Introduction to Measurement & Verification in Super ESPCs
Why do you need M&V?

• Savings guarantees are contractually and legally required.
• But guarantees are only as good as the M&V behind them.
• When done right, M&V verifies that guarantees are being met and savings will persist.
• M&V helps allocate risk and identify problems.

“What you don’t measure, you can’t manage.”
—Jack Welch, former GE CEO
Basic M&V Concepts

• Goal in designing project M&V is to balance savings assurance against added cost

• Good M&V plans require ESCOs to measure key performance parameters of ECMs

• If M&V plan is weak, guarantee may be met only on paper

• The degree/cost/rigor of M&V should be proportional to:
  1) the ECM’s savings; and
  2) the ECM’s performance risk
FEMP M&V Guidelines, v. 3.0

• For federal energy projects specifically
• Application of International Performance Measurement and Verification Protocol (IPMVP)
• Detailed explanations of main M&V options (A, B, C & D)
• Addresses M&V methods by ECM type
• ESCOs must develop and follow the project M&V plan in compliance with these Guidelines.
# M&V in the Super ESPC Process

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<tr>
<th>Baselines</th>
<th>• Defined in IGA and Final Proposal</th>
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<tr>
<td>M&amp;V Plan</td>
<td>• Developed as part of Final Proposal</td>
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<tr>
<td>Post-Installation M&amp;V Report</td>
<td>• Verification of ECMs’ performance</td>
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<td>Annual M&amp;V</td>
<td>• Activities per M&amp;V Plan</td>
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<td></td>
<td>• Findings documented in M&amp;V reports</td>
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Baselines

- Typically proposed for each ECM by ESCO as part of investment-grade audit — Agency reviews/approves
- Baselines are compared to post-installation energy use to determine savings
- Once project is installed, it’s difficult or impossible to revisit baselines, so it’s important to get them defined properly and documented
- Baselines, particularly for Options C and D, may be models, not point estimates
  - e.g., gas usage = 2500 MMBtu + 460 × (Heating Degree Days)
How is the guarantee met?

• Savings must exceed payments
• Savings that may be used to pay the ESCO are categorized as:
  – Energy and water cost savings
  – Energy- (and water-) related cost savings
Calculating Savings

• There are two components to energy use and energy savings:
  – Performance (rate of energy use)
  – Usage (hours of use)

• Energy use is the product of the two
  – Example: kW (rate) × hours = kWh (total energy)

• Reducing the rate of energy use and/or the number of hours reduces the total energy use
Performance and Usage: Ideal

- Baseline Energy Use
- Improved Efficiency
- Post-retrofit Energy Use
- Reduced Operating Hours
- Post-retrofit Energy Use

Rate (kW) vs. Hours per year
Savings Uncertainty

• We can’t measure savings directly
  – Because it’s the absence of something – i.e., it’s energy use that’s not there any more!

• We measure energy use before and after — the savings are the difference

• We usually don’t know the exact energy use before and after
  – there is almost always some uncertainty in each

• And even when we do, we can’t know for sure what’s responsible for all the change
Options A, B, C, and D

• Options address risk allocation
• Each ECM assigned an M&V option
• Measurements differ by:
  – Level – individual system vs. whole building
  – Duration – spot, short-term, periodic, continual
  – Degree of stipulation
  – Expense
    • Up-front – can range from 1 to 15% (avg. 3%) of project investment
    • Annual – averages about 3% of annual savings
# FEMP and IPMVP M&V Options

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<tr>
<th>M&amp;V Option</th>
<th>How savings are calculated</th>
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<tr>
<td><strong>Option A:</strong> “Retrofit Isolation, Key Parameter” – Based on measured equipment performance, measured or estimated operational factors, and annual verification of “potential to perform.”</td>
<td>Engineering calculations using measured and estimated data</td>
</tr>
<tr>
<td><strong>Option B:</strong> “Retrofit Isolation, All Parameters” – Based on measurements (usually periodic or continuous) taken of all relevant parameters.</td>
<td>Engineering calculations using measured data</td>
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<tr>
<td><strong>Option C:</strong> Based on whole-building or facility-level utility meter data adjusted for weather and/or other factors.</td>
<td>Analysis of utility meter data</td>
</tr>
<tr>
<td><strong>Option D:</strong> Based on computer simulation of building or process; simulation is calibrated with measured data.</td>
<td>Comparing different models</td>
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Options A and B vs. Options C and D

Options A&B are retrofit-isolation methods.

Options C&D are whole-facility methods.

The difference is where the boundary lines are drawn.