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STATE CORPORATION COMMISSION  
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MAY 19 2022

Case No. PUR-2021-00236

Sponsor: ("APCO")

Exhibit No. 6

Witness: STIPULATED

Bailiff: JABARI T. ROBINSON

APCo Exhibit No. \_\_\_\_\_  
Witness: DSD

2021-00236

**DIRECT TESTIMONY OF  
DAVID DIEBEL  
FOR APPALACHIAN POWER COMPANY  
IN VIRGINIA S.C.C. CASE NO. PUR-2021-00236**

EXHIBIT# 6

**SUMMARY OF DIRECT TESTIMONY OF DAVID DIEBEL**

My direct testimony:

- Supports the Company's petition for approval of one new pilot program, the Commercial & Industrial Custom Pilot Program;
- Discusses how the Company plans to comply with the "Rules Governing the Evaluation, Measurement and Verification of the Effects of Utility-Sponsored Demand-Side Management Programs" defined in 20 VAC 5-318-10, *et seq.*;
- Discusses the Company's most recent Evaluation, Measurement and Verification (EM&V) reports for active demand-side management programs; and
- Presents the Company's estimate of Total Annual Energy Savings – cumulative persistent energy savings for previous, existing, and proposed demand-side management programs, including customers who have elected to opt out of the Company's demand-side management programs – as well as the Company's estimates of related carbon emissions reductions and customer bill savings.

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**DIRECT TESTIMONY OF  
DAVID DIEBEL  
FOR APPALACHIAN POWER COMPANY  
IN VIRGINIA S.C.C. CASE NO. PUR-2021-00236**

1    **Q.    PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND POSITION.**

2    A.    My name is David Diebel. I am a Principal at ADM Associates, Inc. (ADM). My  
3    business address is 3239 Ramos Circle, Sacramento, CA 95827.

4    **Q.    PLEASE SUMMARIZE YOUR EDUCATIONAL BACKGROUND AND  
5    BUSINESS EXPERIENCE.**

6    A.    I received a B.A in Economics from the California State University, Sacramento in 2004  
7    and a M.A. in Economics from the California State University, Sacramento in 2006. I am  
8    a Director at ADM. In that capacity, I am responsible for directing the work of ADM's  
9    staff for various evaluation and consulting projects. I joined ADM Associates in 2007 as  
10   an Associate. My initial responsibilities included data analysis related to lighting  
11   technology evaluations. Since then, my role has shifted to program and portfolio  
12   evaluation.

13   **Q.    ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?**

14   A.    I am testifying on behalf of Appalachian Power Company (APCo or Company).

15   **Q.    WOULD YOU PLEASE DESCRIBE ADM?**

16   A.    ADM is a professional services corporation providing energy efficiency program  
17   evaluation and research for utilities and other clients across North America. Founded in  
18   1979, ADM's headquarters are in Sacramento, with offices in Reno, and the San  
19   Francisco Bay Area. ADM has evaluated the Company's 2015-2020 programs, and will  
20   be evaluating the Company's 2021 programs.

1 Q. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY BEFORE THIS  
2 COMMISSION?

3 A. Yes. I testified before the Virginia State Corporation Commission (Commission) in Case  
4 No. PUR-2020-00251.

5 Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

6 A. My testimony supports the Company's petition for approval of one new pilot program,  
7 the Commercial & Industrial Custom Pilot Program.

8 My testimony explains how the Company plans to comply with the "Rules  
9 Governing the Evaluation, Measurement and Verification of the Effects of Utility-  
10 Sponsored Demand-Side Management Programs" (EM&V Rules) issued by the  
11 Commission and codified at 20 VAC 5-318-10, *et seq.* My testimony introduces the  
12 EM&V plan that ADM produced for the pilot program for which the Company seeks  
13 Commission approval of in this proceeding.

14 My testimony discusses the Company's most recent EM&V reports for active  
15 demand-side management (DSM) programs.

16 My testimony also presents the Company's estimate of Total Annual Energy  
17 Savings, a term defined in § 56-576 of the Code of Virginia, which describes the  
18 cumulative persistent energy savings for previous, existing, and proposed DSM  
19 programs, including customers who have elected to opt out of the Company's DSM  
20 programs.

21 Q. ARE YOU SPONSORING ANY EXHIBITS IN THIS PROCEEDING?

22 A. Yes, I am sponsoring:

- 1 • APCo Exhibit No. \_\_\_\_ (DSD) Schedule 1 - 2023-2025 C&I Custom Pilot Program EM&V
- 2 Plan
- 3 • APCo Exhibit No. \_\_\_\_ (DSD) Schedule 2 - Total Annual Energy Savings, Bill Savings,
- 4 and Avoided Carbon Emissions

5 **Q. HOW IS YOUR TESTIMONY ORGANIZED?**

6 **A.** My testimony includes:

- 7 • A discussion of the Company's EM&V plan and its compliance with applicable EM&V
- 8 rules;
- 9 • An overview of the Company's most recent EM&V reports for DSM programs; and
- 10 • A presentation of the Company's estimate of Total Annual Energy Savings, the
- 11 cumulative persistent energy savings for previous, existing, and proposed DSM
- 12 programs, including customers who have elected to opt out of the Company's DSM
- 13 programs.
- 14 • A presentation of the Company's estimates of the carbon emissions reductions and
- 15 customer bill savings related to the Total Annual Energy Savings projected to be
- 16 achieved.

17 **I. EM&V PLAN AND COMPLIANCE WITH EM&V RULES**

18 **Q. PLEASE DESCRIBE HOW THE EM&V RULES WERE PROMULGATED.**

19 **A.** Between March and November 2017, the Commission evaluated "the establishment of  
20 uniform protocols for measuring, verifying, and validating and reporting the impacts of  
21 energy efficiency measures implemented by investor-owned electric utilities providing  
22 retail electric utility service in the Commonwealth" through Staff research, public  
23 hearings and public comments in Case No. PUE-2016-00022. Ultimately, the  
24 Commission issued the EM&V Rules, which became effective January 1, 2018, and  
25 provided the framework that the Company and ADM are following in planning for the  
26 evaluation of, and will be following to evaluate, the Company's proposed new pilot  
27 program.

1 Q. WHAT IS THE PURPOSE OF THE EM&V RULES?

2 A. As set forth in 20 VAC 5-318-10, the EM&V Rules set forth the minimum requirements  
3 for the EM&V of the effects of utility-sponsored EE/DSM programs.

4 Q. PLEASE EXPLAIN THE ADMINISTRATIVE PROCEDURES DETAILED IN  
5 THE EM&V RULES.

6 A. 20 VAC 5-318-30 A requires utilities filing for approval to implement new or to continue  
7 existing DSM measures or programs to file a preliminary plan for the EM&V of the  
8 proposed measures or programs as part of its application (Plan). The Plan must explain  
9 how the utility intends to comply with the minimum requirements for the collection of  
10 EM&V data set forth in 20 VAC 5-318-40. ADM developed the Plan for the pilot  
11 program that the Company has filed for Commission approval. It is attached as APCo  
12 Exhibit No. \_\_ (DSD) Schedule 1.

13 Q. WHAT ARE THE MINIMUM REQUIREMENTS FOR THE COLLECTION OF  
14 EM&V DATA?

15 A. 20 VAC 5-318-40 sets forth the following minimum requirements for the collection of  
16 EM&V data for new or continuation of existing DSM measures or programs:

- 17 • Where available, utility-specific data should be utilized in evaluating proposed DSM  
18 measures or programs. If utility-specific data is not available, the utility should rely  
19 on Virginia-specific data and provide an explanation as to why utility-specific data is  
20 unavailable or impracticable. If neither utility-specific nor Virginia-specific data is  
21 available, the utility may rely on data from non-Virginia jurisdictions, with  
22 appropriate citations to the source documents. The utility must also explain why  
23 utility-specific and Virginia-specific data is unavailable or impracticable, and why the  
24 use of the non-Virginia jurisdictional data is appropriate.
- 25 • EM&V reports must include any relevant workpapers, support documents,  
26 assumptions, and equations used to develop the measurement and verification  
27 methodologies.

- 1 • EM&V reports must include measure-level estimates of kilowatt and kilowatt-hour
- 2 savings, as appropriate. Where appropriate, two estimates should be provided - one
- 3 that has been adjusted for free-ridership, and one that has not.
- 4 • Where appropriate, EM&V should comply with Options A, B, C, or D from the
- 5 International Performance Measurement and Verification Protocol (January 2012),
- 6 though alternative methodologies may be considered with sufficient supporting
- 7 documentation.
- 8 • Utilities are encouraged to use emerging technologies, including "advanced
- 9 measurement and verification" or "evaluation, measurement and verification 2.0"
- 10 where appropriate and cost-effective.

11 **Q. HOW DO RECENT REGULATORY AND LEGAL DEVELOPMENTS IMPACT**

12 **THE LEVEL OF EM&V RIGOR REQUIRED?**

13 A. The Virginia Clean Economy Act, the Commission's Final Order in Case No. PUR-2018-

14 00168, and the EM&V Rules have established the need for EM&V to meet new

15 requirements, including the hierarchy of preferred categories of data sources and the need

16 to provide additional documentation for non-Virginia data sources. The approaches

17 outlined in the EM&V Plan are intended to meet those requirements as well as the

18 requirements outlined in the EM&V Rules.

19 **Q. HOW DO THE APPROACHES OUTLINED IN THE EM&V PLAN COMPLY**

20 **WITH 20 VAC 5-318-40 FOR THE PROGRAMS THAT ARE THE SUBJECT OF**

21 **THIS FILING?**

22 A. The EM&V Plan accounts for the preferred order of data sources for estimating program

23 and measure savings by taking the preferred hierarchy as a starting point in determining

24 the allocation of finite EM&V resources. In accounting for the preferred order, we seek

25 to balance the rigor of the evaluation with the cost of obtaining the data necessary for it.

26 Our approach relies upon site-specific data as inputs to the calculation of savings.

27 First, all sampled sites are evaluated based on the site-specific measures installed, and



1 where applicable, baseline conditions. Additionally, in many cases we collect data to  
2 analyze use factors such as operating hours obtained through either site-specific  
3 schedules, monitored data, or account energy consumption data in estimating savings. In  
4 some instances where measure savings calculation input variables installed have  
5 relatively smaller impacts on measure and program savings and where the cost of  
6 collecting site-specific data is relatively high, we reference stipulated values provided by  
7 the Mid-Atlantic Technical Resource Manual (TRM). For measures for which deemed  
8 savings equations and/or inputs are referenced, if the Mid-Atlantic TRM is not  
9 applicable, ADM will assess recent TRMs in the region, and nationally, if necessary, to  
10 identify the most appropriate source or sources for deriving the deemed savings equations  
11 and/or inputs.

12 Site-specific measurement and verification (M&V) plans will outline the  
13 approach taken with regard to data collection and the determination of values are each  
14 input to the calculation of energy savings. These M&V plans will be included in annual  
15 EM&V reporting.

16 Our EM&V reporting will document all non-utility specific data sources as  
17 required by 20 VAC 5-318-40. Our EM&V approach will be consistent with the EM&V  
18 Plan, and EM&V reporting will cite the EM&V Plan as part of the documentation of the  
19 applied methods. In the event that unforeseen occurrences require a deviation from the  
20 approach outlined in the EM&V Plan, we will note the discrepancy and provide an  
21 explanation regarding how the approach does not adhere to the EM&V Plan and why it  
22 was selected.

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1 The approaches outlined in the EM&V Plan adhere to section 20 VAC 5-318-40.  
 2 We discuss general sampling requirements and the types of sampling to be performed.  
 3 The specific sampling plan will be informed by annual program data and discussion of  
 4 the plans in the EM&V reporting will include descriptions of the statistical calculations  
 5 upon which the reported data are based.

6 Table 1, excerpted from the EM&V plan, summarizes how the evaluation will  
 7 comply with the EM&V Rules.

8 **Table 1 – Compliance with the EM&V Rules**

Section	Requirement	Response
20VAC5-318-40 (A)	In all filings required by 20VAC5-318-30, the sources of all data or estimates used as inputs for proposed DSM measures or programs, in descending order of preference, shall be: 1. Utility-specific data; 2. Virginia-specific data if utility-specific data is unavailable or impracticable. When Virginia-specific data is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable; 3. Data from non-Virginia jurisdictions or sources, if neither utility-specific data nor Virginia-specific data is available or practicable: a. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable. b. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why Virginia-specific data is unavailable or impracticable as well as the sources of all data, to include: (1) Titles, version numbers, publication dates, and page numbers of all source documents, as appropriate; and (2) An explanation as to why, in the utility's assessment, use of this data is appropriate.	The methods that will be used to evaluate pilot program impacts are presented in this plan. The methods comply with the order of preferred data inputs cited in code 20VAC5-318-40 (A). Primary data may be supplemented by secondary data to facilitate cost efficient allocation of EM&V resources.
20VAC5-318-40 (B)	EM&V reports shall include relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.	The EM&V reports will describe the methodologies used to estimate savings for the program measures and include citations of relevant workpapers, support

Section	Requirement	Response
		documents, assumptions, and equations used in developing the measurement and verification methodologies of measures reported.
20VAC5-318-40 (C)	EM&V reports shall include measure-level estimates of kilowatt, kilowatt-hour, dekatherm, and pipeline capacity savings as appropriate. An estimate that has been adjusted for free-ridership as well as an estimate that has not been adjusted for free-ridership should be included as appropriate.	The cost-effectiveness analysis file submitted with the EM&V report will present measure-level estimates of peak kW and kWh energy savings.
20VAC5-318-50 (A)	EM&V of approved DSM measures or programs should be consistent with and contrasted to the preliminary EM&V plan set forth in the filings for approval of such measures or programs or as otherwise specified in a commission order approving such measures or programs. The commission recognizes that each utility has unique characteristics, and new or modified energy efficiency measures are constantly being developed. As such, alternative methodologies may be included in reporting provided that sufficient supporting documentation and explanation of appropriateness of alternative methodologies is provided.	The EM&V reports will detail any deviations from the approach submitted within this plan and the reasons for that deviation.
20VAC5-318-50 (B)	EM&V reports of existing measures or programs shall utilize utility-specific data or other data in conformance with 20VAC5-318-40 A when updating the analysis of the cost effectiveness of each measure, program, or portfolio as appropriate and practicable. EM&V reports of existing measures or programs shall include the information required by 20VAC5-318-40 B and C.	The EM&V reports will include this information.
20VAC5-318-50 (C)	Any changes to or variances from originally approved measure-level inputs and assumptions shall be documented and explained, and the impact of such changes on original cost/benefit estimates for DSM programs or measures shall be quantified.	The EMV&V report will present cost effectiveness analysis based on the ex ante savings estimates to characterize the discrepancy between the benefits resulting from the ex ante estimates and the ex post estimates. The presentation of savings results will include discussion of the reasons for differences between the ex ante savings and ex post savings estimates.
20VAC5-318-50 (D)	EM&V reports shall describe the methodologies by which the measured data was collected, including at a minimum: 1. The sampling plan; and	The sampling approach will be presented in the methodology section of the evaluation reports.

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Section	Requirement	Response
	2. Statistical calculations upon which the reported data is based when applicable.	
20VAC5-318-50 (E)	EM&V reports for ongoing DSM measures or programs shall include an explanation of eligibility requirements for each rate schedule to which the measures or programs are being offered.	The EM&V reports will provide a description of the program that includes information on the measure or program eligibility requirements as provide by the Company.
20VAC5-318-50 (F)	EM&V reports for ongoing DSM measures or programs shall include a comparison of the measured annual measure or program savings estimates to the annual usage of the average rate schedule usage and eligible customer in each rate schedule to which the measures or programs is being offered. A comparison to originally approved estimated savings for the measures or programs that were approved by the commission shall also be provided. This will include a calculation of the expected savings as a percentage of the annual usage of the average rate schedule usage and eligible customer as appropriate and practicable.	The EM&V reports will present a table for each rate class, based on data provided by the Company, that summarizes the following information: Program Name, Rate Class, Total kWh Savings, Number of Participating Customer Accounts, Average kWh Savings per Customer Account, and Average Consumption per Account for the Rate Class
20VAC5-318-50 (G)	<p>EM&amp;V reports for ongoing DSM measures or programs shall include a description of the controls undertaken by the utility to verify proper installation of the measures or programs, as appropriate. Additionally, utilities shall require the contractors and subcontractors that will be implementing the measures or programs, if applicable and practicable, to record details of serviced or replaced equipment, to include at a minimum:</p> <ol style="list-style-type: none"> <li>1. Nameplate efficiency ratings;</li> <li>2. Serial numbers; and</li> <li>3. Model numbers.</li> </ol> <p>This information will be made available to commission staff upon request.</p>	<p>The EM&amp;V reports will include the following information as provided by the Company or otherwise determined through the evaluation effort:</p> <ol style="list-style-type: none"> <li>1) a description of program installation quality controls.</li> <li>2) a description of equipment specification data recorded by the program.</li> </ol>
20VAC5-318-50 (H)	EM&V reports should include actual costs incurred by the utility and each EM&V contractor for (i) the development of the most recent EM&V plan and (ii) the administration of EM&V activities for the reporting period.	Unless otherwise noted, where applicable, costs presented in the cost effectiveness analysis chapter of the EM&V reports are inclusive of actual costs incurred by the utility and each EM&V contractor for the development of the most recent EM&V plan and the administration of EM&V activities for the reporting period.

1 **Q. HOW DOES THE EM&V PLAN MEET THE NEED FOR A HEIGHTENED**  
2 **LEVEL OF EM&V RIGOR?**

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

6 ADM will supplement the impact evaluation with International Performance  
7 Measurement and Verification Protocol (IPMVP) Option C by performing regression  
8 analysis to assess the presence of energy savings during the period subsequent to  
9 implementation of program measures where feasible. National Renewable Energy  
10 Laboratory (NREL) guidance on the use of Option C analysis includes the restriction that  
11 it should be applied when expected energy savings are likely to exceed 10% of building  
12 energy consumption. Furthermore, there needs to be sufficient pre- and post-  
13 implementation data, ideally in full-year increments (e.g., 12 or 24 months pre and post).

14 **Q. PLEASE DESCRIBE THE STANDARD EM&V REPORTING REQUIREMENTS**  
15 **THAT WILL APPLY TO THESE PROGRAMS.**

16 A. The standard EM&V reporting requirements are set forth in 20 VAC 5-318-50 that will  
17 apply to these new and continued DSM Programs are as follows:

- 18 • The EM&V of approved DSM measures or programs must be consistent with the Plan.  
19 Alternative methodologies may be included in the report where necessary, if appropriate  
20 documentation is provided.
- 21 • As discussed above, reports should include utility-specific data (where available), any  
22 relevant workpapers or supporting documentation, and measure-level estimates of  
23 kilowatt, kilowatt-hour, as appropriate.
- 24 • Any variances from originally approved measure-level inputs and assumptions must be  
25 documented and explained, and the impact of any such changes on original cost-benefit  
26 estimates must be quantified.

- 1 • Reports must describe the sampling plan used to collect data, any statistical calculations  
2 upon which the reported data are based, and any other methodologies relevant to data  
3 collection.
- 4 • Reports must include the actual costs incurred by the utility and each EM&V contractor  
5 for developing the EM&V plan and administering the EM&V activities in the current  
6 reporting period.
- 7 • Reports that describe any ongoing DSM measures or programs must:
  - 8 ○ explain the eligibility requirements for each rate schedule to which the measures  
9 or programs are being offered;
  - 10 ○ include a comparison of the measured annual measure or program savings  
11 estimates to: (1) the annual usage of the average rate schedule usage and
  - 12 ○ eligible customer in each rate schedule to which the measures or programs are  
13 being offered; and (2) originally approved estimated savings for the measures or  
14 programs that were approved by the commission, including calculation of the  
15 expected savings as a percentage of the annual usage of the average rate schedule  
16 usage and eligible customer, as appropriate; and describe the controls used by the  
17 utility to verify that the measures were properly installed, and confirm that the  
18 Company has required its implementation contractors to record details of serviced  
19 or replaced equipment (where applicable and practicable), to include at a  
20 minimum:
    - 21 – nameplate efficiency ratings;
    - 22 – serial numbers; and
    - 23 – model numbers.

24 **Q. WILL THE COMPANY COMPLY WITH THESE STANDARD EM&V**  
25 **REPORTING REQUIREMENTS FOR THE NEW PILOT PROGRAM?**

26 A. Yes. The Company and ADM intend to comply with all requirements pursuant to 20  
27 VAC 5-318-50 for the new C&I Custom Pilot Program. The Company and ADM intend  
28 to conduct the EM&V consistent with the approaches outlined in the EM&V Plan  
29 attached hereto. If alternative methodologies are necessary, the adjustment will be  
30 described in the EM&V report along with appropriate documentation.

31 When impact evaluations and/or net-to-gross studies are reported, all data  
32 collection methodologies, including sampling plans, will be documented along with the

1 results. ADM will work with the Company to include explanations of the eligibility  
2 requirements for each rate schedule to which the measures or programs are being offered  
3 in the EM&V report, and include a comparison of the EM&V reported annual measure or  
4 program savings estimates to: (1) the annual usage of the average rate schedule usage and  
5 eligible customer in each rate schedule to which the measures or programs are being  
6 offered; and (2) originally approved estimated savings for the measures or programs that  
7 were approved by the commission, including a calculation of the expected savings as a  
8 percentage of the annual usage of the average rate schedule usage and eligible customer,  
9 as appropriate.

10 ADM will work with the Company to describe the controls used by the utility to  
11 verify that the measures were properly installed, and confirm that the Company has  
12 required the implementation contractors to record details of services to replaced  
13 equipment, to include at a minimum, as applicable:

- 14 1. Nameplate efficiency ratings;
- 15 2. Serial numbers; and
- 16 3. Model numbers.

17 **II. OVERVIEW OF MOST RECENT EM&V REPORTS FOR DSM PROGRAMS**

18 **Q. HOW DO THE APPROACHES OUTLINED IN THE MORE RECENT EM&V**  
19 **REPORTS FOR THE EE/DSM PROGRAMS COMPLY WITH 20 VAC 5-318-40?**

20 **A.** The most recent EM&V reports for the Company's EE/DSM programs cover program  
21 year 2020 (PY2020) activity and reflect application of the preferred order of data sources  
22 for estimating program and measure savings by taking the preferred hierarchy as a

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1 starting point in determining the allocation of finite EM&V resources, while balancing  
2 the rigor of the evaluation with the cost of obtaining the data necessary for it.

3 The EM&V reports demonstrate application of the approaches outlined above in  
4 Table 1 to compliance with the EM&V Rules.

5 **Q. PLEASE PROVIDE INFORMATION REGARDING LOST REVENUE**  
6 **ASSOCIATED WITH PY2020 ACTIVITY.**

7 A. Below, for each PY2020 program, Table 2 presents:

- 8 • Annualized net energy savings;
- 9 • Monthly cumulative net energy savings that accrued during 2020;
- 10 • Base distribution and generation rate determined through analysis of program
- 11 participants; and
- 12 • Lost revenue.

13 For each program, lost revenue is calculated by factoring the 2020 cumulative monthly  
14 energy savings by the applicable base distribution and generation rate.



**Table 2 – Annualized and Monthly Cumulative PY2020 Net Ex Post kWh Savings and  
 Associated Lost Revenue**

<i>Variables</i>	<i>eScore Program</i>	<i>Residential Low Income Weatherization Program</i>	<i>Bring Your Own Thermostat Program</i>	<i>C&amp;I Lighting Program</i>	<i>C&amp;I Standard Program</i>	<i>Small Business Direct Install Program</i>	<i>Total</i>
Annualized Net Ex Post kWh Savings	614,385	431,590	158,957	14,097,160	1,087,755	4,428,946	20,818,792
January	-	2,784	-	606	-	-	3,390
February	7,979	14,893	-	1,153	3,260	67,514	94,799
March	22,884	34,825	-	42,449	6,284	173,037	279,479
April	40,436	47,760	-	110,229	9,093	295,446	502,963
May	57,585	58,813	-	232,072	15,484	422,339	786,294
June	76,733	74,278	-	383,327	31,375	545,402	1,111,116
July	98,192	93,145	-	609,215	52,037	679,812	1,532,402
August	123,277	110,944	-	1,414,284	72,295	837,115	2,557,916
September	149,861	125,803	23,127	2,292,734	89,467	992,213	3,673,205
October	183,255	139,319	32,204	3,255,644	126,023	1,190,627	4,927,072
November	229,462	172,653	33,360	4,263,391	163,089	1,441,021	6,302,976
December	289,195	218,946	33,368	5,484,225	252,835	1,806,248	8,084,817
Base Distribution and Generation Rate	0.0574	0.0574	0.0574	0.0191	0.0260	0.0387	
Lost Revenue	\$16,599.06	\$12,576.24	\$1,916.67	\$104,618.71	\$6,581.25	\$69,958.90	\$212,250.83

**III. ESTIMATE OF TOTAL ANNUAL ENERGY SAVINGS AND RELATED  
 AVOIDED CARBON EMISSIONS AND CUSTOMER BILL SAVINGS FOR  
 PREVIOUS, EXISTING, AND PROPOSED EE/DSM PROGRAMS, INCLUDING  
 CUSTOMERS WHO ELECTED TO OPT OUT OF THE COMPANY'S EE/DSM  
 PROGRAMS**

**Q. FROM AN ENERGY EFFICIENCY PERSPECTIVE, HOW DOES THE  
 VIRGINIA CLEAN ECONOMY ACT (VCEA) DEFINE TOTAL ANNUAL  
 ENERGY SAVINGS?**

**A.** The VCEA defines Total Annual Energy Savings as “the total combined kilowatt-hour savings achieved by electric utility energy efficiency and demand response programs and measures installed in that program year, as well as savings still being achieved by measures and programs implemented in prior years...” Therefore, any energy efficiency

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1 measures included in any previous program(s) that is (are) still producing energy savings,  
2 no matter when the program(s) was (were) initially implemented, would count toward the  
3 "Total Annual Energy Savings" component as defined in the VCEA.

4 **Q. WHAT IS APCO'S PROJECTED ACHIEVEMENT OF THESE TARGETS?**

5 A. ADM conducted an analysis, on behalf of the Company, to estimate the Company's  
6 anticipated progress toward the VCEA energy savings mandates. This analysis included  
7 (1) the persistent energy savings achieved, and verified through EM&V, for programs  
8 through 2020, (2) the estimated persistent energy savings expected to be achieved by  
9 existing programs for the period 2022 through 2025, (3) the estimated persistent energy  
10 savings from the new C&I Custom Pilot Program being requested in this proceeding  
11 through 2025, and (4) the estimated persistent energy savings of customers who have  
12 elected to opt out of the Company's demand-side management programs. This analysis,  
13 the results of which are illustrated below in Table 3 – also attached as Schedule 2 hereto  
14 – takes into account the estimated useful life of each energy efficiency measure to  
15 determine the Total Annual Energy Savings for each calendar year.

16 **Q. WHAT IS APCO'S PROJECTED ACHIEVEMENT OF RELATED CARBON**  
17 **EMISSION REDUCTIONS?**

18 A. On behalf of the Company, ADM developed an estimate of the avoided carbon emissions  
19 related to the Total Annual Energy Savings projected to be achieved during 2023 through  
20 2025. This was done by factoring the Company-provided utility specific residual mix  
21 emissions rate of 1,526 lbs CO<sub>2</sub> / MWh by the applicable estimates of Total Annual  
22 Energy Savings. The estimates of avoided carbon emissions are presented in Table 3  
23 below.

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**Q. WHAT IS APCO'S PROJECTED ACHIEVEMENT OF CUSTOMER BILL SAVINGS?**

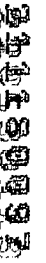
**A.** On behalf of the Company, ADM developed estimates of customer bill savings related to the Total Annual Energy Savings projected to be achieved during 2023 through 2025. Estimates of customer bill savings were developed by factoring the projected savings by a weighted average retail rate, accounting for the anticipated distribution of savings across residential, commercial, and industrial sectors and premised on 2020 retail rates, adjusted to account for a 2% rate increase annually. The estimates of customer bill savings are presented in Table 3 below.

**Table 3 – APCo Virginia Projected Achievements Under the VCEA**

Variable	2022	2023	2024	2025
2015-2020 Programs Cumulative Persistent Energy Savings (MWh)	153,187	148,610	143,033	136,745
Estimated Non-PUR-2021-00236 2021-2025 Programs Cumulative Persistent Energy Savings (MWh)	141,915	227,389	305,926	373,956
Estimated PUR-2021-00236 C&I Custom Pilot Program Cumulative Persistent Energy Savings (MWh)	-	11,964	23,929	35,893
Opt Out Customer Savings	37,734	37,734	37,734	37,734
Estimated Total Annual Energy Savings (MWh)	332,836	425,696	510,621	584,327
Savings Goal (Percentage of 2019 Energy Retail Sales)*	0.5%	1.0%	1.5%	2.0%
Energy Savings Goal (MWh)	72,260	144,521	216,781	289,041
Percent Achievement toward APCo EERS Mandates	460.6%	294.6%	235.5%	202.2%
Customer Bill Savings (\$ Millions)	\$33.03	\$42.95	\$52.50	\$61.21
Avoided Carbon Emissions (Metric Tons)	230,384	294,660	353,443	404,461

**Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?**

**A.** Yes.



# **2023-2025 Appalachian Power Company Commercial and Industrial Custom Pilot Program EM&V Plan**

**November 2021**

**PREPARED BY  
ADM Associates, Inc.**

**PREPARED FOR  
Appalachian Power Company**

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## 1. Introduction

This document presents ADM Associates, Inc., (ADM) proposed approach to performing evaluation, measurement and verification (EM&V) activities for the Commercial and Industrial Custom Pilot Program ("Custom Pilot Program") proposed by Appalachian Power Company (herein referred to as the "Company" or "APCo").

### 1.1 Compliance with EM&V Rules

Description of EM&V data sources and analysis results will be presented in annual reporting along with estimates of the gross and net energy savings (kWh) and peak demand reductions (kW) achieved by the pilot program. Table 1-1 summarizes how the evaluation and reporting will comply with the rules for evaluation, measurement, and verification (EM&V) set forth in Case No. PUR-2017-00047.

Table 1-1 Compliance with Case No. PUR-2017-00047 EM&V Rules

Section	Requirement	Response
20VAC5-318-40 (A)	<p>In all filings required by 20VAC5-318-30, the sources of all data or estimates used as inputs for proposed DSM measures or programs, in descending order of preference, shall be:</p> <ol style="list-style-type: none"> <li>1. Utility-specific data;</li> <li>2. Virginia-specific data If utility-specific data is unavailable or impracticable. When Virginia-specific data is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable;</li> <li>3. Data from non-Virginia jurisdictions or sources, if neither utility-specific data nor Virginia-specific data is available or practicable:               <ol style="list-style-type: none"> <li>a. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable.</li> <li>b. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why Virginia-specific data is unavailable or impracticable as well as the sources of all data, to include:                   <ol style="list-style-type: none"> <li>(1) Titles, version numbers, publication dates, and page numbers of all source documents, as appropriate; and</li> </ol> </li> </ol> </li> </ol>	<p>The methods that will be used to evaluate pilot program impacts are presented in this plan. The methods comply with the order of preferred data inputs cited in code 20VAC5-318-40 (A). Primary data may be supplemented by secondary data to facilitate cost efficient allocation of EM&amp;V resources.</p>

Section	Requirement	Response
	(2) An explanation as to why, in the utility's assessment, use of this data is appropriate.	
20VAC5-318-40 (B)	EM&V reports shall include relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.	The EM&V reports will describe the methodologies used to estimate savings for the program measures and include citations of relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures reported.
20VAC5-318-40 (C)	EM&V reports shall include measure-level estimates of kilowatt, kilowatt-hour, dekatherm, and pipeline capacity savings as appropriate. An estimate that has been adjusted for free-ridership as well as an estimate that has not been adjusted for free-ridership should be included as appropriate.	The cost-effectiveness analysis file submitted with the EM&V report will present measure-level estimates of peak kW and kWh energy savings.
20VAC5-318-50 (A)	EM&V of approved DSM measures or programs should be consistent with and contrasted to the preliminary EM&V plan set forth in the filings for approval of such measures or programs or as otherwise specified in a commission order approving such measures or programs. The commission recognizes that each utility has unique characteristics, and new or modified energy efficiency measures are constantly being developed. As such, alternative methodologies may be included in reporting provided that sufficient supporting documentation and explanation of appropriateness of alternative methodologies is provided.	The EM&V reports will detail any deviations from the approach submitted within this plan and the reasons for that deviation.
20VAC5-318-50 (B)	EM&V reports of existing measures or programs shall utilize utility-specific data or other data in conformance with 20VAC5-318-40 A when updating the analysis of the cost effectiveness of each measure, program, or	Initial pilot program cost effectiveness analysis will be performed on an ex post basis.

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Section	Requirement	Response
	portfolio as appropriate and practicable. EM&V reports of existing measures or programs shall include the information required by 20VAC5-318-40 B and C.	APCo will provide information on avoided energy production and capacity costs, avoided costs from transmission and distribution system losses, and applicable discount rates, and any administration or portfolio level costs as allocated across the portfolio of programs.  ADM will provide net energy savings, peak demand impacts, incremental costs, and effective useful life determined in accordance with this plan.
20VAC5-318-50 (C)	Any changes to or variances from originally approved measure-level inputs and assumptions shall be documented and explained, and the impact of such changes on original cost/benefit estimates for DSM programs or measures shall be quantified.	The EM&V report will present the results of two cost effectiveness analyses – one based on the ex ante savings estimates and the other based on ex post savings estimates. These alternative results characterize the discrepancy between the benefits associated with the ex ante estimates and the ex post estimates. The presentation of savings results will include discussion of the reasons for differences between the ex ante and ex post savings estimates.
20VAC5-318-50 (D)	EM&V reports shall describe the methodologies by which the measured data was collected, including at a minimum:  1. The sampling plan; and  2. Statistical calculations upon which the reported data is based when applicable.	The sampling approach will be presented in the methodology section of the evaluation reports.

Section	Requirement	Response
20VAC5-318-50 (E)	EM&V reports for ongoing DSM measures or programs shall include an explanation of eligibility requirements for each rate schedule to which the measures or programs are being offered.	The EM&V reports will provide a description of the program that includes information on the measure or program eligibility requirements as provided by the Company.
20VAC5-318-50 (F)	EM&V reports for ongoing DSM measures or programs shall include a comparison of the measured annual measure or program savings estimates to the annual usage of the average rate schedule usage and eligible customer in each rate schedule to which the measures or programs is being offered. A comparison to originally approved estimated savings for the measures or programs that were approved by the commission shall also be provided. This will include a calculation of the expected savings as a percentage of the annual usage of the average rate schedule usage and eligible customer as appropriate and practicable.	The EM&V reports will present a table for each rate class, based on data provided by the Company, that summarizes the following information: Program Name, Rate Class, Total Gross and Net kWh Savings, Number of Participating Customer Accounts, Average Gross and Net kWh Savings per Customer Account, and Average Consumption per Account for the Rate Class
20VAC5-318-50 (G)	EM&V reports for ongoing DSM measures or programs shall include a description of the controls undertaken by the utility to verify proper installation of the measures or programs, as appropriate. Additionally, utilities shall require the contractors and subcontractors that will be implementing the measures or programs, if applicable and practicable, to record details of serviced or replaced equipment, to include at a minimum:  1. Nameplate efficiency ratings; 2. Serial numbers; and 3. Model numbers.  This information will be made available to commission staff upon request.	The EM&V reports will include the following information as provided by the Company or otherwise determined through the evaluation effort:  1) a description of program installation quality controls. 2) a description of equipment specification data recorded by the program.

Section	Requirement	Response
20VAC5-318-50 (H)	EM&V reports should include actual costs incurred by the utility and each EM&V contractor for (i) the development of the most recent EM&V plan and (ii) the administration of EM&V activities for the reporting period.	Unless otherwise noted, where applicable, costs presented in the cost effectiveness analysis chapter of the EM&V reports are inclusive of actual costs incurred by the utility and each EM&V contractor for the development of the most recent EM&V plan and the administration of EM&V activities for the reporting period.

## 1.2 Updates to the EM&V Plan

The EM&V plan may be updated on an annual basis. Plan updates may account for revisions to the methods and data sources referenced in performing EM&V activities, lessons learned from EM&V performed, and feedback from EM&V project stakeholders.

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## **2. Commercial and Industrial Custom Pilot Program**

### **2.1 Program Description**

The Commercial and Industrial Custom Pilot Program ("Custom Pilot Program") will provide custom incentives to encourage businesses to make energy saving improvements to their facilities. The pilot will provide incentives for the implementation of measures for which prescriptive incentives cannot be offered through the Company's Commercial and Industrial Program.

### **2.2 Data Collection**

This section summarizes sampling and data collection procedures for the evaluation of the Custom Pilot Program.

#### **2.2.1 Onsite and Remote Site Visits and Data Collection**

##### **2.2.1.1 Sampling Approach**

ADM will select a sample of Custom Pilot Program projects for which ADM will perform measurement and verification (M&V) and calculate gross realized kWh savings and kW demand reductions.

A stratified sampling approach will be used to develop the M&V sample. A stratified sampling approach allows for a given statistical precision and confidence level target to be met with a smaller sample size than would be allowed by simple random sampling. Strata boundaries will be based on ex ante kWh energy savings. ADM will select a sample with a sufficient number of sample units to facilitate estimation of program ex post kWh energy savings with 10% statistical precision at a 90% confidence level.

Completed program projects accumulate over time as the program is implemented, and sample selection will likely occur at multiple points in time. The timing of the performance of sample selection will be contingent upon the timing of the completion of projects during the program year.

##### **2.2.1.2 Data Collection**

ADM anticipates that data collection for the Custom Pilot Program will include a mixture of remote and onsite verification. If current health conditions prevent onsite verification, ADM will use remote verification approaches.

During an on-site visit, ADM staff will accomplish three major tasks:

- First, they will verify the implementation status of all measures for which customers received incentives. They will verify that the energy efficiency measures were indeed installed, that they were installed correctly and that they still functioned properly.
- Second, they will collect the physical data, when necessary, needed to analyze the energy savings that have been realized from the installed improvements and measures. Data will be collected using a form that will be prepared specifically for the project in question after an in-house review of the project file.
- Third, they will interview the contact personnel at a facility to obtain additional information on the installed system to complement the data collected from other sources.

Monitoring may be conducted to gather additional information on the operating hours of the installed measures. Monitoring is conducted at sites for which ADM staff members determine that monitored data are necessary to minimize uncertainty associated with savings calculation of energy impacts. Monitoring is not considered necessary for sites for which other data sources and methods will support estimation of energy impacts with relatively less uncertainty.

Under certain circumstances, M&V may be completed through remote verification in lieu of site visits.

- Use a phone application that allows site staff to perform a walkthrough captured on video.
- Use telephone or email verification to perform remote verification and collect data on factors such as building operation schedules or heating and cooling types.
- For cases where Option B (retrofit isolation) would be applied, ADM may request energy use data collected through EMS systems or other onsite monitoring efforts implemented by site staff or their contractors, if available. As needed, and if acceptable to the customer, ADM will schedule video conferencing with our experienced engineers and field staff to assist customers with getting this data. As mentioned above, ADM may mail and ask customers to install and mail back monitoring equipment where the site staff have the technical resources to support the data collection effort and other M&V approaches are not viable. We will only take this approach for equipment that involves no safety risks to the customer.
- Application of IPMVP Option C (whole building analysis) for custom measures where feasible, supplemented by information collected by telephone or email on schedule and equipment changes that may have occurred during the pre-and post-installation period.

#### **2.2.2 Participant Surveys**

ADM will collect data from project decision makers to support net-to-gross and the process evaluation through online and telephone surveys. Online surveying will be the primary mode for data collection and telephone surveying will be used secondarily to reach contacts not responsive to email recruitment used for the online survey. ADM will attempt to complete surveys with a census of program participant contacts. We will use data obtained from participant surveys to estimate the net savings impacts of the program. Survey-based net savings estimates are appropriate for this program because the participants are aware of the incentives provided, the methodology is transparent and cost effective, and developing a non-participant control group is not practicable.

#### **2.2.3 Trade ally Interviews**

ADM will complete interviews with program trade allies during the years that a process evaluation is planned. The interviews will use a semi-structured interview guide to focus the discussion but allow for addressing any issues raised during the interview. We will seek to complete interviews with up to 10 trade allies. We will employ a purposive sampling approach to target interviews with trade allies who have a mix of experience with the program and who provide varying services (e.g., lighting contractors, HVAC designers). We will offer a \$50 gift card to participating trade allies and expect the interviews to last approximately 20 minutes.

#### **2.2.4 Program Staff Interviews**

ADM will complete interviews with the Company's program manager and the implementation contractors program manager during years that a process evaluation is planned. Interviews may occur during years that a process evaluation is not planned as necessary to understand changes in program design or performance.

### **2.3 Gross Impact Evaluation Approach**

#### **2.3.1 Review Program M&V and Due Diligence Procedures**

The Company's program implementation contractor will provide documentation for the sampled energy efficiency projects undertaken at customer facilities. The first step in the evaluation effort will be to review this documentation and other program materials that are relevant to the evaluation effort.

- Documentation for the equipment changed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Documentation for the new equipment installed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Information about the savings calculation methodology, including (1) what methodology was used, (2) specifications of assumptions and sources for these specifications, and (3) correctness of calculations.

Following this review, ADM will develop recommended quality assurance/quality control (QA/QC) and due diligence procedures for program implementation contractors with the goal of minimizing the variance between ex ante and ex post energy impacts to the extent feasible and practical. Recommended QA/QC protocols may include:

- Procedures for program implementation contractors to use to document measure installation and facilitate post implementation verification; and
- Procedures for determining baseline energy use.

In addition to the above activities, ADM will complete a review of program tracking data. The purpose of the review is to assess the sufficiency of the tracking data for supporting program implementation and evaluation. To this end, ADM will review the program data to verify that the following fields are tracked, that the fields are populated (i.e., the data is not missing), and that the values are reasonable.

- Unique customer identifier, such as customer account number;
- Customer specific such as contact name and information, building type;
- Project milestone dates such as application submission date, application approval, incentive payment (where applicable);
- Measure specific information such as:
  - type of measure;
  - specific measure;
  - ex ante measure kWh energy savings and peak kW reductions;
  - measure attributes necessary to estimate measure savings (where applicable);
  - unique measure identifier (e.g., numeric or alpha-numeric code);
  - unit serial number (where applicable);
  - incremental costs / project costs
- Vendor/Contractor business name, contact name and information (where applicable);
- Incentive amounts; and

- Application status.

### 2.3.1.1 Pre-Installation Project Review

In coordination with APCo and the program implementation contractor, ADM will perform pre-installation reviews of select Custom Pilot Program projects to provide early information regarding project energy savings estimates. The following are potential applications of pre-installation reviews:

- For lighting controls, determine the baseline lighting hours of use, potentially through installation of monitoring equipment to collect data with which pre-implementation lighting annual hours of operation may be estimated.
- For HVAC projects, review of applicant engineering energy savings methodologies and, when available, review of inputs of building energy model simulations.
- For projects with very high anticipated savings (>250,000 kWh), remote or on-site verification of baseline conditions and operating schedules and identification of any existing building management systems.

### 2.3.2 Estimation of Sample Project Gross Savings

The method ADM employs to determine gross savings impacts is dependent upon the types of measures being analyzed. ADM typically employs a specific set of methods to determine project gross savings that is dependent upon the type of measure being analyzed. These methods are summarized in Table 2-1.

Table 2-1 Typical Methods to Determine Savings for Commercial & Industrial Measures

Type of Measure	Methods to Determine Savings
Lighting	Reference to data on wattages of newly-installed measures, hours-of-use data obtained from site-specific data collection (e.g., monitoring), with baseline data informed by applicable standards or pre-existing equipment characteristics.  Mid-Atlantic TRM energy savings algorithm variable inputs.
HVAC (including packaged units, chillers, cooling towers, controls/energy management systems)	eQUEST model using DOE-2 as its analytical engine estimating HVAC loads and calibrated with site-level billing data for large projects.  Econometric analysis referencing pre- and post-implementation energy usage data and weather data.  Mid-Atlantic TRM or other secondary sources if needed for smaller measures.
Motors and variable frequency drives	Mid-Atlantic TRM.  eQUEST model using DOE-2 as its analytical engine for estimating HVAC loads and calibrated with site-level billing data to establish a benchmark.
Refrigeration	Mid-Atlantic TRM; doors, controls and operation parameters verified on-site.  Simulation utilizing DEER prototypical models used for refrigerated case door retrofits. Engineering analysis referencing Energy Star equations and variables.

Type of Measure	Methods to Determine Savings
Commercial Kitchen Equipment	Mid-Atlantic TRM or other secondary sources, if needed
Compressed Air Systems	Engineering analysis, with monitored data on power, load factor, and schedule of operation
Process Improvements	Engineering analysis, with monitored data on power, load factor, and schedule of operation

Activities specified in Table 2-1 produce verified gross kWh savings calculations for each sampled project.

The following methods to calculate ex post gross kW demand reduction may be applied:

- Secondary research. The Mid-Atlantic TRM or other secondary research may be referenced to calculate the measure ex post gross kW demand reductions.
- Hourly energy savings profile. In cases in which ADM has developed an 8,760 hour annual kWh savings profile, ADM may use this information to calculate ex post gross kW demand reductions. In this case, the applicable peak period referenced in the calculation of program ex post gross kW demand reductions is June through August on weekdays between 2:00 PM and 6:00 PM. The ex post gross kWh savings occurring during that time period are divided by the number of hours occurring during that time period to calculate ex post gross kW demand reductions.

A kWh energy savings gross realization rate and a peak kW reduction gross realization rate is calculated for each site that is part of the M&V sample. Sites with relatively high or low gross realization rates are analyzed to determine the reasons for the discrepancy between ex ante and ex post energy savings. The site-level gross impact analysis results for each M&V sample site will be presented in the annual program EM&V report.

### 2.3.2.1 Supplementary Econometric Analysis of Energy Savings

ADM will supplement the impact evaluation with IPMVP Option C by performing regression analysis to assess the presence of energy savings during the period subsequent to implementation of program measures where feasible. NREL guidance on the use of Option C analysis includes the restriction that it should be applied when expected energy savings are likely to exceed 10% of building energy consumption. Furthermore, there needs to be sufficient pre- and post-implementation data, ideally in full-year increments (e.g., 12 or 24 months pre and post).<sup>1</sup> With these limitations in mind, ADM plans to use Option C analysis.

For the Custom Pilot Program, the Option C analysis will be performed on individual sites that are selected via application of a sampling plan. A site-specific approach is taken to estimate assess the presence of energy savings from program projects using consumption data. The approach uses the following regression model:

$$kWh_{monthly} = \beta_1 \#Days + \beta_2 CDD + \beta_3 HDD + \beta_4 Pre_{post} + \epsilon$$

Table 2-2 summarizes the variables used in the model.

<sup>1</sup> International Performance Measurement & Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Volume I. Revised March 2002.



Table 2-2 Analysis Model Variables

Variable Name	Variable Description
$kWh_{monthly}$	Monthly kWh consumption
$\beta 1 \# Days$	Number of days for the month
$\beta 2 CDD$	Cooling Degree Days for the month
$\beta 3 HDD$	Heating Degree Days for the month
$\beta 4 Pre_{post}$	Binary Flag for Pre and Post Retrofit (Pre = 0, Post = 1)

The results of the supplementary econometric analyses will be referenced to estimate associated upper and lower bounds of estimated energy savings based on the coefficient and statistical significance of the coefficient of interest.

### 2.3.3 Estimation of Program-Level kWh Energy Savings and kW Peak Reductions

The kWh gross realization rate is the ratio of sampled measure ex post gross kWh energy savings to sampled measure ex ante kWh energy savings. The kW gross realization rate is the ratio of sampled measure ex post gross kW demand savings to sampled measure ex ante kW demand savings. Since a stratified sampling approach is employed for this program, stratum-level kWh and kW gross realization rates will be developed for each sampling stratum.

Program-level gross ex post gross kWh energy savings are calculated as follows:

- The ex ante kWh energy savings of non-sampled measures are factored by the applicable stratum-level kWh gross realization rates to calculate ex post gross kWh energy savings for non-sampled measures.
- The ex post gross kWh energy savings of all sampled measures and all non-sampled measures are summed.

To facilitate calculation of program-level kW demand reductions, for each end use, the ratio of sampled measure ex post kW savings to sampled measure ex post kWh savings will be applied for the purpose of estimating the ex post kW demand reductions of non-sampled measures.

### 2.3.4 Estimation of Effective Useful Life

Where applicable, ADM will cite the Mid-Atlantic TRM in the estimation of measure-level effective useful life (EUL) of measures implemented at sampled sites. Where the Mid-Atlantic TRM is inapplicable to the determination of measure EUL for sampled sites, ADM may cite other sources including other TRMs, other secondary data sources, or anticipated equipment operating characteristics and equipment specification information. To facilitate calculation of program-level lifetime kWh savings, for a given end use, the gross ex post kWh-weighted EUL will be applied to non-sampled measures.

### 2.3.5 Estimation of Incremental Cost

Where applicable, ADM will cite the Mid-Atlantic TRM in the estimation of measure-level incremental cost of measures implemented at sampled sites. Where the Mid-Atlantic TRM is inapplicable to the determination of measure incremental cost for sampled sites, ADM may cite other sources including other TRMs, other secondary data sources, and actual cost data. To facilitate calculation of program-level

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incremental cost, for a given end use, the incremental cost per gross ex post kWh saved for sampled measures will be applied for the purpose of estimating the incremental cost of non-sampled measures.

## **2.4 Net Impact Evaluation Approach**

The net savings analysis is used to determine what part of the gross energy savings achieved by program participants can be attributed to the effects of the program. The net savings attributable to program participants are the gross savings less free ridership, plus spillover.

### **2.4.1 Estimation of Free Ridership**

Information collected through a survey of a sample of program participants will be used for the net-to-gross analysis.

All survey response data are systematically reviewed by a researcher who is familiar with the program, the individual project, and the social science theory underlying the decision maker survey instrument. As part of this review, the researcher may determine whether the available information justifies modifying the free ridership score calculated in accordance with the algorithm outlined below. The free ridership score calculated in accordance with the algorithm outlined below may be revised in instances in which there are significant apparent inconsistencies between responses provided by the decision maker or in cases in which the responses are apparently invalidated by other information regarding the project. As part of this review, the researcher may communicate with the decision maker to attempt to resolve any apparent inconsistency. In some cases in which the decision maker responses are apparently inconsistent, the researcher may drop the sample point. Information on any modifications to the free ridership score along with associated rationale and references to supporting data will be presented in the EM&V reporting.

- Several factors are considered in the determination of the presence of free ridership. These include:
- Financial ability to afford the installed measure without a program rebate;
- Plans and intentions of the firm to install a measure even without support from the program;
- Influence that the program had on the decision to install a measure; and
- A firm's previous experience with a measure installed under the program.

To assess these factors, program participants are asked a series of questions about the decision to implement the program project. Based on their responses, respondents are assigned a free ridership score used to estimate the extent of project free ridership.

Several criteria are used to determine what portion of a customer's savings for a particular project should be attributed to free ridership. The first criterion is based on the response to the following two questions:

- Would you have been financially able to install the equipment or measures without the financial incentive from the [Program Name]?
- To confirm, your organization would NOT have allocated the funds to complete a similar energy saving project if the program incentive was not available. Is that correct?

If a customer answers "No" to the first question and "Yes, that is correct" to the second, a free ridership score of 0 is assigned to the project. That is, if a customer required financial assistance from the program to undertake a project, then that customer is not deemed a free rider.

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For decision makers that indicate that they are able to undertake energy efficiency projects without financial assistance from the program, three factors are analyzed to determine what percentage of savings may be attributable to free ridership. The three factors are:

- Plans and intentions of firm to install a measure even without support from the program;
- Influence that the program had on the decision to install a measure; and
- A firm's previous experience with a measure installed under the program.

For each of these factors, rules are applied to develop binary variables indicating whether a participant's behavior shows free ridership. These rules make use of answers to questions on the decision maker survey questionnaire.

The first factor requires determining if a participant's intention was to install an energy efficiency measure even without the program. The answers to a combination of several questions are used with a set of rules to determine whether a participant's behavior indicates likely free ridership. Two binary variables account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answers "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you completed the [MEASURE] project even if you had not participated in the program?"
- The respondent answers "definitely would have installed" to the following question: "If the financial incentive from the [PROGRAM] had not been available, how likely is it that you would have installed [MEASURE] anyway?"
- The respondent answers "did not affect timing of purchase and installation" to the following question: "How did the availability of information and financial incentives through the [PROGRAM] affect the timing of your purchase and installation of [MEASURE]?"
- The respondent answers "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "Did you purchase and install the [MEASURE] earlier than you otherwise would have without the program?"

The second, less restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answers "yes" to the following two questions: "Did you have plans to install the [MEASURE] before participating in the program?" and "Would you completed the [MEASURE] project even if you had not participated in the program?"
- Either the respondent answers "definitely would have installed" or "probably would have installed" to the following question: "If the financial incentive from the [PROGRAM] had not been available, how likely is it that you would have installed [MEASURE] anyway?"
- Either the respondent answers "did not affect timing of purchase and installation" to the question: "Did you purchase and install the [MEASURE] earlier than you otherwise would have without the program?" or the respondent indicates that that while program information and

financial incentives did affect the timing of equipment purchase and installation, in the absence of the program they would have purchased and installed the equipment within the next two years.

- The respondent answers "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "Did you choose equipment that was more energy efficient than you would have chosen because of the program?"

The second factor requires determining if a customer reports that a recommendation from a Program representative or experience with the program was influential in the decision to install a particular piece of equipment or measure.

The criterion indicating that program influence may signify a lower likelihood of free ridership is that either of the following conditions is true:

- The respondent answers "very important" to the following question: "How important was previous experience with the [Program Name] in making your decision to install [Equipment/Measure]?"
- The respondent answers "yes" to the following question: "Did a representative of the [Program Name] recommend that you install [Equipment/Measure]?"

The third factor requires determining if a participant in the program indicates that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure is considered to have a likelihood of free ridership.

The criteria indicating that previous experience may signify a higher likelihood of free ridership are as follows:

- The respondent answers "yes" to the following question: "Before participating in the [Program Name], had you installed any equipment or measure similar to [Rebated Equipment/Measure] at your facility?"
- The respondent answers "yes, purchased energy efficient equipment but did not apply for financial incentive." to the following question: "Has your organization purchased any energy efficient equipment in the last three years for which you did not apply for a financial incentive through the [Program Name]?"

The four sets of rules just described are used to construct four different indicator variables that address free ridership behavior. For each customer, a free ridership value is assigned based on the combination of variables. With the four indicator variables, there are 12 applicable combinations for assigning free ridership scores for each respondent, depending on the combination of answers to the questions creating the indicator variables. Table 2-3 shows these values.

Table 2-3 Free Ridership Scoring

Indicator Variables				Free Ridership Score
Had Plans and Intentions to Install Measure without the Program? (Definition 1)	Had Plans and Intentions to Install Measure without the Program? (Definition 2)	The Program had influence on Decision to Install Measure?	Had Previous Experience with Measure?	
Y	N/A	Y	Y	100%
Y	N/A	N	N	100%
Y	N/A	N	Y	100%
Y	N/A	Y	N	67%
N	Y	N	Y	67%
N	Y	N	N	33%
N	N	N	Y	33%
N	Y	Y	Y	33%
N	Y	Y	N	0%
N	N	N	N	0%
N	N	Y	N	0%
N	N	Y	Y	0%

#### 2.4.2 Estimation of Participant Spillover

Program participants may implement additional energy saving measures without receiving a program incentive because of their participation in the program. The energy savings resulting from these additional measures constitute program participant spillover effects.

To assess participant spillover savings, survey respondents are asked whether they implemented any additional energy saving measures for which they did not receive a program incentive. Respondents are also asked to provide information on the measures implemented for use in estimating the associated energy savings.

To determine if the savings from the reported measures are attributable to the program, survey respondents are asked questions about the degree to which their experience with the program influenced them to implement the measures and the likelihood of implementing the measures in the absence of the program. Specifically, respondents are asked the following questions:

- SO1: How important was your experience with the [PROGRAM\_NAME] in your decision to install this lighting equipment?
- SO2: If you had NOT participated in the [PROGRAM\_NAME], how likely is it that your organization would still have installed this lighting equipment?

The responses to these questions are used to develop a spillover score as follows:

$$\text{Spillover} = \text{Average}(\text{SO1}, 10 - \text{SO2})$$

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Savings from measures associated with a spillover score greater than 7 are considered attributable to the program.

All survey response data are systematically reviewed by a researcher who is familiar with the portfolio and the survey instrument. As part of this review, the researcher may determine whether the available information justifies modifying the spillover score calculated in accordance with the algorithm outlined below. The spillover score calculated in accordance with the algorithm outlined above may be revised in instances in which there are significant apparent inconsistencies between responses provided by the decision maker or in cases in which the responses are apparently invalidated by other information regarding the measure(s). As part of this review, the researcher may communicate with the respondent to attempt to resolve any apparent inconsistency. In some cases in which the responses are apparently inconsistent, the researcher may drop the sample point. Information on any modifications to the spillover score along with associated rationale and references to supporting data will be presented in the EM&V reporting.

## 2.5 Process Evaluation Approach

ADM will complete a process evaluation of the Custom Pilot Program annually. The process evaluation will evaluate the program implementation and design.

Table 2-4 summarizes the research topics, questions, and data sources. ADM will address these topics through:

- Interviews with program staff and participating trade allies;
- Surveys of program participants;
- Review of program documentation including any available program manuals, contractor / vendor training materials, application forms, and the program website; and
- Review and analysis of program data.

Table 2-4 Process Evaluation Topics, Research Questions, and Data Sources

Topic	Example Research Questions	Data Sources
Measure offering and incentive design	Are there any missed opportunities for additional measures to include?	Review of program materials, trade ally, participant surveys, and staff interviews.
	Are the incentive levels appropriate?	Review of program materials, trade ally, participant surveys, and staff interviews
	How do incentives compare to those offered by other utilities in the region (e.g., Dominion)? Are they competitive with these other offerings to attract trade allies?	Review of program materials, trade ally, and staff interviews
Marketing and Outreach	Is the trade ally network comprised of the right mix of expertise?	Review of contractor network and staff interviews.
	How well is the program working with key account representatives?	Staff interviews
	Is the program providing sufficient support to trade allies and what are	Trade ally interviews and staff interviews.

Topic	Example Research Questions	Data Sources
	the activities taken to keep trade allies engaged?	
	What marketing and educational activities has the program engaged in or sponsored?	Staff interviews and program materials review.
	What aspects of the program marketing influenced customer participation?	Customer surveys.
Application Processes	Does the application process balance customer burden with the need for appropriate documentation?	Review of application materials and submission procedures. Staff interviews.
	Is the application process clear to customers and trade allies?	Trade ally interviews. Participant surveys.
Quality assurance and control	What are the criteria for verification? What levels of project review are there and are these appropriate to cost efficiently mitigate risk?	Staff interviews and program materials review.
	What are the data quality and control procedures?	Staff interviews and review of program tracking data.

2014-2015-2016-2017-2018-2019-2020-2021-2022-2023-2024-2025

### Total Annual Energy Savings, Bill Savings, and Avoided Carbon Emissions

Variable	2022	2023	2024	2025
2015-2020 Programs Cumulative Persistent Energy Savings (MWh)	153,187	148,610	143,033	136,745
Estimated Non-PUR-2021-00236 2021-2025 Programs Cumulative Persistent Energy Savings (MWh)	141,915	227,389	305,926	373,956
Estimated PUR-2021-00236 C&I Custom Pilot Program Cumulative Persistent Energy Savings (MWh)	-	11,964	23,929	35,893
Opt Out Customer Savings	37,734	37,734	37,734	37,734
Estimated Total Annual Energy Savings (MWh)	332,836	425,696	510,621	584,327
Savings Goal (Percentage of 2019 Energy Retail Sales)*	0.5%	1.0%	1.5%	2.0%
Energy Savings Goal (MWh)	72,260	144,521	216,781	289,041
Percent Achievement toward APCo EERS Mandates	460.6%	294.6%	235.5%	202.2%
Customer Bill Savings (\$ Millions)	\$33.03	\$42.95	\$52.50	\$61.21
Avoided Carbon Emissions (Metric Tons)	230,384	294,660	353,443	404,461