Measurement and Verification (M&V)

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Johnson Controls

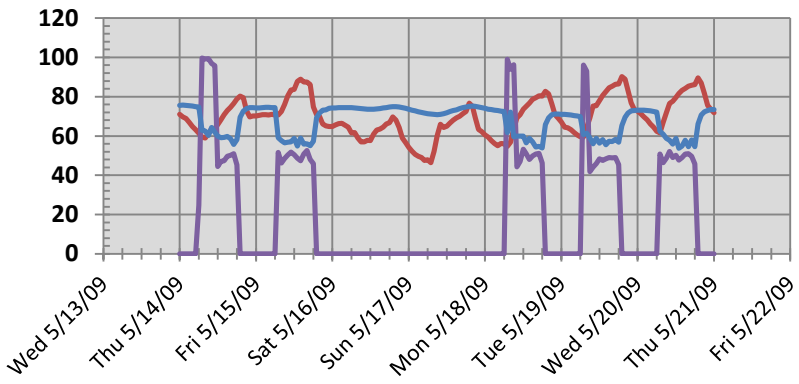
Agenda

- What is M&V?
- Why use it?
- What goes in an M&V Plan
- M&V Standards
- Summary of M&V Options
- Non Measured Savings
- Common Questions
- Wrap up and questions

What is Measurement and Verification?

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 ECMs.

International Performance Measurement and Verification Protocol

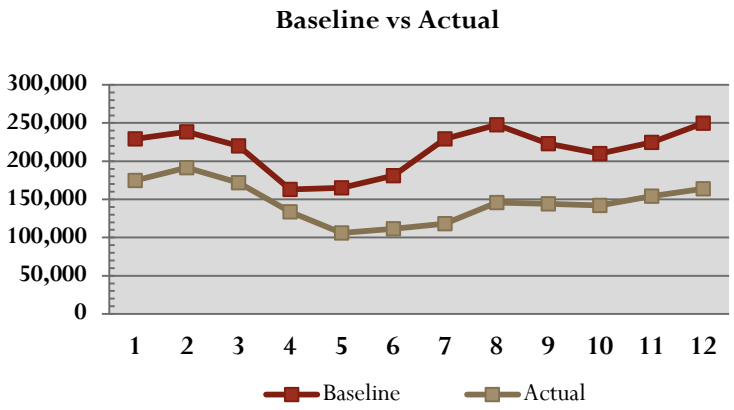


Who uses M&V?

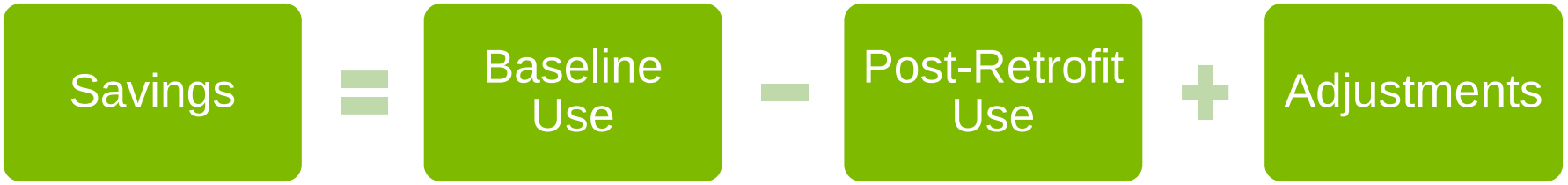
- Energy Services Companies (ESCOs)
  - *Performance contracting (ESPC, UESC, PPA, etc.)*
- *US Federal requirements*
  - *ECIP (Energy Conservation Investment Program) for DoD*
  - *Today ERCIP (Energy Resilience and Conservation Investment Program)*
- *LEED 2009*
  - *Not in LEED V4*

How to Determine *Savings?*

- Energy savings represent the ***absence*** of energy use
  - Usually determined by comparing energy use *before* the project (Pre-Retrofit) to energy use *after* the project (Post-Retrofit)
  - Pre-Retrofit energy usage is called the “Baseline”



M&V Plan



- Baseline Conditions
  - Pre-measurements, Rates, Escalation, Informational Sources, Assumptions
- Post-measurement Procedures
  - Methods/Options chosen, Responsibilities, Calculations, Adjustments
- Report Delivery Requirements
  - Frequency, Format, Future Projections & Activities, Other Responsibilities
- Adjustments
  - Use changes, weather, or other changes from the baseline

ECM XX– ECM NAME

- Brief Description:
- M&V Recommendation - Option XX
- Baseline Development Activities
- Post-Installation M&V Activities
- Performance Period M&V Activities

Considerations for Choosing an M&V Option

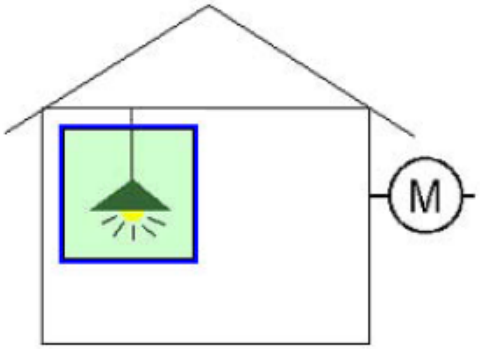
- **CUSTOMER** expectations
- Project cost & expected savings
- Certainty of savings being achieved
- Length of contract term
- Costs to manage the guarantee
- Future plans for facility
- Number and types of ECMs
- Total energy impact of ECMs
- Availability of historical utility information
- Ability to establish baseline
- Legislative requirements

M&V Guidelines

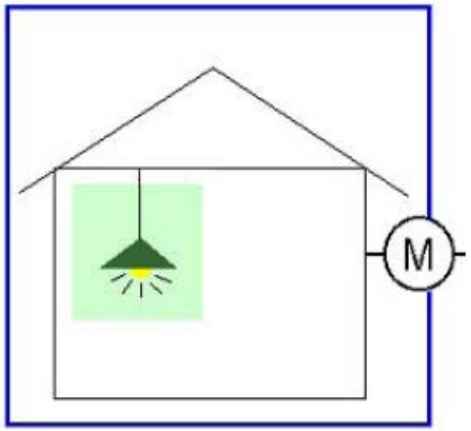
- International Performance Measurement and Verification Protocol, Core Concepts (2016)
- ASHRAE Guideline 14-2014, Measurement of Energy, Demand, and Water Savings
- FEMP M&V Guidelines, Version 4.0
  - Documents common terms and methods to evaluate performance for buyers, sellers, and financiers.
  - Provides best practice methods, with different levels of cost and accuracy, for determining savings.

The Options

- M&V Options
  - Retrofit Isolation (Options A & B)
  - Whole Facility (Option C)
  - Calibrated Simulation (Option D)



Options A, B



Options C, D

Source: M&V Guidelines: Measurement and Verification Guidelines for Federal Energy Management Projects

M&V Option A - Retrofit Isolation with Key Parameter Measurement

- Savings measured at improvement (ECM) level
- Short term or continuous field measurements of key variables impacting energy usage
- Parameters not measured are estimated
  - Manufacturer's specifications
  - Historical information
  - Engineering judgment
- Sampling is acceptable
- Uses engineering calculations, component, or system models
- Generally least expensive option

M&V Option B - Retrofit Isolation with All Parameter Measurement

- Savings measured at improvement (ECM) level
- Short term or continuous field measurements of all variables impacting energy usage
- Sampling is acceptable
- Uses engineering calculations, component or system models
- Typically more expensive than Option A

M&V Option C - Whole Facility

- Savings measured at the utility meter
- Regression of utility meter data utilizing weather, occupancy, etc.
- Only used if savings are greater than 10% (preferably 20%) of the metered utility usage
- Annual savings reporting normally includes adjustments
  - Weather
  - Changes in facility operation
- Often very expensive
  - Typically only applied to projects with interactive ECMs and complex systems
  - Doesn't show savings by measure
  - Requires at least 12 months of baseline utility bills and analysis and documentation of baseline operations across all energy consuming equipment
  - Reporting all facility changes
- Hard to identify source of shortfalls

M&V Option D - Calibrated Simulation

- Detailed computer simulation
- Utilizes short term data and trended data points
- Calibrated to whole-building metered utility data
- Annual savings reporting normally includes adjustments
- Utilized when improvements affects many systems
- Typically for new construction or in cases where baseline energy data does not exist
- Can be very expensive

Non-Measured Savings

- Guaranteed
  - Operational Savings
  - Utility Rebates
    - Grants

- Not Guaranteed
  - Capital Contribution
  - Operational Savings
  - Utility Rebates
    - Grants

Common Questions

- What if an ECM impacts the savings of another ECM?
- Can an Option A and Option C be used in the same building?
- Can the M&V Option change during a project?
- Does M&V go the life of the project?
- Do we really have to document “XXX”?

Wrap up

- Questions?

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