

Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009





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FEMP M&V GUIDELINES VERSION 3.0



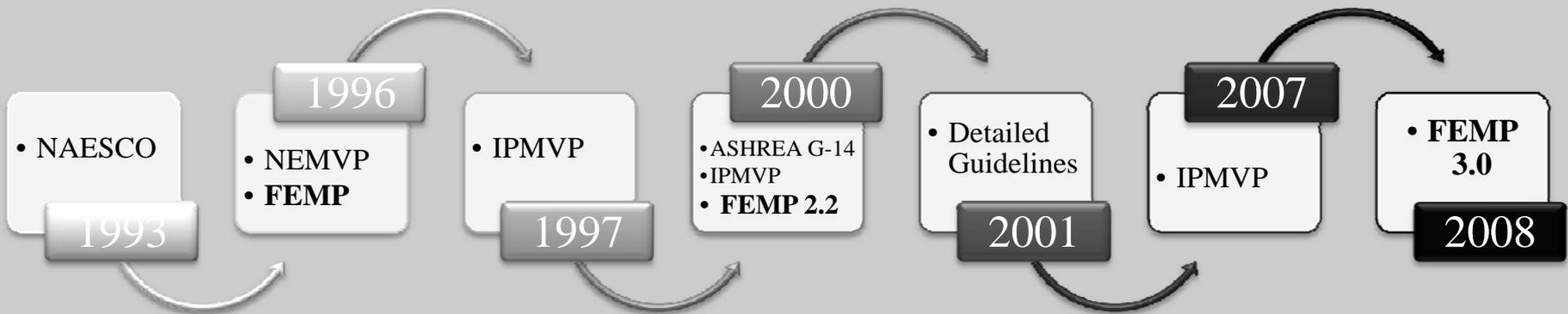
Purpose of the FEMP M&V Guide

- The M&V Guide contains procedures and guidelines for **quantifying the savings** resulting from energy efficiency equipment, water conservation, improved operation and maintenance, renewable energy, and cogeneration projects implemented through ESPCs.
- Since the M&V approach calculates and documents energy savings, it is one of the most important activities associated with implementing performance contracts and is a crucial issue in contract negotiations.



M&V Development Timeline

As the DOE ESPC process continues to expand, the FEMP M&V Guidelines have modified to include the changes and best practices used in the field as shown below.



Implemented in 2008, **FEMP M&V Guidelines Version 3.0** is the latest guidance in Measurement and Verification activities and documentation.



M&V Options

Analysis of Review

Summary of Findings

- ☐ 1999 & 2003 reports show that **Option A** is most common in Super ESPC.
- ☐ **Option A** using 100% stipulated values was a common practice.
- ☐ Detailed Guidelines (2001) emphasized measurement in **Option A.**
- ☐ Family of tools has increased M&V rigor.



IPMVP 2000 vs. FEMP 2.2

IPMVP 2000

- Option A called “partially measured retrofit isolation”. At least one parameter must be measured.
- Unmeasured parameters referred to as “stipulations”.
- **M&V Goal:** Minimize uncertainty in the savings estimate.

FEMP 2.2

- Allows 100% use of stipulated savings. (LE-A-01, CH-A-01, WCM-A-01)
- Detailed Guidelines discuss proper application of Option A and encourage measurements.
- **M&V Goal:** Allocate risks & responsibilities to the appropriate party



IPMVP 2007 vs. FEMP 3.0

IPMVP 2007

- Option A now called “key parameter measurement retrofit isolation”. The key parameters must be measured.
- “Stipulation” replaced with “estimation”.
- **M&V Goal:** Minimize uncertainty in the savings estimate, evaluate the potential magnitude of the error resulting from estimations.

FEMP 3.0

- FEMP 3.0 drops technology-specific designations.
- Option A focuses on measuring principal performance parameter.
- Estimations (stipulations) allowed, but with reservations.
- **M&V Goal:** Allocate risks to appropriate parties.



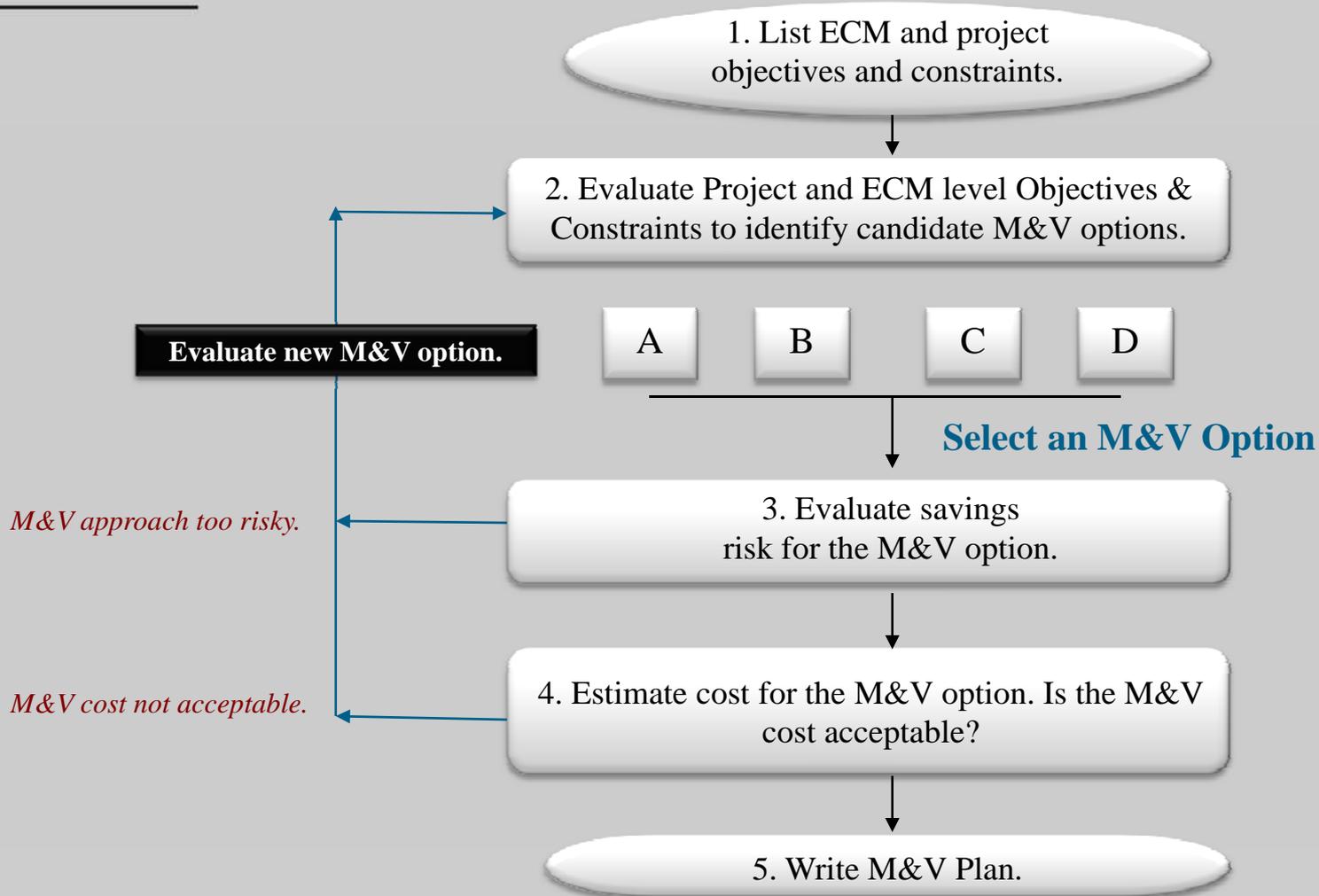
Summary of Major Changes

IPMVP 2007 and FEMP 3.0

- Provides more guidance on selecting appropriate M&V approach.
(Relative to IPMVP 2000)
 - ☐ IPMVP M&V Selection Path starts with goals & available information.
 - ☐ FEMP M&V Planning Tool balances objectives & constraints, including cost-effectiveness.
- Provides more guidance on contents in an M&V plan.
(Relative to IPMVP 2000)
 - ☐ IPMVP shows M&V Plan contents.
 - ☐ FEMP has sample plans, and templates in Appendix.
- **Requires all Option A measures to have at least one key parameter measured.**



FEMP M&V Planning Strategy





About Version 3.0

Version 3.0 was adopted in 2008 after an extensive review of Version 2.2 (2000). **The updates to the FEMP M&V Guidelines include the following:**

- Updated terminology and processes to harmonize with the 2008 Super ESPC master contract.
- Updated definitions of savings and adjustments to match IPMVP 2007.
- Revised **OPTION A** strategies to be in line with IPMVP 2007, noting when exceptions can be made.
- Eliminated several measure-specific approaches and added a discussion on key issues related to the most common energy conservation measures (ECMs).
- Added significant information on planning for operations and maintenance in ESPCs.
- Added detailed formats for M&V plans and reports.
- Included FEMP's Standard M&V Plan for Lighting Replacements.



Comparison of FEMP 2.2 and 3.0

Item	FEMP 2.2	FEMP 3.0
Document Size	340 Pages	129 Pages
Full Stipulation Allowed	Yes	No
Risk Allocation	Some Discussion	More Discussion (Usage vs. Performance)
Statistics and Uncertainty	Some Discussion	More Discussion
Witnessing and Cx	Some Discussion	More Discussion
Example Plans	No	Yes
Review Templates	No	Yes



M&V Process Timeline

Schedule		Activity
Before Project Implementation	Step 1	Allocate Project Responsibilities
	Step 2	Develop Project-Specific M&V
	Step 3	Define Baseline
During Project Implementation	Step 4	Install and Commission Equipment and Systems
	Step 5	Conduct Post-Installation Verification Activities
After Project Implementation	Step 6	Perform Regular Interval Verification Activities During the Performance Period



M&V Options

How savings are calculated

- **Option A:** Based on *measured* equipment performance, measured or *estimated* operational factors, and annual verification of “*potential to perform.*”
- Engineering calculations
- **Option B:** Based on *periodic or continuous measurements* taken throughout the term of the contract at the device or system level.
- Engineering calculations using measured data
- **Option C:** Based on *whole-building* or facility-level utility meter or sub metered data adjusted for weather and/or other factors.
- Analysis of utility meter data with regression analysis
- **Option D:** Based on *computer simulation* of building or process; simulation is calibrated with measured data.
- Comparing building system models, base vs. upgraded



M&V Process – Step 1

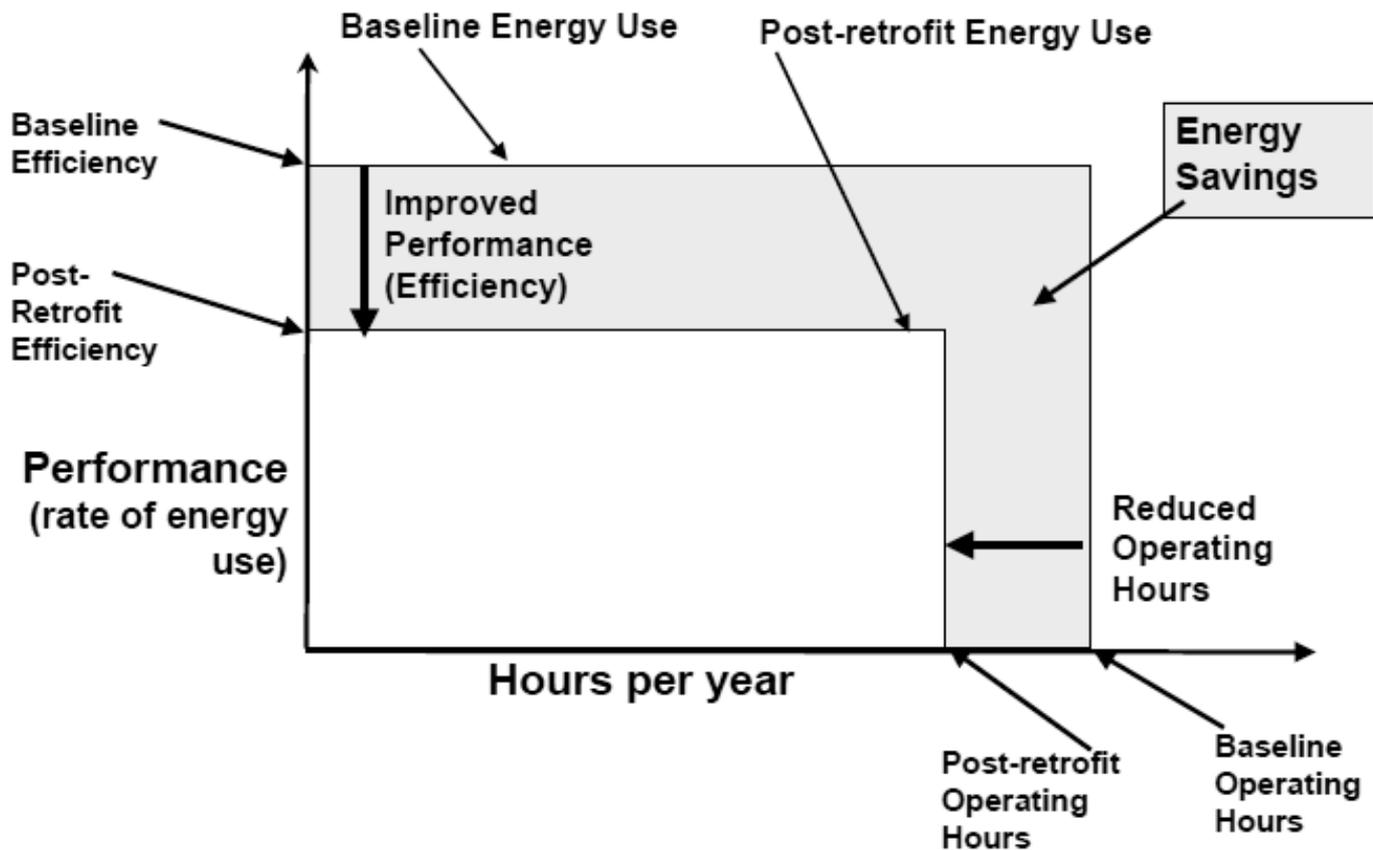


- Identify performance factors
 - ☐ kW, COP, η
- Identify usage factors
 - ☐ Weather
 - ☐ Occupancy
- Identify cost factors
 - ☐ Rates
 - ☐ Escalation
- Consider O&M tasks
- Consider ESCO risk tolerance
- Consider Agency risk tolerance
- Complete R&R Matrix



M&V Process – Step 1

Determining Usage vs. Performance

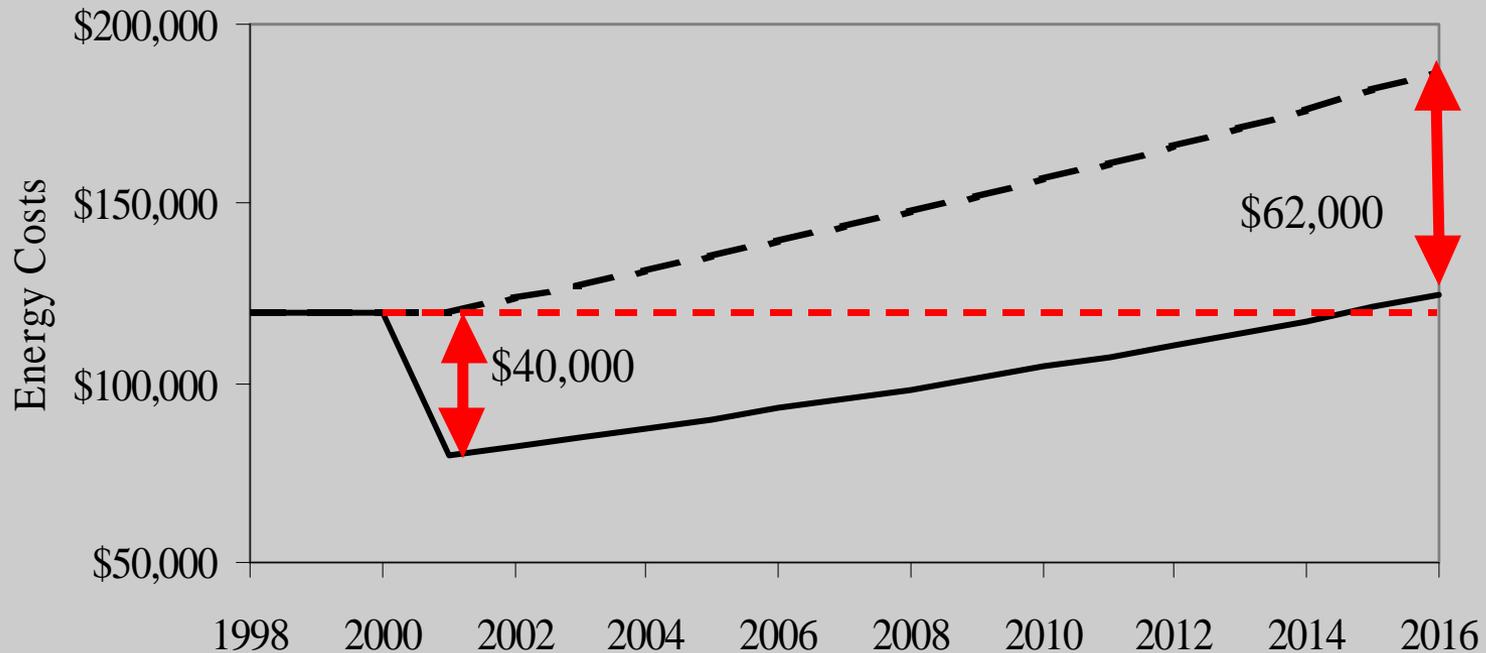




M&V Process – Step 1

Escalation Rate Example

Energy Costs and Savings at 3% Inflation





M&V Process – Step 2

Developing The M&V Plan

For each measure:

- Define how usage factors will be determined
 - ☐ Initially
 - ☐ Long-term
- Define how performance will be validated
 - ☐ Initially
 - ☐ Long term
- Baseline adjustments (if any)
- O&M Savings



M&V Process – Step 3

Defining The Baseline

Investment Grade Audit (IGA)

- Measure & document usage factors
 - ☐ Utility Bill Data
 - ☐ Metered System Data
 - ☐ Physical conditions
- Measure performance factors
 - ☐ Set Points
 - ☐ Loads
- Document O&M costs
- Agency Acceptance & Witnessing



M&V Process – Step 4

Install and Commission



Project Implementation

- Install
- Measure
- Test
- Cx (follow Cx plan)
- Agency Acceptance & Witnessing



M&V Process – Step 5

Post Installation

Post Installation Report

- As-built conditions
- Performance measurements
- Construction period savings
- Status of rebates and incentives
- Estimate Year-1 savings
- Agency Acceptance & Witnessing



M&V Process – Step 6

Performance Period

Annual Performance Reports

- Document site visit & inspection
- Measurement results
- *Verify Potential to Perform*
- Document O&M savings
- Report problems; identify actions
- Verify Savings & Witnessing
- Compare to Guarantee



Post-Installation Project Plan (PIPP)

Background and Purpose

- Developed in 2009 to aid the agency in the post-installation performance period management for ESPC projects.
- Tracking and controlling performance period and contractual documents for comprehensive project management for the life of the contract.
 - ☐ Monitors and verifies performance of the equipment
 - ☐ Verification of the savings guarantees for the life of the contract
 - ☐ Maintains document location records and tools for Agency use



PIPP Document Tracking Scope



Awarded Project Information

- Point of Contact
- Contract Guarantees



Operations and Maintenance



Financial Schedules

- Annual Project Savings To Date
- Preventative Maintenance



Measurement and Verification from IGA

- Ongoing M&V Status and Checklist
- Annual M&V Report



Repair and Replacement



Q & A



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