Residential Agriculture	2022-Ongoing	97%	Dominion Energy program design assumption
IX	Non-Residential Building Automation	2022-Ongoing	90%	Dominion Energy program design assumption
IX	Non-Residential Building Optimization	2022-Ongoing	90%	Dominion Energy program design assumption
IX	Non-Residential Customer Engagement	2022-Ongoing	90%	Dominion Energy program design assumption
IX	Non-Residential Prescriptive Enhanced	2022-Ongoing	90%	Dominion Energy program design assumption
Peak Shaving Programs				
I	Residential Smart Cooling Rewards	2010-Ongoing	100%	KEMA, October 2011 Operability Study replaced net-to-gross. Required by PJM and not applicable in 2019
II	Non-Residential Distributed Generation	2012-Ongoing	100%	DNV, May 15, 2022 for Dominion Energy
VIII	Residential Electric Vehicle Rewards	2020-Ongoing	93%	Dominion Energy program design assumption
VIII	Residential Thermostat Rewards	2020-Ongoing	95%	DNV, May 15, 2022 for Dominion Energy
IX	Residential Water Savings Demand Response	2021-Ongoing	95%	Dominion Energy program design assumption

3.1.7 Life cycle or lifetime savings

3.1.7.1 Measure lives

Starting in 2021, DNV has been calculating gross and net life cycle or lifetime savings using a bottom-up load shape approach that applies hourly end use load shapes to the gross and net annualized savings calculated using the methods described in the above sections, over each measure's measure life for all the Company's programs with persistent savings as of year-end 2021 (i.e., all Phase I through VIII programs). The resulting program life cycle or lifetime savings for all DSM programs are presented in Appendix Q for Virginia and North Carolina, at the annual level.

Before 2021, the measure lives that DNV used to calculate life cycle or lifetime savings that were reported in prior EM&V reports for the Phase I through VII programs were the program design measure-lives that were a single aggregated value per program at the program-level. They were estimates that were filed with the SCC and NCUC when each program was considered for approval. These program-level lives generally represented an average of the measure-level lives for individual measure weighted by the savings projected to be contributed from those measures at the time of the program design.

Since it's more common than not that the actual measure mix in a program is different than what is assumed at the program design, starting in 2021 and with the Phase VIII programs and for all future phases of programs, DNV modified the measure life assignment to be at the measure-level. DNV assigns them based on independent research in other TRMs. Measures in the Phase I through VII programs continue and will continue to use the program-level measure lives until those programs' savings expire.

These measure life values by program and measure are documented in the Dominion Energy TRM, in Appendix F.

3.1.7.2 Hourly load shape development

Since 2013, each year DNV develops annualized 8,760 DSM impact load shapes for each active DSM program, based on the year-end participants. These load shapes were used by the Company's Demand-side Planning team to represent the per-participant level incremental energy contribution that would be multiplied by forecasted program participation, for the purposes of the Company's Integrated Resource Plan (IRP).

This task consists of building end use measure load shapes based on the ratio of annual energy usage to peak demand developed by DNV using the methods described in the previous sections, resulting in estimated total annualized energy savings impacts reported in Appendices K and L, the Program Performance Indicator Tables of this report for each DSM program and measure. Based on the sector (residential or non-residential), end use (e.g., cooling, lighting), measure type (e.g., replacement equipment efficiency improvement, technology replacement), and the ratio of annual usage to peak reported for each program, an end use load shape best matching the characteristics and load usage pattern of each measure is selected from a library of available end use load shapes that DNV has compiled over many years. The sources for the load shape library vary, including (in order of priority):

1. Any metered load data collected for the Company's service territory, especially as part of any impact evaluation projects
2. Load shapes from regional or national sources that can be adjusted (e.g., for weather)
3. Engineering models

The selection is based on the closest fit of the candidate end use load shape annual usage to peak ratio as those reported for each program in Appendices K and L. The load shapes are developed and stored using a ratio format that consists of a set of four sets of ratios that, when combined, completely describes an 8,760 (or 8,784) hourly annual load shape in a way that enables scalability to any target annual energy usage and is independent of the calendar year the load shape would be applied to. The four sets of ratios are:

1. **Monthly usage allocation**: Percentage of annual usage assigned to each month
2. **Weekend to weekday ratio (WEWD)**: Ratio of a typical weekend day usage to a typical weekday usage (by month). A value of 1.0 means that weekend day and weekday usage are assumed to be equal
3. **Peak day adjustment factor (PDAF)**: Ratio of the daily usage for a peak day versus that of a typical weekday (by month). For example, a value of 1.5 means that peak day consumption is 50% higher than for a typical weekday for the same period. These factors are primarily driven by daily weather sensitivity.
4. **Per-unit day-type load shapes**: Hourly load shape represented in per-unit of daily maximum, for each type of day (i.e., peak day, weekday, weekend day) for each month.

The advantage of creating a summarized version of hourly load shapes is that it facilitates the ability to adjust, scale, and otherwise calibrate each of the four load shape parameters independently to match that of the target customer or end use group more closely, but it can also capture sufficient variation in loads.

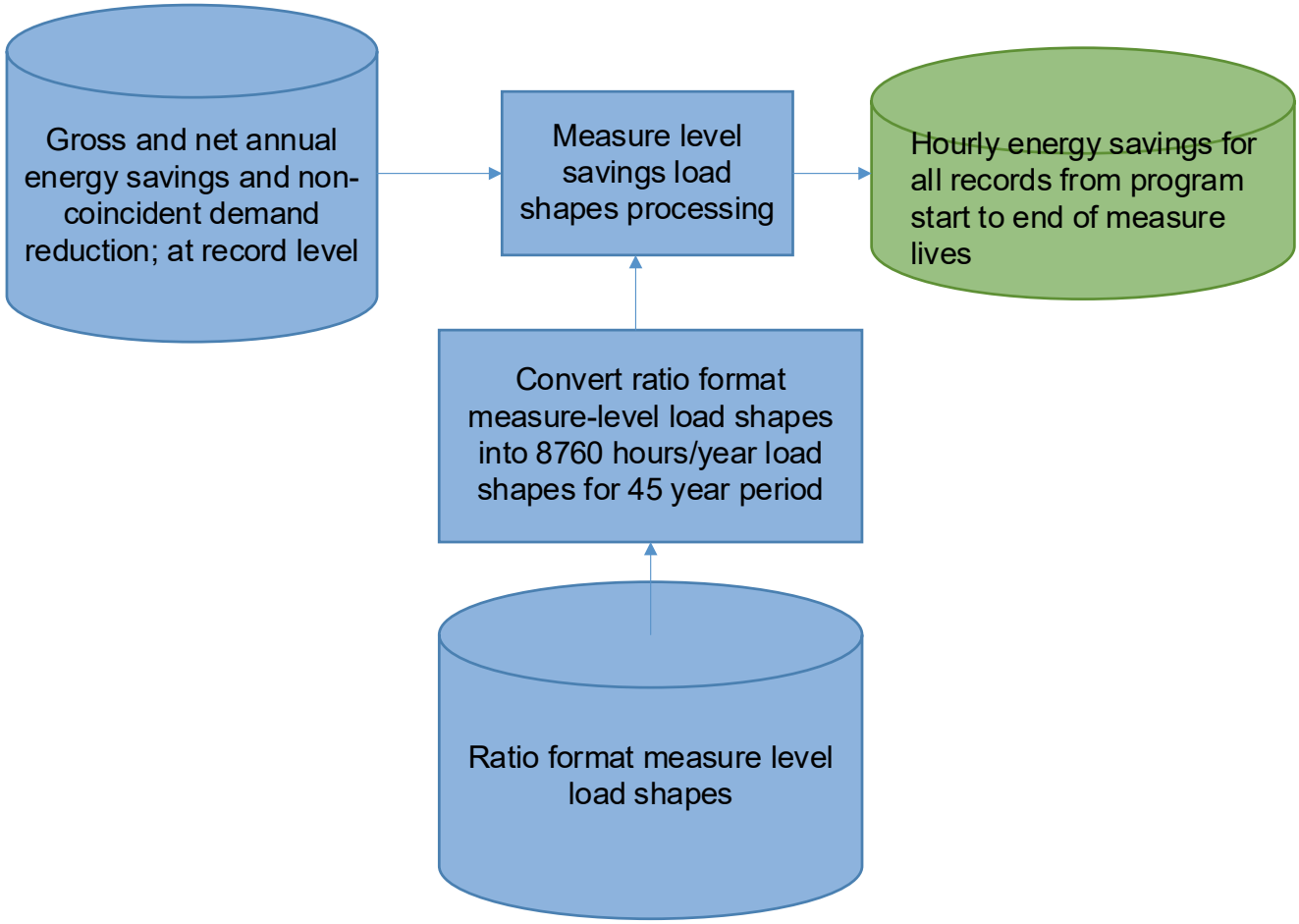
The annualized load shapes are developed from each program assuming the participants are contributing to the DSM impacts all year as a hypothetical full-year impact. And as described above, they were and continue to be used by the Company's DSP team to multiply with forecasted program participants to forecast the impact of DSM in future years in the Company's IRP.

3.1.7.3 Load shape-based phase-in and phase-out process

Starting with the 2021 lifetime savings calculation, DNV is leveraging these same load shape ratios to backward apply them to all past years of annualized gross and net savings through those measures' lives at the hourly level. These outputs are known as the fixed hourly savings. The fixed hourly savings values are used by the Company's Demand-side Planning team

to estimate the savings impacts of the Company's DSM programs on the system. This new approach more accurately accounts for the DSM impacts at a more granular hourly level. This method is an improvement from the prior method of calculating lifetime savings that approximated lifetime savings equally across all 12 months of the year, from the month that a customer enrolled through the end of the measure life. For example, using the updated load shape-based lifetime savings approach, a participant adopting a new lighting measure (e.g., LEDs) to replace their existing lighting, will start contributing to system load reduction at the start of the month that the LEDs are installed and continue only until the measure life (e.g., 10 years) expires. And DNV is outputting the savings from these LED at the hourly level, reflecting any potential daily or seasonal variations from such a lighting measure. Figure 3-3 is a high-level illustration of the process that is described in sections below.

Figure 3-3. Hourly lifetime savings calculation process



First, DNV creates a library of base load shape indexes that serves as the foundation for estimating hourly savings over the life of a given measure. Applying hourly savings at the measure level allows for the savings load shapes to be aggregated in the result reports by other characteristics such as a program that the measure was implemented in, program participant's rate schedule, and the state in which the measure was implemented.

Overall, this process ingests annual measure load shapes stored in the ratio format described above. It then expands the ratios into a normalized 8,760 hours per year format for the duration of each measure's lifetime. In this expansion step, a data frame with the following elements is first created:

- Date
- Time stamp
- Day type
- Count of days per month (DPM), and
- Annual intervals

The day type assignments for each day of each month from the applicable measure load shape are then used to calculate daily usages for each day of the year and the applicable per-unit hourly load shapes are used to generate each hour's loads downstream for each applicable future calendar year over the course of the measure life. From these inputs, the following are calculated:

$$Usage_{month} = Ratio_{month} \times Annual\ Usage$$
$$Daily\ Usage_{weekday} = \frac{1}{Count_{DPM} \times \frac{5}{7} + Count_{DPM} \times \frac{2}{7} \times Ratio_{WEWD}} \times Interval_A \times Ratio_{month}$$
$$Daily\ Usage_{peak\ day} = Total_{weekday} \times Ratio_{Peak}$$
$$Daily\ Usage_{weekend} = Total_{weekday} \times Ratio_{WEWD}$$

Where:

$Ratio_{Month}$	=	Ratio of monthly energy usage to total annual energy usage
$Count_{DPM}$	=	Count of days per month
$Ratio_{WEWD}$	=	Ratio of weekend to weekday daily energy usage
$Interval_A$	=	Annual Intervals (e.g., 8,760 for non-leap years and 8,784 for leap years)

From here, a daily usage total is calculated using Daily $Usage_{weekday}$, Daily $Usage_{peak\ day}$, and Daily $Usage_{weekend}$. See Table 3-5 for the calculations based on day type for each month.

Table 3-5. Calculations based on day type

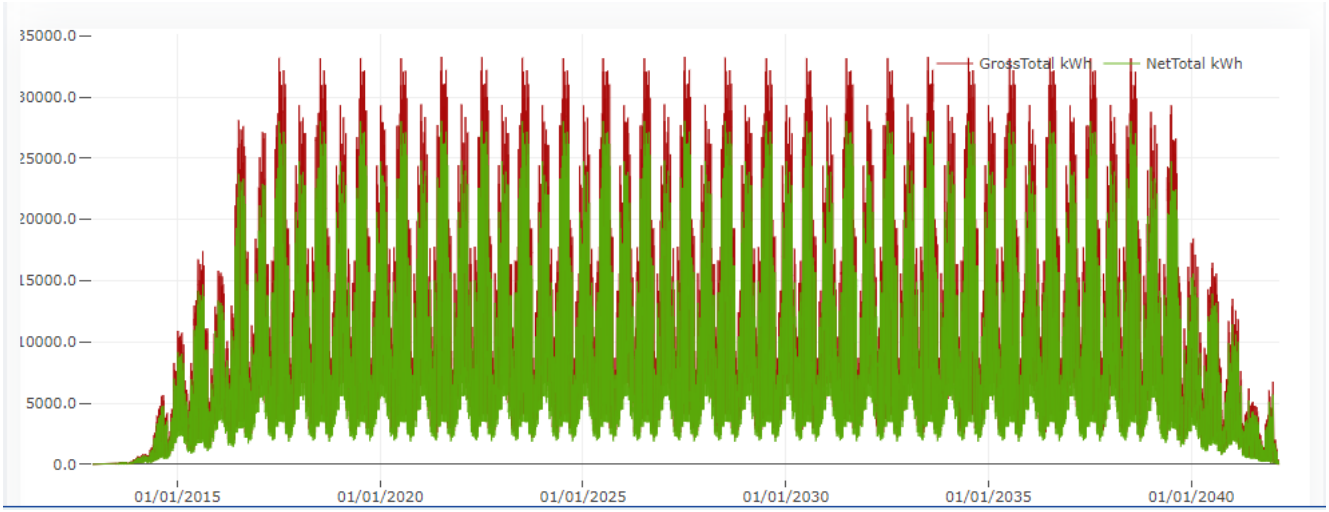
Day type	Count per month	Day usage calculation
1	1	= Peak Day Usage
2	Remainder of weekdays	= Weekday Usage
3	Actual	= Weekend Usage
4	1	= Weekday Usage−(Peak Day Usage−Weekday Usage) (Low Day)
5	2	= Weekday Usage−(Peak Day Usage−Weekday Usage) × (⅔)
6	4	= Weekday Usage−(Peak Day Usage−Weekday Usage) × (⅓)
7	2	= (Peak Day Usage−Weekday Usage) × (⅔) + Weekday Usage
8	4	= (Peak Day Usage−Weekday Usage) × (⅔) + Weekday Usage

The applicable day type hourly per-unit load shapes (i.e., Daily $Usage_{Peak}$, Daily $Usage_{Weekday}$, and Daily $Usage_{Weekend}$) are then applied to the corresponding daily usages (Peak load shape to peak day (day type 1), weekend load shape to weekend days (day type 3), and weekday load shape to all the remaining weekdays (day types 2, 4, 5, 6, 7, and 8) as shown in Table 3-5.

In the second stage of this process, the normalized base load shape ratios output from the prior step are applied to the gross and net measure-level annual savings for each year of the measure life. For example, if a measure for a given program is installed on April 28, 2010, and has a 10-year measure time, the hourly normalized ratio is applied to the annual savings from April 28, 2010 to April 28, 2020. This produces hourly savings at the measure level for the full measure life.

The third stage of this process involves loading the measure-level hourly savings for gross savings and net savings into DNV's Envisage interval data storage and processing platform, where they can be aggregated as needed for mapping to any combination of program, rate schedule, and state-levels for enhanced reporting purposes.[3] See Figure 3-4 for an example program loadshape hourly energy saving for a non-residential program measure in Virginia.

Figure 3-4. Illustrative hourly savings load shape for an example non-residential measure in Virginia



Lastly, these hourly outputs are used as inputs by the Company's Demand-side Planning team's Integrated Resource Plan (IRP) tools to model the contributions of DSM on the Company's system and aggregated at the annual level and presented in Appendix Q of this report.

3 Envisage is DNV's flexible data storage and processing platform

4 VIRGINIA CLEAN ECONOMY ACT REQUIREMENTS NON-ENERGY METRICS

The following additional non-energy metric is also reported in this EM&V report, as required by the Virginia Clean Economy Act.

- Related emissions reductions
- Total customer bill savings that the programs and portfolios produce
- Other quantifiable benefits of each program
- Utility spending on each program, including any associated administrative costs
- Review each utility's avoided costs and cost-benefit analyses

The methodologies, assumptions, calculations, and methodology pros and cons for the emissions, customer bill savings, non-energy impacts, and avoided cost and cost-benefit analyses are described in detail in later sections in this appendix.

4.1 Bill savings

4.1.1 Introduction

Dominion Energy is required to utilize the services of a third party to perform evaluation, measurement, and verification services to review the utility's total customer bill savings that the programs and portfolios produce per the Virginia Clean Economy Act Code Section 56-596.2 C. The following sections highlight the process that DNV used to review Dominion Energy's total bill savings for their energy efficiency programs.

To meet the requirements described above related to customer bill savings (also referred to as bill impacts) resulting from Dominion Energy's programs, DNV used data from several sources to estimate each participating customer's pre-participation energy use and load shape, then applied the estimated energy savings from the Dominion Energy Business Intelligence tracking data (i.e., program tracking data) along with the savings load shape to estimate the post-participation energy use and load shapes. The difference between the pre-participation and post-participation billing parameters was calculated. Then rates and riders were applied to the differences in billing parameters and the results were reported as the bill impacts. This analysis was performed and reported by rate schedule and program, then aggregated across the rate schedules and programs to get the estimated total bill impacts for all program participants.

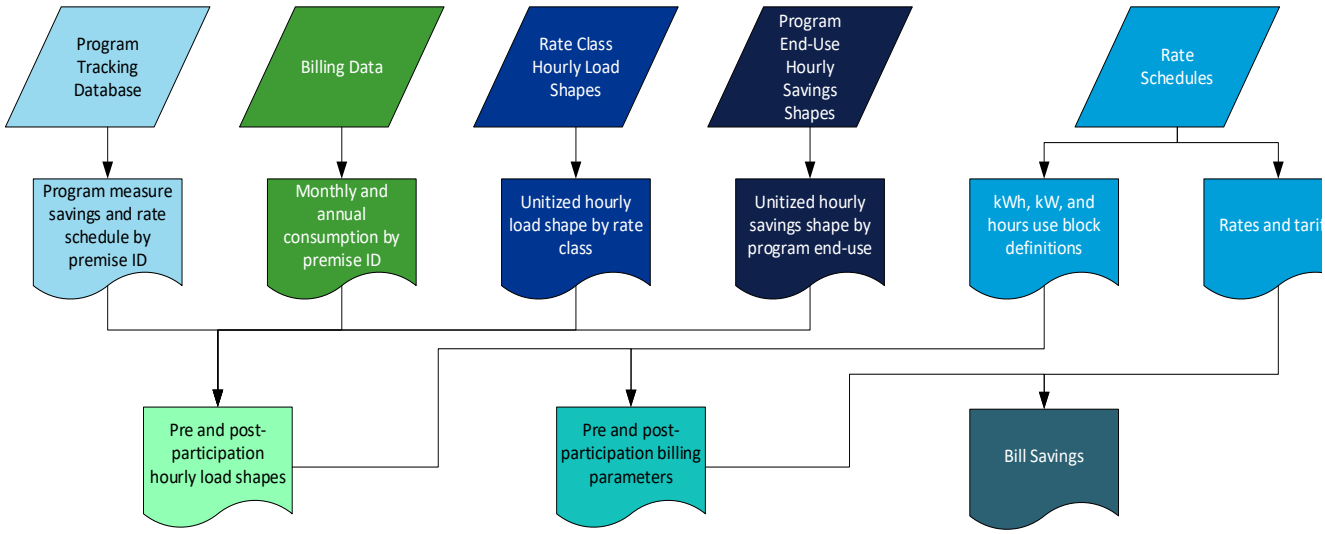
4.1.2 Methodology

DNV calculates the bill impacts by program and rate schedule per the algorithm as follows, and illustrated in Figure 4-1 :

1. The participant population is defined by rate schedule and program using the program tracking data. This represents the total population of participating customers and is the starting point for the analysis. This database includes the account number, the premise ID, the rate schedule the customer is served under, the program in which the customer was a participant, and the estimated kWh/year savings that the customer achieved through participation in the program.
2. This participant population data is matched with the pre-participation billing data provided by Dominion Energy, using premise ID to match the physical location of each customer to maximize the number of customers with billing data.
3. Rate class hourly load shapes from the Dominion Energy Load Research team are unitized and then matched with each of the participant customers based on the rate schedule. Since most of the participating customers do not have interval data available, we must use the average load shape for the rate class as their assumed load shape. This is done by distributing each customer's annual billing energy across the year based on the rate class unitized load shape.

4. The unitized measure-specific hourly savings shapes are calibrated to the savings for each measure installed for each customer. These calibrated hourly savings shapes are totaled for each customer, and that savings shape is then used to distribute the savings across the hours of the year.
5. With a savings shape and a pre-participation load shape for each customer, an estimated post-participation load shape can be calculated as the pre-participation load minus the savings for each hour. Using these load shapes, both the pre-participation and the post-participation billing parameters for each month can be calculated, based on the requirements of the rate schedule for which the customer is enrolled. The difference between the pre-participation and post-participation billing parameters is the difference due to the program, and the bill impact is the rate components applied to the difference in the calculated bills, across all billing parameters, with and without the program. The rates involve many different types of charges, but the billing parameters needed include:
   a. Monthly kWh energy and peak kW demand, for all hours and for time-of-use (TOU) periods (e.g., on-peak, intermediate, and off-peak). Seasonal differences in rates are applied to the individual months based on seasonal definitions.
   b. Monthly kWh consumption for each block, with the blocks defined in the rate schedule (e.g., Schedule 1), or defined based on hours use applied to peak kW (i.e., using kWh per kW to define the blocks). Seasonal differences in rates are applied based on seasonal definitions.
   c. Monthly kW demand for each block for rate schedules with kW blocks (e.g., Schedule 6).
   d. On-peak and off-peak kWh consumption based on the different day classifications (i.e., Day type A, B, or C) and seasons for experimental rate schedules (e.g., Schedule 10).
   e. All fixed monthly charges are ignored since they will be assessed the same way before and after participation, so will not affect the calculation of bill impacts.
6. After the changes in all appropriate billing parameters are calculated, those billing parameters are summed across customers by program and rate schedule, and then rates and riders from the tariffs are applied to the totals of the billing parameters to get the bill impact by rate schedule and program.

Figure 4-1. Bill savings estimation process



7. Not all participants could be matched with billing data. The bill impacts for those not matched were estimated in one of two ways[4][5][6]:
   a. For customers in the Residential Efficient Products Marketplace lighting program, the measures were not associated with individual customers since this is an upstream program. For customers in the Residential New Construction program, the homes were at varying sales stages from builders to residential homeowners at the time of the rebate; however, the savings occur once sold and occupied. For these two programs, the participants were all assumed to be on Schedule 1 (i.e., residential). Because Schedule 1 has a kWh block rate, the savings kWh was split between the two blocks based on the proportion of residential customers with billing data available that had consumption in the upper block versus only in the lower block. The two kWh block rates were applied to the estimated energy savings by block, and then summed to get the total bill impacts.
   b. For all other program and rate schedule combinations, an average bill impact per kWh of savings was calculated for those that did have billing data, and that was multiplied by the reported savings for those customers on that program and rate schedule that did not have billing data to get an estimated bill impact. The total bill impact for each program and rate schedule combination was then the sum of the bill impacts for those with and without billing data.

Many assumptions had to be made to allow the estimation of load shapes, the calculation of billing parameters, and the application of rates and riders to those billing parameters. The following assumptions were made:

- The impacts are “first-year impacts” – they correspond to the first year of customer savings after measures have been installed, regardless of the actual date of installation. The savings estimates are based on a calendar year, using the calendar for 2022.
- The impacts are based on deemed savings, which represent weather normalized savings, not savings for a particular year with actual weather.
- The impacts use the modeled measure savings shapes created by DNV, which are intended to be based on normal weather.
- Because individual customer load shapes are not available, we used 2021 rate class average load shapes from the Company’s Load research to estimate before-savings customer load shapes for calculating customer demands and TOU billing parameters. The 2021 load shapes were adjusted to reflect the 2022 calendar. These load shapes were then unitized and applied to each customer’s annual consumption to provide an estimated customer load shape.
- Individual customer annual energy is allocated across months based on monthly customer billing data for calculating block energy rates.
- Customer billing energy is for the prior year, before the program year (i.e., 2021 billing consumption for 2022 participants), so appropriately reflects pre-participation consumption
- For the TOU rate, the calendar of day categories (e.g., A, B, and C) are from 2022, so that it matches the calendar for the adjusted load shapes.
- We made the simplifying assumption that each program’s bill impact is the only impact for that customer and did not combine all savings for all programs for each customer. This only affects the bill impacts related to block rates for

[4] For NC, one individual customer accounted for more than 20% of NC 2022 portfolio savings and could not be matched with billing data. This customer was dropped from the bill savings analysis since no other customers on the same rate schedule were available to estimate an average bill impact per kWh as a proxy.

[5] For VA, one individual customer was dropped from the bill savings analysis since no other customers on the same rate schedule were available to estimate an average bill impact per kWh as a proxy. This customer accounted for about 0.1% of VA 2022 portfolio savings.

[6] For VA, CEEP program savings were dropped from the bill savings analysis since CEEP is a commercial midstream program. Since CEEP is a midstream program with no customer billing data, there is not enough data to estimate bill impacts. CEEP accounted for about 0.6% of VA 2022 portfolio savings.

customers participating in multiple programs. This also allows the reporting of information by rate schedule and program.

- No participants are receiving power from an alternate supplier.
- All billing periods are assumed to match calendar months since billing cycle data is unavailable.
- Not all rate schedules were included in the analysis – those with very few customers were not calculated

Additional rate schedule-specific assumptions had to be made to allow the calculation of the impacts for certain rate schedules. These rate schedule-specific assumptions include:

- For Residential, Schedule 1, we assume that participants are not net-metered.
- For Schedule 5, Schedule 5C, Schedule 5P, Schedule 10, Schedule GS-1, Schedule GS-2, Schedule GS-2T, Schedule GS-3, and Schedule GS-4, no customers are non-exempt of distribution charges (though there is no actual charge difference, as this rate is $0.000).
- For Schedule GS-3 and Schedule GS-4, rkVA did not change as a result of the program.
- For Schedule 10, we assumed the contract demand was the same as the measured demand.
- For Schedule 10, all participants are assumed to be receiving service Secondary voltage unless indicated otherwise.
- For Schedule GS-4, all participants are assumed to be receiving service at Primary voltage.
- For Schedule 5, the kWh blocks were based on the levels in the tariff, and not reset based on the customers' kW demands.

4.1.3 Results

The bill savings due to the program was calculated as the rate components for each rate applied to the difference between the pre-participation and post-participation billing parameters across all billing parameters, with and without the program. The total Virginia and North Carolina bill savings were calculated at $34,526,777 and $479,819, respectively.

Table 4-1. Virginia bill savings by program and rate schedule

Program	Rate Schedule	Billing Data ($)	No Billing Data ($)	Total ($)
Non-Residential Agricultural Energy Efficiency - DSM Phase IX	Schedule GS-1	573	-	573
	Schedule GS-2 ND	582,171	23,782	605,954
Non-Residential Building Optimization - DSM Phase IX	Schedule 10 (Secondary)	59,588	-	59,588
	Schedule GS-3	40,285	-	40,285
Non-Residential Heating and Cooling Efficiency - DSM Phase VII	Schedule 10 (Secondary)	23,650	-	23,650
	Schedule GS-1	1,482	-	1,482
	Schedule GS-2 ND	177,832	-	177,832
	Schedule GS-2T	41,851	-	41,851
	Schedule GS-3	306,207	-	306,207
	Schedule GS-4	77,615	-	77,615
Non-Residential Lighting Systems & Controls - DSM Phase VII	Schedule 10 (Secondary)	34,577	-	34,577
	Schedule 5	-	9,628	9,628
	Schedule 5C	5,325	-	5,325
	Schedule 5P	1,927	-	1,927
	Schedule GS-1	111,253	14,353	125,606
	Schedule GS-2 ND	1,398,016	17,741	1,415,757
	Schedule GS-2T	240,840	-	240,840
	Schedule GS-3	17,455	-	17,455

Program	Rate Schedule	Billing Data ($)	No Billing Data ($)	Total ($)
Non-Residential Multifamily - DSM Phase VIII	Schedule GS-1	18,034	-	18,034
Non-Residential Prescriptive Enhanced - DSM Phase IX	Schedule 10 (Secondary)	11,375	-	11,375
	Schedule 5C	1,058	-	1,058
	Schedule 5P	191	-	191
	Schedule GS-1	53,391	3,421	56,812
	Schedule GS-2 ND	690,972	-	690,972
	Schedule GS-2T	104,121	-	104,121
	Schedule GS-3	58,036	1,407	59,443
	Schedule GS-4	710	-	710
Non-Residential Prescriptive - DSM Phase VI	Schedule GS-1	65	-	65
	Schedule GS-2 ND	5,645	-	5,645
	Schedule GS-2T	20,106	-	20,106
Non-Residential Window Film - DSM Phase VII	Schedule GS-1	1,606	244	1,850
	Schedule GS-2 ND	1,373	-	1,373
	Schedule GS-3	11,697	-	11,697
	Schedule 10 (Secondary)	3,851	8,338	12,189
	Schedule GS-1	92,280	-	92,280
	Schedule GS-2 ND	90,997	9,191	100,187
	Schedule GS-2T	27,806	-	27,806
	Schedule GS-3	67,992	113,800	181,792
Non-Residential Office - DSM Phase VII	Schedule GS-2 ND	475,291	-	475,291
	Schedule GS-2T	18,255	-	18,255
Residential Income and Age Qualifying Energy Efficiency - DSM Phase IX	Schedule 1	382,440	3,376	385,816
	Schedule GS-1	118	118	237
Income and Age Qualifying Solar Program - DSM Phase IX	Schedule 1	3,963	-	3,963
Residential Appliance Recycling - DSM Phase VII	Schedule 1	179,251	897	180,148
Residential Customer Engagement - DSM Phase VIII	Schedule 1	6,469,140	28	6,469,168
Residential Efficient Products Marketplace (Non-Lighting) - DSM Phase VII	Schedule 1	299,444	17,160	316,604
Residential Efficient Products Marketplace (Lighting) - DSM Phase VII	Schedule 1	18,154,203	-	18,154,203
Residential Electric Vehicle Energy Efficiency and Demand Response - DSM Phase VIII	Schedule 1	3,203	148	3,351
Residential Home Retrofit - DSM Phase VIII	Schedule 1	14,622	-	14,622
Residential HVAC Health and Safety - DSM Phase VIII	Schedule 1	121,049	1,077	122,126
	Schedule GS-1	39	129	168
Residential Kits - DSM Phase VIII	Schedule 1	409,115	21,541	430,657
	Schedule GS-1	13	-	13
Residential Multifamily - DSM Phase VIII	Schedule 1	53,350	640	53,990
	Schedule GS-1	28	-	28

Program	Rate Schedule	Billing Data ($)	No Billing Data ($)	Total ($)
Residential Manufactured Housing - DSM Phase VIII	Schedule 1	38	-	38
Residential New Construction - DSM Phase VIII	Schedule 1	649,589	-	649,589
Residential Smart Home - DSM Phase IX	Schedule 1	916	-	916
Residential Thermostat Purchase and WeatherSmart - DSM Phase VIII	Schedule 1	218,305	3,988	222,293
Residential Home Energy Assessment - DSM Phase VII	Schedule 1	1,568,627	11,913	1,580,539
Residential Virtual Energy Audit - DSM Phase IX	Schedule 1	234,480	3,236	237,716
Residential Water Savings - DSM Phase IX	Schedule 1	11,485	-	11,485
Non-Residential Small Business Improvement Enhanced - DSM Phase VIII	Schedule 5C	26,688	-	26,688
	Schedule 5P	268	-	268
	Schedule GS-1	231,460	681	232,141
	Schedule GS-2 ND	343,377	7,401	350,778
	Schedule GS-2T	1,829	-	1,829
Total		**34,252,538**	**274,239**	**34,526,777**

Table 4-2. North Carolina bill savings by program and rate schedule

Program	Rate Schedule	Billing Data ($)	No Billing Data ($)	Total ($)
Non-Residential Heating and Cooling Efficiency - DSM Phase VII	Schedule 10 (Secondary)	11,032	-	11,032
Non-Residential Lighting Systems & Controls - DSM Phase VII	Schedule 5	12,470	-	12,470
	Schedule 5P	26,932	-	26,932
Residential Income and Age Qualifying Energy Efficiency - DSM Phase IX	Schedule 1	5,788	-	5,788
Residential Appliance Recycling - DSM Phase VII	Schedule 1	1,713	52	1,765
Residential Efficient Products Marketplace (Non-Lighting) - DSM Phase VII	Schedule 1	8,092	539	8,631
Residential Efficient Products Marketplace (Lighting) - DSM Phase VII	Schedule 1	338,821	-	338,821
Residential Kits - DSM Phase VIII	Schedule 1	20,271	2,110	22,380
Residential Smart Home - DSM Phase IX	Schedule 1	47	-	47
Residential Thermostat Purchase and WeatherSmart - DSM Phase VIII	Schedule 1	9,069	246	9,315
Residential Home Energy Assessment - DSM Phase VII	Schedule 1	3,526	-	3,526
Residential Virtual Energy Audit - DSM Phase IX	Schedule 1	4,740	144	4,884

Program	Rate Schedule	Billing Data ($)	No Billing Data ($)	Total ($)
Non-Residential Small Business Improvement Enhanced - DSM Phase VIII	Schedule 5	34,226	-	34,226
Total		**476,728**	**3,091**	**479,819**

4.2 Non-energy impacts

4.2.1 Introduction

Dominion Energy is required to utilize the services of a third party to perform evaluation, measurement, and verification services to review the other quantifiable benefits of the program (i.e., non-energy impacts) per the Virginia Clean Economy Act Code Section 56-596.2 C. The following sections highlight the process that DNV used to review Dominion Energy's NEIs for their energy efficiency programs.

This was the third year DNV conducted this analysis for the portfolio, and it targeted the same three end use categories as the previous years: lighting upgrades, HVAC upgrades, and variable-frequency/variable-speed drives (VFD/VSD) at motors. The targeted categories are limited to upgrades where high-efficiency equipment replaced existing equipment or was added to existing equipment.

Table 4-3 lists the programs, end use categories, and measures included in this analysis along with a count of the 2022 records included. Measures included those delivered by programs active in 2022 that yielded annual gross deemed electric savings greater than zero kWh/year using the methodology established in the Dominion Energy TRM Version 2022.

Table 4-3. Included programs and measures and number of records analyzed

Program – DSM Phase	End use	Measure	#Records VA	#Records NC
Residential Programs				
Efficient Products Marketplace – DSM Phase VII	Lighting	LED A-Line	263,877	10,932
		Fixture and Retrofit Kit		
		LED Reflector		
		LED Specialty		
Home Energy Assessment – DSM Phase VII	HVAC	Heat Pump Upgrade	47	0
	Lighting	LED	63,092	115
Home Retrofit – DSM Phase VIII	Lighting	Lighting	22	0
HVAC Health and Safety – DSM Phase VIII	HVAC	Heat Pump Upgrade	1,039	0
Energy Efficiency Kits – DSM Phase VIII	Lighting	Lighting	767	31
Multifamily – DSM Phase VIII	Lighting	Lighting	1,650	0
Manufactured Housing – DSM Phase VIII	Lighting	Lighting	7	0
Virtual Audit – DSM Phase IX	Lighting	Lighting	3,622	72
Income and Age Qualifying Enhanced – DSM Phase IX	Lighting	40W-equivalent LED	5,078	22
		60W-equivalent LED		
Non-Residential Programs				
Lighting Systems and Controls – DSM Phase VII	Lighting	LED Lamp	762	48
		T8/T5 Lamp		
	HVAC	Heat Pump Upgrade	360	14

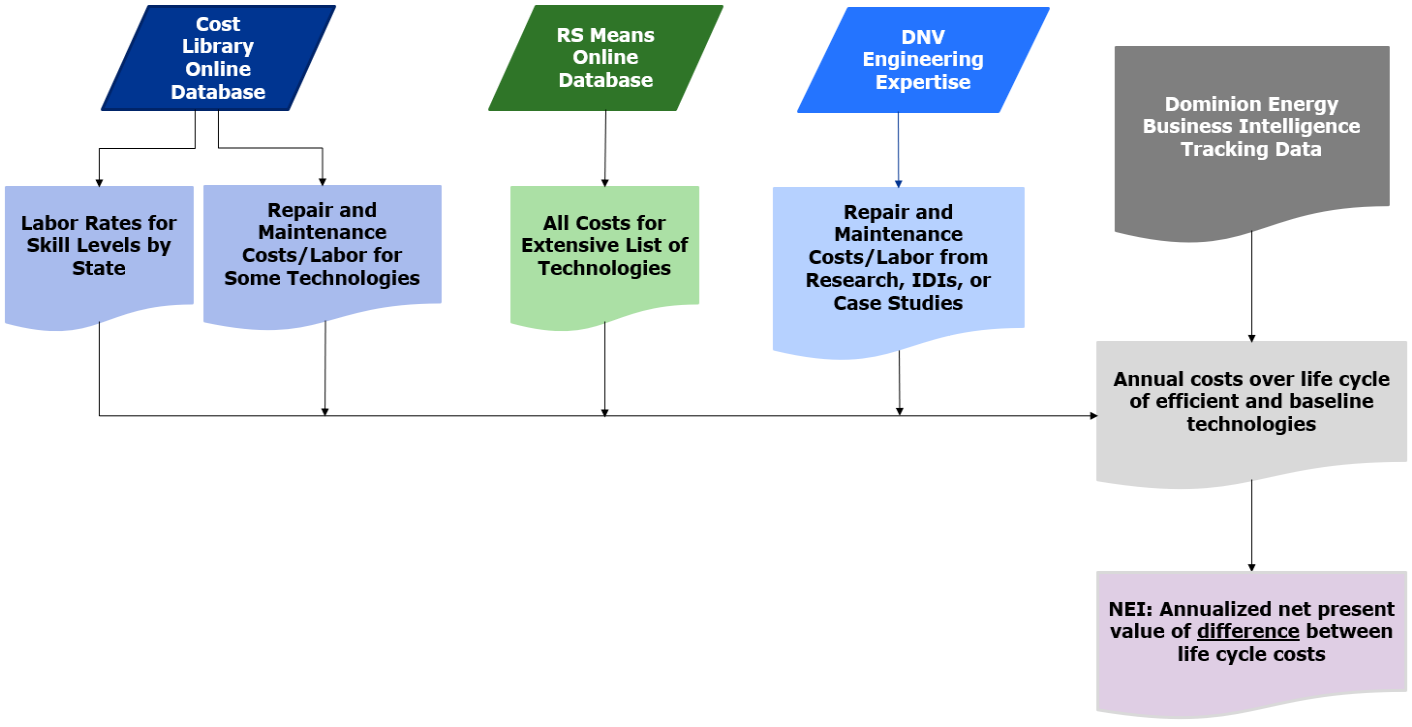
Program – DSM Phase	End use	Measure	#Records VA	#Records NC
Heating and Cooling Efficiency – DSM Phase VII		Unitary AC Upgrade		
		Chiller Upgrade		
	Drive/Motor	VFD at space-conditioning motor	505	13
Small Business Improvement Enhanced – DSM Phase VIII	Lighting	LED Lamp	415	34
		T8/T5 Lamp		
Midstream Energy Efficiency Products – DSM Phase VIII	HVAC	Chiller Upgrade	25	0
		Unitary AC Upgrade		
Multifamily – DSM Phase VIII	Lighting	LED Lamp	6	0
Agriculture – DSM Phase IX	Lighting	Horticulture LED	12	0
Total	**All**	**All**	**341,286**	**11,281**

To determine non-energy impacts, the annualized net present value ($/kWh) of the operations and maintenance costs (O&M) of specific measures were analyzed by program and end use. As this program year was the third to analyze such impacts, the assumptions and limitations of the analysis are detailed in the following sections.

4.2.2 Methodology

DNV calculates non-energy impacts utilizing our Life Cycle Cost (LCC) tool that leverages data gathered from two third-party sources—Cost Library by CBRE Whitestone and RS Means by Gordian—and, in some cases, primary research conducted by DNV. Both sources are commonly used by cost estimators for new construction. We have fine-tuned this method through lessons learned on previous projects and via institutional knowledge and expertise. Our data sources are shown in Figure 4-2.

Figure 4-2. Data sources utilized by LCC tool to estimate measure-level NEIs



Using the LCC tool requires employing the steps described as follows:

- Identify measure description from tracking data including detailed measure description, program-level expected useful life (EUL), equipment size, and annual electric savings, etc.
- Identify measures from the existing LCC data sources that match most closely to each tracking data record.
  - This step requires an engineering review of all measures in the tracking data alongside each of the available data sources contained in the LCC tool. Each data source contains replacement, repair, and maintenance cycles and costs for a finite set of measures. The engineering review identifies measures contained in the published data that most closely align with the tracked measures. Once the closest measure is identified, the source for the data (Cost Library, RS Means, or DNV research) is identified.
- Auto-populate replacement, repair, and maintenance costs from the relevant existing data source for the best match to an identified published measure.

Assumptions used for the NEI analyses:

- **Labor rate**: The labor rate tells the LCC Tool whether to select union or non-union labor rates from the existing data source. For this analysis, union labor rates were used.
- **Measure life**: While each of the published data sources contains information regarding the "Replacement Years," to identify the expected life of the measure as documented by the published life-cycle data, these values are not used for this analysis. Instead, the program-specific planned savings-weighted measure lives were used. This assumption has a substantial impact on the annualized net present value of the life cycle costs—the shorter the assumed equipment life the higher the annualized net present value of the life cycle costs. Alternative approaches include using either the measure lives in the published data source leveraged or those established in the related Technical Reference Manual (TRM) that were cited within the Dominion Energy TRM for each given measure. Where a partial year was assumed for the final year of the program's EUL, we rounded to the nearest whole year.
- **First costs**: The costs of purchasing and installing the upgraded equipment —including any heavy equipment rental rates—are included in the analysis results.
- **Incentives:** The first costs are not offset by the amount of the incentive offered by the program.
- **Repair costs:** The costs of materials and labor to perform periodic repairs are included in the analysis.
- **Maintenance costs:** The costs of materials and labor to perform periodic maintenance are included in the analysis.
- **Discount rate:** We assume a discount rate of 6.4% to determine the annualized net present value of the life cycle costs for each efficient and baseline technology. The discount rate applied was provided by the Company's Integrated Strategic Planning Team and represents the customer discount rate.
- **Timing of Costs incurred:** Costs are assumed to be incurred at the beginning of each year within the lifetime of the equipment.
- **Records excluded:** A record was excluded whenever one or more of the following conditions were met:
  - A measure record yielded zero annual gross deemed savings (kWh/year) per the STEP Manual methodology
  - If only one of two equipment types—efficiency or baseline—could be matched to the data in the LCC tool
  - If a given record was missing a value for quantity (i.e., number of units installed, number of existing lamps, number of new lamps)
- **End use category:** There were specific assumptions established that varied by end use as listed.

- For measures classified as HVAC or Drive/Motor, the size or capacity of the new equipment provided in the Dominion Energy Business Intelligence tracking data is assumed to be the size or capacity of the old unit that was replaced (a one-to-one replacement). This is aligned with the methodology established in the STEP Manual for estimating gross annual electric savings.
- On the other hand, lighting measure analyses accommodated differing efficient- and baseline-case wattages and quantities for this analysis.
- For variable-frequency/variable-speed drive (VFD/VSD) installed at a motor, the baseline is assumed to be the same motor without a VFD/VSD.

A known limitation of the secondary data sources:

- **Efficient equipment:** Neither Cost Library nor RS Means provide cost differences between standard and high-efficiency equipment for many types of equipment. In those cases where the same cost data were used for both the efficient and baseline cases, the resulting NEI was always zero.

4.2.3 Results

The combined annualized net present value of the non-energy impacts provided by active 2022 programs totaled approximately $12.7 million for the lighting, HVAC, and VFD upgrades, combined for both VA and NC. These include the first costs of purchasing and installing the equipment, repair costs, and maintenance costs over the life of each program. The NEIs by program and end use are shown in Table 4-4 and Table 4-5. The program-level NEIs are summarized in Table 4-6 and Table 4-7. Finally, the end use-specific NEIs are summarized in Table 4-8.

Table 4-4. Annualized net present value NEI by program and end use by active Virginia programs in 2022

Program – DSM Phase	End Use	Annual $NEI	Annual $NEI/kWh
Residential programs			
Efficient Products Marketplace – DSM Phase VII	Lighting	8,260,302	0.0660
Home Energy Assessment – DSM Phase VII	HVAC	0	0.0000
	Lighting	3,311,785	0.2850
Home Retrofit – DSM Phase VIII	Lighting	644	0.1437
HVAC Health and Safety– DSM Phase VIII	HVAC	- 8,251	- 0.0223
Energy Efficiency Kits – DSM Phase VIII	Lighting	91,072	0.5848
Multifamily – DSM Phase VIII	Lighting	147,057	1.1620
Manufactured Housing – DSM Phase VIII	Lighting	184	0.5942
Virtual Audit – DSM Phase IX	Lighting	313,690	0.4442
Income and Age Qualifying Enhanced – DSM Phase IX	Lighting	43,797	0.0789
Non-residential programs			
Lighting Systems and Controls – DSM Phase VII	Lighting	16,315	0.0010
Heating and Cooling Efficiency – DSM Phase VII	HVAC	6,731	0.0033
	Drive/Motor	- 468,836	-0.0591
Small Business Improvement Enhanced – DSM Phase VIII	Lighting	169,090	0.0368
Midstream Energy Efficiency Products – DSM Phase VIII	HVAC	-546,750	-0.4531
Multifamily – DSM Phase VIII	Lighting	-3,204	-0.0193
Agriculture – DSM Phase IX	Lighting	1,283,211	0.2685
Total		**12,616,838**	**0.0719**

Table 4-5. Annualized net present value NEI by program and end use by active North Carolina programs in 2022

Program – DSM Phase	End use	Annual $NEI	Annual $NEI/kWh
Residential programs			
Efficient Products Marketplace – DSM Phase VII	Lighting	59,349	0.0399
Home Energy Assessment – DSM Phase VII	Lighting	27,821	1.0068
Energy Efficiency Kits – DSM Phase VIII	Lighting	2,483	0.3410
Virtual Audit – DSM Phase IX	Lighting	5,457	0.4211
Income and Age Qualifying Enhanced – DSM Phase IX	Lighting	224	0.0626
Non-residential programs			
Lighting Systems and Controls – DSM Phase VII	Lighting	68,089	0.0490
Heating and Cooling Efficiency – DSM Phase VII	HVAC	0	0
	Drive/Motor	-11,425	-0.1834
Small Business Improvement Enhanced – DSM Phase VIII	Lighting	3,852	0.0127
Total		**155,850**	**0.0464**

Table 4-6. Annualized net present O&M value per annual electric savings by active Virginia programs in 2022

Program – DSM Phase	Annual $NEI	Annual $NEI/kWh
Residential programs		
Efficient Products Marketplace – DSM Phase VII	8,260,302	0.0660
Home Energy Assessment – DSM Phase VII	3,311,785	0.2840
Home Retrofit – DSM Phase VIII	644	0.1437
HVAC Health and Safety– DSM Phase VIII	- 8,251	- 0.0223
Energy Efficiency Kits – DSM Phase VIII	91,072	0.5848
Multifamily – DSM Phase VIII	147,057	1.1620
Manufactured Housing – DSM Phase VIII	184	0.5942
Virtual Audit – DSM Phase IX	313,690	0.4442
Income and Age Qualifying Enhanced – DSM Phase IX	43,797	0.0789
Non-residential programs		
Lighting Systems and Controls – DSM Phase VII	16,315	0.0010
Heating and Cooling Efficiency – DSM Phase VII	-462,105	-0.0464
Small Business Improvement Enhanced – DSM Phase VIII	169,090	0.0368
Midstream Energy Efficiency Products – DSM Phase VIII	-546,750	-0.4531
Multifamily – DSM Phase VIII	-3,204	-0.0193
Agriculture – DSM Phase IX	1,283,211	0.2685
Total	**12,616,838**	**0.0719**

Table 4-7. Annualized net present O&M value per annual electric savings by active North Carolina programs in 2022

Program – DSM Phase	Annual $NEI	Annual $NEI/kWh
Residential programs		
Efficient Products Marketplace – DSM Phase VII	59,349	0.0399
Home Energy Assessment – DSM Phase VII	27,821	1.0068
Energy Efficiency Kits – DSM Phase VIII	2,483	0.3410
Virtual Audit – DSM Phase IX	5,457	0.4211
Income and Age Qualifying Enhanced – DSM Phase IX	224	0.0626
Non-residential programs		
Lighting Systems and Controls – DSM Phase VII	68,089	0.0490
Heating and Cooling Efficiency – DSM Phase VII	-11,425	-0.0891
Small Business Improvement Enhanced – DSM Phase VIII	3,852	0.0127
Total	**155,850**	**0.0464**

Table 4-8. Overall annualized net present value NEI by end use

End use	State	Annual $NEI	Annual $NEI/kWh
Drive/Motor	VA	-468,836	-0.0591
	NC	-11,425	-0.1834
HVAC	VA	-548,271	-0.1510
	NC	-	-
Lighting	VA	13,633,945	0.0831
	NC	167,275	0.0517
Total	VA	**12,616,838**	**0.0719**
	NC	**155,850**	**0.0464**

4.3 Avoided emissions

4.3.1 Introduction

Dominion Energy is required to utilize the services of a third party to perform evaluation, measurement, and verification services to determine the utility's related emissions reductions per the Virginia Clean Economy Act Code Section 56-596.2 C. The following sections highlight the process that DNV used to review Dominion Energy's emission reductions for their energy efficiency programs. The objective of this activity was to estimate the emissions effects of program activities affecting the 2022 calendar year because of program participants for years up to and including 2022 that would impact 2022 emissions levels.

The level of accuracy of these estimates is subject to the level of accuracy of the source data on hourly emissions, which was obtained from WattTime.org, an independent private non-profit company.[7] WattTime's marginal emissions rate data is proprietary and available via subscription. WattTime does not rely upon any data from utilities to model the emissions.

The accuracy of the load shapes applied to the emissions levels is based on the Dominion Energy deemed savings developed by DNV based on the engineering models from the Dominion Energy Technical Reference Manual (DE TRM), or Appendix F of this report. Full hourly load shapes per year are developed by DNV based on the best available data from (in decreasing priority order):

1. Metered program data on samples of program-specific participants and non-participants
2. Comparable end use profiles from other programs
3. Load shape library of public end use load studies compiled by DNV

All load shapes are calibrated to the total annualized (or the first year) energy savings by end use measure to ensure that the ratio of energy to demand matches as closely as possible to the deemed energy savings and demand reductions to produce the same annual usage impacts and match the peak demand impacts as closely as possible.

Some key assumptions in the analysis are:

[7] WattTime is a non-profit company that offers technology solutions that make it easy for anyone to achieve emissions reductions without compromising cost, comfort, or function.

- Emissions data for Marginal Operating Emissions Rate (MOER), measured in lbs. CO2/MWh were obtained from the WattTime.org site, using the PJM DC (District of Columbia) Area, which covers the Eastern Virginia and Northern North Carolina area comparable to the Dominion Energy franchise area. DNV has a subscription for this service.
- Emissions rates for Virginia and North Carolina are considered to be the same, although energy savings for the Virginia jurisdiction are over 95% of the total for Dominion Energy.
- Emissions data for 2022 would apply to all savings measures contributing to 2022.
- The split between Virginia and North Carolina jurisdiction emissions savings was based on the split in 2022 annual cumulative kWh savings by state.

4.3.2 Methodology

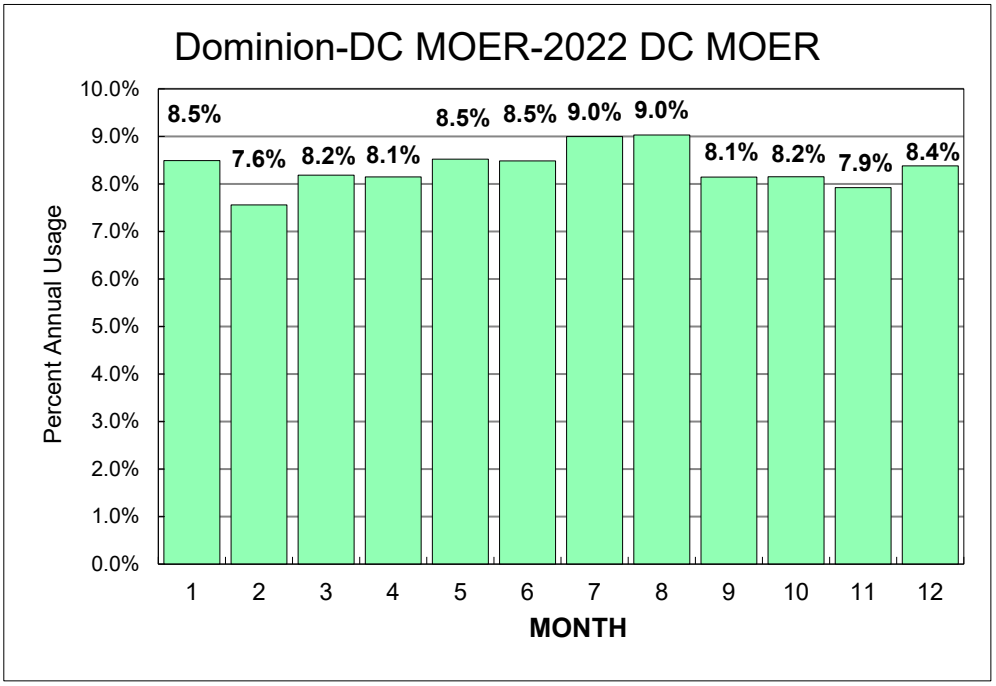
DNV calculates emissions impacts by applying the hourly emissions rates to the hourly DSM program savings for each program, splitting the overall Dominion Energy emissions savings by state based on each state's annual 2022 usage savings percentage. The steps involved were the following:

1. Obtain the 2022 emissions levels from the WattTime.org using the PJM DC Historical emissions data, which is stored as UTC time zone.
2. Convert the UTC time zone data to East Coast local time, accounting for DST conversions
3. Used the hourly 2021 DSM cumulative energy savings from load shapes already developed by program
4. Multiplied the 2021 hourly emissions rates (lbs. CO_2 per MWh) by the hourly DSM kWh/year energy savings to produce the emissions impacts, in metric tons of CO_2 units.
5. Calculated the percentage split between Virginia and North Carolina State energy impacts for 2021.
6. Applied State percentages to overall Dominion Energy emissions factors to calculate state-specific emissions.

Emissions data was obtained from Watttime.org, which consists of Marginal Operating Emissions Rate (MOER), measured in lbs. CO_2/MWh. Data was obtained for 2018 through 2022 and compared, to identify any trends in the pattern.

For the monthly pattern, the 2022 emissions for the PJM DC Area showed only a slight summer-seasonal pattern, as shown in Figure 4-3.

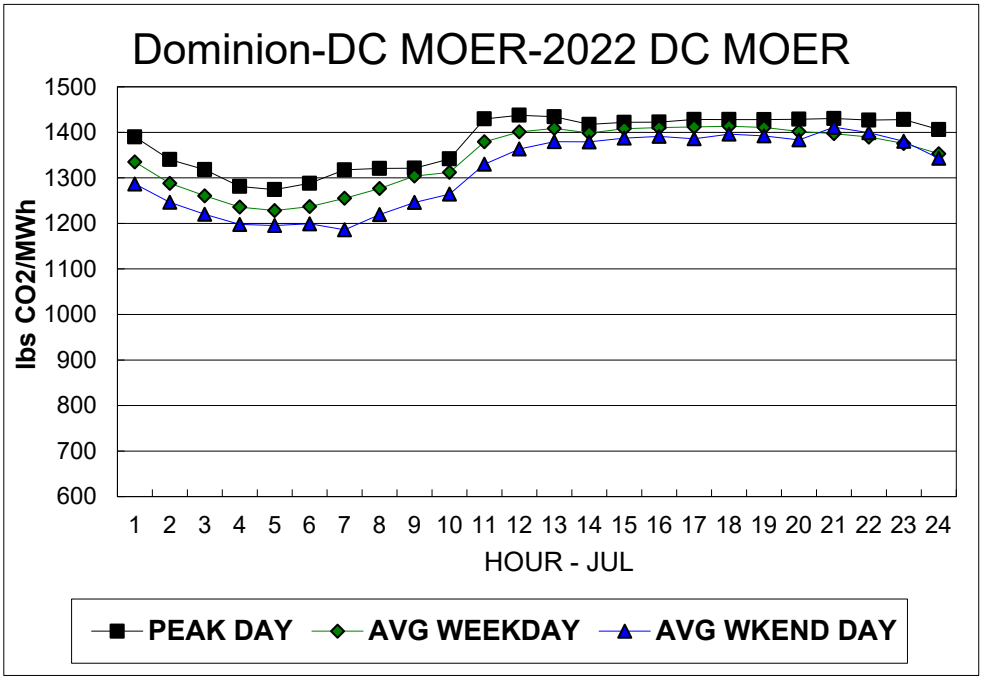
Figure 4-3. PJM DC 2022 monthly marginal operating emissions rate



Comparing 2018 through 2022, 2022 showed slightly less summer seasonality.

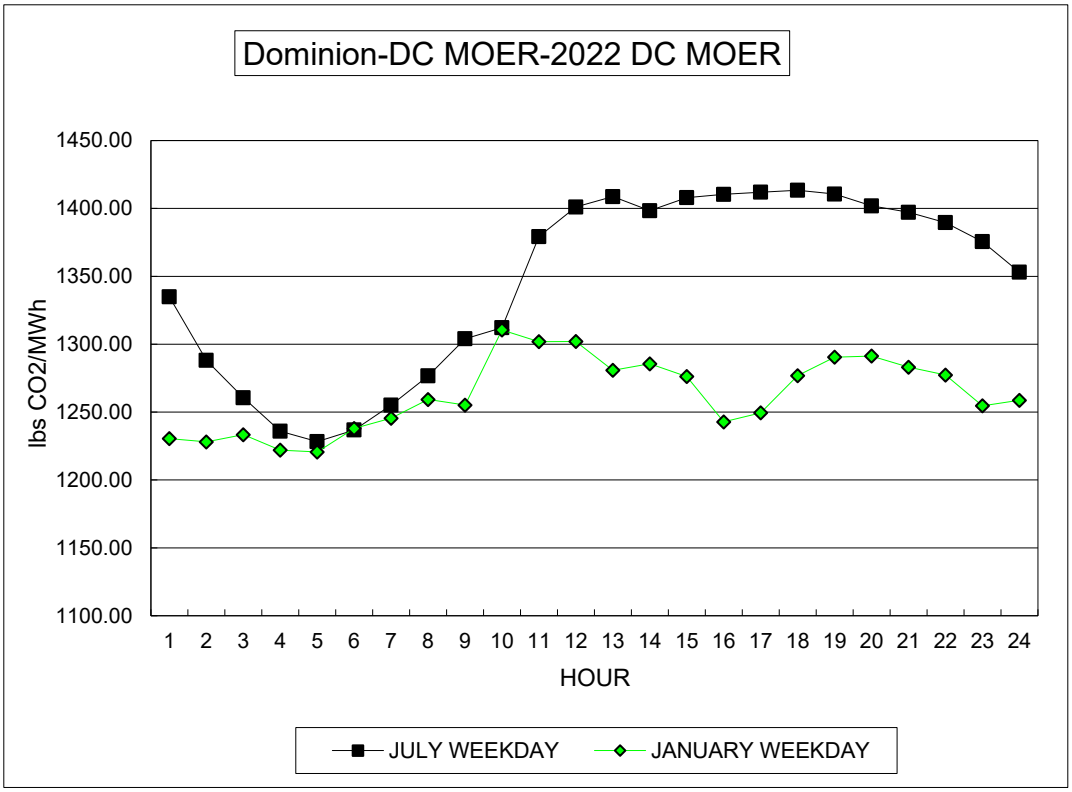
For the peak month (July), the day type hourly pattern showed slightly higher late afternoon and early evening emissions rates, as noted in Figure 4-4.

Figure 4-4. PJM DC July 2022 hourly marginal operating emissions rate



Comparing winter vs. summer showed no comparable evening peak for winter, but slightly lower evening emission rates instead for average weekdays as shown in Figure 4-5.

Figure 4-5. PJM January vs. July 2022 weekday hourly marginal operating emissions rate



The summer vs. winter differences were similar for 2022 as in previous years. As a result, the 2022 emissions rates were considered sufficient for evaluating the overall emissions impacts.

Table 4-9 below indicates the Wattime source 5-minute interval CO_2 Avoided Rates from the MOER for the first 2 hours of 2022 in UTC time. Units are lbs. CO2 per MWh. The data is available in both UTC and local time format and in 8760 1-column (same as load shapes delivered to Dominion) and 365x24 format.

Table 4-9. Illustration of Wattime source 5-minute interval CO2 avoided rate

Timestamp (UTC)	MOER ibs co2/MWH	MOER version	Frequency	UTC date	UTC Hour
2022-01-01T00:00:00+00:00	1251	3.2	300	1/1/2022	1
2022-01-01T00:05:00+00:00	1251	3.2	300	1/1/2022	1
2022-01-01T00:10:00+00:00	1251	3.2	300	1/1/2022	1
2022-01-01T00:15:00+00:00	1244	3.2	300	1/1/2022	1
2022-01-01T00:20:00+00:00	1244	3.2	300	1/1/2022	1
2022-01-01T00:25:00+00:00	1244	3.2	300	1/1/2022	1
2022-01-01T00:30:00+00:00	1245	3.2	300	1/1/2022	1
2022-01-01T00:35:00+00:00	1245	3.2	300	1/1/2022	1
2022-01-01T00:40:00+00:00	1245	3.2	300	1/1/2022	1
2022-01-01T00:45:00+00:00	1246	3.2	300	1/1/2022	1

Timestamp (UTC)	MOER ibs co2/MWH	MOER version	Frequency	UTC date	UTC Hour
2022-01-01T00:50:00+00:00	1243	3.2	300	1/1/2022	1
2022-01-01T00:55:00+00:00	1243	3.2	300	1/1/2022	1
2022-01-01T01:00:00+00:00	1240	3.2	300	1/1/2022	2
2022-01-01T01:05:00+00:00	1240	3.2	300	1/1/2022	2
2022-01-01T01:10:00+00:00	1240	3.2	300	1/1/2022	2
2022-01-01T01:15:00+00:00	1235	3.2	300	1/1/2022	2
2022-01-01T01:20:00+00:00	1239	3.2	300	1/1/2022	2
2022-01-01T01:25:00+00:00	1235	3.2	300	1/1/2022	2
2022-01-01T01:30:00+00:00	1229	3.2	300	1/1/2022	2
2022-01-01T01:35:00+00:00	1229	3.2	300	1/1/2022	2
2022-01-01T01:40:00+00:00	1229	3.2	300	1/1/2022	2
2022-01-01T01:45:00+00:00	1232	3.2	300	1/1/2022	2
2022-01-01T01:50:00+00:00	1233	3.2	300	1/1/2022	2
2022-01-01T01:55:00+00:00	1232	3.2	300	1/1/2022	2

Conversion to local time for Dominion Energy (Eastern U.S.) was done as follows, in Table 4-10, (first 10 hours of January 1 – 10), including conversion to local time with DST (March 13 – November 6):

Table 4-10. Illustration of conversion to local time for Dominion Energy

Date	1	2	3	4	5	6	7	8	9	10
1/1/2022	1,230	1,225	1,223	1,220	1,219	1,223	1,232	1,235	1,231	1,238
1/2/2022	1,226	1,223	1,215	1,219	1,207	1,229	1,234	1,230	1,210	1,231
1/3/2022	1,189	1,204	1,208	1,213	1,209	1,219	1,213	1,221	1,205	1,259
1/4/2022	1,226	1,225	1,230	1,214	1,216	1,236	1,223	1,262	1,261	1,295
1/5/2022	1,227	1,221	1,233	1,227	1,214	1,226	1,243	1,242	1,243	1,292
1/6/2022	1,207	1,214	1,218	1,210	1,204	1,222	1,216	1,243	1,248	1,274
1/7/2022	1,215	1,227	1,225	1,208	1,214	1,243	1,250	1,256	1,264	1,337
1/8/2022	1,257	1,248	1,245	1,233	1,220	1,224	1,256	1,253	1,273	1,316
1/9/2022	1,225	1,225	1,136	1,218	1,215	1,224	1,227	1,230	1,229	1,247
1/10/2022	1,212	1,204	1,206	1,210	1,206	1,230	1,239	1,249	1,250	1,314

The source data units (lbs CO_2 per MWh) were then converted to Metric Tons of CO_2 per kWh for application to the energy savings.

Conversion equations:

$$\frac{Metric\ Tons}{2{,}204{,}620\ kWh} = \frac{1\ lbs CO_2}{1\ MWh} \times \frac{1\ MWh}{1{,}000\ kWh} \times \frac{1\ Metric\ Ton}{2{,}204.62\ lbs}$$

$$Metric\ Tons = \frac{1\ Metric\ Ton}{2{,}204.62\ lbs} \times kWh$$

Table 4-11 below shows the CO_2 Avoided Rates from the DC MOER for the first 12 hours of 2022. Units are lbs. CO_2 per MWh, which were then converted to metric tons of CO_2 per kWh.

Table 4-11. Example hourly emission rates excerpt for first 12 hours of 2022

Date	Hour	Month	MOER Lbs CO2/MWH (Local Time)	Metric Tons CO2/kWh (local time)
1/1/2022	1	1	1,230	0.00056
1/1/2022	2	1	1,225	0.00056
1/1/2022	3	1	1,223	0.00056
1/1/2022	4	1	1,220	0.00055
1/1/2022	5	1	1,219	0.00055
1/1/2022	6	1	1,223	0.00055
1/1/2022	7	1	1,232	0.00056
1/1/2022	8	1	1,235	0.00056
1/1/2022	9	1	1,231	0.00056
1/1/2022	10	1	1,238	0.00056
1/1/2022	11	1	1,251	0.00057
1/1/2022	12	1	1,230	0.00056
1/1/2022	13	1	1,242	0.00056
1/1/2022	14	1	1,250	0.00057
1/1/2022	15	1	1,247	0.00057
1/1/2022	16	1	1,226	0.00056
1/1/2022	17	1	1,224	0.00056
1/1/2022	18	1	1,220	0.00055
1/1/2022	19	1	1,214	0.00055
1/1/2022	20	1	1,238	0.00056
1/1/2022	21	1	1,229	0.00056
1/1/2022	22	1	1,229	0.00056
1/1/2022	23	1	1,218	0.00055
1/1/2022	24	1	1,230	0.00056

Each program with contributions to 2022 emissions was included, covering several stages of Dominion Energy program rollouts, both residential and non-residential, totalling 30 Programs. They are listed in Table 4-12 below.

Table 4-12. Dominion Energy programs included in emissions calculations for 2022

Dominion Programs	
Program acronym	Program title
CAGR	Non-Residential Agricultural Energy Efficiency

Dominion Programs	
CBOT	Non-Residential Building Optimization
CEEP	Non-Residential Midstream Energy Efficiency Products
CHV3	Non-residential Heating and Cooling Efficiency
CLT3	Non-residential Lighting Systems & Controls
CMFP	Non-Residential Multifamily
CNR2	Non-Residential Prescriptive Enhanced
CNRP	Non-residential Prescriptive
CSW2	Non-residential Window Film
CTSM	Non-residential Small Manufacturing
CTSO	Non-residential Office
EAL4	Residential Income and Age Qualifying Energy Efficiency
EALS	Income and Age Qualifying Solar Program
RAR2	Residential Appliance Recycling
RCEB	Residential Customer Engagement
REEC	Residential Efficient Products Marketplace
REVEE	Residential Electric Vehicle Purchase Energy Efficiency
RHRF	Residential Home Retrofit
RHVC	Residential HVAC Health and Safety
RKTS	Residential Kits
RMFP	Residential Multifamily
RMHP	Residential Manufactured Housing
RNCR	Residential New Construction
RSMH	Residential Smart Home
RTEB	Residential Thermostat Purchase and WeatherSmart
RTEE	Residential Thermostat Purchase and WeatherSmart
RTHO	Residential Home Energy Assessment
RVAU	Residential Virtual Energy Audit
RWEE	Residential Water Savings
SBI2	Non-residential Small Business Improvement Enhanced

Hourly load shapes by DSM program previously developed were used, having already been calibrated to the annualized or first-year deemed savings developed through the TRM, updated through the final versions of the annualized savings through December 2022. The percentage split between Virginia and North Carolina was calculated based on annual usage by state.

4.3.3 Calculation approach

Marginal operating emissions rates (MOER) were applied to hourly estimates of program-level kWh and the resulting units are in metric tons of CO2. Each hour of 2022 emissions was multiplied by the same hour of the 2022 usage impacts. Percentages by state were then applied to produce separate emissions impacts for Virginia and North Carolina.

It should be noted that separate load shapes are not typically produced by the state; therefore, any differences in program participation mix, in terms of types of customers and measures implemented by the state, will not be reflected. However, given the dominance of Virginia participation (over 95%) in program impacts, and consistent pattern of emissions across months and hours, it was not considered worthwhile to develop state-specific hourly load impacts and resulting emissions impacts.

4.3.4 Results

Overall, avoided emissions impacts (in metric tons CO_2 Avoided) totaled 460,589 metric tons CO_2 avoided per year for the 30 programs that were active in Virginia and North Carolina in 2022 (see Table 4-13 and Figure 4-6).

The REEC Program for Residential Efficient Products Marketplace had the greatest impact, totalling 235,126 metric tons of CO_2 avoided in 2022, 51.0% of all program impacts reported for 2022. Next was the RCEB Program for Residential Customer Engagement with 66,336 metric tons CO_2 (14.4%), then the CNRP program for Non-Residential Prescriptive, with 49,337 metric tons of CO_2 avoided (10.7%). These three programs totalled over 76% of all emissions for the selected programs. These high contributor programs are highlighted in Figure 4-6. All other programs each contributed less than 10% of all program impacts.

Overall, Virginia program participants contributed 98.2% of all Dominion Energy emissions impacts.

Overall, monthly program impacts (as shown in Figure 4-7) were distributed fairly evenly across the year, reflecting the combination of lighting (evenly distributed), some heating-oriented (winter seasonal, such as EAL4, program (Residential Income/Age Qualifying Energy Efficiency) and some cooling-oriented (summer-seasonal, such as CNRP). Figure 4-8 and Figure 4-9 show the highest contributors to summer and winter seasonal reductions, respectively.

Table 4-13. Monthly emissions by active 2022 programs

Dominion Emissions Impacts (Metric Tons CO2) from DSM Programs Dominion Totals														
Program	Month (2022)												Annual	Pct by
For 2022	1	2	3	4	5	6	7	8	9	10	11	12	2022	Program
CAGR	234.55	217.94	240.86	234.97	245.94	252.37	252.30	266.81	239.36	229.22	234.24	242.69	**2,891.23**	**0.628%**
CBOT	166.92	130.27	95.27	65.24	50.83	56.02	68.11	62.39	45.53	56.52	84.54	121.09	**1,002.73**	**0.218%**
CEEP	98.06	85.37	69.28	48.70	46.87	56.26	180.26	169.57	49.42	47.90	58.44	82.24	**992.35**	**0.215%**
CHV3	1,642.03	1,380.61	875.82	313.10	115.71	275.65	313.54	326.27	197.56	289.37	660.37	1,222.38	**7,612.42**	**1.653%**
CLT3	3,352.68	3,059.49	3,341.43	3,299.31	3,432.67	3,474.58	3,600.21	3,678.06	3,308.98	3,266.00	3,214.65	3,393.69	**40,421.75**	**8.776%**
CMFP	7.93	7.21	7.87	7.76	8.19	8.27	8.49	8.75	7.88	7.64	7.65	8.02	**95.67**	**0.021%**
CNR2	193.26	177.57	215.84	292.96	491.76	802.70	927.36	934.06	566.51	255.71	195.61	192.84	**5,246.18**	**1.139%**
CNRP	3,474.24	3,122.72	3,408.32	3,581.26	4,302.23	5,228.47	5,804.99	5,835.64	4,436.87	3,523.15	3,235.96	3,383.38	**49,337.24**	**10.712%**
CSW2	21.93	19.30	25.09	26.02	26.88	29.94	29.23	31.26	26.95	25.80	24.18	22.15	**308.73**	**0.067%**
CTSM	236.05	217.14	230.91	230.98	244.45	246.64	264.35	265.80	237.36	233.62	223.31	233.17	**2,863.79**	**0.622%**
CTSO	126.04	118.60	147.44	181.31	267.14	396.42	546.09	505.83	380.32	188.03	154.43	143.31	**3,154.98**	**0.685%**
EAL4	269.33	220.07	171.80	99.79	75.90	107.84	145.93	128.59	90.49	144.94	142.00	204.40	**1,801.08**	**0.391%**
EALS	0.93	1.13	1.83	1.99	2.27	2.37	2.48	2.23	1.86	1.32	1.15	0.95	**20.50**	**0.004%**
RAR2	155.20	139.07	161.31	170.15	177.40	193.66	217.22	208.24	177.75	166.69	151.36	155.19	**2,073.23**	**0.450%**
RCEB	7,776.65	7,836.08	5,540.85	3,515.99	4,561.02	5,568.14	6,340.80	5,900.31	4,443.01	3,409.67	5,214.24	6,228.86	**66,335.62**	**14.402%**
REEC	15,777.71	14,461.50	16,718.73	18,223.47	20,145.59	23,279.41	26,493.06	25,101.44	22,374.65	19,650.67	17,027.06	15,872.86	**235,126.16**	**51.049%**
REVEE	2.20	2.16	2.22	2.34	2.33	1.42	1.59	1.92	1.72	1.55	1.50	1.82	**22.76**	**0.005%**
RHRF	31.50	24.98	18.22	9.22	6.12	11.32	16.95	14.24	8.47	14.64	14.35	22.23	**192.22**	**0.042%**
RHVC	227.97	176.76	122.73	69.03	48.51	78.79	114.80	96.92	56.32	80.31	101.26	157.75	**1,331.15**	**0.289%**
RKTS	396.39	356.92	349.19	316.22	325.03	323.91	344.46	344.41	314.92	326.88	350.06	409.90	**4,158.28**	**0.903%**
RMFP	30.26	25.27	20.70	14.39	13.31	19.01	25.38	22.58	15.47	18.06	18.03	24.76	**247.22**	**0.054%**
RMHP	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	**0.71**	**0.000%**
RNCR	283.94	247.35	243.96	257.94	311.58	481.51	644.75	569.00	363.71	253.94	234.95	265.23	**4,157.88**	**0.903%**
RSMH	0.45	0.42	0.40	0.36	0.39	0.41	0.44	0.44	0.37	0.35	0.38	0.42	**4.84**	**0.001%**
RTEB	-	-	-	8.02	21.14	57.32	88.52	73.69	35.30	7.36	-	-	**291.34**	**0.063%**
RTEE	323.68	245.61	162.09	94.87	59.68	70.52	95.73	81.56	50.15	75.98	139.89	219.65	**1,619.41**	**0.352%**
RTHO	1,995.34	1,759.68	1,879.56	1,879.09	1,985.24	2,022.67	2,181.37	2,138.18	1,900.06	1,883.91	1,824.08	1,955.60	**23,404.79**	**5.081%**
RVAU	111.06	101.57	101.20	92.67	91.79	88.47	95.40	93.77	84.74	88.70	96.65	111.63	**1,157.63**	**0.251%**
RWEE	4.23	3.97	4.37	4.51	4.87	5.10	5.55	5.56	4.85	4.53	4.36	4.75	**56.66**	**0.012%**
SBI2	357.07	336.33	372.34	369.67	397.21	435.54	446.69	468.57	393.45	358.31	353.25	372.28	**4,660.71**	**1.012%**
Year-end December 2022 Impacts														
Dominion Totals	**37,297.66**	**34,475.13**	**34,529.68**	**33,411.41**	**37,462.10**	**43,574.79**	**49,256.12**	**47,336.13**	**39,814.09**	**34,610.84**	**33,768.00**	**35,053.30**	**460,589.26**	**100.0%**
Percent by Month	**8.1%**	**7.5%**	**7.5%**	**7.3%**	**8.1%**	**9.5%**	**10.7%**	**10.3%**	**8.6%**	**7.5%**	**7.3%**	**7.6%**		

Figure 4-6. Dominion Energy 2022 emissions by largest impact contributors

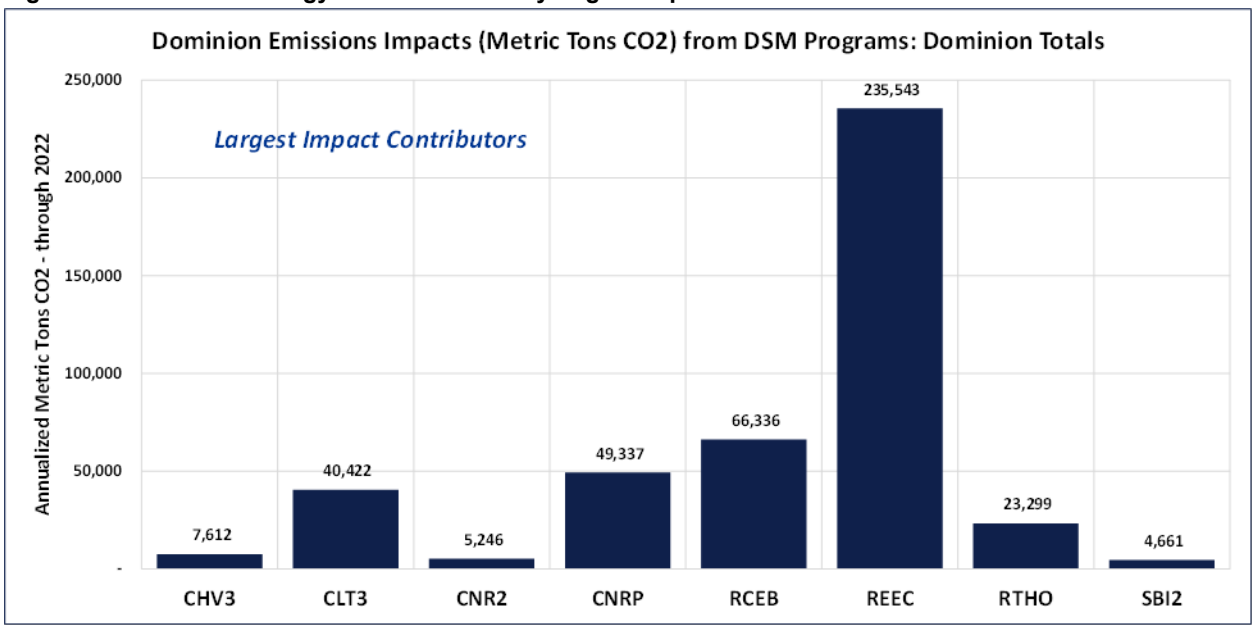


Figure 4-7. Dominion Energy 2022 emissions by active programs

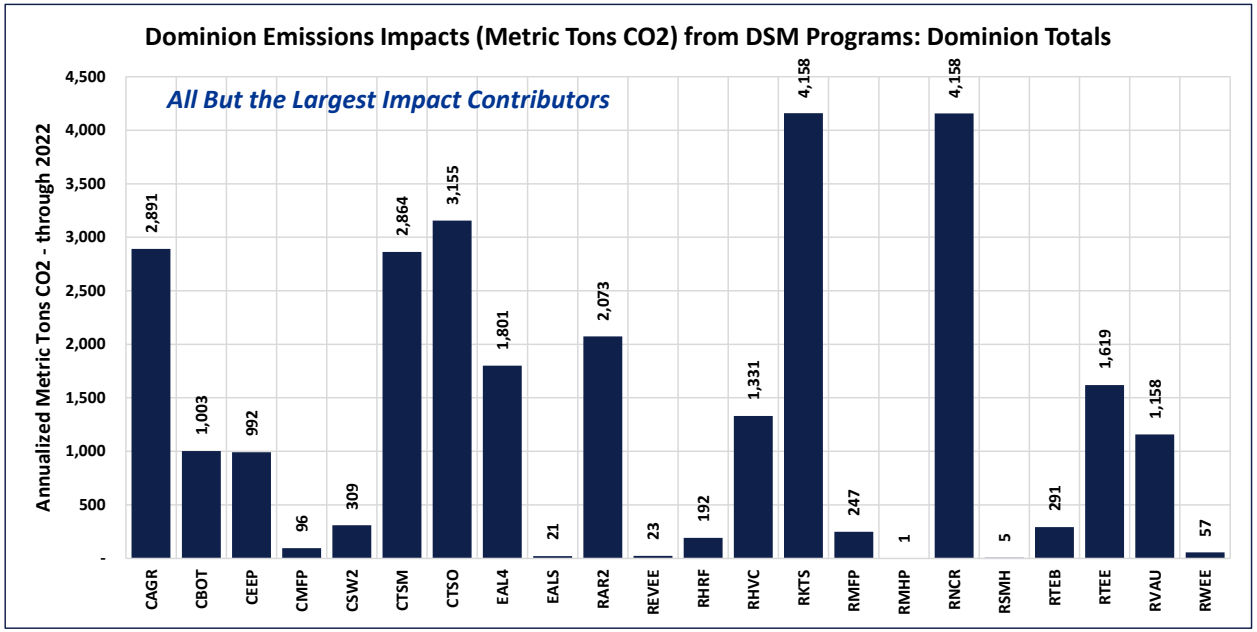


Figure 4-8. Dominion Energy 2022 summer seasonal programs

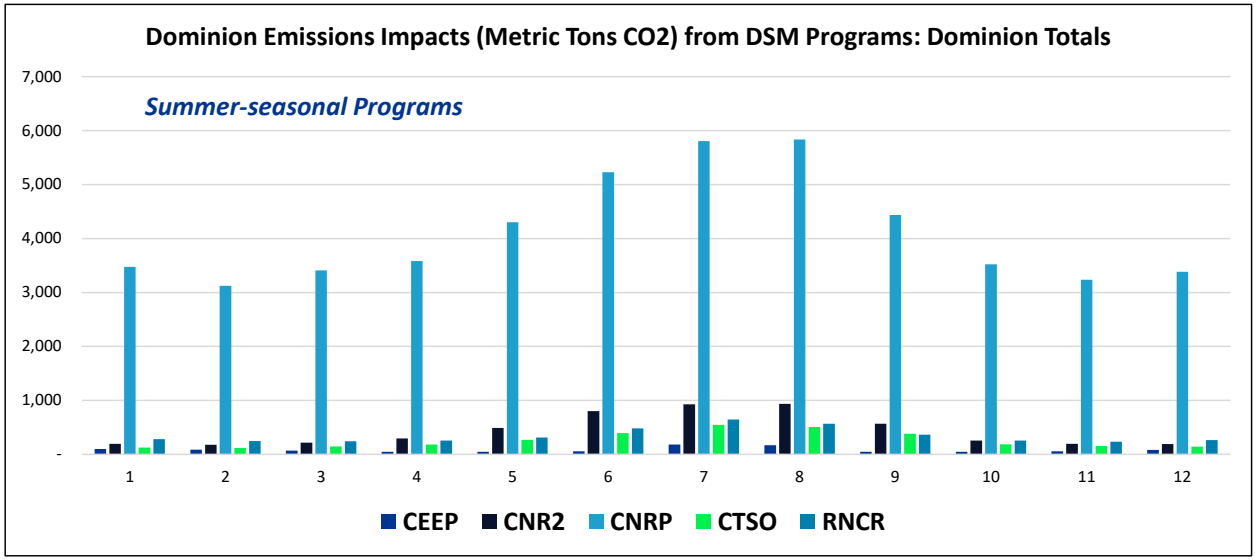
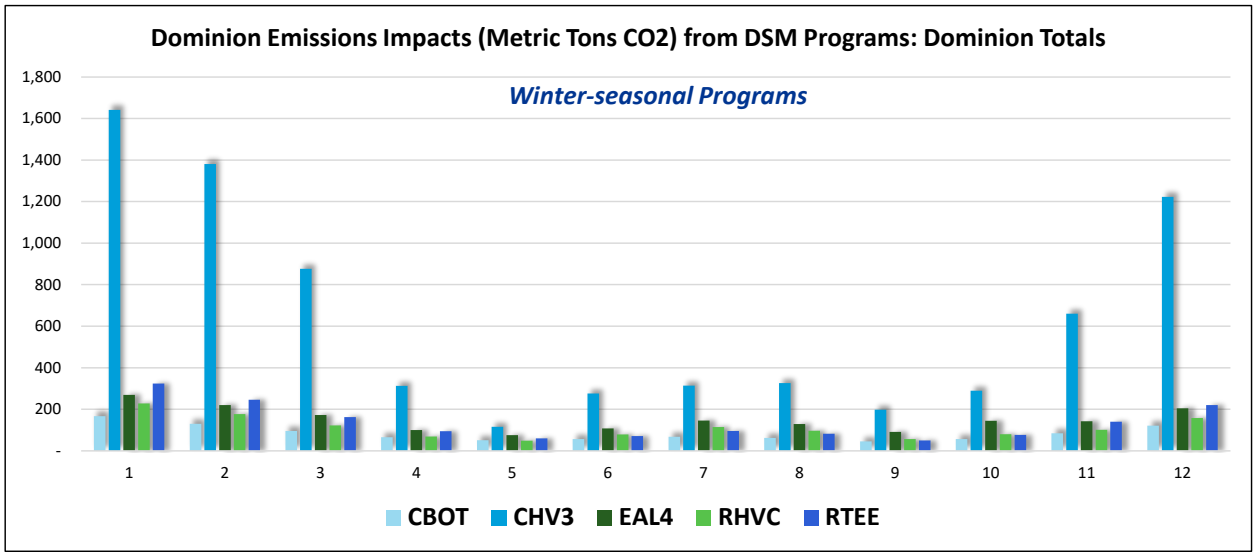


Figure 4-9. Dominion Energy 2022 winter seasonal programs



4.3.4.1 Results by State – Virginia

Overall, Virginia programs accounted for 452,212 Metric Tons CO2, or 98.2% of total Dominion Energy emissions. The largest contributors were REEC (50.9% of Virginia totals), RCEB (14.7%), and CNRP (10.5%). See Table 4-14 and Figure 4-11 for detailed results.

Table 4-14. Virginia monthly emissions by active 2022 programs

Dominion Emissions Impacts (Metric Tons CO2) from DSM Programs Virginia Totals														
Program	Month (2022)												Annual	Pct by
For 2022	1	2	3	4	5	6	7	8	9	10	11	12	2022	Program
CAGR	234.55	217.94	240.86	234.97	245.94	252.37	252.30	266.81	239.36	229.22	234.24	242.69	**2,891.23**	**0.639%**
CBOT	166.92	130.27	95.27	65.24	50.83	56.02	68.11	62.39	45.53	56.52	84.54	121.09	**1,002.73**	**0.222%**
CEEP	98.06	85.37	69.28	48.70	46.87	56.26	180.26	169.57	49.42	47.90	58.44	82.24	**992.35**	**0.219%**
CHV3	1,624.54	1,365.90	866.49	309.77	114.48	272.71	310.20	322.80	195.46	286.29	653.33	1,209.36	**7,531.34**	**1.665%**
CLT3	3,267.53	2,981.78	3,256.57	3,215.52	3,345.49	3,386.33	3,508.77	3,584.64	3,224.94	3,183.05	3,133.00	3,307.50	**39,395.12**	**8.712%**
CMFP	7.93	7.21	7.87	7.76	8.19	8.27	8.49	8.75	7.88	7.64	7.65	8.02	**95.67**	**0.021%**
CNR2	193.26	177.57	215.84	292.96	491.76	802.70	927.36	934.06	566.51	255.71	195.61	192.84	**5,246.18**	**1.160%**
CNRP	3,344.22	3,005.85	3,280.76	3,447.24	4,141.22	5,032.80	5,587.74	5,617.25	4,270.82	3,391.29	3,114.86	3,256.76	**47,490.82**	**10.502%**
CSW2	21.21	18.66	24.26	25.16	25.99	28.95	28.27	30.23	26.06	24.95	23.38	21.42	**298.53**	**0.066%**
CTSM	236.05	217.14	230.91	230.98	244.45	246.64	264.35	265.80	237.36	233.62	223.31	233.17	**2,863.79**	**0.633%**
CTSO	125.06	117.68	146.30	179.91	265.06	393.34	541.85	501.91	377.37	186.57	153.23	142.19	**3,130.49**	**0.692%**
EAL4	265.28	216.76	169.22	98.29	74.76	106.22	143.73	126.66	89.13	142.76	139.87	201.33	**1,774.01**	**0.392%**
EALS	0.93	1.13	1.83	1.99	2.27	2.37	2.48	2.23	1.86	1.32	1.15	0.95	**20.50**	**0.005%**
RAR2	154.61	138.55	160.70	169.51	176.73	192.93	216.40	207.45	177.08	166.06	150.79	154.60	**2,065.41**	**0.457%**
RCEB	7,776.65	7,836.08	5,540.85	3,515.99	4,561.02	5,568.14	6,340.80	5,900.31	4,443.01	3,409.67	5,214.24	6,228.86	**66,335.62**	**14.669%**
REEC	15,459.96	14,170.26	16,382.03	17,856.47	19,739.88	22,810.58	25,959.52	24,595.92	21,924.04	19,254.92	16,684.15	15,553.20	**230,390.93**	**50.948%**
REVEE	2.20	2.16	2.22	2.34	2.33	1.42	1.59	1.92	1.72	1.55	1.50	1.82	**22.76**	**0.005%**
RHRF	31.50	24.98	18.22	9.22	6.12	11.32	16.95	14.24	8.47	14.64	14.35	22.23	**192.22**	**0.043%**
RHVC	227.97	176.76	122.73	69.03	48.51	78.79	114.80	96.92	56.32	80.31	101.26	157.75	**1,331.15**	**0.294%**
RKTS	377.63	340.02	332.66	301.25	309.65	308.57	328.15	328.10	300.01	311.40	333.49	390.50	**3,961.44**	**0.876%**
RMFP	30.26	25.27	20.70	14.39	13.31	19.01	25.38	22.58	15.47	18.06	18.03	24.76	**247.22**	**0.055%**
RMHP	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	**0.71**	**0.000%**
RNCR	283.94	247.35	243.96	257.94	311.58	481.51	644.75	569.00	363.71	253.94	234.95	265.23	**4,157.88**	**0.919%**
RSMH	0.43	0.40	0.38	0.34	0.37	0.39	0.42	0.42	0.36	0.34	0.37	0.40	**4.62**	**0.001%**
RTEB	-	-	-	7.75	20.43	55.40	85.56	71.23	34.12	7.11	-	-	**281.60**	**0.062%**
RTEE	314.88	238.93	157.69	92.29	58.06	68.61	93.13	79.34	48.78	73.92	136.08	213.68	**1,575.39**	**0.348%**
RTHO	1,989.46	1,754.50	1,874.03	1,873.56	1,979.39	2,016.71	2,174.95	2,131.89	1,894.46	1,878.36	1,818.70	1,949.84	**23,335.85**	**5.160%**
RVAU	108.81	99.51	99.16	90.79	89.93	86.68	93.47	91.87	83.02	86.90	94.69	109.37	**1,134.20**	**0.251%**
RWEE	4.23	3.97	4.37	4.51	4.87	5.10	5.55	5.56	4.85	4.53	4.36	4.75	**56.66**	**0.013%**
SBI2	335.99	316.47	350.36	347.85	373.76	409.83	420.33	440.91	370.23	337.16	332.40	350.30	**4,385.59**	**0.970%**
Year-end December 2022 Impacts														
Virginia Totals	**36,684.13**	**33,918.54**	**33,915.55**	**32,771.77**	**36,753.31**	**42,760.05**	**48,345.72**	**46,450.79**	**39,057.41**	**33,945.80**	**33,162.03**	**34,446.91**	**452,212.01**	**100.0%**
Percent by Month	**8.1%**	**7.5%**	**7.5%**	**7.2%**	**8.1%**	**9.5%**	**10.7%**	**10.3%**	**8.6%**	**7.5%**	**7.3%**	**7.6%**		

Figure 4-10. Virginia 2022 emissions by largest impact contributors

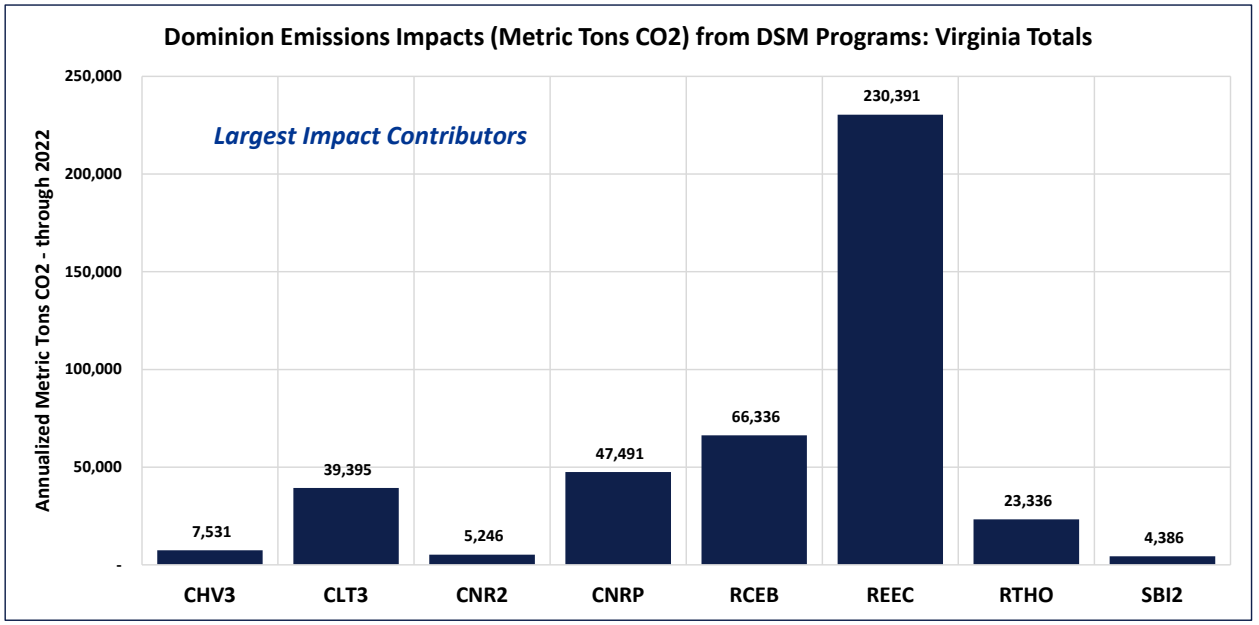
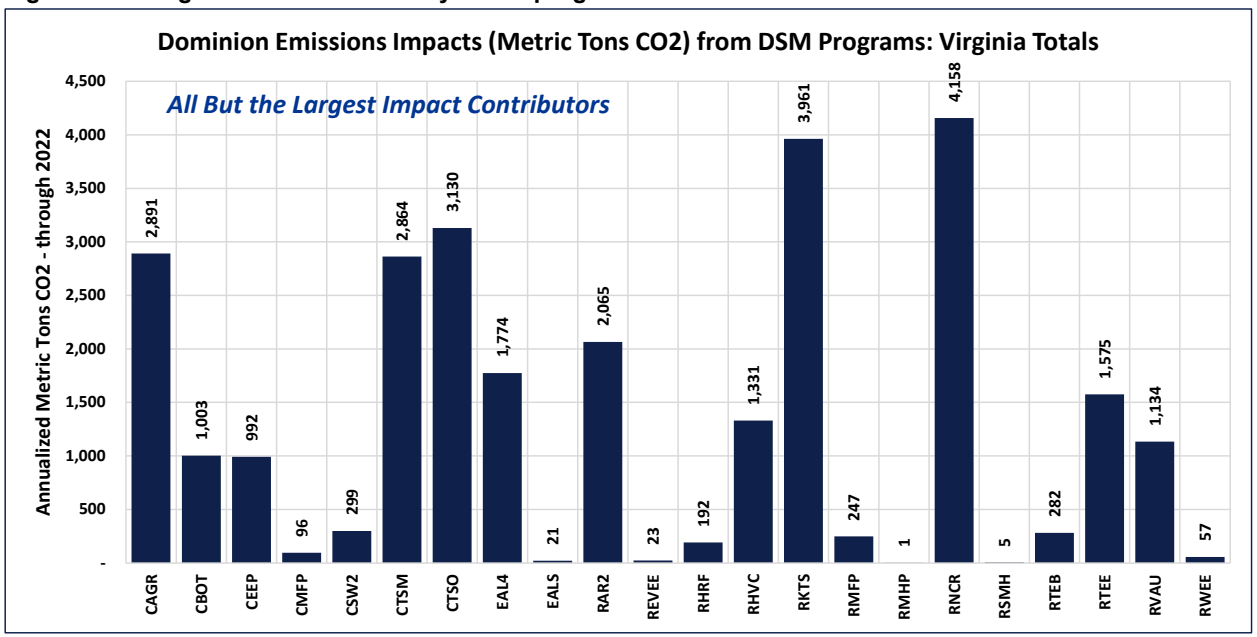


Figure 4-11. Virginia 2022 emissions by active programs



4.3.4.2 Results by State – North Carolina

Overall, North Carolina programs accounted for 8,377 Metric Tons CO2, or 1.8% of total Dominion Energy emissions. The largest contributors were REEC (56.5% of North Carolina totals), CNRP (22.0%) and CLT3 (12.3%). See Table 4-15, Figure 4-12, and Figure 4-13 for detailed results.

Table 4-15. North Carolina monthly emissions by active 2022 programs

Dominion Emissions Impacts (Metric Tons CO2) from DSM Programs North Carolina Totals														
Program	Month (2022)												Annual	Pct by
For 2022	1	2	3	4	5	6	7	8	9	10	11	12	2022	Program
CAGR	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CBOT	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CEEP	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CHV3	17.49	14.70	9.33	3.33	1.23	2.94	3.34	3.48	2.10	3.08	7.03	13.02	81.08	0.968%
CLT3	85.15	77.70	84.87	83.80	87.18	88.25	91.44	93.42	84.04	82.95	81.65	86.19	1,026.63	12.255%
CMFP	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CNR2	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CNRP	130.02	116.87	127.55	134.03	161.01	195.67	217.25	218.40	166.05	131.85	121.10	126.62	1,846.42	22.041%
CSW2	0.72	0.64	0.83	0.86	0.89	0.99	0.97	1.03	0.89	0.85	0.80	0.73	10.20	0.122%
CTSM	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
CTSO	0.98	0.92	1.14	1.41	2.07	3.08	4.24	3.93	2.95	1.46	1.20	1.11	24.50	0.292%
EAL4	4.05	3.31	2.58	1.50	1.14	1.62	2.19	1.93	1.36	2.18	2.13	3.07	27.08	0.323%
EALS	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RAR2	0.59	0.52	0.61	0.64	0.67	0.73	0.82	0.79	0.67	0.63	0.57	0.59	7.82	0.093%
RCEB	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
REEC	317.75	291.24	336.70	367.00	405.71	468.83	533.55	505.52	450.61	395.75	342.91	319.66	4,735.23	56.525%
REVEE	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RHRF	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RHVC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RKTS	18.76	16.90	16.53	14.97	15.39	15.33	16.31	16.30	14.91	15.47	16.57	19.40	196.84	2.350%
RMFP	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RMHP	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RNCR	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
RSMH	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.22	0.003%
RTEB	-	-	-	0.27	0.71	1.92	2.96	2.46	1.18	0.25	-	-	9.74	0.116%
RTEE	8.80	6.68	4.41	2.58	1.62	1.92	2.60	2.22	1.36	2.07	3.80	5.97	44.02	0.525%
RTHO	5.88	5.18	5.54	5.53	5.85	5.96	6.42	6.30	5.60	5.55	5.37	5.76	68.93	0.823%
RVAU	2.25	2.06	2.05	1.88	1.86	1.79	1.93	1.90	1.71	1.80	1.96	2.26	23.43	0.280%
RWEE	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000%
SBI2	21.08	19.85	21.98	21.82	23.45	25.71	26.37	27.66	23.23	21.15	20.85	21.98	275.12	3.284%
Year-end December 2022 Impacts														
North Carolina Totals	613.53	556.59	614.13	639.63	708.79	814.74	910.40	885.34	756.68	665.05	605.97	606.39	8,377.24	100.0%
Percent by Month	7.3%	6.6%	7.3%	7.6%	8.5%	9.7%	10.9%	10.6%	9.0%	7.9%	7.2%	7.2%		

Figure 4-12. North Carolina 2022 emissions by largest impact contributors

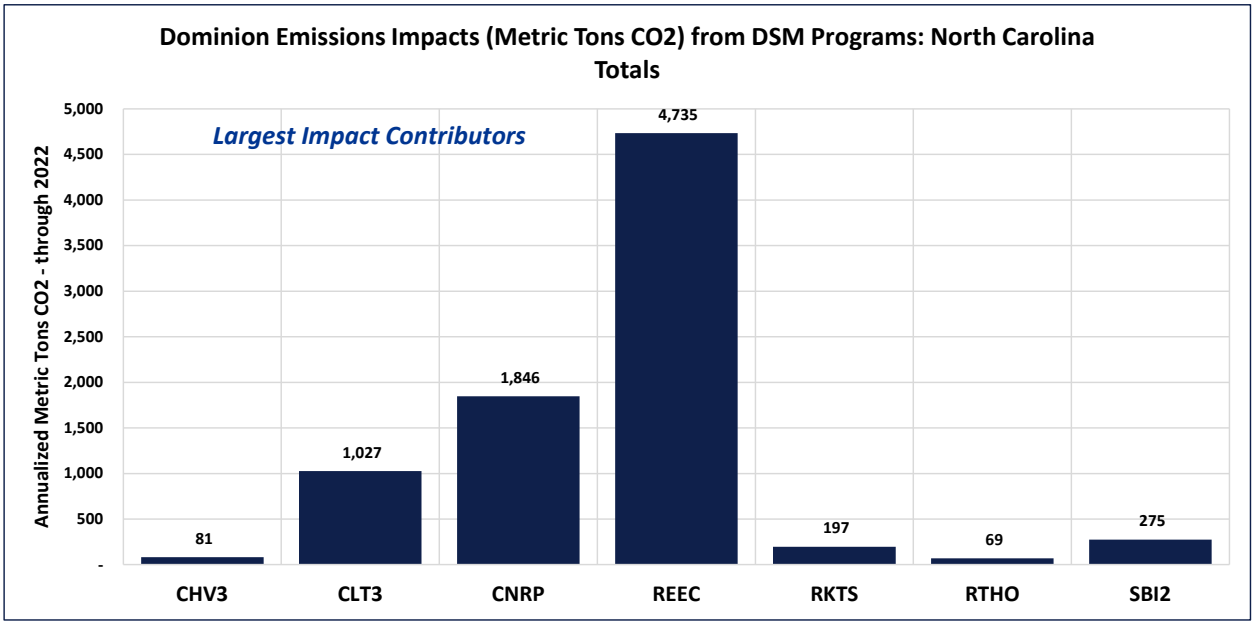
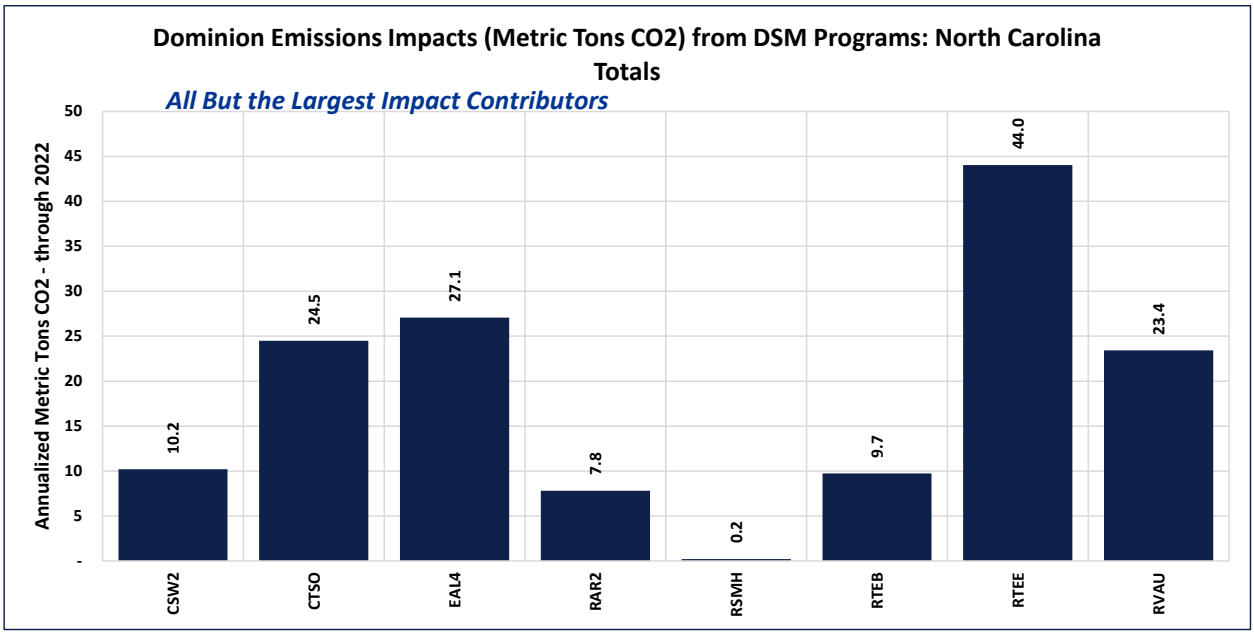


Figure 4-13. North Carolina 2022 emissions by active programs



4.4 Benefit/cost and avoided cost methodology review

In 2021, Dominion Energy developed the Load Modifier Tool (LMT) as a replacement for the DSM Strategist modeling tool they used to perform cost-benefit calculations for demand side management (DSM) programs. Per the Virginia Clean Economy Act Code Section 56-596.2 C, Dominion Energy must "utilize the services of a third party to perform evaluation, measurement, and verification services to review the utility's avoided costs and cost-benefit analyses". DNV performed a third-party review of the LMT's new processes and calculations and Dominion Energy's QC process. To verify the LMT calculations, DNV developed a Microsoft Excel Workbook (DNV Program Review Workbook) based on Dominion Energy's QC process.

Four programs were selected for review in 2022—Residential Efficient Product Marketplace (REEC), Residential Peak Time Rebate (RPTR), Residential Home Retrofit Update (RHR2), and Non-Residential Custom (CST4). These programs were selected to represent a variety of programs, based on the customer class served (residential or non-residential), the type of program (energy efficiency or demand response), and new and existing programs. The programs selected were also distinct from previously reviewed DSM programs.

4.4.1 Overview of load modifier tool (LMT)

LMT is used to calculate cost-benefit scores for DSM programs using global assumptions (e.g., avoided costs, customer rates, discount rates, etc.), and program-specific assumptions (e.g., program costs, supply-side costs, participation, program load shapes, etc). The LMT is used in conjunction with Plexos for individual program screenings. Plexos is the energy modeling tool used by Dominion Energy to evaluate energy costs associated with different resource mixes under different scenarios. Dominion Energy's current approach involves measuring the changes in the revenues and costs under the base case without DSM resources versus scenarios with DSM resources. The LMT program load shapes must be incorporated into Plexos to produce updated supply side costs. DSM loadshapes are supplied by vendors (or program designers) for new programs. Those loadshapes are developed based on outcomes from similar programs in other jurisdictions. Loadshapes for existing programs are developed from the evaluation of those existing programs.

On November 16, 2022, the DSP team held a virtual working session to provide DNV with a detailed walk-through of the process for a single program using Microsoft Teams, which allowed DNV to view the entire process through screensharing. In the working session, the inputs and assumptions were discussed, and the DSP team answered DNV's questions about data flow and output generation. In the virtual working session, the DSP team confirmed the application of vendor loadshapes for new programs and the use of DNV loadshapes for existing programs and verified the "replacement in-kind" assumption had been removed.

Programs are developed based on the planning cycle—i.e., a number of years—and are approved or changed through regulatory proceedings. In previous iterations of benefit-cost analyses, the replacement in-kind assumption was used to assume that a program or a similar program would continue after the current program period ends. The implication of using the replacement in-kind assumption is that the benefits and costs associated with the program are expected to continue beyond the current planning cycle. By removing the replacement in-kind assumption, program costs are limited to the planning period. And the removal of this assumption can be verified in the avoided cost calculations. To enable external verification of the process in LMT, the DSP team provided DNV with all relevant input, assumptions, and output files for all programs reviewed.

Individual costs and benefits calculated within LMT are shown in Table 4-16, in addition to the following four cost-effectiveness tests.[8]

- **Participant Cost Test (PCT):** "measure of the quantifiable benefits and costs to the customer due to participation in a program"
- **Program Administrator Cost Test (PACT) or Utility Cost Test (UCT):** "measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant"
- **Total Resource Cost (TRC) Test:** "measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs"
- **Ratepayer Impact Measure (RIM):** "measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program"

Table 4-16. LMT benefit-cost inputs by cost-effectiveness test[9]

Test category / test	PCT	UCT	TRC	RIM	Methodology description
Benefits					
Customer bill savings	P	-	-	-	NPV annual bill savings; annual bill savings equals [total gross (including free riders with no spillover) MWh reduction * rate per kWh * (1 – line loss %)]
Other customer benefits	P	-	T	-	NPV other variable customer benefits (number of participants * variable customer benefits)
Production cost savings	-	U	T	R	NPV of avoided energy costs Avoided energy costs = per kWh avoided cost * kWh savings * (1+ line loss %)
Deferred T&D capacity costs	-	U	T	R	NPV T&D capacity cost change; equals T&D demand credit * kW reduction * (1+ line loss %)
Deferred generation capacity costs	-	U	T	R	NPV of avoided capacity costs Avoided capacity costs = per kW avoided cost * kW reduction * (1 + FPR Margin) * (1+ line
Incentive payments	P	-	-	-	NPV of incentive payments; equal to annual new participation * per unit one-time incentive * (1 + ROE)
Costs					
Direct customer costs	P (gross)	-	T (net)	-	NPV of incremental measure cost. Gross for the participant test, net for the TRC
Generation capacity cost increase		-	-	-	Offsets to deferred generation capacity costs (see Deferred Generation Capacity Cost
DSM expenses	-	U	T	R	NPV of utility program marketing and admin expenses with ROE
Evaluation expenses	-	U	T	R	NPV of program evaluation costs
Incentive payment	-	U	-	R	NPV incentive payments; equal to annual new participation * per unit one-time incentive * (1 +
Utility revenue decrease	-	-	-	R	NPV reduction in utility revenue due to customer bill savings

[8] California Standard Practice Manual. Economic Analysis of Demand-side Programs and Projects. October 2001. https://www.raponline.org/wp-content/uploads/2016/05/cpuc-standardpractice-manual-2001-10.pdf

[9] P, U, T, R represent the benefits and costs in the respective test. Participant Cost Test (P), Utility Cost Test (U), Total Resource Cost Test (T), Ratepayer Impact Test (R).

4.4.2 LMT inputs and sources

The inputs and data sources used in the LMT process are detailed in Table 4-17 below.

Table 4-17. LMT inputs and sources

LMT inputs and sources	Units (/year)	Description	Source
Avoided energy & capacity costs	$/kWh / $/kW	Annual avoided costs including reserve margin forecast pool requirements (FPR) of 10%	Conservation & Load Management Team (DE)
Avoided T&D costs	$/kW	Annual avoided T&D costs and seasonal T&D splits for cost allocation	Conservation & Load Management Team (DE)
Customer growth rates	%	Growth rates for individual customer counts by segment, incorporated into annual participation	Integrated Strategic Planning (DE)
Customer rates	$/kWh	Utility rates by customer class with built-in escalation, incorporated into customer bill savings	Integrated Strategic Planning (DE)
Drop out rate	Number of customers	Replacement in kind – driven by program life and equipment life	Calculated from annual new participants, program life, and equipment life
Energy sales	kWh/unit	Annual kWh reduction per installed unit	Program-specific vendor
Fixed expenses	$	Annual fixed program expenses	Program-specific vendor
Fixed marketing expense	$	Program marketing expenses (fixed marketing, program design, etc.), calculated w/ROE. Input is also used to capture miscellaneous utility fixed expenses not captured elsewhere.	Program-specific vendor, ROE obtained from IRP
Fixed evaluation expense	$	Program evaluation expenses (vendor M&V, support, etc.), calculated with ROE	Program-specific vendor, ROE obtained from IRP
Free riders percentage	%	Percentage of free riders based on vendor assumptions and the in-service rate (100% for most measures)	From Net-to-Gross ratio, provided by vendor
New participant customer benefit	$/unit	Benefits other than those from energy and demand savings	Program-specific vendor
New participant customer cost	$/unit	Average incremental measure cost for each new participant	Program-specific vendor
New participant marketing expense	$/unit	Average incremental marketing cost for each new participant	Program-specific vendor
New participant incentives	$/unit	One-time incentive paid by utility, adjusted for ROE	Program-specific vendor
Number of participants	Number of customers	Annual penetration for each program year	Program-specific vendor
Other rates	%	Discount rates (utility, customer, ROE), inflation rate, and line losses	Integrated Strategic Planning (DE)
Other variable customer benefits	$/unit	Average maintenance savings per unit, adjusted for inflation. Zero for all reviewed programs	Program-specific vendor, if applicable

LMT inputs and sources	Units (/year)	Description	Source
Peak reduction	kW/unit	Non-coincident peak energy savings per unit based upon the contribution at peak	Program-specific vendor
Penetration factor	Number of customers	Total new participation per year	Program-specific vendor
Supply-side costs	$ (individual years and NPV)	Calculated in Plexos using program-specific load shapes, includes base and DSM costs to calculate program impacts	IRP team, Plexos (DE)

4.4.3 Program overview

DNV coordinated with the DSP team to review avoided cost calculations in LMT for the four selected DSM Phase XI programs. Given the high-level nature of this review, DNV did not use LMT directly or view the underlying code. The DSP team provided a detailed virtual walk-through of the individual screening process through a Microsoft Teams call with screensharing. The walk-through used the Non-Residential Custom (CST4) program as an example. The four Phase XI programs reviewed and the criteria for selection are described below in Table 4-18.

Table 4-18. LMT programs reviewed

Program name	Program description	Type of program & review purposes
Residential Efficient Product Marketplace (REEC3)	The program provides residential customers an incentive to purchase specific energy-efficient appliances with a rebate through an online marketplace and stores.	• Residential • Energy efficiency • Existing program with additional measures to be added
Residential Peak Time Rebate (RPTR)	The program would enable residential customers to reduce their energy usage consumption during peak time periods as called upon by the Company. During peak time rebate event days, proposed program design would alert customers with text messaging, emails, or outbound telemarketing voicemail, as well as by utilizing the Company's dominionenergy.com website with banner announcements informing participants an event is in progress	• Residential • Demand response • New program
Residential Home Retrofit Update (RHR2)	The proposed program redesign incorporates key program measures from the Company's Phase VII Residential Home Energy Assessment Program.	• Residential • Energy efficiency • Existing program to be combined with another program
Non-Residential Custom (CST4)	The program would provide qualifying non-residential customers, with a focus on larger facilities with demand greater than 300 kW, with the technical support and incentives needed to pursue non-standard, more complex energy efficiency projects. The proposed program would help qualifying customers develop tailored projects that best meet their unique facility and organizational goals while achieving savings from a diverse mix of measures.	• Non-Residential • Energy efficiency • New program

4.4.4 Review of avoided costs

Virginia's Electric Utility Regulation Act requires a review of each utility's avoided costs and cost benefit analyses by the third-party evaluator.[10] In compliance, DNV conducted a review of the benefits and costs used in LMT and assessed the cost-effectiveness framework used by Dominion Energy compared to the California Standard Practice Manual (SPM). The SPM was last published in 2001 by the California Public Service Commission (CPUC) and has been adopted around the country as one of the standards for assessing demand side management programs. In Virginia, 20 VAC 5-304-20 provides direction for utilities to assess energy efficiency programs in the public interest by conducting several benefit-cost analyses. The rule is derived from PUE900070 and took effect in June of 1993.[11] The rule does not prescribe the version of the test or the inputs that should be used by Dominion Energy to calculate the avoided costs. However, DNV compared DE's benefits and costs categories to the benefits and costs outlined in the SPM. The comparison analysis results are illustrated in Table 4-19.

Table 4-19. Benefit-cost categories for benefit-cost test

Categories	Ratepayer Impact Measure Test (RIM)		Total Resource Cost Test (TRC)		Utility Cost Test (UCT)		Participant Cost Test (PCT)	
	SPM	DE	SPM	DE	SPM	DE	SPM	DE
Benefits								
Avoided costs**								
• Energy	√	ü	√	ü	√	ü		
• Transmission	√	ü	√	ü	√	ü		
• Distribution	√	ü	√	ü	√	ü		
• Generation	√	ü	√	ü	√	ü		
Bill reduction							√	ü
Incentive received							√	ü
Revenue gain	√	D						
Tax credit*	√	-	√				√	-
Costs								
Admin costs	√	ü	√		√	ü		
Bill increase							√	D
Customer out-of-pocket cost							√	-
Equipment cost			√	≠	√		√	ü
Increase supply costs	√	D	√		√	D		
Incentives paid	√	ü		ü		ü		
Revenue loss	√	D						

√--Categories included in the SPM
✓--Categories included in Dominion Energy analyses consistent with SPM
≠--Categories included in Dominion Energy analyses but inconsistent with SPM
- Indicates the category is not included in the Dominion Energy analyses
*Reduction in costs in the TRC
D—Difference between Benefit and Cost components used in Dominion Energy calculations. SPM includes separate Benefit and Cost components.
(-) Not explicitly accounted

The broad categories used in the Dominion Energy benefit cost calculations are consistent with the categories outlined in the SPM. There are several benefit and cost categories explicitly outlined in the SPM that are accounted for in the Dominion Energy analyses by using the difference between the categories. These include "Bill increase" and "Bill reduction," "Revenue gain" and "Revenue loss," and "Increased supply costs."

[10] Chapter 23-Virginia Electric Utility Regulation Act. § 56-596.2. Energy efficiency programs; financial assistance for low-income customers (virginia.gov)
[11] PUE900070

Dominion Energy accounts for bill savings and revenue changes based on the difference in the categories are shown by D in Table 4-19. Supply costs and emission costs are implicitly accounted for as the difference between the IRP base case and the DSM case in the production cost calculations produced from Plexos. The SPM includes separate categories for avoided greenhouse gas (GHG) emissions, renewable portfolio standard (RPS), and ancillary costs in the avoided cost of supplying electricity.

For the TRC, tax credits are captured as a reduction to costs in the SPM. Currently, the Dominion Energy calculations do not explicitly capture tax credits in the calculations—indicated by (-) in Table 4-19. For the PCT, the SPM describes the cost to a program participant as "all out-of-pocket expenses incurred as a result of participating in a program, plus any increases in the customer's utility bill(s)".[12] The Dominion Energy calculations do not capture out-of-pocket costs in the PCT other than equipment costs.

The SPM indicates that participant incremental costs should be counted on a gross basis for the PCT, but on a net basis for the TRC, while the current tool counts these on a gross basis for both tests. This point is discussed further below. As of the time of this report, the Company is making the correction in the LMT, and plan to have it implemented in future filings.

4.4.5 Net versus gross

Dominion Energy is appropriately applying the net and gross energy savings in the calculations. The SPM states that load impacts for the participants' test should be based on gross, whereas net is appropriate for all other tests.[13] As the SPM prescribes, Dominion Energy is applying the gross load impact in the participant test (PCT) and net load impacts in the RIM, UCT, and TRC.

Similarly, it makes sense to count only the program-attributable portion of incremental costs in the TRC, since only that portion of savings is counted on the benefits side. (As indicated in Table 4-19, customer incremental costs are not included in the RIM or UCT.) Including only the program-attributable portion of incremental costs means multiplying the total incremental costs by the net-to-gross ratio, or by (1-free ridership) for the TRC test. The SPM text does not describe this adjustment to the incremental cost, but the TRC formulas in the SPM include "net participant costs," while the PCT formula includes "participant costs" with no netting.

4.4.6 Other benefits categories

Since the SPM was published in 2001, the benefits calculations for the different cost-effectiveness tests have been updated to account for policy changes in California. Although all these changes may not fit in the Virginia regulatory framework, the application of different cost-benefit categories to energy efficiency and other DSM resources is examined below. In Decision 10.12.24, the California Public Utilities Commission (CPUC) acknowledged that the cost and benefits of demand response can be "based on uncertain inputs or are subject to considerable variation, making them difficult or prohibitively expensive to quantify."[14] However, recognizing the role these benefits would play as the market developed, the protocols required qualitative analysis of hard-to-quantify costs and benefits for comparative purposes.[15] Load serving entities (LSEs) were allowed to estimate the costs and benefits or provide a description for consideration in the cost-effectiveness analysis of the demand response program including the use of sensitivity analysis of certain key variables such as participant costs, avoided generation capacity, T&D costs, and load impacts.[16] The three benefits highlighted at the time were:

- Environmental benefits

[12] SPM at 8.
[13] SPM at 27
[14] Decision 10-012-024 at 31.
[15] Id at 31.
[16] Id at 31.

- Market and reliability benefits—5% adjustment applied as a market benefit for spillover effect[17]
- Non-energy/non-monetary benefits

Environmental benefits are accounted for at least in part in the production cost calculations. While a general spillover adder has been accepted in California and some other jurisdictions, this is not currently available for Dominion Energy.

Explicitly accounting for non-energy benefits and any associated costs in the benefit-cost analyses could better capture the impact of the programs and allow for a more complete assessment of the cost-effectiveness. Based on Dominion Energy's current benefit-cost structure, the additional benefits and costs could be captured in the "Other Customer Benefits" categories; however, none of the programs reviewed capture any benefits in the category. Some of the non-energy benefits included in California and other jurisdictions are:

- Operation and maintenance
- Water savings
- Health and safety
- Asset value
- Home comfort
- Avoided collections costs

4.4.6.1 Cost-effectiveness comparative analysis

The benefit-cost categories used in the Dominion Energy cost-effectiveness analysis align with the SPM. However, there are some opportunities to refine the calculations to capture benefits and costs on a more granular level. Dominion Energy has improved the granularity of the benefits and costs in LMT compared to the DSM Strategist Tool used previously by Dominion Energy (before 2021) by incorporating 8,760 loadshapes, annual savings, and avoided costs. As the DSM programs change and the energy market accommodates more distributed energy resources, the ability to attribute benefits and costs to specific actions in the market will require a more detailed breakdown of costs and benefits.

- **Exploring benefits and costs attributable to different distributed energy resources (DERs) and based on location**. There are differences in the benefits and costs of energy efficiency, demand response, and distributed generation as they provide distinguishable services to the grid. For example, demand response programs can be designed for targeted curtailment—addressing needs in specific locations at specific times—or quick curtailment that provides general load reduction. The ability to measure and assign these benefits and costs based on the type and location of the resources can help improve program design, delivery, and outcomes.
- **Differences between SPM and DE's benefit-cost analyses**. Section 4.4.4 highlights differences in the SPM and the Dominion Energy analyses. Namely, these differences include capturing categories such as out-of-pocket costs and tax credits; and distinguishing between bill increase and bill reduction, and revenue gain and revenue loss. Explicitly accounting for these values will add transparency to the benefit-cost calculations.

[17] D. 12-11-015-- A default market effects adjustment of 5% shall be applied to the total portfolio cost-effectiveness of Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Gas Company, and Southern California Edison Company to account for program spillover. Program-specific estimates will be developed by evaluation studies in 2013 and 2014—at 142.

About DNV

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Appendix E

Evaluation, Measurement, and Verification (EM&V) Plans

Dominion Energy

May 31, 2023

APPENDIX E. EVALUATION, MEASUREMENT, AND VERIFICATION (EM&V) PLANS

TABLE OF CONTENTS

E1. DEMAND-SIDE MANAGEMENT PORTFOLIO EVALUATION, MEASUREMENT, AND VERIFICATION APPROACH

This document contains the evaluation, measurement, and verification (EM&V) plans for the Dominion Energy DSM programs. The plans are organized in the following manner:

- Program summary – high-level program description
- Measures – high-level description of proposed program measures
- Evaluation, Measurement, and Verification overview – high-level description of EM&V approach
- Deemed savings approach – upon program approval, deemed savings calculation approach will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate
- Evaluated savings approach or verified savings approach – program evaluation approach based on the guidelines outlined in the final order of SCC Case No. PUR-2020-00156 ("Final Order").[1]
- Lost revenue methodology – steps for calculating lost revenue
- Timeline and scope of work – description of the EM&V schedule and scope of work
- Document revision history

The evaluation methods described in the following EM&V plans meet the standards of section A of 20 VAC 5-318-40 and The Final Order.[2] All evaluation methodologies align with Options A, B, C, or D from the International Performance Measurement and Verification Protocol (IPMVP) and the protocols defined in the U.S Department of Energy's Uniform Methods Project for Determining Energy Efficiency Savings for Specific Measures (UMP).[3] Other referred EM&V guidance and industry best-practices are provided in Section E2.

The Final Order states that program-specific EM&V approaches, methods, and timing are guided by the value of information (VOI) framework outlined in The Final Order. The VOI framework assesses the extent to which various evaluation activities cost-effectively reduce uncertainty and mitigate risk. The following considerations are taken from The Final Order:

- The magnitude of portfolio uncertainty contributed by a particular program, measure, or parameter
- The potential contribution to uncertainty in a future portfolio, even if the current program is small
- Uncertainty as to whether a particular program or measure passes a basic benefit/cost screening test, or uncertainty in other key design questions
- The ability of empirical studies to reduce those uncertainties, and at what cost
- Overall budget constraints
- DNV's evaluation of uncertainty assessments and sensitivity analyses as described in Case No. PUR-2020-00156 Exhibit 21 (Feng Rebuttal) at pp. 15–16

EM&V of Dominion Energy's DSM programs follow a two-stage approach. Following implementation, kilowatts and kilowatt-hour savings are estimated using a deemed calculation savings approach. In addition to the deemed savings approach,

[1] PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order, Appendix A. Virginia State Corporation Commission. Effective date, 10/27/2021.

[2] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Ch. 318, Final Reg. Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective date 01/01/2018.

3 Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org; Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

programs are considered for follow-on evaluation to estimate adjusted gross savings and/or net adjusted savings according to the VOI framework outlined in The Final Order. Programs that adopt an evaluated savings approach will use the method most suitable to the program, program measures, and evaluation objectives, again, guided by VOI framework. The evaluated savings approaches described here include impact analyses, market studies, surveys, and process evaluations.

Deemed savings approach –References and data

All deemed calculations are documented in the Dominion Energy Virginia and North Carolina Technical Reference Manual (DE TRM) which is included as an appendix to the annual EM&V report. The DE TRM is a collection of deemed engineering equations used to calculate kilowatt and kilowatt-hour savings for each measure implemented by the Company in Virginia and North Carolina. The DE TRM is updated annually.

In the absence of a state-wide technical reference manual (TRM) in Virginia and North Carolina, DNV will derive deemed savings calculations from the Mid-Atlantic Technical Reference Manual (Mid-Atlantic TRM).[4] The Mid-Atlantic TRM is used in states neighboring Virginia and elsewhere in the mid-Atlantic region of the United States. (e.g., Maryland, District of Columbia, Delaware). For program measures that are not available in the Mid-Atlantic TRM, DNV assesses regional technical reference manuals (TRM), and TRMs outside the region, if necessary, to identify the most appropriate source(s) for deriving the deemed savings calculations, variables, and the and/or factors used in the DE TRM. Each TRM contains complete citations for all deemed savings calculations, variables, and factors.

As much as practicable, the DE TRM currently produces kilowatt and kilowatt-hour savings estimates using customer-specific participant data as inputs to the deemed savings calculations described above. In the absence of customer-specific data, utility-specific data is used. When utility-specific data are unavailable or impracticable to collect, DNV uses proxy utility-specific program participant data to assign assumed inputs derived from Virginia-specific or North Carolina-specific data or data from non-Virginia or non-North Carolina jurisdictions, and with appropriate citation to the source documents.

To gather utility- and customer-specific program tracking and usage data, DNV provides the Company with a list of the EM&V data requirements that are necessary to estimate deemed/tracked savings and document the measure baseline, DNV develops this list, keeping in mind when it may be impractical to collect specific data variables (e.g., equipment nameplate information may be inaccessible or sun-bleached and illegible). The Company's program managers, analysts, and information technology ("IT") staff generate the program tracking data stored in the Company's IT systems. The Company's IT staff defines the information management system that generates the data and delivers it to DNV monthly.

DNV applies the combination of customer-specific, program-generated utility-specific data, and other default inputs to the deemed calculations documented in the DE TRM to calculate and report the kilowatt and kilowatt-hour savings for each implemented measure. The record-level savings are aggregated at the measure level, where appropriate, without adjustment for free-ridership values. DNV reports the savings in the annual EM&V report after adjustments for free-ridership, and/or spillover based on either the initial program design assumed free-ridership value, or the evaluated free-ridership and/or spillover values determined through EM&V.

[4] Northeast Energy Efficiency Partnerships, Maryland/Mid-Atlantic Technical Reference Manual, Version 10. May 2020 (prepared by Shelter Analytics). The manual can be found at https://neep.org/sites/default/files/media-files/trmv10.pdf.

E2. REFERENCES AND CITATIONS

In developing the EM&V plans for the Company's DSM programs, DNV consulted the following set of core EM&V standards and guidance documents.

Efficiency Valuation Organization (EVO). International Performance Measurement and Verification Protocol. The International Performance Measurement and Verification Protocol (IPMVP) provides an overview of current best practices for determining and verifying results of energy efficiency. It is one of the most recognized M&V protocols for demand-side energy activities. https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

U.S. Department of Energy. Uniform Methods Project. July 2018. Uniform Methods Project protocols provide standardized, common-practice M&V methods for determining gross energy savings for many of the most common residential and commercial measures and programs offered by administrators of energy efficiency programs in North America for utility customers. The UMP also includes cross-cutting protocols for topics such as net savings determination, metering, and persistence of savings determination. http://energy.gov/eere/about-us/ump-protocols

ASHRAE Guideline 14-2014: Measurement of Energy and Demand Savings. American Society of Heating, Refrigerating, and Air-Conditioning Engineers. Guideline 14 provides a standardized set of energy, demand, and water-savings calculation procedures. This publication guides minimum acceptable levels of performance for determining energy and demand savings, using measurements, in commercial transactions. https://webstore.ansi.org/Standards/ASHRAE/ASHRAEGuideline142014

U.S. Department of Energy Federal Energy Management Program. M&V Guidelines: Measurement and Verification for Performance-Based Contracts, Version 4.0. November 2015. Prepared for DOE's Federal Energy Management Program, the purpose of this document is to provide guidelines and methods for documenting and verifying the savings associated with federal agency performance contracts. It contains procedures and guidelines for quantifying the savings resulting from energy efficiency equipment, water conservation, improved operations and maintenance, renewable energy, and cogeneration projects. https://www.energy.gov/sites/prod/files/2016/01/f28/mv_guide_4_0.pdf

Mid-Atlantic Technical Reference Manual, Version 10. The Mid-Atlantic TRM provides detailed deemed savings equations and common assumptions for prescriptive residential and non-residential DSM measures. Measures were chosen by consensus of the Mid-Atlantic TRM subcommittee and project team. For each measure, the TRM includes either specific deemed values, factors, or algorithms for calculating gross annual electric energy savings, gross electric summer coincident peak demand savings, gross annual fossil fuel energy savings, other resource savings, incremental costs, and measure life. https://neep.org/sites/default/files/media-files/trmv10.pdf

PJM Manual 18B: Energy Efficiency Measurement & Verification, Revision: 04, Effective Date: August 22, 2019, PJM Forward Market Operations. The PJM Manual for Energy Efficiency Measurement & Verification is one of the PJM procedure manuals under the Reserve Manuals category. https://pjm.com/~/media/documents/manuals/m18b.ashx

State & Local Energy Efficiency Action (SEE Action) Evaluation, Measurement, and Verification Resource Portal. EM&V Resource Portal is an EM&V resource for energy efficiency program administrators and project managers. https://www4.eere.energy.gov/seeaction/evaluation-measurement-and-verification-resource-portal#guidance

Dominion Energy Virginia and North Carolina Technical Reference Manual (DE TRM). The residential and non-residential Dominion Energy Technical Reference Manual (formerly the Standard Tracking and Engineering Protocol or STEP Manual) filed with the 2022 EM&V Report as "Appendix F1 and F2 – Residential and Non-Residential Standard Dominion Energy Technical Reference Manual 2021 (see DSM 9 case: PUR-2020-00274 at https://www.scc.virginia.gov/docketsearch#caseDocs/141608).

E3. RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE PROGRAM EM&V PLAN (PHASE VII)

E3.1. Program summary

The program would provide residential customers an incentive to purchase specific energy-efficient appliances with a rebate through an online marketplace and stores.

E3.2. Measures

The following measures are included in the Residential Efficient Products Marketplace Program:

Table 3-1. Residential Efficient Products Marketplace Program measures

End-use	Measure
Lighting	▪ A-Lines ▪ Reflectors ▪ Decorative ▪ Globes ▪ Retrofit kit and fixture
Refrigeration	▪ Freezer ▪ Refrigeration
Appliances	▪ Dehumidifier ▪ ENERGY STAR® Air Purifier ▪ Clothes dryer
Domestic hot water	▪ Dishwasher ▪ Clothes washer

E3.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[5]

The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: Baseline consumption will be calculated from AMI participant and AMI non-participant consumption data.
2. **Deemed savings:** Deemed savings (or gross savings) values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings (or net savings) will be determined by the methods described in Section E3.5. The evaluated savings will use program tracking data, customer energy consumption data, other customer data, and equipment data to estimate program savings.

[5] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[6]

E3.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Efficient Products Marketplace Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E3.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[7]

According to Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol of The Uniform Methods Project (UMP), the evaluation uses a survey approach to estimate gross and net program energy savings and free-ridership. Sample design will follow the protocols outlined in Chapter 11: Sample Design Cross-Cutting Protocol of the UMP.[8]

The EM&V method estimates gross and net program energy savings, including net-to-gross savings and free-ridership. The following data will be used to determine evaluated program savings:

- **Lighting supplier interviews:** The benefit of these interviews is to collect information for net-to-gross calculations.
- **Survey of appliance rebate participants:** Participants will be asked whether the program influenced the energy efficiency of the appliance and timing of their purchase.
- **Survey of upstream lighting participants:** If lighting participants are surveyed, alternate recruitment methods will be employed since retail lighting channels do not collect end-user information. As of 2020 participant-level data for the retail lighting channel is not available.
- **Program tracking data:** Review of lighting shipment invoices

[6] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[7] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[8] Baumgartner, Robert. (2017). Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol the Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory, NREL/SR-7A40-68568, https://www.nrel.gov/docs/fy17osti/68568.pdf; Khawaja, Sami M. Rushton, Josh. Keeling, Josh. (2017). Chapter 11: Sample Design Cross-Cutting Protocol: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68567, https://www.nrel.gov/docs/fy17osti/68567.pdf.

E3.5.1. Sample design considerations

DNV will attempt to interview the population of participating lighting suppliers. A random sampling strategy, stratified by appliance type, will be used for the appliance participants. The following characteristics will be considered:

1. Confidence interval: 85 to 90% (at the appliance level)
2. Relative precision: 10 to 15% (at the appliance level)
3. Upstream measures
4. Rebate measures
5. Budget, schedule, and geographical distribution

If applicable, for the lighting participants, a pre-survey sample design is not possible, since the types of customers responding to a web survey are unknown. However, post-stratification of the sample to develop weights based on lighting type and retail channel can be performed. Table 3-2 describes the EM&V activities, data collection modes, and the data that estimates net and gross savings.

Table 3-2. EM&V activities, data collection modes, and the data that estimates net and gross savings

Activity	Data collection mode	Net savings data
Lighting supplier interviews	In-depth phone interview	Confirmation of shipment quantities Retrospective and prospective net-to-gross ratios
Survey of appliance participants	Web survey	Confirm the appliance is installed and operating correctly
Pending available data: Surveys of lighting participants[9]	Web survey	▪ Confirm gross savings estimation inputs (e.g., lighting quantity, installation rate, etc.) ▪ Retrospective and prospective net-to-gross ratios

E3.5.2. Net-to-gross assessment

If applicable, free-ridership may be estimated using the approaches described below:

Free-ridership estimates from the lighting supplier interviews

In-depth interviews with participating lighting suppliers are one source of net savings estimates. For prospective net-to-gross ratios, suppliers are asked to project what share of their future lighting sales in the Virginia/North Carolina market will be LEDs.

To reliably estimate the program impact on sales, the volume of program sales must be significant enough for the suppliers to report the fluctuation in sales between program and non-program periods, or between participating and non-participating stores. The volume of appliance sales through the program, especially when appliances are sourced from multiple suppliers, is not large enough to estimate program effects. Therefore, appliance suppliers will not be interviewed.

Free-ridership estimates from the participating end users

Surveys of appliance and lighting participants are used to obtain net-to-gross estimates. An end-user self-report net-to-gross method uses three attribution factors: timing, efficiency, and quantity to calculate net savings.

[9] Not available as of December 31, 2020.

Participant spill-over

Spill-over energy savings are awarded under the following criteria:

- The original tracked purchase is at least partially attributable to the program
- The subsequent purchase is at least partially attributable to the participant's experience with their earlier tracked purchase

E3.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the evaluation.[10]
2. Apply the evaluated savings to the participant data to arrive at program-level energy savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E3.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E3.8. Residential Efficient Products Marketplace Program – Revision history

Table 3-3. Revision history for Residential Efficient Products Marketplace Program EM&V Plan

Version	Date	Notes
Version 1	2019	Initial release
Version 2	3/22/2021	▪ Removed CATI survey mode ▪ Removed footnote that cited A-line availability for 2019 and that participant-level data is not available for the retail lighting channel. ▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Formatted measure table.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)

[10] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E4. RESIDENTIAL ELECTRIC VEHICLE ENERGY EFFICIENCY AND DEMAND RESPONSE PROGRAM EM&V PLAN (EE ONLY) (PHASE VIII)

E4.1. Program summary

This Program would provide an incentive to customers to purchase a qualifying level 2 charger for their electric vehicle (EV) and who agree to enroll in the Residential Electric Vehicle Rewards (demand response) Program.

E4.2. Measures

The measure offered by the Residential Electric Vehicle Program (EE) is shown in Table 4-1.

Table 4-1. Measure offered by Residential Electric Vehicle (EE) Program

End-use	Measure
Plug load	▪ Qualifying Level 2 EV chargers with connected functionality

E4.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[11] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program are:

1. **Baseline consumption:** Baseline consumption will be calculated from AMI participant consumption data if available, and vendor-supplied charging data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E4.5. The evaluated savings will use program tracking data, customer energy consumption data, EV charger data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[12]

E4.4. Deemed savings approach

For the energy efficiency portion of the program, upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Electric Vehicle (EE) Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. Given that EV utility programs are relatively new, deemed savings estimates are more uncertain compared to more mature measures. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to

[11] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[12] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E4.5. Evaluated savings approach for energy efficiency

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[13]

There are two approaches to compare consumption (hourly and overall) of a given group of EV customers who receive Level 2 chargers: whole building hourly load analysis and end-use vehicle metering analysis. Both approaches have their respective strengths and weaknesses, because EVs and charging behavior are continuing to evolve, and interval consumption data may not be available. Both approaches may be considered. Table 4-2 presents sample research questions to be addressed by an EV program energy impacts analysis.

Table 4-2. Research questions and associated analyses for EV Program energy impact analysis

Sample research questions	Overview of approaches
What is the incremental load (kWh and kW) associated with adoption of an EV?	▪ End-use metering analysis ▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load
What is the change in energy consumption due to the combined effects of: ▪ The net consumption changes from Level 2 chargers versus a Level 1 charger. ▪ Added load due to program-attributable EV adoption	▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load ▪ Develop pre/post load shapes
▪ What is the difference in charging load shape with a Level 2 charger versus a Level 1 charger? ▪ How do changes in load shape align with Dominion Energy's targeted load shifting?	▪ End-use metering analysis ▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load ▪ Develop pre/post load shapes

[13] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

Table 4-3 lists potential sources of data useful for an impact analysis.

Table 4-3. List of potential data sources for EV Program M&V

Dataset	Data source	Purpose
Vehicle registrations	▪ Virginia Automobile Dealers Association, Statistical Reports ▪ Atlas EV HUB,[14] State EV registration data, ▪ Other third-party data providers	▪ Survey stratification ▪ Develop comparison groups
Program tracking data	Dominion Energy BI data, program participants, implementation vendor	▪ Identify participants ▪ Link participants to third-party data ▪ Analysis
Consumption data	Dominion Energy	▪ Analysis ▪ Develop comparison groups
AMI data or high-frequency interval data	Dominion Energy	▪ Analysis ▪ Develop comparison groups
Vehicle charging data	Implementers	▪ Customer-specific charging information ▪ Analysis
End-use metering data	Primary data collection	▪ Analysis
Consumer survey	Primary data collection	▪ Collect additional attribute data about customers ▪ Segmentation analysis of consumption behavior
Third party-data	U.S. Census, American Community Survey, customer tax assessor, other providers	▪ Identifies EV owners and attributes not otherwise publicly available

E4.5.1. Sample design considerations

The size of the sample will be determined using the PJM sample size approach for participating customers. If AMI data is used in the evaluation, the evaluation will be performed on a census of AMI-enabled participants. Depending on the relative proportion of AMI-enabled and non-AMI participants, it may be necessary to develop a representative sample and install AMR meters at customer households designated for the sample.

The following characteristics will be considered:

- Confidence interval: 85%
- Relative precision: 10–15%
- Budget, schedule, vehicle type, charging conditions, and geographical distribution

E4.5.2. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

[14] EV HUB. https://www.atlasevhub.com/.

E4.5.3. Sample design considerations

There are several sampling options based on the size of the program and the number of AMI-enabled participants.

The evaluation will be performed on the census of AMI-enabled customers. The AMI accounts are assigned weights based on connected loads and the service divisions of all participants to ensure that the AMI analysis is representative of the program population.

E4.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[15]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E4.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E4.8. Residential Electric Vehicle (EE) Program – Revision history

Table 4-4. Revision history for Residential Electric Vehicle (EE) Program EM&V Plan

Version	Date	Notes
Version 1	11/26/20	Initial release
Version 2	3/22/2021	▪ Minor word changes to data type ▪ Removed reference to monthly consumption data and UMP Chapter 8 ▪ Added reference that vehicle charging data is available from the implementer in section N.3 and Table N-3. ▪ Changed reference from AMI to AMR meter is section N.5.1 and N.6.1 ▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)

[15] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Removed demand response savings estimation methods (see instead the EM&V plan for the Residential Electric Vehicle Rewards Program (DR).
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E5. RESIDENTIAL ENERGY EFFICIENCY KITS PROGRAM EM&V PLAN (PHASE VIII)

E5.1. Program summary

This Program would provide residential customers with new customer accounts the opportunity to receive Welcome Kits consisting of energy efficiency measures. The Welcome Kits will be sent to new residential customers only, any new customer who contacts the Company to start their service for a new residence will receive the free Welcome Kit. The Welcome kit will include a Tier 1 advanced power strip and an educational insert informing customers about opportunities to manage their energy use and how to opt in to receiving additional free measures by going online to the program website or calling the program hotline. To receive the additional measures, customers will have to confirm their address and account status and answer a few questions to confirm the measures will be of value in producing electric energy savings in the home such as custom LED Lighting; showerhead, bath, and kitchen aerators and pipe insulation; window weather-stripping; door sweep, ten outlet gaskets, a can of insulating foam and a tube of caulk. Additionally, each customer will receive educational materials along with the program measures educating them on the proper use of each measure, general wise energy use, and the EE savings available through the Company's other energy efficiency programs. Minimal program marketing will be needed as the initial kits would be sent to each new residential customer as they initiate new service

E5.2. Measures

The measures included in the kit offered by the Residential Energy Efficient Kits Program are listed in Table 5-1.

Table 5-1. Measures offered by Residential Energy Efficient Kits Program

End-use	Measure
Building envelope	▪ Door weather stripping ▪ Window and door weather stripping ▪ Door sweep ▪ Outlet/switch gaskets ▪ Caulking
Domestic hot water	▪ Low-flow showerheads ▪ Kitchen and bathroom aerators ▪ Water heater pipe insulation
Lighting	▪ LED lamps
Plug load	▪ Tier 1 smart strip

E5.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[16] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

[16] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings**: Evaluated savings will be determined by the methods described in Section E5.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[17]

E5.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Energy Efficient Kits Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E5.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[18]

According to Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol of The Uniform Methods Project (UMP), the evaluation uses a survey approach to energy savings, free-ridership, and spillover. Sample design will follow the protocols outlined in Chapter 11: Sample Design Cross-Cutting Protocol of the UMP.[19]

E5.5.1. Savings estimation

A survey of the Residential Energy Efficient Kits Program participants will be used to estimate program energy savings, free-ridership, and spillover. Sample topics include:

- Measure installation rates
- Measure removal rates

[17] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[18] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[19] Baumgartner, Robert. (2017). Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol; Khawaja, Sami M. Rushton, Josh. Keeling, Josh. (2017). Chapter 11: Sample Design Cross-Cutting Protocol; Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices. From Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578.

- Effectiveness of education and enrollment in other energy efficiency programs
- Optional areas of research include:
- Motivation for participation
- Barriers to participation
- Strategies for increasing participation and installation rates

E5.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

1. Confidence interval: 85–90%
2. Relative precision: 10–15%
3. Budget, schedule, and geographical distribution

E5.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E5.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the analysis.[20]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E5.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

[20] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E5.8. Residential Energy Efficient Kits Program – Revision history

Table 5-2. Revision history for Residential Energy Efficient Kits Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E6. RESIDENTIAL SMART THERMOSTAT PURCHASE AND WEATHERSMART℠ PROGRAM EM&V PLAN (PHASE VIII)

E6.1. Program summary

This Program would provide an incentive to either purchase a qualifying smart thermostat and/or enroll in an energy efficiency program, which would help customers manage their daily heating and cooling energy usage by allowing remote optimization of their thermostat operation and would provide specific recommendations by e-mail or letter that customers can act on to realize additional energy savings. The Program would be open to several thermostat manufacturers, makes, and models that meet or exceed the ENERGY STAR® requirements and have communicating technology. Rebates for the purchase of a smart thermostat would be provided on a one-time basis; incentives for participation in remote thermostat management would be provided on an annual basis. For those customers who enroll in thermostat management, additional energy-saving suggestions, based on operational data specific to the customer's heating and cooling system, would be provided to the customer at least quarterly.

Residential Smart Thermostat Purchase and WeatherSmart provides an incentive to participate in smart thermostat optimization. The program will help customers manage their daily heating and cooling energy consumption by allowing remote optimization of their thermostat operation. In addition, the customer will receive recommendations and educational materials by mail or e-mail that describe strategies for realizing additional energy savings.

The Program would be open to several thermostat manufacturers, makes, and models that meet or exceed the ENERGY STAR® requirements and have communicating technology.

E6.2. Measures

The measures offered by the Residential Smart Thermostat Purchase and WeatherSmart Program are shown in Table 6-1.

Table 6-1. Measures offered by Residential Smart Thermostat Purchase and WeatherSmart Program

End-use	Measure
HVAC	▪ Smart thermostat ▪ Heat pump system optimization and behavioral messaging ▪ Air conditioning system optimization and behavioral messaging

E6.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[21] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings, and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data and thermostat telemetry data if available and strengthens the analysis.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.

[21] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E6.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[22]

E6.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Smart Thermostat Purchase and WeatherSmart Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E6.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[23]

According to Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group. The analysis will use a site-level or panel-model billing analysis approach (see Section E6.5.1. .[24]

E6.5.1. Billing analysis

The billing analysis for the Residential Smart Thermostat Purchase and WeatherSmart Program requires a comparison group. The evaluation will apply a matching algorithm to a range of customer characteristics (e.g., pre-period monthly energy consumption data, geography, heating and/or cooling type), to identify comparison group customers who are like participants with respect to consumption characteristics. Cross participation with the Smart Thermostat demand reduction program will be accounted for in the evaluation.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level.

[22] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[23] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[24] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

The weather-normalized annual consumption (NAC) estimates are then combined in a second-stage regression to provide either average customer savings or average measure-level savings.

2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.
3. The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

E6.5.2. Sample design considerations

The census of Smart Thermostat Purchase and WeatherSmart Program participants will be evaluated. Precision will be a function of the number of participants and the magnitude of savings.

E6.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E6.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[25]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E6.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

[25] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E6.8. Residential Smart Thermostat Purchase and WeatherSmart Program (EE) – Revision history

Table 6-2. Revision history for Residential Smart Thermostat Purchase and WeatherSmart Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	Initial release
Version 2	3/22/2021	▪ Added reference to thermostat telemetry data in M.3 Combined measure list for purchase and optimization component and removed duplicate text. ▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis ▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E7. RESIDENTIAL SMART HOME PROGRAM EM&V PLAN (PHASE IX)

E7.1. Program summary

The Residential Smart Homes Program would provide the Company's residential customers with a suite of smart home products that provide seamless integration into the home. The program will deliver the energy-efficient measures bundled in two versions of a Smart Home Kit so that customers can benefit from a fully integrated set of compatible smart products. The Smart Home Kit will include general instructions for installing the specific energy-efficient measure within their home. Customers will be encouraged to utilize their smart phone or tablet to access the connected functionality of the Smart Home Kit through individual manufactured smart thermostats, smart home hub, and smart home energy monitor applications (apps). Smart phone and tablet apps and individual manufacturer websites will include links to videos and installation "how-to" guidance documents, especially for do-it-yourself products such as smart plugs, LEDs, and motion sensors. Customers will be guided to enroll separately in the Dominion Smart Thermostat DR and HVAC optimization programs based on individual program eligibility requirements.

E7.2. Measures

The measures offered by the Residential Smart Home Program are shown in Table 7-1.

Table 7-1. Measures offered by Smart Home Program

End-use	Measure
Plug load	▪ Smart Plug ▪ Smart home hub with entry and motion sensor
HVAC	▪ Smart thermostat with voice control and temperature/humidity sensor
Lighting	▪ Connected 9.5W Energy Star® LED
Multiple	▪ Smart home energy monitor (with solar option)

E7.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[26] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant consumption data.
2. **Deemed savings**: Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E7.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

26 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[27]

E7.4. Deemed savings approach

For the energy efficiency portion of the program, upon program approval by the Virginia State Corporation Commission, deemed savings calculation approach or protocol for the Smart Home Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies or protocols, as appropriate. Given that Smart Home utility programs are relatively new, deemed savings calculation estimates are more uncertain compared to more mature measures. The deemed savings calculation protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E7.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[28]

According to Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group. The analysis will use a site-level and panel-model billing analysis approach.[29]

E7.5.1. Billing analysis

The billing analysis for the Smart Homes Program requires a comparison group. The evaluation will apply a matching algorithm to a range of customer characteristics (e.g., pre-period monthly energy consumption data, geography, program enrollment, heating and/or cooling type) to identify comparison group customers who are like participants with respect to consumption characteristics.

The billing analysis will use two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second-stage regression to provide either average customer savings or average measure-level savings.

[27] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[28] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[29] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf;

2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.

E7.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

1. Confidence interval: 85–90%
2. Relative precision: For billing analysis, relative precision is a function of the magnitude of savings, the natural variability of consumption and savings, and the size of the population. A relative precision of 50% or better is considered strong for a billing analysis.
3. Installed measures
4. Budget and schedule

E7.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E7.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[30]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E7.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

[30] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E7.8. Residential Smart Home Program – Revision history

Table 7-2. Revision history for Smart Home Program EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Changed reference from tracked savings to deemed savings in EM&V Overview ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis ▪ Changed sub-section title from "Savings Estimation" to "Billing Analysis"
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E8. RESIDENTIAL WATER SAVINGS (EE) PROGRAM EM&V PLAN (PHASE IX)

E8.1. Program summary

The Residential Water Savings (EE) Program is designed to give the Company's residential customers control over their water-related energy use. The proposed Program leverages the installation of smart communicating water heating and pool pump technologies to facilitate more efficient operation while reducing overall electricity usage and peak demand response. Customers have the option to purchase a qualified program product online and in-store or through an equipment distributor or qualified local trade allies.

E8.2. Measures

The measures offered by the Residential Water Savings (EE) are as shown in Table 8-1.

Table 8-1. Measures offered by Residential Water Savings (EE) Program

End-use	Measure
Domestic hot water	▪ Heat pump water heater
Recreation	▪ Variable-speed pool pump

E8.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[31] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant consumption data.
2. **Deemed savings**: Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.
3. **Evaluated savings**: Evaluated savings will be determined by the methods described in Section E8.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[32]

E8.4. Deemed savings approach

For the energy efficiency portion of the program, upon program approval by the Virginia State Corporation Commission, deemed savings calculation approach or protocol for the Residential Water Savings Program (EE) Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs, relevant studies or protocols, as appropriate. The deemed savings calculation protocol for measures in this program will be documented in

[31] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[32] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E8.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[33]

The analysis will likely follow the general approach of IPMVP, Option A, Partially Measured Retrofit Isolation.[34] This approach uses engineering calculations, spot measurements, post-retrofit metering data, and stipulations. With this approach, key parameters are determined either from spot measurements in different operating states or short-term metering.

For heat pump water heaters, applying Option A would likely mean setting controls to electric resistance mode to simulate a baseline. In this state, power would be monitored to determine baseline energy and water usage patterns. The efficient case would be established by monitoring the power while in heat pump mode. Other supporting parameters may be metered as well, such as air temperature, inlet water temperature, and outlet water temperature.

For variable-speed pool pumps, applying Option A may require post-retrofit short-term metering of power or current, along with spot power measurements in various operating stages. Baseline power and schedule may need to be approximated with TRM values informed by implementer data.

Customer AMI data can be used to identify equipment cycling and load. Table 8-2 summarizes the approaches used for this program.

Table 8-2. Approaches for determining energy savings from residential water savings (EE)

Approach	Protocol	Description
End-use metering	Option A: Partially Measured Retrofit Isolation	▪ Key parameters are metered and applied to engineering calculation. ▪ May require changing control settings to simulate baseline conditions. ▪ In other cases, baseline conditions can be approximated using implementer data and TRM-based assumptions ▪ Metering period may be a couple of weeks or longer to get representative data set.
Consumption data analysis	Uniform Methods Project	▪ Billing analysis

E8.5.1. Sample design considerations

The evaluation will be performed on the census of participants. If a census is not possible the sample frame will be comprised of a representative sample of projects following guidance for the PJM sample size approach.[35] Project size,

[33] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[34] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.

[35] PJM Manual 18B: Energy Efficiency Measurement & Verification, Revision: 04, Effective Date: August 22, 2019, PJM Forward Market Operations.

measure mix, facility type, vendor, location, and other project characteristics may be considered in the sample design. The following characteristics will be considered:

1. Confidence interval: 85%
2. Relative precision: 10–15%
3. Installed measures
4. Budget and schedule

E8.5.2. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E8.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[36]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E8.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E8.8. Residential Water Savings (EE) Program – Revision history

Table 8-3. Revision History for Residential Water Savings (EE) EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	▪ Initial release
Version 2	4/22/2022	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number, formatting. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

[36] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Changed reference from Tracked Savings Deemed Savings in EM&V Overview ▪ Replaced IPMVP Option C with billing analysis from the Inform methods project
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E9. RESIDENTIAL APPLIANCE RECYCLING PROGRAM EM&V PLAN (PHASE VII)

E9.1. Program summary

This program would provide incentives to residential customers to recycle freezers and refrigerators that are of a specific age and size. Appliance pick-up and proper recycling services are included.

E9.2. Measures

Removal of and recycling of operating refrigerators and freezers

E9.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[37] The EM&V method estimates gross and net program energy savings, including net-to-gross savings (NTG) and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: The baseline wattage of all installed measures will be computed using baseline conditions tracked in the program participation data using protocols developed in the DE TRM and North Carolina Technical Reference Manual (TRM). Therein, the deemed savings approach for each measure is predominantly derived from the most recent version of the Mid-Atlantic TRM and, as appropriate, from other technical Reference manuals.
2. **Deemed savings:** Deemed savings (or gross savings) values will be estimated using calculation approaches in the TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** (or net savings) will be determined using a combination of on-site and telephone/website survey data. The wattage and hours-of-use data for the removed appliance will be collected and metered through an on-site study of the appliances—just before their removal—from a representative sample of participants.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[38]

E9.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Appliance Recycling Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the Company's TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

[37] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[38] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E9.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[39]

According to Chapter 7: Refrigerator Recycling Evaluation Protocol[40] of The Uniform Methods Project[41] (UMP), the key parameters necessary for determining gross savings and peak demand reductions include measure verification, annual energy consumption data, and the proportion of the year that the appliance was in operation.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[42] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E9.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

1. Confidence interval: 85 to 90%
2. Relative precision: 10 to 15%
3. Measure-level error ratio: to be updated before sample selection
4. Budget, schedule, and geographical distribution

E9.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of premise-level participants will be performed using one or more of the following levels of rigor:

- Telephone survey or online survey verification, only
- On-site verification, short-term measurements, and long-term metering of approximately two to three weeks during a period of typical operations

The above efforts will be used to determine the verified annual energy savings and peak coincident demand reductions using gathered data, as appropriate, for each sampled project at the premises.

In a limited set of cases, other kinds of verification strategies, such as whole-house simulation modeling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program.

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[39] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[40] Keeling, J.; Bruchs, D. (2017). Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68563. http://www.nrel.gov/docs/fy17osti/68563.pdf

[41] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[42] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and the extent to which these were affected by exogenous changes.

Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

According to the UMP, the appropriate approach to use is defined by the International Performance Measurement and Verification Protocol[43] (IPMVP) Option B, Retrofit Isolation. Using Option B, savings are determined by field measurement of the energy use of the refrigerators or freezers to be recycled (separate from the energy use of the rest of the home). This approach can be used to determine the change in energy and demand due to the removal of the appliance from the home at a representative sample of participants. These efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E9.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, location, type of usage, and timing of removal had the program not been available.

E9.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E9.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E9.8. Residential Appliance Recycling Program – Revision history

Table 9-1. Revision history for Residential Appliance Recycling Program EM&V Plan

Version	Date	Notes
Version 1	2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Slight word changes to measure description.

[43] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

Version	Date	Notes
Version 3	4/22/2021	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Changed reference from verified savings to evaluated savings
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E10. RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM EM&V PLAN (PHASE VII)

E10.1. Program summary

The Residential Home Energy Assessment Program provides residential customers an incentive to install a variety of energy-saving measures following completion of a walk-through home energy assessment. Recommendations from the program may lead to participation in other Dominion Energy programs.

E10.2. Measures

A home energy assessment is required for a customer to be eligible for the direct-install and incentivized measures.

Table 10-1. Residential Home Energy Assessment Program measures

End-use	Measure
HVAC	▪ HVAC ductless heat pump upgrades ▪ High-efficiency fan motors ▪ Heat pump tune-up / upgrade / duct sealing ▪ AC and heat pump duct insulation
Lighting	▪ LED A-lines
Domestic hot water	▪ Water heater thermostat set point adjustment ▪ Water heater replacement with a heat pump water heater ▪ Low-flow showerheads and aerators ▪ Water heater pipe insulation

E10.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[44] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Deemed savings:** Deemed savings (or gross savings) values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings**: Evaluated savings (or net savings) will be determined by the methods described in Section E10.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

[44] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[45]

E10.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Home Energy Assessment Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E10.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[46]

According to Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group. The analysis will use a site-level or panel-model billing analysis approach (see section E10.5.1.). [47]

E10.5.1. Billing analysis

The billing analysis for the Residential Home Energy Assessment Program will require a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.
2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.

[45] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[46] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[47] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf

3. The evaluation will determine which approach to use based on the size and customer composition of the program at the time of evaluation.

E10.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

1. Confidence interval: 85 to 90%
2. Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
3. Installed measures
4. Budget, schedule, and geographical distribution

E10.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E10.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[48]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E10.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

[48] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E10.8. Residential Home Energy Assessment Program – Revision history

Table 10-2. Revision History for Residential Home Energy Assessment program EM&V Plan

Version	Date	Notes
Version 1	2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Format measure table. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis. ▪ Changed section title from Savings Estimation to Billing Analysis
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E11. RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (PHASE VIII)

E11.1. Program summary

This Program would provide educational insights into the customer's energy consumption via a home energy report (online and/or paper version). The home energy report is intended to provide periodic suggestions on how to save energy based upon analysis of the customer's energy usage. Customers can opt out of participating in the program at any time.

E11.2. Measures

The measures included in the kit offered by the Residential Customer Engagement Program (CEP) are listed in Table 11-1.

Table 11-1. Measures offered by Residential Customer Engagement Program

End-use	Measure
Whole house	▪ Electronic home energy report ▪ Paper home energy report

E11.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[49] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data from the treatment and control groups.
2. **Deemed savings:** In the first year of the program, deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E11.5. The evaluated savings will use program tracking data and customer energy consumption data from the treatment and control groups.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[50]

E11.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential CEP will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into

[49] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[50] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E11.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[51]

The CEP will be evaluated using billing analysis as recommended by Chapter 17, Residential Behavior Evaluation Protocol of the Uniform Methods Project (UMP).[52]

E11.5.1. Savings estimation

Behavior programs take multiple years to reach their full potential. Typically, savings are estimated on an ongoing basis due to challenges of assigning a deemed savings estimate to a behavioral measure.

The evaluation assumes that the CEP will be implemented in a randomized controlled treatment (RCT) experimental design. The evaluation will validate the experimental design and use it to develop unbiased estimates of behavior-motivated savings. The evaluation will use a lagged dependent variable approach to estimate savings. This approach uses pre- and post-program monthly consumption data from both the treatment and control group in a specification designed to maximize the precision of estimates. Each evaluation will produce monthly estimates of average per-participant savings. Combining average savings with the number of active participants remaining in the program for each month produces accurate annual estimates of raw program savings.

Incentive program uplift estimation

The evaluation will develop an incentive program uplift adjustment that also makes use of the CEP program RCT. Uplift estimates adjust savings estimates to account for behavior-inspired activity in rebate programs (e.g., Residential Smart Thermostat Program). All incentive program activity by CEP treatment and control group participants during the post-HER report period will be aggregated and compared on an average per-customer basis. If the average cumulative incentive program-related savings stream of treatment group customers is greater than the control group customers' incentive program-related savings, then that estimate is used to adjust overall CEP savings estimates.

Upstream program uplift estimation

Upstream uplift will be estimated using data from customer surveys that are conducted with both treatment and control groups. Survey data will indicate whether lighting products and appliances supported by Dominion Energy's upstream program (e.g., Residential Energy Efficient Product Program) have been purchased. As with incentive programs, all upstream program activity by CEP program treatment and control group participants during the post-HER report period is aggregated and compared on a per-customer basis. If the average cumulative upstream program-related savings stream of the treatment group customers is greater than the control group customers' upstream program-related savings, then that estimate is used to adjust overall CEP savings estimates.

E11.5.2. Sample design considerations

DNV will coordinate with the program implementation vendor and Dominion Energy to put in place the RCT experimental design for the program in advance of the implementation of each wave of the program. After the target population is

[51] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[52] Steward, James. Todd, Anika. (2017). Chapter 17: Residential Behavior Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68573. https://www.nrel.gov/docs/fy17osti/68573.pdf.

identified, a subset of that population will be randomly allocated to a control group that does not receive the reports. The RCT will be developed within strata defined by geography and energy consumption bins. The size of the control group will be determined by the:

1. Desired precision of savings estimates
2. Expected duration of program
3. Targeted populations
4. Program design over time

The precision of behavioral savings estimates is a function of the number of participants and the magnitude of the load reduction. In a large program, the sample will support a 90% confidence interval at 10% relative precision once the program reaches its full potential. Budget, schedule, and geographical distribution will also be considered in the sample design.

E11.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[53]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E11.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E11.8. Residential Customer Engagement Program – Revision history

Table 11-2. Revision History for Customer Engagement Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial Release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Deleted redundant paragraph on program uplift Section L.5.1.

[53] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis
Version 4	2/11/2023	▪ Clarified confidence interval in Section E12.5.2. “Sample design considerations” ▪ Updated hyperlinks and language based on editorial feedback

E12. RESIDENTIAL MANUFACTURED HOUSING PROGRAM EM&V PLAN (PHASE VIII)

E12.1. Program summary

This Program would provide residential customers in manufactured housing within the Company's Virginia service territory with educational assistance and an incentive to install energy efficiency measures. The auditor will perform a walk-through audit covering the envelope and all energy systems in the home paying particular attention to the condition of DHW and HVAC systems, levels of insulation, and the condition of the belly board. The contractor will be required to use the program-approved energy analysis software to collect required data to perform energy calculations and generate a detailed report showing projected energy and potential cost savings specific to each customer's home. The audit software calculates and captures measure-level savings values which produce a consumer-friendly report outlining additional energy savings recommendations. The auditor will review the findings and recommendations of the complete report with the homeowner. As part of the audit, the auditor will install all low-cost measures that meet the installation protocols, similar to the approach in the DSM Phase VII Residential Home Energy Assessment Program, but specific to the construction needs of manufactured housing.

Along with the homeowner energy analysis report, the contractor will provide consumer education and site-specific energy conservation information to the customer tailored specifically to manufactured home issues. A key part of the auditor's responsibility at the audit is to encourage and motivate participants to move forward with the selection and completion of the installation of the most comprehensive set of energy efficiency measures. The auditor will review the various options and program incentives with the customer in detail helping them understand the costs and benefits of each option and answer questions to drive the customer to a decision to move forward. The auditor will show customers how they can find and select a quality installation contractor and walk them through the available program incentives.

The Program will be delivered through an expanded network of local trade allies as well as the program implementation vendor's current network of participating contractors.

E12.2. Measures

The measures offered by the Residential Manufactured Housing Program as listed in Table 12-1.

Table 12-1. Measures offered by Residential Manufactured Housing Program

End-use	Measure
Building envelope	▪ Door weather-stripping ▪ Door sweep ▪ Caulking ▪ Foaming ▪ Poly tape for windows ▪ Air sealing ▪ Attic/wall insulation ▪ Mobile home belly insulation ▪ ENERGY STAR® cool roofs
Domestic hot water	▪ Water heater replacement with a heat pump water heater ▪ Low-flow showerheads and aerators ▪ Water heater pipe insulation ▪ Water heater thermostat set point adjustment

End-use	Measure
HVAC	▪ ENERGY STAR® room/wall AC units ▪ Heat pump tune-up/upgrade/duct sealing ▪ Central AC filter replacement ▪ Heat pump filter replacement ▪ Smart thermostat installation ▪ Digital switch plate wall thermometer ▪ AC cover for wall/window units(s)
Lighting	▪ LED lighting
Plug load	▪ ENERGY STAR® refrigerator/freezer ▪ High-efficiency fan motors ▪ Refrigerator/freezer

E12.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[54] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Deemed savings**: Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings**: Evaluated savings will be determined by the methods described in Section E12.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[55]

E12.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Manufactured Housing Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols,

[54] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[55] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E12.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[56]

According to Chapter 8: Whole- Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group. The analysis will use a site-level or panel-model billing analysis approach (see Section E12.5.1.). [57]

E12.5.1. Billing analysis

The billing analysis for the Residential Manufactured Housing Program will require a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.
2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.

The evaluation will determine which approach to use based on the size and customer composition of the program at the time of evaluation.

E12.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
- Installed measures
- Budget, schedule, and geographical distribution

[56] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[57] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

E12.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E12.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[58]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E12.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E12.8. Residential Manufactured Housing Program – Revision history

Table 12-2. Revision History for Manufactured Housing Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis.

[58] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E13. RESIDENTIAL/NON-RESIDENTIAL MULTIFAMILY PROGRAM EM&V PLAN (PHASE VIII)

E13.1. Program summary

The Program is designed to encourage investment in both residential and commercial service aspects of multifamily properties. The program is designed using a whole-building approach where the implementation vendor will identify as many cost-effective measure opportunities as possible in the entire building (both residential and commercial meters) and encourage property owners to address the measures as a bundle. This approach provides a one-stop shop programming for multifamily property owners with solutions to include direct install-in-unit measures, incentives for prescriptive efficiency improvements, and access to project improvements for both in-unit and commercial common area measures. Furthermore, the Program will identify, track, and report residential (in-unit) and commercial (common space) savings separately according to the account type. The Program will be delivered through an expanded network of local trade allies that the program implementation vendor will recruit and support while also establishing a robust relationship with property management companies since they are the gatekeeper for determining enrollment for their multifamily communities. Once a property management company has decided to enroll the residential property into the Program, the program implementation vendor will send the tenants a letter that will provide information about program benefits along with an opportunity to opt out of participating within a defined time period. If a tenant does not notify the program implementation vendor that they are opting out of participation, their unit will be included in the enrolled locations receiving the installed measures during the delivery phase.

The program implementation vendor intends to complete site assessments at the time of the enlistment visit or within two weeks to identify all eligible electric measure savings. From the assessment, the property owner or manager will receive an assessment report identifying and quantifying savings opportunities with estimated project costs and available incentives. The program implementation vendor or trade ally auditor will perform a walk-through audit covering the envelope and all energy systems in the buildings, paying attention to the condition of DHW and HVAC systems, level of insulation, and lighting. After assessing the entire structure and living units, the auditor will use the tool to perform appropriate calculations and generate a report showing projected energy and potential cost savings specific to each unit and/or common area. The auditor will review the findings and recommendations of the complete with the property owner and assist them in making measure installation and investment decisions. Participation will require that all services or installations qualifying for an incentive be completed by a participating contractor or properly credentialed building maintenance staff.

E13.2. Measures

The measures offered by the Residential/Non-Residential Multifamily Program are listed in Table 13-1.

Table 13-1. Measures offered by Residential/Non-Residential Multifamily Program

End-use	Measure
Building envelope	▪ Air sealing ▪ Attic insulation ▪ Wall insulation (residential only)
Domestic hot water	▪ Low-flow showerhead ▪ Faucet aerator ▪ Water heater thermostat set point adjustment ▪ Water heater pipe insulation

End-use	Measure
HVAC	▪ Heat pumps ▪ Heat pump tune-ups ▪ Smart thermostat ▪ Duct sealing
Lighting	▪ LED lighting ▪ Occupancy sensors
Plug load	▪ ENERGY STAR® refrigerator (residential only) ▪ Clothes washer/dryer ▪ Pool pumps (commercial only)
Refrigeration	▪ Refrigerator coil brush (residential only) ▪ Refrigerator thermostat (residential only)

E13.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[59] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data, if available.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E13.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[60]

E13.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential/Non-Residential Multifamily Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings

[59] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[60] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E13.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[61]

There is no Uniform Methods EM&V protocol that comprehensively addresses multifamily programs hence the proposed approach is based on a combination of methods, listed below, modified for a multifamily program to accommodate the variety of residential and non-residential customers that may participate in this program.

According to Chapter 8: Whole- Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis, with a comparison group where feasible. The analysis will use a site-level or panel-model billing analysis approach (see Section E14.5.1. [62]

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP) and modified for a residential and non-residential multifamily program, the evaluation approach will include calibrated building simulation as recommended in Chapter 15.[63] The analysis will also follow the general approach of the IPMVP, Option D, Calibrated Simulation.[64]

E13.5.1. Savings estimation

Multifamily program evaluations may require a combination of consumption data analysis and/or engineering approaches to evaluate the variety of potential multifamily participants (e.g., individually metered units, master metered buildings with multiple units, and common areas). An objective of the evaluation for this program is to evaluate savings separately for the residential and non-residential customers. The program participation mix and data availability will dictate the most appropriate approach or combination of approaches:

A regression analysis of billing data is the most cost-effective and comprehensive if the savings are measurable in a statistically significant way and most of the program impacts may be isolated. The billing analysis for the Residential/Non-Residential Multifamily Program will have a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use an approach cited in the UMP, Chapter 8, assuming comparison groups are available. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.

[61] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[62] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf;

[63] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[64] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.

2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.

In some cases where specific measures are only installed by customers in either the residential or non-residential rate schedules, and those measures have high installation rates and high relative impacts, the regression models can be examined to see if measure-level savings are statistically significant and can be evaluated with a reasonable level of accuracy from the models.[65]

If measure-level savings are not found to be statistically significant for all participants through billing analysis, a comparison group is not feasible, or the program impacts cannot be confidently isolated, a whole-building simulation analysis may be appropriate for all or a subset of participants. The whole-building simulation analysis will require a sample of program participants to represent the population of participants. DNV will use the program simulation models and occupied electric and gas billing information for each building in the sample. The sample will be stratified based on modeled site-level savings. The simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from occupied buildings. The savings impacts will then be computed by starting with the calibrated occupied building model and using building code standards or existing conditions for the baseline measure inputs. The site level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sample-weighted average to represent the overall program-level realization rate.

The deemed savings for each measure can be evaluated through parametric analysis of the building models where the measures are implemented in the model one at a time and incremental savings are calculated with each change. This is not recommended until the program has been running for multiple years to accumulate measure-level data that can provide meaningful results.

In a limited set of cases, other verification strategies can be used to estimate changes in energy use. For example, savings may be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key parameters for those measures will be identified to determine gross savings and peak demand reduction. Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

All these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E13.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

1. Confidence interval: 85–90%
2. Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
3. Installed measures, multifamily type
4. Budget, schedule, and geographical distribution

[65] This generally requires large numbers of installations (thousands) to yield meaningful results.

E13.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E13.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[66]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E13.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E13.8. Residential/Non-Residential Multifamily Program – Revision history

Table 13-2. Revision history for Residential/Non-Residential Multifamily Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number, formatting. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”

[66] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Removed feasibility assessment of the comparison group from Section E11.5.1.
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E14. RESIDENTIAL HOME RETROFIT PROGRAM EM&V PLAN (PHASE VIII)

E14.1. Program summary

This Program would target high end-users of electricity within the Company's Virginia service territory with an incentive to conduct a comprehensive and deep whole-house diagnostic home energy assessment by BPI-certified whole-house building technicians. The diagnostic-driven audit will typically take between 2½ and 4 hours depending on home size and will include: a visual inspection of all areas of the home including attic and crawl spaces; blower door testing of envelope leakage; duct blaster equivalent testing of the ducting system if present; line logger testing of major appliances; thermal imaging where required; physical measurements of key spaces and insulation levels; and efficiency determinations of major equipment. The contractor will be required to use the program-approved energy analysis software to collect the required data to perform energy modeling and savings calculations.

The software will generate a detailed report showing projected energy and potential cost savings specific to the customer's site conditions and current energy usage patterns. The auditor will provide the customer with the complete report and review the findings and recommended priorities. The report will show the collective costs and impacts of various scenarios of combined measures giving the homeowner a clear picture of the best options available to them. The program will provide rebate incentives for the installation of specific measures recommended as cost effective by the modeling software. The contractor will work with the homeowner to find the mix of measures that provides the cost-effective energy savings that best meets their specific needs. Along with the homeowner energy analysis report, the contractor will be required to provide consumer education and site-specific energy conservation information to the customer related to the installed measures and behaviors recommended by the assessment report for follow-up by the customer.

E14.2. Measures

The measures offered by the Residential Home Retrofit Program are listed in Table 14-1.

Table 14-1. Measures offered by Residential Home Retrofit Program

End-use	Measure
Building envelope	▪ Air sealing ▪ AC and heat pump duct insulation ▪ Attic insulation ▪ Wall insulation ▪ Basement wall insulation ▪ Crawl space insulation
Domestic hot water	▪ Low-flow showerheads and aerators ▪ Water heat pipe insulation ▪ Water heater thermostat set point adjustment ▪ Water heater replacement with a heat pump water heater
HVAC	▪ Heat pump tune-up/upgrade/duct sealing ▪ Ground source heat pump ▪ High-efficiency fan motors ▪ HVAC ductless unit upgrades ▪ Smart thermostat installation

E14.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[67] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E14.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[68]

E14.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Home Retrofit Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E14.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[69]

According to Chapter 8: Whole- Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group. The analysis will use a site-level or panel-model billing analysis approach (see Section E14.5.1.)[70]

[67] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[68] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[69] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[70] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

E14.5.1. Billing analysis

The billing analysis for the Residential Home Retrofit Program will require a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.
2. The panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.
3. The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

E14.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable.

The following characteristics will be considered:

1. Confidence interval: 85–90%
2. Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
3. Installed measures
4. Budget, schedule, and geographical distribution

E14.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E14.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[71]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.

[71] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.

4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E14.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E14.8. Residential Home Retrofit Program – Revision history

Table 14-2. Revision History for Residential Home Retrofit Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E15. RESIDENTIAL VIRTUAL AUDIT PROGRAM EM&V PLAN (PHASE VIII)

E15.1. Program summary

The Residential Virtual Audit Program would offer customers a self-directed home energy assessment using energy-audit software, completed by the customer, with no trade ally entering the home. Customers would be directed to a website or toll-free number where they would answer a set of questions to describe the conditions and systems in their home with prompts to help them answer accurately. From this information, the software would generate a report of recommended measures and actions available to the customer to improve the efficiency of their home. The audit will typically take between 15 and 30 minutes to complete, depending on home complexity, and will include: taking an inventory of energy-consuming systems and appliances as well as attic and crawl spaces; approximating leakage and insulation levels; and determining efficiencies of major equipment using customer descriptions. The report would also identify the Company's other active energy-efficiency programs that fit each customer's needs.

The software will generate a report showing projected energy and potential cost savings specific to the customer's site conditions. The customer can access the report and review the findings and recommended priorities at any time at their convenience. The Program will then provide participating customers with access to lists of participating contractors and tips on how they can find and select a quality installation contractor.

Customers who complete an energy self-assessment would then be allowed to receive a kit of low-cost measures at no cost to them. The measures would be based on questions in the assessment determining which measures would address specific energy savings opportunities in each home. The kit will consist of some combination of LED specialty bulbs, energy-efficient showerheads and faucet aerators, and weatherization products along with instructions on the installation and proper use of the kit measures.

E15.2. Measures

The measures offered by the Residential Virtual Audit Program are shown in Table 15-1.

Table 15-1. Measures offered by Residential Virtual Audit Program

End-use	Measure
Domestic hot water	▪ Showerhead ▪ Faucet aerator ▪ Pipe insulation
Lighting	▪ LED lighting
Plug load	▪ Tier 1 smart strip
Weatherization	▪ Weatherstripping ▪ Door sweep ▪ Outlet / switch gasket ▪ Caulking

E15.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[72] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption**: Baseline consumption will be calculated from monthly or AMI participant consumption data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E15.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[73]

E15.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings calculation approach or protocol for the Residential Energy Efficient Kits Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM and other TRMs or relevant studies or protocols, as appropriate. The deemed savings calculation protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E15.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[74]

According to Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol of The Uniform Methods Project (UMP), the evaluation uses a survey approach to energy savings, free-ridership, and spillover. Sample design will follow the protocols outlined in Chapter 11: Sample Design Cross-Cutting Protocol of the UMP.[75]

During program implementation, Dominion Energy will determine, in consultation with DNV, the appropriateness of conducting evaluations to estimate program net savings in net kilowatt and net kilowatt-hours.

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72 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

73 Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

74 Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

75 Robert Baumgartner. (2017). Chapter 12: Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68568. http://www.nrel.gov/docs/fy17osti/68568.pdf;

E15.5.1. Savings estimation

A survey of the Residential Virtual Audit Program participants will be used to estimate program energy savings, free-ridership, and spillover. Sample topics include:

1. Measure installation rates
2. Measure removal rates
3. Effectiveness of education and enrollment in other energy efficiency programs
4. Optional areas of research include:
   - Motivation for participation
   - Barriers to participation
   - Strategies for increasing participation and installation rates

E15.5.2. Sample design considerations

Sample design will follow the protocols outlined in Chapter 11: Sample Design Cross-Cutting Protocol of the Uniform Methods Project.[76] Energy consumption, building type, location, and other customer characteristics may be considered in the sample design. The following characteristics will be considered:

1. Confidence interval: 85–90%
2. Relative precision: 10–15%
3. Installed measures
4. Budget and schedule

E15.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E15.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[77]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

[76] Chapter 11: Sample Design Cross-Cutting Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40- 68567. http://www.nrel.gov/docs/fy17osti/68567.pdf

[77] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E15.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E15.8. Residential Virtual Audit Program – Revision history

Table 15-2. Revision history for Residential Virtual Audit Program EM&V Plan

Version	Date	Notes
Version 1	Nov 2020	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Changed reference from Tracked Savings Deemed Savings in EM^V Overview
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E16. RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII)

E16.1. Program summary

The Program will provide incentives to home builders for the construction of new homes that are ENERGY STAR certified by directly recruiting existing networks of homebuilders and Home Energy Rating System (HERS) Raters to build and inspect ENERGY STAR® Certified New Homes. ENERGY STAR certification requires that homes be efficient at the system level instead of a menu-based offering. ENERGY STAR certification of new homes involves a whole-house set of standards that ensure homes are at least 15% more efficient than a home built to state-level minimum codes. Key components include shell improvements, HVAC performance, and proper ventilation requirements and durability (proper weather sealing, flashing details, site, and foundation details). Participating homes must submit an energy model of their home using Ekotrope or REM/Rate energy modeling software, along with a copy of the home's ENERGY STAR certificate (both provided by the rater) to qualify for an incentive.

E16.2. Measures

The measures included in the Residential New Construction Program are listed in Table 16-1.

Table 16-1. Measures offered by Residential New Construction Program

End-use	Measure
Whole house	▪ Attached single-family home ▪ Detached single-family home

E16.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[78] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be estimated based on a home built to meet building code energy efficiency requirements.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E16.5. The evaluated savings approach will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[79]

[78] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[79] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E16.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential New Construction Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E16.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[80]

There is no Uniform Methods EM&V protocol for residential new construction hence the proposed methods are based on Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP) and modified for a residential new construction program. The evaluation approach will include calibrated building simulation as recommended in Chapter 15.[81] The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[82]

E16.5.1. Savings estimation

The whole building simulation analysis for the Residential New Construction Program will require a sample of program participants to represent the population of program participants. We will require program-collected Ekotrope or REM/Rate models and occupied electric and gas billing information for every home in the sample. Since the program-reported deemed savings are the same for each participating home, the sample will be stratified, and sample weights will be developed, based on site-level post-occupancy kWh consumption. The sample will be further stratified by heating fuel. The REM/Rate simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from inhabited homes. The site-level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sampling-weighted average to represent the overall program-level realization rate. We will evaluate savings for attached and detached single-family homes separately.

E16.5.2. Sample design considerations

Sampling will be used for the impact evaluation and may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%

[80] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[81] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[82] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.

- Installed measures
- Budget, schedule, and geographical distribution

E16.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E16.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the calibrated energy simulations.[83]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E16.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E16.8. Residential New Construction Program – Revision history

Table 16-2. Revision history for Residential New Construction Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022.

[83] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E17. RESIDENTS HVAC HEALTH AND SAFETY EM&V PLAN (PHASE VIII)

E17.1. Measures

An extensive list of heating, ventilation, and air conditioning (HVAC) and weatherization energy efficiency measures is proposed for this program, but as directed by HB 2789 it also includes health and safety measures. Some of the measures are available to residential customers only, while others are available to both residential and non-residential customers who are eligible for this program. The measures and measure classifications are listed in Table 17-1.

Table 17-1. Measures offered by Residential HVAC Health and Safety Program

End-use	Measure
Building envelope	▪ Insulation repair/upgrade wall ▪ Insulation repair/upgrade floor ▪ Comprehensive air sealing, envelope improvements, insulation ▪ Roof repair (residential only)
HVAC	▪ Heat pump replacement ▪ Duct sealing/insulation/repair/replacement ▪ Electric baseboard heat upgrade ▪ Upgrades to mini-split/ductless heat pumps ▪ Thermostat replacement ▪ HVAC tune-up ▪ HVAC/home-ventilation improvements
Health & Safety	▪ Mold/mildew removal (residential only) ▪ Re-wiring (residential only) ▪ Air quality control (residential only) ▪ Carbon monoxide detectors and sources (residential only) ▪ Assessments of indoor air quality (residential only) ▪ Combustion appliance safety checks/enhancements (residential only) ▪ Fire and fall safety checks/enhancements (residential only) ▪ Dehumidifiers (residential only)

As an alternative to the direct installation of specific measures at participant residences, the Company may provide, on a case-by-case basis, portions of the incentive budget to organizations that assist low-income, elderly, and disabled individuals.

E17.2. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[84] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E17.4. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[85]

E17.3. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the HB 2789 Heating and Cooling System Component Program energy efficiency and weatherization measures will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E17.4. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[86]

There is no Uniform Methods EM&V protocol that comprehensively addresses multifamily programs hence the proposed approach is based on a combination of methods, listed below, modified for a multifamily program to accommodate the variety of residential and non-residential customers that may participate in this program.

[84] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[85] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[86] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

According to Chapter 8: Whole- Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis, with a comparison group where feasible.[87] The analysis will use a site-level or panel-model billing analysis approach (see Section E17.4.1.

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP) and modified for a multifamily program, the evaluation approach will include calibrated building simulation as recommended in Chapter 15.[88] (see Section E17.4.1.). The analysis will also follow the general approach of IPMVP, Option D, Calibrated Simulation.[89]

E17.4.1. Savings estimation

Evaluations that include multifamily building types may require a combination of consumption data analysis and/or engineering approaches to evaluate the variety of potential multifamily participants (e.g., individually metered units, master metered buildings with multiple units, common spaces). An objective of the evaluation for this program is to evaluate savings separately for the residential and non-residential customers. The program participation mix and data availability will dictate the most appropriate approach or combination of approaches:

A regression analysis of billing data is the most cost-effective and comprehensive if the savings are measurable in a statistically significant way, and most of the program impacts may be isolated. The billing analysis for the HB 2789 Heating & Cooling–Health & Safety Program will have a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8, depending on whether comparison groups are available. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group if a comparison group is available. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.
2. The panel model approach estimates a single model for all participants and comparison group customers if a comparison group is available. The model accounts for heating and cooling, differences between the participant and comparison groups (if a comparison group is available), and the participant pre-post consumption difference.

The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation. In some cases where specific measures are only installed by customers in either the residential or non-residential rate schedules, and those measures have high installation rates and high relative impacts, the regression models can be examined to see if measure-level savings are statistically significant and can be evaluated with a reasonable level of accuracy from the models.[90]

If measure-level savings are not found to be statistically significant for all participants through billing analysis, a comparison group is not feasible, or the program impacts cannot be confidently isolated, a whole-building simulation analysis may be

[87] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf;

[88] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[89] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

[90] This generally requires large numbers of installs (thousands) to yield meaningful results.

appropriate for all or a subset of participants. The whole-building simulation analysis will require a sample of program participants to represent the population of participants. DNV will use the program simulation models and occupied electric and gas billing information for each building in the sample. The sample will be stratified based on modeled site-level savings. The simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from occupied buildings. The savings impacts will then be computed by starting with the calibrated occupied building model and using building code standards or existing conditions for the baseline measure inputs. The site-level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sample-weighted average to represent the overall program-level realization rate.

The deemed savings for each measure can be evaluated through parametric analysis of the building models where the measures are implemented in the model one at a time and incremental savings calculated with each change. This is not recommended until the program has been running for multiple years to accumulate measure level data that can provide meaningful results.

In a limited set of cases, other verification strategies can be used to estimate changes in energy use. For example, savings may be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key parameters for those measures will be identified to determine gross savings and peak demand reduction. Adoption of a whole-facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

All these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E17.4.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
- Installed measures
- Budget, schedule, and geographical distribution

E17.4.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E17.5. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[91]

[91] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits,

2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E17.6. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E17.7. Residential HVAC Health and Safety Program – Revision history

Table 17-2. Revision History for Residential HVAC Health and Safety Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number, formatting. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated program name from “HB2789 Heating and Cooling Health and Safety” to “Residential HVAC Health and Safety” ▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation” ▪ Removed feasibility assessment of the comparison group from Section E17.4.1.
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E18. RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT ENERGY EFFICIENCY (PHASE IX)

E18.1. Program Summary

The Residential Income and Age Qualifying Program would provide in-home energy assessments and installation of select energy-saving products at no cost to eligible participants. As with the Company's other low-income programs, the Company will partner with weatherization service providers to perform community outreach and install program measures at the homes of eligible customers.

E18.2. Measures

The measure offered by the Residential Income and Age Qualifying Program are as shown in Table 18-1

Table 18-1. Measures Offered by Residential Income and Age Qualifying Energy EfficiencyProgram

End-Use	Measure
Lighting	▪ LED lighting
Domestic Hot Water	▪ Showerhead ▪ Faucet aerator ▪ Pipe insulation ▪ Insulating tank wrap
Building Envelope	▪ Attic insulation ▪ Floor insulation ▪ Air sealing
HVAC	▪ Heat pump tune-up ▪ AC tune-up ▪ Duct sealing
Refrigeration	▪ Refrigerator replacement

E18.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[92] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. Baseline Consumption: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
1. Deemed Savings: Deemed savings (or gross savings) values will be estimated from the DE TRM, which are derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.

[92] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

2. Evaluated Savings: Evaluated savings (or net savings) will be determined by the methods described in Section E10.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meets the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[93]

E18.4. Deemed Savings Approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Income and Age Qualifying Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E18.5. Evaluated Savings Approach

The program specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[94]

According to Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis, with a comparison group where feasible.95 The analysis will use a site-level and panel-model billing analysis approach.

E18.5.1. Billing Analysis

The billing analysis for the Residential Income and Age Qualifying Program will require a comparison group of non-participating customers. The matched comparison group customers will be selected based on their similarity to program participant consumption characteristics.

The billing analysis will use one of two approaches cited in the UMP, Chapter 8. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. The site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site-level. The weather-normalized annual consumption (NAC) estimates are then combined in a second stage regression to provide either average customer savings or average measure-level savings.

[93] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[94] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

[95] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

2. The panel model approach estimates a single model for all participant and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups, and the participant pre-post consumption difference.

The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

E18.5.2. Sample Design Considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: For billing analysis, relative precision is a function of the magnitude of savings, the natural variability of consumption and savings and the size of the population. A relative precision of 50% or better is considered strong for a billing analysis.
- Installed measures
- Budget and schedule

E18.5.3. Net-to-Gross Assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV GL standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E18.6. Lost Revenue Methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[96]
2. Apply the evaluated savings to the participant data to arrive at program level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E18.7. Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 15 of each year following program launch).
- Update DE TRM annually for updates that occurred to its referenced sources.

[96] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g. billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

- Develop baseline use, efficient use, and measure savings load shapes annually.
- If appropriate, conduct impact evaluation studies.
- Provide regulatory support as necessary.

E18.8. Residential Income and Age Qualifying Home Improvement Energy Efficiency (Phase IX) – Revision History

Table 18-2. Residential Income and Age Qualifying Program (Phase IX) EM&V Plan

Version	Date	Notes
Version 1	Nov 2020	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number, formatting. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site level analysis ▪ Changed sub-section title from "Savings Estimation" to "Billing Analysis"

E19. INCOME AND AGE QUALIFYING SOLAR PROGRAM EM&V PLAN (PHASE IX)

E19.1. Program summary

This program would provide a mechanism for customers who meet certain income, age, or disability eligibility requirements as well as previous program-participation requirements regarding weatherization to receive, at no cost to the customer, photovoltaic solar panels installed at their residence.

Program characteristics

- Solar installations must be installed behind the participant's meter and net energy metered.
- Solar panels and associated inverters and connecting equipment would be owned by the program participant.
- Solar installations would be standardized across participants. Residential participants would receive an installation with a maximum value to be established in consultation with stakeholders in the range of 3-5 kW_{ac}; individually metered multifamily residences or facilities providing residences would receive an installation no larger than 10 kW_{ac}.
- Funding for battery energy storage systems not included in program.
- Limited funding would be provided for necessary roof repair/reinforcement.

The program would be managed by a demand-side management program implementation firm. The solar installations would be managed by Weatherization Service Providers who are participating in the Company's DSM Phase IX Income and Age Qualifying Program.

The program implementation firm would provide a minimum of the following services:

- Confirm customer/project eligibility.
- Confirm site suitability screening.
- Review and approve project scopes of work.
- Perform on-site visits to ensure quality control.
- Review project submittals to ensure all documentation is captured.
- Approve projects and administer funds.
- Facilitate solar training for the provider network and implementer staff.
- Identify certified solar installers to participate in areas not covered by the Weatherization Service Provider (WSP) network.
- Track/Evaluate program spending.

The Weatherization Service Providers would provide a minimum of the following services:

- Identify eligible customers and eligible worksites for projects.
- Perform initial site suitability assessment.
- Educate eligible customers on the process and systems to ensure the perfect match.
- Submit project scopes of work to program implementer for review.
- Contract with certified solar installers to perform all work and ongoing maintenance.
- Oversee projects through completion and ensure projects meet quality standards.
- Submit completed projects to program implementer for reimbursement.
- Provide primary telephone contacts for interested and participating customers.

- Participating solar providers will be expected to hire diverse firms for the solar component work and participate in Targeted Solar Education Program.

Training/workforce development

The program would provide the following:

- Training for program implementation staff and 1-2 staff members at each WSP aimed at enabling the WSP to oversee a solar project from start to finish, ensuring certain levels of installation quality and competence. The program implementer will help facilitate a training program that meets industry standards, such as those recognized by DOE, that apply toward the industry standard certification through the North American Board of Certified Energy Practitioners (NABCEP).
- Targeted solar education funding aimed at funding solar technician NABCEP-certified training targeting small, diverse-owned firms.

E19.2. Measures

The measure offered by the HB 2789 (Solar Component) is shown in Table 19-1.

Table 19-1. Measures offered by HB 2789 (Solar Component) Program

End-use	Measure
Generation	▪ Installation of roof- or pole-mounted solar photovoltaic panels on the customer's property

E19.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[97] The basis for DNV's approach to estimating generation is:

1. **Modeled generation:** PV generation will be estimated from the DE TRM (see Section E19.4. using standard engineering methods. Methods will reference other State TRMs, protocols, related research, and applicable evaluation studies.
2. **Evaluated generation:** Evaluated generation will be determined by the methods described in Section E19.5.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[98]

E19.4. Deemed generation approach

Upon program approval by the Virginia State Corporation Commission, the tracking protocols for the HB2789 (Solar Component) will be developed according to industry standards and best practices.[99]

97 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

98 Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

99 For example, S. Pless, M. Deru, P. Torcellini, and S. Hayter. October 2005. Procedure for Measuring and Reporting the Performance of Photovoltaic Systems in Buildings, National Renewable Energy Laboratory, NREL/TP-550-38603.

Photovoltaic solar production is based on system design (azimuth, tilt, shading, and component performance characteristics) and local conditions, including weather. Generation models may be developed with assumed design characteristics and customer-specific site studies and site-specific data such as shade analysis and production estimates for each project. Both the deemed calculation and evaluated methods will require site-specific engineering analyses, documentation from the installing contractor and program implementer, production records, utility billing and AMI data, and other customer data. DNV will work with program implementers and Dominion Energy to identify the data to collect from installation contractors and program participants to estimate generation in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research.

All models and protocols will be documented in the DE TRM and calculated using utility-reported program participant data. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all analysis protocols, model inputs and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E19.5. Evaluated PV generation approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[100]

Table 19-2 lists several IPMVP-based approaches for determining PV generation.[101] The selection of a given approach will be influenced by the data availability and the level of rigor desired. The program evaluation will make use of site-specific engineering analyses, documentation from the installing contractor and program implementer, production records, utility billing and AMI data, and other customer data.

Table 19-2. Approaches for evaluating PV generation

Approach	IPMVP description	Description
Production data analysis	▪ Option B, Retrofit Isolation	▪ Using monthly or shorter interval production data. ▪ Annualizing and weather normalizing production estimates.
Verified solar contractor models	▪ Option D, Calibrated Simulation	▪ In the absence of monthly or shorter interval site-level production data, perform desk reviews of contractor models. ▪ Site-specific verification can be used to inform the models. ▪ If longer interval production data are available, the model can be calibrated.
Solar models	▪ Option D: Calibrated Simulation	▪ This approach uses solar models for a given site or a prototype system. ▪ The model can be calibrated using site-level production if available. ▪ If prototype models are used, verified site-specific characteristics can be the basis for determining which prototype model or combination of models apply to a project.
Consumption data analysis	▪ Option C: Whole Facility	▪ This approach can be used if only net meter data are available. ▪ Takes advantage of utility billing data and post-net metering data.

[100] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[101] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol (IPMVP).

Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

E19.5.1. Sample design considerations

The sample frame will be a representative sample of projects. Project size, solar installer, build type, and other project characteristics may be considered in the sample design. Additionally, the evaluation approach and data availability may impact the sample design. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget and schedule

E19.6. Lost revenue methodology

Lost revenue will not be calculated for this program.

E19.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline use and measure generation load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E19.8. Income and Age Qualifying Solar Program – Revision history

Table 19-3. Revision History for HB2789 (Solar Component) EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	▪ Initial release
Version 2	4/22/2022	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number, formatting.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E20. NON-RESIDENTIAL INCOME AND AGE QUALIFYING PROGRAM FOR HEALTH CARE AND RENTAL PROPERTY OWNERS EM&V PLAN (PHASE X)

E20.1. Program summary

The Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners would offer installation of select energy-saving measures to be installed in properties that house low-income and aging residents, but the electric bill is paid by the property, rather than the individual resident. This would include housing authority and master-metered properties, assisted living residences, and nursing homes. These properties could enroll through the usual process, have the incomes of the residents verified, and participate in all the same program measures as the recently approved DSM Phase IX Residential Income and Age Qualifying Home Improvement Program and the proposed DSM Phase X Residential IAQ Enhancements Program.

Energy assessments and installations will be conducted by qualified, local weatherization service providers ("WSP") who currently offer weatherization-related services through the Virginia Department of Housing and Community Development and have been approved by the Income and Age Qualifying Program to complete assessments and install the selected energy-saving products in the residential living areas.

E20.2. Measures

The energy efficiency measures listed in Table 20-1 will be offered by the Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners.

Table 20-1. Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners Measures by end use

End use	Measure
Plug load	▪ Refrigerator upgrade ▪ ENERGY STAR® clothes washer ▪ ENERGY STAR clothes dryer ▪ ENERGY STAR dishwasher
Building envelope	▪ Attic insulation ▪ Floor insulation ▪ Air sealing ▪ Window film ▪ Door upgrade ▪ ENERGY STAR windows
Domestic hot water	▪ Heat pump water heater upgrade ▪ Energy-saving showerhead ▪ High-efficiency faucet aerator ▪ Pipe wrap for water heaters ▪ Water heater tank wrap
HVAC	▪ Heat pump tune-up ▪ AC tune-up ▪ Duct sealing
Lighting	▪ LEDs

E20.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[102] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates. The basis for DNV's savings evaluation approach includes:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data, as available.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E20.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor in its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion—and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analysis or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E20.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[103] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate

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102 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

103 Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E20.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program impacts.

Since there are no widely recognized protocols that comprehensively address multifamily programs hence the proposed approach draws from a combination of methods, listed below, that are modified to evaluate multifamily programs to accommodate the diversity of residential and non-residential customers who may participate in this program. Every effort will be made to accommodate a billing analysis approach.

According to Chapter 8: Whole- Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group where feasible.[104] The analysis will use a site-level or panel-model billing analysis approach (see Section E20.5.1. The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[105]

As described in Chapter 15: Commercial New Construction Evaluation Protocol of the UMP and modified for a residential and non-residential multifamily program, the evaluation approach may include calibrated building simulation as recommended in Chapter 15[106] (see Section E20.5.1. The analysis will also follow the general approach of the IPMVP, Option D, Calibrated Simulation.[107]

E20.5.1. Savings estimation

Multifamily program evaluations may require a combination of consumption data analysis and/or engineering approaches to evaluate the variety of potential multifamily participants (e.g., individually-metered units, master-metered buildings with multiple units, and common areas). The program participation mix and data availability will dictate the most appropriate approach or combination of approaches described herein.

A regression analysis of billing data is the most cost-effective and comprehensive approach as long as the savings are measurable to a statistically significant extent and the majority of the program impacts may be isolated. While the billing analysis for the Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners should have a comparison group of non-participating customers; however, this may be challenging to design given the anticipated diversity of program participants. The matched comparison group customers will be selected based on their similarity to program participant rate, building type, and consumption characteristics.

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[104] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

[105] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[106] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[107] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

The billing analysis will use an approach cited in the UMP, Chapter 8, assuming comparison groups can be established. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. When a comparison group can be established, the site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second-stage regression to provide either average customer savings or average measure-level savings.
2. When a comparison group can be established, the panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling differences between the participant and comparison groups as well as the participant pre-post consumption differences.

In some cases where specific measures are only installed by customers in either the residential or non-residential rate schedules and those measures have high installation rates and high relative impacts, the regression models can be examined to assess whether measure-level savings are statistically significant and can be determined with a reasonable level of accuracy from those models.[108]

If measure-level savings are not found to be statistically significant for all participants through billing analysis or a comparison group cannot be identified, a whole-building simulation analysis may be appropriate for all or a subset of participants. The whole-building simulation analysis will require a sample of program participants to represent the population of participants. DNV will use the program simulation models and occupied electric billing information for each building in the sample. The sample will be stratified based on modeled site-level savings. The simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from occupied buildings. The savings impacts will then be computed by starting with the calibrated occupied building model and using building code standards or existing conditions for the baseline measure inputs. The site level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sample-weighted average to represent the overall program-level realization rate. The deemed savings for each measure can be determined through parametric analysis of the building models where the measures are implemented in the model one at a time and incremental savings calculated with each change. This is not recommended until the program has been running for multiple years to allow for the accumulation of measure level data that can provide meaningful results.

In a limited set of cases, other verification strategies can be used to estimate changes in energy use. For example, savings may be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. This approach is in accordance with IPMVP Option C. The key parameters for those measures will be identified in consultation with the Uniform Methods Project (UMP) to determine annual electric energy savings and peak demand reduction.

All these efforts will be considered to determine the verified annual electric energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E20.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%

[108] This generally requires large numbers of installations (thousands) to yield meaningful results.

- Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
- Installed measures, multifamily type
- Budget, schedule, and geographical distribution

E20.5.3. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E20.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data gathered during the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level annual electric energy savings and peak demand reduction, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E20.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E20.8. Non-Residential Income and Age Qualifying Program for Healthcare and Rental Property Owners – Revision history

Table 20-2. Non-Residential Income and Age Qualifying Home Improvement Program for Healthcare and Rental Property Owners revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the "STEP Manual" to "DE TRM" • Updated footnote 109 to refer to the most recent publicly available version of the DE TRM • Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section • Updated hyperlinks and language based on editorial feedback

E21. RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (PHASE X)

E21.1. Program summary

The Residential Income and Age Qualifying Home Improvement Enhanced Program will provide income-and-age-qualifying residential customers with in-home energy assessments and the installation of select energy-saving measures. Energy assessments and installations will be conducted by qualified, local weatherization service providers ("WSP") who currently offer weatherization-related services through the Virginia Department of Housing and Community Development and have been approved by the Income and Age Qualifying Program to complete assessments and install selected energy-saving products. The enhanced program measures will allow homes to be treated more comprehensively by allowing additional appliance upgrades, a wider variety of LED bulb upgrades, window and door upgrades, and water heater upgrades.

This program would also complement and operate in conjunction with the recently approved DSM Phase IX Residential Income and Age Qualifying Home Improvement Enhanced Program.

E21.2. Measures

The energy efficiency measures listed in Table 21-1 will be offered by the Residential Income and Age Qualifying Home Improvement Enhanced Program.

Table 21-1. Residential Income and Age Qualifying Home Improvement Enhanced Program measures by end use

End use	Measure
Plug load	▪ ENERGY STAR® clothes dryer
Building envelope	▪ Window film
	▪ ENERGY STAR windows
Domestic hot water	▪ ENERGY STAR clothes washer
	▪ ENERGY STAR dishwasher
	▪ Heat pump water heater upgrade
Lighting	▪ LEDs

E21.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[109] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach includes:

109 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data, as available.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E21.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion—and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E21.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Residential Income and Age Qualifying Home Improvement Enhanced Program will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[110] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the order of priorities given in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E21.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV —the appropriateness of conducting evaluations to estimate program impacts.

[110] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

Since there are no widely recognized EM&V protocols that comprehensively address multifamily programs, the proposed approach draws from a combination of methods, listed below, that are modified to evaluate multifamily programs to accommodate the diversity of residential and non-residential customers who may participate in this program. Every effort will be made to accommodate a billing analysis approach.

According to Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include a billing analysis with a comparison group where feasible.[111] The analysis will use a site-level or panel-model billing analysis approach (see Section E21.5.1. The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[112]

As described in Chapter 15: Commercial New Construction Evaluation Protocol of the UMP and modified for a residential and non-residential multifamily program, the evaluation approach may include calibrated building simulation as recommended in Chapter 15 (see Section E21.5.1. [113] The analysis will also follow the general approach of IPMVP, Option D, Calibrated Simulation.[114]

E21.5.1. Savings estimation

Multifamily program evaluations may require a combination of billing or consumption data analyses and/or engineering approaches to evaluate the variety of potential multifamily participants (e.g., individually-metered units, master-metered buildings with multiple units, and common areas). The program participation mix and data availability will dictate the most appropriate approach or combination of approaches described herein.

A regression analysis of billing data is the most cost-effective and comprehensive approach as long as the savings are measurable to a statistically significant extent and the majority of the program impacts may be isolated. While the billing analysis for the Non-Residential Income and Age Qualifying Program should have a comparison group of non-participating customers, this may be challenging to design given the anticipated diversity of program participants. The matched comparison group customers will be selected based on their similarity to program participant rate, building-type, and consumption characteristics.

The billing analysis will use an approach cited in the UMP, Chapter 8, assuming comparison groups are available. Results will consider actual weather conditions and weather-normalized results for both approaches.

1. When a comparison group can be established, the site-level approach will estimate site-level models for each customer in the participant and comparison group. The site-level models control for heating and cooling using a method that facilitates weather normalization at the site level. The weather-normalized annual consumption (NAC) estimates are then combined in a second-stage regression to provide either average customer savings or average measure-level savings.

[111] Agnew, K., Goldberg, M. (2017). Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory; NREL/SR-7A40-68564. http://www.nrel.gov/docs/fy17osti/68564.pdf.

[112] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[113] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[114] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

2. When a comparison group can be established, the panel model approach estimates a single model for all participants and comparison group customers. The model accounts for heating and cooling, differences between the participant and comparison groups (assuming a comparison group is available), and the participant pre-post consumption differences.

In some cases where specific measures are only installed by customers in either the residential or non-residential rate schedules and those measures have high installation rates and high relative impacts, the regression models can be examined to assess whether measure-level savings are statistically significant and can be determined with a reasonable level of confidence from those models.[115]

If measure-level savings are not found to be statistically significant for all participants through billing analysis or a suitable comparison group cannot be identified, a whole-building simulation analysis may be appropriate for all or a subset of participants. The whole-building simulation analysis will require a sample of program participants to represent the population of participants. DNV will use the program simulation models and occupied electric billing information for each building in the sample. The sample will be stratified based on modeled site-level savings. The simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from occupied buildings. The savings impacts will then be computed by starting with the calibrated occupied building model and using building code standards or existing conditions for the baseline measure inputs. The site level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sample-weighted average to represent the overall program-level realization rate. The deemed savings for each measure can be determined through parametric analysis of the building models where the measures are implemented in the model one at a time and incremental savings calculated with each change. This is not recommended until the program has been running for multiple years to allow for the accumulation of measure level data that can provide meaningful results.

In a limited set of cases, other verification strategies can be used to estimate changes in energy use. For example, savings may be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site; This approach is in accordance with IPMVP Option C. The key parameters for those measures will be identified in consultation with the UMP to determine annual electric energy savings and peak demand reduction.

All these efforts will be considered to determine the verified annual electric energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E21.5.2. Sample design considerations

Billing analysis is conducted on the program population, or census, over the analysis period. Sampling may be applied for a free-ridership survey, if applicable. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: In the billing analysis context, precision is a function of the number of participants and the magnitude of savings.
- Installed measures
- Budget, schedule, and geographical distribution

[115] This generally requires large numbers of installations (thousands) to yield meaningful results.

E21.5.3. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E21.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data gathered during the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level annual electric energy savings and peak demand reduction, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E21.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E21.8. Residential Income and Age Qualifying Home Improvement Enhanced Program (Phase X) – Revision history

Table 21-2. Residential Income and Age Qualifying Home Improvement Enhanced Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Updated footnote 116 to refer to the most recent publicly available version of the DE TRM • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

E22. RESIDENTIAL INCOME AND AGE QUALIFYING TARGET REPORT PROGRAM EM&V PLAN (PHASE X)

E22.1. Program summary

The Residential Income and Age Qualifying Energy Target Report Program (IAQ Energy Target Report Program) would offer the opportunity for low-income qualifying customers to save energy in their homes while providing incentives for verified energy savings. The goal of each customer is to target their energy savings of 1-4% when compared to their previous energy consumption data. The energy targets will be generated by integrating hourly Building Energy Modeling (BEM) in addition to the customer's consumption data. The personalized energy target reduction reports will be sent digitally or by mail to the customer. The report will introduce the customer to the Program which runs from June to September, identify the customer's customized energy reduction targets, and highlight the two different incentive levels, which consist of tier 1: $100 (Approx. 1-2% energy reduction) and tier 2: $150 (Approx. 3-4% energy reduction). Each report will also include a list of three to four energy-saving tips to help the customer achieve personal targets, as well as information and cross-promotion of the Company's other DSM program offerings. The customer would also receive a mid-summer update to show progress made toward targets, and the final report identifying the customer's achievement of target goals. Customers can opt out of participation in the Program at any time.

Eligibility applies to any household whose annual income does not exceed 80% of the local area median income as set forth by Virginia Housing or 60% of the state median income as determined by the Virginia Department of Housing and Community Development, whichever is greater. It is also available to customers who are 60 years or older with a household income of 120% of the state's median income. The Program is available to qualified individuals living in single-family homes, multifamily homes, and mobile homes.

E22.2. Measures

The energy efficiency measures listed in Table 22-1 will be offered by the IAQ Energy Target Report Program.

Table 22-1. IAQ Energy Target Report Program measures by end use

End use	Measure
Whole Building	▪ Home energy target report – Mail ▪ Home energy target report – Digital

E22.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[116] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach include:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data, as available.

116 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E22.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur after the first year of program operations and annually thereafter.

E22.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the IAQ Energy Target Report Program will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[117] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E22.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV—the appropriateness of conducting evaluations to estimate program impacts.

The IAQ Energy Target Report Program will be evaluated using billing analysis as recommended by Chapter 17, Residential Behavior Evaluation Protocol of the Uniform Methods Project (UMP) and consistent with the general approach of International Performance Measurement and Verification Protocol (IPMVP) Option C, Whole Facility.[118]

[117] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

[118] Steward, James. Todd, Anika. (2017). Chapter 17: Residential Behavior Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68573. https://www.nrel.gov/docs/fy17osti/68573.pdf; Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol, Option C, Whole Facility.

E22.5.1. Savings estimation

Behavior programs take multiple years to reach their full potential. Typically, savings are estimated on an ongoing basis due to challenges of assigning a deemed savings estimate to a behavioral measure.

The evaluation assumes that the IAQ Energy Target Report Program will be implemented in a randomized controlled treatment (RCT) experimental design. The evaluation will validate the experimental design and use it to develop unbiased estimates of behavior-motivated savings. The evaluation will use a lagged dependent variable approach to estimate savings. This approach uses pre- and post-program monthly consumption data from both the treatment and control group in a specification designed to maximize the precision of estimates. Each evaluation will produce monthly estimates of average per-participant savings. Combining average savings with the number of active participants remaining in the program for each month produces accurate annual estimates of raw program savings.

Incentive program uplift estimation

The evaluation will develop an incentive program uplift adjustment that also makes use of the IAQ Energy Target Report Program RCT. Uplift estimates adjust savings estimates to account for behavior-inspired activity in rebate programs (e.g., the Residential Income and Age Qualifying Home Improvement Enhanced Program). All incentive program activity by IAQ Energy Target Report Program treatment and control group participants during the post-energy target report period will be aggregated and compared on an average per-customer basis. If the average cumulative program-related savings stream of the treatment group of customers is greater than those for the control group customers, then that estimate is used to adjust the overall IAQ Energy Target Report Program savings estimates.

Upstream program uplift estimation

Upstream uplift will be estimated using data from customer surveys that are conducted with both treatment and control groups. Survey data will indicate whether lighting products or other measures from other DSM programs, including other existing income and age-qualifying programs. As with incentive programs, all upstream program activity by the IAQ Energy Target Report Program treatment and control group participants during the post-energy target report period is aggregated and compared on a per-customer basis. If the average cumulative upstream program-related savings stream of treatment group customers exceeds those for the control group customers, then that estimate is used to adjust overall IAQ Energy Target Report Program treatment savings estimates.

E22.5.2. Sample design considerations

DNV will coordinate with the program implementation vendor and Dominion Energy to put in place the RCT experimental design for the program in advance of the implementation of each wave of the program. After the target population is identified, a subset of that population will be randomly allocated to a control group that does not receive the reports. The RCT will be developed within strata defined by geography and energy consumption bins. The size of the control group will be determined by considering the following factors:

- Desired precision of savings estimates
- Expected duration of program
- Targeted populations
- Program design over time

The precision of behavioral savings estimates is a function of the number of participants and the magnitude of the load reduction. In a large program, the sample will support 90/10 precision once the program reaches its full potential. Budget, schedule, and geographical distribution will also be considered in the sample design.

E22.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data gathered during the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level annual electric energy savings and peak demand reduction, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E22.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E22.8. Residential Income and Age Qualifying Target Report Program – Revision history

Table 22-2. Residential Income and Age Qualifying Energy Target Report Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

E23. NON-RESIDENTIAL PRESCRIPTIVE PROGRAM EM&V PLAN (PHASE VI)

E23.1. Program summary

In the Non-Residential Prescriptive program, qualifying customers are eligible to pursue one or more of the qualified energy efficiency measures through a local, participating contractor in Dominion's contractor network. To qualify for this program, the customer must be responsible for the electric bill and must be the owner of the facility or reasonably able to secure permission to complete the measures.

This program is part of demand side management (DSM) Phase VI in Virginia and North Carolina.

E23.2. Measures

The following measures are included in the Non-Residential Prescriptive Program.

Table 23-1. Measures offered by Non-Residential Prescriptive Program

End-use	Measure
Cooking	▪ Commercial convection oven
	▪ Commercial electric combination oven
	▪ Commercial electric fryer
	▪ Commercial griddle
	▪ Commercial hot food holding cabinet
	▪ Commercial steam cooker
HVAC	▪ Duct testing & sealing
	▪ Unitary/split AC & HP tune-up
	▪ Variable speed drives on kitchen fan
Plug load	▪ Smart strip
Refrigeration	▪ Door closer
	▪ Door gasket
	▪ Evaporator fan control
	▪ Floating head pressure control
	▪ Refrigeration night cover
	▪ Refrigeration coil cleaning
	▪ Suction pipe insulation
	▪ Strip curtain
	▪ Vending machine miser
	▪ Commercial freezers and refrigerators – solid door
	▪ Ice maker
	▪ Low/No-sweat door film

E23.3. Evaluation, Measurement & Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[119] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline estimation approach:** The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered from an on-site study of installed rebated measures from a representative sample of participants.
2. **Deemed savings approach:** Deemed savings values will be developed and incorporated into the DE TRM for planning purposes.
3. **Evaluated savings approach**: The wattage and hours of use data for each measure will be collected and metered through an on-site study of installed efficiency measures from a representative sample of participants.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[120]

E23.4. Deemed savings approach

Refer to the Non-Residential Prescriptive Program section of the DE TRM Manual for the standard deemed savings approaches for the measures in this program.

E23.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[121]

The Evaluation approach will follow International Performance Measurement and Verification Protocol (IPMVP) Option A: For physically accessible equipment measures, an EM&V method like IPMVP Option A is applied. IPMVP Option A is a partially-measured retrofit isolation study that measures the selected parameters leading to the change in energy and demand of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's program participation data. IPMVP Option A shall be applied to a sample of all implemented measures.[122]

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The ratio of the weighted, measured, and verified savings to the weighted deemed savings, also called a realization rate, is then applied to the population of participants to estimate program savings. This approach will capture Company-specific customer usage data, which will be applied to the actual measures installed to quantify energy and peak demand savings.

[119] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[120] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[121] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[122] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

E23.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based on the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges and exclude Fuel Charge Rider A and all other applicable riders) for the rate period to arrive at lost revenues.

E23.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E23.8. Non-Residential Prescriptive Program – Revision history

Table 23-2. Revision history for Non-Residential Prescriptive Program EM&V Plan

Version	Date	Notes
Version 1		▪ Initial release
Version 2		▪ Formatting updates ▪ Updated from DNV Energy to DNV Energy Insights
Version 3	2020	▪ Formatting updates
Version 4	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Minor word changes in measure introduction.
Version 5	4/20/2022	▪ Corrected a typo by adding activities to the timeline to align with the EM&V plan structure. Moved evaluated savings approach from “EM&V Overview” to “Evaluated Savings Approach” ▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. Removed version and phase number from title
Version 5	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E24. NON-RESIDENTIAL PRESCRIPTIVE ENHANCED PROGRAM EM&V PLAN (PHASE IX)

E24.1. Program summary

The proposed Program will provide qualifying non-residential customers with incentives for the installation of refrigeration, commercial kitchen equipment, HVAC improvements, and maintenance and installation of other program-specific, energy-efficient measures.

E24.2. Measures

The measures offered by the Non-Residential Prescriptive Enhanced Program are as shown in Table 24-1.

Table 24-1. Measures offered by Non-Residential Enhanced Prescriptive Program

End-use	Measure
	▪ Commercial oven ▪ Commercial electric fryer ▪ Commercial griddle ▪ Commercial hot food holding cabinet ▪ Commercial steam cooker ▪ Commercial dishwasher ▪ Food seal wrapper ▪ Pre-rinse sprayer
HVAC	▪ AC & HP tune Up ▪ Duct testing & sealing ▪ Electrically commutated motor (ECM) ▪ Guest room energy management ▪ Parking ventilation VSD
Plug load	▪ Advanced power strip ▪ Commercial dryer ▪ Commercial washing machine ▪ Ozone laundry ▪ Vending machine miser
Recreation	▪ Heat pump pool heater ▪ Pool pump VSD ▪ Pool spa cover

End-use	Measure
Refrigeration	▪ Anti-sweat door film ▪ Auto closer ▪ Coil cleaning ▪ Commercial cooler & freezer ▪ Door gasket ▪ Evaporator fan control ▪ Evaporator fan ECM ▪ Floating head pressure control ▪ Ice maker ▪ Night cover ▪ Strip curtain ▪ Suction pipe insulation

E24.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[123] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption:** Baseline consumption will be calculated per the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
2. **Deemed savings:** Deemed savings values will be estimated per the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs or protocols.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E24.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[124]

E24.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, other TRMs, or relevant studies or protocols. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into

123 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

124 Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E24.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[125]

According to "Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment," the key measured parameters for HVAC measures include the unit size, unit-rated efficiencies (energy-efficient and baseline cases), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or an on-site audit.[126]

For the refrigeration and food service measures, savings will be based on the DE TRM with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration and cooking measures, the key parameters for determining gross savings and peak demand reductions include quantity, wattage (baseline and efficient), Cooling loads, operating setpoint, and annual hours of operation.

For VSDs and ECM measures, the key measured parameter is the annual operating hours at part-load conditions, and—for peak demand reductions—coincidence factor. The first parameter can be verified by either a desk review or on-site audit.[127]

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[128] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E24.5.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone or email survey verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

[125] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[126] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf

[127] Romberger, Jeff. (2017). Chapter 18: Variable Frequency Drive Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68574. https://www.nrel.gov/docs/fy17osti/68574.pdf

[128] The "realization rate" is the proportion of deemed calculated or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

If metering is used, it will be conducted according to the IPMVP as shown in Table 24-2. [129]

Table 24-2. Preferred IPMVP options for Non-Residential Prescriptive Program measures

End-use/measure	IPMVP option	Key parameter(s)
Food service	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Quantity ▪ Wattage (baseline and efficient) ▪ Operating setpoints ▪ Annual hours of operation
HVAC & Retro-commissioning	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling loads ▪ Heating loads (if applicable) ▪ Operating setpoints ▪ Annual hours of operation ▪ HVAC equipment type
HVAC: VSD & ECM	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part- and full-load conditions
Plug load	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Quantity ▪ Wattage (baseline and efficient) ▪ Operating setpoints ▪ Annual hours of operation
Recreation	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Quantity ▪ Wattage (baseline and efficient) ▪ Operating setpoints ▪ Annual hours of operation
Refrigeration	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling loads ▪ Annual hours of operation

IPMVP Option A, the Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for most of the measures in the program. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

IPMVP Option B, Retrofit Isolation is most appropriate for VSD and ECM retrofits. Using Option B, savings are determined by field measurement of the energy use of the system components. By performing a bin analysis of the pre- and post-installation energy data, it is possible to determine the energy savings and demand reduction.

In a limited set of cases, other kinds of verification strategies, such as building simulation models can be used to estimate program-related energy impacts. Similarly, DNV may opt to use a whole-facility approach (Option C) if appropriate. Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

[129] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.

E24.5.2. Sample design considerations

The sample frame will be comprised of a representative sample of projects. Project size, measure mix, facility type, vendor, and other project characteristics may be considered in the sample design. The sample frame will also be influenced by the evaluation approach and available data. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

E24.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E24.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[130]
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E24.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Annually update The DE TRM, as needed, to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E24.8. Non-Residential Prescriptive Program – Revision history

Table 24-3. Revision history for Non-Residential Prescriptive Program EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release

[130] The realization rate is the proportion of deemed calculated or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
Version 2	4/22/2022	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version and phase number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E25. NON-RESIDENTIAL HEATING AND COOLING EFFICIENCY PROGRAM EM&V PLAN (PHASE VII)

E25.1. Program summary

This program would provide qualifying non-residential customers with incentives to implement new and upgrade existing high-efficiency heating and cooling system equipment to more efficient HVAC technologies that can produce verifiable savings.

E25.2. Measures

The following high-efficiency HVAC measures are included in the program:

Table 25-1. Measures offered by Non-Residential Heating and Cooling Efficiency Program

End-use	Measure
HVAC	▪ Air conditioner upgrade ▪ HP upgrade ▪ Geothermal HP ▪ Mini split HP ▪ Water source HP ▪ Chiller upgrade ▪ Economizers ▪ Variable frequency drives ▪ Variable refrigerant flow ▪ Unitary AC

E25.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[131] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate:** The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered in on-site studies of installed rebated measures from a representative sample of participants.
2. **Deemed savings:** Deemed savings (or gross savings) values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings:** Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

[131] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[132]

E25.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocol for the Non-Residential Heating and Cooling Efficiency Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate demand and energy savings in kW and kWh, respectively. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the data source priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E25.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[133]

Our approach relies heavily on the DOE's Uniform Methods Project protocols (UMP):[134] According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment,[135] the key measured parameters for HVAC measures include the unit size, unit-rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or on-site audit. According to Chapter 18—VFD,[136] the key measured parameters at VFD installations include: hours of operation at each VFD speed, fan/pump motor horsepower, rotational speed, motor enclosure type, motor efficiency, and VFD efficiency.

According to Chapter 19—HVAC Controls,[137] the key measured parameters at dual-enthalpy economizer installations include: pre- and post-installation energy consumption of HVAC system components. These are normalized to TMY3 weather data.

For all measures in this program, the annual operating hours vary by climate, building type, occupancy type, etc. A high-rigor evaluation would require metering for a sample of the participants that represented all of these categories. However,

[132] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[133] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[134] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[135] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf

[136] Romberger, Jeff. (2017). Chapter 18: Variable Frequency Drive Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68574. http://www.nrel.gov/docs/fy17osti/68574.pdf

[137] Romberger, Jeff. (2017). Chapter 19: HVAC Controls (DDC/EMS/BAS) Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68575. http://www.nrel.gov/docs/fy17osti/68575.pdf

because this approach can be expensive, a lower-rigor approach using metering for only a sample of the predominant building types may be considered.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[138] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E25.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection
- Budget, schedule, and geographical distribution

E25.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the International Performance Measurement and Verification Protocol[139] (IPMVP) as shown in Table 25-2.

[138] The “realization rate” is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[139] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

Table 25-2. Preferred IPMVP options for Non-Residential Heating and Cooling Efficiency Program measures

Measure	IPMVP option	Key parameter(s)
Package terminal air conditioners and package terminal heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Unitary and split air-conditioning systems and air-source heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Variable frequency drives	Option B. Retrofit Isolation: All Parameter Measurement	• Annual hours of operation at part-load conditions
Economizers	Option D. Calibrated Simulation	• Verify proper operation • Annual hours of operation
Water- and air-cooled chillers	Option A. Retrofit Isolation: Key Parameter Measurement Approach or Option C. Whole Facility, if energy management system data are available and project-level savings are large compared to other energy variations at facility	• Cooling loads • Outside air temperatures • Manufacturer part-load efficiency data • Annual hours of operation
Geothermal heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Variable-refrigerant-flow systems and mini-split heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation

According to UMP, IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for HVAC system replacement measures. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data.

According to UMP, IPMVP Option B, Retrofit Isolation is most appropriate for economizer retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data, and local weather data, it is possible to determine the energy savings and demand reductions.

According to UMP, IPMVP Option D—Calibrated Simulation is most appropriate for installed or replaced economizer measures. IPMVP Option D uses computer simulation software (e.g., DOE-2.2 software) to predict the change in energy and demand of efficiency measures from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The computer simulation is developed using economizer system inputs collected on-site or through interviews with installation and service contractors. On-site hourly meter data is collected from the cooling systems and is used to calibrate the simulation for accuracy.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All of these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E25.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E25.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured consumption and demand data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand impacts, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E25.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E25.8. Non-Residential Heating and Cooling Efficiency Program – Revision history

Table 25-3. Revision history for Non-Residential Heating and Cooling Efficiency Program EM&V Plan

Version	Date	Notes
Version 1		▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section

Version	Date	Notes
		▪ Updated hyperlinks and language based on editorial feedback

E26. NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS PROGRAM EM&V PLAN (PHASE VII)

E26.1. Program summary

This program would provide qualifying non-residential customers with an incentive to implement more efficient lighting technologies that can produce verifiable savings. The program promotes the installation of lighting technologies, including, but not limited to, LED-based bulbs and lighting control systems.

E26.2. Measures

The following high-efficiency lighting measures are included in the program:

Table 26-1. Measures offered by Non-Residential Lighting Systems & Controls Program

End-use	Measure
Lighting	▪ High-efficiency T8/T5 lamps ▪ LED lamps ▪ Occupancy sensor(s) and lighting controls

E26.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[140] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: The baseline wattage will be computed using the prescriptive replacement combinations presented in the DE TRM. The replaced lighting fixtures from the rebate application data will be used, applying hours of use as metered in on-site studies of installed rebated measures from a representative sample of participants in Virginia.
2. **Deemed savings**: Deemed savings (or gross savings) values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings**: Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[141]

E26.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Non-Residential Lighting Systems & Controls Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in

[140] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[141] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E26.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[142]

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol[143] of The Uniform Methods Project[144] (UMP), the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline). According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol,[145] the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[146] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E26.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection
- Budget, schedule, and geographical distribution

[142] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[143] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68558. http://www.nrel.gov/docs/fy17osti/68558.pdf

[144] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[145] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

[146] The “realization rate” is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and the extent to which these were affected by exogenous changes.

E26.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of premise-level participants will be performed using one or more of the following levels of rigor:

- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

According to UMP, International Performance Measurement and Verification Protocol (IPMVP) Option A—Retrofit Isolation, Key Parameter Measurement Approach) is the appropriate method for lighting fixture retrofits and most occupancy sensor retrofits.[147] IPMVP Option A is a partially measured retrofit isolation study that determines the actual energy and demand of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The adjustment factor, also called a realization rate,[148] is then applied to the population of participants to estimate program savings.

DNV will verify the hours of use, the quantity of fixtures, and the type and wattage of fixtures for a representative sample of the energy-efficient retrofits. To verify the hours of use, electronic metering equipment is typically installed temporarily throughout the duration of the measurement period. For facilities with constant schedules, the measurement period must last for a minimum of four weeks; for facilities with variable schedules, additional metering time may be required to be representative of the average operation over the full range of variable schedules. In facilities with energy management systems (EMS) that monitor lighting circuits, hours of use may be verified by gathering EMS data.

To verify the baseline conditions, a facility representative will be interviewed. If no lighting control measures were implemented at a given lighting circuit in the sample, the baseline hours of use equal the efficient; otherwise, they will usually be greater. Next, the heating and cooling status and associated fuel type will also be verified to account for interactive effects using stipulated values. DNV will either confirm or correct all reported values described in this section.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E26.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

[147] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

[148] The "realization rate" is the proportion of deemed or reported energy savings and peak demand reductions that have been verified for all customers or projects in a sample. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E26.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E26.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E26.8. Non-Residential Lighting Systems & Controls Program – Revision history

Table 26-2. Revision history for Non-Residential Lighting Systems & Controls Program EM&V Plan

Version	Date	Notes
Version 1	2022	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Formatted measure table.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E27. NON-RESIDENTIAL SMALL MANUFACTURING PROGRAM EM&V PLAN (PHASE VII)

E27.1. Program summary

This program would provide qualifying customers incentives for the installation of energy efficiency improvements, consisting of primarily compressed air systems measures for small manufacturing facilities.

E27.2. Measures

The following measures are included in the Non-Residential Small Manufacturing Program.

Table 27-1. Measures offered by Non-Residential Small Manufacturing Program

End-use	Measure
Compressed Air	▪ Compressed air nozzles ▪ Leaks ▪ No loss drains ▪ Additional compressed air storage ▪ Heat of compression dryer ▪ Low-pressure Drop filter ▪ Variable speed drive air compressor ▪ Cycling refrigerant dryer ▪ Dewpoint controls ▪ Pressure reduction ▪ Downsized variable frequency drive compressor

E27.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[149] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate**: The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered from an on-site study of installed rebated measures from a representative sample of participants.
2. **Deemed savings**: Deemed savings (or gross savings) values will be developed and incorporated into the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings**: Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for each measure will be collected and metered through an on-site study of installed efficiency measures from a representative sample of participants.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[150]

[149] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[150] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E27.4. Deemed savings approach

Deemed savings approach or protocol for the Non-Residential Small Manufacturing Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the data source priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E27.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[151]

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. In keeping with accepted practices defined by Chapter 22: Compressed Air Evaluation Protocol[152] of The Uniform Methods Project[153] (UMP), the key parameters for determining gross savings and peak demand reductions include: airflow rate, line pressure, compressor power, production rates, and operating hours.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[154] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E27.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection

[151] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[152] Benton, N.; Burns, P. (2017). Chapter 22: Compressed Air Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68577. http://www.nrel.gov/docs/fy18osti/68577.pdf

[153] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[154] The “realization rate” is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

- Budget, schedule, and geographical distribution

E27.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of premise-level participants will be performed using one or more of the following levels of rigor:

- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the International Performance Measurement and Verification Protocol (IPMVP).[155]

IPMVP Option A. Retrofit Isolation, Key Parameter Measurement: It is a partially-measured retrofit isolation study that measures the selected parameters leading to the change in energy and demand of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's program participation data. IPMVP Option A shall be applied to a sample of air-compressor system retrofit and re-commissioning measures by performing spot measurements of compressor load current or root-mean-square power. These are supplemented by on-site observations of airflow and line pressure, site-contact reported hours of use and historical production data, and manufacturer specifications and standard data sheets.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

The above efforts will be used to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E27.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E27.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.

[155] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E27.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E27.8. Non-Residential Small Manufacturing Program – Revision history

Table 27-2. Revision history for Non-Residential Small Manufacturing Program EM&V Plan

Version	Date	Notes
Version 1	2020	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Formatted measure table.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E28. NON-RESIDENTIAL WINDOW FILM PROGRAM EM&V PLAN (PHASE VII)

E28.1. Program summary

This program would provide qualifying non-residential customers with an incentive to install solar reduction window film to lower their cooling bills and improve occupant comfort.

E28.2. Measures

Solar window film installation(s) are eligible for a rebate through the program under specified conditions.

E28.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[156] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership.

The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate**: The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered in on-site studies of installed rebated measures from a representative sample of participants.
2. **Deemed savings:** Deemed savings (or gross savings) values will be estimated from the DE TRM. The source of the deemed savings values will be models of 21 prototypical building types using Database for Energy Efficiency References (DEER) average values for building parameters (building sq. ft., EFLH, etc.).157 Variations in deemed savings values are provided in the DE TRM for some important parameters reported on customer rebate applications, including weather zone, window orientation, and heating system type.
3. **Verified savings:** Verified savings (or net savings) will be determined using on-site data. Solar emittance spot measurement data and operation schedules will be collected through an on-site study of installed rebated measures from a representative sample of participants. Load data from applicable non-residential HVAC measures across all other Dominion programs will be used in the simulation model as the basis of the measured savings load shape.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[158]

E28.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Non-Residential Window Film Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate

[156] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[157] California Electronic Technical Reference Manual, DEER Database, https://cedars.sound-data.com/deer-resources/deer-database/.

[158] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E28.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[159]

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[160] (UMP) does not specifically address this measure, the key parameter for determining gross savings and peak demand reductions include the surface area of treated windows and the SHGC.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[161] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E28.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection
- Budget, schedule, and geographical distribution

E28.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of premise-level participants will be performed using one or more of the following levels of rigor:

- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

As recommended in UMP, the International Performance Measurement and Verification Protocol (IPMVP) Option D. Calibrated Simulation,[162] is a calibrated simulation study that uses computer simulation software (e.g. DOE 2 eQUEST or

[159] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[160] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[161] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and the extent to which these were affected by exogenous changes.

Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

Energy Plus software packages), will be used to predict the change in energy and demand of efficiency measures from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's program participation data. The computer simulation is developed using building and window film parameters collected on-site or through interviews with installation and service contractors.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

The above efforts will be used to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E28.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E28.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E28.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E28.8. Non-Residential Window Film Program – Revision history

Table 28-1. Revision history for Non-Residential Window Film Program EM&V Plan

Version	Date	Notes
Version 1		▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Added reference to DEER database.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E29. NON-RESIDENTIAL MIDSTREAM EFFICIENCY PRODUCTS PROGRAM EM&V PLAN (PHASE VIII)

E29.1. Program summary

Unlike the Company's other EE Program portfolio offerings, the proposed Midstream program does not enroll end-use customers. Instead, the program enrolls equipment distributors into the program through an agreement to provide point-of-sales data in an agreed-upon format each month. The distributor will discount the rebate-eligible items sold to end-use customers. This program aims to increase the availability and uptake of efficient equipment for the Company's non-residential customers. The monthly sales data will contain the data necessary to perform measurement and verification for the program in the Company's service territory.

E29.2. Measures

The measures to be offered through the Non-Residential Midstream Efficient Products Program are provided in Table 29-1.

Table 29-1. Measures offered by the Non-Residential Midstream Efficiency Products Program

End-use	Measure
Cooking	▪ Commercial kitchen equipment
HVAC	▪ Efficient heat pumps ▪ Efficient air conditioning units ▪ Air- and water-cooled chillers
Refrigeration	▪ Commercial freezers and coolers

E29.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[163] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated per the DE TRM, which are derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E29.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[164]

[163] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[164] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E29.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Non-Residential Midstream Efficient Products Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E29.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[165]

For the cooking measures, savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[166] (UMP) does not specifically address cooking measures, the key parameter for determining gross savings and peak demand reductions include hours of operation, cooking load, and equipment type.

According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment,[167] savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key measured parameters for HVAC measures include the unit size, unit-rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or on-site audit.

According to Chapter 14—Chiller Equipment,[168] savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key measured parameters include operating schedule and pre- and post-installation energy consumption of chiller measure(s). For chillers that provide space cooling, these are normalized to TMY3 weather data.

For the refrigeration measures, savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration measures, the key parameters for determining gross savings and peak demand reductions include hours of operation, whether the equipment is in a conditioned space, and equipment type.

For most measures in this program, the annual operating hours vary by climate, building type, occupancy type, etc. A high-rigor evaluation would require metering for a sample of the participants that represented all listed categories. However,

[165] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[166] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[167] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf

[168] Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf

because this approach can be expensive, a lower-rigor approach using metering for only a sample of the predominant building types may be considered.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[169] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E29.5.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the International Performance Measurement and Verification Protocol (IPMVP) as shown in Table 29-2. [170]

Table 29-2. Preferred IPMVP options for Non-Residential Midstream Efficiency Products program measures

Measure	IPMVP option	Key parameter(s)
Cooking equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooking loads ▪ Annual hours of operation
PTACs, Unitary and split air-conditioning systems and air-source heat pumps, and mini-split systems	Option A. Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling loads ▪ Heating loads (if applicable) ▪ Annual hours of operation
Air- and water-cooled chillers	Option A. Retrofit Isolation: Key Parameter Measurement Approach or, Option C. Whole Facility, if energy management system data are available and project-level savings are large compared to other energy variations at facility	▪ Cooling loads ▪ Outside air temperatures ▪ Manufacturer part-load efficiency data ▪ Annual hours of operation
Refrigeration equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	▪ Space-conditioning category ▪ Annual hours of operation

[169] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[170] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

According to UMP, IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for replacements of cooking equipment, most HVAC-system types, and refrigeration equipment. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

According to UMP, IPMVP Option C: Whole Facility Approach is most appropriate for chiller equipment at facilities with building management systems. Gross savings are determined by taking the difference between the measured energy use at the whole facility, before and after the measure implementation, from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data. Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and, as necessary, adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E29.5.2. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 15,000 participants (or units) or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

E29.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E29.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the gross impact evaluation method as appropriate.[171]

[171] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits,

2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E29.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E29.8. Non-Residential Midstream Efficiency Products Program – Revision history

Table 29-3. Revision history for Non-Residential Midstream Energy Efficiency Products Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial Release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Minor word edits to measure section.
Version 3	4/22/2022	▪ Updated program name from “Non-Residential Midstream Energy Efficient Products Program” to “Non-Residential Midstream Energy Efficiency Products Program” ▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E30. NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS EXTENSION PROGRAM EM&V PLAN (PHASE X)

E30.1. Program summary

The proposed program design would offer a seamless continuation of the Company's DSM Phase VII Non-Residential Lighting Systems and Controls Program, consisting of the same program measures.

This Program would provide qualifying non-residential customers with an incentive to implement more efficient lighting technologies that can produce verifiable savings. The Program promotes the installation of lighting technologies including, but not limited to LED-based bulbs and lighting control systems.

All non-residential customers, who have not opted out of paying the rider are eligible.

E30.2. Measures

The energy efficiency measures listed in Table 30-1 will be offered by the Non-Residential Lighting Systems and Controls Program Extension Program.

Table 30-1. Non-Residential Lighting Systems and Controls Program extension measures by end use

End use	Measure
Lighting	▪ High-efficiency T8/T5 lamps ▪ LED lamps and fixtures ▪ Occupancy sensor(s) and lighting controls

E30.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[172] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption**: The baseline wattage will be computed using the prescriptive replacement combinations presented in the DE TRM. The replaced lighting fixtures from the rebate application data will be used, applying hours of use as metered in on-site studies of installed rebated measures from a representative sample of participants in Virginia.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings:** Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost-effective

[172] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using a deemed savings approach. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion – and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole-facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E30.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Non-Residential Lighting Systems and Controls Program Extension will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[173] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priorities given in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E30.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program impacts.

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of The Uniform Methods Project (UMP), the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline).[174]

[173] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

[174] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68558. http://www.nrel.gov/docs/fy17osti/68558.pdf

According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.[175]

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate, is then applied to the population of participants to estimate overall program savings.[176] This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify annual electric energy savings and peak demand reductions.

E30.5.1. Savings estimation

Measurement and verification of the installation and operation of a sample of premise-level participants will be performed using one or more of the following levels of rigor:

- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

According to UMP, the International Performance Measurement and Verification Protocol (IPMVP) Option A—Retrofit Isolation, Key Parameter Measurement Approach) is the appropriate method for lighting fixture retrofits and most occupancy sensor retrofits. IPMVP Option A is a partially measured retrofit isolation study that determines the actual energy and demand of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms, as applied to Dominion Energy's reported program participation data. The adjustment factor, also called a realization rate, is then applied to the population of participants to estimate program savings.[177]

DNV will verify the hours of use, the quantity of fixtures, and the type and wattage of fixtures for a representative sample of the energy-efficient retrofits. To verify the hours of use, electronic metering equipment is typically installed temporarily throughout the duration of the measurement period. For facilities with constant schedules, the measurement period must last for a minimum of four weeks; for facilities with variable schedules, additional metering time may be required to be representative of the average operation over the full range of variable schedules. In facilities with energy management systems (EMS) that monitor lighting circuits, hours of use may be verified by gathering EMS data.

To verify the baseline conditions, a facility representative will be interviewed. If no lighting control measures were implemented at a given lighting circuit in the sample, the baseline hours of use equal the efficient; otherwise, they will usually be greater. Next, the heating and cooling status and associated fuel type will also be verified to account for interactive effects using stipulated values. DNV will either confirm or correct all reported values described in this section.

In a limited set of cases, other kinds of verification strategies, such as building or campus simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program.

[175] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

[176] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and the extent to which these were affected by exogenous changes.

[177] Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, https://evo-world.org/en/.

Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified annual electric energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E30.5.2. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection
- Budget, schedule, and geographical distribution

E30.5.3. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E30.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data gathered during the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level annual electric energy savings and peak demand reduction, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E30.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E30.8. Non-Residential Lighting Systems and Controls Program Extension – Revision history

Table 30-2. Non-Residential Lighting Systems and Controls Program extension revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

E31. NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII)

E31.1. Program summary

This Program would provide qualifying facility owners with incentives to install energy-efficient program measures in new construction projects. The program engineers will determine what potential energy efficiency upgrades are of interest to the owner and feasible within the existing budget. These measures coupled with basic facility design data will be analyzed to determine the optimized building design. This in-depth analysis will be performed using building energy simulation models, which account for the interactive effects of measure bundles. The results of the various measures and measure bundles will be presented to the facility owner to determine which measures(s) are to be installed. Program design building types modeled include small offices, medium offices, stand-alone retail, and outpatient health care.

E31.2. Measures

The program will incentivize "above code" measures to save energy in newly constructed buildings. Example measures to be offered through the program are provided in Table 31-1.

Table 31-1. Measures offered by the Non-Residential New Construction Program

End-use	Measure
Lighting	▪ Exterior LED lighting
HVAC	▪ High efficiency and variable speed chillers ▪ High-efficiency direct expansion (DX) cooling equipment ▪ High-efficiency packaged air-source heat pumps ▪ Demand controlled ventilation ▪ Variable air volume (VAV) dual-max controls ▪ Chiller controls
Plug load	▪ Supervisory Plug load management systems

E31.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[178] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated using a combination of operating schedule and setpoint and controls schedules for model inputs and will be simulated using prototype commercial computer models. Since this is a new construction program there will be no monthly or AMI participant consumption data.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.

[178] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E31.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[179]

E31.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Non-Residential New Construction Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E31.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[180]

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include calibrated building simulation.[181] The analysis will use a site-level analysis approach (see Section E31.5.1. The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[182]

E31.5.1. Savings estimation

The whole-building simulation analysis for the Non-Residential New Construction Program will require a sample of program participants to represent the population of participants. DNV will use the program simulation models and occupied electric and gas billing information for each building in the sample. The sample will be stratified based on modelled site level savings. The simulation models for the sampled participants will be reviewed for accuracy and calibrated using energy consumption from occupied buildings. The savings impacts will then be computed by starting with the calibrated occupied building model and using building code standards for the baseline measure inputs. The site level realization rates (the ratio of verified site savings to deemed site savings) will be combined using a sample-weighted average to represent the overall program-level realization rate.

[179] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[180] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[181] Keates, Steven. (2017). Chapter 15: Commercial New Construction Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68571. www.nrel.gov/docs/fy17osti/68571.pdf.

[182] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

The deemed savings for each measure can be evaluated through parametric analysis of the building models where the measures are implemented in the model one at a time and incremental savings calculated with each change. This is not recommended until the program has been running for multiple years to accumulate measure level data that can provide meaningful results.

E31.5.2. Sample design considerations

Sampling will be used for the impact evaluation and may be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Modeled site-level savings
- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Building type
- Budget, schedule, and geographical distribution

E31.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E31.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the calibrated simulation analysis.[183]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E31.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

[183] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

7. If appropriate, support lost revenue recovery activities.

E31.8. Non-Residential New Construction Program – Revision history

Table 31-2. Revision History for Non-Residential New Construction Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E32. NON-RESIDENTIAL SMALL BUSINESS IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (PHASE VIII)

The Program is an enhancement to the existing DSM Phase V Small Business Improvement Program. The program would provide small businesses with an energy use assessment and tune-up or re-commissioning of electric heating and cooling systems, along with financial incentives for the installation of specific energy efficiency measures. Participating small businesses would be required to meet certain size and connected load requirements.

E32.1. Measures

The following measures are included in the Non-Residential Small Business Improvement Enhanced Program (Phase VIII).

Table 32-1. Measures offered by Non-Residential Small Business Improvement Enhanced Program

End-use	Measure
Building envelope	▪ Window film
HVAC	▪ Efficient air conditioning upgrades ▪ Efficient heat pump upgrades ▪ Variable Frequency Drives ▪ Window film ▪ Prescriptive re-commissioning
Lighting	▪ Direct install lighting ▪ Dimmers and controls
Refrigeration	▪ Refrigeration measures

E32.2. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[184] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated per the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
2. **Deemed savings:** Deemed savings values will be estimated per the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic Technical TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E32.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").

[184] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

E32.3. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Small Business Improvement Enhanced Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E32.4. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[185]

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[186] (UMP) does not specifically address window film, the key parameter for determining gross savings and peak demand reductions include the surface area of treated windows and the Solar Heat Gain Coefficient (SHGC).

According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment, the key measured parameters for HVAC measures include the unit size, unit rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or on-site audit.[187]

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP,[188] the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline). According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol,[189] the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.

For the refrigeration measures, savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration measures, the key parameter for

[185] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[186] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[187] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf

[188] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68558. http://www.nrel.gov/docs/fy17osti/68558.pdf

[189] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

determining gross savings and peak demand reductions include hours of operation, whether located in a conditioned space, and equipment type.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[190] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E32.4.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone survey verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the International Performance Measurement and Verification Protocol (IPMVP) as shown in Table 32-2.[191]

Table 32-2. Preferred IPMVP options for Small Business Improvement Enhanced Program measures

Measure	IPMVP option	Key parameter(s)
Window film	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Area of window film ▪ HVAC and lighting annual hours of operation
Duct testing & sealing and HVAC tune-ups	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling loads ▪ Heating loads (if applicable) ▪ Annual hours of operation
PTACs, Unitary AC/HP systems, mini-split systems	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling loads ▪ Heating loads (if applicable) ▪ Annual hours of operation
VFDs	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part-load conditions
Economizers	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	▪ Verify proper operation ▪ Annual hours of operation

[190] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[191] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

Measure	IPMVP option	Key parameter(s)
Programmable thermostats	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Operating setpoints ▪ Annual hours of operation ▪ Equipment type
Lighting & lighting controls	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Fixture quantity (baseline and efficient) ▪ Wattage (baseline and efficient) ▪ Annual hours of operation
Refrigeration equipment	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Space-conditioning category ▪ Annual hours of operation

According to UMP, IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for window film, most HVAC-system types, typical economizers, and typical refrigeration equipment. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

According to UMP, IPMVP Option B, Retrofit Isolation is most appropriate for VFD retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data and local weather data, it is possible to determine the energy savings and demand reduction.

According to UMP, IPMVP Option D—Calibrated Simulation may be most appropriate for installed or replaced economizer measures at complex installations. IPMVP Option D uses computer simulation software (e.g., DOE-2.2 software) to predict the change in energy and demand of efficiency measures from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The computer simulation is developed using economizer system inputs collected on-site or through interviews with installation and service contractors. On-site hourly meter data is collected from the cooling systems and is used to calibrate the simulation for accuracy.

In a limited set of cases, other kinds of verification strategies, such as building simulation modelling incorporating various types of data can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified annual energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E32.4.2. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size.

Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%

- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

E32.4.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E32.5. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the gross impact evaluation methods as appropriate.[192]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E32.6. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced sources.
4. Develop baseline and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E32.7. Small Business Improvement Enhanced Program (Phase VIII) – Revision history

Table 32-3. Revision history for Small Business Improvement Enhanced Program (Phase VIII) EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Minor word changes in measure introduction.

[192] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E33. NON-RESIDENTIAL SMALL BUSINESS BEHAVIORAL PROGRAM EM&V PLAN (PHASE X)

E33.1. Program summary

The Small Business Behavioral Program would provide small businesses with customized business energy reports (BER), either digitally or through the mail, with energy-saving tips, forecasting, and recommendations. The proposed program design also incorporates higher-touch customer engagement, which engages small business owners in a quick online experience to learn more about their energy usage, find customized ways to save energy, provide data to the program to improve energy savings personalization for each business segment and cross-promote other DSM programs in addition to connecting the customer with the program design vendor's energy advisors. The energy advisors will provide eligible customers with coaching and recommendations on their energy savings opportunities.

A significant portion of the anticipated savings from this program will come from HVAC energy reduction in the summer and winter peak periods and require adjusting thermostat setpoints and schedules. Additionally, the BERs include recommendations of low-to-no-cost measures that result in improved indoor air quality for the business staff and/or customer health.

All non-residential customers who do not exceed the 100-kW demand threshold and who occupy the facility with at least 12 months of historical consumption data. Customers can opt out of participation in the program at any time.

E33.2. Measures

The following measures are included in the Small Business Behavioral Program.

Table 33-1. Small Business Behavioral Program Measures by end use

End Use	Measure
Whole Building	▪ Business Energy Reports – Mail ▪ Business Energy Reports – Digital

E33.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[193] The EM&V method estimates gross and net program annual electric energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data from the treatment and control groups.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.

193 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E33.5. The evaluated savings will use program tracking data and customer energy consumption data from the treatment and control groups.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur after the first year of program operations and annually thereafter.

Early in the third year of the program, or earlier at the Company's discretion—and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E33.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Small Business Behavioral Program will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[194] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priorities given in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E33.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program impacts.

There are no Uniform Methods Project (UMP) protocols for small business behavior programs so the Small Business Behavioral Program will be evaluated using billing analysis as recommended by Chapter 17, Residential Behavior Evaluation Protocol of the UMP and consistent with the general approach of International Performance Measurement and Verification Protocol (IPMVP) Option C, Whole Facility.

[194] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

E33.5.1. Savings estimation

Behavior programs take multiple years to reach their full potential. Typically, savings are estimated on an ongoing basis due to challenges of assigning a deemed savings estimate to a behavioral measure.

The evaluation assumes that the Small Business Behavioral Program will be implemented in a randomized controlled treatment (RCT) experimental design. The evaluation will validate the experimental design and use it to develop unbiased estimates of behavior-motivated savings. The evaluation will use a lagged dependent variable approach to estimate savings. This approach uses pre- and post-program monthly consumption data from both the treatment and control group in a specification designed to maximize the precision of estimates. Each evaluation will produce monthly estimates of average per-participant savings. Combining average savings with the number of active participants remaining in the program for each month produces accurate annual estimates of raw program savings.

Incentive program uplift estimation

The evaluation will develop an incentive program uplift adjustment that also makes use of the Small Business Behavioral Program RCT. Uplift estimates adjust savings estimates to account for behavior-inspired activity in non-residential DSM programs. All incentive program activity by Small Business Behavioral Program treatment and control group participants during the post-intervention target report period will be aggregated and compared on an average per-customer basis. If the average cumulative incentive program-related savings stream of treatment group customers is greater than the control group customers' incentive program-related savings, then that estimate is used to adjust overall Small Business Behavioral Program savings estimates.

Upstream program uplift estimation

Upstream uplift will be estimated using data from customer surveys that are conducted with both treatment and control groups. Survey data will indicate whether lighting products or other measures from other DSM programs, including other income and age qualifying programs have been implemented. As with incentive programs, all upstream program activity by Small Business Behavioral Program treatment and control group participants during the post-small business energy report period is aggregated and compared on a per-customer basis. If the average cumulative upstream program-related savings stream of treatment group customers is greater than the control group customers' upstream program-related savings, then that estimate is used to adjust overall Small Business Behavioral Program treatment savings estimates.

E33.5.2. Sample design considerations

DNV will coordinate with the program implementation vendor and Dominion Energy to put in place the RCT experimental design for the program in advance of the implementation of each wave of the program. After the target population is identified, a subset of that population will be randomly allocated to a control group that does not receive the treatment. The RCT will be developed within strata defined by geography and electric energy consumption bins. The size of the control group will be determined by the:

- Desired precision of savings estimates
- Expected duration of program
- Targeted populations
- Program design over time

The precision of behavioral savings estimates is a function of the number of participants and the magnitude of the load reduction. In a large program, the sample will support 90/10 precision once the program reaches its full potential. Budget, schedule, and geographical distribution will also be considered in the sample design.

E33.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the billing analysis.[195]
2. Apply the evaluated savings to the participant data to arrive at program-level annual electric energy savings and peak demand reductions, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly electric energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly electric energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E33.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E33.8. Non-Residential Small Business Improvement Enhanced Program – Revision history

Table 33-2. Small Business Behavioral Program Revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

[195] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E34. NON-RESIDENTIAL AGRICULTURAL PROGRAM EM&V PLAN (PHASE IX)

E34.1. Program summary

This Program would provide qualifying non-residential customers with incentives to implement specific energy efficiency measures to help agribusinesses replace aging, inefficient equipment, and systems with new, energy-efficient technologies. The Program is designed to help agricultural customers make their operations more energy-efficient by providing incentives for efficient agricultural equipment and lighting technologies specific to agricultural applications.

E34.2. Measures

The measures offered by the Non-Residential Agricultural Program are as shown in Table 34-1.

Table 34-1. Measures offered by Non-Residential Agricultural Program

End-use	Measure
HVAC	▪ Circulation fan ▪ High volume low-speed fan ▪ Ventilation fan ▪ Livestock warming equipment
Lighting	▪ Lighting ▪ Dairy lighting control ▪ Greenhouse LED lighting
Process	▪ Agricultural VFD ▪ Automatic milker takeoff ▪ Efficient grain dryer ▪ Grain storage aeration control ▪ Low-pressure irrigation ▪ Heat reclaimer ▪ Dairy plate cooler
Refrigeration	▪ Refrigeration tune-up

E34.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[196] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency program is:

1. **Baseline consumption**: Baseline consumption will be calculated per the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs or protocols.
2. **Deemed savings**: Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.

196 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E34.5. The evaluated savings will use program tracking data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[197]

E34.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings calculation approach or protocol for the Non-Residential Agricultural Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies or protocols, as appropriate. The deemed savings calculation protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E34.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[198]

To the extent possible, DNV draws from the Uniform Methods Project[199] (UMP) to establish protocols for evaluating measures. According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment, the key measured parameters for HVAC measures include the unit size, unit rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. While the measures offered through this program are not typical of those covered by Chapter 4, the methodology is still applicable. The first two parameters can be verified by either a desk review or an on-site audit.[200]

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP, the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline). According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol,[201] the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.

For the process and refrigeration measures, savings will be based on the DE TRM deemed calculations with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address such measures, the key

[197] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[198] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[199] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf.

[200] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf.

[201] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

parameter for determining gross savings and peak demand reductions include hours of operation, whether located in a conditioned space, and equipment type.

At a high level, the ratio of the measured and verified savings to the deemed savings calculation for the sample, also called a realization rate, is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E34.5.1. Savings estimation

The analysis will follow the general approach of IPMVP, Option A, Partially Measured Retrofit Isolation. This approach uses engineering calculations using spot measurements, post-metering data, and stipulations.[202] The program evaluation will make use of site-specific engineering analyses, documentation from the installing contractor and program implementer, program tracking data, utility billing and AMI data, survey, and other customer data.

If metering is used, it will be conducted according to the International Performance Measurements and Verification Protocol (IPMVP) as shown in Table 34-2.

Table 34-2. Preferred IPMVP options for Non-Residential Agricultural Program measures

Measure	IPMVP option	Key parameters
HVAC	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Annual hours of operation ▪ Equipment efficiency
Lighting and controls	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Fixture quantity (baseline and efficient) ▪ Wattage (baseline and efficient) ▪ Annual hours of operation
Process equipment	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part-load conditions for VFDs ▪ Full-load amperage ▪ Heat exchange rate (flow rates and temperature differences)
Refrigeration tune-up	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Equipment location ▪ Annual hours of operation

E34.5.2. Sample design considerations

The sample frame will be comprised of a representative sample of projects. Project size, measure mix, facility type, vendor, and other project characteristics may be considered in the sample design. The sample frame will also be influenced by the evaluation approach and available data. The following characteristics will be considered:

- Confidence interval: 85-90%%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

[202] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.

E34.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E34.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies or consumption data analysis.[203]
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E34.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E34.8. Non-Residential Agricultural Program – Revision history

Table 34-3. Revision history for Non-Residential Agricultural Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section

[203] The realization rate is the proportion of deemed calculated or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
		▪ Updated hyperlinks and language based on editorial feedback

E35. NON-RESIDENTIAL DATA CENTER PROGRAM EM&V PLAN (PHASE X)

E35.1. Program summary

This Non-Residential Data Center Program would provide qualifying non-residential customers with incentives to install energy efficiency measures related to equipment in and operation of data centers. Program services, as well as program measure installation, for this Program will be delivered through a network of qualified contractors and/or consultants with the appropriate specialization and experience to provide relevant, up-to-date advice on the measures included in the proposed program design.

All non-residential customers, who have not opted out of paying the rider are eligible.

E35.2. Measures

The energy efficiency measures listed in Table 35-1 will be offered by the Non-Residential Data Center Program.

Table 35-1. Non-Residential Data Center Program measures by end use

End use	Measure
HVAC	▪ High-efficiency computer room air conditioning and computer room air handler (CRAC and CRAH) ▪ CRAC or CRAH Fan Variable Frequency Drive (VFD) or Electronically Commutated Motor (ECM) ▪ Increase space-conditioning cooling temperature setpoint ▪ Custom airflow measures
Lighting	▪ Lighting measures ▪ Lighting occupancy sensors (Common Areas)
Miscellaneous	▪ Energy audit
Power supply/ storage	▪ High-efficiency uninterruptible power supply (UPS) ▪ High-efficiency power supply unit (PSU)

E35.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[204] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate**: The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying equivalent full load hours (EFLH) as metered in on-site studies of installed rebated measures from a representative sample of participants.

[204] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings:** Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost-effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using a deemed savings approach. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion – and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E35.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Non-Residential Data Center Program will be developed through research primarily in the most recent version of the Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[205] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate demand and energy savings in kW and kWh, respectively. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the data source priorities given in 20 VAC 5-318-40. However, given the limited data availability and access to IT spaces, and the varied access to data center power-draw data, an M&V plan must be flexible and accommodate a wide range of available data.[206] Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

[205] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

[206] Huang, R.; Masanet, E. (2017). Chapter 20: Data Center IT Efficiency Measures Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40- 68576. http://www.nrel.gov/docs/fy17osti/68576.pdf

E35.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program savings in kilowatt and kilowatt-hours. Our approach relies heavily on the DOE's Uniform Methods Project protocols (UMP).[207]

According to Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment, the key measured parameters for HVAC measures include the unit size, unit rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or on-site audit.[208] Larger chiller systems may require cooling load data and outdoor air temperature.

According to Chapter 14: Chiller Equipment, savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key measured parameters include the operating schedule and pre- and post-installation electric energy consumption of chiller measure(s). For chillers that provide space cooling, these are normalized to TMY3 weather data.[209]

According to Chapter 18: VFD, the key measured parameters at VFD installations include: hours of operation at each VFD speed, fan/pump motor horsepower, rotational speed, motor enclosure type, motor efficiency, and VFD efficiency.[210]

According to Chapter 19: HVAC Controls, the key measured parameters at dual-enthalpy economizer installations include: pre- and post-installation electric energy consumption of HVAC system components. These are normalized to TMY3 weather data.[211]

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, the key measured parameters are the hours of operation, fixture quantity, and fixture wattage. [212]

Energy audits identify opportunities for measures but do not produce direct savings. Therefore, they do not have an EM&V approach.

[207] Huang, R.; Masanet, E. (2017). Chapter 20: Data Center IT Efficiency Measures Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40- 68576. http://www.nrel.gov/docs/fy17osti/68576.pdf

[208] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf.

[209] Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf.

[210] Romberger, Jeff. (2017). Chapter 18: Variable Frequency Drive Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68574. http://www.nrel.gov/docs/fy17osti/68574.pdf

211 Romberger, Jeff. (2017). Chapter 19: HVAC Controls (DDC/EMS/BAS) Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68575. http://www.nrel.gov/docs/fy17osti/68575.pdf

[212] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40- 68558. https://www.nrel.gov/docs/fy17osti/68558.pdf.

According to Chapter 20: Data Center IT Efficient Measure Evaluation Protocol, the key parameter is the power draw (baseline and efficient). Additionally, the changes in load should be considered.[213]

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate, is then applied to the population of participants to estimate overall program savings.[214] This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify annual electric energy savings and peak demand reductions.

1.1.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone survey verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the IPMVP as shown in Table 35-2.[215]

Table 35-2. Preferred IPMVP options for Non-Residential Data Center Program

Measure	IPMVP option	Key parameter(s)
CRAC and CRAH	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling load ▪ Heating load (if applicable) ▪ Annual hours of operation
VFDs or ECMs	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part-load conditions ▪ Outdoor temperature
Increase space-conditioning cooling temperature setpoint	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Setpoints ▪ Cooling load ▪ Annual hours of operation

[213] Huang, R..; Masanet, E. (2017). Chapter 20: Data Center IT Efficient Measures Evaluation Protocol: The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40- 68558. https://www.nrel.gov/docs/fy17osti/68558.pdf.

[214] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[215] Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, https://evo-world.org/en/.

Measure	IPMVP option	Key parameter(s)
Custom airflow measures	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Setpoints ▪ Cooling load ▪ TBD (project-specific)
Lighting and lighting occupancy sensors	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Fixture quantity (baseline and efficient) ▪ Wattage (baseline and efficient) ▪ Annual hours of operation
UPS and PSU	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Wattage (baseline and efficient)

According to UMP, the IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for CRAC and CRAH, custom airflow measures, lighting and lighting occupancy sensors, and UPS and PSU IPMVP Option A is a partially measured, retrofit-isolation method that meters the actual energy and peak demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data. IPMVP Option A may also apply to custom airflow measures. The key parameters for custom projects would be determined by the measure description for sampled projects.

According to UMP, IPMVP Option B: Retrofit Isolation is most appropriate for VFD or ECM retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data and local weather data, it is possible to determine the annual electric energy savings and peak demand reduction.

1.1.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 1200 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection
- Budget, schedule, and geographical distribution

1.1.2. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E35.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data gathered during the on-site studies.

2. Apply the measured data to the actual participant data to arrive at program-level annual electric energy savings and peak demand reduction, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly electric energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly electric energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E35.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E35.8. Non-Residential Data Center Program – Revision history

Table 35-3. Non-Residential Data Center Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

E36. NON-RESIDENTIAL HEALTHCARE PROGRAM EM&V PLAN (PHASE X)

E36.1. Program summary

The proposed Non-Residential Health Care Program would target the health care customer segment and would provide those qualifying non-residential customers with incentives to install energy efficiency measures. The program implementation vendor would assist the customer in identifying the project and provide technical assistance and incentives for prescriptive and custom projects to encourage the purchase and installation of energy efficient equipment and program measures. In addition to the energy efficiency savings, the proposed Program will promote non-energy benefits such as improved health and well-being of building occupants by emphasizing measures that enhance indoor air quality, thermal comfort, improved building ventilation, and air filtration. Furthermore, the proposed measure offering is comprehensive, customized, and provides higher incentive levels for non-residential health care participants. The healthcare segment has unique participation barriers and motivators because of its distinctive decision-making structure, goals, and pain points. This uniqueness requires a highly customized and targeted approach and incentive structure to effectively influence energy consumption.

E36.2. Measures

The energy efficiency measures listed in Table 36-1 will be offered by the Non-Residential Health Care Program. For a full, detailed list of the proposed program measures, please see Appendix A, Schedule 46A Statement 2.

Table 36-1. Non-Residential Health Care Program measures by end use

End use	Measure
Plug load	▪ Commercial smart strip
Building envelope	▪ Window film
Cooking	▪ Cooking equipment
HVAC	▪ Ventilation controls ▪ Cooling equipment ▪ Economizers ▪ Heat pumps ▪ Smart thermostats ▪ Motors and VFDs ▪ Duct testing and sealing and HVAC Tune-ups ▪ Demand control ventilation ▪ Custom HVAC measures
Lighting	▪ Indoor and outdoor lighting ▪ Advanced lighting controls ▪ Daylighting ▪ Custom lighting measures
Miscellaneous	▪ Custom measures
Refrigeration	▪ Refrigeration equipment and controls ▪ Vending/vending machine controls ▪ Ice machines

End use	Measure
	▪ Custom refrigeration measures

E36.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[216] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated per the DE TRM. These methodologies and assumptions are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E35.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatt and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion—and assuming they are approved for the five years that they have been filed—they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E36.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Non-Residential Health Care Program will be developed through research primarily in the most recent version of the Mid-

216 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[217] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priorities given in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E36.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program impacts.

Savings for the commercial smart strips measure will be based on the relevant version(s) of the DE TRM deemed values. The installation will be verified while onsite or with phone surveys.

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address window film, the key parameter for determining annual electric energy savings and peak demand reductions include the surface area of treated windows and the solar heat gain coefficient.[218]

For the cooking measures, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although UMP does not specifically address cooking measures, the key parameter for determining gross annual electric energy savings and peak demand reductions include hours of operation, cooking load, and equipment type.

According to Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment, the key measured parameters for HVAC measures include the unit's size, rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or an on-site audit.[219]

According to Chapter 14: Chiller Equipment, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key measured parameters include operating schedule and pre- and post-installation energy consumption of chiller measure(s). For chillers that provide space cooling, these are normalized to TMY3 weather data.[220]

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[217] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: PUR-2020-00274.

[218] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[219] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf; Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf.

[220] Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP, the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline).[221]

According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.[222]

For custom HVAC measures, lighting, refrigeration, or other end-uses, the relevant UMP key parameters will be collected through desk reviews or site visits. If the measure does not have an applicable UMP, engineering judgment and other resources may be used to identify the key parameters. Key parameters will vary by project but may include operating schedules, setpoints, baseline and efficient operating conditions, control sequences, and equipment performance specifications. Depending on the measure, short-term metering or EMS trend data may be collected to capture the equipment operation. Savings are calculated using simple engineering calculations or temperature regression analysis normalized to weather data, if applicable.

For the refrigeration measures, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration measures, the key parameter for determining gross annual electric energy savings and peak demand reductions include hours of operation, whether located in a conditioned space, and equipment type. At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate, is then applied to the population of participants to estimate overall program savings.[223] This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E36.5.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone survey verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the IPMVP as shown in Table 36-2.[224]

[221] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68558. http://www.nrel.gov/docs/fy17osti/68558.pdf

[222] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

[223] The “realization rate” is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[224] Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, https://evo-world.org/en/.

Table 36-2. Preferred IPMVP options for Non-Residential Health Care Program Measures

Measure	IPMVP option	Key parameter(s)
		▪ Plug load ▪ Annual hours of operation ▪ Verify installation
Window film	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Area of window film ▪ Orientation of building facade ▪ Building occupancy and HVAC schedule
Cooking equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooking load ▪ Annual hours of operation
Chillers, unitary AC/HPs, room ACs, mini-split systems, geothermal HPs, and PTACs	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling load ▪ Heating load (if applicable) ▪ Annual hours of operation
Economizers	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	▪ Verify proper operation ▪ Annual hours of operation
Smart thermostats	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Operating setpoints ▪ Annual hours of operation ▪ Equipment type
Motors and VFDs	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part-load conditions
Duct testing and sealing and HVAC tune-ups	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling load ▪ Heating load (if applicable) ▪ Annual hours of operation
Demand control ventilation	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Verify proper operation ▪ Annual hours of operation ▪ Occupancy ▪ Setpoints
Indoor and outdoor lighting. Advanced lighting controls. Daylighting	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Fixture quantity (baseline and efficient) ▪ Wattage (baseline and efficient) ▪ Annual hours of operation
Custom measures	Option A: Retrofit Isolation: Key Parameter Measurement Approach or Option B: Retrofit Isolation: All Parameter Measurement	▪ Project-specific, to be determined
Refrigeration equipment and controls	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Refrigeration load ▪ Space-conditioning category ▪ Annual hours of operation ▪ Control strategy and setpoints

According to UMP, the IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for window film, most HVAC-system types, typical economizers, demand control ventilation, cooking equipment, and typical

refrigeration equipment. IPMVP Option A is a partially-measured, retrofit-isolation method that meters the actual energy and peak demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

According to UMP, IPMVP Option B: Retrofit Isolation is most appropriate for VFD retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data and local weather data, it is possible to determine the annual electric energy savings and peak demand reduction. IPMVP Option B may also apply to custom HVAC measures or other end-uses. The key parameters for custom projects would be determined by the measure description for sampled projects.

According to UMP, IPMVP Option D: Calibrated Simulation may be most appropriate for installed or replaced economizer measures at complex installations. IPMVP Option D uses computer simulation software (e.g., DOE-2.2 software) to predict the change in energy and demand of efficiency measures from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The computer simulation is developed using economizer system inputs collected on-site or through interviews with installation and service contractors. On-site hourly meter data is collected from the cooling systems and is used to calibrate the simulation for accuracy.

In a limited set of cases, other kinds of verification strategies, such as building simulation modelling can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified gross annual electric energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E36.5.2. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 300 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

E36.5.3. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E36.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the gross impact evaluation methods as appropriate.[225]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E36.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E36.8. Non-Residential Healthcare Program – Revision history

Table 36-3. Non-Residential Health Care Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Updated footnote 223 to refer to the most recent publicly available version of the DE TRM • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

[225] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E37. NON-RESIDENTIAL HOTEL AND LODGING PROGRAM EM&V PLAN (PHASE X)

E37.1. Program summary

The proposed Non-Residential Hotel and Lodging program would target the hotel and lodging customer segment and would provide those qualifying non-residential customers with incentives to install energy efficiency measures. The program implementation vendor would assist the customer in identifying the project and provide technical assistance and incentives for prescriptive and custom projects to encourage the purchase and installation of energy efficient equipment and program measures. In addition to the energy efficiency savings, the proposed Program will promote non-energy benefits such as improved health and well-being of building occupants by emphasizing measures that enhance indoor air quality, thermal comfort, improved building ventilation and air filtration. Furthermore, this particular customer segment has unique participation barriers and motivators because of its distinctive decision-making structure, goals, and pain points, with guest satisfaction a high priority. This uniqueness requires a highly customized and targeted approach and incentive structure to effectively influence energy consumption.

All non-residential customers, who have not opted out of paying the rider are eligible.

E37.2. Measures

The energy efficiency measures listed in Table 37-1 will be offered by the Non-Residential Hotel and Lodging Program. For a full, detailed list of the proposed program measures, please see Appendix A, Schedule 46A Statement 2.

Table 37-1. Non-Residential Hotel and Lodging Program measures by end use

End use	Measure
Plug load	▪ Commercial smart strip
Building envelope	▪ Window film
Cooking	▪ Cooking equipment
HVAC	▪ Ventilation controls ▪ Cooling equipment ▪ Economizers ▪ Heat pumps ▪ Smart thermostats ▪ Motors and VFDs ▪ Duct testing and sealing and HVAC tune-ups ▪ Demand control ventilation ▪ Custom HVAC measures
Lighting	▪ Indoor and outdoor lighting ▪ Advanced lighting controls ▪ Daylighting ▪ Custom lighting measures
Miscellaneous	▪ Custom measures
Refrigeration	▪ Refrigeration equipment and controls ▪ Vending/vending machine controls

End use	Measure
	▪ Ice machines ▪ Custom refrigeration measures

E37.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[226] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated per the DE TRM. These methodologies and assumptions are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and, as appropriate, other TRMs.
2. **Deemed savings**: Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E37.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatt and kilowatt-hour savings are estimated using deemed methods. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and during the periods between more rigorous EM&V.

Once participation has levelized or reached planned levels and realized savings can be quantified, the program is considered for more rigorous evaluation. Based on results from past programs, DNV anticipates this will occur in year two or three of program operations.

Early in the third year of the program, or earlier at the Company's discretion (assuming they are approved for the five years that they have been filed), they will be evaluated with the method most suitable to the program, program measures, and evaluation objectives. Methods include impact analysis using engineering analyses or whole facility methods, market studies, and process evaluations. Programs selected for evaluation in each year will be prioritized based on several factors, including, but not limited to, the uncertainty or variability of realized savings, its contribution to portfolio savings, program costs relative to all programs, the elapsed time since the last evaluation, or to address targeted research questions.

E37.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocols for the Non-Residential Hotel and Lodging Program will be developed through research primarily in the most recent version of the

226 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

Mid-Atlantic and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM, also known as the Company's TRM, and calculated using utility-reported program participant data.[227] DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priorities given in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E37.5. Evaluated savings approach

Dominion Energy will determine—during program implementation and in consultation with DNV, the appropriateness of conducting evaluations to estimate program impacts.

Savings for commercial smart strips will be based on the relevant version(s) of the DE TRM deemed values. The installation will be verified while onsite or with phone surveys.

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address window film, the key parameter for determining annual electric energy savings and peak demand reductions include the surface area of treated windows and the solar heat gain coefficient.[228]

For the cooking measures, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although UMP does not specifically address cooking measures, the key parameter for determining gross annual electric energy savings and peak demand reductions include hours of operation, cooking load, and equipment type.

According to Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment, the key measured parameters for HVAC measures include the unit's size, rated efficiency (energy efficient and baseline), annual operating hours, and—for peak demand reductions—coincidence factor. The first two parameters can be verified by either a desk review or an on-site audit.[229]

According to Chapter 14: Chiller Equipment, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. The key measured parameters include operating schedule and pre- and post-installation energy consumption of chiller measure(s). For chillers that provide space cooling, these are normalized to TMY3 weather data.[230]

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[227] Due to its volume, DNV has not included a copy of the DE TRM with this EM&V Plan. The DE TRM was most recently filed on June 15, 2022 in the Company's 2019 DSM Proceeding, Petition of Virginia Electric and Power Company for approval of its 2020 DSM Update pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2020-00274 (Appendix F to the EM&V Report), and is available at the following link: https://www.scc.virginia.gov/docketsearch#caseDocs/141608.

[228] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[229] Jacobson, D. and Metoyer, J. (2017). Chapter 4: Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment-Efficiency Upgrade Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf; Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf.

[230] Tiessen, A. (2017). Chapter 14: Chiller Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68570. http://www.nrel.gov/docs/fy17osti/68570.pdf

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP, the key measured parameters for lighting retrofits include the hours of use and the fixture wattages (energy efficient and baseline).[231] According to Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, the key measured parameters for occupancy sensor retrofits include the hours of use (energy efficient and baseline) and the controlled fixture wattages.[232]

For custom HVAC measures, lighting, refrigeration, or other end-uses, the relevant UMP key parameters will be collected through desk reviews or site visits. If the measure does not have an applicable UMP, engineering judgment and other resources may be used to identify the key parameters. Key parameters will vary by project but may include operating schedules, setpoints, baseline and efficient operating conditions, control sequences, and equipment performance specifications. Depending on the measure, short-term metering or EMS trend data may be collected to capture the equipment operation. Savings are calculated using simple engineering calculations or temperature regression analysis normalized to TMY3 weather data, if applicable.

For the refrigeration measures, savings will be based on the relevant version(s) of the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration measures, the key parameter for determining gross annual electric energy savings and peak demand reductions include hours of operation, whether located in a conditioned space, and equipment type.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate, is then applied to the population of participants to estimate overall program savings.[233] This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E37.5.1. Savings estimation

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- Desk-review verification
- Phone survey verification
- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the IPMVP as shown in Table 37-2.[234]

[231] Gowans, D.; Telarico, C. (2017). Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68558. http://www.nrel.gov/docs/fy17osti/68558.pdf

[232] Carlson, Stephen. (2017). Chapter 3: Commercial and Industrial Lighting Controls Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68559. http://www.nrel.gov/docs/fy17osti/68559.pdf

[233] The “realization rate” is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

[234] Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, https://evo-world.org/en/.

Table 37-2. Preferred IPMVP options for Non-Residential Hotel and Lodging Program measures

Measure	IPMVP option	Key parameter(s)
Commercial smart strip	Option A. Retrofit Isolation: Key Parameter Measurement Approach	
Window film	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Area of window film ▪ Orientation of building facade ▪ Building occupancy and HVAC schedule
Cooking equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooking load ▪ Annual hours of operation
Chillers, unitary AC/HPs, room ACs, mini-split systems, geothermal HPs, and PTACs	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling load ▪ Heating load (if applicable) ▪ Annual hours of operation
Economizers	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	▪ Verify proper operation ▪ Annual hours of operation
Smart thermostats	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Operating setpoints ▪ Annual hours of operation ▪ Equipment type
Motors and VFDs	Option B: Retrofit Isolation: All Parameter Measurement	▪ Annual hours of operation at part-load conditions
Duct testing and sealing and HVAC tune-ups	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Cooling load ▪ Heating load (if applicable) ▪ Annual hours of operation
Demand control ventilation	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Verify proper operation ▪ Annual hours of operation ▪ Occupancy ▪ Setpoints
Indoor and outdoor lighting Advanced lighting controls Daylighting	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Fixture quantity (baseline and efficient) ▪ Wattage (baseline and efficient) ▪ Annual hours of operation
Custom measures	Option A: Retrofit Isolation: Key Parameter Measurement Approach or Option B: Retrofit Isolation: All Parameter Measurement	▪ Project-specific, to be determined
Refrigeration equipment and controls	Option A: Retrofit Isolation: Key Parameter Measurement Approach	▪ Refrigeration load ▪ Space-conditioning category ▪ Annual hours of operation ▪ Control strategy and setpoints

According to UMP, the IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for window film, most HVAC-system types, typical economizers, demand control ventilation, cooking equipment, and typical refrigeration equipment. IPMVP Option A is a partially measured, retrofit-isolation method that meters the actual energy and

peak demand reduction of an installed efficiency measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

According to UMP, IPMVP Option B: Retrofit Isolation is most appropriate for VFD retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data and local weather data, it is possible to determine the annual electric energy savings and peak demand reduction. IPMVP Option B may also apply to custom HVAC measures or other end-uses. The key parameters for custom projects would be determined by the measure description for sampled projects.

According to UMP, IPMVP Option D: Calibrated Simulation may be most appropriate for installed or replaced economizer measures at complex installations. IPMVP Option D uses computer simulation software (e.g., DOE-2.2 software) to predict the change in energy and demand of efficiency measures from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The computer simulation is developed using economizer system inputs collected on-site or through interviews with installation and service contractors. On-site hourly meter data is collected from the cooling systems and is used to calibrate the simulation for accuracy.

In a limited set of cases, other kinds of verification strategies, such as building simulation modelling can be used to estimate changes in energy use associated with customer participation in the program. Similarly, DNV may opt to use a billing analysis approach if billing data can be obtained and other conditions necessary for the application of this family of methods are met.

All these efforts will be considered to determine the verified gross annual electric energy savings and peak demand reductions using gathered data, as appropriate, for each sampled project at the premises.

E37.5.2. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 300 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

E37.5.3. Net-to-gross assessment

If applicable, free-ridership and spillover may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E37.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the gross impact evaluation methods as appropriate.[235]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program for the rate period to arrive at lost revenues. Such analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E37.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E37.8. Non-Residential Hotel and Lodging Program – Revision history

Table 37-3. Non-Residential Hotel and Lodging Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Updated footnote 233 to refer to the most recent publicly available version of the DE TRM • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback

[235] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E38. NON-RESIDENTIAL OFFICE PROGRAM EM&V PLAN (PHASE VII)

E38.1. Program summary

This program would provide qualifying customers incentives for the installation of energy efficiency improvements, consisting of recommissioning measures at smaller office facilities.

E38.2. Measures

The following measures are included in the Non-Residential Office Program.

Table 38-1. Measures offered by Non-Residential Office Program

End-use	Measure
HVAC	▪ Schedule HVAC ▪ Temperature setback ▪ Condenser water reset ▪ Discharge air temp reset ▪ Static pressure reset ▪ Enthalpy economizer ▪ Variable air volume box minimum
Lighting	▪ Schedule lighting

E38.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[236] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate:** The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered from an on-site study of installed rebated measures from a representative sample of participants.
2. **Deemed savings:** Deemed savings (or gross savings) values will be developed and incorporated into the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.
3. **Verified savings:** Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for each measure will be collected and metered through an on-site study of installed efficiency measures from a representative sample of participants.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[237]

[236] 20 VAC 5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[237] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E38.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, the deemed savings approach or protocol for the Non-Residential Office Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the data source priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E38.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[238]

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site. In keeping with accepted practices defined by Chapter 16: Retrocommissioning Evaluation Protocol[239] of The Uniform Methods Project[240] (UMP), the key parameters for determining gross savings and peak demand reductions include: equivalent full-load operating hours, building energy management data, and estimated savings.

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,[241] is then applied to the population of participants to estimate overall program savings. This approach will capture Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

E38.5.1. Sample design considerations

The sample frame will be comprised of the earlier of either approximately 2,000 participants or all participants in the first three years of program activity (whichever milestone is reached first). Planned sample size and design are determined by considering the participant population and may change from the estimated sample size. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85 to 90%
- Relative precision: 10 to 15%
- Measure-level error ratio: to be updated before sample selection

[238] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[239] Tiessen, A. (2017). Chapter 16: Retrocommissioning Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68572. http://www.nrel.gov/docs/fy17osti/68572.pdf

[240] Li, M.; Haeri, H.; Reynolds, A. (2018). The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-70472. http://www.nrel.gov/docs/fy18osti/70472.pdf

[241] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or a given sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed correctly and determine the extent to which these measures were affected by exogenous changes.

- Budget, schedule, and geographical distribution

E38.5.2. Measurement and verification

Measurement and verification of the installation and operation of a sample of participants at the premises level will be performed using one or more of the following levels of rigor:

- On-site verification, only
- On-site verification and short-term measurements
- On-site verification, short-term measurements, and long-term metering of approximately six to eight weeks during a period of typical operations

If metering is used, it will be conducted according to the International Performance Measurement and Verification Protocol[242] (IMPVP). IPMVP Option A. Retrofit Isolation, Key Parameter Measurement: For physically accessible equipment measures, an EM&V method like IPMVP Option A is applied. IPMVP Option A is a partially-measured retrofit isolation study that measures the selected parameters leading to the change in energy and demand of an installed retrocommissioning measure from a representative sample of participants and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's program participation data. IPMVP Option A shall be applied to a sample of HVAC Retrocommissioning measures for which annual savings are <75,000 kWh.

IPMVP Option C. Whole Facility: Where multiple retrocommissioning measures are implemented at given premises, a whole-facility study that makes use of Building Energy Management System data may be more cost-effective. This requires access to at least one year, each, of pre-and post-retrocommissioning data, including electric energy consumption data, for analysis. Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

At facilities for which neither Option A nor Option C is feasible and cost-effective, deemed savings may be appropriate upon verifying the implementation of the retrocommissioning measures. For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DE TRM deemed values with adjustments to key inputs that can be verified while on-site.

The ratio of the weighted, measured, and verified savings to the weighted deemed savings, also called a realization rate,[243] is then applied to the population of participants to estimate program savings. This approach will capture Company-specific customer usage data, which will be applied to the actual measures installed to quantify energy and peak demand savings.

E38.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

[242] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org

[243] The "realization rate" is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E38.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the measured data based off the on-site studies.
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E38.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually to account for updates to referenced source.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E38.8. Non-Residential Office Program – Revision history

Table 38-2. Revision history for Non-Residential Office Program EM&V Plan

Version	Date	Notes
Version 1	2020	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Formatted measure table.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E39. NON-RESIDENTIAL BUILDING AUTOMATION PROGRAM EM&V PLAN (PHASE IX)

E39.1. Program summary

This Program would provide qualifying non-residential customers with incentives to install new building automation systems (BAS) in facilities that do not have centralized controls or have antiquated systems that require full replacement. The Program would be marketed and promoted to controls contractors who design, install, and maintain building automation systems.

E39.2. Measures

The measure offered by the Non-Residential Building Automation Program are as shown in Table 39-1.

Table 39-1. Measures offered by Non-Residential Building Automation Program

End-use	Measure
HVAC	▪ Efficient building automation system programming

E39.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[244] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption**: Baseline consumption will be calculated from data available from the BAS, temporary meters, participant monthly billing or AMI data, or using deemed calculation estimates and algorithms based on the DE TRM or other published deemed values or calculations from other TRMs or sources. Baseline consumption may also be estimated using building simulation software, provided that baseline control strategies are understood, and that the baseline energy model can be calibrated to baseline energy consumption levels within accepted levels. The source of the baseline energy consumption will be dependent on data availability, level of savings, and savings interactivity with other measures or systems.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research or protocols, or evaluation studies.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E39.5. The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[245]

244 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

245 Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E39.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, a deemed savings calculations approach or protocol for the Non-Residential Building Automation Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, other TRMs, relevant studies or protocols, as appropriate.

Given that Non-Residential Building Automation Programs can include a variety of new control sequences that can affect many types of equipment unique to any particular building, deemed savings calculation estimates are more uncertain than for most measures. The deemed savings calculation protocol for the measures in this program are documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E39.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[246]

E39.5.1. Savings estimation

Chapter 19 of the UMP, "HVAC Controls (DDC/EMS/BAS)," lists four approaches for determining the energy savings resulting from the HVAC controls measures.[247] Table 39-2 describes each approach. The selected method will depend on the level of savings and relative cost of the different approach options.

Table 39-2. Approaches for determining energy savings from HVAC controls

Approach	IPMVP description	Description
Consumption data analysis	▪ Option C: Whole Facility	▪ Can be used if industry-accepted statistical criteria are met[248] ▪ With daily data, savings as low as 3% of a facility's entire energy usage can be detected using this methodology meeting the ASHRAE Guideline 14 criteria above.[249]
End use regression model	▪ Option B: All parameter measurement	Requires pre-and post-metering of affected equipment
Deemed calculation methodology	▪ Although not in IPMVP, it can incorporate Option	▪ This approach can be used in most situations, with varying amounts of measured versus deemed values and calculations

[246] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[247] Romberger, Jeff. (2017). Chapter 19: HVAC Controls (DDC/EMS/BAS) Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68575. http://www.nrel.gov/docs/fy17osti/68575.pdf

[248] ASHRAE Guideline 14: Measurement of Energy and Demand Savings (2002), Page 16, Table 5-2, Performance Method Approach

[249] Kelly, A and Sinnamon, C. Detecting Savings Under 10% Using IPMVP Option C. (2020). https://evo-world.org/en/news-media/m-v-focus/883-october-2020-m-v-focus-issue-7/1192-detecting-savings-under-10-using-ipmvp-option-c

Approach	IPMVP description	Description
(Bin Model Calculations)	A: Key Parameter Measurement	▪ Bin model calculation can refer to either standard 5°F or 10°F bin models or annual hourly spreadsheet model, with 8,760 bins for each hour of the year
Calibrated Simulation	▪ Option D: Calibrated Simulation	▪ This approach can be used for complex facilities and can be cost effective if building simulation model already exists but can be costly if a building simulation model does not already exist.

Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

We recommend that as part of the project incentive review and approval process, the implementer include a site- or project-specific M&V plan that are typically produced for internal use between the implementer and customers, outlining a proposed methodology for measuring and verifying the savings for each particular site or project. We recommend that this site- or project-specific M&V plan should include all relevant baseline data, including independent and dependent variables, in accordance with the IPMVP, and describe the measure-case data that will be collected immediately after project completion to verify measure installation. The evaluation will utilize this baseline data, and post-case data collected immediately after project completion, and post-case data collected during the evaluation monitoring period.

E39.5.2. Sample design considerations

The sample frame will be comprised of a representative sample of projects. Project size, measure mix, facility type, vendor, and other project characteristics may be considered in the sample design. The sample frame will also be influenced by evaluation approach and available data. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and project type

E39.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E39.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from impact evaluation.[250]

[250] The realization rate is the proportion of deemed calculated or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses,

2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E39.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E39.8. Non-Residential Building Automation Program – Revision history

Table 39-3. Revision history for Non-Residential Building Automation Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title. Changed reference from Tracked Savings to Deemed savings in EM&V Overview ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

E40. NON-RESIDENTIAL BUILDING OPTIMIZATION PROGRAM EM&V PLAN (PHASE IX)

E40.1. Program summary

This Program would provide qualifying non-residential customers incentives for the installation of energy-efficient recommissioning measures. The Program seeks to capture energy savings through control system audits and tune-up measures in facilities with building energy management systems.

E40.2. Measures

The measures offered by the Non-Residential Building Optimization Program are as shown in Table 40-1.

Table 40-1. Measures offered by Non-Residential Building Optimization Program

End-use	Measure
Lighting	▪ Schedule lighting
HVAC	▪ Schedule HVAC ▪ Temperature setback or setup ▪ Condenser water temperature reset ▪ Discharge-air temperature reset ▪ Static pressure reset ▪ Enthalpy economizer ▪ Variable air-volume (VAV) box minimum ▪ Chilled water temperature reset ▪ Outdoor air damper adjustments ▪ Coil cleaning ▪ Pump pressure reduction ▪ Schedule equipment ▪ Advanced rooftop-unit controls ▪ Custom recommissioning measure ▪ Study rebate

E40.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[251] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption:** Baseline consumption will be calculated from data available from a facility's Building Automation System (BAS), temporary meters, monthly or participant AMI consumption data, or using deemed calculation estimates and algorithms based on the DE TRM or other published deemed calculations or algorithms from other TRMs or sources. The source of the baseline energy consumption will be dependent on data availability, level of savings, and savings interactivity with other measures or systems.

251 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which will be derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs or protocols, related research, or evaluation studies.
3. **Evaluated savings**: Evaluated savings will be determined through the methods described in Section E40.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[252]

E40.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, a deemed savings calculation approach or protocol for the Non-Residential Building Optimization Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, other TRMs, and relevant studies or protocols, as appropriate.

Given that Non-Residential Building Optimization Programs include numerous measures that can be different for each building or application, deemed savings calculation estimates are more uncertain than other measures. The deemed savings calculation protocol for some of the measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatts and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will consider the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E40.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[253]

E40.5.1. Savings estimation

According to Chapter 16: Retrocommissioning Evaluation Protocol of the UMP:[254]

> *Measurement is inherent with most RCx projects because RCx measures typically involve modifications made through a facility's BAS. As mentioned, RCx implementation (an iterative process) often leverages metered data to evaluate and optimize changes throughout the process. Therefore, in many cases, a retrofit isolation approach adhering to Option A or Option B of the IPMVP proves most logical. That said, scenarios exist where Option C, Option D, or even a deemed approach may be more appropriate.*

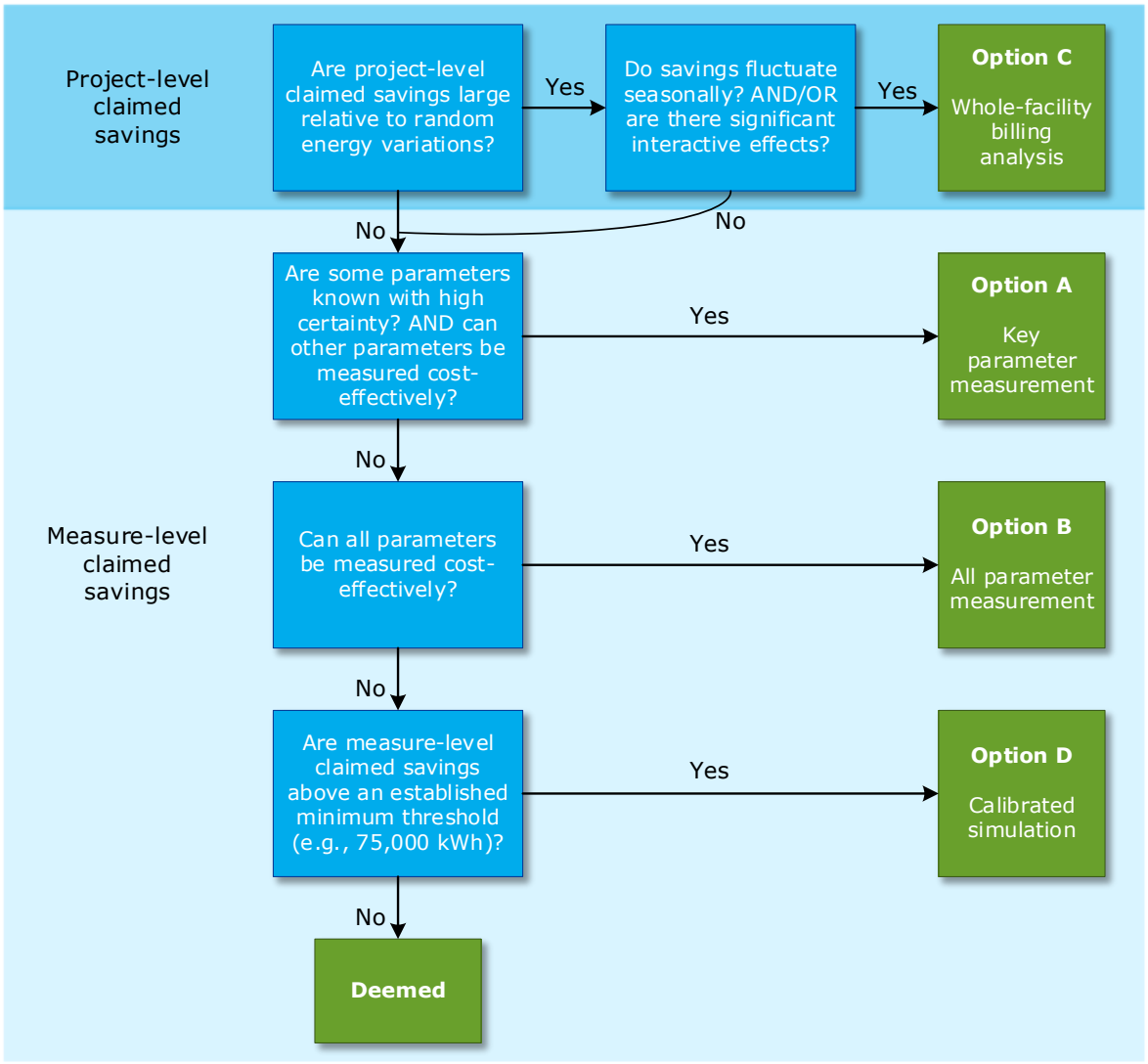
[252] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

[253] Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

[254] Tiessen, A. (2017). Chapter 16: Retrocommissioning Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68572., 8.

Figure 40-1 is a flow chart from Chapter 16: Retro-commissioning Evaluation Protocol of the UMP outlining a proposed decision process for determining which approach from the IPMVP to use for evaluating a specific retrocommissioning measure, or group of retrocommissioning measures.[255]

Figure 40-1. Measurement and verification approach decision flow chart for retro-commissioning measures (Uniform Methods Project, Chapter 16)



For the evaluation of specific measures completed, the evaluation will rely upon data available from the facility's BAS, temporary meters, monthly or AMI participant consumption data, or using deemed calculation estimates and algorithms based on a) the DE TRM or other published deemed calculations, or b) algorithms from other TRMs or protocols.

DNV will review any project measurement and verification plan provided by implementers and include it as a component of program tracking data. DNV recommends that the project M&V plan include all relevant baseline data, including independent and dependent variables in accordance with the IPMVP, and describe the post-case data that will be collected immediately

after project completion to verify measure installation. The evaluation will utilize this baseline data, post-case data collected immediately after project completion, and post-case data collected during the evaluation monitoring period (if applicable).

Table 40-2 lists key parameters for each retro-commissioning measure offered through this program that may require collection during the baseline- and measure-case periods to evaluate a measure's performance. Table 40-2 also lists the potential evaluation methodologies that can be utilized for estimating measure-level savings. The approach selected for each measure is going to depend on the level of savings and relative cost of the various approach options. For projects involving multiple measures, it may be more cost-effective and appropriate to utilize an IPMVP Option C whole-building approach, if the accepted statistical criteria for using such an approach are met.

Table 40-2. Key parameters and potential evaluation methodologies for building optimization measures

Measure	Key parameters (Baseline and post)	Methodologies
Schedule lighting	▪ Fixture quantity, wattage, hours of operation, control type	▪ Option A
Schedule HVAC	▪ Equipment quantity, capacity, and capacity profile, efficiency, and efficiency profile ▪ Equipment hours of operation profile ▪ Variables affecting equipment efficiency	▪ Option A–B
Temperature setback or setup	▪ Space temperature and temperature setpoint ▪ Outdoor air temperature ▪ Building heat-loss characteristics ▪ HVAC equipment details	▪ Deemed calculation ▪ Option A, D
Condenser water temperature reset	▪ Condenser water temperature and setpoint temperature ▪ Cooling tower design approach temperature ▪ Cooling tower sequence of operation, fan control type, operating kW, operating hours ▪ Chiller type, efficiency points or curves as a function of condenser water temperature and chiller load ▪ Chiller operating characteristics ▪ Chiller hours of operation	▪ Deemed calculation ▪ Option A, D
Discharge-air temperature reset	▪ Discharge air temperature and temperature setpoint ▪ Mixed air temperature ▪ Airflow rate across heating or cooling coil ▪ Primary cooling/heating efficiency and/or efficiency curve ▪ Primary cooling/heating equipment hours of operation ▪ Primary air-moving equipment hours of operation	▪ Deemed calculation ▪ Option A–B, D
Static pressure reset	▪ Fan sequence of operations, static pressure, static pressure setpoint ▪ Supply airflow rate, operating kW, hours of operation	▪ Deemed calculation ▪ Option A–B

Measure	Key parameters (Baseline and post)	Methodologies
Enthalpy economizer	▪ Economizer type ▪ Outdoor and supply air temperature and humidity ▪ Mixed-air temperature and humidity ▪ Supply airflow rate ▪ Outdoor air damper position	▪ Deemed calculation ▪ Option A–B, D
Variable air volume box minimum	▪ VAV box minimum open %, open % ▪ Supply and discharge air temperature ▪ Supply airflow ▪ Mixed air temperature ▪ Heating/cooling equipment, and AHU hours of operation	▪ Deemed calculation ▪ Option B
Chilled water reset	▪ Chilled water supply temperature and temperature setpoint ▪ Chiller efficiency points or curves as a function of condenser water temperature and chiller load ▪ Chiller operating characteristics and hours of operation ▪ Outdoor air temperature and humidity	▪ Deemed calculation ▪ Option A, D
Outdoor air damper adjustments	▪ Outdoor air flow ▪ Damper control sequence of operation ▪ Damper control signal values and damper position ▪ Mixed air, outdoor and return air temperature ▪ Supply air temperature ▪ Heating/cooling equipment efficiencies and hours of operation ▪ Supply fan hours of operation	▪ Deemed calculation ▪ Option A, D
Coil cleaning	▪ Pressure drop across coil ▪ Airflow rate across coil ▪ Fan hours of operation	▪ Deemed calculation ▪ Option A–B
Pump pressure reduction	▪ Pump differential pressure and operating kW ▪ Independent variable such as schedule, outdoor air temperature ▪ Pump performance curve	▪ Deemed calculation ▪ Option A–B
Scheduling non-HVAC equipment	▪ Equipment quantity, capacity, and capacity profile ▪ Equipment efficiency and efficiency profile ▪ Equipment hours of operation profile ▪ Variables affecting equipment efficiency	▪ Option A–B

Measure	Key parameters (Baseline and post)	Methodologies
Advanced rooftop controls	▪ Fan control type ▪ RTU operating kW ▪ RTU hours of operation	▪ Option A–B
Custom recommissioning measure	Varies	▪ Deemed calculation ▪ Option A–D

Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

E40.5.2. Sample design considerations

The sample frame will be comprised of a representative sample of projects. Project size, measure mix, facility type, vendor, and other project characteristics may be considered in the sample design. The sample frame will also be influenced by evaluation approach and available data. Using standard sampling approaches and tools, the following characteristics will be considered:

- Confidence interval: 85%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and project type

E40.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E40.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[256]
2. Apply the measured data to the actual participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
3. Develop cumulative monthly energy savings based on measured and verified data to represent the lost sales (kWh) associated with the program.

[256] The realization rate is the proportion of deemed calculated or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E40.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E40.8. Non-Residential Building Optimization Program – Revision history

Table 40-3. Revision history for Non-Residential Building Optimization Program EM&V Plan

Version	Date	Notes
Version 1	Nov 2020	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Changed reference from Tracked Savings Deemed Savings in EM^V Overview ▪ Provided clarification of Option C and non-routine events to “Savings Estimation”
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E41. NON-RESIDENTIAL ENGAGEMENT PROGRAM EM&V PLAN (PHASE IX)

E41.1. Program summary

The proposed Program would engage commercial buildings in energy management best practices to increase awareness of operational and behavioral energy-saving opportunities. The Program would educate and train businesses' facility management staff on ways to achieve energy savings through optimization of building energy performance and integrating ongoing commissioning best practices into their operations.

Through a customer engagement portal, building operators can also access educational content and technical resources as part of a series of operator challenges. By completing these challenges, participants will review and implement energy efficient operational best practices, earning them points while competing against facility teams from other participating buildings.

The non-residential engagement program's operator energy challenges were designed to include technical resources and advice to educate building operators on how they can evaluate their building system performance and take corrective action. The energy challenges include, but are not limited to the following building retuning activities:

- Review outside air damper operation.
- Minimize the introduction of outside air.
- Review of supply fan operation and minimum flow setpoints.
- Review of airside economizer operation and performance.
- Review of air-handler supply air temperature sequences and setpoints.
- Review of HVAC schedules and zone temperature setbacks.
- Review lighting schedules and alignment with occupancy and use.
- Review lighting levels.
- Review condenser water setpoint and sequencing.
- Review chilled water temperature setpoint and sequencing.
- Review off-peak heating loads and lockouts.
- Review AHU static pressure setpoints and sequencing.
- VAV box sequencing

E41.2. Measures

The measure offered by the Non-Residential Engagement are as shown in Table 41-1.

Table 41-1. Measures offered by the Non-Residential Engagement Program

End-use	Measure
Cross-cutting	▪ Building operator training

E41.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[257] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach for the energy efficiency portion of the program is:

1. **Baseline consumption:** Baseline consumption will be calculated from data available from a facility's BAS, temporary meters, monthly or participant AMI consumption data, or using deemed calculation estimates and algorithms based on the DE TRM or other published deemed calculation or algorithms from other TRMs or sources. The source of the baseline energy consumption will be dependent on data availability, level of savings, and savings interactivity with other measures or systems.
2. **Deemed savings:** Deemed savings values will be estimated from the DE TRM, which is derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs, related research, or evaluation studies.
3. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E41.5.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[258]

E41.4. Deemed savings approach

For the energy efficiency portion of the program, upon program approval by the Virginia State Corporation Commission, deemed savings calculation approach or protocol for the Non-Residential Engagement Program will be developed through research primarily in the most recent version of the Mid-Atlantic TRM, and other TRMs or relevant studies or protocols, as appropriate. Given that EV utility programs are relatively new, deemed savings calculation estimates are more uncertain compared to more mature measures. The deemed savings calculation protocol for measures in this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data are impractical for implementation contractors to collect, DNV will use either proxy variables or defaults that are determined based on secondary research. In selecting the most appropriate values, DNV will take into consideration the priority order in 20 VAC 5-318-40. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

E41.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.[259]

257 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

258 Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

259 Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

E41.5.1. Savings estimation

Because there are no national evaluation protocols for non-residential engagement programs without enabling technologies, this EM&V plan follows guidance from Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol from the UMP.[260]

The Non-Residential Engagement Program is expected to produce energy savings across multiple end-uses with a high potential for interactive energy effects between end-uses. Regression-based statistical analysis that adheres to IPMVP Whole Building Section C, and ASHRAE 14 Annex D requirements for modeling energy savings is the preferred evaluation approach.[261] Adoption of a whole facility approach will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model.

Whole facility analyses can be used to evaluate the program if energy savings are large enough to be detected with a statistical analysis of the AMI or monthly billing data. Statistical power analyses using baseline energy consumption data to estimate the probability of detecting the expected savings can be used to determine whether a regression-based statistical approach is recommended. Adoption of a whole facility approach under Option C will require an understanding of facility energy consumption and its relationship to operational parameters to construct a valid facility energy consumption model. This requires identification and as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

If savings are too small to be detected with whole-facility regressions methods, surveys of building operators may be used to estimate program energy savings. Sample topics include:

- Measure installation
- Measure removal
- Schedule changes
- Operations and maintenance practices
- Engagement with customer engagement tools and benchmarking practices,
- Effectiveness of education
- Motivation for participation
- Barriers to participation
- Strategies for increasing participation and installation rates

E41.5.2. Sample design considerations

The evaluation will be performed on the census of participants. If a census is not possible the sample frame will be comprised of a representative sample of projects following guidance for the PJM sample size approach.[262] Project size, measure mix, facility type, vendor, location, and other project characteristics may be considered in the sample design. The following characteristics will be considered:

- Confidence interval: 85%
- Relative precision: 50%
- Installed measures, if any
- Budget and schedule

[260] Stewart, James. 2017. Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68316. http://www.nrel.gov/docs/fy17osti/68316.pdf

[261] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol; ASHRAE Guideline 14-2014, Measurement of Energy, Demand, and Water Savings, Informative Annex D: Regression Techniques

[262] PJM Manual 18B: Energy Efficiency Measurement & Verification, Revision: 04, Effective Date: August 22, 2019, PJM Forward Market Operations.

E41.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E41.6. Lost revenue methodology

Measured and verified lost revenues for this program will be calculated as follows:

1. Calculate program savings by applying the realization rate derived from the impact evaluation.[263]
2. Apply the evaluated savings to the participant data to arrive at program-level energy and demand savings, reflected monthly. Program savings are annualized in the EM&V tracking reports based on monthly participation.
3. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
4. Multiply the cumulative monthly energy savings by the monthly marginal base distribution and generation rate derived using a marginal rate analysis of the participants in this program (such analysis will exclude the Basic Customer Charges, the Fuel Charge Rider A, and all other applicable riders) for the rate period to arrive at lost revenues.

E41.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E41.8. Non-Residential Customer Engagement Program – Revision history

Table 41-2. Revision history for Non-Residential Engagement Program EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release
Version 2	4/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Updated IPMVP reference from 2012 to 2022. ▪ Removed version number from title ▪ Changed reference from Tracked Savings Deemed Savings in EM^V Overview ▪ Provided clarification of Option C and non-routine events to “Savings Estimation” ▪ Added the use of survey methods to estimate savings

[263] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or sample stratum. It is expressed as a percentage and is derived from follow-up research (e.g., billing analyses, on-site visits, and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.

Version	Date	Notes
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E42. NON-RESIDENTIAL DISTRIBUTED GENERATION PROGRAM EM&V PLAN (PHASE II)

E42.1. Program summary

The Non-Residential Distributed Generation Program provides qualifying commercial customers with an incentive to curtail load by operating backup generation at the request of the Company, up to a limited number of hours per year. Participants must have at least 200 kW demand to be eligible for this program. The program implementer is responsible for installing remote generation equipment controls, monitoring the customer's generators, and dispatching load under the direction of the Company. The program implementer is notified of a dispatch event 30 minutes in advance of the event either by e-mail or phone. Monthly average site-level load curtailment must be at least 95% of registered/enrolled kW to receive the incentive. Average monthly site level load curtailment must be at least 50% of registered/enrolled kW for continued program participation.

E42.2. Measures

The program dispatches power from on-site generators of participating customers

E42.3. Evaluation, Measurement & Verification overview

International Performance Measurement and Verification Protocol (IPMVP - Option B): Because impacts are calculated from metered energy consumption, IPMVP Option B is the appropriate EM&V method. Program participants are known, and the load curtailment will be metered directly.[264]

1. **Baseline estimation approach:** The baseline for this program is 0 kW because the power generators are not operating at the beginning of each event.
2. **Demand reduction** will be evaluated using the methods described in Section E34.5. The evaluated approach will use program tracking data, customer energy consumption data, and customer-specific control histories to estimate demand reduction.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[265]

E42.4. Deemed savings approach

Deemed savings are not calculated for the Non-Residential Distributed Generation Program.

E42.5. Evaluated savings approach

E42.5.1. Load reduction estimation for demand response

Metered generation data is collected from the implementer using Company and implementer owned equipment. Total and average measured generation is metered on-site and is the amount of load curtailed by the participant per event-hour interval. Total and average dispatched generation is the amount of load curtailment, in kW, requested by the Company, per event-hour, aggregated and reported at the daily, monthly, seasonal, and yearly level. Impacts are evaluated on the census of participants.

[264] Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. www.evo-world.org.

[265] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

The realization rate is calculated by dividing the average monthly measured generation by the average monthly dispatched generation for participating sites, expressed as a percent. Measured generation before or following an event is not attributed to the Program.

E42.5.2. Sample design considerations

A census of participant data will be evaluated since electrical output from 100% of enrolled generators will be metered, the event times are known, and the load and run time hours will be directly metered and reported. Missing meter data will be replaced to the extent possible with redundant meter data.

E42.6. Lost revenue methodology

Not applicable.

E42.7. Timeline and scope of work

1. Analysis of program tracking and metered data: Annual Report (June 15 of each year following program launch).
2. Semi-annual program tracking summary table (ending July 2015). 2015 will be final year of semi-annual reporting, as North Carolina submissions will be changing next year to line up with Virginia. Semi-annual program tracking summary table (July of each year).
3. Annual event season report (November of each year).
4. Annual updates to the DE TRM.
5. Develop baseline, measure savings, and efficient load shapes.
6. Provide regulatory support as necessary.

E42.8. Non-Residential Distributed Generation Program – Revision history

Table 42-1. Revision history for Non-Residential Distributed Generation Program EM&V Plan

Version	Date	Notes
Version 1	2011	▪ Added semi-annual program tracking summary table in the “Frequency of EM&V Measurement & Timeline” section.
Version 2	2012	▪ No material changes to the content. ▪ Added semi-annual program tracking summary table in the “Frequency of EM&V Measurement & Timeline” section.
Version 3	2013	▪ No material changes to the content.
Version 4	2014	▪ Updated program requirements with more details, as shown below: ▪ Added minimum kW demand requirement of 200 kW to be eligible for this program to the “Program Summary” section. ▪ Added customer notification process of each DG event through e-mail or phone 30 minutes in advance. ▪ Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW. ▪ Changed “KEMA” to “DNV KEMA.” ▪ Changed “Program Penetration & Initial Baseline Assumptions” section title to “Program Penetration” and removed initial baseline assumptions. ▪ Updated program penetrations and added “Source” column to the “Program Penetration” table. ▪ Changed “Revision History” section title to “Document Revision History.” ▪ Updated planned penetration table based on 2013 IRP.
Version 5	2015	▪ Removed 2013 planned customer penetration numbers. ▪ Added sentence on PJM requirements to end of “EM&V Method.”

Version	Date	Notes
		▪ Updated program requirements with more details, as shown below: ▪ Added minimum kW demand requirement of 200 kW to be eligible for this program to the "Program Summary" section. ▪ Added customer notification process of each DG event through e-mail or phone 30 minutes in advance. ▪ Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW. ▪ Changed "KEMA" to "DNV KEMA." ▪ Changed "Program Penetration & Initial Baseline Assumptions" section title to "Program Penetration" and removed initial baseline assumptions. ▪ Updated program penetrations and added "Source" column to the "Program Penetration" table. ▪ Changed "Revision History" section title to "Document Revision History." ▪ Updated planned penetration table based on 2013 IRP.
Version 6	2016	▪ Updated DNV KEMA to DNV Energy. ▪ Clarified that compliance is defined by total monthly average load curtailment that is at least 95% of committed peak shaving enrolled kW (rather than +/- 5% of enrolled kW). ▪ Renamed "Frequency of EM&V Measurement and Timeline" section title to "EM&V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section. ▪ Added on-going scope that was not explicitly mentioned to "EM&V Measurement, Timeline and Scope of Work" section. ▪ Deleted program penetrations section. ▪ Removed 2013 planned customer penetration numbers. ▪ Added sentence on PJM requirements to end of "EM&V Method."
Version 7	2017	▪ Clarified that compliance for program participation is 50% of enrolled, but compliance for payments is 95% of enrolled kW. Updated bullet "Semi-annual program tracking summary table (as required)." to "Semi-annual program tracking summary table (ending July 2015). 2015 will be final year of semi-annual reporting, as North Carolina submissions will be changing next year to line up with Virginia. ▪ Updated DNV KEMA to DNV Energy. ▪ Clarified that compliance is defined by total monthly average load curtailment that is at least 95% of committed peak shaving enrolled kW (rather than +/- 5% of enrolled kW). ▪ Renamed "Frequency of EM&V Measurement and Timeline" section title to "EM&V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section. ▪ Added ongoing scope that was not explicitly mentioned to "EM&V Measurement, Timeline and Scope of Work" section. ▪ Deleted program penetrations section. ▪ Updated bullet "Semi-annual program tracking summary table (as required)." to "Semi-annual program tracking summary table (ending July 2015). 2015 will be final year of semi-annual reporting, as North Carolina submissions will be changing next year to line up with Virginia." ▪ Clarified difference between payment compliance (95% of enrolled load) and program participation compliance (50% of enrolled load).
Version 8	2018	▪ Updated "April 1" report date to "May 1" in "EM&V Measurement, Timeline, and Scope of Work" section.
Version 9	2019	▪ Minor edits. ▪ Formatting updates. ▪ Updated from DNV Energy to DNV Energy Insights.
Version 10	2020	▪ Formatting updates.
Version 11	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Slight word changes to measure

Version	Date	Notes
		description. Additional detail added to deemed and evaluated savings methodologies in Sections FF.4 and FF.5.
Version 12	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title
Version 13	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E43. RESIDENTIAL ELECTRIC VEHICLE REWARDS PROGRAM EM&V PLAN (DR ONLY) (PHASE VIII)

E43.1. Program summary

The peak shaving program would provide customers who already have a qualifying level 2 electric vehicle (EV) charger and wish to participate in the demand response (DR) component only (no purchase incentive)

E43.2. Measures

The measures offered by the Residential Electric Vehicle Rewards (DR) Program are as shown in Table 43-1.

Table 43-1. Measures offered by Residential Electric Vehicle Rewards (DR) Program

End-use	Measure
Plug load	▪ EV charging demand response events

E43.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[266] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from AMI participant data, charger data, and non-participant AMI consumption and charger data, if available.
2. **Evaluated savings:** Load reduction will be determined by the methods described in Section E43.5. The evaluated demand reduction will use program tracking data, customer energy consumption data, EV charger data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").

E43.4. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

E43.5. Evaluated savings approach

E43.5.1. Load reduction estimation for demand response

Using AMI data, EV charging and event data, and weather data, regression analysis is used to calculate ex post impacts for each event hour. The ex ante estimates are calculated using a regression analysis of the ex post impacts for each event-hour and temperature humidity index (THI).

E43.5.2. Sample design considerations

There are several sampling options based on the size of the program and the number of AMI-enabled participants.

[266] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

The evaluation will be performed on the census of AMI-enabled customers. The AMI accounts are assigned weights based on connected loads and the service divisions of all participants to ensure that the AMI analysis is representative of the program population.

If an insufficient number of AMI participants enter the program, it may be necessary to develop a representative sample of participants and install AMI or interval meters at customer households designated for the sample.

Both approaches will make use of AMI or interval data from Dominion Energy's customers to produce an estimate of the necessary sample size required to meet precision requirements for load reduction estimates.

E43.6. Lost revenue methodology

Not applicable.

E43.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Annually update The DE TRM, as needed, to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E43.8. Residential Electric Vehicle Rewards (DR) Program–Revision history

Table 43-2. Revision History for Residential Electric Vehicle Rewards (DR) Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/21/2021	▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.
Version 3	4/22/2021	▪ Replaced section head "Load Reduction Estimation for Demand Response" with "Evaluated Savings Approach."
Version 4	4/22/2022	▪ Updated program name from "Residential Electric Vehicle (DR) Program" to "Residential Electric Vehicle Rewards (DR) Program" ▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title
Version 5	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E44. RESIDENTIAL SMART THERMOSTAT REWARDS (DR) PROGRAM EM&V PLAN (PHASE VIII)

E44.1. Program summary

All residential customers who are not already participation in the Company's DSM Phase I Smart Cooling Rewards Program and who have a qualifying smart thermostat would be offered the opportunity to enroll in a peak demand response program. Demand response would be called by the Company during times of peak system demand throughout the year and thermostats of participating customers would be gradually adjusted to achieve a specified amount of load reduction while maintaining reasonable customer comfort and allowing customers to opt out of specific events if they choose to do so.

E44.2. Measures

The measures offered by the Residential Smart Thermostat Rewards Program include those listed in Table 44-1.

Table 44-1. Measures offered by Residential Smart Thermostat Rewards Program

End-use	Measure
HVAC	▪ Heat pump demand response, peak reduction ▪ Air conditioning system demand response, peak reduction

E44.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[267] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.
2. **Evaluated savings:** Load reduction will be determined by the methods described in Section E44.5.2. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[268] The Smart Thermostat Rewards Program is evaluated annually for the life of the program.

E44.4. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

[267] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

[268] Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order.

E44.5. Evaluated savings approach

E44.5.1. Load reduction estimation for demand response

This EM&V plan calls for an annual impact evaluation. The evaluation reports ex post impacts by event hour and THI, event average THI's, event opt-out percentages, and ex ante estimates by event hour and THI.

E44.5.2. Data

Four sources of data are used in the impact analysis:

- Event records of controlled participants
- Half-hourly AMI customer consumption data collected from customer meters
- Regional weather data to account for customer-specific temperature and humidity for each event hour.[269]

E44.5.3. Methodology

The following steps are used to calculate the kW impact demand reduction estimates for the program:

1. AMI interval data are merged with the record of controlled customers for each event.
2. Using AMI data, event control data, and weather data, regression analysis is used to predict event-day baseline consumption for each controlled AMI-enabled account. The predicted and actual consumption for AMI-enabled accounts is weighted to the full program population and the difference between baseline predicted consumption and actual consumption is the calculated ex post impact.
3. The ex ante estimates are calculated using a regression analysis of the ex post impacts for each event-hour as the dependent variable and temperature humidity index (THI) as the independent variable. Ex ante results are the predicted impacts for each event hour and THI and are used to estimate the program impacts at the Company's peak planning conditions of 95°F at 43% relative humidity at hour-ending 17 (THI 83.4).[270]
4. AMI customer accounts are assigned weights based on state, connected loads, and the participant's location within the Company's service territory to ensure that the AMI population is representative of the program population.

E44.5.4. Sample design considerations

For customers who already have AMI meters installed, the evaluation will be performed on a census of these sites. For customers without AMI meters, it will be necessary to develop a representative sample and install AMI meters at customer households designated for the sample.

E44.6. Lost revenue methodology

Not applicable.

E44.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Annually update The DE TRM, as needed, to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.

[269] National Oceanic and Atmospheric Association (NOAA), National Centers for Environmental Information, Local Climatological Data.

[270] Dominions Energy's peak planning condition is hour-ending 17 at 95°F at 43% RH, or 83.4 THI. Temperature Humidity Index = THI = Td – (0.55 – 0.55*RH) * (Td – 58) where Td is dry bulb temperature and RH is relative humidity. Source: PJM Glossary: http://www.pjm.com/Glossary.aspx

5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

E44.8. Residential Smart Thermostat Rewards Program revision history

Table 44-2. Revision history for Smart Thermostat Rewards Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.
Version 3	4/22/2022	▪ Provided additional detail to evaluated savings method. ▪ Removed reference to the PJM sample size approach ▪ Changed program name from Smart Thermostat Demand Response Program to Smart Cooling Rewards Program ▪ Added reference to annual evaluation ▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM) ▪ Replaced “DNV EM&V approach” to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section ▪ Updated hyperlinks and language based on editorial feedback

E45. RESIDENTIAL WATER SAVINGS (DR) PROGRAM EM&V PLAN (PHASE IX)

E45.1. Program summary

As part of the proposed Residential Water Savings (DR) Program, all customers who purchase and install a qualified product (EE component) will be offered the opportunity to enroll in the peak demand reduction (DR) component of the DR Program. Customers who have previously purchased a qualifying product and who have the eligible products installed, will be offered the opportunity to enroll in the DR component of the Program. Customers will be offered an annual incentive (above and beyond the product purchase incentive amount) to participate in the peak reduction component year-round and an additional reduced incentive for each subsequent year they continue to participate. Customers would be allowed to opt out of a certain number of events.

E45.2. Measures

The measure offered by the Residential Water Savings (DR) are as shown in Table 45-1.

Table 45-1. Measures offered by Residential Water Savings Program (DR)

End-use	Measure
Domestic hot water	▪ Heat pump water heater
Recreation	▪ Variable speed pool pump

E45.3. Evaluation, Measurement, and Verification Overview

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40 and the final order of SCC Case No. PUR-2020-00156 ("Final Order").[271]

The basis for DNV's savings evaluation approach for the program is:

1. **Baseline consumption:** Baseline consumption will be calculated from AMI participant data and non-participant AMI consumption and charger data if it's available.
2. **Evaluated savings:** Load reduction will be determined by the methods described in Section E45.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

The Residential Water Savings Program (DR) is evaluated annually for the life of the program.

E45.4. Deemed savings approach

Estimates of load reduction in demand response programs are not based on deemed calculations methods.

[271] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission, PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.], Final Order. Effective Date: October 27, 2021.

E45.5. Evaluated savings approach

E45.5.1. Load reduction estimation for demand response

Most evaluation methods assume that telemetry run-time data from the water heaters and pool pumps will be available. The best approach to estimating a baseline is using a randomly assigned control group that is not dispatched for the event. A subset of participants can be in the control group for any single event and provide an accurate estimate of baseline run-time. The reduction in run-time of dispatched water heaters and pool pumps relative to this baseline is transformed to a load reduction estimate using unit connected load.

In the absence of a control group, a regression-based estimate will be tested which will provide a baseline estimate of run-time.

E45.5.2. Sample design considerations

The evaluation will be performed on a census of AMI-enabled participants. For customers without AMI meters, it may be necessary to use AMR data or develop a representative sample and install interval meters at customer households designated for the sample. The following characteristics will be considered:

- Confidence interval: 85%
- Relative precision: 10–15%
- Budget and schedule

E45.5.3. Net-to-gross assessment

If applicable, free-ridership may be estimated using a standard survey-based, self-report method. The survey will follow a DNV standard attribution question strategy to determine the quantity, efficiency, and timing of installations had the program not been available.

E45.6. Lost revenue methodology

Lost revenue is not calculated for demand response programs.

E45.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update The DE TRM annually to account for updates to referenced sources.
4. Develop baseline use, efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

E45.8. Residential Water Savings Program (DR) – Revision history

Table 45-2. Revision History for Residential Water Savings (DR) EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.

Version	Date	Notes
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM) ▪ Replaced "DNV EM&V approach" to the approach defined in the Final Order of SCC PUR-2020-00156, Ex Parte: In the matter of baseline determination, methodologies for EM&V of existing DSM programs, [etc.] ▪ Removed version number from title ▪ In sample design considerations, removed reference to the PJM sample size
Version 4	2/11/2023	▪ Changed annual EM&V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section ▪ Updated hyperlinks and language based on editorial feedback

E46. VOLTAGE OPTIMIZATION PROGRAM EM&V PLAN (PHASE X)

E46.1. Program summary

The Voltage optimization (VO) program will reduce energy consumption for a wide cross-section of customers. Control of the program will be implemented on Dominion Energy equipment, but 98–99% of the energy reduction occurs behind the meter at the end-use loads.[272] This allows VO to benefit many customers with minimal outreach costs.

Most customer end-uses use less energy when supplied with a lower input voltage. Best utility practices provide a buffer or bandwidth in the supplied voltage to ensure service voltage meets industry standards and the Company's Terms and Conditions, with consideration given for the inherent voltage drop within the distribution grid.[273] Investments in grid technology allow near-real-time voltage feedback from the end of the line and from smart meters (i.e., AMI) at the customer premise level. This creates an opportunity for more precise voltage control that results in lower energy use by customers.

VO will be implemented largely by utilizing a centralized control system that changes the voltage set point at transformer load tap changers and voltage regulators (collectively, "devices"), with feedback from end-of-line (EOL) voltage measurements. The proposed program design implements VO on all suitable devices across the Company's Virginia service territory, approximately 1,000 devices and growing, over a six-year rollout.[274]

Customers will see benefits in reduced bills due to reductions in both energy consumption and peak demand.

The program will target residential and commercial customers who are served by eligible devices across the Company's Virginia service territory. A small number of devices will be excluded due to lower voltage levels (e.g., 4 kV) that result in higher voltage drop along the distribution feeder, leaving less buffer to optimize within the prescribed voltage range.

Additionally, a limited number of devices serving express feeds to customers may have VO implemented via calculation of more efficient device settings rather than centralized control. The program will also benefit non-jurisdictional customers served by eligible participating devices, such as government buildings located in residential and commercial communities. Non-jurisdictional benefit is estimated at 15% of total energy reduction.

E46.2. Measures

The measures listed in Table 46-1 are included in the Voltage Optimization Program.

Table 46-1. Voltage Optimization Program measure by end use

End use	Measure
Various	Voltage Optimization (VO)

[272] K.P Schneider, F. K. Tuffner, J. C. Fuller, and R. Singh. 2010. Evaluation of Conservation Voltage Reduction (CVR) on a National Level. Pacific Northwest National Laboratory, PNNL-19596, 35.

[273] Electric Power Systems and Equipment, Voltage Ratings (60 Hertz), ANSI Standard C84.1-2020, Mar. 2020.

[274] In Case No. PUR-2021-00127, the Company requested a determination on the reasonableness and prudence of making the improvements necessary to enable voltage optimization on feeders where AMI has been installed. That case is pending, with a final order expected by January 7, 2022.

E46.3. Evaluation, Measurement, and Verification (EM&V) overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.[275] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) ratio and free-ridership estimates. The basis for DNV's savings evaluation approach is:

1. **Baseline usage estimate:** The baseline usage will be estimated through the savings evaluation activities.
2. **Deemed savings**: Deemed savings (or annual gross electric energy savings) values will be VO factors to be measured through the savings evaluation.
3. **Verified savings:** Verified savings (or net savings) will be determined using an VO-ON and VO-OFF day testing approach as described below.

E46.4. Deemed savings approach

The deemed savings approach or protocols for the Voltage Optimization Program will be developed through primary evaluation research as described in the Evaluated Savings Approach section below. Results from each year's testing will be used in the deemed savings calculations for future year savings estimates.

E46.5. Evaluated savings approach

E46.5.1. EM&V approach

To assess program impacts, a one-year test period will be applied to a sample of devices where VO is implemented on alternating days. Voltage will be controlled during VO-ON days and VO-OFF days. The one-year test period will allow data to be collected for all three seasons (winter, shoulder, and summer) accounting for seasonal weather impacts. The proposed sample will include 30 devices each year. While the sampled devices will only achieve savings for half of their first year of operation, the remaining implemented devices in the population will be in a perpetual VO-ON operation. See the description of sample design considerations below.

DNV will conduct a regression analysis at the conclusion of the test year to estimate energy savings and voltage reductions. The savings factor will be calculated using the ratio of energy savings to voltage reduction. The savings factors will be estimated by season, for each sampled device.

The analysis will use hourly temperature data, demand (kW), and voltage data for each sampled device. Demand and voltage will be metered at the delivery point of the device and voltage data will be taken from the EOL. Data will be collected hourly over 24 hours, for each day type, and for each climate season.

Using the population characteristics to expand the results (e.g., customer composition, heating saturations, density), the savings factors will be used to estimate savings factors and savings for the population of implemented devices operating in perpetual VO-ON mode.

A cross circuit regression model, which will use the known characteristics of all devices to estimate performance of non-sampled zones may be considered based on device data and other factors. This methodology is untested due to smaller relative participant pool sizes in other evaluations. Otherwise, a more traditional weighting strategy will be adopted.

[275] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018; Virginia State Corporation Commission. Case No. PUR-2020-00156. Final Order issued on October 27, 2021; Virginia Clean Economy Act, Approved April 11, 2020.

E46.5.2. Sample design

Sampling will be conducted annually to evaluate program savings as AMI is deployed by the Company. The sampling strategy assumes that an unbiased sample can be established from the implemented devices. An unbiased sample will allow the results to be expanded to reflect the population of implemented devices. This expansion would be based on known characteristics of the sample and population. Circuit characteristics describing the types of loads on each circuit are required to conduct a cross circuit regression. Examples of these characteristics are:

- Distribution of residential load versus non-residential load
- Distribution of electric heating versus non-electric heating
- Population density

E46.6. Lost revenue methodology

Lost revenues will be determined by:

1. Calculating the cumulative monthly electric energy savings for each device, by month or pricing period to represent the lost sales (kWh) associated with the program
2. Multiplying the cumulative monthly electric energy savings by the monthly marginal base distribution and derived generation rate using a marginal rate analysis of the participants in this program for the rate period. The analysis will exclude the basic customer charges, Fuel Charge Rider A, and all other applicable riders.

E46.7. Timeline and scope of work

1. Develop and update EM&V plan annually.
2. Analyze program tracking data: Annual report (June 15 of each year following program launch).
3. Update the DE TRM annually for changes that occurred to its referenced sources.
4. Conduct VO-ON and VO-OFF testing.
5. Provide regulatory support as necessary.
6. If appropriate, support lost revenue recovery activities.

E46.8. Voltage Optimization Program – Revision history

Table 46-2. Voltage Optimization Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	• Changed references to the “STEP Manual” to “DE TRM” • Changed annual EM&V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section • Updated hyperlinks and language based on editorial feedback