

Better Buildings Partnership

Measurement and Verification Procedures Guideline

(to be applied to Measures eligible for BBP Electricity Conservation Incentive Payments)

The following table lists the Measurement and Verification (M&V) Procedures to be applied according to:

- Type of Measure
- ‘Basic’ or ‘Enhanced’ M&V
- kW or kWh incentive claim

Generally,

‘Basic’ M&V will be considered for measures with less than 50 kW or 400,000 kWh/yr savings.

‘Enhanced’ M&V will be considered for measures with greater than 50 kW, 400,000 kWh/yr savings

Measure Type	M&V CODE	
	‘Basic’	‘Enhanced’
Lighting Retrofit	LR-B	LR-E
Equipment Replacement	ER- B	ER-E
HVAC Re-Design		HVAC-E
Variable Speed Drives (VSDs)	VSD-B	VSD-E
Building Envelope	BE-B	BE-E
Building Automation Systems (BAS)	BAS-B	BAS-E
Lighting Controls	LC-B	LC-E
Sub Metering		SM-E
Deep Lake Water Cooling		DLWC-E
Ground Source Heat Pumps		GSHP-E
Other Custom Measures		OCM-E
Fuel Substitution Measures	FS- B	FS-E

1. Lighting Retrofit

- Likely to claim \$/kW.
- Load is constant when operating
- Stipulation of operating hours is acceptable, subject to validity checks.
- Same procedure applies to both kW and kWh incentive measures.

LR-B: 'Basic' M&V:

- Baseline wattage established from industry references to the various lamp/ballast types installed.
- Post-retrofit wattage is to be established from manufacturer's data sheets (to be provided with application) and/or industry references.

LR- E: 'Enhanced' M&V:

- Provide same information as LR-B, plus
- Spot measurement RMS wattage readings for a minimum of 6 randomly selected fixtures of each type of lamp/ballast combination for both Baseline and Post-Retrofit conditions.
- Post retrofit measurements must allow for min. 100 hours of burn-in (Note: Applicants must be prepared to demonstrate wattage readings during site inspections by the Project Evaluator).

NOTE: Both LR-B and LR-E require the Applicant to provide detailed site surveys that include:

- Inventory of lamp/ballast fixture type by area
- Usage area designation and operating periods (e.g. common space 7x24; tenant space – lease hours).
- Counts of operating and non-operating fixtures and lamps

Where there are different lamp types being employed in a given fixture, the default baseline condition will generally be the lowest wattage value.

2. Equipment Replacement: Chillers, Motors, Refrigeration

- Claim \$/kW or \$/kWh.
- Whether load is constant or variable, refer to manufacturer's data, industry references, for kW ratings at various load points.
- Assumptions for operating profile, both load and hours, to be reviewed for reasonableness.

- Provide detailed inventory of all equipment, baseline and proposed post-retrofit, showing quantities, thermal and electrical ratings.

ER – B: ‘Basic’ M&V

Chillers and Refrigeration:

- kW savings - stipulated values, at 80 % of nameplate capacity of operating equipment, of baseline and post-retrofit kW, Baseline kW shall assume OEM rated or shop tested efficiency.
- kWh savings – stipulated values for baseline and post-retrofit kW at representative distributed load levels spanning total capacity, multiplied by stipulated hours at each point.
- Exclude chiller auxiliary equipment (pumps and cooling tower) unless this equipment is changed as well

Motors:

- kW savings - stipulated values for efficiency and power factor, at 80% load, using manufacturer ratings.
- kWh savings = kW savings x stipulated hours
- If variable load, stipulate efficiency and power factor at representative load levels, and stipulate hours at each level.

ER – E: ‘Enhanced’ M&V

Chillers and Refrigeration:

- kW savings - Baseline and post retrofit performance is to be measured at current peak design load. This is to reflect design load for the facility, not 100% capacity of the equipment. Measurements are to be made at three different times and averaged. Measurements may be normalized to design temperature conditions. If equipment capacity is to be changed, apply the baseline tonnage for both measurements. If Amperage measurements are used they must be referenced to manufacturer’s performance data sheets showing amps vs. tonnage load.

In the absence of measured performance data the default assumption will be 60% of nameplate rated load.

- kWh savings – Baseline and post retrofit performance is to be measured at representative distributed load levels spanning total design loads, multiplied by stipulated hours at each point.

Motors:

- kW savings – spot or short term measurements of kW input and power factor.
- kWh savings = kW savings x stipulated hours
- If variable load, measure kW input and power factor at representative load levels, and stipulate hours at each level.
- Measurements shall be made on not less than 20% of a sample population and load of comparable equipment.

3. HVAC Redesigns (all require ‘Enhanced’ M&V)

HVAC – E: ‘Enhanced’ M&V

- Could claim either \$/kW or \$/kWh
- Review of baseline conditions, including short-term measurement, reference to engineering estimates.
- Engineering review and validation of proposed changes, subject to spot or short-term measurement for post-retrofit conditions.
- Component measures within the HVAC Re-design are to be considered separately and in isolation, to the extent practical.

4. Variable Speed Drives (VSD’s)

- Likely will claim \$/kWh
- Load is likely constant for baseline, variable (by definition) post retrofit.
- Refer to manufacturer’s data, industry references, for kW ratings at various load points.

VSD – B: ‘Basic’ M&V

- Stipulate baseline motor efficiency and % load if baseline is constant; stipulate efficiency and representative load levels if baseline is variable; stipulate hours at each level.
- Assumptions of operating profile, both load and hours, will be reviewed for reasonableness.
- Discount savings that have supporting baseline data by 0-25% based on relevance of monitoring data.

VSD – E ‘Enhanced’ M&V

- Spot or short-term measurements to establish operating load profile for baseline and post-retrofit conditions.
- Applicant should ensure comparable operating conditions for both baseline and post-retrofit measurements.
- Measurements shall be made on not less than 10% of a sample
- Population and load of comparable equipment and operating profiles.
- Discount savings that can be spot tested by 0-25% based on relevance of monitoring data.
- Discount savings that cannot be spot tested by 50%

5. Building Envelope

- May claim either \$/kW or \$/kWh.
- Involves consideration of cooling efficiency in assessing summer savings.
- Refer to manufacturer’s data, industry references, for thermal or leakage properties.

BE – B: ‘Basic’ M&V

- Stipulated values for cooling kW/ton
- Stipulated values, referenced to manufacturers data, industry references, for heating and cooling load reduction.

BE- E: ‘Enhanced’ M&V

- Refer to ER- E for determination of cooling kW/ton
- Use hour-by-hour annual energy simulation model for kWh savings. (Peak month only for kW). Simulations should demonstrate solar effects and coincident loading for all orientations.
- Detailed models as provided by manufacturers that account for glazing types and orientation are acceptable in the absence of simulation models for the specific facility.
- Blower door test for infiltration reduction

6. Building Automation System (BAS)

- Recognized as inherently uncertain.
- May be a new BAS installation or an enhancement of an existing system.
- Likely to claim \$/kWh.

BAS – B: ‘Basic’

- Provide detailed description of baseline and post-retrofit operating conditions, with anticipated savings.
- Provide operating logs or other monitoring data to support claimed operating conditions.
- Discount savings that have supporting baseline data by 0-25% based on relevance of monitoring data.
- Discount savings that have no supporting baseline data by 50%

BAS – E: ‘Enhanced’

- Spot or short-term measurements, during the summer season, to substantiate operating profile and set points (baseline and post-retrofit) in a sample of loads.
- Discount savings that can be spot tested by 0-25% based on relevance of monitoring data.
- Discount savings that cannot be spot tested by 50%

7. Lighting Controls

- Recognized as inherently uncertain.
- May be a new installation or an enhancement of an existing system.
- Likely to claim \$/kWh.

LC – B: ‘Basic’ M&V

- Provide detailed description of baseline and post-retrofit operating conditions, with anticipated savings.
- Provide operating logs or other monitoring data to support claimed operating conditions.
- Discount savings that have supporting baseline data by 0-25% based on relevance of monitoring data.
- Discount savings that have no supporting baseline data by 50%

LC – E: ‘Enhanced’ M&V

- Spot or short-term measurements, during the summer season, to substantiate operating profile and set points (baseline and post-retrofit) in a sample of loads representing not less than 10% of similar circuits.
- Discount savings that can be spot tested by 0-25% based on relevance of monitoring data.
- Discount savings that cannot be spot tested by 50%

8. Sub-Metering

Provide detailed description of:

- loads that are proposed to be sub metered
- details of the tenant billing procedure.
- description of planned tenant education and engagement activities to support the reduction of tenant energy usage.
- Preliminary estimate of metered tenant load, including assumptions.
- Actual metered tenant load shall be determined from measurements of at least one month duration following implementation. The initial incentive payment will be based on 5% of the evaluator approved tenant load value estimate.

Following an implementation period of not less than 6 months, provide:

- Description of tenant engagement experience and supporting metering of tenant usage over the period.
- A calculation of savings, based on the minimum 6 month engagement period, properly reconciling for vacant space and material changes to energy consuming equipment.
 - The incremental payment will be made based on the difference between the post 6-month calculation of savings, less the initial 5% payment. There will be no claw back of the initial 5% payment.
 - Due to inherently uncertain sustained month over month usage patterns, a discount of incremental savings will be from 0-50%, depending on the duration of measurement and quality of data and presentation.

9. Deep Lake Water Cooling (all require 'Enhanced' M&V)

- Likely to claim \$/kW.

DLWC – E: 'Enhanced' M&V

- Rigorous review of existing chiller operations, including peripherals (cooling tower, condenser pumps): kW/ton, peak loading, equivalent run-hours. Reference to industry norms, manufacturer's data, and submetering data where available. Utilize billing data and interval data for validation where possible.
- Savings will be discounted by a stipulated value (provided by BOMA) to account for energy requirements in the delivery of DLWC.
- Option to use actual measured tons and ton-hours post retrofit to confirm final savings.

10. Ground Source Heat Pumps (all require 'Enhanced' M&V)

- May claim \$/kW or \$/kWh

GSHP – E: 'Enhanced' M&V

- Involves consideration of existing cooling plant operations, and (if applicable) existing electric heat operations.
- Refer to manufacturer's data, industry references, for kW load impacts.
- Utilize short-term measurement where applicable.
- Utilize generic or facility specific simulation models for savings impacts.
- Savings will be discounted relative to the extent of un-measured or un-modelled effects being used for savings determination.

11. Other Custom Measures. (All require 'Enhanced' M&V)

OCM – E: 'Enhanced' M&V

M&V for other Custom measures must adhere to the principles described in IPMVP Volume 1, 2007 or later. M&V should also be consistent with the principles described here as applying to the BBP ECI Program and consistent with measure specific M&V procedures as described here, to the extent applicable.

12. Fuel Substitution Measures

- Can involve space heating, space cooling, domestic water heating and other processes. Generation projects are not eligible under this category.
- Space heating measures that do not impact summer peak kW will be assessed only on a \$/kWh basis.

FS – B: 'Basic' M&V

- Provide specifications, including power ratings, of existing installed electrical equipment.
- Provide calculations of existing annual operating energy (kWh) based on heat loss calculations specific to the application.
- Provide details of the proposed new gas (or other fuel) equipment, including ratings and efficiency.
- Provide details of any operational changes from the existing electrical equipment.
- If providing kW reduction in summer demand, consideration must be given to operating diversity of installed equipment to properly reflect actual diversified demand.

- If the project involves gas absorption or gas driven cooling equipment, the base load conditions for the existing electric chillers shall be established as per “Equipment Replacement – Chiller” (ER-B)

FS – E: ‘Enhanced’ M&V

- In addition to all FS - B requirements, heat load and heat loss calculations will be subject to more rigorous assessment, requiring supporting data specific to the application.
- Use of spot measurement or short term monitoring, and/or equipment operating logs is expected.