



Evaluation, Measurement & Verification Essentials

A Training and Capacity-building Exercise
for the Local Govt. EE Community

in conjunction with

the LG Stakeholder Advisory Group
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Dr. Katherine Johnson, Advisor to the Energy Division

Tips and How-to's

- For the webinar unplugged to be a success, all callers will need to have their phones set to mute.
- Participants should call in five minutes prior to the start of the webinar. The line will accommodate 100 participants on a first come, first served basis.
- Call-in line: (866) 630-5989
- Participant code: 336 2110#

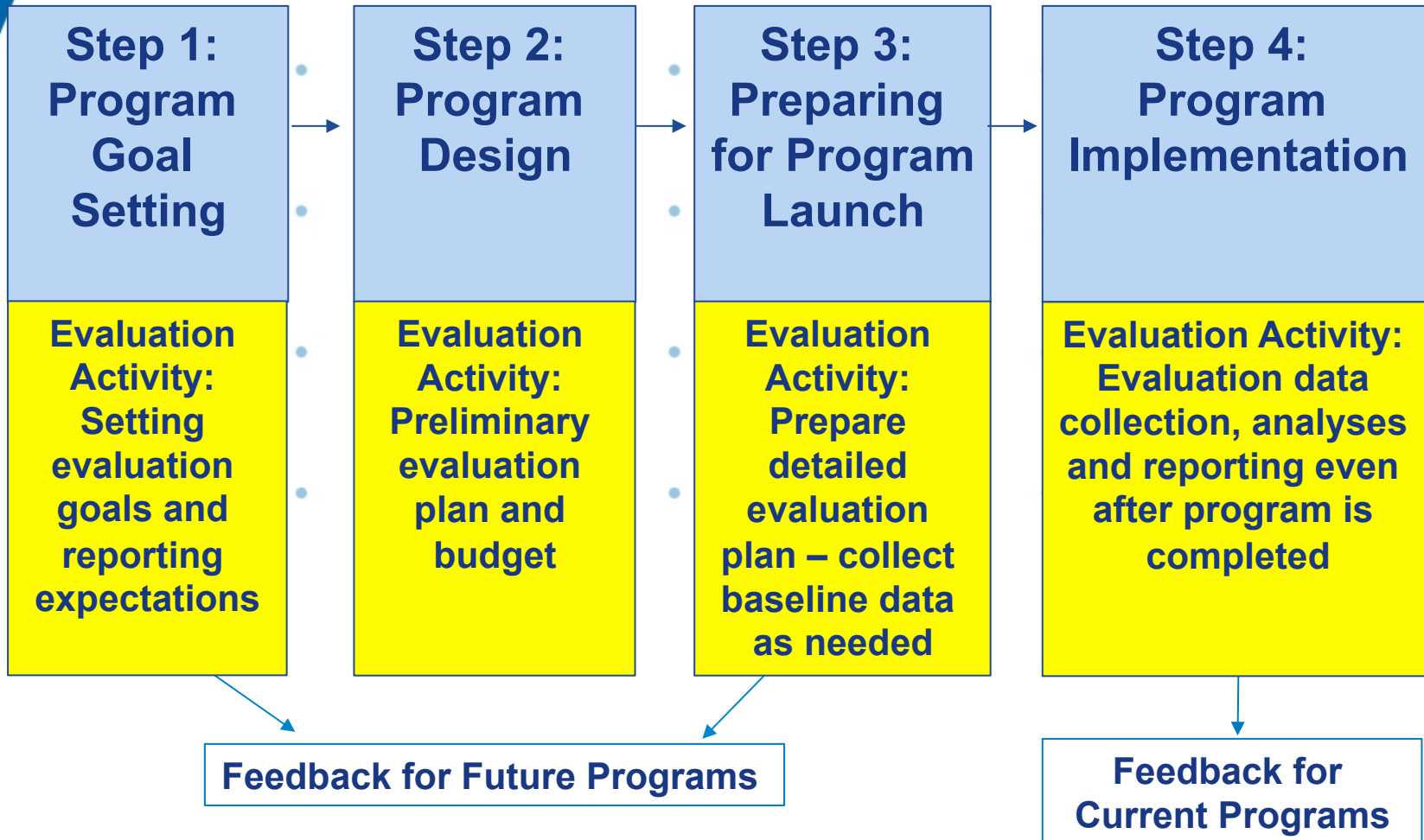
Tips and How-to's

- The presenter will prompt participants when it is time to advance to the next slide.
- At the conclusion of each section of the presentation, the host will pause to ask if there are questions, at which point, callers with questions may unmute.
- At these question times and at the conclusion of the presentation, questions may also be emailed to the presenter at kjohnson@johnsonconsults.com.
- All parties posing questions are asked to identify themselves and their agency.

Why Evaluate?

- ***Quantify Results:*** Document and measure the energy savings of a program in order to determine how well it has met its goals.
- ***Understand why*** program effects occurred and identify ways to improve current and future programs as well as select future programs.

Provides Feedback for Program Planning & Implementation



Defining EM&V

- ***Evaluation*** - The performance of studies and activities aimed at determining the effects of a program;
- ***Measurement and Verification*** – Data collection, monitoring, and analysis associated with the calculation of gross energy and demand savings from individual sites or projects.
- ***EM&V*** - is a common shorthand for determining both program and project impacts

Definition of Program Evaluations

The American Evaluation Association defines evaluation as:

“assessing the strengths and weaknesses of programs, policies, personnel, products and organisations to improve their effectiveness.”

Program Evaluations in California Rely on Several Key Protocols

The California Evaluation Framework – June 2004 and Revised January 24, 2006

- **Provides** Direction on Program Planning
- **Provides** Specific Requirements for Conducting:
 - Process Evaluations
 - Impact Evaluations
 - Discusses Many Other Critical Issues Regarding Program Evaluation

Two Types of Evaluations Used Most in CPUC Studies

- **Process Evaluation** describes and assesses program materials and activities.
- **Impact Evaluation** examines the long-term effects from a program, including those unintended effects.
- Process and impact evaluations **work together** to provide a complete picture; activities related to these separate evaluation efforts often overlap.

Fundamental EM&V Issues

Evaluation attempts to measure “what did not happen” – it’s an estimate.

- Savings cannot be determined **directly** but have to be measured by what would have happened without the program.
- EM&V is about **risk management** – documenting savings, using feedback to mitigate the risk of uncertainty.

Source: Schiller Consulting 2011)

Evaluation Timing is Critical

The decision regarding the appropriate evaluation time frame has two components:

- ***When and over what period*** of time will the evaluation effort take place?
- ***What is the level of detail*** or “granularity” required for the evaluation analyses?

Sources of Information for Process and Impact Evaluations

Records Review

Literature Review

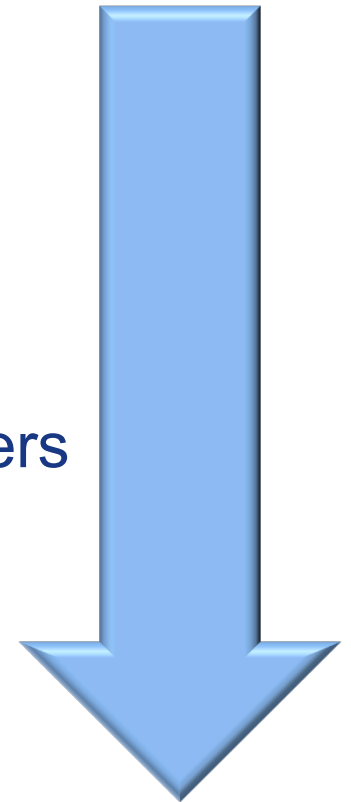
Focus Groups

In-depth interviews with key decision makers

Surveys

Site Visits

Low Cost



High Cost

Key Definitions Used in EM&V

- **Ex Ante:** Latin for “beforehand.” In models where there is uncertainty, the ex ante values are those that are calculated in advance of the actual program.
- **Ex Post:** Latin for “after the fact.” In models where there is uncertainty, the ex post values are those that are calculated after the uncertainty has been resolved.
- **Free Ridership:** Customers who would have installed program measures on their own and were not influenced by the program incentive or rebate.
- **Spillover:** Additional measure that have been installed by participants as a result of program influence.

More Key EM&V Definitions

- **Measure:** An energy efficiency technology installed through a program (e.g., light bulbs, heating/cooling equipment, insulation).
- **Deemed:** Indicates that the savings estimates for a particular energy efficiency measure has already been predetermined.
- **Custom:** Indicates that the measure savings must be determined through measurement & verification methods.
- **DEER:** The Database for Energy Efficient Resources (DEER) provides estimates of the energy-savings potential for typical measures.

Objectives of a Process Evaluation

“A systematic assessment of an energy efficiency ‘program’ for the purposes of:

- (1) **documenting** program operations at the time of the examination; and
- (2) **identifying and recommending** improvements that can be made to the program to increase the program’s efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.”

(TecMarket Works Team 2006)

Reasons for Conducting a Process Evaluation

- **Purpose:**
 - **Process evaluations benefit programs:**
 - *As a management tool;*
 - To **improve cost-effectiveness**; and
 - To **understand** customer and market perceptions (Peters & McRae 2009).
- **Process evaluations are particularly valuable when:**
 - **New Program** or has many changes;
 - Benefits are being achieved more **slowly** than expected;
 - **Limited** program participation;
 - **Slow** startup;
 - Does not appear to be **cost-effective**.

Potential Limitations of Process Evaluations

- **Provides** a “snapshot in time” of a program’s operations;
- Needs to be **comprehensive** to avoid jumping to conclusions (Peters & McRae 2009);
- Further reinforces importance of **“triangulation”** by not relying on data from just a single fact or source.

Objectives of an Impact Evaluation

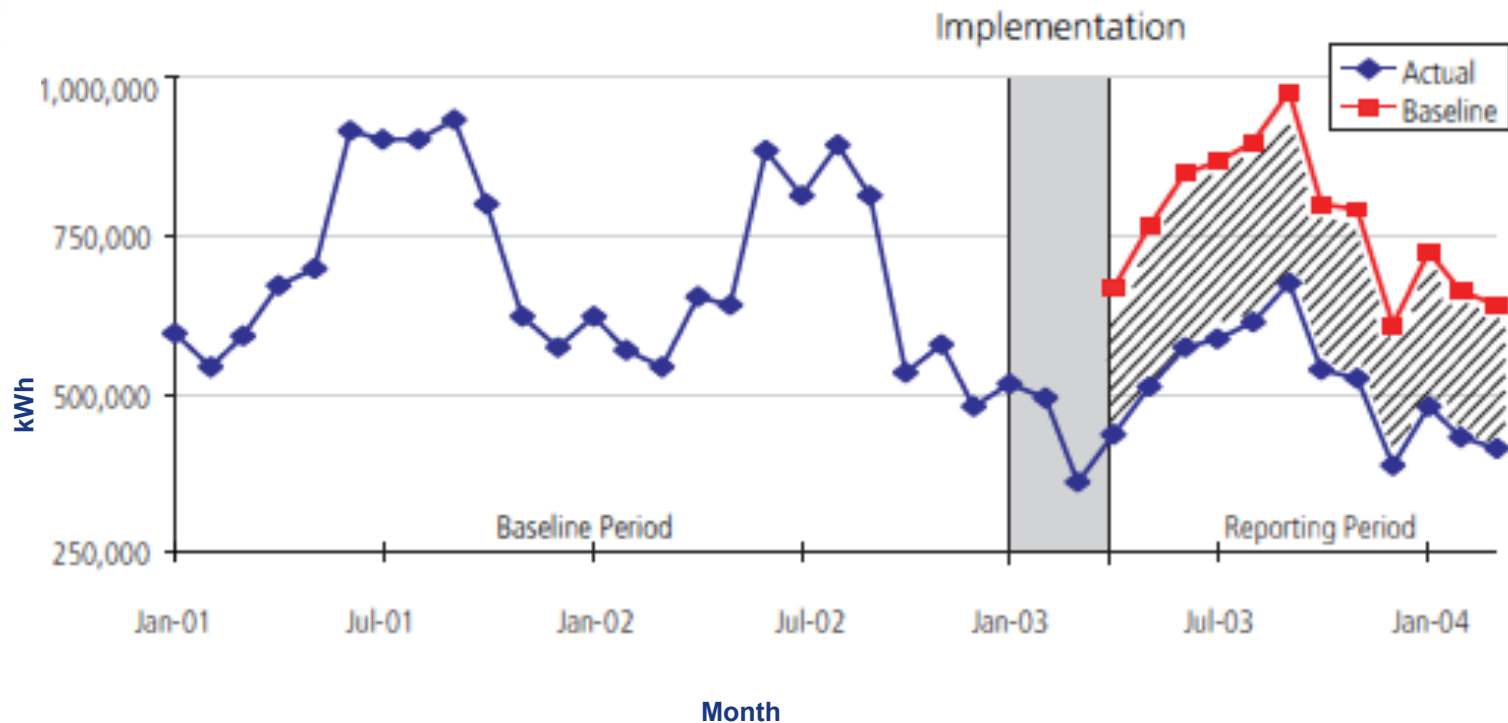
- ***Provides an impartial*** comparison of program results against benchmarks or a baseline;
- ***Determines gross savings*** of a program; and
- ***Determines net savings*** attributable to program activities.

$$\text{Impact} = \text{Actual}_{\text{post}} - \text{Projected}_{\text{pre}} \pm \text{Adjustments}$$

Determining Program Baselines

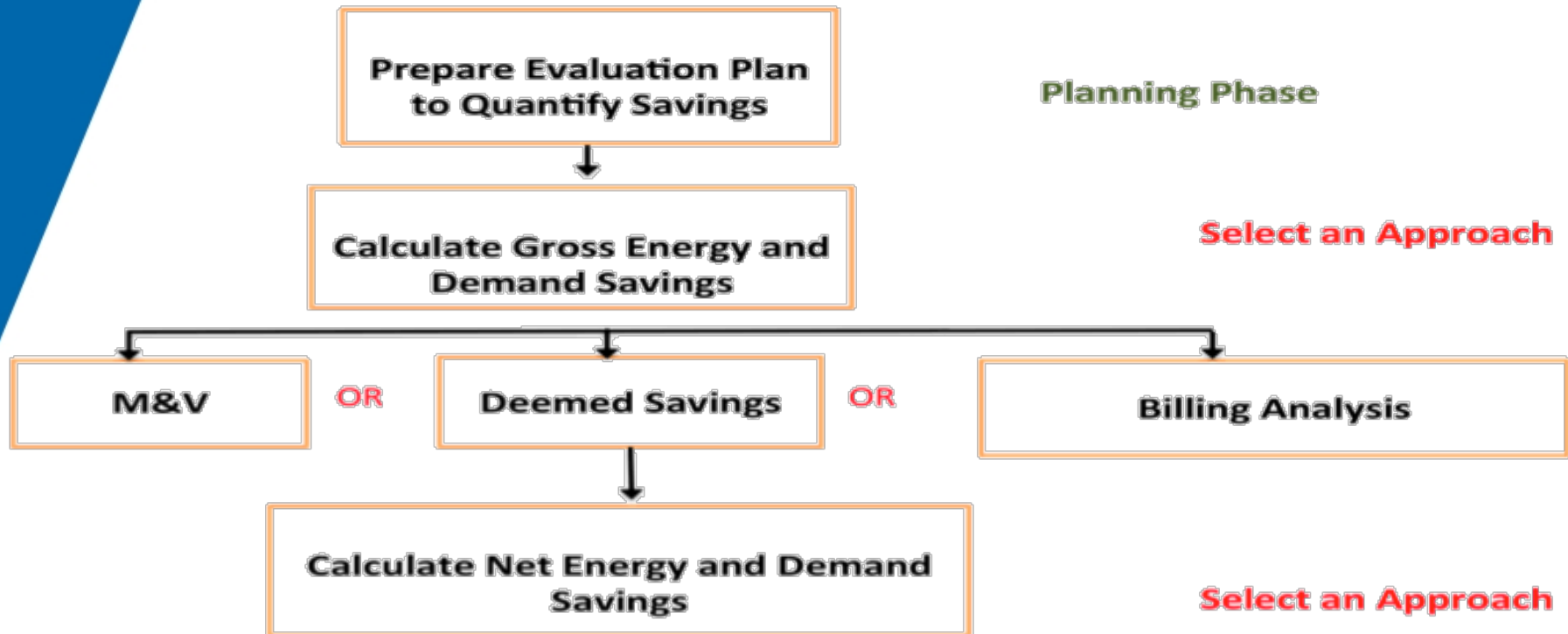
- A baseline reflects conditions, including energy consumption, that were occurring **before** the launch of the program.
- It is also important to consider where in the **life cycle** of the existing equipment or systems the new equipment was installed. Options are:
 - **Early replacement** of equipment that had not reached the end of its useful life;
 - **Failed equipment replacement**, with new energy efficient equipment installed; or
 - **New construction**

Impact Evaluations Compare Actual to Estimated Results Using Baselines

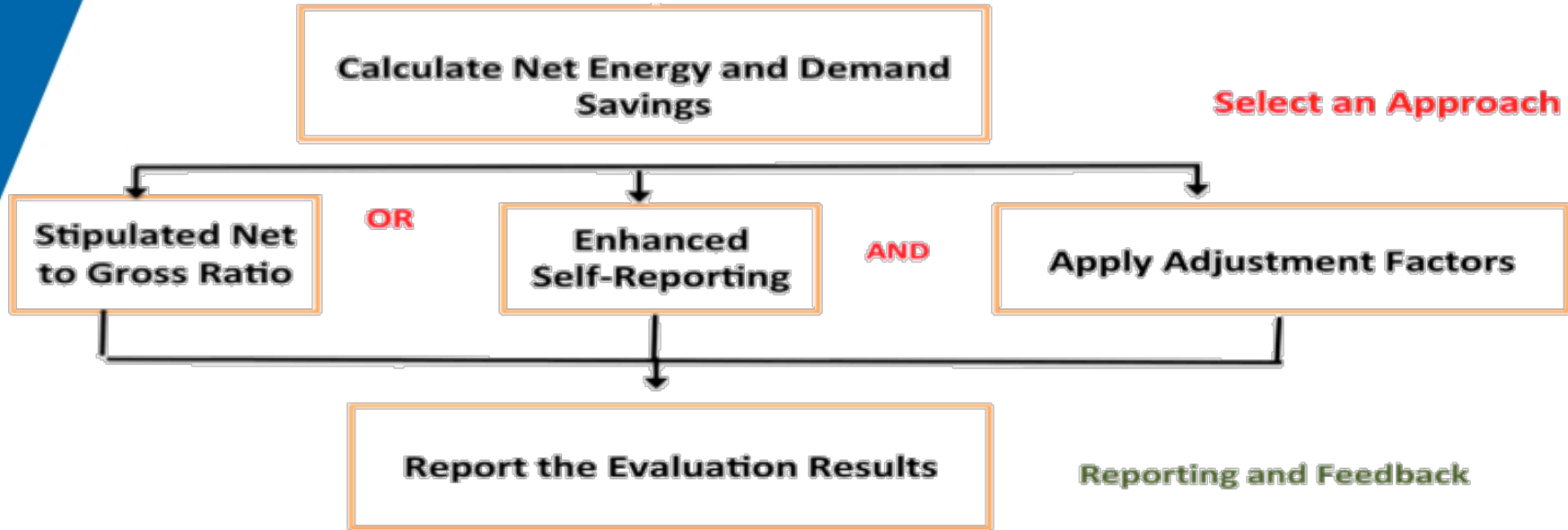


(Source: Schiller Consulting and NAPEE 2010)

Key Impact Evaluation Steps



Key Impact Evaluation Steps – Continued



Gross Savings Methodologies in California Rely on the IPMVP

IPMVP M&V Options	Measure Performance Checklist	Data Requirements
Option A: Engineering calculations using spot or short term measurements and/or historical data	Constant Performance	<ul style="list-style-type: none"> • Verified Installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time measurements
Option B: Engineering calculations using metered data	Constant or Variable Performance	<ul style="list-style-type: none"> • Verified installation • Nameplate or stipulated performance parameters • End-use metered data

IPMVP = International Performance Measurement & Verification



Additional IPMVP Options

IPMVP M&V Options	Measure Performance Characteristics	Data Requirements
<p>Option C: Analysis of utility meter data using a variety of techniques from simple comparisons to multi-variate regression analysis</p>	<p>Variable Performance</p>	<ul style="list-style-type: none"> • Verified Installation • Utility metered or end-use metered data • Engineering estimates of savings input to SAE model
<p>Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly billing data and/or end-use metering</p>	<p>Variable Performance</p>	<ul style="list-style-type: none"> • Verified Installation • Spot measurements, run-time hour monitoring and/or end-use metering to prepare inputs to the models • Utility billing records, end-use metering, or other indicies to calibrate model



Billing Analysis-Option C Methodology

Strengths

- Is relatively easy to develop a model
- Relatively inexpensive compared to other approaches

Limitations

- Requires at least one year of data to provide meaningful comparisons
- Billing Analysis is subject to unknown selection and spillover bias (Agnew and Goldberg 2013 cited in Violette and Rathbun 2014)

Adjustments to Net Savings

Free ridership effects –

This effect reduces gross savings.

Rebound (or Snap Back) effect –

This effect reduces gross savings.

Spillover effects –

This effect increases gross savings.

Adjustments are also made to account for changes in economic conditions, weather, changes to operating conditions, etc.

Keys to a Successful Program Evaluation

- **Incorporate** an evaluation plan and budget into the program plan at the beginning.
- **Prioritize** evaluation resources where the risks are highest.
- **Allow** evaluation criteria to vary across program types to allow for education, outreach, and innovation.
- **Conduct** ongoing verification as part of the program process.
- **Establish** a program tracking system that includes necessary information for evaluation

Keys to a Successful Program Evaluation (continued)

- **Match** evaluation techniques to the situation with regard to the evaluation costs, the level of precision required, and feasibility.
- **Maintain** separate staff for evaluation and for program implementation. The program evaluations should be conducted independently of program operations.
- **Evaluate** regularly to refine programs as needed to meet changing market conditions.

(Source: NAPEE 2007)

Additional Sources of Information

- **California Energy Efficiency Evaluation Protocols** Created for the CPUC to guide evaluations of investor owned utility energy efficiency programs.
- **Evaluation Process Protocols** to guide the evaluation process conducted by California state staff (CPUC and CEC staff) and are non technical.
- **Standard Practice Manual (SPM)** is for Economic Analysis of Demand Side Programs and Projects.
- **International Performance Measurement and Verification Protocol (IPMVP)** is required in the California Energy Efficiency Evaluation Protocols for some evaluation work.
- **California Evaluation Framework** is also required in the California Energy Efficiency Evaluation Protocols for some evaluation work.

Additional Sources of Information (continued)

- **EERE Guide for Evaluations** (pdf) is a guide for managing program evaluation studies from the US Department of Energy
- ***Energy Efficiency Program Evaluation: A Guide to the Guides***, 2007. National Action Plan for Energy Efficiency and the Department of Energy's Office of Energy Efficiency & Renewable Energy, Washington D.C.
- ***International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings***, 2010 Volume I, prepared by the International Performance Measurement & Verification Protocol Committee, www.evo-world.org

Questions?



For More Information

Dr. Katherine Johnson

Energy Division EM&V Advisor

[Email: kjohnson@johnsonconsults.com](mailto:kjohnson@johnsonconsults.com)

Phone: 301 461 4865

ED staff contact

Jeremy.Battis@cpuc.ca.gov

Local Government Programs Lead Analyst