Protocols for Advanced M & V: Helping You See Clearly

Webinar
April 30, 2020
Welcome and Acknowledgments

• This webinar is brought to you as part of the “Standardized, Sustainable and Transparent EM&V – Integrating New Approaches” project

• Thank You to project funders:
  – U.S. DOE State Energy Partner Grant,
  – CT Department of Energy and Environmental Protection,
  – Lawrence Berkeley National Lab,
  – Northeast Energy Efficiency Partnerships, Inc.
  – Eversource and Avangrid (UI)
  – State Partners: NYSERDA, Vermont Department of Public Services, New Hampshire Public Utility Commission, Rhode Island Office of Energy Resources
Please note

Audience is muted: Please use Chat Box for questions

We will unmute for Q&A Session at end of webinar and distribute answers to questions if time is short

The webinar is being recorded
Why are AM&V protocols and guidance important now?
• The industry experience with AM&V is growing
• AM&V is an increasingly relevant tool for states to have in their mix – e.g. P4P program design, CA NMEC protocols, as support for time-differentiated savings impacts, customer engagement and climate goals
• New Efficiency Valuation Organization (EVO- IPMVP) best practice for AM&V offers global consistency and credibility
• Proper guidance and protocols will ensure that AM&V is used appropriately
Goals of Webinar

1. Share information on advanced M&V
   - Guidance and Protocols
2. Introduce new resources for advanced M&V
   - Available and Coming Soon
3. What role do protocols play in deploying advanced M&V in building analytics?
4. Future directions
   - More protocols work needed and Where AM&V is headed
Definitions

- **Advanced M&V:** Large data sets, near real-time, ongoing feedback, non-linear analytical methods, whole building meter-based savings calculations, frequent intervals. (Similar but different from traditional billing analysis and applicable to portfolios, some programs, and individual sites, for program implementation and evaluation).

- **Protocols:** Set of concepts and commonly accepted conditions ensuring credibility of a product. Technical details.

- **Guidance:** How to meet conditions set forth by protocols. Advice on best practices for applications. Often locally agreed upon.
Agenda and Presenters

• An Evaluation and Portfolio Perspective on AM&V
  – Kevin Warren, Warren Engineering
• A Program Planning Perspective: Software Protocols and AM&V Implementation Guide
  – Eliot Crowe, Lawrence Berkeley National Lab
• The Project Perspective: Technical Issues and New EVO Publications
  – Lia Webster, Facility Energy Solutions
• The State Perspective: Developing and Applying Guidance
  – Carmen Best, Recurve
• Future Directions!
• Q&A
Kevin Warren

*Warren Engineering*

An Evaluation and Portfolio Perspective on AM&V
Major Use Cases

• ESCOs or EMIS Providers
  – Use interval data analysis to prove the savings from a building tune-up

• Impact Evaluation
  – Determine the savings from a utility program after it has happened or in real time

• Program Implementation and Tracking
  – Embedded into the program delivery process
Ex-ante 2.0

- Pre/post billing analysis
- Continuous (or at least ongoing)
- All participants
- Embedded in program functions
- Used for more than just savings reconciliation
- Other methods may be used for estimating savings prior to measure installation (TRM, engineering calcs)
Program Characteristics that Influence the Ex-ante 2.0 Approach

• Do we care only about savings at the program-level (or average results for a large number of participants) or do we care about facility-level savings?

• Are participants relatively homogenous (residential) or relatively unique?

• What is the average value of the savings for each participant?
### Relevant Prior Protocols

\[
\text{Savings} = (\text{Baseline Period Energy} - \text{Reporting Period Energy}) \\
\pm \text{Routine Adjustments} \pm \text{Non Routine Adjustments}
\]

<table>
<thead>
<tr>
<th>Population</th>
<th>Applicable Sectors</th>
<th>Baseline Adjustment Technique</th>
<th>Protocols</th>
</tr>
</thead>
</table>
| Homogenous         | Residential        | Comparison group              | • UMP Chapter 8  
• SEE Action Impact Evaluation Guide                                      |
| Heterogeneous      | Nonresidential     | NRA                           | • IPMVP  
• UMP Chapter 16  
• UMP Chapter 19  
• UMP Chapter 24                                                     |
## Flavors of Ex-ante 2.0

<table>
<thead>
<tr>
<th>Ex-ante 2.0 Flavor</th>
<th>Treatment of NRAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with Comparison</td>
<td>Embedded billing analysis with a comparison group</td>
</tr>
<tr>
<td>Population w/o Comparison</td>
<td>Embedded billing analysis without a comparison group</td>
</tr>
<tr>
<td>Embedded Option C</td>
<td>Embedded billing analysis of all participants while attempting to identify and quantify NRAs at high rigor.</td>
</tr>
<tr>
<td>Raw Site Level</td>
<td>No NRA</td>
</tr>
</tbody>
</table>
Do Ex-ante 2.0 Programs Require Evaluation?

<table>
<thead>
<tr>
<th>Ex-ante 2.0 Flavor</th>
<th>Evaluation Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population with Comparison</td>
<td>Review analysis, review comparison group</td>
</tr>
<tr>
<td>Population w/o Comparison</td>
<td>Comparison group analysis, difference of differences</td>
</tr>
<tr>
<td>Embedded Option C</td>
<td>• Sample (after reviewing CUSUMs and CRRs)</td>
</tr>
<tr>
<td></td>
<td>• Use Option C for some but not all</td>
</tr>
<tr>
<td></td>
<td>• For Opt C, high rigor verify NRAs, missing data, dates</td>
</tr>
<tr>
<td>Raw Site Level</td>
<td>• Adjust baseline if not existing conditions</td>
</tr>
<tr>
<td></td>
<td>• Calculate Realization Rates</td>
</tr>
<tr>
<td></td>
<td>• Review reserved savings analysis, site visits, and/or M&amp;V to answer “Why?”</td>
</tr>
</tbody>
</table>
Ex-ante 2.0 Gives Evaluators New Tools

- Early feedback to programs
- Better information on the timing of savings
- New sampling methods using CRR and CUSUM
  - $CRR = \frac{\text{Claimed (ex-ante)}}{\text{Reserved}}$
  - CUSUM Plots
Eliot Crowe

Lawrence Berkeley National Lab

A Program Planning Perspective:
Software Protocols and AM&V Implementation Guide
Implementation Resource Guide

- Overview
- Tools & methods
- Tool selection
- Data gathering & preparation
- Workflow
- Documentation guidance
- Getting started
M&V Tool Selection

• Many models/tools available
• Proprietary vs. transparent / open source
• Example free tools:
  – ECAM
  – RMV2.0
  – OpenEEMeter
  – Universal Translator
  – NMECR
M&V Tool Selection

- Need to customize models?
- Can the tool be easily configured to output baseline model goodness of fit metrics?
- Need for individual building savings and aggregated?
- Is the tool capable of “batch mode” data input?
- Need to accommodate continuous meter data feeds?
- Any desired model inputs beyond weather and time?
- Has tool been vetted, for example in prior pilots, third-party testing, or by other means?
- Preference for additional features?
  - Customer dashboard
  - Opportunity ID
  - Project management features
  - Etc.
How do you test an M&V tool?

- **Predictive capability:** Out-of-sample testing
- **Robustness:** Use a test dataset covering many buildings
- **Trusted:** Ensure that test method/results do not allow for ‘gaming’ the test

1. Training period ambient temp
2. Training period consumption
3. Prediction period ambient temp
4. ....???
Test Results

<table>
<thead>
<tr>
<th>Model Name</th>
<th>Test Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>LBHL TONT</td>
<td>April 17, 2019, 10:05 p.m.</td>
</tr>
</tbody>
</table>

* This table includes both public and private model submissions. Identifying information has been hidden for private submissions.
EVO Advanced M&V Testing Portal

Download the test data and create baseline models for Training Period

Use Prediction Period temperature data to generate modeled hourly kWh values

Upload prediction data and get results
Test Metrics

Model Fitness

Predictive Capability

Real (imperfect) data!
Did I Pass?

http://mvportal.evo-world.org/
M&V Tool Testing

• Good tool = guaranteed results?
Baseline Model Fitness

- $R^2$, target $>0.7$
- $CV(\text{RMSE})$, target $<25\%$
- $\text{NMBE}$, target $<0.5\%$
- ($\text{MAPE}$ is another to consider)

R² 0.85, CV(RMSE) 7%, NMBE 0%

R² 0.33, CV(RMSE) 67%, NMBE 0.27%
Other baseline considerations

- Residuals / scatter chart
- Data management / meters
- Dates
- Weather data
Savings Tracking and Visualization

- Time series of predicted vs actual energy use
- Time series of savings
- Cumulative savings (CUSUM)
The Project Perspective:
Technical Issues and New EVO Publications
• AM&V Perspectives
• M&V and EM&V Protocols & Guidelines
• Technical issues in AM&V
• Areas under development
• Technical resources
AM&V Program Perspectives

**Project Focused**
- Commercial & Industrial sites
- Unique projects
- Technically rigorous
- M&V plan
- Non-Routine Adjustments
- Accurate site-level savings (Ex-ante)

**Aggregated Approach**
- Small Commercial & Residential
- Uniform population
- Generous acceptance criteria
- Control Groups
- Portfolio level savings

**Impact Evaluation**
- Sample of Projects
- External factors
- Program impacts
- Realization Rates
- Ex-post savings
M&V Protocol

IPMVP:
• Used worldwide
• Provides M&V terms & definitions
• Framework to determine savings
• Defines 4 M&V approaches
• Focus on projects

ISO 17741 / 50001:
• Superior Energy Performance (SEP)
• Limited application to AM&V
EM&V Protocols

DOE SEE Action:

- Provides terms & definitions
- Focus on programs
- Framework to determine net & gross savings
- EM&V Approaches:
  - M&V Approach (IPMVP Options)
  - Deemed Savings
  - Large Scale Consumption Analyses (control groups)
EM&V Guidelines

**DOE UMP**
- Compilation of individual ‘protocols’
  - 18 ECM specific, 5 ‘Cross-cutting’
- Focus on evaluation

**EPA Guidebook on EM&V**
- Compiles guidance from DOE
- Promotes best practices

**State-by-State Guidance**
- CA Standard Practice Manual
- Technical Reference Manuals (TRMs)
- Public utilities commissions
- Other
M&V Guidelines

Based on IPMVP

- ASHRAE Guideline 14
- M&V Guidelines for Federal Energy Projects (FEMP)
- Strategic Energy Management (SEM) MT&R Guidelines
- State and utility guidelines
M&V Requirements: IPMVP

IPMVP

Requirements for “Adherence”: 
M&V Requirements: IPMVP

IPMVP
Requirements for “Adherence”:

• Follow procedures & principles
• Detailed M&V plan & report
• Use IPMVP terminology & equations
• Consider Uncertainty in savings
• Operational verification

Option C: Whole Building specific:

• Regression modeling
• Energy data requirements
• Non-Routine adjustments
### Advanced M&V industry is active!

#### P4P Utility Programs
- IOUs in California (NMEC)
- Seattle City Light
- NYSERDA / Con Ed
- BayREN (CA)
- Others...

#### AM&V Software
- ECAM
- LBNL RMV2.0
- Universal Translator (UT3)
- Gridium
- OpenEEMeter
- NMECR
- Others...

#### Ongoing Research
- Model types
- Uncertainty methods
- Efficacy of aggregated approaches
- Accuracy of adjustments
- NRE automated detection methods
## Current AM&V Programs

<table>
<thead>
<tr>
<th>State/Province</th>
<th>Utility or Sponsor</th>
<th>Program Name</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>Energy Trust of Oregon</td>
<td>Pay for Performance Pilot</td>
<td>Residential</td>
</tr>
<tr>
<td>CA</td>
<td>PG&amp;E</td>
<td>Pay for Performance</td>
<td>Residential</td>
</tr>
<tr>
<td>NY</td>
<td>NYSERSDA, Con Ed</td>
<td>Business Energy Pro - P4P Pilot</td>
<td>Small Commercial</td>
</tr>
<tr>
<td>NJ</td>
<td>State of NJ’s Clean Energy Program</td>
<td>Pay for Performance Existing Buildings*</td>
<td>Small Commercial</td>
</tr>
<tr>
<td>CA</td>
<td>BayREN</td>
<td>Pay for Performance</td>
<td>Commercial</td>
</tr>
<tr>
<td>BC (Canada)</td>
<td>BC Hydro</td>
<td>Strategic Energy Management</td>
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<tr>
<td>IL</td>
<td>ComEd and Nicor Gas</td>
<td>Strategic Energy Management</td>
<td></td>
</tr>
<tr>
<td>DC</td>
<td>DC Sustainable Energy Utility</td>
<td>Pay for Performance (P4P)</td>
<td></td>
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<tr>
<td>MI</td>
<td>DTE Energy</td>
<td>Strategic Energy Management</td>
<td>Commercial</td>
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<tr>
<td>VT</td>
<td>Efficiency Vermont</td>
<td>Deep Retrofit</td>
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<tr>
<td>MA, RI</td>
<td>National Grid</td>
<td>Pay for Performance (MBCx &amp; EBCx)</td>
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<tr>
<td>WA</td>
<td>Seattle City Light</td>
<td>Deep Retrofit Pay for Performance</td>
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<tr>
<td>CA</td>
<td>SoCalREN</td>
<td>Metered Savings Program</td>
<td></td>
</tr>
<tr>
<td>WA, OR, ID, MT</td>
<td>BPA, Idaho Power, PacifiCorp, PSE</td>
<td>Strategic Energy Management</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td>Efficiency Vermont</td>
<td>Continuous Energy Improvement (SEM &amp; EBCx)</td>
<td>Commercial &amp; Industrial</td>
</tr>
<tr>
<td>OR</td>
<td>Energy Trust of Oregon</td>
<td>Strategic Energy Management</td>
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<tr>
<td>CA</td>
<td>SCE</td>
<td>SCE Public Sector Performance-Based Retrofit HOPs</td>
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<tr>
<td>CA</td>
<td>PG&amp;E</td>
<td>NMEC meter-based savings platform</td>
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# AM&V Software

<table>
<thead>
<tr>
<th>Area</th>
<th>Feature</th>
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<tbody>
<tr>
<td>Model</td>
<td>Model Type(s)</td>
</tr>
<tr>
<td></td>
<td>Variables &amp; Inputs Used</td>
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<tr>
<td></td>
<td>User Interface</td>
</tr>
<tr>
<td></td>
<td>Level of User Adjustments</td>
</tr>
<tr>
<td></td>
<td>Equations of Model(s) Shown</td>
</tr>
<tr>
<td>Energy Data Used</td>
<td>Interval Data Accepted</td>
</tr>
<tr>
<td></td>
<td>Hourly</td>
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<tr>
<td></td>
<td>Daily</td>
</tr>
<tr>
<td></td>
<td>Monthly</td>
</tr>
<tr>
<td>Overview</td>
<td>Level of Automation</td>
</tr>
<tr>
<td></td>
<td>Software Used</td>
</tr>
<tr>
<td></td>
<td>Code Language</td>
</tr>
<tr>
<td></td>
<td>Open Source</td>
</tr>
<tr>
<td>Tool Features</td>
<td>NRE detection</td>
</tr>
<tr>
<td></td>
<td>Data Coverage Assessment / Limiting</td>
</tr>
<tr>
<td></td>
<td>Performance Period Weather Data</td>
</tr>
<tr>
<td></td>
<td>Residual Review for Autocorrelation</td>
</tr>
<tr>
<td></td>
<td>Model Statistics Provided</td>
</tr>
<tr>
<td>Savings Type</td>
<td>Avoided Energy Use</td>
</tr>
<tr>
<td></td>
<td>Normalized Savings</td>
</tr>
</tbody>
</table>

### Free & Open Source Tools

- ECAM
- RMV2.0
- OpenEEMeter
- UT3 M&V Module
- NMECR
## Key considerations for AM&V

### Application Issues
- Commercial vs. Residential
  - Building level vs. Population based
- Avoided energy use vs. Normalized savings
- Level of Automation
  - Costs
  - Periodic reporting vs. Dashboard
  - Need for customized models, QC
  - Energy data access and cleaning

### Technical Issues
- Variations in M&V tool capabilities
- Need for customized models
- Savings uncertainty limitations
- Model acceptance criteria
  - “Bad” buildings
- Detecting Non-Routine events
- Making Non-Routine adjustments
Variations in M&V Tools

Form of Models:
- Change-point Models
- Time of week and temperature
  - Variations
- Tools with multiple types of models

Data Used:
- Inclusion of Holidays
- Use additional variables (e.g., Occupied Sq. Ft.)
- Hourly, Weekly, or Monthly energy intervals
Devil’s in the details... *Savings Uncertainty*

**Fractional Savings Uncertainty**
- From ASHRAE G-14
- Based on concept that savings uncertainty decreases over time
- Auto-correlation problems with interval data
  - Correction factors
  - Under-estimates FSU

**Model Goodness of Fit**
- Use regression statistics
- Ensure quality modeling procedures
- Not as transparent as FSU
- Ensure savings are detectible
Mitigate Uncertainty & Maximize Savings

Reduce Saving Uncertainty

- Use stringent model acceptance criteria
- Screen for non-routine events
- Fall-back M&V Approach:
  - “Bad” buildings
  - Critical projects
- Avoided energy use
  - Less error than normalized savings
  - Includes extremes, reflects actual impacts
Mitigate Uncertainty & Maximize Savings

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  - Less error than normalized savings
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Increase Program Savings

- Accurate models capture lower levels of savings ~ more savings reported
- Lower % savings allowable ~ broader range of eligible projects
- More accurate models ~ better detection and remediation of non-routine events
- More accurate savings ~ higher realization rates
# Minimize Uncertainty in Baseline Model

<table>
<thead>
<tr>
<th>Industry Guideline</th>
<th>Model Fit Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CV(RMSE)</td>
</tr>
</tbody>
</table>
| **ASHRAE G14 - Whole Building Performance Path** | Varies. See FSU | None | < 0.005% | ✓ Fractional Savings Uncertainty (FSU) < 50% annual savings at 68% confidence level\(^{29}\)  
Note: FSU ~ f(CV(RMSE), % savings, # baseline & reporting period points) |
| **ASHRAE G14 - Whole Building Prescriptive Path** | <25% | None | < 0.005% | ✓ Expected savings > 10%  
✓ Daily data is minimum interval  
✓ Baseline model uncertainty, depends on length of reporting period:  
  Energy < 20 – 30%,  
  Demand < 30 – 40% |
| **Superior Energy Performance (SEP) M&V Protocol** | None | > 0.50 | None | ✓ F-test for overall model fit must have a p-value < 0.1 (i.e., the overall fit of the model is greater than the 10% significance level).  
✓ All included relevant variables in the model shall have a p-value of less than 0.20.  
✓ At least one of the relevant variables in the model shall have a p-value of less than 0.10. |
| **BPA Regression for M&V: Reference Guide** | A low value is desirable (often interpreted as 10% or 15%) | > 0.75\(^*\) | < 0.005% | ✓ p-value for independent variables <0.10 to 0.01  
✓ t-statistic for independent variables >1.96 (95% confidence level)  
✓ F-statistic (used for entire model instead of individual variables; Larger the better.)  
✓ Adjusted R-squared for multiple regression models.  
✓ A low $R^2$ does not indicate a poor model; Professional judgment should be applied.  
\(^*\) This is a rule of thumb value |
Screen for Non-Routine Events (NREs)

Baseline Period:
• Increased uncertainty in energy model

Implementation Period:
• Can obscure savings from ECMs

Reporting Period:
• Direct increase or decrease in Avoided energy use, or
• Added uncertainty in reporting period model
Areas of Ongoing Development

- Open-source software
- Methods for determining savings uncertainty
- Evaluation of aggregated approaches
- Automated detection methods NRE
# Technical Resources

<table>
<thead>
<tr>
<th>Organization</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPA</td>
<td>3_BPA_Regression for M&amp;V: Reference Guide</td>
</tr>
<tr>
<td>BPA</td>
<td>7_BPA_Verification By Energy Modeling</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>ASHRAE 14 - 2014</td>
</tr>
<tr>
<td>EVO</td>
<td>IPMVP Core Concepts</td>
</tr>
<tr>
<td>EVO</td>
<td>IPMVP Uncertainty Assessment Application Guide</td>
</tr>
<tr>
<td>EVO</td>
<td>IPMVP’s Snapshot on Advanced Measurement &amp; Verification</td>
</tr>
<tr>
<td>NW SEM Collaborative</td>
<td>SEM Energy Modeling Method Selection Guide</td>
</tr>
</tbody>
</table>

**IPMVP Application Guide on Advanced M&V Methods and Non-Routine Adjustments - Coming soon!**
Thank you!

lwebster@facilityenergysolutions.com
Carmen Best

*Recurve*

The State Perspective: Developing and Applying Guidance
advanced

/ədˈvanst/

adjective

adjective: advanced

far on or ahead in development or progress. "negotiations are at an advanced stage"

- new and not yet generally accepted. "his advanced views made him unpopular"
Advanced History of NMEC in California
Normalized Metered Energy Consumption

Is a Means To Streamline and Scale EE to Double Energy Efficiency in California

“The energy efficiency savings and demand reduction . . . achieving the targets established pursuant to paragraph (doubling of EE by 2030) shall be measured taking into consideration the overall reduction in normalized metered electricity and natural gas consumption where these measurement techniques are feasible and cost effective.”

– SB 350
The Ruling was modeled after the regulatory requirements for behavior programs.

Intended to provide more timely information to customers, program administrators and regulators on performance without significant re-casting of savings on an ex post basis.

Upfront agreement and review of methods appropriate for the program and in some cases for the specific project.

Process of advice letter review served as the “case law” documenting the detailed direction on the proposals and methods coming from the Commission.

Ruling on High Opportunity Programs and Projects - CPUC 2015
Advanced = Enabling Effective Application of M&V
M&V Protocols and standards . . .

Reproducible Execution

Professional Guidance

IPMVP Option (C)

Time of Week & Temperature Model

The California Evaluation


. . . enable settlement.

California EM&V Framework Refresh Needs Assessment

Final Report
October 13, 2017
Revenue Grade = Transparent, Consistent, Repeatable

- Standard M&V Calculation Methods
- Monthly, Daily, and Hourly
- Public Stakeholders Empirical Process
- www.CalTRACK.org

- Python CalTRACK Engine
- Open Source Apache 2.0
- How It Works: https://goo.gl/mhny2s
- Code Repo: https://goo.gl/qFdW4P
Advanced = Enabling Flexibility + Accountability
The Market is Complex

Meter-based Demand Flexibility is Technology and Business Model Agnostic
CPUC NMEC Rulebook 2.0 - Overview

Details the **Program Level Requirements** including:
- M&V plan requirements
- Payments & Incentives

**General Requirements** include detailed information on:
- Commission roles for review
- Tools, Methods, Analytical Approaches and Calculation Software
- Savings claims

**Definitions & Matrix of Approval Requirements**

Weinbar: [How to Make the New Mandatory NMEC Rulebook Work for Your Program](#)
Program Fit

Programs must meet the Population-level NMEC regulatory and filing requirements described in this document;

Meter-Based

Energy savings determinations are made using an NMEC approach based on pre and post-intervention energy usage data observed at the meter.

Pre-Defined & Consistent

Measurement methods and calculation software are set before the program starts (and not subsequently changed) and apply to all sites in a uniform fashion.

For More Detail: CPUC Releases Version 2.0 of the Meter-Based NMEC Rulebook
## Tools, Methods, Analytical Approaches & Calculation Software

<table>
<thead>
<tr>
<th><strong>Ex-post Evaluation:</strong></th>
<th>...subject to Commission review of savings measurement methods and estimates, for purposes of program and/or project-level feedback and for purposes of ex-post impact evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Savings Calculations:</strong></td>
<td>All analytical methods, including tools, algorithms and software used in savings and incentive or compensation payment calculations, must be made available...</td>
</tr>
<tr>
<td><strong>Measurement Period:</strong></td>
<td>Savings determinations must be made by comparing at least 12 months of post-intervention energy consumption to at least 12 months of pre-intervention energy consumption.</td>
</tr>
<tr>
<td><strong>Transparency:</strong></td>
<td>Data, methods and calculations must be made available to the PAs well as the Commission and its impact evaluators.</td>
</tr>
<tr>
<td><strong>Documentation and Replicability:</strong></td>
<td>..methods used to calculate savings for NMEC programs must be documented...such that savings calculations are able to be replicated</td>
</tr>
<tr>
<td><strong>Consistent, Pre-Set Method:</strong></td>
<td>For Population-level NMEC programs, the specific measurement method(s) and calculation software must be determined before the program begins and applied uniformly...</td>
</tr>
<tr>
<td><strong>Proprietary Methods &amp; Software:</strong></td>
<td>Savings measurement methods and calculation software that is public, and especially those that are open-source, benefit from a stakeholder vetting process that allows experts and practitioners to share their knowledge and use updated information to inform savings estimates.</td>
</tr>
</tbody>
</table>
"Proprietary Methods & Software: Savings measurement methods and calculation software that is public, and especially those that are open-source, benefit from a stakeholder vetting process that allows experts and practitioners to share their knowledge and use updated information to inform savings estimates. The Commission has supported the development of public, open-source processes to develop NMEC methods (e.g. CALTRACK) and encourages stakeholders to engage in these open-source initiatives." p. 18
advanced M&V

Democratized access to impact evaluation results

More cost effective delivery of demand side strategies with insights from M&V

Transparent, consistent understanding of performance

Incremental improvements in methods identified through practice

Scaled investments in energy efficiency and other demand side strategies
advanced M&V =

Aggregators (programs)

Contractor Management
Sales and Marketing
Project Finance
Consumer Finance

Savings  Comfort  Health

DEMAND FLEXIBILITY

BUSINESS MODELS
Future Directions
Future Directions

• What guidelines are needed short term/long term?
• Future directions for AM&V?
THANK YOU!

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