



# EVALUATION, MEASUREMENT, AND VERIFICATION REPORT

Developed for: Virginia Electric and Power Company  
(Dominion Energy Virginia/Dominion Energy North Carolina)

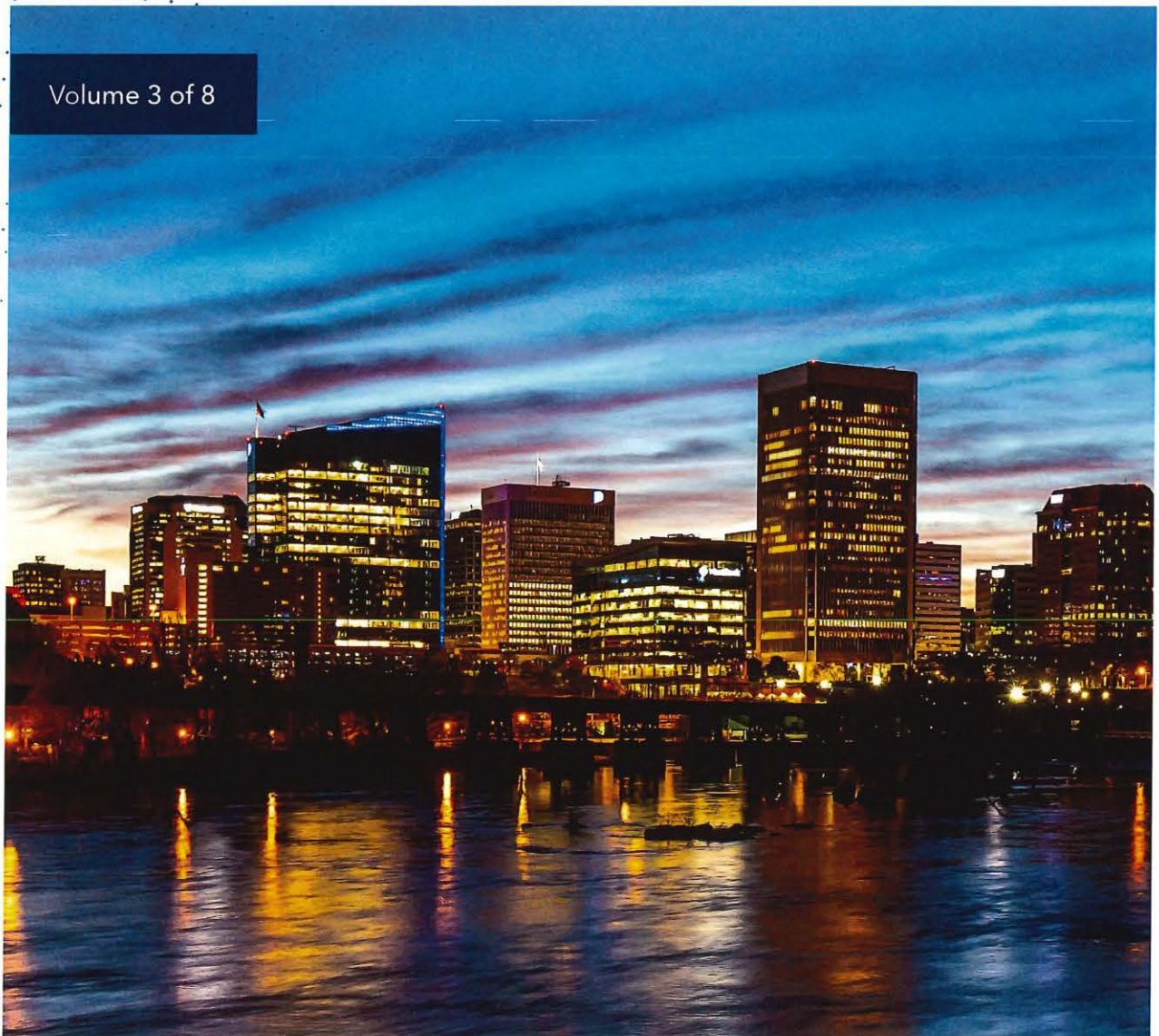
Case No. PUR-2022-00210 (Virginia)  
Docket No. E-22, Sub 676 (North Carolina)

Public version

June 12, 2024

Prepared by DNV Energy Insights USA Inc. (DNV)

Volume 3 of 8







# Appendix E

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

Dominion Energy

June 4, 2024





Copyright © 2024, DNV Energy Insights USA, Inc.

This document, and the information contained herein, is the exclusive, confidential, and proprietary property of DNV and is protected under the trade secret and copyright laws of the United States and other international laws, treaties, and conventions. No part of this work may be disclosed to any third party or used, reproduced, or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, without first receiving the express written permission of DNV. Except as otherwise noted, all trademarks appearing herein are proprietary to DNV.



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

### TABLE OF CONTENTS

E1.	DEMAND-SIDE MANAGEMENT PORTFOLIO EVALUATION, MEASUREMENT, AND VERIFICATION APPROACH.....	1
E2.	REFERENCES AND CITATIONS.....	3
E3.	RESIDENTIAL APPLIANCE RECYCLING PROGRAM EM&V PLAN (PHASE VII).....	4
E4.	RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE PROGRAM EM&V PLAN (PHASE VII).....	8
E5.	RESIDENTIAL ENERGY EFFICIENCY MARKETPLACE PROGRAM EM&V PLAN (PHASE XI).....	13
E6.	RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM EM&V PLAN (PHASE VII).....	16
E7.	RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (PHASE VIII).....	20
E8.	RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (PHASE XI).....	24
E9.	RESIDENTIAL ELECTRIC VEHICLE ENERGY EFFICIENCY AND DEMAND RESPONSE PROGRAM EM&V PLAN (EE ONLY) (PHASE VIII).....	27
E10.	RESIDENTIAL HOME RETROFIT PROGRAM EM&V PLAN (PHASE VIII).....	32
E11.	RESIDENTIAL ENHANCED HOME RETROFIT BUNDLE PROGRAM EM&V PLAN (PHASE VIII).....	36
E12.	RESIDENTIAL ENERGY EFFICIENCY KITS PROGRAM EM&V PLAN (PHASE VIII).....	40
E13.	RESIDENTIAL MANUFACTURED HOUSING PROGRAM EM&V PLAN (PHASE VIII).....	44
E14.	RESIDENTIAL/NON-RESIDENTIAL MULTIFAMILY PROGRAM EM&V PLAN (PHASE VIII).....	49
E15.	RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII).....	55
E16.	RESIDENTIAL SMART THERMOSTAT PURCHASE AND WEATHERSMART <sup>SM</sup> PROGRAM EM&V PLAN (PHASE VIII).....	59
E17.	RESIDENTIAL SMART HOME PROGRAM EM&V PLAN (PHASE IX).....	63
E18.	RESIDENTIAL VIRTUAL ENERGY AUDIT PROGRAM EM&V PLAN (PHASE IX).....	67
E19.	RESIDENTIAL WATER SAVINGS (EE) PROGRAM EM&V PLAN (PHASE IX).....	71
E20.	RESIDENTIAL HVAC HEALTH AND SAFETY PROGRAM EM&V PLAN (PHASE VIII).....	75
E21.	INCOME AND AGE QUALIFYING SOLAR PROGRAM EM&V PLAN (PHASE IX).....	80
E22.	RESIDENTIAL INCOME AND AGE QUALIFYING ENERGY EFFICIENCY PROGRAM EM&V PLAN (PHASE IX).....	84



E23.	RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (PHASE X).....	88
E24.	NON-RESIDENTIAL INCOME AND AGE QUALIFYING PROGRAM FOR HEALTH CARE AND RENTAL PROPERTY OWNERS PROGRAM EM&V PLAN (PHASE X) .....	93
E25.	RESIDENTIAL INCOME AND AGE QUALIFYING TARGET REPORT PROGRAM EM&V PLAN (PHASE X) .....	99
E26.	RESIDENTIAL INCOME AND AGE QUALIFYING BUNDLE PROGRAM EM&V PLAN (PHASE XI) .....	103
E27.	NON-RESIDENTIAL INCOME AND AGE QUALIFYING BUNDLE PROGRAM EM&V PLAN (PHASE XI) .....	108
E28.	NON-RESIDENTIAL HEATING AND COOLING EFFICIENCY PROGRAM EM&V PLAN (PHASE VII).....	113
E29.	NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS PROGRAM EM&V PLAN (PHASE VII).....	119
E30.	NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS EXTENSION PROGRAM EM&V PLAN (PHASE X) .....	123
E31.	NON-RESIDENTIAL OFFICE PROGRAM EM&V PLAN (PHASE VII).....	128
E32.	NON-RESIDENTIAL SMALL MANUFACTURING PROGRAM EM&V PLAN (PHASE VII).....	132
E33.	NON-RESIDENTIAL WINDOW FILM PROGRAM EM&V PLAN (PHASE VII).....	136
E34.	NON-RESIDENTIAL MIDSTREAM EFFICIENCY PRODUCTS PROGRAM EM&V PLAN (PHASE VIII).....	140
E35.	NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII).....	145
E36.	NON-RESIDENTIAL PRESCRIPTIVE ENHANCED PROGRAM EM&V PLAN (PHASE IX) .....	149
E37.	NON-RESIDENTIAL PRESCRIPTIVE BUNDLE PROGRAM EM&V PLAN (PHASE IX).....	155
E38.	NON-RESIDENTIAL SMALL BUSINESS IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (PHASE VIII).....	162
E39.	NON-RESIDENTIAL AGRICULTURAL ENERGY EFFICIENCY PROGRAM EM&V PLAN (PHASE IX).....	168
E40.	NON-RESIDENTIAL BUILDING AUTOMATION PROGRAM EM&V PLAN (PHASE IX).....	173
E41.	NON-RESIDENTIAL BUILDING OPTIMIZATION PROGRAM EM&V PLAN (PHASE IX) .....	177
E42.	NON-RESIDENTIAL ENGAGEMENT PROGRAM EM&V PLAN (PHASE IX) .....	184
E43.	NON-RESIDENTIAL DATA CENTER PROGRAM EM&V PLAN (PHASE X) .....	189
E44.	NON-RESIDENTIAL HEALTHCARE PROGRAM EM&V PLAN (PHASE X).....	195
E45.	NON-RESIDENTIAL HOTEL AND LODGING PROGRAM EM&V PLAN (PHASE X).....	202
E46.	NON-RESIDENTIAL SMALL BUSINESS BEHAVIORAL PROGRAM EM&V PLAN (PHASE X) .....	209
E47.	NON-RESIDENTIAL CUSTOM PROGRAM EM&V PLAN (PHASE XI) .....	213



E48. NON-RESIDENTIAL DISTRIBUTED GENERATION PROGRAM EM&V PLAN (PHASE II)..... 219

E49. RESIDENTIAL ELECTRIC VEHICLE REWARDS (DR ONLY) PROGRAM EM&V (PHASE VIII)..... 223

E50. RESIDENTIAL SMART THERMOSTAT REWARDS (DR) PROGRAM EM&V PLAN (PHASE VIII AND PHASE XI) ..... 226

E51. RESIDENTIAL WATER SAVINGS (DR) PROGRAM EM&V PLAN (PHASE IX)..... 229

E52. RESIDENTIAL TELEMATICS VEHICLE CHARGER PILOT (DR) PROGRAM EM&V PLAN (PHASE XI) ... 232

E53. RESIDENTIAL PEAK TIME REBATE (DR) PROGRAM EM&V PLAN (PHASE XI)..... 234

E54. VOLTAGE OPTIMIZATION PROGRAM EM&V PLAN (PHASE X)..... 237

**LIST OF FIGURES**

Figure 40-1. Measurement and verification approach decision flow chart for retro-commissioning measures (Uniform Methods Project, Chapter 16) ..... 179

**LIST OF TABLES**

Table 3-1. Revision history for Residential Appliance Recycling Program EM&V Plan.....6

Table 4-1. Residential Efficient Products Marketplace Program measures .....8

Table 4-2. EM&V activities, data collection modes, and the data that estimates net and gross savings..... 10

Table 4-3. Revision history for Residential Efficient Products Marketplace Program EM&V Plan..... 11

Table 5-1. Residential Energy Efficiency Marketplace Program Measures..... 13

Table 5-2. Revision history for Residential Energy Efficiency Marketplace Program EM&V Plan..... 15

Table 6-1. Residential Home Energy Assessment Program measures ..... 16

Table 6-2. Revision history for Residential Home Energy Assessment program EM&V Plan..... 19

Table 11-1. Measures offered by Residential Customer Engagement Program ..... 20

Table 11-2. Revision History for Customer Engagement Program EM&V Plan ..... 22

Table 7-1. Measures offered by Residential Customer Engagement Program ..... 24

Table 7-2. Revision history for Residential Customer Engagement Program EM&V Plan ..... 26

Table 8-1. Measure offered by Residential Electric Vehicle (EE) Program ..... 27

Table 8-2. Research questions and associated analyses for EV Program energy impact analysis ..... 28

Table 8-3. List of potential data sources for EV Program M&V ..... 29

Table 8-4. Revision history for Residential Electric Vehicle (EE) Program EM&V Plan ..... 30

Table 9-1. Measures offered by Residential Home Retrofit Program..... 32

Table 9-2. Revision history for Residential Home Retrofit Program EM&V Plan..... 35

Table 10-1. Measures offered by the Phase VIII Residential Home Retrofit Program Update ..... 36

Table 10-2. Revision history for Phase VIII Residential Home Retrofit Program Update EM&V Plan..... 39

Table 12-1. Measures offered by Residential Energy Efficient Kits Program ..... 40

Table 12-2. Revision history for Residential Energy Efficient Kits Program EM&V Plan ..... 43

Table 13-1. Measures offered by Residential Manufactured Housing Program ..... 44

Table 13-2. Revision history for Manufactured Housing Program EM&V Plan ..... 47

Table 14-1. Measures offered by Residential/Non-Residential Multifamily Program..... 49

Table 14-2. Revision history for Residential/Non-Residential Multifamily Program EM&V Plan..... 53

Table 15-1. Measures offered by Residential New Construction Program..... 55

Table 15-2. Revision history for Residential New Construction Program EM&V Plan..... 58

Table 16-1. Measures offered by Residential Smart Thermostat Purchase and WeatherSmart Program ..... 59

Table 16-2. Revision history for Residential Smart Thermostat Purchase and WeatherSmart Program EM&V Plan ..... 62

Table 17-1. Measures offered by Smart Home Program ..... 63

Table 17-2. Revision history for Smart Home Program EM&V Plan ..... 66

Table 18-1. Measures offered by Residential Virtual Audit Program..... 67

Table 18-2. Revision history for Residential Virtual Audit Program EM&V Plan..... 70



Table 19-1. Measures offered by Residential Water Savings (EE) Program .....71

Table 19-2. Approaches for determining energy savings from residential water savings (EE) .....72

Table 19-3. Revision history for Residential Water Savings (EE) EM&V Plan .....74

Table 21-1. Measures offered by Residential HVAC Health and Safety Program.....75

Table 21-2. Revision history for Residential HVAC Health and Safety Program EM&V Plan .....79

Table 22-1. Measures offered by HB 2789 (Solar Component) Program .....81

Table 22-2. Approaches for evaluating PV generation.....82

Table 22-3. Revision History for HB2789 (Solar Component) EM&V Plan .....83

Table 23-1. Measures Offered by Residential Income and Age Qualifying Energy Efficiency Program.....84

Table 23-2. Residential Income and Age Qualifying Program (Phase IX) EM&V Plan .....87

Table 24-1. Residential Income and Age Qualifying Home Improvement Enhanced Program measures by end use .....88

Table 24-2. Residential Income and Age Qualifying Home Improvement Enhanced Program revision history .....92

Table 25-1. Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners Measures by end use .....93

Table 25-2. Non-Residential Income and Age Qualifying Home Improvement Program for Healthcare and Rental Property Owners revision history.....98

Table 26-1. IAQ Energy Target Report Program measures by end use .....99

Table 26-2. Residential Income and Age Qualifying Energy Target Report Program revision history .....102

Table 27-1. Measures offered by Residential Bundling of Income and Age Qualifying Programs .....103

Table 27-2. Revision history for Residential Bundling of the Income and Age Qualifying Home Improvement Programs ....107

Table 28-1. Measures offered by Non-Residential Bundling of Income and Age Qualifying Programs.....108

Table 28-2. Revision history for Non-Residential Bundling of Income and Age Qualifying Programs .....112

Table 29-1. Measures offered by Non-Residential Heating and Cooling Efficiency Program .....113

Table 29-2. Preferred IPMVP options for Non-Residential Heating and Cooling Efficiency Program measures.....116

Table 29-3. Revision history for Non-Residential Heating and Cooling Efficiency Program EM&V Plan .....117

Table 30-1. Measures offered by Non-Residential Lighting Systems & Controls Program .....119

Table 30-2. Revision history for Non-Residential Lighting Systems & Controls Program EM&V Plan .....122

Table 30-1. Non-Residential Lighting Systems and Controls Program extension measures by end use.....123

Table 30-2. Non-Residential Lighting Systems and Controls Program extension revision history .....127

Table 31-1. Measures offered by Non-Residential Office Program.....128

Table 31-2. Revision history for Non-Residential Office Program EM&V Plan.....131

Table 32-1. Measures offered by Non-Residential Small Manufacturing Program.....132

Table 32-2. Revision history for Non-Residential Small Manufacturing Program EM&V Plan .....135

Table 33-1. Revision history for Non-Residential Window Film Program EM&V Plan.....138

Table 34-1. Measures offered by the Non-Residential Midstream Efficiency Products Program .....140

Table 34-2. Preferred IPMVP options for Non-Residential Midstream Efficiency Products program measures.....142

Table 34-3. Revision history for Non-Residential Midstream Energy Efficiency Products Program EM&V Plan.....144

Table 35-1. Measures offered by the Non-Residential New Construction Program .....145

Table 35-2. Revision History for Non-Residential New Construction Program EM&V Plan .....148

Table 36-1. Measures offered by Non-Residential Enhanced Prescriptive Program .....149

Table 36-2. Preferred IPMVP options for Non-Residential Prescriptive Program measures.....152

Table 36-3. Revision history for Non-Residential Prescriptive Program EM&V Plan .....153

Table 10-1. Measures Offered by Non-Residential Prescriptive Program.....155

Table 10-2. Preferred IPMVP options for Non-Residential Prescriptive Program measures.....159

Table 10-3. Revision history for Non-Residential Prescriptive Enhanced Program EM&V Plan .....161

Table 37-1. Measures offered by Non-Residential Small Business Improvement Enhanced Program.....162

Table 37-2. Preferred IPMVP options for Small Business Improvement Enhanced Program measures .....164

Table 37-3. Revision history for Small Business Improvement Enhanced Program (Phase VIII) EM&V Plan .....166

Table 38-1. Measures offered by Non-Residential Agricultural Program .....168

Table 38-2. Preferred IPMVP options for Non-Residential Agricultural Program measures .....170

Table 38-3. Revision history for Non-Residential Agricultural Program EM&V Plan .....171

Table 39-1. Measures offered by Non-Residential Building Automation Program .....173

Table 39-2. Approaches for determining energy savings from HVAC controls .....174

Table 39-3. Revision history for Non-Residential Building Automation Program EM&V Plan .....176

Table 40-1. Measures offered by Non-Residential Building Optimization Program.....177

Table 40-2. Key parameters and potential evaluation methodologies for building optimization measures .....180

Table 40-3. Revision history for Non-Residential Building Optimization Program EM&V Plan .....183

Table 41-1. Measures offered by the Non-Residential Engagement Program .....184

Table 41-2. Revision history for Non-Residential Engagement Program EM&V Plan.....187

Table 42-1. Non-Residential Data Center Program measures by end use .....189





Table 42-2. Preferred IPMVP options for Non-Residential Data Center Program.....192

Table 42-3. Non-Residential Data Center Program revision history.....194

Table 43-1. Non-Residential Health Care Program measures by end use .....195

Table 43-2. Preferred IPMVP options for Non-Residential Health Care Program Measures .....199

Table 43-3. Non-Residential Health Care Program revision history.....201

Table 44-1. Non-Residential Hotel and Lodging Program measures by end use.....202

Table 44-2. Preferred IPMVP options for Non-Residential Hotel and Lodging Program measures .....206

Table 44-3. Non-Residential Hotel and Lodging Program revision history.....208

Table 45-1. Small Business Behavioral Program Measures by end use.....209

Table 45-2. Small Business Behavioral Program Revision history.....212

Table 46-1. Measures offered by the Non-Residential Custom Program.....213

Table 46-2. Preferred IPMVP options for Non-Residential Heating and Cooling Efficiency Program measures.....216

Table 46-3. Revision history for the Non-Residential Custom Program EM&V plan .....218

Table 47-1. Revision history for Non-Residential Distributed Generation Program EM&V Plan .....220

Table 48-1. Measures offered by Residential Electric Vehicle Rewards (DR) Program.....223

Table 48-2. Revision History for Residential Electric Vehicle Rewards (DR) Program EM&V Plan .....224

Table 49-1. Measures offered by Residential Smart Thermostat Rewards Program .....226

Table 49-2. Revision history for Smart Thermostat Rewards Program EM&V Plan.....228

Table 50-1. Measures offered by Residential Water Savings Program (DR) .....229

Table 50-2. Revision History for Residential Water Savings (DR) EM&V Plan .....230

Table 51-1. Measures offered by Residential Electric Vehicle Telematics Pilot Program .....232

Table 51-2. Revision history for Residential EV Telematics Pilot Program EM&V Plan.....233

Table 52-1. Measures offered by Residential Peak Time Rebate Program .....234

Table 52-2. Revision history for Residential Peak Time Rebate Program (Demand response EM&V plan) .....236

Table 53-1. Voltage Optimization Program measure by end use.....237

Table 53-2. Voltage Optimization Program revision history .....239



## 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”).<sup>1</sup>
- 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.<sup>2</sup> 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).<sup>3</sup> 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, 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

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://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>



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).<sup>4</sup> 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.

<sup>4</sup> 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](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 APPLIANCE RECYCLING PROGRAM EM&V PLAN (PHASE VII)

#### E3.1. 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.

#### E3.2. Measures

Removal of and recycling of operating refrigerators and freezers

#### 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.<sup>5</sup> 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").<sup>6</sup>

#### E3.4. 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.

<sup>5</sup> 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.

<sup>6</sup> 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.



### 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.<sup>7</sup>

According to Chapter 7: Refrigerator Recycling Evaluation Protocol<sup>8</sup> of The Uniform Methods Project<sup>9</sup> (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,<sup>10</sup> 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.

#### E3.5.1. 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

#### E3.5.2. 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.

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

<sup>8</sup> 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>

<sup>9</sup> 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>

<sup>10</sup> 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<sup>11</sup> (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.

### E3.5.3. 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.

### 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 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.

### 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 Appliance Recycling Program – Revision history

**Table 3-1. 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.

<sup>11</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



Version	Date	Notes
<b>Version 3</b>	4/22/2021	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Changed reference from verified savings to evaluated savings</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>





## E4. RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE PROGRAM EM&V PLAN (PHASE VII)

### E4.1. 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.

### E4.2. Measures

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

**Table 4-1. Residential Efficient Products Marketplace Program measures**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ A-Lines</li> <li>▪ Reflectors</li> <li>▪ Decorative</li> <li>▪ Globes</li> <li>▪ Retrofit kit and fixture</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Freezer</li> <li>▪ Refrigeration</li> </ul>
Appliances	<ul style="list-style-type: none"> <li>▪ Dehumidifier</li> <li>▪ ENERGY STAR® Air Purifier</li> <li>▪ Clothes dryer</li> </ul>
Domestic hot water	<ul style="list-style-type: none"> <li>▪ Dishwasher</li> <li>▪ Clothes washer</li> </ul>

### 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.<sup>12</sup>

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 E4.5. The evaluated savings will use program tracking data, customer energy consumption data, other customer data, and equipment data to estimate program savings.

<sup>12</sup>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").<sup>13</sup>

#### E4.4. 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.

#### E4.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>14</sup>

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.<sup>15</sup>

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

<sup>13</sup> 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.

<sup>14</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>15</sup> 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>.



### E4.5.1. 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 4-2 describes the EM&V activities, data collection modes, and the data that estimates net and gross savings.

**Table 4-2. 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 <sup>16</sup>	Web survey	<ul style="list-style-type: none"> <li>▪ Confirm gross savings estimation inputs (e.g., lighting quantity, installation rate, etc.)</li> <li>▪ Retrospective and prospective net-to-gross ratios</li> </ul>

### E4.5.2. 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.

<sup>16</sup> 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

**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 evaluation.<sup>17</sup>
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.

**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 Efficient Products Marketplace Program – Revision history**

Table 4-3. Revision history for Residential Efficient Products Marketplace Program EM&V Plan

Version	Date	Notes
Version 1	2019	Initial release
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Removed CATI survey mode</li> <li>▪ Removed footnote that cited A-line availability for 2019 and that participant-level data is not available for the retail lighting channel.</li> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Formatted measure table.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> </ul>

<sup>17</sup> 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
		<ul style="list-style-type: none"> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

Jun 14 2024



## E5. RESIDENTIAL ENERGY EFFICIENCY MARKETPLACE PROGRAM EM&V PLAN (PHASE XI)

### E5.1. Program summary

The Residential Energy Efficiency Marketplace Program provides residential customers an incentive to purchase specific energy efficient appliances with a rebate through an online marketplace and through stores.

### E5.2. Measures

The measures included in the Residential Energy Efficiency Marketplace Program are listed in Table 5-1.

Table 5-1. Residential Energy Efficiency Marketplace Program Measures

End-use	Measure
Building Envelope	<ul style="list-style-type: none"> <li>▪ Spray foam</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Freezer</li> <li>▪ Refrigeration</li> </ul>
Plug Load	<ul style="list-style-type: none"> <li>▪ Dehumidifier</li> <li>▪ ENERGY STAR air purifier</li> <li>▪ Clothes dryer</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Room air conditioner</li> <li>▪ Bathroom vent fan</li> <li>▪ Air filter</li> </ul>
Domestic Hot Water	<ul style="list-style-type: none"> <li>▪ Water dispenser</li> <li>▪ Clothes washer</li> </ul>
Misc.	<ul style="list-style-type: none"> <li>▪ APS uninterruptible power supply</li> </ul>

### 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<sup>18</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>19</sup>

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 are derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs.

<sup>18</sup> 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.

<sup>19</sup> 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.



3. Evaluated savings: Evaluated savings (or net savings) will be determined by the methods described in Section E5.5. . The evaluated savings will use program tracking data, customer energy consumption data, other customer data, and equipment data to estimate program savings.

### E5.4. Deemed savings approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Energy Efficiency Marketplace Program will be developed through research primarily in the most recent version of the Maryland/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 and will document baseline assumptions from the program filing as required by the Final Order. 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.<sup>20</sup>

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 set forth in Chapter 11: Sample Design Cross-Cutting Protocol of the UMP.<sup>21</sup>

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:

- Survey of appliance rebate participants: Participants will be asked whether the program influenced the energy efficiency of the appliance and timing of their purchase.
- Program tracking data

#### E5.5.1. Sample design considerations

A random sampling strategy, stratified by appliance type, will be used for the appliance participants. The following characteristics will be considered:

- Confidence interval: 85 to 90% (at the appliance level)
- Relative precision: 10 to 15% (at the appliance level)
- Upstream measures
- Rebate measures

<sup>20</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>21</sup> 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>.



- Budget, schedule, and geographical distribution

### E5.5.2. Net-to-gross assessment

If applicable, free-ridership and spill-over may be estimated from participating end-users 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, to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

### E5.5.3. 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

## 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 evaluation<sup>22</sup>
2. Apply the evaluated savings to the participant data to arrive at program level energy savings, reflected monthly
3. Program savings are annualized in the EM&V tracking reports based on monthly participation
4. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program
5. 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

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

## E5.8. Residential Energy Efficiency Marketplace Program – revision history

Table 5-2. Revision history for Residential Energy Efficiency Marketplace Program EM&V Plan

Version	Date	Notes
Version 1	2022	Initial release -- based on the same plan as the Phase XIII Residential Customer Engagement Program with modifications for additional measures

<sup>22</sup> 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. RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM EM&V PLAN (PHASE VII)

### E6.1. 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.

### E6.2. Measures

A home energy assessment is required for a customer to be eligible for the direct-install and incentivized measures.

**Table 6-1. Residential Home Energy Assessment Program measures**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ HVAC ductless heat pump upgrades</li> <li>▪ High-efficiency fan motors</li> <li>▪ Heat pump tune-up / upgrade / duct sealing</li> <li>▪ AC and heat pump duct insulation</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ LED A-lines</li> </ul>
Domestic hot water	<ul style="list-style-type: none"> <li>▪ Water heater thermostat set point adjustment</li> <li>▪ Water heater replacement with a heat pump water heater</li> <li>▪ Low-flow showerheads and aerators</li> <li>▪ Water heater pipe insulation</li> </ul>

### 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.<sup>23</sup> 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 E6.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

<sup>23</sup> 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").<sup>24</sup>

#### **E6.4. 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.

#### **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.<sup>25</sup>

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. ).<sup>26</sup>

##### **E6.5.1. 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.

<sup>24</sup> 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.

<sup>25</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>26</sup> 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.

### E6.5.2. 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

### 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.<sup>27</sup>
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.

<sup>27</sup> 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 Home Energy Assessment Program – Revision history**

**Table 6-2. Revision history for Residential Home Energy Assessment program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	2019	<ul style="list-style-type: none"> <li>Initial release</li> </ul>
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Removed version number from title</li> <li>Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis.</li> <li>Changed section title from Savings Estimation to Billing Analysis</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E7. RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (PHASE VIII)

### E7.1. 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.

### E7.2. 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	<ul style="list-style-type: none"> <li>▪ Electronic home energy report</li> <li>▪ Paper home energy report</li> </ul>

### 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.<sup>28</sup> 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:

8. **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data from the treatment and control groups.
9. **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.
10. **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E7.5. 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”).<sup>29</sup>

### E7.4. 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

<sup>28</sup> 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.

<sup>29</sup> 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.

## **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.<sup>30</sup>

The CEP will be evaluated using billing analysis as recommended by Chapter 17, Residential Behavior Evaluation Protocol of the Uniform Methods Project (UMP).<sup>31</sup>

### **E7.5.1. 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.

### **E7.5.2. 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

<sup>30</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>31</sup> 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:

11. Desired precision of savings estimates
12. Expected duration of program
13. Targeted populations
14. 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.

### E7.6. Lost revenue methodology

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

15. Calculate program savings by applying the realization rate derived from the billing analysis.<sup>32</sup>
16. 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.
17. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program.
18. 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

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

### E7.8. 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.

<sup>32</sup> 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
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Clarified confidence interval in Section E12.5.2. “Sample design considerations”</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>





## E8. RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (PHASE XI)

### E8.1. Program summary

This Residential Customer Engagement Program would provide educational insights into the customer’s energy consumption via a home energy report (on-line and/or paper version). The home energy report is intended to provide periodic suggestions on how to save on energy based upon analysis of the customer’s energy usage. Customers can opt-out of participating in the program at any time.

### E8.2. Measures

The measures included in the Residential Customer Engagement Program (CEP) are listed in Table 7-1.

**Table 7-1. Measures offered by Residential Customer Engagement Program**

End-use	Measure
Whole house	Home energy report

### 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<sup>33</sup> and the final order of SCC Case No. PUR-2020-00156 (“Final Order”).<sup>34</sup> 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:

- **Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data from the treatment and control groups.
- **Deemed savings:** In the first year of the program, deemed savings values will be estimated from the DE TRM, which are derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs.
- **Evaluated savings:** Evaluated savings will be determined by the methods described in Section E7.5. . The evaluated savings will use program tracking data and customer energy consumption data from the treatment and control groups.

### E8.4. 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 Maryland/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 and will document baseline assumptions from

<sup>33</sup> 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.

<sup>34</sup> 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 program filing as required by the Final Order. 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.<sup>35</sup>

The CEP will be evaluated using billing analysis as recommended by Chapter 17, Residential Behavior Evaluation Protocol of the Uniform Methods Project (UMP).<sup>36</sup>

### **E8.5.1. 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 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 treatment group customer is greater than control group customers upstream program-related savings, then that estimate is used to adjust overall CEP savings estimates.

### **E8.5.2. 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

<sup>35</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>36</sup> 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>.



RCT will be developed within strata defined by geography and 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.

### 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 billing analysis<sup>37</sup>
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

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

### E8.8. Residential Customer Engagement Program – revision history

Table 7-2. Revision history for Residential Customer Engagement Program EM&V Plan

Version	Date	Notes
Version 1	10/19/2022	Initial Release – based on the same plan as the Phase XIII Residential Customer Engagement Program with no changes to approach

<sup>37</sup> 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.



## E9. RESIDENTIAL ELECTRIC VEHICLE ENERGY EFFICIENCY AND DEMAND RESPONSE PROGRAM EM&V PLAN (EE ONLY) (PHASE VIII)

### E9.1. 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.

### E9.2. Measures

The measure offered by the Residential Electric Vehicle Program (EE) is shown in Table 8-1.

**Table 8-1. Measure offered by Residential Electric Vehicle (EE) Program**

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

### 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.<sup>38</sup> 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 E8.5. 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”).<sup>39</sup>

### E9.4. 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 collect from program participants, where practical, to estimate savings in kilowatt and kilowatt-hours. Where such data is

<sup>38</sup> 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.

<sup>39</sup> 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.



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.

**E9.5. 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.<sup>40</sup>

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 8-2 presents sample research questions to be addressed by an EV program energy impacts analysis.

**Table 8-2. 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?	<ul style="list-style-type: none"> <li>▪ End-use metering analysis</li> <li>▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load</li> </ul>
What is the change in energy consumption due to the combined effects of: <ul style="list-style-type: none"> <li>▪ The net consumption changes from Level 2 chargers versus a Level 1 charger.</li> <li>▪ Added load due to program-attributable EV adoption</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load</li> <li>▪ Develop pre/post load shapes</li> </ul>
<ul style="list-style-type: none"> <li>▪ What is the difference in charging load shape with a Level 2 charger versus a Level 1 charger?</li> <li>▪ How do changes in load shape align with Dominion Energy's targeted load shifting?</li> </ul>	<ul style="list-style-type: none"> <li>▪ End-use metering analysis</li> <li>▪ Compare charging load shapes from whole-building hourly load analysis and end-use metering approaches to determine incremental EV load</li> <li>▪ Develop pre/post load shapes</li> </ul>

<sup>40</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.



Table 8-3 lists potential sources of data useful for an impact analysis.

**Table 8-3. List of potential data sources for EV Program M&V**

Dataset	Data source	Purpose
Vehicle registrations	<ul style="list-style-type: none"> <li>▪ Virginia Automobile Dealers Association, Statistical Reports</li> <li>▪ Atlas EV HUB,<sup>41</sup> State EV registration data,</li> <li>▪ Other third-party data providers</li> </ul>	<ul style="list-style-type: none"> <li>▪ Survey stratification</li> <li>▪ Develop comparison groups</li> </ul>
Program tracking data	Dominion Energy BI data, program participants, implementation vendor	<ul style="list-style-type: none"> <li>▪ Identify participants</li> <li>▪ Link participants to third-party data</li> <li>▪ Analysis</li> </ul>
Consumption data	Dominion Energy	<ul style="list-style-type: none"> <li>▪ Analysis</li> <li>▪ Develop comparison groups</li> </ul>
AMI data or high-frequency interval data	Dominion Energy	<ul style="list-style-type: none"> <li>▪ Analysis</li> <li>▪ Develop comparison groups</li> </ul>
Vehicle charging data	Implementers	<ul style="list-style-type: none"> <li>▪ Customer-specific charging information</li> <li>▪ Analysis</li> </ul>
End-use metering data	Primary data collection	<ul style="list-style-type: none"> <li>▪ Analysis</li> </ul>
Consumer survey	Primary data collection	<ul style="list-style-type: none"> <li>▪ Collect additional attribute data about customers</li> <li>▪ Segmentation analysis of consumption behavior</li> </ul>
Third party-data	U.S. Census, American Community Survey, customer tax assessor, other providers	<ul style="list-style-type: none"> <li>▪ Identifies EV owners and attributes not otherwise publicly available</li> </ul>

### E9.5.1. 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

### E9.5.2. 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.

<sup>41</sup> EV HUB. <https://www.atlasevhub.com/>.



### E9.5.3. 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.

### 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 billing analysis.<sup>42</sup>
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.

### 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 Electric Vehicle (EE) Program – Revision history

Table 8-4. 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	<ul style="list-style-type: none"> <li>▪ Minor word changes to data type</li> <li>▪ Removed reference to monthly consumption data and UMP Chapter 8</li> <li>▪ Added reference that vehicle charging data is available from the implementer in section N.3 and Table N-3.</li> <li>▪ Changed reference from AMI to AMR meter is section N.5.1 and N.6.1</li> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> </ul>

<sup>42</sup> 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
		<ul style="list-style-type: none"> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Removed demand response savings estimation methods (see instead the EM&amp;V plan for the Residential Electric Vehicle Rewards Program (DR).</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>





## E10. RESIDENTIAL HOME RETROFIT PROGRAM EM&V PLAN (PHASE VIII)

### E10.1. 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.

### E10.2. Measures

The measures offered by the Residential Home Retrofit Program are listed in Table 9-1.

**Table 9-1. Measures offered by Residential Home Retrofit Program**

End-use	Measure
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Air sealing</li> <li>▪ AC and heat pump duct insulation</li> <li>▪ Attic insulation</li> <li>▪ Wall insulation</li> <li>▪ Basement wall insulation</li> <li>▪ Crawl space insulation</li> </ul>
<b>Domestic hot water</b>	<ul style="list-style-type: none"> <li>▪ Low-flow showerheads and aerators</li> <li>▪ Water heat pipe insulation</li> <li>▪ Water heater thermostat set point adjustment</li> <li>▪ Water heater replacement with a heat pump water heater</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Heat pump tune-up/upgrade/duct sealing</li> <li>▪ Ground source heat pump</li> <li>▪ High-efficiency fan motors</li> <li>▪ HVAC ductless unit upgrades</li> <li>▪ Smart thermostat installation</li> </ul>



### 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.<sup>43</sup> 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 E9.5. 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").<sup>44</sup>

### E10.4. 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.

### 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.<sup>45</sup>

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 E9.5.1.)<sup>46</sup>

<sup>43</sup> 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.

<sup>44</sup> 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.

<sup>45</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>46</sup> 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>.



### E10.5.1. 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.

### 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: 85–90%
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.<sup>47</sup>
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.

---

<sup>47</sup> 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.

**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.

**E10.8. Residential Home Retrofit Program – Revision history**

Table 9-2. Revision history for Residential Home Retrofit Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Changed sub-section title from "Savings Estimation" to "Billing Analysis"</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY  
Jun 14 2024



## E11. RESIDENTIAL ENHANCED HOME RETROFIT BUNDLE PROGRAM EM&V PLAN (PHASE VIII)

### E11.1. Program summary

The proposed program re-design incorporates key program measures from the Company's Phase VII Residential Home Energy Assessment Program. Beginning in 2024, the requirement for all contractors to have BPI certification will no longer be required for this program. Instead, BPI certification will only be required for those contractors that perform measures that require BPI certification – air sealing, attic insulation, drill and fill wall insulation, basement wall insulation, and crawl space insulation.

A-line LEDs are not included in the program redesign in response to recent EISA-driven changes to baseline efficiency. Program design introduces a handful of select new measures including the replacement of electric baseboard heating with air source heat pump, high-efficiency room air conditioning upgrades, and shower thermostats.

### E11.2. Measures

The measures included in the Phase VIII Residential Home Retrofit Program Update are listed in Table 10-1.

**Table 10-1. Measures offered by the Phase VIII Residential Home Retrofit Program Update**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ LED lamp upgrades</li> </ul>
Building envelope	<ul style="list-style-type: none"> <li>▪ Wall insulation</li> <li>▪ Attic insulation</li> <li>▪ Basement wall insulation</li> <li>▪ Crawl space insulation</li> <li>▪ Cool roof</li> <li>▪ Air sealing</li> </ul>
Domestic Hot Water	<ul style="list-style-type: none"> <li>▪ Water heat pipe insulation</li> <li>▪ Water heater thermostat set point adjustment</li> <li>▪ Shower thermostats</li> <li>▪ Water heater replacement with a heat pump water heater</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Heat pump tune-up / upgrade / duct sealing</li> <li>▪ AC and heat pump duct insulation</li> <li>▪ Smart thermostat installs</li> <li>▪ Ground source heat pump</li> <li>▪ High-efficiency fan motors</li> <li>▪ HVAC ductless unit upgrades</li> <li>▪ Electric baseboard heating with air source heat pump</li> <li>▪ High efficiency room AC upgrades</li> </ul>



### **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<sup>48</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>49</sup> 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 are derived primarily from the most recent version of the Maryland/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 EE10.5. . . The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

### **E11.4. Deemed savings approach**

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Phase VIII Residential Home Retrofit Program Upgrade will be developed for any new measures that are not currently in the program through research primarily in the most recent version of the Maryland/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 and will document baseline assumptions from the program filing as required by the Final Order. 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.<sup>50</sup>

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. ).<sup>51</sup>

<sup>48</sup> 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.

<sup>49</sup> 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.

<sup>50</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>51</sup> 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>



### E11.5.1. Billing analysis

The billing analysis for the Phase VIII Residential Retrofit Program Update 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 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.
3. The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

### E11.5.2. 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 to 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

### E11.5.3. Net-to-gross assessment

If applicable, free-ridership and spill-over 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, to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

## 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.<sup>52</sup>
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.

<sup>52</sup> 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.



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**

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

**E11.8. Phase VIII Residential Home Retrofit Program update – revision history**

**Table 10-2. Revision history for Phase VIII Residential Home Retrofit Program Update EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	10/19/2022	Initial release – based on the EM&V plans for the Phase VII Residential Home Energy Assessment and Phase VIII Residential Retrofit programs





## E12. RESIDENTIAL ENERGY EFFICIENCY KITS PROGRAM EM&V PLAN (PHASE VIII)

### E12.1. 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

### E12.2. Measures

The measures included in the kit offered by the Residential Energy Efficient Kits Program are listed in Table 12-1.

**Table 12-1. Measures offered by Residential Energy Efficient Kits Program**

End-use	Measure
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Door weather stripping</li> <li>▪ Window and door weather stripping</li> <li>▪ Door sweep</li> <li>▪ Outlet/switch gaskets</li> <li>▪ Caulking</li> </ul>
<b>Domestic hot water</b>	<ul style="list-style-type: none"> <li>▪ Low-flow showerheads</li> <li>▪ Kitchen and bathroom aerators</li> <li>▪ Water heater pipe insulation</li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ LED lamps</li> </ul>
<b>Plug load</b>	<ul style="list-style-type: none"> <li>▪ Tier 1 smart strip</li> </ul>

### 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.<sup>53</sup> The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

<sup>53</sup> 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 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").<sup>54</sup>

## E12.4. 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.

## 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.<sup>55</sup>

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.<sup>56</sup>

### E12.5.1. 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
- Effectiveness of education and enrollment in other energy efficiency programs

<sup>54</sup> 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.

<sup>55</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>56</sup> 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.



- Optional areas of research include:
- Motivation for participation
- Barriers to participation
- Strategies for increasing participation and installation rates

### 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:

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

### 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 analysis.<sup>57</sup>
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.

<sup>57</sup> 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.



**E12.8. Residential Energy Efficient Kits Program – Revision history**

**Table 12-2. Revision history for Residential Energy Efficient Kits Program EM&V Plan**

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Updated IPMVP reference from 2012 to 2022.</li> <li>Removed version number from title</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E13. RESIDENTIAL MANUFACTURED HOUSING PROGRAM EM&V PLAN (PHASE VIII)

### E13.1. 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.

### E13.2. Measures

The measures offered by the Residential Manufactured Housing Program as listed in Table 13-1.

**Table 13-1. Measures offered by Residential Manufactured Housing Program**

End-use	Measure
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Door weather-stripping</li> <li>▪ Door sweep</li> <li>▪ Caulking</li> <li>▪ Foaming</li> <li>▪ Poly tape for windows</li> <li>▪ Air sealing</li> <li>▪ Attic/wall insulation</li> <li>▪ Mobile home belly insulation</li> <li>▪ ENERGY STAR® cool roofs</li> </ul>
<b>Domestic hot water</b>	<ul style="list-style-type: none"> <li>▪ Water heater replacement with a heat pump water heater</li> <li>▪ Low-flow showerheads and aerators</li> <li>▪ Water heater pipe insulation</li> <li>▪ Water heater thermostat set point adjustment</li> </ul>



End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ ENERGY STAR® room/wall AC units</li> <li>▪ Heat pump tune-up/upgrade/duct sealing</li> <li>▪ Central AC filter replacement</li> <li>▪ Heat pump filter replacement</li> <li>▪ Smart thermostat installation</li> <li>▪ Digital switch plate wall thermometer</li> <li>▪ AC cover for wall/window units(s)</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ LED lighting</li> </ul>
Plug load	<ul style="list-style-type: none"> <li>▪ ENERGY STAR® refrigerator/freezer</li> <li>▪ High-efficiency fan motors</li> <li>▪ Refrigerator/freezer</li> </ul>

### 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.<sup>58</sup> 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 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”).<sup>59</sup>

### E13.4. 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,

<sup>58</sup> 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.

<sup>59</sup> 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.

### **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.<sup>60</sup>

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 E13.5.1. ).<sup>61</sup>

#### **E13.5.1. 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.

#### **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:

- 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

<sup>60</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>61</sup> 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>.



### 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.<sup>62</sup>
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 Manufactured Housing Program – Revision history

Table 13-2. Revision history for Manufactured Housing Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis.</li> </ul>

<sup>62</sup> 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
		<ul style="list-style-type: none"> <li>▪ Changed sub-section title from "Savings Estimation" to "Billing Analysis"</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E14. RESIDENTIAL/NON-RESIDENTIAL MULTIFAMILY PROGRAM EM&V PLAN (PHASE VIII)

### E14.1. 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.

### E14.2. Measures

The measures offered by the Residential/Non-Residential Multifamily Program are listed in Table 14-1.

**Table 14-1. Measures offered by Residential/Non-Residential Multifamily Program**

End-use	Measure
Building envelope	<ul style="list-style-type: none"> <li>▪ Air sealing</li> <li>▪ Attic insulation</li> <li>▪ Wall insulation (residential only)</li> </ul>
Domestic hot water	<ul style="list-style-type: none"> <li>▪ Low-flow showerhead</li> <li>▪ Faucet aerator</li> <li>▪ Water heater thermostat set point adjustment</li> <li>▪ Water heater pipe insulation</li> </ul>



End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Heat pumps</li> <li>▪ Heat pump tune-ups</li> <li>▪ Smart thermostat</li> <li>▪ Duct sealing</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ LED lighting</li> <li>▪ Occupancy sensors</li> </ul>
Plug load	<ul style="list-style-type: none"> <li>▪ ENERGY STAR® refrigerator (residential only)</li> <li>▪ Clothes washer/dryer</li> <li>▪ Pool pumps (commercial only)</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Refrigerator coil brush (residential only)</li> <li>▪ Refrigerator thermostat (residential only)</li> </ul>

### 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.<sup>63</sup> 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 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").<sup>64</sup>

### E14.4. 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

<sup>63</sup> 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.

<sup>64</sup> 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.

## 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.<sup>65</sup>

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. )<sup>66</sup>

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.<sup>67</sup> The analysis will also follow the general approach of the IPMVP, Option D, Calibrated Simulation.<sup>68</sup>

### E14.5.1. 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.

<sup>65</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>66</sup> 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>;

<sup>67</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>68</sup> 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.<sup>69</sup>

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.

### 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, multifamily type
4. Budget, schedule, and geographical distribution

---

<sup>69</sup> This generally requires large numbers of installations (thousands) to yield meaningful results.



### 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.<sup>70</sup>
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.

### 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/Non-Residential Multifamily Program – Revision history

Table 14-2. Revision history for Residential/Non-Residential Multifamily Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Provided clarification of Option C and non-routine events to "Savings Estimation"</li> <li>▪ Removed feasibility assessment of the comparison group from Section E14.5.1.</li> </ul>

<sup>70</sup> 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
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"><li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li><li>▪ Updated hyperlinks and language based on editorial feedback</li></ul>

OFFICIAL COPY

Jun 14 2024



## E15. RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII)

### E15.1. 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.

### E15.2. Measures

The measures included in the Residential New Construction Program are listed in Table 15-1.

**Table 15-1. Measures offered by Residential New Construction Program**

End-use	Measure
Whole house	<ul style="list-style-type: none"> <li>▪ Attached single-family home</li> <li>▪ Detached single-family home</li> </ul>

### E15.3. Evaluation, Measurement, and Verification

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>71</sup> 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 E15.5. The evaluated savings approach will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

<sup>71</sup>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").<sup>72</sup>

#### **E15.4. 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.

#### **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.<sup>73</sup>

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.<sup>74</sup> The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.<sup>75</sup>

##### **E15.5.1. 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.

<sup>72</sup> 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.

<sup>73</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>74</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>75</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.



### E15.5.2. 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%
- Installed measures
- Budget, schedule, and geographical distribution

### 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 calibrated energy simulations.<sup>76</sup>
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.

### 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.
7. If appropriate, support lost revenue recovery activities.

---

<sup>76</sup> 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.



**E15.8. Residential New Construction program – Revision history**

**Table 15-2. Revision history for Residential New Construction Program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	11/26/2019	<ul style="list-style-type: none"> <li>Initial release</li> </ul>
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Updated IPMVP reference from 2012 to 2022.</li> <li>Removed version number from title</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>



## E16. RESIDENTIAL SMART THERMOSTAT PURCHASE AND WEATHERSMART<sup>SM</sup> PROGRAM EM&V PLAN (PHASE VIII)

### E16.1. 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<sup>®</sup> 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<sup>®</sup> requirements and have communicating technology.

### E16.2. Measures

The measures offered by the Residential Smart Thermostat Purchase and WeatherSmart Program are shown in Table 16-1.

**Table 16-1. Measures offered by Residential Smart Thermostat Purchase and WeatherSmart Program**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Smart thermostat</li> <li>▪ Heat pump system optimization and behavioral messaging</li> <li>▪ Air conditioning system optimization and behavioral messaging</li> </ul>

### 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.<sup>77</sup> 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.

<sup>77</sup> 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 E16.5. 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").<sup>78</sup>

#### **E16.4. 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.

#### **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.<sup>79</sup>

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 E16.5.1.)<sup>80</sup>

##### **E16.5.1. 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.

<sup>78</sup> 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.

<sup>79</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>80</sup> 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.

### E16.5.2. 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.

### 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 billing analysis.<sup>81</sup>
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.

<sup>81</sup> 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.



**E16.8. Residential Smart Thermostat Purchase and WeatherSmart Program (EE) – Revision history**

**Table 16-2. Revision history for Residential Smart Thermostat Purchase and WeatherSmart Program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	11/26/2019	Initial release
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added reference to thermostat telemetry data in M.3 Combined measure list for purchase and optimization component and removed duplicate text.</li> <li>▪ 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.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis</li> <li>▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E17. RESIDENTIAL SMART HOME PROGRAM EM&V PLAN (PHASE IX)

### E17.1. 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.

### E17.2. Measures

The measures offered by the Residential Smart Home Program are shown in Table 17-1.

**Table 17-1. Measures offered by Smart Home Program**

End-use	Measure
Plug load	<ul style="list-style-type: none"> <li>▪ Smart Plug</li> <li>▪ Smart home hub with entry and motion sensor</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Smart thermostat with voice control and temperature/humidity sensor</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ Connected 9.5W Energy Star® LED</li> </ul>
Multiple	<ul style="list-style-type: none"> <li>▪ Smart home energy monitor (with solar option)</li> </ul>

### E17.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>82</sup> 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 E17.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

<sup>82</sup> 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").<sup>83</sup>

#### **E17.4. 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.

#### **E17.5. Evaluated savings approach**

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>84</sup>

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.<sup>85</sup>

##### **E17.5.1. 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.

<sup>83</sup> 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.

<sup>84</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>85</sup> 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.

### E17.5.2. 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

### E17.5.3. 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.

## E17.6. 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.<sup>86</sup>
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.

## E17.7. 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.

<sup>86</sup> 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.



**E17.8. Residential Smart Home Program – Revision history**

**Table 17-2. Revision history for Smart Home Program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	Nov. 2020	Initial release
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Changed reference from tracked savings to deemed savings in EM&amp;V Overview</li> <li>▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site-level analysis</li> <li>▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E18. RESIDENTIAL VIRTUAL ENERGY AUDIT PROGRAM EM&V PLAN (PHASE IX)

### E18.1. 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.

### E18.2. Measures

The measures offered by the Residential Virtual Audit Program are shown in Table 18-1.

**Table 18-1. Measures offered by Residential Virtual Audit Program**

End-use	Measure
Domestic hot water	<ul style="list-style-type: none"> <li>▪ Showerhead</li> <li>▪ Faucet aerator</li> <li>▪ Pipe insulation</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ LED lighting</li> </ul>
Plug load	<ul style="list-style-type: none"> <li>▪ Tier 1 smart strip</li> </ul>
Weatherization	<ul style="list-style-type: none"> <li>▪ Weatherstripping</li> <li>▪ Door sweep</li> <li>▪ Outlet / switch gasket</li> <li>▪ Caulking</li> </ul>



### 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.<sup>87</sup> 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 E18.5. 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").<sup>88</sup>

### E18.4. 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.

### 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.<sup>89</sup>

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.<sup>90</sup>

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.

<sup>87</sup> 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.

<sup>88</sup> 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.

<sup>89</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>90</sup> 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>.



### E18.5.1. 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

### E18.5.2. Sample design considerations

Sample design will follow the protocols outlined in Chapter 11: Sample Design Cross-Cutting Protocol of the Uniform Methods Project.<sup>91</sup> 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

### 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 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.<sup>92</sup>
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.

<sup>91</sup> 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>

<sup>92</sup> 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.



**E18.7. 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.

**E18.8. Residential Virtual Audit Program – Revision history**

**Table 18-2. Revision history for Residential Virtual Audit Program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	Nov 2020	Initial release
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Changed reference from Tracked Savings Deemed Savings in EM^V Overview</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E19. RESIDENTIAL WATER SAVINGS (EE) PROGRAM EM&V PLAN (PHASE IX)

### E19.1. 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.

### E19.2. Measures

The measures offered by the Residential Water Savings (EE) are as shown in Table 19-1.

**Table 19-1. Measures offered by Residential Water Savings (EE) Program**

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

### 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.<sup>93</sup> 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:

- Baseline consumption:** Baseline consumption will be calculated from monthly or AMI participant consumption data.
- 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.
- Evaluated savings:** Evaluated savings will be determined by the methods described in Section E19.5. 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”).<sup>94</sup>

### E19.4. 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 the DE TRM and calculated using utility-reported program participant data. DNV will work with program implementers and

<sup>93</sup> 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.

<sup>94</sup> 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.





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.

**E19.5. Evaluated savings approach**

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>95</sup>

The analysis will likely follow the general approach of IPMVP, Option A, Partially Measured Retrofit Isolation.<sup>96</sup> 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 19-2 summarizes the approaches used for this program.

**Table 19-2. Approaches for determining energy savings from residential water savings (EE)**

Approach	Protocol	Description
<b>End-use metering</b>	Option A: Partially Measured Retrofit Isolation	<ul style="list-style-type: none"> <li>▪ Key parameters are metered and applied to engineering calculation.</li> <li>▪ May require changing control settings to simulate baseline conditions.</li> <li>▪ In other cases, baseline conditions can be approximated using implementer data and TRM-based assumptions</li> <li>▪ Metering period may be a couple of weeks or longer to get representative data set.</li> </ul>
<b>Consumption data analysis</b>	Uniform Methods Project	<ul style="list-style-type: none"> <li>▪ Billing analysis</li> </ul>

<sup>95</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>96</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.



### E19.5.1. 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.<sup>97</sup> 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:

1. Confidence interval: 85%
2. Relative precision: 10–15%
3. Installed measures
4. Budget and schedule

### E19.5.2. 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.

## E19.6. 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.<sup>98</sup>
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.

## 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 and efficient use, and measure savings load shapes annually.
5. If appropriate, conduct impact evaluation studies.
6. Provide regulatory support as necessary.

<sup>97</sup> PJM Manual 18B: Energy Efficiency Measurement & Verification, Revision: 04, Effective Date: August 22, 2019, PJM Forward Market Operations.

<sup>98</sup> 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.



**E19.8. Residential Water Savings (EE) Program – Revision history**

**Table 19-3. Revision history for Residential Water Savings (EE) EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	Nov. 2020	<ul style="list-style-type: none"> <li>Initial release</li> </ul>
<b>Version 2</b>	4/22/2022	<ul style="list-style-type: none"> <li>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.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Removed version number from title</li> <li>Changed reference from Tracked Savings Deemed Savings in EM&amp;V Overview</li> <li>Replaced IPMVP Option C with billing analysis from the Inform methods project</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E20. RESIDENTIAL HVAC HEALTH AND SAFETY PROGRAM EM&V PLAN (PHASE VIII)

### E20.1. 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 21-1.

**Table 21-1. Measures offered by Residential HVAC Health and Safety Program**

End-use	Measure
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Insulation repair/upgrade wall</li> <li>▪ Insulation repair/upgrade floor</li> <li>▪ Comprehensive air sealing, envelope improvements, insulation</li> <li>▪ Roof repair (residential only)</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Heat pump replacement</li> <li>▪ Duct sealing/insulation/repair/replacement</li> <li>▪ Electric baseboard heat upgrade</li> <li>▪ Upgrades to mini-split/ductless heat pumps</li> <li>▪ Thermostat replacement</li> <li>▪ HVAC tune-up</li> <li>▪ HVAC/home-ventilation improvements</li> </ul>
<b>Health &amp; Safety</b>	<ul style="list-style-type: none"> <li>▪ Mold/mildew removal (residential only)</li> <li>▪ Re-wiring (residential only)</li> <li>▪ Air quality control (residential only)</li> <li>▪ Carbon monoxide detectors and sources (residential only)</li> <li>▪ Assessments of indoor air quality (residential only)</li> <li>▪ Combustion appliance safety checks/enhancements (residential only)</li> <li>▪ Fire and fall safety checks/enhancements (residential only)</li> <li>▪ Dehumidifiers (residential only)</li> </ul>

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.



## E20.2. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>99</sup> 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 E21.4. 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").<sup>100</sup>

## E20.3. 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.

## E20.4. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>101</sup>

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.

<sup>99</sup> 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.

<sup>100</sup> 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.

<sup>101</sup> 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.<sup>102</sup> The analysis will use a site-level or panel-model billing analysis approach (see Section E21.4.1.).

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.<sup>103</sup> (see Section E21.4.1. ). The analysis will also follow the general approach of IPMVP, Option D, Calibrated Simulation.<sup>104</sup>

### E20.4.1. 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.<sup>105</sup>

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

<sup>102</sup> 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>;

<sup>103</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>104</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).

<sup>105</sup> 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.

#### **E20.4.2. 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

#### **E20.4.3. 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.

#### **E20.5. 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.<sup>106</sup>

<sup>106</sup> 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.

**E20.6. 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.

**E20.7. Residential HVAC Health and Safety Program – Revision history**

Table 21-2. Revision history for Residential HVAC Health and Safety Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated program name from “HB2789 Heating and Cooling Health and Safety” to “Residential HVAC Health and Safety”</li> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Provided clarification of Option C and non-routine events to “Savings Estimation”</li> <li>▪ Removed feasibility assessment of the comparison group from Section E21.4.1.</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

and/or customer surveys) to verify that measures were installed, are operating as intended, and whether these were affected by exogenous changes.





## E21. INCOME AND AGE QUALIFYING SOLAR PROGRAM EM&V PLAN (PHASE IX)

### E21.1. 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<sub>ac</sub>; individually metered multifamily residences or facilities providing residences would receive an installation no larger than 10 kW<sub>ac</sub>.
- 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.

**E21.2. Measures**

The measure offered by the HB 2789 (Solar Component) is shown in Table 22-1.

**Table 22-1. Measures offered by HB 2789 (Solar Component) Program**

End-use	Measure
Generation	<ul style="list-style-type: none"> <li>▪ Installation of roof- or pole-mounted solar photovoltaic panels on the customer's property</li> </ul>

**E21.3. Evaluation, Measurement, and Verification overview**

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>107</sup> The basis for DNV's approach to estimating generation is:

1. **Modeled generation:** PV generation will be estimated from the DE TRM (see Section E22.4. 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 E22.5.

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").<sup>108</sup>

**E21.4. 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.<sup>109</sup>

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

<sup>107</sup> 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.

<sup>108</sup> 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.

<sup>109</sup> 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.



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.

### E21.5. Evaluated PV generation approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>110</sup>

Table 22-2 lists several IPMVP-based approaches for determining PV generation.<sup>111</sup> 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 22-2. Approaches for evaluating PV generation**

Approach	IPMVP description	Description
<b>Production data analysis</b>	<ul style="list-style-type: none"> <li>Option B, Retrofit Isolation</li> </ul>	<ul style="list-style-type: none"> <li>Using monthly or shorter interval production data.</li> <li>Annualizing and weather normalizing production estimates.</li> </ul>
<b>Verified solar contractor models</b>	<ul style="list-style-type: none"> <li>Option D, Calibrated Simulation</li> </ul>	<ul style="list-style-type: none"> <li>In the absence of monthly or shorter interval site-level production data, perform desk reviews of contractor models.</li> <li>Site-specific verification can be used to inform the models.</li> <li>If longer interval production data are available, the model can be calibrated.</li> </ul>
<b>Solar models</b>	<ul style="list-style-type: none"> <li>Option D: Calibrated Simulation</li> </ul>	<ul style="list-style-type: none"> <li>This approach uses solar models for a given site or a prototype system.</li> <li>The model can be calibrated using site-level production if available.</li> <li>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.</li> </ul>
<b>Consumption data analysis</b>	<ul style="list-style-type: none"> <li>Option C: Whole Facility</li> </ul>	<ul style="list-style-type: none"> <li>This approach can be used if only net meter data are available.</li> <li>Takes advantage of utility billing data and post-net metering data.</li> </ul>

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

<sup>110</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>111</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol (IPMVP).



as necessary adjustment for non-routine events that would affect pre-post usage analysis and are unrelated to the measure being assessed.

### E21.5.1. 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

### E21.6. Lost revenue methodology

Lost revenue will not be calculated for this program.

### 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 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.

### E21.8. Income and Age Qualifying Solar Program – Revision history

Table 22-3. Revision History for HB2789 (Solar Component) EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	4/22/2022	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number, formatting.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Provided clarification of Option C and non-routine events to “Savings Estimation”</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E22. RESIDENTIAL INCOME AND AGE QUALIFYING ENERGY EFFICIENCY PROGRAM EM&V PLAN (PHASE IX)

### E22.1. 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.

### E22.2. Measures

The measures offered by the Residential Income and Age Qualifying Program are as shown in Table 23-1.

**Table 23-1. Measures Offered by Residential Income and Age Qualifying Energy Efficiency Program**

End-Use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ LED lighting</li> </ul>
Domestic Hot Water	<ul style="list-style-type: none"> <li>▪ Showerhead</li> <li>▪ Faucet aerator</li> <li>▪ Pipe insulation</li> <li>▪ Insulating tank wrap</li> </ul>
Building Envelope	<ul style="list-style-type: none"> <li>▪ Attic insulation</li> <li>▪ Floor insulation</li> <li>▪ Air sealing</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Heat pump tune-up</li> <li>▪ AC tune-up</li> <li>▪ Duct sealing</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Refrigerator replacement</li> </ul>

### E22.3. Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>112</sup> 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 are derived primarily from the most recent version of the Mid-Atlantic TRM, and as appropriate, other TRMs.

<sup>112</sup>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 (or net savings) will be determined by the methods described in Section E23.5. 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").<sup>113</sup>

#### **E22.4. 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.

#### **E22.5. Evaluated savings approach**

The program specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>114</sup>

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.<sup>115</sup> The analysis will use a site-level and panel-model billing analysis approach.

##### **E22.5.1. 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.

<sup>113</sup> 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.

<sup>114</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>115</sup> 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.

### E22.5.2. 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

### E22.5.3. 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.

## 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 impact evaluation.<sup>116</sup>
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.

## E22.7. 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.
- Develop baseline use, efficient use, and measure savings load shapes annually.
- If appropriate, conduct impact evaluation studies.

<sup>116</sup> 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.



- Provide regulatory support as necessary.

**E22.8. Residential Income and Age Qualifying Energy Efficiency (Phase IX) – Revision History**

**Table 23-2. Residential Income and Age Qualifying Program (Phase IX) EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	Nov 2020	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ Removed reference to IPMVP Option C (whole facility) because Option C is designed for site level analysis</li> <li>▪ Changed sub-section title from “Savings Estimation” to “Billing Analysis”</li> </ul>





## E23. RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (PHASE X)

### E23.1. 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.

### E23.2. Measures

The energy efficiency measures listed in Table 24-1 will be offered by the Residential Income and Age Qualifying Home Improvement Enhanced Program.

**Table 24-1. Residential Income and Age Qualifying Home Improvement Enhanced Program measures by end use**

End use	Measure
Plug load	<ul style="list-style-type: none"> <li>▪ ENERGY STAR® clothes dryer</li> </ul>
Building envelope	<ul style="list-style-type: none"> <li>▪ Window film</li> <li>▪ ENERGY STAR windows</li> </ul>
Domestic hot water	<ul style="list-style-type: none"> <li>▪ ENERGY STAR clothes washer</li> <li>▪ ENERGY STAR dishwasher</li> <li>▪ Heat pump water heater upgrade</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ LEDs</li> </ul>

### E23.3. 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.<sup>117</sup> 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:

<sup>117</sup> 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 E24.5. 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.

#### **E23.4. 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.<sup>118</sup> 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.

#### **E23.5. Evaluated savings approach**

Dominion Energy will determine—during program implementation and in consultation with DNV—the appropriateness of conducting evaluations to estimate program impacts.

<sup>118</sup> 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.<sup>119</sup> The analysis will use a site-level or panel-model billing analysis approach (see Section E24.5.1.) The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.<sup>120</sup>

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 E24.5.1.)<sup>121</sup> The analysis will also follow the general approach of IPMVP, Option D, Calibrated Simulation.<sup>122</sup>

### E23.5.1. 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.

<sup>119</sup> 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>.

<sup>120</sup> Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

<sup>121</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>122</sup> 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.<sup>123</sup>

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.

### E23.5.2. 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

<sup>123</sup> This generally requires large numbers of installations (thousands) to yield meaningful results.



**E23.5.3. 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.

**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 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.

**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 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.

**E23.8. Residential Income and Age Qualifying Home Improvement Enhanced Program (Phase X) – Revision history**

**Table 24-2. Residential Income and Age Qualifying Home Improvement Enhanced Program revision history**

Version	Date	Notes
<b>Version 1</b>	December 2021	Initial release
<b>Version 2</b>	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Updated footnote 116 to refer to the most recent publicly available version of the DE TRM</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY  
Jun 14 2024



## E24. NON-RESIDENTIAL INCOME AND AGE QUALIFYING PROGRAM FOR HEALTH CARE AND RENTAL PROPERTY OWNERS PROGRAM EM&V PLAN (PHASE X)

### E24.1. 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.

### E24.2. Measures

The energy efficiency measures listed in Table 26-1 will be offered by the Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners.

**Table 25-1. Non-Residential Income and Age Qualifying Program for Health Care and Rental Property Owners Measures by end use**

End use	Measure
<b>Plug load</b>	<ul style="list-style-type: none"> <li>▪ Refrigerator upgrade</li> <li>▪ ENERGY STAR® clothes washer</li> <li>▪ ENERGY STAR clothes dryer</li> <li>▪ ENERGY STAR dishwasher</li> </ul>
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Attic insulation</li> <li>▪ Floor insulation</li> <li>▪ Air sealing</li> <li>▪ Window film</li> <li>▪ Door upgrade</li> <li>▪ ENERGY STAR windows</li> </ul>
<b>Domestic hot water</b>	<ul style="list-style-type: none"> <li>▪ Heat pump water heater upgrade</li> <li>▪ Energy-saving showerhead</li> <li>▪ High-efficiency faucet aerator</li> <li>▪ Pipe wrap for water heaters</li> <li>▪ Water heater tank wrap</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Heat pump tune-up</li> <li>▪ AC tune-up</li> <li>▪ Duct sealing</li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ LEDs</li> </ul>



### E24.3. 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.<sup>124</sup> 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 E25.5. 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 leveled 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.

### E24.4. 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.<sup>125</sup> DNV will work with program implementers and Dominion Energy to identify the data to collect from program participants, where practical, to estimate

<sup>124</sup> 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.

<sup>125</sup> 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.

## E24.5. 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.<sup>126</sup> The analysis will use a site-level or panel-model billing analysis approach (see Section E25.5.1.) The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.<sup>127</sup>

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<sup>128</sup> (see Section E25.5.1. ). The analysis will also follow the general approach of the IPMVP, Option D, Calibrated Simulation.<sup>129</sup>

### E24.5.1. 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.

<sup>126</sup> 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>.

<sup>127</sup> Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

<sup>128</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>129</sup> 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.<sup>130</sup>

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.

### E24.5.2. 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%

<sup>130</sup> 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

### **E24.5.3. 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.

### **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 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.

### **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. 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.



**E24.8. Non-Residential Income and Age Qualifying Program for Healthcare and Rental Property Owners – Revision history**

Table 25-2. 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	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Updated footnote 109 to refer to the most recent publicly available version of the DE TRM</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>



## E25. RESIDENTIAL INCOME AND AGE QUALIFYING TARGET REPORT PROGRAM EM&V PLAN (PHASE X)

### E25.1. 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.

### E25.2. Measures

The energy efficiency measures listed in Table 26-1 will be offered by the IAQ Energy Target Report Program.

**Table 26-1. IAQ Energy Target Report Program measures by end use**

End use	Measure
Whole Building	▪ Home energy target report – Mail
	▪ Home energy target report – Digital

### E25.3. 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.<sup>131</sup> 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.

<sup>131</sup> 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 E26.5. 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 leveled 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.

#### **E25.4. 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.<sup>132</sup> 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.

#### **E25.5. 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.<sup>133</sup>

<sup>132</sup> 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>.

<sup>133</sup> 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.



### E25.5.1. 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.

### E25.5.2. 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.



**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 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.

**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 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.

**E25.8. Residential Income and Age Qualifying Target Report Program – Revision history**

Table 26-2. 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	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>



## E26. RESIDENTIAL INCOME AND AGE QUALIFYING BUNDLE PROGRAM EM&V PLAN (PHASE XI)

The proposed bundled version of the Residential Income and Age Qualifying Home Improvement Program combines the Company’s existing Phase 9 and 10 low-income programs while adding several new program measures and creating a bundled income qualifying program that would provide income and age qualifying residential customers with in-home energy assessments and 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 the selected energy-saving products. The newly added program measures are wall insulation, heat pump replacement, baseboard upgrade, upgrade to mini split, ventilation fan, and duct replacement as well as ENERGY STAR® ceiling fans, smart power strips, and T8 and T12 (fluorescent tube lighting) upgrade to LED lighting.

This bundled program approach will allow homes to be treated more comprehensively and offer qualifying customers the opportunity to implement a wider variety of energy efficiency measures during the in-home energy assessment stage.

### E26.1. Measures

An extensive list of heating, ventilation, and air conditioning (HVAC), weatherization, efficient appliance, and safety measures is proposed for this program and are listed in Table 21-1.

**Table 27-1. Measures offered by Residential Bundling of Income and Age Qualifying Programs**

End-use	Measure
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ LED lighting</li> </ul>
<b>Building Envelope</b>	<ul style="list-style-type: none"> <li>▪ Insulation repair/upgrade wall</li> <li>▪ Insulation repair/upgrade floor</li> <li>▪ Insulation repair/upgrade attic</li> <li>▪ Comprehensive air sealing</li> <li>▪ Window Film</li> <li>▪ Doors</li> <li>▪ ENERGY STAR windows</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Heat pump replacement</li> <li>▪ Duct sealing/insulation/repair/replacement</li> <li>▪ Electric baseboard heat upgrade</li> <li>▪ Upgrades to mini-split/ductless heat pumps</li> <li>▪ Thermostat replacement</li> <li>▪ HVAC tune-up</li> <li>▪ HVAC/home-ventilation improvements and fans</li> </ul>
<b>Domestic Hot Water</b>	<ul style="list-style-type: none"> <li>▪ Heat pump water heater</li> <li>▪ Showerhead</li> <li>▪ Faucet aerator</li> <li>▪ Pipe insulation</li> </ul>





End-use	Measure
	<ul style="list-style-type: none"> <li>▪ Insulating water heater tank wrap</li> </ul>
Plug Load	<ul style="list-style-type: none"> <li>▪ ENERGY STAR clothes washer</li> <li>▪ ENERGY STAR dishwasher</li> <li>▪ ENERGY STAR clothes dryer</li> <li>▪ Smart power strip</li> </ul>
Health & Safety	<ul style="list-style-type: none"> <li>▪ Safety measure</li> </ul>

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.

**E26.2. Evaluation, measurement, and verification overview**

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>134</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>135</sup> 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 are derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs.
3. Evaluated savings: Evaluated savings will be determined by the methods described in Section E27.4. . The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

**E26.3. Deemed savings approach**

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Bundling of the Income And Age Qualifying Home Improvement Program energy efficiency and weatherization measures will be developed through research primarily in the most recent version of the Maryland/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 and will document baseline assumptions from the program filing as required by the Final Order. Sources for all savings protocols,

<sup>134</sup>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.

<sup>135</sup> 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.



inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

## E26.4. Evaluated savings approach

The program specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>136</sup>

There is no Uniform Methods EM&V protocol that comprehensively addresses multifamily programs hence the proposed approach is based on a combination of methods modified for a multifamily program to accommodate the variety of residential customers that may participate in this program.

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, and common spaces). The program participation mix and data availability will dictate the most appropriate approach or combination of approaches.

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.<sup>137</sup> The analysis will use a site-level or panel-model billing analysis approach (see Section E27.4.1. ).

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP) and modified for a multifamily program, the evaluation approach may include, if deemed appropriate, a calibrated building simulation as recommended in Chapter 15.<sup>138</sup> (see Section E27.4.1. ). The analysis will also follow the general approach of IPMVP, Option D, Calibrated Simulation.<sup>139</sup>

### E26.4.1. Savings estimation

A regression analysis of billing data is the most cost-effective and comprehensive if the savings are measurable in a statistically significant way and the majority of the program impacts may be isolated. The billing analysis for the Residential Bundling of the Income and Age Qualifying Home Improvement Programs 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 by 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.

<sup>136</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>137</sup> 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>.

<sup>138</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>139</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



2. The panel model approach estimates a single model for all participant 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.

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 multifamily 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 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 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.

#### E26.4.2. 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

#### E26.4.3. Net-to-Gross assessment

If applicable, free-ridership and spill-over 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, to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

#### E26.5. 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<sup>140</sup>
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

<sup>140</sup> 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.



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.

**E26.6. Timeline and scope of work**

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

**E26.7. Residential Bundling of the Income and Age Qualifying Home Improvement Programs – revision history**

Table 27-2. Revision history for Residential Bundling of the Income and Age Qualifying Home Improvement Programs

Version	Date	Notes
Version 1	10/19/2022	Initial release – combined approaches from Phase XIII Residential HVAC Health and Safety Program EM&V plan with Phase IX Residential Income and Age Qualifying Enhanced Program EM&V plan



## E27. NON-RESIDENTIAL INCOME AND AGE QUALIFYING BUNDLE PROGRAM EM&V PLAN (PHASE XI)

### E27.1. Program summary

The Non-Residential Income and Age Qualifying Program 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 the bundled Non-Residential IAQ Program. The 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.

### E27.2. 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 28-1.

**Table 28-1. Measures offered by Non-Residential Bundling of Income and Age Qualifying Programs**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ LED lighting</li> </ul>
Building Envelope	<ul style="list-style-type: none"> <li>▪ Insulation repair/upgrade wall</li> <li>▪ Insulation repair/upgrade floor</li> <li>▪ Insulation repair/upgrade attic</li> <li>▪ Comprehensive air sealing</li> <li>▪ Window Film</li> <li>▪ Doors</li> <li>▪ ENERGY STAR windows</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Heat pump replacement</li> <li>▪ Duct sealing/insulation</li> <li>▪ Upgrades to mini-split/ductless heat pumps</li> <li>▪ Thermostat replacement</li> <li>▪ HVAC tune-up</li> <li>▪ HVAC/home-ventilation improvements and fans</li> </ul>
Domestic Hot Water	<ul style="list-style-type: none"> <li>▪ Heat pump water heater</li> <li>▪ Showerhead</li> <li>▪ Faucet aerator</li> <li>▪ Pipe insulation</li> <li>▪ Insulating water heater tank wrap</li> <li>▪ ENERGY STAR dishwasher</li> <li>▪ ENERGY STAR clothes washer</li> </ul>



End-use	Measure
Plug Load	<ul style="list-style-type: none"> <li>▪ ENERGY STAR clothes dryer</li> </ul>

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.

**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<sup>141</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>142</sup> 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 are derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs.
3. Evaluated savings: Evaluated savings will be determined by the methods described in Section E28.5. . The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

**E27.4. Deemed savings approach**

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Non-Residential Bundling of Income and Age Qualifying Programs energy efficiency and weatherization measures will be developed through research primarily in the most recent version of the Maryland/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 and will document baseline assumptions from the program filing as required by the Final Order. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

<sup>141</sup> 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.

<sup>142</sup> 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.



## 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.<sup>143</sup>

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.<sup>144</sup> The analysis will use a site-level or panel-model billing analysis approach (see Section E28.5.1. . ).

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,<sup>145</sup> The analysis may also follow the general approach of IPMVP, Option D, Calibrated Simulation.<sup>146</sup>

### E27.5.1. Savings estimation

Evaluations that include multifamily building or non-residential 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, and common spaces). 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 the majority of the program impacts are isolated. The billing analysis for the Non-Residential Bundling of Income and Age Qualifying Programs 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 participant 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 characteristics of occupancy at the time of evaluation. In some cases where specific measures have high installation rates and high relative impacts, the regression

<sup>143</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>144</sup> 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>.

<sup>145</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>146</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



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.<sup>147</sup>

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 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 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.

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.

The deemed savings for each individual 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.

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.

### E27.5.2. 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

### E27.5.3. Net-to-Gross assessment

If applicable, free-ridership and spill-over 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, to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

<sup>147</sup> This generally requires large numbers of installs (thousands) to yield meaningful results.





**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 billing analysis<sup>148</sup>
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.

**E27.7. Timeline and scope of work**

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

**E27.8. Non-Residential Bundling of Income and Age Qualifying Programs – revision history**

**Table 28-2. Revision history for Non-Residential Bundling of Income and Age Qualifying Programs**

Version	Date	Notes
Version 1	10/19/2022	Initial release– based on the approaches from Phase XIII Non-Residential HVAC Health and Safety Program EM&V plan with minor modifications for differences in measures

<sup>148</sup> 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.



## E28. NON-RESIDENTIAL HEATING AND COOLING EFFICIENCY PROGRAM EM&V PLAN (PHASE VII)

### E28.1. 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.

### E28.2. Measures

The following high-efficiency HVAC measures are included in the program:

**Table 29-1. Measures offered by Non-Residential Heating and Cooling Efficiency Program**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Air conditioner upgrade</li> <li>▪ HP upgrade</li> <li>▪ Geothermal HP</li> <li>▪ Mini split HP</li> <li>▪ Water source HP</li> <li>▪ Chiller upgrade</li> <li>▪ Economizers</li> <li>▪ Variable frequency drives</li> <li>▪ Variable refrigerant flow</li> <li>▪ Unitary AC</li> </ul>

### 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.<sup>149</sup> 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.

<sup>149</sup> 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").<sup>150</sup>

#### **E28.4. 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.

#### **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.<sup>151</sup>

Our approach relies heavily on the DOE's Uniform Methods Project protocols (UMP):<sup>152</sup> According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment,<sup>153</sup> 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,<sup>154</sup> 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,<sup>155</sup> 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,

<sup>150</sup> 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.

<sup>151</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>152</sup> 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>.

<sup>153</sup> 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>.

<sup>154</sup> 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>.

<sup>155</sup> 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,<sup>156</sup> 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 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<sup>157</sup> (IPMVP) as shown in Table 29-2.

<sup>156</sup> 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.

<sup>157</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



**Table 29-2. Preferred IPMVP options for Non-Residential Heating and Cooling Efficiency Program measures**

Measure	IPMVP option	Key parameter(s)
<b>Package terminal air conditioners and package terminal heat pumps</b>	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>• Cooling loads</li> <li>• Heating loads (if applicable)</li> <li>• Annual hours of operation</li> </ul>
<b>Unitary and split air-conditioning systems and air-source heat pumps</b>	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>• Cooling loads</li> <li>• Heating loads (if applicable)</li> <li>• Annual hours of operation</li> </ul>
<b>Variable frequency drives</b>	<u>Option B</u> . Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>• Annual hours of operation at part-load conditions</li> </ul>
<b>Economizers</b>	<u>Option D</u> . Calibrated Simulation	<ul style="list-style-type: none"> <li>• Verify proper operation</li> <li>• Annual hours of operation</li> </ul>
<b>Water- and air-cooled chillers</b>	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach or <u>Option C</u> . Whole Facility, if energy management system data are available and project-level savings are large compared to other energy variations at facility	<ul style="list-style-type: none"> <li>• Cooling loads</li> <li>• Outside air temperatures</li> <li>• Manufacturer part-load efficiency data</li> <li>• Annual hours of operation</li> </ul>
<b>Geothermal heat pumps</b>	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>• Cooling loads</li> <li>• Heating loads (if applicable)</li> <li>• Annual hours of operation</li> </ul>
<b>Variable-refrigerant-flow systems and mini-split heat pumps</b>	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>• Cooling loads</li> <li>• Heating loads (if applicable)</li> <li>• Annual hours of operation</li> </ul>

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.

**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 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.

**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 Heating and Cooling Efficiency Program – Revision history**

**Table 29-3. Revision history for Non-Residential Heating and Cooling Efficiency 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.
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
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
		<ul style="list-style-type: none"> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

Jun 14 2024



## E29. NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS PROGRAM EM&V PLAN (PHASE VII)

### E29.1. 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.

### E29.2. Measures

The following high-efficiency lighting measures are included in the program:

**Table 30-1. Measures offered by Non-Residential Lighting Systems & Controls Program**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ High-efficiency T8/T5 lamps</li> <li>▪ LED lamps</li> <li>▪ Occupancy sensor(s) and lighting controls</li> </ul>

### 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.<sup>158</sup> 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").<sup>159</sup>

### E29.4. 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 this program will be documented in the DE TRM and calculated using utility-reported program participant data. DNV will

<sup>158</sup> 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.

<sup>159</sup> 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.





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.

## 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.<sup>160</sup>

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol<sup>161</sup> of The Uniform Methods Project<sup>162</sup> (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,<sup>163</sup> 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,<sup>164</sup> 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. 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

<sup>160</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>161</sup> Gowans, D.; Talarico, 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>

<sup>162</sup> 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>

<sup>163</sup> 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>

<sup>164</sup> 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.



### E29.5.2. 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.<sup>165</sup> 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,<sup>166</sup> 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.

### 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.

<sup>165</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).

<sup>166</sup> 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.



**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 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.

**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 upon sufficient program participation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

**E29.8. Non-Residential Lighting Systems & Controls Program – Revision history**

Table 30-2. Revision history for Non-Residential Lighting Systems & Controls Program EM&V Plan

Version	Date	Notes
Version 1	2020	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Formatted measure table.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## 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	<ul style="list-style-type: none"> <li>▪ High-efficiency T8/T5 lamps</li> <li>▪ LED lamps and fixtures</li> <li>▪ Occupancy sensor(s) and lighting controls</li> </ul>

### 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.<sup>167</sup> 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:

8. **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.
9. **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.
10. **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

<sup>167</sup> 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.<sup>168</sup> 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).<sup>169</sup>

<sup>168</sup> 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>.

<sup>169</sup> Gowans, D.; Talarico, 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.<sup>170</sup>

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.<sup>171</sup> 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.<sup>172</sup>

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.

<sup>170</sup> 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>

<sup>171</sup> 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.

<sup>172</sup> 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**

11. Develop and update EM&V plan annually.
12. Analyze program tracking data: Annual report (June 15 of each year following program launch).
13. Update the DE TRM annually for changes that occurred to its referenced sources.
14. Develop baseline use, efficient use, and measure savings load shapes annually.
15. If appropriate, conduct impact evaluation studies upon sufficient program participation.
16. Provide regulatory support as necessary.
17. 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	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>





## E31. NON-RESIDENTIAL OFFICE PROGRAM EM&V PLAN (PHASE VII)

### E31.1. Program summary

This program would provide qualifying customers incentives for the installation of energy efficiency improvements, consisting of recommissioning measures at smaller office facilities.

### E31.2. Measures

The following measures are included in the Non-Residential Office Program.

**Table 31-1. Measures offered by Non-Residential Office Program**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Schedule HVAC</li> <li>▪ Temperature setback</li> <li>▪ Condenser water reset</li> <li>▪ Discharge air temp reset</li> <li>▪ Static pressure reset</li> <li>▪ Enthalpy economizer</li> <li>▪ Variable air volume box minimum</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ Schedule lighting</li> </ul>

### 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.<sup>173</sup> 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”).<sup>174</sup>

<sup>173</sup> 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.

<sup>174</sup> 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.



### **E31.4. 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.

### **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.<sup>175</sup>

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<sup>176</sup> of The Uniform Methods Project<sup>177</sup> (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,<sup>178</sup> 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.

#### **E31.5.1. 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

<sup>175</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>176</sup> 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>

<sup>177</sup> 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>

<sup>178</sup> 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

### E31.5.2. 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<sup>179</sup> (IPMVP). 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,<sup>180</sup> 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.

### 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.

<sup>179</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org)

<sup>180</sup> 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.



### 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 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.

### 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 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.

### E31.8. Non-Residential Office Program – Revision history

Table 31-2. Revision history for Non-Residential Office Program EM&V Plan

Version	Date	Notes
Version 1	2020	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Formatted measure table.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Provided clarification of Option C and non-routine events to "Savings Estimation"</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E32. NON-RESIDENTIAL SMALL MANUFACTURING PROGRAM EM&V PLAN (PHASE VII)

### E32.1. 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.

### E32.2. Measures

The following measures are included in the Non-Residential Small Manufacturing Program.

**Table 32-1. Measures offered by Non-Residential Small Manufacturing Program**

End-use	Measure
Compressed Air	<ul style="list-style-type: none"> <li>▪ Compressed air nozzles</li> <li>▪ Leaks</li> <li>▪ No loss drains</li> <li>▪ Additional compressed air storage</li> <li>▪ Heat of compression dryer</li> <li>▪ Low-pressure Drop filter</li> <li>▪ Variable speed drive air compressor</li> <li>▪ Cycling refrigerant dryer</li> <li>▪ Dewpoint controls</li> <li>▪ Pressure reduction</li> <li>▪ Downsized variable frequency drive compressor</li> </ul>

### E32.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>181</sup> 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”).<sup>182</sup>

<sup>181</sup> 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.

<sup>182</sup> 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.



### E32.4. 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.

### E32.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>183</sup>

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<sup>184</sup> of The Uniform Methods Project<sup>185</sup> (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,<sup>186</sup> 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.

#### E32.5.1. 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

<sup>183</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>184</sup> 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>

<sup>185</sup> 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>

<sup>186</sup> 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.



### E32.5.2. 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).<sup>187</sup>

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.

### E32.5.3. 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.

### E32.6. 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.

<sup>187</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



**E32.7. 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.

**E32.8. Non-Residential Small Manufacturing Program – Revision history**

Table 32-2. Revision history for Non-Residential Small Manufacturing Program EM&V Plan

Version	Date	Notes
Version 1	2020	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Formatted measure table.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>





## E33. NON-RESIDENTIAL WINDOW FILM PROGRAM EM&V PLAN (PHASE VII)

### E33.1. 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.

### E33.2. Measures

Solar window film installation(s) are eligible for a rebate through the program under specified conditions.

### 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.<sup>188</sup> 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.).<sup>189</sup> 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").<sup>190</sup>

### E33.4. 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

<sup>188</sup> 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.

<sup>189</sup> California Electronic Technical Reference Manual, DEER Database, <https://cedars.sound-data.com/deer-resources/deer-database/>.

<sup>190</sup> 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.

### **E33.5. Evaluated savings approach**

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>191</sup>

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<sup>192</sup> (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,<sup>193</sup> 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.

#### **E33.5.1. 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

#### **E33.5.2. 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,<sup>194</sup> is a calibrated simulation study that uses computer simulation software (e.g. DOE 2 eQUEST or Energy Plus software packages), will be used to predict the change in energy and demand of efficiency measures from a

<sup>191</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>192</sup> 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>

<sup>193</sup> 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](http://www.evo-world.org).



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.

**E33.5.3. 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.

**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 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.

**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 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.

**E33.8. Non-Residential Window Film Program – Revision history**

Table 33-1. Revision history for Non-Residential Window Film Program EM&V Plan

Version	Date	Notes
---------	------	-------



<b>Version 1</b>		<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number. Added reference to DEER database.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E34. NON-RESIDENTIAL MIDSTREAM EFFICIENCY PRODUCTS PROGRAM EM&V PLAN (PHASE VIII)

### E34.1. 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.

### E34.2. Measures

The measures to be offered through the Non-Residential Midstream Efficient Products Program are provided in Table 34-1.

**Table 34-1. Measures offered by the Non-Residential Midstream Efficiency Products Program**

End-use	Measure
Cooking	<ul style="list-style-type: none"> <li>▪ Commercial kitchen equipment</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Efficient heat pumps</li> <li>▪ Efficient air conditioning units</li> <li>▪ Air- and water-cooled chillers</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Commercial freezers and coolers</li> </ul>

### 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.<sup>195</sup> 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 E34.5. 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").<sup>196</sup>

<sup>195</sup> 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.

<sup>196</sup> 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.



#### **E34.4. 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.

#### **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.<sup>197</sup>

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<sup>198</sup> (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,<sup>199</sup> 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,<sup>200</sup> 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,

<sup>197</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>198</sup> 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>

<sup>199</sup> 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>

<sup>200</sup> 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,<sup>201</sup> 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

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 34-2.<sup>202</sup>

**Table 34-2. Preferred IPMVP options for Non-Residential Midstream Efficiency Products program measures**

Measure	IPMVP option	Key parameter(s)
<b>Cooking equipment</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooking loads</li> <li>▪ Annual hours of operation</li> </ul>
<b>PTACs, Unitary and split air-conditioning systems and air-source heat pumps, and mini-split systems</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Air- and water-cooled chillers</b>	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	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Outside air temperatures</li> <li>▪ Manufacturer part-load efficiency data</li> <li>▪ Annual hours of operation</li> </ul>
<b>Refrigeration equipment</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Space-conditioning category</li> <li>▪ Annual hours of operation</li> </ul>

<sup>201</sup> 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.

<sup>202</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://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.

### E34.5.2. 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

### 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 gross impact evaluation method as appropriate.<sup>203</sup>

<sup>203</sup> 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.

**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 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.

**E34.8. Non-Residential Midstream Efficiency Products Program – Revision history**

Table 34-3. Revision history for Non-Residential Midstream Energy Efficiency Products Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial Release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Minor word edits to measure section.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated program name from "Non-Residential Midstream Energy Efficient Products Program" to "Non-Residential Midstream Energy Efficiency Products Program"</li> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Provided clarification of Option C and non-routine events to "Savings Estimation"</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E35. NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (PHASE VIII)

### E35.1. 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.

### E35.2. 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 35-1.

**Table 35-1. Measures offered by the Non-Residential New Construction Program**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ Exterior LED lighting</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ High efficiency and variable speed chillers</li> <li>▪ High-efficiency direct expansion (DX) cooling equipment</li> <li>▪ High-efficiency packaged air-source heat pumps</li> <li>▪ Demand controlled ventilation</li> <li>▪ Variable air volume (VAV) dual-max controls</li> <li>▪ Chiller controls</li> </ul>
Plug load	<ul style="list-style-type: none"> <li>▪ Supervisory Plug load management systems</li> </ul>

### 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.<sup>204</sup> 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.

<sup>204</sup> 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 E35.5. 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").<sup>205</sup>

#### **E35.4. 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.

#### **E35.5. Evaluated savings approach**

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>206</sup>

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include calibrated building simulation.<sup>207</sup> The analysis will use a site-level analysis approach (see Section E35.5.1. . The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.<sup>208</sup>

##### **E35.5.1. 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.

<sup>205</sup> 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.

<sup>206</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>207</sup> 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](http://www.nrel.gov/docs/fy17osti/68571.pdf).

<sup>208</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://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.

### E35.5.2. 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

### E35.5.3. 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.

## 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 calibrated simulation analysis.<sup>209</sup>
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.

## 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 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.

<sup>209</sup> 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.



### E35.8. Non-Residential New Construction Program – Revision history

Table 35-2. Revision History for Non-Residential New Construction Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>Initial release</li> </ul>
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Updated IPMVP reference from 2012 to 2022.</li> <li>Removed version number from title</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E36. NON-RESIDENTIAL PRESCRIPTIVE ENHANCED PROGRAM EM&V PLAN (PHASE IX)

### E36.1. 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.

### E36.2. Measures

The measures offered by the Non-Residential Prescriptive Enhanced Program are as shown in Table 36-1.

**Table 36-1. Measures offered by Non-Residential Enhanced Prescriptive Program**

End-use	Measure
	<ul style="list-style-type: none"> <li>▪ Commercial oven</li> <li>▪ Commercial electric fryer</li> <li>▪ Commercial griddle</li> <li>▪ Commercial hot food holding cabinet</li> <li>▪ Commercial steam cooker</li> <li>▪ Commercial dishwasher</li> <li>▪ Food seal wrapper</li> <li>▪ Pre-rinse sprayer</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ AC &amp; HP tune Up</li> <li>▪ Duct testing &amp; sealing</li> <li>▪ Electrically commutated motor (ECM)</li> <li>▪ Guest room energy management</li> <li>▪ Parking ventilation VSD</li> </ul>
Plug load	<ul style="list-style-type: none"> <li>▪ Advanced power strip</li> <li>▪ Commercial dryer</li> <li>▪ Commercial washing machine</li> <li>▪ Ozone laundry</li> <li>▪ Vending machine miser</li> </ul>
Recreation	<ul style="list-style-type: none"> <li>▪ Heat pump pool heater</li> <li>▪ Pool pump VSD</li> <li>▪ Pool spa cover</li> </ul>



End-use	Measure
Refrigeration	<ul style="list-style-type: none"> <li>▪ Anti-sweat door film</li> <li>▪ Auto closer</li> <li>▪ Coil cleaning</li> <li>▪ Commercial cooler &amp; freezer</li> <li>▪ Door gasket</li> <li>▪ Evaporator fan control</li> <li>▪ Evaporator fan ECM</li> <li>▪ Floating head pressure control</li> <li>▪ Ice maker</li> <li>▪ Night cover</li> <li>▪ Strip curtain</li> <li>▪ Suction pipe insulation</li> </ul>

### E36.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>210</sup> 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 E36.5. 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").<sup>211</sup>

### E36.4. 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

<sup>210</sup> 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.

<sup>211</sup> 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.

### **E36.5. Evaluated savings approach**

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>212</sup>

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.<sup>213</sup>

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.<sup>214</sup>

At a high level, the ratio of the measured and verified savings to the deemed savings for the sample, also called a realization rate,<sup>215</sup> 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.

#### **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 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

<sup>212</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion’s DSM Programs.

<sup>213</sup> 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>

<sup>214</sup> 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>

<sup>215</sup> 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 36-2.<sup>216</sup>

**Table 36-2. Preferred IPMVP options for Non-Residential Prescriptive Program measures**

End-use/measure	IPMVP option	Key parameter(s)
<b>Food service</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Quantity</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> </ul>
<b>HVAC &amp; Retro-commissioning</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> <li>▪ HVAC equipment type</li> </ul>
<b>HVAC: VSD &amp; ECM</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part- and full-load conditions</li> </ul>
<b>Plug load</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Quantity</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> </ul>
<b>Recreation</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Quantity</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> </ul>
<b>Refrigeration</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Annual hours of operation</li> </ul>

**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.

<sup>216</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.



### E36.5.2. 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

### E36.5.3. 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.

### 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 impact evaluation.<sup>217</sup>
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.

### 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. 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.

### E36.8. Non-Residential Prescriptive Program – Revision history

Table 36-3. Revision history for Non-Residential Prescriptive Program EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release

<sup>217</sup> 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	<ul style="list-style-type: none"> <li>Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>Updated IPMVP reference from 2012 to 2022.</li> <li>Removed version and phase number from title</li> <li>Provided clarification of Option C and non-routine events to "Savings Estimation"</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

JUN 14 2024



## E37. NON-RESIDENTIAL PRESCRIPTIVE BUNDLE PROGRAM EM&V PLAN (PHASE IX)

### E37.1. Program summary

The Non-Residential Prescriptive Program would offer a more comprehensive program bundle that would incorporate the Company's expiring DSM Phase VII Non-Residential Heating and Cooling Efficiency, Non-Residential Manufacturing and Non-Residential Window Film Programs into the overarching DSM Phase IX Non-Residential Prescriptive Enhanced Program offering. The consolidation of various program measures into a more enhanced version of the Phase IX Non-Residential Prescriptive Program would allow the Company to consolidate programs and offer qualifying non-residential customers the ease of implementing a wide variety of energy efficiency measures.

This program would provide qualifying non-residential customers with incentives for the installation of refrigeration, commercial kitchen equipment, HVAC improvements, window film installation and maintenance and installation of other program specific, energy efficiency measures.

### E37.2. Measures

The measures offered by the Non-Residential Prescriptive Program are as shown in Table 10-1.

**Table 10-1. Measures Offered by Non-Residential Prescriptive Program**

End-Use	Measure
<b>Building Envelope</b>	<ul style="list-style-type: none"> <li>▪ Window Film installation</li> </ul>
<b>Food Service</b>	<ul style="list-style-type: none"> <li>▪ Commercial kitchen appliances</li> <li>▪ Food seal wrappers</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Air conditioner upgrade</li> <li>▪ Geothermal HP</li> <li>▪ Mini split HP</li> <li>▪ Water source HP</li> <li>▪ HP Upgrades</li> <li>▪ Chiller upgrade</li> <li>▪ Economizers</li> <li>▪ Variable frequency drives</li> <li>▪ Variable refrigerant flow</li> <li>▪ Unitary AC</li> <li>▪ Guest room energy management</li> <li>▪ Parking ventilation VSD</li> <li>▪ Duct testing &amp; sealing</li> <li>▪ Pressure reduction</li> <li>▪ Electrically commutated motor (ECM)</li> </ul>
<b>Plug Load</b>	<ul style="list-style-type: none"> <li>▪ Commercial dryer</li> <li>▪ Ozone laundry</li> </ul>
<b>Recreation</b>	<ul style="list-style-type: none"> <li>▪ Heat pump pool cover</li> <li>▪ Pool pump VSD</li> </ul>
<b>Compressed Air</b>	<ul style="list-style-type: none"> <li>▪ Heat of compression dryer</li> <li>▪ Low pressure drop filter</li> </ul>



End-Use	Measure
	<ul style="list-style-type: none"> <li>▪ Compressed air study</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Cycling refrigerant dryer</li> <li>▪ Dewpoint controls</li> </ul>
Misc.	<ul style="list-style-type: none"> <li>▪ Custom: See EM&amp;V plan for Non-Residential Custom Program</li> <li>▪ Leaks</li> <li>▪ No loss drains</li> <li>▪ Add storage</li> </ul>

### E37.3. Evaluation, measurement, and verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>218</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>219</sup> 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:

- Baseline consumption: Baseline consumption will be calculated per the DE TRM, which is derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs.
- Deemed savings: Deemed savings values will be estimated per the DE TRM, which is derived primarily from the most recent version of the Maryland/Mid-Atlantic TRM, and as appropriate, other TRMs or protocols.
- Evaluated savings: Evaluated savings will be determined by the methods described in Section 10.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.

### E37.4. 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 Maryland/Mid-Atlantic TRM, and 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 consideration the priority order in 20 VAC 5-318-40 and will document baseline assumptions from the program filing as required by the Final Order. Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

<sup>218</sup> 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.

<sup>219</sup> 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.



### E37.5. Evaluated savings approach

The program specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>220</sup>

**For HVAC Measures**, the EM&V approach relies heavily on the DOE's Uniform Methods Project protocols (UMP);<sup>221</sup>

According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment,<sup>222</sup> 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,<sup>223</sup> 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,<sup>224</sup> 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 represent all of these categories. However, 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,<sup>225</sup> 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.

**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, annual hours of operation.

<sup>220</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>221</sup> 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>

<sup>222</sup> 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>

<sup>223</sup> 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>

<sup>224</sup> 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>

<sup>225</sup> 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.



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.<sup>226</sup>

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<sup>227</sup> (UMP) does not specifically address window film, the key parameter for determining gross savings and peak demand reductions include surface area of treated windows and the Solar Heat Gain Coefficient (SHGC).

For **compressed air 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 of The Uniform Methods Project (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, 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.

### 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 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

If metering is used, it will be conducted according to the IPMVP as shown in Table 10-2.<sup>228</sup>

<sup>226</sup> 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>

<sup>227</sup> 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>

<sup>228</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.



Table 10-2. Preferred IPMVP options for Non-Residential Prescriptive 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	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
Unitary and Split Air-conditioning Systems and Air-source Heat Pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
Variable Frequency Drives	Option B. Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions</li> </ul>
Economizers	Option D. Calibrated Simulation	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> </ul>
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	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Outside air temperatures</li> <li>▪ Manufacturer part-load efficiency data</li> <li>▪ Annual hours of operation</li> </ul>
Geothermal Heat Pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
Variable-refrigerant-flow systems and mini-split heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
Window Film	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Area of window film</li> <li>▪ HVAC and lighting annual hours of operation</li> </ul>
Duct Testing & Sealing and HVAC Tune-ups	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
Refrigeration Equipment	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Space-conditioning category</li> <li>▪ Annual hours of operation</li> </ul>

**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 the **IPMVP Option C** whole facility approach 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.

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.

As recommended in UMP, the International Performance Measurement and Verification Protocol (IPMVP) Option D. Calibrated Simulation,<sup>229</sup> is a calibrated simulation study that uses computer simulation software (e.g. DOE 2 eQUEST or 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.

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.

### E37.5.2. 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: 85–90%
- Relative precision: 10–15%
- Installed measures
- Budget, schedule, and geographical distribution

### E37.5.3. Net-to-gross assessment

If applicable, free-ridership and spill-over 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

---

Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



the program not been available, to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

**E37.6. Lost revenue methodology**

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

7. Calculate program savings by applying the realization rate derived from the impact evaluation<sup>230</sup>
8. Apply the measured data to the actual participant data to arrive at program level energy and demand savings, reflected on a monthly basis. Program savings are annualized in the EM&V tracking reports based on monthly participation data.
9. Develop cumulative monthly energy savings based on measured and evaluated data to represent the lost sales (kWh) associated with the program
10. 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

**E37.7. Timeline and scope of work**

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

**E37.8. Non-Residential Prescriptive Enhanced Program – revision history**

Table 10-3. Revision history for Non-Residential Prescriptive Enhanced Program EM&V Plan

Version	Date	Notes
Version 1	10/19/2022	Initial release

<sup>230</sup> 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.



## E38. 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.

### E38.1. Measures

The following measures are included in the Non-Residential Small Business Improvement Enhanced Program (Phase VIII).

**Table 37-1. Measures offered by Non-Residential Small Business Improvement Enhanced Program**

End-use	Measure
Building envelope	<ul style="list-style-type: none"> <li>▪ Window film</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Efficient air conditioning upgrades</li> <li>▪ Efficient heat pump upgrades</li> <li>▪ Variable Frequency Drives</li> <li>▪ Window film</li> <li>▪ Prescriptive re-commissioning</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ Direct install lighting</li> <li>▪ Dimmers and controls</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Refrigeration measures</li> </ul>

### E38.2. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>231</sup> 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 E38.4. 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”).

<sup>231</sup> 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.



### E38.3. 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.

### E38.4. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>232</sup>

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<sup>233</sup> (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.<sup>234</sup>

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP,<sup>235</sup> 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,<sup>236</sup> 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

<sup>232</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>233</sup> 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>

<sup>234</sup> 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>

<sup>235</sup> 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>

<sup>236</sup> 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,<sup>237</sup> 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.

### E38.4.1. 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 37-2.<sup>238</sup>

**Table 37-2. Preferred IPMVP options for Small Business Improvement Enhanced Program measures**

Measure	IPMVP option	Key parameter(s)
<b>Window film</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Area of window film</li> <li>▪ HVAC and lighting annual hours of operation</li> </ul>
<b>Duct testing &amp; sealing and HVAC tune-ups</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>PTACs, Unitary AC/HP systems, mini-split systems</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>VFDs</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions</li> </ul>
<b>Economizers</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> </ul>

<sup>237</sup> 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.

<sup>238</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



Measure	IPMVP option	Key parameter(s)
<b>Programmable thermostats</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> <li>▪ Equipment type</li> </ul>
<b>Lighting &amp; lighting controls</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Fixture quantity (baseline and efficient)</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Refrigeration equipment</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Space-conditioning category</li> <li>▪ Annual hours of operation</li> </ul>

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.

### E38.4.2. 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

### E38.4.3. 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.

### E38.5. 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.<sup>239</sup>
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.

### E38.6. 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.

### E38.7. Small Business Improvement Enhanced Program (Phase VIII) – Revision history

Table 37-3. 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.
Version 3	4/22/2022	▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)

<sup>239</sup> 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
		<ul style="list-style-type: none"> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

Jun 14 2024





## E39. NON-RESIDENTIAL AGRICULTURAL ENERGY EFFICIENCY PROGRAM EM&V PLAN (PHASE IX)

### E39.1. 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.

### E39.2. Measures

The measures offered by the Non-Residential Agricultural Program are as shown in Table 38-1.

**Table 38-1. Measures offered by Non-Residential Agricultural Program**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Circulation fan</li> <li>▪ High volume low-speed fan</li> <li>▪ Ventilation fan</li> <li>▪ Livestock warming equipment</li> </ul>
Lighting	<ul style="list-style-type: none"> <li>▪ Lighting</li> <li>▪ Dairy lighting control</li> <li>▪ Greenhouse LED lighting</li> </ul>
Process	<ul style="list-style-type: none"> <li>▪ Agricultural VFD</li> <li>▪ Automatic milker takeoff</li> <li>▪ Efficient grain dryer</li> <li>▪ Grain storage aeration control</li> <li>▪ Low-pressure irrigation</li> <li>▪ Heat reclaimer</li> <li>▪ Dairy plate cooler</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Refrigeration tune-up</li> </ul>

### 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.<sup>240</sup> 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.

<sup>240</sup> 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 E38.5. 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").<sup>241</sup>

#### **E39.4. 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.

#### **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.<sup>242</sup>

To the extent possible, DNV draws from the Uniform Methods Project<sup>243</sup> (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.<sup>244</sup>

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,<sup>245</sup> 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

<sup>241</sup> 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.

<sup>242</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>243</sup> 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>.

<sup>244</sup> 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>.

<sup>245</sup> 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.

### E39.5.1. 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.<sup>246</sup> 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 38-2.

**Table 38-2. Preferred IPMVP options for Non-Residential Agricultural Program measures**

Measure	IPMVP option	Key parameters
<b>HVAC</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Annual hours of operation</li> <li>▪ Equipment efficiency</li> </ul>
<b>Lighting and controls</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Fixture quantity (baseline and efficient)</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Process equipment</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions for VFDs</li> <li>▪ Full-load amperage</li> <li>▪ Heat exchange rate (flow rates and temperature differences)</li> </ul>
<b>Refrigeration tune-up</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Equipment location</li> <li>▪ Annual hours of operation</li> </ul>

### 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 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

<sup>246</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol.



### 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 the measured data based off the on-site studies or consumption data analysis.<sup>247</sup>
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 (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.

### E39.8. Non-Residential Agricultural Program – Revision history

Table 38-3. 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	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

<sup>247</sup> 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.



OFFICIAL COPY

JUN 14 2024



## E40. NON-RESIDENTIAL BUILDING AUTOMATION PROGRAM EM&V PLAN (PHASE IX)

### E40.1. 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.

### E40.2. 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

### 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.<sup>248</sup> 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”).<sup>249</sup>

<sup>248</sup> 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.

<sup>249</sup> 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.



### E40.4. 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.

### 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.<sup>250</sup>

#### E40.5.1. 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.<sup>251</sup> 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
<b>Consumption data analysis</b>	<ul style="list-style-type: none"> <li>Option C: Whole Facility</li> </ul>	<ul style="list-style-type: none"> <li>Can be used if industry-accepted statistical criteria are met<sup>252</sup></li> <li>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.<sup>253</sup></li> </ul>
<b>End use regression model</b>	<ul style="list-style-type: none"> <li>Option B: All parameter measurement</li> </ul>	Requires pre-and post-metering of affected equipment
<b>Deemed calculation methodology (Bin Model Calculations)</b>	<ul style="list-style-type: none"> <li>Although not in IPMVP, it can incorporate Option A: Key Parameter Measurement</li> </ul>	<ul style="list-style-type: none"> <li>This approach can be used in most situations, with varying amounts of measured versus deemed values and calculations</li> </ul>

<sup>250</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>251</sup> 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>

<sup>252</sup> ASHRAE Guideline 14: Measurement of Energy and Demand Savings (2002), Page 16, Table 5-2, Performance Method Approach

<sup>253</sup> 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
		<ul style="list-style-type: none"> <li>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</li> </ul>
<b>Calibrated Simulation</b>	<ul style="list-style-type: none"> <li>Option D: Calibrated Simulation</li> </ul>	<ul style="list-style-type: none"> <li>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.</li> </ul>

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.

### 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 impact evaluation.<sup>254</sup>

<sup>254</sup> 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.

**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 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	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title. Changed reference from Tracked Savings to Deemed savings in EM&amp;V Overview</li> <li>▪ Provided clarification of Option C and non-routine events to “Savings Estimation”</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

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.



## E41. NON-RESIDENTIAL BUILDING OPTIMIZATION PROGRAM EM&V PLAN (PHASE IX)

### E41.1. 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.

### E41.2. 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	<ul style="list-style-type: none"> <li>▪ Schedule lighting</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Schedule HVAC</li> <li>▪ Temperature setback or setup</li> <li>▪ Condenser water temperature reset</li> <li>▪ Discharge-air temperature reset</li> <li>▪ Static pressure reset</li> <li>▪ Enthalpy economizer</li> <li>▪ Variable air-volume (VAV) box minimum</li> <li>▪ Chilled water temperature reset</li> <li>▪ Outdoor air damper adjustments</li> <li>▪ Coil cleaning</li> <li>▪ Pump pressure reduction</li> <li>▪ Schedule equipment</li> <li>▪ Advanced rooftop-unit controls</li> <li>▪ Custom recommissioning measure</li> <li>▪ Study rebate</li> </ul>

### 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.<sup>255</sup> 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.

<sup>255</sup> 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").<sup>256</sup>

#### E41.4. 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.

#### 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.<sup>257</sup>

##### E41.5.1. Savings estimation

According to Chapter 16: Retrocommissioning Evaluation Protocol of the UMP:<sup>258</sup>

*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.*

<sup>256</sup> 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.

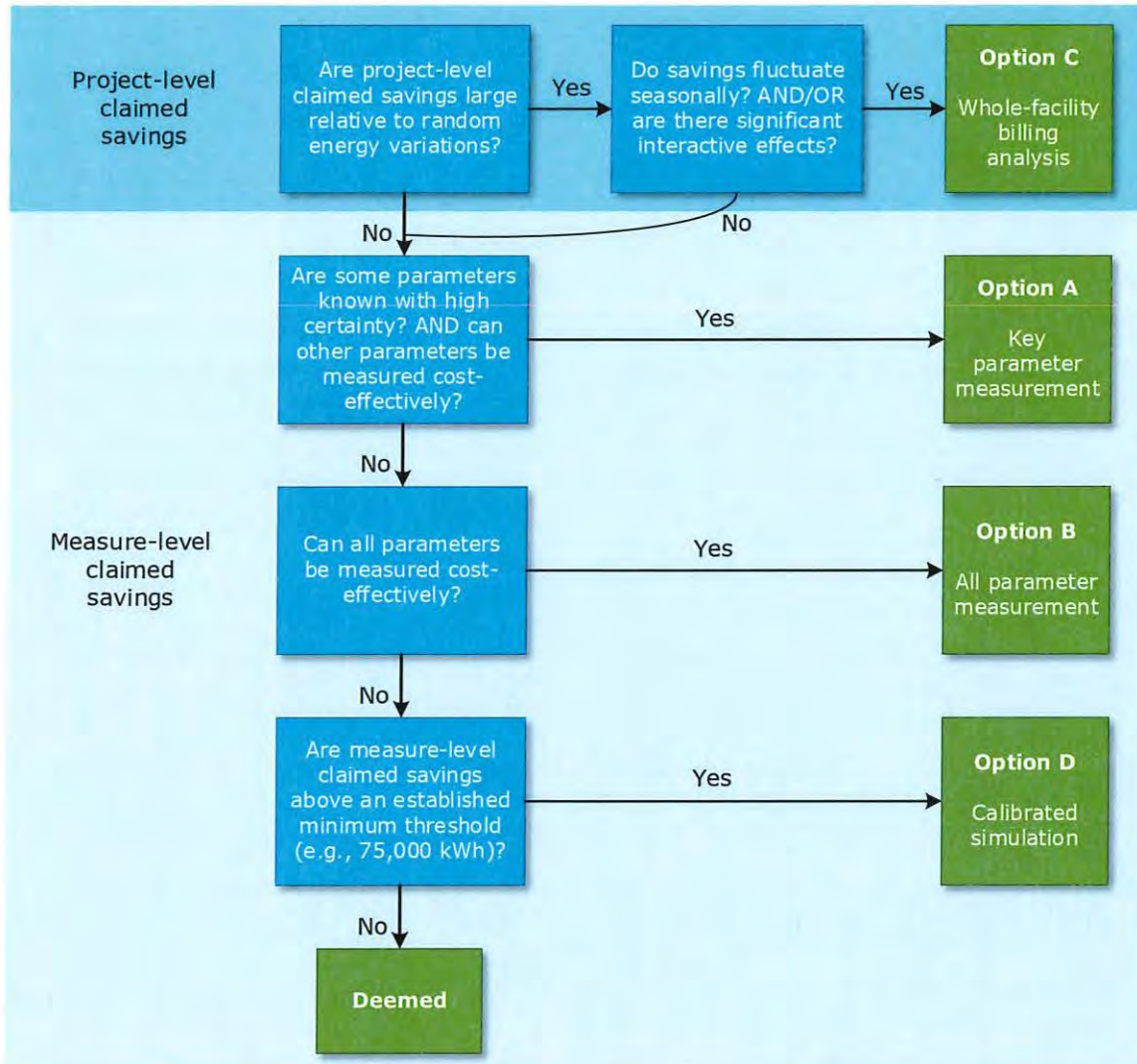
<sup>257</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.

<sup>258</sup> 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.<sup>259</sup>

**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
<b>Schedule lighting</b>	<ul style="list-style-type: none"> <li>▪ Fixture quantity, wattage, hours of operation, control type</li> </ul>	<ul style="list-style-type: none"> <li>▪ Option A</li> </ul>
<b>Schedule HVAC</b>	<ul style="list-style-type: none"> <li>▪ Equipment quantity, capacity, and capacity profile, efficiency, and efficiency profile</li> <li>▪ Equipment hours of operation profile</li> <li>▪ Variables affecting equipment efficiency</li> </ul>	<ul style="list-style-type: none"> <li>▪ Option A–B</li> </ul>
<b>Temperature setback or setup</b>	<ul style="list-style-type: none"> <li>▪ Space temperature and temperature setpoint</li> <li>▪ Outdoor air temperature</li> <li>▪ Building heat-loss characteristics</li> <li>▪ HVAC equipment details</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A, D</li> </ul>
<b>Condenser water temperature reset</b>	<ul style="list-style-type: none"> <li>▪ Condenser water temperature and setpoint temperature</li> <li>▪ Cooling tower design approach temperature</li> <li>▪ Cooling tower sequence of operation, fan control type, operating kW, operating hours</li> <li>▪ Chiller type, efficiency points or curves as a function of condenser water temperature and chiller load</li> <li>▪ Chiller operating characteristics</li> <li>▪ Chiller hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A, D</li> </ul>
<b>Discharge-air temperature reset</b>	<ul style="list-style-type: none"> <li>▪ Discharge air temperature and temperature setpoint</li> <li>▪ Mixed air temperature</li> <li>▪ Airflow rate across heating or cooling coil</li> <li>▪ Primary cooling/heating efficiency and/or efficiency curve</li> <li>▪ Primary cooling/heating equipment hours of operation</li> <li>▪ Primary air-moving equipment hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–B, D</li> </ul>
<b>Static pressure reset</b>	<ul style="list-style-type: none"> <li>▪ Fan sequence of operations, static pressure, static pressure setpoint</li> <li>▪ Supply airflow rate, operating kW, hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–B</li> </ul>



Measure	Key parameters (Baseline and post)	Methodologies
<b>Enthalpy economizer</b>	<ul style="list-style-type: none"> <li>▪ Economizer type</li> <li>▪ Outdoor and supply air temperature and humidity</li> <li>▪ Mixed-air temperature and humidity</li> <li>▪ Supply airflow rate</li> <li>▪ Outdoor air damper position</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–B, D</li> </ul>
<b>Variable air volume box minimum</b>	<ul style="list-style-type: none"> <li>▪ VAV box minimum open %, open %</li> <li>▪ Supply and discharge air temperature</li> <li>▪ Supply airflow</li> <li>▪ Mixed air temperature</li> <li>▪ Heating/cooling equipment, and AHU hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option B</li> </ul>
<b>Chilled water reset</b>	<ul style="list-style-type: none"> <li>▪ Chilled water supply temperature and temperature setpoint</li> <li>▪ Chiller efficiency points or curves as a function of condenser water temperature and chiller load</li> <li>▪ Chiller operating characteristics and hours of operation</li> <li>▪ Outdoor air temperature and humidity</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A, D</li> </ul>
<b>Outdoor air damper adjustments</b>	<ul style="list-style-type: none"> <li>▪ Outdoor air flow</li> <li>▪ Damper control sequence of operation</li> <li>▪ Damper control signal values and damper position</li> <li>▪ Mixed air, outdoor and return air temperature</li> <li>▪ Supply air temperature</li> <li>▪ Heating/cooling equipment efficiencies and hours of operation</li> <li>▪ Supply fan hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A, D</li> </ul>
<b>Coil cleaning</b>	<ul style="list-style-type: none"> <li>▪ Pressure drop across coil</li> <li>▪ Airflow rate across coil</li> <li>▪ Fan hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–B</li> </ul>
<b>Pump pressure reduction</b>	<ul style="list-style-type: none"> <li>▪ Pump differential pressure and operating kW</li> <li>▪ Independent variable such as schedule, outdoor air temperature</li> <li>▪ Pump performance curve</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–B</li> </ul>
<b>Scheduling non-HVAC equipment</b>	<ul style="list-style-type: none"> <li>▪ Equipment quantity, capacity, and capacity profile</li> <li>▪ Equipment efficiency and efficiency profile</li> <li>▪ Equipment hours of operation profile</li> <li>▪ Variables affecting equipment efficiency</li> </ul>	<ul style="list-style-type: none"> <li>▪ Option A–B</li> </ul>



Measure	Key parameters (Baseline and post)	Methodologies
<b>Advanced rooftop controls</b>	<ul style="list-style-type: none"> <li>▪ Fan control type</li> <li>▪ RTU operating kW</li> <li>▪ RTU hours of operation</li> </ul>	<ul style="list-style-type: none"> <li>▪ Option A–B</li> </ul>
<b>Custom recommissioning measure</b>	Varies	<ul style="list-style-type: none"> <li>▪ Deemed calculation</li> <li>▪ Option A–D</li> </ul>

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.

### E41.5.2. 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

### 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.<sup>260</sup>
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.

<sup>260</sup> 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.

**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 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	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Changed reference from Tracked Savings Deemed Savings in EM^V Overview</li> <li>▪ Provided clarification of Option C and non-routine events to “Savings Estimation”</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>





## E42. NON-RESIDENTIAL ENGAGEMENT PROGRAM EM&V PLAN (PHASE IX)

### E42.1. 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

### E42.2. 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	<ul style="list-style-type: none"> <li>▪ Building operator training</li> </ul>



### E42.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>261</sup> 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").<sup>262</sup>

### E42.4. 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.

### E42.5. Evaluated savings approach

The program-specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order.<sup>263</sup>

<sup>261</sup> 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.

<sup>262</sup> 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.

<sup>263</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework for Dominion's DSM Programs.



### E42.5.1. 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.<sup>264</sup>

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.<sup>265</sup> 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

### E42.5.2. 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.<sup>266</sup> 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

<sup>264</sup> 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>

<sup>265</sup> 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

<sup>266</sup> PJM Manual 18B: Energy Efficiency Measurement & Verification, Revision: 04, Effective Date: August 22, 2019, PJM Forward Market Operations.



**E42.5.3. 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.

**E42.6. 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.<sup>267</sup>
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.

**E42.7. 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.

**E42.8. 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	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Updated IPMVP reference from 2012 to 2022.</li> <li>▪ Removed version number from title</li> <li>▪ Changed reference from Tracked Savings Deemed Savings in EM&amp;V Overview</li> <li>▪ Provided clarification of Option C and non-routine events to "Savings Estimation"</li> <li>▪ Added the use of survey methods to estimate savings</li> </ul>
Version 4	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> </ul>

<sup>267</sup> 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
		▪ Updated hyperlinks and language based on editorial feedback

OFFICIAL COPY

Jun 14 2024



## E43. NON-RESIDENTIAL DATA CENTER PROGRAM EM&V PLAN (PHASE X)

### E43.1. 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.

### E43.2. Measures

The energy efficiency measures listed in Table 42-1 will be offered by the Non-Residential Data Center Program.

Table 42-1. Non-Residential Data Center Program measures by end use

End use	Measure
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ High-efficiency computer room air conditioning and computer room air handler (CRAC and CRAH)</li> <li>▪ CRAC or CRAH Fan Variable Frequency Drive (VFD) or Electronically Commutated Motor (ECM)</li> <li>▪ Increase space-conditioning cooling temperature setpoint</li> <li>▪ Custom airflow measures</li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ Lighting measures</li> <li>▪ Lighting occupancy sensors (Common Areas)</li> </ul>
<b>Miscellaneous</b>	<ul style="list-style-type: none"> <li>▪ Energy audit</li> </ul>
<b>Power supply/storage</b>	<ul style="list-style-type: none"> <li>▪ High-efficiency uninterruptible power supply (UPS)</li> <li>▪ High-efficiency power supply unit (PSU)</li> </ul>

### 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, Section 56-596.2 of the Virginia Clean Economy Act, and the Final Order to Case No. PUR-2020-00156 with the SCC.<sup>268</sup> 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.
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.

<sup>268</sup> 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. **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.

#### **E43.4. 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.<sup>269</sup> 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.<sup>270</sup> Sources for all savings protocols, inputs, and assumptions will be documented to include titles, version numbers, publication dates, and page numbers, as appropriate.

<sup>269</sup> 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>.

<sup>270</sup> 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>



### E43.5. 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).<sup>271</sup>

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.<sup>272</sup> 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.<sup>273</sup>

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.<sup>274</sup>

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.<sup>275</sup>

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol, the key measured parameters are the hours of operation, fixture quantity, and fixture wattage.<sup>276</sup>

Energy audits identify opportunities for measures but do not produce direct savings. Therefore, they do not have an EM&V approach.

<sup>271</sup> 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>.

<sup>272</sup> 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>.

<sup>273</sup> 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>.

<sup>274</sup> 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>

<sup>275</sup> 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>

<sup>276</sup> 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.<sup>277</sup>

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.<sup>278</sup> 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 42-2.<sup>279</sup>

**Table 42-2. Preferred IPMVP options for Non-Residential Data Center Program**

Measure	IPMVP option	Key parameter(s)
<b>CRAC and CRAH</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling load</li> <li>▪ Heating load (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>VFDs or ECMs</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions</li> <li>▪ Outdoor temperature</li> </ul>
<b>Increase space-conditioning cooling temperature setpoint</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Setpoints</li> <li>▪ Cooling load</li> <li>▪ Annual hours of operation</li> </ul>

<sup>277</sup> 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>.

<sup>278</sup> 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.

<sup>279</sup> 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)
<b>Custom airflow measures</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Setpoints</li> <li>▪ Cooling load</li> <li>▪ TBD (project-specific)</li> </ul>
<b>Lighting and lighting occupancy sensors</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Fixture quantity (baseline and efficient)</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Annual hours of operation</li> </ul>
<b>UPS and PSU</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Wattage (baseline and efficient)</li> </ul>

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.

## E43.6. 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.

**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. 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.

**E43.8. Non-Residential Data Center Program – Revision history**

Table 42-3. Non-Residential Data Center Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY  
Jun 14 2024



## E44. NON-RESIDENTIAL HEALTHCARE PROGRAM EM&V PLAN (PHASE X)

### E44.1. 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.

### E44.2. Measures

The energy efficiency measures listed in Table 43-1 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 43-1. Non-Residential Health Care Program measures by end use**

End use	Measure
<b>Plug load</b>	<ul style="list-style-type: none"> <li>▪ Commercial smart strip</li> </ul>
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Window film</li> </ul>
<b>Cooking</b>	<ul style="list-style-type: none"> <li>▪ Cooking equipment</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Ventilation controls</li> <li>▪ Cooling equipment</li> <li>▪ Economizers</li> <li>▪ Heat pumps</li> <li>▪ Smart thermostats</li> <li>▪ Motors and VFDs</li> <li>▪ Duct testing and sealing and HVAC Tune-ups</li> <li>▪ Demand control ventilation</li> <li>▪ Custom HVAC measures</li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ Indoor and outdoor lighting</li> <li>▪ Advanced lighting controls</li> <li>▪ Daylighting</li> <li>▪ Custom lighting measures</li> </ul>
<b>Miscellaneous</b>	<ul style="list-style-type: none"> <li>▪ Custom measures</li> </ul>
<b>Refrigeration</b>	<ul style="list-style-type: none"> <li>▪ Refrigeration equipment and controls</li> <li>▪ Vending/vending machine controls</li> <li>▪ Ice machines</li> <li>▪ Custom refrigeration measures</li> </ul>



### E44.3. 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.<sup>280</sup> 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 E43.5. . 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 leveled 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.

### E44.4. 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-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

<sup>280</sup> 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.



participant data.<sup>281</sup> 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.

#### **E44.5. 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.<sup>282</sup>

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.<sup>283</sup>

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.<sup>284</sup>

<sup>281</sup> 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.

<sup>282</sup> 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>

<sup>283</sup> 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>.

<sup>284</sup> 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).<sup>285</sup>

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.<sup>286</sup>

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.<sup>287</sup> 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.

#### E44.5.1. 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 43-2.<sup>288</sup>

<sup>285</sup> 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>

<sup>286</sup> 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>

<sup>287</sup> 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.

<sup>288</sup> Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, <https://evo-world.org/en/>.



**Table 43-2. Preferred IPMVP options for Non-Residential Health Care Program Measures**

Measure	IPMVP option	Key parameter(s)
<b>Window film</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Plug load</li> <li>▪ Annual hours of operation</li> <li>▪ Verify installation</li> <li>▪ Area of window film</li> <li>▪ Orientation of building facade</li> <li>▪ Building occupancy and HVAC schedule</li> </ul>
<b>Cooking equipment</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooking load</li> <li>▪ Annual hours of operation</li> </ul>
<b>Chillers, unitary AC/HPs, room Acs, mini-split systems, geothermal HPs, and PTACs</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling load</li> <li>▪ Heating load (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Economizers</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> </ul>
<b>Smart thermostats</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> <li>▪ Equipment type</li> </ul>
<b>Motors and VFDs</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions</li> </ul>
<b>Duct testing and sealing and HVAC tune-ups</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling load</li> <li>▪ Heating load (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Demand control ventilation</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> <li>▪ Occupancy</li> <li>▪ Setpoints</li> </ul>
<b>Indoor and outdoor lighting. Advanced lighting controls. Daylighting</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Fixture quantity (baseline and efficient)</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Custom measures</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach or Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Project-specific, to be determined</li> </ul>
<b>Refrigeration equipment and controls</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Refrigeration load</li> <li>▪ Space-conditioning category</li> <li>▪ Annual hours of operation</li> <li>▪ Control strategy and setpoints</li> </ul>

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.

#### E44.5.2. 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

#### E44.5.3. 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.



### E44.6. 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.<sup>289</sup>
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.

### 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. 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.

### E44.8. Non-Residential Healthcare Program – Revision history

Table 43-3. Non-Residential Health Care Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Updated footnote 223 to refer to the most recent publicly available version of the DE TRM</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>

<sup>289</sup> 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.



## E45. NON-RESIDENTIAL HOTEL AND LODGING PROGRAM EM&V PLAN (PHASE X)

### E45.1. 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.

### E45.2. Measures

The energy efficiency measures listed in Table 44-1 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 44-1. Non-Residential Hotel and Lodging Program measures by end use**

End use	Measure
<b>Plug load</b>	<ul style="list-style-type: none"> <li>▪ Commercial smart strip</li> </ul>
<b>Building envelope</b>	<ul style="list-style-type: none"> <li>▪ Window film</li> </ul>
<b>Cooking</b>	<ul style="list-style-type: none"> <li>▪ Cooking equipment</li> </ul>
<b>HVAC</b>	<ul style="list-style-type: none"> <li>▪ Ventilation controls</li> <li>▪ Cooling equipment</li> <li>▪ Economizers</li> <li>▪ Heat pumps</li> <li>▪ Smart thermostats</li> <li>▪ Motors and VFDs</li> <li>▪ Duct testing and sealing and HVAC tune-ups</li> <li>▪ Demand control ventilation</li> <li>▪ Custom HVAC measures</li> </ul>
<b>Lighting</b>	<ul style="list-style-type: none"> <li>▪ Indoor and outdoor lighting</li> <li>▪ Advanced lighting controls</li> <li>▪ Daylighting</li> <li>▪ Custom lighting measures</li> </ul>
<b>Miscellaneous</b>	<ul style="list-style-type: none"> <li>▪ Custom measures</li> </ul>
<b>Refrigeration</b>	<ul style="list-style-type: none"> <li>▪ Refrigeration equipment and controls</li> <li>▪ Vending/vending machine controls</li> </ul>



End use	Measure
	<ul style="list-style-type: none"> <li>▪ Ice machines</li> <li>▪ Custom refrigeration measures</li> </ul>

### E45.3. 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.<sup>290</sup> 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 E44.5. 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 leveled 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.

### E45.4. 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

<sup>290</sup> 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.<sup>291</sup> 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.

### **E45.5. 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.<sup>292</sup>

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.<sup>293</sup>

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.<sup>294</sup>

<sup>291</sup> 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>.

<sup>292</sup> 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>

<sup>293</sup> 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>.

<sup>294</sup> 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).<sup>295</sup> 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.<sup>296</sup>

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.<sup>297</sup> 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.

### E45.5.1. 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 44-2.<sup>298</sup>

<sup>295</sup> 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>

<sup>296</sup> 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>

<sup>297</sup> 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.

<sup>298</sup> Efficiency Valuation Organization. (2016). International Performance Measurement and Verification Protocol, EVO 10000 – 1:2016, <https://evo-world.org/en/>.



Table 44-2. Preferred IPMVP options for Non-Residential Hotel and Lodging Program measures

Measure	IPMVP option	Key parameter(s)
<b>Commercial smart strip</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	
<b>Window film</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Area of window film</li> <li>▪ Orientation of building facade</li> <li>▪ Building occupancy and HVAC schedule</li> </ul>
<b>Cooking equipment</b>	Option A. Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooking load</li> <li>▪ Annual hours of operation</li> </ul>
<b>Chillers, unitary AC/HPs, room Acs, mini-split systems, geothermal HPs, and PTACs</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling load</li> <li>▪ Heating load (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Economizers</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> </ul>
<b>Smart thermostats</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Operating setpoints</li> <li>▪ Annual hours of operation</li> <li>▪ Equipment type</li> </ul>
<b>Motors and VFDs</b>	Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Annual hours of operation at part-load conditions</li> </ul>
<b>Duct testing and sealing and HVAC tune-ups</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Cooling load</li> <li>▪ Heating load (if applicable)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Demand control ventilation</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Verify proper operation</li> <li>▪ Annual hours of operation</li> <li>▪ Occupancy</li> <li>▪ Setpoints</li> </ul>
<b>Indoor and outdoor lighting Advanced lighting controls Daylighting</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Fixture quantity (baseline and efficient)</li> <li>▪ Wattage (baseline and efficient)</li> <li>▪ Annual hours of operation</li> </ul>
<b>Custom measures</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach or Option B: Retrofit Isolation: All Parameter Measurement	<ul style="list-style-type: none"> <li>▪ Project-specific, to be determined</li> </ul>
<b>Refrigeration equipment and controls</b>	Option A: Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Refrigeration load</li> <li>▪ Space-conditioning category</li> <li>▪ Annual hours of operation</li> <li>▪ Control strategy and setpoints</li> </ul>

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.

### E45.5.2. 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

### E45.5.3. 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.





**E45.6. 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.<sup>299</sup>
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.

**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 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.

**E45.8. Non-Residential Hotel and Lodging Program – Revision history**

Table 44-3. Non-Residential Hotel and Lodging Program revision history

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Updated footnote 233 to refer to the most recent publicly available version of the DE TRM</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>

<sup>299</sup> 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.



## E46. NON-RESIDENTIAL SMALL BUSINESS BEHAVIORAL PROGRAM EM&V PLAN (PHASE X)

### E46.1. 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.

### E46.2. Measures

The following measures are included in the Small Business Behavioral Program.

**Table 45-1. Small Business Behavioral Program Measures by end use**

End Use	Measure
Whole Building	▪ Business Energy Reports – Mail
	▪ Business Energy Reports – Digital

### E46.3. 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.<sup>300</sup> 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.

<sup>300</sup> 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 E45.5. 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 leveled 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.

#### **E46.4. 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.<sup>301</sup> 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.

#### **E46.5. 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.

<sup>301</sup> 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>.



### E46.5.1. 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.

### E46.5.2. 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.



**E46.6. 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.<sup>302</sup>
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.

**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. 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.

**E46.8. Non-Residential Small Business Improvement Enhanced Program – Revision history**

**Table 45-2. Small Business Behavioral Program Revision history**

Version	Date	Notes
Version 1	December 2021	Initial release
Version 2	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>

<sup>302</sup> 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.



## E47. NON-RESIDENTIAL CUSTOM PROGRAM EM&V PLAN (PHASE XI)

### E47.1. Program summary

The Non-Residential Custom 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. Through this proposed program, the Company can help qualifying customers develop tailored projects that best meet their unique facility and organizational goals while achieving savings from a diverse mix of measures.

The proposed program design approach consists of the following project implementation phases:

1. Customer engagement: Consists of high-touch customer support and project identification services to increase awareness and simply participation
2. Project pre-approval: Customer/vendor submit initial project application. Program implementation vendor pre-screens to validate eligibility and the assigned engineer performs a technical review of proposed energy savings. A pre-installation inspection is also performed at this point to verify the baseline.
3. Project installation
4. Project review and approval: Customer or vendor submits final project documentation. An administrative review will take place and engineers will verify alignment with pre-approved savings. A post-installation inspection will occur to verify submitted documentation.
5. Incentive payment

### E47.2. Measures

The measures included in the Phase VIII Residential Home Retrofit Program Update are listed in Table 46-1.

**Table 46-1. Measures offered by the Non-Residential Custom Program**

End-use	Measure
Lighting	<ul style="list-style-type: none"> <li>▪ Custom indoor lighting</li> <li>▪ Custom outdoor lighting</li> </ul>
HVAC	<ul style="list-style-type: none"> <li>▪ Custom EMS/HVAC controls</li> <li>▪ Custom HVAC retrofit</li> </ul>
Refrigeration	<ul style="list-style-type: none"> <li>▪ Custom refrigeration upgrade</li> <li>▪ Custom refrigeration controls</li> <li>▪ Custom refrigerated tank insulation</li> <li>▪ Custom chiller</li> </ul>
Process	<ul style="list-style-type: none"> <li>▪ Custom agriculture process</li> <li>▪ Custom process controls</li> </ul>
Compressed Air	<ul style="list-style-type: none"> <li>▪ Custom compressed air retrofit</li> <li>▪ Custom compressed air leaks</li> </ul>
Water Processing	<ul style="list-style-type: none"> <li>▪ Custom wastewater aerators</li> <li>▪ Custom process electric water heating</li> </ul>
Motors, Pumps, and Fans	<ul style="list-style-type: none"> <li>▪ Custom pumps and fans</li> <li>▪ Custom motors and drives</li> </ul>
Miscellaneous	<ul style="list-style-type: none"> <li>▪ Custom other miscellaneous</li> </ul>



### E47.3. Evaluation, measurement, and verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>303</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>304</sup> 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. **Project file review:** project files will be provided by the vendor and reviewed by the EM&V service provider.
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.

### E47.4. Deemed savings approach

In lieu of calculating traditional deemed savings, project files will be provided by the vendor and include the calculated project savings using custom calculations. Custom calculations will be developed depending on the project and can be reviewed for capturing baseline conditions and the appropriate savings methodology and assumptions.

### E47.5. Evaluated savings approach

The program specific evaluated savings approach is guided by a Value of Information (VOI) framework outlined in the Final Order<sup>305</sup> and standard evaluation protocols such as DOE's Uniform Methods Project (UMP) and IPMVP Options A, B, C and D.

For **lighting measures**, according to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol of the UMP,<sup>306</sup> 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,<sup>307</sup> the key measured parameters for lighting controls measures include the hours of use (energy efficient and baseline) and the controlled fixture wattages.

For **HVAC Measures**, the EM&V approach relies heavily on the DOE's Uniform Methods Project protocols (UMP):<sup>308</sup> According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling

<sup>303</sup> 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.

<sup>304</sup> 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.

<sup>305</sup> Virginia State Corporation Commission, PUR-2020-00156, Final Order, Appendix A, EM&V Framework For Dominion's DSM Programs.

<sup>306</sup> 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>

<sup>307</sup> 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>

<sup>308</sup> 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>



Equipment,<sup>309</sup> 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 19—**HVAC Controls measures**,<sup>310</sup> 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. Chapter 14—Chiller Evaluation Protocol describes a similar methodology.

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 represent all of these categories. However, 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,<sup>311</sup> 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.

For **the refrigeration measures**, savings will be based on key inputs that can be verified while on-site. Although the UMP does not specifically address refrigeration, the key parameters for determining gross savings and peak demand reductions include quantity, power (baseline and efficient), loads, efficiency and operating setpoint, annual hours of operation.

For **Process measures, water processing, and miscellaneous custom measures** savings will be calculated based on key inputs that can be collected while on-site, through metering, or from energy management trend data. This data can be used to determine baseline and efficient energy consumption. Consumption data can be normalized with annual production or equipment loads. The key parameters and analysis will be tailored to the specific project and equipment using engineering equations.

For **compressed air measures**, the evaluation will select a sample for on-site verification and develop savings estimates.. Savings will be based on the baseline and efficient case energy consumption. Adjustments to key inputs that can be verified while on-site. In keeping with accepted practices defined by Chapter 22: Compressed Air Evaluation Protocol of The Uniform Methods Project (UMP), the key parameters for determining gross savings and peak demand reductions include: airflow rate, line pressure, compressor power, production rates, and operating hours.

<sup>309</sup> 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>

<sup>310</sup> 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>

<sup>311</sup> 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.





For **motors, fan and pump measures**, Chapter 18—VFD,<sup>312</sup> can be leveraged. While this methodology may not be applicable to all projects, the key measured parameters include hours of operation, percent time at each VFD speed, fan/pump motor horsepower, rotational speed, motor enclosure type, motor efficiency, and VFD efficiency.

For measures in this program, the annual operating hours vary by climate, building type, occupancy type, process, etc. A high-rigor evaluation would require metering for a sample of the participants that represent all of these categories. However, because this approach can be expensive, a lower-rigor approach using metering for only a sample of projects may be considered.

At a high level, the ratio of the measured and verified savings to the project file savings for the sample, also called a realization rate,<sup>313</sup> 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 savings and demand reductions.

### E47.5.1. Sample design considerations

A random sampling strategy, stratified by measure and other parameters may be applied. The following characteristics will be considered

- Confidence interval: 85–90%
- Relative precision: 10–15%
- Measure-level error ratio: to be updated prior to sample selection
- Budget, schedule, and geographical distribution

### E47.5.2. 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<sup>314</sup> (IPMVP) as shown in Table 46-2.

**Table 46-2. Preferred IPMVP options for Non-Residential Heating and Cooling Efficiency Program measures**

End-Use	IPMVP Option	Key Parameter(s)
Lighting	Option A. Retrofit Isolation: Key Parameter Measurement Approach,	<ul style="list-style-type: none"> <li>▪ hours of use</li> <li>▪ fixture wattages (energy efficient and baseline)</li> </ul>

<sup>312</sup> 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>

<sup>313</sup> 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.

<sup>314</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).



End-Use	IPMVP Option	Key Parameter(s)
HVAC	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach, <u>Option C</u> . Whole Facility Approach, or <u>Option D</u> . Calibrated Simulation Approach	<ul style="list-style-type: none"> <li>▪ controls</li> <li>▪ Cooling loads</li> <li>▪ Heating loads (if applicable)</li> <li>▪ Outside air temperatures</li> <li>▪ Annual hours of operation</li> <li>▪ Setpoints and schedule</li> <li>▪ Operating efficiency</li> <li>▪ EMS trend points Air flow rates, temperatures, valve positions, etc. (as applicable)</li> </ul>
Refrigeration	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Power (baseline and efficient)</li> <li>▪ Loads</li> <li>▪ Efficiency</li> <li>▪ Operating setpoint</li> <li>▪ Annual hours of operation</li> </ul>
Process, Water Processing, and Miscellaneous	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach, <u>Option C</u> . Whole Facility Approach, or <u>Option D</u> . Calibrated Simulation Approach	<ul style="list-style-type: none"> <li>▪ Measure-specific parameters that pertain the process, equipment operation and changed from the existing conditions to the new condition: flow rates, temperatures and loads (as applicable).</li> </ul>
Compressed Air	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Airflow rate</li> <li>▪ Line pressure</li> <li>▪ Compressor power</li> <li>▪ Production rates</li> <li>▪ Operating hours.</li> </ul>
Motors, Pumps, and Fans	<u>Option A</u> . Retrofit Isolation: Key Parameter Measurement Approach	<ul style="list-style-type: none"> <li>▪ Hours of operation</li> <li>▪ Percent time at each vfd speed</li> <li>▪ fan/pump motor horsepower,</li> <li>▪ Rotational speed,</li> <li>▪ Motor enclosure type,</li> <li>▪ Motor efficiency</li> <li>▪ VFD efficiency</li> </ul>

Given the viability of custom measures, flexibility will be needed in evaluating this program. In general, IPMVP Option A can be applied. However, when determining the methodology, the data availability, magnitude savings and sensitivity to weather or other factors need to be considered. There may be instances with IPMVP Option B, C or D are a more appropriate approach. The primary goal is to capture baseline and efficient energy consumption and peak loads.

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.

### E47.5.3. Net-to-gross assessment

If applicable, free-ridership and spill-over 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 to assess free-ridership. The survey will follow the appropriate spill-over questions, depending on program-specific characteristics.

**E47.6. 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 on a monthly basis. 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.

**E47.7. Timeline and scope of work**

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

**E47.8. Non-Residential Custom Program – revision history**

Table 46-3. Revision history for the Non-Residential Custom Program EM&V plan

Version	Date	Notes
Version 1	10/19/2022	▪ Initial release



## **E48. NON-RESIDENTIAL DISTRIBUTED GENERATION PROGRAM EM&V PLAN (PHASE II)**

### **E48.1. 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.

### **E48.2. Measures**

The program dispatches power from on-site generators of participating customers

### **E48.3. 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.<sup>315</sup>

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 E47.5. 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").<sup>316</sup>

### **E48.4. Deemed savings approach**

Deemed savings are not calculated for the Non-Residential Distributed Generation Program.

### **E48.5. Evaluated savings approach**

#### **E48.5.1. 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.

<sup>315</sup> Efficiency Value Organization. 2022. Core Concepts, International Performance Measurement and Verification Protocol. [www.evo-world.org](http://www.evo-world.org).

<sup>316</sup> 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.

**E48.5.2. 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.

**E48.6. Lost revenue methodology**

Not applicable.

**E48.7. 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.

**E48.8. Non-Residential Distributed Generation Program – Revision history**

Table 47-1. Revision history for Non-Residential Distributed Generation Program EM&V Plan

Version	Date	Notes
Version 1	2011	<ul style="list-style-type: none"> <li>▪ Added semi-annual program tracking summary table in the “Frequency of EM&amp;V Measurement &amp; Timeline” section.</li> </ul>
Version 2	2012	<ul style="list-style-type: none"> <li>▪ No material changes to the content.</li> <li>▪ Added semi-annual program tracking summary table in the “Frequency of EM&amp;V Measurement &amp; Timeline” section.</li> </ul>
Version 3	2013	<ul style="list-style-type: none"> <li>▪ No material changes to the content.</li> </ul>
Version 4	2014	<ul style="list-style-type: none"> <li>▪ Updated program requirements with more details, as shown below:</li> <li>▪ Added minimum kW demand requirement of 200 kW to be eligible for this program to the “Program Summary” section.</li> <li>▪ Added customer notification process of each DG event through e-mail or phone 30 minutes in advance.</li> <li>▪ Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW.</li> <li>▪ Changed “KEMA” to “DNV KEMA.”</li> <li>▪ Changed “Program Penetration &amp; Initial Baseline Assumptions” section title to “Program Penetration” and removed initial baseline assumptions.</li> <li>▪ Updated program penetrations and added “Source” column to the “Program Penetration” table.</li> <li>▪ Changed “Revision History” section title to “Document Revision History.”</li> <li>▪ Updated planned penetration table based on 2013 IRP.</li> </ul>
Version 5	2015	<ul style="list-style-type: none"> <li>▪ Removed 2013 planned customer penetration numbers.</li> <li>▪ Added sentence on PJM requirements to end of “EM&amp;V Method.”</li> <li>▪ Updated program requirements with more details, as shown below:</li> </ul>

OFFICIAL COPY  
Jun 14 2024



Version	Date	Notes
		<ul style="list-style-type: none"> <li>Added minimum kW demand requirement of 200 kW to be eligible for this program to the "Program Summary" section.</li> <li>Added customer notification process of each DG event through e-mail or phone 30 minutes in advance.</li> <li>Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW.</li> <li>Changed "KEMA" to "DNV KEMA."</li> <li>Changed "Program Penetration &amp; Initial Baseline Assumptions" section title to "Program Penetration" and removed initial baseline assumptions.</li> <li>Updated program penetrations and added "Source" column to the "Program Penetration" table.</li> <li>Changed "Revision History" section title to "Document Revision History."</li> <li>Updated planned penetration table based on 2013 IRP.</li> </ul>
Version 6	2016	<ul style="list-style-type: none"> <li>Updated DNV KEMA to DNV Energy.</li> <li>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).</li> <li>Renamed "Frequency of EM&amp;V Measurement and Timeline" section title to "EM&amp;V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section.</li> <li>Added on-going scope that was not explicitly mentioned to "EM&amp;V Measurement, Timeline and Scope of Work" section.</li> <li>Deleted program penetrations section.</li> <li>Removed 2013 planned customer penetration numbers.</li> <li>Added sentence on PJM requirements to end of "EM&amp;V Method."</li> </ul>
Version 7	2017	<ul style="list-style-type: none"> <li>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.</li> <li>Updated DNV KEMA to DNV Energy.</li> <li>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).</li> <li>Renamed "Frequency of EM&amp;V Measurement and Timeline" section title to "EM&amp;V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section.</li> <li>Added ongoing scope that was not explicitly mentioned to "EM&amp;V Measurement, Timeline and Scope of Work" section.</li> <li>Deleted program penetrations section.</li> <li>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."</li> <li>Clarified difference between payment compliance (95% of enrolled load) and program participation compliance (50% of enrolled load).</li> </ul>
Version 8	2018	<ul style="list-style-type: none"> <li>Updated "April 1" report date to "May 1" in "EM&amp;V Measurement, Timeline, and Scope of Work" section.</li> </ul>
Version 9	2019	<ul style="list-style-type: none"> <li>Minor edits.</li> <li>Formatting updates.</li> <li>Updated from DNV Energy to DNV Energy Insights.</li> </ul>
Version 10	2020	<ul style="list-style-type: none"> <li>Formatting updates.</li> </ul>
Version 11	3/22/2021	<ul style="list-style-type: none"> <li>Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number. Slight word changes to measure description. Additional detail added to deemed and evaluated savings methodologies in Sections FF.4 and FF.5.</li> </ul>
Version 12	4/22/2022	<ul style="list-style-type: none"> <li>Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> </ul>



Version	Date	Notes
		<ul style="list-style-type: none"> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> </ul>
<b>Version 13</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E49. RESIDENTIAL ELECTRIC VEHICLE REWARDS (DR ONLY) PROGRAM EM&V (PHASE VIII)

### E49.1. Program summary

The peak shaving program would provide customers with a qualifying level 2 electric vehicle (EV) charger and wish to participate in the demand response (DR) program.

### E49.2. Measures

The measures offered by the Residential Electric Vehicle Rewards (DR) Program are as shown in Table 48-1.

**Table 48-1. Measures offered by Residential Electric Vehicle Rewards (DR) Program**

End-use	Measure
Plug load	▪ EV charging demand response events

### E49.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>317</sup> and the final order of SCC Case No. PUR-2020-00156 (“Final Order”). The EM&V method estimates load reduction resulting from demand response events called by Dominion Energy.

The basis for DNV’s savings evaluation approach is:

- 1. Baseline consumption:** Baseline consumption will be calculated from AMI participant data, EV charger data, and weather data.
- 2. Evaluated savings:** Load reduction will be determined by the methods described in Section E48.5. The evaluated demand reduction will use program tracking data, customer energy consumption data, and EV charger data to estimate program savings versus the calculated baseline.

The evaluation methods described in the following EM&V plan meet the standards of section A of 20 VAC 5-318-40

### E49.4. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

### E49.5. Evaluated savings approach

#### E49.5.1. Load reduction estimation for demand response

Using program tracking data, AMI data, EV charging and event data, and weather data, regression analysis is used to calculate ex post impacts for each event hour. EV charging devices with sufficient data use a temperature-adjusted site-level regression. Devices without sufficient data use an average weekday baseline methodology. The two baseline methodologies are described below:

<sup>317</sup> 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.





1. The regression baseline produces weekday-specific results with a temperature adjustment as there is evidence of weather correlation with EV drivers' total charging consumption. The noted weather correlation is statistically significant in important charging hours and DNV thus includes the temperature adjustment to appropriately characterize charging behavior. As summer DR events typically occur on hot days, controlling for weather ensures that the baseline is appropriately adjusted for the hotter temperature days.
2. The general baseline creates a single average hourly load shape based on all non-event weekday data for the given device. DNV applies this single hourly shape as the baseline for every event day.

The ex ante estimates are calculated using an average of the ex post impacts for each event-hour.

**E49.6. Sample design considerations**

The evaluation will be performed on the census of AMI-enabled customers.

**E49.7. Lost revenue methodology**

Not applicable.

**E49.8. 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. Conduct annual impact evaluation.
6. Provide regulatory support as necessary.
7. If appropriate, support lost revenue recovery activities.

**E49.9. Residential Electric Vehicle Rewards – Revision history**

Table 48-2. Revision History for Residential Electric Vehicle Rewards (DR) Program EM&V Plan

Version	Date	Notes
Version 1	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
Version 2	3/21/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed “Document” from “Document Revision History.” Removed decimal place from version number.</li> </ul>
Version 3	4/22/2021	<ul style="list-style-type: none"> <li>▪ Replaced section head “Load Reduction Estimation for Demand Response” with “Evaluated Savings Approach.”</li> </ul>
Version 4	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated program name from “Residential Electric Vehicle (DR) Program” to “Residential Electric Vehicle Rewards (DR) Program”</li> <li>▪ Updated the title of “STEP Manual” to the “Dominion Energy Virginia and North Carolina Technical Reference Manual” (DE TRM)</li> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> </ul>



Version	Date	Notes
		<ul style="list-style-type: none"> <li>Removed version number from title</li> </ul>
<b>Version 5</b>	2/11/2023	<ul style="list-style-type: none"> <li>Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>Updated hyperlinks and language based on editorial feedback</li> </ul>
<b>Version 6</b>	5/29/2024	<ul style="list-style-type: none"> <li>Updated evaluated savings approach</li> </ul>

OFFICIAL COPY

Jun 14 2024



## E50. RESIDENTIAL SMART THERMOSTAT REWARDS (DR) PROGRAM EM&V PLAN (PHASE VIII AND PHASE XI)

### E50.1. 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.

### E50.2. Measures

The measures offered by the Residential Smart Thermostat Rewards Program include those listed in .

**Table 49-1. Measures offered by Residential Smart Thermostat Rewards Program**

End-use	Measure
HVAC	<ul style="list-style-type: none"> <li>▪ Heat pump demand response, peak reduction</li> <li>▪ Air conditioning system demand response, peak reduction</li> </ul>

### E50.3. Evaluation, Measurement, and Verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.<sup>318</sup> 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 E49.5. 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").<sup>319</sup> The Smart Thermostat Rewards Program is evaluated annually for the life of the program.

### E50.4. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

<sup>318</sup> 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.

<sup>319</sup> 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.



## E50.5. Evaluated savings approach

### E50.5.1. 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.

### E50.5.2. 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.<sup>320</sup>

### E50.5.3. 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).<sup>321</sup>
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.

### E50.5.4. 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.

## E50.6. Lost revenue methodology

Not applicable.

## E50.7. 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.

<sup>320</sup> National Oceanic and Atmospheric Association (NOAA), National Centers for Environmental Information, Local Climatological Data.

<sup>321</sup> Dominion Energy's peak planning condition is hour-ending 17 at 95°F at 43% RH, or 83.4 THI. Temperature Humidity Index =  $THI = Td - (0.55 - 0.55 \cdot RH) \cdot (Td - 58)$  where  $Td$  is dry bulb temperature and  $RH$  is relative humidity. Source: PJM Glossary: <http://www.pjm.com/Glossary.aspx>



- 6. Provide regulatory support as necessary.
- 7. If appropriate, support lost revenue recovery activities.

**E50.8. Residential Smart Thermostat Rewards Program revision history**

**Table 49-2. Revision history for Smart Thermostat Rewards Program EM&V Plan**

Version	Date	Notes
<b>Version 1</b>	11/26/2019	<ul style="list-style-type: none"> <li>▪ Initial release</li> </ul>
<b>Version 2</b>	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
<b>Version 3</b>	4/22/2022	<ul style="list-style-type: none"> <li>▪ Provided additional detail to evaluated savings method.</li> <li>▪ Removed reference to the PJM sample size approach</li> <li>▪ Changed program name from Smart Thermostat Demand Response Program to Smart Cooling Rewards Program</li> <li>▪ Added reference to annual evaluation</li> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> <li>▪ Replaced "DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the "Timeline and Scope of Work" section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>



## E51. RESIDENTIAL WATER SAVINGS (DR) PROGRAM EM&V PLAN (PHASE IX)

### E51.1. 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.

### E51.2. Measures

The measure offered by the Residential Water Savings (DR) are as shown in Table 50-1.

**Table 50-1. Measures offered by Residential Water Savings Program (DR)**

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

### E51.3. 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").<sup>322</sup>

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 E50.5. 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.

### E51.4. Deemed savings approach

Estimates of load reduction in demand response programs are not based on deemed calculations methods.

<sup>322</sup> 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.



## E51.5. Evaluated savings approach

### E51.5.1. 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.

### E51.5.2. 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

### E51.5.3. 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.

## E51.6. Lost revenue methodology

Lost revenue is not calculated for demand response programs.

## E51.7. 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.

## E51.8. Residential Water Savings Program (DR) – Revision history

Table 50-2. Revision History for Residential Water Savings (DR) EM&V Plan

Version	Date	Notes
Version 1	Nov. 2020	Initial release
Version 2	3/22/2021	<ul style="list-style-type: none"> <li>▪ Added date to revision history and removed "Document" from "Document Revision History." Removed decimal place from version number.</li> </ul>
Version 3	4/22/2022	<ul style="list-style-type: none"> <li>▪ Updated the title of "STEP Manual" to the "Dominion Energy Virginia and North Carolina Technical Reference Manual" (DE TRM)</li> </ul>



Version	Date	Notes
		<ul style="list-style-type: none"> <li>▪ Replaced “DNV EM&amp;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&amp;V of existing DSM programs, [etc.]</li> <li>▪ Removed version number from title</li> <li>▪ In sample design considerations, removed reference to the PJM sample size</li> </ul>
<b>Version 4</b>	2/11/2023	<ul style="list-style-type: none"> <li>▪ Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>▪ Updated hyperlinks and language based on editorial feedback</li> </ul>

OFFICIAL COPY

Jun 14 2024





## E52. RESIDENTIAL TELEMATICS VEHICLE CHARGER PILOT (DR) PROGRAM EM&V PLAN (PHASE XI)

### E52.1. Program summary

The proposed Residential EV Telematics Pilot Program would run in parallel with the active Residential Electric Vehicle Demand Response Program. Instead of communicating with the electric vehicle charger, the proposed pilot program would allow for integration with the onboard vehicle telematics to capture charging data and control the charging rate during load curtailment events dispatched by the Company.

### E52.2. Measures

The measures offered by the Residential Electric Vehicle Telematics Pilot Program are as shown in Table 51-1.

**Table 51-1. Measures offered by Residential Electric Vehicle Telematics Pilot Program**

End-use	Measure
Plug Load	Electric vehicle with capable telematics

### E52.3. Evaluation, measurement, and verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>323</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>324</sup> 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 E51.5. The evaluated demand reduction will use program tracking data, customer energy consumption data, EV charger data, and other customer data to estimate program savings.

### E52.4. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

### E52.5. Evaluated savings approach

#### E52.5.1. 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).

<sup>323</sup> 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.

<sup>324</sup> 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.



**E52.5.2. 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.

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.

**E52.6. Lost revenue methodology**

Not applicable.

**E52.7. Timeline and scope of work**

- Develop and update EM&V plan annually
- Analyze program tracking data: Annual report (June 15 of each year following program launch)
- Annually update The DE TRM, as needed, to account for updates to referenced sources
- Develop baseline use, efficient use, and measure savings load shapes annually
- If appropriate, conduct impact evaluation studies
- Provide regulatory support as necessary
- If appropriate, support lost revenue recovery activities

**E52.8. Residential EV Telematics Pilot Program–revision history**

Table 51-2. Revision history for Residential EV Telematics Pilot Program EM&V Plan

Version	Date	Notes
Version 1	10/19/2022	Initial release



## E53. RESIDENTIAL PEAK TIME REBATE (DR) PROGRAM EM&V PLAN (PHASE XI)

### E53.1. Program summary

The Residential Peak Time Rebate 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 will 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. The post-event communications will include the following:

- Text messaging acknowledging the customer's participation, with a statement of savings
- Ongoing behavioral messaging and nudges, reinforcing the behavioral model
- On-going maintenance messaging using bill inserts and bill messaging post education campaign

Additional program design parameters include the following:

- There will be 10 PTR events per year and each event will be approximately 4 hours in duration (5 events in the summer and 5 events in the winter).
- 500k cumulative participants will be enrolled in the PTR program over a 5-year deployment period between 2024 and 2028.
- Program design assumes that 50% of the enrollees will participate in each PTR event called.
- Program design assumes, on average, each event participating customer will shift approximately 2.25 kWh per event. This equates to approximately \$2.80 in bill credit @ \$1.25/kWh.

Finally, all customers who participate in the program will be required to have an AMI meter to facilitate the calculation of site-level baseline and load reduction estimates.

### E53.2. Measures

The measures included in the Residential Peak Time Rebate Program are listed in Table 52-1.

**Table 52-1. Measures offered by Residential Peak Time Rebate Program**

End-use	Measure
HVAC	Peak Time Rebate

### E53.3. Evaluation, measurement, and verification overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318<sup>325</sup> and the final order in SCC Case No. PUR-2020-00156.<sup>326</sup> 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:

- Baseline consumption: Baseline consumption will be calculated from metered AMI interval data.

<sup>325</sup> 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.

<sup>326</sup> 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.



- Evaluated savings: Load reduction will be determined by the methods described in Section E52.3.2. . The Residential Peak Time Rebate Program is evaluated annually for the life of the program.

### E53.3.1. Deemed savings approach

Estimates of load reduction in demand response programs are not deemed.

### E53.3.2. Evaluated savings approach

This EM&V plan calls for an annual impact evaluation for the life of the program. To assess the customer baseline, the estimated baseline and the true load must be known. The EM&V uses both elements to determine PTR load reduction for activated and not activated participants. The evaluation report will report customer baselines, ex post impacts by event hour and THI, event average THI's, event opt-out percentages. The EM&V approach may include ex ante estimates by event hour and THI.

### E53.3.3. Data

Four sources of data are used in the impact analysis:

- PTR event records of participants
- Half-hourly AMI activated and non-activated comparison group data collected from customer meters.
- Regional weather data to account for customer-specific temperature and humidity for each event hour.<sup>327</sup>

### E53.3.4. 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 PTR tracking data record of all participating customers for each event.
2. For each event, participants are flagged as activated or non-activated participants.
3. Using AMI data and weather data, a regression is estimated for summer and winter non-event days for each site.
4. A comparison of predicted and actual event period consumption for activated and non-activated AMI accounts in a difference in difference framework provides an unbiased estimate of load reduction for each hour of each event.
5. Not activating a random sample of approximately 5% of participants for each event will substantially improve the robustness of the evaluation.
6. If a sample is used to limit the burden on Dominion, this result will be weighted to the full program population.
7. 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).<sup>328</sup>
8. AMI customer accounts are assigned weights based on state, and the participant's location within the Company's service territory to ensure that the population is representative of the program population.

### E53.3.5. Sample design considerations

The demand response impact analysis can be calculated on a random sample of participants. Sampling may also be applied for a free-ridership survey, if applicable. The following characteristics will be considered:

- Confidence interval: 85–90%
- Relative precision: Precision is a function of the baseline method, number of participants, and the magnitude of savings.
- The non-participant matched comparison group

<sup>327</sup> National Oceanic and Atmospheric Association (NOAA), National Centers for Environmental Information, Local Climatological Data.

<sup>328</sup> Dominion Energy's peak planning condition is hour-ending 17 at 95°F at 43% RH, or 83.4 THI. Temperature Humidity Index =  $THI = T_d - (0.55 - 0.55 \cdot RH) \cdot (T_d - 58)$  where  $T_d$  is dry bulb temperature and RH is relative humidity. Source: PJM Glossary: <http://www.pjm.com/Glossary.aspx>



- Budget and schedule

**E53.4. Lost revenue methodology**

Not applicable.

**E53.5. Timeline and scope of work**

- Develop and update EM&V plan annually
- Analyze program tracking data: Annual report (June 15 of each year following program launch)
- Annually update The DE TRM, as needed, to account for updates to referenced sources
- Develop baseline use, efficient use, and measure savings load shapes annually
- Conduct impact evaluation studies
- Provide regulatory support as necessary

**E53.6. Residential Peak Time Rebate Program – revision history)**

Table 52-2. Revision history for Residential Peak Time Rebate Program (Demand response EM&V plan)

Version	Date	Notes
Version 1	10/19/2022	Initial release



## E54. VOLTAGE OPTIMIZATION PROGRAM EM&V PLAN (PHASE X)

### E54.1. 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.<sup>329</sup> 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.<sup>330</sup> 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.<sup>331</sup>

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.

### E54.2. Measures

The measures listed in Table 53-1 are included in the Voltage Optimization Program.

**Table 53-1. Voltage Optimization Program measure by end use**

End use	Measure
Various	Voltage Optimization (VO)

<sup>329</sup> 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.

<sup>330</sup> Electric Power Systems and Equipment, Voltage Ratings (60 Hertz), ANSI Standard C84.1-2020, Mar. 2020.

<sup>331</sup> 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.



### **E54.3. 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.<sup>332</sup> 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.

### **E54.4. 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.

### **E54.5. Evaluated savings approach**

#### **E54.5.1. 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.

<sup>332</sup> 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.



**E54.5.2. 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

**E54.6. 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.

**E54.7. 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.

**E54.8. Voltage Optimization Program – Revision history**

**Table 53-2. Voltage Optimization Program revision history**

Version	Date	Notes
<b>Version 1</b>	December 2021	Initial release
<b>Version 2</b>	2/11/2023	<ul style="list-style-type: none"> <li>• Changed references to the “STEP Manual” to “DE TRM”</li> <li>• Changed annual EM&amp;V report due date from May 1 to June 15 in the “Timeline and Scope of Work” section</li> <li>• Updated hyperlinks and language based on editorial feedback</li> </ul>