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3. Please **mute** yourself when you call in to avoid interference 
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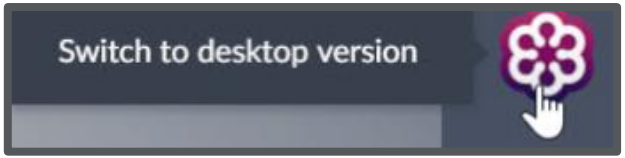
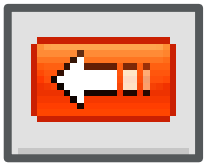
GoToTraining Tools

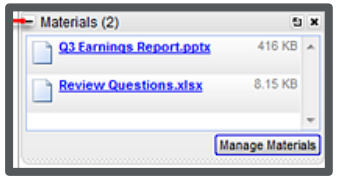
Use the Desktop App (If possible)



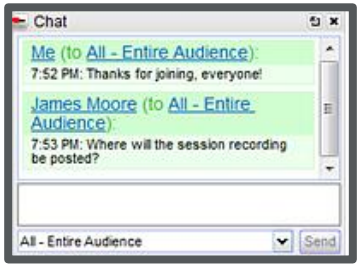
Expand the toolbar to see the full dashboard



Select the Materials button to access supplementary documents



Open up the Chat to chat with the Meeting Organizers



Save on Energy Retrofit Program

M&V Essentials and Sample M&V Plans

Tips, tools, and best practices for creating and submitting M&V plans

September 29, 2020

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This webinar will demonstrate…

1. Overview of what M&V is and why it's required
2. How to plan for and prepare an M&V Plan
3. Pump VFD Basic M&V Plan
4. Lighting Controls Enhanced M&V Plan
5. Identifying common information requests and how to avoid them
6. What support is available

REMEMBER:

- Program deadlines
- Retrofit projects must be Pre-Approved before December 31, 2020
- Technical review can take 2 days to 2 months depending on project complexity
- Retrofit Projects must be In-Service before December 31, 2021

Note: This webinar pertains to M&V requirements for projects in the Interim Framework

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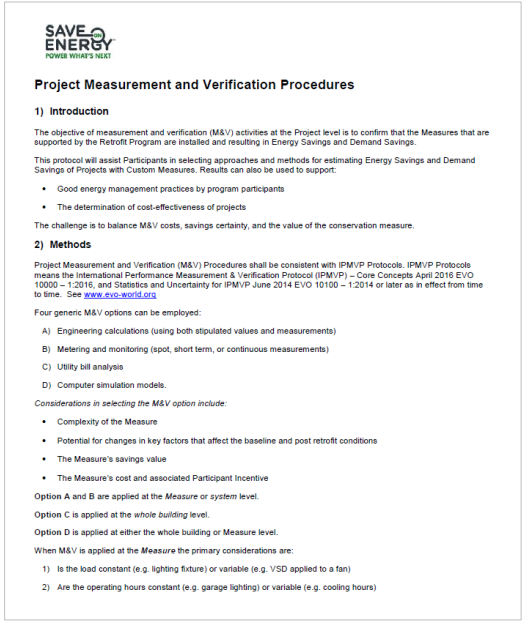
Support resources are available online

M&V Procedures



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Project Measurement and Verification Procedures

1) Introduction

The objective of measurement and verification (M&V) activities at the Project level is to confirm that the Measures that are supported by the Retrofit Program are installed and resulting in Energy Savings and Demand Savings.

This protocol will assist Participants in selecting approaches and methods for estimating Energy Savings and Demand Savings of Projects with Custom Measures. Results can also be used to support:

- Good energy management practices by program participants
- The determination of cost-effectiveness of projects

The challenge is to balance M&V costs, savings certainty, and the value of the conservation measure.

2) Methods

Project Measurement and Verification (M&V) Procedures shall be consistent with IPMVP Protocols. IPMVP Protocols means the International Performance Measurement & Verification Protocol (IPMVP) – Core Concepts April 2016 EVO 10000 – 1:2016, and Statistics and Uncertainty for IPMVP June 2014 EVO 10100 – 1:2014 or later as in effect from time to time. See www.evo-world.org

Four generic M&V options can be employed:

A) Engineering calculations (using both stipulated values and measurements)

B) Metering and monitoring (spot, short term, or continuous measurements)

C) Utility bill analysis

D) Computer simulation models.

Considerations in selecting the M&V option include:

- Complexity of the Measure
- Potential for changes in key factors that affect the baseline and post retrofit conditions
- The Measure's savings value
- The Measure's cost and associated Participant Incentive

Option A and **B** are applied at the *Measure* or *system* level.

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When M&V is applied at the ***Measure*** the primary considerations are:

1) Is the load constant (e.g. lighting fixture) or variable (e.g. VSD applied to a fan)

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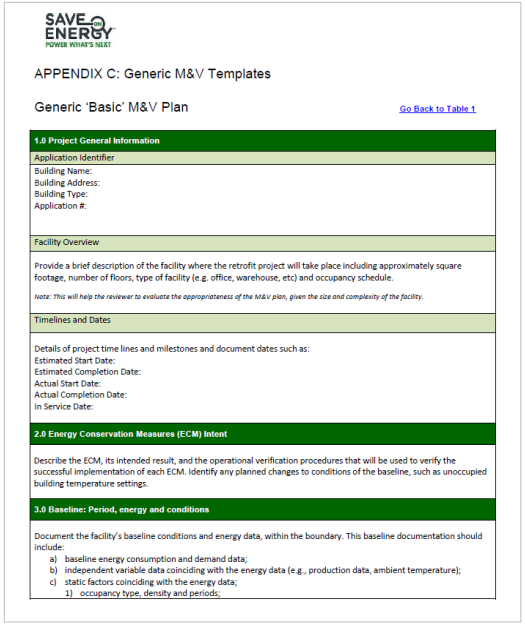
M&V Procedures

Plan Templates



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APPENDIX C: Generic M&V Templates

Generic 'Basic' M&V Plan

Go Back to Table 1

1.0 Project General Information
Application Identifier
Building Name: Building Address: Building Type: Application #:
Facility Overview
Provide a brief description of the facility where the retrofit project will take place including approximately square footage, number of floors, type of facility (e.g. office, warehouse, etc) and occupancy schedule. *Note: This will help the reviewer to evaluate the appropriateness of the M&V plan, given the size and complexity of the facility.*
Timelines and Dates
Details of project time lines and milestones and document dates such as: Estimated Start Date: Estimated Completion Date: Actual Start Date: Actual Completion Date: In Service Date:
2.0 Energy Conservation Measures (ECM) Intent
Describe the ECM, its intended result, and the operational verification procedures that will be used to verify the successful implementation of each ECM. Identify any planned changes to conditions of the baseline, such as unoccupied building temperature settings.
3.0 Baseline: Period, energy and conditions
Document the facility's baseline conditions and energy data, within the boundary. This baseline documentation should include: a) baseline energy consumption and demand data; b) independent variable data coinciding with the energy data (e.g., production data, ambient temperature); c) static factors coinciding with the energy data; 1) occupancy type, density and periods;

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Overview of Measurement and Verification

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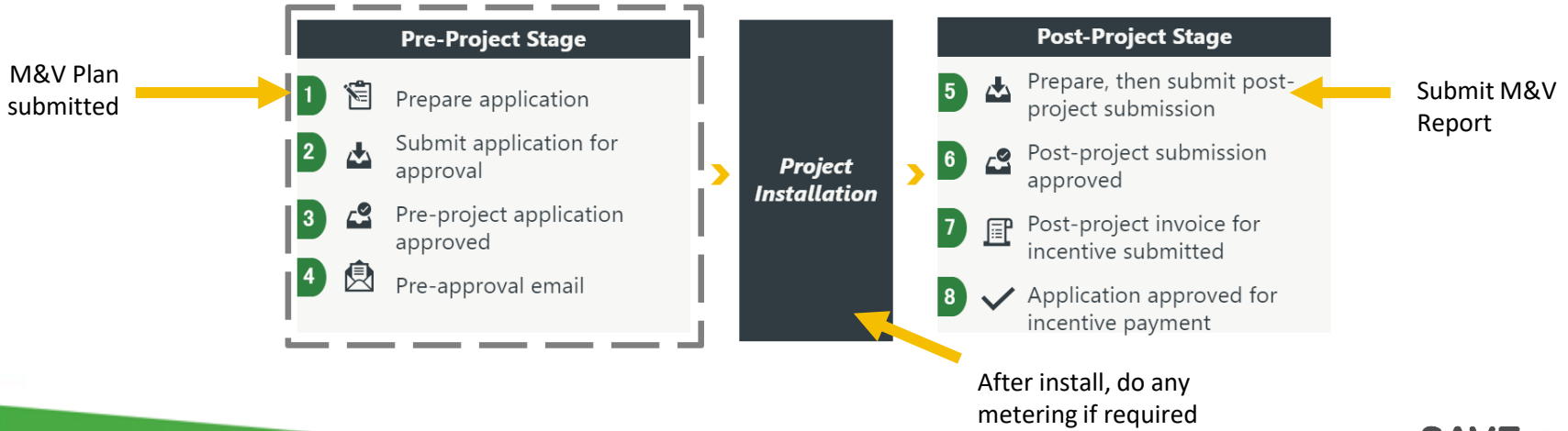
Record energy use before and after the retrofit to verify savings

Measurement and Verification (M&V) is the process of planning, measuring, collecting and analyzing data for the purpose of verifying and reporting energy savings within an individual facility resulting from the implementation of Energy Conservation Measures.



M&V is essential to the energy efficiency sector

Identifies energy consumption in the pre-project and post-project stages to **determine project savings**

Accurately determines energy savings for calculating the project incentive amount

Provides Applicants with **confidence** that all energy savings are accounted for to receive an **accurate incentive**

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M&V involves documenting project energy use

A ***Project M&V Plan*** describes measurements and data to be gathered, analysis methods employed, and verification activities that are conducted to evaluate the performance of a measure or a project (EVO, 2016, 35).

A ***Project M&V Report*** is provided at the end of the project and it documents the overall performance (measured and verified Energy and Demand Savings) of the measure and project using procedures outlined in the M&V Plan (EVO, 2016, 42).

Efficiency Valuation Organization (EVO). *Core Concepts International Performance Measurement and Verification Protocol*. EVO, 2016. Documents can be found on the EVO Website

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Preparing for M&V takes place prior to submitting a Retrofit application

The M&V Plan should be submitted in the pre-project stage, before the project is implemented.
There are **two different M&V thresholds** for large custom projects:

BASIC M&V

- Custom Incentive between $10,000 - $40,000
- Requires only calculations with engineering worksheets

ENHANCED M&V

- Custom Incentive greater than $40,000
- Requires metered data (on site measurements)

The M&V Plan outlines what will be provided in the **post-stage M&V Report**

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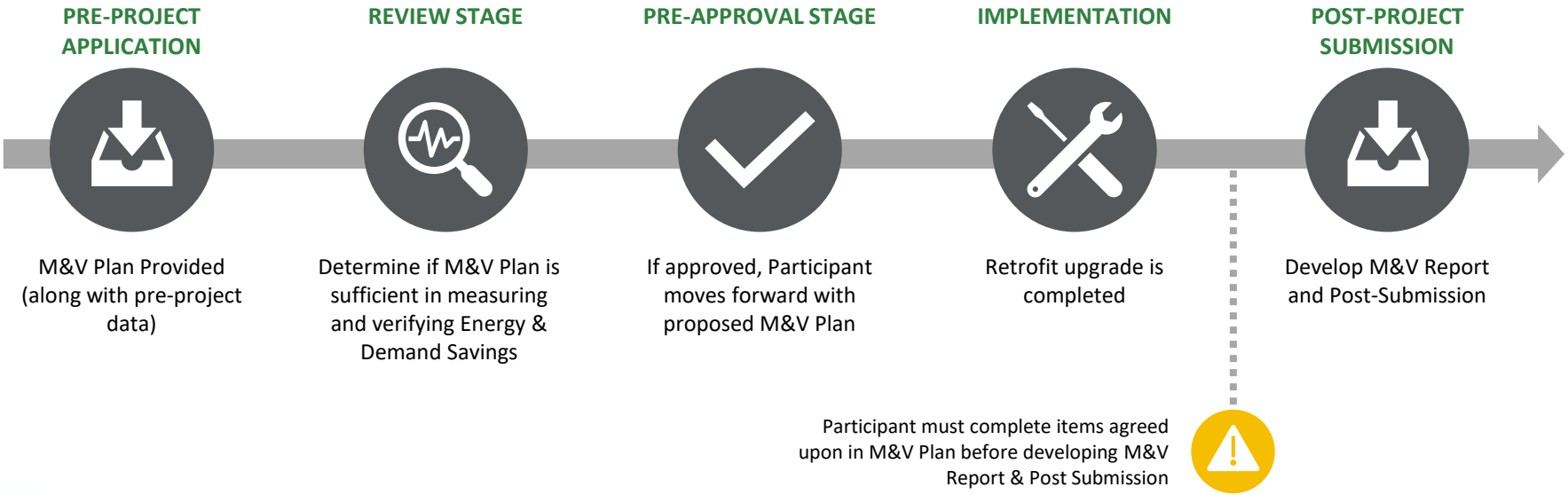
When M&V is required, it must occur at specific stages of the project process



Good M&V planning and reporting have multiple benefits for applicants

- A **detailed M&V Plan** will make success more likely during a time-limited review.
- **Fewer questions** from Reviewers because the explanation of the calculations, assumptions, or methodology is provided
- Provides more accurate energy consumption, along with the **possibility of greater savings and incentives**

REMEMBER:

- Program deadlines are fast approaching
- Retrofit Projects must be Pre-Approved before December 31, 2020
- Retrofit Projects must be In-Service before December 31, 2021

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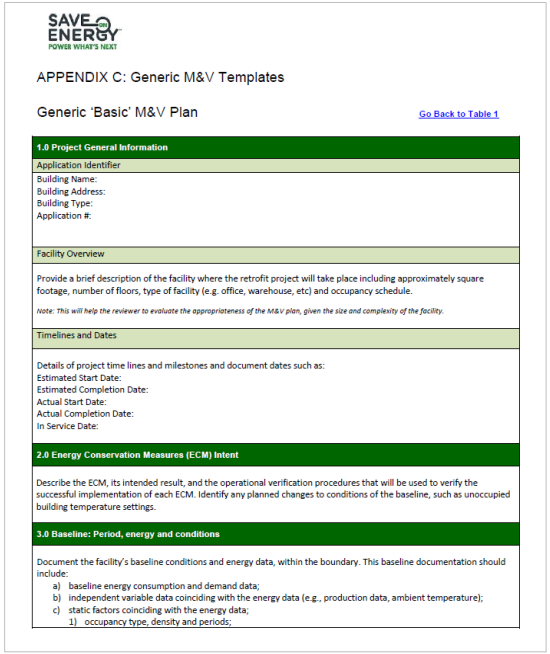
M&V documents can come in many forms, templates are available online

- M&V Plan Templates are available in Appendix C of the *Save on Energy Retrofit Program – Project Measurement and Verification Procedures document*
- Custom M&V document formats or templates can be submitted as long as all project M&V information is provided



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Details of project time lines and milestones and document dates such as:
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c) static factors coinciding with the energy data;
   1) occupancy type, density and periods;

Preparing an M&V Plan

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Basic M&V requires less data and documentation than enhanced M&V

BASIC M&V

- ✓ Prepared using engineering calculations (stipulated and rated values, and/or measurements) There is no requirement for on-site physical measurements
- ✓ Supporting/Reference Documents – nameplate data, DLC listings, CAGI Sheets.
- ✓ Perform mandatory QA/QC

ENHANCED M&V

- ✓ Done using metering and monitoring (spot, short term or continuous measurements) for pre-project and post-project
- ✓ Perform mandatory QA/QC

A good M&V Plan provides additional specifics on the project

An M&V Plan is meant to communicate:

- ✓ The scope of the project and proposal of what to measure and how to verify savings
  - **Basic M&V Plans:** What assumptions were made, and which values were rated/stipulated?
  - **Enhanced M&V Plans:** What parameters are being metered and how?
- ✓ The M&V Plan should be included in the initial submission

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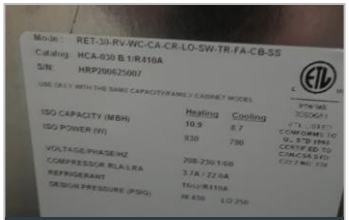
Note: Basic & Enhanced M&V's are specific to Save on Energy and are not defined in the IPMVP

Mandatory QA/QC will be required for projects greater than $10k in incentive

- Large projects will be selected to provide Quality Assurance/Quality Control photo verification
- Please provide nameplate, close-ups, and long-shot photos for each piece of equipment in the application
- Please make sure photos are as legible as possible

REMEMBER: QA/QC is not the same as M&V

Long Shot



Nameplate

Close Up

Additional Resource: QA/QC Guidelines, Best Practices for Photo Requirements

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Main sections that are required for a Basic M&V Plan

1. Project General Information
2. Energy Conservation Measures intent
3. Baseline: Period, energy, and conditions
4. Basis for Adjustment
5. Analysis Procedure
6. Report Format

What needs the most attention: Energy Conservation Measures intent, Baseline, and Analysis

Main sections that are required for an Enhanced M&V Plan

1. Project General Information
2. Energy Conservation Measures intent
3. Selected IPMVP Option and Measurement Boundary
4. Baseline: Period, energy, conditions
5. Reporting Period
6. Basis for Adjustment
7. Analysis Procedure
8. Energy Prices
9. Meter Specifications
10. Monitoring Responsibilities
11. Expected Accuracy
12. Budget
13. Report Format
14. Quality Assurance

LEGEND

- Included in Basic M&V
- Specific to Enhanced M&V

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The difference between Option A and Option B will almost always depend on the extent of measurement

IPMVP Option selected (select only one):

☐ Option A Retrofit Isolation: Key Parameter Measurement
■ Option B Retrofit Isolation: All Parameter Measurement
☐ Option C Whole Facility: Utility Bill Analysis
☐ Option D Calibrated Simulation

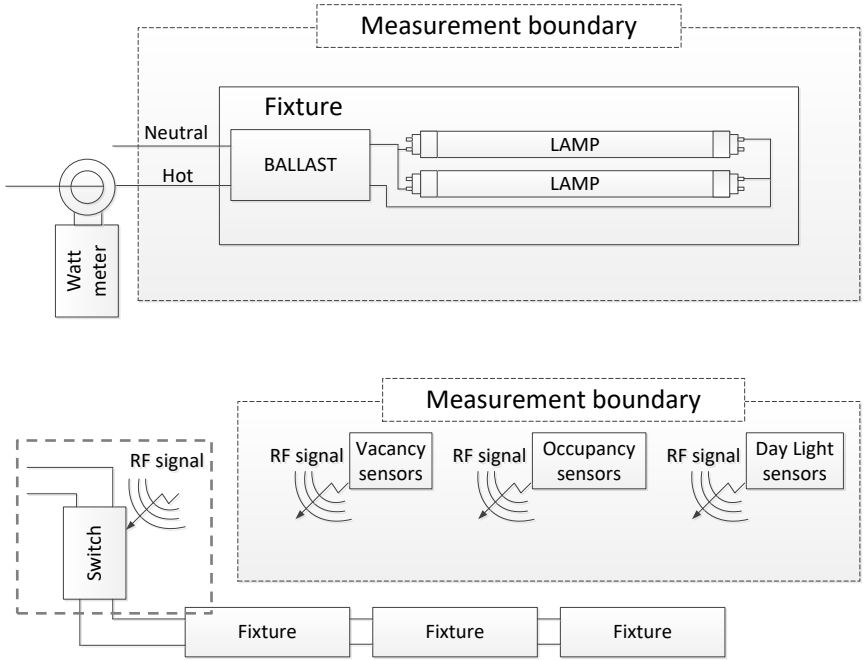
Select Option B if you are metering large amounts of data

Select Option A if you are not metering as much

Option C and D are almost never used in the Retrofit Program

M&V requires a Measurement Boundary

- It is drawn around the Retrofit energy conservation measure to determine project savings
- The boundary can be facility-wide or specific equipment depending on project



Efficiency Valuation Organization. *Core Concepts International Performance Measurement and Verification Protocol*. EVO, 2016.

Baselines and adjustments are important to M&V

Baseline is the existing consumption, within the measurement boundary. This is determined in the pre-project stage, and all energy savings will be determined against the baseline.

Baseline Adjustment is the set of conditions for which energy measurement will be adjusted to account for significant changes in consumption.

Certain projects may require the savings to be discounted

Measures with a **high degree of uncertain savings** will be discounted

EXAMPLES

Building Automation Systems and **Lighting Controls** are recognized as inherently uncertain; they will always receive discounted savings.

- 25% discount for savings that have a supported baseline
  - i.e., utility bills, case studies, spec sheets
- 50% discount for savings that have no supporting baseline
  - i.e., calculated baseline from nameplates of equipment

Select and measure the parameters that best satisfy the M&V requirements

Data Measurement Questions:

- ✓ Which/What variables to measure?
  - i.e., voltage (V), amps (A), flow (cfm), power (kW)
- ✓ How to measure the variable?
- ✓ Duration of measurements (i.e., spot measurements, continuous measurement)

The table below identifies the Project M&V Procedure to be used dependent on the Custom Measure Type and whether Basic or Enhanced M&V is required.

Table 1: Selection of M&V Procedures (Ctrl+Click to follow link)

#	Custom Measure Type	M&V Procedure	
		'Basic'	'Enhanced'
1	Lighting Retrofit	LR-B	LR-E
2a)	Equipment Replacement – Chillers	ERC-B	ERC-E
2b)	Equipment Replacement – Refrigeration	ERR-B	ERR-E
2c)	Equipment Replacement – Motors	ERM-B	ERM-E
2d)	Equipment Replacement – Air Compressors	ERAC-B	ERAC-E
2e)	Equipment Replacement – Aeration Blowers	-	ERAB-E
3	HVAC Redesign	-	HVAC-E
4	Variable Speed Drives (VSDs)	VSD-B	VSD-E
5	Building Envelope	BE-B	BE-E
6	Building Automation Systems (BAS)	BAS-B	BAS-E
7	Lighting Controls	LC-B	LC-E
8	Tenant Sub Metering (TSM)	-	TSM-E
9	Monitoring and Targeting (M+T)	-	MT-E
10	Other Custom Measures	-	OCM
11	Power Conditioning Devices	-	PCD-E

Refer to M&V Procedures for above guidelines

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Knowledge Check

- Which of the following are components of a Basic M&V Plan AND an Enhanced M&V Plan?

The M&V Report is developed after the completion of the project

M&V Report must be completed and reviewed **before the post-project submission is approved**

Report should follow the **Approved M&V Plan**
Summarizing the scope and intent of the project

- **Basic M&V**: Stipulated values should be accurately supported and calculated
- **Enhanced M&V**: Baseline and Retrofit case consumptions should all be measured and summarized in the Report

More details will be provided during the **Oct 7** webinar, which will focus on M&V Reporting

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M&V Review Process

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Provide complete and accurate M&V documents to achieve application Pre-Approval faster

- ✓ Upload your completed **M&V Plan** at the time of submission with your other documents
- ✓ Submitting **metered data** with M&V Plan and waiting for plan approval is recommended prior to commencing project
- ✓ Include **QA/QC photos** of your existing equipment
- ✓ Include supporting **calculations**
- ✓ Include all **regular submission documents**: quotation, specification sheets, DLC/Energy Star listings, as applicable

TIPS:

- Reach out to a Save on Energy representative for any questions regarding metering/pre-approval timelines
- Refer to our pre-project checklist or webinar for non-M&V Pre-approval advice

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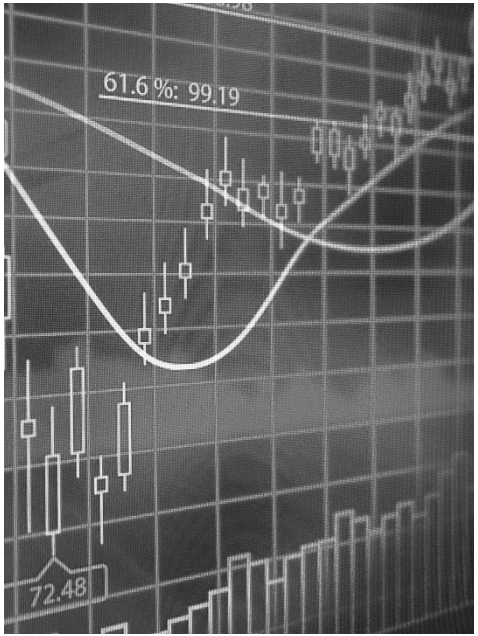
Technical reviewers are looking for specific information in an M&V Plan

- The **variables** to be measured in the post-project stage and references for **assumptions** of parameters (i.e., power factor, load factor, motor efficiency)
- **Duration** of measurements in the post- project stage – spot versus continuous measurements (i.e., 2 weeks for compressor flow cases)
- Agreeing on **baseline adjustments** in the post-project stage (reporting) of the project.
- Commitment to **provide missing data measurements** for key variables during the baseline period in the post-project stage
- Confirmation that **production/operations will remain the same** pre-project and post-project, or adjustments made if not the same



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Common M&V mistakes that slow down the review process and can be avoided

1. **Missing M&V Plan in the initial submission**
2. **Incomplete M&V Plan**
   - Missing data measurements of key variables during the baseline period (applicable for enhanced projects)
   - Missing information on which variables will be measured in the post (reporting) stage and for what time intervals
   - Missing references for the assumptions of different variables made in the calculations

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Knowledge check

- Which of these are things will technical reviewers look for in your M&V Plan?

M&V Plan Examples

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Example Plans that will be covered today

1. **Pump VFD measure**
   - Basic M&V
   - Incentive (> $10,000 and ≤ $40,000)

2. **Lighting Controls measure**
   - Enhanced M&V
   - Incentive (> $40,000)

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Basic M&V Plan Example

Pump VFD Measure

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Collect the required information to complete the Basic M&V Plan for a Pump VFD

- Determine which method of quantifying the savings suits the project best:
  - Custom calculations
  - Variable Speed Drive on Pump Engineering Worksheet – Found under Application Documents
- Motor information (best source is nameplate photos) & load factor assumption for the motor
- Operating hours and flow profile during the baseline period
- Assumed operating hours and flow profile for the post retrofit phase

Note: Assumptions on operating hours and flow profile will be checked for reasonableness. Therefore, data/measurements might be requested.

Avoid these common mistakes found in Pump VFD custom calculations

1. Using ‘Industry Standard’ values without referencing them in Calculations or in the M&V Plan
2. Not referencing the engineering equation used for savings determination
3. Not providing model numbers of the existing and proposed equipment

! These common mistakes can be avoided when using the **Variable Speed Drive on Pump Engineering Worksheet**

Mistakes in using Affinity Laws for VFD Projects:

- Using the theoretical Power (P) and Speed (N) relationship from the Affinity Laws

  Note: The exponent in the theoretical formula is 3, but Reviewers typically use 2.6 to account for real-world inefficiencies

$$\frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^3 \rightarrow \frac{P_1}{P_2} = \left(\frac{N_1}{N_2}\right)^{2.6}$$

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Technical Reviewers commonly request information that is missing in M&V documents

- Reference/Explanation required for assumed **motor efficiency** and **power factor** values if different than industry standards
- Requesting the reference for engineering equations and calculations if not provided
- Reasoning/Explanation for unusual flow profiles or operating hours.
- Missing nameplate photos for motors
- Confirmation of data representing year-round operations

Knowledge check

- When using affinity laws, what exponent is typically considered more realistic by technical reviewers than the theoretical value of 3?

Enhanced M&V Plan Example

Lighting Controls Measure

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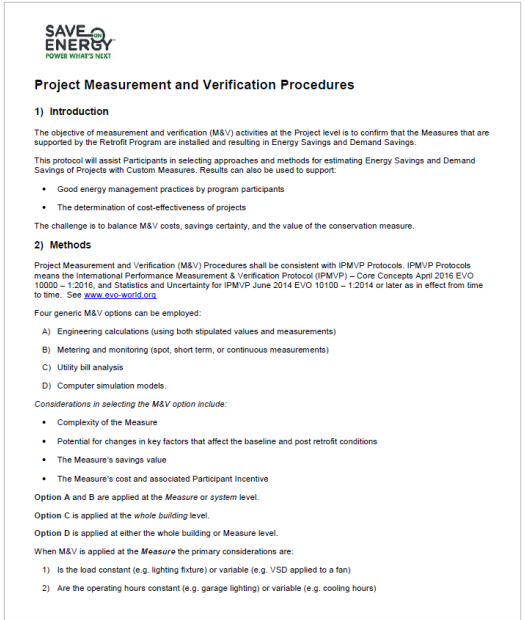
Remember the thresholds and be sure Enhanced M&V is required

- Enhanced M&V for Lighting Controls is required for estimated incentives >$40,000
- Fixture wattage and logged operating hours must be provided, this would fall under Option B of IPMVP and **Enhanced Lighting Controls (LC-E)** under the M&V Procedures.
- Pre-Project Submission should include quotation, DLC/Energy Star listings & worksheets if applicable, QA/QC photos and M&V Plan.
- Prepare accordingly for upcoming deadlines

M&V Procedures



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2) Are the operating hours constant (e.g. garage lighting) or variable (e.g. cooling hours)

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Planning and metering process for Enhanced lighting controls

1. Create an inventory of the lamp/ballast fixture types in the scope of the project and organize them based on usage groups
2. Select IPMVP Option B and determine what to/how to meter to fulfill the metering requirements

   E.g., spot metered wattage of fixtures, continuous measurements of hours
3. Determine the appropriate sample sizes for each usage group for measurement, refer to M&V procedures (**E.g.,** 6 fixtures must be measured from each category of lighting)

Process to plan and meter for Enhanced Lighting controls

1. Create the M&V Plan and submit with Application for review
   Tip: Refer to page 28 of M&V Procedures
2. Once the M&V Plan is approved, choose to meter during a period that is representative of normal operation
3. Meter both the fixture wattage and the hours of operation
   Tip: For more information, refer to M&V Procedures
4. Process data and submit data to the Reviewer

Avoid common mistakes found in lighting control application submissions

- ✓ Remember to provide detailed descriptions of locations, lamps, and operating hours
- ✓ Provide spot metered data for a sample of baseline lamps – a 10% sample size is recommended
- ✓ Provide a minimum of one week of continuous metering (recommended)
- ✓ For missing nameplate photos - disclose why they weren't provided in the submission and when they will be provided
- ✓ Provide QA/QC photos during pre-submission
- ✓ Include the M&V Plan with the pre-submission documents

Commonly missed items in the M&V plan that Technical Reviewers will request

1. How was the base case verified and how will the energy-efficient case be verified?

   Tip: Be specific in the M&V Plan on what will be measured and how

2. Discussions on sample sizes of usage groups with the Reviewer

   Tip: Refer to the M&V Procedures on guidelines to determine sample sizes

Involve suppliers and contractors to collect application-specific information and documentation

- The project will require mandatory QA/QC

  Tip: Ensure that photos of nameplates of base case and retrofit case are taken

- Work with contractors/suppliers to understand how to best meet the M&V requirements

  E.g., metering at a circuit panel vs. individual fixtures

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Conclusion

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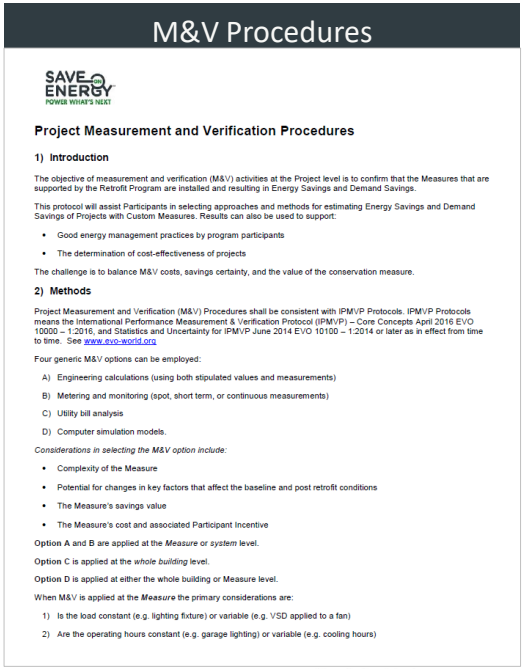
Understanding M&V can expand your incentive options and help you meet deadlines

- ✓ M&V is a core activity in improving energy efficiency
- ✓ Pump VFD basic M&V Plan overview
- ✓ Lighting controls enhanced M&V Plan overview
- ✓ Sample M&V documents are available
- ✓ Guide for M&V Procedures



M&V Procedures

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Project Measurement and Verification Procedures

1) Introduction

The objective of measurement and verification (M&V) activities at the Project level is to confirm that the Measures that are supported by the Retrofit Program are installed and resulting in Energy Savings and Demand Savings.

This protocol will assist Participants in selecting approaches and methods for estimating Energy Savings and Demand Savings of Projects with Custom Measures. Results can also be used to support:

- Good energy management practices by program participants
- The determination of cost-effectiveness of projects

The challenge is to balance M&V costs, savings certainty, and the value of the conservation measure.

2) Methods

Project Measurement and Verification (M&V) Procedures shall be consistent with IPMVP Protocols. IPMVP Protocols means the International Performance Measurement & Verification Protocol (IPMVP) – Core Concepts April 2016 EVO 10000 – 1:2016, and Statistics and Uncertainty for IPMVP June 2014 EVO 10100 – 1:2014 or later as in effect from time to time. See www.evo-world.org

Four generic M&V options can be employed:

A) Engineering calculations (using both stipulated values and measurements)

B) Metering and monitoring (spot, short term, or continuous measurements)

C) Utility bill analysis

D) Computer simulation models.

Considerations in selecting the M&V option include:

- Complexity of the Measure
- Potential for changes in key factors that affect the baseline and post retrofit conditions
- The Measure's savings value
- The Measure's cost and associated Participant Incentive

Option A and **B** are applied at the *Measure or system* level.

Option C is applied at the *whole building* level.

Option D is applied at either the whole building or Measure level.

When M&V is applied at the ***Measure*** the primary considerations are:

1) Is the load constant (e.g. lighting fixture) or variable (e.g. VSD applied to a fan)
2) Are the operating hours constant (e.g. garage lighting) or variable (e.g. cooling hours)

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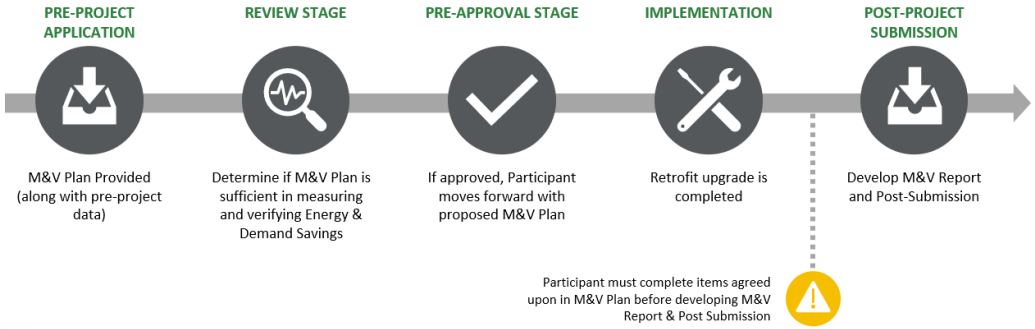
M&V Plan Process: Next Steps

1. Once the M&V Plan is completed and the application is approved, you may start your retrofit project

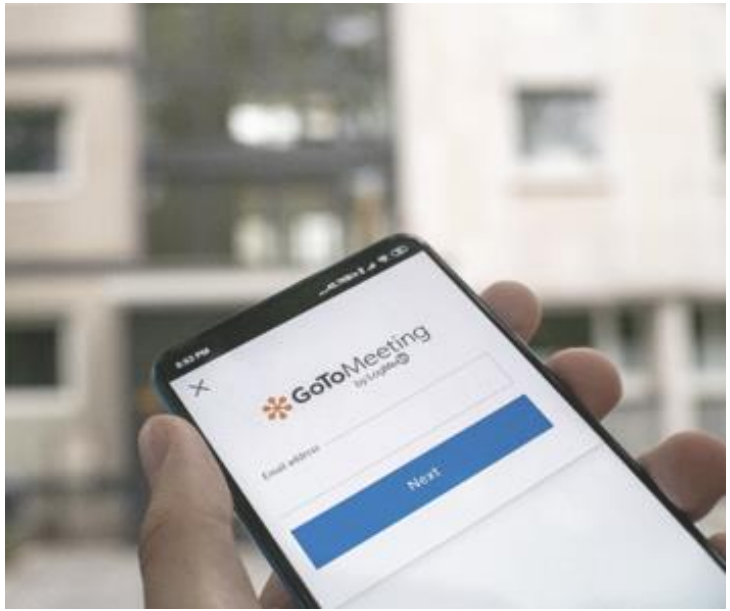
2. Preparing for the M&V Report should occur before post-project submission

Tip: Certain projects require a specific amount of time to pass before post-metering can be completed (ex. 100 burn in hours for lighting retrofits)



Learn more about M&V Reporting on Oct 7th

- Completing the M&V Plan was the scope of this webinar
- Our next webinar will cover **M&V Reporting during the post-project stage**
- Register for the event at https://lnkd.in/gqcmY2u



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Reminder of Retrofit program timelines

To be eligible for a project incentive through the Retrofit program, applications must receive pre-approval by December 31, 2020, and projects must be completed by December 31, 2021.

- Applies only to projects submitted during the Interim Framework

Achieving pre-approval includes a technical review process, which typically takes 2 – 8 weeks to complete, depending on the size and complexity of the project and completeness of the project application. **It is recommended that applications are submitted by the end of October to ensure there is sufficient time to obtain pre-approval**.

Applicant representatives are encouraged to help applicants use fast-track processes, where available, for certain projects in the prescriptive track with incentives less than $6,000, as pre-approval can occur in one or two days

- Contact your Save on Energy representative to see if your project is eligible for the fast-track process

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Need Retrofit Assistance?

Contact

Retrofit Support Services

Support Line: 1-844-303-5542
Monday – Friday, 8:30am – 5:00pm

Email: retrofit@ieso.ca

Tips for emails to retrofit@ieso.ca : Describe the issue thoroughly and illustrate with screenshots

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Thank you for participating!

Questions or Comments?

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