



The Parker Ranch installation in Hawaii

**Developing an Evaluation,
Measurement and Verification
Plan For Municipal Building
Energy Efficiency Projects**

Feb. 9, 2011, 2-3pm EST

Julie Michals, Northeast Energy
Efficiency Partnerships, Inc.
Jonathan Kleinman, CLEAResult

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:

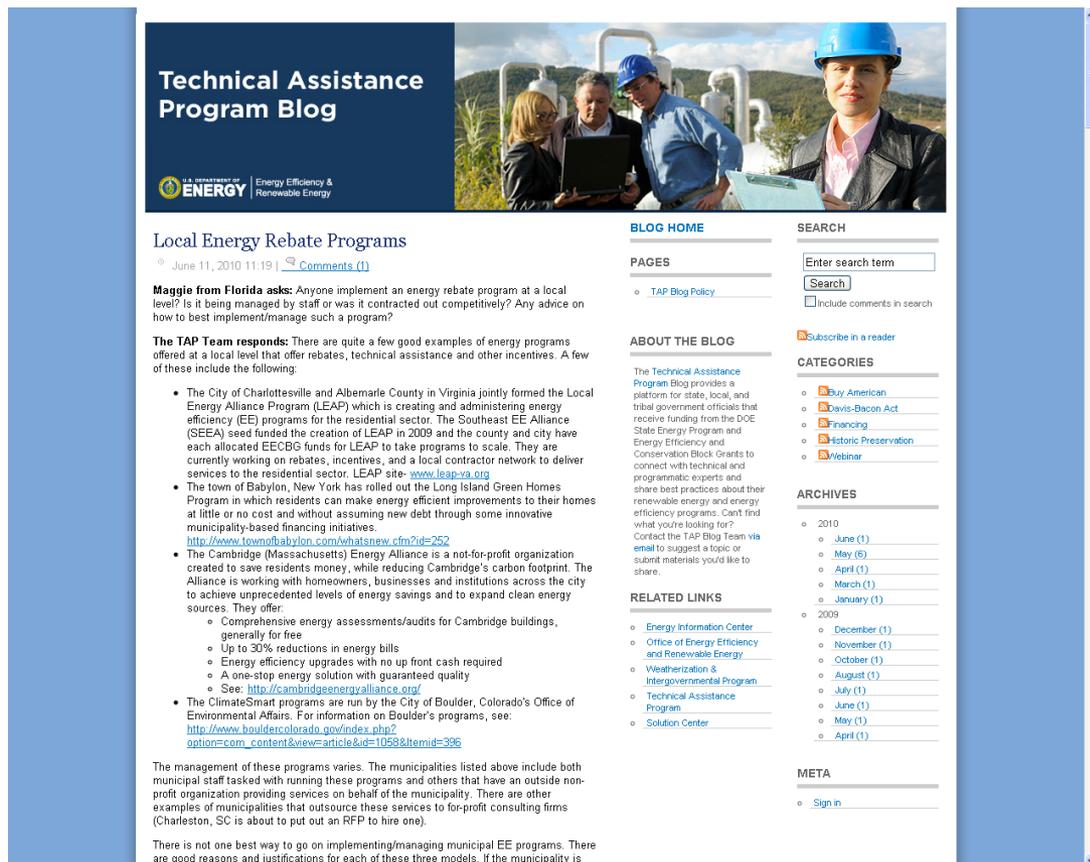
- One-on-one assistance
- Extensive online resource library, including:
 - Webinars
 - Events calendar
 - TAP Blog
 - Best practices and project resources
- Facilitation of peer exchange

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](#)
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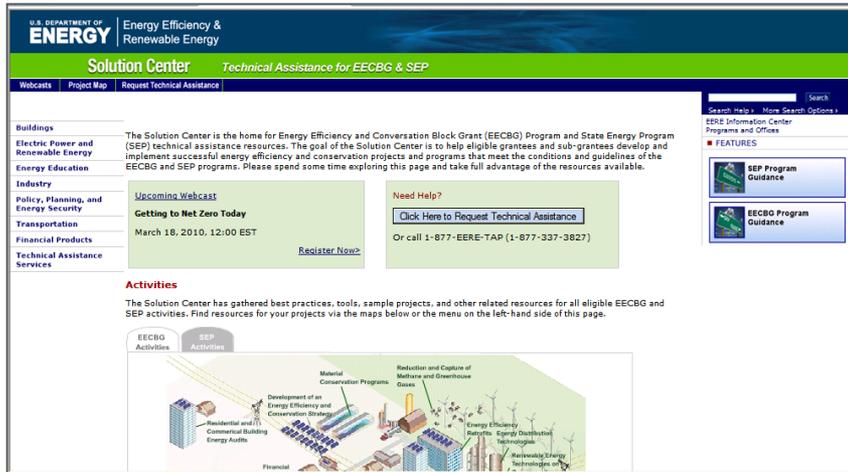
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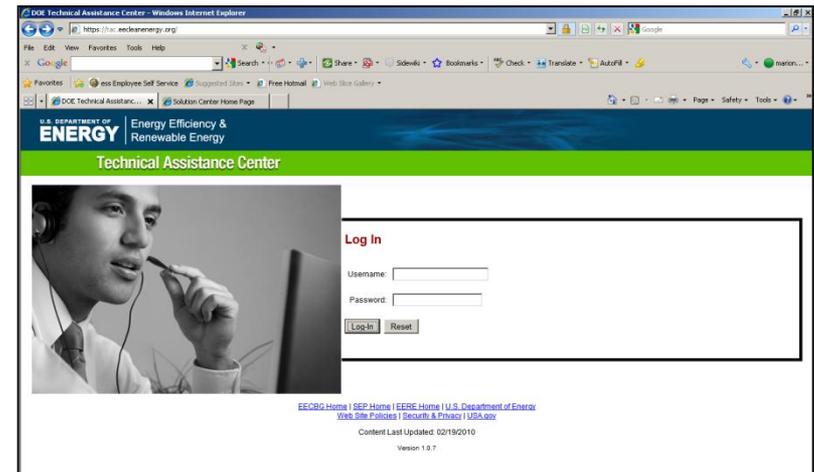
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We encourage you to:

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

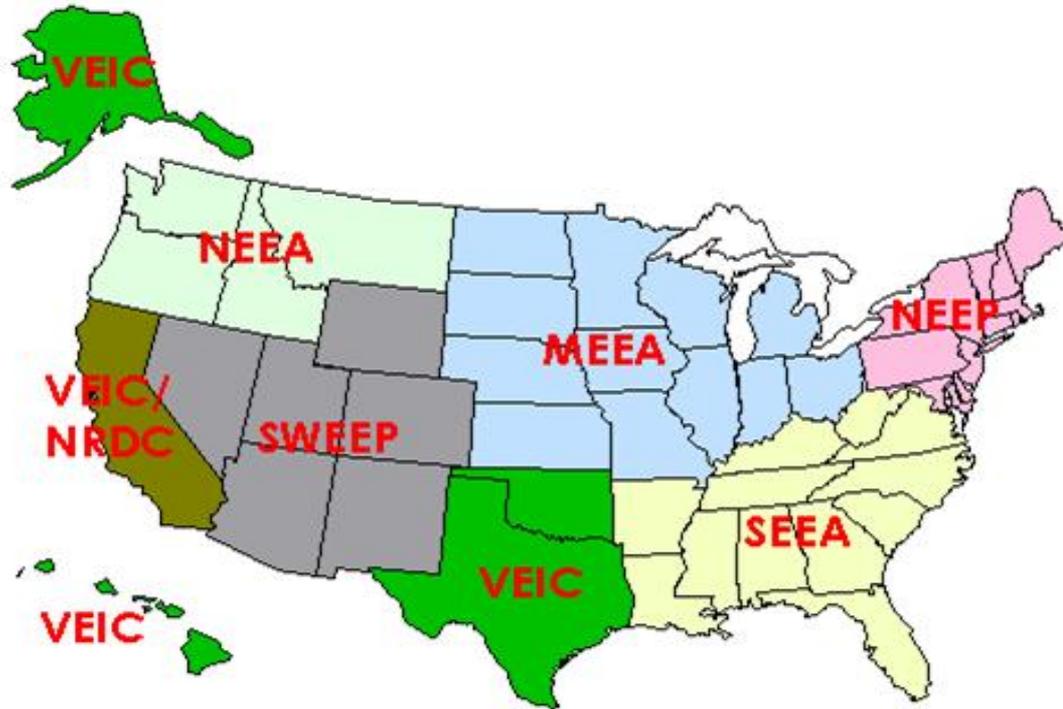


2) Submit a request via the [Technical Assistance Center](#)



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



NORTHWEST
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1. Distinguishing between Evaluation, Measurement & Verification (EM&V); Energy Performance Management (EPM); and Reporting
2. DOE Guidance on EM&V, EPM and Reporting
3. Developing a plan for Municipal Building EE projects:
 - *Energy Performance Management* – basic steps and tools
 - *EM&V* – simple or more comprehensive
 - *Case Studies* – EM&V Planning, coordinating with local utility program versus without
 - *Helpful Resources*
4. Q&A

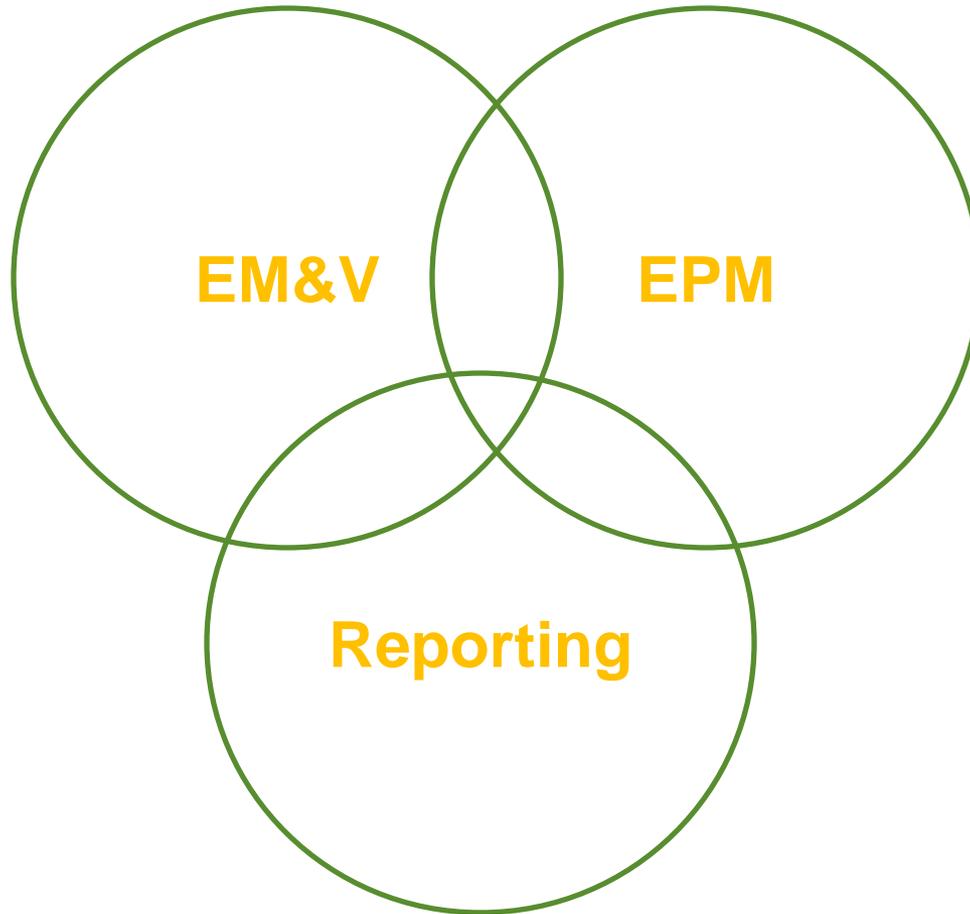
EM&V of Energy Efficiency projects/programs includes:

- **Measurement & Verification:** The *collection of data* (pre- and post installation of an efficiency measure, project or facility) *to support energy savings calculations* using e.g., site surveys, metering of energy consumption, and monitoring of certain variables
- **Evaluation:** The *analysis of the performance of efficiency programs, or collections of projects* (which can include M&V for a statistically significant sample of individual projects)

Energy Performance Management (EPM) for energy efficiency projects:

- Like EM&V, also involves establishing a baseline and collecting data
- *Compares* the performance of your buildings to others – to help identify opportunities for improvement
- *Prioritizes* the buildings, systems, technologies, and techniques on which to focus efficiency efforts
- *Verifies and Tracks Progress* of improvement projects by monitoring long-term energy performance of buildings

Interrelationships: EM&V, EPM and Reporting



Reporting required on:

- Job Impacts
 - 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

- DOE requires reporting of energy savings, but does not require specific EM&V as part of Grantees award agreement
- Estimates can be calculated using **Recovery Act Benefits Calculator**, but not intended to replace more rigorous EM&V techniques. See:
<http://www1.eere.energy.gov/wip/solutioncenter/calculator/default.aspx>
- ***NEW*** Updated DOE Guidance on EM&V and EPM:
http://www1.eere.energy.gov/wip/pdfs/11_001_eecbg_sep_building_best_practice.pdf . Includes use of no-cost tool **ENERGY STAR's Portfolio Manager**. Provides outputs for quarterly reporting in PAGE.
- Grantees with resources to conduct **more sophisticated EM&V** are encouraged to conduct studies in accordance with Program Notice 10-017, and to share results with DOE through Project Officers. See
http://www1.eere.energy.gov/wip/pdfs/eecbg_evaluation_guidelines_10_017.pdf

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)
- Measures and tracks pre- and post-installation energy performance at whole building level, with automatic adjustments to weather normalize
- For M&V, provides platform for IPMVP Option C approach
- Refer to earlier TAN Portfolio Manager webinars

Trainings available at www.energystar.gov/businesstraining

EM&V offers quantitative analysis of collected data and precise measurement and persistence of savings achieved, which can help you better:

- *Track cost-effectiveness* of efficiency projects, and how much energy and \$\$ is actually being saved
- *Plan for future* projects/investments
- Develop estimates of *jobs created, emissions reduced, and other economic benefits*

Developing an EM&V Plan helps to:

- *Standardize EM&V* monitoring and reporting throughout the municipality
- Outlines EM&V *expectations*
- Promotes *ongoing success* and achievements

EPM involves *benchmarking* buildings by comparing utility bills before and after measure installations.

Benefits include:

- Low-Cost way to prioritize buildings for assessment using Key Performance Indicators:
 - ✓ High energy use (kBtu/Sq.ft)
 - ✓ Low percentile rankings and/or low Portfolio Manager scores
 - ✓ Large floor areas (Sq.ft)
- Can use utility bill data pre- and post-installation
- Can satisfy IPMVP Option C (*more later*)
- Complement with EM&V to get more rigorous/precise savings results and verify project savings

What is needed to benchmark facilities?

- At least 12 months of utility energy data
 - per meter
 - if an EE project has been implemented try to obtain data 12 months prior to in-service date

- **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

Key Components:

1. Establish priority for data gathering and reporting in energy performance across all departments
2. Establish an energy baseline for your buildings and benchmark your buildings to assess your performance
3. Define scope of overall energy savings opportunity
4. Identify high-level strategies for achieving energy efficiency
5. Include an M&V Plan
6. Allow for senior management endorsement

An EM&V Plan should be written before you start a project. Generally, the plan should:

- Be adaptable and continuously evolving
- Identify personnel/departments accountable for energy data
- Establish data gathering and reporting timelines
- Include facilities overview/description
- Outline EE projects
 - Implemented
 - Identified
- Outline process, if applicable, for leveraging Utility EE Programs and associated EM&V resources

Approach #1: Coordinate with your Utility Company

Approach #2: Use of Publicly-Available Deemed Savings Values, or Engineering Estimates

Approach #3: Conduct some EM&V, and/or combine with Approach #2

Approach #1: Coordinate with your Utility Company – ask about:

- Free services
 - Electronic historic usage data
 - Online bill analyzers and graphs
 - Training workshops – energy accounting
- Incentive programs / rebates
- Developing EE project savings calculations (and what data collection is needed to support utility EM&V)
- If you have an assigned utility Account Manager, work through him or her to engage services
- *Upcoming Case Study – City of Grand Prairie*

Key EM&V Plan Elements

Approach #1

Element	Timing
Baseline data collection and benchmarking	Beginning of process, 1-2 months
Contact utility company to request support of energy efficiency programs	Beginning of process
Work with utility company to identify project opportunities	1-2 months after benchmarking
Determine EM&V approach with utility for projects – deemed savings, simple M&V, or full M&V – that specifies data to collect and timing	During project identification
Collect pre-project data: count equipment and document nameplate data for deemed savings; conduct simple metering (e.g., light loggers) for simple M&V	According to project EM&V requirements: weeks to months before project
Contractors or staff implement project	Weeks to months
Collect post-project data	According to project EM&V requirements; weeks to months after project
Re-benchmark building(s) to verify savings realization	Up to 12 months after project

If no opportunity to coordinate with local utility EE program

Approach #2: Use of Deemed Savings Values, Engineering Estimates

- Can use DOE Benefits Calculator
- Other Deemed Savings values/algorithms available
- *With complement use of benchmarking tool*

Approach #3: Conduct some EM&V, and/or combine with #2

- Complement use of benchmarking tool (e.g. Portfolio Manager Tool) with some EM&V
- *Upcoming Case Study – Natural Gas Efficiency Project*

Key EM&V Plan Elements

Approaches #2 or #3

Element	Timing
Baseline data collection and benchmarking	Beginning of process, 1-2 months
Work with staff and/or contractor (e.g., energy services company) to identify project opportunities, solicit bids	After benchmarking
Establish EM&V approach for projects – researching deemed savings, use EECBG calculator, or M&V plan – independently, or contact TAC for assistance	During project identification
Establish project-specific M&V plans – data collection to used deemed savings or calculator, supplemental data collection (e.g., light loggers), or whole building utility bill analysis (IPMVP Option C)	1-2 months after project identification
Collect pre-project data	According to project EM&V plan
Contractors or staff implement project	Weeks to months
Collect post-project data	According to project EM&V plan
Re-benchmark building(s) to verify savings realization	Up to 12 months after project

Key EM&V Plan Steps

Summary

Step 1: Define baseline conditions accurately

Step 2: Develop project-specific M&V plan

- Project description
- Proposed calculation methodology (e.g., formulas, data to be collected)
- Proposed data requirements (e.g., physical, equipment, and field data collection)
- Supporting documentation

Step 3: Commission systems to ensure proper equipment was installed

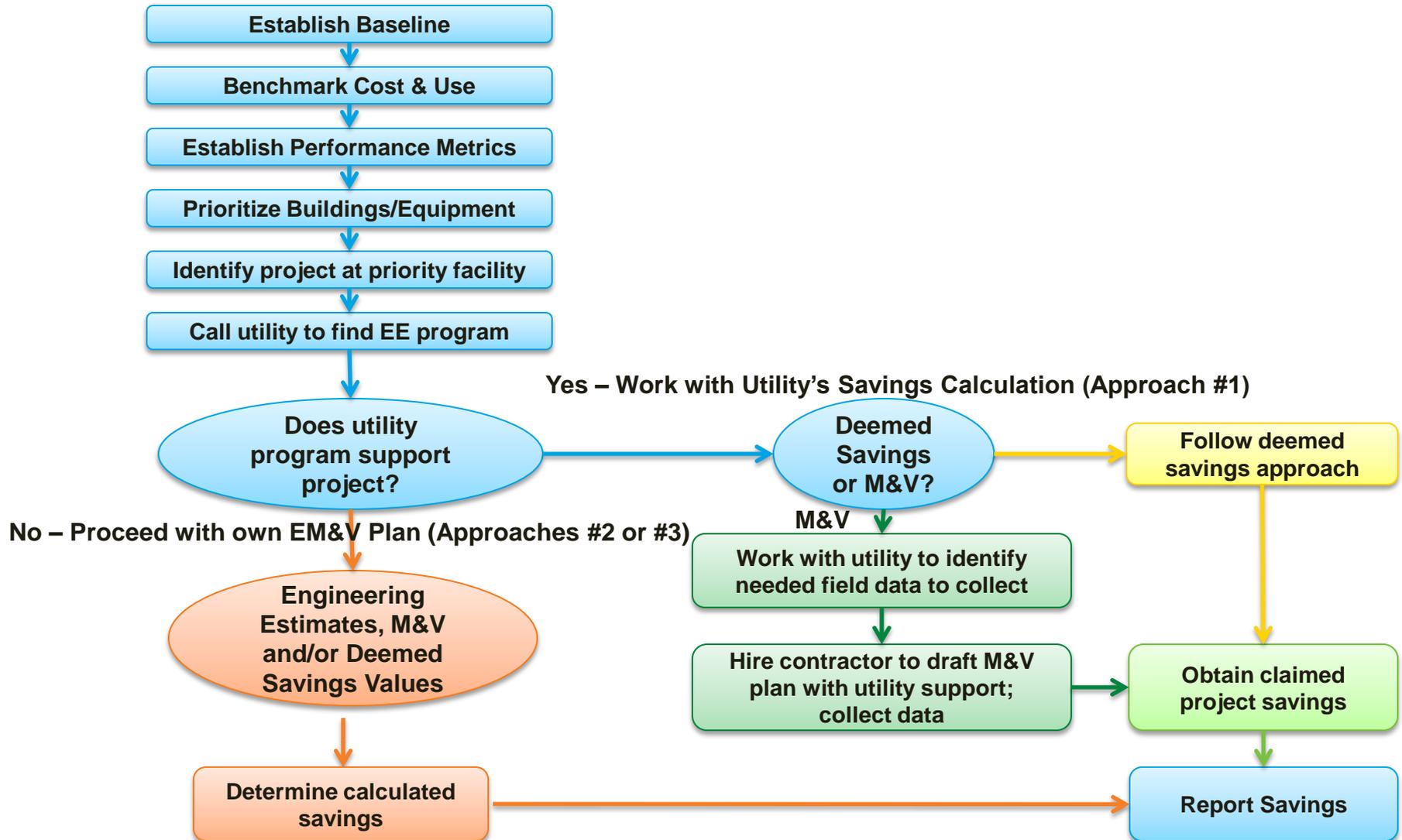
Step 4: Post-installation verification

Step 5: Regular-interval verification

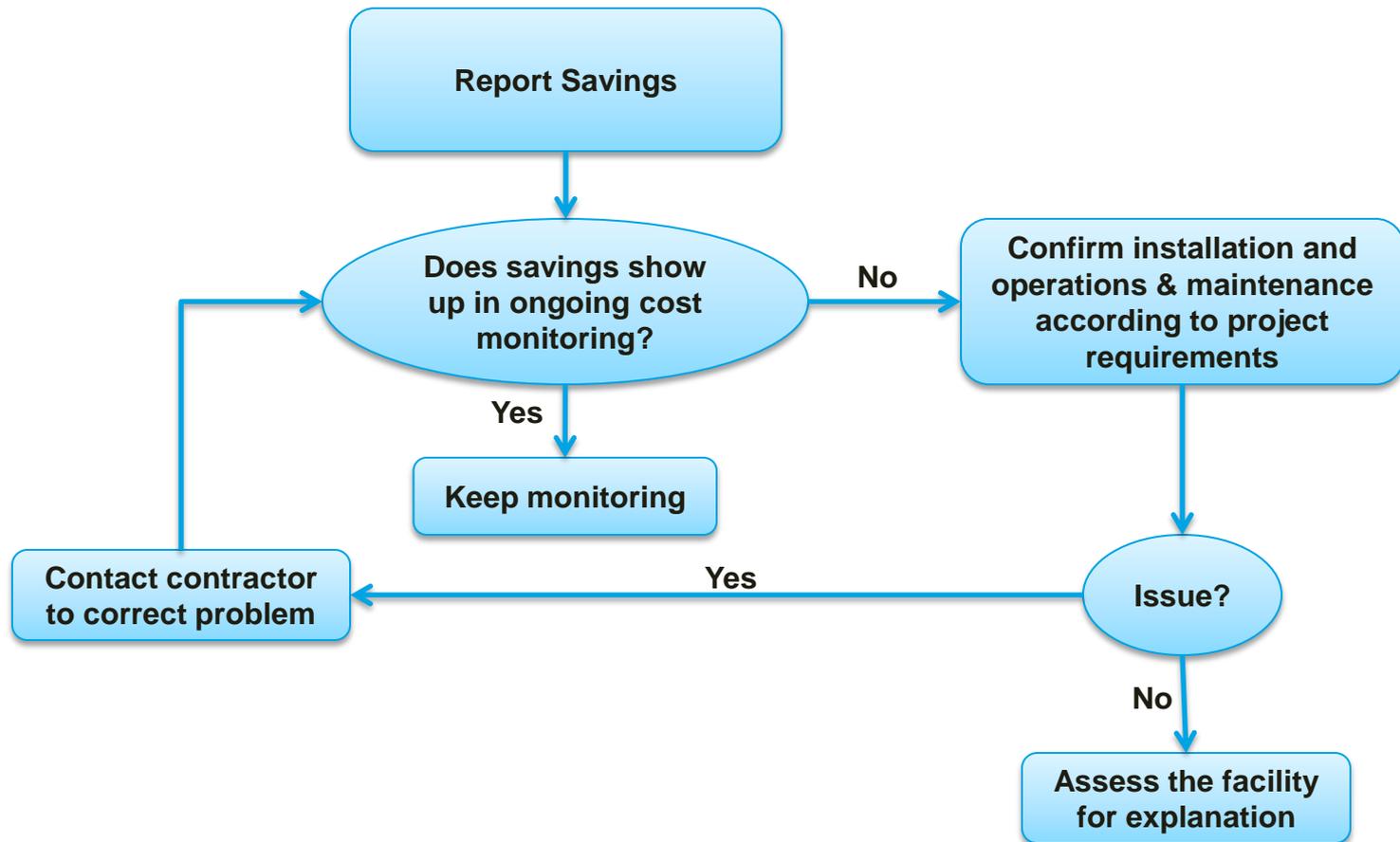
See: International Performance Measurement & Verification Protocol
(IPMVP Vol 1, 2010 www.evo-world.org)

Detailed steps at: http://www1.eere.energy.gov/femp/pdfs/intro_mv.pdf

Energy Performance Management Framework



Process continued...



Common Obstacles

- Cost (varies depending on extent of EM&V)
- Available Personnel
- Access to energy data
- Understanding and organizing energy data
 - kWh vs. kW Demand
 - Rate structures
 - Meters and corresponding equipment/facilities
- Choosing an accounting/tracking software e.g.,
 - Excel
 - ENERGYSTAR Portfolio Manager
 - Utility Manager Pro
 - Other

CASE STUDY #1

City of Grand Prairie, TX

- Participated in ONCOR's Government Facilities Program and City Grants Program

- **Step 1:** Define baseline conditions accurately
 - Benchmarked 42 City Owned Buildings at no cost (*2 months*)
 - Provided 12 months of utility data for all associated meters

- Participated in an Energy Master Planning Workshop
 - Developed Energy Master Plan (*additional 2 months*)

- Identified several EE opportunities, including:
 - Lighting retrofits
 - HVAC equipment replacements, including rooftop units and chilled water systems

Step 2: Develop Project-Specific M&V Plan (Approach #1)

- Oncor programs have deemed savings methodologies for lighting and HVAC projects approved by Public Utility Commission of Texas
- Program staff, municipal staff, and energy services company (McKinstry) complete full equipment inventories of existing light fixtures and HVAC equipment, including photo-documentation of HVAC equipment (*2-3 months*)
- Oncor sends inspector to verify accuracy of submitted equipment data (*1 month*)

Step 3: Project installation and system commissioning

Step 4: Post-installation verification

- Program staff, municipal staff, and energy services company (McKinstry) complete full equipment inventories of existing light fixtures and HVAC equipment, including photo-documentation of HVAC equipment (*2-3 months*)
- Oncor sends inspector to verify accuracy of submitted equipment data (*1 month*)

Step 5: Regular-Interval verification

- Re-benchmarking of facilities under discussion
- All projects estimated to have saved 250 kW and over 1.2 million kWh per year
- Financial incentives from utility also received

- **Sample Project**

- Replacement of old steam boiler with its distribution system (i.e., radiators) with a high-efficiency hot water boiler and the existing distribution system
- Re-piping where necessary

- **Assumptions**

- There is no local utility natural gas energy efficiency program
- There are no changes to the building's energy use (e.g., no window replacements, weatherization)

Step 1: Define baseline conditions

- Track fossil fuel use over past 12 to 24 months, and compare with other facilities' weather-normalized consumption (per square foot) if possible (e.g., through Portfolio Manager) (*2 months*)

Step 2: Project-specific M&V Plan

- Option 1: ask contractor to estimate existing system efficiency with proposed system efficiency, and determine % savings estimate by efficiency ratios – have contractor verify all existing equipment efficiency levels (*1 month*)
- Option 2: hire local engineering firm or other energy expert to develop project savings estimate based upon project specifications and utility bill history – have engineering firm verify all existing equipment efficiency levels (*3 to 6 months, depending on bid process for engineering firm*)

Step 3: Project installation and Commissioning

Step 4: Post-installation verification

- Municipal staff confirm installation of project according to project specifications, and verify system efficiency with nameplate data
(*1 month*)

Step 5: Regular interval verification

- Track utility bill consumption for additional 12 months to confirm system performance (*12 months*)
- If expected savings do not materialize, contact contractor and/or engineering firm to re-commission system

- Information from this webinar will be expanded into a Technical Assistance guidance document with more detail *March 2011*
- Upcoming EM&V TAN webinar to address Energy Management and EM&V for *Residential Retrofit* projects *March 2011*
- Final guidance document to cover Energy Management and EM&V Planning for *Municipal Buildings* and *Residential Retrofit*, with supporting case studies *May 2011*

Questions?

ADDITIONAL BACKGROUND INFO AND RESOURCES

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)

Grantees can refer to existing state energy efficiency program administrator data assumptions and algorithms if project data is not all available/collected. These “**Technical Reference Manuals**” (TRMs) include a mix of stipulated data, prior EM&V data and/or manufacturer specs. Existing resources include:

- 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 (MD, DC, DE) available at: <http://neep.org/emv-forum/emv-library/research-evaluation-studies>
- Other state TRMs

Savings Estimate Example

Commercial Lighting Retrofit

Algorithms for Energy and Demand Savings:

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

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

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

1. Approaches/methods range from simple/direct to complex/indirect where more complex methods require more detailed data and higher cost
2. Guidelines for EM&V measurement/analysis include:
 - US DOE/EPA Model Energy Efficiency Program Impact Evaluation Guide http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf
 - US DOE Program Evaluation Guide: http://www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf
 - CA Evaluation Protocols: <http://www.calmac.org>
 - Regional EM&V Forum Guidelines: <http://neep.org/emv-forum/forum-products-and-guidelines> (Northeast and mid-Atlantic region)
 - NW Regional Technical Forum Protocols <http://www.nwcouncil.org/energy/rtf/>
 - 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 of the above refer to IPMVP: The International Performance Measurement & Verification Protocol (IPMVP Vol 1, 2010 www.evo-world.org)

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Please join us again:

- **Title: Financing Programs: RFP & Contract Terms and Conditions**
- Host: Chris Lohmann, U.S. Department of Energy, Financial Market Development Team
- Date: February 15, 2011
- Time: 1:00 – 2:30 Eastern

- **Title: Integration of Renewables and Efficiency: Leveraging Interest and Funding**
- Host: Cheryl Jenkins, VEIC
- Date: February 17, 2011
- Time: 2:00 – 3:00 Eastern

- **Title: Optimizing Solar Installations – Tools and Strategies**
- Host: Sarah Busche, NREL
- Date: February 23, 2011
- Time: 3:00 – 4:15 Eastern

- **Title: Energy Savings Performance Contracting: Savings Measurement and Verification (M&V)**
- Host: Meg Giuliano, ICF/SRA
- Date: February 24, 2011
- Time: 1:30 – 2:30 Eastern

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