



Energy-Saving

HOMES, BUILDINGS,
& MANUFACTURING

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

An Introduction to Measuring Energy Savings

Presentation for NASEO

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Measuring Savings

- Is it possible to “measure” savings?
- The way we quantify energy savings varies based on who we are quantifying the savings for.
- Two Examples:
 - Scenario 1: A utility offers an appliance rebate to residential customers to incent them to purchase an energy efficient air-conditioning unit (energy efficiency program).
 - Scenario 2: A building owner implements efficiency improvements and wants to know how much they are saving as a result of those investments (energy efficiency project).
- This scenario illustrates what is often referred to as the “baseline” issue. The baseline from which the savings measured is different in these two scenarios.

Baseline Example – Installing an Energy Efficient Appliance

Historical Consumption – 120 kWh per year

Minimum Efficiency Appliance – 100 kWh per year

Energy Efficient Appliance – 80 kWh per year

Savings using an existing conditions baseline: 40 kWh per year

Savings using a code/standard baseline: 20 kWh per year

Savings using a common practice baseline: 10 kWh per year
(assumes 50% of the market installs the minimum efficiency appliance and 50% install the efficient appliance)

Common Practice Baseline

- The EPA, for purposes of the emission guidelines, defines EE savings as the difference between observed electricity usage and an appropriate common practice baseline (CPB).
- One benefit of using a CPB is that it inherently adjusts the baseline over time to reflect market conditions and naturally occurring improvements in efficiency over time.

For additional reading on net-savings and the common practice baseline:

<http://energy.gov/sites/prod/files/2015/01/f19/UMPChapter17-Estimating-Net-Savings.pdf>

Gross & Net Savings

- **Gross Savings:** Changes in energy consumption that result directly from program-related actions taken by participants of an EE program, regardless of why they participated.
- **Net Savings:** Changes in energy use that are attributable to a particular EE program. These changes may implicitly or explicitly include the effects of free ridership, spillover, and induced market effects.

*Uniform Methods Project: "Estimating Net Savings: Common Practices," Chapter 17
<http://energy.gov/sites/prod/files/2015/01/f19/UMPCChapter17-Estimating-Net-Savings.pdf>

EPA's Common Practice Baseline

- In the context of EE programs, the term gross savings refers to savings calculated with respect to a defined baseline, while net savings is due to the difference between energy consumption with the program in place and that which would have occurred absent the program.
- The CPB as defined in Section 2.2.2 is consistent with baseline definitions used for gross savings by many existing EE programs. Thus, for much of the EE activity within existing programs, the “gross savings” that would be determined using current methods and practices for those programs will be consistent with the savings relative to the CPB as defined here, and can be reported as MWh savings for purposes of the CPP.

Common Ways to Quantify Savings

- IPMVP (International Performance Measurement and Verification Protocol)
 - Uniform Methods Project (programs)
 - FEMP M&V Guidelines (projects)
- Deemed Savings
- Experimental and Quasi-experimental methods

Lifetime Savings

Program:

- Expected energy savings over the lifetime of the measure.
- Usually calculated by multiplying the first-year energy savings times the number of years the measure will be in place.
- Can be adjusted for various reasons.

Project:

- Lifetime savings may require ongoing M&V.

Deemed Savings

- Deemed (stipulated) savings are used to define savings values for projects with well-known and documented savings values in defined applications.
- The use of deemed values in a savings calculation is an agreement to accept a pre-determined value, irrespective of what actually “happens.”
- Deemed values and deemed calculation approaches are often documented in a “Technical Reference Manual” – the Northwest’s “RTF” is an example as is California’s “DEER”

*Steve Schiller, WREGIS/WECC September 2015

Technical Reference Manuals

- A TRM is a database of standardized, state or region specific deemed savings calculations and associated deemed savings values for well-documented energy efficiency measures.
- TRM (technical reference manual) is a resource document that includes information used in program planning and reporting of energy-efficiency programs. It can include savings values for measures, engineering algorithms to calculate savings, impact factors to be applied to calculated savings (e.g., net-to-gross values), source documentation, specified assumptions, and other relevant material to support the calculation of measure and program savings. A TRM may be in the form of a document or an electronic database.

Mid-Atlantic TRM

TRM includes either specific deemed values or algorithms for calculating:

- Gross annual electric energy savings;
- Gross electric summer coincident peak demand savings;
- Gross annual fossil fuel energy savings (for electric efficiency measures that also save fossil fuels, and for certain measures that can save electricity or fossil fuels);
- Other resource savings if appropriate (e.g. water savings, O&M impacts);
- Incremental costs; and
- Measure lives.

Mid-Atlantic TRM

The TRM is intended to be easy to use and to serve a wide range of important users and functions, including:

- Utilities and efficiency Program Administrators – for cost-effectiveness screening and program planning, tracking, and reporting.
- Regulatory entities, independent program evaluators, and other parties – for evaluating the performance of efficiency programs relative to statutory goals and facilitating planning and portfolio review.

What's Inside a TRM?

- Measure description
- Definition of the baseline condition
- Definition of the efficient condition
- Annual energy savings algorithm
 - $\Delta\text{kWh} = ((\text{WattsBase} - \text{WattsEE}) / 1000) * \text{ISR} * \text{HOURS} * (\text{WHFeHeat} + (\text{WHFeCool} - 1))$
- Summer Coincident Peak kW Savings Algorithm
- Measure Life
- Incremental Cost

For a more detailed presentation on TRMs, this presentation was created for Kentucky: <http://eetd.lbl.gov/publications/introduction-to-technical-reference-m>

Interactive Effects

- Interactive effects increases or decreases in the use of electricity or fossil fuels that occur outside of the end uses targeted by a specific EE measure, project, or program.
- For example, reduction in lighting loads through an energy-efficient lighting retrofit can reduce buildings' air conditioning and increase heating requirements because less heat is generated by energy-efficient lighting systems compared with less efficient lighting systems.

Non-Energy Benefits

Impacts associated with program implementation or participation. Can be positive or negative. Some examples include: avoided emissions and environmental benefits, productivity improvements, jobs created and local economic development, reduced utility customer disconnects, higher comfort and convenience.

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For more information:

<http://www.synapse-energy.com/project/driving-efficiency-non-energy-benefits>

<https://www4.eere.energy.gov/seeaction/publication/best-practices-energy-efficiency-program-screening-how-ensure-value-energy-efficiency>

Energy Efficiency Stakeholder Collaboratives

- Massachusetts Energy Efficiency Advisory Council
- Arkansas Parties Working Collaboratively
- Illinois Energy Efficiency Stakeholder Advisory Group
- California Technical Forum
- Northwest Power and Conservation Council – Regional Technical Forum

DOE EM&V Resources

SEE Action Energy Efficiency Program Impact Evaluation Guide

https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/emv_ee_program_impact_guide_1.pdf

DOE's uniform Methods Project, Energy Efficiency Program M&V Protocols

<http://energy.gov/eere/about-us/ump-home>

Federal Energy Management Program's standard procedures and guidelines for M&V for federal energy managers, procurement officials, and energy service providers.

<http://energy.gov/eere/femp/downloads/mv-guidelines-measurement-and-verification-performance-based-contracts-version>

SEE Action Collaboratives paper (addresses EE collaboratives in general but does discuss EM&V components of the collaboratives)

<https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-collaboratives>

Additional Resources

EPA's Clean Power Plan with a Focus on Energy Efficiency and EM&V by Steve Schiller, LBNL, presentation for the Western Electricity Coordinating Council:

https://emp.lbl.gov/sites/all/files/schiller_cpp_presentation_v5a_wecc_09_15_15.pdf

For more presentations on EE EM&V go to:

<http://eetd.lbl.gov/people/steven-schiller>

Northeast Energy Efficiency Partnerships, Common Reporting Guidelines and Form:
<http://www.neep.org/initiatives/emv-forum/model-emv-methods-standardized-reporting-forms>

Lawrence Berkeley National Lab, Program Administrator Cost of Saved Energy study:

<https://emp.lbl.gov/sites/all/files/lbnl-6595e.pdf>

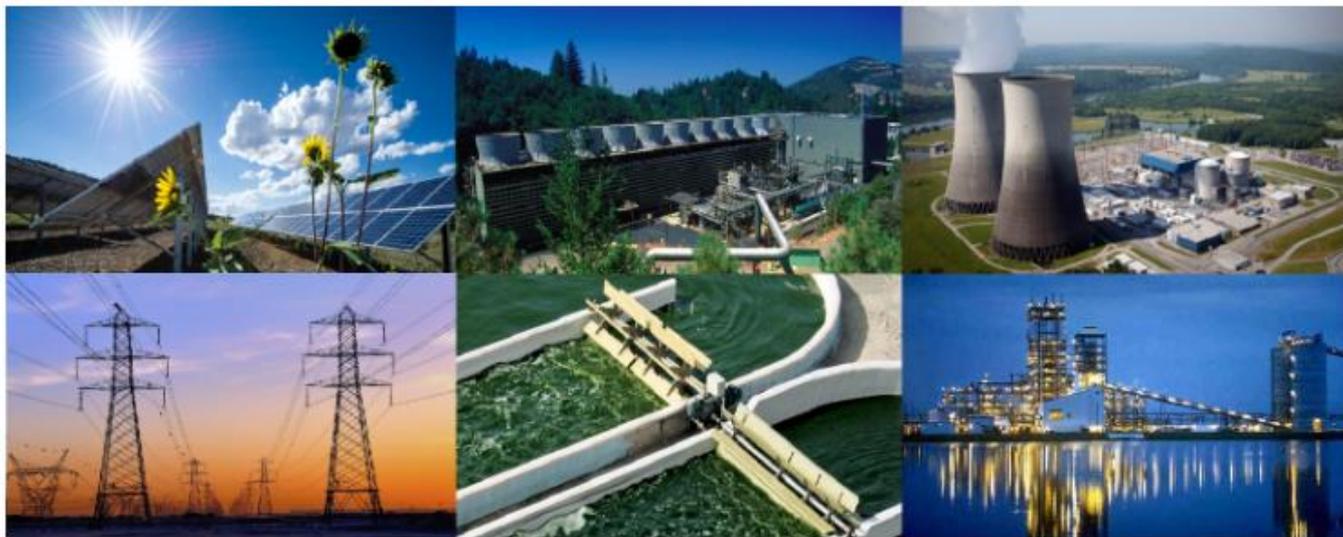
International Energy Program Evaluation Conference:

<http://www.iepec.org>

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STATE, LOCAL AND TRIBAL TECHNICAL ASSISTANCE GATEWAY



Frequently Asked Questions

Featured Topic: Greenhouse Gas Reduction Strategies in the Electric Power Sector

CONTACT US

For more information about technical assistance at the Department of Energy, contact us via e-mail.

ENERGY.GOV/TA

The State, Local and Tribal Technical Assistance Gateway provides an access point to DOE's technical assistance and cooperative activities with state, local and tribal officials. Through its [program and staff offices](#), DOE has engaged extensively with various levels of state, local and tribal governments, providing technical assistance on a range of energy issues. Our existing technical assistance and other activities, as well as relevant information offered by other federal agencies, are provided below by program or topic.

If you're a state, local or tribal official, or a representative from an organization of such officials, with a specific question or need for assistance, [email us](#) and we'll work collaboratively across the DOE to address your inquiry. Responses could include access



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Energy Efficiency Policy and Program Resources

Explore what's working to advance energy efficiency across the country—based on state and local government experience.

- [Behavior-Based Energy Efficiency >](#)
- [Combined Heat and Power >](#)
- [Commercial and Public Building Energy Efficiency >](#)
- [Energy Efficiency Financing >](#)
- [Energy Use Data Access >](#)
- [Evaluation, Measurement, and Verification >](#)
- [Industrial Energy Efficiency >](#)
- [Ratepayer-Funded Efficiency through Regulatory Policy >](#)
- [Residential Energy Efficiency >](#)

The State and Local Energy Efficiency Action Network (SEE Action) offers [resources](#), discussion forums, and [technical assistance](#) to state and local decision makers as they provide low-cost, reliable energy to their communities through energy efficiency.



Least-Cost Pathways to Reduce Emissions in the Power Sector

Who's In The Network?

Meet our network of state and local leaders and subject matter experts advancing energy efficiency.



[Meet Our Network](#)

Upcoming Events

Webinar | February 26, 2016
12:00 pm to 1:00 pm EST
Engineering Simulation Model or Billing Analysis Webinar

Webinar | March 9, 2016
2:00 pm to 3:00 pm EST
2020 Leadership Agenda for Existing Commercial and Multifamily Buildings Webinar

[More Events](#)

Thank You

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