BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Kansas City Power & Light Company's Notice of Intent to File an Application for Authority to Establish a Demand-Side Programs Investment Mechanism	))))	File No. EO-2019-0132
In the Matter of KCP&L Greater Missouri Operations Company's Notice of Intent to File an Application for Authority to Establish a Demand-Side Programs Investment Mechanism	))))	File No. EO-2019-0133

EVERGY MISSOURI METRO AND EVERGY MISSOURI FILING
APPLICATION TO UPDATE MEEIA CYCLE 3
EVALUATION MEASUREMENT & VERIFICATION PLANS

COMES NOW, Evergy Metro, Inc. d/b/a Evergy Missouri Metro ("Evergy Missouri Metro") and Evergy Missouri West, Inc. d/b/a Evergy Missouri West ("Evergy Missouri West") (collectively, the "Company"), and submits this *Application to Update MEEIA Cycle 3 Evaluation Measurement & Verification Plans ("Plans")* to the Missouri Public Service Commission ("Commission"), as attached hereto.

1. On December 11, 2019, the Commission approved the Company's MEEIA 3 application in its *Report and Order*. The initial application for MEEIA 3 approval as filed on November 29, 2018 included a single Evaluation Measurement & Verification ("EM&V") Plan (See Appendix 8.4). The Plans have since been modified to reflect updated EM&V methodologies and responsibilities, report formats, and reporting timelines. In addition, two separate Plans are hereby being submitted as there are two EM&V contractors performing MEEIA Cycle 3 evaluation services.

2. A summary of the updated Plans was discussed with the Missouri Stakeholder group on December 7, 2020 with no concerns indicated. Additionally, the updated Plans were provided

to Commission Staff on January 29, 2021; Commission Staff supports the revisions to the updated plans.

3. Details of the updated Plans are attached, as follows:

Exhibit A: *Evaluation Measurement & Verification Plans MEEIA Cycle 3*, dated December 2020, and prepared by ADM Associates, Inc.

Exhibit B: ***Evaluation Measurement & Verification (EM&V) Plan MEEIA Cycle 3*** - Business Custom, Business Standard, Business Process Efficiency and Online Business Energy Audit (OBEA), dated December 16, 2020, and prepared by Guidehouse, Inc.

WHEREFORE, the Company requests the Commission issue an order approving the proposed revisions to the EM&V plans.

Respectfully submitted,

/s/ Roger W. Steiner

Robert J. Hack, MBN 36496
Roger W. Steiner, MBN 39586
Evergy, Inc.
1200 Main Street, 16th Floor
Kansas City, MO 64105
Telephone: (816) 556-2314
Facsimile: (816) 556-2110
E-Mail: Rob.Hack@evergy.com
E-Mail: Roger.Steiner@evergy.com

Attorneys for Evergy Missouri Metro and Evergy Missouri West

CERTIFICATE OF SERVICE

I do hereby certify that a true and correct copy of the foregoing document has been hand delivered, emailed or mailed, postage prepaid, to all counsel of record in this case on this 2nd day of February 2021.

/s/ Roger W. Steiner

Counsel for Evergy Missouri Metro and Evergy Missouri West

Evaluation, Measurement and Verification Plans
MEEIA Cycle III

December 2020

Prepared by:

ADM Associates, Inc.
3239 Ramos Circle
Sacramento, CA 95827
916-363-8383

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1. Executive Summary

In accordance with the Missouri Energy Efficiency Investment Act (MEEIA) Rules and the Stipulation and Agreement, Evergy Services, Inc. (ESI) (hereafter referred to as Evergy) on behalf of its affiliates Evergy MO West and Evergy Metro, has contracted with ADM Associates to evaluate, measure, and verify the information tracked by Evergy MO West and Evergy Metro for its portfolio of Seven Residential programs and 3 Demand Response programs for the 3-year program cycle beginning January 1, 2020 through December 31, 2022. Specific Evergy programs covered by this evaluation include:

1) Residential Programs:
    a. Heating Cooling & Home Comfort
    b. Energy Savings Products
    c. Income-Eligible Multifamily
    d. Home Energy Report
    e. Online Home Energy Audit
    f. Products & Services Incubator
    g. PAYS
2) Demand Response Programs
    a. Business Demand Response
    b. Residential Demand Response
    c. Business Smart Thermostat

This document provides a summary of ADM's plans to accomplish the following impact evaluation, process evaluation, and cost-effectiveness analysis tasks

In accordance with the Missouri Code of State Regulations 20 CSR 4240-22.070 (8) (Missouri regulations), Evergy is required to complete an impact evaluation for each program using one or both methods detailed below.

Method 1: *At a minimum, comparisons of one (1) or both of the following types shall be used to measure program and rate impacts in a manner that is based on sound statistical principles:*

- *Comparisons of pre-adoption and post-adoption loads of program or demand-side rate participants, corrected for the effects of weather and other inter-temporal differences; and*
- *Comparisons between program and demand-side rate participants' loads and those of an appropriate control group over the same time period.*

Method 2: *The evaluator shall develop load-impact measurement protocols that are designed to make the most cost-effective use of the following types of measurements, either individually or in combination:*

- *Monthly billing data, hourly load data, load research data, end-use load metered data, building and equipment simulation models, and survey responses; or*
- *Audit and survey data on appliance and equipment type, size and efficiency levels, household characteristics, or energy-related building characteristics.*

The process evaluation will answer the following five questions on program design as set forth in the Missouri regulations.

1. *What are the primary market imperfections that are common to the target market segment?*
2. *Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?*
3. *Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?*
4. *Are the communication channels and delivery mechanisms appropriate for the target market segment?*
5. *What can be done to overcome the identified market imperfections more effectively and to increase the rate of customer acceptance and implementation of each end-use measure included in the program?*

2. Heating, Cooling and Home Comfort

2.1 Description of Heating, Cooling, and Home Comfort Program

The Heating, Cooling, and Home Comfort Program provides educational and financial incentives to residential customers by increasing awareness and incorporation of energy efficiency into their homes, while also generating cost-effective energy and demand savings for Evergy. The program encourages home improvements that increase operational energy efficiency and home comfort. It consists of three primary components:

- Direct Install (DI) Kit – a free direct installed energy saving kit provided both virtually and on-site by ICF employees includes discretionary energy assessments to targeted low-income residents. The energy assessments are a walk-through assessment and do not include blower-door tests to evaluate building envelope leakage. Each kit provides direct install measures such as faucet aerators, low-flow showerheads, advanced power strips, hot water pipe insulation, and energy-efficient lighting;
- Insulation and Air Sealing – provides incentives for installing home envelope/weatherization measures, such as insulation and air sealing. An energy audit must be performed for all insulation and air sealing measures;
- HVAC – incentivizes energy-efficiency improvements to a homes' HVAC, such as heat pumps and central air conditioners. It offers equipment rebates for qualifying HVAC equipment installed by an authorized trade ally.

2.1.1 Program Goals and Objectives

The Heating, Cooling, and Home Comfort Program seeks to provide financial incentives on a variety of categorically applicable measures and drive market adoption of energy efficient measures and practices through the education of customers and the community of local contractors. This program is eligible to customers that own or rent[1] a residence or are building a new residence[2]. HVAC contractors are also eligible for participation as trade allies for the program.

By fostering the development of customers' and contractors' knowledge base in addition to supporting the purchase and adoption of these efficient technologies, the Heating,

[1] For customers who rent a residence, the incentive most always goes to the landlord who owns the home.

[2] Measures available to new construction residences include ground source heat pumps and ductless mini-split heat pumps.

Cooling, and Home Comfort Program can overcome market barriers and generate energy and demand savings that are aligned with Evergy's energy-efficiency goals.

2.1.2 Expected Energy and Demand Savings

Targeted energy and demand impacts for program years 2020 - 2022 are shown in Table 2-1. These targeted savings are taken from KCP&L filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233.

Table 2-1: Program Targeted Net Savings by Year

Program Year	Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)
Evergy Metro		
2020	3,346,358	1,607
2021	4,814,841	2,225
2022	5,426,432	2,480
Total	**13,587,631**	**6,312**
Evergy Missouri West		
2020	7,236,542	3,133
2021	7,767,640	3,392
2022	8,338,188	3,655
Total	**23,342,370**	**10,180**

2.2 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform for Evergy's MEEIA Cycle III Heating, Cooling, and Home Comfort Program.

2.2.1 Data Collection and Measure Verification

Data used for this evaluation will include:

- Program tracking data from the main tracking database;
- Deemed savings from the Evergy Technical Reference Manual
- Program applications and supporting documentation;
- Participant survey data collected through online survey
- General population survey data from Evergy customers obtained via online survey

- Data from relevant secondary sources, such as the ENERGY STAR® database of certified products[3]

ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy and demand impacts. The data review will include an assessment of whether savings reported in the tracking system comply with deemed savings values and guidelines set by the Evergy Technical Reference Manual (Evergy TRM).

The supporting document review will consist of reviewing project documentation to ensure the total quantities, product types, and product descriptions for all measures to match with what is reported in the program tracking system. Additionally, ADM will review LED light bulb model numbers to ensure that key variables such as the bulb characteristics (type, wattage, etc.) and technical specifications match up with what is claimed in the tracking system. In addition to the supporting document review procedure, the verification effort will focus on confirming measure installation and operation through an online survey to a sample of program participants.

Table 2-2 below summarizes the data collection activities and corresponding impact evaluation research objectives.

Table 2-2: Impact Evaluation Data Collection Activities Summary

Data Collection Activity	Impact Evaluation Research Objectives
Program Tracking Data Review and Audit	Verify that the tracking data provides sufficient information to calculate energy and demand impacts
	Verify proper application of deemed savings estimates
	Audit data to insure there are no duplicate or erroneous entries
Online Participant Survey	Verify measure installation
	Assess customer purchasing and decision-making processes; estimate net-to-gross ratio
	Assess customer satisfaction with measures and overall program

Table 2-3 below summarizes the data collection activities and corresponding approach and proposed sample size.

[3] Accessible via: https://www.energystar.gov/products/certified-products/detail/set; Last accessed: July 2019

Table 2-3: Summary of Approaches and Data Collection

Measure	Sample Size
DI Kit Measures	70 participants for 90% confidence with ± 10% precision
Home Envelope and Weatherization Measures	Sample of participants for 90% confidence with ± 10% precision
Energy-Efficient HVAC Equipment	Sample of participants for 90% confidence with ± 10% precision
	Census of participating homes

2.2.2 Sampling Plan for the Impact Evaluation

Program data will be stratified by measure and service territory[4], as appropriate. Actual sample sizes will depend on the number of participants and types of measures installed. As a preliminary estimate, ADM anticipates the following sampling activities:

- A census review of all measures listed in the tracking system to ensure appropriate use of deemed savings values.
- A sample of participants for 90% confidence with ± 10% precision for the net-to-gross analysis, in-service rate calculations, and process evaluation.

For the calculation of sample size for survey completes, a coefficient of variation of 0.5[5] was assumed, as shown in the following formula:

Equation 2-1: Minimum Sample Size Formula for 90 Percent Confidence Level

$$n_0 = \left(\frac{Z * CV}{RP}\right)^2 = \left(\frac{1.645 * 0.5}{0.10}\right)^2 = 68$$

Where:

n_0 = minimum sample size

Z = Z-statistic value (1.645 for the 90% confidence level)

CV = Coefficient of Variation (assumed to be 0.5)

RP = Relative Precision (0.10)

[4] A separate sample of participants for 90% confidence with ± 10% precision for the net-to-gross analysis, in-service rate calculations, and process evaluation will be developed for the two Evergy service territories, Missouri West and Missouri Metro.

[5] The coefficient of variation, cv(y), is a measure of variation for the variable to be estimated. Its value depends on the mean and standard deviation of the distribution of values for the variable (i.e., cv(y) = sd(y)/mean(y)).

2.2.3 Estimating Gross Savings

Gross savings calculation methodologies are detailed in the following sections.

2.2.4 Direct Install Kit Measures

For LED light bulbs, faucet aerators, low flow showerheads, hot water pipe insulation, and advanced power strips, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to identify unique customers for surveying and to calculate energy savings and demand impacts. This will include an assessment of whether savings reported in the tracking system comply with savings values and guidelines from the Evergy TRM. Additionally, ADM will administer a participant survey collect supplementary information on variables such as home and household demographics to enable accurate savings calculations for each measure provided to customers in the DI kits.

2.2.4.1 *ENERGY STAR® LED Light Bulbs*

ADM will check LED model numbers listed in the program tracking data against ENERGY STAR® databases[6] to verify that each LED model distributed the DI kits was ENERGY STAR® certified. If installation location information data is not available through the program tracking data, ADM will use a participant survey to gather data on where DI kits bulbs were installed in residential homes to accurately establish hours of use and waste heat factors for program bulbs. In addition, measure in-service rates (ISR) will be determined from the participant survey.

ADM will analyze the savings from verified lighting measures using data for new/retrofitted fixtures on wattages before and after retrofit. Fixture wattages are generally taken from a table of standard wattages or cut sheets when feasible, with corrections made for non-operating fixtures. ADM will calculate energy savings and demand reductions using prescriptive algorithms from the Evergy TRM, Illinois Technical Reference Manual (IL TRM), and other relevant program sources, as necessary. If needed, ADM will adjust the baseline hours of use. Additionally, HVAC interactive effects will be accounted for using partially deemed algorithms from the Evergy TRM dependent upon heating and cooling systems serving areas where lighting systems are installed.

Savings algorithms for omni-directional LED bulbs were taken from the Evergy TRM. The equations used to calculate energy savings and demand reductions are shown in Equation 2-2 and Equation 2-3. The kWh savings and kW demand reductions from the installation of LED bulbs will be determined using Equation 2-2 through Equation 2-3 below:

[6] www.energystar.gov

Equation 2-2: kWh Energy Savings from LED Bulbs

$$\Delta kWh = \frac{W_{base} - W_{ee}}{1000} \times HOU \times WHF_e \times ISR$$

Equation 2-3: kW Peak Demand Reduction from LED Bulbs

$$\Delta kW = \frac{W_{base} - W_{ee}}{1000} \times CF \times WHF_d \times ISR$$

2.2.4.2 *Faucet Aerators*

This measure relates to the installation of a low flow faucet aerator in a household kitchen or bath faucet fixture. To qualify for this measure the installed equipment must be a low flow faucet aerator, for bathrooms rated at 1.5 gallons per minute (GPM) or less, or for kitchens rated at 2.2 GPM or less. Savings are calculated on an average savings per faucet fixture basis. The baseline condition is assumed to be a standard bathroom faucet aerator rated at 2.2 GPM or greater, or a standard kitchen faucet aerator rated at 2.2 GPM or greater. Average measured flow rates are used in the algorithm and are lower, reflecting the penetration of previously installed low flow fixtures (and therefore the free ridership rate for this measure will be 0), use of the faucet at less than full flow, debris buildup, and lower water system pressure than fixtures are rated at.

ADM will utilize savings algorithms found in the Evergy TRM for all faucet aerators (kitchen and bathroom) in the program. Final savings will be based on the number of faucet aerators per household, the number of faucet aerators retrofitted, and the type of water heating unit in the home. The kWh savings and kW demand reductions from the installation of faucet aerators will be determined using Equation 2-4 and Equation 2-5 below:

Equation 2-4: kWh Energy Savings for Faucet Aerators

$$\begin{aligned}\Delta\text{kWh} = {} & \%\text{ElectricDHW} \times ((\text{GPM\_base} \times \text{L\_base} \\ & - \text{GPM\_low} \times \text{L\_low}) \times \text{Household} \times 365.25 \times \text{DF} / \text{FPH}) \\ & \times \text{EPG\_electric} \times \text{ISR}\end{aligned}$$

Where:

%ElectricDHW = proportion of water heating supplied by electric resistance heating

GPM_base = Average flow rate, in gallons per minute, of the baseline faucet "as-used." This includes the effect of existing low flow fixtures and therefore the free ridership rate for this measure should be 0.

= Measured full throttle flow * 0.83 throttling factor[7]

GPM_low = Average flow rate, in gallons per minute, of the low-flow faucet aerator "as-used"

= Rated full throttle flow * 0.95 throttling factor[8]

L_base = Average baseline daily length faucet use per capita for faucet of interest in minutes

L_low = Average retrofit daily length faucet use per capita for faucet of interest in minutes

Household = Average number of people per household

DF = Drain Factor

FPH = Faucets Per Household

EPG_electric = Energy per gallon of water used by faucet supplied by electric water heater

= 0.0795 kWh/gal (Bath), 0.0969 kWh/gal (Kitchen), 0.0919 kWh/gal (Unknown)

WaterTemp = Assumed temperature of mixed water

= 86ºF for Bath, 93ºF for Kitchen, 91ºF for Unknown[9]

SupplyTemp = Assumed temperature of water entering house

= 54.1ºF[10]

RE_electric = Recovery efficiency of electric water heater

= 98%[11]

ISR = In service rate of faucet aerators dependent on install method

[7] 2008, Schultdt, Marc, and Debra Tachibana. Energy related Water Fixture Measurements: Securing the Baseline for Northwest Single-Family Homes. 2008 ACEEE Summer Study on Energy Efficiency in Buildings. Page 1-265. www.seattle.gov/light/Conserve/Reports/paper_10.pdf

[8] 2008, Schultdt, Marc, and Debra Tachibana. Energy related Water Fixture Measurements: Securing the Baseline for Northwest Single-Family Homes. 2008 ACEEE Summer Study on Energy Efficiency in Buildings. Page 1-265.

[9] Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum dated June 2013, directed to Michigan Evaluation Working Group. If the aerator location is unknown an average of 91% should be used which is based on the assumption that 70% of household water runs through the kitchen faucet and 30% through the bathroom (0.7*93) + (0.3*86) = 0.91.

[10] 2 US DOE Building America Program. Building America Analysis Spreadsheet. For Chicago, IL http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

[11] Electric water heaters have recovery efficiency of 98%. http://www.ahridirectory.org/ahridirectory/pages/home.aspx

= 0.95 (direct install – single family)[12]

Equation 2-5: kW Peak Demand Savings for Faucet Aerators

$$\Delta\text{kW} = \Delta\text{kWh} / \text{Hours} \times \text{CF}$$

Where:

ΔkWh = kWh savings from faucet aerators

Hours = Annual electric DHW recovery hours for faucet use per faucet

= ((GPM_base L_base) * Household/FPH * 365.25 * DF) * 0.545 / GPH

GPH = Gallons per hour recovery of electric water heater calculated for 70.9ºF temp rise (125-54.1), 98% recovery efficiency, and typical 4.5kW electric resistance storage tank

= 25.5

CF = Coincidence Factor for electric load reduction

= 0.022[13]

2.2.4.3 *Low Flow Showerheads*

This measure relates to the installation of a low flow showerhead in a single or multi-family household. To qualify for this measure, the installed equipment must be a low flow showerhead rated at least 0.5 gallons per minute (GPM) less than the existing showerhead. Savings are calculated on a per showerhead fixture basis. The baseline condition is assumed to be a standard showerhead rated at 2.0 GPM or greater. Average measured flow rates are used in the algorithm and are lower, reflecting the penetration of previously installed low flow fixtures (and therefore the free ridership rate for this measure will be 0), use of the shower at less than full flow, debris buildup, and lower water system pressure than fixtures are rated at.

[12] ComEd Energy Efficiency/ Demand Response Plan: Plan Year 2 (6/1/2009 - 5/31/2010) Evaluation Report: All Electric Single-Family Home Energy Performance Tune-Up Program Table 3-8.

[13] Calculated as follows: Assume 18% aerator use takes place during peak hours (based on: http://www.aquacraft.com/sites/default/files/pub/DeOreo-%282001%29-Disaggregated-Hot-Water-Use-in-Single-FamilyHomes-Using-Flow-Trace-Analysis.pdf) There are 65 days in the summer peak period, so the percentage of total annual aerator use in peak period is 0.18*65/365 = 3.21%. The number of hours of recovery during peak periods is therefore assumed to be 3.21% *180 = 5.8 hours of recovery during peak period where 180 equals the average annual electric DHW recovery hours for faucet use including SF and MF homes. There are 260 hours in the peak period so the probability you will see savings during the peak period is 5.8/260 = 0.022.

ADM will utilize savings algorithms found in the Evergy TRM all low flow showerheads in the program. Final savings will be based on the number of showerheads per household, the number of showerheads retrofitted, and the type of water heating unit in the home. The kWh savings and kW demand reductions from the installation of faucet aerators will be determined using Equation 2-6 and Equation 2-7 below:

Equation 2-6: kWh Energy Savings for Low Flow Showerheads

$$\Delta\text{kWh} = \%\text{ElectricDHW} \times ((\text{GPM\_base} \times \text{L\_base} - \text{GPM\_low} \times \text{L\_low}) \times \text{Household} \times \text{SPCD} \times 365.25 / \text{SPH}) \times \text{EPG\_electric} * \text{ISR}$$

Where:

%ElectricDHW = proportion of water heating supplied by electric resistance heating

GPM_base = Flow rate of the baseline showerhead

= 2.67[14]

GPM_low = As-used flow rate of the low-flow showerhead

L_base = Shower length in minutes with baseline showerhead

= 7.8 min[15]

L_low = Shower length in minutes with low-flow showerhead

= 7.8 min[16]

Household = Average number of people per household

SPCD = Showers Per Capita Per Day

= 0.6[17]

SPH = Showerheads per household so that per-showerhead savings fractions can be determined

EPG_electric = Energy per gallon of hot water supplied by electric

= 0.117 kWh/gal

ShowerTemp = Assumed temperature of water

[14] Based on measured data from Ameren IL EM&V of Direct-Install program. Program targets showers that are rated 2.5 GPM or above.

[15] Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum dated June 2013, directed to Michigan Evaluation Working Group. This study of 135 single and multi-family homes in Michigan metered energy parameters for efficient showerhead and faucet aerators.

[16] Ibid.

[17] Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum dated June 2013, directed to Michigan Evaluation Working Group.

= 101ºF[18]

SupplyTemp = Assumed temperature of water entering house

= 54.1ºF[19]

RE_electric = Recovery efficiency of electric water heater

= 98%[20]

ISR = In service rate of showerhead

Equation 2-7: kW Peak Demand Savings for Low Flow Showerheads

$$\Delta\text{kW} = \Delta\text{kWh}/\text{Hours} \times \text{CF}$$

Where:

ΔkWh = kWh savings from low flow showerheads

Hours = Annual electric DHW recovery hours for showerhead use

GPH = Gallons per hour recovery of electric water heater calculated for 65.9F temp rise (120-54.1), 98% recovery efficiency, and typical 4.5 kW electric resistance storage tank

= 27.51

CF = Coincidence Factor for electric load reduction

= 0.0278[21]

2.2.4.4 *Pipe Insulation*

This measure describes adding insulation to un-insulated domestic hot water pipes. The measure assumes the pipe wrap is installed to the first length of both the hot and cold pipe up to the first elbow. This is the most cost-effective section to insulate since the water

[18] Cadmus and Opinion Dynamics Showerhead and Faucet Aerator Meter Study Memorandum dated June 2013, directed to Michigan Evaluation Working Group.

[19] US DOE Building America Program. Building America Analysis Spreadsheet. For Chicago, IL http://www1.eere.energy.gov/buildings/building_america/analysis_spreadsheets.html

[20] Electric water heaters have recovery efficiency of 98%: http://www.ahridirectory.org/ahridirectory/pages/home.aspx

[21] Calculated as follows: Assume 11% showers take place during peak hours (based on: http://www.aquacraft.com/sites/default/files/pub/DeOreo-%282001%29-Disaggregated-Hot-Water-Use-in-Single-FamilyHomes-Using-Flow-Trace-Analysis.pdf). There are 65 days in the summer peak period, so the percentage of total annual aerator use in peak period is 0.11*65/365 = 1.96%. The number of hours of recovery during peak periods is therefore assumed to be 1.96% * 369 = 7.23 hours of recovery during peak period where 369 equals the average annual electric DHW recovery hours for showerhead use including SF and MF homes with Direct Install and Retrofit/TOS measures. There are 260 hours in the peak period so the probability you will see savings during the peak period is 7.23/260 = 0.0278.

pipes act as an extension of the hot water tank up to the first elbow which acts as a heat trap. Insulating this length therefore helps reduce standby losses. Default savings are provided per 3ft length and are appropriate up to 6ft of the hot water pipe and 3ft of the cold. The baseline is an un-insulated hot water pipe.

ADM will utilize savings algorithms found in the Evergy TRM for all pipe insulation in the program. Final savings will be based on the length of pipe that the pipe wrap insulation covers. The kWh savings and kW demand reductions from the installation of pipe insulation will be determined using Equation 2-8 and Equation 2-9 below:

Equation 2-8: kWh Energy Savings for Pipe Insulation

$$\Delta\text{kWh} = ((1/R_{\text{exist}} - 1/R_{new}) \times (\text{L} \times \text{C}) \times \Delta\text{T} \times 8{,}766)/\eta_{DHW}/3413$$

Where:

R_{exist} = Pipe heat loss coefficient of uninsulated pipe (existing) [(hr-°F-ft)/Btu]

= 1.0[22]

R_{new} = Pipe heat loss coefficient of insulated pipe (new) [(hr-°F-ft)/Btu]

= 1.0 + R value of insulation

L = Length of pipe from water heating source covered by pipe wrap (ft)

C = Circumference of pipe (ft) (Diameter (in) * π/12)

= 0.5” pipe = 0.131ft, 0.75” pipe = 0.196ft

ΔT = Average temperature difference between supplied water and outside air temperature (°F)

= 60°F[23]

η_{DHW} = Recovery efficiency of electric hot water heater

= 0.98[24]

Equation 2-9: kW Peak Demand Savings for Pipe Insulation

$$\Delta\text{kW} = \Delta\text{kWh}/8766$$

[22] Navigant Consulting Inc., April 2009; “Measures and Assumptions for Demand Side Management (DSM) Planning; Appendix C Substantiation Sheets”, p77.
[23] Assumes 125°F water leaving the hot water tank and average temperature of basement of 65°F.
[24] Electric water heaters have recovery efficiency of 98%: http://www.ahridirectory.org/ahridirectory/pages/home.aspx

Where:

ΔkWh = kWh savings from pipe wrap installation

2.2.4.5 *Advanced Power Strips*

This measure relates to Advanced Power Strips (Tier 1) which are multi-plug power strips with the ability to automatically disconnect specific connected loads depending upon the power draw of a control load, also plugged into the strip. Power is disconnected from the switched (controlled) outlets when the control load power draw is reduced below a certain adjustable threshold, thus turning off the appliances plugged into the switched outlets. By disconnecting, the standby load of the controlled devices, the overall load of a centralized group of equipment (i.e., entertainment centers and home office) can be reduced. Uncontrolled outlets are also provided that are not affected by the control device and so are always providing power to any device plugged into it. This measure characterization provides savings for a 7-plug strip. The assumed baseline is a standard power strip that does not control connected loads.

ADM will utilize savings algorithms found in the Evergy TRM for all advanced power strips in the program. The kWh savings and kW demand reductions from the installation of advanced power strips will be determined using Equation 2-10 and Equation 2-11 below:

Equation 2-10: kWh Energy Savings for Advanced Power Strips

$$\Delta\text{kWh}_{7-\text{Plug}} = 103\ \text{kWh}^{25}$$

Equation 2-11: kW Peak Demand Savings for Advanced Power Strips

$$\Delta\text{kW} = \Delta\text{kWh} / \text{Hours} \times \text{CF}$$

Where:

Hours = Annual number of hours during which the controlled standby loads are turned off by the Advanced power Strip

= 7,129[26]

CF = Summer Peak Coincidence Factor for measure

= 0.8[27]

$\Delta kW_{7\text{-Plug}}$ = 0.0115 kW

[25] Ibid.

[26] Average of hours for controlled TV and computer from; NYSERDA Measure Characterization for Advanced Power Strips.

[27] Efficiency Vermont coincidence factor for advanced power strip measure –in the absence of empirical evaluation data, this was based on assumptions of the typical run pattern for televisions and computers in homes.

2.2.5 Home Envelope and Weatherization Measures

For insulation and air sealing improvements, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy savings and demand impacts in addition to information that enables the identification of unique customers for surveying and visual verification visits[28]. This will include an assessment of whether savings reported in the tracking system comply with savings values and guidelines from the Evergy TRM. Additional field work completed at a sample of participant homes will provide visual verification of reported heat loss coefficients ("R values").[29]

2.2.5.1 *Air Sealing*

Thermal shell air leaks are sealed through strategic use and location of air-tight materials. Leaks are detected and leakage rates measured with the assistance of a blower-door test. The initial and final tested leakage rates are performed in such a manner that the identified reductions can be properly discerned, particularly in situations wherein multiple building envelope measures may be implemented simultaneously.

ADM will utilize savings algorithms found in the Evergy TRM for all air sealing in the program. The kWh savings and kW demand reductions from the air sealing will be determined using Equation 2-12 through Equation 2-14 below:

Equation 2-12: kWh Energy Savings for Air Sealing

$$\Delta\text{kWh} = \Delta\text{kWh\_cooling} + \Delta\text{kWh\_heating}$$

Where:

ΔkWh_cooling = If central cooling, reduction in annual cooling requirement due to air sealing

ΔkWh_heating = If electric heat (resistance or heat pump), reduction in annual electric heating due to air sealing OR

= If gas furnace heat, kWh savings for reduction in fan run time

[28] Visual verification visits may be conducted virtually for PY2020.

[29] In PY2020, field work and conducting blower test at a sample of participant homes may not be feasible amid safety measures intended to reduce the spread of COVID-19. ADM may conduct additional online participant surveys where deemed necessary to verify insulation and air sealing improvements.

Equation 2-13: kWh Savings for Reduction in Annual Cooling Requirement Due to Air Sealing

$$\Delta\text{kWh}_{\text{cooling}} = [(((\text{CFM50\_existing} - \text{CFM50\_new})/\text{N\_cool}) \times 60 \times 24 \times \text{CDD} \times \text{DUA} \times 0.018) / (1000 \times \eta_{\text{Cool}})] \times \text{LM}$$

Where:

CFM50_existing = Infiltration at 50 Pascals as measured by blower door before air sealing

CFM50_new = Infiltration at 50 Pascals as measured by blower door after air sealing

N_cool = Conversion factor from leakage at 50 Pascal to leakage at natural conditions

CDD = Cooling Degree Days

DUA = Discretionary Use Adjustment (reflects the fact that people do not always operate their air conditioner when conditions may call for it)

η_{Cool} = Efficiency (SEER) of air conditioning equipment (kBtu/kWh)

LM = Latent multiplier to account for latent cooling demand[30]

Equation 2-14: kWh Savings for Reduction in Annual Electric Heating Due to Air Sealing

$$\Delta\text{kWh}_{\text{heating}} = (((\text{CFM50\_existing} - \text{CFM50\_new})/\text{N\_heat}) \times 60 \times 24 \times \text{HDD} \times 0.018) / (\eta_{\text{Heat}} \times 3{,}412)$$

Where:

N_heat = Conversion factor from leakage at 50 Pascal to leakage at natural conditions

HDD = Heating Degree Days

η_{Heat} = Efficiency of heating system

Equation 2-15: kWh Savings for Reduction in Fan Run Time (Gas Furnace Heat) Due to Air Sealing

$$\Delta\text{kWh}_{\text{heating}} = \Delta\text{Therms} \times \text{Fe} \times 29.3$$

[30] Derived by calculating the sensible and total loads in each hour. For more information see Bruce Harley, CLEAResult "Infiltration Factor Calculations Methodology.doc".

Where:

F_e = Furnace fan energy consumption as a percentage of annual fuel consumption

= 3.14%[31]

Equation 2-16: kW Peak Demand Savings for Air Sealing

$$\Delta kW = (\Delta kWh\_cooling / FLH\_cooling) \times CF$$

Where:

FLH_cooling = Full load hours of air conditioning

CF_{SSP} = Summer System Peak Coincidence Factor for Central A/C (during system peak hour)

= 68%[32]

CF_{SSP} = Summer System Peak Coincidence Factor for Heat Pumps (during system peak hour)

= 72%[33]

CF_{PJM} = PJM Summer Peak Coincidence Factor for Central A/C (average during peak period)

= 46.6%[34]

2.2.5.2 *Ceiling/Attic Insulation*

Insulation is added to ceiling/attic. This measure requires a member of the implementation staff evaluating the pre- and post-R-values and measure surface areas. The existing condition will be evaluated by implementation staff and is likely to be little or no attic insulation.

[31] F_e is not one of the AHRI certified ratings provided for residential furnaces, but can be reasonably estimated from a calculation based on the certified values for fuel energy (Ef in MMBtu/yr) and Eae (kWh/yr). An average of a 300-record sample (non-random) out of 1495 was 3.14%. This is, appropriately, ~50% greater than the Energy Star version 3 criteria for 2% Fe. See "Programmable Thermostats Furnace Fan Analysis.xlsx" for reference.

[32] Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory.

[33] Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC's 2010 system peak; 'Impact and Process Evaluation of Ameren Illinois Company's Residential HVAC Program (PY5)'.

[34] Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

ADM will utilize savings algorithms found in the Evergy TRM for all wall and ceiling/attic insulation in the program. The kWh savings and kW demand reductions from the installation of ceiling/attic insulation will be determined using Equation 2-17 through Equation 2-20 below:

Equation 2-17: kWh Energy Savings for Ceiling/Attic Insulation

$$\Delta\text{kWh} = \Delta\text{kWh\_cooling} + \Delta\text{kWh\_heating}$$

Where:

ΔkWh_cooling = If central cooling, reduction in annual cooling requirement due to insulation

ΔkWh_heating = If electric heat (resistance or heat pump), reduction in annual electric heating due to insulation

= If gas furnace heat, kWh savings for reduction in fan run time

Equation 2-18: kWh Savings for Reduction in Annual Cooling Requirement Due to Ceiling/Attic Insulation

$$\Delta\text{kWh}_{\text{cooling}} = ((((1/\text{R\_old} - 1/\text{R\_wall}) \times \text{A\_wall} \times (1 - \text{Framing\_factor\_wall}) + (1/\text{R\_old} - 1/\text{R\_attic}) \times \text{A\_attic} \times (1 - \text{Framing\_factor\_attic})) \times 24 \times \text{CDD} \times \text{DUA}) / (1000 \times \eta\text{Cool})) \times \text{ADJ}_{\text{WallAtticCool}}$$

Where:

R_wall = R-value of new wall assembly (including all layers between inside air and outside air)

R_attic = R-value of new attic assembly (including all layers between inside air and outside air)

R_old = R-value value of existing assemble and any existing insulation (Minimum of R-5 for uninsulated assemblies[35])

A_wall = Net area of insulated wall (ft^2)

A_attic = Total area of insulated ceiling/attic (ft^2)

Framing_factor_wall = Adjustment to account for area of framing

= 25%[36]

[35] An estimate based on review of Madison Gas and Electric, Exterior Wall Insulation, R-value for no insulation in walls, and NREL's Building Energy Simulation Test for Existing Homes (BESTEST-EX).

[36] ASHRAE, 2001, "Characterization of Framing Factors for New Low-Rise Residential Building Envelopes (904-RP)," Table 7.1

Framing_factor_attic = Adjustment to account for area of framing

= 7%[37]

CDD = Cooling Degree Days

DUA = Discretionary Use Adjustment (reflects the fact that people do not always operate their air conditioner when conditions may call for it)

= 0.75[38]

ηCool = Seasonal Energy Efficiency Ratio of cooling system (kBtu/kWh)

$ADJ_{WallAtticCool}$ = Adjustment for cooling savings from basement wall insulation to account for prescriptive engineering algorithms overclaiming savings[39]

= 80%

Equation 2-19: kWh Savings for Reduction in Annual Electric Heating (Resistance or Heat Pump) Due to Ceiling/Attic Insulation

$$\Delta kWh_{heating} = ((((1/R\_old - 1/R\_wall) \times A\_wall \times (1 - Framing\_factor\_wall)) + (1/R\_old - 1/R\_attic) \times A\_attic \times (1 - Framing\_factor\_attic)) \times 24 \times HDD] / (\eta Heat \times 3412)) \times ADJ_{WallAtticHeat}$$

Where:

HDD = Heating Degree Days

ηHeat = Efficiency of heating system

$ADJ_{WallAtticHeat}$ = Adjustment for wall and attic insulation to account for prescriptive engineering algorithms overclaiming savings[40]

= 60%

Equation 2-20: kWh Savings for Reduction in Fan Run Time (Gas Furnace Heat) Due to Ceiling/Attic Insulation

$$\Delta kWh_{heating} = \Delta Therms \times Fe \times 29.3$$

[37] Ibid.

[38] This factor's source is: Energy Center of Wisconsin, May 2008 metering study; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research", p31.

[39] As demonstrated in two years of metering evaluation by Opinion Dynamics, see Memo "Results for AIC PY6 HPwES Billing Analysis", dated February 20, 2015. TAC negotiated adjustment factor is 80%.

[40] As demonstrated in two years of metering evaluation by Opinion Dynamics, see Memo "Results for AIC PY6 HPwES Billing Analysis", dated February 20, 2015. TAC negotiated adjustment factor is 60%

Where:

F_e = Furnace fan energy consumption as a percentage of annual fuel consumption

= 3.14%[41]

Equation 2-21: kW Peak Demand Savings for Ceiling/Attic Insulation

$$\Delta kW = (\Delta kWh\_cooling / FLH\_cooling) \times CF$$

Where:

FLH_cooling = Full load hours of air conditioning

CF_{SSP} = Summer System Peak Coincidence Factor for Central A/C (during system peak hour)

= 68%[42]

CF_{SSP} = Summer System Peak Coincidence Factor for Heat Pumps (during system peak hour)

= 72%[43]

CF_{PJM} = PJM Summer Peak Coincidence Factor for Central A/C (average during peak period)

= 46.6%[44]

2.2.6 Energy-Efficient HVAC Equipment

ADM's desk review of all rebated HVAC equipment upgrades will confirm that all models meet efficiency standards prescribed by the program criteria.[45] In addition, the desk review will verify that program data includes adequate information to calculate energy savings and demand impacts, as well as information that enables the identification of

[41] F_e is not one of the AHRI certified ratings provided for residential furnaces but can be reasonably estimated from a calculation based on the certified values for fuel energy (Ef in MMBtu/yr) and Eae (kWh/yr). An average of a 300-record sample (non-random) out of 1495 was 3.14%. This is, appropriately, ~50% greater than the Energy Star version 3 criteria for 2% Fe. See "Programmable Thermostats Furnace Fan Analysis.xlsx" for reference.

[42] Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory.

[43] Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC's 2010 system peak; 'Impact and Process Evaluation of Ameren Illinois Company's Residential HVAC Program (PY5)'.

[44] Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

[45] https://www.evergy.com/-/media/documents/ways-to-save/rebates/rebate-incentive-chart.pdf?la=en

unique customers for surveying. Savings will be determined per HVAC measure, following the Evergy TRM.

ADM will rely on the Evergy TRM for all energy-efficient HVAC measures with savings algorithms defined in IL TRM, Vol3, v7. Calculations will be based on if the HVAC unit was defined as time of sale or early replacement. Time of sale units relate to the replacement of an existing unit at the end of its useful life, or the installation of a new heating and cooling system in a new home. Early replacements units relate to the early removal of functioning heating and cooling systems from service, prior to its natural end of life, and replacement with a new HVAC unit. Participant surveys will be used to gather data from rebate recipients to confirm installation of rebated measures.

2.2.6.1 *Central Air Conditioner*

This measure characterizes time of sale and early replacement central air conditioners following the Evergy TRM. ADM will utilize savings algorithms found in the Evergy TRM for all central air conditioners in the program. The kWh savings and kW demand reductions from the installation of central air conditioners will be determined using Equation 2-22 through Equation 2-25 below:

Equation 2-22: kWh Energy Savings for Central Air Conditioners (Time of Sale)

$$\Delta\text{kWH} = (\text{FLHcool} \times \text{Capacity} \times (1/(\text{SEER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff}))))/1000$$

Equation 2-23: kWh Energy Savings for Central Air Conditioners (Early Replacement)

$$\Delta\text{kWH for remaining life of existing unit (first 6 years)} = (\text{FLHcool} \times \text{Capacity} \times (1/(\text{SEER}_{exist} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff}))))/1000$$

$$\Delta\text{kWH for remaining measure life (next 12 years)} = (\text{FLHcool} \times \text{Capacity} \times (1/(\text{SEER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff}))))/1000$$

Where:

FLHcool = Full load cooling hours

Capacity = Size of new equipment in Btu/hr (note 1 ton = 12,000Btu/hr)

$SEER_{base}$ = Seasonal energy-efficiency ratio of baseline unit (kBtu/kWh)

= 13[46]

$SEER_{exist}$ = Seasonal energy-efficiency ratio of existing unit (kBtu/kWh)

$SEER_{ee}$ = Rated seasonal energy-efficiency ratio of ENERGY STAR® unit (kBtu/kWh)

$SEER_{adj}$ = Adjustment percentage to account for in-situ performance of the unit

$= [0.805 \times \left(\frac{EER_{ee}}{SEER_{ee}}\right) + 0.367]$

$DeratingCool_{Eff}$ = Efficient central air conditioner cooling derating

= 0% if Quality Installation is performed

= 10% if Quality Installation is not performed or unknown[47]

$DeratingCool_{Base}$ = Baseline central air conditioner cooling derating

= 10%

Equation 2-24: kW Peak Demand Savings for Central Air Conditioners (Time of Sale)

$$\Delta\text{kW} = (\text{Capacity} \times (1/(\text{EER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{EER}_{ee} \times (1 - \text{DeratingCool}_{Eff})))/1000 \times \text{CF}$$

Equation 2-25: kW Peak Demand Savings for Central Air Conditioners (Early Replacement)

$$\Delta\text{kW for remaining life of existing unit (first 6 years)} = (\text{Capacity} \times (1/(\text{EER}_{exist} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{EER}_{ee} \times (1 - \text{DeratingCool}_{Eff})))/1000 \times \text{CF}$$

$$\Delta\text{kW for remaining measure life (next 12 years)} = (\text{Capacity} \times (1/(\text{EER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{EER}_{ee} \times (1 - \text{DeratingCool}_{Eff})))/1000 \times \text{CF}$$

[46] Based on Minimum Federal Standard.

[47] Based on Cadmus assumption provided in preparation of the 2014 Interstate Power and Light TRM based upon proper refrigerant charge, evaporator airflow, and unit sizing, Appears conservative in comparison to ENERGY STAR statements (see 'Sponsoring an ENERGY STAR Verified HVAC Installation (ESVI) Program'). Note pending ComEd evaluation will provide an update to these assumptions.

Where:

EER_{base} = EER Efficiency of baseline unit

= 10.5[48]

EER_{exist} = EER Efficiency of existing unit

EER_{ee} = EER Efficiency of ENERGY STAR unit

CF_{SSP} = Summer System Peak Coincidence Factor for Central A/Cs (during system peak hour)

= 68%[49]

CF_{PJM} = PJM Summer Peak Coincidence Factor for Central A/Cs (average during peak period)

= 46.6%[50]

Other variables as defined above.

2.2.6.2 *Air Source Heat Pump*

This measure characterizes time of sale and early replacement air source heat pumps following the Evergy TRM. ADM will utilize savings algorithms found in the Evergy TRM for all air source heat pumps in the program. The kWh savings and kW demand reductions from the installation of air source heat pumps will be determined using Equation 2-26 through Equation 2-29 below:

Equation 2-26: kWh Energy Savings for Air Source Heat Pumps (Time of Sale)

$$\Delta\text{kWh} = ((\text{FLH\_cooling} \times \text{Capacity\_cooling} \times (1/(\text{SEER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff})))) / 1000) + ((\text{FLH\_heat} \times \text{Capacity\_heating} \times (1/(\text{HSPF}_{base} \times (1 - \text{DeratingHeat}_{Base})) - 1/(\text{HSPF}_{ee} \times \text{HSPF}_{adj} \times (1 - \text{DeratingHeat}_{Eff})))) / 1000)$$

[48] The federal Standard does not currently include an EER component. The value provided is based on Opinion Dynamics and Cadmus metering study of Ameren HVAC program participants; See 'AIC HVAC Metering Study Memo FINAL 2_28_2018'.

[49] Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory.

[50] Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

Equation 2-27: kWh Energy Savings for Air Source Heat Pumps (Early Replacement)

$$\Delta\text{kWH for remaining life of existing unit (first 6 years)} = ((\text{FLH\_cooling} \times \text{Capacity\_cooling} \times (1/(\text{SEER}_{exist} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff})))) / 1000) + ((\text{FLH\_heat} \times \text{Capacity\_heating} \times (1/(\text{HSPF}_{exist} \times (1 - \text{DeratingHeat}_{Base})) - 1/(\text{HSPF}_{ee} \times \text{HSPF}_{adj} \times (1 - \text{DeratingHeat}_{Eff})))) / 1000)$$

$$\Delta\text{kWH for remaining measure life (next 12 years)} = ((\text{FLH\_cooling} \times \text{Capacity\_cooling} \times (1/(\text{SEER}_{base} \times (1 - \text{DeratingCool}_{Base})) - 1/(\text{SEER}_{ee} \times \text{SEER}_{adj} \times (1 - \text{DeratingCool}_{Eff})))) / 1000) + ((\text{FLH\_heat} \times \text{Capacity\_heating} \times (1/(\text{HSPF}_{base} \times (1 - \text{DeratingHeat}_{Base})) - 1/(\text{HSPF}_{ee} \times \text{HSPF}_{adj} \times (1 - \text{DeratingHeat}_{Eff})))) / 1000)$$

Where:

FLH_cooling = Full load hours of air conditioning

Capacity_cooling = Cooling Capacity of Air Source Heat Pump (Btu/hr)

$SEER_{exist}$ = Seasonal Energy Efficiency Ratio of existing cooling system (kBtu/kWh)

$SEER_{base}$ = Seasonal Energy Efficiency Ratio of baseline Air Source Heat Pump (kBtu/kWh)

= 14[51]

$SEER_{ee}$ = Rated Seasonal Energy Efficiency Ratio of ENERGY STAR unit (kBtu/kWh)

$SEER_{adj}$ = Adjustment percentage to account for in-situ performance of the unit[52]

$= [0.805 \times \left(\frac{EER_{ee}}{SEER_{ee}}\right) + 0.367]$

$DeratingCool_{Eff}$ = Efficient air source heat pump cooling derating

= 0% if Quality Installation is performed

= 10% if Quality Installation is not performed or unknown[53]

[51] Based on Minimum Federal Standard effective 1/1/2015.

[52] In situ performance based on Opinion Dynamics and Cadmus metering study of Ameren HVAC program participants; See 'AIC HVAC Metering Study Memo FINAL 2_28_2018'.

[53] Based on Cadmus assumption provided in preparation of the 2014 Interstate Power and Light TRM based upon proper refrigerant charge, evaporator airflow, and unit sizing, Appears conservative in comparison to ENERGY STAR statements (see 'Sponsoring an ENERGY STAR Verified HVAC Installation (ESVI) Program'). Note pending ComEd evaluation will provide an update to these assumptions.

$DeratingCool_{Base}$ = Baseline Cooling derating

= 10%

FLH_heat = Full load hours of heating

Equation 2-28: kW Peak Demand Savings for Air Source Heat Pumps (Time of Sale)

$$\Delta kW = (Capacity\_cooling \times (1/(EER_{base} \times (1 - DeratingCool_{Base})) - 1/(EER_{ee} \times (1 - DeratingCool_{Eff})))) / 1000 \times CF$$

Equation 2-29: kW Peak Demand Savings for Air Source Heat Pumps (Early Replacement)

$$\Delta kW \text{ for remaining life of existing unit (first 6 years)} = (Capacity\_cooling \times (1/(EER_{exist} \times (1 - DeratingCool_{Base})) - 1/(EER_{ee} \times (1 - DeratingCool_{Eff})))) / 1000 \times CF$$

$$\Delta kW \text{ for remaining measure life (next 12 years)} = (Capacity\_cooling \times (1/(EER_{base} \times (1 - DeratingCool_{Base})) - 1/(EER_{ee} \times (1 - DeratingCool_{Eff})))) / 1000 \times CF$$

Where:

EER_{exist} = Energy Efficiency Ratio of existing cooling system (kBtu/hr / kW)

EER_{base} = Energy Efficiency Ratio of baseline air source heat pump (kBtu/hr / kW)

= 11[54]

EER_{ee} = Energy Efficiency Ratio of efficient air source heat pump (kBtu/hr / kW)

CF_{SSP} = Summer System Peak Coincidence Factor for heat pumps (during system peak hour)

= 72%[55]

CFP_{JM} = PJM Summer Peak Coincidence Factor for heat pumps (average during peak period)

[54] The Federal Standard does not include an EER requirement. The value provided is based on Opinion Dynamics and Cadmus metering study of Ameren HVAC program participants; See 'AIC HVAC Metering Study Memo FINAL 2_28_2018'.

[55] Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC's 2010 system peak; 'Impact and Process Evaluation of Ameren Illinois Company's Residential HVAC Program (PY5)'

= 46.6%[56]

Other variables as defined above.

2.2.6.3 *Ground Source Heat Pump*

This measure characterizes time of sale and early replacement ground source heat pumps (non-fuel switch) following the Evergy TRM. ADM will utilize savings algorithms found in the Evergy TRM for all ground source heat pumps in the program. The kWh savings and kW demand reductions from the installation of ground source heat pumps will be determined using Equation 2-30 through Equation 2-33 below:

Equation 2-30: kWh Energy Savings for Ground Source Heat Pumps (Time of Sale)

$$\Delta\text{kWh} = [\text{FLH}_{\text{cool}} \times \text{Capacity\_cooling} \times (1/\text{SEER}_{base} - 1/\text{EER}_{PL})/1000] + [\text{FLHheat} \times \text{Capacity\_heating} \times (1/\text{HSPF}_{ASHP} - 1/(\text{COP}_{PL} \times 3.412))/1000] + [\text{ElecDHW} \times \%\text{DHWDisplaced} \times ((1/\text{EF}_{ELEC} \times \text{GPD} \times \text{Household} \times 365.25 \times \gamma\text{Water} \times (\text{T}_{OUT} - \text{T}_{IN}) \times 1.0) / 3412)]$$

Equation 2-31: kWh Energy Savings for Ground Source Heat Pumps (Early Replacement)

$$\Delta\text{kWH for remaining life of existing unit (first 8 years)} = [\text{FLHcool} \times \text{Capacity\_cooling} \times (1/\text{SEER}_{exist} - 1/\text{EER}_{PL})/1000] + [\text{ElecHeat} \times \text{FLHheat} \times \text{Capacity\_heating} \times (1/\text{HSPF}_{exist} - 1/(\text{COP}_{PL} \times 3.412))/1000] + [\text{ElecDHW} \times \%\text{DHWDisplaced} \times ((1/\text{EF}_{ELEC} \times \text{GPD} \times \text{Household} \times 365.25 \times \gamma\text{Water} \times (\text{T}_{OUT} - \text{T}_{IN}) \times 1.0) / 3412)]$$

$$\Delta\text{kWH for remaining measure life (next 17 years)} = [\text{FLHcool} \times \text{Capacity\_cooling} \times (1/\text{SEER}_{base} - 1/\text{EER}_{PL})/1000] + [\text{ElecHeat} \times \text{FLHheat} \times \text{Capacity\_heating} \times (1/\text{HSPF}_{base} - (1/(\text{COP}_{PL} \times 3.412))/1000] + [\text{ElecDHW} * \%\text{DHWDisplaced} \times ((1/\text{EF}_{ELEC} \times \text{GPD} \times \text{Household} \times 365.25 \times \gamma\text{Water} \times (\text{T}_{OUT} - \text{T}_{IN}) \times 1.0) / 3412)]$$

Where:

FLH_{cool} = Full load cooling hours

Capacity_cooling = Cooling Capacity of ground source heat pump (Btu/hr)

$\text{SEER}_{\text{base}}$ = SEER Efficiency of new replacement baseline unit

$\text{SEER}_{\text{exist}}$ = SEER Efficiency of existing cooling unit

[56] 1 Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

EER_{PL}	= Part Load EER Efficiency of efficient ground source heat pump unit[57]
ElecHeat	= 1 if existing building is electrically heated
	= 0 if existing building is not electrically heated
FLHheat	= Full load heating hours
Capacity_heating	= Heating Capacity of ground source heat pump (Btu/hr)
$HSPF_{base}$	= Heating System Performance Factor of new replacement baseline heating system (kBtu/kWh)
$HSPF_{exist}$	= Heating System Performance Factor of existing heating system (kBtu/kWh)
COPPL	= Part Load Coefficient of Performance of efficient unit[58]
ElecDHW	= 1 if existing DHW is electrically heated
	= 0 if existing DHW is not electrically heated
%DHWDisplaced	= Percentage of total DHW load that the ground source heat pump will provide
EF_{ELEC}	= Energy Factor (efficiency) of electric water heater
GPD	= Gallons Per Day of hot water use per person
Household	= Average number of people per household
γWater	= Specific weight of water
T_{OUT}	= Tank temperature
	= 125°F
T_{IN}	= Incoming water temperature from well or municipal system
	= 54°F[59]

Equation 2-32: kW Peak Demand Savings for Ground Source Heat Pumps (Time of Sale)

$$\Delta\text{kW} = (\text{Capacity\_cooling} \times (1/\text{EER}_{base} - 1/\text{EER}_{FL}))/1000 \times \text{CF}$$

[57] As per conversations with David Buss territory manager for Connor Co, the SEER and COP ratings of an ASHP equate most appropriately with the part load EER and COP of a ground source heat pump.
[58] As per conversations with David Buss territory manager for Connor Co, the SEER and COP ratings of an ASHP equate most appropriately with the part load EER and COP of a ground source heat pump.
[59] US DOE Building America Program. Building America Analysis Spreadsheet.

Equation 2-33: kW Peak Demand Savings for Ground Source Heat Pumps (Early Replacement)

$$\Delta\text{kW for remaining life of existing unit (first 8 years)} = (\text{Capacity\_cooling} \times (1/\text{EER}_{exist} - 1/\text{EER}_{FL}))/1000 \times \text{CF}$$

$$\Delta\text{kW for remaining measure life (next 17 years)} = (\text{Capacity\_cooling} \times (1/\text{EER}_{base} - 1/\text{EER}_{FL}))/1000 \times \text{CF}$$

Where:

EER_{base} = Energy Efficiency Ratio of new replacement baseline unit

EER_{exist} = Energy Efficiency Ratio of existing cooling unit (kBtu/hr / kW)

EER_{FL} = Full Load Energy Efficiency Ratio of ENERGY STAR ground source heat pump unit[60]

CF_{SSP} = Summer System Peak Coincidence Factor for heat pumps (during system peak hour)

= 72%[61]

CF_{PJM} = PJM Summer Peak Coincidence Factor for heat pumps (average during peak period)

= 46.6%[62]

Other variables as defined above.

2.2.6.4 *Ductless Mini-Split Heat Pump*

This measure characterizes time of sale and early replacement ductless mini-split heat pumps (non-fuel switch) following the Evergy TRM. ADM will utilize savings algorithms found in the Evergy TRM for all ductless mini-split heat pumps in the program. The kWh savings and kW demand reductions from the installation of ground source heat pumps will be determined using Equation 2-34 through Equation 2-37 below:

[60] As per conversations with David Buss territory manager for Connor Co, the EER rating of an air source heat pump equate most appropriately with the full load EER of a ground source heat pump unit.

[61] Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC's 2010 system peak; 'Impact and Process Evaluation of Ameren Illinois Company's Residential HVAC Program (PY5)'.

[62] Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

Equation 2-34: kWh Energy Savings for Ductless Mini-Spilt Heat Pumps (Time of Sale)

$$\Delta\text{kWh} = [(\text{Elecheat} \times \text{Capacity}_{heat} \times \text{EFLH}_{heat} \times (1/\text{HSPF}_{Base} - 1/\text{HSPF}_{ee})) / 1000] + [(\text{Capacity}_{cool} \times \text{EFLH}_{cool} \times (1/\text{SEER}_{Base} - 1/\text{SEER}_{ee})) / 1000]$$

Equation 2-35: kWh Energy Savings for Ductless Mini-Spilt Heat Pumps (Early Replacement)

$$\Delta\text{kWH for remaining life of existing unit (first 6 years)} = [(\text{ElecHeat} \times \text{Capacity}_{heat} \times \text{EFLH}_{heat} \times (1/\text{HSPF}_{exist} - 1/\text{HSPF}_{ee})) / 1000] + [(\text{Capacity}_{cool} \times \text{EFLH}_{cool} \times (1/\text{SEER}_{exist} - 1/\text{SEER}_{ee})) / 1000]$$

$$\Delta\text{kWH for remaining measure life (next 12 years)} = [(\text{ElecHeat} \times \text{Capacity}_{heat} \times \text{EFLH}_{heat} \times (1/\text{HSPF}_{base} - 1/\text{HSPF}_{ee})) / 1000] + [(\text{Capacity}_{cool} \times \text{EFLH}_{cool} \times (1/\text{SEER}_{base} - 1/\text{SEER}_{ee})) / 1000]$$

Where:

ElecHeat	= 1 if existing building is electrically heated
	= 0 if existing building is not electrically heated
Capacity_{heat}	= Heating capacity of the ductless heat pump unit in Btu/hr
EFLH_{heat}	= Equivalent Full Load Hours for heating
HSPF_{base}	= Heating System Performance Factor of new replacement baseline heating system (kBtu/kWh)
HSPF_{exist}	= HSPF rating of existing equipment (kbtu/kwh)
HSPF_{ee}	= HSPF rating of new equipment (kbtu/kwh)
Capacity_{cool}	= the cooling capacity of the ductless heat pump unit in Btu/hr
SEER_{base}	= SEER rating of new replacement baseline unit
SEER_{ee}	= SEER rating of new equipment (kbtu/kwh)
SEER_{exist}	= SEER rating of existing equipment (kbtu/kwh)
EFLH_{cool}	= Equivalent Full Load Hours for cooling

Equation 2-36: kW Peak Demand Savings for Ductless Mini-Split Heat Pumps (Time of Sale)

$$\Delta\text{kW} = (\text{Capacitycool} \times (1/\text{EERbase} - 1/\text{EERee})) / 1000) \times \text{CF}$$

Equation 2-37: kW Peak Demand Savings for Ductless Mini-Split Heat Pumps (Early Replacement)

$$\Delta\text{kW for remaining life of existing unit (first 6 years)} = (\text{Capacitycool} \times (1/\text{EER}_{exist} - 1/\text{EER}_{ee})) / 1000) \times \text{CF}$$

$$\Delta\text{kW for remaining measure life (next 12 years)} = (\text{Capacitycool} * (1/\text{EER}_{base} - 1/\text{EER}_{ee})) / 1000) \times \text{CF}$$

Where:

EER_{base} = Energy Efficiency Ratio of new replacement unit

EER_{exist} = Energy Efficiency Ratio of existing cooling system (kBtu/hr/kW)

EER_{ee} = Energy Efficiency Ratio of new ductless mini-split heat pumps (kBtu/hr/kW)

CF_{SSP} = Summer System Peak Coincidence Factor for heat pumps (during utility peak hour)

CF_{PJM} = PJM Summer Peak Coincidence Factor for heat pumps (average during PJM peak period)

2.2.7 Estimating Net Savings

2.2.7.1 *Net-to-Gross Ratio*

Program implementation is designed to minimize free-ridership and maximize net-to-gross ratios, while ensuring the program does the following: appropriately influences customer decisions, accurately tracks, and verifies equipment and its installation, and drives market transformation.

ADM will use the self-reported data collected as part of the participant and trade ally surveys, to assess free ridership (as detailed in Section 2.2.7.2). A separate free ridership estimate will be developed for each category of measures identified in Sections 2.2.4.1 through Section 2.2.6.4, above. ADM will assess spillover at the sector level as described in Section 2.2.7.3, below. A portion of the total sector-level spillover will be allocated to this program based on the proportion of sector-level gross savings that the program makes up.

Self-report approaches will be used for both free ridership and spillover assessment. Self-report free ridership assessment primarily relies upon responses from program participants but will also incorporate input from the trade allies. Program participants will be identified from the tracking data.

2.2.7.2 *Free Ridership*

The free ridership self-report uses participant and trade ally surveys to develop an estimate of savings that would have occurred absent the program. In ADM's approach, data is collected on contextual factors that influence customers' decisions in addition to customers' perceptions of program influence to estimate free ridership. Customers will be asked questions about the circumstances around the decision to implement measure. The surveys will focus on factors that limit energy efficiency investments that the program may directly address. For example,

Would the customer have been financially able to install the measure or allocated the money for the efficiency improvement without the program incentive?

Did the customer already have plans to install the equipment before learning of the program or is the program effectively reaching customers who would otherwise not be engaged in making the efficiency improvement?

Did the customer have previous experience with similar efficiency measures that demonstrate a familiarity with them? Were they aware that they could save on energy costs before exposure to program informational supports such as energy audits?

The participant survey will also include questions that directly ask customers to estimate the influence of the program and/or their likelihood of taking the same action if the program was not available. The responses to the questions about the decision-making context provide more information to help make decisions about program design and implementation than responses to rating scale questions.

For some projects, there may be program influences that are not directly observable by program participants. In such cases the participant's response creates an incomplete picture of the program's influence. For example, a contractor's recommendation may have influenced a customer's decision and that contractor's recommendation may have in turn been influenced by the program. In these cases, we propose enhanced self-report methodologies that incorporate self-reports from other market actors in addition to participant self-reports.

Survey respondents will be asked a series of questions to elicit feedback regarding influences on their decision to participate in the program. Each respondent will then be assigned a free ridership score based on a consistent free ridership scoring algorithm. The Fast Feedback participant survey, trade ally survey, and a flow chart showing the free ridership scoring algorithm from the survey will be provided in a separate appendix.

2.2.7.3 *Participant and Non-Participant Spillover*

Spillover refers to energy-saving purchases or actions that result from program influence but did not receive direct program support, such as incentives. This can occur both with

participants and non-participants. Among participants, the program influence typically is understood to be the program participation itself. Among non-participants, the program influence could result from program marketing or outreach, including engagement with program representatives or trade allies.

Spillover is assessed by asking survey respondents (participants and non-participants) if they have implemented any efficient equipment in the service territory without receiving a program incentive. Respondents that indicate that they did implement such equipment are asked a series of follow-up questions to facilitate estimation of the energy savings associated with the equipment and to assess the program's influence on the equipment implementation.

There are at least two reasons why the above method may result in the underestimation of spillover. First, even if program participation influenced a participant to implement additional equipment, that additional implementation may occur weeks or months after the program participation. Therefore, participants who are surveyed relatively soon after program participation may not report spillover although they may be responsible for some later within that program year. It is easy to see that this is likely to minimize spillover that is assessed through a Fast Feedback approach. Second, asking respondents to rate program influence assumes that the influence is direct and observable by the respondent. In fact, program influence on both participants and especially non-participants may be indirect, via the distributors and contractors who work with the customers.

To address the above concerns, an innovative approach will be used that uses both customer (participant and non-participant) and trade ally (distributors and contractors) feedback to assess the program's indirect influence on identified energy-efficiency upgrades. The approach asks customers to assess the influence of the program and the influence of trade allies on their un-incented purchases and asks trade allies to assess the influence of the program on their efforts to sell program-qualifying equipment. The program indirect influence is the product of the program influence on trade allies and the trade ally influence on customers. This approach uses trade ally survey data to estimate the quantity of un-incented equipment installed. Therefore, it does not suffer from the under-estimation that may come from relying on participant reports occurring shortly after program participation.

3. Energy Saving Products

3.1 Description of Energy Saving Products

The Energy Saving Products (ESP) program focuses on promoting, cultivating, and facilitating the adoption of energy efficient products in residential settings. To do this, the program has been designed with two key focuses:

- *Education* – the expansion of both residential customer and sales associate knowledge of and familiarity with the advantages of various energy efficient products available; and
- *Efficient Product Adoption* – market transformation that results from increased awareness of the benefits of energy efficient technology and is supported through financial, point-of-sale incentives for the purchase of products that meet high efficiency standards.

Through the ESP program, customers can receive instant discounts for a variety of efficient measures. Only LED lights will be discounted during PY2020. In PY2021 and PY2022, the program may be expanded to include room air conditioners, advanced power strips, smart thermostats, or other energy efficient measures.

3.1.1 Energy and Demand Savings Targets

Program energy and demand impact targets for program years 2020-2022, as specified in KCP&L filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233, are shown in Table 3-1.

Table 3-1: Program Net Savings Targets by Year

Program Year	Evergy Missouri Metro		Evergy Missouri West		Program Overall	
	Energy Savings (kWh)	Peak Demand Reductions (kW)	Energy Savings (kWh)	Peak Demand Reductions (kW)	Energy Savings (kWh)	Peak Demand Reductions (kW)
2020	12,153,179	889	13,038,632	955	25,191,811	1,844
2021	9,722,590	725	10,416,978	756	20,139,568	1,481
2022	7,555,117	558	8,079,124	582	15,634,241	1,140
Total	**29,430,886**	**2,172**	**31,534,734**	**2,293**	**60,965,620**	**4,465**

3.2 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform to assess Evergy's ESP program in MEEIA Cycle III.

3.2.1 Data Collection and Measure Verification

Data used for this evaluation will include:

- Program tracking data from the main tracking database, as outlined in Table 3-2
- Program applications and supporting documentation, including itemized retailer invoices, product agreements, and discount amounts per measure.
- General population survey data from a sample of 5,000 Evergy customers (stratified by service territory), obtained via an online survey.
- Geospatial map (shapefile) of Evergy Missouri West and Evergy Missouri Metro service territories.
- Data from relevant secondary sources, such as the ENERGY STAR® database of certified products.[63]

As a first step, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy and demand impacts. The data review will include an assessment of whether savings reported in the tracking system comply with deemed savings values and guidelines set by the Evergy Technical Reference Manual.

The desk review will consist of reviewing a census of retailer invoices to ensure the total quantity and product types for all measures with upstream discounts match what is reported in the program tracking system. ADM will also review rebated model numbers using the ENERGY STAR® database to ensure that key variables such as the bulb characteristics (type, wattage, etc.) and technical specifications match up with what is claimed in the tracking system. In addition to the desk review procedure, the verification effort will focus on confirming measure installation and operation through an email survey to a sample of Evergy customers. A random sample of customers will be invited to participate in the survey and a screening process will be used to identify customers who purchased and installed qualifying products spanning each program year.

Table 3-2 below summarizes the data collection activities and corresponding impact evaluation research objectives.

[63] Accessible via https://www.energystar.gov/products/certified-products/detail/set. Accessed: September 2020.

Table 3-2: Impact Evaluation Data Collection Activities Summary

Data Collection Activity	Impact Evaluation Research Objectives
Program Tracking Data Review and Audit	Verify that the tracking data provides sufficient information to calculate energy and demand impacts
	Verify proper application of deemed savings estimates
	Audit data to ensure there are no duplicate or erroneous entries
General Population Email Survey	Verify measure installation
	Assess customer purchasing and decision-making processes; estimate net-to-gross ratio
	Assess customer satisfaction with recent purchases of program promoted measures

3.2.2 Sampling Plan for the Impact Evaluation

Program data will be stratified by service territory. If additional measures are incorporated into the program, sample sizes will depend on the number of participants. As a preliminary estimate, ADM anticipates the following sampling activities:

- A census review of all measures listed in the tracking system to ensure appropriate use of deemed savings values
- A census review of all retailer invoices associated with upstream and downstream markdowns
- At least 500 general population survey completes for net-to-gross analysis, in-service rate calculations, and process evaluation

3.2.3 Estimating Gross Savings

ADM's approach to savings analysis depends largely on the types of measures installed. Whenever possible, deemed savings values and algorithms from the Evergy Technical Reference Manual (TRM) will be used to determine verified gross energy savings and demand impacts. Care will be taken to assure any assumptions are reasonable and current, and that there are no errors in the algorithms. At the conclusion of the analysis at the end of the reporting cycle, ADM will provide input and support of the development of the subsequent year's TRM.

For each measure in the program, total gross energy and demand savings are determined as a product of the number of measures verified to qualify for a rebate and the gross savings per measure.

To determine the quantity of measures rebated and installed ADM will review all invoices and entries in the tracking system to ensure that (a) all measures are program eligible, (b) invoices were processed during the program year and (c) there are no duplicate or otherwise erroneous entries.

Gross savings calculation methodologies are detailed in the following section.

3.2.3.1 *ENERGY STAR® LEDs*

Lighting measures may include retrofits of existing fixtures, screw-in LED lamps, and linear fluorescent bulbs and fixtures. These types of measures reduce demand, but operating hours for fixtures are generally the same pre- and post-retrofit.

ADM will check that all LED model numbers listed in the program tracking data against the ENERGY STAR® databases to verify that each model distributed was ENERGY STAR® certified. ADM will then analyze the savings from verified lighting measures using data for new/retrofitted fixtures on wattages before and after retrofit. Fixture wattages are generally taken from a table of standard wattages or cut sheets when feasible, with corrections made for non-operating fixtures. ADM will calculate energy savings and demand reductions using prescriptive algorithms from the Evergy and Illinois (IL) TRMs and other relevant program sources, as necessary. If needed, ADM will adjust the baseline hours of use. Additionally, HVAC interactive effects will be accounted for using partially deemed algorithms from the Evergy TRM dependent upon heating and cooling systems serving areas where lighting systems are installed.

Energy savings (kWh) and demand reductions (kW) from the installation of LED and Fluorescent bulbs will be determined based on the Evergy TRM (2020-05-01). The Evergy TRM stipulates Equation 3-1 and Equation 3-2, shown below, and deemed values specified in the IL TRM.

Equation 3-1: kWh Energy Savings from Efficient Lighting

$$kWh = \frac{W_{base} - W_{ee}}{1000} \times HOU \times WHF_e \times ISR$$

Equation 3-2: kW Peak Demand Reduction from Efficient Lighting

$$kW = \frac{W_{base} - W_{ee}}{1000} \times CF \times WHF_d \times ISR$$

Where:

W_{base} = Input wattage of the existing or baseline system

W_{ee} = Actual wattage of the lighting measure installed

HOU = Average hours of use per year

WHF_e = Waste heat factor for energy to account for cooling energy savings from efficient lighting

= 1.051[64]

WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting

= 1.093[65]

CF = Summer peak coincidence factor

= 0.128[66]

HF = Heating factor, the percentage of lighting savings that must be replaced by heating system

= 0.49% for interior or unknown location, 0% for exterior locations[67]

η_{heat} = Average heating system efficiency

= 0.70[68]

ISR = Measure in-service rate. Determined from general population survey

3.2.3.2 *Point-of-Sale Measure Leakage*

Programs that provide incentives at the point-of-sale can result in installations outside of the territory of the sponsoring utility. This effect, referred to as "leakage", can be particularly prominent when a service territory is not geographically contiguous, or when a major retailer is located near the border of a service territory. When leakage takes place, bulbs that have been discounted through a utility's program are installed outside of the program territory and therefore the energy and demand impacts from the discounted bulbs are not realized within the territory of the utility that financially supported and claimed the savings.

The "geo-mapping" approach to calculating leakage is where each program storefront is assigned a leakage score based on the percentage of the sponsoring utilities customers within a maximum of a 60-minute drive from the store. Drive time estimates (how far customers are willing to travel to a given storefront) can be obtained via the general population survey or from prior leakage studies. The strength of this approach is that each

[64] As stipulated by the Evergy TRM 2020-05-01
[65] Ibid.
[66] Ibid.
[67] As stipulated by IL TRM, v5.0, vol3, page 264
[68] As stipulated by IL TRM, v5.0, vol3, page 265

storefront is assigned its own leakage score, and the overall estimate of leakage represents a weighted average of program storefronts. The specific steps for this approach include:

1. Overlay utility service areas and population data from the U.S. Census Bureau.

   Match the utility service area to all population points within the area based on the most recent census data.

2. Estimate the customer base for each retail store by calculating store territory from drive times to each store.

   Develop territories for each program storefront by mapping out drive time areas based on 5-minute increments from 0-60 minutes. When storefront drive times overlap, they are split down the middle between the stores.

3. Combine utility/census data with drive time data.

   The drive time for each store is combined with the census/utility data points to determine the population types (within territory vs. out of territory) present within each store's drive time.

4. Allocate subsidies for each store to the population within the store territory, using actual sales data.

   Each store is assigned a leakage score, with some percentage of the incentivized product assigned to the sponsoring utility customers and some percentage assumed to have leaked out of the territory.

5. Calculate overall leakage.

   Combine all the stores to determine an overall leakage rate for the Evergy operating company.

3.2.4 Estimating Net Savings

3.2.4.1 *Net-to-Gross Ratio for Lighting Discounts*

Determining the net effects of retail lighting discounts requires estimating the percentage of energy savings from efficient purchases that would have occurred without program intervention. Ideally, participating retailers could provide sales data for non-program time periods and/or from similar non-program retail locations. This data would provide adequate information from which to calculate the lift in LED sales attributable to the program price mark downs. However, retailers in the past have been reluctant to release sales data for this purpose and non-program sales data has not made available to ADM in prior years.

As a result, evaluating the net effects of the price discounts requires estimating free ridership without non-program sales data. Several methodologies have been used in similar evaluations across the country, all of which have certain advantages and disadvantages.[69] For the evaluation of the MEEIA Cycle III ESP program retail discounts, ADM will use self-report rates from a general population survey or a random sample of Evergy customers.

3.2.4.2 *General Population Survey*

ADM will conduct a general population survey of Evergy customers to understand decision making for light bulb purchases. The goal of this survey is to elicit information from which to estimate the number of bulbs that the customers would have purchased in the counterfactual scenario where LEDs were not discounted. Self-report survey methods for determining free ridership are generally recognized as susceptible to certain biases and error. This may be especially true for upstream price markdown programs, where the counterfactual scenario of regular retail prices may be difficult to explain or grasp. The self-report methodologies also rely on specific scoring algorithms, which may bias the free ridership estimates if they do not accurately reflect the customer decision making process.

In designing the general population survey, we attempt to strike a balance between low incidence levels (i.e., LED purchases) and the additional sample size that would be required when using a shorter recall period. For example, if we limited the survey to recall of purchases made in the past week, we would need to survey a great many more customers to reach a sufficient sample size of customers that have purchased LEDs, which would greatly increase the cost of the survey effort.

Additionally, while duration may impact the recall of information used to estimate net savings, it is not clear that the direction of that bias would be such that it would lead to responses that would systematically result in over or under estimation of free ridership.

It is also important to note that we are employing multiple methods for estimating free ridership to mitigate biases present in any one method.

This evaluation relies on self-report survey data from one surveying effort:

- The survey effort will be conducted via email. The strength of this approach is the ability to obtain a random and relatively large sample size cost-effectively. It also allows for further questioning regarding the fate of recently purchased

[69] Violette, D. M. and Rathbun, P. (2017) Chapter 21: Estimating Net Savings – Common Practices *in* The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. National Renewable Energy Laboratory, *Technical Monitor*: Charles Kurnik, *Subcontract Report*: NREL/SR-7A40-68578, *Contract No.* DE-AC36-08GO28308. *Last accessed June 2019 via:* https://www.nrel.gov/docs/fy17osti/68578.pdf

bulbs (e.g., installed immediately, stored for future use, location of installation, etc.). The biggest drawback to the approach is the potential for respondent recall bias. For example, it may be difficult to get accurate responses to questions about the number of bulbs the respondent recently purchased and whether they were discounted through the program.

- ADM will target the general population within Evergy territory by inviting a random sample of Evergy customers to participate in an emailed survey.
- ADM will utilize general population survey data exclusively from survey respondents that have purchased LEDs in the last eight months to a year.

Survey respondents will be asked a series of questions to elicit feedback regarding influences on their light bulb purchasing decisions. Each respondent will then be assigned a free ridership score based on a consistent free ridership scoring algorithm.

For the survey, responses will not be weighted. That is, each response has equal weight in estimating the average free ridership level for the program.

For light bulb purchases, the "behavior without discount" scoring is the primary determinate of respondents' free ridership scores. This section asks whether the respondent would have purchased the same light bulbs if they had cost the regular retail price. This may be a question that is particularly prone to social desirability bias – the tendency to respond in a manner that might be viewed favorably by others. For this reason, a consistency check will be performed. Each respondent will be asked to state light bulb characteristics that are important to them when choosing between available options. If a respondent lists price as the most important characteristic, but then goes on to indicate that they would have still purchased efficient options at full retail price, their response will be eliminated from the data population.

3.2.4.3 *Spillover and Market Effects*

It is worth noting that none of the methodologies used to estimate program free ridership include estimates of spillover or market effects. Spillover refers to savings that occur because of program influences on customers but for which an incentive or rebate is not given. In the context of a program for LED price mark downs, the following examples illustrate potential sources of spillover:

- Participant spillover: a customer who purchases program discounted bulbs is influenced to install additional (non-rebated) energy efficiency measures or change their energy usage behavior because of their program experience.
- Non-participant spillover: a customer notices Evergy sponsored discounts or receives educational resources form an in-store promotional event. While they do not ultimately purchase program discounted bulbs, their interaction

with the program encourages them to install other (non-rebated) energy efficiency measures or change their energy usage behavior.

Market effects refer to changes in market structure or market actor behavior due to program influence that results in non-incented adoption of energy efficiency measures. In the context of a program for LED price mark downs, the following examples illustrate potential sources of market effects:

- Market pricing related effects: it is possible that the program sponsored discounts for certain lighting products cause downward pressure on prices for competing products (non-program bulbs). The competing products could potentially be LEDs at participating retailers or non-participating retailers. If pricing for these competing products is lowered in response to program discounts and a corresponding increase in purchases (and installations) occurs, then there may be additional savings attributable to program influences.
- Market manufacturing/stocking effects: it is possible that the program sponsored inducements cause bulb manufacturers and retailers to adjust their lighting product offerings. To the extent that the program causes lesser efficiency bulbs to be displaced with higher efficiency bulbs at the manufacturer/retailer level, there may be additional savings attributable to program influences.

It is likely that some combination of these effects increases the savings attributable to the lighting component of the ESP program. However, there is also reason to believe these effects may be small overall. Participant and non-participant spillover typically occurs through customer education. The lighting component of the ESP program component does include regular in-store promotional/educational events, but the number of customers reached relative to overall program sales is likely small. Additionally, the promotional events usually provide information designed to encourage customers to participate in other Evergy energy efficiency programs, which would not constitute spillover if these customers ultimately did participate and receive a rebate.

Market effects may exist to some extent but disaggregating the Evergy program influences from other influences such as technological advances and other lighting discount programs across the country is difficult. The current lighting component of the ESP program component covers a substantial share of the bulbs sold in the Evergy - Missouri service territory, with no immediate plans for discontinuing the price markdowns.

Overall, it should be noted that spillover and market effects likely remain a minor factor, and the net-to-gross estimate developed in this evaluation should be considered with these omitted effects in mind.

4. Income-Eligible Multi-Family

4.1 Description of the Multi-Family Program

The Income-Eligible Multi-Family (IEMF) program provides qualifying, income-eligible properties with assistance through energy assessments, program applications, technical support, and upgrade incentives. The program consists of two components. The first component provides direct install kits which include a suite of measures installed in the units and common areas to benefit occupants and property/building managers/owners. Measures may include low-flow faucet aerators and showerheads, advanced power strips, LEDs, HVAC cleaning and maintenance, and other measures. The second component of the program provides incentives for upgrading in-unit and common area measures in the form of prescriptive or custom rebates. The two components provide benefits to both the resident and the property manager by increasing the value of the property, reducing utility bills, and making the property more comfortable, healthier, and safer.

The program partners with the Low-Income Housing Tax Credit (LIHTC) program representatives and has been enhanced to allow for a longer payout period for rebates up to 12 months after the cycle ends as to better coordinate with the LIHTC.

4.1.1 Eligibility and Program Impact Targets

To qualify for the Income-Eligible Multi-Family program the property must be receiving service from Evergy and meet one of the following requirements:

- Documented participation in a Federal, State, or Local housing program
- Location in a low-income census tract
- Rent roll documentation, where at least 50% of units have rents affordable to households at or below 80% of area median income, as published annually by the Department of Housing and Urban Development (HUD).
- Documented tenant income information demonstrating at least 50% of units are rented to households either at or below 200% of the Federal poverty level, or at or below 80% of area median income.
- Documented information demonstrating the property is on the waiting list for, currently participating in, or has in the last five years participated in the Weatherization Assistance Program.

Program energy and demand impact targets for program years 2020-2025, as specified in filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233, are shown in Table 4-1.

Table 4-1: Income-Eligible Multi-Family Program Savings Targets

Program Year	Evergy Missouri Metro		Evergy Missouri West		Program Overall	
	Energy Savings (kWh)	Peak Demand Reductions (kW)	Energy Savings (kWh)	Peak Demand Reductions (kW)	Energy Savings (kWh)	Peak Demand Reductions (kW)
2020	1,368,009	248	1,388,947	243	2,756,956	491
2021	1,160,994	228	1,181,931	223	2,342,925	451
2022	1,160,994	228	1,181,931	223	2,342,925	451
2023	906,913	183	923,401	180	1,830,314	363
2024	945,949	197	963,321	193	1,909,270	390
2025	992,465	214	1,010,700	210	2,003,165	424
Total	**6,535,323**	**1,297**	**6,650,231**	**1,271**	**13,185,554**	**2,568**

4.2 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform for the MEEIA Cycle III Multifamily Program.

4.2.1 Data Collection and Measure Verification

Data used for this evaluation will include:

- Program tracking data from the main tracking database, as outlined in Table 4-2
- Participant survey data from a sample of participants
- Data from relevant secondary sources, such as the ENERGY STAR® database of certified products.[70]

As a first step, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy and demand impacts. The data review will include an assessment of whether savings reported in the tracking system comply with deemed savings values and guidelines set by the Evergy Technical Reference Manual.

The desk review will consist of reviewing a sample of retailer invoices to verify the quantity of treated units matches what is reported in the program tracking system. Additionally,

[70] Accessible via https://www.energystar.gov/products/certified-products/detail/set. Accessed: September 2020.

when relevant ADM will review measure model numbers using the ENERGY STAR® database to ensure that key variables such as the bulb characteristics (type, wattage, etc.) and technical specifications match what is reported in the tracking data.

Table 4-2 below summarizes the data collection activities and corresponding impact evaluation research objectives.

Table 4-2: Impact Evaluation Data Collection Activities Summary

Data Collection Activity	Evaluation Research Objectives
Program Tracking Data Review and Audit	Verify that the tracking data provides sufficient information to calculate energy and demand impacts
	Verify proper application of deemed savings estimates
	Audit data to insure there are no duplicate or erroneous entries
Participant survey	Verify measure installation and collect other primary data

4.2.2 Sampling Plan for Impact Evaluation

ADM will conduct a property manager survey to collect primary data for program evaluation. Property managers will be invited to complete an online survey verifying measure installation from a sample of units where measures were installed. A gift card incentive will be provided to encourage participation.

If insufficient survey responses are collected within the time and budget allotted, ADM will conduct additional surveying efforts with residents and tenants. Residents will be contacted by phone, via email, and/or through door hangers, and invited to participate in a short survey to verify the measures installed in the unit. As with the property manager survey, a small incentive will be provided to encourage participation.

Surveying income-eligible multi-family residences poses unique challenges as compared to other customer segments. The sample design should allow for gross program impacts to be estimated at 90% confidence level with ±10% relative precision or better. If insufficient responses are collected through both program manager and resident surveys for the required precision to be achieved, ADM will utilize deemed measure installation rates from the Evergy Technical Reference Manual.

4.2.3 Program Provided Measures

The Income-Eligible Multi-Family program provides customers with utility savings through education and incentives, including direct install (DI) and prescriptive and/or custom measures.

- Direct Install measures include LED bulbs, faucet aerators, low-flow showerheads, advanced power strips, and HVAC cleaning and tune-ups.
- Rebates for prescriptive and/or custom measures may include additional lighting measures and appliances.

4.2.4 Estimating Measure-Specific Gross Savings

ADM's approach to project level savings analysis depends largely on the types of measures installed. Whenever possible, deemed savings and prescribed algorithms from the Evergy TRM will be used to determine verified gross savings. Care will be taken to assure any assumptions are reasonable and current, and that there are no errors in the algorithms. At the conclusion of the analysis at the end of the report cycle, ADM will provide input and support of the development of the subsequent year's TRM.

The following discussion describes, in general, our plan for analyzing savings from different measure types:

4.2.4.1 *Efficient Lighting*

Lighting measures may include retrofits of existing fixtures, screw-in LED lamps in units and common areas, linear fluorescent bulbs and fixtures, and outdoor lighting. These types of measures reduce energy demand, though operating hours for fixtures are generally the same before and after retrofit.

ADM will check that LED model numbers listed in the program tracking data appear in the ENERGY STAR® databases to verify that each model distributed was ENERGY STAR® certified. ADM will then analyze the savings from verified lighting measures using data for new/retrofitted fixtures on wattages before and after retrofit. ADM will calculate energy savings and demand reductions using prescriptive algorithms from the Evergy TRM and other relevant program sources, as necessary. If needed, ADM will adjust the baseline hours of use. HVAC interactive effects will be accounted for using deemed algorithms from the Evergy TRM, dependent upon heating and cooling systems serving areas where lighting measures were installed.

The Evergy TRM Cycle 3 (2020-05-01) specifies the use of savings algorithms from the IL TRM Total kWh savings and kW demand reductions from the installation of LED and Fluorescent bulbs will be determined using Equation 4-1 and Equation 4-2 below:

Equation 4-1: kWh Energy Savings from Efficient Lighting

$$kWh = \frac{W_{base} - W_{ee}}{1000} \times HOU \times WHF_e \times ISR$$

Equation 4-2: kW Peak Demand Reduction from Efficient Lighting

$$kW = \frac{W_{base} - W_{ee}}{1000} \times CF \times WHF_d \times ISR$$

Where:

W_{base} = Input wattage of the existing or baseline system

W_{ee} = Actual wattage of the lighting measure installed

HOU = Average hours of use per year

WHF_e = Waste heat factor for energy to account for cooling energy savings from efficient lighting

= 1.04 (interior), 1.00 (exterior)[71]

WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting

= 1.07 (interior), 1.00 (exterior)[72]

CF = Summer peak coincidence factor

= 0.128 (interior), 0.273 (exterior)[73]

ISR = Measure in-service rate. Determined from program surveys

4.2.4.2 *Low-Flow Faucet Aerator*

The Evergy TRM Cycle 3 (2020-05-01) specifies the use of savings algorithms from the IL TRM Energy savings and peak demand reduction for low-flow faucet aerators will be calculated using Equation 4-3 and Equation 4-4 below. Savings and demand reductions are dependent on the installation location (kitchen or bathroom), as specified in the program tracking data.

Equation 4-3: Energy Savings from Low-Flow Faucet Aerators

$$\Delta kWh = \%\text{ElectricDHW} \times \left((GPM_{base} \times L_{base} - GPM_{low} \times L_{low}) \times Household \times 365.25 \times {}^{DF}/_{FPH}\right) \times EPG_{electric} \times ISR$$

Equation 4-4: Peak Demand Reduction from Low-Flow Faucet Aerators

$$\Delta kW = \frac{\Delta\text{kWh}}{\text{Hours}} \times CF$$

[71] As stipulated by the Evergy TRM, 2020-05-01
[72] Ibid.
[73] Ibid.

Where:

Hours = Annual electric DHW recovery hours for faucet use per faucet

$$= \left((GPM_{base} \times L_{base}) \times \frac{Household}{FPH} \times 365.25 \times DF \right) \times \frac{0.545543}{GPH}$$

%ElectricDHW = proportion of water heating supplied by electric resistance heating

GPM_{base} = Average flow rate, in gallons per minute, of the baseline faucet

= 2.2 gpm[74]

GPM_{low} = Average flow rate, in gallons per minute, of the installed faucet

= 1.0 in bathrooms, 1.5 in kitchens[75]

$L_{base} = L_{low}$ = Average daily length faucet use per capita in minutes

= 1.6 in bathrooms, 4.5 in kitchens[76]

Household = Average number of people per household

= 2.1[77]

DF = Drain Factor

= 0.90 in bathrooms, 0.75 in kitchens[78]

FPH = Faucets per Household

= 1.5 in bathrooms, 1 in kitchens[79]

$EPG_{electric}$ = Energy per gallon of water used by faucet supplied by electric water heater

= 0.0795 in bathrooms, 0.0969 in kitchens[80]

GPH = Gallons per hour recovery of electric water heater calculated for 70.9F temp rise (125-54.1), 98% recovery efficiency, and typical 4.5kW electric resistance storage tank.

= 25.5[81]

CF = Peak coincidence factor

[74] As stipulated by the Evergy TRM, 2020-05-01
[75] Ibid.
[76] Ibid.
[77] Ibid.
[78] Ibid.
[79] Ibid.
[80] Ibid.
[81] As stipulated by IL TRM v5.0, vol 3, page 179

= 0.022[82]

ISR = In-Service Rate for faucet aerators

4.2.4.3 *Low-Flow Showerheads*

The Evergy TRM Cycle 3 (2020-05-01) specifies the use of savings algorithms from the IL TRM. Energy savings, and peak demand reduction for low-flow showerheads will be calculated using Equation 4-5 and Equation 4-6 below.

Equation 4-5: Energy Savings from Low-Flow Showerheads

$$\Delta kWh = \%\text{ElectricDHW} \times \left((GPM_{base} \times L_{base} - GPM_{low} \times L_{low}) \times Household \times SPCD \times {}^{365.25}/_{SPH} \right) \times EPG_{electric} \times ISR$$

Equation 4-6: Peak Demand Reduction from Low-Flow Faucet Aerators

$$kW = \frac{kWh}{Hours} \times CF$$

Where:

%ElectricDHW = proportion of water heating supplied by electric resistance heating

Hours = Annual electric DHW recovery hours for showerhead

$$= \left((\text{GPM}_{\text{base}} \times \text{L}_{\text{base}}) \times \frac{\text{Person}}{\text{Home}} \times \text{SPCD} \times 365.25 \right) \times \frac{0.712}{\text{GPH}}$$

GPM_{base} = Average flow rate, in gallons per minute, of the baseline showerhead

= 2.67 gpm[83]

GPM_{low} = Average flow rate, in gallons per minute, of the installed showerhead

= 1.5 gpm[84]

L_{base} & L_{low} = Average daily length showerhead use per capita, in minutes

= 7.8 minutes[85]

Household = Average number of people per household

[82] As stipulated by the Evergy TRM, 2020-05-01
[83] As stipulated by the Evergy TRM, 2020-05-01
[84] Ibid.
[85] Ibid.

= 2.1[86]

SPCD = Showers per capita per day

= 0.6[87]

SPH = Showerheads Per Household so that per-showerhead savings fractions can be determined

= 1.3[88]

$EPG_{electric}$ = Energy per gallon of water used by faucet supplied by electric water heater

= 0.117 kWh/gal[89]

GPH = Gallons per hour recovery of electric water heater calculated for 65.9F temp rise (120-54.1), 98% recovery efficiency, and typical 4.5kW electric resistance storage tank.

= 27.51[90]

CF = Peak coincidence factor

= 0.0278[91]

ISR = In-Service Rate for faucet aerators

4.2.4.4 *Advanced Power Strip*

The Evergy TRM provides specified deemed savings values for 7-plug power strips, shown below. Demand savings for smart strip power strips will be determined per the Evergy TRM using Equation 4-7.

Energy Savings: $\Delta kWh_{7\text{-}Plug}$ = 103 kWh[92]

Equation 4-7: Smart Power Strips Calculation of Summer Coincident Peak Demand Savings

$$\Delta kW = \frac{\Delta kWh}{Hours} \times CF$$

[86] Ibid.
[87] Ibid.
[88] Ibid.
[89] Ibid.
[90] As stipulated by IL TRM v5.0, vol 3, page 187
[91] As stipulated by the Evergy TRM, 2020-05-01
[92] Ibid.

Where:

Hours = Annual number of hours during which the controlled standby loads are turned off by the Smart Strip.
= 7,129[93]

CF = Summer Peak Coincidence Factor for measure
= 0.8[94]

$\Delta kW_{7\text{-Plug}}$ = 102.8 / 7129 * 0.8
= 0.012 kW

4.2.4.5 *HVAC Tune-Up*

This measure involves the measurement of refrigerant charge levels and airflow over the central air conditioning or heat pump unit coil, correction of any problems found and post-treatment re-measurement. This measure assumes that the existing unit being maintained is either a residential central air conditioning unit or an air source heat pump that has not been serviced for at least 3 years.

The Evergy TRM Cycle 3 (2020-05-01) specifies the use of savings algorithms from the IL TRM for all HVAC tune-ups in the program. The kWh savings and kW demand reductions from the HVAC tune-ups will be determined using Equation 4-8 through Equation 4-10 below.

Equation 4-8: kWh Energy Savings for HVAC Tune-Ups

$$\Delta kWh_{\text{Central AC}} = \frac{\left(FLH_{cool} \times Capacity_{cool} \times \left(\frac{1}{SEER_{CAC}}\right)\right)}{1000} \times MF_{e}$$

[93] Ibid.
[94] Ibid.

Equation 4-9: kWh Energy Savings for HVAC Tune-Ups (Air Source Heat Pump)

$$\Delta\text{kWh}_{Air\ \text{Source Heat Pump}} = \left(\frac{\left(\text{FLH}_{\text{cool}} \times \text{Capacity}_{\text{cool}} \times \left({}^{1}/_{\text{SEER}_{\text{ASHP}}}\right)\right)}{1000} \times \text{MF}_{\text{e}}\right) + \left(\frac{\left(\text{FLH}_{\text{heat}} \times \text{Capacity}_{\text{heat}} \times \left({}^{1}/_{\text{HSPF}_{\text{ASHP}}}\right)\right)}{1000} \times \text{MF}_{\text{e}}\right)$$

Equation 4-10: kW Peak Demand Savings for HVAC Tune-Ups

$$\Delta\text{kW} = \text{Capacity}_{\text{cool}} \times \frac{\left(\frac{1}{\text{EER}}\right)}{1000} \times \text{MF}_{\text{d}} \times \text{CF}$$

Where:

FLH_{cool} = Full load cooling hours

$Capacity_{cool}$ = Cooling capacity of equipment in Btu/hr

$SEER_{CAC}$ = SEER Efficiency of existing central air conditioning unit receiving maintenance

MF_e = Maintenance energy savings factor

= 0.05[95]

$SEER_{ASHP}$ = SEER Efficiency of existing air source heat pump unit receiving maintenance

FLH_{heat} = Full load heating hours

$Capacity_{heat}$ = Heating capacity of equipment in Btu/hr

$HSPF_{ASHP}$ = Heating Season Performance Factor of existing air source heat pump unit receiving maintenance

EER = EER Efficiency of existing unit receiving maintenance in Btu/H/Watts

= -0.02 * $SEER^2$ + 1.12 * SEER[96]

MF_d = Maintenance demand savings facto

[95] Energy Center of Wisconsin, May 2008; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research."

[96] Based on Wassmer, M. (2003). A Component-Based Model for Residential Air Conditioner and Heat Pump Energy Calculations. Master's Thesis, University of Colorado at Boulder. Note this is appropriate for single speed units only.

= 0.02[97]

CF_{SSP} = Summer System Peak Coincidence Factor for central a/c (during system peak hour)

= 68%[98]

CF_{SSP} = Summer System Peak Coincidence Factor for heat pumps (during system peak hour)

= 72%[99]

CF_{PJM} = PJM Summer Peak Coincidence Factor for central a/c and heat pumps (average during peak period)

= 46.6%[100]

4.2.4.6 *Custom and Prescriptive Measures*

ADM will complete a desk review of all rebated prescriptive and/or custom equipment upgrades to confirm that all models meet efficiency standards prescribed by the program. Savings will be determined on a per-measure basis, following the Evergy TRM or additional, agreed upon resources, if necessary. Inputs to savings algorithms will be determined using primary sources such as program surveys and interviews with owners or property managers, where feasible. For savings inputs where primary research is not justifiable given budgetary constraints, deemed values from the Evergy TRM or other relevant sources will be used.

4.2.5 Estimating Net Savings

Net program impact analysis is used to determine what part of gross energy savings and demand reductions achieved by participants in a program can be attributed directly to the program offering.

The Net-To-Gross Ratio (NTGR) for the Income-Eligible Multi-Family program is stipulated at 1.00, due to (1) the specific targeting of the low-income sector; and (2) the

[97] 2 Based on June 2010 personal conversation with Scott Pigg, author of Energy Center of Wisconsin, May 2008; "Central Air Conditioning in Wisconsin, A Compilation of Recent Field Research" suggesting the average WI unit system draw of 2.8kW under peak conditions, and average peak savings of 50W.

[98] Based on metering of 24 homes with central AC during PY4 and PY5 in Ameren Illinois service territory.

[99] Based on analysis of metering results from 24 heat pumps in Ameren Illinois service territory in PY5 coincident with AIC's 2010 system peak; 'Impact and Process Evaluation of Ameren Illinois Company's Residential HVAC Program (PY5)'.

[100] Based on analysis of Itron eShape data for Missouri, calibrated to Illinois loads, supplied by Ameren. The average AC load over the PJM peak period (1-5pm, M-F, June through August) is divided by the maximum AC load during the year.

small contributions of the program to the overall portfolio saving, which do not justify the cost of conducting primary research needed to adjust the NTGR from stipulated values.

5. Home Energy Report

5.1 Description of Home Energy Reports

The Home Energy Report Program began providing Home Energy Reports (HERs) in 2013 to a portion of single-family residential customers. The program is designed to provide information to residential customers intended to educate and influence customer's behavior to lower energy usage. The Home Energy Report is delivered in paper, and/or email format, and is composed of several modules of information to help customers understand and manage their energy use. The household receives personalized information about their own kWh consumption and comparison to household energy usage information with similar types of customers, or "neighbors". Also included on the reports is information on other Evergy energy efficiency programs to encourage additional home improvements towards reduced energy usage. This normative information on electric usage and targeted tips on energy saving behaviors is aimed to reduce the participant household's energy consumption.

Since its launch, the program had expanded with ten additional cohorts, totaling to eleven waves. One of the cohorts, launched in 2014, consisted of income-eligible customers. This single cohort defines the Income-Eligible Home Energy Report Program. ADM will apply the same methodology detailed in this EM&V Plan for all cohorts, including the income-eligible cohort. The program uses a third-party implementation contractor, Opower. All waves have experimental design using randomized controlled trials (RCT), which randomly assign a subset of Evergy's residential customers into a treatment or control group. Table 5-1 summarizes the cohorts implemented in the Home Energy Report program within the Evergy service area.

Table 5-1 Summary of Evergy Home Energy Report Program Cohorts

Cohort	Treatment Start Date
201308_E	March 2013
201407_E_High_Users	July 2014
201407_E_Low_Income	July 2014
201503_E_GMO	March 2015
201503_E_KMO	March 2015
201604_E_GMO	April 2016
201607_E	July 2016
201706_E_GMO	June 2017
201904_E_GMO	April 2019
202002_E_GMO	May 2020
202002_E_KMO	May 2020

5.2 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform for Evergy's MEEIA Cycle III Home Energy Report Program and Income-Eligible Home Energy Report Program. ADM will analyze each of the cohorts treated during the 2020 through 2022 program years. We will summarize our results for each calendar year, necessary for compliance with the Evergy reporting. ADM will also report the Income-Eligible Home Energy Report Program separately from the Home Energy Report Program by estimating the income-eligible cohort in 2014 separately in program totals.

The work effort will be divided into the following categories:

1. Data preparation and cleaning, including true-up and calendarization;
2. Test remaining treatment and control groups from RCT for equivalency during baseline period;
3. Create matched ad-hoc control group via propensity score matching for cohorts in which validity was compromised;
4. Estimate monthly and annual billed consumption differences between treatment and control groups via regression modeling;
5. Estimate and remove joint savings from other programs; and
6. Estimate demand reductions.

We will use participant and control group billing data in the pre-period (before the household starts receiving home energy reports) and in the post-period (after household starts receiving home energy reports) to estimate program impact for each wave. We will also estimate joint savings from other downstream and upstream energy efficiency programs offered to Evergy's residential customers.

ADM will include the following as deliverables:

- Weekly phone call with Evergy HER evaluation project manager to discuss project status, results, and questions related to program evaluation;
- Draft impact evaluation reports for review;
- Final impact evaluation report;
- Analysis datasets, analysis program scripts, and data dictionaries with descriptions of variables.

5.2.1 Billing Analysis Methods

ADM will explore three different approaches for the impact evaluation of the Home Energy Report program. Each approach involves panel linear regression models to estimate energy savings for the treatment group. These proposed methods require bi-monthly billing data for the program participants. One of the methods requires a designated control group to be created by the evaluators in instances where the control group as designed does not pass equivalency checks (which may occur as the result of natural customer attrition).

We will explore the following types of linear fixed effects regression (LFER) models during the evaluation of this program: Difference in Difference (D-in-D) and Post-Program Regression (PPR). We will finalize model specifications in collaboration with Evergy. The Uniform Methods Project (UMP) by the National Renewable Energy Laboratory[101] recommends D-in-D as it uses data from the treatment and control groups during the pre- and post-period and therefore allows the evaluator to control for outside factors that may also contribute to energy usage differences. The PPR model is a panel regression model that calculates the differences between treatment and control consumption in the post-program period, while controlling for any small systematic differences between the participant and control customers in pre-treatment usage trends. It controls for such differences by including in the model a relationship between the energy use for each calendar month of the pre-program period and the energy use for the each of the same calendar months in the post-program period. The TO model does not use a control group, but measures weather-normalized effects in the treatment group between the pre-period

[101] https://www.nrel.gov/docs/fy18osti/70472.pdf

and the post-period. We will explore the inclusion of independent variables such as Cooling/Heating Degree Days (C/HDD) for weather control and other household characteristics where applicable to improve model confidence.

ADM presents the following two methodologies:

1. Method 1: D-in-D or PPR billing analysis with RCT treatment and control groups
2. Method 2: D-in-D or PPR billing analysis with treatment group and matched post-hoc control group

The first method requires the RCT for the cohort to remain statistically valid. We will check validity by comparing customers in the treatment and control group on each billing read in the pre-treatment period (after having eliminated customers who opted out of the program). We will test each such comparison for statistically significant differences (using a *t*-test).

The second method requires the evaluators to create a quasi-experimental control group to compare against participant billing data if the cohort RCT is no longer valid. Both methods will utilize a fixed effects panel regression controlling for weather to estimate energy savings.

To gather the most reliable results, it is ideal to have a randomized control trial (RCT). However, some RCTs may become no longer viable due to changes in implementation or natural attrition. ADM will test the validity of each RCT by completing *t*-tests for the average daily usage of each of the pre-period months between the remaining treatment group and remaining control. If the pre-period average daily usage rejects the null hypothesis at the 90% confidence interval for any of the 12 pre-period months, the RCT is considered invalid. In the case a cohort no longer passes equivalency testing, ADM proposes a method for producing post-hoc control groups via quasi-experimental methods.

ADM will attempt to create a sufficiently matched control group for cohorts that fail RCT validation, however, it is not possible to guarantee a sufficient match. We will attempt quasi-experimental methods because it allows reduction of bias and outside influence as much as possible without randomization.

ADM will present savings estimates in three formats for each program year:

- Daily and annual energy savings per home
- Annual percent savings per home
- Program-level savings

The percent savings per home is calculated by dividing the average annual energy savings estimated in the treatment group by the average annual energy consumption from the control group for each program year. The program-level savings are calculated by

multiplying the average annual household impact estimate by the weighted number of active program participants in the treatment group and after removing double counted savings, by program year.

5.2.2 Data Requirements

ADM proposes to estimate the HER program's energy impacts through a billing analysis. The data necessary to be provided by Evergy consists of the following:

- Participant and nonparticipant customer information;
- Treatment and control customer monthly billing data in pre-period through post-period;
- Treatment and control customer AMI interval data in pre-period through post-period;
- Tracking data from Evergy downstream programs in each evaluated program year;
- Contact information of all RCT treatment and control group customers for use in survey deployment.

ADM will conduct the analysis using monthly billing data for waves in which AMI interval data is not available for the full pre-period and post-period. It is expected that data for all participants are used in the billing analysis regressions, but the actual sample sizes will depend on the quality of the billing data.

5.2.3 Data Preparation

The evaluation team will use participant and non-participant billing data in the pre-period (before intervention of HERs) and participant and non-participant billing data in the post-period (after intervention of HERs) in a fixed-effects panel regression model to predict electric savings, as detailed in the UMP behavioral chapter.

The following steps will be taken to prepare data:

1. Identify homes in the billing data that were assigned to the treatment or control group in the original RCT design
2. Exclude homes without sufficient billing history
3. Exclude homes without sufficient post-period billing data
4. Exclude homes with consumption data indicating it is an outlier
5. Verify if remaining RCT control households are still a valid comparison for the remaining treatment households

ADM will examine data for outliers using multiple accepted identification techniques. These include simple Z-scores, Bonferroni Outlier Test, Grubbs Test for Outliers (G-test), or others as appropriate. In the past, we have often identified high outlier thresholds at around 200 kWh per day. This level of consumption is unrealistic for residential households and can reasonably be categorized as the result of a reading error rather than a valid reading from a high user. ADM aims to remove error reading rather than remove high and low users, as these subgroups contribute real behaviors to the average savings estimate.

ADM will report parameters necessary to portray model accuracy and significance such as coefficient p-values, adjusted R-squared values, and measure-level savings at 90% confidence intervals. Program year savings estimates at the monthly- and annual-level will also be reported for the measure.

5.2.4 True-Up

Provided Evergy uses estimated meter reads, as part of the data preparation process, ADM will correct for estimated reads and adjusted actual reads by using a "true-up" process. For each metered read and all estimated reads immediately preceding it, ADM will total the billed usage and number of days spanning those bills. The total billed usage for that cumulative period will then be divided by the total number of days in each individual bill to generate a corrected usage value. Because the number of estimated reads per actual read is inconsistent, the number of estimated reads prior to the first actual read in the provided dataset will not be assumed. Therefore, the first metered read and all estimated reads preceding it will be excluded from the dataset. Similarly, estimated reads that do not have a corresponding actual read (generally towards the tail end of provided billing data) will also be excluded from analysis. The following equation provides the means for calculating the adjusted usage for billing data after the first metered read and all prior estimated reads have been excluded:

Equation 5-1 Billing Data Adjustment Calculation

$$Adjusted\ Usage = \sum_{i}^{n} Billed\ usage \times \frac{Billing\ days_m}{\sum_i^n Billing\ days}$$

Where:

i = First estimated bill in a sequence of estimated bills leading to a metered bill

n = A metered bill providing an adjustment factor for preceding estimated bills

m = The billing month of interest

$Billed\ usage$ = The total kWh billed in a month (monthly bills) or consumed in a month (AMI interval data)

$Billing\ days$ = The total number of days in a monthly bill's billing period or AMI interval month

5.2.5 Calendarization

Monthly billing periods in monthly billed data do not fall on consistent dates between participants. For example, one customer's June bill may run from May 16th to June 17th while another customer's may run from May 20th to July 5th. To make the monthly billing data consistent between participants and to represent each month accurately, ADM will calendarize the data into monthly calendar bills. Calendarization is the process of correcting monthly billing data to match calendar dates. For example, if 15 days in a billing period belonged to June and 15 days belonged to July, 50% of the billed usage would be attributed to June and 50% attributed to July. The proportionated usage and number of days that fall under a given calendar month are then summed to generate a calendarized usage value and the number of billed days for that month. The following equation provides the method for calculating the monthly usage by calendar month:

Equation 5-2 Monthly Billing Data Calculation

$$Monthly\ usage_m = \sum_{i}^{n} \left(Adjusted\ usage_i \times \frac{Month\ days_i}{Billing\ days_i} \right)$$

Where:

i = First bill containing the month of interest

n = Last bill containing the month of interest

m = The month of interest

$Monthly\ usage$ = The calendarized monthly usage for a given month

$Month\ days$ = The number of days belonging to the month of interest in a billing period

$Billing\ days$ = The number of days in a billing period

5.2.6 Validity Testing

The method for evaluation requires the counterfactual group remains statistically valid for each treatment group. Validity is tested by examining each billing read in the pre-treatment period for customers in each the treatment and control group. Each calendarized monthly is tested for statistically significant differences using a simple two-

tailed *t*-test. ADM will perform equivalency for each month between the provided RCT treatment group and the provided RCT control group.

ADM will test the validity of each RCT by completing *t*-tests for the average daily usage of each of the pre-period months between the remaining treatment group and remaining control. If the pre-period average daily usage rejected the null hypothesis at the 90% confidence interval for several the 12 pre-period months, the RCT is considered invalid.

For waves that do not pass equivalency testing, the ADM will perform propensity score matching (PSM) to create a post-hoc control group comprising of participants that have not received home energy reports. The control group created undergoes equivalency testing to confirm it is statistically comparable to the treatment group in pre-period usage. The next section details propensity score matching methods ADM will use if necessary.

5.2.7 Propensity Score Matching

Due to complications in program implementation or design (or as the result of significant participant attrition), the RCT groups may no longer pass validity testing and become invalid. Regression model analyses are unable to be run on cohorts in which a statistically comparable control group is not defined. Therefore, to analyze cohorts that have non-equivalent counterfactual groups, a post-hoc control group is required to be created. ADM will attempt to create a statistically similar control group using propensity score matching (PSM), a method that allows the evaluators to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing.

A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households. To create a post-hoc control group, ADM will compile billing data of all control participants from all waves to compare against treatment households via quasi-experimental methods. This will allow ADM to select from a large group of similar households that have not received home energy reports. With this information, ADM will attempt to create a statistically valid matched control group via seasonal pre-period usage. After matching, a *t*-test will be conducted for each month in the pre-period to help determine the success of PSM.

After creating a PSM control group, the cohort will undergo the same regression modeling as the remaining statistically valid cohorts. The regression specifications to be explored and details are summarized in the next section.

5.2.8 Linear Regression

The following section defines the linear regression modeling specifications ADM will explore during the evaluation of the Home Energy Report Program and Income-Eligible Home Energy Report Program.

5.2.8.1 *Method 1: Billing Analysis with RCT*

The approach indicated under Method 1 utilizes the control group created during the RCT design in either a D-in-D or PPR model. This requires a successful validation test between the cohort's treatment and control group. This approach is detailed in the UMP as a preferred method for evaluation of opt-out behavioral programs.

The following sections summarize the two model specifications we will explore during analysis under Method 1.

Difference-in-Difference Model Specification

The fixed-effects model specification contains customer-specific dummy variables to account for exogenous heterogeneity that cannot be explicitly controlled for and is not relevant to the estimation of program savings. The specification of customer specific effects allows the model to capture much of the baseline differences across customers while obtaining reliable estimates of the impact of the report.

ADM will include independent variables such as Heating Degree Days (HDD) and Cooling Degree Days (CDD) for weather control and other household characteristics, where applicable, to improve model confidence. ADM will then fit a fixed effects panel regression model to estimate weather-dependent daily consumption differences between treatment and control households.

Equation 5-3: Fixed-Effects Difference-in-Difference (D-in-D) Panel Regression Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(HDD)_{it} + \beta_3(CDD)_{it} + \beta_4(Post \times HDD)_{it} + \beta_5(Post \times CDD)_{it} + \beta_6(Post \times HDD \times Treatment)_{it} + \beta_7(Post \times CDD \times Treatment)_{it} + \varepsilon_{it}$$

Where:

ADC_{it} = Estimated average daily consumption (dependent variable) in home *i* during period *t*

$Post_{it}$ = Dummy variable indicating whether period *t* was in pre- or post-retrofit

$Treatment_i$ = Dummy variable indicating whether household *i* was in treatment group or control group

HDD_{it} = Average heating degree days during period *t* at home *i*

CDD_{it} = Average cooling degree days during period *t* at home *i*

ε_{it} = Customer-level random error

α_0 = The model intercept for home *i*

β_{1-8} = Coefficients determined via regression

The coefficients β_6 and β_7 represent the average change in daily weather-related consumption between the groups in the post-period. HDD and CDD are calculated from local weather data. HDD and CDD will be estimated using a range of balance points (55- to 75-degree temperature base) and the HDD and CDD combination that yields the greatest model R-square will be used in the final analysis. This accounts for the "dead-band" in residential heating and cooling loads, as there is a range of temperatures in which a residential customer will be neither heating nor cooling.

Post-Program Regression Model Specification

The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers. In particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use. The version we estimate includes monthly fixed effects and interacts these monthly fixed effects with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

Equation 5-4 Post-Program Regression (PPR) Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Treatment)_i + \beta_2\,(PreUsage)_i + \beta_3\,(PreUsageSummer)_i + \beta_4(PreUsageWinter)_i + \beta_5(Month)_t + \beta_6(Month \times PreUsage)_{it}$$

$$+\beta_7(Month \times PreUsageSummer_{)it}$$

$$+\beta_8(Month \times PreUsageWinter)_{it}$$

$$+\varepsilon_{it}$$

Where:

i	= the i^{th} household
t	= the first, second, third, etc. month of the post-treatment period
ADC_{it}	= Average daily usage for reading *t* for household *i* during the post-treatment period
$Treatment_i$	= Dummy variable indicating whether household *i* was in the treatment or control group
$Month_t$	= Dummy variable indicating month-year of month *t*
$PreUsage_i$	= Average daily usage across household *i*'s available pre-treatment billing reads
$PreUsageSummer_i$	= Average daily usage in the summer months across household *i*'s available pre-treatment billing reads
$PreUsageWinter_i$	= Average daily usage in the winter months across household *i*'s available pre-treatment billing reads
ε_{it}	= Customer-level random error
α_0	= The model intercept for home *i*
β_{1-8}	= Coefficients determined via regression

The coefficients β_6 and β_8 represent the average change in consumption between the pre-period and post-period for the treatment group.

In this specification, savings are calculated by:

Equation 5-5 Monthly Savings Estimate

$$Savings = \sum Treatment\ Coeff \times Number\ of\ recipients\ in\ month\ i \times Number\ of\ days\ in\ month\ i$$

5.2.8.2 *Method 2: Billing Analysis with Quasi-Experimental Control Group*

Due to complications in program implementation or design (or as the result of significant participant attrition), RCT groups may at some point may no longer pass validity testing

and become invalid, as described in Section 5.2.6. If this occurs, ADM will estimate savings through a quasi-experimental control group.

We will verify if each cohort has a valid experimental design by reviewing pre-period billed energy consumption between the treatment and control groups for each wave. If randomization testing proves the treatment and control groups are no longer a valid match for a wave or if a randomized controlled trial (RCT) was not conducted for a wave, we will create a valid post-hoc control group from nonparticipant billing data via quasi-experimental methods. Quasi-experimental methods are required when the control group has not been randomly assigned as it would be in a RCT.

We will create a statistically similar control group using propensity score matching (PSM), a method that allows the us to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing.

A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households. ADM has conducted several analyses involving quasi-experimental methods and is familiar with the intricacies associated with them.

To create a post-hoc control group, ADM must compile billing data for a control group to compare against treatment households via quasi-experimental methods. ADM will request additional billing data from customers that have not received any HERs to attempt to build this control group. In addition, ADM will require information on the characteristics used to select each cohort, such as minimum annual usage, rate schedule, or focused geographic region. With this information, ADM will attempt to create a statistically valid control group via PSM.

The variables we propose to match on include, but are not limited to:

1. Seasonal or monthly pre-usage;
2. Household zip code.

Quasi-experimental methods may result in selection bias, the possibility that those who are chosen in the treatment group are systematically different from those who were not chosen to participate. The PSM method we propose ensures to the extent feasible that average characteristics of the treatment and comparison groups are similar, resulting in minimal bias within a non-RCT design.

ADM will ensure the control group is statistically similar to the treatment group by conducting a hypothesis *t*-test for each month in the pre-period between each group. If the post-hoc control group passes the *t*-test for the majority of pre-period months, and the groups are validly balanced, ADM will continue with the linear fixed effects D-in-D or PPR model presented in Equation 5-3 and Equation 5-4.

5.2.9 Remove Double Count Savings

After regression models have been finalized, ADM will estimate and remove double count savings found from the customers in the treatment group from other Evergy energy efficiency programs.

The Evergy HER program reports may also increase the customer's propensity to participate in other programs. This additional participation is known as uplift. The HER sent to customers includes information about other Evergy incentives and programs, which may lead to customers' adopting more energy efficient upgrades for their home. When a household participates in an efficiency program because of this encouragement, the utility might count their savings twice: once in the regression-based estimate of HER program savings and again in the estimate of savings for the other energy efficiency program. Although uplift rarely displays a statistically significant difference between the treatment and control groups, the UMP recommends removing uplift from each group at the household level.

ADM will estimate savings from program uplift and subtract them from the efficiency program portfolio savings. To achieve this, ADM will gather information on the total net kWh saved in "other programs." We will calculate the double count savings on a per-household level for each treatment group in each cohort as follows:

Equation 5-6 Double Count Specification

$$Double\ Counting = \left(\frac{OP\ kWh}{Household_{Treatment}} - \frac{OP\ kWh}{Household_{Control}}\right) \times \#\ Accounts_{Treatment}$$

Where:

$\frac{OP\ kWh}{Household_{Treatment}}$ = Other program kWh per household in the treatment group

$\frac{OP\ kWh}{Household_{Control}}$ = Other program kWh per household in the control group

$\#\ Accounts_{Treatment}$ = Total accounts in the treatment group

We will subtract the double counted savings, whether positive or negative, from the wave's gross savings estimates from the regression analysis to get total verified savings. Often, the difference in other program savings between the treatment group and the control group is not statistically significant at the 95% level. Nevertheless, it is standard practice to deduct double counted savings from the estimated savings for a behavioral program. If the cohort comparison group was selected through quasi-experimental methods, this estimate may also exhibit selection bias. However, with PSM and provided data, we will reduce this bias as much as possible.

The approach for removal of double counted savings will differ based on whether the other program is a downstream or upstream program. The following sections detail our proposed methodology for each.

5.2.9.1 *Downstream Programs*

Downstream programs traditionally track installed measures at the customer level. This information usually contains available unique customer IDs, customer names, and customer addresses, which are easily correlated with HER program data. For downstream measures, ADM will request customer-level tracking data with gross and net savings from other programs Evergy offers to customers in the HER program.

To estimate BB program savings from downstream program uplift, ADM will:

1. Match the HER program treatment and control group customers to the utility energy efficiency program tracking data by customer ID or address;
2. Calculate the savings per treatment group subject from efficiency uplift as the difference between treatment and control groups in average efficiency program savings per subject
3. Multiply that difference by the number of subjects who are in the treatment group

ADM will summarize and remove program uplift for each wave and treatment status for each of the other residential program offerings.

5.2.9.2 *Upstream Programs*

To account for programs with upstream delivery methods, ADM recommends a survey-based approach to verify the proportion of treatment and control group participants that interacted with the program during the year.

Estimating savings from program uplift for measures that the utility does not track at the customer level is more difficult. Because upstream programs are unable to track participation at the customer-level, the approach to estimating program uplift differs from that of downstream programs. Upstream program uplift estimation therefore requires household surveys to be conducted. These household surveys implemented by the other Evergy programs must include questions about the customer's purchase of items discounted through upstream programs.

For this purpose, ADM will use the general population survey of Evergy customer households to estimate upstream program participation. If this information is not available, ADM will conduct a literature review that addresses the extent to which upstream or point-of-sale programs result in increased savings among treatment group customers. This will allow ADM to estimate the difference in energy savings between the treatment group and control group that has already been claimed in the uplift program.

ADM will determine if persistence of savings is statistically different between the treatment and control groups via customer surveys. ADM will include questions in the survey to address prior year program participation for both treatment and control customers. In the case a statistically significant difference exists between the groups in any wave, ADM will include an adjustment factor and remove incremental double counted persistence savings.

5.2.10 Demand Reductions

ADM proposes the following methodology to calculated demand reductions for the Evergy Home Energy Report Program. To calculate demand reductions, monthly billing data contains insufficient granularity information. Typically, demand impact modeling requires hourly or AMI meter data.

Opower, the implementor of the program, calculates coincident demand savings by taking the energy savings from August and dividing it by the number of hours in August times a factor of 1.5. ADM will apply the same calculation to the evaluated savings from August for the estimate of program demand reductions. ADM will summarize demand reductions for each evaluated wave and each program year evaluated.

6. Online Home Energy Audit

6.1 Description of Online Home Energy Audits

The Online Home Energy Audit (OHEA) program was designed with three primary objectives: increasing awareness of residential customers' energy consumption in the home, expanding knowledge about energy efficiency, and developing customers' familiarity with the variety of demand side management (DSM) programs available to help them achieve their energy efficiency goals. Through the *My Account* portal, residential customers can access a wealth of educational material that is designed to educate them about energy consumption in their home, promote the advantages of adopting energy efficient technologies and behaviors, and provide a path towards implementing energy efficient practices through Evergy's programs. There are no defined impact goals for energy savings through this program; therefore, ADM will not complete an impact evaluation for the Online Home Energy Audit Program.

The focus of process evaluation is to (1) address the five required questions per the Missouri Code of State Regulations 20 CSR 4240-22.070 (8) ("MO Regulations") and (2) identify program process improvements to increase program participation and savings.

6.2 Process Evaluation Objectives

In evaluating the MEEIA Cycle III Online Home Energy Audit Program, ADM will implement a variety of process activities. Each year's process evaluation will be designed to answer research questions that are common to process evaluations in general and to those of this type of program specifically as well as to address questions that may have arisen from the previous year's evaluation. The research questions are:

- What is the underlying program theory and how, if at all, has it changed since the previous program years?
- How have the program implementation and delivery changed, if at all since the previous program years? How are these changes related to previous evaluation results and how are they expected to change program affects going forward?
- Did the program implementation reflect its current design? In what ways did it deviate and how did that affect program success?
- Do program utility and implementation contractor staff effectively coordinate to deliver the program?
- Are there ways to improve the design or implementation process?
- What are the barriers to getting customers to use the home Energy Audit?

- To what extent do customers access educational material through the *My Account* portal? Which digital tabs do they use within the Energy Analyzer page (Trend, Compare, Analyze, Save, Reports)? What are the barriers to doing so?
- What do customers think of the education measures and other "widgets" they access? Do the customer education measures have the intended effects (such as driving customers to other Evergy programs)?
- What actions, if any, do participants report taking to save energy and to what extent can that be attributed to the education measures or other program measures?
- How has the COVID-19 crisis affected program implementation and delivery, if at all?
- Which widgets draw attention of customers across various home demographics?
- How frequently and for how long do residential customers interact with the OHEA online tool? Do these metrics correlate with cross-program participation rates?
- At what rate do residential participants cross-participate in other Evergy programs?

6.3 Process Evaluation Approach

To address the research objectives, ADM's process evaluation activities will include: 1) annual reviews of the program database and materials and in-depth interviews with Evergy and implementer staff; 2) monthly "fast feedback" surveys of program participants; 3) feedback from nonparticipants collected through the annual general population survey (online-phone); and 4) customer journey mapping at least once per MEEIA cycle.

Table 6-1 below summarizes the data collection activities and corresponding process evaluation research objectives.

Table 6-1: Process Evaluation Data Collection Activities Summary

Data Collection Activity	Process Evaluation Research Objectives
Program Materials Review	Review reports and support materials for clarity and consistency with program objectives
Program Staff Interviews	Assess program staff perspectives regarding program operations, strengths, or barriers to success
Participant Online Survey	Assess participant knowledge, perceptions, awareness, attitudes, and behavior
Mixed Mode (Online-Phone) General Population Survey	Assess nonparticipant knowledge, perceptions, awareness, attitudes, and behavior

6.3.1 Review Program Materials

As an initial step in each year's process evaluation, ADM will review program documents and marketing materials such as delivery schedules, sample reports and samples of any additional engagement materials. The purpose of reviewing these materials is to understand what information is communicated to participants and how it is communicated.

6.3.2 Customer Engagement Review

ADM will review customer engagement data and analytics collected and provided by the implementation team, such as click-through tracking and utility of information provided to residential customers. The click-through rates, duration of visit, and frequency of return visits from program participants may provide useful information in combination with other process survey results. ADM will explore the utility of these analytics throughout the process evaluation steps to draw meaningful insights where possible.

6.3.3 Program Staff Interviews

Each year, ADM plans to conduct program staff and implementor interviews. During the interviews, ADM will clarify the program activities, including program marketing and customer engagement and seek to understand the various digital pages or "widgets" that are made available to customers. ADM also will seek to learn how participation, and cross-participation with other Evergy programs, is tracked. ADM also will explore the program manager's perspective on the opportunities for and barriers to a successful program. Additionally, we will explore program operations in interviews with implementation staff.

We will ask about any changes that have occurred in program design, implementation, or delivery, such as the Online Energy Management platform upgrade and web redesign and AMI data integration.

ADM will compare the results to program documentation to identify any areas where operations or priorities are not fully consistent with the program goals. This will form the basis to explore further in the evaluation any warranted recommendations on how the program management, design or other practices should be changed.

6.3.4 Participant Customer Surveys

Each year, ADM will contribute questions to Oracle's customer engagement tracker survey. We will adapt survey questions that we have developed previously in evaluating similar programs, which address several of the research questions for this evaluation. We will augment the instrument to address additional issues identified in interviews with program and implementer staff. Research questions will include, but may not be limited to, the following:

- How did customers learn about OHEA and what motivated them to participate?
- Did customers notice and access the various online widgets? How many did they notice and use, and how much did they use them?
- What did the customers think of the widgets, including the information provided? How easy was it to understand? What, if anything, was not easy to understand or did not make sense?
- How much do customers understand about what drives energy usage and what are the best ways to reduce it?
- How much are customers aware of their current energy use?
- Was information on their home's energy use accurate and up to date? If they think it was not, what did they disagree with and why?
- How much energy do customers believe they use compared to neighbors with similar residences? If they used the "Compare to neighbors" widget, did it change their opinion about that and, if not, why not?
- How useful was the energy saving information provided? What would have made it more useful?
- What actions have customers taken to save energy? What has kept them from taking other recommended actions? What might have induced them to take additional recommended actions?

- What would they change about how the program tools and information are provided?
- How has the COVID-19 pandemic affected customer behaviors and energy usage?
- Customer demographics and home characteristics.

If the respondent is familiar with the widgets, then a "Don't know" response could be another way of saying "I have no opinion" or "I have not thought about it." Therefore, we will add such response options in addition to "Don't know" to clarify "Don't know" responses. In addition, assessing how thoroughly the respondent read the reports (as indicated above) may shed light on "don't know" responses.

6.3.5 Nonparticipant Customer Surveys

Each year, ADM will survey nonparticipants via our annual general population survey. Our target for that survey will be 268 program nonparticipants, of whom 68 will be low-income customers.

The sample size will provide much better than 10% precision with 90% confidence on the reported energy efficiency knowledge, behaviors, and intentions assessed in the surveys.

Also, as with the participant survey, we will adapt survey questions that we have developed previously in evaluating similar programs, augmented as needed to address additional issues identified in interviews with program and implementer staff. Research questions will include, but may not be limited to, the following:

- How much are nonparticipants interested in and aware of OHEA? What prevents them from enrolling?
- How much do customers understand about what drives energy usage and what are the best ways to reduce it?
- What are customers' sources of information about how to reduce energy?
- What do the customers think of the information provided in those sources? How easy was it to understand? How useful was it?
- How much are customers aware of their current energy use?
- How much energy do customers believe they use compared to neighbors with similar residences?
- What actions have customers taken to save energy? What has kept them from taking other recommended actions? What might induce them to take additional recommended actions?

- How has the COVID-19 pandemic affected customer behaviors and energy usage?

The survey also will capture information on customer demographics and home characteristics.

Although Evergy does not claim energy savings from the OHEA program, the information from survey program nonparticipants will help in assessing the program's effects on customer knowledge, awareness, attitudes, and behaviors.

It is important to note that the sample sizes provide only moderate statistical power for detecting small population differences between the participant and nonparticipant groups with a high level of confidence.[102] However, the results are likely to provide reasonable confidence (e.g., at an alpha of .10) whether substantial differences exist between the participant and controls groups in customer knowledge, perceptions, attitudes, or behavior.

[102] The amount of statistical power that a given sample size depends on several factors. For any sample size, power is lower when the difference between two groups in the examined population parameter is smaller, when the variance of the examined parameter is larger in one or both groups, and when the significance level (alpha) being used is smaller. The variance of a proportions is defined as $p(1-p)/n$, and so the variance is greatest when $p = .5$ and least when p is closer to 0 or 100. This means that, for any absolute difference in the population percentage of participants and nonparticipants who, say, engage in energy-saving behaviors, the statistical power for detecting a difference in the sample will be smaller when the respective percentages are closer to 50% (because that is when the variances are greatest) and the power will be greater when the respective percentages are closer to 0% or 100%. Thus, for example, if 55% of the participant population but only 45% of the nonparticipant population engage in energy-saving behavior, respective samples of 68 and 200 will provide about 30% power to detect a statistically significant difference at an alpha of .05, but they will provide about 72% power if the respective population percentages are 15% and 5% or if they are 95% and 85%..

7. Business Demand Response

This chapter describes the evaluation activities that will be performed by ADM for the Business Demand Response Program.

7.1 Description of the Program

The Business Demand Response (BDR) Program is designed to reduce participant load during peak periods to improve system reliability, offset forecasted system peaks that could result in future generation capacity additions, and/or provide a more economical option to generation or purchasing energy in the wholesale market. The Program can call events from June 1 to September 30 and within designated curtailment hours of 12:00 p.m. to 8:00 p.m., Monday through Friday excluding Holidays.

The BDR Program provides an incentive for those commercial customers who reduce their electrical load during events. The incentive for customers enrolled in the program for one year is calculated as:

$$Incentive = \$28.00 \times kW\ Enrolled \times Percentage\ of\ Enrolled\ kW\ Achieved$$

The incentive or customers enrolled in the program for multiple years is calculated as:

$$Incentive = \$30.00 \times kW\ Enrolled \times Percentage\ of\ Enrolled\ kW\ Achieved$$

For both incentive calculations, incentive is capped at 110% of enrolled kW and less than 40% performance receives no payment. To remain eligible for the multi-year agreement bonus, participants must meet 90% performance.

7.2 Expected Energy and Demand Savings

Targeted energy and demand impacts for Evergy's Business Demand Response program years 2020-2022 are shown in Table 7-1 and Table 7-2. These projected savings are taken from KCP&L filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233, respectively

Table 7-1: Program Targeted Net Savings by Year, Evergy Metro

Program Year	Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)
2020	0	15,000
2021	0	15,000
2022	0	15,000
Total	0	45,000

Table 7-2: Program Targeted Net Savings by Year, Evergy MO West

Program Year	Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)
2020	0	49,488
2021	0	52,092
2022	0	54,834
Total	0	156,414

7.3 Impact Evaluation Objectives

In evaluating the MEEIA Cycle III Business Demand Response Program, ADM will implement a variety of impact evaluation exercises that include estimates of gross and net peak demand reductions (kW) as framed by the following research questions:

- How many Evergy customers participated in the program?
- What are the demand savings achieved by participants, according to the ex-ante DERMS customer baselines (CBLs)?
- Can the DERMS CBL estimates and incentive payments be independently reproduced?
- Which baseline estimation technique produces the least error and bias in estimating loads during non-event days?
- What is the average kW reduction during event hours compared to this baseline?

Additionally, the impact evaluation will provide benefit-cost analysis based on the five standard cost-effectiveness tests, listed below:

- Total resource cost test (TRC)
- Utility cost test (UCT)
- Ratepayer impact measure test (RIM)
- Societal cost test (SCT)
- Participant cost test (PCT)

7.4 Impact Evaluation Approach

This section describes the impact evaluation activities that will be performed by ADM for the Business Demand Response Program.

7.4.1 Data Needs for Evaluation

ADM's impact evaluation of the BDR program will require, at a minimum, the following data:

- Interval meter data for each facility participating in the BDR Program, with a minimum time resolution of 1 hour. ADM requests data for all participants where it is available from May through September. Data should be identified as hour ending[103] or hour beginning[104];
- A full schedule of BDR Program events including the time of the event and when participants were notified of each event;
- The baseline estimate for each event by customer;
- Copies of the spreadsheets/calculators/algorithms used internally by Evergy for the purpose of determining reported savings and program tracking;
- Any information that may clarify participants' load patterns and event day performance (e.g., communications between program managers and customers regarding planned outages, confirmed opt-outs, etc.); and
- A contact name, contact email, facility name, and address for each participant

7.4.2 Data Collection and Verification

ADM will collaborate with both Evergy and the implementation contractor, CLEAResult, on the following data collection and verification tasks:

- Establish a data transfer process with Evergy for 15-minute interval data;
- Establish a data transfer process with CLEAResult for cleaned hourly data created from Evergy interval data; and
- Request customer-level DERMS baselines, reported savings, and incentive payments.

Using this data, ADM will perform the following tasks:

- Process and perform data cleaning procedure on Evergy 15-minute interval data and transform it into an hourly format;
- Compare ADM's processed hourly interval data to CLEAResult's results from the same process;
- Compare ADM and CLEAResult's processed hourly interval data to DERMS interval data;
- Replicate DERMs baseline estimates;

[103] Hour ending denotes the preceding hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour ending 01. Hour ending 18 is the time period from 5:01 p.m. to 6:00 p.m.
[104] Hour beginning denotes the following hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour beginning 00. Hour ending 17 is the time period from 5:01 p.m. to 6:00 p.m.

- Independently reproduced the incentive payment calculation; and
- Estimate verified kW savings.

7.4.3 Customer Baseline (CBL)

In the evaluation of demand response programs, energy savings are estimated by comparing a participant's load shape during a demand response event with a baseline load shape. This baseline load is assumed to be a good estimate of the counterfactual load—that is, the load that would have manifested had there not been an event called that day.

In general, determining this baseline is a non-trivial task, especially in the context of C&I customers whose energy usage could theoretically be a function of the weather, the number of orders received, shift schedules, economic trends, and any number of variables that cannot always be explicitly modeled. Due to the intractability of modeling energy usage at this level of detail, baselines are typically estimated using heuristic rules applied to historical usage data. For example, if an event were called for Tuesday afternoon, a very simple heuristic would be to use Monday afternoon's load profile as the Tuesday event's baseline.

While, on the face of it, the above baseline rule seems overly simplistic, it could perform adequately for a certain kind of business, such as one whose energy needs do not change from day to day. However, for most businesses, these assumptions do not hold, and this simple baseline rule would not be adequate.

For the purposes of determining reported savings and customer payouts, the demand reduction achieved by the BDR Program customers is estimated with CBLs. ADM also plans to employ CBLs for evaluation. Evergy and ADM follow the general approach outlined below for event day *D*:

1. Starting with the day before *D*, take the most recent days in the defined lookback window. These are the eligible baseline days.
    a. "Any Weekday" CBLs use any non-holiday, non-event weekdays.
    b. "Similar Day of Week" CBLs use any non-holiday, non-event days that are a "similar day" to the event.
        i. For Evergy and ADM models, Monday and Friday are defined as similar. Tuesday, Wednesday, Thursday are also defined as similar days.
    c. "Same Day of Week" CBLs use any non-holiday, non-event days that are the same day of the week as the event.

2. For each of the eligible baseline days, calculate the average electric demand during the hours defined by the CBL rules. Rank the eligible baseline days in descending order of this average peak time demand.
3. Take the top days from the previous step and average their loads hour by hour. This is the unadjusted baseline*, B*. The number of days selected is determined by CBL rules.
4. Adjustments to the unadjusted baseline can be made based on usage or weather.
    a. If the average loads of *B* and *D* differ, *B* can be scaled up to match *D* in the pre-event period
        i. Adjustments can be additive (adding the sum of the difference between *B* and *D*), multiplicative (multiplying by *D* / *B*)
            1. Some CBL's cap upward and downward adjustment.
    b. A weather adjustment can made by comparing historic customer usage and weather data

In the next sections, ADM describes the approach Evergy uses for reported savings purposes, and then provides an overview of alternative approach that ADM plans on using.

7.4.4 Implementation Baseline Methodology

Evergy has selected one of the CBL's in Table 7-3 for each of the customers in the BDR Program.

Table 7-3: Evergy Baselines

Days in Lookback Window	Days Selected from Lookback Window	Day Type	Hours Used to Determine Baseline Day Selection	Load Adjustment	Load Adj. Min	Load Adj. Max
4	3	Any weekday	2-6pm	None	NA	NA
9	2	Any weekday	2-6pm	Usage based - Additive	0.8	1.2
3	3	Similar day of week	2-6pm	Usage based	NA	NA
10	3	Any weekday	2-6pm	Usage based	NA	NA
3	2	Same day of week	12-8pm	None	NA	NA
2	2	Any weekday	2-6pm	Usage based	0.8	1.2
4	3	Same day of week	2-6pm	Usage based	0.7	1.3
8	2	Similar day of week	12-3pm	Usage based	0.8	1.2
4	2	Same day of week	2-6pm	Usage based	0.8	1.2
9	2	Any weekday	2-6pm	Usage based	0.7	1.3

The selection was made in a four-step process:

1. Selection of test days: the top three hottest non-event days in 2019 were selected for each customer, ensuring at least one test event from each “similar” day type. The hottest days are identified as the days with the highest temperature during the test event period, 2 PM – 6 PM.
2. All ten of the CBLs above are calculated for each customer on the test days.
3. Bias screen: any method which underpredicts load on test days greater than 70% of the time, or less than 30% of the time is eliminated.
4. Accuracy Rank: rank-order remaining methods by RMSE and choose the most accurate method (lowest RMSE).

7.4.5 Evaluation Baseline Methodology

In the case of evaluating demand reduction impacts associated with the BDR Program, CBLs, should represent what participant’s usage would have been if the event had not occurred. ADM will employ multiple baseline models and select the best fitting models (i.e., models that produced load profiles which best represented participant’s usage in absence of the program as determined by a statistical test) for each customer. A list of models can be found in Appendix A.

ADM will identify CBL “best fits” for each customer using residual root mean squared error (RRMSE) scores from typical event hours during the five weekdays with the highest

system peak during the program year. These days serve as a good proxy for event days as they were days when an event was close to being called and will be referred to as "test event days."

It has been ADM's experience that CBL construction methods often produce generally consistent results, but in some cases CBLs may produce divergent results. To minimize calculation bias, we propose to combine results as a weighted average of the best three models for each customer. The weights will be the inverse squares of the model RRMSEs. For example, of three models having RRMSEs of 5%, 11%, and 52% respectively, their relative weights will be 82%, 17%, and 1% respectively.

7.4.6 Estimating Gross Peak Demand Reductions (kW)

The BDR Program events will be estimated on a customer-by-customer basis. The customer demand reduction is calculated as the average load shed (in kW) during the duration of all events. The program peak demand reduction will then be equal to the sum of each customer's demand reduction. Hourly load shed will be calculated by subtracting hourly usage from the CBL baseline calculated for each customer for each event.

7.4.7 Estimating Net Demand Reductions (kW)

In demand response programs, it is typically assumed that there are neither spillover effects (customers are not expected to curtail without participating), nor free ridership. Although customers can find workarounds to make up for lost productivity due to DR events, they are compensated only if they reduce peak demand, which is, in any case, the primary program goal. As such, the net-to-gross ratio for this program will be assumed to be one (1). Customers that volunteer to curtail without incentive will be considered participants and will not have their demand reduction attributed to spillover.

7.4.8 Sampling Plan for the Impact Evaluation

ADM anticipates evaluating a census of participants.

7.4.9 COVID-19 Impact Considerations

While ADM does not plan on conducting fieldwork for the BDR program, there remain considerations for the program related to the coronavirus pandemic. ADM will not use a day as a test event day if the day or lookback window used to estimate the baseline for that day was before June 16th. Prior to June 16th, Missouri was under Phase 1 of its COVID-19 reopening plan which had restrictions on business operations and could potentially lead to biased model selection. All events in 2020 were called under Phase 2 of Missouri's reopening plan which contains no statewide public health order.

8. Residential Demand Response

This chapter describes the evaluation activities that will be performed by ADM to evaluate the Residential Demand Response Program.

8.1 Description of the Program

The Residential Demand Response (RDR) program uses automatic event call technology to curtail energy use during peak demand periods. Eligible customers are provided an incentive to participate in curtailment events.

Participation Channels:

- Customers can purchase devices and install the device themselves.
- Customers can receive devices provided at a discounted price and receive professional installation.

Called upon devices (Cycle 3) will increase a customer's setpoint between 2- and 5-degrees Fahrenheit. Pre-cooling occurs prior to an event and the customer receives notification via their smart device app.

8.2 Expected Energy and Demand Savings

Targeted energy and demand impacts for the Residential Demand Response program years 2020-2022 are shown in the tables below. These targeted savings are taken from KCP&L filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233

Table 8-1: Program Targeted Net Savings by Year, Evergy Metro[105]

Program Year	Expected Energy Savings (MWh)	Expected Peak Demand Reductions (MW)
2020	1,171	8.68
2021	1,330	9.96
2022	1,466	11.14
Total	3,967	29.78

[105] Source: https://www.evergy.com/-/media/documents/billing/missouri/rules_and_regulations_mo/meeia-programs-010120.pdf?la=en

Table 8-2: Program Targeted Net Savings by Year, Evergy Missouri West[106]

Program Year	Expected Energy Savings (MWh)	Expected Peak Demand Reductions (MW)
2020	1,221	9.22
2021	1,402	10.6
2022	1,549	11.17
Total	4,172	30.99

8.3 Impact Evaluation Objectives

In evaluating the MEEIA Cycle III Residential Demand Response Program, ADM will implement a variety of impact evaluation exercises that include estimates of gross and net energy savings (kWh) as well as peak demand reductions (kW) as framed by the following research questions:

- How many Evergy customers participated in the program? What is the quantity and type of measures incentivized/rebated?
- What are the gross energy savings for each incentivized measure?
- What is the gross peak demand reduction for each incentivized measure?
- What percentage of gross savings is directly attributable to the program (net savings analysis)?

Additionally, the impact evaluation will provide benefit-cost analysis based on the five standard cost-effectiveness tests, listed below:

- Total resource cost test (TRC)
- Utility cost test (UCT)
- Ratepayer impact measure test (RIM)
- Societal cost test (SCT)
- Participant cost test (PCT)

8.4 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform for Evergy's MEEIA Cycle III Residential Demand Response Program. The impact evaluation will be

[106] Source: https://www.evergy.com/-/media/documents/billing/missouri/rules_and_regulations_mo/meeia-programs-010120.pdf?la=en

performed for Evergy Metro and Evergy Missouri West. Table 8-3 provides a summary of the savings approach by program year.

Table 8-3: Savings Approaches by Program Year

Program Year	kW Savings (Demand Response)	kWh Savings
2020	Calculated	Deemed
2021	Calculated	Deemed
2022	PY2021 Value	Deemed

8.4.1 Data Collection and Measure Verification

Data used for this evaluation will include:

- Program tracking data for PY20. This data identifies which customers participated in the program and contains data fields such as thermostat installation date, number of devices installed, thermostat device type, measure type, and other relevant data fields for the evaluation.
- Interval meter data for each customer participating in the RDR Program, with a minimum time resolution of 1 hour. ADM requests data for all participants where it is available from May through September. Data should be identified as hour ending[107] or hour beginning[108];
- 15-minute run time data for each customer participating in the RDR Program, with a minimum time resolution of 1 hour. ADM requests data for all participants where it is available from May through September.
- A full schedule of RDR Program events including the time of the event and when each participant was notified of each event;

As a first step, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy and demand impacts. The data review will include an assessment of whether savings reported in the tracking system comply with deemed savings values and guidelines set by the Evergy

[107] Hour ending denotes the preceding hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour ending 01. Hour ending 18 is the time period from 5:01 p.m. to 6:00 p.m.

[108] Hour beginning denotes the following hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour beginning 00. Hour ending 17 is the time period from 5:01 p.m. to 6:00 p.m.

Technical Reference Manual. In addition, the heating and cooling equipment type for a sample of customers will be reviewed to ensure tracking data was entered correctly (e.g., Energy Efficiency Ratio and AC capacity). The review of equipment data fields will only be relevant to customers that have the smart thermostat professionally installed.

8.4.1.1 *Weather Data*

ADM will collect two types of weather data for the evaluation: 1) actual recorded weather from the National Oceanographic and Atmospheric Administration (NOAA) and 2) 30-year weather normal or Typical Meteorological year (TMY) weather data. Actual weather data will be used when fitting the model and TMY data will be used to extrapolate savings.

ADM will collect monthly Heating Degree Days (HDD) and Cooling Degree Days (CDD) from NOAA.gov for use in the regression analysis. Data will be collected from the nearest available weather stations and assigned to each customer based on customer zip code. Monthly HDDs are calculated as the sum of daily average temperature values under the heating setpoint (e.g., 60°F) in a given month, while monthly CDDs are calculated as the sum of daily average temperature values over the cooling setpoint (e.g., 70°F) in a given month. The actual setpoint values for HDDs and CDDs will be determined by running regressions with multiple setpoints from 60°F-80°F and choosing the setpoint combination with the highest adjusted R-squared value (i.e., best fit).

ADM will collect Typical Meteorological Year (TMY) data[109] from the nearest relevant weather station/s which will be used to extrapolate estimated annual savings.

8.4.2 Estimating Gross Savings

8.4.2.1 *Demand Savings (kW)*

Demand savings for the DR portion of the program will be estimated using a weather-adjusted Linear Fixed Effects Regression (LFER) model. The model uses customers' thermostat run time or AMI data on event and non-event days to estimate the impact on energy demand. The LFER model specifies energy demand as a function of temperature and other variables that influence usage.

ADM will estimate savings in kW/ton separately for both Evergy Metro and Evergy Missouri West. If savings per ton cannot be obtained, ADM will default to providing savings estimates in kW/unit.

With 15-minute AMI data, kW is known and does not have to be estimated prior to running the LFER model. However, AMI data is not restricted to HVAC loads and introduces more

[109] https://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/by_state_and_city.html

uncertainty into the savings estimates. If thermostat/HVAC run time data is available, ADM will utilize it to compare savings estimates for both types of data.

Prior to running the LFER model, ADM will convert thermostat run time values into kW using an average utility-specific AC unit capacity (Btu/Hr) and Energy Efficiency Ratio (EER). This step applies only to thermostat run time data (15-minute AMI data will provide kW values at the meter level). These values will be obtained from the tracking data. The following model will be run to estimate the run time and demand relationship:

$$Usage\ (kW)_{it} = \alpha_0 + \beta_1 * \frac{Runtime * \frac{Btu}{hr}}{EER * 1{,}000} + \beta_2 * CDH\ + \beta_3 * CDH * \frac{Runtime * \frac{Btu}{hr}}{EER * 1{,}000} + \epsilon_{it}$$

Where:

Runtime	= the length of time the AC unit is running
CDH	= cooling degree hours
Btu/h	= average assumed AC unit capacity
EER	= the assumed Energy Efficiency Ratio (Btu/W)

In addition, ADM will identify non-event days during the same month as the DR events whose weather pattern most closely matches the weather pattern on event days. These days will serve as the counterfactual baseline.

Regardless of whether AMI or run time data is utilized, the general form of the LFER model is shown below. The final form of the model will depend on model fit (adjusted R2) and statistical significance of predictors.

$$Usage\ (kW)_{it} = \alpha_0 + \beta_1 CDH_{it} + \beta_2 PreCooling_{it} + \beta_3 NHBU_{it} * Event_{it} + \beta_4 Snapback_{it} + \beta_5 MA4CDH_i + \beta_6 MA24CDH_{it} + \epsilon_{it}$$

Where,

α_0	= the intercept term
t	= the index for time intervals
i	= the index for smart thermostat devices
β_k	= a vector of coefficients. The primary coefficient of interest is β_3 which provides the average kW reduction estimate during the demand response events
CDH	= cooling degree hours
$PreCooling$	= a dummy variable for the three hours preceding an event
$NHBU$	= normalized heat build-up, defined as the cumulative heat buildup based on the weighted average of past hourly values. The weighting

uses a compounded discount factor of 0.95833 for the number of hours prior (up to 72 hours)

$Event$ = a binary dummy variable for event hours;

$Snapback$ = a binary dummy variable for the three hours following an event;

$MA4CDH$ = a moving average of the last 4 hours CDH;

$MA24CDH$ = a moving average of the last 24 hours CDH;

ϵ = the error term.

Prior to running the model, ADM will verify completeness and accuracy of the thermostat run time data and remove devices that fail to meet certain criteria, including:

- Missing zip code for a device/customer (due to inability to map to correct weather data);
- Non-responding devices (NRD).

A device is considered "non-responding" (NRD) if it does not respond to the curtailment signal for reasons other than the device being manually overridden by the customer. Common causes of non-response are system outages, internet accessibility issues or other physical barriers that may block the signal.

Prior to the calculation of kW factors, non-responding devices are identified and removed from the sample using an appropriate NRD identification algorithm from ADM's residential DR analysis toolkit.

Manual Overrides

DR programs typically provide a process by which the customer may override DR curtailments. If the customer does not wish to participate in a DR event, depending on the subprogram, they may override the curtailment over the internet, by calling a customer support hotline or manually doing so on the device. Manual overrides can be measured using whatever event tracking data sets are provided by the utility and its implementers. These override logs differ between device types in what data is recorded and can be presented in this analysis. ADM will perform a manual override analysis using whatever override data is available from the program devices. While this analysis feeds into the DR event analysis, ADM also provides override percentages per event hour for any program devices with applicable data. Customers that override DR curtailments will not be counted for events and will not contribute to demand savings.

8.4.2.2 *Energy Savings (kWh)*

ADM will utilize deemed savings from the Evergy Technical Resource Manual (TRM). This specifies 197.00 kWh/unit for smart thermostats. The total energy savings (kWh) for

the program will be calculated by taking the deemed kWh/unit TRM value and multiplying by the number of thermostat units considered part of the program for a given Program Year.

8.4.3 Estimating Net Savings

In demand response programs, it is typically assumed that there are neither spillover effects nor free ridership (only participating customers are expected to curtail usage). As such, the net-to-gross ratio for this program will be assumed to be 100%.

8.4.4 Sampling Plan for the Impact Evaluation

ADM anticipates evaluating a census of participants.

8.4.5 COVID-19 Impact Considerations

ADM anticipates impacts from COVID-19 on demand savings. Prior to June 16th, Missouri was under Phase 1 of its COVID-19 reopening plan which had restrictions on business operations. Phase 2 of Missouri's reopening plan began on June 16th and contains no statewide public health order. If all events were called after Phase 2, ADM will restrict non-event baseline days to days on or after June 16th. If events occur during both Phase 1 and Phase 2, ADM will include a dummy variable in the model to account for which phase the baseline and event days occur.

9. Business Smart Thermostats

This chapter describes the evaluation activities that will be performed by ADM to evaluate the Business Smart Thermostat Program.

9.1 Description of the Program

The Business Smart Thermostat (BST) program offers customers the ability to control and monitor energy usage through their smart thermostat.

Participation Channels:

- Customers can purchase devices and install the device themselves.
- Customers can receive devices provided at a discounted price and receive professional installation.

9.2 Expected Energy and Demand Savings

Targeted energy and demand impacts for the Business Smart Thermostat Response program years 2020-2022 are shown in the tables below. These projected savings are taken from KCP&L filing EO-2019-0132 and KCP&L-GMO filing EO-2019-0233.

Table 9-1: Program Targeted Net Savings by Year, Evergy Metro

Program Year	Expected Energy Savings (MWh)	Expected Peak Demand Reductions (MW)
2020	29	0.21
2021	58	0.43
2022	87	0.64
Total	174	1.28

Table 9-2: Program Targeted Net Savings by Year, Evergy Missouri West

Program Year	Expected Energy Savings (MWh)	Expected Peak Demand Reductions (MW)
2020	28	0.21
2021	57	0.41
2022	85	0.62
Total	170	1.24

9.3 Impact Evaluation Objectives

In evaluating the 2020 Business Smart Thermostat Program, ADM will implement a variety of impact evaluation exercises that include estimates of gross and net energy savings (kWh) as well as peak demand reductions (kW) as framed by the following research questions:

- How many Evergy customers participated in the program? What is the quantity and type of measures incentivized/rebated?
- What are the gross energy savings for each incentivized measure?
- What is the gross peak demand reduction for each incentivized measure?
- What percentage of gross savings is directly attributable to the program (net savings analysis)?

Additionally, the impact evaluation will provide benefit-cost analysis based on the five standard cost-effectiveness tests, listed below:

- Total resource cost test (TRC)
- Utility cost test (UCT)
- Ratepayer impact measure test (RIM)
- Societal cost test (SCT)
- Participant cost test (PCT)

9.4 Impact Evaluation Approach

This chapter describes the impact evaluation activities that ADM will perform for Evergy's 2020 Business Smart Thermostat Program. Table 9-3 provides a summary of the savings approach by program year.

Table 9-3: Savings Approaches by Program Year

Program Year	kW Savings (Demand Response)	kWh Savings
2020	Calculated	Calculated/Deemed
2021	Calculated	PY2020 Value
2022	PY2021 Value	PY2020 Value

9.4.1 Data Collection and Measure Verification

Data used for this evaluation will include:

- Program tracking data. This data identifies which customers participated in the program and contains data fields such as thermostat installation date, number of devices installed, thermostat device type, measure type, and other relevant data fields for the evaluation.
- Interval meter data for each customer participating in the BST Program, with a minimum time resolution of 1 hour. ADM requests data for all participants where it is available from May through September. Data should be identified as hour ending[110] or hour beginning[111];
- 15-minute run time data for each customer participating in the BST Program, with a minimum time resolution of 1 hour. ADM requests data for all participants where it is available from May through September.
- A full schedule of BST Program events including the time of the event and when each participant was notified of each event;

As a first step, ADM will review data tracking systems associated with the program to ensure that the data provides sufficient information to calculate energy and demand impacts. The data review will include an assessment of whether savings reported in the tracking system comply with deemed savings values and guidelines set by the Evergy Technical Reference Manual. In addition, the heating and cooling equipment type for a sample of customers will be reviewed to ensure tracking data was entered correctly (e.g., Energy Efficiency Ratio and AC capacity). The review of equipment data fields will only be relevant to customers that have the smart thermostat professionally installed.

9.4.1.1 *Weather Data*

ADM will collect two types of weather data for the evaluation: 1) actual recorded weather from the National Oceanographic and Atmospheric Administration (NOAA) and 2) 30-year weather normal or Typical Meteorological year (TMY) weather data. Actual weather data will be used when fitting the model and TMY data will be used to extrapolate savings.

ADM will collect monthly Heating Degree Days (HDD) and Cooling Degree Days (CDD) from NOAA.gov for use in the regression analysis. Data will be collected from the nearest available weather stations and assigned to each customer based on customer zip code. Monthly HDDs are calculated as the sum of daily average temperature values under the

[110] Hour ending denotes the preceding hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour ending 01. Hour ending 18 is the time period from 5:01 p.m. to 6:00 p.m.

[111] Hour beginning denotes the following hourly time period. For example, 12:01 a.m. to 1:00 a.m. is hour beginning 00. Hour ending 17 is the time period from 5:01 p.m. to 6:00 p.m.

heating setpoint (e.g., 60°F) in a given month, while monthly CDDs are calculated as the sum of daily average temperature values over the cooling setpoint (e.g., 70°F) in a given month. The actual setpoint values for HDDs and CDDs will be determined by running regressions with multiple setpoints from 60°F-80°F and choosing the setpoint combination with the highest adjusted R-squared value (i.e., best fit).

ADM will collect Typical Meteorological Year (TMY) data[112] from the nearest relevant weather station/s which will be used to extrapolate estimated annual savings.

9.4.2 Estimating Gross Savings

9.4.2.1 *Demand Savings (kW)*

Demand savings for the DR portion of the program will be estimated using a weather-adjusted Linear Fixed Effects Regression (LFER) model. The model uses customers' thermostat run time or AMI data on event and non-event days to estimate the impact on energy demand. The LFER model specifies energy demand as a function of temperature and other variables that influence usage.

ADM will estimate savings in kW/ton separately for both Evergy Metro and Evergy Missouri West. If savings per ton cannot be obtained, ADM will default to providing savings estimates in kW/unit.

With 15-minute AMI data, kW is known and does not have to be estimated prior to running the LFER model. However, AMI data is not restricted to HVAC loads and introduces more uncertainty into the savings estimates. If thermostat/HVAC run time data is available, ADM will utilize it to compare savings estimates for both types of data.

Prior to running the LFER model, ADM will convert thermostat run time values into kW using an average utility-specific AC unit capacity (Btu/Hr) and Energy Efficiency Ratio (EER). This step applies only to thermostat run time data (15-minute AMI data will provide kW values at the meter level). These values will be obtained from the tracking data. The following model will be run to estimate the run time and demand relationship:

$$Usage\ (kW)_{it} = \alpha_0 + \beta_1 * \frac{Runtime * \frac{Btu}{hr}}{EER * 1{,}000} + \beta_2 * CDH\ + \beta_3 * CDH * \frac{Runtime * \frac{Btu}{hr}}{EER * 1{,}000} + \epsilon_{it}$$

Where:

Runtime = the length of time the AC unit is running;

CDH = cooling degree hours;

[112] https://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/by_state_and_city.html

Btu/h = average assumed AC unit capacity;

EER = the assumed Energy Efficiency Ratio (Btu/W).

In addition, ADM will identify non-event days during the same month as the DR events whose weather pattern most closely matches the weather pattern on event days. These days will serve as the counterfactual baseline.

Regardless of whether AMI or run time data is utilized, the general form of the LFER model is shown below. The final form of the model will depend on model fit (adjusted R2) and statistical significance of predictors.

$$Usage\ (kW)_{it} = \alpha_0 + \beta_1 CDH_{it} + \beta_2 PreCooling_{it} + \beta_3 NHBU_{it} * Event_{it} + \beta_4 Snapback_{it} + \beta_5 MA4CDH_i + \beta_6 MA24CDH_{it} + \epsilon_{it}$$

Where:

α_0 = the intercept term;

t = the index for time intervals;

i = the index for smart thermostat devices;

β_k = a vector of coefficients. The primary coefficient of interest is β_3 which provides the average kW reduction estimate during the demand response events.

CDH = cooling degree hours;

$PreCooling$ = a dummy variable for the three hours preceding an event;

$NHBU$ = normalized heat build-up, defined as the cumulative heat buildup based on the weighted average of past hourly values. The weighting uses a compounded discount factor of 0.95833 for the number of hours prior (up to 72 hours);

$Event$ = a binary dummy variable for event hours;

$Snapback$ = a binary dummy variable for the three hours following an event;

$MA4CDH$ = a moving average of the last 4 hours CDH;

$MA24CDH$ = a moving average of the last 24 hours CDH;

ϵ = the error term.

Prior to running the model, ADM will verify completeness and accuracy of the thermostat run time data and remove devices that fail to meet certain criteria, including:

- Missing zip code for a device/customer (due to inability to map to correct weather data);

- Non-responding devices (NRD).

A device is considered “non-responding” (NRD) if it does not respond to the curtailment signal for reasons other than the device being manually overridden by the customer. Common causes of non-response are system outages, internet accessibility issues or other physical barriers that may block the signal.

Prior to the calculation of kW factors, non-responding devices are identified and removed from the sample using an appropriate NRD identification algorithm from ADM’s residential DR analysis toolkit.

Manual Overrides

DR programs typically provide a process by which the customer may override DR curtailments. If the customer does not wish to participate in a DR event, depending on the subprogram, they may override the curtailment over the internet, by calling a customer support hotline or manually doing so on the device. Manual overrides can be measured using whatever event tracking data sets are provided by the utility and its implementers. These override logs differ between device types in what data is recorded and can be presented in this analysis. ADM will perform a manual override analysis using whatever override data is available from the program devices. While this analysis feeds into the DR event analysis, ADM also provides override percentages per event hour for any program devices with applicable data. Customers that override DR curtailments will not be counted for events and will not contribute to demand savings.

9.4.2.2 *Energy Savings (kWh)*

Energy savings for smart thermostat customers who do not participate in demand response will be estimated using a weather-adjusted Lagged Dependent Variable (LDV) ordinary least-squares (OLS) regression model. A matched comparison group will be created using a propensity score matching (PSM) approach. With the PSM approach, a propensity score is estimated for treatment customers (i.e., those who received program services) and a group of customers who did not receive program services using a logit model. Customers in the treatment and control groups are matched based on seasonal pre-period usage (e.g., summer, spring, fall, and winter) and zip code (or other geographical identifiers).

Control group customers will be selected from customers who have not participated in any demand response or energy efficiency programs[113]. In addition, the LDV model will utilize post period data only. Data for control customers will be restricted to the post period timeframe for their matched participant (to ensure the same number of observations in

[113] ADM will cross-reference customers with tracking datasets for other energy efficiency programs when constructing treatment and control cohorts.

the post period). After creating a matched comparison group, the program impacts will be estimated with the following regression. The final form of the model will depend on model fit (adjusted R2) and statistical significance of predictors.

The general form of the model is shown below.

$$Usage\ (kWh)_{it} = \alpha_0 + \sum_{m=1}^{12} \alpha_m * Month_{m,t} + \beta_1 * Lag12_{kWh_{it}} + \beta_2 * No\_Thermostats_{it} * HDD_{it} + \beta_3 * No\_Thermostats_{it} * CDD_{it} + \beta_4 * HDD_{it} + \beta_5 * CDD_{it} + \epsilon_{it}$$

Where:

α_0	= the intercept term;
t	= the index for the time interval (e.g., hour or 15-min if AMI data);
i	= the index for the customer;
Month	= a dummy variable for month of the year;
kWh_{it}	= average kilowatt hours consumed during time interval t;
$Lag12\ \_kWh_{it}$	= kilowatt hours consumed during time interval t one year prior;
$No\_Thermostats_{it}$	= the number of thermostats installed for customer i (equal to 0 if customer is in the control group);
CDD_{it}	= average cooling degree hours for time interval t;
HDD_{it}	= average heating degree hours for time interval t;
ϵ_{it}	= the error term;
α, β	= parameters to be estimated by the model.

Additional covariates may include zip code or geographic identifiers, multifamily indicator, Home Energy Report treatment indicator, hour of the day (if using AMI data), and other relevant predictors.

In the event kWh cannot be estimated (e.g., due to a small cohort), ADM will utilize deemed savings from the Evergy Technical Resource Manual (TRM). This specifies 197.00 kWh/unit for smart thermostats. The total energy savings (kWh) for the program will be calculated by taking the deemed kWh/unit TRM value and multiplying by the number of thermostat units considered part of the program for a given Program Year.

9.4.3 Estimating Net Savings

In demand response programs, it is typically assumed that there are neither spillover effects nor free ridership (only participating customers are expected to curtail usage). As such, the net-to-gross ratio for this program will be assumed to be 100%.

9.4.4 Sampling Plan for the Impact Evaluation

ADM anticipates evaluating a census of participants.

9.4.5 COVID-19 Impact Considerations

ADM anticipates impacts from COVID-19 on demand savings. Prior to June 16th, Missouri was under Phase 1 of its COVID-19 reopening plan which had restrictions on business operations. Phase 2 of Missouri's reopening plan began on June 16th and contains no statewide public health order. If all events were called after Phase 2, ADM will restrict non-event baseline days to days on or after June 16th. If events occur during both Phase 1 and Phase 2, ADM will include a dummy variable in the model to account for which phase the baseline and event days occur.

10. Products & Services Incubator (R&P) & PAYS

10.1 Introduction

This plan focuses on evaluating the overall effectiveness, and to the extent possible, the gross and net energy savings for its pilot programs. Given the unique nature of these pilot programs, the staggered launch dates and the specialized outreach, the initial focus of these EM&V plans will be on performing a limited process evaluation. As the programs grow and expand, ADM will conduct impact evaluations to determine gross and net savings.

This document summarizes proposed evaluation activities to be conducted for the evaluation of the Incubator Programs program during the 2020-2022 MEEIA cycle.

10.1.1 Description of MEEIA Cycle III Incubator Programs

10.1.1.1 *Energy Efficiency for Non-Profits (EENP) Pilot*

This pilot will target Evergy commercial or residential customers, specifically nonprofit, 501(c)(3) organizations, that primarily provide lodging and social services to low-income, homeless, and/or at-risk populations. The pilot will operate on a similar model to the existing Evergy Income-Eligible Multi-Family and Business Energy Savings Program. However, rebates will be adjusted to better serve the customer segment – to likely include a free Direct Install component, offering free lighting upgrades, free insulation, air sealing and free HVAC tune-ups. Standard and Custom Incentives may also be available for Appliances or HVAC upgrades/replacements, which will be funded through this Pilot offer.

10.1.1.2 *KC - Low Income - Leadership Assistance Collaborative*

The collaborative will bring together local support resources / agencies / associations / corporations, etc. together to offer the best and most comprehensive experience for this area's low-income customers. The focus will be to link three different, but interconnected, home components, including: energy efficiency, health, and structural integrity. The pilot will target the low-income support channels and low-income residents.

10.1.1.3 *HVAC Quality Install Pilot*

This pilot will target contractors (Trade Allies) that work throughout the Evergy service territory, with a focus on those who already have implemented Measure Quick technology within their business practice. Using Measure Quick technology, Trade Allies will be able to quickly test, document and verify that a true quality installation has been performed but with a reduced level of effort. The HVAC QI pilot will provide Trade Allies an incentive to perform this deeper retrofit benefiting both the program and the customer with higher

modeled energy savings and a more efficient HVAC system with a longer lifespan. This pilot will help determine the extra level of effort required during the installation, as well as the level of incentive dollars needed to make the deeper retrofit valuable enough for the Trade Ally to perform regularly.

10.1.1.4 *Pay as You Save Pilot Program (PAYS)*

PAYS is designed to reduce the first-cost and split-incentive barrier for comprehensive whole-house retrofits. This program model assigns the repayment obligation to the utility meter rather than to the homeowner or renter, with the energy savings being used to pay down the cost of the retrofit.

Table 10-1 summarizes net savings for each incubator program.

Table 10-1: Pilot Programs Targeted Net Savings

Program	Program Year	Evergy Missouri Metro		Evergy Missouri West		Program Overall	
		Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)	Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)	Expected Energy Savings (kWh)	Expected Peak Demand Reductions (kW)
EENP	2020-21	33	330,000	33	330,000	66	660,000
HVAC QI Program	2020-21	42,700	49	42,700	49	85,400	98
KC LILAC	2020-21	NA	NA	NA	NA	NA	NA
PAYS	2021-22	TBD	TBD	TBD	TBD	TBD	TBD

Table 10-2 and Table 10-3 summarize the impact and process evaluation activities that will be completed for program years 2 & 3. Program year one will include review of available program materials & program staff interviews.

Table 10-2: Impact Evaluation Data Collection Activities Summary

Data Collection Activity	Impact Evaluation Research Objectives
Program Tracking Data Review and Audit	Verify that the tracking data provides sufficient information to calculate energy and demand impacts
	Verify proper application of deemed savings estimates
	Audit data to insure there are no duplicate or erroneous entries

Table 10-3: Summary of Process Evaluation Data Collection Activities for Incubator Programs

Data Collection Activity	Process Evaluation Research Objectives
Program Materials Review	Review reports and support materials for clarity and consistency with program objectives.
Program Staff Interviews	Assess program staff perspectives regarding program operations, strengths, weaknesses, barriers to success, and opportunities for improvement.
Customer Journey Mapping	Document customers' thoughts, feelings, and actions across the stages of program participation

Table 10-4 summarizes the proposed timing for these EM&V activities.

Table 10-4: Proposed Timing of Incubator EM&V Activities

Program	Process Evaluation Activities			Impact Evaluation Activities	
	Staff Interviews in Compliance with 20 CSR 4240-22.070 (8) (A),	Database Records Review	Customer Journey Mapping	Participant Surveys	Contractor Surveys
EENP	2020,2021,2022	2021, 2022	2021	2021	NA
HVAC QI Program	2020,2021,2022	2020,2021, 2022	2021	NA	2021
KC LILAC	2020,2021,2022	2021,2022	NA	NA	NA
PAYS Program	2021,2022	2021,2022	2021	2021, 2022	2021, 2022 (TBD)

10.2 Pilot-Specific Evaluation Plans

This section summarizes the specific scope of the EM&V activities that we will conduct. However, given that pilot programs are designed to test new program designs, the evaluation activities will focus on identifying the strengths, weaknesses, and overall success of each pilot activity at the end of the three-year cycle. We summarize our proposed approach for each incubator program next.

10.2.1 Energy Efficiency for Non-Profits (EENP) Pilot

Impact Evaluation Approach: To the extent possible, we will leverage the impact evaluation activities from Evergy's existing Income-Eligible Multi-Family and Business Energy Program Savings. The participant survey will follow the same format and

approach designed to determine measure installation rates, measure persistence from the Direct Install component, and savings from the measures installed through this pilot program. We will also follow the same calculation methods to determine net and gross savings. For specific details regarding the scope of impact evaluation activities, please consult the following EM&V Plans: Income-Eligible Multi-Family and Business Energy Savings Programs.

Process Evaluation Approach: Each year we will conduct a focused process evaluation that will include in-depth interviews with the program staff, a review of the program materials. In Program Year 2, we will complete a journey map, which will highlight the interactions between Evergy, the participating non-profit organizations, and the program participants. This information will be used to refine the program outreach and delivery methods.

10.2.2 KC - Low Income - Leadership Assistance Collaborative (KC-LILAC)

Impact Evaluation Approach: Since there are no specific gross or net savings goals associated with this incubator program, no impact evaluation activities will be collected.

Process Evaluation Approach: Each year we will conduct a focused process evaluation that will include in-depth interviews with the program staff and the KC LILAC participants. We will also review any program materials, outreach activities, and other relevant documentation as applicable. Given that this is not a participant-facing program, we do not anticipate completing a customer journey map for this program.

10.2.3 HVAC QI- Impact Evaluation Approach

Impact Evaluation Approach: As way to test the overall effectiveness of this pilot program, we will launch a trade ally survey in the fall of 2021 and 2022. This survey will determine the overall effectiveness of the proposed rebate. We will also conduct a trade ally survey targeting all participating contractors regarding the effectiveness and accuracy of the savings associated with using Measure Quick. Given that this is a pilot program, we will not conduct any free-ridership analysis.

Process Evaluation Approach: Each year we will conduct in-depth interviews with the program staff and implementer and include specific questions regarding the overall effectiveness of program delivery and operation in both the customer and trade ally surveys. We will also review any program materials, outreach activities, and other relevant documentation as applicable. We will develop a customer-journey map during the second year of program operations, as the in-depth interviews will allow us to develop a comprehensive understanding of this pilot program.

10.2.4 Pay-As-You-Save (PAYS) Program

Impact Evaluation Approach: The general approach for impact evaluation of the Pilot would apply IPMVP Option C and analysis of customer billing data pre-and post-retrofit to evaluate savings impacts. This is similar to approaches described in the EM&V plans for the weatherization programs. We will also conduct the following analyzes:

- **Comparison of savings to estimates for payback from program implementers:** When establishing the payback timeline, program implementers need to put an estimate of savings by month. This will vary by month due to seasonality of energy use. We will develop monthly savings profiles and compare this to the payback schedule established for Pilot participants and address the extent of over- or under-collection.
- **Compare savings acquisition costs to Evergy's other programs for similar measures:** In addition to the billing analysis-based savings, we will calculate savings applying Evergy TRM protocols and compare the value of projects relative to their acquisition cost.

10.3 Estimating Net Savings

Net savings will apply a self-report approach. Questions will emphasize the Pilot's impact in defraying the first-cost barrier, and will examine the following counterfactuals:

- If the respondent would have completed a project in another ESI program
- If the respondent would have completed a project outside of ESI programs
- If the timeline of the project was advanced due to the financing option

Process Evaluation Approach*:* We will conduct the following activities: 1) in-depth interviews with Evergy and implementer staff at the beginning and end of the pilot year and a review of the program database and materials at the end of the pilot year; 2) a phone or online survey of program participants at the end of the pilot year; and 3) feedback on program awareness and interest from the general population survey.

Program-specific areas of focus for this process evaluation will include factors that influenced participants to enroll in PAYS financing. Did participants enroll because they expected to remain in their homes for the duration of the financing? Were they at all concerned that doing so might make it difficult to sell their house later and, if so, what convinced them to take that risk? The evaluation also will assess whether participants did experience a net reduction in their energy bill. We may identify additional research questions through the review of databases and materials and staff interviews

We will also develop a customer journey mapping during PY2022 to illustrate ways in which participants and contractors have engaged in this program during the pilot period.

10.4 Process Evaluation Objectives

The process evaluation objectives will conform to industry best practices by ensuring that ADM gathers data from a variety of sources including program staff, market actors, trade allies, program participants, and non-participants. As part of addressing the five high-level CSR-mandated questions, the process evaluation for the Heating, Cooling, and Home Comfort Program will address program design, administration, implementation, delivery, and market response.[114] Specifically, each process evaluation will address several key research questions:

- Is the program design appropriate for its objectives?
- What is the general level of program awareness?
- How effective is program communication, within and between Evergy and implementers and between the program and trade allies?
- How effective is program marketing and outreach? What is most and least effective?
- How effectively is the program delivered by implementers and trade allies?
- Does the mix of measures installed through the program reflect expectations?
- Are program rules, procedures, and processes reasonable?
- What are customers' motives for saving energy?
- How do customers make decisions about energy-using equipment and products?
- What are the barriers to program participation?
- How can the program improve communication, marketing and outreach, delivery, and processes or otherwise remove barriers to participation?
- In addition to the key research questions identified above, the process evaluation will address additional research questions through the review of databases and materials and staff interviews. Additional questions appropriate for this type of program could include:
- What are the barriers to getting customers to sign up for the home Energy Audit? Are customers skeptical that the DI measures are actually free?
- What other factors might make it difficult for assessors to carry out the home Energy Audits? For example, do assessors ever have concerns about their own safety or have difficulty locating an address?

[114] http://www.calmac.org/events/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006.pdf.

- What home factors might mitigate the effectiveness of insulation and air sealing measures, such as openings that are too large to be effectively sealed?
- Do the customer education measures have the intended effects?

ADM will also investigate how the COVID-19 crisis affected program implementation and delivery, if Evergy staff deem that appropriate.

11. Process Evaluation Activities

This chapter describes the process evaluation activities that ADM will perform for Evergy's portfolio of Residential, & Demand Response, programs.

The process evaluation will include the following activities:

- Annual reviews of the program database and materials and in-depth interviews with Evergy and implementer staff
- Monthly Fast Feedback participant survey
- Non-participant feedback from the annual general population survey
- Feedback from surveys and/or interviews with program contractors and installers
- Customer journey mapping of the Heating, Cooling, and Home Comfort Program in MEEIA 3 Cycle (Year 2 only)

11.1 Program Tracking Review

The first critical task will be to review the program databases that will complement the impact evaluation review of the program databases. Specifically, this review will determine whether the program database is capturing all critical information. The database review will also include summaries of the essential program metrics as appropriate such as:

- Number of measures installed by program and program delivery channel
- Number of unique participants by program and by utility relative to program participation estimates

Application process metrics by program, including application processing times, reasons for denial, and distribution of participants by geographic location

Program Marketing Materials and Website Review

ADM will review the current program marketing materials. This will include examining relevant program documents such as program marketing materials, application/rebate forms, and website materials.

The findings from this review will be summarized in an overall assessment of the effectiveness of current marketing and outreach activities, especially those targeting trade allies. Specifically, ADM will provide a summary of the overall effectiveness of these materials, including any available data on web site visits, click-throughs, and associated metrics. The review also will compare the current market tactics to industry best practices for marketing residential energy-efficiency programs.

11.2 Program Staff and Implementer Review

ADM will conduct interviews with both the program staff and implementer staff. ADM will conduct interviews with the utility program staff responsible for deploying the programs. The in-depth interviews will be conducted via telephone. These interviews will discuss the respondent's roles and responsibilities for the program, the effectiveness of current program design, assess overall program operations, outreach and marketing approaches, customer and contractor satisfaction, barriers to participation and areas for program improvement.

ADM will also conduct interviews with appropriate staff from the various implementation contractors involved in program operations. These will include the implementation contractors and other key stakeholders, such as internal or external marketing and advertising staff, as determined by the utility program manager. The in-depth interviews will be conducted via telephone. The discussions will cover the same process evaluation topics to ensure consistency across all interview guides.

11.3 Trade Ally Surveys and Interviews

ADM will conduct trade ally surveys and interviews to provide additional information regarding specific downstream and midstream program activities, as well as to provide inputs for our improved spillover estimation method. The annual online survey of trade allies will include questions to assess spillover, as well as questions addressing program awareness, contractor satisfaction, barriers to program participation, and current installation rates and market trends.

11.4 Property Manager Interviews

As a part of ADM's process evaluation for the IEMF program, we will conduct a phone interview of property owners or managers who have participated in the program. ADM will utilize program tracking data to contact property managers or owners. The interview will gather data on participant knowledge and awareness of the program, business practices, satisfaction, reasons for participating, decision-making process, as well as general attitudes and behaviors regarding energy efficiency, the IEMF program, and Evergy as their utility. These interviews will be conducted with an ADM Evaluator.

11.5 Participant Surveys

ADM will use a monthly Fast Feedback survey of all recent participants for the Heating, Cooling, and Home Comfort Program. The Fast Feedback methodology will consist of monthly surveys of customers who participated in the program in the previous month. These will be online surveys to assess satisfaction and customer decision-making,

including free ridership and spillover questions, and to identify areas for program improvement.

For the Fast Feedback survey, the process team at ADM will develop quarterly quotas for the program, targeting 90%/10% confidence and precision, with monthly completion targets designed to achieve the quarterly quotas. Month-to-month fluctuations in program participation might occur, but prior participation patterns will be used to establish a "soft" target and the target for the second and third months within a quarter as needed, based on the completion rate of the previous month(s).

Online survey will be conducted each month of participants whose incentive or rebate check was processed in the previous month. ADM will screen out any customers who have participated in other customer surveys during this evaluation year and will deduplicate each month's sample frame to ensure that participants who had multiple projects or measures that month are represented only once. Participants will be surveyed about the program or measure for which that month's sample frame is least likely to yield the desired number of survey completions.[115]

By incorporating both process and impact questions into the Fast Feedback survey, ADM will be able to provide monthly and quarterly updates regarding key program metrics including:

- Current customer satisfaction rates across the program
- Estimated NTG and spillover rates to monitor DSM impacts
- Analysis of monthly participation rates by program or measure
- Continuous monitoring of ongoing program operations to allow for timely course corrections as needed

ADM will utilize results from the Evergy resident surveys left on postage-paid cards in participating units to assess resident satisfaction with Evergy and the IEMF program. For the HER program ADM will conduct participant & control group surveys.

11.5.1 General Population Survey

ADM will conduct a mixed-mode (online-phone) general population survey in the residential sector each year of the MEEIA 3 program cycle. The purposes of this survey are to:

[115] For example, if the number of completed projects or measures of one type is 10 times the number needed to achieve the target sample size and the number of completed projects or measures of another type is five times the number needed to achieve the target, ADM will survey the participant about the second project or measure.

1) Provide insights regarding overall awareness of Evergy's Program offerings among program non-participants
2) Assess the influence of programs and trade allies (contractors and distributors) on equipment purchases to assess spillover rates

Evergy customer records will be the preferred source for developing the sample frame for the general population survey. This source will ensure that ADM contacted only Evergy customers, it will provide the most up-to-date contact information, and it will allow stratification by rate class or energy usage among residential customers. If Evergy is unable to provide customers records, ADM will purchase contact lists.

As many customers as needed will be surveyed to achieve the non-participant and participant quotas in each sector. Once the quota for a specific group has been achieved, ADM will either screen out additional survey respondents from that group or possibly either conduct an abbreviated version of the survey or introduce survey questions assessing a new topic.

11.5.2 Customer Journey Mapping

ADM Evaluators will conduct customer journey mapping for the ESP program once per evaluation cycle. The customer journey mapping will document customers' thoughts, feelings, and actions across the stages of program participation. The maps will illustrate the ESP program processes, customer engagement points, and key performance indicators as well as the overall customer experience, including key decision-points. One of the key benefits of this technique will be to identify key "pain points" that must be addressed or eliminated to improve overall program operations. ADM will incorporate the MO Code of State Regulations 20 CSR 4240-22.070 (8) research questions into the journey map and document each program's progress in meeting these objectives annually.

The findings will be synthesized from the in-depth interviews with program staff, trade allies, implementation contractors as customer input from the customer surveys to create the journey maps. The journey map will identify program "disconnects," point to actionable recommendations for program improvement and identify additional market opportunities.

12. Cost – Benefit Analysis

12.1 Calculation

Cost-effectiveness values will be calculated utilizing a transparent excel based workbook and will include ADM-verified EM&V findings, including energy and demand impacts, incremental costs, NTG ratios, participation numbers, and measure lifetimes. All program and avoided cost data, and discount rates, will be provided by Evergy. The results will be included in the EM&V report.

12.2 Cost Tests Utilized

ADM will perform the Participant Cost Test, Ratepayer Impact Measure, Utility Cost Test, and Total Resource Cost, Societal Cost Test for annually for MEEIA Cycle 3. This will give an all-encompassing perspective on the program's annual cost effectiveness, as well as the cost effectiveness of the program over the portfolio cycle.

A common misperception is that there is a single best perspective for evaluation of cost-effectiveness. Each test is useful and accurate, but the results of each test are intended to answer a different set of questions. The questions to be addressed by each cost test[116] are shown in Table 12-1.

Table 12-1: Questions Addressed by the Various Cost Tests

Cost Test	Questions Addressed
Participant Cost Test (PCT)	■ Is it worth it to the customer to install energy efficiency? ■ Is the customer likely to want to participate in a utility program that promotes energy efficiency?
Ratepayer Impact Measure (RIM)	■ What is the impact of the energy efficiency project on the utility's operating margin? ■ Would the project require an increase in rates to reach the same operating margin?
Program Administrator Cost Test (PACT –also referred to as the Utility Cost Test or UCT)	■ Do total utility costs increase or decrease? ■ What is the change in total customer bills required to keep the utility whole?
Total Resource Cost Test (TRC)	■ What is the regional benefit of the energy efficiency project including the net costs and benefits to the utility and its customers? ■ Are all the benefits greater than all the costs (regardless of who pays the costs and who receives the benefits)?

[116] National Action Plan for Energy Efficiency (2008) Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers. *Energy and Environmental Economics, Inc., and Regulatory Assistance Project*. *Last accessed July 2019 via:* https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

Cost Test	Questions Addressed
	■ Is more or less money required by the region to pay for energy needs?
Societal Cost Test (SCT)	■ What is the overall benefit to the community of the energy efficiency project including indirect benefits? ■ Are all the benefits, including indirect benefits, greater than all the costs (regardless of who pays the cost and who receives the benefits)?

Overall, the results of all five-cost effectiveness tests provide a more comprehensive picture than the use of any one test alone. The TRC and SCT cost tests help to answer whether energy efficiency is cost-effective overall. The PCT, UCT, and RIM help to answer where the selection of measures and design of the program is balanced from participant, utility, and non-participant perspectives, respectively. The scope of the benefit and cost components included in each test ADM performed are summarized in Table 12-2.

Table 12-2: Summary of Benefits and Costs Included in Cost-Effectiveness Test

Test	Benefits	Costs
PCT (Benefits and costs from the perspective of the customer installing the measure)	■ Incentive payments ■ Bill Savings ■ Applicable tax credits or incentives	■ Incremental equipment costs ■ Incremental installation costs
UCT (Perspective of utility, government agency, or third party implementing the program)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	■ Program overhead costs ■ Utility/program administrator incentive & installation costs
TRC (Benefits and costs from the perspective of all utility customers in the utility service territory)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution ■ Additional resource savings ■ Monetized environmental and non-energy benefits ■ Applicable tax credits	■ Program overhead costs ■ Program installation costs ■ Incremental measure costs
SCT (Benefits and cost to all in the utility service territory, state, or nation as a whole.)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution ■ Non-monetized environmental and non-energy benefits	■ Program overhead costs ■ Program installation costs ■ Incremental measure costs
RIM (Impact of efficiency measure on non-participating ratepayers overall)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	■ Program overhead costs ■ Utility/program administrator incentive & installation costs ■ Lost revenue due to reduced energy bills

13. Reporting and Scheduling

13.1 Evaluation Schedule

A draft of the final evaluation report of the 2020 Evergy Energy Efficiency and Demand Response portfolio of programs will be submitted to Evergy and the Missouri Stakeholder group for comment in approximately April following the completion of each program year. Comments and questions received from Evergy and from the Missouri stakeholders will be given proper consideration and a revised report will be submitted to the parties per the proposed schedule below.

The detailed proposed evaluation schedule for 2020 is shown in Table 13-1, below.

Table 13-1: 2020 Evaluation Schedule

Task/Activity	Task Completion # Days	Cumulative Days	Due Date
Program Year-End Date			**12/31/2020**
Estimated Reconciled Final Data Delivery	30	-	01/31/2021
Annual Evaluation Reporting			**-**
Draft EM&V Report Circulated to Stakeholders	30	90	04/01/2021
Comments and Recommendations on Draft EM&V Report	60	150	05/31/2021
Meeting to Discuss Comments Prior to Final Draft Report	TBD		
Final EM&V Report Issued	30	180	06/30/2021

ADM will work with stakeholders, including the EM&V Auditor, on a regular basis throughout the evaluation process, involving stakeholders through the following key review touch points:

- Annual evaluation report review
- Survey instrument review (as they become available)
- Progress updates (quarterly)
- Ad hoc meetings (as required – particularly for key approach issues)

13.2 EM&V Reporting

The annual EM&V report will provide the final estimate of the effects of the programs achieving energy and demand savings and will summarize all the work conducted in evaluating the program. The report will present an overview of the EM&V efforts and identify key issues confronted in the evaluation along with a summary of how they were handled. ADM will provide a combined annual evaluation report for both territories. A Draft of the report will be provided for Evergy and the Missouri Stakeholder group comment.

The final evaluation report will include the following information:

- Verified energy and peak demand savings achieved by the program;
- A comparison of targeted savings, reported savings, and verified savings;
- Number of participants and count of total measures in the program;
- A comparison of targeted program budget and actual program spending, with an explanation for any non-spending;
- A description of any proposed changes in program plans;
- Actionable recommendations to strengthen program processes and answers to questions 1 through 5 as stated in in the process evaluation requirements of the Missouri Code of State Regulations ("MO Regulations") 20 CSR 4240-22.070 (8) (A).
- Results for the five standard cost tests for each program

13.3 TRM Updates

ADM will review Evergy's TRM on an annual basis and provide updates to the Residential, and Demand Response, programs based on the Final Report evaluation results, when changes are warranted.

Evaluation, Measurement, and Verification (EM&V) Plan for MEEIA Cycle 3

Business Custom, Business Standard, Business Process Efficiency and Online Business Energy Audit (OBEA)

Prepared for:

Evergy Services Inc.,

Presented by:

Guidehouse Inc.
1375 Walnut Street, Suite 100
Boulder, CO 80302

303-728-2479

guidehouse.com

Reference No: 213765
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Background and Context

In accordance with the Missouri Energy Efficiency Investment Act (MEEIA) Rules and the Stipulation and Agreement, Evergy Services, Inc. (ESI) (hereafter referred to as Evergy) on behalf of its affiliates Evergy MO West and Evergy Metro, has contracted with Guidehouse to evaluate, measure, and verify the information tracked by Evergy MO West and Evergy Metro for its portfolio of three Commercial and Industrial demand-side management programs and one Educational and Behavioral program for the 3-year program cycle beginning January 1, 2020 through December 31, 2022. Specific Evergy programs covered by this evaluation include:

1) Commercial & Industrial Programs:
    a. Business Standard
    b. Business Custom
    c. Business Process Efficiency
2) Educational & Behavioral Programs:
    a. Online Business Energy Audit (OBEA)

This document provides a summary of Guidehouse's plans to accomplish the following impact evaluation, process evaluation, and cost-effectiveness analysis tasks:

- Through impact evaluation activities, evaluate the gross and net energy and peak demand savings from Evergy's energy efficiency (EE) Commercial and Industrial programs[1].
- Through process evaluation activities, evaluate the effectiveness of and develop actionable recommendations to improve the design of the Commercial and Industrial programs and the OBEA program.
- Estimate the cost-effectiveness of the aforementioned programs.

[1] Note, it is Guidehouse's understanding that the OBEA program does not claim energy or demand savings.

The evaluation plan is divided into the following chapters:

Evaluation Approach – This chapter summarizes Guidehouse's approach for the impact evaluation, Net-to-Gross (NTG) analysis, process evaluation, cost-effectiveness analysis, and reporting requirements for the evaluation, measurement, and verification (EM&V) of Evergy MO West and Evergy Metro's programs.

Resource Allocation – This chapter presents the allocation of evaluation resources by program for the impact evaluation, process evaluation, NTG analysis, and cost-effectiveness analysis.

Schedule and Stakeholder Interaction – This chapter details the schedule for reporting and stakeholder meetings through the 3-year program implementation and evaluation cycle.

Evaluation Approach

This section presents Guidehouse's approach for the impact evaluation, NTG analysis, process evaluation, cost-effectiveness analysis, and reporting requirements for the EM&V of Evergy's programs. Guidehouse has developed a number of data collection and analysis tools as part of its evaluation of Evergy's MEEIA 1 and MEEIA 2 programs. We will leverage these tools when appropriate to be most efficient with evaluation resources.

This chapter is divided into the following sections:

- Gross Impact Evaluation Summary
- NTG Analysis Summary
- Process Evaluation Summary
- Cost-Effectiveness Analysis
- EM&V Reporting

Gross Impact Evaluation Summary

In accordance with the Missouri Code of State Regulations 20 CSR 4240-22.070 (8) (Missouri regulations), Evergy is required to complete an impact evaluation for each program using one or both of the methods detailed below.

> *1. Impact evaluation methods. At a minimum, comparisons of one (1) or both of the following types shall be used to measure program and rate impacts in a manner that is based on sound statistical principles:*
>
> *A. Comparisons of pre-adoption and post-adoption loads of program or demand-side rate participants, corrected for the effects of weather and other inter-temporal differences; and*
> *B. Comparisons between program and demand-side rate participants' loads and those of an appropriate control group over the same time period.*
>
> *2. The Evaluator shall develop load-impact measurement protocols that are designed to make the most cost-effective use of the following types of measurements, either individually or in combination:*
>
> *A. Monthly billing data, hourly load data, load research data, end-use load metered data, building and equipment simulation models, and survey responses; or*
> *B. Audit and survey data on appliance and equipment type, size and efficiency levels, household or business characteristics, or energy-related building characteristics.*

The Evaluator will also be required to develop protocols to gather information and to provide estimates of program free ridership, spillover, and program net-to-gross ratios.

The Guidehouse team's proposed methods and protocols, as they align with MO requirements, for the impact evaluation are summarized in Table 1 below.

Table 1. MO Regulations Impact Evaluation Methods and Protocols

Sector	Program	Impact Evaluation Method	Impact Evaluation Protocol
C&I EE Programs	Business Custom Program	1A	2A and/or 2B
	Bustiness Standard Program	1A	2A and/or 2B
	Process Efficiency Program	1A	2A and/or 2B
Educational/Behavioral Programs[2]	Online Business Energy Audit	NA	NA

Impact Evaluation Methods

This section presents the methods Guidehouse will employ in its impact evaluation and how they align with the Missouri Regulations (MO Regulations) for data collection. Gross savings are the changes in energy use that are the direct result of a program without considering actions participants may have taken without the program. Available methods for estimating gross savings include end-use monitoring, calibrated simulation models, calibrated engineering analysis, engineering review, and billing analysis.

Guidehouse will use the evaluation methods below with varying levels of rigor and different objectives for evaluating impacts of Evergy's C&I programs. We will refine these approaches with Evergy and possibly stakeholders. As a result of these refinements, it may be decided that not every task is necessary to complete each year. Guidehouse's approach takes advantage of previously collected data and tools developed for the Custom and Standard programs to maximize the value of the data while optimizing evaluation resources. We recognize that some of these approaches might need to be modified in order to provide the most value within the budget limits specified by Evergy.

[2] Guidehouse assumes no savings will be claimed for the OBEA program in MEEIA Cycle 3.

1. **Tracking System and Database Review**

   Guidehouse will review program implementation databases and identify any additional data required for calculating gross energy and demand savings. Data fields that are typically required for savings verification are equipment characteristics such as size/capacity, efficiency, and customer information, including building or industry type.

2. **Deemed Savings Review and Memo**

   Guidehouse will review the algorithms and assumptions supporting current reported savings for all programs and measures. The results of this review may result in refinements to the current algorithm, the inputs to the algorithm, or an entirely new engineering model. Guidehouse will leverage recent EM&V reports and other secondary sources for similar programs and measures to identify the operating characteristics that best reflect the Evergy service territories and program designs. These operating characteristics include operation hours, coincidence factors, installation rates, and leakage rates.

3. **Analytic Database Development**

   Guidehouse will develop and update analysis tools that calculate savings based on engineering algorithms and project-specific equipment specifications and performance data provided in the implementation databases. This approach provides Evergy with an indication of how verified savings are tracking against reported values at greater frequency than the annual report. Guidehouse's research over the 3-year period will be used to update these analytic databases on an ongoing basis.

   These savings verification tools will be leveraged throughout the year to provide Evergy with an indication of how verified savings are tracking against reported values at greater frequency than the annual report.

4. **Desk/Phone Review**

   For some custom measures without deemed savings we will conduct a thorough review of the reported savings models used to estimate impacts. The results of this review may result in refinements to the algorithm, the inputs to the algorithm, or an entirely new engineering model. Guidehouse will review the algorithms and assumptions supporting reported savings for all programs. Guidehouse will leverage recent EM&V reports and other secondary sources for similar programs and measures to identify the operating characteristics that best reflect the Evergy service territories and program designs. These operating characteristics include operation hours, coincidence factors, installation rates, and leakage rates.

   Guidehouse may conduct telephone surveys with the program participants with the primary objective of verifying the installation and operation of measures rebated through the programs or the delivery of a service rebated through the programs. This evaluation activity

will be leveraged for both the impact and process evaluations.

5. **Onsite Verification and Metering (Optional)**

   For some measures, we will collect onsite equipment specifications and monitoring data to be used to update or calibrate engineering models (either reported savings algorithms or stipulated savings estimates). For example, a value may be based on an engineering model that is a function of a number of parameters. We may find that one of the key parameters that drive this result should be updated. We would estimate this parameter using onsite data to provide a more accurate and precise overall estimate of the measure's savings. The result of this task may be revised algorithm approaches, or the same reported algorithm, but with inputs that better reflect current performance of the program and behavior of program participants. If selected by Evergy, Guidehouse would conduct onsite verification and metering on a subset of program participants to verify installation quantities, confirm project scope, and refine assumptions related to performance variables that influence savings estimates. The metered data will be analyzed to determine operation characteristics such as hours of use (HOU) and peak coincident load factors.

Table 2 provides a summary of all impact evaluations planned by Guidehouse for MEEIA Cycle 3.

Table 2. Summary of Impact Evaluation Activities

Sector	Program	Tracking System & Database Review	Deemed Savings Review	Analytic Database Devel & Eng Analysis	Desk/Phone Review	Onsite Verification and Metering (Optional)
Commercial & Industrial Programs	Business Custom Program	PY1 – PY3	PY1 – PY3	PY1 – PY3	PY1 – PY3	PY2 or PY3
	Bustiness Standard Program		PY1 – PY3	PY1 – PY3		
	Process Efficiency Program		N/A		PY2 – PY3	
Educational & Behavior Programs	Online Business Energy Audit	No expected savings claimed in MEEIA Cycle 3				

Data Management Protocols and Transfers

Existing data integrations provide Guidehouse with an ongoing feed of AMI and billing data for all ESI customers that can be leveraged for each program to provide greater insights. AMI data provides useful insight into potential locations for field work where end-use metering or additional data collection could be implemented. Before field work occurs during MEEIA 3, Guidehouse will analyze AMI and billing data to inform the stratification of samples, minimize the number of site visits, and to inform the activities that occur during each site visit. Guidehouse's data management supporting activities include the following:

- Support and maintenance of daily feed of AMI and Billing data from ESI
- Ongoing processing and verification of AMI and billing data
- Preparation of AMI and billing information needed for TOU and other program evaluation activities

Net Savings Analysis Summary

Net savings for each program will be developed over the course of the 3-year evaluation cycle. The objective of this approach will be to accurately estimate net savings through the use of multiple methods to estimate net-to-gross (NTG) indicators such as free ridership and spillover over the course of the 3-year program cycle.

Guidehouse will use two primary methods to develop net savings for each program, including:

1) **NTG ratios,** which involves the derivation of NTG components including free ridership and spillover
2) **Direct estimation** of net savings, which involves conducting a billing analysis

NTG Component Method

For programs where net savings must be calculated using a NTG ratio, Guidehouse will collect NTG component data from the following three sources of information: (1) program participant surveys (conducted soon after the customer's decision to participate), (2) program participant end-of-year telephone surveys, and (3) program participant trade ally telephone interviews. This allows for triangulation of results, tests of consistency, and sensitivity analyses—all part of a best-practices application. Guidehouse will use the following definitions, provided by the Uniform Methods Project,[3] to calculate net savings.

- **Free ridership (FR):** The program savings attributable to free riders (i.e., program participants who would have implemented a program measure or practice in the absence of the program).
- **Participant spillover (PSO):** The additional energy savings that are achieved when a program participant—as a result of the program's influence—installs EE measures or practices outside the efficiency program after having participated.
- **Non-participant spillover (NPSO):** The additional energy savings that are achieved when a non-participant implements EE measures or practices as a result of the program's influence (e.g., through exposure to the program) but is not accounted for in program savings.

Using these definitions, the NTG ratio will be calculated as follows:

Equation 1

$$NTG\ Ratio = 1 - FR\ rate + PSO\ rate + NPSO\ rate$$

[3] Violette, Daniel M. & Rathbun, Pamela. (2014). *Estimating Net Savings: Common Practices*, Chapter 23 in The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf.

Where:

FR rate = Free Ridership Rate

PSO rate = Participant Spillover Rate

NPSO rate = Non-Participant Spillover Rate

Participating end-use customers are in the best position to articulate the likelihood that they are able to afford the increased-efficiency equipment without rebates. Trade allies are best suited to comment on the influences of a program beyond the rebate (such as a program's influence on their technical knowledge, stocking patterns, and typical product specifications and recommendations). The participants are often unaware of how these non-rebate program influences may have shaped their experiences with the trade ally, and thus they may be prone to overestimating free ridership in self-report surveys. Programs that will leverage the NTG component method include:

1. Business Standard
2. Business Custom

In an effort to address the EM&V Auditor's comments regarding freeridership estimates, Guidehouse has made the following adjustments to the participant surveys:

- Added a question to the spillover battery asking if they worked with the same contractor or a different contractor (or no contractor) to better assess the potential for spillover double counting between PSO and NPSO.
- Added a question to the spillover battery asking "how do you know the equipment is high efficiency?"

The Guidehouse team will continue to work with the EM&V Auditor throughout PY1 and MEEIA Cycle 3 to address their concerns regarding freeridership and spillover estimates.

Direct Estimation Method

Net savings can also be determined directly through billing analyses to identify differences between program participant and non-participant energy use. Guidehouse will account for free ridership and spillover within engineering models by developing a baseline calibrated to "pre" activity and by removing any capital expenditures that also received incentives.

This direct estimation method will be used for the following programs:

1) Business Process Efficiency

Process Evaluation Summary

The focus of Guidehouse's process evaluation is to (1) address the five required questions per the Missouri Code of State Regulations 20 CSR 4240-22.070 (8) ("MO Regulations") and (2) identify program process improvements to increase program participation and savings.

For each program, the process evaluation will answer the following five questions on program design as set forth in the MO Regulations.

1. *What are the primary market imperfections that are common to the target market segment?*
2. *Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?*
3. *Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment?*
4. *Are the communication channels and delivery mechanisms appropriate for the target market segment?*
5. *What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation of each end-use measure included in the program?*

Process Evaluation Methods

The primary objective of this effort will be to help program designers and managers structure their programs to achieve cost-effective energy savings while maintaining high levels of customer and trade ally program satisfaction, especially for new programs. Timely process evaluations are critical for ensuring that (1) each program is implemented effectively and efficiently; (2) appropriate performance metrics are being collected for ongoing program management decision-making and for program evaluation; and (3) customer and trade ally marketing, recruitment, and onboarding processes support Evergy's long-term goal attainment. Leveraging insights from the past two MEEIA Cycles and our online survey approach, the Guidehouse team's process evaluation efforts will provide new insights and recommendations to improve the future performance of each program as well as ensure the reliability of inputs to the impact evaluation in a timely manner.

The Guidehouse team will implement process evaluation research in tandem with the impact evaluation efforts in order to coordinate data collection efforts and capture operational efficiencies to the greatest extent possible. Such integration will enable the team to make a closer link between the observed program impacts and the actual operation of the programs and will have the added benefit of minimizing the number of times respondents are contacted by the evaluation effort (i.e., minimize respondent fatigue). Additionally, Guidehouse will work with Evergy's overall survey efforts to also minimize the same targets being asked the same questions by different surveys by collaborating across Evergy, Guidehouse, and the implementation contractor on questions to be asked of targets.

1. **Program Manager/Implementer Interviews**

   The process evaluation for each program will include an in-depth, qualitative interview with Evergy program staff and implementers. The Guidehouse team will use these interviews to develop a thorough understanding of the final program design, procedures, and implementation strategies for each program and to gain a deeper understanding of current issues for each continuing program. The team will also use the interviews to

identify research topics to include in the trade ally interviews and customer surveys discussed below and to discuss available program materials (e.g., marketing and outreach materials, print and radio advertising copy) that can be used to support the evaluation. The Guidehouse team will prepare a draft program staff/implementer interview guide and a revised final program staff/implementer interview guide that incorporates revisions as agreed upon with the Evergy project management team.

The Guidehouse team will conduct in-depth interviews for each program once over the course of the 3-year cycle. However, the Guidehouse team expects to engage in ongoing communications with Evergy program staff and implementers throughout the evaluation process. As a practical matter, Guidehouse finds it important to provide early, timely, and continuous feedback to program implementers and staff. Such ongoing communication will provide program staff and implementers with the information necessary to adjust programs as needed to increase the likelihood of meeting or exceeding the programs' energy savings goals. These communications will be carried out at all times in a manner that preserves the Guidehouse team's independence and objectivity.

2. Review of Program Information

Program materials and documentation will provide critical insight into program operations and help Evergy assess the effectiveness of messaging on participation and the customer experience. Guidehouse will review program materials for clarity, consistency, and effectiveness in general messaging, program requirement summaries, and participation process descriptions. The program materials reviewed will ideally include the relevant Evergy website(s), contractor directories, print brochures, application forms, and marketing content such as print and radio advertisements. Guidehouse will also access websites (e.g. online application forms) and web applications for usability as appropriate. These detailed reviews will be conducted once over the cycle, but the team will use the follow ups with program managers to understand and note any changes and their relative impacts on program processes.

3. Trade Ally Surveys

The Guidehouse team will conduct surveys with participating trade allies with the goal of learning more about how allies promote (or can promote) each program they are involved in and their motivation(s) for participating in the programs. Surveys will trade allies also inform spillover estimates, a key metric in estimating NTG. As necessary, the Guidehouse team will develop research instruments for each trade ally type that reflect the unique attributes of the programs, namely the delivery strategy, target market, eligible measures, incentive structure, and other aspects.

4. Customer Online / Telephone Surveys

The Guidehouse team will also conduct quantitative surveys with program participants and. The team will use a variety of survey modes, including telephone and online surveys. Online surveys will be Guidehouse's primary mode of interacting with participants. For more sensitive or harder to reach participants, Guidehouse may leverage telephone surveys. Results of these surveys will be reported to Evergy on an

annual basis, although informal updates will be provided to Evergy on an ongoing basis.

5. **Fast Feedback Surveys**

   As an optional survey task, a fast feedback survey approach will report findings to Evergy on a timely (i.e. monthly) basis, as well as report detailed findings annually.

   Guidehouse will use the surveys to gather information regarding:

   - Participant satisfaction with program participation and measures
   - Effectiveness of program marketing and outreach activities
   - Perceived barriers to and motivations for program participation
   - Program influence on other efficiency actions taken

Table 3 provides a summary of all process evaluation activities planned for MEEIA Cycle 3 by Guidehouse. The Business Custom program underwent strategic design and implementation changes between MEEIA Cycle 2 and 3. For this reason, Guidehouse will conduct Process/NTG research for the Custom program in PY1 in order to accurately capture key process and NTG findings to allow Evergy the opportunity to address these findings at the onset of the Cycle. The Business Standard program has remained relatively consistent from MEEIA Cycle 2 and Cycle 3 in the offered measures, incentives and program design. Guidehouse will conduct process and NTG research in PY2 of Cycle 3.

Table 3. Process Evaluation Activities by Program

Sector	Program	Program Manager/Implementer Interviews	Review of Program Information	Trade Ally Surveys	Customer Surveys	Customer Fast Feedback Surveys (optional)
Commercial & Industrial Programs	Business Custom Program	On-going	On-going	PY1	PY1	PY2, PY3
	Bustiness Standard Program			PY2	PY2	PY2, PY3
	Process Efficiency Program			PY2 or PY3	PY2 or PY3	

Cost-Effectiveness Analysis

Guidehouse will calculate benefit-cost ratios and total net benefits at the program and portfolio level for the five standard benefit-cost tests: Total Resource Cost (TRC) test, Societal Cost Test (SCT), Utility Cost Test (UCT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. Benefit-cost ratios are informative as they show the value of monetary benefits relative to the value of monetary costs as seen from various stakeholder perspectives.

The evaluation team's formulation of the benefit-cost tests will follow the 2001 California Standard Practice Manual (SPM)[4] and will not account for the subsequent 2007 SPM Clarification Memo.[5] Guidehouse will provide Evergy with the evaluated savings included in the analysis to support their performance incentive calculation.

Guidehouse's benefit-cost analysis will account for the following cash flows:

- Avoided energy costs
- Avoided capacity costs
- Incentives
- Lost revenue/bill reductions
- Administrative costs[6]
- Participant equipment costs

Table 4 summarizes how program costs and benefits are assigned to each of the cost tests consistent with the California SPM. In this analysis, the TRC test and the SCT test only differ in the discount rate assumed (i.e., externalities are not included in this SCT analysis).

[4] California Public Utilities Commission. "California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects." October 2001. http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf.

[5] California Public Utilities Commission. "2007 SPM Clarification Memo." 2007. http://www.cpuc.ca.gov/NR/rdonlyres/004ABF9D-027C-4BE1-9AE1-CE56ADF8DADC/0/CPUC_STANDARD_PRACTICE_MANUAL.pdf.

[6] Including portfolio-level costs related to EE and DR programs, software development costs, EM&V costs, and educational program costs.

Table 4. Cost and Benefit Assignments by Cost Test

Item	TRC Test	SCT	UCT	PCT	RIM Test
Avoided Costs	Benefit	Benefit	Benefit	N/A	Benefit
Incentives	Transfer	Transfer	Cost	Benefit	Cost
Lost Revenues	Transfer	Transfer	N/A	Benefit	Cost
Administrative Costs	Cost	Cost	Cost	N/A	Cost
Participant Equip. Costs	Cost	Cost	N/A	Cost	N/A

TRC = total resource cost, SCT = societal cost test, UCT = utility cost test, PCT = participant cost test, RIM = ratepayer impact measurement
Source: Guidehouse analysis

Source of Benefit and Cost Assumptions

The sources of data that will be used in the benefit-cost analysis are summarized in Table 5. Many of the input assumptions used in Guidehouse's analysis will be provided directly from Evergy.

Table 5. Sources of Benefit and Cost Data

Data	Source
Avoided energy costs	*Provided by Evergy*
Avoided capacity costs	*Provided by Evergy*
Retail rates	*Provided by Evergy*
Load shapes	*Guidehouse developed model load shapes with input from Evergy.*
Discount rates	*Provided by Evergy*
Participant equipment costs	*Illinois Technical Reference Manual (TRM), Evergy assumptions*
Energy and peak demand savings	*Guidehouse engineering analyses*
EUL	*Illinois TRM, program tracking data, Evergy Assumptions*
RUL	*Guidehouse analysis based on lifetime of replaced equipment and related mortality analysis techniques.*
NTG	*Guidehouse NTG analysis*
Line loss factors	*Provided by Evergy*
Incentives	*Program tracking database*
Participation	*Program tracking database*
Administrative costs	*Provided by Evergy*

Source: Guidehouse analysis

EM&V Reporting

Guidehouse will submit evaluation findings and recommendations for their programs as part of a single report after the cycle has been completed. The report will detail the process and impact evaluation methods used, findings and results from Guidehouse's analysis, and actionable recommendations to enhance Evergy's programs. The report will include a summary table of the cycle EM&V cumulative annual energy and demand savings and EM&V cumulative annual net shared benefits for each program. Draft reports will be delivered to Evergy and the Missouri Stakeholder group for comment 60 days[7] after the end of the program year.

Guidehouse will provide a combined annual evaluation report for both service territories. If separate reports for each service territory are required based on input from Evergy and/or the stakeholders, additional reporting costs would be covered under Discretionary Activities. EM&V reports will document the methods supporting, and the findings and recommendations resulting

[7] Draft and Final Report deliverable timelines will be dependent on receiving complete program tracking data for all programs within one week of the close of the program year.

from process and impact evaluation activities. This includes:

- Actionable recommendations to strengthen program processes and answers to questions 1 through 5 as stated in in the process evaluation requirements of the Missouri Code of State Regulations ("MO Regulations") 20 CSR 4240-22.070 (8) (A).
- Program-to-date and annual gross and net energy and demand savings for each program.
- Techniques used to determine savings and their alignment with MO regulations.
- Results for the five standard cost tests for each program.

Guidehouse will submit Draft and Final reports. As with all other final deliverables, Guidehouse will incorporate Evergy staff comments and suggestions in the Final Reports, as well as comments by the EM&V Auditor and MO stakeholders. Guidehouse will work with Evergy and MO stakeholders to determine the most efficient and effective way for reporting evaluation findings across service territories. At the conclusion of MEEIA Cycle 2, Guidehouse developed a "condensed" reporting format that provided Evergy and Stakeholders with the most impactful EM&V results for the program year and summarized program-to-date activity. Guidehouse will continue to build on this reporting format to deliver required evaluation metrics and results in a cost-effective manner, subject to approval by the stakeholders. Separate reporting by jurisdiction is a discretionary activity and thus would be completed at additional cost. Guidehouse will provide interim memoranda and presentations as requested by Evergy or as determined by the evaluation team.

Resource Allocation

Guidehouse has developed an estimate of how it intends to allocate resources among impact evaluation, process evaluation, net savings analysis, and cost-effectiveness analyses that cut across programs, as well as costs associated with program-specific activities. Additionally, we have estimated the costs for overall planning, reporting, project management, and management of data. A high-level breakdown the resource allocation over the 3-year evaluation is provided below in Table 8. We note that these allocations represent our best estimate and are likely to change over the course of the evaluation as new information is obtained and as variances of actual costs relative to forecast costs become apparent.

Table 6. Resource Allocation

Activity	Percent of Total Resource Allocation
Cross Cutting	
Project Management	9%
Evaluation Plan Development	6%
Cost Effectiveness	2%
TRM and Impact Evaluation Alignment	5%
Establish Net-to-Gross Evaluation Protocols/Methods	4%

Data Management	3%
Travel & Stakeholder Engagement & Meetings	2%
Program Specific	
Business Custom	
Impact Evaluation	18%
Process Evaluation	8%
Annual Reporting	5%
Business Standard	
Impact Evaluation	11%
Process Evaluation	5%
Annual Reporting	5%
Business Process Efficiency	
Impact Evaluation	9%
Process Evaluation	4%
Annual Reporting	2%
OBEA	
Impact Evaluation	NA
Process Evaluation	2%
Annual Reporting	<1%

Schedule and Stakeholder Interaction

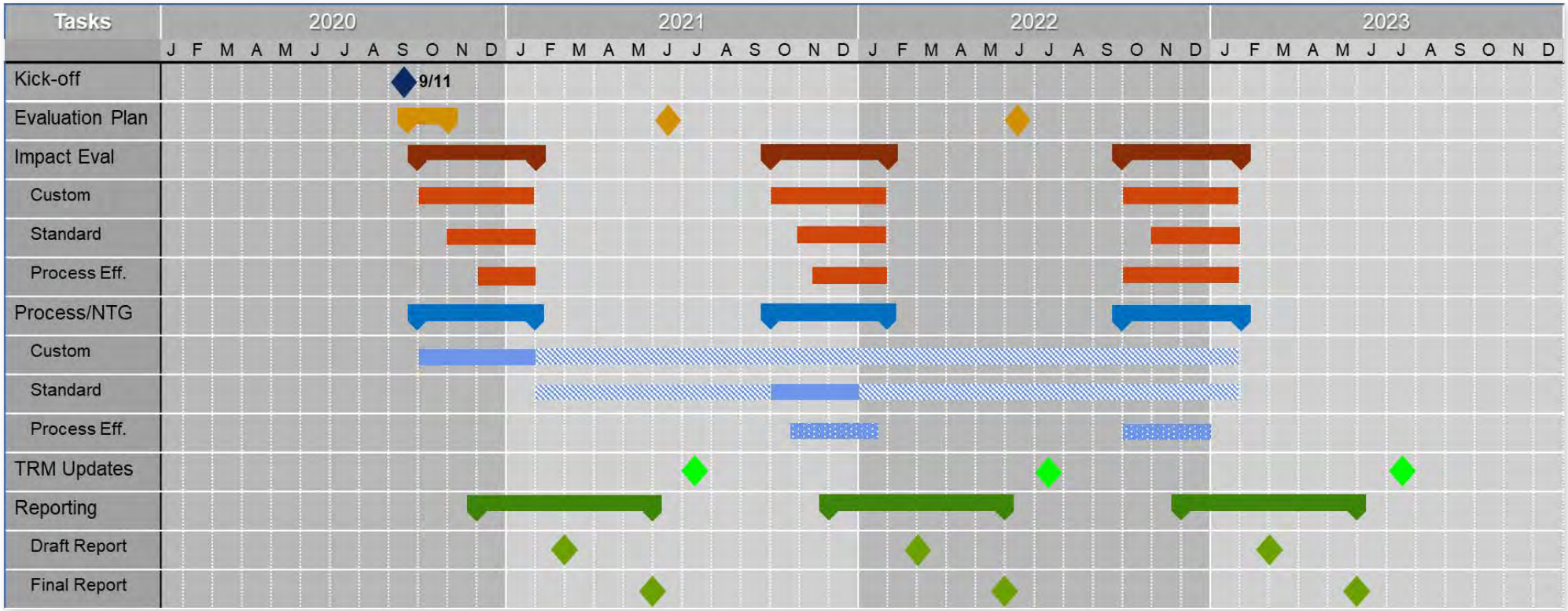
Evaluation activities are proposed to be conducted per the schedule provided below in Table 7 and expanded further below.

Please note, the following activities are not captured in Table 9 but are planned for MEEIA Cycle 3:

- Monthly Evergy/Guidehouse Meetings
- Monthly Evergy/TRC/Guidehouse Meetings
- Quarterly DSM Advisory Meetings
- Annual PM/IC Interviews

Please note, the evaluation schedule in Table 9 below is reflective of a draft report due 60 days from the program year end-date. This date has been postponed by 30 days, as reflected in Table 10. Subsequently, all workstreams presented in Table 9 would add an additional 30 days.

Table 7. Schedule of Evaluation Activity



Evaluation Kick-off

Guidehouse will host an evaluation kick-off meeting with Evergy to discuss and evaluation priorities, ongoing concerns with program delivery and design, and to summarize Guidehouse's proposed approach to impact, process and net-to-gross evaluation research.

Development of Evaluation Plan

The Guidehouse team will develop an EM&V plan detailing the data collection and evaluation tasks for completing the impact and process evaluations, and cost-effectiveness analysis for all programs. This task will be divided into the three subtasks described below.

Impact and Process Evaluation

This task represents research activities Guidehouse will employ in its impact and process evaluation and how they align with the Missouri Regulations (MO Regulations) for data collection.

Methods for deriving impacts include end-use monitoring (optional), engineering review, and billing analysis.

The process evaluation research will include several discrete evaluation and data collection activities, including: in-depth interviews with program staff and implementers; review of program tracking systems and other secondary information; review or development of program theory and logic models; trade ally interviews; customer interviews; and account representative interviews.

TRM Updates

Guidehouse will review Evergy's TRM on an annual basis and provide updates to the Business Standard, Business Custom and Process Efficiency programs based on the Final Report evaluation results, when changes are warranted.

Draft and Final Evaluation Reports

This task encompasses the development of the annual report to meet the requirements listed above. Guidehouse will provide a continuous review of the program tracking systems, Evergy program cost data, and cost-effectiveness analysis throughout its evaluation to ensure the data is accurate and sufficient to meet these requirements. Any data issues that may affect the timely development of the annual report will be raised with Evergy and resolved quickly to meet regulatory deadlines and facilitate the development of this report.

Table 8 provides a summary of the annual evaluation reporting schedule according to the Stipulation and Agreement. Please note, the dates provided in the "Date" column are an example of the PY1 reporting schedule and will vary between PY2 and PY3 and will depend on

Guidehouse's receival of final program tracking data.

Table 8. Annual Evaluation Reporting Schedule

Task/Activity	Program Year Days	Cumulative Days	Date
Annual Evaluation Reporting			
Program Year End-Date			12/31/2020
Draft EM&V Report Circulated to Stakeholders	90		04/01/2021
Comments and Recommendations on Draft EM&V Report	60	150	05/31/2021
Meeting to Discuss Comments Prior to Final Draft Report		TBD	
Final EM&V Report Issued	30	180	06/30/2021

Source: Stipulation and Agreement

Guidehouse recognizes the importance of involving stakeholders, including the EM&V Auditor, on a regular basis throughout the evaluation process. As such, Guidehouse further intends to involve stakeholders through the following key review touch points:

- Annual evaluation report review
- Survey instrument review (as they become available)
- Progress updates (quarterly)
- Ad hoc meetings (as required – particularly for key approach issues)