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THINK BEYOND

# South Carolina Performance Contracting Workshop Monitoring and Verification (M&V)

May 4<sup>th</sup>, 2016



# Agenda/Topics



- **M&V Process**
- **M&V Basics**
  - **Why Measure and Verify**
  - **Savings Definition**
  - **M&V Planning**
  - **Types of Guarantees**
  - **Using M&V to Allocate Risk**
- **M&V Resource**
- **Commissioning**
- **Case Study**

# Measurement and Verification (M&V) Process



<b>Phase</b>	<b>M&amp;V Activity</b>
<b>Preliminary Phase</b>	<b>Conceptual M&amp;V approach</b>
<b>Detailed Phase (Investment Grade Audit)</b>	<b>Detailed M&amp;V Plans, Baseline documentation</b>  → <b>Contract</b>
<b>Installation</b>	<b>Various M&amp;V activities</b>  → <b>Post Installation Verification</b>
<b>Performance Period</b>	<b>Quarterly reporting, Annual Reconciliation, Regular Inspections</b>  → <b>End of Term</b>

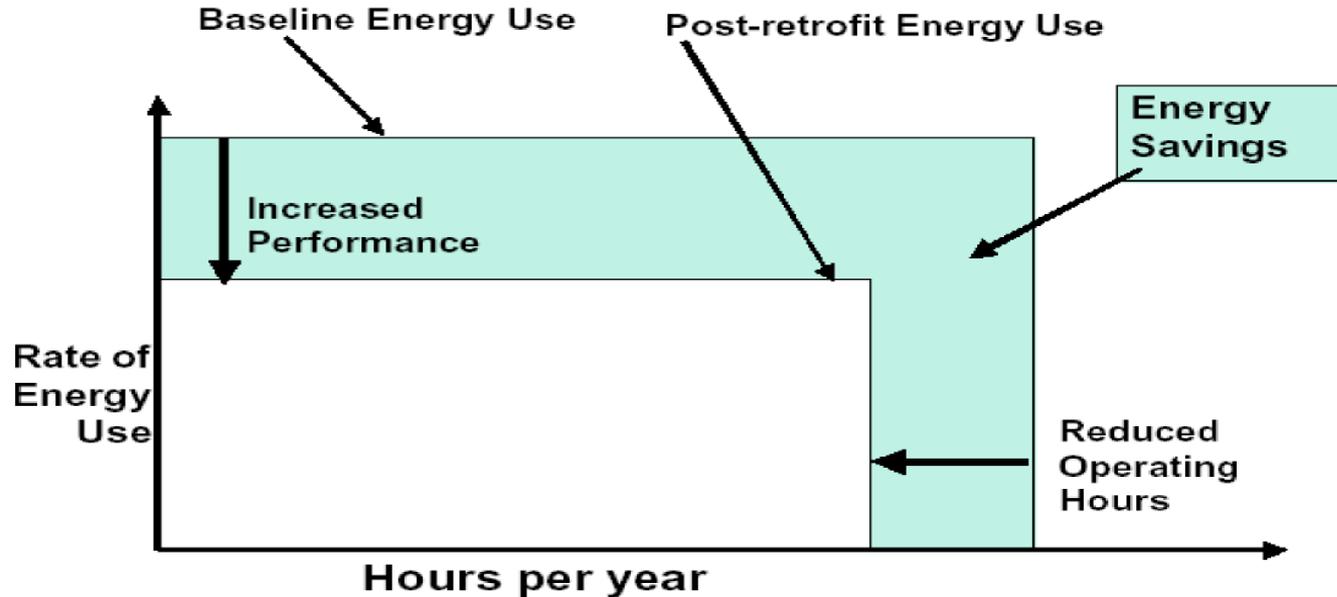
- **Accurately assess energy savings for a project;**
- **Allocate risks to the appropriate parties;**
- **Reduce uncertainties to reasonable levels;**
- **Ensure that the client achieves utility budget savings;**
- **Monitor equipment performance;**
- **Find additional savings;**
- **Improve operations & maintenance;**
- **Verify savings guarantee is met;**
- **Allow for future adjustments, as needed;**
- **Required by legislation or other regulations.**

*Many reasons for M&V, what are your requirements?*

# M&V Basics - Savings Definition



$$\text{Savings} = (\text{Baseline Energy} - \text{Post Installation Energy}) \pm \text{Adjustments}$$



*Achieving savings requires both the ESCO and client*

# M&V Basics – M&V Planning



Cost of M&V needs to be weighed between many factors including;

- Level of uncertainty that is comfortable and affordable (law of diminishing returns)
- Project costs and expected savings
- Complexity of the ECM
- Number of interrelated ECMs at a single facility
- Uncertainty or risk of savings being achieved
- Risk allocation between the parties
- Other uses for M&V data and systems

***An energy performance contract requires that both parties believe the information on which the savings are based is valid and accurate***

## Value of ECM Needs to be Looked at in Terms of Projected Savings and Project Costs

### *FEMP Guidelines, Section 5.1.1 States:*

The scale of a project, energy rates, term of the contract, comprehensiveness of energy conservation measures (ECMs), the benefit-sharing arrangement, and the magnitude of savings can all affect the value of the ECM or ESPC project. The M&V effort should be scaled to the value of the project so that the value of the information provided by the M&V activity is appropriate to the value of the ECM and the project itself

Source: US-DOE, Federal Energy Management Program

M&V Guidelines: Measurement and Verification for Federal Energy Projects, Version 3.0

***Don't spend \$1000 to validate and measure \$10 of savings***

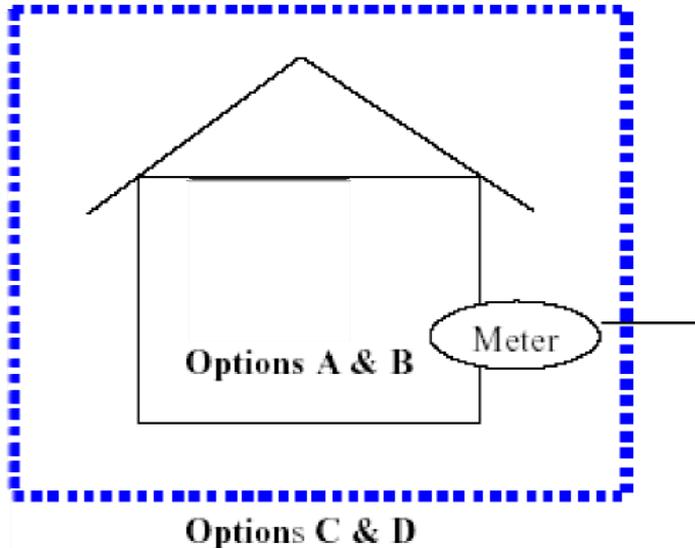
# M&V Basics – M&V Planning



- M&V costs should align with the value of the information provided and the value of the project
- Rule-of-Thumb estimates annual M&V costs at 1% to 10% of typical project cost savings
- All estimates have some uncertainty in reported numbers
- The goal is to reduce the uncertainty of reported savings values

***Effort should be scaled to the value of the project***

## What Type of M&V Plan Should I do?



Options A&B are *retrofit isolation* methods

Options C&D are *whole-facility* methods

The difference is where the boundary lines are drawn.

***Clear understanding of M&V goals is needed for proper selection***

International Performance Measurement and Verification Protocol (IPMVP)

- Most ESCO's have standardized around these industry definitions

- **Option A**

- Partially Measured Retrofit Isolation

- **Option B**

- Retrofit Isolation

- **Option C**

- Whole Facility

- **Option D**

- Calibrated Simulation

**Source: Efficiency Valuation Organization, International Performance Measurement and Verification Protocol Concepts and Options for Determining Energy and Water Savings, Volume 1, January 2012**

## •Partially Measured Retrofit Isolation

- Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied, separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameter(s) may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Careful review of ECM design and installation will ensure that stipulated values fairly represent the probable actual value. Stipulations should be shown in the M&V Plan along with analysis of the significance of the error they may introduce.

*Monitors and measures elements that can be isolated and controlled*

## •Retrofit Isolation

- Savings are determined by field measurement of the energy use of the systems to which the ECM was
- applied, separate from the energy use of the rest of the facility.
- Short-term or continuous measurements are taken throughout the post-retrofit period.

*Used for conservation strategies on “systems” that can be isolated*

# IPMVP Option C



- Whole Facility

- Savings are determined by measuring energy use at the whole facility level.
- Short-term or continuous measurements are taken throughout the post-retrofit period.
- Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

***Commonly know as whole building or utility bill comparison***

- Calibrated Simulation

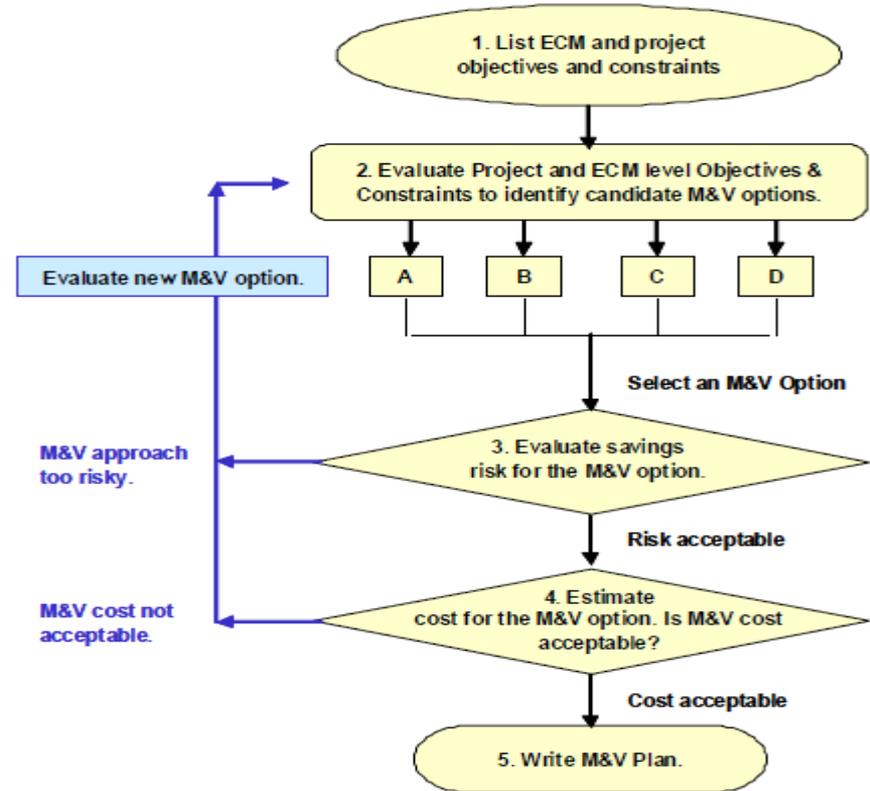
- Savings are determined through simulation of the energy use of components or the whole facility.
- Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility.
- This option usually requires considerable skill in calibrated simulation.
- Energy use simulation, calibrated with hourly or monthly utility billing

***Typically used for new construction (existing facility does not exist)***

# Selecting An M&V Approach

## Typical Objectives

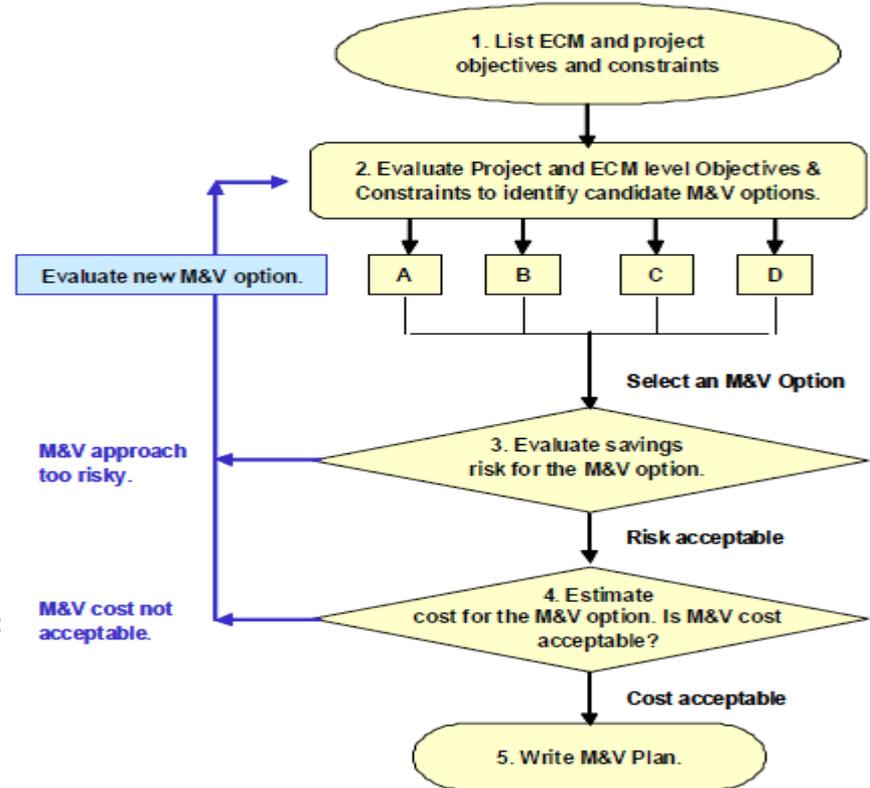
- Verify energy savings through utility metering
- Verify performance continuously / annually
- Track post-retrofit consumption
- Track individual measures
- Adjust baseline for changes
- Maximize infrastructure by using least-cost M&V option



# Selecting An M&V Approach

## Typical Constraints

- Historical data not available
- Lack of dedicated Utility meters
- High degree of interaction between ECMs
- ECMs scope affects a small portion of overall utility baseline



## Savings as a Contractual Term...

- Energy Savings and Energy Cost Savings, when defined in a Performance Contract, are *contractual* terms

## M&V Plan

- Fundamentally defines the meaning of the word “savings” for each project and the contract
- Project specific M&V plans are developed during the detailed Investment Grade Audit
- M&V Plan determines “contractual savings”, instead of “actual savings” you may want to see on the bills

***The M&V plan needs to be defined in contract terms***

# M&V Basics - Using M&V to Allocate Risk



- M&V practices allow “project performance” risks to be understood, managed and allocated among parties
- M&V is primarily focused on the risks that affect the determination of savings
- These risks are defined in the terms of the contracts between the parties

***Both Client and ESCO need to be clear on terms of the agreement***

Uncertainty – The Savings determination process itself introduces uncertainties through:

- Instrumentation Error
- Modeling Error
- Sampling Error
- Planned or Unplanned Assumptions

The M&V process should focus on managing the uncertainty

*A hallmark of a successful ESPC project is open*

*communication between Client, ESCO, and 3<sup>rd</sup> Party Consultant (If engaged) , it reduces uncertainty*

***There is no such thing as an absolutely “correct” savings number***

# M&V Resources



- Measure and Verification Guidelines for Guaranteed Energy Savings Program in State of Minnesota Facilities (GESP Master Contract, Attachment 1)  
<http://mn.gov/commerce/energy/images/EnergySav-MC-Attach1-M%26V.pdf>
- International Performance Measurement and Verification Protocol: *Concepts and Options for Determining Energy and Water Savings Volume I*  
[IPMVP – January 2012](#)  
[www.evo-world.org](http://www.evo-world.org)
- M&V Guidelines: Measurement and Verification for Federal Energy Projects  
[FEMP/DOE – Version 3.0 – April 2008](#)  
[http://www.eere.energy.gov/femp/financing/superespcs\\_mvresources.cfm](http://www.eere.energy.gov/femp/financing/superespcs_mvresources.cfm)
- ASHRAE Guideline 14: Measurement of Energy and Demand Savings  
[ASHRAE 14 – 2002](#)

# Central Piedmont Community Charlotte, NC



## SITUATION

- ▶ 5<sup>th</sup> largest Community College in the US with aging infrastructure and limited capital funding.

## APPROACH

- ▶ Assess building systems and energy use
- ▶ Recommend mission-focused ECMs
- ▶ Design & install upgrades on all 6 campuses
  - ▶ HVAC upgrades & re-commissioning
  - ▶ Web-enabled building control system
  - ▶ Sky lighting & lighting retrofits
  - ▶ Electric-gas oven conversion



## MEASURE/VALIDATE RESULTS

- **Estimated annual energy savings of \$950,000+ per year**
- **M&V results ranged from 8%-12% in surplus savings during the first 3 years**
- **\$ 9.8 M program funded entirely by energy savings**

# Questions?



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