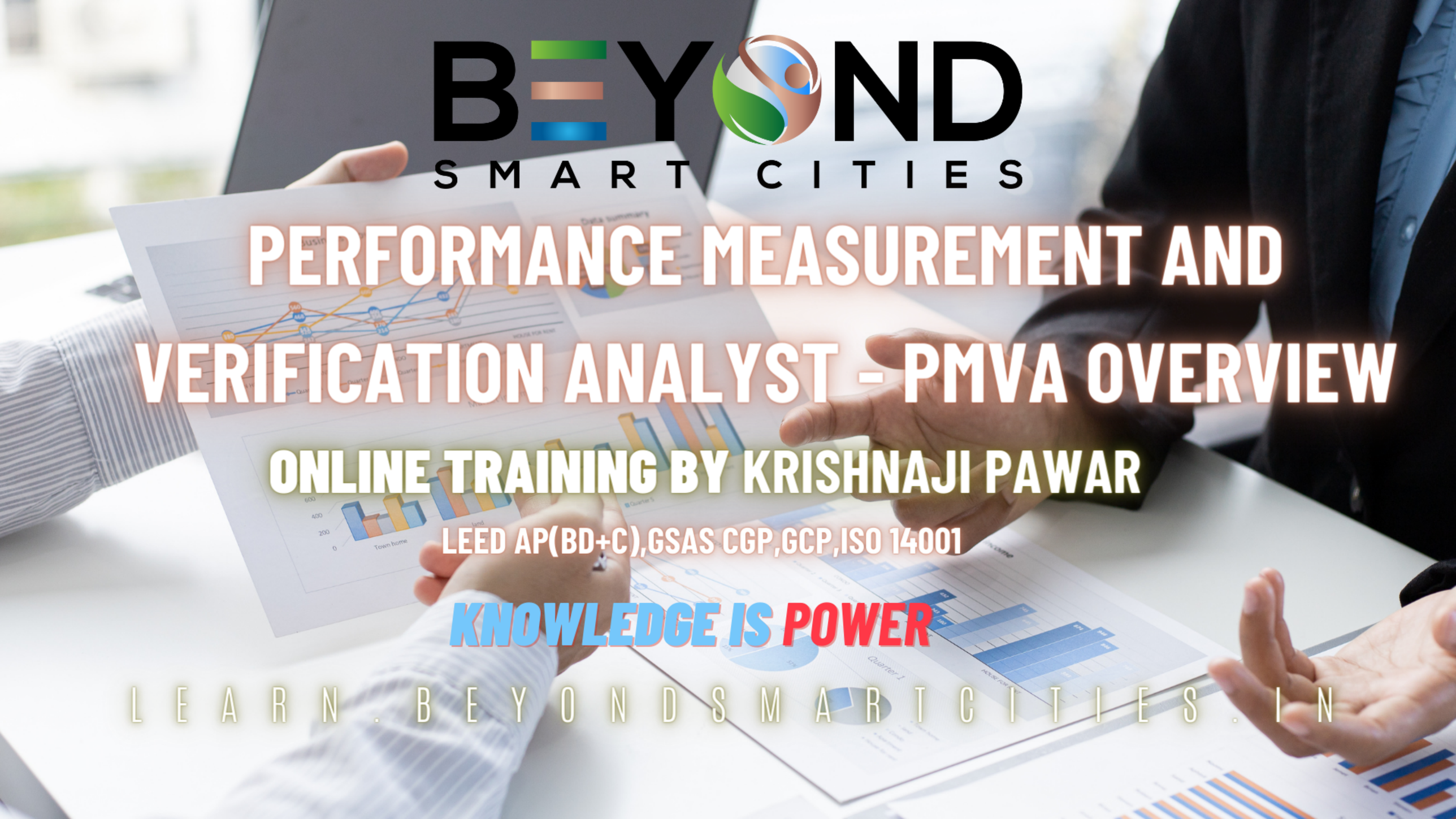

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PERFORMANCE MEASUREMENT AND VERIFICATION ANALYST - PMVA OVERVIEW
ONLINE TRAINING BY KRISHNAJI PAWAR
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MODULE 5

Measurement and Verification Process

KRISHNAJI PAWAR - CEO & FOUNDER

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PERFORMANCE MEASUREMENT AND VERIFICATION ANALYST - PMVA OVERVIEW

“Measurement and Verification” (M&V) is the process of planning, measuring, collecting and analyzing data for the purpose of verifying and reporting energy

Learning Objectives

- Introduction
- Knowing the Process of PMVA Credentialing
- Basic Concepts of Measurement & Verification
- Organizational Fundamentals
- Measurement and Verification Process
- Specialist Certification in Measurement and Verification
- Protocols and Advantages of M&V
- Summary and Resources

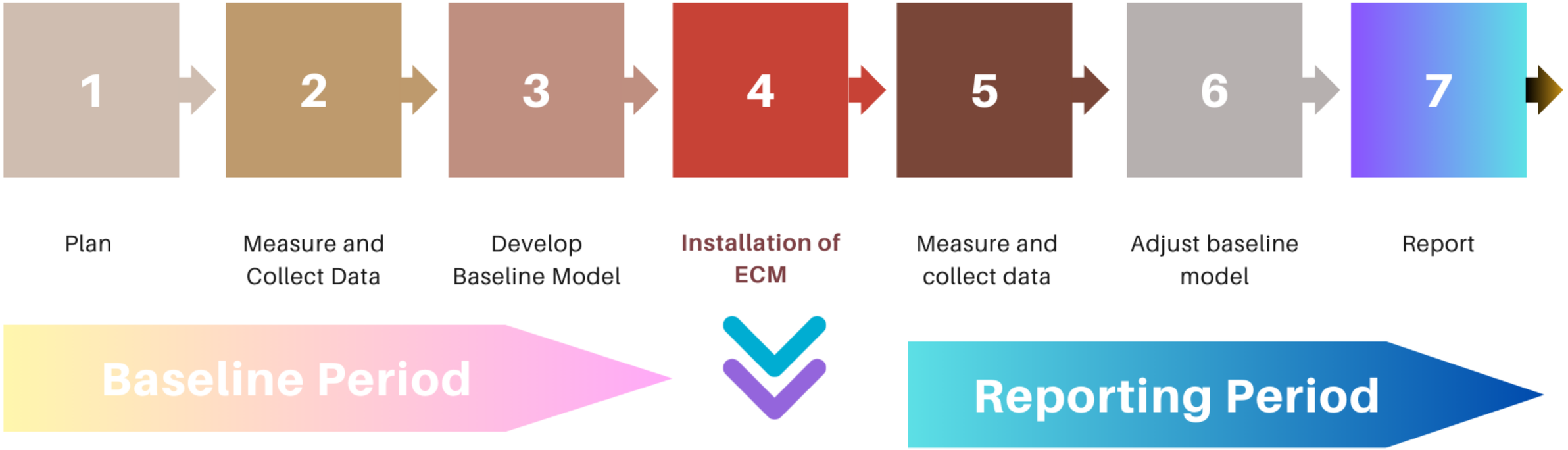
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INTRODUCTION

- M&V involves planning, measuring, collecting, and analyzing data to verify and report energy savings from energy conservation measures (ECMs).
- Savings are determined by comparing measured use before and after project implementation and making adjustments for changes in conditions.
- An M&V Plan is crucial for savings determination and verification.
- It includes estimated baseline performance, description of ECMs, overview of chosen IPMVP option, documentation of post ECMs and operating data, and costs of M&V operations and equipment.

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M&V, STEP BY STEP



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M&V ACTIVITIES CONSIST OF SOME OR ALL OF THE FOLLOWING:

01 Evaluating energy flows and sources of savings

02 Meter installation, calibration, and maintenance

03 Data gathering, storage, and quality control







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M&V ACTIVITIES CONSIST OF SOME OR ALL OF THE FOLLOWING:

04 Development of a computation method & acceptable estimates; computations with measured data

05 Planning and verifying the completion of operational verification

06 Reporting, quality assurance, and third-party verification of reports







M&V PROCESS

01.	Step 1: Determine Goals for M&V Efforts
02.	Step 2: Select IPMVP Option(s) and Approaches
03.	Step 3: Document Baseline Data
04.	Step 4: Develop M&V Plan
05.	Step 5: Set-up Metering and Ongoing Data Collection Processes
06.	Step 6: Monitor for Changes in Site Conditions

M&V PROCESS

07.	Step 7: Confirm Operational Verification
08.	Step 8: Ongoing Data Collection
09.	Step 9: Determine Savings for Period
10.	Step 10: M&V Report for Period
11	Step 11: Track Energy Performance and Savings



Why measurement and verification are important

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WHY ARE MEASUREMENT AND VERIFICATION IMPORTANT?

1. Savings

M&V services reduce energy and financing costs. These services provide operational performance feedback, which helps owners and managers adjust their facility's operations for higher savings and lower costs.M&V methods applied to all projects, not just construction, give lenders confidence to finance. This helps us overcome red tape and bureaucracy!

2. Improves engineering and operations

Engineering design, facility operations, and maintenance all benefit from M&V. When problems related to these processes have been identified through M&V, companies benefit from quicker repairs and a more efficient facility overall.





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WHY ARE MEASUREMENT AND VERIFICATION IMPORTANT?

3. Enhances the value of emission-reduction credits

By improving project efficiency and sustainability, emission-reduction credits add value. Energy efficiency investments can reduce harmful emissions by documenting emissions reductions from reduced energy consumption.





International Performance Measurement and Verification Protocol

- The International Performance Measurement and Verification Protocol ("IPMVP") provides guidance for measuring the savings produced by energy efficiency initiatives or projects.
- IPMVP is a compilation of best industry practices for determining the degree to which efficiency measures produce savings.
- IPMVP provides a framework that determines energy and water savings resulting from the implementation of an energy efficiency program.

ECMs that the IPMVP covers include:

1. Fuel-saving measures
2. Water efficiency measures
3. Load shifting.
4. Energy reductions through the installation or retrofit of equipment.
5. Modification of operating procedures

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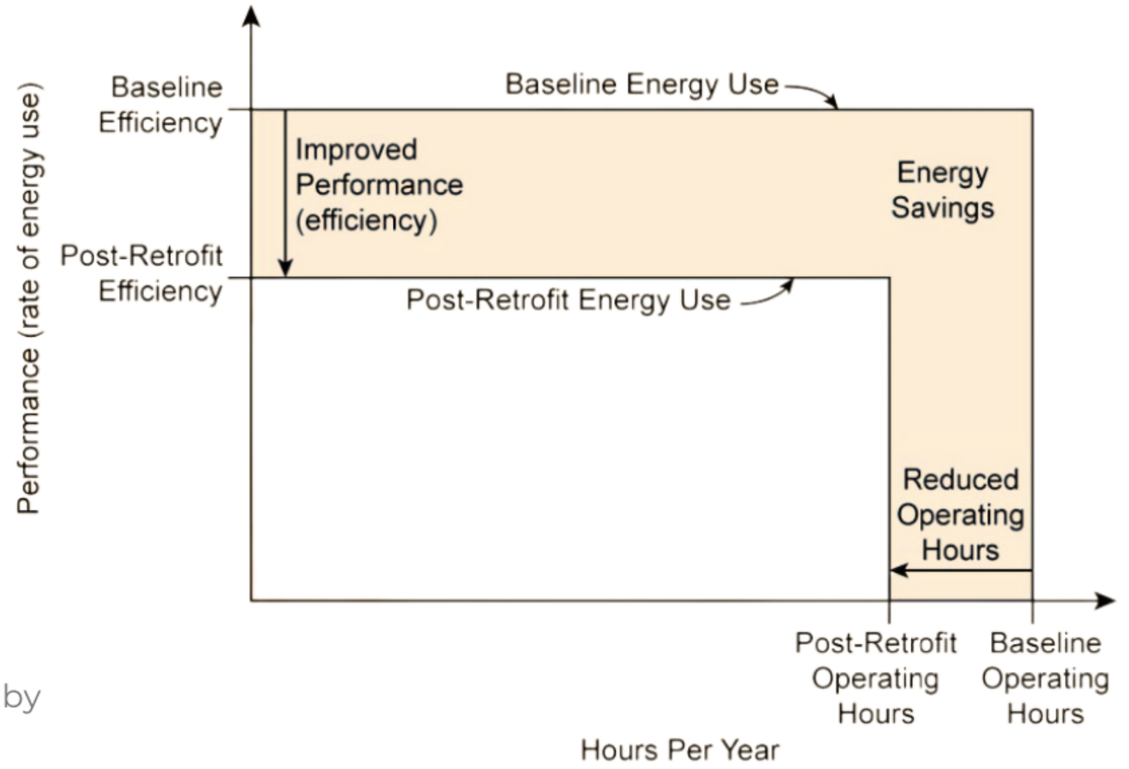
Fundamental Factors Driving Energy Savings

ECM PERFORMANCE

THE RATE AT WHICH ENERGY IS USED TO ACCOMPLISH A SPECIFIC TASK.

ECM USE

HOW MUCH OF THE TASK IS REQUIRED.



In Figure 1, the total amount of energy used in the baseline case is shown by the area of the large box. The smaller box shows how the total amount of energy used goes down when either the rate of energy use goes down (performance goes up) or the amount of energy used goes down (operating hours go down). The amount of energy saved is shown by the shaded area between the two boxes.

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Savings Measurements

The very simple formula for measuring savings is defined below:

Energy Savings = Base Year Energy Use - Post Retrofit Energy Use + or - Adjustments

Where adjustments are made in order to realistically compare post-retrofit conditions to the base-year conditions (i.e., due to significant changes in area, operational hours, and weather conditions).

An illustration of saving measurements is shown in Figure 2.



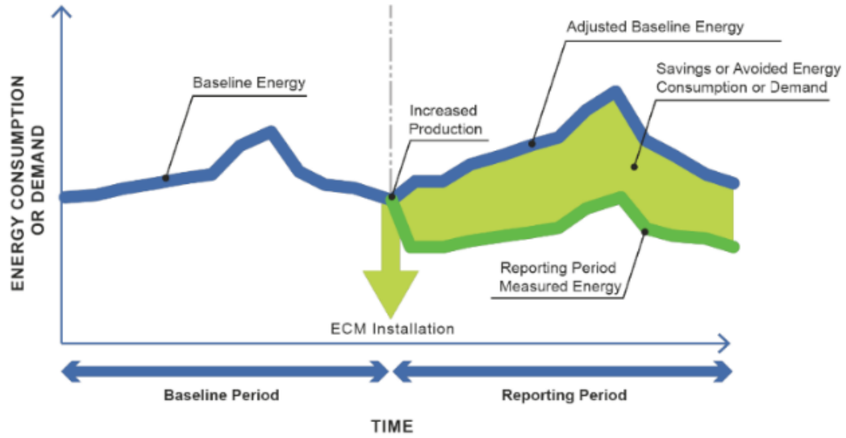


FIGURE 2: ILLUSTRATION OF SAVING MEASUREMENTS

Measuring Energy Consumption



There are two fundamental factors that drive energy savings, which are:

1. Performance: this describes the amount of energy used to accomplish a specific task and may also be referenced as efficiency or rate of energy use.
2. Usage: which describes the operating hours, or total time, that a piece of equipment runs.

To determine savings, energy consumption must be calculated as follows:

Energy Consumption = Performance (Efficiency) X Usage (Operation Hours)

Figure 3.3 illustrates the impact of performance and usage improvements on achieving energy savings.

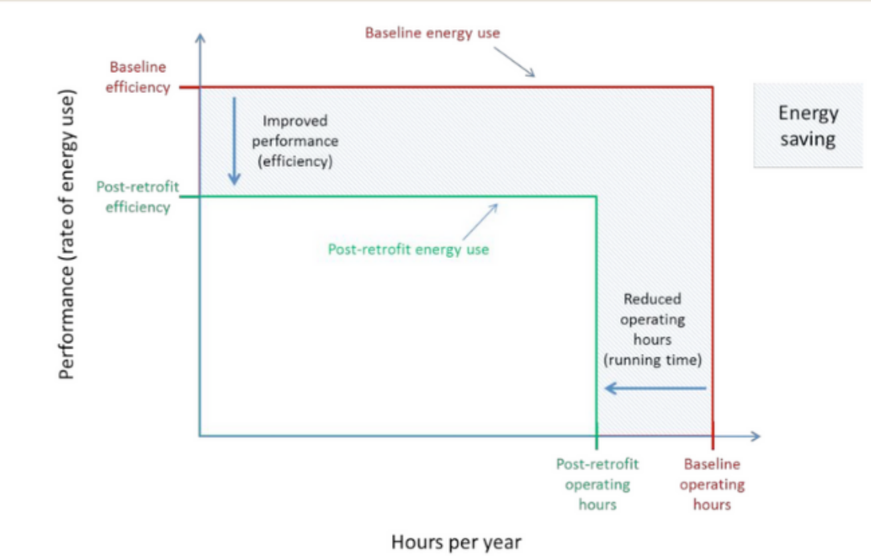


Figure 3.3: Impact of Energy Efficiency Measure

M&V Methods and Measurement Options

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M&V Methods and Measurement Options

M&V approaches are divided into two general methods, and IPMVP defines four options to measure savings that are termed "Options A, B, C, and D."

1. Retrofit isolation methods look only at the affected equipment or system, independent of the rest of the facility.
2. Whole facility methods, which consider only the total energy use while ignoring specific equipment performance.

Figure 3.4 provides an illustration of the measurement boundaries associated with the different M&V options.



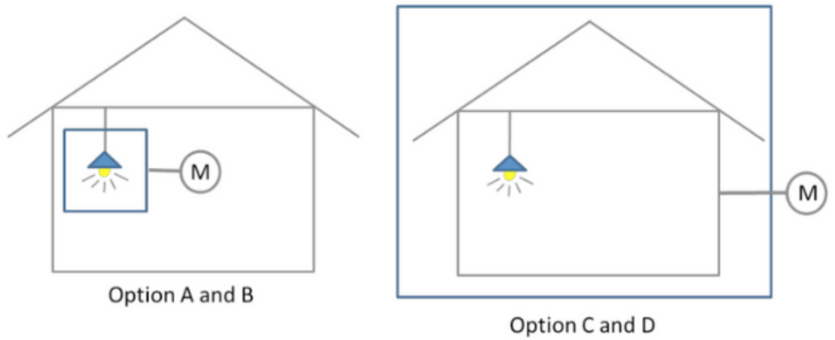
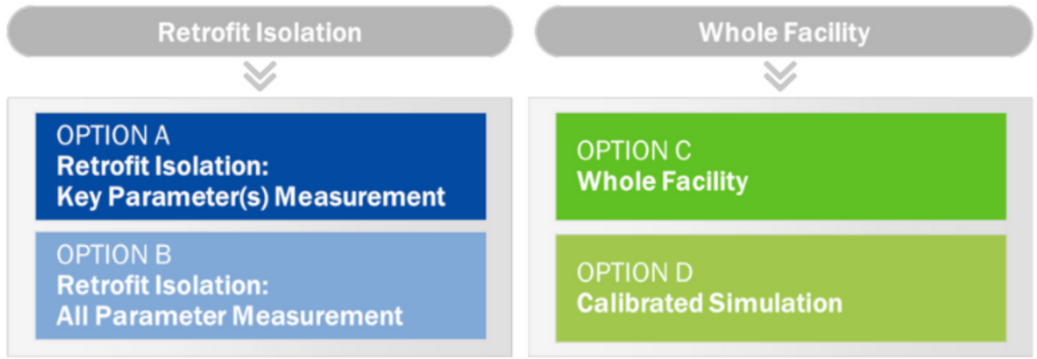


Figure 3.4: Illustration of Measurement Options: retrofit-isolation method (options A and B), whole-facility method (options C and D)

FIGURE 3.4: ILLUSTRATION OF SAVING MEASUREMENTS

Overview of IPMVP Options

- It should be noted that all savings are estimates since they cannot be directly measured. Generally, the accuracy of savings estimates improves as more measurements are used in defining the baseline and monitoring the post-installation conditions.
- Measurements are used to verify equipment operation and demonstrate that savings can be achieved. Two measurements are made before and after installation if the parameter is expected to change following installation.
- Stipulating a parameter can be done, and in such a case, its value will be held constant regardless of what the actual value is, thereby eliminating the measurement process for such a parameter.



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OPTION A: RETROFIT ISOLATION WITH KEY PARAMETER MEASUREMENT

OPTION B: RETROFIT ISOLATION WITH ALL PARAMETER MEASUREMENT

OPTION C - WHOLE- FACILITY MEASUREMENT

OPTION D: CALIBRATED COMPUTER SIMULATION



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M&V Options as per the IPMVP

OPTION A

Retrofit Isolation with Key Parameter Measurement

E.g.; Lighting retrofit projects

OPTION B

Retrofit Isolation with All Parameter Measurement

E.g.; Installation of new electric motor with a variable-speed drive and associated controls

OPTION C

Whole Facility Measurement

E.g.; Replacement of a chiller plant and lighting

OPTION D

Calibrated Simulation

E.g.; Comprehensive retrofit involving multiple interactive conservation measures in a large building with lack of utility data

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OPTION SELECTION PROCESS DIAGRAM

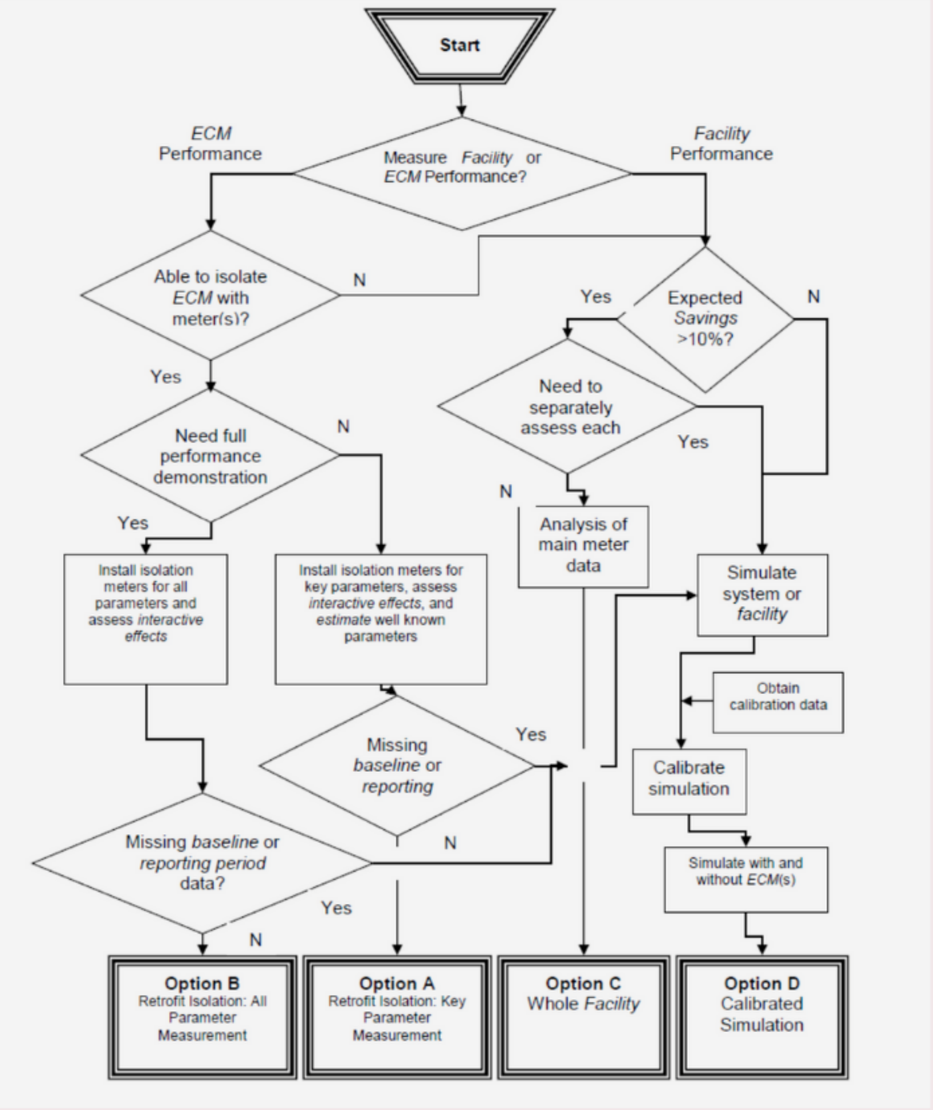
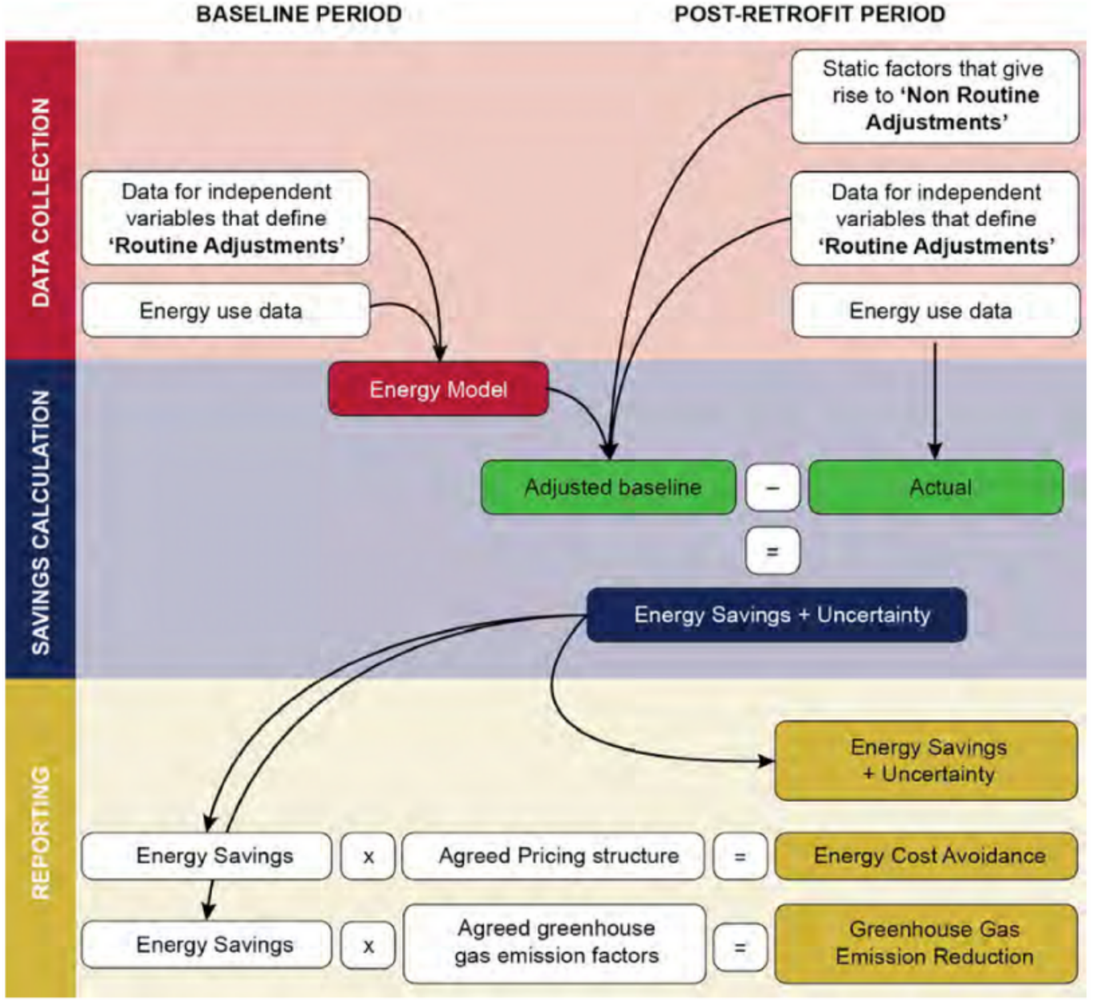


Figure 3: Process diagram of standard savings calculation



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THANK YOU

