International Performance Measurement and Verification Protocol

Concepts and Options for Determining
Energy and Water Savings
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4.6 Overview Of IPMVP Options

The *energy* quantities in the several forms of Equation 1) can be measured by one or more of the following techniques:

- Utility or fuel supplier invoices, or reading utility meters and making the same adjustments to the readings that the utility makes.
- Special meters isolating an *ECM* or portion of a *facility* from the rest of the *facility*. Measurements may be periodic for short intervals, or continuous throughout the *baseline* or *reporting periods*.
- Separate measurements of parameters used in computing *energy* use. For example, equipment operating parameters of electrical load and operating hours can be measured separately and multiplied together to compute the equipment's energy use.
- Measurement of proven *proxies* for *energy* use. For example, if the energy use of a motor has been correlated to the output signal from the variable speed drive controlling the motor, the output signal could be a proven *proxy* for motor energy.
- Computer simulation that is calibrated to some actual performance data for the system or *facility* being modeled. One example of computer simulation is DOE-2 analysis for buildings (Option D only).

If the a *energy* value is already known with adequate accuracy or when it is more costly to measure than justified by the circumstances, then measurement of *energy* may not be necessary or appropriate. In these cases, *estimates* may be made of some *ECM* parameters, but others must be measured (Option A only).

IPMVP provides four Options for determining *savings* (A, B, C and D). The choice among the Options involves many considerations including the location of the *measurement boundary* (see Chapter 4.4). If it is decided to determine *savings* at the *facility* level, Option C or D may be favored. However if only the performance of the *ECM* itself is of concern, a retrofit-isolation technique may be more suitable (Option A, B or D).

Table 2 summarizes the four Options that are detailed in Chapters 4.8 through 4.10. Examples of the use of the Options are contained in Appendix A. Section 4.11 offers guidance on selecting the proper Option for any specific project.

Table 2 Overview of IPMVP Options

IPMVP Option	How Savings Are Calculated	Typical Applications
A. Retrofit Isolation: Key Parameter Measurement *Savings* are determined by field measurement of the key performance parameter(s) which define the *energy* use of the *ECM*'s affected system(s) and/or the success of the project. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the *reporting period*. Parameters not selected for field measurement are *estimated. Estimates* can based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the *estimated* parameter is required. The plausible *savings* error arising from *estimation* rather than measurement is evaluated.	Engineering calculation of *baseline* and *reporting period energy* from: ○ short-term or continuous measurements of key operating parameter(s); and ○ *estimated* values. *Routine* and *non-routine adjustments* as required.	A lighting retrofit where power draw is the key performance parameter that is measured periodically. Estimate operating hours of the lights based on *facility* schedules and occupant behavior.
B. Retrofit Isolation: All Parameter Measurement *Savings* are determined by field measurement of the *energy* use of the *ECM*-affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the *savings* and the length of the *reporting period*.	Short-term or continuous measurements of *baseline* and *reporting-period energy*, and/or engineering computations using measurements of proxies of *energy* use. Routine and non-routine adjustments as required.	Application of a variable-speed drive and controls to a motor to adjust pump flow. Measure electric power with a kW meter installed on the electrical supply to the motor, which reads the power every minute. In the *baseline period* this meter is in place for a week to verify *constant* loading. The meter is in place throughout the *reporting period* to track variations in power use.

Table 2 Overview of IPMVP Options

IPMVP Option	How Savings Are Calculated	Typical Applications
C. Whole Facility *Savings* are determined by measuring energy use at the whole *facility* or sub-*facility* level. Continuous measurements of the entire *facility's energy* use are taken throughout the *reporting period*.	Analysis of whole *facility baseline* and *reporting period* (utility) meter data. *Routine adjustments* as required, using techniques such as simple comparison or regression analysis. *Non-routine adjustments* as required.	Multifaceted energy management program affecting many systems in a *facility*. Measure energy use with the gas and electric utility meters for a twelve month *baseline period* and throughout the *reporting period*.
D. Calibrated Simulation *Savings* are determined through simulation of the *energy* use of the whole *facility*, or of a sub-*facility*. Simulation routines are demonstrated to adequately model actual *energy* performance measured in the *facility*. This Option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data. (Energy end use metering may be used to help refine input data.)	Multifaceted energy management program affecting many systems in a facility but where no meter existed in the *baseline* period. Energy use measurements, after installation of gas and electric meters, are used to calibrate a simulation. *Baseline* energy use, determined using the calibrated simulation, is compared to a simulation of *reporting period* energy use.

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