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

Case No. PUR-2019-00201 (Virginia)
Docket No. E-22 Sub 589 (North Carolina)
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Date: May 14, 2021
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APPENDIX H.   RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT PROGRAM EM&V PLAN

H.1 Residential Income and Age Qualifying Home Improvement Program Manual

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H. RESIDENTIAL INCOME AND AGE QUALIFYING HOME IMPROVEMENT PROGRAM EM&V PLAN (VERSION 11)

H.1 Program Summary

The Income and Age Qualifying Home Improvement Program is designed to provide qualifying low-income (60% or less of Virginia state median income) and elderly (60+ and household income of up to 120% Virginia state median income) residential customers of the Company with a free energy audit that identifies certain areas where they can save money on their monthly electric bill. If homeowners (or authorized renters) approve, auditors may immediately make certain improvements while at the home.

H.2 Measures

The following high efficiency measures are covered by the program:

End-use	Measure
Whole house	▪ Attic insulation
Lighting	▪ LEDs (up to 6)
Domestic Hot Water	▪ Low flow Showerhead (electric) ▪ Kitchen and bathroom aerators ▪ Pipe wrap on exposed H2O supply (electric)

H.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[1] 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 include:

▪ Baseline Consumption: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data, if available.

▪ Deemed Savings: Deemed savings values will be estimated from the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

▪ Evaluated Savings: Evaluated savings will be determined by the methods described in Section H.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 in the periods between more rigorous EM&V.

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[1] 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.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

H.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[2] 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.

H.5   Evaluated Savings Approach

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.

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.[3] The analysis will use a site-level or panel-model billing analysis approach (see Section H.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[4]

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[2] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[3] 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;

[4] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

As described in 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.[5] (see Section H.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[6]

H.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, 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 the majority of the program impacts may be isolated. The billing analysis for the Residential/Non-residential Multifamily Program should have a comparison group of non-participating customers, however given the diversity of the participants who may be in the program this may not be feasible. 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, 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.

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.[7]

If measure-level savings are not found to be statistically significant for all participants through billing analysis, a comparison group is not feasible, 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

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[5] 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.

[6] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[7] This generally requires large numbers of installations (thousands) to yield meaningful results.

be combined using a sample-weighted average to represent the overall program level realization rate. 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 DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site, which 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 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.

H.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, multifamily type
- Budget, schedule, and geographical distribution

H.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.

H.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 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, and exclude Fuel Charge Rider A and all other applicable riders) for the rate period to arrive at lost revenues.

H.7 Timeline and Scope of Work

- Analysis of program tracking data: Annual Report (May 15 of each year following program launch).
- Annual updates to STEP Manual for updates that occurred to its referenced sources.
- Develop baseline, measure savings, and efficient load shapes.
- Provide regulatory support as necessary

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H.8   Residential Income and Age Qualifying Home Improvement Program – Revision History

Version	Date	Notes
Version 7	2017	▪ Initial release
Version 8	2018	▪ Edited "EM&V Measurement, Timeline, and Scope of Work" section to be consistent with other programs
Version 9	2019	▪ Formatting updates ▪ Updated from DNV Energy to DNV Energy Insights
Version 10	2020	▪ Formatting updates ▪ Updated "Evaluated Savings Approach"
Version 11	3/22/2021	▪ Methodology transitioned from site level IPMVP - Option C to a program level billing analysis with the potential for a calibrated engineering model for multi-family households, if required. ▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted 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.

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APPENDIX I. RESIDENTIAL APPLIANCE RECYCLING PROGRAM EM&V PLAN

I.1 Residential Appliance Recycling Program Quality Control Description

I. RESIDENTIAL APPLIANCE RECYCLING PROGRAM EM&V PLAN (VERSION 2)

I.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.

I.2 Measures

Removal of and recycling of operating refrigerators and freezers

I.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[8] 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:

- 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 DNV Standard Tracking and Engineering Protocols (STEP) Manual. Therein, the deemed savings approach for each measure is predominantly derived from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM) and, as appropriate, from other TRMs.

- Deemed Savings: Deemed savings (or gross savings) values will be estimated using calculation approaches in the DNV STEP Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

- Verified Savings: Verified 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 prior to their removal—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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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,

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[8] 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.

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.

I.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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.

I.5　Evaluated Savings Approach

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.

According to Chapter 7: Refrigerator Recycling Evaluation Protocol[9] of The Uniform Methods Project[10] (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,[11] 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.

I.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 prior to sample selection
- Budget, schedule, and geographical distribution

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[9] 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

[10] 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

[11] 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.

I.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. 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[12] (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.

I.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.

I.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.

I.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).

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[12] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

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- Update STEP Manual 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.

- Provide regulatory support as necessary.

- If appropriate, support lost revenue recovery activities.

I.8   Residential Appliance Recycling Program – Revision History

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 change to measure description.

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APPENDIX J. RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE PROGRAM EM&V PLAN

J.1 Impact Evaluation of the Residential Efficient Products Marketplace Program

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Evaluation, Measurement, and Verification Report for Dominion Virginia Power

Appendix J-1
Impact Evaluation of the Residential Efficient Products Marketplace Program

Date: May 14, 2021

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1 EXECUTIVE SUMMARY

1.1 Study purpose and objectives

The primary objective of this study was to conduct an impact evaluation of Dominion Energy's (Dominion's) Residential Efficient Products Marketplace Program (REEC). The Marketplace Program offers upstream lighting incentives that result in price discounts on energy-efficient lighting products for shoppers at program-participating stores. It also offers rebates on ENERGY STAR®-rated appliances. Table 1-1 lists all the energy-efficient measures implemented under this program.

Table 1-1: Program energy-efficient measures

Lighting Measure (LEDs)	Appliance Measures ENERGY STAR
A-Lines	Freezer
Reflectors	Refrigeration
Decorative	Clothes Washer
Globes	Dehumidifier
Retrofit Kit and Fixtures	Air Purifier
A-Lines	Clothes Dryer
Reflectors	Dishwasher

This impact evaluation provides estimates of ex post gross energy savings and net energy savings, which account for the effect of free-ridership (FR). Net-to-gross (NTG) ratios were calculated from reported estimates and applied to tracking data for realization rates and cost -effectiveness. The evaluation also used information from surveys of customers and lighting and appliance market actors to better understand the markets in which the Marketplace Program operates and gather participant perspectives on the program's effectiveness.

This study satisfies the applicable requirements of the Residential Efficient Products Marketplace Program EM&V Plan (Version 1.0) for Residential Efficient Products Marketplace Program according to the EM&V Rule (20 VAC 5-318). These include calculating impacts as well as informing future Marketplace Program design and implementation through insights gained from interview and survey data.

1.2 Key findings

The following is a summary of the key findings which the report describes in more detail in later sections.

1.2.1 Adjusted gross savings

This study determined that no adjustment is needed to the Marketplace Program's gross energy savings claims because:

1. All the interviewed lighting manufacturers and retail buyers confirmed the summary of their July 2019–July 2020 program sales that the DNV team had emailed them before the interviews.
2. The DNV team verified that all the quantities of LED product types that appeared in the sample of lighting manufacturer invoices for November–December 2019 (which accounted for nearly half of program sales during the July 2019–July 2020 period) matched those in the program tracking data.

3. Only two of the 1,519 surveyed appliance participants described a situation where the program should lose some savings—either because the appliance had not been installed or it had been installed outside the Dominion service territory.

1.2.2   Net savings for lighting

As discussed in more detail later in the report, the DNV team calculated adjustment factors for net savings using self-reported values from in-depth interviews. These values were applied to each supplier's sales after averaging the suppliers' NTG estimates with their partnered retail buyer's NTG estimates. The breakdown of each bulb category's NTG estimates is shown in Table 1-2 along with confidence intervals and standard error calculations.

Table 1-2: Lighting NTG summary by LED product type

	A-line Lamps	Specialty Lamps	Fixtures & Retrofit Kits	Reflector Lamps
Adjusted Program Sales with NTG estimates	1,134,374	550,646	229,131	970,911
Program Sales	1,890,624	933,298	381,885	1,277,515
NTG Ratio	60%	59%	60%	76%
Standard Error	0.3%	0.5%	0.2%	1.1%
Lower Confidence Interval	59.2%	58.6%	59.9%	74.6%
Upper Confidence Interval	60.2%	60.2%	60.6%	78.1%

1.2.3   Net savings for appliances

The DNV team also estimated net savings for the appliance component of the program using a methodology described later in the report. Figure 1-1 shows total attributable energy savings for the appliance component of the program (the ratio between program-attributable energy savings and total program savings is the NTG ratio). Figure 1-2 breaks down the program attributable savings by appliance. The smaller appliances (dehumidifiers, air purifiers) had higher NTG ratios than the larger appliances.

One possible reason for this, as discussed later in the report, is that the program accelerated the purchase of dehumidifiers and air purifiers more than any other appliances (this timing attribution is a key component of program attribution). This is

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likely because participants can delay purchasing a new dehumidifier or air purifier with less inconvenience than would be the case if they delayed the purchase of a new refrigerator, clothes washer, or clothes dryer, especially when these larger appliances are replacements for non-functioning equipment.

The ratio between the program rebate and the average equipment purchase prices was also much higher for air purifiers (40%) than any of the other appliances. As discussed in the body of the report, there is some evidence that this might be related to its higher level of program attribution.

Figure 1-1: Total attributable energy savings for the appliance component of the program

Savings not attributed to program
53%

Savings attributed to program (net savings)
47%
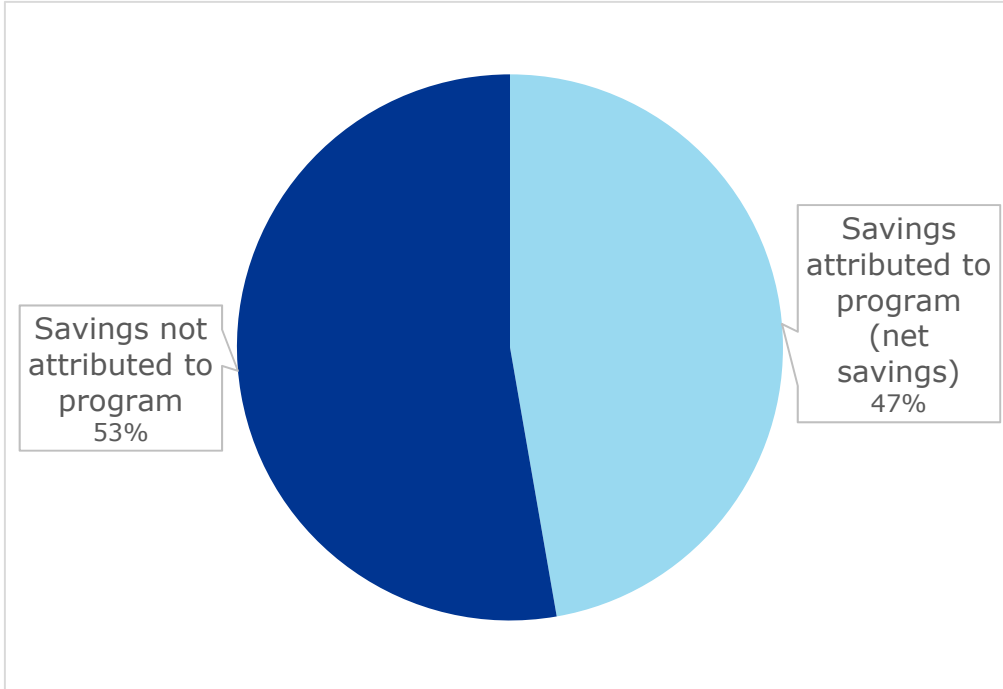
Figure 1-2: Program-attributable energy savings by appliance

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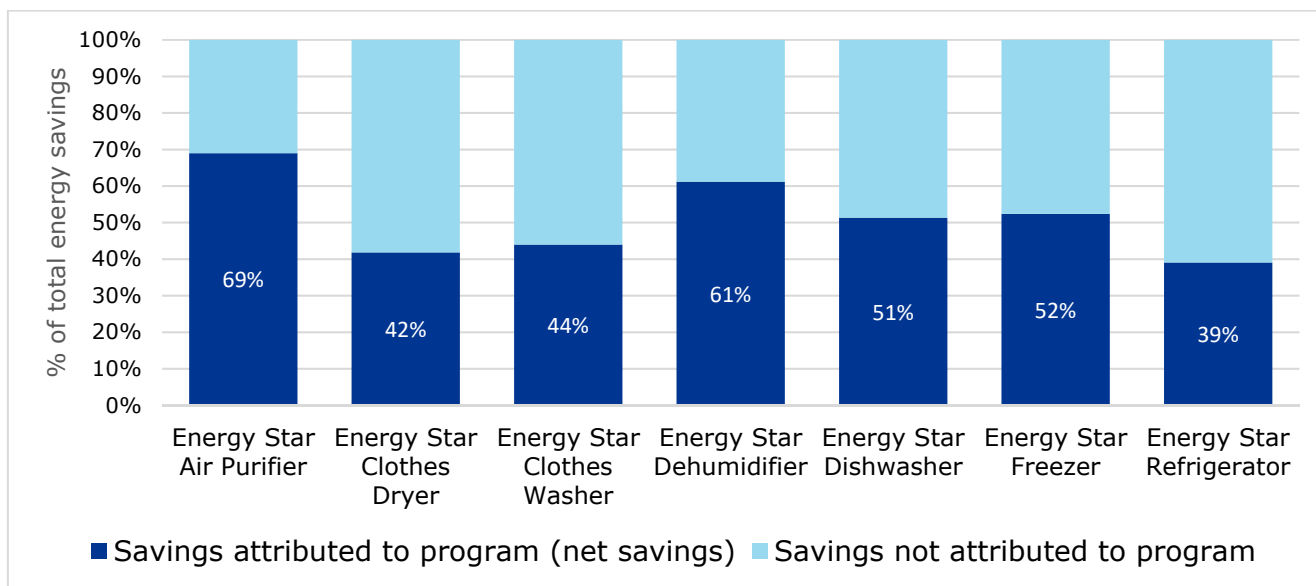
Table 1-3 shows the program attribution ratios for these appliances along with information on sample sizes, standard errors, and confidence intervals.

Table 1-3: Program-attributable energy savings by appliance with confidence intervals

Measure	Number of Respondents	Mean	Standard Error	One-Sided Lower C.I.	One-Sided Upper C.I.
ENERGY STAR Air Purifier	58	0.7	0.1	0.5	0.8
ENERGY STAR Clothes Dryer	502	0.4	0.0	0.4	0.5
ENERGY STAR Clothes Washer	607	0.4	0.0	0.4	0.5
ENERGY STAR Dehumidifier	85	0.6	0.1	0.5	0.7
ENERGY STAR Dishwasher	265	0.5	0.0	0.4	0.6
ENERGY STAR Freezer	21	0.5	0.1	0.3	0.8
ENERGY STAR Refrigerator	476	0.4	0.0	0.3	0.4

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1.2.4   Program marketing and outreach

Most appliance participants first heard about the program in the store: Two-thirds of them said they first heard about the rebates in the retail store. The Dominion website was a distant second (10% of respondents) as a first information source for the rebates.

In-store Point-of-Purchase, bill stuffers, and emails were the most recommended ways for participants to hear about energy efficiency programs and rebates. Over two-thirds of the participants recommended in-store displays, and about half suggested bill stuffers or email communications. There were many other recommendations cited less frequently as Figure 1-3 shows.

Figure 1-3: How participants prefer to get future program information
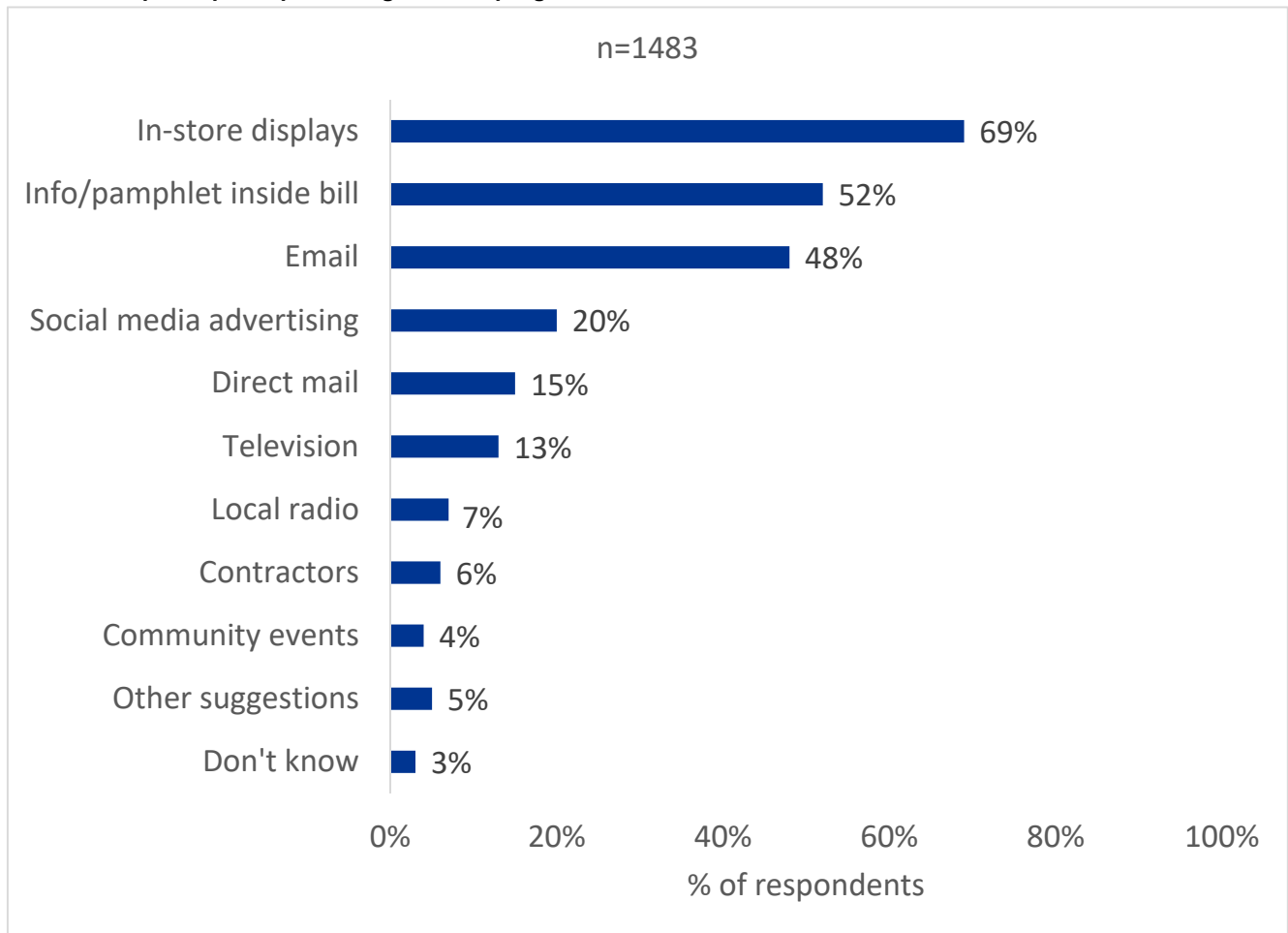
1.2.5   Program satisfaction

- *Program satisfaction was high*: The DNV asked the participants about their satisfaction with the Marketplace Program as well as with various aspects of the program including the website, the rebate application process, the timeliness of the rebate payment, the rebate amounts, and the rebated appliances. The participants were most satisfied with the rebated appliances and least satisfied with the timeliness of the rebate payments, as Figure 1-4 shows.

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Figure 1-4: Program satisfaction
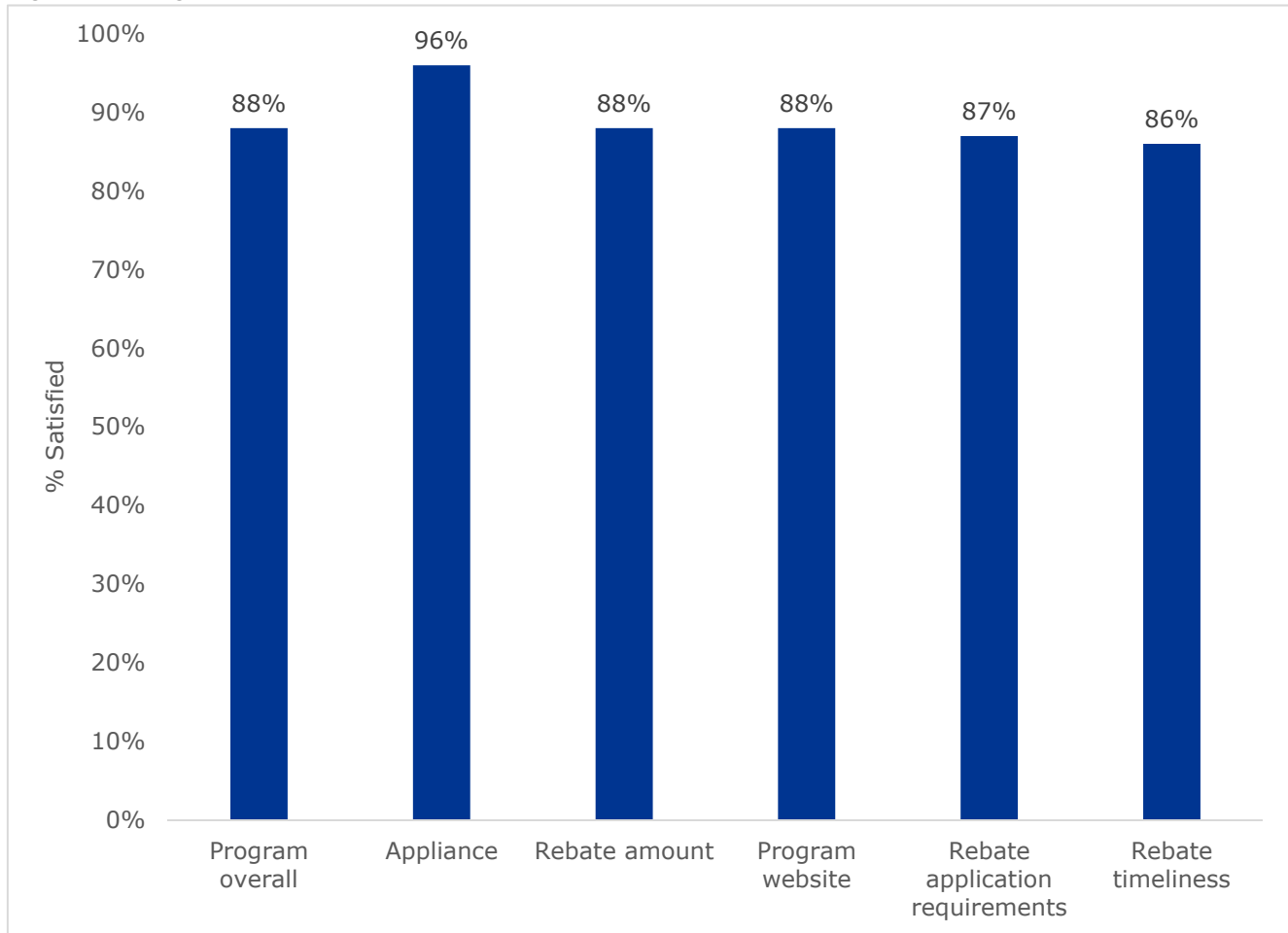
- *Few participants had suggestions for improving the program*: Only 10% of the appliance participants had suggestions for program improvements. Program satisfaction shows that the two most-cited suggestions were to improve the rebate application process and do more program marketing.

DNV

Figure 1-5: Participant suggestions for program improvements
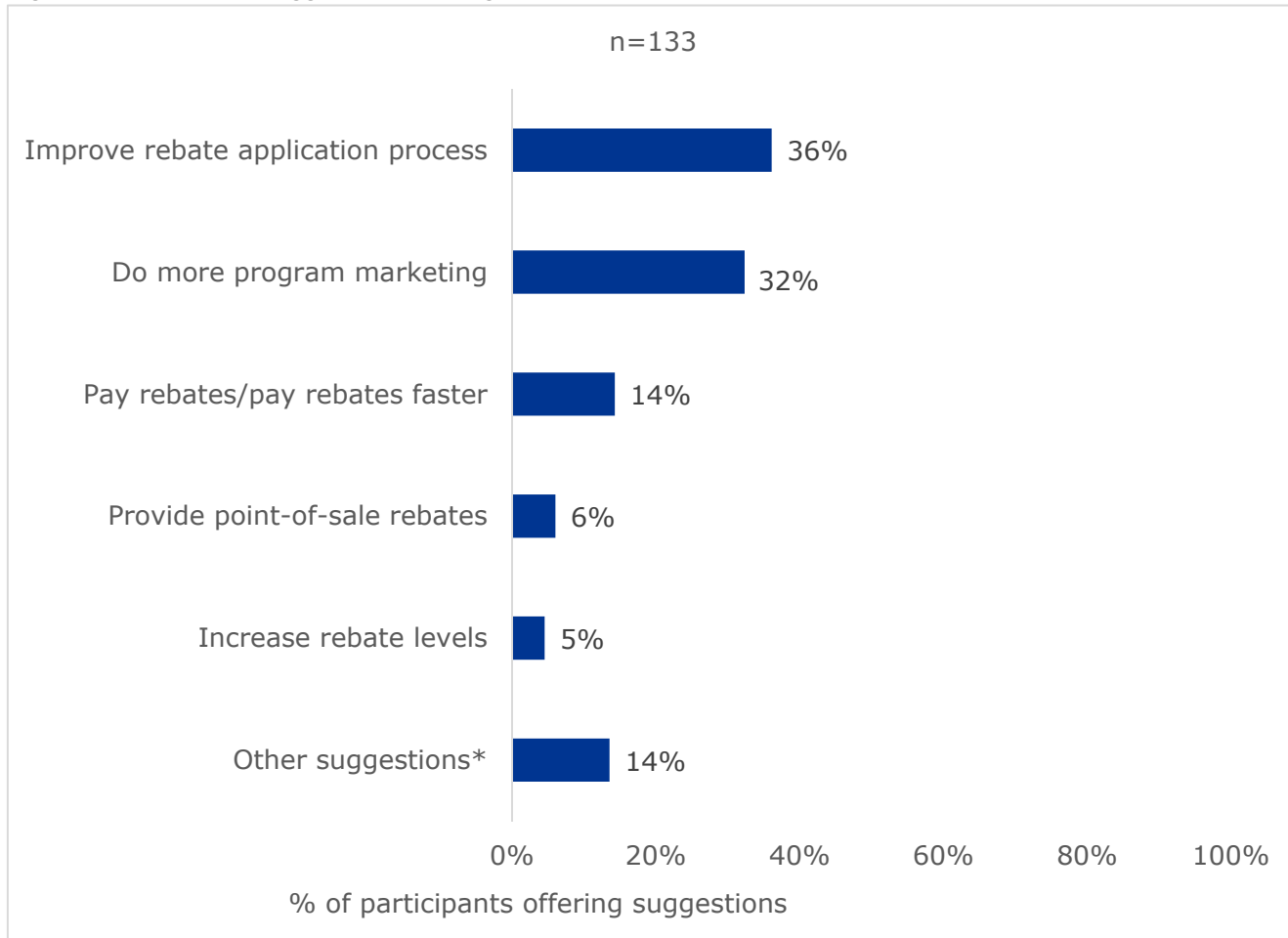
n=133

- Improve rebate application process — 36%
- Do more program marketing — 32%
- Pay rebates/pay rebates faster — 14%
- Provide point-of-sale rebates — 6%
- Increase rebate levels — 5%
- Other suggestions* — 14%

% of participants offering suggestions

Note: The percentages exceed 100% because the participants could provide multiple suggestions. *Other suggestions included allowing bill credits, offering rebates for a wider range of appliances, and supporting solar programs.

1.2.6   The impacts of the pandemic on energy efficiency

The DNV team asked the participants what impacts, if any, the COVID-19 pandemic had on their plans for improving the energy efficiency of their homes.

- *Over a third of participants said the pandemic impacted the timing or size of their energy efficiency upgrades*. Thirty-six percent of the appliance participants who said that they were planning energy efficiency upgrades such as new energy-efficient appliances or lighting (n=644) said the pandemic impacted the timing or size of their energy efficiency projects.
- *Financial consideration and concerns about people entering homes were top reasons why participants changed their energy efficiency programs:* The team asked participants who reported having energy efficiency plans impacted by the pandemic why their planned energy efficiency activities changed. The three most commonly mentioned reasons were financial considerations or risk aversion and participant discomfort with contractors entering their house (Figure 1-6).

DNV

Figure 1-6: Why participants changed their EE projects due to the pandemic
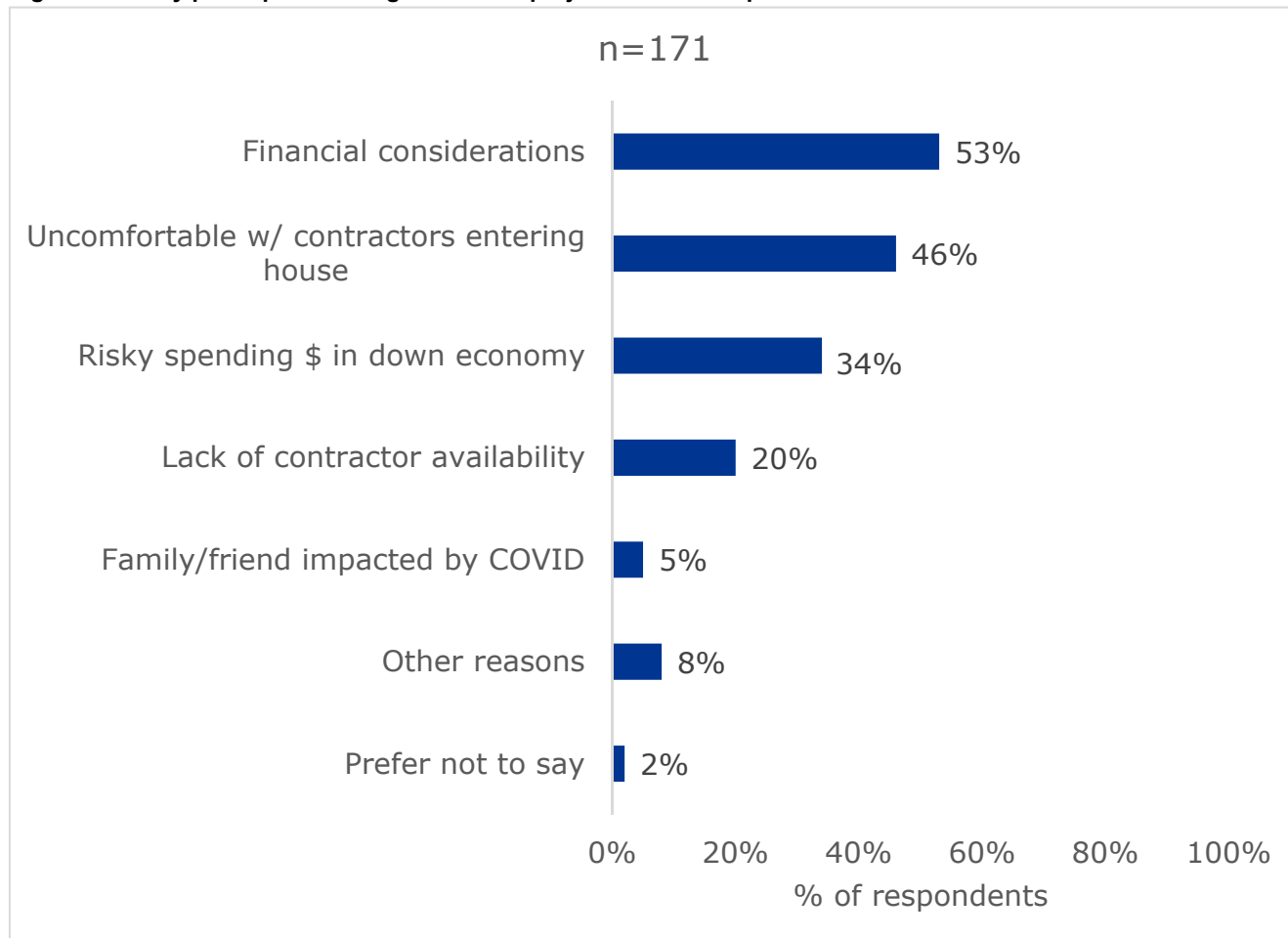
n=171

Reason	%
Financial considerations	53%
Uncomfortable w/ contractors entering house	46%
Risky spending $ in down economy	34%
Lack of contractor availability	20%
Family/friend impacted by COVID	5%
Other reasons	8%
Prefer not to say	2%

% of respondents

Note: The percentages exceed 100% because the participants could provide multiple reasons.

1.3 Recommendations

Based on the findings from this report, the DNV team makes the following recommendations for improving the future delivery of the Marketplace Program:

1. *Promote more program LED sales through the dollar store/discount channel:* During the interviews, the lighting manufacturers indicated that the participating discount/dollar stores would not have been able to sell the ENERGY STAR LED products if not for the price discounts offered by the program (which averaged over $4/lamp). The desired price points for the dollar/discount stores are low enough (even when not strictly $1) that they would not stock these LED products without these large program price discounts. Absent the program, such stores would likely sell cheaper and less energy-efficient halogen and incandescent lighting products. Numerous upstream lighting evaluations which produced NTG estimates by retail channel (e.g., in California, Massachusetts, Connecticut) have found that the NTG ratios for the discount channel (which includes not only $ stores but also thrift retailers are usually in the 90-100% range for the reasons stated above. Therefore, increasing the volume of program lamp sales through this channel could translate to a higher overall NTG ratio.

DNV

In addition, focusing the program more on this discount retail channel would help Dominion reach program equity goals such as ensuring that rural customers who may only have these dollar/discount stores within convenient driving distance can get fair access to the discounted LEDs.

2. *Promote more program LED reflector sales:* The NTG ratio for the LED reflectors (73%) was higher than those for the other LED product categories (56% for A-lines, 53% for specialty lamps, and 60% for fixtures/retrofit kits). Increasing the volume of LED reflector sales through the Marketplace Program could translate to a higher overall NTG ratio.

3. *Promote more program small appliance sales:* The NTG ratios for the smaller appliances—air purifiers (69%) and dehumidifiers (61%) were higher than those for other appliances, likely due to some of the factors mentioned above (e.g., rebates accounting for a larger proportion of the appliance purchase price, and the program having great purchase acceleration impacts). Furthermore, when the DNV team asked program participants which factors influenced their decision to purchase the energy-efficient equipment, the small appliance purchasers were more likely to mention the utility rebate than the large appliance purchasers (50% vs. 39%, a statistically significant difference). The small appliance purchasers were also more likely to value the ENERGY STAR branding than the large appliance purchasers (51% vs. 41%, a statistically significant difference).

4. *Work with the program implementer to improve the timeline of the rebate payment process:* While participants were generally satisfied with the program, the lowest satisfaction level (86%) was with the timeliness of the rebate payment. Improving the timing of the rebate payments was also one of the participants' top suggestions for improving the program.

DNV

2 INTRODUCTION

2.1 Study purpose and objectives

The primary objective of this study was to conduct an impact evaluation of Dominion's Residential Efficient Products Marketplace Program (Marketplace Program). The Marketplace Program offers upstream lighting incentives that result in price discounts on energy-efficient lighting products for shoppers at program-participating stores. It also offers rebates on ENERGY STAR-rated appliances. Table 2-1 lists all the energy-efficient measures implemented under this program.

Table 2-1: Program energy-efficient measures

Lighting Measure (LEDs)	Appliance Measures ENERGY STAR
A-Lines	Freezer
Reflectors	Refrigeration
Decorative	Clothes Washer
Globes	Dehumidifier
Retrofit Kit and Fixtures	Air Purifier
A-Lines	Clothes Dryer
Reflectors	Dishwasher

This impact evaluation provides estimates of ex post gross energy savings and net energy savings, which account for the effect of FR. NTG ratios were calculated from reported estimates and applied to tracking data for realization rates and cost-effectiveness. The evaluation also used information from surveys of customers and lighting and appliance market actors to better understand the markets in which the Marketplace Program operates and gather participant perspectives on the program's effectiveness.

This study satisfies the applicable requirements of the Residential Efficient Products Marketplace Program EM&V Plan (Version 1.0) for Residential Efficient Products Marketplace Program according to the EM&V Rule (20 VAC 5-318). These include calculating impacts as well as informing future Marketplace Program design and implementation through insights gained from interview and survey data.

2.2 Organization of report

The remainder of this report is organized as follows:

Section 3 – Methodology and approach

Section 4 – Adjusted gross savings

Section 5 – Adjusted net findings

Section 6 – Participant perspectives on program marketing

Section 7 – Program satisfaction

Section 8 – Impact of pandemic on energy efficiency

Section 9 – Other findings

Section 10 – Recommendations

3 METHODOLOGY AND APPROACH

This section describes how DNV calculated the adjusted gross savings factors and adjusted NTG ratios. Figure 3-1 provides a high-level overview of the methodology described in sections 3–5.

Figure 3-1: Methodology overview
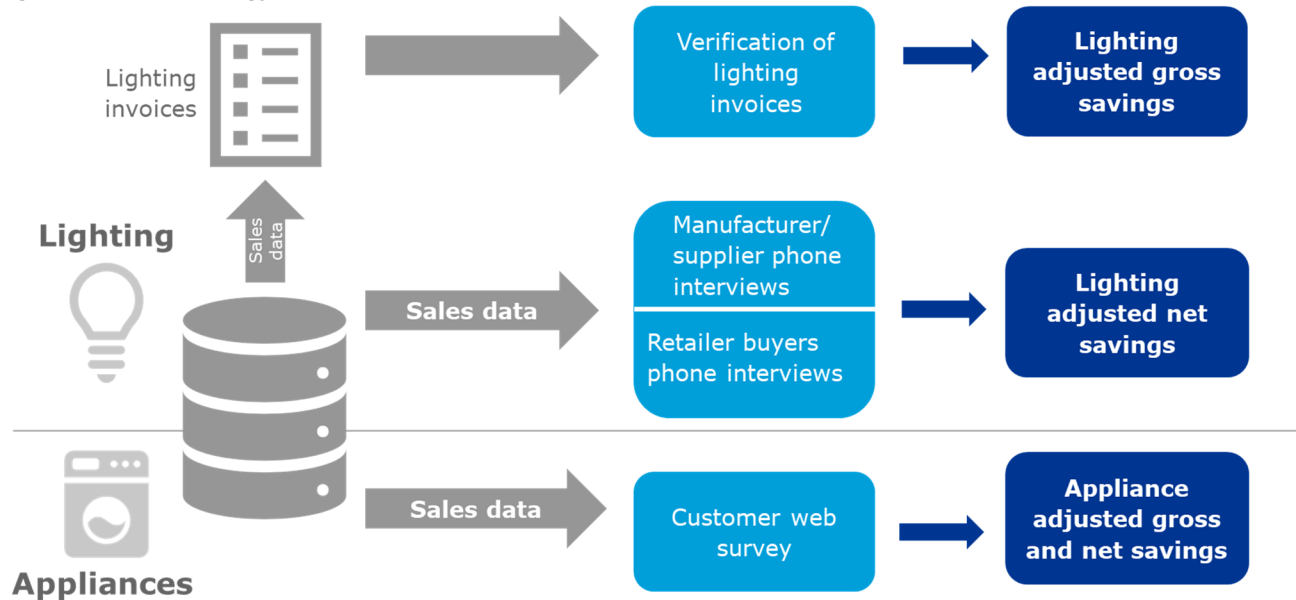
The study followed the Residential Efficient Products Marketplace Program EM&V Plan (Version 1.0) and national protocols for designing survey and survey samples and measuring net savings such as the Uniform Methods Project (UMP).[1] The evaluation used well-established survey methodologies to estimate program impacts. First, the DNV team interviewed the Dominion program manager and staff from the program implementer, CLEAResult, to gain greater insights and background knowledge of the program. These interviews helped the DNV team write informed questions for the impact, marketing, and satisfaction sections of the survey instruments.

For the lighting portion of the study, the DNV team conducted in-depth interviews (IDI) with lighting manufacturers and retailers who participated in the program. It first asked them to confirm their sales through the program as stated in the program tracking data. It then asked the manufacturers and retailers to estimate the impact on their sales if the Marketplace Program, with its price discounts and point-of-purchase promotional materials, had not been available. The team asked this series of program attribution (NTG) questions for four different classes of LED lighting products: 1) A-line lamps, 2) reflectors, 3) specialty lamps, and 4) fixtures and retrofit kits.

The team then asked the manufacturers and retailers questions about market trends including possible barriers to LED product demand and the future direction of LED product pricing. Finally, it asked the manufacturers and retailers to rate their satisfaction with the Marketplace Program. The survey instruments for the suppliers and retailers can be found in Appendix C and D, respectively.

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[1] Daniel M. Violette and Pamela Rathbun, (2017) *Chapter 21: Estimating Net Savings – Common Practices, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578; 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.

3.1 Sample design

This subsection describes the sample designs for each component of the Marketplace Program.

3.1.1 The lighting sample design

For the lighting part of the evaluation, the DNV team reviewed the July 2019–July 2020 Marketplace Program tracking data and identified 22 participating lighting manufacturers and 15 participating large retailers. These small populations allowed for a census approach to the data collection where the team attempted to complete interviews with all participating manufacturers and large retailers. Therefore, no formal sample design was needed.

3.1.2 The appliance sample design

For the appliance part of the evaluation, the team sent out web survey invitations to all Marketplace Program participants in the July 2019–July 2020 tracking data. To reduce respondent fatigue, if participants had received more than two appliances through the program, they were only asked about two of these. In such cases, to determine which appliances to ask about, the team gave priority to the less common appliances (i.e. ENERGY STAR freezer, ENERGY STAR dehumidifier, and ENERGY STAR air purifier).

After the survey was out of the field, the team checked the representativeness of the sample by comparing the characteristics of the respondents to those of the full program population. Table 3-1 presents these characteristics. The sample compares well to the population, with the possible exception of the average purchase price of the ENERGY STAR Purifiers (15% higher for the population than for the sample) and the ENERGY STAR Freezers (13% higher for the sample than for the population).

Table 3-1 shows that program participants purchased 11,633 appliances that total 1,735 MWh/year in deemed savings. These appliances had a cost of $9.5 million dollars and received $719,000 in rebates.

Table 3-1: Appliance characteristics: program participants vs study participants

Appliance	Number of Units	Percent Number of Units	Total Savings (kWh/year)	Percent Savings	Average Savings (kWh/year)	Sum of Purchase Price ($)	Percent of Sum of Price	Average Purchase Price ($)	Sum of Rebates ($)	Percent of Rebates	Average Rebate ($)
Full Population											
ENERGY STAR Air Purifier	371	3%	243,899	14%	657	60,223	1%	162	18,525	3%	50
ENERGY STAR Clothes Dryer	2,903	25%	507,425	29%	175	2,174,781	23%	749	290,300	40%	100
ENERGY STAR Clothes Washer	3,960	34%	735,212	42%	186	2,924,109	31%	738	198,000	28%	50
ENERGY STAR Dehumidifier	328	3%	34,646	2%	106	68,112	1%	208	8,200	1%	25
ENERGY STAR Dishwasher	1,521	13%	54,761	3%	36	899,110	9%	591	76,050	11%	50
ENERGY STAR Freezer	97	1%	3,925	0%	40	57,912	1%	597	4,850	1%	50
ENERGY STAR Refrigerator	2,453	21%	155,066	9%	63	3,322,517	35%	1,354	122,650	17%	50
Total	**11,633**	**100%**	**1,734,934**	**100%**	*	**9,506,764**	**100%**	*	**718,575**	**100%**	*
Study Participants (Sample)											
ENERGY STAR Air Purifier	84	4%	55,200	17%	657	11,577	1%	138	4,200	3%	50
ENERGY STAR Clothes Dryer	520	24%	90,995	28%	175	385,528	22%	741	52,000	40%	100
ENERGY STAR Clothes Washer	676	31%	122,651	38%	181	500,772	29%	741	33,800	26%	50
ENERGY STAR Dehumidifier	92	4%	9,738	3%	106	18,962	1%	206	2,300	2%	25
ENERGY STAR Dishwasher	270	13%	9,729	3%	36	160,063	9%	593	13,500	10%	50
ENERGY STAR Freezer	21	1%	898	0%	43	14,125	1%	673	1,050	1%	50
ENERGY STAR Refrigerator	493	23%	30,685	10%	62	655,726	38%	1,330	24,650	19%	50
Total	**2,156**	**100%**	**319,897**	**100%**	*	**1,746,752**	**100%**	*	**131,500**	**100%**	*

* Not applicable

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Figure 3-2 and Figure 3-3 illustrate the savings and rebates for each of the program appliances. For example, ENERGY STAR clothes washers account for 43% of the program savings but only 27% of the program rebates. In contrast, ENERGY STAR clothes dryers account for 29% of savings and 40% of rebates.

Figure 3-2: Appliance program savings

DNV
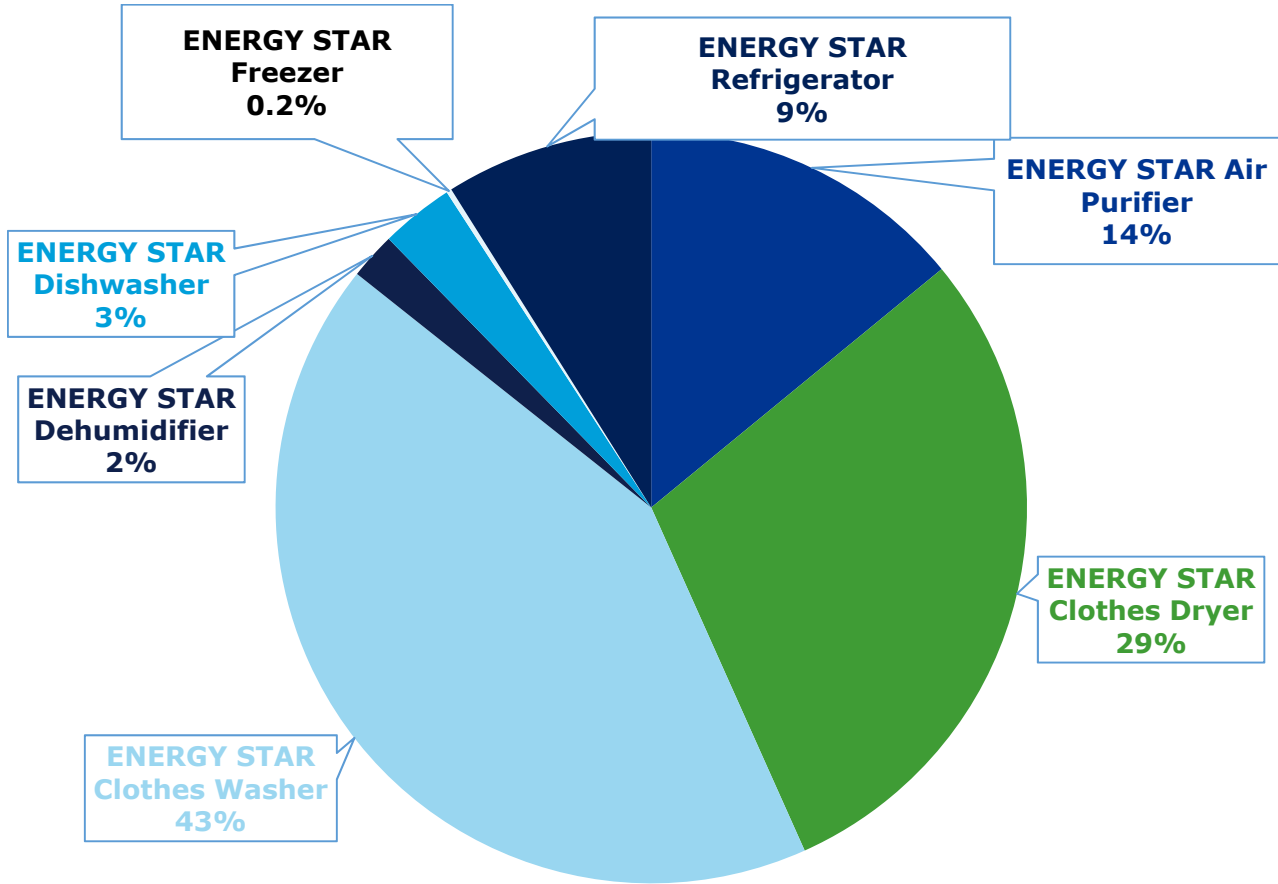
Figure 3-3: Appliance program rebates

ENERGY STAR Refrigerator 17%

ENERGY STAR Air Purifier 3%

ENERGY STAR Freezer 1%

ENERGY STAR Clothes Dryer 40%

ENERGY STAR Dishwasher 11%

ENERGY STAR Dehumidifier 1%

ENERGY STAR Clothes Washer 27%
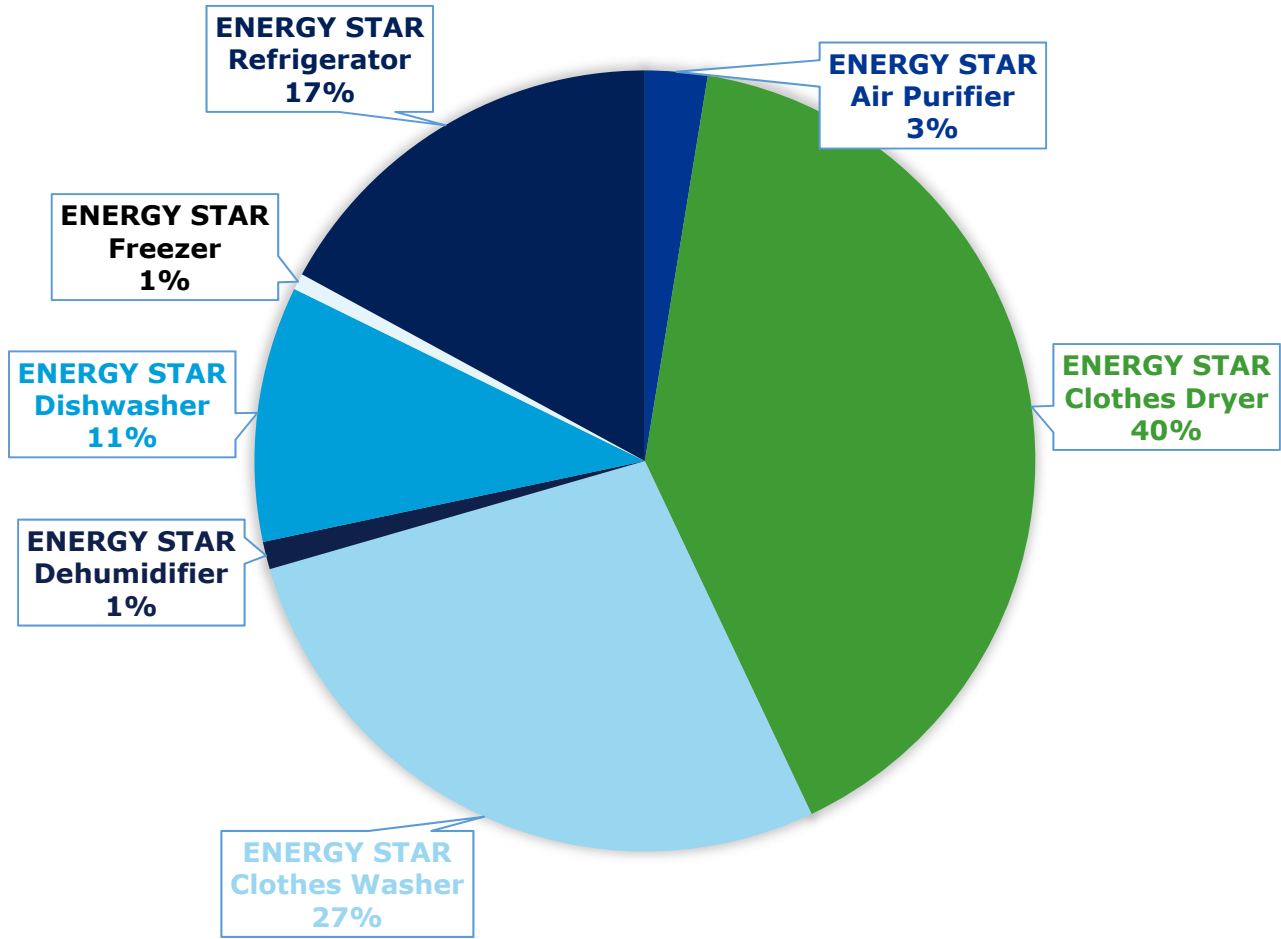
The DNV team also compared the reasons for purchase stated in the rebate form for all program participants to those of the sample. Table 3-2 shows that in this respect, the sample is a good representation of the population.

Table 3-2: Reasons for purchase stated in rebate form

Reason for Purchase Stated in Rebate Form	All Program Participants (Population No. of Units)	% of Program Participants	Study Participants (Sample No. of Units)	% of Study Participants
Replace Broken	4,936	42%	932	43%
Replace working unit (upgrade) / Remodel	3,493	30%	675	31%
Purchase for new move into existing home	1,605	14%	245	11%
Purchase additional unit(s) in existing home	849	7%	165	8%
Purchase for newly built home (new construction)	711	6%	125	6%
No answer	39	0%	14	1%
Totals	**11,633**	**100%**	**2,156**	**100%**

3.2   Data sources

The DNV team obtained program tracking data from the program implementer for the July 2019–July 2020 period for both the lighting and appliance components of the program. For the lighting component, the team also acquired invoices from participating lighting manufacturers for the November-December 2019 period as well as contact information for all the participating manufacturers and retail buyers. Since the contact information provided by Dominion was incomplete, the DNV team supplemented it via web searches and contact information it had compiled from previous evaluations of upstream lighting programs in other jurisdictions.

The DNV team attempted a census of all lighting manufacturers and retailers for the data collection interviews with a particular focus on the manufacturers and retail buyers who accounted for the largest volume of programs. When there was resistance to the interviews from a few manufacturers, DNV team enlisted the help of Dominion and the program implementer to encourage cooperation from those manufacturers.

In the end, the team was successful in interviewing the largest program actors. It completed interviews with seven of the eight lighting manufacturers who accounted for the largest volume of program sales. It also completed interviews with three of the four retail buyers who had the largest share of program sales. In total, the team completed interviews with nine participating manufacturers and four participating retail buyers. Table 3-3 shows that the interviewed manufacturers accounted for 86% of program sales and Table 3-4 shows that the interviewed retail buyers represented 63% of program sales. The tables also show that these sale percentages varied with the LED product type.

DNV

Table 3-3: Program sales accounted for by interviewed lighting manufacturers

Sales Volume	A-Lines	Specialty	Fixtures and Retrofit Kits	Reflectors	Total
Program Sales of Interviewed Manufacturers (July 2019–2020)	1,591,139	826,436	288,051	1,144,806	3,850,432
Total Program Sales (July 2019–2020)	1,890,624	933,298	381,885	1,277,515	4,483,322
% of Program Sales Accounted for by Interviewees	84%	89%	75%	90%	86%

Table 3-4: Program sales accounted for by interviewed lighting retailers

Sales Category	A-Lines	Specialty	Fixtures and Retrofit Kits	Reflectors	Total
Program Sales of Interviewed Retailers (July 2019–2020)	1,063,233	685,352	322,017	775,935	2,846,537
Total Program Sales (July 2019–2020)	1,890,624	933,298	381,885	1,277,515	4,483,322
% of Program Sales Accounted for by Interviewees	56%	73%	84%	61%	63%

DNV

4   ADJUSTED GROSS SAVINGS

The DNV team verified gross savings for the Marketplace Program in three different ways:

1. Asked participating lighting manufacturers and retail buyers to verify the volume of their LED product sales through the Marketplace Program
2. Compared a sample of invoices from lighting suppliers to the program tracking data used to estimate gross savings
2. Asked participants who received a program-rebated appliance to confirm that the appliance had been installed in the Dominion service territory

4.1   Lighting manufacturer/retail buyer verification of sales

Before the interviews with the participating lighting manufacturers and retail buyers, the DNV team emailed them a table summarizing their sales through the Marketplace Program during the July 2019–July 2020 period broken out by LED product type. During the interviews, the team asked them to verify the quantities in the summary tables. All nine of the lighting manufacturers and all four of the retail buyers whom the team interviewed said that the quantities in the summary tables appeared to be accurate.

4.2   Lighting supplier invoice verification

The DNV team also verified gross energy savings claims for the Marketplace Program by reviewing a sample of invoices from participating lighting suppliers and matching them with LED shipments data from the program tracking data. The team selected a sample of invoices from November-December 2019, which accounted for 42,905,456 kWh/year of the program's ex ante savings. We selected this sample for the following reasons:

1. *It was the highest two-month period of upstream lighting activity:* Table 4-1 shows that the November-December 2019 sample accounted for almost half of program sales from August 2019–May 2020. This allowed the DNV team to capture a larger share of program activity than any other two-month sample would have captured. It is also likely that a program's most active period is the time when it would be at greatest risk of data entry errors due to the volume of transactions.

Table 4-1: Upstream kWh bulb savings by month

Reporting month	Sum of kWh savings	Percentage of total by month
Aug-19	378,729	0%
Sep-19	2,005,686	2%
Oct-19	15,152,926	14%
Nov-19	25,903,912	24%
Dec-19	26,150,656	25%
Jan-20	8,408,510	8%
Feb-20	9,474,681	9%
Mar-20	8,955,529	8%
Apr-20	6,199,302	6%
May-20	3,327,775	3%
Total	**105,957,705**	**100%**

DNV

2. *It preceded the A-line phaseout:* Starting in January 2020, the program temporarily suspended sales of A-line LED lamps. Choosing a sample from 2019 allowed the DNV team to capture the program's A-line sales.

3. The DNV team reviewed total as well as average LED shipments by distribution channel (e.g., discount, drug store, etc.) as well as by product type (A-line, globe, PAR, candelabra base, etc.). For each invoice/application selected for verification, we compared the program tracking data to what was provided in the invoice form. In addition to the quantity of utility-discounted products shipped, we attempted to verify the following key metrics:

   – Manufacturer name
   – Measure name
   – Product type
   – Retailer name and location
   – Invoice completion date
   – Total bulb quantity
   – Total units

The invoice verification was able to verify 100% of the sample invoices against the tracking data.

4.3 Appliance participant installation verification

The DNV team asked the customers who had participated in the appliance component of the program to verify that their rebated appliance had been installed at the address indicated in the program tracking data.[2] Only 13 of the 1,519 surveyed participants (<1%) said that this was not the case.[3]

The team then asked these 13 participants what they did with the appliance. Ten of the 13 responded to this follow-up question:

- Seven responded they had installed the appliance at a different address within the Dominion service territory.
- One responded they had not yet installed the rebated appliance (a dehumidifier).
- One responded they had installed their rebated appliance at a different address outside the Dominion territory.
- One chose the "Other" response option on the web survey without specifying details.

Since only two of the 1,519 surveyed appliance participants described a situation where savings would be discounted and the associated savings were less than 1%—either because the appliance had not been installed or it had been installed outside the Dominion service territory—the DNV team determined that there was effectively no reduction to the gross savings for the appliance component of the program.

4.4 Summary

This study determined that no adjustment to gross energy savings claims was needed because:

1. All the interviewed lighting manufacturers and retail buyers confirmed the summary of their July 2019–July 2020 program sales from the tracking data, which the DNV team had emailed them before the interviews.

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[2] The DNV team assumed that the program implementation contractor had checked to make sure the addresses in the program tracking data were within the Dominion Energy service territory before approving the rebates. For appliance rebates, customer validation occurs via the online portal that customers use to submit rebate applications. In this portal customers must provide their Dominion Account Number and name on the account along with contact information which includes an address. Once a rebate is submitted, customer information is verified with an API connection (web service) that the program implementation contractor set up with Dominion Energy. The implementation contractor's processing team verifies all these required validations during the processing as well to further confirm customer eligibility.

[3] These 13 participants represented 14 appliances because one of them had not installed two of the rebated appliances.

DNV

2. The DNV team verified that all the quantities of LED product types that appeared in the sample of lighting manufacturer invoices for November-December 2019 (which accounted for nearly half of program sales during the July 2019–July 2020 period) matched those in the program tracking data.

2. Only two of the 1,519 surveyed appliance participants (accounting for <1% of gross savings) described a situation where the program would be discounted savings—either because the appliance had not been installed or because it had been installed outside the Dominion service territory.

DNV

5 ADJUSTED NET SAVINGS

This section summarizes the findings concerning net savings estimates for both the lighting and appliance components of the Marketplace Program

5.1 Net energy savings estimates for lighting

To estimate net energy savings for the upstream lighting component of the program, the team used the supplier self-report methodology.[4] The methodology is one of the few available for estimating NTG ratio for upstream lighting programs that do not collect contact information from participating customers. First used to estimate NTG ratios for California's upstream lighting program in 2007,[5] supplier self-report methodology has subsequently been used for many years to calculate NTG ratios for some of the nation's largest upstream lighting programs, including in California, Massachusetts. Illinois, and the service territory of the Tennessee Valley Authority (TVA).

The supplier self-report methodology bases NTG estimates on what the participating lighting manufacturers and retail buyers believe would have been the impact on their sales of the program-rebated LED products if the program's price discounts and point-of-purchase promotional materials had not been available. Table 5-1 shows generic and condensed versions of the actual interview questions (which can be found in Appendices C and D).

Evaluations of upstream lighting programs in other jurisdictions have found that certain discount retailers, such as dollar stores and thrift stores, stop selling the program-discounted lighting products when the discounts are no longer available. Question Q1 in Table 5-1 is designed to identify these situations in the lighting manufacturer interviews. Question Q2 is designed to cover the majority of situations, where the lighting manufacturers and retail buyers estimate that they would continue to sell the discounted LED products without the program, but at lower sales volumes.

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[4] Daniel M. Violette and Pamela Rathbun, (2017) *Chapter 21: Estimating Net Savings – Common Practices, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578;

[5] *2004/2005 Statewide Residential Retrofit Single-Family Family Energy Efficiency Rebate Evaluation*, Final Report, Prepared for California's Investor-Owned Utilities, October 2, 2007, CPUC-ID#:1115-04.

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Table 5-1: Example NTG questions from manufacturer/retail buyer interviews

Question Scope	Question Language
Sales impact questions asked only of lighting manufacturers	**Q1.** The Dominion Program paid average buydown or markdown discounts of $<average_buydown> per <lamp type>. Are there any retailers or retailer categories that you worked with through the program that you think would not have been selling any <lamp type> if these discounts had not been available? As a reminder, you worked with <retailers >. **Q1a.** [IF YES] Which retailers or retailer categories? **Q1b.** [IF YES] Why do you say this?
Sales impact questions asked of both lighting manufacturers and retail buyers[6]	**Q2.** Dominion Program paid average buydown or markdown discounts of $<average_buydown> per <lamp type>. If these program buydown/markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs through <retailers_string> in Virginia and North Carolina would have been about the same, lower, or higher? **Q2a.** [IF THE SAME OR HIGHER] Why do you say this? **Q2b.** [IF LOWER] By what percentage do you estimate your sales of <lamp type> through <retailers string> would be lower during 2019 if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE] **Q2c.** I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM Q2b] % lower without the program support. So, if you actually sold <lamp type> in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM Q2b) * 100)] in that period if the buydowns/markdowns hadn't been available?

The DNV team assigned a NTG ratio of 100% to any LED product sales identified in response to question Q1 because it assumed that these sales would not have occurred without the program. For any responses to question Q2 that indicated a decline in sales absent the program, the team assigned a NTG ratio equivalent to the estimated drop in sales. For example, if a lighting manufacturer representative or a retail buyer estimated that their sales of a given LED product would decline 60% absent the program, the NTG ratio would be 60%.

The team collected separate NTG ratios for each of four LED product types: 1) A-lines, 2) reflectors, 3) specialty lamps, and 4) fixtures/retrofit kits. The specialty lamps category included globes, candelabra base lamps, candles, and other specialty lamps. However, it only asked the manufacturer representatives or retail buyers about a particular LED product type if they sold that product type through the program.

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[6] The example question Q2 here is the one used for the lighting manufacturer interviews. The question for the retail buyers is shorter because there is no need to break out the question by retail channel.

The team asked the manufacturer representatives to also provide NTG estimates that were specific to the retailers their company used to sell their products through the program. To reduce respondent fatigue, however, if manufacturers sold program-discounted through many retailers, the team only asked the manufacturer representatives to provide NTG estimates for the retailers that accounted for the largest percentage of their sales through the program.

The final step was to combine the NTG estimates provided by the nine manufacturer representatives and four retail buyers to produce separate NTG estimates for each LED product type. The DNV team weighted each NTG estimate by the volume of program sales represented by the interviews. If the team had obtained two NTG estimates for the same sales "stream" (e.g., Manufacturer A sold 10,000 A-line lamps through Retailer B), then it averaged the NTG estimates from Manufacturer A and Retailer B for those 10,000 A-line lamps.

As discussed earlier, the DNV team calculated adjustment factors for net savings using self-reported values from in-depth interviews. These values were applied to each supplier's sales after averaging the suppliers' NTG estimates with their partnered retail buyer's NTG estimates. The breakdown of each bulb category's NTG estimates is shown in Table 5-2.

Table 5-2: Lighting NTG summary by LED product type

	A-line Lamps	Specialty Lamps	Fixtures & Retrofit Kits	Reflector Lamps
Adjusted Program Sales with NTG estimates	1,134,374	550,646	229,131	970,911
Program Sales	1,890,624	933,298	381,885	1,277,515
NTG Ratio	60%	59%	60%	76%
Standard Error	0.3%	0.5%	0.2%	1.1%
Lower Confidence Interval	59.2%	58.6%	59.9%	74.6%
Upper Confidence Interval	60.2%	60.2%	60.6%	78.1%

As with all NTG methodologies, the supplier self-report methodology has its advantage and disadvantages. The advantages include:

- Market knowledge: Lighting manufacturers and retail buyers are very knowledgeable about lighting market trends. When bidding into upstream lighting programs, it is in the manufacturers' best interests to reliably estimates how many LED products they can expect to sell given a certain price level. Understanding the dynamics between price and sales volume is key for making good NTG estimates.

- Evaluation efficiency: Since a few lighting manufacturers and retailers account for a large percentage of program sales, it is possible to get NTG estimates for a significant portion of program activity with only a few estimates. For example, in this evaluation the team was able to account for 86% of program sales with only nine lighting manufacturer interviews.

The disadvantages include:

- Gaming biases: Since lighting manufacturers directly benefit from the price discounts offered by upstream lighting programs, it is in their best interest to overestimate the sales impacts of the program price discounts to ensure these programs continue.

- Other biases: Some retailers may exaggerate their capability to sell 'green" products and therefore underestimate the importance of price discounts provided by upstream lighting programs.[7]

The DNV team conducted a jurisdictional scan of similar upstream lighting and appliance rebate programs in other utility service territories. Figure 5-1 and Figure 5-2 show NTG values for programs administered in Massachusetts, Connecticut, and Illinois between 2015 and 2020. This research showed similar NTG values for the lighting program while the appliance program had lower-than-average ratios.

Figure 5-1: Similar lighting program NTG ratios[8]

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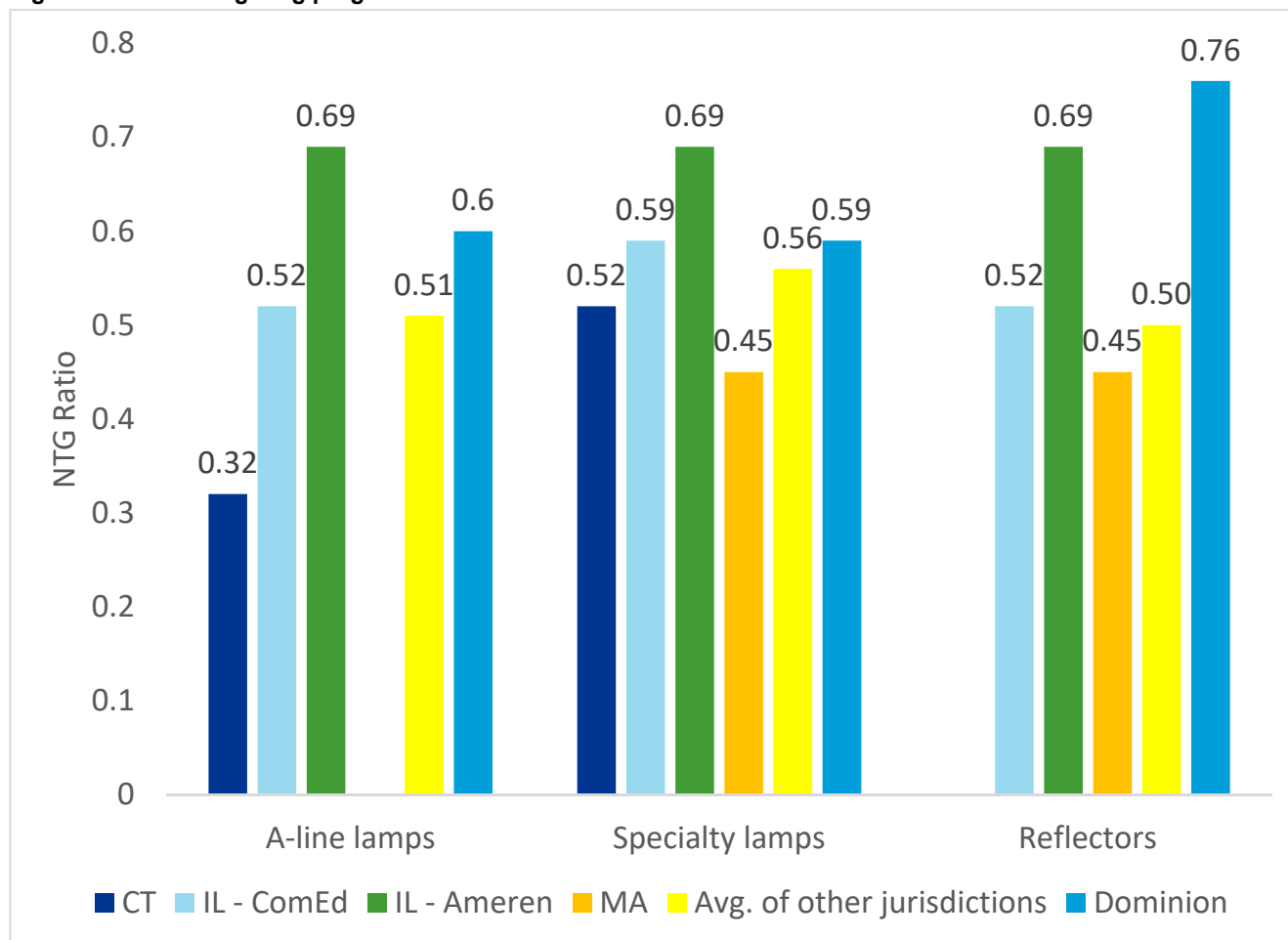
[7] See for example "Multistage Lighting Net‑to‑Gross Assessment: Overall Report," Prepared for The Electric and Gas Program Administrators of Massachusetts, Part of the Residential Evaluation Program Area, August 2015.

[8] Massachusetts Electric and Gas Energy Efficiency Program Administrators. (October 2018) *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures 2019–2021 - Plan Version.* Joseph Bebrin et al. (March 1, 2020) *Connecticut's 2020 program Savings Document 16th Edition.* www.ilsag.info/evaluator-ntg-recommendations-for-2021/

DNV

Figure 5-2: Similar appliance program NTG ratios[9]
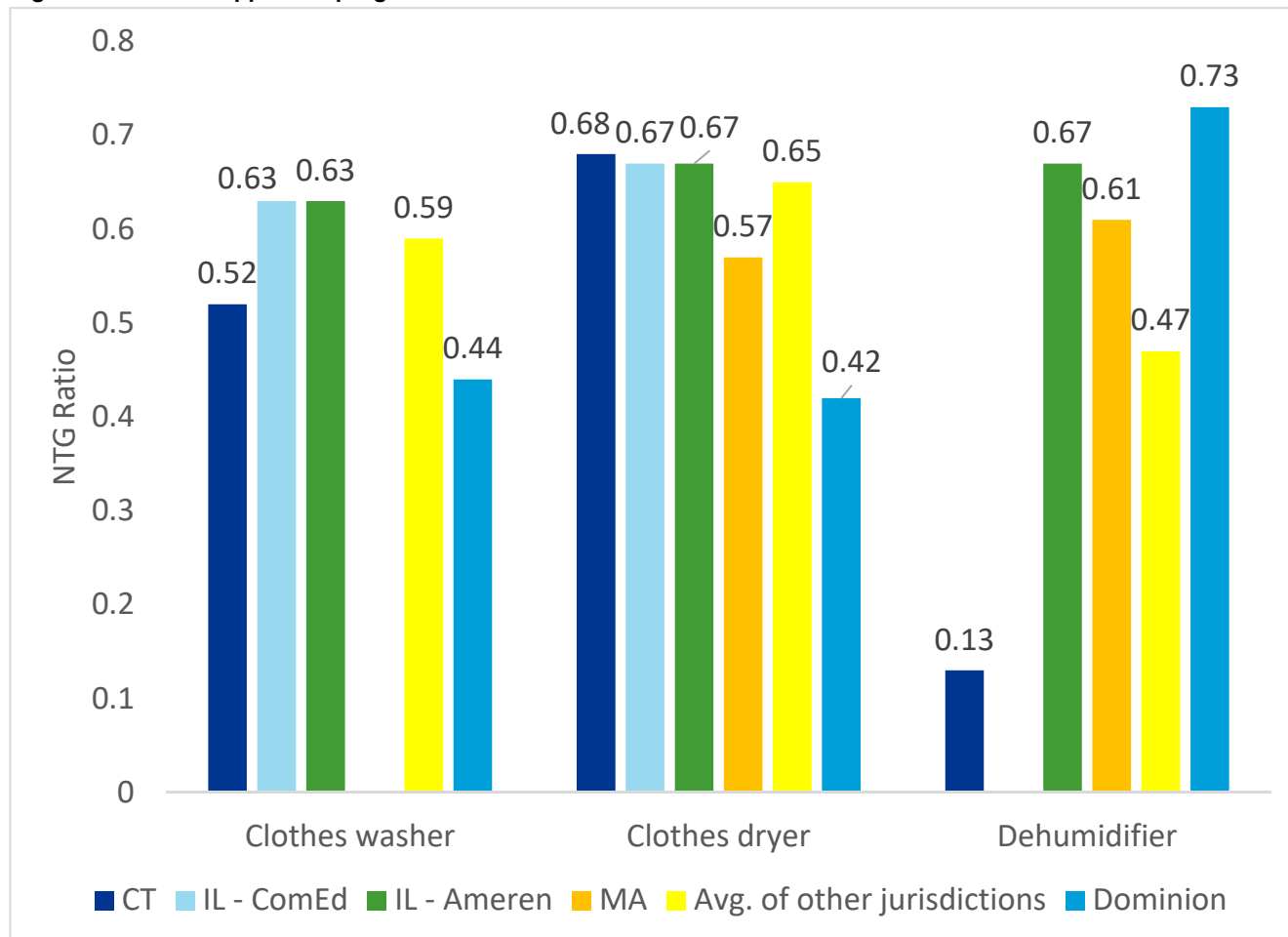
5.2 Net energy savings estimates for appliances

The DNV team estimated net savings for the appliance component of the program by applying an adjustment factor that reflects program influence. The adjustment factor is expressed as the percent of savings that are attributed to the program, and net program savings are the fraction of deemed savings that were caused by the program.

Net Program Savings = Deemed Program Savings x Attribution Factor

DNV calculated attribution factors for each appliance in the Marketplace Program. The factors have two components: the influence of the program on (1) the timing of the purchase, and (2) the efficiency level of the chosen appliances.

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[9] Massachusetts Electric and Gas Energy Efficiency Program Administrators. (October 2018) *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures 2019–2021 - Plan Version.* Joseph Bebrin et al. (March 1, 2020) *Connecticut's 2020 program Savings Document 16th Edition.* www.ilsag.info/evaluator-ntg-recommendations-for-2021/

5.2.1   Timing

Table 5-3 shows the influence the program had on *when* the equipment was purchased. The acceleration period corresponds to the number of months between when the equipment was purchased and when it would have been purchased in the absence of the program.

The program had the most significant influence on the timing of ENERGY STAR Air Purifier purchases.

Table 5-3: Summary of acceleration by measure

Measure	Number of Respondents	Program Acceleration (mean number of months)	Standard Error	One-Sided 90% Confidence Interval Lower Bound	One-Sided 90% Confidence Interval Upper Bound
ENERGY STAR Air Purifier	58	4.5	0.9	3.0	6.0
ENERGY STAR Clothes Dryer	502	2.9	0.3	2.5	3.3
ENERGY STAR Clothes Washer	607	3.0	0.2	2.6	3.3
ENERGY STAR Dehumidifier	85	3.7	0.6	2.7	4.8
ENERGY STAR Dishwasher	265	3.1	0.3	2.5	3.6
ENERGY STAR Freezer	21	2.8	0.9	1.3	4.3
ENERGY STAR Refrigerator	476	2.6	0.2	2.2	3.0

* Confidence intervals represent the range of the mean. If the range includes zero, the mean is deemed to not be statistically different than zero. In other words, timing was not conclusively affected for these appliances.

DNV

To calculate timing attribution, the DNV team assigned a score to each survey participant's response that reflects the program's acceleration of the purchase of the equipment above compared to when it would have been purchased otherwise (Table 5-4). Table 5-5 shows timing attribution.

Table 5-4: Attribution scores by response type

Response Type	Attribution Score
Missing	-1
No Effect	0
Effect	1
Don't Know	2

Table 5-5: Summary of timing attribution by appliance

Measure	Number of Respondents	Mean Score	Standard Error	One-Sided Lower C.I.	One-Sided Upper C.I.
ENERGY STAR Air Purifier	58	0.5	0.1	0.4	0.7
ENERGY STAR Clothes Dryer	502	0.3	0.0	0.3	0.4
ENERGY STAR Clothes Washer	607	0.4	0.0	0.3	0.4
ENERGY STAR Dehumidifier	85	0.5	0.1	0.4	0.6
ENERGY STAR Dishwasher	265	0.5	0.0	0.4	0.5
ENERGY STAR Freezer	21	0.5	0.1	0.3	0.8
ENERGY STAR Refrigerator	476	0.3	0.0	0.3	0.4

* Confidence intervals represent the range of the mean. If the range includes zero, the mean is deemed to not be statistically different than zero. In other words, the program did not conclusively affect the timing of the purchase for these appliances.

5.2.2 Efficiency

Table 5-6 shows efficiency attribution. To calculate efficiency attribution, the DNV team assigned a score to each survey participant's response that reflects the program's influence on the efficiency of the equipment purchased compared to the efficiency level of the equipment that would have been purchased otherwise in the absence of the program (see Table 5-4 above for attribution scores).

Table 5-6: Summary of efficiency attribution by appliance

Measure	Number of Respondents	Mean	Standard Error	One-Sided Lower C.I.	One-Sided Upper C.I.
ENERGY STAR Air Purifier	58	0.4	0.1	0.3	0.5
ENERGY STAR Clothes Dryer	502	0.2	0.0	0.2	0.2
ENERGY STAR Clothes Washer	607	0.2	0.0	0.1	0.2
ENERGY STAR Dehumidifier	85	0.2	0.0	0.2	0.3
ENERGY STAR Dishwasher	265	0.2	0.0	0.1	0.2
ENERGY STAR Freezer	21	0.2	0.1	0.1	0.4
ENERGY STAR Refrigerator	476	0.2	0.0	0.1	0.2

* Confidence intervals represent the range of the mean. If the range includes zero, the mean is deemed to not be statistically different than zero. The program's impact on appliance efficiency is statistically significant for all appliances.

5.2.3 Program attribution

Table 5-7 shows simple program attribution. To calculate simple program attribution, the DNV team used the timing and efficiency attribution scores assigned to each survey participant's response. The fraction of deemed savings that would have occurred without the program is the product of the timing attribution score, f_T, and the efficiency attribution score, f_E.

$$f_{QE} = f_T \, f_E$$

The simple program attribution (SPA) is the complement of this FR portion.

$$SPA = 1 - (1-f_E)(1- f_T)$$

Table 5-7: Summary of simple program attribution (SPA) by appliance

Measure	Number of Respondents	Mean	Standard Error	One-Sided Lower C.I.	One-Sided Upper C.I.
ENERGY STAR Air Purifier	58	0.7	0.1	0.5	0.8
ENERGY STAR Clothes Dryer	502	0.4	0.0	0.4	0.5
ENERGY STAR Clothes Washer	607	0.4	0.0	0.4	0.5
ENERGY STAR Dehumidifier	85	0.6	0.1	0.5	0.7
ENERGY STAR Dishwasher	265	0.5	0.0	0.4	0.6
ENERGY STAR Freezer	21	0.5	0.1	0.3	0.8
ENERGY STAR Refrigerator	476	0.4	0.0	0.3	0.4

* Confidence intervals represent the range of the mean. If the range includes zero, the mean is deemed to not be statistically different than zero. Simple program attribution is deemed to be statistically significant for all appliances.

DNV

The DNV team used the product of SPA and deemed gross savings for each participant and measure.

Net kWh Savings = Deemed Gross kWh Savings x SPA

Table 5-8. NTG summary by measure

Measure	Number. of Respondents	Sum of Weights	Mean Timing Attribution	Mean Efficiency Attribution	Mean SPA	Gross kWh/yr. Savings	Net kWh/yr. Savings
ENERGY STAR Air Purifier	58	340	0.5	0.4	0.7	245,065	169,010
ENERGY STAR Clothes Dryer	502	2697	0.3	0.2	0.4	479,658	200,654
ENERGY STAR Clothes Washer	607	3633	0.4	0.2	0.4	686,315	301,888
ENERGY STAR Dehumidifier	85	283	0.5	0.2	0.6	33,242	20,336
ENERGY STAR Dishwasher	265	1370	0.5	0.2	0.5	50,601	25,969
ENERGY STAR Freezer	21	87	0.5	0.2	0.5	3,622	1,897
ENERGY STAR Refrigerator	476	2183	0.3	0.2	0.4	140,774	55,008

Figure 5-3 shows total attributable energy savings for the appliance component of the program. Figure 5-4 breaks down the program attributable savings by appliance. The smaller appliances (dehumidifiers, air purifiers) had higher NTG ratios than the larger appliances. One possible reason for this is that the program rebates accounted for a larger share of the purchase prices of the smaller appliances than all the larger appliances except the ENERGY STAR air dryers.

Figure 5-4 also shows that the program accelerated the purchase of dehumidifiers and air purifiers more than any other appliances. This is likely because participants could delay purchasing a new dehumidifier or air purifier with less inconvenience than would be the case if they delayed the purchase of a new refrigerator, clothes washer, or clothes dryer, especially when these larger appliances were replacements for non-functioning equipment.

Figure 5-3: Total attributable energy savings for the appliance component of the program

Savings not attributed to program 53%

Savings attributed to program (net savings) 47%
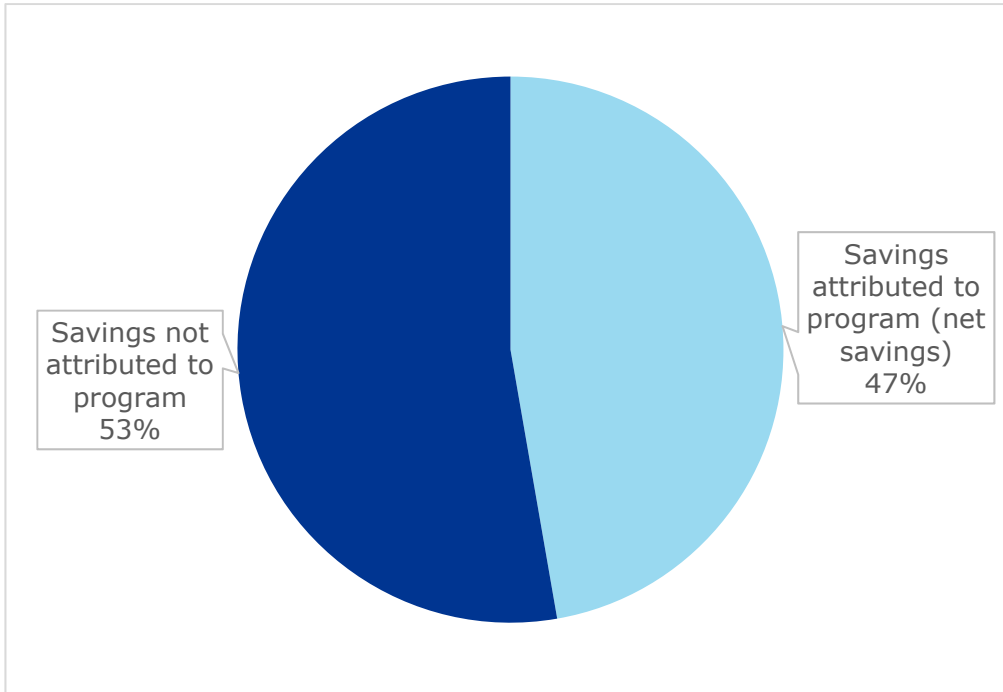
Figure 5-4: Program-attributable energy savings by appliance
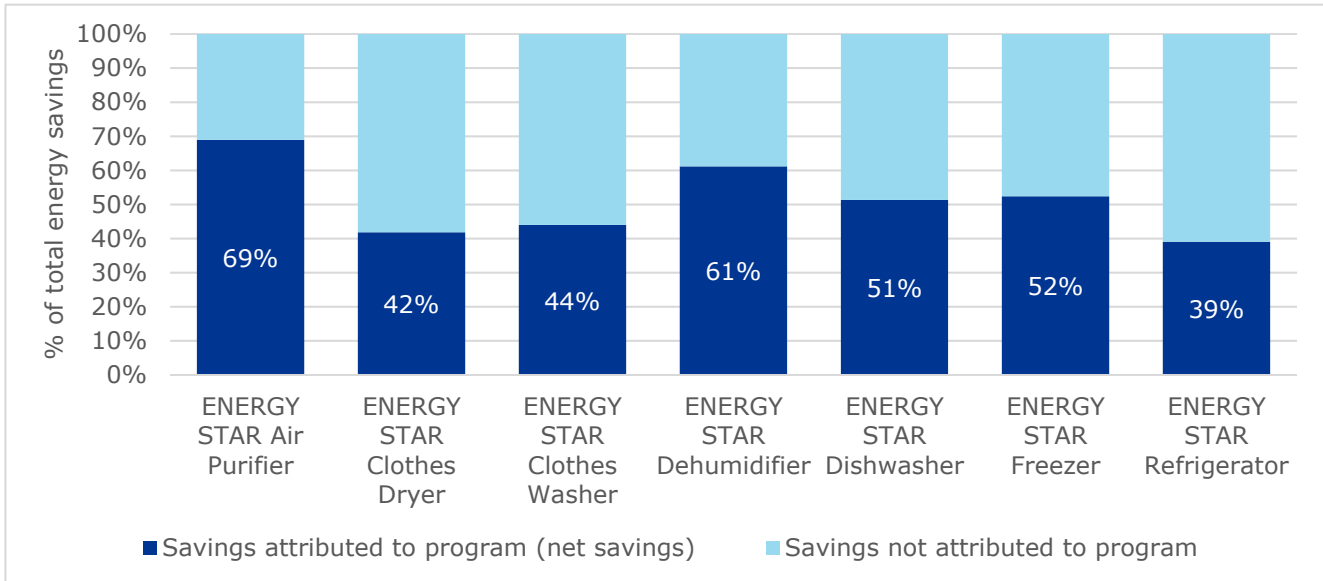
The DNV team examined whether there was a relationship between how early customers participated in the appliance component of the program and what their program attribution scores were. It is likely that the program did not have time to educate and influence many early participants, which could have reduced how much influence they attributed to the program for their appliance purchase decisions.

DNV

The team first calculated, for each of the appliance types, the average amount of time that had elapsed between when the program participants received the rebates and when they completed the evaluation's web survey. Table 5-9 shows that the dehumidifier participants had the shortest average time interval between rebate and survey and the clothes dryer participants had the longest.

Table 5-9: The timing of program participation by appliance

Measure	Sample Size	Mean Simple Program Attribution	Mean Days*
Energy Star Air Purifier	58	0.7	162.0
Energy Star Clothes Dryer	502	0.4	167.4
Energy Star Clothes Washer	607	0.4	165.5
Energy Star Dehumidifier	85	0.6	118.3
Energy Star Dishwasher	265	0.5	160.9
Energy Star Freezer	21	0.5	158.2
Energy Star Refrigerator	476	0.4	153.2

*The average number of days between participant's receipt of the program rebate and their completion of the evaluation web survey.

To further investigate the effect of the time between rebates and survey submission, the DNV team calculated Spearman's rank correlation coefficients looking at the relationship between participants' simple program attribution (SPA) scores and the days lapsed between rebate and survey submission.[10] This was done across the program and by measure.

Table 5-10 shows the measure-level calculations. A correlation coefficient between ±0.1 – ±0.3 is a weak correlation, a correlation between ±0.3 - ±0.6 is a moderate correlation, and a correlation between ±0.6 - ±1.0 is a strong correlation. Correlation coefficients range between -1.0 and +1.0. There was a weak correlation between SPA scores and the mean number of days between rebate and survey for the air purifiers, dehumidifiers, and freezers and no correlations for the other appliances. It should be noted that the freezer sample size was small (n=21) which can increase the variability of results. The overall correlation between participants' simple program attribution scores and days lapsed between rebate and survey submission for the program was 0.07 (p<0.05).

Table 5-10: Correlations between program attribution and days between rebate and survey submission by measure

Measure	R_S	P-Value
Energy Star Air Purifier	0.29	<0.05
Energy Star Clothes Dryer	0.05	0.25
Energy Star Clothes Washer	0.08	0.04
Energy Star Dehumidifier	0.20	<0.05
Energy Star Dishwasher	0.08	0.19
Energy Star Freezer	-0.58	<0.05
Energy Star Refrigerator	0.07	0.08

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[10] The Spearman's rank correlation coefficient is a non-parametric test. This was used instead of the more common Pearson's rho because the SPA does not meet the assumptions necessary for the Pearson's rho. The SPA for each survey respondent is a whole number score from 0 to 2 and is not continuous

DNV

The DNV team also examined possible relationships between program attribution and the ratio between the program rebates and the purchase prices of the appliances. Table 5-11 shows that the ratio between rebate level and appliance purchase cost was highest for air purifiers and lowest for clothes washers.

Table 5-11: The ratio of program rebates to appliance purchase costs

Measure	Sample Size	Mean Simple Program Attribution	Mean % of Cost*
Energy Star Air Purifier	58	0.7	40.2%
Energy Star Clothes Dryer	502	0.4	14.2%
Energy Star Clothes Washer	607	0.4	7.6%
Energy Star Dehumidifier	85	0.6	12.4%
Energy Star Dishwasher	265	0.5	10.1%
Energy Star Freezer	21	0.5	10.7%
Energy Star Refrigerator	476	0.4	10.2%

*% of Cost = (rebate amount/appliance purchase price) x 100

The DNV team also calculated Spearman's rank correlation coefficients looking at the relationship between participants' simple program attribution scores and the ratio between the program rebates and the purchase prices of the appliances. This was done across the program and by measure. As noted, a correlation coefficient between ±0.1 – ±0.3 is a weak correlation, a correlation between ±0.3 - ±0.6 is a moderate correlation, and a correlation between ±0.6 - ±1.0 is a strong correlation. Table 5-12 shows that there were weak correlations between program attribution and the ratio between rebates and purchase price for air purifiers, dishwashers, freezers, and refrigerators. As previously mentioned, the sample size for freezers was small. The overall correlation between participants simple program attribution scores and percentage of rebate to purchase price for the program was 0.15 ($p < 0.0001$).

Table 5-12: Correlations between program attribution and the ratio between rebates and purchase price

Measure	R_S	P-Value
Energy Star Air Purifier	0.16	0.16
Energy Star Clothes Dryer	0.05	0.29
Energy Star Clothes Washer	0.09	<0.05
Energy Star Dehumidifier	0.05	0.58
Energy Star Dishwasher	0.14	<0.05
Energy Star Freezer	0.12	0.58
Energy Star Refrigerator	0.25	<.0001

DNV

6 PARTICIPANT PERSPECTIVES ON PROGRAM MARKETING

This section describes how the program was marketed, how participating customers heard about the rebates, and how they prefer to receive program information in the future.

6.1 How the program was marketed

Interviews with Dominion's project manager and the program implementation contractor revealed that Point-of-Purchase (POP) marketing materials in retail stores are the primary means of promoting the Marketplace Program. For the energy-efficient lighting products this includes signage next to the rebate-eligible products as well as additional signage in the aisles. For the ENERGY STAR appliances this includes signage on the program-eligible models, a two-page educational brochure that is left at the appliance counter, and a tear pad with information on how customers can apply for rebates on the program portal. Figure 6-1 and Figure 6-2 provide examples of this POP signage.

Figure 6-1: Sample Marketplace Program lighting signage

Figure 6-2: Sample Marketplace Program appliance signage
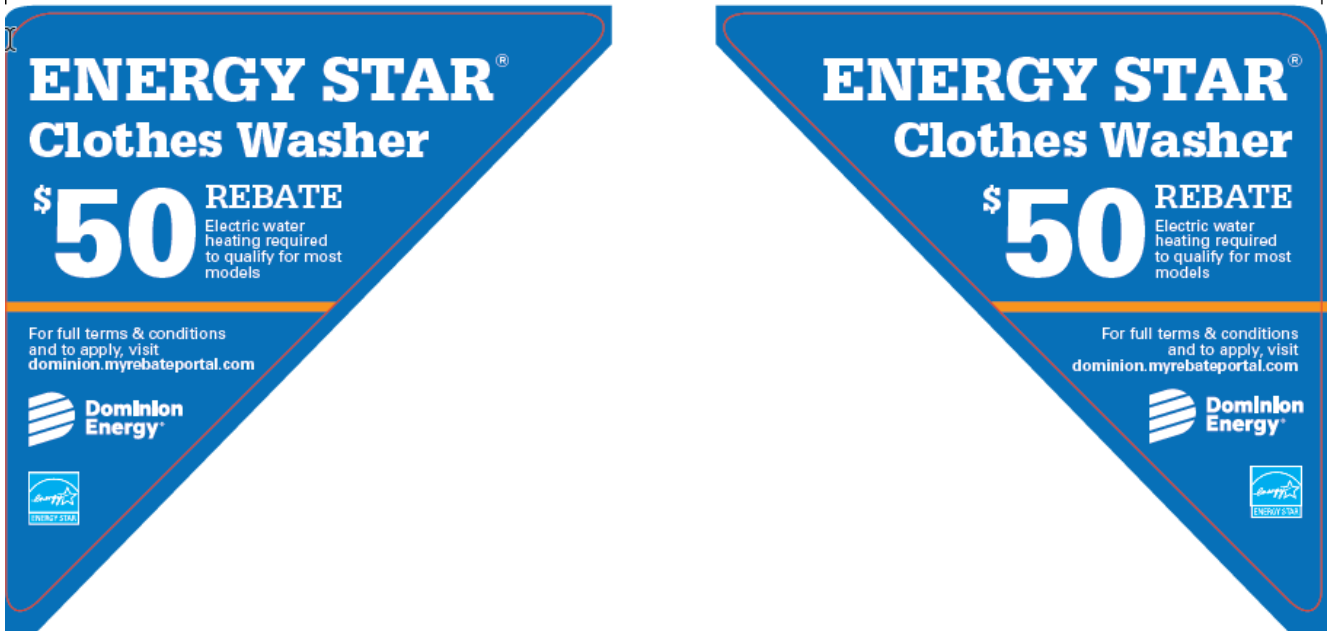
6.2 How participants heard about the rebates

The DNV team asked the appliance participants how they first learned about the Marketplace Program rebates available to them. Figure 6-3 shows their responses. Two thirds said they first heard about the rebates in the retail store. The Dominion website was a distant second (10% of respondents) as a first information source for the rebates.

DNV

Figure 6-3: How participants heard about the Marketplace Program rebates

n=1539

Source	%
Retail/ appliance/home improvement store	67%
Dominion Energy website	9%
Dominion Energy bill insert	9%
Word of mouth	5%
Dominion Energy email	3%
Other information sources*	6%
Don't know	2%

% of respondents
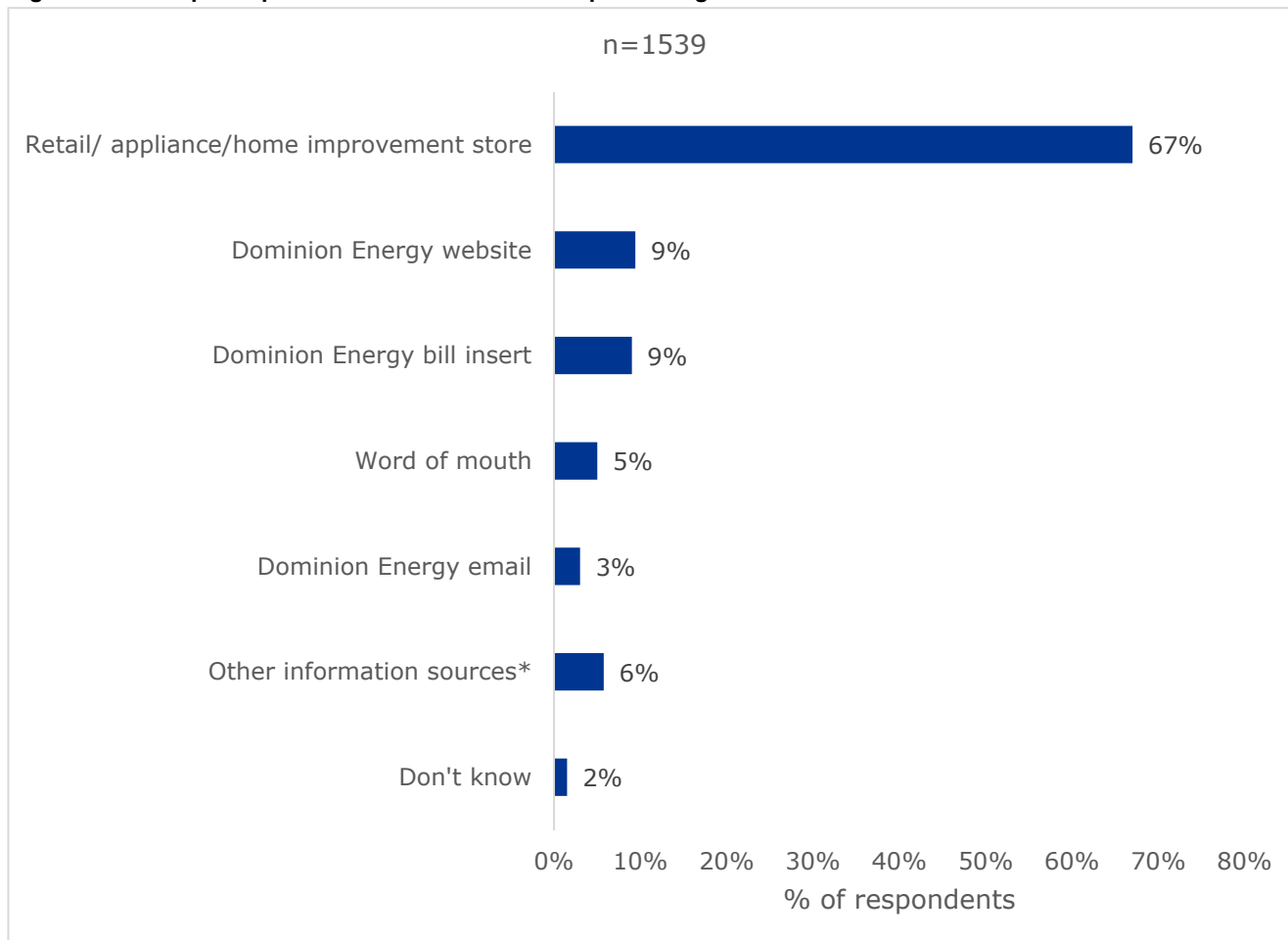
*Other information sources included previous EE program participation, Dominion social media, retailer websites, own internet research, and manufacturer's websites.

There were some statistically significant differences in the frequencies with which survey respondents reported first hearing about the program rebates:

- Appliance size: Purchasers of large appliances were more likely (69% of respondents) than purchasers of small appliances (47% of respondents) to say they first heard about the program rebates in the retail store.
- Where purchased: Participants who purchased their appliances in a store were more likely to recall first hearing about the program in the store (71% of respondents) than participants who purchased their appliance online (59% of respondents) or who purchased their appliances both in the store and online (59% of respondents).
- Income level: Participants who reported annual household incomes of less than $75,000 were more likely (72% of respondents) to say they first heard about the program rebates in the retail store than those who reported household incomes of $125,000 or greater (64% of respondents). The participants in this higher income category were twice as likely (12% of respondents) to report first hearing about the program rebates from the Dominion website compared to those in the less-than-$75,000 income category (only 6% of respondents).
- Education: Participants who reported having less education (only a high school or vocational degree) were more likely (72% of respondents) had to say they first heard about the program rebates in the retail store than those who reported having graduate degrees (62% of respondents).

DNV

The DNV team asked the participants who reported buying their appliances in a retail store whether, when they were in the store, they recalled "any Dominion Energy promotional rebate/discount materials such has stickers on merchandise, clings, or signs in the aisle or in the store." Figure 6-4 shows that about half (54%) of these participants recall observing these POP materials. This response rate is surprising considering that that, as noted earlier, 71% of participants who bought their appliances in retail stores reported first hearing about the rebates in the store. However, it is possible they heard about it from a salesperson or from signage which the retailer produced.

Figure 6-4: Participant recall of in-store Dominion promotional material
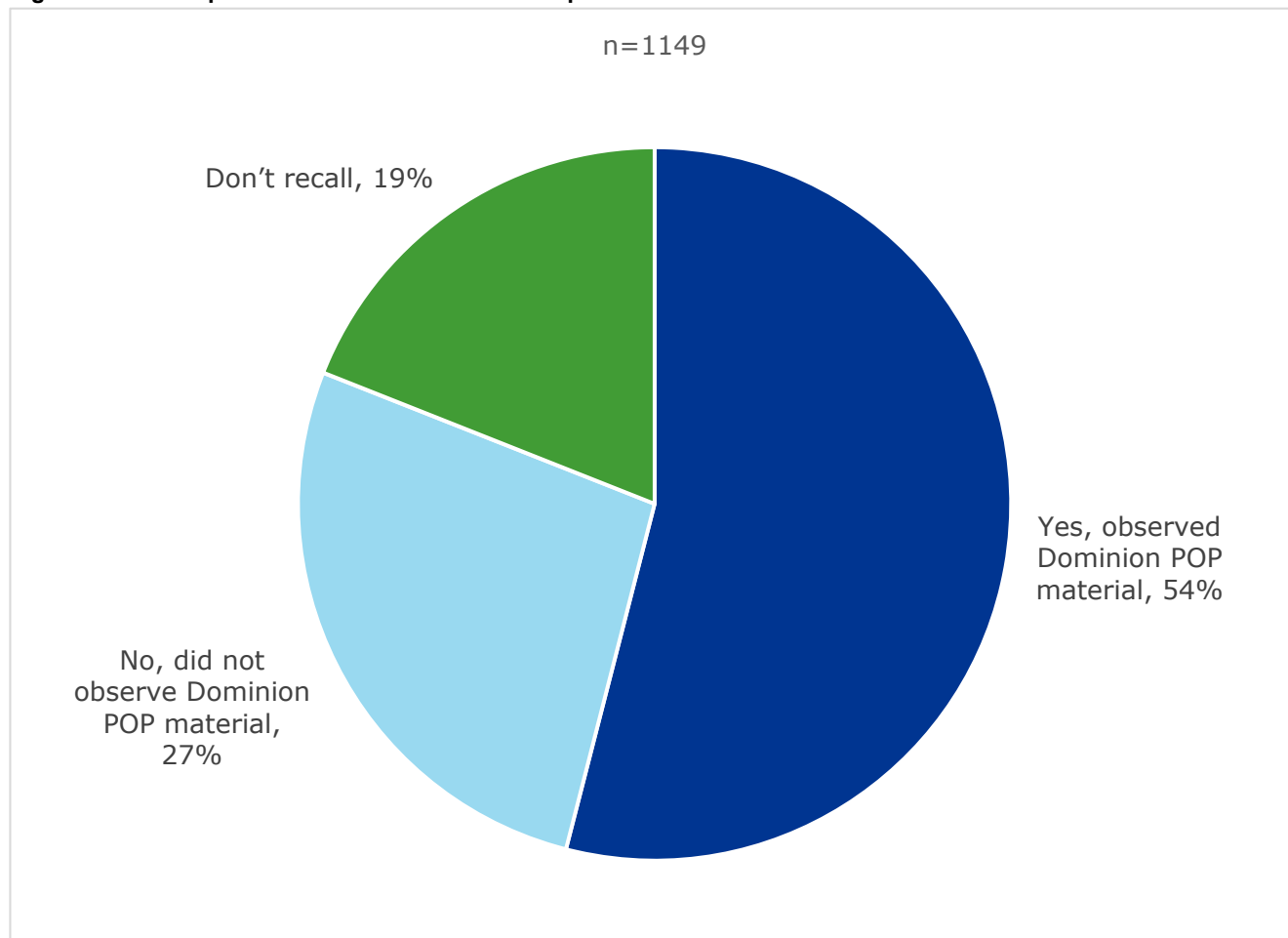
n=1149

Don't recall, 19%

Yes, observed Dominion POP material, 54%

No, did not observe Dominion POP material, 27%

There were some statistically significant differences in the frequencies with which participants recalled seeing the programs in-store promotion materials:

- Influence of rebates: The participants who said that the program rebates influenced their purchase of the energy-efficient appliance were much more likely (65% of respondents) to have recalled the program's in-store promotional materials than those who said that the rebate was not influential (31% of respondents).
- Education: Respondents with a vocational degree were more likely (61% of respondents) than those with an advanced degree (48% of respondents) to report seeing the program's in-store promotional materials.

DNV

6.3   How participants prefer to get future program information

The DNV team asked the participants, "If Dominion wanted to inform customers like yourself about the rebates and services they offer for energy-efficient programs, what do you suggest would be the best way to do that?" Figure 6-5 shows that over two-thirds of the participants recommended in-store displays and about half suggested bill stuffers or email communications.

Figure 6-5: How participants prefer to get future program information

DNV
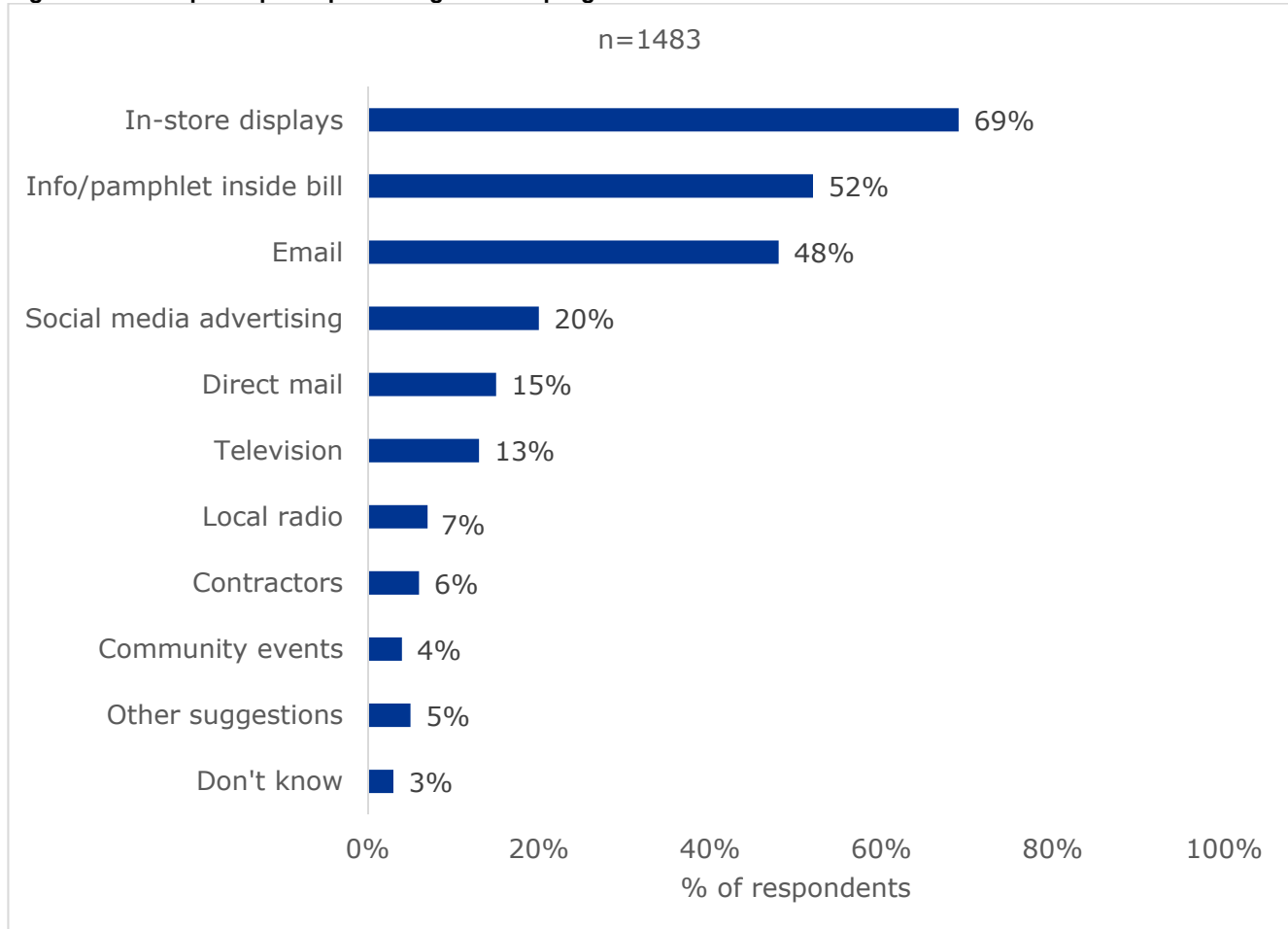
7   PROGRAM SATISFACTION

The DNV team asked the participants about their satisfaction with the Marketplace Program as well as with various aspects of the program including the website, the rebate application process, the timeliness of the rebate payment, the rebate amounts, and the rebated appliances. The team asked the participants to use a five-point satisfaction scale where five indicated "very satisfied" and one indicated "very dissatisfied. "Figure 7-1 shows the percentage of percentages who were satisfied (4 or 5 satisfaction ratings) with the overall program as well as with the program components.[11] The participants were most satisfied with the rebated appliances and least satisfied with the timeliness of the rebate payments.

Figure 7-1: Program satisfaction
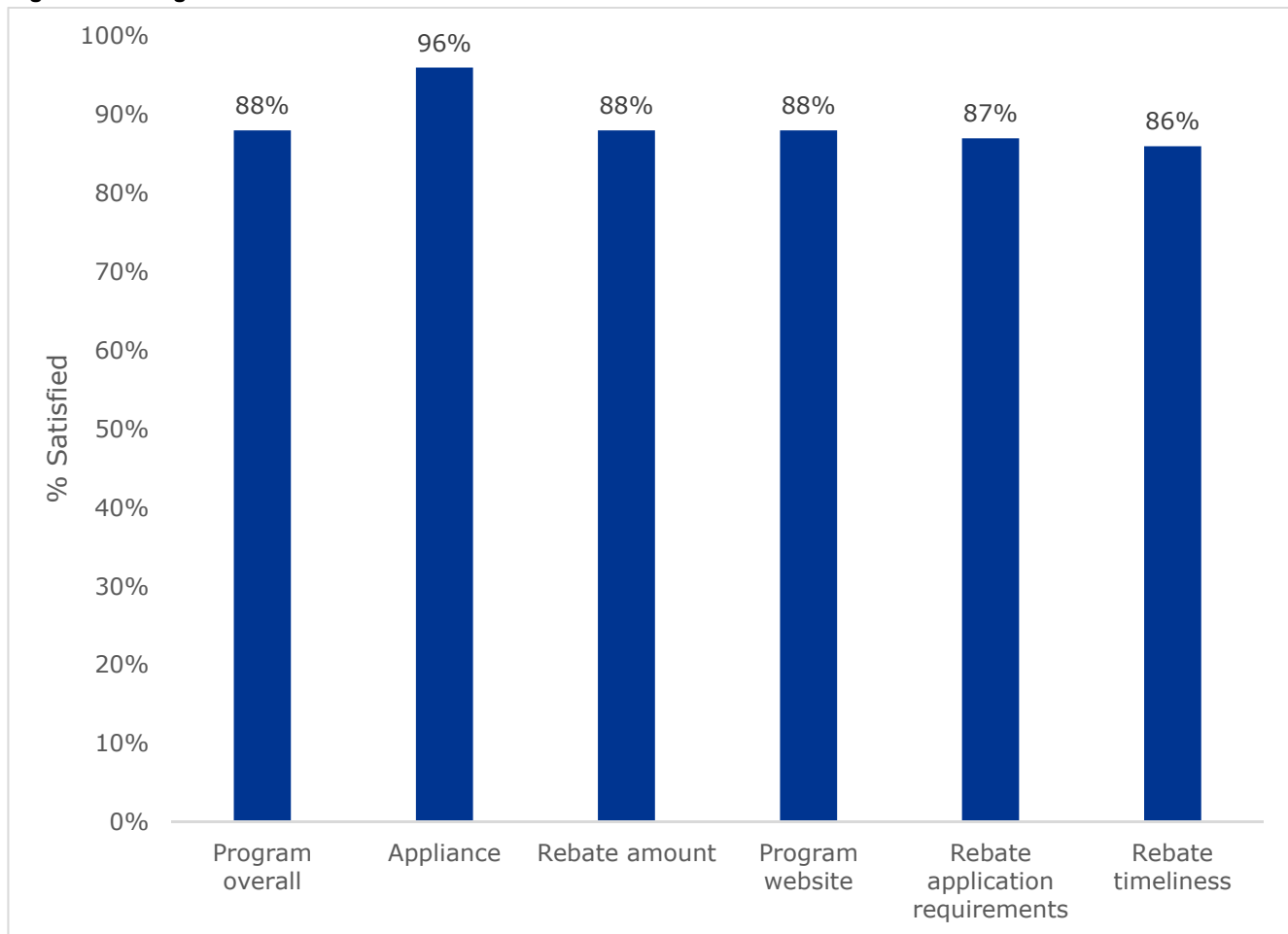
As described in more detail in the following subsections, there were some statistically significant differences in the frequencies with which participants gave these satisfaction ratings. Participants who reported being concerned with their home energy use were more likely to be satisfied with the program components than those who did not have these concerns. It is possible that their level of program satisfaction got a boost from the program's ability to assuage their concerns about their home energy use.

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[11] While the program has little control over the quality of the appliances, it is still useful to measure participant satisfaction with their appliances since dissatisfaction with an appliance can sometimes influence their satisfaction with other aspects of the program.

DNV

Participants who said that they were likely to have purchased the same efficiency of appliance without the program[12] were also more likely to be satisfied with the program components. One possible explanation for this is that because the rebates were not influential in their decision to purchase the ENERGY STAR appliance, they were less concerned with the size of the rebate than participants who were less likely to have purchased the ENERGY STAR appliance without the rebates.

7.1 Satisfaction with the program website

Eighty-eight percent of the participants were satisfied (satisfaction ratings of 4 or 5) with the program's website with 52% of the participants being "very satisfied" (satisfaction ratings of 5). There were some statistically significant differences in the survey results, including:

- Source of first program information: Participants who said they first heard about the rebates through word-of-mouth or bill inserts/emails were more satisfied with the program's website (94% and 93% satisfied, respectively) than participants who said they first heard about the rebates when they were in the store where they bought the appliance (88% satisfied).
- Likelihood of purchase without the program: Participants who said they were "very likely" or "likely" to have purchased the same efficiency of appliance without the program were more satisfied with the program's website (88% and 89% satisfied respectively) than participants who said they were very unlikely or somewhat unlikely to have purchased the same efficiency of appliance without the program (only 81% of these were satisfied with the program website).

7.2 Satisfaction with the rebate application requirements

Eighty-seven percent of the participants were satisfied with the program's rebate amounts with 52% of the participants being "very satisfied." There were some statistically significant differences in the survey results including:

- Concern about energy use: Participants who said they were "very concerned" about their home energy use or "concerned" about their energy use were more satisfied with the program's paperwork requirements (89% and 88% satisfied respectively) than participants who said they were "not concerned" with their home energy use (only 69% of these were satisfied with the program paperwork requirements).
- Education level: Participants who said their highest level of education was high school/less than high school or a vocational degree/some college were more satisfied with the program paperwork requirements (92% and 90% respectively) than those with advanced degrees (85% of these were satisfied).
- Likelihood of purchase without program: Eighty-eight percent of the participants who said they were very likely to have purchased the same efficiency of appliance without the program, were satisfied with the program paperwork requirements. In contrast, only 81% of the participants who said they were very unlikely or somewhat unlikely to have purchased the same efficiency of appliance without the program were satisfied with these requirements.

7.3 Satisfaction with the rebate amounts

Eighty-eight percent of the participants were satisfied with the program's rebate amounts with 52% of the participants being "very satisfied." There were some statistically significant differences in the survey results including:

- Concern about energy use: Ninety percent of the participants who said they were "concerned" about their home energy use also said they were satisfied with the program's rebate dollar amounts. In contrast, only 75% of the participants who said they were "not concerned" with their home energy use said they were satisfied with the program rebate dollar amounts.

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[12] The wording in the survey question was: "Without the Dominion Energy rebate, how likely would you have been to purchase the same high efficiency appliance(s) at your own expense, would you say...very likely, somewhat likely, likely, somewhat unlikely, or very unlikely?"

DNV

- Likelihood of purchase without the program: Eighty-nine percent of the participants who said they were very likely or somewhat likely to have purchased the same efficiency of appliance without the program, were satisfied with the rebate dollar amounts. In contrast, only 79% of the participants who said they were very unlikely or somewhat unlikely to have purchased the same efficiency of appliance without the program were satisfied with the rebate dollar amounts.

The DNV team also asked the participants who were less than satisfied with the rebate amounts (satisfaction ratings of 3, 2, or 1 on the five-point satisfaction scale) what the program could do better. Figure 7-2 shows that while increasing the rebate amount was the most common recommendation, some dissatisfaction with the rebate amount was tied to dissatisfaction with other aspects of the program such as the rebate application process and the timeliness of the rebate payment.

Figure 7-2: Reasons for being less than satisfied with rebate amounts
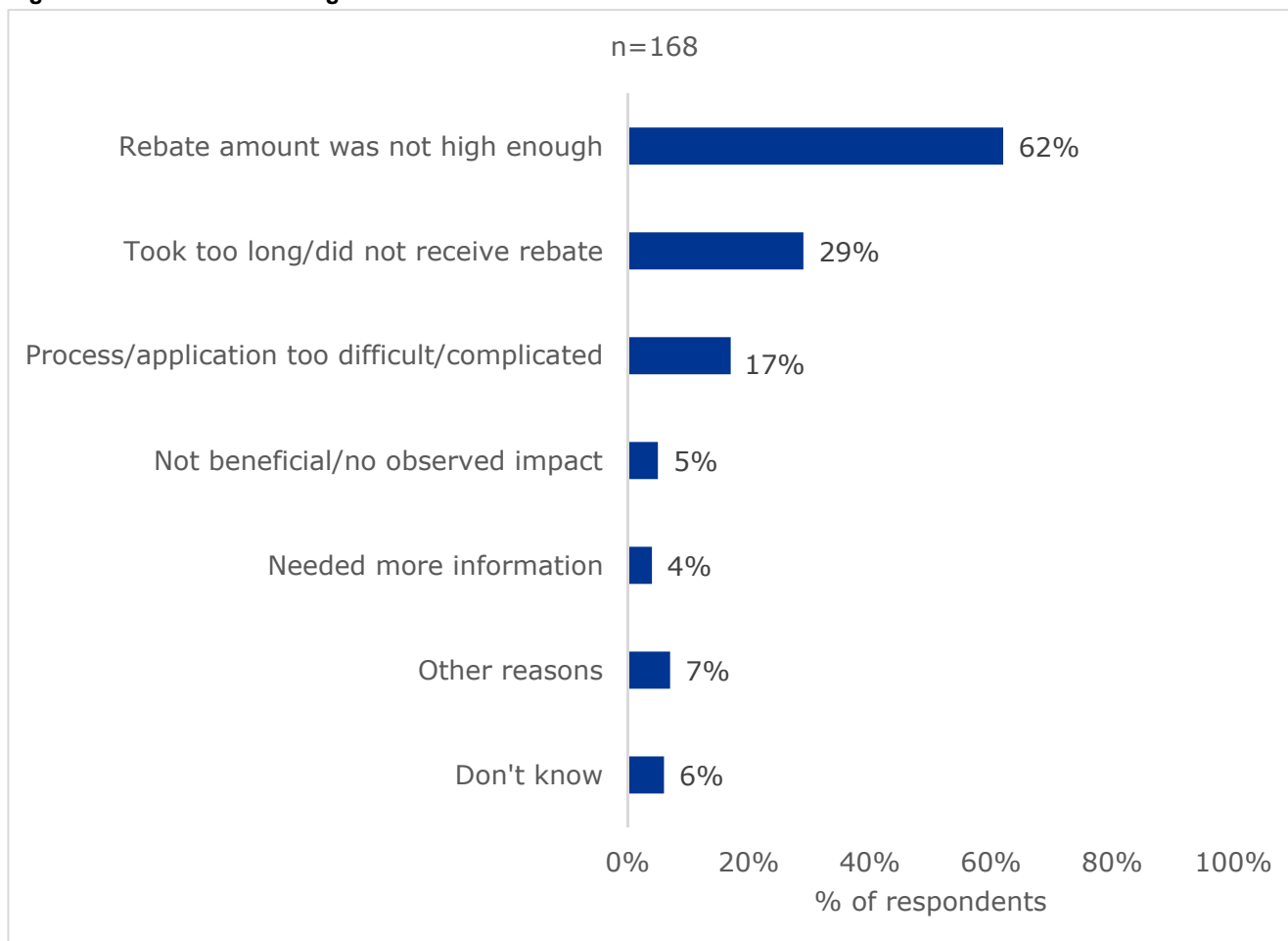
Note: The percentages exceed 100% because the participants could provide multiple reasons.

7.4   Satisfaction with the timeliness of the rebate payments

Eighty-six percent of the participants were satisfied with the timeliness of the program rebates with 55% of the participants being "very satisfied." There were some statistically significant differences in the survey results. Participants who said they were "very concerned" about their home energy use or "concerned" about their energy use were more satisfied with the timeliness of the rebate payments (87% and 88% satisfied respectively) than participants who said they were "not concerned" with their home energy use (only 65% of these were satisfied with the timeliness of the rebate payments).

DNV

The DNV team also asked the participants who were less than satisfied with the timelines of the rebate payments (satisfaction ratings of 3, 2, or 1 on the five-point satisfaction scale) what the program could do better. Figure 7-3 shows that apart from being dissatisfied with the late arrival of rebates, 17% of the participants claimed that they had never received the rebates. Considering that the survey was fielded in November 2020 and covered participation no later than July 2020, it is unclear why these participants would still be waiting for rebates.

Figure 7-3: Reasons for being less than satisfied with rebate amounts
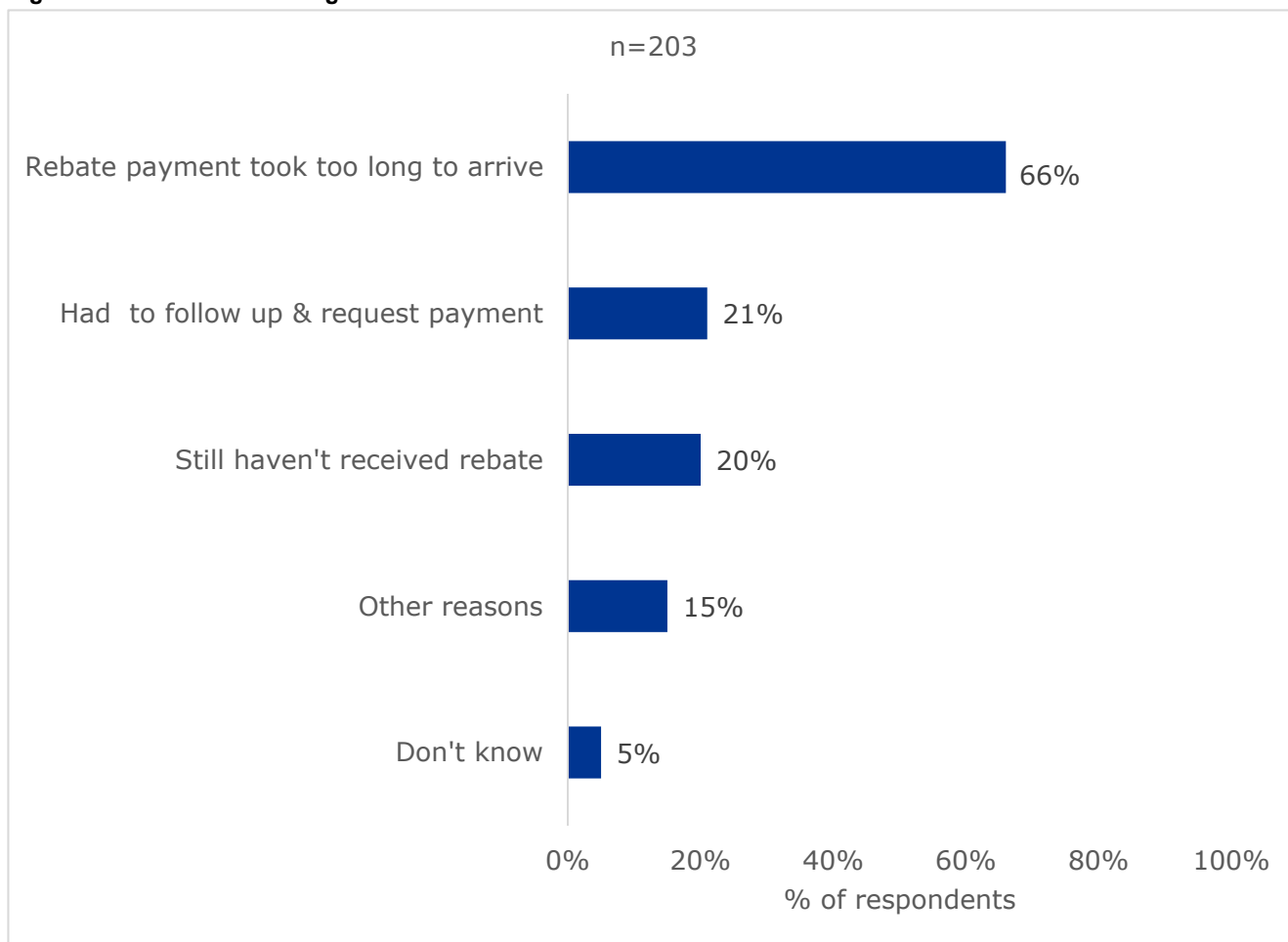
Note: The percentages exceed 100% because the participants could provide multiple reasons.

7.5   Satisfaction with the appliance

Ninety-six percent of the participants were satisfied with their rebated appliance with 65% of the participants being very satisfied. Participants who said they were very likely or somewhat likely to have purchased the same efficiency of appliance without the program were more satisfied with their appliances (97% and 96% satisfied respectively) than participants who said they were very unlikely or somewhat unlikely to have purchased the same efficiency of appliance without the program (90% of these were satisfied with their rebated appliances).

7.6　Satisfaction with the overall program

Eighty-eight percent of the participants were satisfied with the overall program, with 55% of the participants being very satisfied. There were some statistically significant differences in the survey results. Participants who said their highest level of education was a vocational degree/some college or a bachelor's degree were more satisfied with the overall program (91% and 89%, respectively) than those with advanced degrees (85% of these were satisfied).

7.7　Participant suggestions for program improvements

The DNV team asked the participants: "Do you have any suggestions to improve the delivery of this program for customers like yourself?" Only 10% of them had suggestions for program improvements. Figure 7-4 shows that the two most-cited suggestions were to improve the rebate application process and do more program marketing.

Figure 7-4: Participant suggestions for program improvements
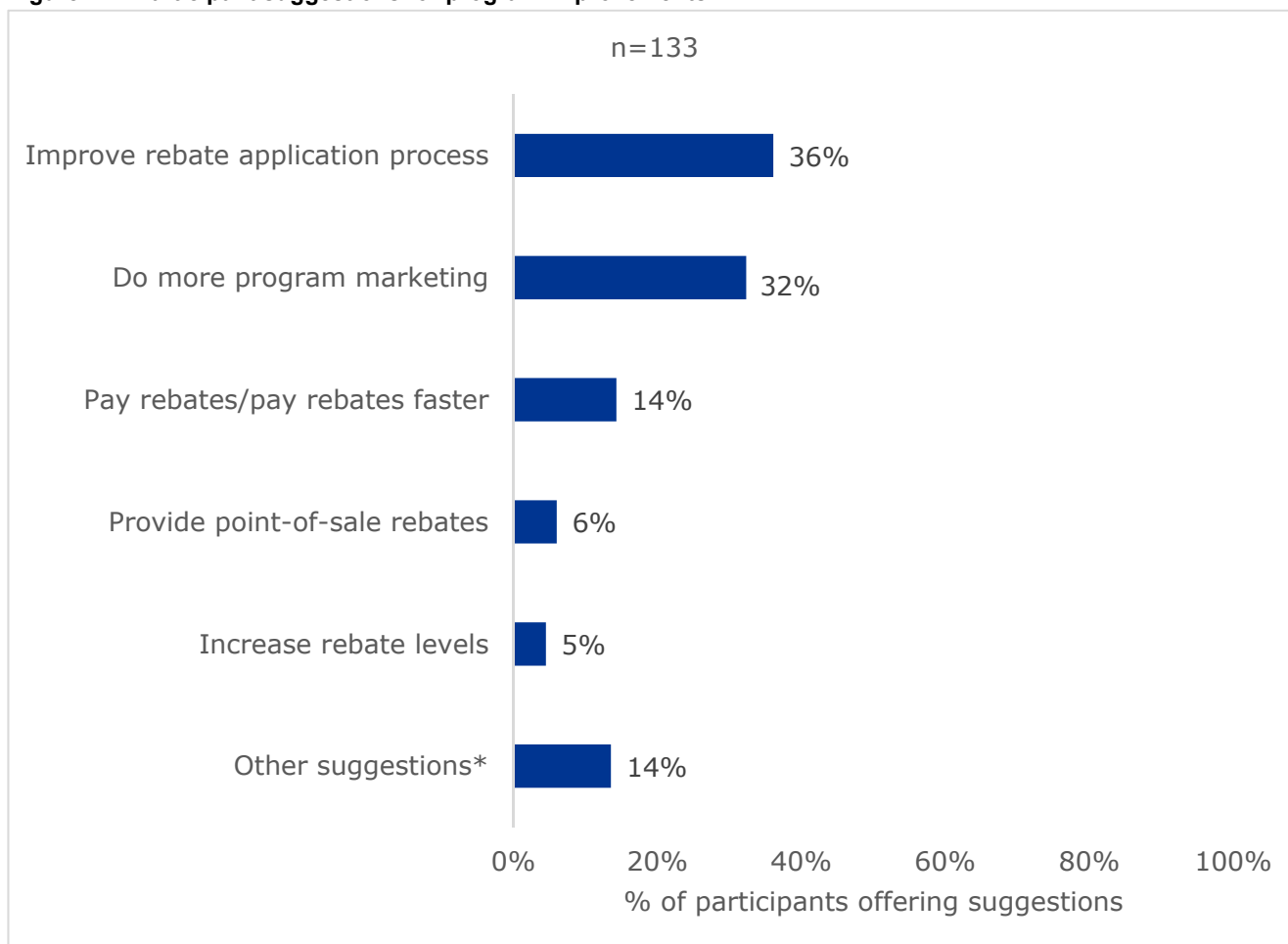
Note: The percentages exceed 100% because the participants could provide multiple suggestions. *Other suggestions included allowing bill credits, offering rebates for a wider range of appliances, and supporting solar programs.

Table 7-1 shows the most frequent suggestions that participants made for improving the rebate application process. The two most common suggestions were to make the rebate application requirements clearer for the program and to be less strict about the criteria for approving applications. The program requirements the participants most frequently mentioned as not clear or prominent enough included the deadlines for the rebate application and the requirements that participants provide information such as serial numbers for the appliances that were removed. The suggestions for the program to be less strict

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about approving applications usually originated from participants who had been unaware of the rebate application deadlines and therefore either missed out on rebates or had to scramble to get the application submitted on time.

Table 7-1: Most frequent suggestions for improving the rebate application process

Suggestion	No. of Participants Making Suggestion
Make rebate application requirements clearer	14
Be less strict about criteria for approving applications	10
Streamline the rebate application process	5
Require less information on the application form	5
Be more responsive to questions about rebate applications	5
Allow applications for multiple appliances	4
Provide way to check status of rebate applications	4

Table 7-2 shows the most frequent suggestions for doing more program marketing. Increasing in-store promotions and advertising the program in the monthly utility bills were the two most common suggestions.

Table 7-2: Most frequent suggestions for doing more program marketing

Suggestion	No of Participants Making Suggestion
More in-store promotions	10
Advertise program in monthly bill (online or paper)	9
Advertise the program through emails	8
Get more retailers to advertise program on their websites/flyers and through their salespeople	7
Advertise the program online	4
Advertise the program by direct mail	4

8 IMPACTS OF THE PANDEMIC ON ENERGY EFFICIENCY

The DNV team asked the participants what impacts, if any, the COVID-19 pandemic had on their plans for improving the energy efficiency of their homes. The team first asked them, "Before the COVID-19 pandemic began, did you have any plans to install or perform energy efficiency upgrades like a new appliance or insulation in your home?" Figure 8-1 shows that almost half (44%) of the participants had plans for energy efficiency upgrades before the pandemic.

Figure 8-1: Whether participants had EE plans before the pandemic

n=1479

Don't know, 9%

Had EE plans before pandemic, 44%

No EE plans before pandemic, 48%
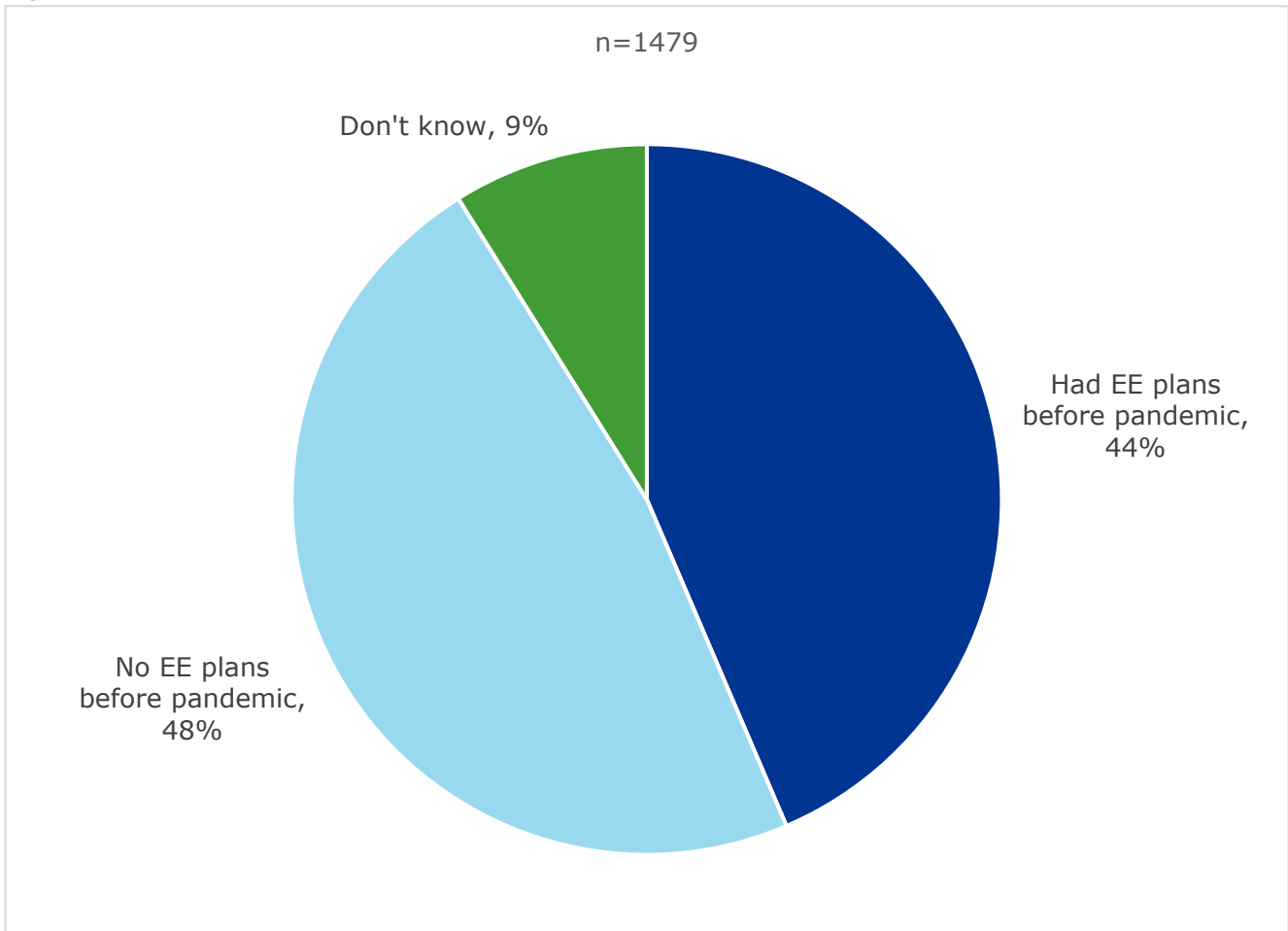
The team then asked the participants who reported having energy efficiency plans: "What energy efficiency actions were you planning?" The large majority (71%) said they had plans to purchase new appliances with over a third (35%) reporting plans to purchase new lighting. Figure 8-2 shows all their responses.

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Figure 8-2: What energy efficiency projects participants were planning

n=642

Category	%
Purchase new appliances	71%
Purchase new lighting	35%
Add insulation, weatherization	27%
Replace windows, doors	24%
Replace AC	18%
Replace heater	15%
Aesthetic enhancements	10%
Other activities	6%

% of participants with EE plans
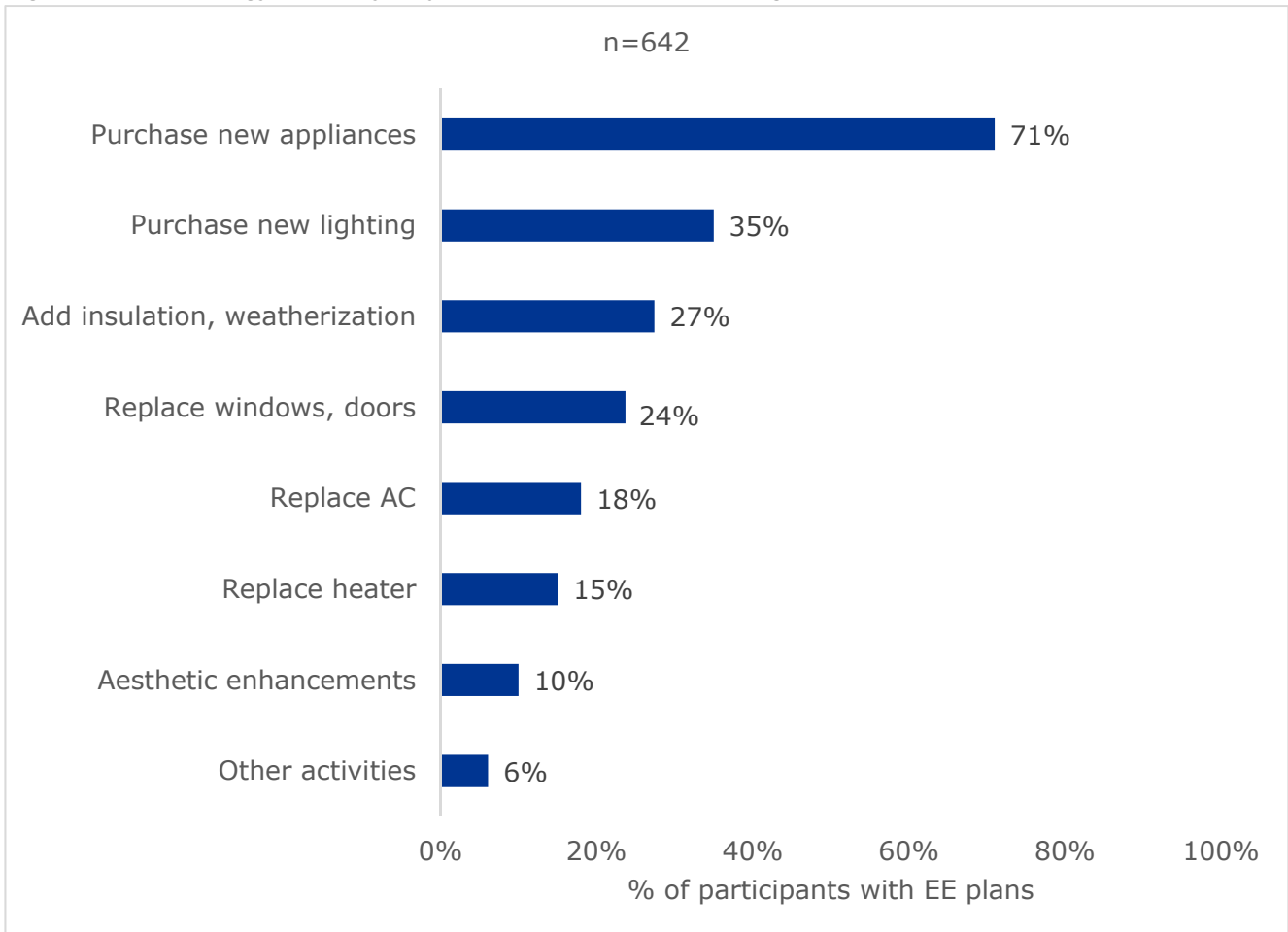
Note: The percentages exceed 100% because the participants could mention multiple projects.

The team then asked the participants who reported having energy efficiency plans, "Did the COVID-19 pandemic and the resulting stay-at-home orders change the timing or size of those planned energy efficiency projects?" Over a third (36%) of the participants said that the pandemic did impact the timing or size of their energy efficiency projects (Figure 8-3).

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Figure 8-3: Impact of pandemic on planned EE projects
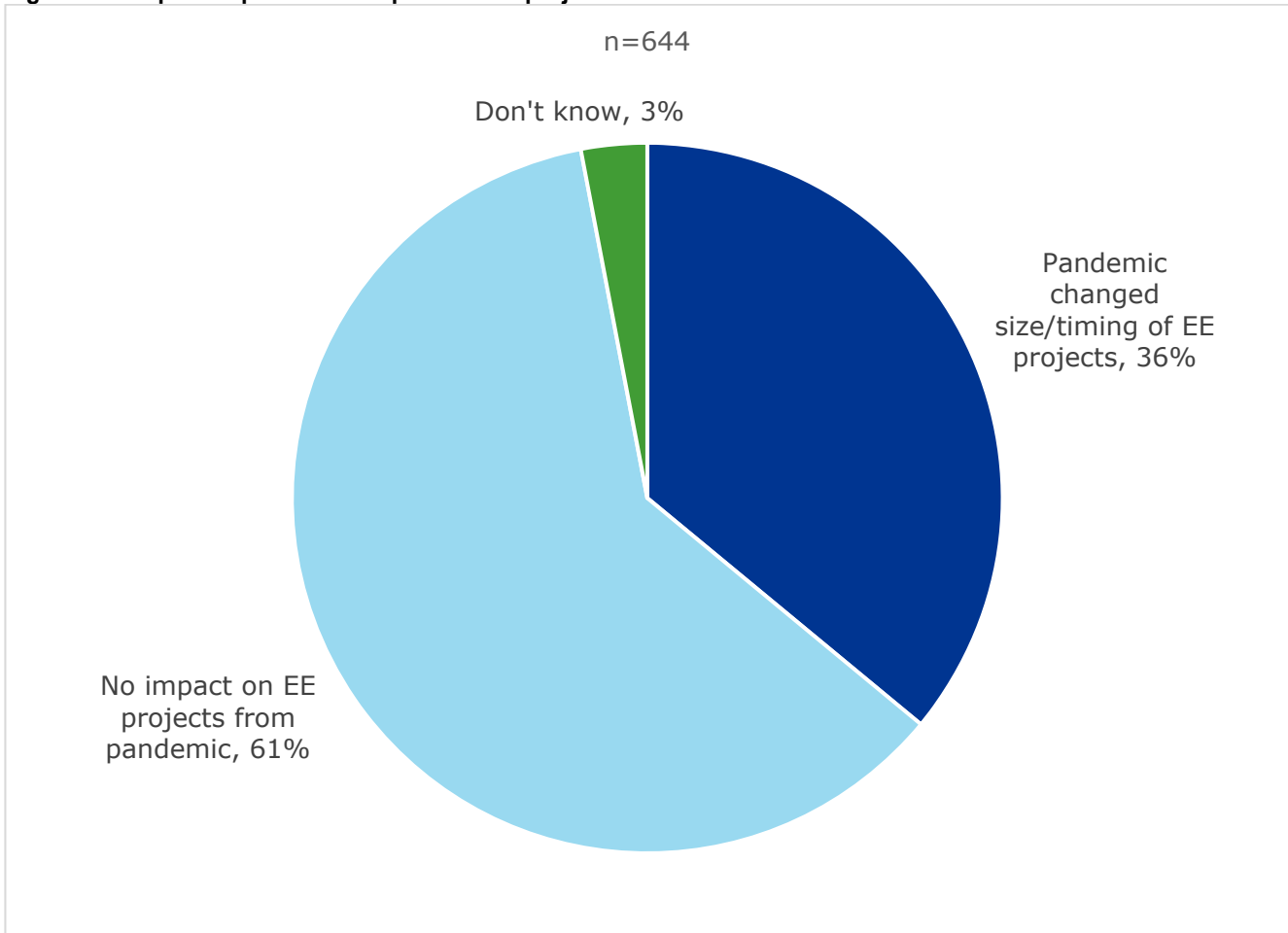
n=644

Don't know, 3%

Pandemic changed size/timing of EE projects, 36%

No impact on EE projects from pandemic, 61%

The team then asked the participants who reported having energy efficiency plans impacted by the pandemic for more details on how their projects were impacted. By far, the most common impact (reported by 60% of the participants with impacted projects) was the postponement of planned projects. Other effects included the acceleration of planned projects (19% of respondents) and the reduction in project size or quantity (14% of respondents). Figure 8-4 shows all the responses.

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Figure 8-4: Detailed impacts of pandemic on planned EE projects
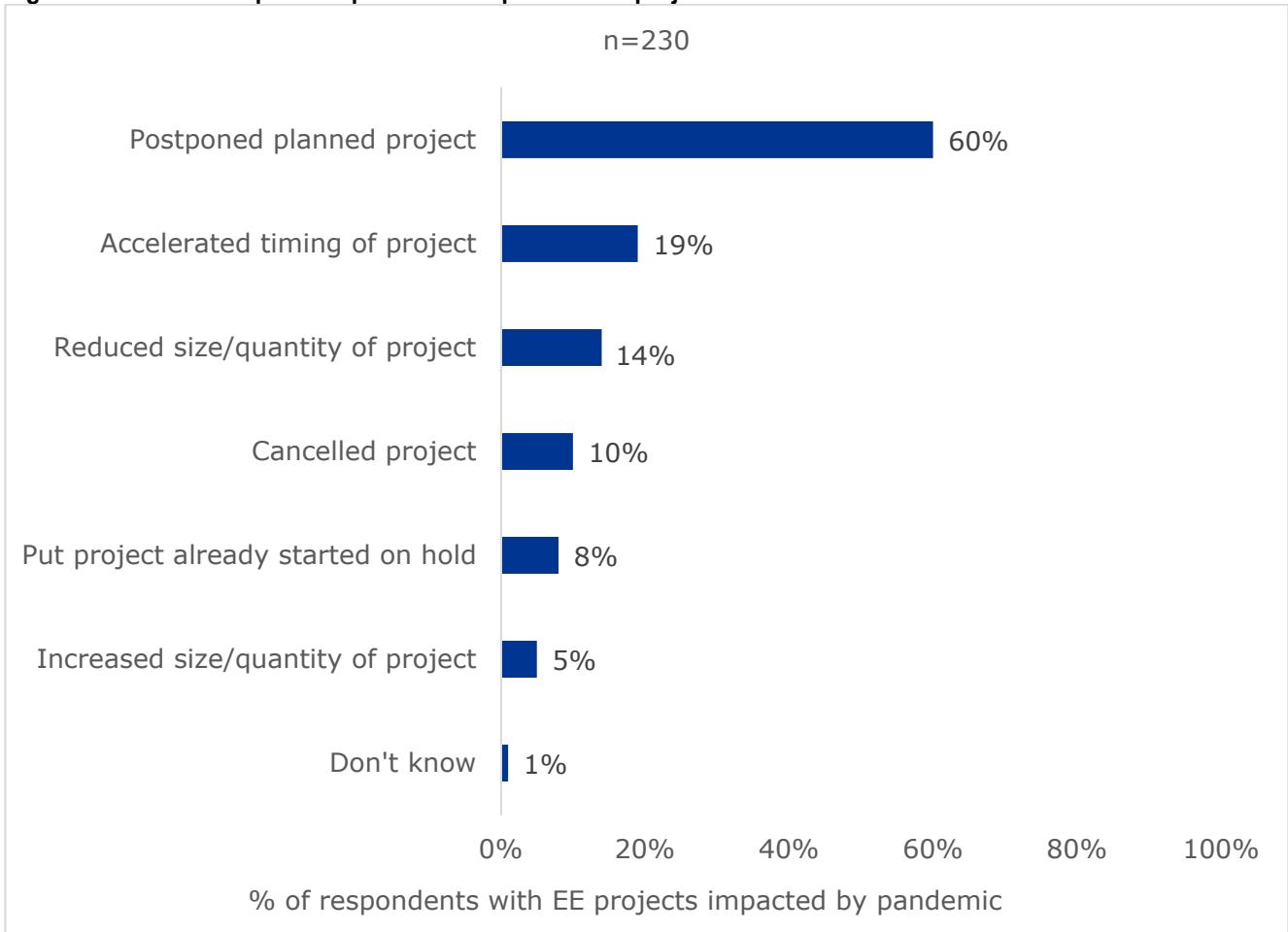
n=230

% of respondents with EE projects impacted by pandemic

Note: The percentages exceed 100% because the participants could provide multiple reasons.

The team then asked the participants who reported having energy efficiency plans impacted by the pandemic why their planned energy efficiency activities changed. The three most commonly mentioned reasons were financial considerations or risk aversion and participant discomfort with contractors entering their house. Figure 8-5 shows the various reasons given.

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Figure 8-5: Why participants changed their EE projects due to the pandemic
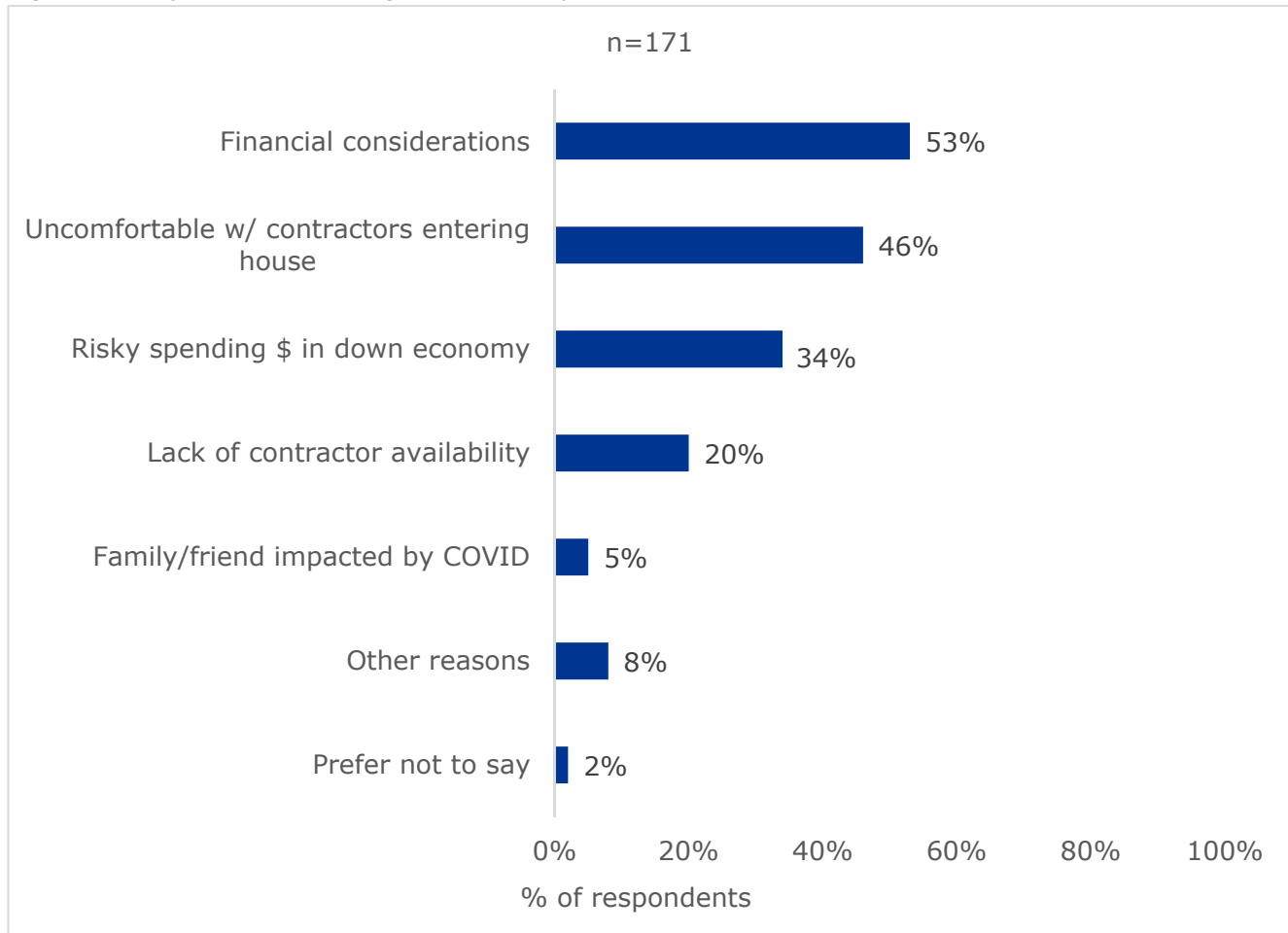
n=171

Reason	%
Financial considerations	53%
Uncomfortable w/ contractors entering house	46%
Risky spending $ in down economy	34%
Lack of contractor availability	20%
Family/friend impacted by COVID	5%
Other reasons	8%
Prefer not to say	2%

% of respondents

Note: The percentages exceed 100% because the participants could provide multiple reasons.

There were some statistically significant differences in the response rates depending on the participants' incomes. Figure 8-6 shows that as incomes increased, participants were less likely to cite financial considerations as the reasons for changing/postponing projects and more likely to mention discomfort with having a contractor in the house.

Figure 8-6: Differences in reasons for changing or postponing EE projects based on income
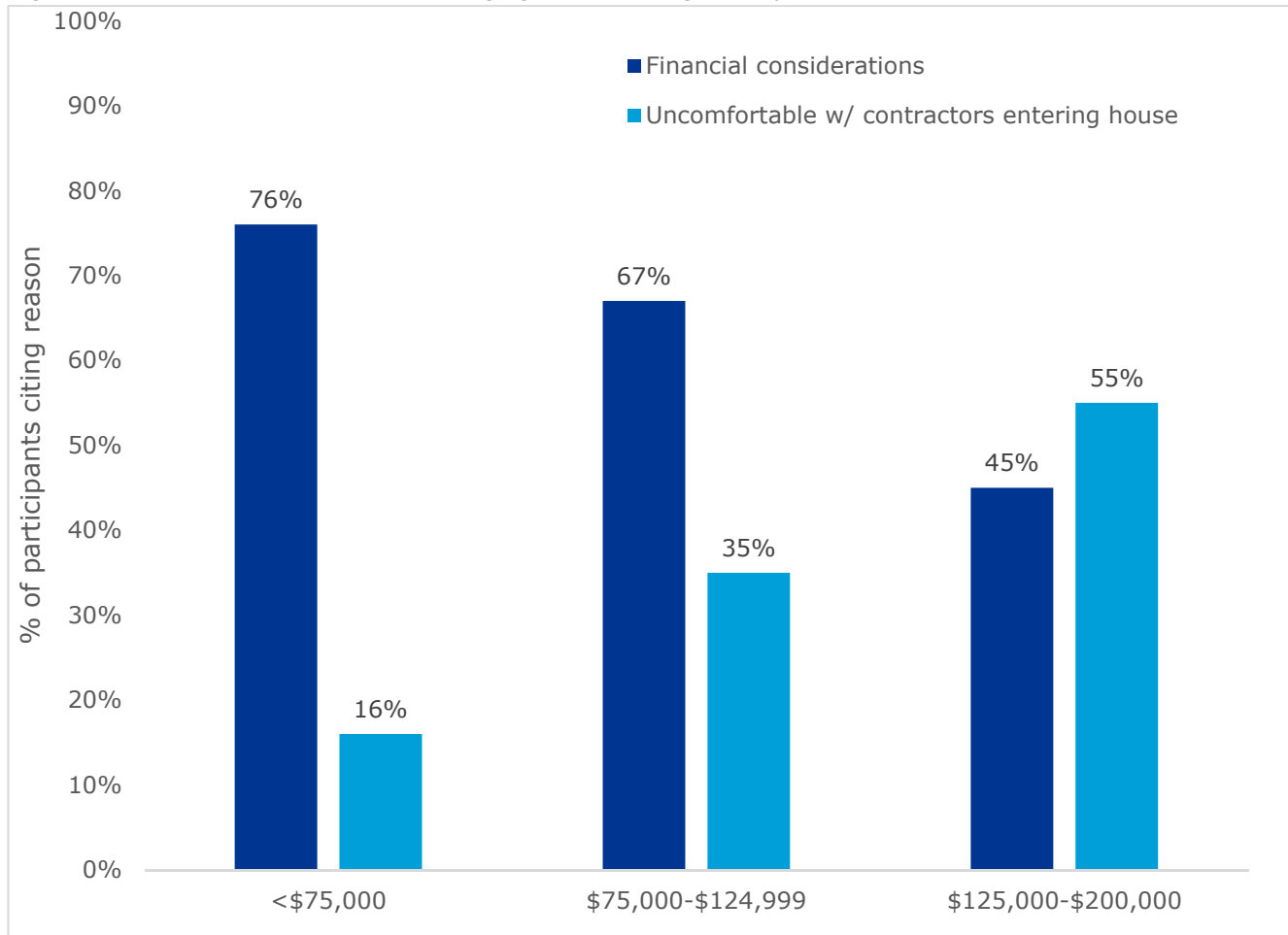
Participants who reported household incomes of less than $75,000 or $75,000-$125,000 were more likely to cite financial considerations as reasons for changing their energy efficiency activities (76% and 67%, respectively, from these two income groups gave this reason) than participants who reported household incomes of greater than $125,000 (only 45% of respondents).

9 OTHER FINDINGS

In addition to NTG estimates, the DNV team asked participating lighting suppliers and retail buyers about LED market trends and program satisfaction. This feedback can help inform program design or implementation since many suppliers and retail buyers interact with similar programs in different utility service territories offering insights and comparisons to similar upstream lighting programs.

9.1 Market trends

The first set of questions asked market actors to share their understanding of current conditions of the LED market throughout Virginia, North Carolina, and the United States. Suppliers and retail buyers were asked to provide any demand barriers that are limiting customer demand for LED products. Most respondents cited price points and suggested the continued need for price discounts. Other respondents suggested greater customer education is still needed to inform customers of either the cost savings of LEDs compared to non-LEDs or the benefits of ENERGY STAR-certified products. Most respondents reported that these barriers do not vary by bulb type. A few suggested A-lines are better understood by customers due to their similar appearance to non-LED equivalent bulbs. There was no clear trend if suppliers and retail buyers thought LED prices would increase, decrease or stay the same in the coming year. Finally, all respondents expected their sales of A-lines would increase if the A-line bulb incentives were reinstated through the program—although they reported different levels of sales increases, citing price sensitivity as a major driver of sales.

9.2 Lighting manufacturer/retail buyer satisfaction

Respondents were asked to rate their satisfaction with the program implementor, CLEAResult on a scale of 1 to 5 where 5 is very satisfied and 1 is very dissatisfied. Nine lighting suppliers and three retail buyers were satisfied with the program implementer. However, one respondent suggested the need for expanding aspects of the program such as increase incentive levels.

Most interviewees reported having a great working relationship with the program implementer. When asked to use the same scale to rate the program overall, eight of the nine suppliers and three of four retail buyers were satisfied with the program. Respondents who were less than satisfied suggested a greater need for online sales strategies as a result of the Covid-19 pandemic, another was disappointed with the removal of certain participating stores during the program year.

Respondents were asked what could be done to improve the program process. Some suppliers suggested improvements to sales data processing when submitting invoices, stating "If you're not going to use it, don't ask for it." Other interviewees suggested a need to work with more retail stores throughout Dominion Energy's service territory although they did not specify if this meant more stores with participating retailers or adding new retail partners to the program. When asked about additional bulb types to include in the program that currently were not include, the most common response was a request for the reintroduction of A-line bulbs into the program. Overall, these results suggest a robust program with some opportunities for improvement in future program design and implementation.

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10 RECOMMENDATIONS

Based on the findings from this report, the DNV team makes the following recommendations for improving the future delivery of the Marketplace Program:

1. *Promote more program LED sales through the dollar store/discount channel:* During the interviews, the lighting manufacturers indicated that the participating discount/dollar stores would not have been able to sell the ENERGY STAR LED products if not for the price discounts offered by the program (which averaged over $4/lamp). The desired price points for the dollar/discount stores are low enough (even when not strictly $1) that they would not stock these LED products without these large program price discounts. Absent the program, such stores would likely sell cheaper and less energy-efficient halogen and incandescent lighting products. Numerous upstream lighting evaluations which produced NTG estimates by retail channel (e.g. in California, Massachusetts, Connecticut) have found that the NTG ratios for the discount channel (which includes not only $ stores but also thrift retailers are usually in the 90–100% range for the reasons stated above. Therefore, increasing the volume of program lamp sales through this channel could translate to a higher overall NTG ratio.

    In addition, focusing the program more on this discount retail channel would help Dominion reach program equity goals such as ensuring that rural customers who may only have dollar/discount stores within convenient driving distance can get fair access to the discounted LEDs.

3. *Promote more program LED reflector sales:* The NTG ratio for the LED reflectors (73%) was higher than those for the other LED product categories (56% for A-lines, 53% for specialty lamps, and 60% for fixtures/retrofit kits). Increasing the volume of LED reflector sales through the Marketplace Program could translate to a higher overall NTG ratio.

4. *Promote more program small appliance sales:* The NTG ratios for the smaller appliances – air purifiers (69%) and dehumidifiers (61%)were higher than those for other appliances, likely due to some of the factors mentioned above (e.g., rebates accounting for a larger proportion of the appliance purchase price, and the program having great purchase acceleration impacts). Furthermore, when the DNV team asked program participants which factors influenced their decision to purchase the energy-efficient equipment, the small appliance purchasers were more likely to mention the utility rebate than the large appliance purchasers (50% vs. 39%, a statistically significant difference). The small appliance purchasers were also more likely to value the ENERGY STAR branding than the large appliance purchasers (51% vs. 41%, a statistically significant difference).

5. *Work with the program implementer to improve the timeline of the rebate payment process:* While participants were generally satisfied with the program, the lowest satisfaction level (86%) was with the timeliness of the rebate payment. Improving the timing of the rebate payments was also one of the participants' top suggestions for improving the program.

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APPENDIX A. STUDY WORK PLAN

Residential Efficient Products Marketplace – Impact and Net-to-Gross Evaluation Plan

Program Year July 2019 – July 2020

Prepared by DNV Energy Insights USA, Inc.

August 27, 2020

DNV

INTRODUCTION

This is the detailed work plan for evaluation of the Residential Efficient Products Marketplace program (REEC) implemented by CLEAResult and administered by the Virginia Electric and Power Company, hereafter Dominion. This impact evaluation will provide estimates of both ex post gross energy savings and net energy savings, which account for the effect of free ridership (FR). Net-to-Gross (NTG) ratios will be calculated from reported estimates and applied to tracking data for realization rates and cost effectiveness.

The programs evaluation year will cover the July 2019 to July 2020 period. This evaluation plan is designed to maximize the available funding while providing an analysis that is tailored to lighting and appliance measures. This evaluation will be conducted in accordance with the REEC EM&V Plan, calculate impacts, inform future REEC program design and implementation through insights gained from interview and survey data.

Overview of Implemented Programs and Measures

The Marketplace Program offers upstream lighting incentives which result in price discounts on energy-efficient lighting products for shoppers at program-participating stores. It also offers rebates on Energy Star® rated appliances. Table 10-1 lists all the energy-efficient measures implemented under this program.

Table 10-1: Program energy-efficient measures

Lighting Measures (LEDs)	Appliance Measures Energy Star
▪ A-Lines	▪ Freezer
▪ Reflectors	▪ Refrigeration
▪ Decorative	▪ Clothes Washer
▪ Globes	▪ Dehumidifier
▪ Retrofit Kit and Fixture	▪ Air Purifier
	▪ Clothes Dryer
	▪ Dishwasher
	▪ Freezer

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EVALUATION PLAN

This section provides an overview of the REEC EM&V approach. Subsequent sections describe the impact evaluation approaches for the upstream lighting (UL) measures and the appliance rebate (AR) measures. These approaches are based on best practices for designing survey and survey samples and measuring net savings such as the Uniform Methods Project (UMP).[13]

The first step in the evaluation will be for DNV to complete in-depth interviews with both the Dominion program manager and the program manager from the program's implementation contractor. The purpose of these interviews will be to ensure that DNV has a deep understanding of the design and delivery of the program before the survey instruments and analysis plan are finalized.

The interviews will derive NTG estimates by asking the suppliers and retail buyers to estimate what their level of sales of led lamps would have been without the price discounts provided by the Marketplace Program (the counterfactual scenario).

Table 10-2 summarizes the data collection activities for the impact evaluation. Because customer contact information is not tracked for the upstream lighting program, the evaluation will rely on program invoices and the STEP manual to estimate gross savings. DNV will rely on in-depth interviews with participating lighting manufacturers and retailers to estimate net savings for upstream lighting.

The program tracking data includes customer contact information for the AR participants and will use customer surveys to estimate both gross and net energy savings.

Table 10-2. Data collection summary

Program	Target Market Actor or Program Staff	Population Size	Target Number of Completed Interviews or Surveys	Mode of Data Collection
Upstream Lighting & Appliance Rebates	Dominion PM (Nick Meter)	1	1	In-depth interview
	CLEAResult Program Manager	1	1	In-depth interview
Upstream Lighting	Participating lighting manufacturers	22	22	In-depth interview
	Participating large retailers	15	15	In-depth interview
Appliance Rebates	Participating customers with email addresses	~4,700	300	Web surveys

The sample design will aim for a representative sample of program participants based on characteristics such as the type of appliance purchased and the participant's geographical location. The design will attempt to achieve 85/15 precision (15% relative precision with 85% confidence intervals) at the program level and will explore the feasibility of achieving similar levels of precision for individual appliances.

Impact Evaluation Approach – Upstream Lighting

Estimating net and gross savings

The impact evaluation verifies program savings by verifying the installation of tracked measures if customer contact information data is available. The evaluation of the Dominion upstream lighting program, as with most upstream lighting

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[13] Daniel M. Violette and Pamela Rathbun, (2017) *Chapter 21: Estimating Net Savings – Common Practices, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578; 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.

programs, will rely on alternative methods to estimate gross and net energy savings since it cannot rely on customer self-reporting.

For estimating gross energy savings for the upstream lighting program, DNV will use two methods.

- Review the program tracking data to verify that the lighting deemed savings values in the STEP manual are being properly applied to program participants.
- Review invoices from participating suppliers to ensure the lamp quantities in the tracking databases match those in the program tracking data and note any discrepancies (a sample invoice request is included at the end of this plan).

For estimating net energy savings for the upstream lighting program, DNV will conduct in-depth interviews with participating lighting suppliers and retailers. DNV will attempt to interview the census of 22 lighting suppliers, also referred to as manufacturers. In addition, it will attempt to complete interviews with representatives of the largest participants who are responsible for purchasing lighting products for their stores, also referred to as "retail buyers."

Before the interviews, DNV will send the lighting suppliers and retail buyers a summary of their Dominion sales to refresh their memory on their involvement with the Dominion program, since most lighting suppliers participate in many similar programs in other jurisdictions. However, it also gives DNV another opportunity to verify reported quantity of lamp sales.

For each invoice/application selected for verification, we compared the program tracking data to what is provided in electronic form. In addition to quantity of utility-discounted products shipped, we attempt to verify the following key metrics:

- Manufacturer name
- Per unit rebate

- Measure name
- Total rebate paid

- Product type
- Shipment and sales dates

- Retailer name and location

DNV will develop the NTG questions in the interview guide that it will submit for Dominion review. However, the following is an example of a typical question.

> The Dominion program provided discounts of $X for every [LED LAMP TYPE Y] sold through the program. If these discounts had not been available, do you think your business would have sold any of [LED lamp type Y] in the Dominion service territory during the July 2019 – July 2020 period?
>
> - [IF THEY WOULD HAVE SOLD SOME OF LED LAMP TYPE Y WITHOUT THE PROGRAM] If these average buydown discounts of $X for [LED LAMP TYPE Y] offered by the program were not available, do you think your sales of these bulbs would be about the same, lower, or higher?
>   - [IF LOWER] By what percentage do you estimate your company's/store's sales of LED LAMP Y] would be lower in the Dominion service territory during this 2019–2020 period if the program discounts had not available?

The lighting suppliers' and retail buyer's estimates of their expected decline in sales absent the program forms the basis of DNV's NTG estimates for the upstream lighting program. DNV will use the volume of program sales of the different suppliers or retailers participating in the program to sales weight the individual NTG estimates when combining them to come up with program-level NTG estimates.

As the sample questions above show, this NTG methodology has the capability to provide separate NTG estimates for different LED lamp types. However, since most lighting suppliers and retailers sell multiple LED lamp types, asking them to

provide separate NTG estimates for each lamp type would be burdensome. To overcome this, DNV groups similar lamp types to reduce respondent fatigue.

Additional Areas of Inquiry

Although developing NTG estimates will be the focus of the lighting supplier and retail buyer interviews, DNV plans to ask some additional questions to better understand the lighting market in the Dominion service territory. These questions will cover the extent to which these suppliers and retail buyers sell program-qualified LEDs outside the program, why they sell these qualified lamps outside the program, whether they sell non-Energy Star LEDs and how the quality of these lamps differ from their Energy Star models. If Dominion and the program implementation contractor are interested, DNV can also ask the lighting suppliers and retail buyers about their level of satisfaction with the program.

DNV will attempt to contract manufacturers 5-6 times before exhausting each contact.

Supplemental Data Collection

Because four of the lighting suppliers participating in the upstream lighting program account for about 75% of the program sales, there is a risk that if one or more of these suppliers decline to provide NTG estimates, the validity of the program-level NTG estimates will be reduced.

If this occurs, DNV will supplement the lighting supplier and retail buyers' interviews with computer-aided telephone (CATI) surveys with managers at participating retail locations. The CATI surveys will ask the store managers NTG questions like those described above for the lighting suppliers and retail buyers. Since the store managers have first-hand experience with upstream lighting program stocking and signage practices, these surveys can also be used to collect the store manager's perspectives on the effectiveness of program delivery.

Impact Evaluation Approach – Appliance Rebates

DNV proposes an online survey which will allow for agile data collection given the accelerated project timeline. This approach also eliminates costs associated with printing, mailing, and postage, and conserves natural resources. DNV uses a proprietary interactive data collection platform to build and field an online survey that meets DNV's and DEV data security requirements. Online data collection has advantages over traditional print or telephone methods including, but not limited to:

- Accelerated response time. Online surveys are faster to complete, thus relieving the burden on the customer.
- Improved data quality. Online surveys use visual clues to help the customer identify equipment and technology.
- Automated skip patterns offer another time-saver and validity check.
- Streamlined status reporting using the integrated online tool reporting tool. DEV can review progress reports and monitor response rates.
- Customers can participate from multiple platforms, including their computers, tablets, or mobile devices.
- DNV will prepare a Frequently Asked Questions (FAQs) guide and sample inquiry response script for the DEV call center. DNV will also be a resource to customers who have questions about the tool or instrument.
- Appropriate sample design will target a confidence interval between 85 to 90% with relative precision between 10 to 15% across all appliances.

The AR impact evaluation will verify program savings by verifying tracked measures installation of customers between June 2019 and July 2020. The survey will cover the following topics:

- Program awareness and participation
- Verification of purchased appliance(s)
- Satisfaction with various program aspects

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- ▪ Energy attitudes (including COVID-19 impacts)
- ▪ Demographics

This survey will be sent to participating customers email addresses three times with A/B subject testing to strengthen data collection efforts. Testing multiple subject lines will help increase response rates by using the subject that results in the most clicks. An optional opt-out could be added after the verification questions to allow for greater data collection. This could increase the sample size collected for the most important components of the data collection efforts, verification and program participation, and ensure greater precision.

COMMUNICATION AND REPORTING

Project Schedule

Completed the evaluation on an accelerated schedule is dependent upon the program responding to data requests in a timely fashion and delay in receiving complete data sets or collection efforts may cause disruption to the embedded milestone events. The evaluation schedule is presented below in Table 10-3. Dates for each deliverable are listed in bold with 2 weeks to review and provide comments for each draft survey instrument. DNV regularly allows for 4 weeks between draft report distribution and the final report deadline, allowing for 2 weeks of client review and 2 weeks to finalize the report. The schedule may also be impacted by circumstances outside of Dominions or DNV's control resulting from the Covid-19 pandemic.

Table 10-3: Schedule

Tasks / Milestones	Sep	Oct	Nov	Dec	Jan	Feb
Program Manager Interviews	▓					
NTG Survey Instrument - Draft	▓					
NTG Survey Instrument - Final		▓				
AR Survey Instrument - Draft	▓					
AR Survey Instrument - Final		▓				
NTG Survey Implementation		▓	▓	▓		
AR Survey Implementation		▓	▓	▓		
Impact Analysis			▓	▓	▓	
Report - Draft					▓	
Report - Final						▓

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APPENDIX B. DATA REQUEST FOR PROJECT INVOICES AND CONTACT INFORMATION

Memo to:

Elizabeth Buchanan, CLEAResult

Mark Hervey, CLEAResult

Tom Nagaweicki, CLEAResult

Date: September 18, 2020

Copy:

Nicholas Meyer, Dominion Energy

Michelle Marean, DNV

Christopher Dyson, DNV

Dan Feng, DNV

Prep. by: Christopher Dyson, DNV
Christopher Hoffman, DNV

Residential Efficient Products Marketplace – Impact and Net-to-Gross Evaluation

Upstream Lighting Documentation Request

Thank you for your support for the net-to-gross (NTG) and impact evaluation of the REEC program. As part of the evaluation, DNV is requesting:

– *The invoices and supporting documentation for the July 2019 and June 2020 upstream lighting measures.* DNV is requesting invoices from participating lighting manufacturers covering programs sales for the 07/01/19 through 06/30/20 period. The invoices will be used to verify that the tracking data reflects the point of sale (or as close to point of sale as is available) for the information provided by retailers. From the invoices, DNV will verify what was shipped, where it was shipped, and how shipments are accounted for in the tracking data.
We recognize that for various reasons the tracking data may not correspond with invoice date or month. Therefore, please also provide any documentation needed to tie the tracked data to the invoices.

– *Contact information for participating manufacturers and retailers:* DNV is also requesting contact information for all lighting manufacturers and retailers participating in the upstream lighting component of the program. For the retailers participating in the upstream lighting component, this contact information should include both the retailer representatives working directly with the program as well as the names of any participating store managers (if available). Contact information should include name, title/role (if available), phone number, and email address. If CLEAResult has staff assigned to certain participating lighting manufacturers or lighting retailers, please provide these names also since this will facilitate DNV's in-depth interviews with the lighting manufacturers and retailers.

– *CLEAResult's support in completing the manufacturer/retailer interviews:* In a recent meeting, CLEAResult indicated it would support DNV's efforts to interview the participating lighting manufacturers and retailers. CLEAResult has existing relationships with these lighting manufacturers and retailers and therefore might be able to increase their willingness to complete DNV program evaluation interviews. This support might either take the form of CLEAResult making initial contact with these manufacturers/retailers or, if DNV makes the initial interview request, reassuring the manufacturers/retailers about the validity and importance of DNV's evaluation efforts.

CLEAResult can use existing systems for secure data transfer or DNV can provide an SFT link for uploading the documents. Please notify DNV when the files have been uploaded. If not all the requested documentation is available or finalized at this time, or some of these documents simply do not exist, please let us know so that we can prioritize projects with complete information in our initial reviews.

Please contact Chris Hoffman or Chris Dyson with any questions or concerns related to this documentation request. You can reach Chris Hoffman [phone] or [email] mailto:and Chris Dyson at [phone] or [email].

APPENDIX C. LIGHTING RETAIL BUYER IN-DEPTH INTERVIEW GUIDE

RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE – IMPACT AND NET-TO-GROSS EVALUATION

Interview Information

Interviewer		Survey Length (min)	
Completion Date			

Contact Information

Phone	
Email	

Call Tracking

Date/Time	Notes

Variables

<alines_sold>	Total A-Lines sold through the program
<fixtures_retrofits_sold>	Total fixture and retrofits sold through the program
<specialty_sold>	Total globes, candelabra, candle, and other specialty bulbs sold through the program
<reflectors_sold>	Total Multifaceted, parabolic aluminized reflectors, bulged and other reflectors sold through the program
<average_buydown>	Average buydown amount from tracking data specific to each retailer

Introduction

[NOTE: THE QUESTIONS IN THIS INTERVIEW GUIDE WILL NOT NECESSARILY BE READ VERBATIM BUT MAY BE MODIFIED TO SUIT THE INTERVIEW]

1. Hi, my name is _____, and I am calling from DNV on behalf of Dominion Energy regarding the Residential Efficient Products Marketplace Lighting Discounts program which support the sales of efficient lighting products for retailers across Virginia and North Carolina. According to our records, your company has recently sold lighting products as part of that program. I would like to ask you some questions about your participation and about trends in the residential lighting market in general.

[IF RESPONDENT IS NOT PROGRAM-FAMILIAR CONTACT, GET IN TOUCH WITH PROGRAM-FAMILIAR CONTACT AND REPEAT]

DNV

[IF ASKED] We anticipate this interview will last about 20-30 minutes. Any information you provide will be treated as confidential.

[IF ASKED] DNV is an independent contractor hired to do this research. You can verify the legitimacy of this research by calling Nicholas Meyer from Dominion Energy at 804-771-6101.

VERIFICATION OF PROGRAM SALES

First, I would like to review some information about the nature of your recent participation in Dominion Energy's Residential Efficient Products Marketplace Program which offers discounts on Energy Star LED lighting products in Virginia and North Carolina.

V1. I emailed you information on your sales of energy-efficient lamps through the 2019–2020. Does that information appear generally correct? [IF SOME OF THE INFORMATION IS INCORRECT, MAKE ANY CORRECTIONS IN THE SECOND ROW].

V2. My records indicate that in 2019–2020 your company **did not** receive discounts from the Dominion Energy's REEC Program for the following lighting applications: [NAME ALL LIGHTING APPLICATION PRODUCTS IN SECOND ROW OF TABLE 1 WHERE QUANTITY IS = 0] Is this information correct? [IF SOME OF THE INFORMATION IS INCORRECT, MAKE ANY CORRECTIONS IN THE THIRD ROW OF THE TABLE.]. Is that correct?

High-Level Verification of Program Tracking Data

Response Category	# of PY 2019–20 A-Lines	# of PY 2019–20 Reflectors	# of PY 2019–20 Specialty*	# of PY 2019–20 Fixtures & Retrofits
Upstream Program Sales from Tracking Data**				
1-1. Program sales data looks reasonably correct?	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused
1-2 Is it true that you did not sell these lighting products through the program?	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused

* Specialty bulbs include Globes, Candelabra Base, Candle, and Other Specialty bulbs
** Interviewers will pre-populate this row with tracking data

2019–2020 Program Attribution

Net-to-Gross – A-Lines

PA3. The Dominion Energy REEC Program paid average buydown or markdown discounts of $<average_buydown> per A-Line bulb. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019, do you think your sales of these types of bulbs in your stores in Virginia and North Carolina would have been about the same, lower, or higher?

PA3a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA4]

PA3b. [IF LOWER] By what percentage do you estimate your sales of Energy Star A-Lines would be lower during 2019 if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

PA3c. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA3b] % lower without the program support. So, if you actually sold 100 A-Lines in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA3b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

PA3d. [IF LOWER] You said that you would have sold fewer Energy Star LED A-Lines if the Dominion Energy program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LEDs A-line sales with sales of less expensive non-Energy Star LED products?

    i)   [IF YES] About what percent of these lost Energy Star A-Lines sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

PA3e. [IF LOWER] Would you have tried to make up for these lost Energy Star LEDs A-line sales with sales of less expensive non-LED products such as halogens or incandescents?

    i)   [IF YES] About what percent of these lost Energy Star A-Lines sales would you have likely made up with sales of these non-LED products?

PA3f. The Dominion Energy program ceased offering rebates for Energy Star A-Line LEDs at the end of 2019. What impacts did this have on your volume of sales of these Energy STAR A-line LEDs in Dominion's Virginia and North Carolina service territories in 2020?

    1)   [IF THEY SAID THEIR SALES OF ENERGY STAR LED A-LINES DECLINED IN 2020] By about what % did these sales decline?

Net-to-Gross – Reflectors

PA4. The Dominion Energy lighting program paid average buydown or markdown discounts of $<average_buydown> per reflector bulb. If these program buydown/markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs in your stores in Virginia and North Carolina would have been about the same, lower, or higher?

PA4a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA5]

PA4b. [IF LOWER] By what percentage do you estimate your sales of reflectors would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

PA4c. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 reflector bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

PA4d. [IF LOWER. ALSO IF THEY ALREADY SAID, IN RESPONSE TO PREVIOUS QUESTIONS, THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star LED reflectors if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star reflector sales with sales of less expensive non-Energy Star LED products?

i)   [IF YES] About what percent of these lost Energy Star reflector sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

PA4e. [IF LOWER] Would you have tried to make up for these lost Energy Star LED reflector sales with sales of less expensive non-LED products such as halogens or incandescents?

i)   [IF YES] About what percent of these lost Energy Star LED reflector sales would you have likely made up with sales of these non-LED products?

Net-to-Gross – Specialty

PA5. The Dominion Energy Lighting Program paid average buydown or markdown discounts of $<average_buydown> per Energy Star LED specialty bulb. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs in your Virginia and North Carolina stores would have been about the same, lower, or higher?

PA5a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA6]

PA5b. [IF LOWER] By what percentage do you estimate your Virginia & North Carolina sales of Energy Star specialty LED bulbs would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

PA5c. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b) * 100] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

PA5d. [IF LOWER. ALSO IF THEY ALREADY SAID IN RESPONSE TO PREVIOUS QUESTIONS, THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star specialty LED lamps if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LEDs specialty lamp sales with sales of less expensive non-Energy Star LED products?

i)   [IF YES] About what percent of these lost Energy Star specialty LED sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

PA5e. [IF LOWER] Would you have tried to make up for these lost Energy Star specialty LED sales with sales of less expensive non-LED products such as halogens or incandescents?

i)   [IF YES] About what percent of these lost Energy Star LED specialty LED sales would you have likely made up with sales of these non-LED products?

Net-to-Gross – Fixtures and Retrofit Kits

PA6. The Dominion REEC Program paid average buydown or markdown discounts of $<average_buydown> per fixtures & retrofit kits. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of LED fixtures and retrofit kits through your stores in Virginia and North Carolina would have been about the same, lower, or higher?

    PA6a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA5]

    PA6b. [IF LOWER] By what percentage do you estimate your Virginia & North Carolina sales of Energy Star fixtures and retrofit kit LED would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

    PA6c. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

    PA6d. [IF LOWER. ALSO IF THEY ALREADY SAID (IN RESPONSE TO PREVIOUS QUESTIONS) THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star lighting fixtures if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LED fixture sales with sales of less expensive non-Energy Star LED products?

    i)   [IF YES] About what percent of these lost Energy Star LED fixture sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

    PA6e. [IF LOWER] Would you have tried to make up for these lost Energy Star LED fixture sales with sales of less expensive non-LED products such as halogens or incandescents?

    ii)   [IF YES] About what percent of these lost Energy Star LED fixture sales would you have likely made up with sales of these non-LED products?

Lighting Market Trends and Program Design

This last set of questions will address lighting market trends and aspects of the Dominion REEC Program's design.

Market Trends

LM1.   What are the most important factors that are limiting customer demand for LED products? Please explain.

    LM1a. To what degree have these demand barriers varied with the type of LED product?

    LM1b. [IF DEMAND BARRIERS IDENTIFIED] Has there been any progress recently to reduce these barriers?

    LM1c. [IF YES] What factors lead to the reduced barriers?

    LM1d. [IF DEMAND BARRIERS IDENTIFIED] What needs to happen to overcome these demand-side barriers?

LM2.   Do you think LED lighting product prices will increase, decrease, or stay the same in 2021?

    LM2a. What factors are causing you to make this prediction?

LM2b. [IF SAID PRICES WILL DROP] By what percentage do you think LED prices will drop in 2021? [RECORD %]

LM3. A-Lines were not incented through the program in 2020. If A-Lines were incented through the program in 2021, would you expect your sales of A-Lines to increase, decrease, or stay the same.

> **LM3a.** Why do you say that?

Program Satisfaction

Finally, I would like to find out your level of satisfaction with Dominion's REEC Program.

PS1. Using a scale of 1 to 5 where 5 = very satisfied and 1 = very dissatisfied, how satisfied have you been with CLEAResult, the contractor delivering the Dominion REEC Program?

> **PS1a.** [ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS2. Have you had any interaction with Dominion Energy staff while participating in this program?

> **PS2a.** [IF YES] Using a scale of 1 to 5 where 5 = very satisfied and 1 = very dissatisfied, how satisfied have you been with the Dominion Energy staff who you interacted with?
>
> > i) ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS3. Using the same scale, how would you rate your level of satisfaction with the program in general?

> **PS3a.** [ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS4. In what way could the program processes be improved?

PS5. Are there any lighting products not currently offered through the program that you would like to be included in the program?

> **PS5a.** [IF YES] Which products?

PS6. Are you planning to participate in the program going forward?

> **PS6a.** [IF YES] Why do you say that?

Closing

Thank you for your time with this interview and participating in this program. Have a great day.

DNV

APPENDIX D. LIGHTING MANUFACTURER AND DISTRIBUTOR IN-DEPTH INTERVIEW GUIDE

RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE – IMPACT AND NET-TO-GROSS EVALUATION

Interview Information

Interviewer		Survey Length (min)	
Completion Date			

Contact Information

Phone	
Email	

Call Tracking

Date/Time	Notes

Variables

<alines_sold>	Total A-Lines sold through the program
<fixtures_retrofits_sold>	Total fixture and retrofits sold through the program
<specialty_sold>	Total globes, candelabra, candle, and other specialty bulbs sold through the program
<reflectors_sold>	Total Multifaceted, parabolic aluminized reflectors, bulged and other reflectors sold through the program
<retailer_string>	A list of retailers that received bulbs from a specific manufacturer
<average_buydown>	Average buydown amount from tracking data specific to each manufacturer

Introduction

[NOTE: THE QUESTIONS IN THIS INTERVIEW GUIDE WILL NOT NECESSARILY BE READ VERBATIM BUT MAY BE MODIFIED TO SUIT THE INTERVIEW]

1. Hi, my name is _____, and I am calling from DNV on behalf of the Dominion regarding the Residential Efficient Products Marketplace Lighting Discounts program which support the sales of efficient lighting products for retailers across Virginia and North Carolina. According to our records, your company has recently sold lighting products as part of that program. I would like to ask you some questions about your participation and about trends in the residential lighting market in general.

DNV

[IF RESPONDENT IS NOT PROGRAM-FAMILIAR CONTACT, GET IN TOUCH WITH PROGRAM-FAMILIAR CONTACT AND REPEAT]

[IF ASKED] We anticipate this interview will last about 20-30 minutes. Any information you provide will be treated as confidential.

[IF ASKED] DNV is an independent contractor hired to do this research. You can verify the legitimacy of this research by calling Nicholas Meyer from Dominion at 804-771-6101.

VERIFICATION OF PROGRAM SALES

First, I would like to review some information about the nature of your recent participation in Dominion Energy's Residential Efficient Products Marketplace (REEC) Program which offers discounts on Energy Star LED lighting products in Virginia and North Carolina.

V1. I emailed you information on your sales of energy-efficient lamps through the 2019–2020. Does that information appear generally correct? [IF SOME OF THE INFORMATION IS INCORRECT, MAKE ANY CORRECTIONS IN THE SECOND ROW].

V2. My records indicate that in 2019–2020 your company **did not** receive discounts from the Dominion REEC Program for the following lighting applications: [NAME ALL LIGHTING APPLICATION PRODUCTS IN SECOND ROW OF TABLE 1 WHERE QUANTITY IS = 0] Is this information correct? [IF SOME OF THE INFORMATION IS INCORRECT, MAKE ANY CORRECTIONS IN THE THIRD ROW OF THE TABLE.]. Is that correct?

High-Level Verification of Program Tracking Data

Response Category	# of PY 2019–20 A-Lines	# of PY 2019–20 Reflectors	# of PY 2019–20 Specialty*	# of PY 2019–20 Fixtures & Retrofits
Upstream Program Sales from Tracking Data**				
1-1. Program sales data looks reasonably correct?	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused
1-2 Is it true that you did not sell these lighting products through the program?	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused	Yes No DK Refused

* Specialty bulbs include Globes, Candelabra Base, Candle, and Other Specialty bulbs
** Interviewers will pre-populate this row with tracking data

2019–2020 Program Attribution

Whether They Would Have Sold Any EE Lighting Products without the Program

PA1. The Dominion REEC Program paid average buydown or markdown discounts of $4.72 per A-Line and $4.40 per Reflectors. Are there any retailers or retailer categories that you worked with through the program that you think would not

have been selling any A-Lines or reflector products if these discounts had not been available? As a reminder you worked with <retailer_string>.

> **PA1a.** [IF YES] Which retailers or retailer categories?
>
> **PA1b.** [IF YES] Why do you say this?

PA2. The Dominion REEC Program paid average buydown or markdown discounts of $4.23 per Specialty and $4.73 per Fixture/Retrofits. Are there any retailers or retailer categories that you worked with through the program that you think would not have been selling any of these specialty or fixtures/retrofit kits products in Virginia and North Carolina if these discounts had not been available? As a reminder you worked with <retailer_string>.

> **PA2a.** [IF YES] Which retailers or retailer categories?
>
> **PA2b.** [IF YES] Why do you say this?

Net-to-Gross – A-Lines

PA3. [INSTRUCTIONS TO SURVEYOR: FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILERS (PA1 & PA2) THROUGH WHICH THEY SOLD THE MOST A-LINES THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILERS THAT THEY IDENTIFIED IN QUESTION PA1 AS NOT SELLING ANY LIGHTING PRODUCTS AT ALL WITHOUT THE BUYDOWNS. REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THEIR TOTAL PROGRAM SALES OR FOR ANY SUBCHANNELS PRE-IDENTIFIED AS "HARD-TO-REACH"]

The Dominion REEC Program paid average buydown or markdown discounts of $<average_buydown>per A-Line bulb. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs through [RETAILER CATEGORY] stores in Virginia and North Carolina would have been about the same, lower, or higher?

> **PA3a.** [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA4]
>
> **PA3b.** [IF LOWER] By what percentage do you estimate your sales of Energy Star A-Lines through [RETAILER CATEGORY] would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]
>
> **PA3c.** I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA3b] % lower without the program support. So, if you actually sold 100 A-Lines in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA3b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]
>
> **PA3d.** [IF LOWER] You said that you would have sold fewer Energy Star LED A-Lines if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LEDs A-line sales with sales of less expensive non-Energy Star LED products?
>
> > ii)   [IF YES] About what percent of these lost Energy Star A-Lines sales would you have likely made up with sales of these less expensive non=Energy Star LED products?
>
> **PA3e.** [IF LOWER] Would you have tried to make up for these lost Energy Star LEDs A-line sales with sales of less expensive non-LED products such as halogens or incandescents?

DNV

ii)   [IF YES] About what percent of these lost Energy Star A-Lines sales would you have likely made up with sales of these non-LED products?

PA3f. The Dominion program ceased offering rebates for Energy Star A-Line LEDs at the end of 2019. What impacts did this have on your volume of sales of these Energy STAR A-line LEDs in Dominion's Virginia and North Carolina service territories in 2020?

2)   [IF THEY SAID THEIR SALES OF ENERGY STAR LED A-LINES DECLINED IN 2020] By about what % did these sales decline?

Net-to-Gross – Reflectors

PA4.   [INSTRUCTIONS TO SURVEYOR: FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILER CATEGORY THROUGH WHICH THEY SOLD THE MOST REFLECTORS THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILER CATEGORIES THAT THEY IDENTIFIED IN PA1 AS NOT SELLING ANY REFLECTORS AT ALL WITHOUT THE BUYDOWNS. REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES]

The Dominion Lighting Program paid average buydown or markdown discounts of $<average_buydown> per reflector bulb. If these program buydown/markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs through <retailer_string> in Virginia and North Carolina would have been about the same, lower, or higher?

PA4a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA5]

PA4b. [IF LOWER] By what percentage do you estimate your sales of reflectors would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

PA4c. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 reflector bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

PA4d. [IF LOWER. ALSO IF THEY ALREADY SAID, IN RESPONSE TO PREVIOUS QUESTIONS, THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star LED reflectors if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star reflector sales with sales of less expensive non-Energy Star LED products?

ii)   [IF YES] About what percent of these lost Energy Star reflector sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

PA4e. [IF LOWER] Would you have tried to make up for these lost Energy Star LED reflector sales with sales of less expensive non-LED products such as halogens or incandescents?

ii)   [IF YES] About what percent of these lost Energy Star LED reflector sales would you have likely made up with sales of these non-LED products?

Net-to-Gross – Specialty

PA5. [INSTRUCTIONS TO SURVEYOR: FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILER CATEGORY THROUGH WHICH THEY SOLD THE MOST SPECIALTY BULBS THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILER CATEGORIES THAT THEY IDENTIFIED IN PA1 AS NOT SELLING ANY SPECIALTY BULBS AT ALL WITHOUT THE BUYDOWNS. REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES] *Reminder: Specialty bulbs include Globes, Candelabra Base, Candle, and Other Specialty bulbs*

The Dominion Lighting Program paid average buydown or markdown discounts of $<average_buydown> per Energy Star LED specialty bulb. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs to <retailer_string> in Virginia and North Carolina would have been about the same, lower, or higher?

> **PA5a.** [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA6]

> **PA5b.** [IF LOWER] By what percentage do you estimate your Virginia & North Carolina sales of Energy Star specialty LED bulbs would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

> **PA5c.** I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

> **PA5d.** [IF LOWER. ALSO IF THEY ALREADY SAID IN RESPONSE TO PREVIOUS QUESTIONS, THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star specialty LED lamps if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LEDs specialty lamp sales with sales of less expensive non-Energy Star LED products?

> > ii)　　[IF YES] About what percent of these lost Energy Star specialty LED sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

> **PA5e.** [IF LOWER] Would you have tried to make up for these lost Energy Star specialty LED sales with sales of less expensive non-LED products such as halogens or incandescents?

> > iii)　　[IF YES] About what percent of these lost Energy Star LED specialty LED sales would you have likely made up with sales of these non-LED products?

Net-to-Gross – Fixtures and Retrofit Kits

PA6. [INSTRUCTIONS TO SURVEYOR: FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILERS THROUGH WHICH THEY SOLD THE MOST FIXTURES & RETROFIT KITS THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILERS THAT THEY IDENTIFIED IN QUESTION PA1 AS NOT SELLING ANY FIXTURE AND RETROFIT KIT PRODUCTS AT ALL WITHOUT THE

DNV

BUYDOWNS. REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETILERS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES. OR FOR ANY SUBCHANNELS PRE-IDENTIFIED AS "HARD-TO-REACH"]

The Dominion REEC Program paid average buydown or markdown discounts of $<average_buydown> per fixtures & retrofit kits. If these program buydown/ markdown discounts and program promotional materials had not been available during 2019 and early 2020 (before the COVID pandemic), do you think your sales of these types of bulbs through [RETAILER CATEGORY] stores in Virginia and North Carolina would have been about the same, lower, or higher?

> **PA6a.** [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND SKIP TO PA5]

> **PA6b.** [IF LOWER] By what percentage do you estimate your Virginia & North Carolina sales of Energy Star fixtures and retrofit kit LED bulbs would be lower during 2019 and early 2020 (before the COVID pandemic) if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

> **PA6c.** I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM PA4b] % lower without the program support. So, if you actually sold 100 bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM PA4b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE] [REPEAT QUESTION BATTERIES FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES]

> **PA6d.** [IF LOWER. ALSO IF THEY ALREADY SAID (IN RESPONSE TO PREVIOUS QUESTIONS) THAT THEY WOULD NOT SUBSTITUTE NON-ES FOR ES LAMPS UNDER ANY CONDITIONS, YOU CAN SKIP THIS QUESTION] You said that you would have sold fewer Energy Star lighting fixtures if the Dominion program price discounts had not been available. In this scenario, would you have tried to make up for these lost Energy Star LED fixture sales with sales of less expensive non-Energy Star LED products?

> > ii) [IF YES] About what percent of these lost Energy Star LED fixture sales would you have likely made up with sales of these less expensive non=Energy Star LED products?

> **PA6e.** [IF LOWER] Would you have tried to make up for these lost Energy Star LED fixture sales with sales of less expensive non-LED products such as halogens or incandescents?

> > iv) [IF YES] About what percent of these lost Energy Star LED fixture sales would you have likely made up with sales of these non-LED products?

Lighting Market Trends and Program Design

This last set of questions will address lighting market trends and aspects of the Dominion REEC Program's design.

Market Trends

LM1. What are the most important factors that are limiting customer demand for LED products? Please explain.

> **LM1a.** To what degree have these demand barriers varied with the type of LED product?

> **LM1b.** [IF DEMAND BARRIERS IDENTIFIED] Has there been any progress recently to reduce these barriers?

> **LM1c.** [IF YES] What factors lead to the reduced barriers?

> **LM1d.** [IF DEMAND BARRIERS IDENTIFIED] What needs to happen to overcome these demand-side barriers?

DNV

LM2. Do you think LED lighting product prices will increase, decrease, or stay the same in 2021?

LM2a. What factors are causing you to make this prediction?

LM2b. [IF SAID PRICES WILL DROP] By what percentage do you think LED prices will drop in 2021? [RECORD %]

LM3. A-Lines were not incented through the program in 2020. If A-Lines were incented through the program in 2021, would you expect your sales of A-Lines to increase, decrease, or stay the same.

LM3a. Why do you say that?

Program Satisfaction

Finally, I would like to find out your level of satisfaction with Dominion's REEC Program.

PS1. Using a scale of 1 to 5 where 5 = very satisfied and 1 = very dissatisfied, how satisfied have you been with CLEAResult, the contractor delivering the Dominion REEC Program?

PS1a. [ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS2. Have you had any interaction with Dominion Energy staff while participating in this program?

PS2a. [IF YES] Using a scale of 1 to 5 where 5 = very satisfied and 1 = very dissatisfied, how satisfied have you been with the Dominion Energy staff who you interacted with?

ii)   ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS3. Using the same scale, how would you rate your level of satisfaction with the program in general?

PS3a. [ASK ONLY IF SATISFACTION RATING IS 1-3] Why do you say that?

PS4. In what way could the program processes be improved?

PS5. Are there any lighting products not currently offered through the program that you would like to be included in the program?

PS5a. [IF YES] Which products?

PS6. Are you planning to participate in the program going forward?

PS6a. [IF YES] Why do you say that?

Closing

Thank you for your time with this interview and participating in this program. Have a great day.

APPENDIX E. DOMINION ENERGY RESIDENTIAL EFFICIENT MARKETPLACE PROGRAM – WEB SURVEY – FINAL NOVEMBER 2020

Survey Email Invite

From: "Dominion Energy Marketplace Rebates" <energyuse@domenergy.com>
Subject: Tell us About your Experience with Dominion Energy's Rebate Program

Dear [customer_name],

How was your recent experience claiming a rebate through Dominion Energy's Marketplace Rebate Program?

Dominion Energy is seeking your feedback on your experience with the Dominion Energy Marketplace Rebate Program. As a rebate recipient in the 2019–2020 program, your opinions are important. Dominion would like your input and perspectives to understand how to best structure future energy efficiency programs designed to serve customers like you.

To get started click on this link: [ST]

We need your help. DNV is the research provider retained by the Dominion Energy to help administer this survey. DNV, is a company that specializes in energy research and analysis. Your participation is very important as only a limited number of customers were selected to take this 7-minute survey.

Your answers will be held in the strictest confidence. The information you provide will be combined with information from other households that complete the survey. Individual household data will not be published. The results are reported in summaries such as group averages, percentages, and other general statistics.

Thank you for helping to improve energy efficiency programs in Virginia.

domsurvey@dnvgl.com. To learn more about the appliance rebate program, visit: Dominion Energy Marketplace Program.

CONFIDENTIAL COMMUNICATION If you are not the intended recipient of this email message, any review, distribution or copying of this email is strictly prohibited. If you have received this email in error, please immediately delete this message and destroy any copies. If you would like to unsubscribe from this survey request click on this link: [remove]

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Database Variables

Variable	Definition
customer_ name	Contact name(s). need to add to intro
equipment _string [MEAS1] [MEAS2] *NO MORE THAN 2 MEASUR ES ASKED	list of measures the respondent received rebates or price reductions for Energy Star Clothes Dryer, Energy Star Clothes Washer Energy Star Refrigerator Energy Star Clothes Washer Energy Star Dishwasher Energy Star Clothes Dryer Energy Star Air Purifier Energy Star Dehumidifier Energy Star Dishwasher, Energy Star Refrigerator Energy Star Clothes Dryer, Energy Star Clothes Washer, Energy Star Refrigerator Energy Star Clothes Washer, Energy Star Refrigerator

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Introduction/Screener

Hello <Customer Name>,

IN01. **According to Dominion Energy's records, your household received rebates in {year} for one or more household appliances from the Retail Marketplace program. Are you familiar with this purchase(s)?**

1	[Yes]	IN04
2	[No]	IN02
97	[I no longer live there]	

IN02. Is there someone else who may be familiar with this purchase?

1	[Yes]	IN03
2	[No]	THANK & TERMINATE

IN03. Who should we contact? Please provide an alternate email:

1	[Record]	THANK & TERMINATE

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Appliance Installation

A01. In this survey, we ask about {Q7} rebated appliance(s).MV01. [Repeat for each measure] Dominion records show you purchased a/an <measure name>. Just to verify, did you install this equipment? To verify, did you install the following appliance(s) at this address: {Q4}?**

Measure type	Select one of the following responses from the drop down	What did you do with the appliance? Select one of the following responses from the drop down:	Is the location where the appliance is installed served by Dominion Energy or a different utility? Please select one of the following responses from the drop down:
Response options	Yes, installed No, not installed	Returned it to the store Still in storage/not used Installed at my business Installed at a different address Gave it away Other Don't recall	Yes No Don't know
[meas1]			
[meas2]			

Your Experience with this Program

A02.   How did you <u>first</u> learn about the rebates available to you?

Retail/appliance/home improvement store	**A03**
Dominion Energy email notification	
Dominion Energy website	
Dominion Energy bill insert	
Dominion Energy social media page	
Word of mouth, e.g., friends, relatives, co-worker	
Previous participation	
Don't know	
Other, specify:	

A03. Did you purchase the rebated appliance(s) at a store or through an online retailer?

1	In-store	**A03a
2	Online	**A04
3	Both in-store and online	**A03a

**A03a. In the store, did you observe any Dominion promotional rebate/discount materials such has stickers on merchandise, clings, or signs in the aisle or in the store

1	[Yes]	
2	[No]	**A04
97	[Don't recall	

A04. The type of equipment you purchased was more energy efficient than the standard type. Did the availability of the rebate or Dominion Energy's endorsement influence your purchase decision?

1	[Yes]	
2	[No]	**M01

Importance of the Rebate in your Purchase Decision

M1. Which of the following factors had an influence on your decision(s) to purchase the more energy efficient equipment?   Please select all that apply.

1	Equipment failure or end of useful life	M2
2	To reduce my energy bills	
3	General desire for new/upgraded appliances	
4	Utility rebate/discount	
5	Reduce carbon emissions/climate change/good for the environment	
6	Family/friend/neighbor recommendation	
7	Manufacturer or other entity (store) rebate	
8	Appliance brand reputation, features, or characteristics	
9	Price	
10	ENERGYSTAR rating	
11	Availability	
12	Don't know	
13	None of these	
14	Other, specify:	

M2. Without the Dominion Energy rebate, how likely would you have been to purchase the same high efficiency appliance(s) at your own expense, would you say...?

Response options	Very likely
	Somewhat likely
	Likely
	Somewhat unlikely
	Very unlikely
[meas1]	
[meas2]	

M3. WITHOUT the program, would you have purchased the *m_type*(s) at the same time, earlier, later, or never?

Response options	At the Same time or sooner
	1 to 24 months later
	More than 24 months later
	Would not have purchased it at all
	Don't know

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[meas1]	
[meas2]	

M04a. [M3 = If 1 to 24 months, then ask otherwise skip] Use the sliding scale to specify the number of months:
*Click and drag the square on the bar.

Response options	[1 to 24 months later]
[meas1]	[RECORD # months]
[meas2]	[RECORD # months]

M5. We would like to know the effect the rebate had on your decision to purchase an ENERGYSTAR rated appliance(s) as opposed to a standard or lesser efficient model. Without the rebate, would you have purchased the same high efficiency appliance?

Response options	Yes > GoTo **M08 No > GoTo **MO6A Don't know GoTo
[meas1]	
[meas2]	

*M6. WITHOUT the program, would you have purchased a *m_type* that was…

Response options	1. Standard efficiency on the market at time
	2. Slightly higher than standard efficiency
	3. Between standard efficiency and the efficiency purchased
	4. Slightly lower than the efficiency purchased
	5. Don't know
[meas1]	
[meas2]	

Satisfaction with Program

S1. Please rate your satisfaction with the following program processes:

Response options	1. Very satisfied (5)
	2. Satisfied (4)
	3. (3)
	4. Somewhat dissatisfied (2)
	5. Very dissatisfied (1)

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1. Ease of use, navigate the website and find what you're looking 2. Requirements for claim rebate, e.g., forms and proof of purchase 3. Appliance purchased 4. Timeliness of incentive 5. Rebate dollar 6. Program experience overall	If 1,2 or 3 Go To the next question otherwise skip

S2. [If S1.1-S1.6 <4 then ask otherwise skip]

Ease of use, navigate the website and find what you're looking	What could Dominion Energy had done better to improve your website user experience?	[open ended]
Requirements for claim rebate, e.g., forms and proof of purchase	What could Dominion Energy had done better as it relates to submitting forms and proof of purchase?	[open ended]
Appliance purchased	What aspect of the appliance(s) purchased are you less than satisfied with?	[open ended]

Timeliness of incentive	As it relates to the timeliness of the rebate payment, what could the program do better?	[Pick one]
		  Rebate payment took too long to arrive
		  Still haven't received rebate
		  Had to follow up and request payment
		  Rebate was sent to the wrong address
		  Don't know
		  Other

Rebate dollar	As it relates to rebate dollar amount, what could the program do better?	[open ended]

S3. If Dominion wanted to inform customers like yourself about the rebates and services they offer for energy-efficient programs, what do you suggest would be the best way to do that?

Community events	
Contractors	
Email	
In store displays	
Include information/pamphlet inside bill	
Local radio	

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Social media advertising	
Solicit through mail	
Telephone	
Television	
I don't want such information	
No suggestions	
Don't know	
Other	

S4. Do you have any suggestions to improve the delivery of this program for customers like yourself?

1	[Yes - **What do you suggest?**]	
2	[No]	E01
97	[Don't know]	

Energy Attitudes

E01.   How concerned are you with reducing your home's energy use? Would you say...

1	[Not at all concerned]	E02
2	[Somewhat concerned]	
3	[Very concerned]	
97	[Don't know]	

E02.   Before the COVID-19 pandemic began, did you have any plans to install or perform energy efficiency upgrades like a new appliance or insulation in your home?

1	[Yes]	E02a
2	[No]	D01
97	[Don't know]	

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E02a. **What energy efficiency actions were you planning?**

1	[Additional Appliance Upgrades]	
2	[Replace windows/doors]	
3	[Lighting]	
4	[Furnace/Heating]	
5	[Central Air/AC]	E06b
6	[Insulation]	
7	[Aesthetic enhancements]	
77	[Other RECORD VERBATIM]	
97	[Don't know]	

E06b. **Did the COVID-19 pandemic and the resulting stay-at-home orders change the timing or size of those planned energy efficiency measures?**

1	[Yes]	E06c
2	[No]	
97	[Don't know]	D01

E06c. **Which of the following describes how the pandemic changed your planned efficiency activities?**

[ACCEPT MULTIPLE ANSWERS]

1	[Accelerated the completion schedule of planned activities]	
2	[Postponed planned activities]	
3	[Had energy efficiency activities underway that you had to put on hold]	
4	[Cancelled planned energy efficiency activities entirely]	E06d
5	[Reduced the size or quantity of planned activities]	
6	[Increased the size or quantity of the planned activities]	
77	[Other, Specify _____]	

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97	[Don't know]	

E06d.   Why did your planned energy efficiency activities change?

[ACCEPT MULTIPLE ANSWERS]

1	[Financial considerations]	
2	[Availability of contractors]	
3	[Uncomfortable with contractors entering home]	D01
4	[Risk averse, spend when economy is down]	
77	[Other, Specify _____]	
97	[Don't know]	

Dwelling and Demographics

In order to ensure that energy efficiency programs serve all customer segments fairly, we would like to learn more about your dwelling and household demographics.

D01.   Which of the following dwelling type best describes the home at <address>?

Single Family, Detached Home   Duplex, Condominium, or Townhouse   Apartment   Mobile Home/ Trailer
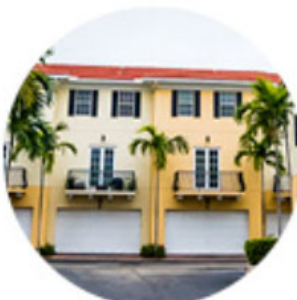
1	[Single-family home detached from any other house]	
2	[Single-family home attached to one or more houses]	D02
3	[A building with 2 apartments]	

4	[A building with 3 or 4 apartments]	
5	[A building with 5 or more apartments]	
6	[Mobile or manufactured home]	
77	[Other, Specify_____]	
97	[Don't know]	

D03. Approximately how many square feet of living space is there in your home, including bathrooms, foyers and hallways? Exclude garages, basements or unheated porches.

1	[Under 1,000]	
2	[1,001 – 1,250]	
3	[1,251 – 1,500]	
4	[1,501 – 2,000]	D04
5	[2,001 – 2,500]	
6	[2,501 – 3,000]	
77	[Greater than 3,000]	
97	[Don't know]	

D04.   Including yourself and children, how many people live in this home year around?

Age group	1. 0 2. 1 3. 2 4. 3 5. 4 6. 5 or more 7. Prefer not to say
12 or younger	
13-17	
18-24	
25-44	

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45-64	
65 or older	

D06. **What is the highest level of education you have completed?**

1	[Less than a high school diploma]	
2	[High school degree or equivalent (e.g., GED)]	
3	[Vocational/Trade school degree]	
4	[Some college (AA, AS) degree]	
5	[Bachelor's degree (BA, BS)]	D07
6	[Master's Degree (MA, MS, Med)]	
7	[Doctorate (PhD, MD, EdD)]	
77	[Other, Specify_____]	
98	[Prefer not to say]	

D07. **Which of the following best represents your annual household income from all sources in 2019, before taxes? This information is collected for internal purposes only and remains confidential. Please check the range that best describes your household's total 2019 annual income.**

	Under $15,000
	$15,000 to $24,999
	$25,000 to $34,999
	$35,000 to $49,999
	$50,000 to $74,999
	$75,000 to $99,999
	$100,000 to $124,999
	$125,000 to $174,999
	$175,000 to $200,000

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	$200,000 or more
	Prefer not to say

Thank you for completing this survey.

End of Survey

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About DNV

Driven by our purpose of safeguarding life, property and the environment, DNV enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter, and greener.

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J. RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE PROGRAM EM&V PLAN (VERSION 2)

J.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 through stores.

J.2 Measures

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

Table J-1. Residential Efficient Products Marketplace Program Measures

End-use	Measure
Lighting	▪ A-Lines ▪ Reflectors ▪ Decorative ▪ Globes ▪ Retrofit Kit and Fixture
Refrigeration	▪ Freezer ▪ Refrigeration
Appliances	▪ Dehumidifier ▪ ENERGY STAR® Air Purifier ▪ Clothes Dryer
Domestic Hot Water	▪ Dishwasher ▪ Clothes Washer

J.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[13]

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings (or net savings) will be determined by the methods described in Section J.5. The evaluated savings will use program tracking data, customer energy consumption data, other customer data, and equipment data to estimate program savings.

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[13] 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.

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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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

J.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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.

J.5   Evaluated Savings Approach

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.[14]

During program implementation Dominion Energy will determine, in consultation with DNV, the appropriateness of conducting evaluations to estimate program net savings in net kilowatt and net kilowatt-hours.

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[14] 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.

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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

Table J-2 describes EM&V activities, survey modes, and the data that estimates net savings.

J.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:

- Confidence interval: 85 to 90% (at the appliance level)
- Relative precision: 10 to 15% (at the appliance level)
- Upstream measures
- Rebate measures
- 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 is unknown. However, post-stratification of the sample to develop weights based on lighting type and retail channel can be performed.

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

Table J-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[15]	Web survey	Confirm gross savings estimation inputs (e.g. lighting quantity, installation rate, etc.) Retrospective and prospective net-to-gross ratios

J.5.2   Net-to-Gross Assessment

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

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

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 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.

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

J.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.[16]
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.

J.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

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16 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.

J.8 Residential Efficient Products Marketplace Program – Revision History

Version	Date	Notes
Version 1	2019	Initial release
Version 2	3/22/2021	▪ Removed CATI survey mode ▪ Removed footnote that cited A-line availability for 2019, and that participant level data is not available for the retail lighting channel. ▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted measure table.

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APPENDIX K.   RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM (DSM VII) EM&V PLAN

DNV

K. RESIDENTIAL HOME ENERGY ASSESSMENT PROGRAM EM&V PLAN (VERSION 2)

K.1 Program Summary

The Residential Home Energy Assessment Program provide 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.

K.2 Measures

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

Table K-1. Residential Home Energy Assessment Program Measures

End-use	Measure
HVAC	▪ HVAC ductless heat pump upgrades ▪ High-efficiency fan motors ▪ Heat pump tune-up / upgrade / duct sealing ▪ AC and heat pump duct insulation
Lighting	▪ LED A-lines
Domestic Hot Water	▪ Water heater thermostat set point adjustment ▪ Water heater replacement with a heat pump water heater ▪ Low-flow showerheads and aerators ▪ Water heater pipe insulation

K.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[17] 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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings (or net savings) will be determined by the methods described in Section K.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

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[17] 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.

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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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

K.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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.

K.5   Evaluated Savings Approach

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.

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.[18] The analysis will use a site-level or panel-model billing analysis approach (see section K.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[19]

K.5.1   Savings Estimation

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.

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[18] 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

[19] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

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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.

The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

K.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

K.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.

K.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.[20]
3. 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.
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.

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

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K.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 STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

K.8   Residential Home Energy Assessment Program – Revision History

Version	Date	Notes
Version 1	2019	• Initial release
Version 2	3/22/2021	• Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Format measure table. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

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APPENDIX L.   RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM (DSM VIII) EM&V PLAN

DNV

L. RESIDENTIAL CUSTOMER ENGAGEMENT PROGRAM EM&V PLAN (VERSION 2)

L.1 Program Summary

This 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.

L.2 Measures

The measures included in the kit offered by the Residential Customer Engagement Program are listed in Table L-1.

Table L-1. Measures Offered by Residential Customer Engagement Program

End-use	Measure
Whole house	▪ Electronic home energy report ▪ Paper home energy report

L.3 Evaluation, Measurement, and Verification Overview

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

The basis for DNV's savings evaluation approach are:

1. Baseline Consumption: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data from the treatment and control groups.

2. Deemed Savings: In the first year of the program, deemed savings values will be estimated from the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section L.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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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

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

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.

L.4 Deemed Savings Approach

Upon program approval by the Virginia State Corporation Commission, deemed savings approach or protocol for the Residential Customer Engagement Program will be developed through research primarily in the most recent version of the Mid-Atlantic Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[22] 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.

L.5 Evaluated Savings Approach

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.

The CEP 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.[23]

L.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 Residential Customer Engagement 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.

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[22] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[23] 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.

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.

L.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 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.

L.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.[24]

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.

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[24] 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.

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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.

L.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

L.8   Residential Customer Engagement Program – Revision History

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.

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APPENDIX M.   RESIDENTIAL SMART THERMOSTAT PURCHASE AND WEATHERSMART PROGRAM (DSM VIII) EM&V PLAN

M. RESIDENTIAL SMART THERMOSTAT PURCHASE AND WEATHERSMART PROGRAM EM&V PLAN (VERSION 2)

M.1 Program Summary

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

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

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

M.2 Measures

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

Table M-1. Measures Offered by Residential Smart Thermostat Purchase and WeatherSmart Program

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

M.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[25] 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 are:

- 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.

- Deemed Savings: Deemed savings values will be estimated from the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

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[25] 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.

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- Evaluated Savings: Evaluated savings will be determined by the methods described in Section M.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 in 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 evaluation. Based on results from the DSM Phase I through III programs—programs that were implemented for more than three years as of this filing, DNV anticipates this will occur in year two 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.

M.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[26] 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.

M.5   Evaluated Savings Approach

During program implementation Dominion Energy will determine, in consultation with DNV, the appropriateness of conducting evaluations to estimate program net savings in net kilowatt and net kilowatt-hours.

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[26] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

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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.[27] The analysis will use a site-level or panel-model billing analysis approach (see Section M.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility. [28]

M.5.1   Savings Estimation

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. 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.

The evaluation will determine which approach to use based on the size and customer composition of program at the time of evaluation.

M.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.

M.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.

M.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.[29]
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.

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[27] 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;

[28] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[29] 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.

M.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

M.8   Residential Smart Thermostat Program (EE) – Revision History

Version	Date	Notes
Version 1	11/26/2019	Initial release
Version 2	3/22/2021	- Added reference to thermostat telemetry data in M.3 Combined measure list for purchase and optimization component and removed duplicate text. - Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

DNV

APPENDIX N.   RESIDENTIAL ELECTRIC VEHICLE PROGRAM (ENERGY EFFICIENCY AND DEMAND RESPONSE) (DSM VIII) EM&V PLAN

N. RESIDENTIAL ELECTRIC VEHICLE PROGRAM (EE) EM&V PLAN (VERSION 2)

N.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 demand response component of the proposed program. Demand response would be called by the Company during times of peak system demand throughout the year to reduce the EV charging load while encouraging customers to charge their vehicles during off-peak hours. Customers can opt-out of specific events if they choose to do so.

N.2 Measures

The measure offered by the Residential Electric Vehicle (EE and DR) Program are as shown in Table N-1.

Table N-1. Measures Offered by Residential Electric Vehicle (EE and DR) Program

End-use	Measure
Plug Load	▪ Qualifying Level 2 EV chargers with connected functionality ▪ EV charging demand response events

N.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[30] 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:

▪ Baseline Consumption: Baseline consumption will be calculated from AMI participant consumption data if available, and vendor supplied charging data.
▪ Deemed Savings: Deemed savings values will be estimated from the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs, related research, or evaluation studies.
▪ Evaluated Savings: Evaluated savings will be determined by the methods described in Section N.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 basis for DNV's savings evaluation approach for the demand response portion of the program are:

1. Baseline Consumption: Baseline consumption will be calculated from AMI participant data and vendor supplied charger 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 N.6. The evaluated demand reduction will use program tracking data, participant AMI energy consumption data, EV demand response event data, charger data, and other customer data.

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.

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30 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.

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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

N.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 Technical Reference Manual (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 STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[31] 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.

Estimates of load reduction in demand response programs are not deemed.

N.5   Evaluated Savings Approach for Energy Efficiency

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.

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

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[31] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

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Table N-2. Research Questions and Associated Analyses for EV Program Energy Impact Analysis

Sample Research QuestionsN.6	Overview of Approaches
What is the incremental load (kWh and kW) associated with adoption of an EV?	• End use metering analysis • Compare charging load shapes from whole building hourly load analysis and end use metering approaches to determine incremental EV load
What is the change in energy consumption due to the combined effects of: • The net consumption changes from Level 2 chargers versus a Level 1 charger. • Added load due to program-attributable EV adoption	• Compare charging load shapes from whole building hourly load analysis and end use metering approaches to determine incremental EV load • Develop pre/post load shapes
• What is the difference in charging load shape with a Level 2 charger versus a Level 1 charger? • How do changes in load shape align with Dominion Energy's targeted load shifting?	• End use metering analysis • Compare charging load shapes from whole building hourly load analysis and end use metering approaches to determine incremental EV load • Develop pre/post load shapes

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

Table N-3. List of Potential Data Sources for EV Program M&V

Dataset	Data source	Purpose
Vehicle Registrations	• Virginia Automobile Dealers Association, Statistical Reports • Atlas EV HUB,[32] State EV registration data, • Other third-party data providers	• Survey stratification • Develop comparison groups
Program tracking data	Dominion Energy BI data, program participants, implementation vendor	• Identify participants • Link participants to third party data • Analysis
Consumption data	Dominion Energy	• Analysis • Develop comparison groups
AMI data or high frequency interval data	Dominion Energy	• Analysis • Develop comparison groups
Vehicle charging data	Implementers	• Customer specific charging information • Analysis
End use metering data	Primary data collection	• Analysis
Consumer survey	Primary data collection	• Collect additional attribute data about customers • Segmentation analysis of consumption behavior
Third party data	U.S. Census, American Community Survey, customer tax assessor, other providers	• Identifies EV owners and attributes not otherwise publicly available

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

N.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

N.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.

N.6 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).

N.6.1 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 AMR 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 a robust estimate of the necessary sample size required to meet precision requirements for load reduction estimates.

N.7 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.[33]
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.

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[33] 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.

DNV

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.

N.8   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

N.9   Residential Electric Vehicle (EE) Program – Revision History

Version	Date	Notes
Version 1	11/26/20	Initial release
Version 2	3/22/2021	- Minor word changes to data type - Removed reference to monthly consumption data and UMP Chapter 8 - Added reference that vehicle charging data is available from the implementer in section N.3 and Table N-3. - Changed reference from AMI to AMR meter is section N.5.1 and N.6.1 - Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number.

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APPENDIX O.   RESIDENTIAL ENERGY EFFICIENCY KITS PROGRAM (DSM VIII) EM&V PLAN

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O. RESIDENTIAL ENERGY EFFICIENCY KITS PROGRAM EM&V PLAN (VERSION 2)

O.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 into 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 proper use of each measure, wise energy use in general 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

O.2 Measures

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

Table O-1. Measures in Welcome Kit Offered by Residential Energy Efficient Kits Program

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

O.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[34] 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 are:

1. Baseline Consumption: Baseline consumption will be calculated from monthly or AMI participant and non-participant consumption data.

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[34] 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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section O.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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

O.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[35] 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.

O.5   Evaluated Savings Approach

During program implementation Dominion Energy will determine, in consultation with DNV, the appropriateness of conducting evaluations to estimate program net savings in net kilowatt and net kilowatt-hours.

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[35] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

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 set forth in Chapter 11: Sample Design Cross-Cutting Protocol of the UMP.[36]

O.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
- Optional areas of research include:

    — Motivation for participation
    — Barriers to participation
    — Strategies for increasing participation and installation rates

O.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: 10–15%
- Budget, schedule, and geographical distribution

O.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.

O.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.[37]

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.

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36 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.

37 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.

O.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

O.8   Residential Energy Efficient Kits Program – Revision History

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.

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APPENDIX P.   RESIDENTIAL HOME RETROFIT PROGRAM (DSM VIII)

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P. RESIDENTIAL HOME RETROFIT PROGRAM EM&V PLAN (VERSION 2)

P.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: visual inspection of all areas of the home including attic and crawl spaces; blower door testing of envelope leakage; duct blaster equivalent testing of 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 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.

P.2 Measures

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

Table P-1. Measures Offered by Residential Home Retrofit Program

End-use	Measure
Building Envelope	- Air sealing - AC and heat pump duct insulation - Attic insulation - Wall insulation - Basement wall insulation - Crawl space insulation
Domestic Hot Water	- Low-flow showerheads and aerators - Water heat pipe insulation - Water heater thermostat set point adjustment - Water heater replacement with a heat pump water heater
HVAC	- Heat pump tune-up/upgrade/duct sealing - Ground source heat pump - High-efficiency fan motors - HVAC ductless unit upgrades - Smart thermostat installation

P.3   Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[38] 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 are:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section P.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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

P.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[39] 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

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[38] 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.

[39] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

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.

P.5   Evaluated Savings Approach

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.

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.[40] The analysis will use a site-level or panel-model billing analysis approach (see Section P.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[41]

P.5.1   Savings Estimation

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 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.

P.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

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[40] 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.

[41] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

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P.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.

P.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.[42]

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.

P.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

P.8   Residential Home Retrofit Program – Revision History

Version	Date	Notes
Version 1	11/26/2019	• Initial release
Version 2	3/22/2021	• Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

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[42] The realization rate is the proportion of deemed or estimated energy and peak demand savings that have been verified for all customers or projects in a sample or 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.

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APPENDIX Q.   RESIDENTIAL MANUFACTURED HOUSING PROGRAM (DSM VIII) EM&V PLAN

DNV

Q.   RESIDENTIAL MANUFACTURED HOUSING PROGRAM EM&V PLAN (VERSION 2)

Q.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 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 produces a consumer-friendly report that outlines 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.

Q.2   Measures

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

Table Q-1. Measures Offered by Residential Manufactured Housing Program

End-use	Measure
Building Envelope	- Door weather-stripping - Door sweep - Caulking - Foaming - Poly tape for windows - Air Sealing - Attic/wall insulation - Mobile home belly insulation - ENERGY STAR® cool roofs
Domestic Hot Water	- Water heater replacement with a heat pump water heater - Low-flow showerheads and aerators - Water heater pipe insulation - Water heater thermostat set point adjustment

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End-use	Measure
HVAC	▪ ENERGY STAR® room/wall AC units ▪ Heat pump tune-up/upgrade/duct sealing ▪ Central AC filter replacement ▪ Heat pump filter replacement ▪ Smart thermostat installation ▪ Digital switch plate wall thermometer ▪ AC cover for wall/window units(s)
Lighting	▪ LED lighting
Plug Load	▪ ENERGY STAR® refrigerator/freezer ▪ High-efficiency fan motors ▪ Refrigerator/freezer

Q.3   Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[43] 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 are:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section Q.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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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,

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[43] 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.

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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.

Q.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[44] 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.

Q.5 Evaluated Savings Approach

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.

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.[45] The analysis will use a site-level or panel-model billing analysis approach (see Section Q.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility. [46]

Q.5.1 Savings Estimation

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.

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[44] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[45] 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.

[46] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

DNV

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.

Q.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

Q.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.

Q.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.[47]
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.

Q.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.

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[47] 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.

- If appropriate, support lost revenue recovery activities.

Q.8 Residential Manufactured Housing Program – Revision History

Version		Notes
Version 1	11/26/2019	- Initial release
Version 2	3/22/2021	- Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

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APPENDIX R.   RESIDENTIAL NEW CONSTRUCTION PROGRAM (DSM VIII)
EM&V PLAN

DNV

R. RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (VERSION 2)

R.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, 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) in order to qualify for an incentive.

R.2 Measures

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

Table R-1. Measures Offered by Residential New Construction Program

End-use	Measure
Whole house	▪ Attached single-family home ▪ Detached single-family home

R.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[48] 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 are:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section R.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

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[48] 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.

are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

R.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[49] 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.

R.5   Evaluated Savings Approach

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.

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.[50] (see Section R.5.1. The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[51]

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[49] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[50] 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.

[51] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

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R.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.

R.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

R.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.

R.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.[52]
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.

R.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual annually for updates that occurred to its referenced sources.

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[52] 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.

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- 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.

R.8   Residential New Construction Program – Revision History

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.

APPENDIX S.   RESIDENTIAL/NON-RESIDENTIAL MULTIFAMILY PROGRAM (DSM VIII) EM&V PLAN

DNV

S.   RESIDENTIAL/NON-RESIDENTIAL MULTIFAMILY PROGRAM EM&V PLAN (VERSION 2)

S.1   Program Summary

The Program is designed to encourage investment in both residential and commercial service aspects of multi-family 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 multi-family 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 multi-family 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.

S.2   Measures

The measures offered by the Residential/Non-residential Multi-family Program are listed in Table S-1.

Table S-1. Measures Offered by Residential/Non-residential Multi-family Program

End-use	Measure
Building Envelope	▪ Air sealing ▪ Attic insulation ▪ Wall insulation (residential only)
Domestic Hot Water	▪ Low-flow showerhead ▪ Faucet aerator ▪ Water heater thermostat set point adjustment ▪ Water heater pipe insulation

End-use	Measure
HVAC	- Heat pumps - Heat pump tune-ups - Smart thermostat - Duct sealing
Lighting	- LED lighting - Occupancy sensors
Plug Load	- ENERGY STAR® refrigerator (residential only) - Clothes washer/dryer - Pool pumps (commercial only)
Refrigeration	- Refrigerator coil brush (residential only) - Refrigerator thermostat (residential only)

S.3　Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[53] 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 include:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section S.5. The evaluated savings will use program tracking data, customer energy consumption data, and other customer data to estimate program savings.
4. 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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

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[53] 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.

DNV

S.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[54] 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.

S.5   Evaluated Savings Approach

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.

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.[55] The analysis will use a site-level or panel-model billing analysis approach (see Section S.5.1).The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[56]

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.[57] The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[58]

S.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, common areas). An objective of the evaluation for this program is to evaluate savings separately for the

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[54] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[55] 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;

[56] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[57] 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.

[58] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

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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 the majority of the program impacts may be isolated. The billing analysis for the Residential/Non-residential Multifamily Program should have a comparison group of non-participating customers, however given the diversity of the participants who may be in the program this may not be feasible. 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.
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.

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.[59]

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 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 DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site, which 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 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.

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[59] This generally requires large numbers of installations (thousands) to yield meaningful results.

DNV

S.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, multifamily type
- Budget, schedule, and geographical distribution

S.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.

S.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.[60]
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.

S.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

S.8   Residential/Non-Residential Multifamily Program – Revision History

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,

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[60] 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.

DNV

Version	Date	Notes
		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.

APPENDIX T.   HB 2789 (HEATING & COOLING—HEALTH & SAFETY) PROGRAM (DSM VIII) EM&V PLAN

DNV

T. HB 2789 – HEATING & COOLING HEALTH & SAFETY PROGRAM EM&V PLAN (VERSION 2)

T.1 Program Summary

This Program, the first of two programs consistent with the directives contained in Virginia House Bill 2789 (2019 Session), would offer incentives for the installation of measures that reduce residential heating and cooling costs, and enhance the health and safety of residents, including repairs and improvements to home heating and cooling systems and installation of energy-saving measures in the house, such as insulation and air sealing. The Program's eligibility is limited based on income, age, and disability status.

T.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 T-1.

Table T-1. Summary of HB 2789 Heating and Cooling System Component Program Measures

End-use	Measure
Building Envelope	- Insulation repair/upgrade wall - Insulation repair/upgrade floor - Comprehensive air sealing, envelope improvements, insulation - Roof repair (residential only)
HVAC	- Heat pump replacement - Duct sealing/insulation/repair/replacement - Electric baseboard heat upgrade - Upgrades to mini-split/ductless heat pumps - Thermostat replacement - HVAC tune-up - HVAC/home-ventilation improvements
Health & Safety	- Mold/mildew removal (residential only) - Re-wiring (residential only) - Air quality control (residential only) - Carbon monoxide detectors and sources (residential only) - Assessments of indoor air quality (residential only) - Combustion appliance safety checks/enhancements (residential only) - Fire and fall safety checks/enhancements (residential only) - Dehumidifiers (residential only)

As an alternative to the direct installation of specific measures at participant residences, the Company may provide, on a case-by-case basis, portions of the incentive budget to organizations that assist low income, elderly and disabled individuals.

DNV

T.3   Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[61] 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 are:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section T.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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two of program operations.

Early in the final year of this three-year 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.

T.4   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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[62] 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

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[61] 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.

[62] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

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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.

T.5 Evaluated Savings Approach

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.

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.[63] The analysis will use a site-level or panel-model billing analysis approach (see Section T.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option C, Whole Facility.[64]

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.[65] (see Section T.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[66]

T.5.1 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 the majority of the program impacts may be isolated. The billing analysis for the HB 2789 Heating & Cooling–Health & Safety Program should have a comparison group of non-participating customers, however given the diversity of the participants who may be in the program this may not be feasible. 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.

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[63] 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;

[64] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[65] 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.

[66] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

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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 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.[67]

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 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 DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site, which is in accordance with IPMVP Option C. The key parameters for those measures will be identified in consultation with the Uniform Methods Project (UMP) for 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.

T.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

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[67] This generally requires large numbers of installs (thousands) to yield meaningful results.

- Budget, schedule, and geographical distribution

T.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.

T.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.[68]
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.

T.7   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

T.8   HB2789 HVAC Program – Revision History

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number, formatting. Option for site-level or panel model approach to billing analysis. Precision is modified to be a function of the number of participants and the magnitude of savings.

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[68] 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.

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APPENDIX U. NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS PROGRAM (DSM VII) EM&V PLAN

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U. NON-RESIDENTIAL LIGHTING SYSTEMS & CONTROLS PROGRAM EM&V PLAN (VERSION 2)

U.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.

U.2 Measures

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

End-use	Measure
Lighting	• High-efficiency T8/T5 lamps • LED lamps • Occupancy sensor(s) and lighting controls

U.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[69] 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 Standard Tracking and Engineering Protocols (STEP) Manual. 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 DNV STEP Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Verified Savings: Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost-effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach. During program start-up, kilowatts and kilowatt-hour savings are estimated using a deemed savings approach. Deemed approaches are a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and in the periods between more rigorous EM&V.

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[69] 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.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

U.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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.

U.5   Evaluated Savings Approach

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.

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol[70] of The Uniform Methods Project[71] (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,[72] 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,[73] is then applied to the population of participants to estimate overall program savings. This approach will capture

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[70] 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

[71] 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

[72] 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

[73] 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.

Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

U.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 prior to sample selection
- Budget, schedule, and geographical distribution

U.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[74] (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 applied to Dominion Energy's reported program participation data. The adjustment factor, also called a realization rate,[75] is then applied to the population of participants to estimate program savings.

DNV will verify the hours of use, 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 controls 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.

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[74] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

[75] 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.

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.

U.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.

U.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.

U.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 STEP Manual 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 upon sufficient program participation.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

U.8   Non-residential Lighting Systems & Controls Program – Revision History

Version	Date	Notes
Version 1		▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted measure table.

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APPENDIX V. NON-RESIDENTIAL SMALL BUSINESS IMPROVEMENT PROGRAM (DSM V) EM&V PLAN

DNV

V. NON-RESIDENTIAL SMALL BUSINESS IMPROVEMENT PROGRAM EM&V PLAN (VERSION 11)

V.1 Program Summary

The Non-Residential Small Business Improvement Program provides low cost energy assessments, direct install measures, and incentives for energy efficiency improvements to small businesses meeting certain size and need-based requirements. It is available to non-residential, small business customers in the Company's Virginia service territory with historic demand not exceeding 100 kW more than 3 times in the past 12 months. Participants must be privately-owned small businesses with five or fewer qualifying locations within the Company's service territory. Participation in this program is strictly voluntary. This program is part of demand side management (DSM) Phase V in Virginia and North Carolina.

V.2 Measures

The following measures are included in the Small Business Improvement Program:

End-use	Measure
HVAC	▪ Unitary/split AC and HP upgrades ▪ Variable frequency drives (VFDs) ▪ Dual enthalpy, air-side economizers ▪ Mini-split HP ▪ Programmable thermostats
Lighting	▪ T8/T5 lamps/fixtures ▪ LED lamps/fixtures ▪ Occupancy sensors & controls
HVAC Re-commissioning Measures	▪ Duct testing and sealing ▪ AC/HP tune-ups ▪ AC/HP Refrigerant charge adjustment
HVAC Retrofit Measures	▪ Unitary/split AC & HP upgrades ▪ Variable frequency drives (VFDs) ▪ Dual enthalpy, air-side economizers ▪ Mini-split heat pumps ▪ Programmable thermostats
HVAC Re-commissioning Measures	▪ Duct testing and sealing ▪ AC/HP tune-ups ▪ AC/HP Refrigerant charge adjustment
Other Measure	▪ Air compressor leak repairs

V.3 Evaluation, Measurement & Verification Overview

International Performance Measurement and Verification Protocol (IPMVP) Option A: For physically accessible equipment measures, an EM&V method like IPMVP Option A is applied. IPMVP Option A is a partially-measured retrofit isolation study that measures the selected parameters leading to the change in energy and demand of an installed efficiency measure from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to the Company's program participation data. IPMVP Option A shall be applied to a sample of unitary/split AC & HP upgrades, variable frequency drives, mini-split heat pumps, and air compressor leak repairs.

IPMVP Option D: IPMVP Option D is a calibrated simulation study that uses computer simulation software (e.g. DOE-2.2 software) to predict the change in energy and demand of the installed efficiency measures from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to the Company's program participation data. IPMVP Option D shall be applied to sample of economizer measures.

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DNV Energy STEP Manual deemed values with adjustments to key inputs that can be verified while on-site. The ratio of the weighted, measured, and verified savings to the weighted deemed savings, also called a realization rate, is then applied to the population of participants to estimate program savings. This approach will capture Company-specific customer usage data, which will be applied to the actual measures installed to quantify energy and peak demand savings.

Baseline Estimation Approach: The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered from an on-site study of installed rebated measures from a representative sample of participants.

Deemed Savings Approach: Deemed savings values will be developed and incorporated into the DNV Energy Standard Tracking and Engineering Protocols (STEP) Manual for planning purposes.

Measured Savings Approach: The wattage and hours of use data for each measure will be collected and metered through an on-site study of installed efficiency measures from a representative sample of participants.

V.4   Deemed Savings Approach

Refer to the Non-Residential Small Business Improvement Program section of the STEP Manual for the standard deemed savings approaches for the measures in this program.

V.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 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 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, and exclude Fuel Charge Rider A and all other applicable riders) for the rate period to arrive at lost revenues.

V.6   Timeline and Scope of Work

- Analysis of program tracking data; Annual Report (May 15 of each year following program launch).
- Annual updates to STEP Manual for updates that occurred to its referenced sources.
- Develop baseline, measure savings, and efficient load shapes.
- Provide regulatory support as necessary.
- Non-Residential Small Business Improvement Program – Revision History

Version	Date	Notes
Version 7	2017	▪ Initial release

Version	Date	Notes
Version 8	2017	▪ Updated "April 1" report date to "May 1" in "EM&V Measurement, Timeline, and Scope of Work" section
Version 9	2018	▪ Formatting updates ▪ Updated from DNV Energy to DNV Energy Insights
Version 10	2019	▪ Formatting updates
Version 11	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted measure table.

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APPENDIX W.   SMALL BUSINESS IMPROVEMENT ENHANCED PROGRAM (DSM VIII) EM&V PLAN

DNV

W. SMALL BUSINESS IMPROVEMENT ENHANCED PROGRAM EM&V PLAN (VERSION 2)

The Program is an enhancement to the existing DSM Phase V Small Business Improvement Program. The program would provide small businesses 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.

W.1 Measures

The following measures are included in the Small Business Improvement Enhanced Program .

Table W-1: End-uses and Measures for Small Business Improvement Enhanced Program

End-use	Measure
Building Envelope	▪ Window Film
HVAC	▪ Efficient air conditioning upgrades ▪ Efficient heat pump upgrades ▪ Variable Frequency Drives ▪ Window film ▪ Prescriptive re-commissioning
Lighting	▪ Direct install lighting ▪ Dimmers and controls
Refrigeration	▪ Refrigeration measures

W.2 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[76] 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 are:

1. Baseline Consumption: Baseline consumption will be calculated per the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which 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 per the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section W.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

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[76] 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.

a cost-effective method for determining reasonable savings estimates in the early stage of implementation, and in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

W.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[77] 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.

W.4   Evaluated Savings Approach

During program implementation, Dominion Energy will determine—in consultation with DNV—the appropriateness of conducting evaluations to estimate program net savings in net kilowatts and net kilowatt-hours.

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[78] (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).

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

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[77] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[78] 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

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.[79]

According to Chapter 2: Commercial and Industrial Lighting Evaluation Protocol[80] 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,[81] 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 DNV STEP Manual 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 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,[82] 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.

W.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 W-2.[83]

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[79] 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

[80] 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

[81] 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

[82] 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.

[83] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

Table W-2. Preferred IPMVP Options for Small Business Improvement Enhanced Program Measures

Measure	IPMVP Option	Key Parameter(s)
Window Film	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Area of window film • HVAC and lighting annual hours of operation
Duct Testing & Sealing and HVAC Tune-ups	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
PTACs, Unitary AC/HP Systems, Mini-split Systems	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
VFDs	Option B: Retrofit Isolation: All Parameter Measurement	• Annual hours of operation at part-load conditions
Economizers	Option A: Retrofit Isolation: Key Parameter Measurement Approach, or Option D. Calibrated Simulation	• Verify proper operation • Annual hours of operation
Programmable Thermostats	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Operating setpoints • Annual hours of operation • Equipment type
Lighting & Lighting Controls	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Fixture quantity (baseline and efficient) • Wattage (baseline and efficient) • Annual hours of operation
Refrigeration Equipment	Option A: Retrofit Isolation: Key Parameter Measurement Approach	• Space-conditioning category • Annual hours of operation

According to UMP, IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for window film, most HVAC-system types, typical economizers, and typical refrigeration equipment. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to the Company's reported program participation data.

According to UMP, IPMVP Option B, Retrofit Isolation is most appropriate for VFD retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data and local weather data, it is possible to determine the energy savings and demand reduction.

According to UMP, IPMVP Option D—Calibrated Simulation may be most appropriate for installed or replaced economizer measures at complex installations. IPMVP Option D uses computer simulation software (e.g., DOE-2.2 software) to predict the change in energy and demand of efficiency measures from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data. The computer simulation is developed using economizer system inputs collected on-site or through interviews with installation and service contractors. On-site hourly meter data is collected from the cooling systems and is used to calibrate the simulation for accuracy.

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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 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.

W.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

W.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.

W.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.[84]
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.

W.6   Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual annually for updates that occurred to its referenced sources.
- Develop baseline use, efficient use, and measure savings load shapes annually.

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[84] 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.

- If appropriate, conduct impact evaluation studies.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

W.7 Small Business Improvement Enhanced Program – Revision History

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.

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APPENDIX X.   NON-RESIDENTIAL PRESCRIPTIVE PROGRAM (DSM VI) EM&V PLAN

X.1 Impact Analysis of the Non-residential Prescriptive Program

DNV

EVALUATION, MEASUREMENT, AND VERIFICATION REPORT FOR DOMINION
VIRGINIA POWER

Appendix X-1
Impact Evaluation of the Non-residential Prescriptive Program

Date: May 14, 2021

DNV

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May 14 2021

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1 EXECUTIVE SUMMARY

This report presents the results of DNV's impact study of Dominion Energy's Non-residential Prescriptive Program.

1.1 Program overview

In the Prescriptive program, qualifying customers are eligible to pursue one or more of the qualified measures through a participating contractor registered with the program. To qualify for this program, the customer must be responsible for the electric bill and must be the owner of the facility or reasonably able to secure permission to complete the measures.

Since the program is implemented through a contractor network, customers must contact a participating vendor to pursue the qualifying measures. Upon completion of the work, a rebate application is submitted by the contractor. Customers can either opt to receive the rebate directly or authorize the rebate to be paid to the contractor. Customers are not counted as participants until a completed application form is processed and a rebate has been issued.

Save money with energy efficiency programs available for your business

The program measures offered are primarily energy efficiency (EE) measures designed to decrease energy consumption through replacement of inefficient equipment, installation of new equipment that exceeds current code efficiency standards, and recommissioning of existing HVAC equipment.

2020 was an extraordinary year by all accounts due to the COVID-19 pandemic. In response to the pandemic, this program was suspended in March 2020 for health and safety reasons and resumed on May 15, 2020. Upon its reopening, the implementation vendors set up new health and safety protocols such as requiring contractors to wear personal protective equipment (PPE) against COVID-19, conducting temperature checks, implementing contact tracing for suspected COVID-19 exposures, social distancing when at the customer site, or offering to visit the customer site after hours. Anecdotally, customers were pleased with the implementation contractor's processes.

Also in response to the pandemic, the company suspended conventional program marketing approaches (bill inserts and online marketing) from March through May. Conventional marketing approaches resumed in August, and some advertising for the Prescriptive Program restarted in November. Alternatively, the implementation vendors also increased marketing to customers more directly through one-on-one phone calls to building managers and other customers, and to trade organizations. There was a large influx of program applications from grocery stores due to Dominion Energy staff actively reaching out to customers to assist the implementation contractor.

1.2 Key findings

DNV concludes that the Prescriptive Program produced 19,437,604 kWh/year of net energy savings and 7,767 kW net demand reduction from November 1, 2017 through July 31, 2020.

This evaluation was conducted to verify deemed key parameters (from tracking data) used to calculate energy savings and demand reduction. The verified savings and demand reduction estimates were then used to estimate a realization rate which adjusts gross savings from engineering (deemed) estimates by incorporating the findings of the onsite verifications. For this period of study, the estimated overall program energy savings realization rate was 68.7% with a relative precision of ±4.2% at an 85% confidence interval.

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The program's overall realization rates are based on measure type realization rates weighted by deemed energy savings per measure type. Realization rates for each measure type and for the program overall are shown in Table 1-1. Measures that were not verified directly through the evaluation were assigned program design realization rates and net-to-gross (NTG) factors. Program design gross realization rates for energy and demand were 100%, and program design NTG factors were 85%. Some verified measures had sample sizes that were insufficient to determine their confidence interval, those measures have "n/a" as their relative precision values.

Table 1-1: Non-residential Prescriptive realization rates by measure type and overall

Measure Type	Energy (kWh/year) Realization Rate	Relative Precision	Demand (kW) Realization Rate	Relative Precision	Net-to-Gross Factor	Relative Precision
Auto-Closers	88.5%	±20.3%	77.1%	±52.0%	80.8%	8.2%
Condenser Coil Clean	41.2%	±57.9%	61.8%	±115.4%	90.8%	n/a
Door Gasket	106.8%	±6.0%	106.7%	±5.9%	68.2%	4.7%
ECM at Evaporator Fan	100.0%	n/a	100.0%	n/a	97.6%	n/a
Freezer and Refrigerator	115.7%	±21.8%	115.9%	±21.5%	68.5%	n/a
Ice Maker	100.0%	n/a	100.0%	n/a	51.2%	n/a
Low/No Sweat Door Film	100.0%	n/a	100.0%	n/a	93.7%	n/a
Night Cover	100.0%	n/a	100.0%	n/a	85.0%	n/a
Strip Curtains	151.4%	±58.2%	151.4%	±58.2%	71.6%	0.5%
Evaporator Fan Control	100.0%	n/a	100.0%	n/a	85.0%	n/a
AC Tune-ups	117.0%	±14.4%	98.8%	±0.1%	76.2%	10.8%
Duct Test and Seal	79.8%	±30.8%	77.4%	±20.5%	75.2%	25.2%
VSDS at Kitchen Exhaust Fan	186.2%	n/a	93.2%	n/a	0.0%	n/a
Hot Food Holder	100.0%	n/a	100.0%	n/a	49.4%	n/a
Convection Oven	100.0%	n/a	100.0%	n/a	85.0%	n/a
Electric Fryer	100.0%	n/a	100.0%	n/a	85.0%	n/a
Steam Cooker	100.0%	n/a	100.0%	n/a	85.0%	n/a
Griddle	100.0%	n/a	100.0%	n/a	85.0%	n/a
Program Overall	**68.7%**	**±4.2%**	**90.2%**	**±2.2%**	**83.1%**	**±21.7%**

The final step of the evaluation was to determine the net program savings, by adjusting the baseline for energy and demand savings that would have occurred in the absence of the program. Program participant interview data were used to calculate an NTG factor of 83.1% with a relative precision of ±21.7% at an 85% confidence interval. This means that 83.1% of estimated impacts were attributed to program influences.

There were two major determinants of the NTG estimate:

- 34% of respondents (weighted by savings) were "not very likely" or "very unlikely" to install measures in the absence of this program. These customers were fully influenced by the program.

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- Of the remaining 63% who said they were "somewhat likely" or "very likely" to have installed measures, about 84% (weighted by savings) would have installed measures later than they did. They were considered to be fully influenced by the program if they responded that it would have taken them 48 months or more to install measures, and partially influenced if they responded that it would have taken then between 1 to 48 months.

From a customer perspective, this program has been very well received with positive customer satisfaction interview results regarding the program (86% satisfaction weighted by savings) and the contractors (84% satisfaction weighted by savings).

2 INTRODUCTION

Dominion Energy offers the Non-residential Prescriptive Program to promote energy efficiency upgrades for eligible non-residential customers by incentivizing installations of approved energy efficiency measures and operation and maintenance (O&M) activities. Program participants start by having their pre-qualified contractor complete the initial assessment form to reserve rebate funding with a program representative.

Specific areas of focus for the Prescriptive program include duct testing and sealing, HVAC system tune-up and upgrades to refrigeration systems and commercial kitchen appliances. A complete list of eligible measures for the evaluation period is given in Section 2.4.

DNV was directed by Dominion Energy to perform an impact evaluation of the program. The subsequent sections provide the details of that evaluation and its results.

2.1 Impact Evaluation Overview

The purpose of this impact evaluation was to estimate the net energy savings and peak demand reductions attributed to the Prescriptive Program. The impact evaluation calculated savings estimates for gross program effects by conducting onsite M&V of a representative sample of customer sites that received audits and performed qualified upgrades. Net program effects were then determined by estimating attributable savings from surveys of a representative sample of program participants. Savings estimates and net program effects for the representative samples are then extrapolated to represent the full population of program participants.

This report summarizes the evaluation methodology employed and presents the study's findings. The basic steps of the study included:

- Program participant analysis
- Sample design
- Program participant NTG survey
- Desk review of a sample of program participants
- Onsite verification of a subsample of program participants selected for the desk review
- Metering of a subsample of program participants selected for onsite verification
- Analysis of gross program impacts
- Analysis of net program impacts

Table 2-1 displays the planned evaluation activities by measure, all measures and associated customers were targeted for NTG survey, but mainly the measures that accounted for a large proportion of program savings were targeted for onsite verification, and only Variable Speed Drives on Kitchen Fans and Refrigerator Coil Cleaning were targeted for metering.

Table 2-1. Overview of planned evaluation activities by measure

End-Use	Measure	Attempted Customer Survey	Desk Review	Onsite Verification	Onsite Metering
Cooking	Commercial Convection Oven	X			
	Commercial Electric Fryer	X			
	Commercial Griddle	X			

	Commercial Hot Food Holding Cabinet	X	X	X	
HVAC	Duct Testing & Sealing	X	X	X	
	Unitary/Split AC/HP Tune-up	X	X	X	
	Variable Speed Drives on Kitchen Fan	X	X	X	X
Refrigeration	Door Auto-Closer	X	X	X	
	Door Gasket	X	X	X	
	Commercial Freezers and Refrigerators	X	X	X	
	Commercial Ice Maker	X	X	X	
	Evaporator Fan ECM Retrofit	X			
	Evaporator Fan Control	X			
	Low/No-sweat Door Film	X			
	Refrigeration Night Cover	X			
	Refrigerator Coil Cleaning	X	X	X	X
	Strip Curtain (Cooler & Freezer)	X	X	X	

2.2 Sample Selection

At the time of survey sample design in September 2020, DNV assessed program participation to develop a sample for data collection activities, Figure 2-1 shows that Refrigeration Condenser Coil Cleaning accounted for nearly 60% of program gross savings, with five other measures (Refrigeration Door Gaskets, HVAC Duct Test and Sealing, AC Tune-up, Refrigeration Strip Curtains, and Refrigeration Low Sweat Door Film) making up the rest. Figure 2-2 shows the program planned electric savings distribution versus the gross savings by measure, confirming that Strip Curtains (not Condenser Coil Cleaning) was expected to account for the majority of program savings.

Figure 2-1: Program Gross savings by measure
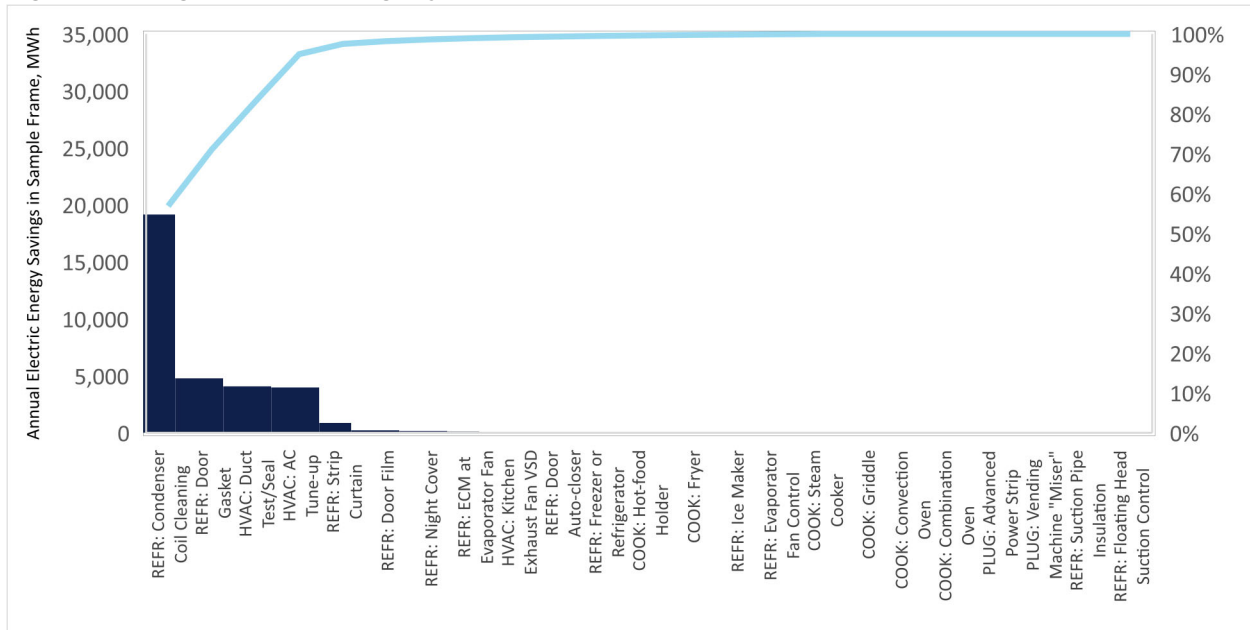
Figure 2-2: Planned versus gross savings by measure
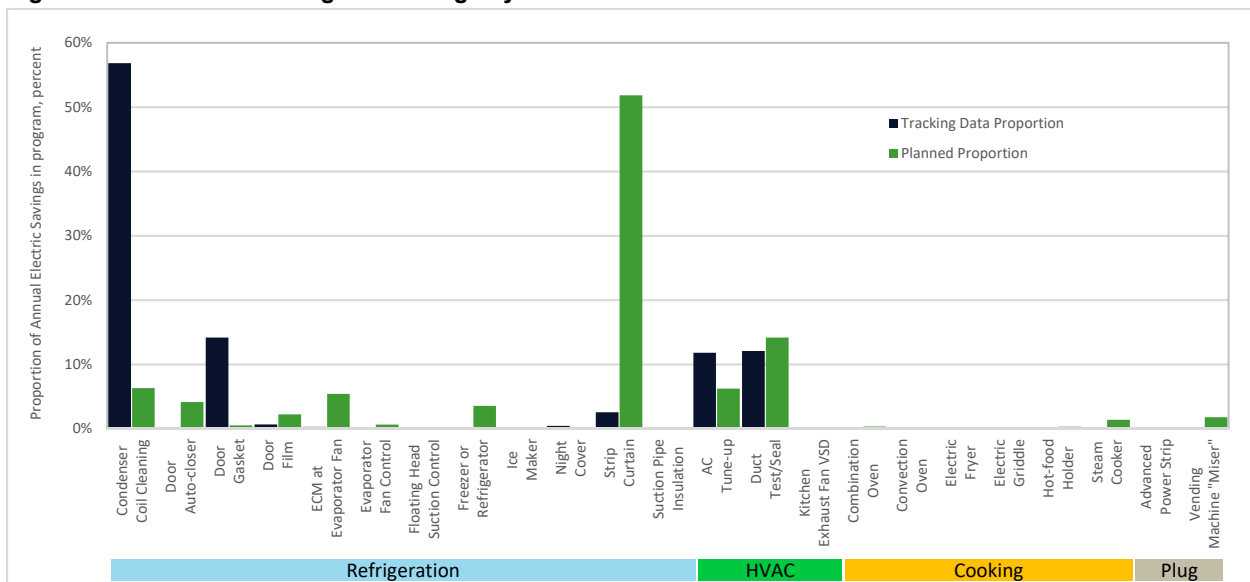
The program participant population consisted of several national retail stores that constituted a major portion of the program savings, but essentially had one or two points of contact. The top 20 contacts account for both 80% of the program savings and 41% of the participant facilities. Because of this, the onsite sample design was created to take advantage of the concentration of savings and similar measures within the same customer groups using model-based statistical sampling principles. Figure 2-3 shows that the gross savings of customers who received onsite verification represent a large proportion of program total gross savings.

DNV

Figure 2-3: Onsite customergross savings compared to program tgross savings by measure
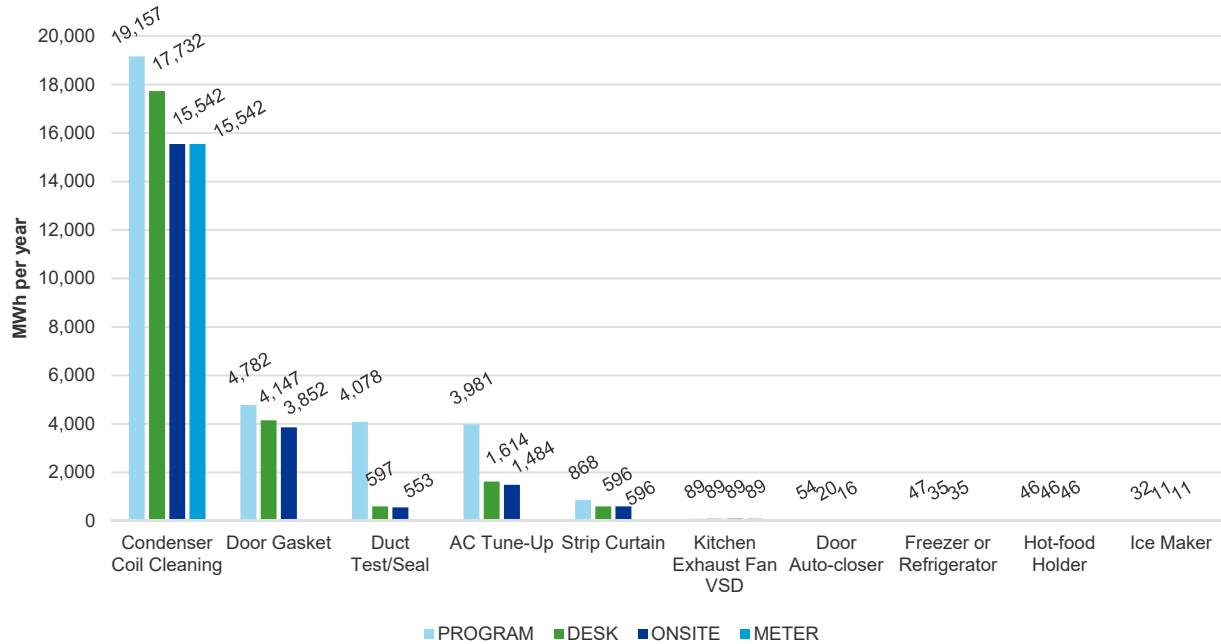
The first five strata were single-customer groups with one or two points of contact for multiple facilities. Figure 2-4 shows that the survey respondents from each stratum represent a large proportion of total program gross savings, but one of the stratum's customer refused to participate in the survey. The Dominion Energy gross database included e-mail addresses as well as phone numbers, so almost all program participants were invited to participate via e-mail. Follow-up phone calls were utilized to ensure sufficient response rates.

Figure 2-4: NTG respondent gross savings compared to total gross savings by strata
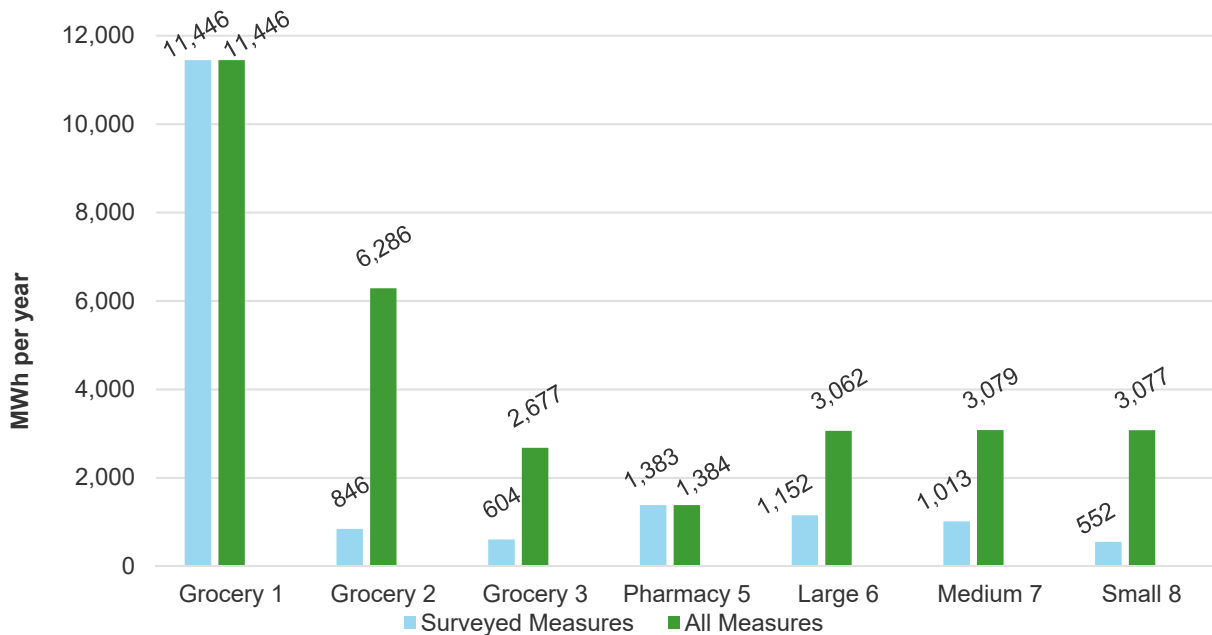
Although this data collection effort involved contacting all participants in the program for this study, not all participants responded. Because of this, each responding participant and installed measure has an assigned weight to account for non-respondents. The weights were used in the computation of all statistics produced from these data collection efforts and account for differences in the distribution of the respondents compared with all program participants. Details of this approach are described in APPENDIX B.

2.3   Data Collection Procedures

Data collection activities in this study consisted of a program participant survey and onsite M&V fieldwork. DNV conducted data collection from December 2020 through February 2021.

The program participant survey captured attribution and participant satisfaction data. Onsite visits verified measure installation and use schedules, and for some measures involved the installation of data loggers to measure time-of-use (TOU) data and to measure equipment operational characteristics.

2.3.1   Survey Research Procedures

From December 2020 through January 2021, DNV staff conducted 45 in-depth interviews with the Prescriptive Program participants' organizational representatives to discuss program participation of the 497 sites they represent. Respondents represented 67% of gross electric savings, 7% of organizational representatives, and 25% of sites.

The participant survey instrument (APPENDIX A) collected data from a series of questions aimed to assess:

- Awareness of the program
- Verification of measure installation
- Influence of the program on the participant's decision to install energy efficiency measures (i.e. the program attribution)
- Influence of the program on the participant's decision to invest in additional energy-saving measures, and
- Participant satisfaction with the program

2.3.2   Onsite M&V Procedures

Onsite M&V activities for the program took place from December 2020 through February 2021. The primary objective of onsite activities was to collect the necessary data to develop independent estimates of gross savings and demand reductions. DNV staff conducted onsite verification at 41 sites, which translated to 2% of the total number of unique sites, and verified installed measures which represented 8.9% of gross electric savings. The onsite verification selected a sample of sites from a sample of customers because each verification method (desk review, site visits, and metering) have large increases in incremental costs in the form of travel, per diem, EM&V equipment, and electrician costs. Figure 2-3 (Section 2.2) showed that the sample of customers selected for onsite verification represented a large proportion of the program's total gross savings which means that the sites visited also represent a large proportion of the program's total gross savings.

The onsite M&V activities included:

- Verification of measure installation
- Verification of tracking data inputs used in gross savings calculations
- Measurement of installed measure characteristics to quantify energy usage characteristics
- Installation of data loggers to quantify energy usage characteristics over time

See APPENDIX C for more detailed descriptions of the onsite data collection methods.

2.4 Adjusted Gross Impact Estimation Procedures

The purpose of onsite data collection was to improve upon the gross energy impact estimates for a representative sample of installed measures. The improved estimates are used to calculate a realization rate (adjustment factor) for each measure type, which is applied to the program population of participating non-residential customers.[1]

For all measures, DNV performed visual verification that the measure had been installed and was in working order.

In addition to the visual verification performed for all measures, the post-retrofit energy use of physically accessible measure types was verified through the International Performance Measurement and Verification Protocol (IPMVP) Option A, Partially Measured Retrofit Isolation.[2] IPMVP Option A is defined as field measurement of the key performance parameter(s) which define the energy use of the affected system. Other parameters in the calculation of system energy use (those not selected for field measurement) were estimated using documented historical data, manufacturer specifications, or engineering judgment.

Application of the IPMVP Option A protocol to this program required measurement of key parameters in the energy and demand algorithms (STEP Manual Version 10.0) of an installed efficiency measure. Due to physical restrictions, the measurement of primary variables in the savings algorithms could not be accomplished for all measure types. We used a combination of onsite spot-measurement, unit information, and site information for physically restricted measure types. Figure 2-5 shows that the priority of data used in the adjusted gross savings was meter data, onsite verification data, and desk review data in conjunction with tracking data and STEP Manual assumptions. Detailed information on the onsite M&V data collection methods for each measure type is provided in Section 3.2.3.

Figure 2-5: Decision Tree for Adjusted Gross Savings Input Values

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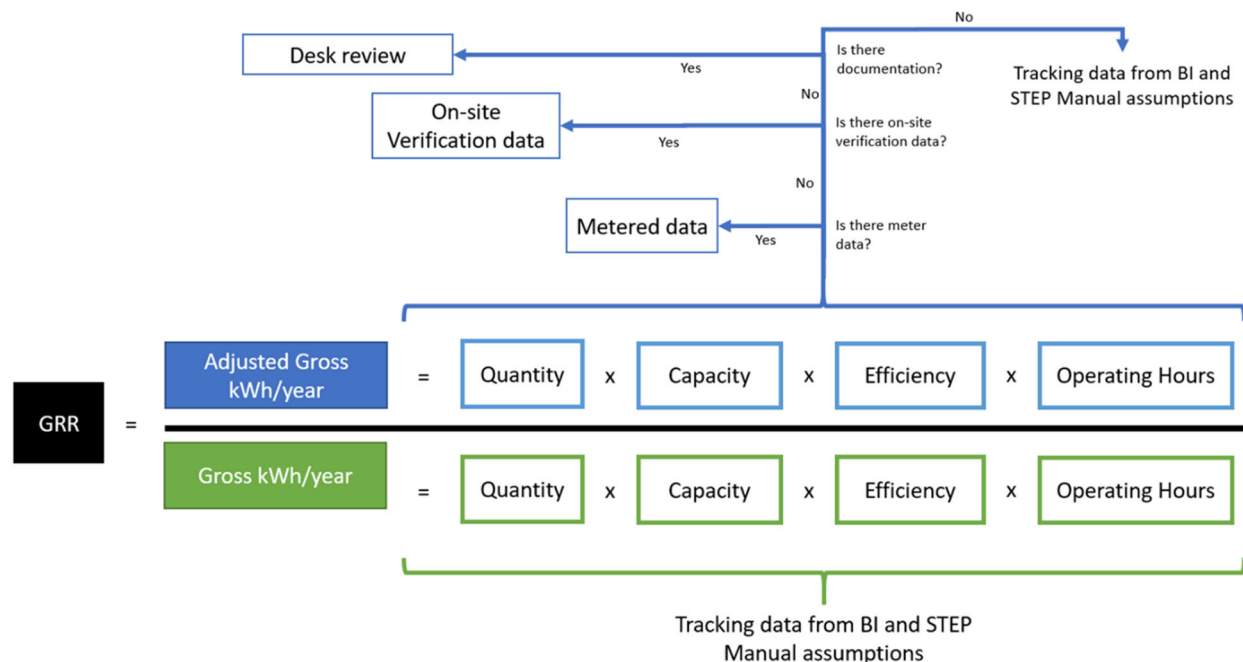
[1] The realization rate is the proportion of assumed or estimated energy and peak demand savings that is realized by a participant or project. It is expressed as a percentage and is derived from onsite inspections or participant surveys to verify that measures were in fact installed, operating as intended, and saving the expected amount of energy or demand.

[2] Efficiency Valuation Organization, *IPMVP Core Concepts, 2014*. http://www.evo-world.org/. Accessed October 30, 2014

Installed measures for which estimates were based on the Option A protocol include:

- Condenser coil cleaning
- VSDs at kitchen exhaust fans[3]

Installed measures that were visually verified in this evaluation period include:[4]

- Duct test and seal
- AC tune-ups
- Door gaskets
- Strip curtains
- Freezer & refrigerator
- Hot food holder
- Ice maker
- Walk-in door closers (auto-closers)

Measures eligible for rebate under the program, but not installed by sample participants in this evaluation period include:

- Refrigeration night cover
- ECM at evaporator fan
- Evaporator fan controls
- Steam cooker
- Anti-sweat door film
- Electric fryer
- Griddle
- Convection oven

Measures eligible for rebate under the program, but not installed by any participants in this evaluation period include:

- Suction pipe insulation
- Floating Head Pressure Control
- Combination Oven
- Advanced power strips
- Vending machine misers

2.5 Net Impact Estimation Procedures

The principal objective of the net savings evaluation was to determine the proportion of adjusted gross energy savings that were attributable to the Non-residential Prescriptive Program. Net savings estimates are the proportion of the program's energy savings that can be attributed to the program (NTG factor) versus the amount of savings that would have occurred in the absence of the program. The program NTG factor was used to determine the net energy savings for program participants.

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[3] 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.

[4] 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. Methods used for Duct test and seal and Ac tune-up measures.

DNV used the statistical procedure of ratio estimation to develop an estimate of program attribution. An attribution factor or NTG factor is a sum of a full attribution factor and a partial attribution factor. The full attribution factor is a score that represents the proportion of adjusted gross energy savings that are 100% influenced by the program. The partial attribution factor is a score that represents the proportion of adjusted gross energy savings that are partially influenced by the program.

For this program, DNV used its three-component evaluation method of NTG factors, which has been used by other utilities in Wisconsin and California.[5] The three components of the partial attribution factor are comprised of timing, efficiency, and quantity, which guide the following questions that were asked:

- Timing: Did the participant install the measure more quickly because of the program than they would otherwise have installed?
- Efficiency: Did the participant install a more efficient measure because of the program than they would otherwise have installed?
- Quantity: Did the participant install more measures because of the program than they would otherwise have installed?

DNV collected answers to these questions through a Non-residential Prescriptive Program participant survey. The survey instrument is available in APPENDIX A.

The program NTG factor estimated from the interview data was then applied to the participant population's adjusted gross savings estimate from January 1, 2020 to December 31, 2020 to estimate the proportions of savings and demand reduction attributable to the program.

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[5] The California Public Utilities Commission (CPUC) has adopted this methodology as its standard battery of survey questions and attribution estimation procedures. More information can be found at: http://www.energydataweb.com/cpuc/home.aspx

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3   DATA COLLECTION ACTIVITIES

Data collection activities consisted of a program participant survey and onsite M&V fieldwork. The survey and M&V data collection activities took place from December 2020 to February 2021.

The primary objectives of the survey were to collect data about program-attributable energy savings and demand reductions, participant awareness about the program, and participant satisfaction. The goals of the onsite activities were to verify measure installation, and where possible, measure key parameters used in the calculation of energy savings and demand reductions. Program impacts were estimated by calculating adjusted gross savings using onsite data and then applying an attribution factor or NTG ratio derived from the study survey responses.

3.1   Program Participant Survey Activities

The survey data collection effort consisted of sample analysis, survey design, participant outreach and notification about the study, and a participant survey. Surveys were conducted with one representative per organization, so one survey could ask about multiple sites/participants. To ensure an adequate sample size, the evaluation attempted a census of contacts for the NTG survey, but a sample of sites when a representative was responsible for more than three sites.

3.1.1   Survey Sample Design

There were participant sites represented by 46 unique organizational representatives or contacts at the time of the full implementation of the Prescriptive Program survey in December 2020. To achieve a robust sample, a census of program participants was attempted.

As shown by the participant contact and site counts, some organizational representatives were responsible for more than three sites. To reduce survey burden on the respondents, organizational representatives with four or more associated sites were offered the option of answering survey questions for only three sites. The sample selection for these three sites used the probability proportional to size sampling technique. This means that those with higher energy savings (from the tracking data) received a higher probability of being selected in the sample. During the actual survey if a respondent was willing to answer questions for more than three sites, then the interviewer was trained to ask the questions about all the sites associated with that contact.

3.1.2   Survey Data Collection Methodology and Response Rates

The survey instrument collected data from a series of questions divided into the following eight categories. Refer to APPENDIX A for the full survey instrument.

- Introduction
- Verification
- Awareness of the program
- Reasons for participation
- Influence of the program on decisions (attribution)
- Program spillover
- Customer satisfaction

Experienced DNV surveyors conducted the phone interviews for organizational representatives in the onsite sample of this evaluation. The surveyors attempted to reach each organizational representative, calling up to five times over different days and times of day before classifying a non-respondent. A web survey was sent by email to participants which were not part of the onsite sample. Three email reminders were sent to non-respondents of the web survey. A

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total of 45 organizational representatives responded to the survey, representing 67% of gross savings and 497 of the 2,003 sites that participated in the program. The response rates are provided in Table 3-1 and Table 3-2.

Table 3-1: Survey response rates

Aggregation Level	All Program Participants	Respondent Count	Response Rate
Organizational representatives (Unique combinations of name and email)	621	45	7%
Number of participating premises (nique premise IDs)	2,003	497	25%
Gross savings (kWh/year)	33,691,659	22,647,369	67%

Table 3-2: Measure-type program counts and survey measure level response rates

Measure Type	Number of Sites by Installed Measure Type		Gross Savings (kWh/year)		Percent Savings Represented in Sample
	Program Participants	Sample	Program Participants	Sample	
AC Tune-ups	1042	298	3,980,530	1,587,502	40%
Auto CLosers	361	52	53,520	10,045	19%
Condenser Coil Clean	247	222	19,156,513	16,152,605	84%
Convection Oven	3		1,132		
Door Gasket	1002	324	4,782,290	2,506,403	52%
Dduct Test and Seal	776	244	4,078,198	1,442,653	35%
ECM at Evaporator Fan	20	17	105,246	88,281	84%
Electric Fryer	20		37,649		
Evaporator Fan Control	1		27,937		
Freezer and Refrigerator	47	19	47,346	17,716	37%
Griddle	1		4,510		
Hot Food Holder	18	6	45,777	19,161	42%
Ice Maker	11	2	28,542	15,124	53%
Low/No Sweat Door Film	5	2	227,191	131,803	58%
Night Cover	17		153,406		
Steam Cooker	2		19,748		
Strip Curtains	347	65	868,249	598,765	69%
VSDS at Kitchen Exhaust Fan	1	1	88,672	88,672	100%
Total	**2003**	**1,252**	33,706,455	22,658,729	67%

3.1.3   Survey Weighting

Sample weights were used to expand survey results from the sample to the total population of participants and measures in a program. Survey results for each respondent were multiplied by an appropriate weight in order to represent all program participants, including non-respondents. For this survey, two sets of weights were developed based on the level of aggregation at which survey questions were asked.

One set of participant survey questions were asked at the organizational representative level, because an organizational representative may represent multiple buildings for which a single decision was made. Questions asked at the organizational representative level were used to understand how participants first heard about the program, why they chose to participate, and their satisfaction with the program.

A second set of participant survey questions was asked for each measure type in a building, where multiple measure types may have been installed per building. Measure-level questions were developed to estimate the effect the program had on participant's decision to install a measure type. The question was asked at the measure type level because the cost, incentive, energy savings, and complexity of the measure could impact the participant's decision, and these factors differ by measure type.

The weights were applied to all measure types and organizational representatives to account for all program participants, including those that did not participate in the survey. APPENDIX B summarizes the method used to calculate weights for survey respondents.

3.2   Onsite M&V Activities

Onsite activities were conducted between December 2020 and February of 2021. The focus of onsite fieldwork was to verify the installation and observe the operational status of efficiency measures, confirm accuracy of tracking data, and determine efficiency measure characteristics to develop adjusted gross and net energy (kWh/year) and demand (kW) savings.

3.2.1   Onsite M&V Sample Design

A stratified sample of program participants were selected for onsite evaluation at the sites based upon the measure savings and customer groups. The Prescriptive Program population was highly leveraged because a significant portion of the program savings were concentrated within a small group of retail chains, primarily grocery stores, that had similar facilities with similar installed measures. The sample design created unique strata for the top five customers by savings (approximately 73% of total gross savings) to ensure a sufficient representation of each facility was included in the sample. The remaining 27% of program savings were stratified into small medium and large sites as shown in Table 3-3. DNV's goal was to recruit 46 unique sites for onsite verification.

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Table 3-3: Onsite sample design

Stratum	Electric Savings	Facilities	Avg. Savings	Sample	Weight	% of Gross Savings
Population Statistics						
Grocery 1	11,446,422	50	228,928	8	6.25	34.0%
Grocery 2	6,286,275	34	184,890	5	6.8	18.7%
Grocery 3	2,677,125	212	12,628	6	35.3	7.9%
Grocery 4	2,662,488	11	242,044	4	2.8	7.9%
Pharmacy 5	1,384,084	205	6,752	6	34.2	4.1%
Large 6	3,078,661	42	73,301	6	7.0	9.1%
Medium 7	3,079,454	136	22,643	6	22.7	9.1%
Small 8	3,077,150	1313	2,344	6	218.8	9.1%
Total	33,691,659	2003	16,821	46	43.5	100.0%

The other aspect of the population that drove the sample design was the high concentration of program savings in the top five savings measures previously discussed in Section 2.2. Although there were 18 measures that were installed, the top five measures accounted for 97.5% of the savings.

Table 3-4 summarizes the onsite sample measure-type savings versus the population frame. Note that the top five savings measures had a relatively high percentage of measure savings included in the sample. Because the sample was selected at the site level and all measures at the site are evaluated there appear to be 125 sites (the sum of the number of sample sites). A total of 47 site visits were completed, and each site had an average of about 2.7 different measures.

Table 3-4: Measure-type savings distribution and onsite measure-level sample

Measure Type	Frame		Onsite M&V Sample	
	Number of Sites by Measure Type	Percent of Total Savings	Number of Sample Sites	Sample Percent of Measure Savings
Condenser Coil Clean	247	56.9%	19	19%
Door Gasket	1,002	14.2%	31	8%
Duct Test and Seal	776	12.1%	17	4%
AC Tune-ups	1,042	11.8%	25	4%
Strip Curtains	347	2.6%	8	5%
Low/No Sweat Door Film	5	0.7%	0	0%
Night Cover	17	0.5%	1	2%
ECM at Evaporator Fan	20	0.3%	1	5%
VSDS at Kitchen Exhaust Fan	1	0.3%	1	100%
Auto-Closers	361	0.2%	13	7%
Freezer and Refrigerator	47	0.1%	5	11%
Hot Food Holder	18	0.1%	2	10%

Measure Type	Frame		Onsite M&V Sample	
	Number of Sites by Measure Type	Percent of Total Savings	Number of Sample Sites	Sample Percent of Measure Savings
Electric Fryer	20	0.1%	2	9%
Evaporator Fan Control	1	0.1%	0	0%
Steam Cooker	2	0.1%	0	0%
Ice Maker	11	0.0%	0	0%
Griddle	1	0.0%	0	0%
Convection Oven	3	0.0%	0	0%

3.2.2   Onsite M&V Weighting

Onsite data collection was conducted for each eligible measure at a recruited site because savings estimation approaches differ by measure type. To expand this data to the population of all program measures, the data was first compiled for measures of the same type within a site. Then weights were developed to extrapolate savings calculations from measure type estimates for each onsite respondent to the population of all measures of each type.

APPENDIX B summarizes the variables that were used in the approach and actual weight adjustments made to the onsite data.

3.2.3   Onsite M&V Data Collection Methodology

After creating a sample, recruiting, and scheduling onsite visits for verification, experienced DNV field engineers were dispatched to the customer sites to evaluate and verify the measures installed.

Each measure involved a different procedure for verifying tracking data, evaluating measure performance, or measuring consumption and usage patterns. As described in Section 2.3.2, some measures allowed the measurement of key parameters according to IPMVP Option A. Others could not be directly measured; rather, installation and some relevant tracking data could be verified onsite.

The data collection procedures for each measure type are outlined in Table 3-5. Detailed descriptions of onsite procedures and onsite data collection instruments are further detailed in APPENDIX C.

Table 3-5: Dominion Energy Prescriptive Program Installed Measure M&V Procedures

Measure	Gross Impact Procedure	M&V Procedure	Logger Model Used
Condenser Coil Clean	IPMVP Option A: Key parameter measurement	Visually inspect presence and operational condition of closer.	Dent ElitePro™ power meter
Door Gaskets	Verification only	Visually inspect presence and condition of gaskets.	-
Duct Test and Seal	Verification only	Visually inspect ducts collect nameplate of HVAC unit.	-
AC Tune-ups	Verification only	Visually inspect HVAC unit and collect nameplate data.	-
Strip Curtains	Verification only	Visually inspect presence and condition of strip curtain.	-

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Measure	Gross Impact Procedure	M&V Procedure	Logger Model Used
VSD at Kitchen Exhaust Fan	IPMVP Option A: Key parameter measurement	Visually inspect presence of VSD collect nameplate data for controlled fans.	Dent ElitePro™ power meter
Auto Closers	Verification only	Visually inspect presence of auto closer and size of door.	-
Freezer and Refrigerator	Verification only	Visually inspect presence of freezer/refrigerator and collect nameplate data.	-
Hot Food Holder	Verification only	Visually inspect presence of hot food holder and collect nameplate data.	-
Ice Maker	Verification only	Visually inspect presence of ice maker and collect nameplate data.	-

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4   ADJUSTED GROSS SAVINGS ESTIMATION APPROACH

The deemed energy savings and demand reductions calculations use the energy savings and demand reductions equations from the STEP Manual version 10.0 where the key parameters are a combination of input variables from various Technical Reference Manuals and participant tracking data. For this evaluation, the adjusted gross energy savings and demand reductions were calculated using the same deemed savings equations from the STEP Manual, where those same key parameters were either measured or verified onsite. These equations calculate savings and reduction values for each measure type installed and eligible for rebate under the program.

Prior to calculating adjusted gross savings and reductions, onsite data was checked for quality to produce reliable results for key variables in the STEP calculations of energy savings and coincident demand impacts. Detailed descriptions of the savings estimation approach and data cleaning processes for each measure type installed under the Prescriptive Program can be found in APPENDIX D.

4.1   Realization Rates

Realization rate ratios represent a weighted scalar applied to deemed energy savings estimates of the participant population to arrive at adjusted gross energy impacts.

DNV calculated a separate realization rate for each measure type installed under the Prescriptive Program, because deemed savings approaches and verification procedures for each measure type can differ significantly from each other. Measure level realization rates are developed instead of program level realization rates because the measure mix can vary through time and each measure can have a significantly different realization rate. To improve deemed savings estimates for measures installed after the evaluation period, measure-level realization rates are applied to future program data at the measure level.

The measure-level and program-level realization rates for energy savings and demand reductions are provided in Table 4-1. The refrigeration condenser coil cleaning measure achieved the lowest realization rate at just over 41% for energy savings and 62% for demand reductions. Since Refrigeration Condenser Coil Cleaning also constituted almost 57% of program energy savings this had a large negative impact on the Prescriptive program gross energy realization rate. The large decrease in onsite evaluated savings was primarily due to the tracking data overstating the capacity of the impacted refrigeration systems, which is directly proportional to the savings. The Duct Test and Seal measure had a realization rate of just under 80%, due to a decrease in the cooling capacity and particularly the electric heating capacity of verified units, as compared to the gross savings estimates. The auto door closer measure also had a realization rate of less than 100% (88.5%), which was due to one site where the closers were no longer functioning. Fortunately, many of the other measures had realization rates of 100% or greater for energy savings, and this somewhat offset the impact of the low realization rate of the Refrigerator Condenser Coil Cleaning measure.

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Table 4-1: Realization rates by measure type and for the overall program

Measure Type	Energy (kWh/year) Realization Rate	Relative Precision	Demand (kW) Realization Rate	Relative Precision
Auto-Closers	88.5%	±20.3%	77.1%	±52.0%
Condenser Coil Clean	41.2%	±57.9%	61.8%	±115.4%
Door Gasket	106.8%	±6.0%	106.7%	±5.9%
ECM at Evaporator Fan	100.0%	n/a	100.0%	n/a
Freezer and Refrigerator	115.7%	±21.8%	115.9%	±21.5%
Ice Maker	100.0%	n/a	100.0%	n/a
Low/No Sweat Door Film	100.0%	n/a	100.0%	n/a
Night Cover	100.0%	n/a	100.0%	n/a
Strip Curtains	151.4%	±58.2%	151.4%	±58.2%
Evaporator Fan Control	100.0%	n/a	100.0%	n/a
AC Tune-ups	117.0%	±14.4%	98.8%	±0.1%
Duct Test and Seal	79.8%	±30.8%	77.4%	±20.5%
VSDS at Kitchen Exhaust Fan	186.2%	n/a	93.2%	n/a
Hot Food Holder	100.0%	n/a	100.0%	n/a
Convection Oven	100.0%	n/a	100.0%	n/a
Electric Fryer	100.0%	n/a	100.0%	n/a
SteamCooker	100.0%	n/a	100.0%	n/a
Griddle	100.0%	n/a	100.0%	n/a
Program Overall	**68.7%**	**±4.2%**	90.2%	**±2.2%**

The program overall realization rates for this population were calculated by applying the measure-level realization rates to each measure type respectively, summing the verified savings for all measure types, and then dividing the total by the sum of the original (deemed) savings estimates for the analysis period. The program's overall energy savings realization rate is 69% with a relative precision of ±4.2% at a confidence interval of 85%. The program's overall realization rate for demand reductions is 90% with a relative precision of ±2.2% at a confidence interval of 85%.

5   NET SAVINGS ESTIMATION APPROACH

This section reviews the net savings estimation approach and presents summaries of the attribution factor, or NTG factor, calculations that are derived from the program participant survey. The NTG factor is designed to distinguish what role the program played in influencing the participants to install the energy efficiency measures. DNV estimates that 83.1% of the adjusted gross energy savings were attributable to the Prescriptive Program.

There are three levels of attribution: full attribution, partial attribution, and no attribution, described in more detail in Section 5.1. The NTG results for the program are shown in Figure 5-1. About 59% of gross savings are fully attributable to the program, 33% are partially attributable to the program, and 9% are not attributable to the program.

Figure 5-1: Overall program attribution as composed of full and partial attribution weighted to gross energy savings
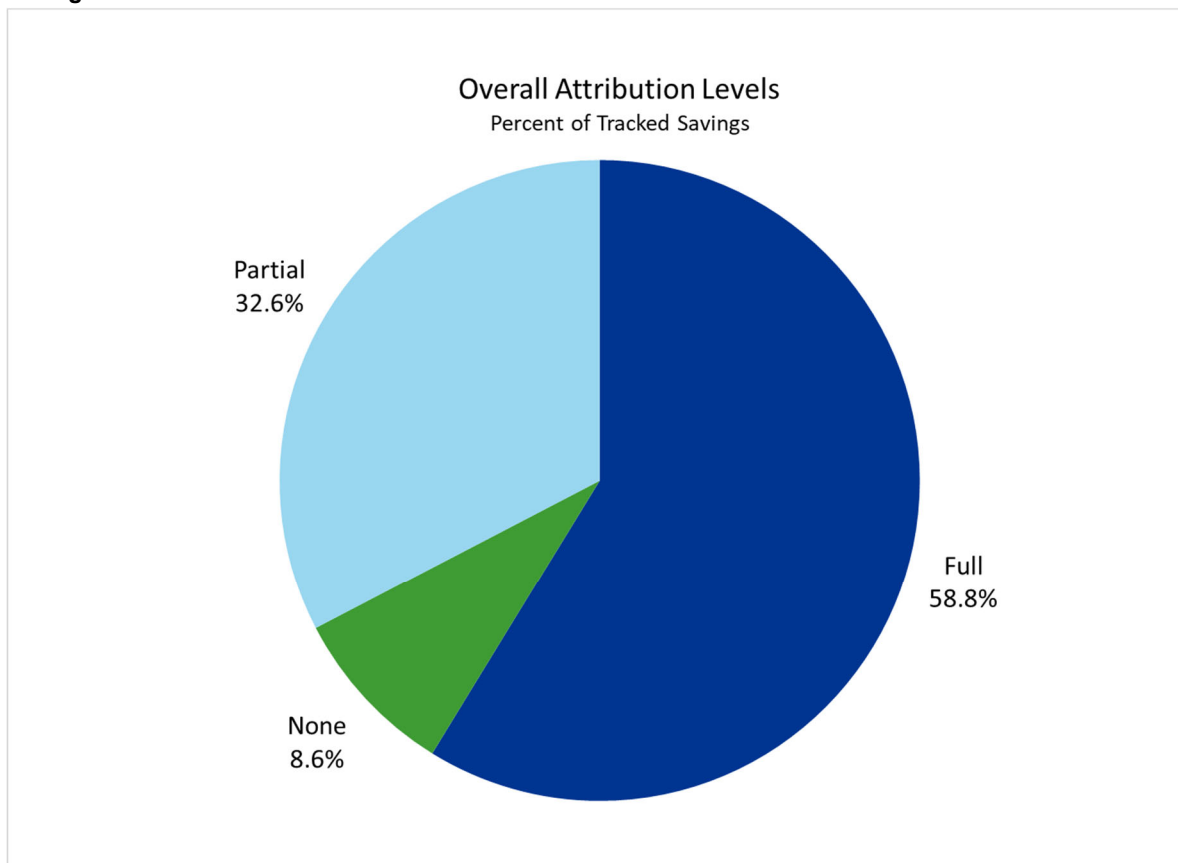
As was described in Section 3.1.3, all survey results were weighted to account for the full program savings at the time that the survey was conducted.[6]

As seen in Table 5-1, NTG factors were calculated for each measure type. To calculate a program total NTG rate, the measure type NTG score was applied to each respective measure for all program participants. The resulting energy savings were then summed for the program and divided by the sum of the original deemed estimates: 83% of energy savings can be attributed to the program.

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[6] There were several contacts that provided responses for multiple sites, particularly in the first 5 strata.

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Table 5-1: NTG factors by measure type and for the overall program

Measure Type	NTG Factor	Relative Precision
Auto-Closers	80.8%	±8.2%
Condenser Coil Clean	90.8%	n/a
Door Gasket	68.2%	±4.7%
ECM at Evaporator Fan	97.6%	n/a
Freezer and Refrigerator	68.5%	n/a
Ice Maker	51.2%	n/a
Low/No Sweat Door Film	93.7%	n/a
Night Cover	85.0%	n/a
Strip Curtains	71.6%	±0.5%
Evaporator Fan Control	85.0%	n/a
AC Tune-ups	76.2%	±10.8%
Duct Test and Seal	75.2%	±25.2%
VSDS at Kitchen Exhaust Fan	0.0%	n/a
Hot Food Holder	49.4%	n/a
Convection Oven	85.0%	n/a
Electric Fryer	85.0%	n/a
Steam Cooker	85.0%	n/a
Griddle	85.0%	n/a
Program Overall	**83.1%**	**±21.7%**

5.1 Program Attribution Components

As presented in the sections below, respondents were either scored as having been entirely influenced by the program (attribution score of 100%), having been partially influenced by the program (attribution score greater than 0% and less than 100%), or having been not influenced by the program (an attribution score of 0%, also known as a "free rider").

Attribution for this program has three components: efficiency, acceleration (timing), and quantity.

- Efficiency attribution measures whether the program influenced the adoption of technologies or services that have higher efficiency than the standard efficiency or the absence of the service.
- Acceleration attribution measures the effect the program had on when measures were installed or services received.
- Quantity attribution measures the effect the program had on the number of measures that were replaced or retrofitted. The quantity attribution determines the proportion of savings attributable to the program for increasing the quantity of installed measures above what would have been installed otherwise.

Each of these components of the scoring method is described in more detail in the following sections.

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5.1.1   Efficiency

Efficiency attribution refers to the program's influence on increasing the efficiency of an adopted measure. Respondents can indicate whether they would have adopted equal efficiency, lower efficiency, or higher efficiency in the absence of the program. If the respondents would have chosen lower efficiency in the absence of the program, the program receives efficiency attribution. As with quantity, if a respondent does not answer the efficiency attribution question, DNV assigns them the average response in their stratum. Figure 5-2 shows that the program increased the level of efficiency for 52% of the gross energy savings, and partially increased the level of efficiency for 9% of the gross savings. The program did not influence the efficiency of the measures for about 47% of gross savings.

Figure 5-2: ProgramInfluence on increasing installed energy efficiency above standard efficiency
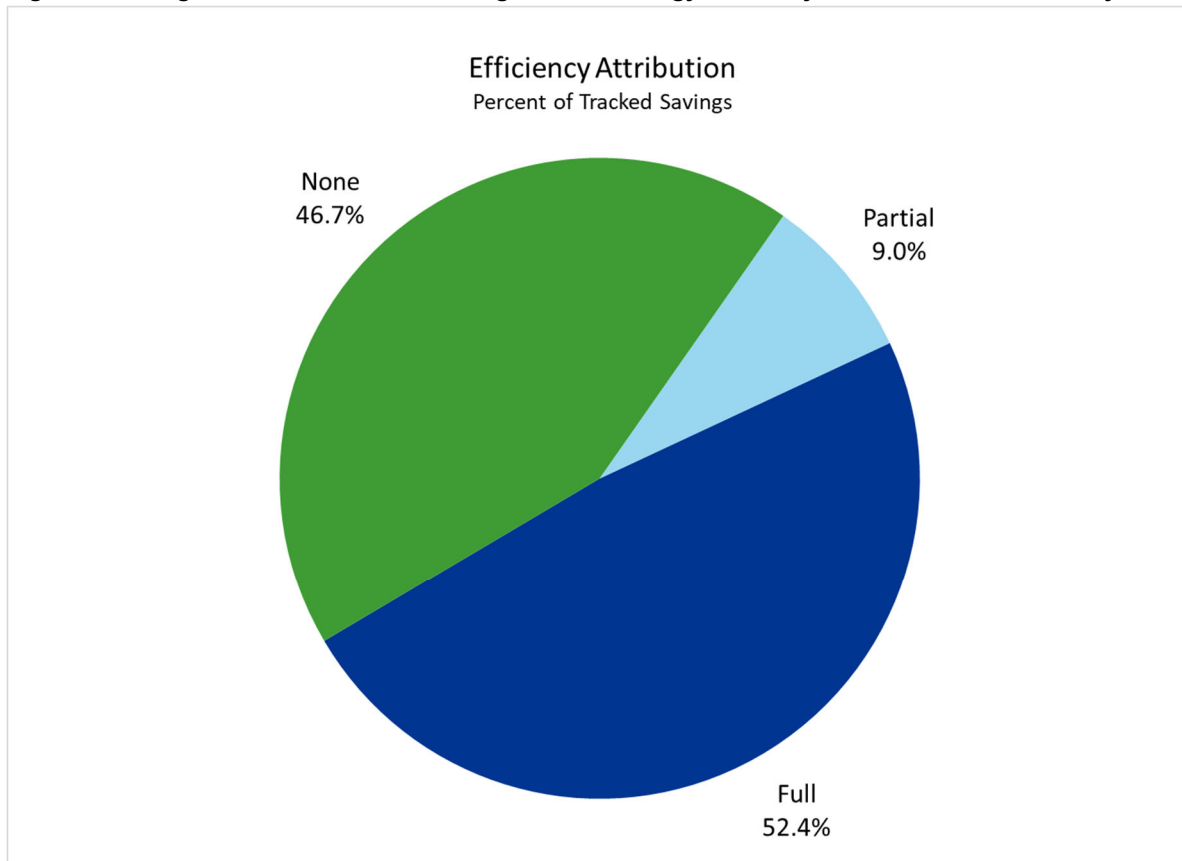
5.1.2   Acceleration

Acceleration (timing) refers to the program's influence on accelerating a program participant's decision to install measures or perform maintenance at a particular site. If a participant received full attribution based on their response to the first attribution question, whether they would have installed the measures without the program, the timing question and other partial attribution questions were not asked. However, if a participant says that they would have installed the measure without the program, the program can get partial attribution if the program accelerated the timing of the installation.

Acceleration attribution is a linear function that corresponds to the number of months between when measures were installed and when they would have been installed in the absence of the program. For participants who say they

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would have installed measures at the same time or earlier without the program, the timing attribution score is zero. For those who say they would have installed measures later, the timing attribution factor is a ratio of the number of months later they specify, up to 48 months later. Estimates of later installation are limited to 48 months because DNV assumes that measure installation plans exceeding 48 months in the future are too speculative. This is also consistent with an annual financial planning cycle. Those who give an answer of 48 months later or more receive full attribution for the timing component.

Figure 5-3 summarizes the timing attribution for this program. It shows that 25% of program savings were accelerated to some degree and that 75% were not accelerated at all. There were no respondents that indicated that the program accelerated the measure adoption by more than 48 months, which would have resulted in "full" acceleration credit.

Figure 5-3: Program Influence on accelerating installation of the energy efficiency measures
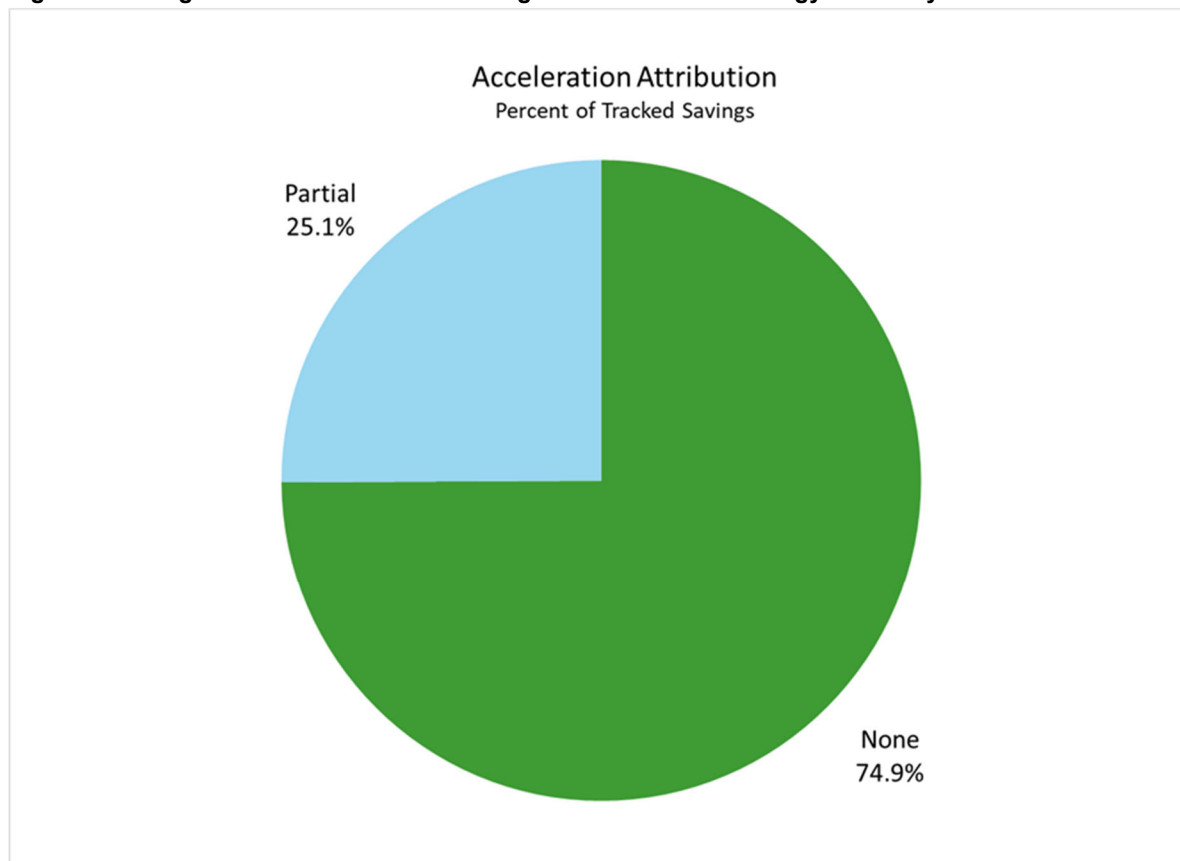
5.1.3   Quantity

The quantity attribution question displays the program's influence on the size or scope of the project that the program participant decides upon at a particular site. As with efficiency, if a respondent does not answer the efficiency attribution question, DNV assigns them the average response in their stratum. Seventy percent of participants (by gross savings weight) who installed measures would have completed the same amount of measures without the program, and 29% completed some additional measures because of the program. Less than 1% of savings received full quantity attribution.

Figure 5-4: Program influence on increasing the quantity of the energy efficiency measures

Quantity Attribution
Percent of Tracked Savings

Partial
29.0%

Full
0.7%

None
70.3%
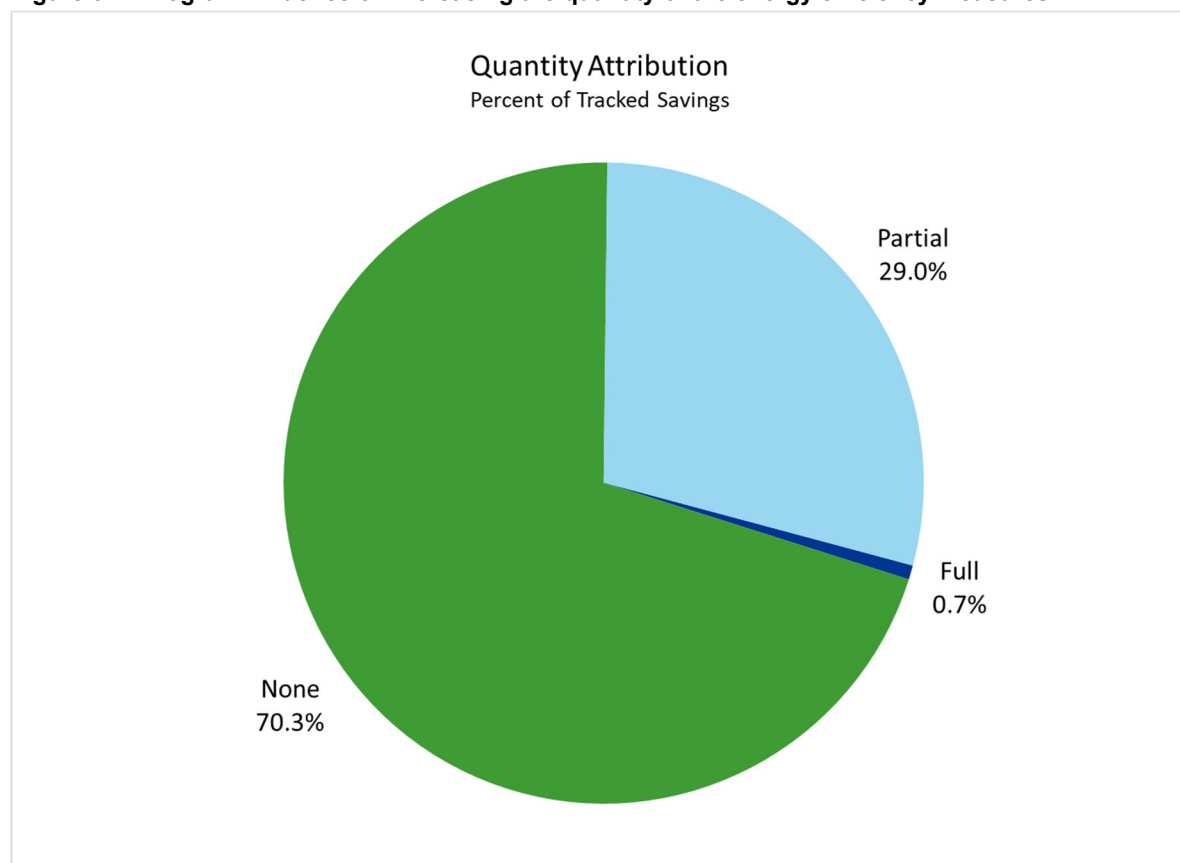
5.2   Threats to the Validity of the NTG Ratio (NTGR)

In the program evaluation literature, reports commonly address "threats to validity." One of the fundamental challenges in evaluating energy efficiency programs is that opportunities for true experimental designs, involving comparisons of randomized and blind treatment and control research subjects, rarely exist. For example, this program is marketed and delivered to the entire service territory. While this follows best practice in program design and program implementation, it also eliminates the possibility of specifying an unbiased control group to use as a baseline to measure the program's influence. While quasi-experimental designs in energy efficiency program evaluation that compare treatment groups to related control groups can be specified under certain circumstances to account for shortcomings in the experimental environment, such research designs need to consider cost, customer burden, and feasibility of implementation. Indeed, energy efficiency programs are subject to numerous exogenous influences for which quasi-experimental designs cannot be entirely controlled, such as economic stagnation, regional market influences (e.g., neighboring states with energy efficiency programs), and federal polices (e.g., building codes, national standards, tax credits, etc.) to name a few. For these reasons, quasi-experimental designs do not generally produce a complete estimate of net energy impacts, and supplemental survey research methods are necessary to fully account for baseline adjustments.

For this program, DNV specified a non-experimental approach using a counterfactual to arrive at a net energy impacts estimate. To estimate gross impacts, DNV applied engineering algorithms (STEP manual version 10.0) to the Company's program participation data. To estimate adjusted gross impacts, DNV applied IPMVP Option A (as described in Section 2.4) to measure and verify those gross savings and adjusted them appropriately using a

realization rate for energy savings and demand reductions. To estimate an NTGR, DNV relied on a survey research methodology to collect data on participant decision-making relative to a counterfactual. The survey research approach used by DNV has been applied in other jurisdictions such as Massachusetts, Connecticut, New York, Wisconsin and California, and is consistent with evaluation research protocols in those states and several others where energy efficiency programs have been operating for many years.[7] The approach taken for estimating net impacts relies primarily on participant survey research data.

Survey research is a common method of data collection, used in evaluation research as well as in other applications such as economic forecasting and customer satisfaction or sentiment, but is not without its limitations.[8] By its nature, all survey data are self-reported. One limitation in relying on self-reported data is the potential for bias in response. Four types of biases are potentially related to self-reported data in the energy program evaluation literature, which, combined, can either under- or over-estimate the resulting NTG estimate. They are as summarized by Ridge (p. 5) as follows:

- Keep the program bias: This is a strategic response to manipulate the outcome of the evaluation to serve the respondents' program preferences. This is generally more pronounced by participants of non-residential programs and vendors supporting all programs.
- I'm a good or smart person bias: Responses biased in this manner are also characterized as normative bias, or the desire to please the interviewer. This applies to many participating populations, but especially residential participants.
- Intention to act bias: This particular bias reflects the gap between the respondents' stated intentions and actual behaviors, because the respondent is aware that the response cannot be verified, or that no penalty exists for stating intentions incorrectly.
- Complicated lines of reference bias: Participants make decisions for their own reasons, and it's not always easy to recall and articulate the reasons for participation in the first place.[9]

To minimize the impacts of self-reported biases, the solutions are generally to implement good, sound survey research practices.[10] The current New York state evaluation framework, modeled after the California guidelines[11], includes guidance on minimizing self-reported bias when estimating NTGRs.[12]

5.3 Comparison of Estimates to Other Jurisdictions

DNV conducted a secondary review of net impact and realization studies from the past ten years for non-residential or commercial audit and refrigeration programs offering similar efficiency measures as Dominion Energy's Non-residential Prescriptive Program. The other programs are not directly comparable to Dominion Energy's program since they are not structured in the same way as Dominion Energy's and often include custom measures that are not

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[7] Self-reported survey methods for estimating net impacts are also supported by the U.S. Department of Energy's Uniform Methods Project (http://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf, p. 22).

[8] Peters, J. and M. McRae. *Free-Ridership Measurement is Out-of-Sync with Program Logic...or, We've Got the Structure Built, but What's Its Foundation?* Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings (2008).

[9] Ridge, R., P. Willems, J. Fagan. *Self-Report Methods for Estimating Net-to-Gross Ratios in California: Honest!* Proceedings of the National Conference of the Association for Energy Services Professionals (2009).

[10] Ridge, R., P. Willems, J. Fagan, and K. Randazzo. *The Origins of the Misunderstood and Occasionally Maligned Self-Report Approach to Estimating the Net-to-Gross Ratio.* Proceedings of International Energy Program Evaluation Conference (2009).

[11] *Guidelines for Estimating Net-to-Gross Ratios Using the Self-Report Approaches.* California Public Utilities Commission and the Master Evaluator Contractor Team (2007).

[12] *New York Evaluation Plan Guidance for EEPS Program Administrators (Appendix G).* Prepared by the New York State Department of Public Service and Energy Advisory Group, August 2013.

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part of the Dominion Energy program. Figure 5-5 compares the Prescriptive Program Gross Realization Ratio (GRR) to other jurisdictions.[13,14,15,16]

Figure 5-5: Comparing the Prescriptive Program RR with other jurisdictions

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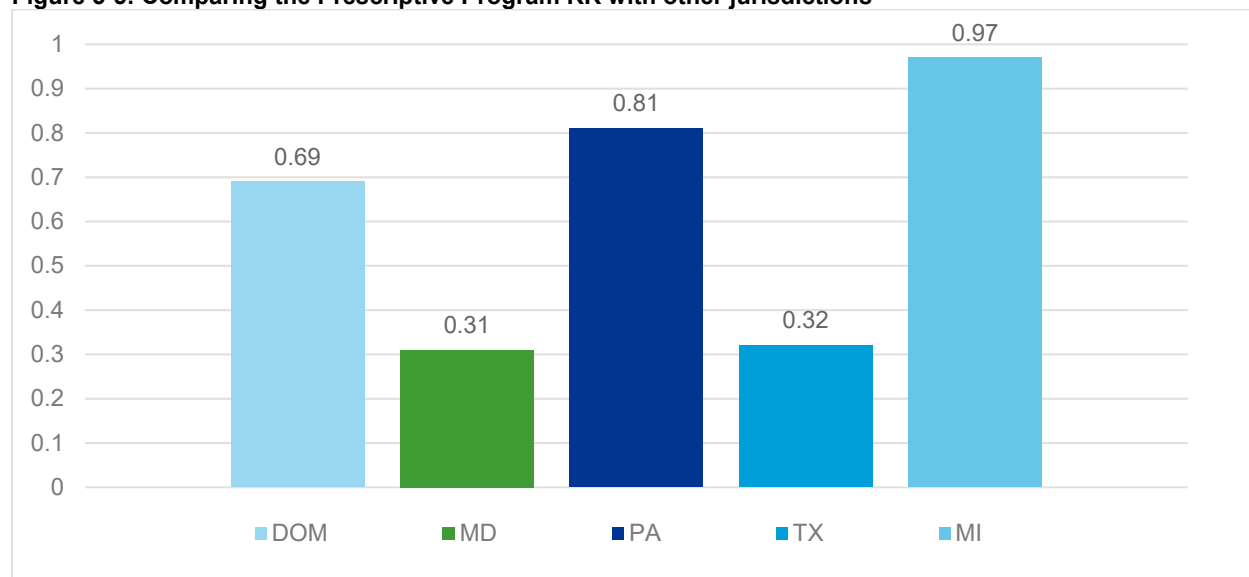
[13] MD: Efficient Buildings Retrocommissioning Program by Delmarva Power; evaluation of 2015-2017 program years; 'Appendix A – Net and Gross Wholesale Program Savings Tables'; pg. 79 (A13); https://insights.esource.com/documents/Delmarva%20-%201.31.2018%20-%202017%20Annual%20Report%20-%209156.pdf

[14] PA: CI Prescriptive Program by Pennsylvania Power; evaluation of 2016-2017 program years; 'Table 367: CI Prescriptive Initiative Energy Gross Realization Rates for Penn
Power'; pg. 278; https://insights.esource.com/documents/First%20Energy%20-%20Met%20Ed%20-%2011.15.2017%20-%20PY8%202017%20Annual%20Report%20-%20M-2015-2514767.pdf

[15] TX: Large Commercial Retro-Commissioning MTP Program by CenterPoint Energy Houston Electric, LLC; evaluation of 2019 program year; 'Table 8: Projected Savings versus Verified and Reported Savings for 2019 (at Meter)'; pg. 26; https://insights.esource.com/documents/Centerpoint%20TX%20-%204.1.2020%20-%202020%20Plan%20and%20Report%20-%2050666.pdf

[16] MI: C&I Prescriptive Program by DTE Energy; evaluation of 2019 program year; 'FIGURE 3-4. C&I PRESCRIPTIVE Reconciliation Results'; pg. 14; https://insights.esource.com/documents/Guidehouse%20-%2006.30.2020%20-%20DTE%20PY%202019%20Evaluation%20Report%20-%20966

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Figure 5-6 compares the Prescriptive Program NTGR to other jurisdictions.[17,18,19,20,21]

Figure 5-6: Comparing the Prescriptive Program NTGR with other jurisdictions

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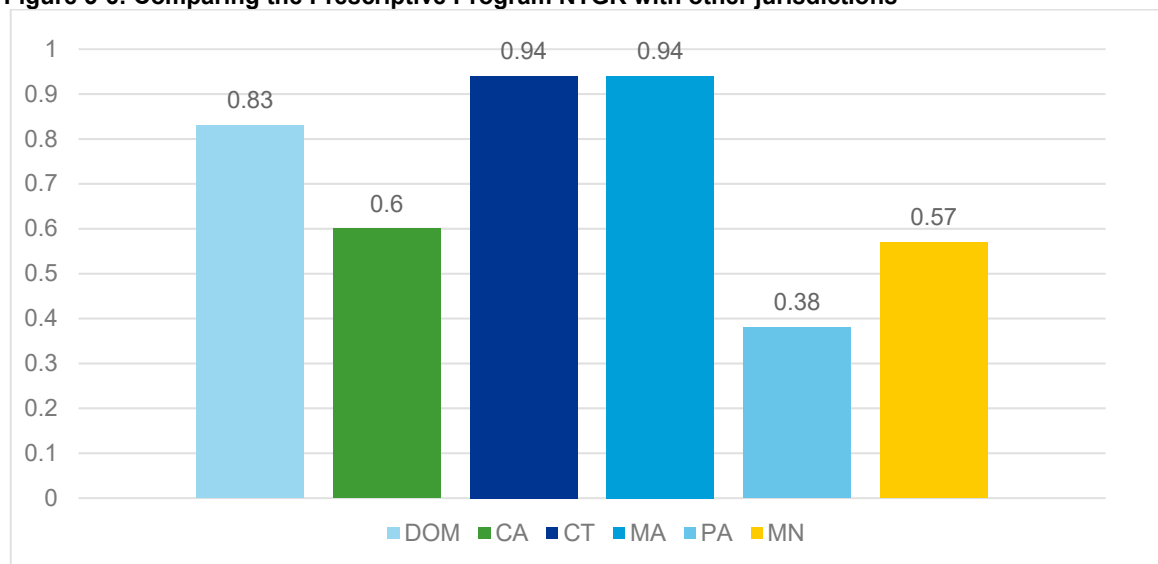
[17] CA: Default NTGR value for 'Com default: Measures >2 yrs old. Measures not covered by other NTG values and measure technology type has been available in marketplace for more than 2 years' from the Database for Energy Efficiency Resources (DEER); http://www.deeresources.com/

[18] CT: Energy Opportunities (EO) Program by Connecticut Energy Efficiency Board; evaluation of 2017 program year; 'Energy Opportunities NTG Study Results by End-use and Fuel type – Electric' Table; pg. 3; 'C1644 - EO NTG Final Report_9.25.19.pdf'

[19] MA: Commercial Retrofit – Prescriptive Program by Massachusetts Program Administrators; evaluation of 2016 program year; 'Recommended 2019-2021 NTG Ratios for Electric Initiatives' Table; pg. 2; 'TXC_49_CI-FR-SO-Report_14Aug2018.pdf'

[20] PA: CI Prescriptive Program by Pennsylvania Power; evaluation of 2016-2017 program years; 'Table 379 CI Prescriptive Initiative Net-to-Gross Results for Penn Power'; pg. 281; https://insights.esource.com/documents/First%20Energy%20-%20Met%20Ed%20-%2011.15.2017%20-%20PY8%202017%20Annual%20Report%20-%20M-2015-2514767.pdf

[21] MN: NR Recommissioning/Retrocommissioning by Otter Tail Power Company; evaluation of 2019 program year; 'Appendix A - Table 5'; pg. 90; https://insights.esource.com/documents/OTP%20MN%20-%205.1.2020%20-%202019%20Annual%20Report%20-%2016-116.03.pdf.pdf

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6 OTHER FINDINGS

This section discusses how satisfied organizational representatives were with different aspects of the Non-residential Prescriptive Program. Sub-topics include customer satisfaction, decision making, NTG, and spillover.

Satisfaction survey results were aggregated to the organizational representative level. As described in previous sections, an organizational representative is the person who decides to participate in the program and may represent multiple buildings. At the time of the survey, a population of 621 decision-makers represented 2,003 sites.

6.1 Decision-making Factors

This section was designed to discover what drives the customer's decision to make building system investments. Customers were asked about their motivation, required payback period, and whether utility rebates had an influence on how projects were prioritized.

Respondents were asked what criteria they consider when making improvements to any of their building systems in general. For this question, they could provide more than one response. "Payback period" was the most frequently cited reason for making improvements to any of their building systems (81%), followed by "organizational goals for sustainability or energy efficiency" (75%). "Rebate offering" had an influence of 42%. Customer responses are shown in Figure 6-1.

Figure 6-1: Reasons for installing efficiency measures

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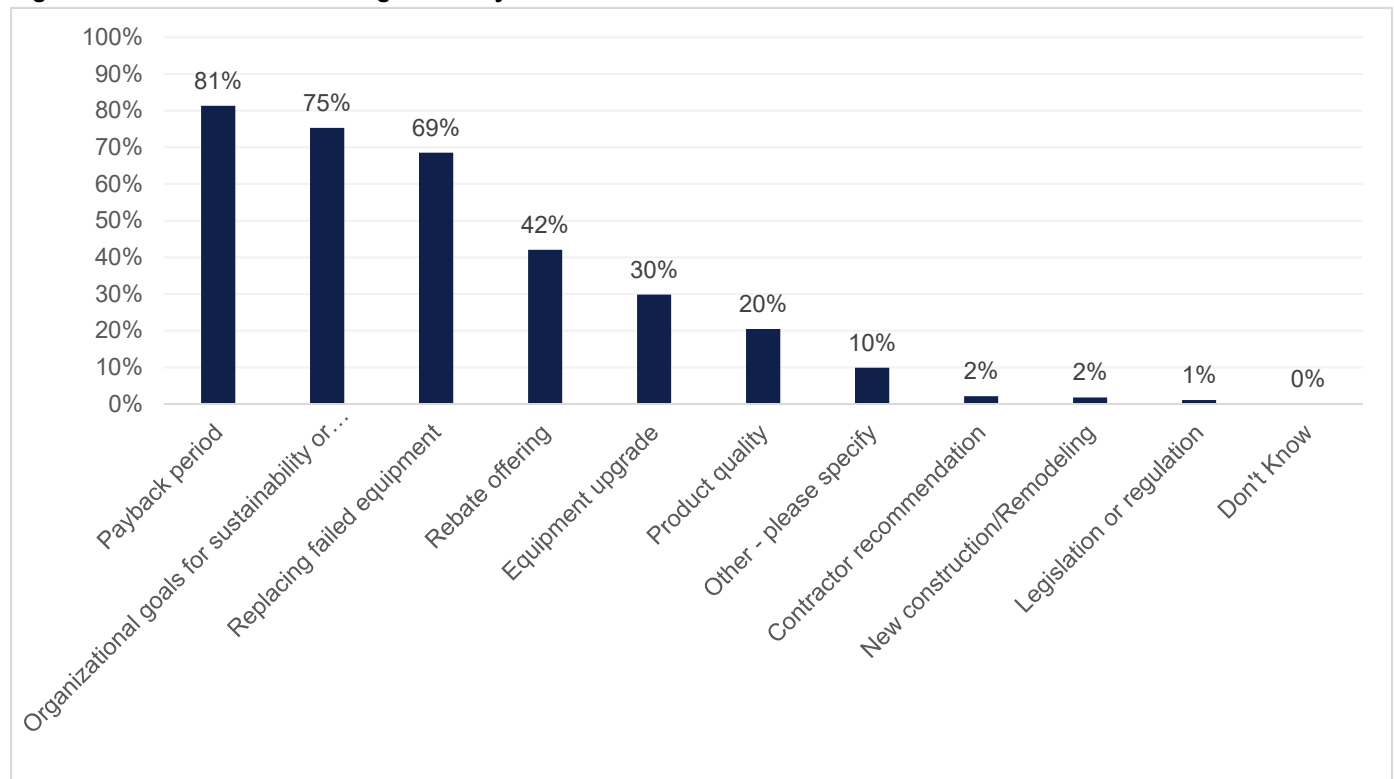
When asked if they prioritize projects based on the availability of utility rebates, 57% responded no, consistent with Figure 6-1. Lastly, when asked when they first considered upgrading their equipment, 35% responded that they considered upgrading after learning about the program.

When asked what payback period their organization required to invest in energy efficiency measures, 49% responded 3 to 4 years, and 29% responded that no specific payback period is required, as shown in Figure 6-2.

Figure 6-2: Required payback period to invest in energy efficiency measures

Legend:
- Less than 1 year
- 1 to 2 years
- 3 to 4 years
- Greater than 4 years
- Other - please specify
- No payback period requirement from organization
- Don't know/No response
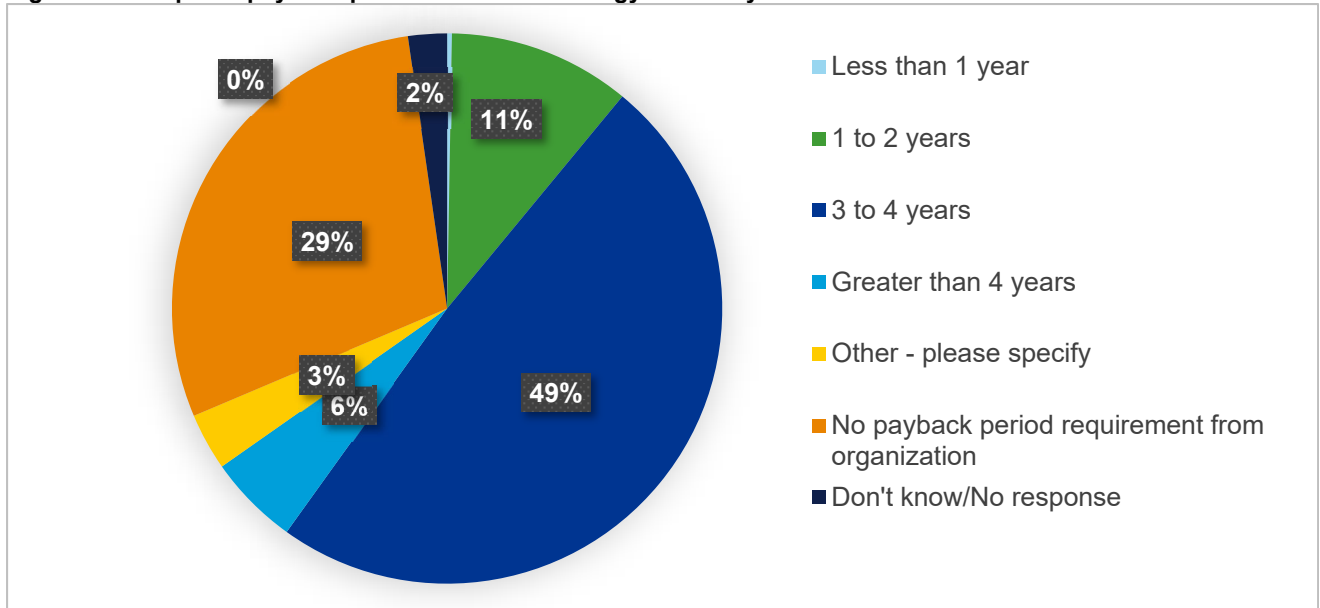
6.2   Customer Satisfaction

Respondents were asked questions related to their satisfaction with various aspects of program delivery, responses are displayed in Figure 6-3, all bars in the chart do not sum to 100% because the not applicable responses are not shown unless they are greater than one percent of responses. In general, the majority of respondents (>56%) were satisfied with all aspects of the program delivery. Timeliness of incentive payments had the lowest satisfaction because many respondents abstained from answering the question, no one reported a negative experience with the timeliness of payments. The survey also asked respondents about their satisfaction with the program overall resulting in 86% satisfaction, in Figure 6-4.

Figure 6-3: Satisfaction with various aspects of the Prescriptive Program
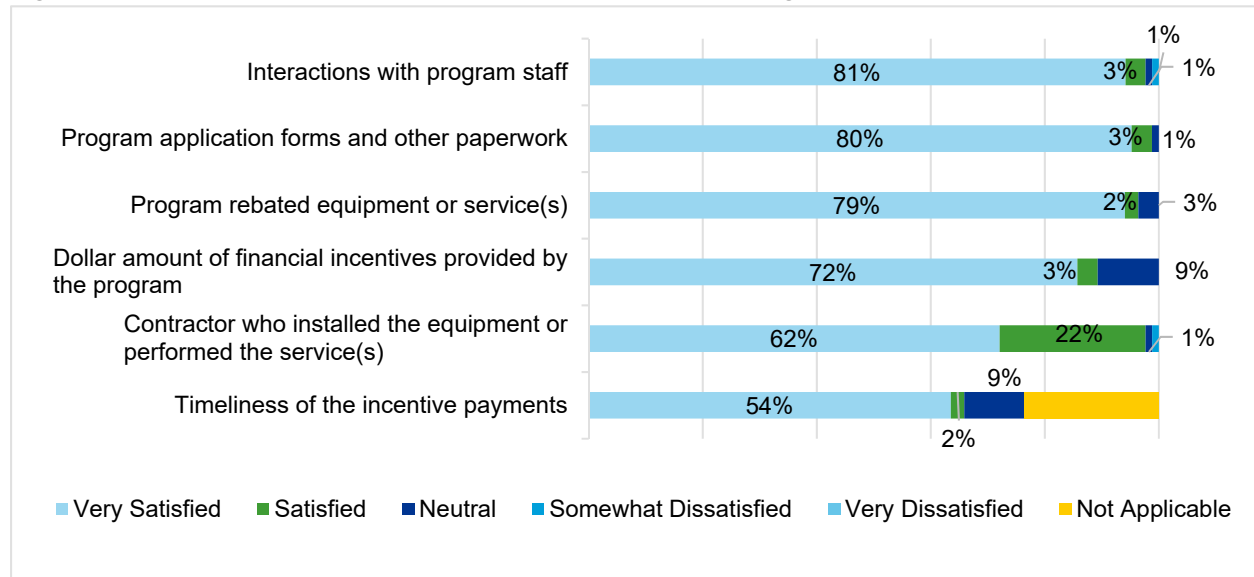
Figure 6-4: Satisfaction with the Prescriptive Program overall
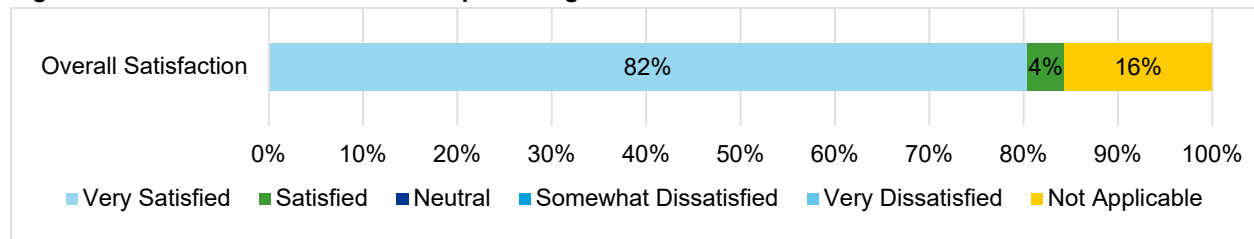
6.3   Evidence of Spillover

Spillover refers to additional energy-efficient measures adopted by a customer due to program influences, but without any financial or technical assistance from the program. Participant "like" spillover refers to the situation in which a customer installed energy-efficient measures through the program, and then installed additional measures of the same type due to program influences. Participant "unlike" spillover is a situation in which the customer installs different types of energy-efficient measures than those installed through the program but are influenced by the program to do so.[22] Non-participant spillover also occurs when the program promotes the acquisition of energy efficiency measures outside of the program by creating externalities that influence customer or vendor choices. For example, a vendor may choose to carry more energy-efficient widgets because the program is in effect, and may continue to do so after the program is over because there is leftover inventory or because customers find them more attractive than regular widgets.

This survey included three questions designed to gauge spillover:

[22] Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study, August 14, 2018

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1. Did participating in Dominion Energy's Non-residential Prescriptive Program lead to additional energy-saving measures at any other of your locations in Dominion Energy's service territory?

   a. Did you receive a rebate from Dominion Energy for those measures?

2. Which measures were installed in Dominion Energy's territory without a rebate?

3. What part(s) of your experience with Dominion Energy's program increased the likelihood that you would complete additional energy efficiency projects?

We found scant evidence of spillover. Four customers provided inconclusive evidence that participating in the program motivated them to adopt energy efficiency measures with no utility rebates. These customers are small (in strata 6 and 8), and thus have limited influence on program results.

In general, a better assessment of spillover requires a study that is conducted after, not during, the customers' program participation period. Even if the program persuades customers to adopt more energy efficiency measures, to do so during the program year is likely to result in additional program participation, not in true spillover.

APPENDIX A. NONRESIDENTIAL PRESCRIPTIVE PROGRAM PARTICIPANT SURVEY INSTRUMENT

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Dominion Energy Non-Residential Prescriptive Program Participant Survey

Dominion Energy Non-residential Prescriptive Program

Hello ,

This brief survey is being conducted on behalf of Dominion Energy with customers that participated in the Non-Residential Prescriptive Program implemented by Honeywell. Our data shows that you participated in this program sometime between 2017 and 2020. We would like to gain your first-hand knowledge and ask you about your experience with the program. The survey should take approximately 15-20 minutes. Your responses will be used to help plan future Dominion Energy programs to benefit customers and save energy.

According to Dominion Energy's records, your organization made the following energy efficiency improvements through the Non-Residential Prescriptive Program. Are you familiar with your organization's decision to participate in the Dominion Energy Non-Residential Prescriptive program for these project(s)?

	Yes	No	Don't recall
<Measure 1>	○	○	○
<Measure 2>	○	○	○
<Measure 3>	○	○	○
<Measure 4>	○	○	○

Is there someone else who might be better positioned to talk about the project(s) you were not involved in?

Name: _____

Title: _____

Phone number: _____

Email: _____

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Dominion Energy Non-Residential Prescriptive Program Participant Survey

Project Decision Making

What was your role and involvement in the project(s)? (select all that apply)

☐ Primary decision maker

☐ One of the decision makers

☐ Financial input

☐ Technical input

☐ Worked with/identified vendors

☐ Not involved with decision making

☐ Other - please specify _____

When your organization considers investments in your building systems in general, what criteria are you looking at when making that decision? (select all that apply)

☐ Organizational goals for sustainability or energy efficiency

☐ Legislation or regulation

☐ Rebate offering

☐ Equipment upgrade

☐ Replacing failed equipment

☐ New construction/Remodeling

☐ Product quality

☐ Contractor recommendation

☐ Payback period

☐ Don't Know

☐ Other - please specify _____

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What is the payback period your organization would require in order to invest in energy efficiency measures?

○ Less than 1 year

○ 1 to 2 years

○ 3 to 4 years

○ Greater than 4 years

○ No payback period requirement from organization

○ Don't know

○ Other - please specify

Does your organization prioritize projects based on the availability of utility rebates?

○ Yes

○ No

○ Don't know

○ Other - please specify

Dominion Energy Non-Residential Prescriptive Program Participant Survey

<Measure> Segment

For the following set of questions we would like you to consider how the Dominion Energy Non-Residential Prescriptive program impacted the scope and timing of the *<measure>* project(s).

Our records show that your company completed *<measure>* projects at locations such as, *<Address 1>*, *<Address 2>*, *<Address 3>*. Does that sound correct?

○ Yes

○ No, the equipment/service is wrong

○ No, the site addresses are wrong

○ No, both the equipment and site addresses are wrong

○ No projects were done at these sites

If _<measure>_ is incorrect, please describe the correct equipment type/service for these sites.

	Information is correct	Record Correction	Don't Know
Actual equipment type/service for <Address 1>	○		○
Actual equipment type/service for <Address 2>	○		○
Actual equipment type/service for <Address 3>	○		○

Please enter the correct addresses where the _<measure>_ project(s) were completed.

	Information is correct	Record Correction	Don't Know
<Address 1>	○		○
<Address 2>	○		○
<Address 3>	○		○

When did you first consider the _<measure>_ project(s)?

○ Prior to learning about the program
○ After learning about the program
○ Don't know
○ Other - please specify

Without Dominion Energy's program, how likely was it you would have completed the <measure> project(s)?

○ Very likely
○ Somewhat likely
○ Not very likely
○ Very unlikely
○ Would not have completed the project at all
○ Don't know

Without Dominion Energy's program offering, when would you have completed the *<measure>* project(s)?

- ○ At the same time or earlier
- ○ 1-12 months later
- ○ 13-24 months later
- ○ 25 to 36 months later
- ○ 37 to 48 months later
- ○ More than 48 months later
- ○ Never
- ○ Don't know

Without Dominion Energy's program, would you have invested in the same *<efficiency/quality/extensiveness>* of *<measure>*? Would you say you would have invested in a *<measure>* that was of:

- ○ Equal *<efficiency/quality/extensiveness>*
- ○ Higher *<efficiency/quality/extensiveness>*
- ○ Lower *<efficiency/quality/extensiveness>*
- ○ Would not have completed the *<measure>* project(s) at all
- ○ Don't know

Without program assistance, how many *<measure>* would you have invested in? Would you have invested in:

- ○ the same number
- ○ more
- ○ fewer
- ○ Don't know

How many *<more/fewer>* would you have done?

	Record Response	Don't know
Quantity		☐

Would you estimate that you would have done:

- ○ Less than 25% *<more/fewer>*
- ○ 25% - 50% *<more/fewer>*
- ○ 51% - 75% *<more/fewer>*
- ○ Greater than 75% *<more/fewer>*

Measure Segment repeated for each measure – max 4 measures

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Dominion Energy Non-Residential Prescriptive Program Participant Survey

Spillover

Did participating in Dominion Energy's Non-Residential Prescriptive Program lead to additional energy-saving measures at any other of your locations in Dominion Energy's service territory?

- ○ Yes
- ○ No
- ○ Don't know

Did you receive a rebate from Dominion Energy for those measures?

- ○ Yes, all
- ○ Yes, some
- ○ No, none
- ○ Don't know

Which measures were installed in Dominion Energy's territory _without_ a rebate?

- ☐ AC Tune-up
- ☐ Auto-closers
- ☐ Condenser Coil Cleaning
- ☐ Door Gaskets
- ☐ Duct Test and Seal
- ☐ Evaporator Fan Control
- ☐ Low/No Sweat Door Film
- ☐ Night Cover
- ☐ Strip Curtains
- ☐ Convection Oven
- ☐ ECM Evaporator Fan
- ☐ Electric Fryer
- ☐ Freezer and Refrigerator
- ☐ Griddle
- ☐ Hot Food Holder
- ☐ Ice Maker
- ☐ Steam Cooker
- ☐ VSD at Kitchen Exhaust Fans

What part(s) of your experience with Dominion Energy's program increased the likelihood that you would complete additional energy efficiency projects?

Need Help? DNV GL has been hired by Dominion Energy to manage this study. DNV GL support representatives can be reached by emailing: Geoffrey.Mitchill@dnvgl.com

Completed: 82%

DNV

Dominion Energy Non-Residential Prescriptive Program Participant Survey

Program Satisfaction

How satisfied are you with the following aspects of the Dominion Energy Non-Residential Prescriptive Program?

	Very Satisfied (5)	Satisfied (4)	Neutral (3)	Somewhat Dissatisfied (2)	Very Dissatisfied (1)	Not applicable
Program rebated equipment or service(s)	○	○	○	○	○	○
Contractor who installed the equipment or performed the service(s)	○	○	○	○	○	○
Dollar amount of financial incentives provided by the program	○	○	○	○	○	○
Timeliness of the incentive payments	○	○	○	○	○	○
Program application forms and other paperwork	○	○	○	○	○	○
Interactions with program staff	○	○	○	○	○	○

Why are you less than satisfied with the program rebated equipment or service(s)?

Why are you less than satisfied with the contractor who installed the equipment or performed the service(s)?

Why are you less than satisfied with the dollar amount of financial incentives provided by the program?

Why are you less than satisfied with the timeliness of the incentive payments?

Why are you less than satisfied with the program application forms and other paperwork?

Why are you less than satisfied with your interactions with program staff?

How satisfied or dissatisfied are you with the Dominion Energy Non-Residential Prescriptive Program overall?

Very Satisfied (5)	Satisfied (4)	Neutral (3)	Somewhat Dissatisfied (2)	Very Dissatisfied (1)	Not applicable
○	○	○	○	○	○

Why are you less than satisfied with the program overall?

DNV

Dominion Energy Non-Residential Prescriptive Program Participant Survey

What, if anything, could Dominion Energy do to get more companies or organizations to participate in the program?

What, if anything, could Dominion Energy do to improve the program?

Need Help? DNV GL has been hired by Dominion Energy to manage this study. DNV GL support representatives can be reached by emailing: Geoffrey.Mitchill@dnvgl.com

Completed: 93%

Dominion Energy Non-Residential Prescriptive Program Participant Survey

Closing

Is there any other feedback you would like to provide to Dominion Energy regarding the Non-Residential Prescriptive Program?

It may be necessary for someone to contact you again for clarification of certain answers. May we follow up with you if needed?

○ Yes

○ No

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Can you provide an alternate contact at your business who is familiar with the energy efficiency project(s)?

○ Yes

○ No

Who do you suggest we contact?

Name: _____

Email: _____

Phone: _____

Those are all the questions I have for you today. Thank you.

Need Help? DNV GL has been hired by Dominion Energy to manage this study. DNV GL support representatives can be reached by emailing: Geoffrey.Mitchill@dnvgl.com

Completed: 100%

APPENDIX B.   SURVEY SAMPLE WEIGHTS

The Non-residential Prescriptive Program survey was completed by 45 organizational representatives, who represented 85 participating sites (for example, a chain of grocery stores has the same representative, but each grocery store is a separate site.) Of the responding sites, DNV performed onsite visits at 41 sites. These visits comprised of verification of all installed measures and measurement of compressor/condenser loads for condenser coils and VSDs on kitchen exhaust fans.

The list of program participants consisted of 621 organizational representatives that represented 2,003 sites. All organizational representatives were invited to participate in the survey, which was implemented via e-mail with phone call follow-ups.

The program population was somewhat unique because a small group of decision makers were responsible for a large proportion of the program savings. In order to reduce survey participant burden and maximize our time with survey participants, those sites were segmented into their own strata. The first five strata were all national retail chains that had one point of contact for multiple sites. These accounted for almost 73% of program savings and 25% of participant facilities.

Figure 6-5 provides a graphical representation of how the number of facilities and the savings were distributed among the top five strata and the remaining three strata that were segmented by size. There were also retail chains and respondents that represented multiple sites within strata six through eight, but they did not represent the same concentration of savings as the first five strata. Note that strata eight had the smallest average savings and even though there were more than 1,300 sites (65% of the total population of sites) they only represented about 9% of program savings.

Figure 6-5: Facility and Savings Distribution by Sample Design Strata

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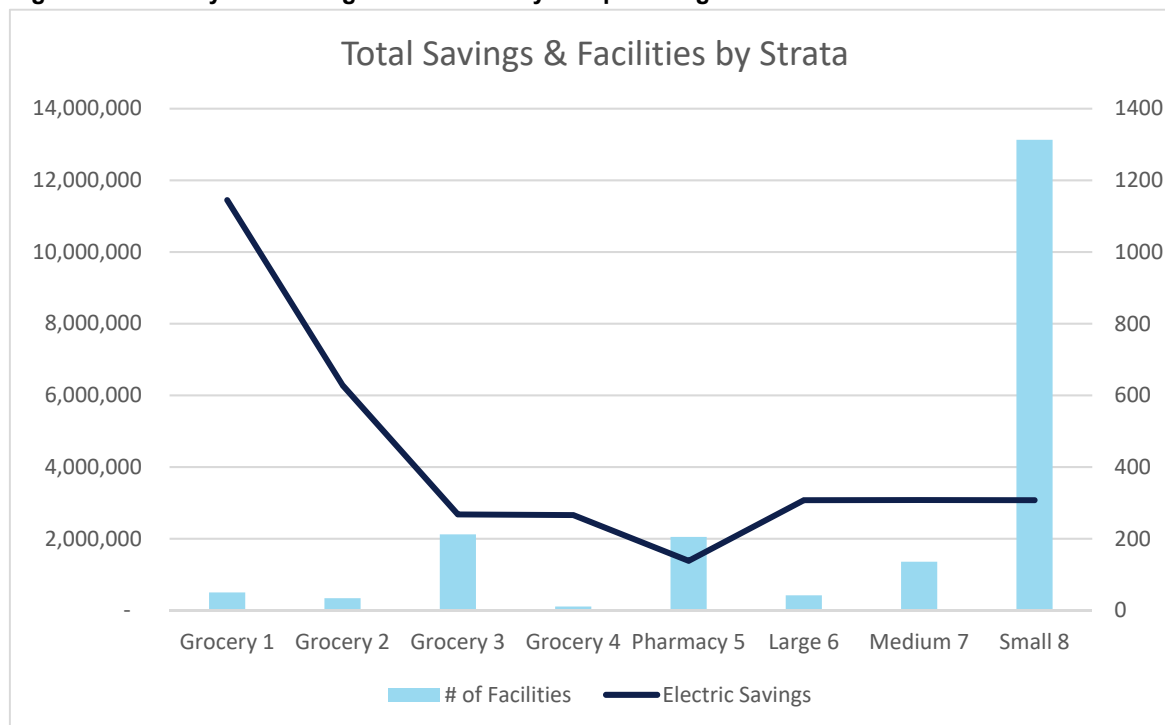
Looking at the response rate on a frequency basis, the survey captured responses for 33% of participant facilities, and about 2% of sites participated in the onsite portion of the study, as summarized in Table 6-1. However, due to the leverage achieved in the sample design, survey respondent savings represented 71% of total program savings.

Table 6-1. Summary of response rates

Sample	Frame Total	Respondents	Response Rate	Respondents Provided Data That Were Used in the Following
Survey Sites	2003	665	33%	Attribution & Customer Satisfaction Analysis
Onsite M&V	2003	39	2%	Realization Rate Analysis

The onsite sample design was developed at the facility level and targeted the high savings measures, because recruiting participants and conducting onsite visits are done one facility at a time. The program participants had multiple measures implemented at each facility. To improve the cost effectiveness of the sample, all of the measures at a facility were included in the analysis and the expansion of savings impacts were done at the measure level. Since the savings expansion was done at the measure level, using facility-level sampling weights would have skewed results unnecessarily and added complex adjustment steps. Therefore, the survey NTGRs and onsite gross measure level savings impacts were calculated proportionally to their tracking savings values. Table 6-2 and Table 6-3 provide the measure level customer survey, and measure level onsite savings percentages (respectively) that were utilized to estimate the savings impacts and net to gross ratios.

Table 6-2. Measure-level Customer Survey Savings

Variable	Population Totals	Respondents		
		Sample	Percent Included	Percent Analyzed
Measure-Level Total				
Total	33,691,659	23,938,075	71%	29%
Measure Type				
AUTO-CLOSERS	53,520	21,770	41%	59%
CONDENSER COIL CLEAN	19,156,513	16,814,363	88%	12%
DOOR GASKET	4,782,290	3,843,882	80%	20%
ECM AT EVAPORATOR FAN	105,246	82,748	79%	21%
FREEZER AND REFRIGERATOR	47,346	42,375	90%	10%
ICE MAKER	13,746	3,764	27%	73%
LOW/NO SWEAT DOOR FILM	227,191	131,803	58%	42%
NIGHT COVER	153,406	-	0%	100%
STRIP CURTAINS	868,249	599,521	69%	31%
EVAPORATOR FAN CONTROL	27,937	-	0%	100%
AC TUNE UPS	3,980,530	1,589,635	40%	60%
DUCT TEST AND SEAL	4,078,198	674,034	17%	83%
VSDS AT KITCHEN EXHAUST FAN	88,672	88,672	100%	0%

Variable	Population Totals	Respondents		
		Sample	Percent Included	Percent Analyzed
HOT FOOD HOLDER	45,777	45,507	99%	1%
CONVECTION OVEN	1,132	-	0%	100%
ELECTRIC FRYER	37,649	-	0%	100%
STEAM COOKER	19,748	-	0%	100%
GRIDDLE	4,510	-	0%	100%

Table 6-3. Onsite Measure-level Savings Sample

Variable	Population Totals	Onsite Sample		
		Sample	Percent Included	Percent Analyzed
Measure-Level Total				
Total	33,691,659	2,869,948	9%	91%
Measure Type				
AUTO-CLOSERS	53,520	1,305	2%	98%
CONDENSER COIL CLEAN	19,156,513	2,265,157	12%	88%
DOOR GASKET	4,782,290	299,467	6%	94%
ECM AT EVAPORATOR FAN	105,246	-	0%	100%
FREEZER AND REFRIGERATOR	47,346	5,351	11%	89%
ICE MAKER	13,746	-	0%	100%
LOW/NO SWEAT DOOR FILM	227,191	-	0%	100%
NIGHT COVER	153,406	-	0%	100%
STRIP CURTAINS	868,249	46,076	5%	95%
EVAPORATOR FAN CONTROL	27,937	-	0%	100%
AC TUNE UPS	3,980,530	110,370	3%	97%
DUCT TEST AND SEAL	4,078,198	137,432	3%	97%
VSDS AT KITCHEN EXHAUST FAN	88,672	-	0%	100%
HOT FOOD HOLDER	45,777	4,790	10%	90%
CONVECTION OVEN	1,132	-	0%	100%
ELECTRIC FRYER	37,649	-	0%	100%
STEAM COOKER	19,748	-	0%	100%
GRIDDLE	4,510	-	0%	100%

DNV

APPENDIX C.   ONSITE DATA COLLECTION METHODS

The following sections outline detailed data collection procedures for each measure type installed during the evaluation period. The sections are organized by general measure types based on the types of systems impacted by the measures as follows:

- Refrigeration system measures

    – Condenser coil cleaning
    – Door gaskets
    – Auto door closers
    – Strip curtains
    – ESTAR freezer and refrigerator

- HVAC measures

    – AC tune-ups
    – Duct test and seal

- Other Measures

    – VSD on kitchen exhaust fans
    – Ice Machines
    – Hot food holders

Condenser Coil Cleaning Measures for Refrigeration Systems

The savings for this measure are due to improved thermal conductivity due to the cleaning of the condenser coils. The savings varies based upon the type of refrigerant and the system operating parameters i.e. the saturated suction temperature (SST) and the saturated condensing temperature (SCT). Savings are determined as a function of the refrigeration capacity, the refrigeration system efficiency and the hours of use in the original savings equation.

During the onsite visits, DNV field engineers utilized the refrigeration system plans and nameplate data to calculate the refrigeration system load, which is determined the compressor capacity at the operating SST and SCT that is served by condensing unit identified in the tracking system. The nameplate data and rated capacity of the condensers were also collected to make sure that they had sufficient capacity to meet the compressor load plus the heat of compression, which is referred to as the total heat rejected (THR).

The onsite engineers also installed interval power meters on the compressors serving the system so that the annual operating hours could be calculated. Since the metering occurred during winter months the only way to measure the system load was by metering the compressors since the condensers power load would be at or close to zero due to low ambient temperatures require minimum fan operation to meet the load. Figure 6-6 provides a picture of a Dent Elite power meter installed on circuits serving a compressor rack at a grocery store.

Figure 6-6: Dent Elite Power Meter Installed on Circuits serving Refrigeration Compressor Rack
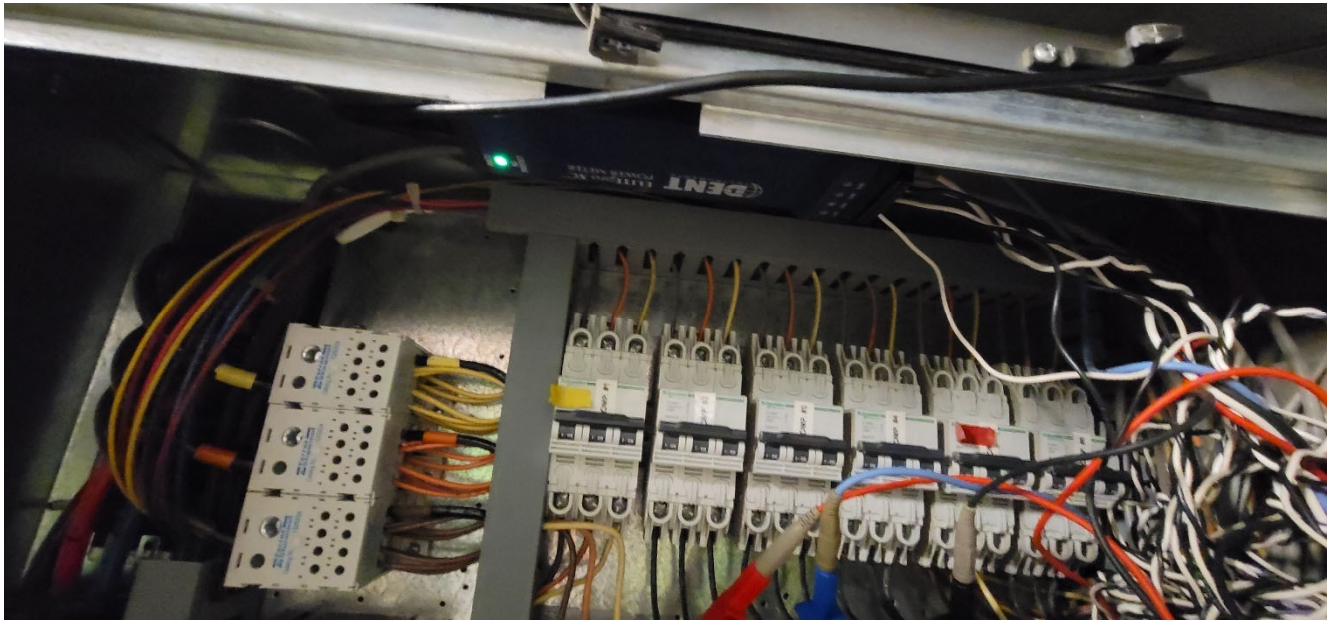
The onsite data collection process was somewhat complicated by the fact that only the condenser unit was documented in the tracking data so the first step in the process was to locate all of the participating condenser units and then identify the refrigeration compressor rack the condensers were serving. Table 6-4 provides the onsite data collection instrument that shows the tracking data available at the top of the form and the additional data that need to be collected to verify the savings in the question and answer section.

Table 6-4: Condenser coil cleaning measure onsite data collection

Items to Verify	Value to Verify	Verification
Manufacturer	Hussman LCVR 6310K	
Refrigeration_System_Load	684,000	
Freezer_Refrigerator	Refrigerator/cooler (high temperature)	
Quantity	1	
Questions	**Answers**	
Store Refrigeration Rack ID	Rack B	
Total Evaporator Capacity (BTUh)	265,100	
Total Compressor Capacity (BTUh)	312,900	
Percent Compressor Load	84.7%	
Total Compressor RLA	132.9	
Saturated Suction Temperature (SST)	15	
Saturated Condensing Temperature (SCT)	110	
Total Heat Rejected (THR) (BTUh)	431,000	
Heat of Compression	1.38	

DNV

Door Gaskets Replacement Measure

The savings for this measure are due to replacing worn out door gaskets on refrigerated cooler and freezer doors to reduce infiltration into the refrigerated spaces. The savings tracking data only tracked the product manufacturer, lineal feet of the door gaskets and the refrigeration case temperature category, either freezer (low/medium temperature) or refrigerated cooler (high temperature) and the type of door, reach-in or walk-in. Since the grocery stores typically utilize the same manufacturer for their case it was somewhat difficult to match up the lineal feet of gaskets with the

Onsite field engineers visually verified the installation and condition of the gasket upgrades on all sampled units. They tracked refrigeration unit make and model, noting whether the unit was being used as a cooler or freezer. Engineers measured the length of the gasket and noted whether it extended entirely around the perimeter of the door.

The onsite data collection instrument for door gaskets is shown in Table 6-5.

Table 6-5: Door gasket onsite data collection instrument

Item to Verify	Value to Verify	Verification
Manufacturer	Anthony	
Quantity	172	
Quantity_Unit	Length, in feet	
Door_Type	Vertical, closed, glass door	
Freezer_Refrigerator	Refrigerator/cooler (high temperature)	
Question	**Answer**	
Door Quantity		
Door height (inches)		
Door width (inches)		
Total lineal feet/door		
Total lineal feet		
Case Temperature		
Freezer/Cooler		

Most door gaskets were installed over a year before onsite verification. This allowed field engineers to verify the proper installation of gaskets such that they were durable over a year of normal operating conditions. Further, new gaskets had not been installed for long periods such that engineers could distinguish between upgraded gaskets and the older gaskets that may still exist on other units at the site.

Walk-in Door Closers for Coolers and Freezers

Walk-in door closers, also called auto-closers, were installed on refrigeration doors in order to prevent incomplete closure. These spring-loaded latches pull the door into a fully closed position after an employee or the door's weight has brought it to a nearly closed position. Without the auto-closer, doors can stay slightly ajar, allowing conditioned air to escape the cooler or freezer. When auto-closers are properly installed and operating correctly, they eliminate leakage and save energy use of refrigeration systems.

During onsite visits, DNV field engineers verified the installation of all auto-closers and checked for proper operation through manual tests. Refrigeration unit tracking data was also verified, including system age, manufacturer, model, door size, and refrigerated products contained. Table 6-6shows the data collection instrument used for walk-in door closers in the field.

Table 6-6: Auto-closer onsite data collection instrument

Item to Verify	Value to Verify	Verification
Manufacturer	BROWN	
Quantity	3	
Quantity_Unit	Number of unit(s) installed	
Door_Type	Walk-in	
Freezer_Refrigerator	Freezer (low or medium temperature)	
Question	**Answer**	
Door Quantity		
Door Type		
Door height (inches)		
Door width (inches)		
Total area/door		
Total area (SQFT)		
Case Temperature		
Freezer/Cooler		

Field engineers document when the walk-in door closers are either malfunctioning or not being used properly. An example of a malfunctioning auto-closer is shown in Figure 6-7, in which the device was not properly attached to the door. Without the closer being snug against the door and firmly attached, the latch did not properly pull the door closed. Other factors, such as damage to the door frame, can impede the door from closing completely and the auto-closer from performing its task. Situations such as these were noted and included in the evaluation of this measure.

Figure 6-7. Malfunctioning walk-in door closer

Strip Curtains in Freezers and Coolers

Strip curtains were installed in walk-in or reach-in refrigeration units in order to reduce the leakage of conditioned air when the door is open. These devices are especially effective when installed on high-traffic doors, or doors that remain open for significant periods of time. Onsite verification of this measure included confirming quantities and condition of installed strip curtains, then recording refrigeration unit characteristics and the type of product stored in the unit. Building operators were asked whether the installed curtains replaced existing strip curtains, or whether no curtains previously existed.

Table 6-7 shows the data collection instrument used in the field.

Table 6-7: Strip curtain onsite data collection instrument

Item to Verify	Value to Verify	Verification
Manufacturer	BROWN	
Quantity	2	
Quantity_Unit	Number of unit(s) installed	
Size1	41	
Size1_Unit	Area of strip curtain, sq. ft.	
Freezer_Refrigerator	Refrigerator/cooler (high temperature)	
Question	**Answer**	
Door Quantity		
Door Type		
Door height (inches)		
Door width (inches)		
Total area/curtain		
Total area (SQFT)		
Case Temperature		
Freezer/Cooler		

ENERGY STAR Refrigeration Freezers and Coolers

This measure involved the installation of ENERGY STAR® qualified commercial refrigeration freezers and coolers that save energy because they are more efficient than the standard baseline new units. These models are designed for warm commercial kitchen environments with frequent door opening. Qualifying equipment utilize a variety of energy-efficient components such as ECM fan motors, hot gas anti-sweat heaters, or high efficiency compressors. The savings for the units are based upon the volume of the unit, type (freezer/refrigerator), configuration (vertical/horizontal) and door type (solid/transparent). There are usage values for baseline and efficient models based on the volume and the other attributes and all of these need to be known in order to calculate savings.

DNV

Table 6-8 provides the onsite data collection instrument that was used to verify the installation and savings for this measure. Since the savings were based on the interior volume of the units that onsite engineers measured the interior of the cases to verify the tracking volume as well as visually verifying the other attributes used for the savings calculation.

DNV

Table 6-8: ENERGY STAR freezer and cooler data collection instrument

Item to Verify	Value to Verify	Verification
Manufacturer	TRAUSLEN	
Model_Number	G12010-32	
Quantity	1	
Quantity_Unit	Number of unit(s) installed	
Size1	23.4	
Size1_Unit	Interior volume, cubic feet	
Freezer_Refrigerator	Refrigerator/cooler (high temperature)	
Door_Type	Vertical, closed, non-transparent door	
Question	**Answer**	
Interior case depth (Inches)		
Interior case width (Inches)		
Interior case height (inches)		
Interior case volume (cubic ft)		
Case type (vertical/horizontal)		
Door type (Solid/Transparent)		
Case Temperature		
Freezer/Cooler		

Air Conditioning Tune-Ups Measure

This measure involves tuning up packaged air conditioning units, heat pump units (both air and ground source), and air-cooled and water-cooled cooled chillers at small commercial and industrial sites. Algorithms and inputs to calculate heating, cooling savings, and demand reductions for unitary/split HVAC and package terminal AC system tune-ups are provided below. The savings calculations vary slightly based on the HVAC type and capacity which primarily impacts the efficiency variable and the EFLH for cooling and heating. There are no heating savings if the primary heating fuel is non-electric.

The primary objective of the on-site data collection activity will be to locate and verify the HVAC equipment that was impacted by the tune-up measure. Since savings area function of the unit capacity, whether there is electric heat and the EFLH data collection should focus on these issues. The On-site verification activities are as follows:

- Verify all of the units included in the AC Tune-up measure by matching the manufacturer and model number for each Record_ID and record all nameplate data and any site specific ID system so that site data can be matched with the unit

  – Verify that the system type is correctly specified in the tracking data
  – Verify that the system capacity is accurate for the system
  – Verify that primary heating fuel electric is accurate and identify whether it is heat pump or electric resistance heat

- Collect heating and cooling setpoint and operating schedule for the measure units

Inquire about obtaining Energy Management System trend data for the measure HVAC equipment specifically compressor cycling data or supply and return temperature data with airflow can be used to estimate the cooling and heating EFLH.

DNV

Table 6-9 provides the onsite data collection form for the AC tune-up measure.

DNV

Table 6-9: Air Conditioning Tune-up measure onsite data collection form

Item to Verify	Value to Verify	Verification
AC_Type	Packaged Terminal AC	
Manufacturer	4 Seasons	
Model_Number	1SPK35-0874-PN9.8-35	
Serial		
SEER	10	
EER	9.2	
IEER		
COP	2.7	
HSPF		
Primary_Heating_Fuel		
Size1		
Chiller_IPLV_EER		
Chiller_Water_Setpoint_F		
RCA_Performed		
Question	**Answer**	
Building occupancy schedule		
Cooling tempertaure setpoint schedule		
Heating temperature setpoint schedule		
Heating system type		

Duct Test and Sealing Measure

This measure produces savings by reducing conditioned air leakage to unconditioned space by first testing the pre-treatment leakage utilizing an aerosol-based product to seal the ducts and then perform a post treatment duct leakage test. Eligible ductwork is connected to HVAC system and occurs within an unconditioned plenum space or between an insulated, finished ceiling and a roof surface. As with the AC tune-up measure there are no heating savings if the primary heating fuel is non-electric.

Although this measure accounts for a significant portion of program savings, there was no opportunity to install any metering equipment or taking spot power measurements primarily because most of the savings are cooling savings and the on-site activity took place in the winter. The primary goal of the on-site will be to identify the HVAC systems included in the measure using the tracking manufacturer and model data and to confirm that the system type, system capacity and duct insulation level are accurate.

The other factor that is extremely important is to verify that units that indicate electric as the primary heating type are accurate. There are numerous examples in the sample data where a unitary AC is indicated along with "electric" as the primary heat. This is suspicious because these units should most likely be identified as unitary heat pumps, which don't appear anywhere in the sample. The unitary AC units could have electric resistance heat but are more likely to have a natural gas as the heat source or be heat pumps that were misclassified. Collecting the nameplate data is important along with looking for that telltale black iron pipe that indicate natural gas. Table 6-10 provides the onsite data collection form for the duct testing sealing measure.

DNV

Table 6-10: Duct Test and Sealing measure onsite data collection form

Item to Verify	Value to Verify	Verification
Manufacturer	CARRIER	
Model_Number	48TJF028	
Serial	Not Reported	
Size1 (cooling capcity tons)	25	
Size2 (heating capacity BTUh)	300,000	
Sq_Foot_of_Conditioned_Space	6,875	
Primary_Heating_Fuel	Non-electric	
AC_Type	Unitary AC: Single Packaged	
Fan_System_Type	Fan - Forward curved	
SEER	0	
EER	10	
COP	2.52	
HSPF	0	
Duct_Type	Flex-duct	
Duct_Testing_Method	Total Leakage Duct Blaster	
Duct_Insulation_R_Value	R2 insulation	
CFM25_Leakagepre	3010	
CFM25_Leakage_PCTpre	30	
CFM25_Leakagepost	1208	
CFM25_Leakage_PCTpost	12	

Question	Answer
Building occupancy schedule	
Cooling tempertaure setpoint schedule	
Heating temperature schedule	
Heating system type	
Are the ducts in unconditioned space?	
What is the building business type?	

Variable Speed Drive on Kitchen Exhaust Fans Measure

This measure involves the installation of variable speed drives (VSDs) at commercial kitchen exhaust fans so that the fan motor speed matches the demand. The baseline condition is the manual on/off switch and magnetic relay or motor starter for commercial kitchen hoods. The baseline assumes that the fan operates at full speed while in operation.

This measure involves retrofitting a VSD controller at an existing kitchen exhaust fan with a make-up-air fan. The measure includes optical and temperature sensors to detect the level of cooking activity and modulate the speed of the exhaust-air fan accordingly. The optical and temperature sensor(s) are typically located either in the collar of or the inlet to the exhaust-fan hood. The kitchen hood exhaust fans are modulated automatically to vary the exhaust airflow rate and make-up

(ventilation) air by adjusting the exhaust and make-up air fan speeds. The savings for this measure have two components, the first being the direct savings in exhaust fan motor load due to reduced speed a the second being the interactive savings due to decreased electric cooling and heating loads due to reduced make-up air. If the fans are operating in unconditioned space that is not cooled or electrically heated, then there would not be no interactive savings. Table 6-11 provide the onsite data collection form for the VSD on kitchen exhaust fan measure.

Table 6-11: VSD on Kitchen exhaust fan measure onsite data collection form

Item to Verify	Value to Verify	Verification
VFD manufacturer	CAPTIVE AIRE	
VFD model number	00318OT3E56Z-48PP	
Size2 (Exhaust fan hp)	3	
Quantity	3	
AC_Type	Unitary AC: Split System Air Conditioning	
Size1 (Floor area kitchen)	1500	
Avg_Hours_Used_per_Day	12	
Days_Used_per_Year	365	
Make_Up_Air_Cooling	Yes	
Make_Up_Air_Electric_Heating	Yes	
Make_Up_Air_COP_Cooling	Not Reported	
Make_Up_Air_COP_Heating	Not Reported	
Exhaust_Fan_Efficiency	Not Reported	
Question		**Answer**
What is annual operating schedule of the exhaust fans?		
What AC unit cools the space served by the exhaust fans?		
What is the primary heating fuel type?		
Is electric heating unit serves the kitchen space?		

In addition to visually verifying the installation of the VSD controlled exhaust fans, the DNV engineer installed interval power meters to monitor the operating schedule of the exhaust fan for a period of about four weeks and collected 5-minute interval data. These data were used to calculate the power savings of the fan motors as well as the decrease in makeup airflow attributable to the VSD controls.

Figure 6-8: Dent Elite Power Meter Installed on VSD Kitchen exhaust fan

Hot Food Holding Cabinet Measure

This measure involves installing an ENERGY STAR® qualified commercial hot food holding cabinet. The installed equipment will incorporate better insulation, reducing heat loss, and may also offer additional energy saving devices such as magnetic door gaskets, auto-door closures, or dutch doors. The baseline equipment is assumed to be a standard efficiency hot food holding cabinet. The savings for this measure are based on the volume of the unit and the annual operating schedule. The DNV engineers will confirm the inside dimensions of the unit to calculate the volume. Table 6-12 provides the data collection form for the hot food holder measure.

DNV

Table 6-12: Hot Food Holder onsite data collection form

Item to Verify	Value to Verify	Verification
Manufacturer	Traulsen	
Model_Number	G14310	
Quantity	1	
Size1 (cubic feet)	24	
Idle_kW_Rate		
Days_Used_per_Year	364	
Avg_Hours_Used_per_Day	10	
Question	**Answer**	
What is the inside height, width and depth of the unit?		
What is annual operating schedule of the hot food holder?		
How many hours per day is the hot food holder used?		
How many days per year is the hot food holder used?		

Ice Maker Measure

This measure involves high-efficiency ice makers meeting ENERGY STAR® or CEE Tier 2 ice maker requirements. The measure applies to batch type (also known as cube type) and continuous type (also known as flake or nugget type) equipment. The equipment includes ice-making head (without storage bin), self-contained, or remote-condensing units. ENERGY STAR® ice makers are limited to only air-cooled units while CEE Tier 2 standards address water-cooled units. The baseline for each type of ice maker is the corresponding Federal standard for the same technology. Table 6-13 provides the data collection form for the ice maker measure.

Table 6-13: Ice maker onsite data collection form

Item to Verify	Value to Verify	Verification
Manufacturer	Scotsman	
Model_Number	C0322MW-1E	
Quantity	12	
Quantity_Unit	Number of unit(s) installed	
Size1	366.00	
Size1_Unit	Rated harvest rate, lb/day	
Ice_Maker_Type	Ice-making head	
Ice_Maker_Batch_Continuous	Continuous	
Ice_Maker_Air_Water_Cooled	Water-cooled	
Question	**Answer**	
Is the ice maker a contiuous or batch style machine?		
Type ofice maker, ice making head, remote condenser, or self-contained style?		
Is the condenser air cooled or water cooled?		
Is ice maker ube/nugget or flake type?		
Does the ice maker operate 24 hours per day 365 days per year?		

APPENDIX D.   SAVINGS ESTIMATION APPROACH

This Appendix describes the analysis procedures used for each measure that was evaluated as part of the Prescriptive program in this evaluation period.

Adjusted gross energy savings and demand reductions for this program were calculated using the deemed energy savings and demand reductions equations from STEP Manual version 10 where key parameters have been either measured or verified onsite.

Physically accessible measures allowed the collection of metered data for key parameters. In this evaluation period, metered data was collected for the refrigeration condenser coil cleaning measure and the VSD on kitchen exhaust fans. All other measures were evaluated through onsite verification of key parameters.

Condenser Coil Cleaning Measure Savings Analysis

The savings for this measure are due to improved thermal conductivity due to the cleaning of the condenser coil. This savings varies based upon the type of refrigerant used in the system. The energy savings calculation uses the following equation:

$$\Delta kWh = \frac{load}{12{,}000\,\frac{BTU}{\frac{h}{ton}}} \times \frac{3.156\,\frac{kW}{ton}}{COP} \times HOU \times ESF$$

Demand Savings is calculated using the following:

$$\Delta kW = \frac{load}{12{,}000\,\frac{BTU}{\frac{h}{ton}}} \times \frac{3.156\,\frac{kW}{ton}}{COP} \times DRF$$

Where:

ΔkWh	=	per measure gross annual energy savings
ΔkW	=	per measure gross coincident demand reduction
load	=	total capacity of condensers (BTU per hour)
COP	=	coefficient of performance of refrigeration equipment
ESF	=	savings factor attributable to coil cleaning for annual energy
DRF	=	savings factor attributable to coil cleaning for demand reductions
HOU	=	annual hours of use

Savings are determined as a function of the refrigeration capacity, the refrigeration system efficiency and the hours of use in the original savings equation. The COP and hours of use have prescriptive values based on the evaporator temperature or suction group temperature which is divided into cooler(high/medium) and freezer (low temperature).

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Table 6-14 provides the condenser coil savings variables and values that were used in the STEP manual to calculate the tacking savings for this measure.

Table 6-14: Condenser Coil Cleaning Measure Variables

Component	Type	Value	Unit	Source(s)
load	Variable	See customer application	Btu/h	Customer application
COP	Fixed	Low Temp (-35°F – -1°F): 1.3 Med Temp (0°F – 30°F): 1.3 High Temp (31°F – 55°F): 2.5	-	Pennsylvania TRM 2016, p. 393
HOU	Fixed	Low Temp (-35°F - -1°F): 6,370 Med Temp (0°F - 30°F): 6,370 High Temp (31°F - 55°F): 6,173	hours, annual	Calculated duty cycle using weather factor, defrost factor, and capacity factor[23]
ESF[24]	Fixed	0.048	-	Qureshi and Zubair (2011)
DRF[25]	Fixed	0.022	-	Qureshi and Zubair (2011)

The key savings variables that were updated as part of the measure evaluation were the refrigeration "load" and the annual hours of use (HOU), which have the most uncertainty and are therefore the key parameters that impact the savings estimate. The refrigeration condenser load on each condenser was taken from the refrigeration plans and used the rated capacity of the compressors at design SST and SCT times the heat of compression, his load is referred to as the total heat rejected (THR). The site engineers matched the refrigeration loads to the condensers form the plans in some cases there were significant variations in the load values between the tracking and verified values and this quantity variable was a significant source of variation between the verified and tracking savings.

The annual hours of use were the other variable that was impacted by the evaluation activity as the interval metered data from the compressors were utilized to estimate the annual hours of use.

Door Gasket Measure Saving Analysis

This measure involves replacing worn out refrigeration case door gaskets with new gaskets to reduce heat gain into the case caused by air infiltration. The energy savings calculation uses the following equation:

$$\Delta kWh = \frac{\Delta kWh}{ft} \times L$$

The demand savings use a similar equation as follows:

$$\Delta kW = \frac{\Delta kW}{ft} \times L$$

Where:

ΔkWh	= per measure gross annual electric energy savings
ΔkW	= per measure gross coincident demand reduction
ΔkWh/ft	= gross annual electric energy savings per linear foot
ΔkW/ft	= gross coincident demand reduction per linear foot
L	= length of gasket applied

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[23] The duty cycle is calculated using the same method as is used by TVA 2016 TRM for refrigeration measures. For coolers, a defrost factor of 0.995, a capacity factor of 0.87, and a weather factor of 0.84 is assumed. For freezers, a defrost factor of 0.90, a capacity factor of 0.87, a and weather factor of 0.90 is assumed.

[24] Qureshi B.A. and Zubair S.M., "Performance degradation of a vapor compression refrigeration system under fouled conditions." International Journal of Refrigeration 24 (2011), p. 1016 – 1027. Figure 2-(a). Assumes a weighting of refrigerant types of 80% R-134 and 20% R-404.

[25] Ibid.

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The savings for this measure are based on an assumed energy and demand savings value per linear foot of gasket being replaced based on door type and case temperature setting. Savings for this measure are applied using the values shown in Table 6-15, multiplying by the number of feet of door gasket.

Table 6-15: Calculation Parameters for Door Gaskets

Refrigeration Type	ΔkWh/ft	ΔkW/ft
Freezer (-35°F to 30°F)		
Walk-In Door	29.5	0.0036
Reach-In Glass Door	22.2	0.0025
Cooler (31°F to 55°F)		
Walk-In Door	9.3	0.0011
Reach-In Glass Door	3.4	0.0004

The key parameters of these equations that were field verified through this evaluation are:

- Number of Doors
- Length of Gasket (default = 15 ft)
- Type (walk-in/ reach-in)
- Temperature (cooler/ freezer)

Additional parameters were verified in order to ensure that we were evaluating and applying savings to the correct measures.

Walk-in Door Closers Savings Analysis

Savings for this measure are applied using the values shown in Table 6-16.

Table 6-16: Calculation Parameters for Auto door closers

Refrigeration Unit Type	Location	Walk-In		Reach-In	
		ΔkWh	ΔkW	ΔkWh	ΔkW
Cooler (High Temperature, 31°F to 55°F)	Richmond, VA	44	0.0050	102	0.0116
	Average of Elizabeth City and Rocky Mount-Wilson, NC	42	0.0048	101	0.0115
Freezer (Medium Temperature, -35°F to 30°F)	Richmond, VA	173	0.0196	439	0.0501
	Average of Elizabeth City and Rocky Mount-Wilson, NC	168	0.0192	432	0.0494

The key parameters of these equations that were field verified through this evaluation are:

- Number of Doors
- Type

  – Walk-in
  – Reach-In

DNV

- Temperature

  - Cooler
  - Freezer

Additional parameters were verified in order to ensure that we were evaluating and applying savings to the correct measures.

Strip Curtains in Freezers and Coolers Savings Analysis

The strip curtain measure creates energy savings by reducing the infiltration of non-refrigerated air into the space of walk-in coolers and freezers. Strip curtain savings only occur during building operating hours as the walk-in door is assumed to be closed during non-operating hours. The energy savings calculation uses the following equation:

$$\Delta kWh = \frac{kWh}{ft^2} \times Area$$

The demand savings is calculated using the following equation:

$$\Delta kW = \frac{\Delta kWh}{HOU}$$

Where:

ΔkWh	= per measure gross annual electric energy
ΔkW	= per measure coincident demand reductions
kWh/ft^2	= average annual kilowatt hour savings per square foot of infiltration barrier
$Area$	= area of doorway where strip curtains are installed

The savings for this measure are based upon the area of the opening, the hours that the main walk-in door is open (built into the $\Delta kWh/ft^2$ values) and the system type, freezer or cooler. The annual hours of 8,760 are only used for the calculation of demand savings impacts actual hours strip curtain can produce savings are imbedded in the energy savings impact. Therefore, we could use those savings hours to calculate a less conservative demand savings impact. The savings factors for the strip curtain are based on the building type and the baseline condition as shown in Table 6-17.

Table 6-17: Strip Curtain Energy Savings Factors

Type	Baseline Curtain	Annual Electric Energy Savings per Square Foot ($\Delta kWh/ft^2$)
Supermarket - Cooler	Yes	37
	No	108
	Unknown	108
Supermarket - Freezer	Yes	119
	No	349
	Unknown	349
Convenience Store - Cooler	Yes	5
	No	20
	Unknown	11

Type	Baseline Curtain	Annual Electric Energy Savings per Square Foot ($\Delta kWh/ft^2$)
Convenience Store - Freezer	Yes	8
	No	27
	Unknown	17
Restaurant - Cooler	Yes	8
	No	30
	Unknown	18
Restaurant - Freezer	Yes	34
	No	119
	Unknown	81
Refrigerated Warehouse	Yes	254
	No	729
	Unknown	287

ENERGY STAR Refrigeration Freezers and Coolers Savings Analysis

This measure involves the installation of an ENERGY STAR® qualified commercial freezer or refrigerator. These models are designed for warm commercial kitchen environments with frequent door opening. Qualifying equipment utilize a variety of energy-efficient components such as ECM fan motors, hot gas anti-sweat heaters, or high efficiency compressors. The energy savings calculation uses the following equation:

$$\Delta kWh = (kWh_{base} - kWh_{ee}) \times Days$$

The demand savings calculation is as follows:

$$\Delta kW = \left(\frac{\Delta kWh}{EFLH}\right) \times CF$$

Where:

ΔkWh = per measure gross annual electric energy savings
ΔkW = per measure gross coincident demand reduction
kWh_{base} = daily energy consumption of the baseline equipment
kWh_{ee} = daily energy consumption of the efficient equipment
Days = days per year
EFLH = equivalent full load hours of equipment
CF = demand coincidence factor

The savings are based whether the cases are vertical or horizontal and based on whether the doors are solid or transparent. The days per year are assumed to be 365 days and the EFLH is assumed to be 5,858 hours with a demand coincidence factor of 0.77. Additionally, the savings vary as a function of the interior volume of the units as shown in Table 6-18, which shows the baseline consumption and Table 6-19 which shows the energy efficient energy consumption

Table 6-18: Baseline Daily Energy Consumption Calculated by Volume

Equipment Type	Refrigerator Energy, kWh	Freezer Energy, kWh
Vertical Closed		
Solid Door	= 0.050 x V + 1.360	= 0.220 x V + 1.380
Transparent	= 0.100 x V + 0.860	= 0.290 x V + 2.950
Horizontal Closed		
Solid Door	= 0.050 x V + 0.910	= 0.060 x V + 1.120
Transparent	= 0.060 x V + 0.370	= 0.080 x V + 1.230

Table 6-19: Energy Efficient Daily Energy Consumption by Volume

Equipment Type and Volume (ft³)	Refrigerator Energy, kWh	Freezer Energy, kWh
Vertical Closed		
Solid Door		
V < 15 ft³	=0.022 x V + 0.970	=0.210 x V + 0.900
15 ⩽ V < 30 ft³	=0.066 x V + 0.310	=0.120 x V + 2.248
30 ⩽ V < 50 ft³	=0.040 x V + 1.090	=0.285 x V - 2.703
V ⩾ 50 ft³	=0.024 x V + 1.890	=0.142 x V + 4.445
Transparent Door		
V < 15 ft³	=0.095 x V + 0.445	=0.232 x V + 2.360
15 ⩽ V < 30 ft³	=0.050 x V + 1.120	=0.232 x V + 2.360
30 ⩽ V < 50 ft³	=0.076 x V + 0.340	=0.232 x V + 2.360
V ⩾ 50 ft³	=0.105 x V - 1.111	=0.232 x V + 2.360
Horizontal Closed		
Solid or Transparent Door		
All Volumes	=0.050 x V + 0.280	=0.057 x V + 0.550

Air Conditioning Tune-Ups Measure Savings Analysis

This measure involves tuning up packaged air conditioning units, heat pump units (both air and ground source), and air-cooled and water-cooled cooled chillers at small commercial and industrial sites. Algorithms and inputs to calculate heating, cooling savings, and demand reductions for unitary/split HVAC and package terminal AC system tune-ups are provided below. The savings calculations vary slightly based on the HVAC type and capacity which primarily impacts the efficiency variable and the EFLH for cooling and heating. As with the duct sealing measure there are no heating savings if the primary heating fuel is non-electric. The energy savings calculation is as follows:

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Cooling Energy Savings

For air-source heat pumps and AC units <65,000 Btu/h, the per measure gross annual electric cooling energy savings are calculated as follows:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12 \frac{kBtuh}{ton}}{SEER} \times EFLH_{cool} \times TUF$$

For air-source heat pumps, AC units ≥65,000 Btu/h, and all ground-source heat pumps, the per measure gross annual electric cooling energy savings are calculated as follows:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12 \frac{kBtuh}{ton}}{IEER} \times EFLH_{cool} \times TUF$$

For air- and water-cooled chillers:

$$\Delta kWh_{cool} = Size_{cool} \times IPLV \times EFLH_{cool} \times TUF$$

Per measure gross coincident demand reduction is calculated according to the following equation for air-conditioning and heat pump systems and chillers:

$$\Delta kW = Size_{cool} \times \frac{12 \frac{kBtuh}{ton}}{EER} \times CF \times TUF$$

Heating Energy Savings

For air-source heat pumps <65,000 Btu/h, the per measure gross annual electric heating energy savings are calculated as follows:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times EFLH_{heat} \times TUF$$

For air-source heat pumps ≥65,000 Btu/h and all ground-source heat pumps, the per measure gross annual electric heating energy savings are calculated as follows:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412 \frac{Btuh}{W}} \times EFLH_{heat} \times TUF$$

For AC units and air- and water-cooled chillers, there are no per measure gross annual electric heating energy savings:

$$\Delta kWh_{heat} = 0$$

Per measure gross annual electric energy savings are calculated by combining the cooling and heating energy savings according to the following equation:

DNV

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

Where:

ΔkWh	= per measure gross annual electric energy savings
ΔkW	= per measure gross coincident demand reductions
ΔkWh_{cool}	= per measure gross annual electric cooling energy savings
ΔkWh_{heat}	= per measure gross annual electric heating energy savings
$Size_{cool}$	= tons of cooling capacity of equipment
$Size_{heat}$	= heating capacity of equipment, if applicable.
SEER	= seasonal energy efficiency ratio (SEER) of the installed air conditioning equipment. It is used for heat pumps and AC units that are smaller than 65,000 Btu/h.
IEER	= integrated energy efficiency ratio (IEER) of the existing or baseline air conditioning equipment. IEER is a weighted average of a unit's efficiency at four load points: 100%, 75%, 50%, and 25% of full cooling capacity. It is used for heat pumps and AC units that are 65,000 Btu/h or larger.
$EFLH_{cool}$	= equivalent full load cooling hours
$EFLH_{heat}$	= equivalent full load heating hours
IPLV	= energy efficiency at integrated part load value (IPLV) of chillers. For air-cooled chillers, this is typically shown as EER_{IPLV}; for water-cooled chillers, this is typically shown as kW/ton_{IPLV}.
TUF	= rate of energy efficiency improvement due to tune-up
EER	= energy efficiency ratio of air-conditioning and heat pump systems and air- and water-cooled chillers at full load conditions.
HSPF	= heating seasonal performance factor (HSPF) of existing heat pump. HSPF is used in heating savings for air-source heat pumps.
COP	= coefficient of performance of existing heating equipment. Ground source heat pumps use COP to determine heating savings.
CF	= coincidence factor

The program application forms have a contractor checklist that includes five activities that can be used to calculate savings by customizing the Tune-up Factor (TUF) to reflect the actual maintenance activities performed on the HVAC unit. These savings values were mapped into data to calculate the savings. One factor that was noted in the document review was the Refrigerant Charge Adjustment (RCA). Although the refrigerant charge was checked for all of the units that were tuned-up, savings would only occur if the units needed a refrigerant adjustment. The tracking savings for all units had savings for RCA whether an actual adjustment was required or not. Table 6-20 provide the savings variables used for the AC tune-up savings calculation which are based on a percentage of the cooling and electric heating loads. There are numerous default values for efficiency and cooling and heating equivalent full load hours (EFLH) provided in the STEP manual that are referenced in the table.

Table 6-20: Input Variables for AC Tune-up Measure

Component	Type	Value	Units	Source(s)
$Size_{cool}$	Variable	See customer application	tons of cooling capacity	Customer application
$Size_{heat}$	Variable	See customer application	kBtu/h	Customer application
		Default for HPs: 12 x $Size_{cool}$		

Component	Type	Value	Units	Source(s)
EFLH$_{cool}$	Fixed	Refer to Sub-appendix F2-II: Non-residential HVAC Equivalent Full Load Hours ACs & HPs: Table 8-4 Chillers: Table 8-6	hours (annual)	Mid-Atlantic TRM 2019, p. 589
EFLH$_{heat}$	Fixed	Refer to Sub-appendix F2-II: Non-residential HVAC Equivalent Full Load Hours HPs: Table 8-5	hours (annual)	Mid-Atlantic TRM 2019, p. 590
HSPF/SEER/IEER/ EER/COP	Variable	Refer to Sub-appendix F2-III: Non-residential HVAC Equipment Efficiency Ratings ACs & HPs: Table 8-10 Chillers: Table 8-12	k/kW-hour (except COP is dimensionless)	ASHRAE 90.1-2013
IPLV	Variable	See customer application	Btu/W for air-cooled chillers; kW/ton for water-cooled chillers	Customer application
		Refer to Sub-appendix F2-III: Non-residential HVAC Equipment Efficiency Ratings Chillers: Table 8-12		ASHRAE 90.1-2013
RCA_Done	Boolean	See customer application	True/False	Customer application
TUF	Fixed	If RCA was not done: ACs: 0.023 HPs: 0.028 Chillers: 0.050 If RCA was also done (only for Commercial Non-Residential Prescriptive Program): ACs: 0.050 HPs: 0.050 Chillers: 0.050	-	Mid-Atlantic TRM 2019 p. 455, California Impact Evaluation of 2013-14 Commercial Quality Maintenance Programs,[26] and Wisconsin Focus on Energy 2019 TRM, pp. 285-288.
CF	Fixed	Use system capacity to assign CF: < 11.5 tons = 0.588 $\geqslant$ 11.5 tons = 0.874	-	Mid-Atlantic TRM 2019, p. 455

Duct Test and Sealing Measure Savings Analysis

This measure produces savings by reducing conditioned air leakage to unconditioned space by first testing the pre-treatment leakage utilizing an aerosol-based product to seal the ducts and then perform a post treatment duct leakage test. Eligible ductwork is connected to HVAC system and occurs within an unconditioned plenum space or between an insulated, finished ceiling and a roof surface. The energy savings calculation is as follows:

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[26] California Public Utilities Commission (2016). Impact Evaluation of 2013-14 Commercial Quality Maintenance Programs (HVAC3), www.calmac.org/publications/HVAC3ImpactReport_0401.pdf. While these proportions were not provided in the report, DNV GL analyzed the same supporting data—though owned by the CPUC and not publicly available—used to produce the tables provided on pages BB-2 and BB-3 of Appendix BB of the report. Whereas the tables provided in Appendix BB were aggregated by program, DNV GL aggregated the raw data by HVAC-system type to determine appropriate TUF values. This analysis showed that for packaged air-conditioning systems, an average of 54.7% of the overall tune-up savings were attributable to the RCA treatment; for packaged heat pump systems, 44.7% of the overall tune-up savings were attributable to the RCA treatment.

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$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

The savings equations to determine cooling and heating energy savings vary based on the equipment type and size as the efficiency variable and Equivalent Full Load Hours (EFLH) for heating and cooling will vary. There will be no electric savings for non-electric primary heat systems.

Unitary systems, for air-source heat pumps and AC units, Size_cool < 65,000 Btu/h:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\frac{kBtuh}{ton}}{SEER} \times EFLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Unitary systems, for air-source heat pumps and AC units, Size_heat < 65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times EFLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

Unitary systems, for air-source heat pumps and AC units, Size_cool ≥ 65,000 Btu/h, and all ground-source heat pumps:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\frac{kBtuh}{ton}}{IEER} \times EFLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Unitary systems, for air-source heat pumps and AC units, Size_heat ≥ 65,000 Btu/h and all ground-source heat pumps:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412\frac{Btuh}{W}} \times EFLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

The coincident demand reduction for all of the above systems is calculated as follows:

$$\Delta kW = Size_{cool} \times \frac{12\frac{kBtuh}{ton}}{EER} \times \left(1 - \frac{n_{dist,pk,base}}{n_{dist,pk,ee}}\right) \times CF$$

DNV

Chiller Systems

Water-cooled chiller systems, cooling savings:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{kW}{ton_{IPLV}} \times EFLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Air-cooled chiller systems, cooling savings:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\frac{kBtuh}{ton}}{EER_{IPLV}} \times EFLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Chiller system heating savings for systems <65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times EFLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

Chiller system heating savings for systems ≥65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412\frac{Btuh}{W}} \times EFLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

Per measure gross coincident demand reduction is calculated according to the following equations:

Water-cooled chiller systems:

$$\Delta kW = Size_{cool} \times \frac{kW}{ton_{full\ load}} \times \left(1 - \frac{\bar{n}_{dist,peak,base}}{\bar{n}_{dist,peak,ee}}\right) \times CF$$

Air-cooled chiller systems:

$$\Delta kW = Size_{cool} \times \frac{12\frac{kBtuh}{ton}}{EER_{full\ load}} \times \left(1 - \frac{\bar{n}_{dist,peak,base}}{\bar{n}_{dist,peak,ee}}\right) \times CF$$

Where:

ΔkWh	=	per measure gross annual electric energy savings
ΔkW	=	per measure gross coincident demand reductions
$Size_{cool}$	=	system cooling capacity in tons, based on nameplate data
$Size_{heat}$	=	nominal rating of the unitary systems (heat pumps or AC units)
SEER	=	seasonal energy efficiency ratio (SEER). It is used for heat pumps and AC units that are smaller than 65,000 Btu/h.
IEER	=	integrated energy efficiency ratio (IEER) of a unit's efficiency at four load points: 100%, 75%, 50%, and 25% of full cooling capacity. It is used for heat pumps and AC units that are 65,000 Btu/h or larger.

EER	=	energy efficiency ratio (EER) of heat pump and air-conditioning systems at full-load conditions.
HSPF	=	heating seasonal performance factor (HSPF). It is used for heat pumps.
COP	=	coefficient of performance (heating)
$\overline{\quad}_{,\,,}$	=	duct system average seasonal efficiency of baseline (pre-sealing) cooling system
$\overline{\quad}_{,\,,}$	=	duct system average seasonal efficiency of baseline (pre-sealing) heating system
$\overline{\quad}_{,\,,\,o}$	=	duct system average seasonal efficiency of efficient (post-sealing) cooling system
$\overline{\quad}_{,\,,}$	=	duct system average seasonal efficiency of efficient (post-sealing) heating system
$_{,\,,}$	=	duct system efficiency of baseline system, under peak conditions (equal to $\overline{\quad}_{,\,,}$)
$_{,\,,}$	=	duct system efficiency of efficient system, under peak conditions (equal to $\overline{\quad}_{,ee,}$)
$EER_{full\text{-}load}$	=	energy efficiency ratio (EER) of air-cooled chillers at full-load conditions.
EER_{IPLV}	=	energy efficiency ratio (EER) of air-cooled chillers at integrated part load value (IPLV).
$\overline{\quad\quad}$	=	energy efficiency of water-cooled chiller system at integrated part load value (IPLV)
$\overline{\quad\quad}$	=	energy efficiency of water-cooled chiller system at full load
$EFLH_{cool}$	=	cooling equivalent full load hours (EFLH)
$EFLH_{heat}$	=	heating equivalent full load hours (EFLH)
CF	=	peak coincidence factor
TRF	=	Thermal regain factor

There are numerous savings variables for this measure and numerous default values depending upon the size and type of the system. The sample population has the pre and post CFM25 leakage and CFM25 percent leakage for the sample measures and these values are used to calculate the duct efficiency based on the building type category and the insulation level of the duct. A linear regression of leakage is created by using the efficiency values for a specific duct system R-Value, building type and heating or cooling mode as shown in Table 6-21. These values are used to calculate the slope and intercept of efficiency as a function of duct leakage and then the pre and post leakage percentages can be used to calculate pre and post duct efficiency in heating and cooling mode. Note that there are only four building type categories in Table 6-21. Table 6-22 provides some guidance for how a broader group of building types can be mapped into the duct system efficiency values.

Table 6-21: Duct System Efficiency by Building Type Categories

Duct Total Leakage	Duct System R-Value	Assembly		Fast Food Restaurant		Full Service Restaurant		Small Retail		Average	
		Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling
8%	Uninsulated	0.857	0.922	0.766	0.866	0.797	0.854	0.614	0.838	0.759	0.870
15%	Uninsulated	0.829	0.908	0.734	0.853	0.765	0.845	0.581	0.827	0.727	0.858
20%	Uninsulated	0.810	0.897	0.714	0.844	0.743	0.837	0.559	0.818	0.707	0.849
25%	Uninsulated	0.793	0.886	0.693	0.834	0.721	0.829	0.538	0.809	0.686	0.840
30%	Uninsulated	0.776	0.873	0.675	0.823	0.701	0.820	0.520	0.799	0.668	0.829
8%	R-2	0.877	0.954	0.821	0.906	0.845	0.904	0.691	0.885	0.808	0.912
15%	R-2	0.846	0.938	0.780	0.889	0.807	0.893	0.648	0.871	0.770	0.898
20%	R-2	0.826	0.926	0.754	0.878	0.781	0.884	0.619	0.861	0.745	0.887
25%	R-2	0.807	0.913	0.729	0.865	0.755	0.874	0.593	0.850	0.721	0.875
30%	R-2	0.789	0.899	0.707	0.852	0.732	0.864	0.570	0.839	0.699	0.863
8%	R-4	0.886	0.970	0.848	0.925	0.869	0.929	0.729	0.908	0.833	0.933
15%	R-4	0.855	0.952	0.802	0.907	0.827	0.917	0.681	0.893	0.791	0.917
20%	R-4	0.833	0.940	0.774	0.894	0.799	0.908	0.649	0.883	0.764	0.906
25%	R-4	0.814	0.926	0.747	0.881	0.772	0.897	0.621	0.871	0.738	0.893
30%	R-4	0.795	0.911	0.723	0.867	0.748	0.885	0.594	0.859	0.715	0.881
8%	R-6	0.896	0.986	0.875	0.945	0.893	0.954	0.767	0.931	0.858	0.954
15%	R-6	0.863	0.967	0.825	0.925	0.848	0.941	0.714	0.915	0.813	0.937
20%	R-6	0.841	0.954	0.794	0.911	0.818	0.931	0.679	0.904	0.783	0.925
25%	R-6	0.821	0.939	0.765	0.896	0.789	0.919	0.648	0.891	0.756	0.911
30%	R-6	0.801	0.924	0.739	0.881	0.763	0.907	0.619	0.879	0.731	0.898
8%	R-8	0.901	0.994	0.889	0.955	0.905	0.967	0.786	0.943	0.870	0.965
15%	R-8	0.867	0.974	0.836	0.934	0.858	0.953	0.731	0.926	0.823	0.947
20%	R-8	0.845	0.961	0.804	0.919	0.827	0.943	0.694	0.915	0.793	0.935
25%	R-8	0.825	0.946	0.774	0.904	0.798	0.930	0.662	0.901	0.764	0.920
30%	R-8	0.804	0.930	0.747	0.888	0.771	0.918	0.631	0.889	0.738	0.906

Table 6-22: duct System Efficiency Mapping to Building Type

Building Type	Associated Duct System Efficiency Building Type
Education **Education – College and University** **Education – High School** **Education – Elementary and Middle School** **Health Care – inpatient** **Health Care – outpatient** **Lodging – (Hotel, Motel, and Dormitory)** **Office – Small (< 40,000 sq ft)** **Office – Large (≥ 40,000 sq ft)** **Other** **Warehouse and Storage**	Average
Food Sales **Food Sales – Gas Station Convenience Store** **Food Sales – Convenience Store** **Food Sales – Grocery** **Mercantile (Retail, not Mall)** **Mercantile (Mall)** **Service (Beauty, Auto Repair Workshop)**	Small Retail
Food Service **Food Service – Fast Food** **Food Service – Other**	Fast Food Restaurant
Food Service – Restaurant **Food Service – Full Service**	Full Service Restaurant
Public Assembly **Public Order and Safety (Police and Fire Station)** **Religious Worship**	Assembly Building

Variable Speed Drive on Kitchen Exhaust Fans Measure Savings Analysis

This measure involves the installation of variable speed drives at commercial kitchen exhaust fans so that the fan motor speed matches the demand. The baseline condition is the manual on/off switch and magnetic relay or motor starter for commercial kitchen hoods. The baseline assumes that the fan operates at full speed while in operation. This measure involves retrofitting a variable-speed drive (VSD) controller at an existing kitchen exhaust fan with a make-up-air fan.

The total measure energy savings includes the energy savings resulted from fan power reduction during part load operation as well as a decrease in heating and cooling requirement of make-up air. If the supplied make-up air is not conditioned, no heating and cooling savings are provided. Furthermore, the measure does not approve heating savings from gas-fired make-up-air units.

Per measure, gross annual electric energy savings for the exhaust fan are calculated according to the following equation:

$$\Delta kWh_{EF} = hp_{EF} \times LF_{EF} \times \frac{0.746}{\eta_{EF}} \times HOU \times \Delta Power_{EF}$$

If the make-up air is conditioned, then the cooling and heating savings are calculated according to the following equations:

DNV

$$\Delta kWh_{cool} = SqFt_{Kitchen} \times \frac{cfm}{SqFt} \times OF_{EF} \times \Delta cfm_{EF} \times CDD \times \frac{24 \times 1.08}{3,412 \times COP_{MUA_{cool}}}$$

$$\Delta kWh_{heat} = SqFt_{Kitchen} \times \frac{cfm}{SqFt} \times OF_{EF} \times \Delta cfm_{EF} \times HDD \times \frac{24 \times 1.08}{3,412 \times COP_{MUA_{heat}}}$$

If make-up air is <u>not</u> conditioned, then the cooling and heating savings equal zero.

$$\Delta kWh_{cool} = \Delta kWh_{heat} = 0$$

Per measure, gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \Delta kWh_{EF} + \Delta kWh_{cool} + \Delta kWh_{heat}$$

Per measure, gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = \frac{\Delta kWh}{HOU}$$

Where:

ΔkWh_{EF} = per measure gross annual electric energy savings for the exhaust fan
ΔkWh_{cool} = per measure gross annual electric energy savings for cooling the make-up air
ΔkWh_{heat} = per measure gross annual electric energy savings for heating the make-up air
ΔkWh = per measure gross annual electric energy savings
ΔkW = per measure gross coincident demand reduction
hp_{EF} = total motor horsepower of exhaust fan(s)
LF_{EF} = load factor of exhaust fan motor(s)
η_{EF} = efficiency of exhaust fan motor(s)
HOU = annual run hours of use of exhaust fan(s)
$\Delta Power_{EF}$ = proportional exhaust fan power reduction due to VFD
$SqFt_{Kitchen}$ = floor area of kitchen
$\frac{cfm}{SqFt}$ = exhaust airflow rate per square foot of kitchen floor area
OF_{EF} = oversize ratio of exhaust fan system
Δcfm_{EF} = proportional exhaust fan airflow reduction due to VFD
CDD = cooling degree days
$COP_{MUA_{cool}}$ = coefficient of performance of cooling component of make-up air system
HDD = heating degree days
$COP_{MUA_{heat}}$ = coefficient of performance of heating component for make-up air system
0.746 = conversion factor for horsepower to kilowatt
3,412 = conversion factor for Btu/h to kilowatt-hour
24 = conversion factor for day to hour
1.08 = sensible heat factor for air, Btuh/cfm/°F

Table 6-23: Input Parameters for VSD on Kitchen Exhaust Fans

Component	Type	Value	Units	Source(s)
hp_{EF}	Variable	See customer application	hp	Customer application
LF_{EF}	Fixed	Default: 90%	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings*: Revisions to FY2019 Protocols, p. 105
η_{EF}	Variable	See customer application	-	Customer application
		Default: See Table 6-25 based on hp_{EF}		See Table 6-25
HOU	Variable	See customer application	hours (annual)	Customer application
		Default: See Table 6-24 that follows		New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2019 Protocols, p. 106
$\Delta Power_{EF}$	Variable	See Table 6-24 that follows	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings*: Revisions to FY2019 Protocols, p. 106
$SqFt_{Kitchen}$	Variable	See customer application	ft^2	Customer application
$\dfrac{cfm}{SqFt}$	Fixed	0.7	cfm/ft^2	ASHRAE 62.1-2013, Table 6.5 – for Kitchen -Commercial
OF_{EF}	Fixed	1.4	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings*: Revisions to FY2019 Protocols, p. 105
Δcfm_{EF}	Variable	See Table 6-24 that follows	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings*: Revisions to FY2019 Protocols, p. 106
CDD	Variable	See Sub-appendix F2-I: Cooling and Heating Degree Days and Hours	Cooling Degree Days	
HDD	Variable	See Sub-appendix F2-I: Cooling and Heating Degree Days and Hours	Heating Degree Days	
MUA_{cool}	Boolean	See customer application	True/False	Customer application
$COP_{MUA_{cool}}$	Variable	See customer application	-	Customer application
		Default: 3.0		New Jersey Clean Energy Program Protocols to Measure Resource Savings 2019, p. 105
$MUA_{electric_{heat}}$	Boolean	See customer application	True/False	Customer application
$COP_{MUA_{heat}}$	Variable	See customer application	-	Customer application
		Default: 3.0		New Jersey Clean Energy Program Protocols to Measure Resource Savings 2019, p. 105

Table 6-24: Annual Hours of Use, Power and Airflow Reductions by Building Type

Facility Type	Annual Hours of Use (hours)	Proportion of Power Reduction ($\Delta Power_{EF}$)	Proportion of Airflow Reduction (Δcfm_{EF})
Campus	5,250	0.568	0.295
Lodging	8,736	0.618	0.330
Restaurant	5,824	0.552	0.295
Supermarket	5,824	0.597	0.320
Other	5,250	0.584	0.310

Table 6-25: Baseline Motor Efficiency

Horsepower (hp)	η
1	0.855
1.5	0.865
2	0.865
3	0.895
5	0.895
7.5	0.917
10	0.917
15	0.924

DNV site engineers installed interval power meters on a sample of exhaust fans and those data were used to calculate the hourly percent reduction of fan power from the baseline full power.

Hot Food Holding Cabinet Measure Savings Analysis

This measure involves installing an ENERGY STAR® qualified commercial hot food holding cabinet. The installed equipment will incorporate better insulation, reducing heat loss, and may also offer additional energy saving devices such as magnetic door gaskets, auto-door closures, or dutch doors. The baseline equipment is assumed to be a standard efficiency hot food holding cabinet.

Savings Estimation Approach

Per measure, gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \frac{(watts_{base,idle} - watts_{ee,idle})}{1,000 \, {W}/{kW}} \times Hours_{daily} \times Days$$

Per measure, gross coincident demand reduction is calculated according to the following equation:

DNV

$$\Delta kW \quad = \frac{(watts_{base,idle} - watts_{ee,idle})}{1,000\ ^W/_{kW}}$$

Where:

  ΔkWh = per measure gross annual electric energy savings
  ΔkW = per measure gross coincident demand reduction
  $watts_{base,idle}$ = idle energy rate of the baseline equipment
  $watts_{ee,idle}$ = idle energy rate of the efficient equipment
  1,000 = conversion factor for W to kW
  $Hours_{daily}$ = average daily operating hours
  Days = annual days of operation

Table 6-26 provides the input parameters use to calculate the savings.

Table 6-26: Input Parameters for Hot Food Holding Cabinet

Component	Type	Value		Units	Source(s)
$watts_{base,idle}$	Variable	40 x Vol		watts	Mid-Atlantic TRM 2019, p. 537
$watts_{ee,idle}$	Variable	<u>Vol < 13:</u> 21.5 x Vol + 0.0 <u>13 ⩽ Vol < 28:</u> 2.0 x Vol + 254.0 <u>Vol ⩾ 28:</u> 3.8 x Vol + 203.5		watts	Mid-Atlantic TRM 2019, p. 537
Days	Variable	See customer application	days, annual		Customer application
		Default: 365			Mid-Atlantic TRM 2019, p. 537
$Hours_{daily}$	Variable	See customer application	hours, daily		Customer application
		Default: 15			Mid-Atlantic TRM 2019, p. 537

Ice Maker Measure Savings Analysis

This measure involves high-efficiency ice makers meeting ENERGY STAR® or CEE Tier 2 ice maker requirements. The measure applies to batch type (also known as cube type) and continuous type (also known as flake or nugget type) equipment. The equipment includes ice-making head (without storage bin), self-contained, or remote-condensing units. ENERGY STAR® ice makers are limited to only air-cooled units while CEE Tier 2 standards address water-cooled units. The baseline for each type of ice maker is the corresponding Federal standard for the same technology.

Savings Estimation Approach

Per measure, gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh \quad = \left(\frac{kWh_{base} - kWh_{ee}}{100\ lb}\right) \times H_{rated} \times DC \times Days$$

Per measure, gross coincident demand reduction is calculated according to the following equation:

DNV

$$\Delta kW \qquad = \frac{\Delta kWh}{8{,}760 \ hours} \times CF$$

Where:

ΔkWh	= per measure gross annual electric energy savings
ΔkW	= per measure gross coincident demand reduction
kWh$_{base}$	= energy consumption per 100 lb of ice produced by the baseline equipment
kWh$_{ee}$	= energy consumption per 100 lb of ice produced by the new equipment
H$_{rated}$	= manufacturer-rated daily harvest rate of equipment
DC	= duty cycle of ice machine
Days	= number of days per year
CF	= demand coincidence factor

Smart Strip Plug Outlet

Gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \left(\frac{days_{work} \times \Delta Wh_{workdays} + (365 \ days/year - days_{work}) \times \Delta Wh_{nonworkdays}}{1{,}000 \ W/kW} \right)$$

Gross coincident demand reductions are assigned as follows:

$$\Delta kW = 0 \ kW$$

Where:

ΔkWh = gross annual electric energy savings

ΔkW = gross coincident demand reductions

days$_{work}$ = average number of workdays, or business days, in a year

ΔWh $_{workdays}$ = gross energy savings of device plugged into the strip on work days, per day

ΔWh $_{nonworkdays}$ = gross energy savings of device plugged into the strip on non-work days, per day

Table E-4: Calculation Parameters for Smart Strip Plug Outlets

Component	Type	Value	Unit	Source(s)
days$_{work}$[27]	Fixed	240	days/year	Ohio TRM, p. 281
ΔWh $_{workday}$[28]	Fixed	63.23	Watt-hour/day	Ohio TRM, p. 281
ΔWh $_{nonworkday}$	Fixed	67.63	Watt-hour/day	Ohio TRM, p. 281

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[27] Ohio TRM 2010, p. 282. Assumes two weeks of vacation and two weeks of holidays for a total of 48 work weeks annually.

[28] Ohio TRM 2010, p. 282. Based on table "Standby Power Consumption of Devices Using Smart Strip Plug Outlets".

DNV

About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.

DNV

X. NON-RESIDENTIAL PRESCRIPTIVE PROGRAM EM&V PLAN (VERSION 11)

X.1 Program Summary

In the Non-residential Prescriptive program, qualifying customers are eligible to pursue one or more of the qualified energy efficiency measures through a local, participating contractor in Dominion's contractor network. To qualify for this program, the customer must be responsible for the electric bill and must be the owner of the facility or reasonably able to secure permission to complete the measures.

This program is part of demand side management (DSM) Phase VI in Virginia and North Carolina.

X.2 Measures

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

End-use	Measure
Cooking	▪ Commercial Convection Oven
	▪ Commercial Electric Combination Oven
	▪ Commercial Electric Fryer
	▪ Commercial Griddle
	▪ Commercial Hot Food Holding Cabinet
	▪ Commercial Steam Cooker
HVAC	▪ Duct Testing & Sealing
	▪ Unitary/Split AC & HP Tune-up
	▪ Variable Speed Drives on Kitchen Fan
Plug Load	▪ Smart Strip
Refrigeration	▪ Door Closer
	▪ Door Gasket
	▪ Evaporator Fan Control
	▪ Floating Head Pressure Control
	▪ Refrigeration Night Cover
	▪ Refrigeration Coil Cleaning
	▪ Suction Pipe Insulation
	▪ Strip Curtain
	▪ Vending Machine Miser
	▪ Commercial Freezers and Refrigerators – Solid Door
	▪ Ice Maker
	▪ Low/No-Sweat Door Film

X.3   Evaluation, Measurement & Verification Overview

International Performance Measurement and Verification Protocol (IPMVP) Option A: For physically accessible equipment measures, an EM&V method like IPMVP Option A is applied. IPMVP Option A is a partially-measured retrofit isolation study that measures the selected parameters leading to the change in energy and demand of an installed efficiency measure from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to the Company's program participation data. IPMVP Option A shall be applied to a sample of all implemented measures.

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DNV Energy STEP Manual deemed values with adjustments to key inputs that can be verified while on-site. The ratio of the weighted, measured, and verified savings to the weighted deemed savings, also called a realization rate, is then applied to the population of participants to estimate program savings. This approach will capture Company-specific customer usage data, which will be applied to the actual measures installed to quantify energy and peak demand savings.

Baseline Estimation Approach: The baseline load shape will be computed based on pre-retrofit capacity data from the rebate application data, applying Equivalent Full Load Hours (EFLH) as metered from an on-site study of installed rebated measures from a representative sample of participants.

Deemed Savings Approach: Deemed savings values will be developed and incorporated into the DNV Energy Standard Tracking and Engineering Protocols (STEP) Manual for planning purposes.

Measured Savings Approach: The wattage and hours of use data for each measure will be collected and metered through an on-site study of installed efficiency measures from a representative sample of participants.

X.4   Deemed Savings Approach

Refer to the Non-Residential Prescriptive Program section of the STEP Manual for the standard deemed savings approaches for the measures in this program.

X.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 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 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, and exclude Fuel Charge Rider A and all other applicable riders) for the rate period to arrive at lost revenues.

X.6   Timeline and Scope of Work

- Analysis of program tracking data; Annual Report (May 15 of each year following program launch).
- Annual updates to STEP Manual for updates that occurred to its referenced sources.
- Develop baseline, measure savings, and efficient load shapes.
- Provide regulatory support as necessary.

X.7 Non-residential Prescriptive Program – Revision History

Version	Date	Notes
Version 8		▪ Initial release
Version 9		▪ Formatting updates ▪ Updated from DNV Energy to DNV Energy Insights
Version 10	2020	▪ Formatting updates
Version 11	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Minor word changes in measure introduction.

DNV

APPENDIX Y.   NON-RESIDENTIAL HEATING AND COOLING EFFICIENCY PROGRAM (DSM VII) EM&V PLAN

DNV

Y. NON-RESIDENTIAL HEATING AND COOLING EFFICIENCY PROGRAM EM&V PLAN (VERSION 2)

Y.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.

Y.2 Measures

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

End-use	Measure
HVAC	▪ Air conditioner upgrade ▪ HP upgrade ▪ Geothermal HP ▪ Mini split HP ▪ Water source HP ▪ Chiller upgrade ▪ Economizers ▪ Variable frequency drives ▪ Variable refrigerant flow ▪ Unitary AC

Y.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[85] 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 DNV Standard Tracking and Engineering Protocols (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

3. Verified Savings: Verified savings (or net savings) will be determined using on-site data. The wattage and hours of use data for the installed efficiency measure will be collected and metered through an on-site study of installed rebated measures from a representative sample of participants.

DNV takes a holistic approach to evaluation planning for the Company's portfolio of energy conservation programs. DNV balances cost-effectiveness and rigor to its evaluation planning so the Company can ensure its programs are cost-effective and yield planned savings. This program will follow a staged evaluation plan, where DNV will take a two-step approach.

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[85] 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.

DNV

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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

Y.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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 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.

Y.5   Evaluated Savings Approach

During program implementation, Dominion Energy will determine, 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):[86]

According to Chapter 4—Small Commercial and Residential Unitary and Split System HVAC Heating and Cooling Equipment,[87] 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,[88] the key measured parameters at VFD

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[86] 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

[87] 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

[88] 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

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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,[89] 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, 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,[90] 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.

Y.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 prior to sample selection
- Budget, schedule, and geographical distribution

Y.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[91] (IPMVP) as shown in Table Y-1.

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89 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

90 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.

91 Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

DNV

Table Y-1. Preferred IPMVP Options for Non-residential Heating and Cooling Program Measures

Measure	IPMVP Option	Key Parameter(s)
Package Terminal Air Conditioners and Package Terminal Heat Pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Unitary and Split Air-conditioning Systems and Air-source Heat Pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Variable Frequency Drives	Option B. Retrofit Isolation: All Parameter Measurement	• Annual hours of operation at part-load conditions
Economizers	Option D. Calibrated Simulation	• Verify proper operation • Annual hours of operation
Water- and Air-cooled Chillers	Option A. Retrofit Isolation: Key Parameter Measurement Approach or Option C. Whole Facility, if energy management system data are available and project-level savings are large compared to other energy variations at facility	• Cooling loads • Outside air temperatures • Manufacturer part-load efficiency data • Annual hours of operation
Geothermal Heat Pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Variable-refrigerant-flow systems and mini-split heat pumps	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation

According to UMP, IPMVP Option A: A Retrofit Isolation, Key Parameter Measurement Approach is most appropriate for HVAC system replacement measures. IPMVP Option A is a partially-measured, retrofit-isolation study that meters the actual energy and demand reduction of an installed efficiency measure from a representative sample of participants, and adjusts the savings estimates derived from engineering algorithms applied to Dominion Energy's reported program participation data.

According to UMP, IPMVP Option B, Retrofit Isolation is most appropriate for economizer retrofits. Using Option B, savings are determined by field measurement of the energy use of the HVAC system components. By performing a bin analysis of the pre- and post-installation energy data, and local weather data, it is possible for 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.

DNV

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.

Y.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.

Y.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.

Y.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 STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

Y.8   Non-residential Heating and Cooling Program – Revision History

Version	Date	Notes
Version 1		▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number.

DNV

APPENDIX Z.   NON-RESIDENTIAL OFFICE PROGRAM (DSM VII) EM&V PLAN

DNV

Z. NON-RESIDENTIAL OFFICE PROGRAM EM&V PLAN (VERSION 2)

Z.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.

Z.2 Measures

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

End-use	Measure
HVAC	▪ Schedule HVAC ▪ Temperature setback ▪ Condenser water reset ▪ Discharge air temp reset ▪ Static pressure reset ▪ Enthalpy economizer ▪ Variable air volume box minimum
Lighting	▪ Schedule lighting

Z.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[92] The EM&V method estimates gross and net program energy savings, including net-to-gross (NTG) savings and free-ridership estimates.

The basis for DNV's savings evaluation approach is:

1. Baseline 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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (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.

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 in the periods between more rigorous EM&V.

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[92] 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.

Once participation has levelized or reached planned levels, and realized savings can be quantified, the program is considered for evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

Z.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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 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.

Z.5   Evaluated Savings Approach

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DNV STEP Manual 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[93] of The Uniform Methods Project[94] (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,[95] 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.

Z.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

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[93] 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

[94] 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

[95] 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.

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 prior to sample selection
- Budget, schedule, and geographical distribution

Z.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[96] (IMPVP protocols). 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 a 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.

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 DNV STEP Manual 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,[97] 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.

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[96] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

[97] 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.

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Z.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.

Z.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.

Z.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 STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

Z.8 Non-residential Office Program – Revision History

Version	Date	Notes
Version 1		▪ Initial release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted measure table.

DNV

APPENDIX AA. NON-RESIDENTIAL SMALL MANUFACTURING PROGRAM (DSM VII) EM&V PLAN

DNV

AA. NON-RESIDENTIAL SMALL MANUFACTURING PROGRAM EM&V PLAN (VERSION 2)

AA.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.

AA.2 Measures

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

End-use	Measure
Compressed Air	▪ Compressed air nozzles ▪ Leaks ▪ No loss drains ▪ Additional compressed air storage ▪ Heat of compression dryer ▪ Low Pressure Drop filter ▪ Variable speed drive air compressor ▪ Cycling refrigerant dryer ▪ Dewpoint controls ▪ Pressure reduction ▪ Downsized variable frequency drive compressor

AA.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[98] 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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (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.

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.

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[98] 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.

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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

AA.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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 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.

AA.5 Evaluated Savings Approach

For all measures, the evaluation will select a sample for on-site verification. Savings will be based on the DNV STEP Manual 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[99] of The Uniform Methods Project[100] (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,[101] is then applied to the population of participants to estimate overall program savings. This approach will capture

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[99] 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

[100] 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

[101] 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.

Company-specific customer usage data, and then apply those to the actual measures installed to quantify energy and peak demand savings.

AA.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 prior to sample selection
- Budget, schedule, and geographical distribution

AA.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[102] (IPMVP).

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.

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[102] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

DNV

AA.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.

AA.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.

AA.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 STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

AA.8 Non-residential Small Manufacturing Program – Revision History

Version	Date	Notes
Version 1		- Initial release
Version 2	3/22/2021	- Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Formatted measure table.

DNV

APPENDIX BB. NON-RESIDENTIAL WINDOW FILM PROGRAM (DSM VII) EM&V PLAN

DNV

BB. NON-RESIDENTIAL WINDOW FILM PROGRAM EM&V PLAN (VERSION 2)

BB.1 Program Summary

This program would provide qualifying non-residential customers with an incentive install solar reduction window film to lower their cooling bills and improve occupant comfort.

BB.2 Measures

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

BB.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[103] 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 DNV Standard Tracking and Engineering Protocols (STEP) Manual. The source of the deemed savings values will be models of 21 prototypical building types using Database for Energy Efficiency Resources (DEER) average values for building parameters (building sq. ft., EFLH, etc.). Variations in deemed savings values are provided in the STEP manual 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.

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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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

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[103] 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.

DNV

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.

BB.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as 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.

BB.5 Evaluated Savings Approach

For the window film measure, the evaluation will select a sample for on-site verification. Savings will be based on the DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[104] (UMP) does not specifically address this measure, the key parameter for determining gross savings and peak demand reductions include 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,[105] 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.

BB.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 prior to sample selection
- Budget, schedule, and geographical distribution

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[104] 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

[105] 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.

DNV

BB.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,[106] 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.

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.

BB.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.

BB.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.

BB.7 Timeline and Scope of Work

- Develop and update EM&V plan annually.

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[106] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

- Analyze program tracking data: Annual report (May 15 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

BB.8 Non-residential Window Film Program – Revision History

Version	Date	Notes
Version 1		• Initial release
Version 2	3/22/2021	• Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number.

DNV

APPENDIX CC.   NON-RESIDENTIAL MIDSTREAM EFFICIENT PRODUCTS PROGRAM (VIII) EM&V PLAN

DNV

CC.   NON-RESIDENTIAL MIDSTREAM EFFICIENT PRODUCTS PROGRAM EM&V PLAN (VERSION 2)

CC.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.

CC.2 Measures

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

Table CC-1: End-uses and Measures for Non-residential Midstream Efficient Products Program

End-use	Measure
Cooking	▪ Commercial kitchen equipment
HVAC	▪ Efficient heat pumps ▪ Efficient air conditioning units ▪ Air- and water-cooled Chillers
Refrigeration	▪ Commercial freezers and coolers

CC.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[107] 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 are:

1. Baseline Consumption: Baseline consumption will be calculated per the DNV Standard Tracking and Engineering Protocol (STEP) Manual, which 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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.
3. Evaluated Savings: Evaluated savings will be determined by the methods described in Section CC.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

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[107] 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.

a cost-effective method for determining reasonable savings estimates in the early stage of implementation and in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year three of program operations. Mid-stream programs tend to take longer to reach targeted levels of participation which is why year three is preferred over year two.

Late 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.

CC.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[108] 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.

CC.5 Evaluated Savings Approach

During program implementation, Dominion Energy will determine—in consultation with DNV—the appropriateness of conducting evaluations to estimate program net savings in net kilowatts and net kilowatt-hours.

For the cooking measures, savings will be based on the DNV STEP Manual deemed values with adjustments to key inputs that can be verified while on-site. Although the Uniform Methods Project[109] (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,[110] savings will be based on the DNV STEP Manual deemed values with adjustments to key inputs that can be

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[108] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[109] 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

[110] 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

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,[111] savings will be based on the DNV STEP Manual 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 DNV STEP Manual 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 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, 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,[112] 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.

CC.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. [113]

Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68560. http://www.nrel.gov/docs/fy17osti/68560.pdf

[111] 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

[112] 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.

[113] Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1. EVO 10000-1:2012, www.evo-world.org.

Table CC-2. Preferred IPMVP Options for Non-residential Midstream Efficient Products Program Measures

Measure	IPMVP Option	Key Parameter(s)
Cooking Equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooking loads • Annual hours of operation
PTACs, Unitary and Split Air-conditioning Systems and Air-source Heat Pumps, and Mini-split Systems	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Cooling loads • Heating loads (if applicable) • Annual hours of operation
Air- and Water-cooled Chillers	Option A. Retrofit Isolation: Key Parameter Measurement Approach or, Option C. Whole Facility, if energy management system data are available and project-level savings are large compared to other energy variations at facility	• Cooling loads • Outside air temperatures • Manufacturer part-load efficiency data • Annual hours of operation
Refrigeration Equipment	Option A. Retrofit Isolation: Key Parameter Measurement Approach	• Space-conditioning category • Annual hours of operation

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.

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.

CC.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

DNV

CC.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.

CC.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.[114]
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.

CC.7 Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

CC.8 Non-residential Midstream Efficient Products Program – Revision History

Version	Date	Notes
Version 1	11/26/2019	▪ Initial Release
Version 2	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Minor word edits to measure section.

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[114] 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.

DNV

APPENDIX DD.   NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM (DSM VIII) EM&V PLAN

DNV

DD. NON-RESIDENTIAL NEW CONSTRUCTION PROGRAM EM&V PLAN (VERSION 2)

DD.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.

DD.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 DD-1.

Table DD-1: End-uses and Measures for Non-residential New Construction Program

End-use	Measure
Lighting	▪ Exterior LED lighting
HVAC	▪ High efficiency and variable speed chillers ▪ High efficiency direct expansion (DX) cooling equipment ▪ High efficiency packaged air-source heat pumps ▪ Demand controlled ventilation ▪ Variable air volume (VAV) dual-max controls ▪ Chiller controls
Plug Load	▪ Supervisory plug load management systems

DD.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[115] 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 are:

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 DNV Standard Tracking and Engineering Protocol (STEP) Manual, which are derived primarily from the most recent version of the Mid-Atlantic Technical Resource Manual (TRM), and as appropriate, other TRMs.

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

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[115] 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.

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 in 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 evaluation. Based on results from the DSM Phase I through III programs, DNV anticipates this will occur in year two 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.

DD.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 Technical Reference Manual (TRM), and other TRMs or relevant studies, as appropriate. The deemed savings protocol for measures in this program will be documented in the STEP Manual, also known as the Company's TRM, and calculated using utility-reported program participant data.[116] 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.

DD.5 Evaluated Savings Approach

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.

According to Chapter 15: Commercial New Construction Evaluation Protocol of The Uniform Methods Project (UMP), the evaluation approach will include calibrated building simulation.[117] The analysis will use a site-level analysis approach (see

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[116] Due to its volume, DNV has not included a copy of the STEP Manual with this EM&V Plan. The STEP manual was most recently filed on May 1, 2019 in the Company's 2017 DSM Proceeding, Petition of Virginia Electric and Power Company for approval to continue an existing demand side management program and for approval of two updated rate adjustment clauses pursuant to § 56-585.1 A 5 of the Code of Virginia, Case No. PUR-2017-00129 (Appendix F to EM&V Report), and is available at the following link: http://www.scc.virginia.gov/docketsearch#caseDocs/137786.

[117] 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.

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Section DD.5.1). The analysis will also follow the general approach of The International Performance Measurement and Verification Protocol (IPMVP), Option D, Calibrated Simulation.[118]

DD.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. 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.

DD.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

DD.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.

DD.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.[119]
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.

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[118] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol.

[119] 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.

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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.

DD.7 Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

DD.8 Non-Residential New Construction Program – Revision History

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.

DNV

APPENDIX EE.   RESIDENTIAL AIR CONDITIONING CYCLING PROGRAM (DSM I) EM&V PLAN

EE.1 Impact Analysis of the Residential Air Conditioning Cycling Program

DNV

EE. RESIDENTIAL AIR CONDITIONER CYCLING PROGRAM EM&V PLAN (VERSION 11)

EE.1 Program Summary

The Residential Air Conditioner (AC) Cycling Program, marketed as "Smart Cooling Rewards," compensates customers who allow the Company to reduce the cycle of their central air conditioning during peak load conditions by 30–50%. When AC cycling events are called, a radiofrequency (RF) paging signal is broadcast throughout the Company's service area. The signal is received by load curtailment switches installed on central air conditioners and heat pumps of participating residential customers. The dispatch of the RF signal to the load curtailment switch reduces the duty cycle of the registered AC units up to 50% during an event. The AC Cycling event season spans June 1 through September 30 on non-holiday weekdays.

EE.2 Measures

The program measure is the AC cycling control switch. The eligible classes of air conditioners and heat pumps in the AC Cycling Program are:

End-use	Measure
HVAC	- AC control switch, central air conditioners - Control switch, electric and duel fuel heat pumps

EE.3 Evaluation, Measurement & Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[120] The EM&V method empirically estimates demand reduction (kW) during AC Cycling program events. The Residential AC Cycling program is evaluated annually for the life of the program.

The basis for DNV's savings evaluation approach is:

1. Baseline Consumption: Baseline consumption will be calculated from AMI participant consumption data.
2. Demand reduction will be evaluated using the methods described in Section **Error! Reference source not found.**EE.5. The evaluated approach will use program tracking data, customer energy consumption data, and customer specific control histories to estimate demand reduction.

The evaluation follows protocols established in International Performance Measurement and Verification Protocol (IPMVP-Option C) and Measurement and Verification for Demand Response, Prepared for the National Forum on the National Action Plan on Demand Response.[121]

EE.4 Deemed Savings Approach

Deemed savings are not calculated for the Residential AC Cycling Program

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[120] 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.

[121] Efficiency Value Organization. 2016. Core Concepts, International Performance Measurement and Verification Protocol, Option C, Whole Facility; Measurement and Verification for Demand Response Prepared for the National Forum on the National Action Plan on Demand Response.: Measurement and Verification Working Group, February 2013. https://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp

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EE.5 Evaluated Savings Approach

Given the investment in this program and the planned peak shaving reductions, this EM&V plan calls for an annual impact evaluation. The evaluation reports ex post impacts event hour and THI, event average THI's, event opt-out percentages, and ex ante estimates by event hour and THI.

EE.6 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.[122]

EE.7 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).[123]
2. 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

EE.8 Lost Revenue Methodology

Not applicable.

EE.9 Timeline and Scope of Work

- Conduct a monthly review of program tracking and AMI participant consumption data
- Prepare monthly tracking indicator tables
- Evaluate impacts of dispatch events and prepare an annual impact evaluation report
- Enter annual updates of model specifications to the STEP Manual
- Provide program and regulatory support as necessary
- Update EM&V plans as needed

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[122] National Oceanic and Atmospheric Association (NOAA), National Centers for Environmental Information, Local Climatological Data.

[123] Dominions Energy's peak planning condition is hour-ending 17 at 95°F at 43% RH, or 83.4 THI. Temperature Humidity Index = THI = Td – (0.55 – 0.55*RH) * (Td – 58) where Td is dry bulb temperature and RH is relative humidity. Source: PJM Glossary: http://www.pjm.com/Glossary.aspx

DNV

EE.10 Residential Air Conditioner Cycling Program – Revision History

Version	Date	Notes
Version 1	2011	▪ Added semi-annual program tracking summary table in the "Frequency of EM&V Measurement & Timeline" section. ▪ Changed assumed error ratio from 0.5 to 0.96 (computed) with an error margin of 9.12%.
Version 2	2012	▪ Updated document formatting. ▪ Updated "KEMA" to "DNV KEMA." ▪ Modified the required sample size from 300. ▪ Changed "Program Penetration & Initial Baseline Assumptions" section title to "Program Penetration" and removed initial baseline assumptions. ▪ Updated planned penetrations and added "Source" column to the "Program Penetration" table. ▪ Changed "Revision History" section title to "Document Revision History."
Version 3	2013	▪ Updated "EM&V Summary and Sampling Strategy" section with description of experimental design analysis for 2013.
Version 4	2014	▪ Update Program Penetration Table based on 2013 IRP.
Version 5	2015	▪ Removed 2013 planned customer penetration numbers. ▪ Added sentence on PJM requirements to end of "EM&V Method." ▪ Updated deemed savings approach to utilize ex ante estimates for aggregate program impacts conditional on temperature humidity index and hour, developed from a regression analysis of historical program performance. Changes affected EM&V Method and EM&V Summary and Sampling Strategy sections.
Version 6	2016	▪ Updated DNV KEMA to DNV Energy. ▪ Updated EM&V method to IPMVP Option C to reflect impact estimation using premise level AMI data. ▪ Added description of analytical tasks to meet requirements for PJM compliance. ▪ Updated error ratio to reflect results used in 2014 sample design. ▪ Added planned annual updates to the representative load shape of the program resource. ▪ Renamed "Frequency of EM&V Measurement and Timeline" section title to "EM&V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section. ▪ Added on-going scope that was not explicitly mentioned to "EM&V Measurement, Timeline and Scope of Work" section. ▪ Deleted program penetrations section.
Version 7	2017	▪ Updated "EM&V Summary and Sampling Strategy" section with description of the 2016 study population which includes all participants with AMI meters. ▪ Changed "semi-annual" to "monthly" program tracking summary table in the "Frequency of EM&V Measurement & Timeline" section. ▪ Prior to 2016, the measured average load reduction was computed from the interval load data of a sample of participating homes with AMI. Starting in 2016 the measured average load reduction is computed from the interval load data of all participants with AMI. ▪ Removed reference to a 96% operability rate. ▪ Added scope description for ex ante and ex post demand reduction estimates in EM&V Measurement, Timeline and Scope of Work.
Version 8	2018	▪ Updated with 2017 ex ante evaluated results.
Version 9	2019	▪ Formatting and minor edits. ▪ Updated from DNV Energy to DNV Energy Insights. ▪ Removed 2018 ex ante impact estimates.

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Version	Date	Notes
Version 10	2020	▪ Formatting updates.
Version 11	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Changed format of measure table. Removed reference to load shapes. Added detail to evaluated savings methodology in EE.5.

DNV

APPENDIX FF. NON-RESIDENTIAL DISTRIBUTED GENERATION PROGRAM (DSM II) EM&V PLAN

FF.1 Impact Analysis of the Non-residential Distributed Generation Program

DNV

FF. NON-RESIDENTIAL DISTRIBUTED GENERATION PROGRAM EM&V PLAN (VERSION 11)

FF.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.

FF.2 Measures

The program dispatches power from on-site generators of participating customers

FF.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.

Baseline estimation approach: The baseline for this program is 0 kW because the power generators are considered non-operational at the beginning of each event.

Deemed savings approach: Deemed savings values based on evaluated impacts are incorporated into the DNV Energy Standard Tracking and Engineering Protocols (STEP).

Measured savings approach: The program participants are known, generated kW is metered, and impacts are calculated using regression models.

FF.4 Deemed Savings Approach

Deemed savings are not calculated for the Non-Residential Distributed Generation Program.

FF.5 Evaluated Savings Approach

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.

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 prior to or following an event is not attributed to the Program.

FF.5.1 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.

FF.6 Lost Revenue Methodology

Not applicable.

FF.7 Timeline and Scope of Work

- Analysis of program tracking and metered data: Annual Report (May 15 of each year following program launch).
- 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).
- Annual event season report (November of each year).
- Annual updates to DNV Energy Standard Tracking and Engineering Protocols (STEP) for updates that occurred to its referenced sources.
- Develop baseline, measure savings, and efficient load shapes.
- Provide regulatory support as necessary.

FF.8 Non-residential Distributed Generation Program – Revision History

Version	Date	Notes
Version 1	2011	- Added semi-annual program tracking summary table in the "Frequency of EM&V Measurement & Timeline" section.
Version 2	2012	- No material changes to the content. - Added semi-annual program tracking summary table in the "Frequency of EM&V Measurement & Timeline" section.
Version 3	2013	- No material changes to the content.
Version 4	2014	- Updated program requirements with more details, as shown below: - Added minimum kW demand requirement of 200 kW to be eligible for this program to the "Program Summary" section. - Added customer notification process of each DG event through e-mail or phone 30 minutes in advance. - Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW. - Changed "KEMA" to "DNV KEMA." - Changed "Program Penetration & Initial Baseline Assumptions" section title to "Program Penetration" and removed initial baseline assumptions. - Updated program penetrations and added "Source" column to the "Program Penetration" table. - Changed "Revision History" section title to "Document Revision History." - Updated planned penetration table based on 2013 IRP.
Version 5	2015	- Removed 2013 planned customer penetration numbers. - Added sentence on PJM requirements to end of "EM&V Method." - Updated program requirements with more details, as shown below: - Added minimum kW demand requirement of 200 kW to be eligible for this program to the "Program Summary" section. - Added customer notification process of each DG event through e-mail or phone 30 minutes in advance.

Version	Date	Notes
		▪ Added compliance requirement that participants must be within +/- 5% of committed peak shaving enrolled kW. ▪ Changed "KEMA" to "DNV KEMA." ▪ Changed "Program Penetration & Initial Baseline Assumptions" section title to "Program Penetration" and removed initial baseline assumptions. ▪ Updated program penetrations and added "Source" column to the "Program Penetration" table. ▪ Changed "Revision History" section title to "Document Revision History." ▪ Updated planned penetration table based on 2013 IRP.
Version 6	2016	▪ Updated DNV KEMA to DNV Energy. ▪ Clarified that compliance is defined by total monthly average load curtailment that is at least 95% of committed peak shaving enrolled kW (rather than +/- 5% of enrolled kW). ▪ Renamed "Frequency of EM&V Measurement and Timeline" section title to "EM&V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section. ▪ Added on-going scope that was not explicitly mentioned to "EM&V Measurement, Timeline and Scope of Work" section. ▪ Deleted program penetrations section. ▪ Removed 2013 planned customer penetration numbers. ▪ Added sentence on PJM requirements to end of "EM&V Method."
Version 7	2017	▪ Clarified that compliance for program participation is 50% of enrolled, but compliance for payments is 95% of enrolled kW. Updated bullet "Semi-annual program tracking summary table (as required)." to "Semi-annual program tracking summary table (ending July 2015). 2015 will be final year of semi-annual reporting, as North Carolina submissions will be changing next year to line up with Virginia. ▪ Updated DNV KEMA to DNV Energy. ▪ Clarified that compliance is defined by total monthly average load curtailment that is at least 95% of committed peak shaving enrolled kW (rather than +/- 5% of enrolled kW). ▪ Renamed "Frequency of EM&V Measurement and Timeline" section title to "EM&V Measurement, Timeline and Scope of Work" to reflect the content more accurately in that section. ▪ Added on-going scope that was not explicitly mentioned to "EM&V Measurement, Timeline and Scope of Work" section. ▪ Deleted program penetrations section. ▪ Updated bullet "Semi-annual program tracking summary table (as required)." to "Semi-annual program tracking summary table (ending July 2015). 2015 will be final year of semi-annual reporting, as North Carolina submissions will be changing next year to line up with Virginia." ▪ Clarified difference between payment compliance (95% of enrolled load) and program participation compliance (50% of enrolled load).
Version 8	2018	▪ Updated "April 1" report date to "May 1" in "EM&V Measurement, Timeline, and Scope of Work" section.
Version 9	2019	▪ Minor edits. ▪ Formatting updates. ▪ Updated from DNV Energy to DNV Energy Insights.
Version 10	2020	▪ Formatting updates.
Version 11	3/22/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number. Slight word change to measure description. Additional detail added to deemed and evaluated savings methodologies in Sections FF.4 and FF.5.

DNV

APPENDIX GG.   RESIDENTIAL ELECTRIC VEHICLE PROGRAM (PEAK SHAVING) (DSM VIII) EM&V PLAN

GG. RESIDENTIAL ELECTRIC VEHICLE PROGRAM DR EM&V PLAN (VERSION 2)

GG.1 Program Summary

The peak shaving program would provide customers who already have a qualifying level 2 electric vehicle (EV) charger and wish to participate in the demand response (DR) component only (no purchase incentive)

GG.2 Measures

The measures offered by the Residential Electric Vehicle (DR) Program are as shown in Table GG-1.

Table GG-1. Measures Offered by Residential Electric Vehicle (DR) Program

End-use	Measure
Plug Load	▪ EV charging demand response events

GG.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[124] 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 are:

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 GG.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.

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.

GG.4 Deemed Savings Approach

Estimates of load reduction in demand response programs are not deemed.

GG.5 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).

GG.5.1 Sample Design Considerations

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

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[124] 20 VAC5-318, Title 20. Virginia State Corporation Commission, Chapter 318, Final Regulation, Rules Governing the Evaluation, Measurement, and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs. Effective Date: January 1, 2018.

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

If an insufficient number of AMI participants enter the program, it may be necessary to develop a representative sample of participants and install AMI or interval meters at customer households designated for the sample.

Both approaches will make use of AMI or interval data from Dominion Energy's customers to produce a robust estimate of the necessary sample size required to meet precision requirements for load reduction estimates.

GG.6 Lost Revenue Methodology

Not applicable.

GG.7 Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

GG.8 Residential Electric Vehicle (DR) Program–Revision History

Version	Date	Notes
Version 1	11/26/2019	▪ Initial release
Version 2	3/21/2021	▪ Added date to revision history and removed "Document" from "Document Revision History). Removed decimal place from version number.

DNV

APPENDIX HH. RESIDENTIAL SMART THERMOSTAT REWARDS PROGRAM (DSM VIII) EM&V PLAN

DNV

HH. RESIDENTIAL SMART THERMOSTAT REWARDS PROGRAM (DR) (VERSION 2)

HH.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.

HH.2 Measures

The measures offered by the Residential Smart Thermostat Rewards Program (DR) include those listed in Table HH-1.

Table HH-1. Measures Offered by Residential Smart Thermostat Rewards Program (DR)

End-use	Measure
HVAC	▪ Heat pump demand response, peak reduction ▪ Air conditioning system demand response, peak reduction

HH.3 Evaluation, Measurement, and Verification Overview

DNV will support Dominion Energy in its EM&V activities to be compliant with 20 VAC 5-318.[125] 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 are:

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 HH.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.

The Residential Smart Thermostat Rewards Program (DR) is evaluated annually for the life of the program.

HH.4 Deemed Savings Approach

Estimates of load reduction in demand response programs are not deemed.

HH.5 Load Reduction Estimation

An unadjusted regression-based estimate will be tested which will provide an unbiased estimate of load reduction regardless of pre-event cooling activity. Some evaluation approaches use a site-level regression baseline adjusted to event-day load.

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[125] 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.

This approach is problematic when applied to smart thermostats that use an optimized load reduction (pre-cooling) algorithm.

HH.5.1 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.

The size of the sample for non-AMI customers will be determined using the PJM sample size approach. This approach will make use of AMI data from existing Dominion Energy's customers to produce a robust estimate of the necessary sample size required to meet precision requirements for load reduction estimates.

HH.6 Lost Revenue Methodology

Not applicable.

HH.7 Timeline and Scope of Work

- Develop and update EM&V plan annually.
- Analyze program tracking data: Annual report (May 1 of each year following program launch).
- Update STEP Manual 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.
- Provide regulatory support as necessary.
- If appropriate, support lost revenue recovery activities.

HH.8 Residential Smart Thermostat Program (DR) Revision History

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.

About DNV

Driven by our purpose of safeguarding life, property, and the environment, DNV enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software, and independent expert advisory services to the maritime, oil & gas, and energy industries. We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide our customers and society with operational and technological foresight. Operating in more than 100 countries, we are dedicated to helping our customers make the world safer, smarter, and greener.

DNV

APPENDIX II.   DOMINION INCOME AND AGE QUALIFYING HOME IMPROVEMENT PROGRAM MANUAL

Nexant

Reimagine tomorrow.

Dominion Energy
Income and Age Qualifying Home
Improvement Program Manual

August 2018

Contents

Contents (continued)

Preface

Marginal and Text Markings

Solid vertical lines in the margins within the body of the code indicate a change or new clarification from the previous program requirements.

(➡) Deletion indicators are provided in the margin where a paragraph or item has been deleted.

Underlines within the body of the code indicate a clarification compared to the previous program requirements.

1   Introduction

The Income and Age Qualifying Home Improvement program (Program) has been designed to help qualifying low-income and elderly customers reduce energy expenses through installation of a select set of energy conservation measures (ECMs). The design of this program aligns with the Virginia Department of Housing and Community Development Weatherization Assistance Program (DHCD WAP), providing an opportunity for Dominion Energy approved Weatherization Service Providers to:

- Install eligible equipment funded by Dominion Energy
- Free up DOE and LIHEAP funds for addition measures under the VA WAP program
- Potentially reach more customers
- Provide energy efficiency measures for customers not traditionally eligible under DOE and LIHEAP

Virginia weatherization providers interested in applying as Dominion Energy Weatherization Service Providers (WSP) must be currently active and in good standing with Virginia's Department of Housing and Community Development (DHCD), and have a service territory that overlaps with Dominion's assigned electric service territory.

1.1   Program Implementer

The Dominion Energy (Dominion) Program is implemented by Nexant, Inc. Dominion has contracted and authorized the Program Implementer to perform activities including, but not limited to: reviewing, processing, and approving WSP and customer applications; qualifying, training, and educating WSPs; inspecting customer projects; and issuing incentive checks.

1.2   Program Manual

This Income and Age Qualifying Home Improvement Manual (Program Manual) is designed for use by Weatherization Service Providers (WSPs) approved to provide services to eligible Dominion customers through the Program. The Program Manual outlines the specific requirements for the Program and is designed to assist WSPs in understanding the program process; customer and measure eligibility requirements; project services; and WSP role.

1.3 Program Manual Updates for 2018

- The sections in the Program Manual have been re-arranged in a format that is similar to other weatherization guidelines.

- Program starts July 1, 2018 and all projects must be submitted by November 30, 2018 to be eligible to receive an incentive in 2018.

- Section 2.2 has been updated. Eligible low income master metered multi-family properties are eligible to participate only under the Energy Share Weatherization Services Program.

- Section 3.1.3 clarification on WSPs working within the confines of their Designated Service Areas. Weatherization agencies that own or manage low income properties are now required to coordinate with the assigned agency to include the property in the local agency's annual spending plan.

- Section 3.3.1 clarification on timeline for application submission. Failure to submit within the designated timeline can result in non-payment.

- Section 3.3.3 and the individual measures have been updated to state that photographs for 10% of each unit type must be submitted for multifamily buildings. 100% of Single Family homes need photos submitted.

- Section 3.3.3 clarification on timeline for completing applications in Missing Information Status and WSP responsibility for reviewing and providing feedback on Weekly Status Report.

- Added Section 3.3.4 WSP site inspection requirements for multi-family units.

- Section 5 Tables:

    - Required Documentation has been updated in each table, including new requirements for including bill of materials and site inspection documents for multi-family properties.

    - Updated the pipe wrap eligibility in Table 5.4 to include that pipe insulation shall be taped (using a high quality tape with good adhesion), caulked (with appropriate caulk to secure and adhere to insulation), or glued at all joints.

- Added Section 5.2.1 to clarify photographic documentation requirements for installed energy conservation measures (ECMs).

- Added Appendix C - Example Ineligible Address List and Signed Attestation

- Added Appendix D – Program Notices. This section is a placeholder for 2018 Program Notices.

- Added Appendix E – Weatherization Agency Site Inspection Checklist

2   Customer Eligibility

This section outlines the customer and property eligibility requirements as well as the requirements for project pre-approvals.

2.1 Customer Eligibility Requirements

WSPs are required to verify the eligibility of potential customers before performing the energy assessment. All customers will be required to certify being income eligible for the Program by executing a Program consent form. To qualify for the Program, a customer must meet the following eligibility requirements:

- Customer must be a current Dominion or a new service customer intending to receive electric services on a residential rate schedule; and either

- Customer must have a total household income that does not exceed 60% of the Virginia Median Income; or

- Customer is 60 years or older with a total household income that does not exceed 120% of the Virginia Median Income.

Both owner-occupied and renter-occupied households are eligible to participate in the Program. Eligible customers must be responsible for the electric bill and either own the home or be able to secure permission from the owner to perform the Program qualifying installations or improvements.

Customer measures receiving incentives through this Program are not eligible to receive incentives through any other programs offered by Dominion. In addition, only one application may be submitted per household.

2.2 Property Eligibility

Eligible customers must be living in single family residences, townhomes, mobile homes, and separately metered multi-family dwellings (apartments and condos) with electric or non-electric heating and electric cooling. Customers residing in a multi-family facility must be in a multi-family facility that is sub-metered. Multifamily facilities owned by local housing authorities are not eligible under the Income and Age Qualifying Home Improvement Program.

Some measures have fuel restrictions (see Section 5.2 for details).

2.3 Multi-family Eligibility – Properties that aren't 100% Income Qualified Properties

Steps to qualification:

1) Responsible weatherization agency shall meet with the property manager or owner to confirm program eligibility requirements are met. In the meeting, the property management firm will bring a list containing the apartment unit number and tenant income. The weatherization agency will provide the income and other program requirements. On a unit by unit basis, the property management representative will confirm whether the individual resident(s) qualify for participation in the program. Please Note: this responsibility falls on the weatherization agency, and is not to be assigned to the subcontractor(s) performing the work

2) Property management representative will execute an attestation that this review has been performed. The items that must be included in the attestation are illustrated in Appendix C of this Program Notice.

3) Units that do not meet the program requirements are to be listed in the project application on the Ineligible Address List tab.

4) Weatherization agency must complete and sign attestation on the Ineligible Address List tab. See Appendix C for example of the ineligible address list tab and example of the signed attestation.

5) Note: Vacant units in properties that are not 100% tax credit or section 8 do not automatically qualify for program eligibility. Weatherization agency understands that if measures are installed, the units may not qualify for reimbursement once the unit is occupied.

2.4 Pre-Approval and Pre-Qualification

▪ All multifamily projects must secure pre-qualification prior to installation of equipment, regardless of incentive amount. Pre-qualification allows the Program Implementer to ensure that the residents meet the program age and income requirements and approve the measures for the project. To submit a project for pre-qualification, provide an email containing the following information 14 days in advance of scheduled ECM installation:

- Contact name and information for the apartment's property manager

- Number of units

- A list of expected measures per unit type (1 bedroom, 2 bedroom, etc.)

- The income limits for the apartment complex

▪ Failure to provide advance notice may delay WSP planned installation schedule.

▪ Dominion Energy is allowing installation of more than 6 LEDs on a case-by-case basis. Nexant must visually pre-qualify any property with more than 6 LEDs to confirm

applicability, and written confirmation (via email) will be provided if approved. The written confirmation is to be submitted with the rebate application.

- The maximum number of LEDs approved to be installed in any individual unit is no greater than 12 LEDs.

3   WSP/Contractor Expectations

This section outlines the roles and responsibilities of the WSP.

3.1 WSP Commitment and Customer Satisfaction

WSPs are the key to success and customer satisfaction for the Program.

3.1.1 Participation Commitment

Program-qualified WSPs are assigned an annual budget allocation for the IAQHI program. On a weekly basis, participation levels are tracked and a weekly status report is emailed to individual WSPs summarizing the status of that WSP's projects. A sample WSP Weekly report is provided in Appendix A.

Program approved WSPs shall provide a spending plan for the assigned allocation by the communicated delivery date for that year. Should Program approved WSPs not provide a spending plan, or if they fail to meet the submitted spending plan by a designated date each year, Dominion reserves the right to service eligible low income customers via a third party subcontractor.

3.1.2 Customer Satisfaction

Customer satisfaction is one of the top priorities of the Program. As such, it is the WSP's responsibility to represent the Program and interact with customers professionally and communicate the requirements for Program qualification accurately. WSPs shall be solely responsible to the customer for the installation of the ECM, and all WSPs are required to enter into a service agreement with customers for the installation services. Failure to do so will result in removal from the Program.

3.1.3 WSP Service Area

WSPs may only perform Program weatherization services in the service area for which the WSP has been approved by the Virginia DHCD or an area defined by Dominion or Program Implementer (Designated Service Area). Dominion and Program Implementer reserve the right to change the Program at any time.

3.1.4 Customer Information

Program Qualified WSPs receiving Customer information shall:

- Treat a customer's personal information as confidential;

- Safeguard customer information and take all reasonable precautions to prevent any unauthorized use or disclosure;

- Not use customer information for any purposes other than for the purpose of performing Program related services;

- Only disclose customer information to WSP employees and subcontractors directly involved in the Program, or as otherwise required by law and comply with all legal requirements to safeguard the customer's information.

3.2 Program Marketing Materials

WSP shall not use Dominion's or Program Implementer's corporate name, trademark, trade name, logo, identity, or any affiliation on WSP marketing or other materials (printed copy or electronic) for any reason, including, without limitation, soliciting customers, without Program Implementer's prior written consent. Approved Program marketing materials will be provided to WSPs with a space for a business card to be added; these materials may only be used for the sole purpose of promoting the Program and may only be used during the Program term.

3.3 WSP Role

3.3.1 Project Services

The WSP's role includes providing the following project services to eligible Dominion customers:

- Recruiting of and assistance to eligible customers participating in the Program including distribution of marketing materials; assistance in completing Program related documentation including completing the energy assessment form with customer; submitting the required documentation for each measure; answering any questions asked by the customer on the Program; and answering any questions or requests for documentation by the Program Implementer or Dominion concerning customer projects;

- Respond to all inquiries from Program Implementer, Dominion and its customers within two (2) business days. WSP shall communicate with the Program staff and Dominion customers, and resolve any customer issues related to a customer project in a timely, professional, and responsive manner;

- Verify customer eligibility prior to performing energy assessment and installing the proposed Program qualifying energy efficiency improvement and measures (ECM) project by:
  - Ensuring that the customer is a current Dominion residential electric customer,
  - Ensuring that the income qualifying customer meets Virginia Department of Housing and Community Development's (DHCD) Income requirements as outlined in the Program Manual, and
  - Ensuring that the age-qualifying customer meets the income threshold of 120% of the State of Virginia's median income if they are 60 years or older;

- Completing an accurate energy assessment of customer's project to identify Program eligible ECMs that would result in energy savings at the customer facility;

- Reviewing the energy assessment form and recommended improvements with the customer and obtain customer approval of WSP's installation of the customer selected ECMs with a signature on an installation agreement between WSP and the customer. Only one energy assessment form may be completed for a qualifying customer facility;

- Installing the ECMs in a professional and safe manner, in compliance with the customer installation agreement and Program requirements;

- Provide a copy of the energy assessment summary to the customer;

- Purchase and stock necessary Program-eligible ECMs;

- <u>Submitting within 30 days of project completion, an invoice (Incentive Worksheet) to Program Implementer for Program Incentives, accurately reporting quantity of measures installed, and providing necessary documentation. In the case of delayed invoice submission, WSP is to communicate reason for delay to Program Implementer. Projects that are not submitted within 90 days risk non-payment.</u>

3.3.2   Qualifying Energy Conservation Measures (ECM)

WSPs are required to submit ECM product technical specifications to Program Implementer for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. Product specification sheet(s) must clearly indicate product and model number, and contain information that illustrates the product's compliance with *Eligibility Requirements* as stated in Tables 5-1 through 5-10.

Periodically the Program Implementer will pull the approved technical specifications and confirm product eligibility throughout the life cycle of the measure. This includes periodic inspection of equipment in the warehouse (or in transit to a site), inspection during installation, or inspection post-installation.

3.3.3   Project Documentation

The WSP shall collect and submit all required Program information and documentation on customer projects. As noted under 3.1.4, Customer Information, customer's personal information is to be treated as confidential. To ensure customer information is protected, the WSP shall submit the following program documentation through the SFTP service provided by the Program Implementer:

- Excel and PDF versions of the energy assessment form.

- PDF versions of the required project documentation for each ECM installed as outlined in Section 5.2. Pre-approved product sheets are not required to be submitted with project applications.

- <u>Photographs, Multi-family –</u> <u>Pre- and post-installation photographs must be submitted for 10% of the total number of units (apartments) participating in the program and must also be distributed to cover 10% of each unit type (i.e. 1 BR, 2 BR, etc.). In addition, photos of the insulation in each building receiving attic insulation must be submitted.</u>

- <u>Photographs, Single Family - 100% of Single Family homes must have photos submitted.</u>

- <u>**All** photos must be equal to the measures shown on the Incentive Worksheet. Inaccurate documentation can result in projects getting stuck in Missing Information status or worse – unapproved for reimbursement.</u> To reduce file sizes, photographs may be uploaded in a JPEG format.

- A copy of the executed (signed) WSP invoice (Incentive Worksheet) for Program eligible ECMs.

- A copy of the executed (wet signature) WSP installation agreement (Project Application) with the customer. Electronic or digital customer signatures are not acceptable.

- A copy of the material invoice or bill of materials for multi-family units

- A copy of the final inspection report for multi-family units

- Emailing documents is not permitted.

- All project applications must be complete prior to uploading to the SFTP. Incomplete applications may be rejected.

- Project applications that cannot be processed as a result of Missing Information must be resolved within 90 days or risk non-payment AND with no exception will payments for work completed in one year be paid after February 28th of the following year.

3.3.4 Site Inspections and Subcontractors

Weatherization Service Providers (WSPs) are required to perform a final inspection of a project before the job is submitted for rebate. In situations where a subcontractor is used to perform a portion or all of the weatherization work, the WSP is responsible for inspecting and certifying that the work has been completed to the program standards.

3.3.5 Other WSP Responsibilities

- Spend the annual budget allocation consistently throughout the program year. Failure to participate and serve eligible customers will result in assignment of a third party contractor to ensure Dominion's customers are served.

- Use the proper personal protective equipment. All Program services shall be performed by WSP in compliance with all applicable local, state, and federal laws, regulations, and ordinances.

- Assume full responsibility for removal of old equipment from the customer facility and for sorting, storage, recycling and proper disposal of equipment and waste material in compliance with all applicable laws and regulations and the prevailing local jurisdiction.

- Provide additional information and documentation, and right to inspect retained Program records, with respect to Program and customers and ECM pertaining to Program when requested by Program Implementer or Dominion.

- Conduct professional and ethical business at all times.

3.3.6 WSP Non-compliance Process

- Weatherization Service Providers (WSPs) are expected to meet the Program service expectations which include, but are not limited to:

  – Commitment to servicing customers and promoting the Program,

  – Customer satisfaction and education,

- Accurate and timely project document submissions,

- Performing quality workmanship,

- Providing a safe work environment, and

- Conducting business in accordance with all applicable laws.

- WSPs will promote an atmosphere of respect and fair business dealings with Dominion's customers, suppliers, business partners and competitors in compliance with applicable law. WSPs will not take unfair advantage of any individual or company through manipulation, concealment, abuse of privileged information, misrepresentation of material facts, or any other unfair practices. WSPs shall deal fairly with all customers and competitors and will not enter into any type of agreement, understanding or arrangement between customers or competitors, whether written or oral, formal or informal, express or implied, that limits or restricts competition.

- Implementing Contractor may suspend WSP's right to participate in the Program if Implementing Contractor determines that there is non-compliance with Program requirements. Upon notice of suspension, all of WSPs rights with regards to the Program Benefits will be terminated during the period of suspension which may include Program customer acquisition and installation work.

  Program Benefits:

  a. *Payment for approved Incentives*

  b. *Program promotional materials*

  c. *Customer referrals*

  d. *Program-related training*

- If WSPs work is not in conformance with project pre-approval documents, the WSP shall correct such work, at its own expense, within seven (7) calendar days of written notice of non-compliance from Implementing Contractor. If the WSP fails or refuses to correct such non-conformance within seven (7) days after such notice, Implementing Contractor shall have the right to withhold the funds from the WSP.

- If WSP fails to comply with the guidelines outlined in this Program Manual or those in the Weatherization Service Provider Application and Agreement, Implementing Contractor may provide WSP with written notice of non-compliance. The written notice of non-compliance shall contain:

  - A summary of the non-compliant action;

  - Expectations for resolution;

  - A time frame for resolution; and

  - Scheduling of a resolution follow-up meeting, if required.

- The Implementing Contractor may terminate this Agreement for any WSP who receives two (2) or more notices of non-compliance.

- If the Implementing Contractor determines, in its sole discretion, that WSP is involved in fraudulent activity, the Implementing Contractor may immediately terminate this

Agreement and remove WSP from the Program. Such fraudulent activity that may result in immediate termination and removal include:

- Falsifying invoices;

- Invoicing for more measures than actually installed;

- Providing inaccurate information in a customer application, project documentation, or invoice in order to obtain or increase incentive amounts;

- Misrepresenting the eligibility requirements for the Program to the customer; or

- Misrepresenting its relationship to third parties.

▪ Implementing Contractor may withhold payment to WSP for any of the reasons noted below. Implementing Contractor shall give WSP written notice, by email is sufficient, stating the specific reasons for disapproval of WSPs submission for incentive payment. When the reason for withholding payment is removed or corrected, payment will be made.

- WSP fails to submit project documentation or deliverables in accordance with Program documentation submission requirements;

- Nonconforming or defective work has not been corrected in a timely fashion; or

- Implementing Contractor has reasonable suspicion that WSP is involved in fraudulent activity.

Removed WSPs

▪ In the event the WSP is removed from the Program, WSP shall:

- Not perform any Program customer acquisition or installation work after the termination date or a date approved by the Implementing Contractor in writing (email is sufficient).

- Cooperate with Implementing Contractor in the Project Close-out Procedures provided below.

- Immediately cease promoting its participation in the Program

▪ A removed WSP is not permitted to perform any work on Program projects as a subcontractor to any other WSP.

▪ A removed WSP is eligible to reapply to the Program after twelve (12) calendar months from the date of notification of removal.

Project Close-out Procedures

▪ After notice of termination, WSP will not be able to submit any projects to the Implementing Contractor for project pre-approval.

▪ For previously approved projects, WSP shall complete the pre-approved scope and submit final project documentation to Implementing Contractor within sixty (60) calendar days of the date of the termination notice in order to be considered for payment of incentives, regardless if a pre-approval notice has stated otherwise. NO PROJECT CLOSE-OUT TIMEFRAME EXTENSION REQUESTS WILL BE GRANTED. If WSP fails to submit the required documentation within the specified timeframe, Implementing

Contractor has the right to reassign the customer application and project to another WSP for completion of any outstanding work.

- All pre-approved projects with completed final documentation will be inspected by the Implementing Contractor and incentives will be paid on actual measures installed that are in compliance with Program requirements.

The above remedies are in addition to any other remedies that are available to Implementing Contractor and Utility under this Agreement or by law.

4   WSP/Contractor Participation Requirements

WSPs participating in the Program are required to comply with the below participation requirements throughout the term of their agreement. WSP is responsible for submitting all required participation documentation to the Program Implementer annually and for updating any changes or additions to their information immediately. During the term of its agreement, WSP shall provide to Program Implementer satisfactory evidence that it continues to be fully licensed and insured along with quality and timely submission of appropriate materials, consistent with the terms of its agreement, within (15) fifteen days of any request by Program Implementer for such verification.

4.1 Background Investigation Requirements

Prior to permitting any individuals to perform Program services on WSP's behalf, WSPs are required to perform background investigations on all WSP employees, and require their subcontractors to perform for their employees, who will have access to a Dominion's customer information and/or will be performing services at a customer's residence through the Program. Background investigations shall include a seven (7) year criminal history check for misdemeanor and felony convictions. WSP must conduct all background investigations in accordance with applicable federal and state laws.

WSP must certify to Program Implementer that background investigations have been completed for all applicable WSP employees and subcontractors prior to performing any services for the Program by submitting the WSP Background Certification Form (Certification) provided below as Exhibit 1. The certification provided by the WSP is an affirmative statement that background investigations for all relevant WSP employees and subcontractors have been completed in compliance with these Background Investigation Requirements and that no material items were discovered during the investigation that would impact performance of services for the Program or that may be deemed to pose an unacceptable safety or security risk to Dominion or its customers ("Adverse Findings"), and that all WSP employees and subcontractors will continue to be in compliance with these terms throughout performance of the services under the Program.

WSP shall not permit any WSP employee or subcontractor to perform services for a Dominion customer under this Program if an investigation shows Adverse Findings or such individuals fail to maintain compliance with these terms. If at any time after the Certification has been provided to Program Implementer, WSP becomes aware of Adverse Findings for employees or subcontractors who were listed in the Key Personnel List as part of the Certification, WSP shall discontinue use of such individual in performance of the Program services and WSP shall notify Program Implementer immediately.

4.2 Insurance Requirements

WSP shall cause its insurers to provide valid proof of insurance to Program Implementer of the applicable coverage and endorsements or copies of the applicable policy language affecting coverage as required before performance of any Program Services. Such insurance will remain in full effect for the term of the agreement. Failure of Program Implementer to enforce the minimum insurance requirements will not relieve the WSP of responsibility for maintaining the coverage(s). WSP is solely responsible for all premiums and deductibles for insurance required by the agreement.

- Automobile Liability Insurance for coverage of owned, non-owned, hired or rented, autos used in the performance of Program Services with minimum combined single limits of $1,000,000 per accident for bodily injury, including death, and property damage.

- Workers' Compensation Insurance for WSP's employees to the extent required by applicable state statutory limits where services are performed or, as required by law, anywhere else a WSP's employee performing services is normally employed. Employers' liability with limits no less than $500,000 Bodily Injury for Each Accident; $500,000 Bodily Injury by Disease for Each Employee; $500,000 Bodily Injury Disease Aggregate.

- Commercial General Liability Insurance on an occurrence basis including bodily injury and property damage, including premises liability, products/completed operations liability, and blanket contractual liability with limits no less than $1,000,000 each occurrence; $1,000,000 general aggregate; $1,000,000 products/completed operations aggregate.

Additional Insurance Provisions

Any insurance required to be carried by WSP will be primary and is not contributing with any other insurance carried by Program Implementer.

Dominion, Nexant Inc., and their respective subsidiaries and each of their officers, directors, and employees shall be named as additional insureds on Commercial General Liability and Automobile Liability policies by a policy provision or endorsement.

WSP's insurer will provide Program Implementer with thirty (30) days prior written notice of cancellation, non-renewal or any material change of its insurance coverage.

WSP hereby grants to Program Implementer a waiver of any right to subrogation which any WSP insurer may acquire by virtue of the payment of any loss under such insurance against (i) the beneficiary, (ii) all additional insureds, (iii) Program Implementer and its subsidiaries, and (iv) the Utility. WSP agrees to obtain any endorsement that may be necessary to effect and permit waiver of subrogation, but this provision applies regardless of whether or not Program Implementer has received a waiver of subrogation endorsement from the insurer.

WSP shall ensure that WSP insurance covers the actions of any WSP subcontractors providing installation services and shall require its subcontractors at all tiers, if any, providing services to

Program customers, to comply with these insurance requirements. WSP shall provide proof of insurance for such subcontractors, as requested by Program Implementer.

Program Implementer reserves the right to modify these requirements, including limits, based on the nature of the risk, prior experience, insurer, coverage, or other special circumstances.

4.3 Licensing and Certification Requirements

WSP licensing and certification requirements are specified below. WSP shall provide copies of all required licenses and certifications to Program Implementer for all applicable WSP employees and subcontractors. The WSP firm must have a current Virginia Department of Professional and Occupational Regulation (DPOR) Contractor's License – Class A, B or C as appropriate - and Residential Building Energy Analyst Firm License.

WSP's field staff and subcontractors performing Program services must meet current Virginia Department of Housing and Community Development (DHCD) Weatherization Assistance Program requirements which include OSHA and EPA training/certifications, DPOR licensing requirements, Building Performance Institute (BPI) certification. These requirements are specified in more detail below:

Required for WAP Energy Auditors (required within 12 - 18 months of employment):

- Retrofit Installer Technician (RIT)
- HVAC Fundamentals
- Duct Sizing Class
- NEAT/MHEA Energy Audit Software
- ASHRAE 62.2
- Energy Auditor Classroom Revised June 2013 Chapter 9 – Training and Technical Assistance Virginia Weatherization Assistance Program Page 3 of 3 Program Operations Manual

Required for WAP Workers (required within 9 months of employment):

- Retrofit Installer Technician (RIT)
- Lead Safe Weatherization (LSW)
- OSHA 10 Construction Safety Course

Required for WAP Crew Leaders (required within 12 months of employment):

- Retrofit Installer Technician (RIT)
- Lead Safe Weatherization (LSW)
- OSHA 30 Construction Safety Course
- Required Lead training

- Lead Safe Weatherization (LSW)

All WAP crew workers and subcontractors working on Weatherization, LIHEAP, or SERC must complete this class:

- Renovation, Repair and Painting (EPA RRP rule)

4.4 Safety Requirements

WSP is responsible for ensuring that all individuals performing Program services on behalf of WSP comply with reasonable safety practices and protocols required to perform the services. WSP is required to have a safety program to be used as guidelines and direction for WSP employees and subcontractors, as applicable. The safety program must meet all federal, state, and local laws. WSP shall provide a copy of WSPs written safety policy to Program Implementer.

WSP's safety program must include the following minimum requirements:

- Safety policy and procedures which address all required local, state and federal occupational safety and health standards and trade-specific licensing and certification requirements and a safety officer responsible for program implementation;

- Safety rules and safe working practices which must be followed by employees at any location for the prevention of illness and injury;

- Processes addressing identification, prevention and control, and communication of safety and health hazards;

- Employee training which includes addressing site specific safety and health requirements;

- Tools, instruments, and safety equipment that meet minimum safety specifications (e.g., ASTM and ANSI standards) which are available and provided to employees by Contractor;

- Requirements for the use of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions or where regulations indicate the need for using such equipment;

- An injury and incident response and reporting procedure including Whistleblower protections and emergency action planning and enforcement procedures to address violations.

5   Program Process

5.1 Process Flow Diagram

Figure 5-1: Process Flow Diagram
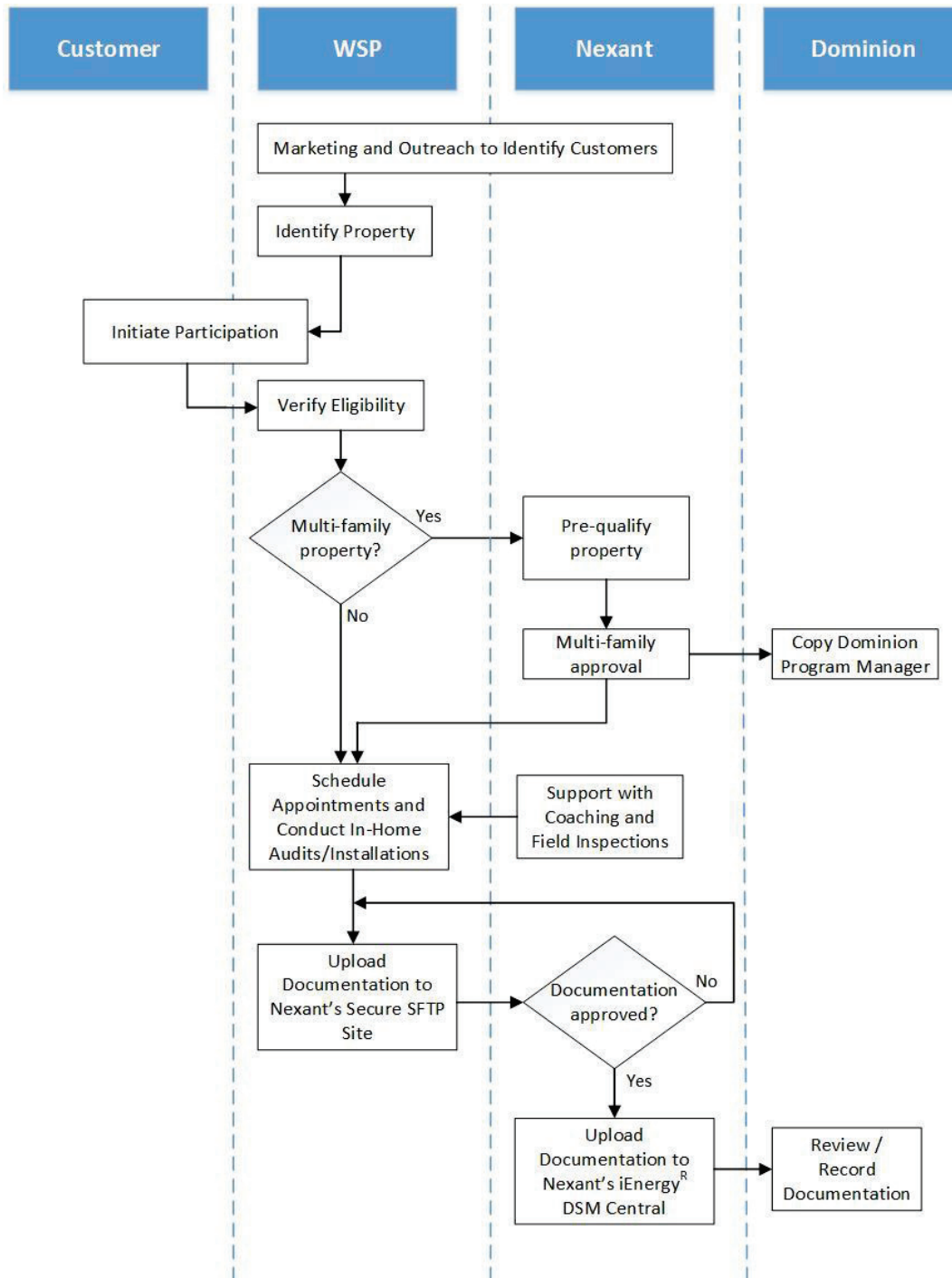
5.2 Measure Description and Documentation Requirements

Energy saving products—i.e., energy conservation measures (ECM)—selected for the Program are aimed to target the most common lighting, space conditioning and water heating related measures that income qualifying customers typically use. The Program includes free installation of the following selected ECM identified in Table 5-1, Table 5-2, Table 5-3, Table 5-4, and Table 5-5 on the following pages.

Table 5-1: LED Lighting

LED Lighting	
Description	ENERGY STAR® qualified LED light bulbs (screw base)
Applicability	Up to six LED light bulbs per dwelling unit that must replace incandescent light bulbs (CFL not eligible) installed in high use applications. Refer to section 2.4 for guidelines on seeking approval for more than 6 and no more than 12 LEDs. ▪ Light fixtures must be permanent unless exception approved. ▪ Existing incandescent lamps must be operational – nonfunctional lamps are not to be replaced. ▪ Installation of LEDs in closets, storage rooms, or exterior fixtures is not approved. ▪ Hall corridors are not typically designated as high use areas. Applicable to homes with electric or non-electric space or water heating.
Bulb Eligibility	LED lights must meet the following requirements: ➢ **Rating:** 40 Watt or 60 Watt equivalent lumen output ➢ **Certification:** ENERGY STAR ➢ **Rated Life:** 25,000 hours ➢ **Efficacy:** 43 Lumens per watt (LPW) for down lights, and 50 LPW for omnidirectional lights ➢ **CRI minimum:** 80
Required Documentation	➢ **Pre-approved Energy Conservation Measure (ECM):** submit lighting technical specifications for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. *See Section 4.3.2 Qualifying ECMs.* ➢ **Photographic Documentation of Product Installation:** Pre- and post-installation photograph requirements are detailed in Section 5.2.1. For multifamily buildings, photographs for 10% of each unit type must be submitted. Pre-qualification email must be submitted with the application when more than 6 LEDs have been previously approved.

> ➤ **Multi-family Project Material Documentation:** <u>Weatherization agencies are required to submit a copy of the material invoice or bill of materials demonstrating quantity of ECMs ordered for individual projects (prices may be redacted from invoices). Refer to Section 5.2.2 for additional information on the bill of materials.</u>

> ➤ **Weatherization Agency Use of Subcontractors:** <u>Agencies are required to inspect each multi-family project where installation has been performed by a subcontractor. A copy of the subcontractor job completion form must be submitted with the application.</u>

Lighting Eligibility Question & Answer:

1. The customer has mixed 40 and 60 Watt bulbs in a single fixture. Are bulbs to be replaced exactly as installed, or are identical wattage bulbs to be installed in the fixture?

ANSWER:

The program is designed to be a 1 for 1 equivalent Wattage replacement with limited flexibility.

Example:
Living room ceiling fan has two (2) 60 W bulbs and (2) 40 W bulbs. Replacement options:
   a) Install 2 – 9 W and 2 – 6 W LEDs
   b) De-rate the 60W incandescent bulbs to 40W bulbs, and install only 6W LEDs. The customer must be made aware that the lumen output is lower and approve of this de-ration substitution.

2. Can incandescent bulbs other than 40 or 60 Watt be replaced?
   The following Incandescent replacements are allowed with proper photo documentation is required.

Incandescent Lamp Rating, Watts	Allowed LED Replacement
38 Watt, 40 Watt, 43 Watt	6 Watt
60 Watt, 65 Watt	9 Watt

3. Can Hollywood bulbs or candelabra bulbs be replaced?
   If the Wattage rating stamped in the brass base is 40 or 60 Watts the bulb is eligible for replacement.

4. Can unmarked bulbs be replaced?
   No. Unfortunately the Wattage rating on some bulbs deteriorates over time. Existing bulbs must be marked to be eligible for replacement.

Table 5-2: Energy Saving Showerhead

Energy Saving Showerhead	
Description	Energy and water saving showerhead
Applicability	Must replace standard showerhead with flow of 2.5 gallons per minute (gpm) or greater in homes with electric water heating. Two (2) showerheads per dwelling unit maximum.
Showerhead Eligibility	Showerhead with flow of 2.0 gpm or less at 80PSI
Required Documentation	➤ **Pre-approved Energy Conservation Measure (ECM):** submit showerhead technical specifications for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. *See Section 3.3.2 Qualifying ECMs* ➤ **Photographic Documentation of Product Installation:** Pre- and post-installation photograph requirements <u>are detailed in Section 5.2.1. For multifamily buildings, photographs for 10% of each unit type must be submitted.</u> ➤ **Multi-family Project Material Documentation:** <u>Weatherization agencies are required to submit a copy of the material invoice or bill of materials demonstrating quantity of ECMs ordered for individual projects (prices may be redacted from invoices). Refer to Section 5.2.2 for additional information on the bill of materials.</u> ➤ **Weatherization Agency Use of Subcontractors:** <u>Agencies are required to inspect each multi-family project where installation has been performed by a subcontractor. A copy of the subcontractor job completion form must be submitted with the application.</u>

Shower Head Eligibility Question & Answer:

1. How is a device determined to be eligible when the GPM marking is damaged or illegible?
   Perform a flow test to confirm GPM of existing device.
   - Place bucket or container under fixture with ounce markings
   - Turn cold water faucet on for exactly 10 seconds (use stopwatch on cell phone)
   - Determine the number of ounces of water captured in 10 seconds
   - Compute GPM:

   $$\frac{\text{\# ounces} \times 6}{128} = \text{GPM rating}$$

2. How is eligibility determined for unmarked devices?
   Unmarked devices are treated the same as illegible devices, UNLESS unmarked devices are identified and measured during pre-qualification of multi-family projects. If unmarked devices identified during pre-qualification are determined to be eligible as a result of the flow test, then any unmarked devices located in the remaining units will be deemed eligible.

Table 5-3: High Efficiency Faucet Aerator

High Efficiency Faucet Aerator	
Description	High efficiency faucet aerator
Applicability	Must replace existing standard faucet aerator with a flow rate of 2.0 GPM or greater in homes with electric water heating. Two (2) faucet aerators per home maximum.
Faucet Aerator Eligibility	Faucet aerator with flow of 1.5 GPM or less
Required Documentation	➤ **Pre-approved Energy Conservation Measure (ECM):** submit faucet aerator technical specifications for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. *See Section 4.3.2 Qualifying ECMs* ➤ **Photographic Documentation of Product Installation:** Pre- and post-installation photograph requirements are detailed in Section 5.2.1. For multifamily buildings, photographs for 10% of each unit type must be submitted. ➤ **Multi-family Project Material Documentation:** Weatherization agencies are required to submit a copy of the material invoice or bill of materials demonstrating quantity of ECMs ordered for individual projects (prices may be redacted from invoices). Refer to Section 5.2.2 for additional information on the bill of materials. ➤ **Weatherization Agency Use of Subcontractors:** Agencies are required to inspect each multi-family project where installation has been performed by a subcontractor. A copy of the subcontractor job completion form must be submitted with the application.

Aerator Eligibility Question & Answer:

1. How is a device determined to be eligible when the GPM marking is damaged or illegible? Perform a flow test to confirm GPM of existing device.
    *   Place bucket or container under fixture with ounce markings
    *   Turn cold water faucet on for exactly 10 seconds (use stopwatch on cell phone)
    *   Determine the number of ounces of water captured in 10 seconds
    *   Compute GPM:

$$\frac{\text{\# ounces x 6}}{128} = \text{GPM rating}$$

2. How is eligibility determined for unmarked devices? Unmarked devices are treated the same as illegible devices, UNLESS unmarked devices are identified and measured during pre-qualification of multi-family projects. If unmarked devices identified during pre-qualification are determined to be eligible as a result of the flow test, then any unmarked devices located in the remaining units will be deemed eligible.

Table 5-4: Pipe Wrap

Pipe Wrap	
Description	Pipe wrap insulation for hot water pipes
Applicability	Homes with electric water heating. All exposed hot water pipes with no previous insulation. Existing insulation that is worn or torn is not eligible for replacement.
Pipe Wrap Eligibility	Self-sealing pipe wrap insulation for hot water pipes. <u>Pipe insulation shall be taped (using a high quality tape with good adhesion), caulked (with appropriate caulk to secure and adhere to insulation), or glued at all joints.</u>
Required Documentation	➢ **Pre-approved Energy Conservation Measure (ECM):** submit pipe wrap technical specifications for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. *See Section 3.3.2 Qualifying ECMs* ➢ **Photographic Documentation of Product Installation:** Pre- and post-installation photograph requirements <u>are detailed in Section 5.2.1. For multifamily buildings, photographs for 10% of each unit type must be submitted.</u> ➢ **Multi-family Project Material Documentation:** <u>Weatherization agencies are required to submit a copy of the material invoice or bill of materials demonstrating quantity of ECMs ordered for individual projects (prices may be redacted from invoices). Refer to Section 5.2.2 for additional information on the bill of materials.</u> ➢ **Weatherization Agency Use of Subcontractors:** <u>Agencies are required to inspect each multi-family project where installation has been performed by a subcontractor. A copy of the subcontractor job completion form must be submitted with the application.</u>

Table 5-5: Attic Insulation

Attic Insulation	
Description	Attic insulation addition
Applicability	Homes with electric or non-electric space heating. Insulation must be installed between a heated and an unconditioned space.
Attic Insulation Eligibility	➢ Insulation type may be fiberglass or cellulose ➢ Homes with electric space heating may be insulated to a maximum of R-49 ➢ Homes with non-electric space heating may be insulated to a maximum of R-38 ➢ Attic insulation must be installed by an approved WSP in qualifying households.
Required Documentation	➢ **Pre-approved Energy Conservation Measure (ECM):** submit technical specifications for review and approval prior to placing orders, stocking inventory, and installing in customers' homes. *See Section 3.3.2 Qualifying ECMs* ➢ **Photographic Documentation of Product Installation:** Pre- and post-installation photograph requirements are detailed in Section 5.2.1. For multifamily buildings, photographs for 10% of each unit type that receives attic insulation must be submitted. Additionally, a photograph of each attic insulation certificate is required. The address including the unit number must be written on the certificate. ➢ **Weatherization Agency Use of Subcontractors:** Agencies are required to inspect each multi-family project where installation has been performed by a subcontractor. A copy of the subcontractor job completion form must be submitted with the application.

5.2.1 PHOTOGRAPHIC DOCUMENTATION OF PRODUCT INSTALLATION:

The 2018 IAQHIP has new documentation requirements for measures.

1. **All photos must include a date and time stamp on the photo.**

2. An exterior photo of each home, building and unit number. The photos must allow visual confirmation that the home, building and unit number match the submitted application.

3. Pre- and post-installation photos per measure:

    a) Lighting:

    - Photo of space (room) where fixture is installed

    - Photo of existing incandescent lamp(s) clearly showing wattage rating

    - Photo of incandescent lamps(s) turned ON

    - For lamps that are unmarked or manufacturer's rating is not legible, the incandescent will be assumed to be rated at 40 Watts

    - Photo of LED lamp wattage

    - Photo of fixture with LED(s) installed and turned ON
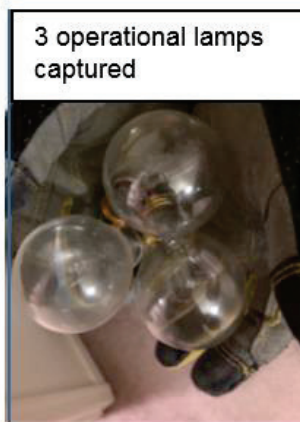
| ROOM, LAMPS ON | LAMP WATTAGE | LED WATTAGE | NEW LEDs |

3. Pre- and post-installation photos per measure, continued:

    b) Aerators

        •   Photo of room and sink

        •   Photo of existing aerator GPM. Aerator should be unscrewed and GPM
            ratings photo-documented if the rating on the installed faucet cannot be
            captured.

        •   Photo of faucet with new aerator

    BATHROOM
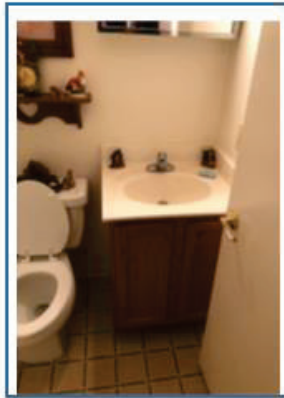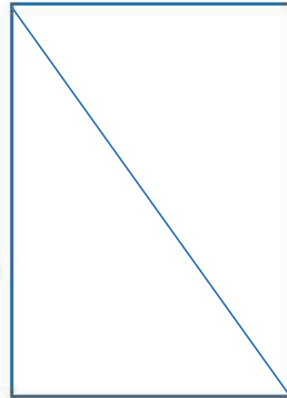
ROOM   OLD AERATOR   CLOSE UP   NEW AERATOR

    KITCHEN
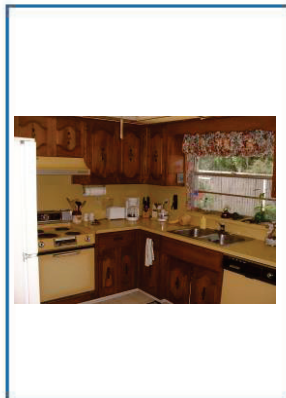
ROOM   KITCHEN SINK   AERATOR GPM   NEW AERATOR

    Photo of Ineligible Aerator to be replaced:

c) Showerheads

- Photo of room with showerhead

- Photo of existing showerhead GPM rating

- Shower enclosure with new showerhead
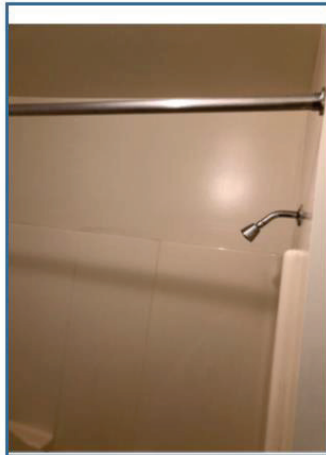
ROOM, OLD SHOWER   SHOWER GPM   NEW SHOWER
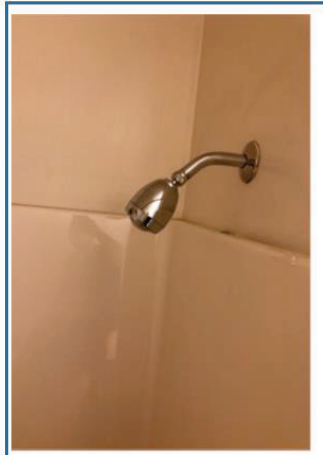
Note: GPM on submitted photo is legible

d) Pipe wrap

- Photo of water heater in room / space, including uninsulated pipe

- Photo of insulated hot water line
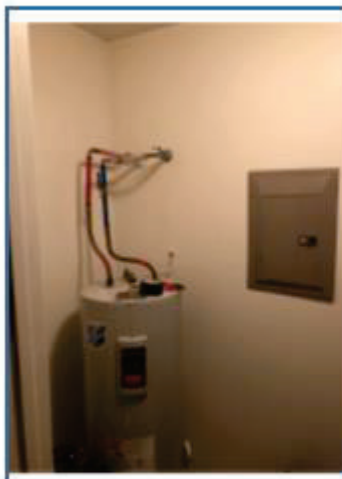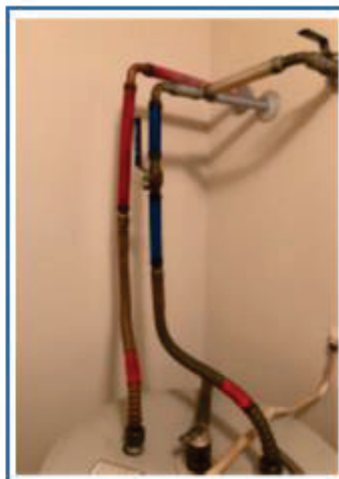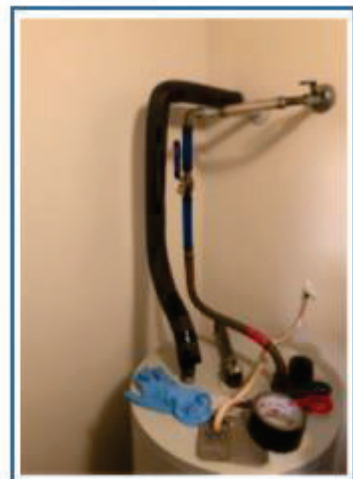
ROOM   UNINSULATED   INSULATED

e) Attic insulation, single family home

- Photo(s) of space to be insulated

- Photo(s) of existing insulation levels at attic ruler

- Photo(s) of installed insulation levels at attic ruler

ATTIC EXISTING   ATTIC EXISTING   ATTIC NEW

Note: ruler is legible
in submitted image

f) Attic insulation, multi-family units, 10% requirement:

- Exterior photo identifying building within property

- Photo(s) of space to be insulated

- Photo(s) of existing insulation levels at attic ruler

- Photo(s) of installed insulation levels at attic ruler

g) Attic insulation, multi-family units, all buildings requirement:

- Photos of the insulation certificate for each insulated space

- Certificate must capture the address / unit number(s) for each space

5.2.2 BILL OF MATERIALS:

The excel application contains a Project Summary tab, created to provide a snapshot summary of all of the measures installed for a single property.

If the quantity of ECMs listed on the bill of materials is greater than the total quantity of ECMs (installed) listed on the project summary tab, the copy of the Bill of Materials is sufficient.

If the quantity of ECMs listed on the bill of materials is less than the total quantity of ECMs (installed) listed on the project summary tab, provide multiple documents to account for the total ECMs installed.

5.3 Incentives

WSPs are required to fund the resources, procure the workforce and material, and install Program qualifying measures at customer households. Dominion will only reimburse the incentive amounts shown in Table 5-6 for the Program ECMs installed according to Program rules and requirements.

Table 5-6: IAQHI Program ECMs and Incentives

Measure Name	Unit	Incentive per Unit
LED Lighting	Per lamp installed	▬▬
Energy Saving Showerhead	Per low flow showerhead installed	▬▬
High Efficiency Faucet Aerator	Per faucet aerator installed	▬▬
Pipe Wrap for Water Heaters	Per linear foot of pipe wrap installed	▬
Attic Insulation	Per R-value per square foot installed	▬

Note: there is a program cap of $4,000 in incentives per home, townhome, apartment, or manufactured home.

ATTIC INSULATION INCENTIVE CALCULATION EXAMPLES:

Example 1:   1,000 ft^2 attic; no existing insulation; electric heat

      Incentive = ▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬

Example 2:   1,000 ft^2 attic; R-11 existing insulation; gas heat

      Incentive = ▬▬▬▬▬▬▬▬▬▬▬▬

5.4 Program Timeline

The Dominion Income and Age Qualifying Home Improvement Program is a three-year program. The associated rebates outlined in this manual are effective starting July 2018. In early December each year, Dominion suspends processing new applications so they can close the books on the current program year.

To ensure a project is processed in the current year, the cutoff date for submitting applications is the last Friday in November. This allows the processing team time to review and submit projects to Dominion for approval. Projects submitted after the cutoff date will continue to be accepted and processed by Nexant. These projects may be processed in the following program year and be applied against the following year's program funds.

Rebate applications are transmitted by the Program Implementer to Dominion on a weekly basis. Section 5.5 contains additional details concerning project applications. To ensure a project is processed in the current year complete project documentation must be received by Program Implementer by <u>November 30th</u> of each year.

<u>Projects submitted by or before November 30th must be resolved by February 28th of the following year. Payments for work completed in one year will not be paid after February 28 of the following year.</u>

<u>Project applications that cannot be processed as a result of Missing Information must be resolved within 90 days or risk non-payment.</u>

Projects submitted in December will be processed with the next year's allocation.

5.5 Project Application Approval Timeline

Providers are encouraged to submit applications as projects are completed. Details of the required documents are contained in section **3.3.3 Project Documentation**. Applications submitted by Weatherization Service Providers are extracted from the Nexant SFTP site on a daily basis and are reviewed.

The quality and accuracy of submitted applications has a direct effect on processing times. Providers submitting applications that are error-free, have an active Dominion account, are eligible to participate in the program, and have included all of the required documentation are processed quickly. Applications submitted with partial information take longer to review and process. Once a week, Nexant will submit a file of approved applications to Dominion for review and approval for payment.

The expected turnaround time for incentive payment checks is 4 to 6 weeks from the date of approved project application submission.

Appendix A   Example WSP Weekly Report

BEST PROVIDERS
2016 Weekly Project Status REPORT

IAQ | 70% | Allocated Funds $50,000.00

ESWS | 48% | $75,000.00

The project number is unique to each project and can be found on the check contained in the Payee information.   See Appendix B.

Address	IAQ	ESWS
Approved	**$12,688.11**	**$10,979.23**
RIAQH_11111: 111 MY STREET	$4,000.00	
RIAQH_11112: 112 MY STREET	$2,000.00	
RIAQH_11117: 117 MY STREET	$3,434.00	
RIAQH_11122: 122 MY STREET	$3,254.11	
PIAHI_11118: 126 MY STREET		$3,510.30
PIAHI_11119: 127 MY STREET		$3,574.35
PIAHI_11124: 132 MY STREET		$3,894.58
Missing Information	**$9,100.00**	**$6,956.55**
RIAQH_11113: 113 MY STREET	$4,555.00	
RIAQH_11118: 118 MY STREET	$4,545.00	
PIAHI_11115: 123 MY STREET		$3,318.15
PIAHI_11120: 128 MY STREET		$3,638.39
Submitted on AFF	**$4,338.01**	**$7,212.74**
RIAQH_11115: 115 MY STREET	$1,212.00	
RIAQH_11120: 120 MY STREET	$3,126.01	
PIAHI_11117: 125 MY STREET		$3,446.25
PIAHI_11122: 130 MY STREET		$3,766.49
Request Payment	**$8,696.02**	**$10,915.18**
RIAQH_11114: 114 MY STREET	$121.00	
RIAQH_11116: 116 MY STREET	$2,323.00	
RIAQH_11119: 119 MY STREET	$3,061.96	
RIAQH_11121: 121 MY STREET	$3,190.06	
PIAHI_11116: 124 MY STREET		$3,382.20
PIAHI_11121: 129 MY STREET		$3,702.44
PIAHI_11123: 131 MY STREET		$3,830.54
Grand Total	**$34,822.14**	**$36,063.69**

PROJECT STATUS KEY	
Approved	Nexant approved, to be included in next weekly batch to Dominion for approval
Missing Information	Unable to process - awaiting further information from WSP
Request Payment	Projects approved by Nexant and Dominion
Submitted on AFF	Nexant approved, submitted to Dominion for approval

Appendix B Sample Incentive Check

Dominion Virginia Power   12440

OUR REF. NO.	YOUR REFERENCE	INVOICE DATE	INVOICE AMOUNT	AMOUNT PAID	DISCOUNT TAKEN	NET CHECK AMOUNT
583523	DOMLIAQ0033	06/14/2016	$1,280.00	$1,280.00	$.00	$1,280.00
SUBTOTALS				$1,280.00	$.00	$1,280.00
TOTALS				$1,280.00	$.00	$1,280.00

Dominion Virginia Power   12440
2223 S. Highland Drive, #E6-333   **BANK OF THE WEST**
Salt Lake City, UT 84106   90-78-1211

Dominion

DATE	CONTROL NO.	AMOUNT
06/21/2016	000012440	$1,280.00

One Thousand Two Hundred Eighty And 00/100 Dollars

PAY TO THE ORDER OF

WEATHERIZATION SERVICE PROVIDER
RIAQH 74337
MAIN STREET
YOUR TOWN, VA

VOID AFTER 90 DAYS
TWO SIGNATURES REQUIRED OVER $20000.00

AUTHORIZED SIGNATURE

⑈012440⑈ ⑈121100782⑈ 040208654⑈

Dominion Virginia Power   12440

WEATHERIZATION SERVICE PROVIDER
RIAQH 74337
MAIN STREET
YOUR TOWN, VA

Uncertain of the address (customer) this
check is reimbursing? Cross reference
the project number with the WSP
Weekly Report.

57686W

Appendix C   Ineligible Address List and Signed Attestation

Dominion Energy® EnergyShare℠

Income and Age Qualifying Home Improvement
Program
Multi-Family Owner Consent Form

Ineligible Address List	V.04.10.18

Property Information

Property name	Date of assessment	# Qualifying Units	# Ineligible Units

We certify that we have met with the property management firm and witnessed their review of tenant eligibilty. We attest that of the total units at this property, the units noted in the list below do not qualify for the ESWS / IAQHI Program.

WX Rep Signature: _____ Date: _____

Please list the tenant addresses that do not meet the income or other program qualification requirements below.

	Address	Unit Number
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
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19		
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21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Weatherization Agency or Property Management Agency Letterhead Example

To all concerned:

This letter is to certify that all residents of <u>Sherwood Forest Homes</u> have been reviewed for compliance with the Tenant Eligibility Criteria noted as follows:

- Customer must have a total household income that does not exceed 60% of the Virginia Median Income; or

- Customer is 60 years of age or older with a total household income that does not exceed 120% of the Virginia Median Income; or

- The account holder is otherwise qualified to receive an energy audit by a Weatherization Assistance Provider certified by the Virginia DHCD; or

- A member of the household is currently receiving disability payments from the Social Security Administration; or

- A member of the household is currently receiving disability payments or supplemental income payments from the Veteran's Administration.

Eligibility Summary for property is as follows:

<u> 25 </u> Residents have a total household income that does not exceed 60% of the currently published Virginia Median Income

<u> 15 </u> Residents are over 60 and their income does not exceed 120% of the Virginia Median Income

<u> 10 </u> Residents are receiving disability payments from the SS Administration, Veteran's Administration, or other state or federal agencies

<u> 5 </u> Residents do not meet the program requirements

<u> 55 </u> = Total Units at this property

Signature: _Robin Hood_____   Date: __April 10, 2018_____

Printed Name: _Robin Hood_____

Title: __Property Manager_____

Company: __Nottingham Properties Inc._____

Appendix D   2018 Program Notices

Placeholder for Program Notices

Appendix E   Background Investigation Certification ("Certification") and Key Personnel List

Capitalized terms have the meanings given in the WSP Agreement. WSP certifies and agrees as follows:

1) (a) WSP performs, or causes its subcontractors to perform, investigations on all employees in accordance with the requirements described in the Background Investigation Requirements of the Program Manual; (b) WSP employees and subcontractors who will be performing services for the Program and will (i) have access to any customer information, and/or (ii) will be performing services at a customer's residence through the Program are identified on the attached Key Personnel List (c) the investigation(s) were conducted in accordance with the provisions of the Fair Credit Reporting Act, applicable federal and state laws, and the Background Investigation Requirements; (d) WSP has reviewed the results of the investigations for all such WSP employees and obtained Certifications for listed subcontractor employees; and (e) WSP did not discover any Adverse Findings in the investigation(s);

2) WSP agrees that if at any time after this Certification is provided, WSP begins utilizing any employee or subcontractor for the Program who were not included as part of the original Certification, WSP shall conduct background investigation, or cause its subcontractors to perform, on such individuals and provide Program Implementer with an updated Certification, or complete updated background investigations on employees, as reasonably requested by Program Implementer or Dominion; and

3) If at any time after this Certification has been provided to Program Implementer, WSP becomes aware of Adverse Findings for employees or subcontractors who were listed in the Key Personnel List as part of this Certification, WSP shall discontinue use of such individual in performance of the Program services and WSP shall notify Program Implementer in accordance with the Background Investigation Requirements.

I am a duly authorized representative of WSP and have read, understand and agree to the accuracy of this Certification.

WSP Name: _____

WSP Representative Signature: _____

Printed Name: _____

Title: _____   Date: _____

Once completed, return this Certification along with the Key Personnel List to the Program Implementer.

Key Personnel List

List the names of the WSP employees and WSP's subcontractor employees who are the subjects of the Background Investigation Certification.

Name	Company	Title	Date Completed

Nexant, Inc.

866-254-2237

www.nexant.com

DNV

APPENDIX JJ.   DOMINION RESIDENTIAL EFFICIENT PRODUCTS MARKETPLACE QUALITY ASSURANCE PLAN

Appendix JJ.

August 2019

Residential Efficient Products Marketplace

Program Quality Assurance Plan

Table of Contents

Introduction

Dominion Energy's Residential Efficient Products Marketplace Program offers rebates for customers that purchase and install qualified lighting and appliance measures in Virginia and North Carolina. The program is designed to transform the Consumer Products market by overcoming the two most common barriers for upgrading to energy efficient products:

- The high initial cost of purchasing energy efficient technologies compared to existing technologies
- Lack of consumer understanding about the benefits, savings and features associated with energy efficient products

The program employs several key offerings for customers and retailers:

- Direct to consumer rebates for the in-store or marketplace purchase of energy efficient clothes washers, clothes dryers, dishwashers, refrigerators, dehumidifiers and air purifiers
- Discounted LED bulbs purchased at participating retailers or on the program's online marketplace

This Quality Assurance (QA) Plan will provide an overview of the processes and protocols that CLEAResult employs to ensure high program quality and provide a basis for meeting Goal #2 (as defined below) of the Scope of Work. This plan should serve as a reference for the collective program management team. As the needs of the program change and are further detailed, the plan will be adjusted to improve and increase the level of confidence in program quality.

Goal #2[1]

> Quality assurance checks performed by Supplier amounting to (i) ongoing quality assurance checks of the operability of online sales portal(s) associated with the Program, (ii) quality assurance checks at physical retail stores monthly, based off of a mutually agreed upon Store Tier list, and (iii) additional quality assurance checks as requested by Purchaser in order to address customer complaints or other specific concerns related to the performance of the web portals(s) and participating retailers. Quality assurance checks will, at a minimum, assess (1) whether sufficient numbers of products are available either online or in retail stores, (2) whether online web portals are functioning properly (3) whether Program-related signage is in place, easily visible, easily understandable at physical retail stores, and (4) whether marketing materials and references to the Program are consistent with professional marketing standards, and (5) whether the signage clearly attributes product discounts to the Program and to Dominion Energy. For the purpose of this Goal #2, a complete quality assurance check will consist of a physical visit to an individual retail store or a full test of all functionality of a web portal and transmission of issues identified to the retail store or web portal provider and to Purchaser.

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[1] From page 4 of Scope of Work

Retail Store Visits

This section outlines what a CLEAResult Field Representative (Rep) will do during a physical visit to a participating retail location.

Although partner relationships may be developed at the national and regional levels those relationships will be solidified through field service calls to all participating stores. One of the most critical elements of the Program is the partner outreach and support, which is provided by the CLEAResult Program Manager (PM) and Field Representatives. CLEAResult has a dedicated staff of Field Representatives to deliver field services for retail partners. This field service involves:

- Merchandising
- Product demonstrations,
- Retailer engagement and training
- Monitoring product shipment, pricing and signage

MERCHANDISING

While in the stores, Field Reps will be responsible for:
- Placing/refreshing POP
- Providing store locations with adequate supply of program marketing materials such as appliance brochures
- Ensuring store shelves are stocked with the appropriate lighting products
- Verifying lighting products are discounted to the proper price and if not, working to get any issues corrected
- Working to gain favorable product placement for lighting within the retailers i.e. wing stacks, end caps, aisle promos etc.

MONITOR PRODUCT SHIPMENT, PRICING, AND SIGNAGE

Field Reps will ensure that all promotional products are placed on the sales floor in a timely manner. Field Reps will verify that incentivized lighting products have been delivered to the correct stores, that they are priced correctly, and that they receive prominent placement in stores, alongside appropriate POP program materials. In many instances, Field Reps will find that product has been delivered to a store, but is still in a storage area or has been placed in unreachable overhead racking so they must work to correct this. Finally, Field Representatives will verify that promoted products are properly displayed with Dominion Energy's approved program signage / branding and make sure sales associates understand what products the program is intended to subsidize.

Finally, CLEAResult field personnel continually refresh the display materials at each retailer location. This means that their vehicles are constantly packed with supplies so that they have the majority of materials handy when they visit stores or support special events. All Field Representatives stock a certain amount of marketing and POP materials and use the supply to set-up and/or replenish stores.

While Field Reps provide partner outreach and support, it is a standard practice to have program management regularly audit work completed out in the field as another level of quality assurance. This could lead to addressing training or performance gaps. While this task is typically performed by the CLEAResult PM, other operational staff members may perform this audit. During this audit, the staff member observes the daily interactions, tasks, and duties of the Field Representative.

Appendix 1 shows a template used for such audits.

Online Marketplace

This section outlines the type of testing EFI will perform to demonstrate marketplace functionality.

EFI does multiple regression testing sessions monthly whenever there are changes made to its sites or platforms.

The finalization of program requirements and eligible measures will allow EFI to detail specifically what will be checked here. This plan will be updated once the team reaches that point.

Invoice Submission and Processing

This section outlines the type of QA and quality control (QC) done with respect to participating sales documentation.

QA/QC

CLEAResult is responsible for ensuring that partners are complying with terms and conditions of their master services agreements it has in place with program partners and that those partners are submitting only valid sales documentation with their invoices. The agreements and Dominion-specific schedules stipulate that certain data must be included with invoices to ensure payment. Some of those fields include: Product type/model, wattage, manufacturer, number of bulbs in package, sale price, incentive amount per bulb and geographic location of storefront that sold each product. This would align with what has been provided to Dominion in the past.

CLEAResult reviews the data on the invoice to check for any anomalies. If the invoice and/or supporting documentation fails the CLEAResult QA/QC process, they will contact and work with the partner to resolve the issue. Once the issue is resolved, the invoice and supporting documentation are run through the QA/QC again.

The review process ensures that:
- The invoice is for the Dominion program and not another utility's program;
- Products sold were those that were prescribed in the Schedule (or subsequent addenda or notifications);
- Incentive amounts per product are correct per the Schedule (or subsequent addenda or notifications);
- Products were sold in a valid date range;

- Store locations are valid per the Schedule (or subsequent addenda or notifications);
- Total incentive allocation amounts have not been exceeded.

For creative partners, CLEAResult will perform unannounced visits at events open to the public to ensure all PA requirements are being adhered to and that partner staff can appropriately address questions and concerns from the public.

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Appendix 1

QA/QC Score Sheet by Retailer

Store Name		Date of Visit	
City		Contact Name	
State		Position/Title	
Field Representative		Interviewer	

	Lighting Store Format - Merchandising	Comments	Max Score	Actual Score	Percentage
1	Shelf Labels- Are all qualified products in the program labeled ?		20		0%
2	Shelf Labels- Are all labels placed in accordance with Merchandising Standards? (i.e. immediate right hand side of retail price label, straight, etc.)		5		0%
3	Mislabeled Non-Qualified Product? (Zero mislabeled=0 points, 1 or more mislabeled= MINUS 10 points)		0		0%
4	Correct incentive pricing? No issues =15 points, 1 or more issues= 0 points		15		0%
5	Program Merchandising Components		10		0%
6	Off Shelf Signage Standards		10		0%
		Merchandising Score	60	0	0%

	Training	Comments	Max Score	Actual Score	Percentage
1	Is Associate's name on training roster?		4		0%
2	Is Store Manager / Owner's name on training roster?		4		0%
3	Have you received training from the Program Field Rep?		4		0%
4	Did the Program Field Rep utilize any training materials in their training presentation?		4		0%
5	Program Manager Supplied Question - Has field rep shared data?		4		0%
		Training Score	20	0	0%

	Relationships	Comments	Max Score	Actual Score	Percentage
1	Has Associate met the Program Field Rep?		5		0%
2	Do they know Program Field Rep name?		3		0%
3	What is the estimated frequency of visits?		3		0%
4	Is the Program Field Rep considerate of their time?		3		0%
5	Rate overall level of satisfaction with Program Field Rep. Very satisfied – we love having them here: 6 of 6 Satisfied – does a good job: 4 of 6 Not satisfied – poor job: 0 of 6		6		0%
		Relationships Score	20	0	0%
		Total Retailer Score	100	0	0%

Notes / Comments

DNV

APPENDIX KK.   HONEYWELL REBATE REVIEW AND APPROVAL PROCESS

Appendix KK.

Rebate Review and Approval Process

- Program Terms and Conditions (T&Cs) for each Program clearly state eligibility requirements, Program guidelines and the documentation that must be submitted before a rebate is eligible to be issued. T&Cs are incorporated into each rebate application and require a customer signature reflecting the acceptance and understanding of those T&Cs.

- Prior to a Program's launch, the Company's Implementation Contractor (IC), the Company's EM&V Vendor and the Company determine data eligibility requirements for the Company's Technical Validations, Daily Activity Files (DAFs), and Rebate Funding Requests. Those data requirements are then used to develop the required information on rebate application forms and data filters that are used to flag potential issues of concern.

- All rebate applications are reviewed for missing information or documentation by the IC. Customers and or contractors are contacted to supply any missing information. Each new participating contractor must have its first five (5) projects field inspected by our IC before it can become a participating vendor/contractor. Afterwards, 5% of all projects by all contractors are randomly selected for quality field inspections. Those quality inspections of the jobsite provide additional data verification by our IC's Quality Assurance Team.

- DAFs for complete projects are passed to Dominion's Business Intelligence Datamart (BI) from the IC. When the DAFs are transferred to the BI, records must pass technical validation via Program-specific data filters to ensure that data is in the proper format, that all required data is present and that the data falls within the allowable range, as agreed prior to the Program's launch.

- Upon receipt of a rebate funding request, the request is matched to the associated DAF in the BI and technical validations are run for the funding request. The validation compares the Company's Billing system, DAFs, and previously submitted rebate requests for the subject premises.

- The responsible Program manager and analyst for each Program receive an account funding report containing all submitted rebate requests weekly. All rebate requests flagged with failing any validation are automatically rejected and flagged for Program Manager/Program Analyst attention. All rebate funding requests are individually reviewed by the Program Manager/Analyst and any rejections must be manually over-ridden to fund the rebate. Rebate· requests that are rejected by the Company are noted in a report sent to the IC to either notify the customer of the rejection or to remedy the problem for resubmission in a later rebate funding request.

- All approved requests are funded in accordance with the Program guidelines and the funding is electronically transmitted to the Company's IC for payment. Following receipt of the funding, IC only issues payment of the rebates to the customer of record in the Company's billing system or the customer's contractor, if designated by the customer during the rebate application process.

- The Company's EM&V vendor receives a monthly download from Dominion's BI of all paid rebates by Program. This data is used to calculate Program savings, but also is used for Program follow-up with regard to customer satisfaction, determination of realization rates and assessment of free ridership. In the course of these activities, any inconsistencies associated with previously paid rebates are reported to the Company for follow-up, offering additional assurance of proper technical validations.