

Public Utility Commission of Texas

Texas Technical Reference Manual

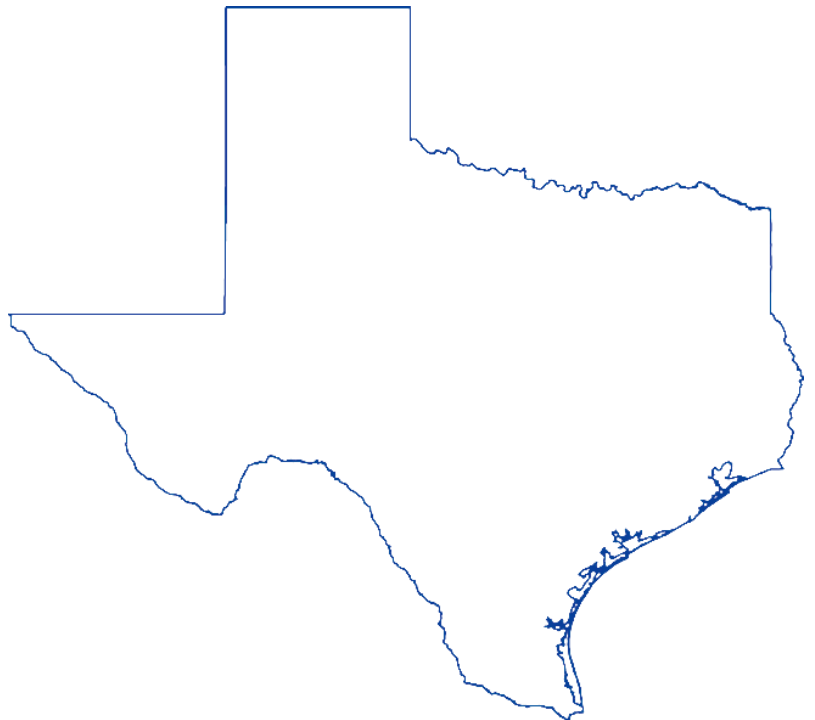
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Volume 4: Measurement and Verification Protocols

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2.5 M&V: LOAD MANAGEMENT

2.5.1 Residential Load Curtailment Measure Overview

TRM Measure ID: R-LM-LM

Market Sector: Residential

Measure Category: Load management

Applicable Building Types: Single family, multifamily, and manufactured

Fuels Affected: Electricity

Decision/Action Types: Operation and maintenance (O&M)

Program Delivery Type: Custom

Deemed Savings Type: Not applicable

Savings Methodology: EM&V

Utilities operate residential load management programs to obtain demand savings: energy savings are estimated as a function of the estimated demand savings.⁴³ Demand savings calculations are performed using utility customer interval energy demand data from IDRs or advanced meters. Measured and verified demand savings for the curtailment period is presented here.

Measure Description

This document presents the M&V savings methodology to participate in a load management program that involves the curtailment of an interruptible load during the summer peak period. Measures participating in a residential load management program may be air-conditioners, heat pumps, swimming pool pumps, or other electricity loads as specified by utility programs. Specific methods of load management for this measure are not defined and are determined by individual programs. The savings reflect the cumulative effect of all participant actions to reduce residence-wide demand during a load management event.

Eligibility Criteria

A project will be eligible for incentives and reporting demand and energy savings when

- Continuous demand interval recording capability (30-minute intervals or less)
- Sufficient interval data exists to measure and verify sufficient comparison-days to establish demand baselines and interval demands during load management events.
- Participants are homes.

⁴³ Some utilities may determine energy savings associated with load management events, which would be calculated as the difference between the baseline and curtailment kW values times the length of the event(s).

Baseline Condition

The baseline condition is an individual participants' load that would have occurred had the load management event and subsequent load management activities not taken place.⁴⁴

High-Efficiency Condition

Not applicable.

Energy and Demand Savings Methodology

Not applicable.

Savings Algorithms and Input Variables

$$\text{Verified Demand Savings} = \text{Baseline Period kW} - \text{Curtailment kW}$$

Equation 60

Where:

Baseline Period kW = *Baseline average demand calculated according to the High 3 of 5 Baseline Method*

Curtailment kW = *Average demand measured during the curtailment period*

High 3 of 5 Baseline with Day-of Adjustment

A high X of Y baseline considers the Y most recent days preceding an event and uses the data from the X days with the highest load within those Y days to calculate the baseline. Day-of adjustments are used to scale the baseline load estimate to the load conditions on the day of the event using data from the two hours prior to the time on the event day when participants were notified of the pending call for curtailment.

Applying this concept to the residential load management measure, the High 3 of 5 baseline for a given curtailment event is estimated by first identifying the five non-holiday weekdays immediately preceding the event in which no prior program curtailment events were called, and calculating each participant's average demand during the same hours as the hours for which the curtailment event was implemented on each of those five days. The three highest of these five average-like day demand values are then averaged to estimate the "unadjusted high three baseline".

The day-of baseline adjustment is estimated by comparing participants' average demand for electricity on the day of the event during the two hours prior to notification of the pending event (the "adjustment period") to participants' average demand for electricity on the "high

⁴⁴ Some utilities may determine energy savings associated with load management events, which would be calculated as the difference between the baseline and curtailment kW values times the length of the event(s).

three” days during those same two hours. In the situation where notification may not be given, the two hours preceding one hour before the event begins on the event day and baseline days will be used as the adjustment period. The average load of the adjustment period on the event day are compared to the average load of the adjustment periods from the baseline days. The difference (positive or negative) between day-of demand and high three baseline day demand in the adjustment period is the uncapped additive adjustment. To apply the adjustment period to the unadjusted baseline, one of two options are selected in the following steps:

- **Step 1.** Calculate an uncapped additive adjustment. The uncapped additive adjustment is the difference of the adjustment period hours’ load of the event day subtracted from the baseline days’ average adjustment period load. For example, if the baseline days have an adjustment period average load of 3.20 kW and the event day has an adjustment period load of 3.80 kW, the uncapped additive adjustment is $3.80 \text{ kW} (-) 3.20 \text{ kW} = 0.60 \text{ kW}$.
- **Step 2.** Calculate an adjustment cap. The adjustment cap is 80 percent of the baseline days’ average load during the event hours. For example, if a participant has a load of 4.00 kW during the baseline days’ event hours, the adjustment cap is $4.00 \text{ kW} (x) 0.80 = 3.2 \text{ kW}$.
- **Step 3.** Select the lowest of the adjustment cap and the absolute value of the uncapped additive adjustment to be the additive adjustment. Using the examples of the preceding two steps, the uncapped additive adjustment (0.60 kW) has the lowest magnitude between the two numbers and is selected as the additive adjustment.
- **Step 4.** Add the additive adjustment to the unadjusted High 3 of 5 baseline to calculate the final baseline used for calculating changes to consumption for the load management event.

Following the calculation of the baseline using the High 3 of 5 method, the following steps are taken to arrive at an event’s total savings and program savings for the year:

- **Step 1.** For an individual meter, the change in consumption is calculated by subtracting the baseline from the average load recorded during the event. If the result is positive, the meter exhibits savings, whereas a negative result indicates an increase in consumption during the event.
- **Step 2.** For a given load management event, sum the change in consumption of all participating meters. If documented, those meters enrolled in the program that opt-out of an event may be removed from the summation. If opt-out meters are not documented, an enrolled meter will be considered to have participated in the event. The sum represents the event’s total change in consumption, presumed to be positive and representing savings.
- **Step 3.** With each event’s savings results, average the event-level savings. The average of the events’ savings represents the program year savings.

An example, below, illustrates the entirety of applying the high 3 of 5 method to calculate load management savings for a single residential participant.

Example Calculation

Table 48 illustrates the steps of the High 3 of 5 baseline calculation method. Specific participant's results may vary.

Table 48. High 3 of 5 Example Load Management Event Data

Event day and potential baseline days	Potential baseline day 5	Potential baseline day 4	Potential baseline day 3	Potential baseline day 2	Potential baseline day 1	Load mgmt.. event date
Event hours	1500-1600	1500-1600	1500-1600	1500-1600	1500-1600	1500-1600
Average kW during event hours	5.67	5.96	4.95	4.58	6.01	5.12
Notification hour						1400
Adjustment period hours	1200-1400	1200-1400	1200-1400	1200-1400	1200-1400	1200-1400
Adjustment period average kW	5.54	5.87	4.86	4.44	5.89	6.03

Calculation Steps:

- Step 1.** Unadjusted High Three Baseline = Average kW during event times in three highest days of five prior to event day (kW)
 Unadjusted High Three Baseline = $(5.67+5.96+6.01)/3 = 5.88$ kW
- Step 2.** Uncapped Additive Adjustment = Average kW during adjustment time on event day (kW)—Average kW during adjustment time in the same three highest days of five prior to event day
 Uncapped Additive Adjustment = $6.03 - (5.54+5.87+5.89)/3 = 0.26$ kW
- Step 3.** Adjustment Cap = 80% of Unadjusted High Three Baseline (kW)
 Adjustment Cap = $0.8 * 5.88 = 4.7$ kW
- Step 4.** Choose Additive Adjustment = Minimum {Absolute value of Uncapped Additive Adjustment, Adjustment Cap} (kW)
 Additive Adjustment = Minimum {0.26, 4.7} = 0.26 kW
- Step 5.** Final Baseline = Additive Adjustment + Unadjusted High Three Baseline (kW)
 Final Baseline = $0.26 + 5.88 = 6.14$ kW
- Step 6.** kW Savings = Final Baseline—Curtailment kW (kW)
 kW Savings = $6.14—5.12 = 1.02$ kW

Additional Calculation Considerations

In the case that individual meters fail to record data sufficient for applying the High 3 of 5 calculation method, savings may still be calculated under the following conditions and method:

- Less than two percent of participating residential customers experience meter recording failures
- The customer can be confirmed as having participated via the practices of the sponsor operating the program or lack of opt-out notification
- The EM&V team is engaged to discuss applying the average savings and any program participation segmentation, and the specific cases are documented
- Savings for the residential segment will be calculated using the average savings of the segment as calculated via the High 3 of 5 method for the balance of the program or segment.

When selecting baseline days in the High 3 of 5 method, in some cases it is possible that some days have the same load for an individual participant, potentially leading to more than three days that could be selected for the baseline days. If four or more days could be selected as baseline days based on their loads during event hours, the days with the highest loads and closest to the event should be picked for the baseline.

Program year kW load management event savings will be calculated as the average savings of all events.

Rounding

Data rounding to the nearest whole number should only occur at the event and program levels for residential load management programs (NOT at the customer level). Utilities that prefer not to round the savings should document that in their calculations and inform the EM&V team (see Volume 5, Section 3.1 for more details).

Meters

Utilities are responsible for calling a test event each program year for the load management programs. The test event has several purposes, including assuring the proper functioning of program meters. Utilities are responsible for maintaining working program meters.

If there are random, non-systematic errors in smart meter data for less than two percent of total participants, the average savings from a similar group of participants (e.g., single-family, multifamily) may be used for claimed savings if: 1) the control event technology and intervention are the same, and 2) the control event intervention can be confirmed based on standard program practices for event confirmation. Utilities should notify the EM&V team in these circumstances to discuss the approach for determining and applying average savings for those customers with incomplete meter data.

Deemed Energy and Demand Savings Tables

Not applicable.

Claimed Peak Demand Savings

A summer peak period value is used for this measure, based on calculation methodology described for this measure.

Additional Calculators and Tools

Not applicable.

Measure Lifetime

Not applicable.

Program Tracking Data and Evaluation Requirements

The following data and information shall be tracked and provided to the EM&V team to enable savings verification:

- For each participant for which savings are being claimed, kWh consumption at intervals no greater than 30-minutes for each event day and for no less than five non-holiday and non-weekend days prior to each event day. Interval data shall be time-stamped with the date and no less than the time period ending the interval.
- Documentation describing the time stamp and whether the time stamp reflects the forward-looking period or period preceding the time stamp
- A list of all load management events affecting residential participants, describing their date, the time the event started, and the time the event ended.
- A list of all participants and addresses with a variable linking to the load or energy consumption interval data and that describes their enrollment date, load management control commissioning date, and any events in which the participant did not participate due to enrollment or equipment installation timing, equipment failures, or other factors known to the implementer or utility.
- Tools, calculators or other datasets that may be useful to the EM&V team, based on discussion between the EM&V team, utilities, and/or program implementer. The process for calculating kW and kWh savings should be provided in the program documentation, including any summation and rounding practices.
- Memos, reports, or results of any equipment test or metering data that provides perspectives, calculations, or metrics related to failure rates of load control receivers, thermostats or similar devices used to control participant loads during events.

The EM&V team may conduct participant-level independent metering studies to inform the verification of load management program savings.

References and Efficiency Standards

Not applicable.

Petitions and Rulings

Not applicable.

Relevant Standards and Reference Sources

Not applicable.

Document Revision History

Table 49. M&V Residential Load Management History

TRM version	Date	Description of change
v2.1	3/31/2015 revised 6/2015	Memo to PUCT staff initiating and establishing High 3 of 5 baseline with day-of adjustment.
v3.1	11/05/2015	TRM v3.1 Volume 4 origin.
v4.0	10/10/2016	Clarified language related to applying the adjustment factor to the High 3 of 5 baseline and additional data provision details
v5.0	10/10/2017	Further clarified the baseline calculation using the High 3 of 5 method.
v6.0	10/2018	No revisions.
v7.0	10/2019	Transferred metering and rounding guidance from Vol. 5.
v8.0	10/2020	Added guidance on rounding, ensuring meters are functioning prior to an event, and changing the error threshold from one to two percent of total participants