



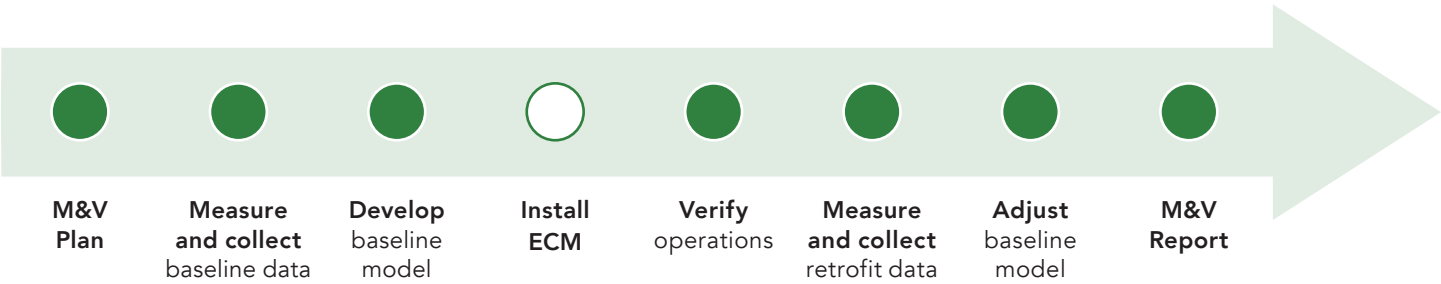
INTRODUCTION TO M&V

WHAT IS M&V?

“Measurement and verification (M&V) is the process of planning, measuring, collecting, and analyzing data to verify and report energy savings resulting from the implementation of energy management opportunities (EMOs) in one or more facilities.”

Source: International Performance Measurement and Verification Protocol (IPMVP), CORE CONCEPTS 2022

M&V ACTIVITIES



M&V efforts always need to balance costs with accuracy: the more money we spend, the more accurately we can calculate savings, but it is not always worth the extra effort.

WHAT ARE THE BENEFITS OF M&V?



INCREASE ENERGY SAVINGS

Accurate determination of energy savings enables facility owners and managers to adjust their energy-efficiency measures for improved, persistent, and consistent energy savings.



ENHANCE FINANCING FOR EFFICIENCY PROJECTS

A robust M&V Plan enhances both the transparency and credibility of reports on energy-efficiency investment outcomes and forecasts.



IMPROVE ENGINEERING DESIGN AND FACILITY OPERATIONS AND MAINTENANCE

A well-executed M&V process helps managers in identifying and mitigating maintenance and operational issues, enabling them to enhance the energy-efficiency of facility management.



MANAGE ENERGY BUDGETS

M&V techniques adapt for facility-operating changes to establish accurate budgets and address budget variances.



ENHANCE THE VALUE OF EMISSION-REDUCTION CREDITS

Accounting for emission reductions provides additional value to energy-efficiency projects.

HOW DO WE DO M&V?



Preliminary questions

- What is the project?
- What is measured and where?
- What is not measured and why?

Measurement Boundary

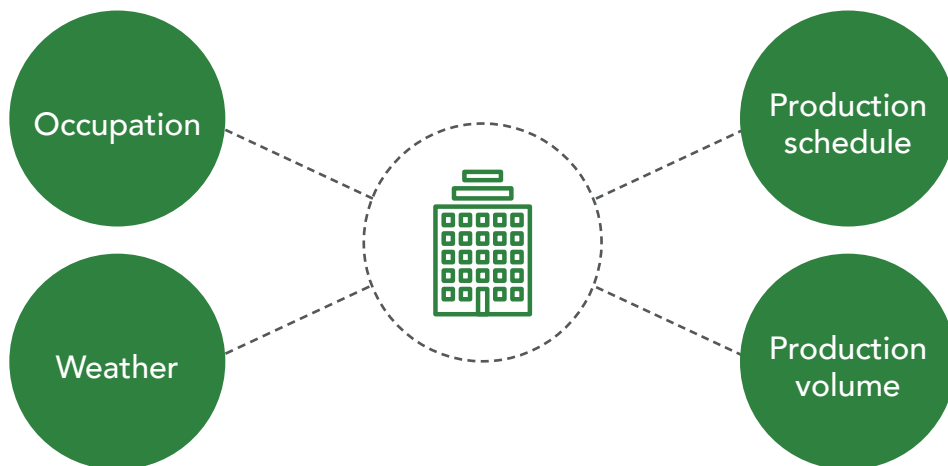
The measurement boundary is a notional perimeter drawn around the equipment, system, or facility relevant to savings calculations.



Whole facility — OR — Project isolation

Independent Variables

The significant factors that impact energy consumption are the independent variables.





BASELINE PERIOD AND CONDITIONS

The baseline period is the interval of time selected to represent facility operations before project implementation. It can be a short- or long-term period. It should:

- Represent all operating modes of the facility or the equipment during a normal operating cycle.
- Include only time periods for which factors that impact energy use of the facility are known.
- Coincide with the time that immediately precedes the upgrade.
- Include documentation of all factors that have an impact on energy consumption, including equipment information and operating conditions.

REPORTING PERIOD AND CONDITIONS

The selected time period during which generated savings are verified after the implementation of an action that improves energy performance. Its length depends on the objectives of the given project. It should:

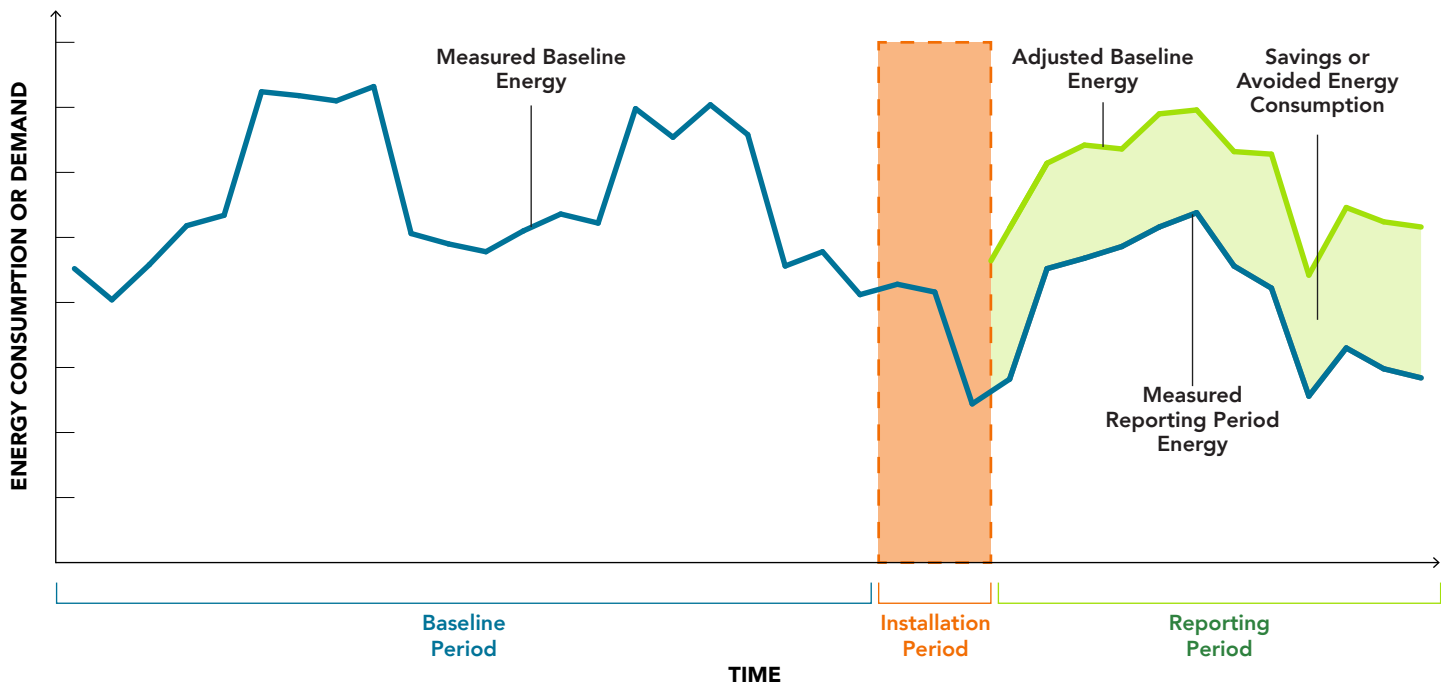
- Represent all operating modes of the facility or the equipment during a normal operating cycle.
- Include documentation of all factors that have an impact on energy consumption, including equipment information and operating conditions.

CALCULATING SAVINGS

The savings generated cannot be directly measured, because they represent **the absence of energy consumption**. Savings are therefore **calculated** by comparing measured consumption before and after project implementation.

$$\text{BASELINE PERIOD ENERGY} - \text{REPORTING PERIOD ENERGY} + \text{ADJUSTMENTS} = \text{ENERGY SAVINGS}$$

Adjustments are used to calibrate the energy and demand of the baseline and reporting periods under the same conditions. Energy consumption levels during both the baseline period and the reporting period must be compared by adjusting them based on the same conditions. Essentially, we want to compare the energy we are actually using in the reporting period with the energy we “would have used” under the same operating conditions, prior to the energy-efficiency improvement project.



Note: Saved or Avoided Energy Consumption or Power Demand (2022 IPMVP PROTOCOL – CORE CONCEPTS 2022)

Documentation is key. M&V plans and reports should include:

- A description of the data analysis and methodology.
- A list of assumptions and sources of data used in calculations.
- A description of the baseline period, adjustments and options selected.