



The Parker Ranch installation in Hawaii

EM&V Basics, Tools and Resources to Assist EECBG and SEP Grantees

Presenters: Julie Michals, Northeast Energy Efficiency Partnerships, Inc.
Phil Sieper, Cadmus Group
Mark Stetz, Stetz Consulting

Date: Nov. 10, 2010
2:00-3:00pm EST

DOE's Technical Assistance Program (TAP) supports the Energy Efficiency and Conservation Block Grant Program (EECBG) and the State Energy Program (SEP) by providing state, local, and tribal officials the tools and resources needed to implement successful and sustainable clean energy programs.



TAP offers:

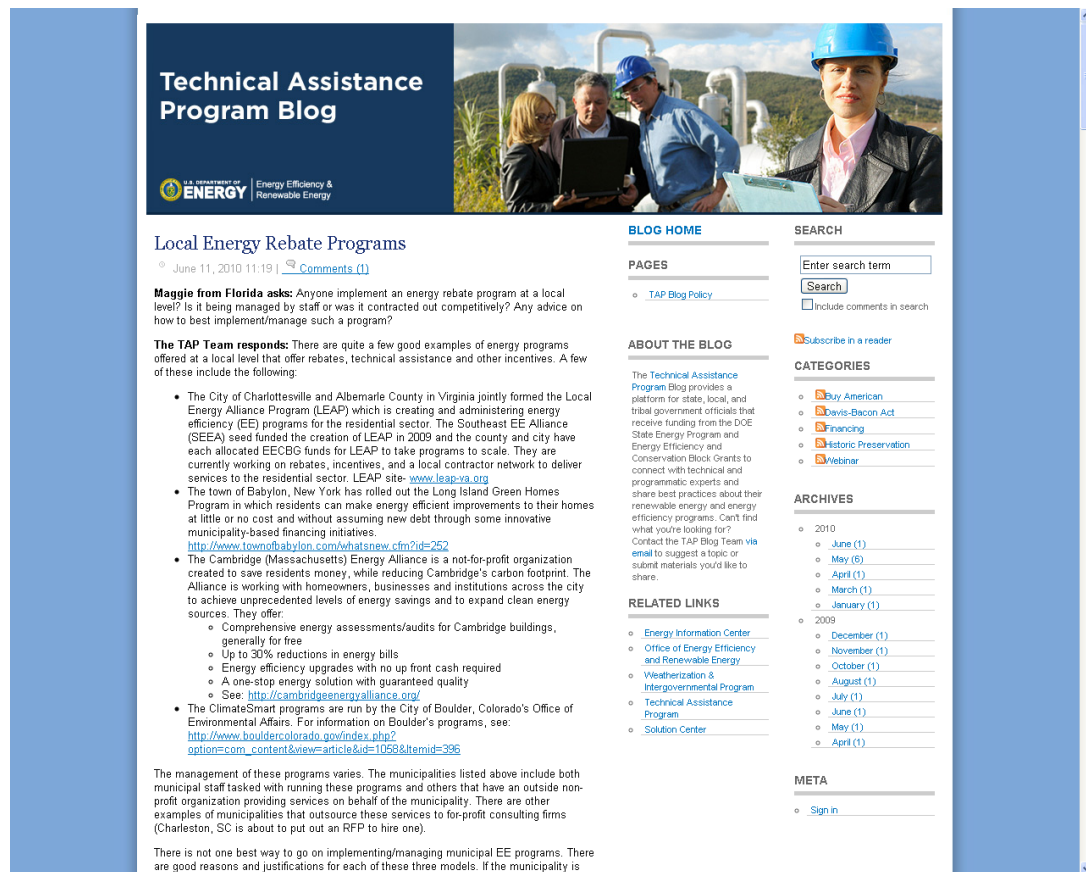
- One-on-one assistance
- Extensive online resource library, including:
 - Webinars
 - Events calendar
 - TAP Blog
 - Best practices and project resources
- Facilitation of peer exchange

On topics including:

- Energy efficiency and renewable energy technologies
- Program design and implementation
- Financing
- Performance contracting
- State and local capacity building

Access the TAP Blog!
<http://www.eereblogs.energy.gov/tap/>

Provides a platform for state, local, and tribal government officials and DOE's network of technical and programmatic experts to connect and share best practices on a variety of topics.



Technical Assistance Program Blog

U.S. DEPARTMENT OF ENERGY Energy Efficiency & Renewable Energy

Local Energy Rebate Programs

June 11, 2010 11:19 | [Comments \(1\)](#)

Maggie from Florida asks: Anyone implement an energy rebate program at a local level? Is it being managed by staff or was it contracted out competitively? Any advice on how to best implement/manage such a program?

The TAP Team responds: There are quite a few good examples of energy programs offered at a local level that offer rebates, technical assistance and other incentives. A few of these include the following:

- The City of Charlottesville and Albemarle County in Virginia jointly formed the Local Energy Alliance Program (LEAP) which is creating and administering energy efficiency (EE) programs for the residential sector. The Southeast EE Alliance (SEEA) seed funded the creation of LEAP in 2009 and the county and city have each allocated EECBG funds for LEAP to take programs to scale. They are currently working on rebates, incentives, and a local contractor network to deliver services to the residential sector. LEAP site- www.leap-va.org
- The town of Babylon, New York has rolled out the Long Island Green Homes Program in which residents can make energy efficient improvements to their homes at little or no cost and without assuming new debt through some innovative municipality-based financing initiatives. <http://www.townofbabylon.com/whatsnew.cfm?id=252>
- The Cambridge (Massachusetts) Energy Alliance is a not-for-profit organization created to save residents money, while reducing Cambridge's carbon footprint. The Alliance is working with homeowners, businesses and institutions across the city to achieve unprecedented levels of energy savings and to expand clean energy sources. They offer:
 - Comprehensive energy assessments/audits for Cambridge buildings, generally for free
 - Up to 30% reductions in energy bills
 - Energy efficiency upgrades with no up front cash required
 - A one-stop energy solution with guaranteed quality
 - See: <http://cambridgeenergyalliance.org/>
- The ClimateSmart programs are run by the City of Boulder, Colorado's Office of Environmental Affairs. For information on Boulder's programs, see: http://www.bouldercolorado.gov/index.php?option=com_content&view=article&id=1058&Itemid=336

The management of these programs varies. The municipalities listed above include both municipal staff tasked with running these programs and others that have an outside non-profit organization providing services on behalf of the municipality. There are other examples of municipalities that outsource these services to for-profit consulting firms (Charleston, SC is about to put out an RFP to hire one).

There is not one best way to go on implementing/managing municipal EE programs. There are good reasons and justifications for each of these three models. If the municipality is

BLOG HOME

PAGES

- [TAP Blog Policy](#)

ABOUT THE BLOG

The Technical Assistance Program Blog provides a platform for state, local, and tribal government officials that receive funding from the DOE State Energy Program and Energy Efficiency and Conservation Block Grants to connect with technical and programmatic experts and share best practices about their renewable energy and energy efficiency programs. Can't find what you're looking for? Contact the TAP Blog Team via email to suggest a topic or submit materials you'd like to share.

RELATED LINKS

- [Energy Information Center](#)
- [Office of Energy Efficiency and Renewable Energy](#)
- [Weatherization & Intergovernmental Program](#)
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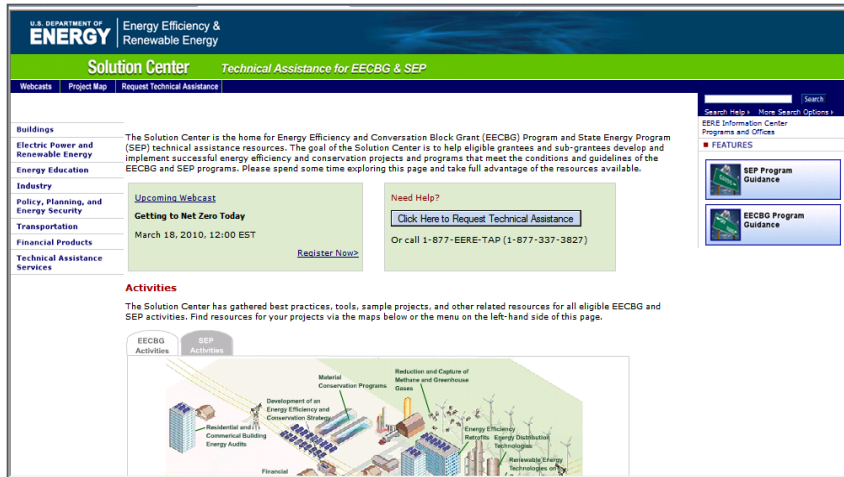
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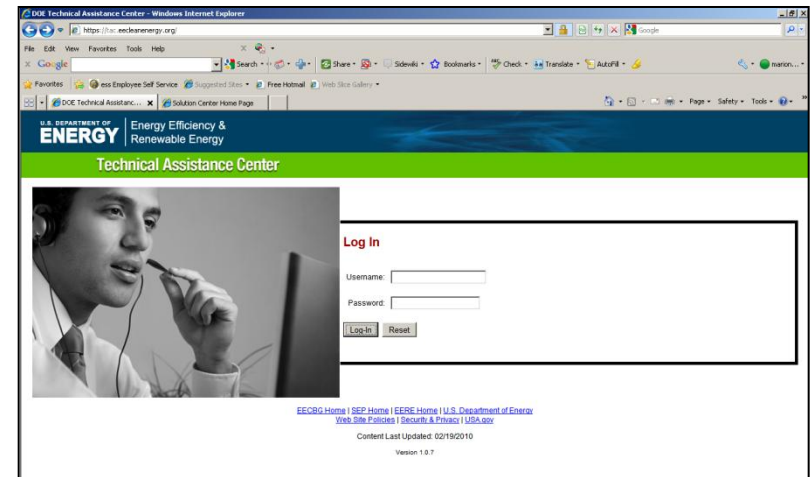
We encourage you to:

1) Explore our online resources via the [Solution Center](#)



The screenshot shows the 'Solution Center' website for Energy Efficiency & Renewable Energy. The header includes the U.S. Department of Energy logo and the text 'Energy Efficiency & Renewable Energy'. Below the header, there are navigation tabs for 'Webcasts', 'Project Map', and 'Request Technical Assistance'. The main content area is titled 'Solution Center Technical Assistance for EECBG & SEP'. It features a search bar, a 'Need Help?' section with a 'Click Here to Request Technical Assistance' button and the phone number '1-877-EERE-TAP (1-877-337-3827)', and an 'Activities' section with a diagram illustrating various energy efficiency and conservation strategies like 'Material Conservation Programs', 'Reduction and Capture of Methane and Greenhouse Gases', and 'Energy Efficient Retrofits'.

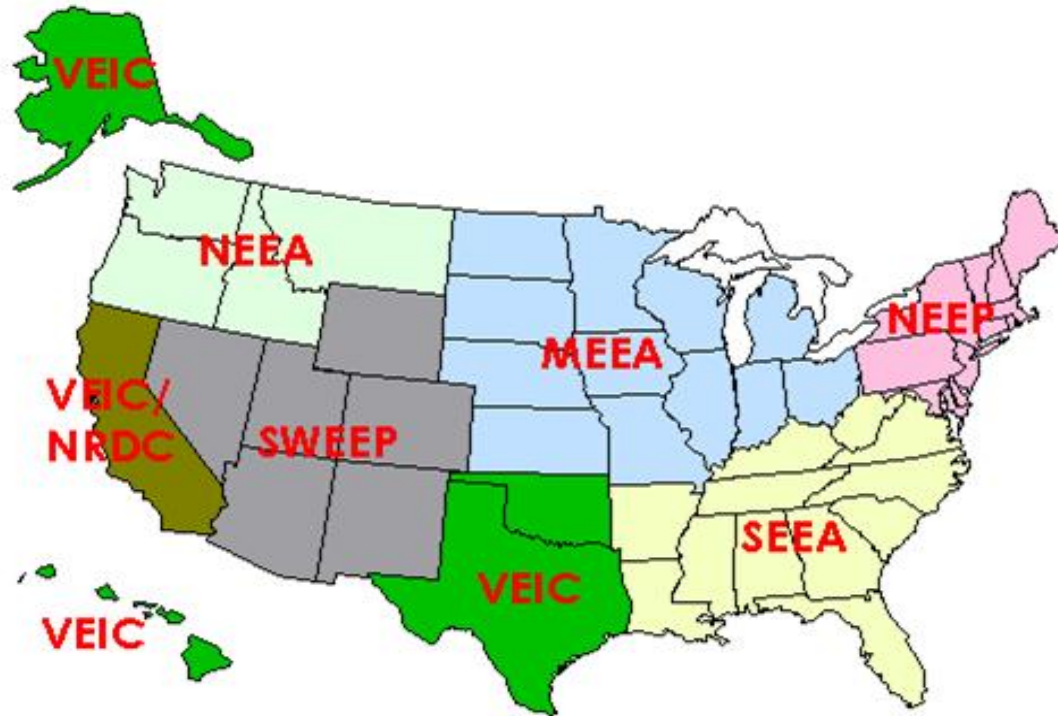
2) Submit a request via the [Technical Assistance Center](#)



The screenshot shows the 'Technical Assistance Center' website in a Windows Internet Explorer browser window. The browser address bar shows 'https://ee.eere.energy.org'. The website header includes the U.S. Department of Energy logo and 'Energy Efficiency & Renewable Energy'. The main content area is titled 'Technical Assistance Center' and features a 'Log In' section with 'Username:' and 'Password:' input fields, and 'Log In' and 'Reset' buttons. Below the login section, there are links for 'EECRG Home', 'SEP Home', 'EERE Home', 'U.S. Department of Energy', 'Web Site Policies', and 'Security & Privacy | USA.gov'. The footer indicates 'Content Last Updated: 02/19/2010' and 'Version 1.0.7'.

3) Ask questions via our call center at 1-877-337-3827 or email us at solutioncenter@ee.doe.gov

Who We Are: Team 4



ACEEE, NRDC: National Support



1. What is EM&V, and why is it important?
2. DOE Guidance on EM&V to Date
3. Initial Project Savings Estimates Using Available Data and Tools/Calculators
4. Data Collection, Tracking Tools and M&V Options/Approaches
 1. If doing limited EM&V (few/no EM&V resources)
 2. If doing third party evaluations
5. Reporting Energy Savings
6. Q&A

- **Measurement & Verification:** collects data to support energy savings for an efficiency measure, project or facility using site surveys, metering of energy consumption, monitoring of certain variables, and verification
- **Evaluation:** Refers to measuring *the performance of programs, or collections of projects* (which can include M&V for a statistically significant sample of individual projects) forming the basis for calculating total program/project savings

EM&V used to determine:

Gross Savings: The change in energy consumption and/or demand that results directly from (ARRA) program or project-related actions taken by participants, regardless of why they participated

Net Savings: The change in energy consumption and/or demand that is attributable to specific (ARRA) program(s) or project(s) that would not have occurred in the absence of the program(s) or project(s)

EM&V supports credibility of efficiency to:

1. Create jobs
2. Track cost-effectiveness of efficiency projects, how much \$\$ is being saved (lower electricity bills), and help plan/inform future projects
3. Reduce air pollution
4. Meet city/community and state climate change goals

Consistency in EM&V approaches/methods used across ARRA Grantees is important, so we can add up collective impact of efficiency investments across the country, along with other efficiency programs (e.g., ratepayer funded efficiency, weatherization programs, etc.)

The basic equation that EM&V addresses:

$$\textit{Annual Energy Savings} = \textit{Baseline} - \textit{Post-retrofit} \pm \textit{Adjustments}$$

Where **Baseline** (i.e., Base Year energy use) is what would have been the energy use in the absence of the retrofit project (program), **Post Retrofit** is energy use *after* the retrofit project, and controlling for **Adjustments** to capture significant changes that did not exist in the base year (e.g., changes in square footage, weather differences/normalization, changes in operational hours, additions of load e.g., new computers)

1. How are you going to *estimate and/or evaluate* savings from your energy efficiency project? i.e., what method/approach will you use?
2. What data will you *collect* to support your energy savings estimate and/or evaluation, and how will you analyze it?
3. How will you track and report the savings data to DOE?

- EM&V not required as part of Grantees award agreement
- Estimates can be calculated using ***Recovery Act Benefits Calculator*** <http://www1.eere.energy.gov/wip/guidance.html> but not intended to replace EM&V
- Grantees with resources to conduct **more sophisticated EM&V** efforts encouraged to conduct studies in accordance with Program Notice 10-017, and encouraged to share results with DOE through Project Officers. Guidelines at http://www1.eere.energy.gov/wip/pdfs/eecbg_evaluation_guidelines_10_017.pdf
- Measure and track post-installation energy performance of a building or building stock, **preferably at the whole building level**, with adjustments to weather normalize. Useful, available no-cost tool = **ENERGY STAR's Portfolio Manager Tool**

Recovery Act Benefits Calculator:

- EECBG and SEP Program Notices 10-07B and 10-006A refer recipients to calculator **that can estimate energy savings** from efficiency projects by identifying measures installed
- Provides high level estimates of savings and emissions, **not intended to replace contractor or engineering estimates**
- Basic data entered e.g., # units installed, HP, square footage, etc. Assumptions and algorithms built into the calculator, no direct EM&V involved
- Includes Residential Retrofit and Non-Residential Retrofit
- Useful for initial savings estimates or if no available EM&V resources

<http://www1.eere.energy.gov/wip/solutioncenter/calculator/default.aspx>

Useful tool, available at no cost to grantees:

www.energystar.gov/benchmark



Whole Building approach for commercial retrofit projects:

- Uses basic building data - square footage, building type, hours of operation, zip code, and utility bill energy use (12 month pre-installation, at least 4 months post-installation)
- Provides weather-normalized baseline and post-installation building energy performance
- For M&V, use IPMVP Option C approach (discussed later)
- Refer to earlier TAN Portfolio Manager webinars

Trainings available at www.energystar.gov/businesstraining

Guidelines for States Conducting or Contracting Evaluations of ARRA Funded SEP Activities (using 3rd party contractors):

http://www1.eere.energy.gov/wip/pdfs/evaluation_webinar_slides_june16_2010.pdf

High level guidelines/standards on:

- ***Evaluation Metrics*** - energy/demand savings, carbon emission reductions, job creation
- ***Independent Evaluations*** - by 3rd independent party
- ***Attribution of Effects*** - net effects due to SEP funds, with guidance on allocation of effects for jointly funded projects
- ***Evaluation Budgeting*** - recommends 5% or less of project budget
- ***Timing of Evaluation*** - evaluation planning to start at same time as when projects are initiated, determine baseline approach, data collection and analysis efforts

Continued...

High level guidelines/standards cont:

- ***State of the Art Analysis*** - evaluation approach should use current state of the art evaluation approaches and analysis methods
- ***Evaluation Rigor and Reliability:*** Study should be as reliable as possible within study approach and budget limits
- ***Study Design and Study Plan:*** Study methods/approach, tasks to be conducted, detailed data collection approach, detailed analysis approach for energy and demand savings
- ***Sampling and Statistical Significance:*** minimize bias and maximize representativeness of the population. Sample to be no less rigorous than 90% confidence level with +/- 10% precision
- ***M&V Approaches:*** analytic approach, baseline and post-installation operation assessments should use IPMVP field data collection frameworks (discussed later)

- Can use DOE Recovery Benefits Calculator
- Can refer to existing state energy efficiency program administrator data assumptions and algorithms where data is not available or not collected:

For example:

- California DEER Database: <http://www.energy.ca.gov/deer/>
- NW Regional Technical Forum: <http://www.nwcouncil.org/energy/rtf/>
- Other state savings assumptions documents for: CT, MA, ME, NJ, NY, VT, PA and multi-state TRM (MD, DC, DE) <http://neep.org/emv-forum/emv-library/research-evaluation-studies>

Algorithms for Energy and Demand Savings:

$$\text{kWh Saved} = (\text{Quantity}_{\text{baseline}} \times \text{Watts}_{\text{baseline}}) - (\text{Quantity}_{\text{installed}} \times \text{Watts}_{\text{installed}}) / (1000 \times (\text{Annual Operating Hours}))$$

$$\text{kW Saved} = (\text{Quantity}_{\text{baseline}} \times \text{Watts}_{\text{baseline}}) - (\text{Quantity}_{\text{installed}} \times \text{Watts}_{\text{installed}}) / (1000 \times (\text{Coincidence Factor}))$$

Where:

Baseline Fixture Quantity = number of existing fixtures

Baseline Fixture Wattage = connected wattage of the existing fixture for C&I retrofit

Installed Fixture Quantity = number of installed fixtures

Installed Fixture Wattage = rated wattage of the installed fixture, inclusive of both lamp and ballast. Obtained from nameplate data

Annual Hours = number of operating hours for the fixture in a typical year, either site-specific or assigned by building type (assumed to remain constant)

Summer Coincidence = ratio of peak demand at the same time as a “summer” period to the peak demand across all periods

Winter Coincidence = ratio of peak demand at the same time as a “winter” period to the peak demand across all periods

Which EM&V Approach to Use for Energy Savings?

1. Approaches/methods range from simple and direct to complex and indirect, sometimes combined, where more complex methods generally require more detailed data and higher cost
2. Guidelines for good measurement/analysis include:
 - US DOE/EPA Model Energy Efficiency Program Impact Evaluation Guide http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf
 - CA Evaluation Protocols: <http://www.calmac.org>
 - Regional EM&V Forum Guidelines: <http://neep.org/emv-forum/forum-products-and-guidelines>
 - NW Regional Technical Forum Protocols
 - U.S. FEMP M&V Guidelines: Measurement and Verification for Federal Energy Projects Version 3.0, 2008 <http://mnv.lbl.gov/>
 - ASHRAE Guideline 14: Measurement of Energy and Demand Savings (2002) - updated version forthcoming 2011. www.ashrae.org
 - Most refer to IPMVP: The International Performance Measurement & Verification Protocol (IPMVP Vol 1, 2010 www.evo-world.org)

2 key components to M&V:

- Verify potential to generate savings
- Determine savings

Lighting retrofit example:

Before



100 Watts/fixture

After



23 Watts/fixture

Savings: Determined by how many fixtures installed and operating hours

Questions:

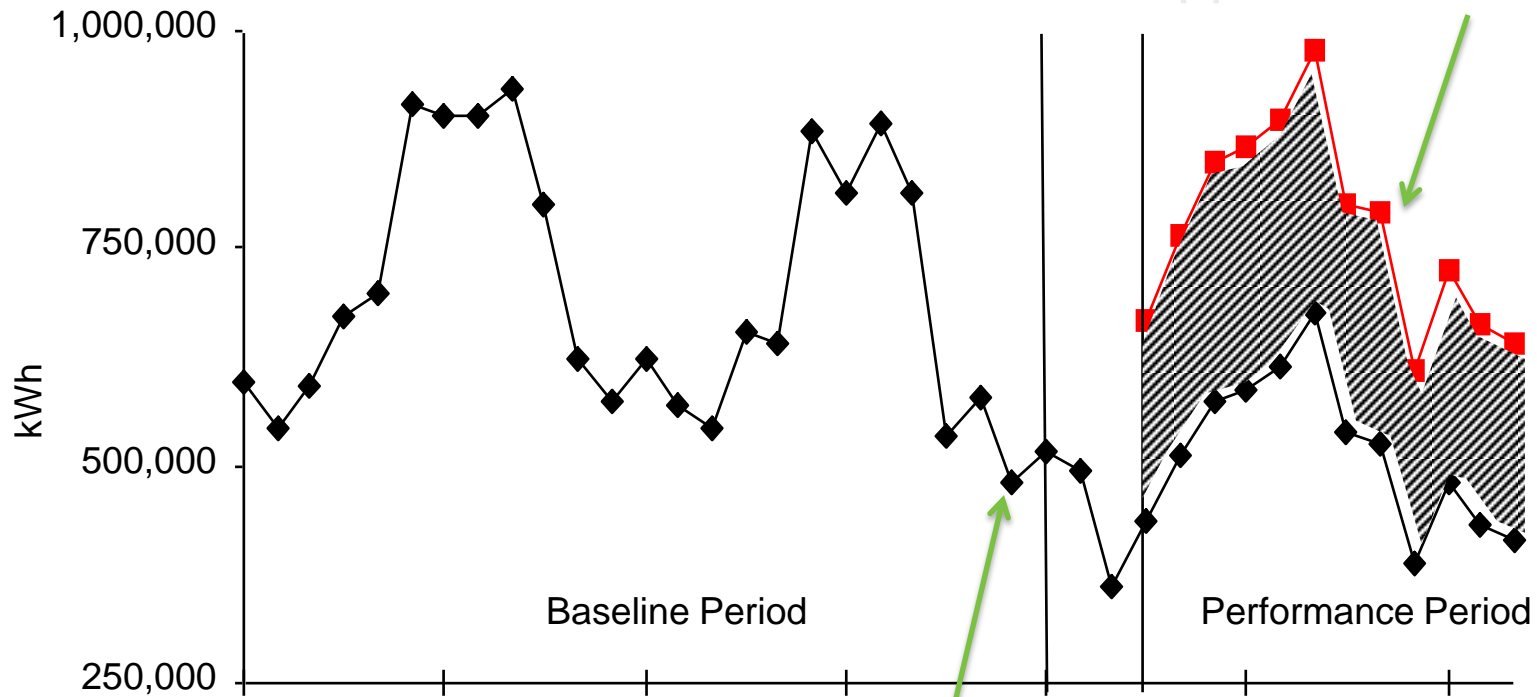
- Were baseline conditions accurately defined? (Were proper equipment/systems installed?)
- Are the systems performing to specification? (Do systems have potential to generate predicted savings?)
- Is there continuing potential for savings?

Baseline and Post-Installation Conditions Are Verified Using:

- Inspections
- Spot measurement tests
- Commissioning activities

Determining Savings Requires Two Types of Meters

What Would Have Happened Meter



Watt-hour Meter

- What would have happened meter “measures” the base year energy use (or baseline)
- What would have happened (and the savings) are determined using one or more of the following M&V methods:
 - Engineering calculations
 - End-use metering (A, B)
 - Whole building (utility) meters (C) - *DOE preference as a minimum*
 - Calibrated computer simulation (D)
- **International Performance Measurement and Verification Protocol (IPMVP)** provides framework for definitions and methods for four options
- IPMVP does NOT cover evaluation activities (sampling, net savings, cost of M&V activities, or design of meter and instrumentation systems)

Regardless of the M&V approach, similar steps taken to “measure & verify” savings:

Step 1: Gather the baseline data (energy, demand and operating conditions)

Step 2: Develop a Project Specific M&V Plan

Step 3: Verify the proper equipment/systems were installed and are performing to specification - *potential to perform*

Step 4: Gather post-retrofit measured data and compute energy and demand savings (and cost avoidance) as defined in the M&V Plan - *actual performance*

Approach	Advantages	Disadvantages	Comments
Engineering Calculations	Low cost, easy	No rigor	Not M&V
End Use Metering – Partial (A)	Low cost, easy, ignores external factors	Makes assumptions about non-measured values	Suitable for simple measures, e.g. lighting
End Use Metering – Full (B)	Low cost, easy	Requires additional analysis, influenced by external factors	Suitable for complex measures, e.g. HVAC, VSDs
Whole Building (C)	Easy to understand results	Influenced by external factors, requires stability, takes time	Suitable where savings > 10% of facility use
Simulation Model (D)	Flexible, historical baseline not required	Can be expensive, requires skilled practitioners	Suitable for complex projects and new construction

Basic Data Collection (at a minimum, e.g., Portfolio Manager, data varies depending on building type):

- Gross floor area (SF)
- Weekly operating hours
- # rooms
- # computers
- % of floor area that is cooled
- % of floor area that is heated

Detailed Data Collection - DOE Guidance for SEP Grantees:

- Contact Information of people served/impacted (name, company, address of contact, phone, email)
- Detail descriptions of services received: address of actions taken, recommendations from audits, measures taken, installation dates etc.
- e.g., CA Evaluation Protocols (April 2006, pg 205)

http://www.calmac.org/events/EvaluatorsProtocols_Final_AdoptedviaRuling_06-19-2006.pdf

- Tracking tools/systems used to compile and report energy efficiency data to support calculations of estimated energy/demand savings and economic goals.
- Basic function is to record collected data
- Tracking systems can be very comprehensive and sophisticated to simple spreadsheets
- Example tracking systems:
 - ENERGY STAR Portfolio Manager
 - Many other examples of tracking systems - possible topic for next EM&V webinar in January is to review options/features and range of costs...

Reporting required on:

- Energy Savings
 - Energy Costs and Savings
 - Renewable Energy Capacity and Generation
 - Emission Reductions
 - Process Metrics: # buildings retrofitted, square footage, efficiency measures purchased, etc.
-
- EEBCG Program Guidance 10-07B - Reporting:
http://www1.eere.energy.gov/wip/pdfs/eecbg_reporting_program_guidance_10_007b.pdf
-
- SEP Program Guidance 10-006BA – Reporting:
http://www1.eere.energy.gov/wip/pdfs/sep_10-006a_arra_reporting_guidance.pdf

Questions?

Please complete poll regarding your priorities for additional information/guidance on EM&V to support your needs/activities

Results will help inform potential January, and other future webinar topics

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Please join us again:

Title: **Energy Efficiency Rebate Programs 101**

Host: Catul Kiti, Senior Manager Energy Efficiency Programs, ICF International

Date: November 15, 2010

Time: 12:00 - 2:00 PM EST

Title: **State Clean Energy Policy Impact**

Host: Liz Doris, NREL

Date: November 17, 2010

Time: 3:00 - 4:15 PM EST

Title: **Negotiating and Entering Into an ESPC**

Host: Meg Giuliano, ICF International and Sentech

Date: November 18, 2010

Time: 1:30 - 2:30 PM EST

Title: **Community Renewables Projects**

Host: Cheryl Jenkins, VEIC

Date: November 30, 2010

Time: 2:00 - 3:00 PM EST

Title: **Defining and Establishing the Role of a Sustainability Manager**

Host: Harrison Rue, ICF International and Katherine Gajewski, Director of Sustainability, City of Philadelphia

Date: December 2, 2010

Time: 12:00 – 1:30 EST

Title: **Building Actionable Climate Action Plans**

Host: Jennifer Clymer, ICF International

Date: December 6, 2010

Time: 2:00-3:30 EST

For the most up-to-date information and registration links, please visit the Solution Center webcast page at www.wip.energy.gov/solutioncenter/webcasts