U.S. DEPARTMENT OF ENERGY

Uniform Methods Project
Overview for PJM

June 5, 2024

Charles "Chuck" Kurnik
National Renewable Energy Laboratory

Current EM&V Practice

There are multiple ways to calculate energy savings for the same energy efficiency measure or program.

- Lack of methodological consistency leads to difficulty understanding and comparing results.
- There is a general lack of transparency about the assumptions and details of savings calculations.

Why is This Project Needed?

U.S. DEPARTMENT OF ENERGY

Seventeen Technical Reference Manuals (TRMs) have been identified, covering 21 states and D.C. (as of Spring 2012)

Different methods for calculating savings for same measures

Savings estimates for same measures varied widely with no clear explanation of the source

Widespread use of the UMP protocols could provide consistency across TRMs

What is This Project?

Develop Savings Calculation Protocols for Energy Efficiency Measures and Programs

- Addresses most common residential and commercial efficiency measures in incentive programs
- Presents step-by-step calculations for determining gross savings
- Includes additional sections to address cross-cutting evaluation requirements

Project Goals & Benefits

Create greater consistency of savings calculations

- Quickly establish good M&V practices
- Facilitate meaningful comparisons

Provide transparency reduces uncertainty

Support development of best practices for energy efficiency

- Sets data requirements early on
- Confidence when setting and meeting savings targets

Provide educational value to broad stakeholder community

- Protocols identify key inputs
- Documentation of methods and calculations
- Educating those new to EM&V

Intended Audience

- **Jurisdictions with no existing protocols or TRMs**
- **Regulators**
- **Program administrators**
- **Implementers**
- **Evaluators**
- **Three primary pathways for adoption**
  - Formally by regulators
  - Adopted by program administrators and provided to implementers and evaluators
  - Recommended to clients by evaluators

Project Organization

Protocols developed in collaboration with energy efficiency program stakeholders:

- Regulators
- Program administrators
- EM&V consultants (including the major U.S. firms that do a large portion of efficiency evaluations)

Industry review process allowed for input from all stakeholders

Public review process allowed for input from all interested parties

Technical Experts & Technical Advisory Group

U.S. DEPARTMENT OF ENERGY

ADM ENERGY RESEARCH AND EVALUATION

CADMUS

sbw ENERGY · WATER · EFFICIENCY

APEX ANALYTICS, LLC

WARREN ENERGY ENGINEERING, LLC

Itron

Left Fork Energy

Jacobson Energy Research LLC

DNV·GL

ICF Marbek an ICF International Company

NREL NATIONAL RENEWABLE ENERGY LABORATORY

NAVIGANT CONSULTING

GDS Associates, Inc. Engineers and Consultants

Nexant

BuildingMetrics, Inc.

TETRA TECH

Commercial Measures

Commercial and Industrial Lighting Evaluation Protocol (October 2017)

Commercial and Industrial Lighting Controls Evaluation Protocol (September 2017)

Chiller Evaluation Protocol (September 2017)

Commercial New Construction Protocol (September 2017)

Retrocommissioning Evaluation Protocol (September 2017

Variable Frequency Drive Evaluation Protocol (June 2017)

HVAC Controls (DDC/EMS/BAS) Evaluation Protocol (September 2017)

Data Center IT Efficiency Measures (October 2017)

Compressed Air Evaluation Protocol (October 2017)

Combined Heat and Power Evaluation Protocol (October 2017)

Strategic Energy Management (SEM) Evaluation Protocol (May 2017)

Residential Measures

Smart Thermostat Evaluation Protocol (June 2023)

Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol (November 2017)

Small Commercial and Residential Unitary and Split System HVAC Cooling Equipment-Efficiency Upgrade Evaluation Protocol (October 2017)

Residential Lighting Evaluation Protocol (October 2017)

Residential Behavior Protocol (October 2017)

Residential Furnaces and Boilers Evaluation Protocol (September 2017)

Refrigerator Recycling Evaluation Protocol (September 2017)

Cross Cutting Issues

U.S. DEPARTMENT OF ENERGY

Peak Demand and Time-Differentiated Energy Savings Cross-Cutting Protocol (October 2017)

Sample Design Cross-Cutting Protocol (October 2017)

Estimating Net Savings - Common Practices (October 2017)

Survey Design and Implementation for Estimating Gross Savings Cross-Cutting Protocol (September 2017)

Assessing Persistence and Other Evaluation Issues Cross-Cutting Protocol (September 2017)

Metering Cross-Cutting Protocol (September 2017)

Covered in Each Protocol

Measure Description and Application

Conditions of Protocol Application

Gross Savings Calculations

Critical Parameters

M&V Plan

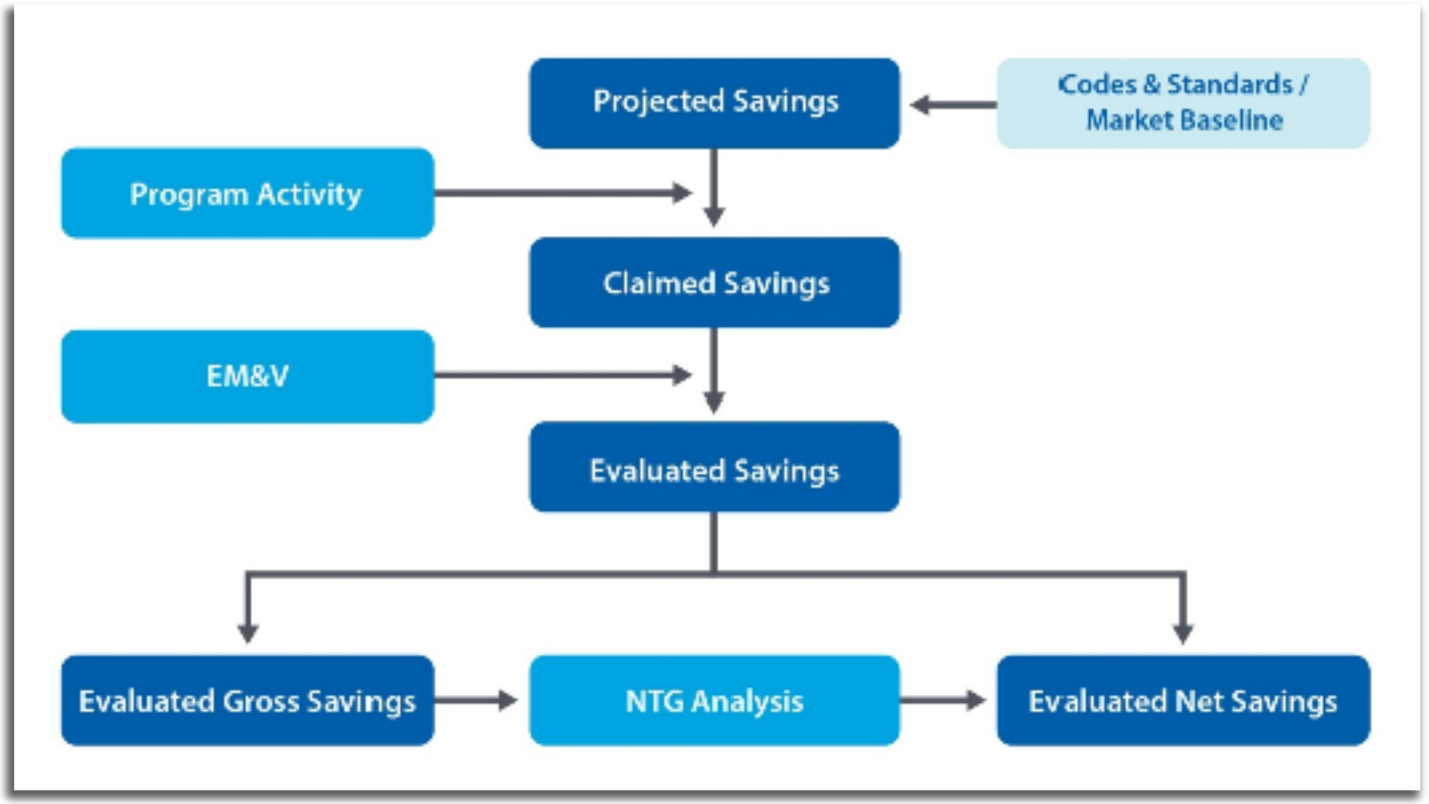
Relevant IPMVP Options

- Option (A) Retrofit Isolation: Key Parameter Measurement
- Option (B) Retrofit Isolation: All Parameter Measurement
- Option (C) Whole Facility
- Option (D) Calibrated Simulation

Data Requirements

Other Evaluation Issues

About Savings (Definitions)



Citations in EM&V RFPs

- **Pay As You Save® Impact Evaluation**
  - Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol
- **Con Edison Impact Evaluation**
- **Duke Energy**
  - Non-Residential Custom Programs
  - Energy Efficiency Education for Schools Program
- **Energize Connecticut**
  - Commercial & Industrial (C&I) Program Evaluation Projects and Related Research

Citations in consultant proposals to RFPs

- **Con Edison Impact Evaluation**
- **Avista Utilities**
  - Net savings
- **PSE Commercial**
  - Commercial lighting
- **Consumers Energy for C&I and Residential EE Programs**
- **Duke Energy**
- **Vectren**
  - Appliance recycling; net savings
- **Clean Energy Works**
  - Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol
- **Entergy LA**
- **Southern California Edison**
  - Commercial Lighting Evaluation Protocol

Examples in M&V studies

- **Ameren Illinois Appliance Recycling Impact Evaluation**
  - Refrigerator Recycling Evaluation Protocol
- **PacifiCorp HES Evaluation**
  - Residential Lighting Evaluation Protocol
- **EmPOWER**
  - Sample Design Cross-Cutting Protocol
- **Vectren Indiana Gas DSM Portfolio Evaluation**
  - Residential Furnaces and Boilers Evaluation Protocol
- **Massachusetts Low-Income Multifamily Initiative Impact Evaluation**
  - Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol
- **Xcel Energy**
  - Residential Lighting Evaluation Protocol

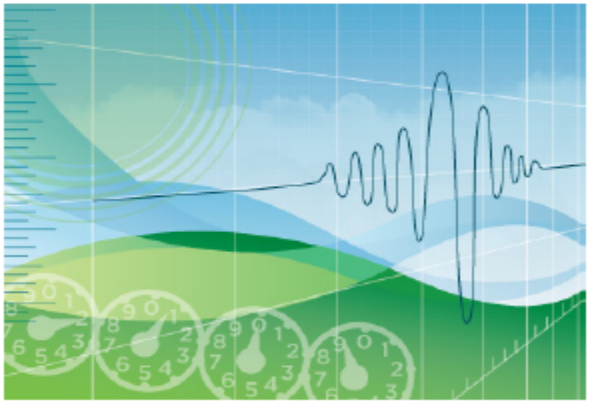
Uses in TRMs

- **2015 Pennsylvania Technical Reference Manual**
  - http://www.puc.pa.gov/pcdocs/1333318.docx
- **Illinois Statewide Technical Reference Manual Version 4.0**
  - https://www.icc.illinois.gov/Electricity/TRM.aspx
- **2015 Iowa Technical Reference Manual**
  - https://iub.iowa.gov/technical-reference-manual-version-1

Where to Find it

eere.energy.gov/ump

The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures



January 2012 — March 2013

Tina Jayaweera
Hossein Haeri
The Cadmus Group
Portland, Oregon

NREL Technical Monitor: Charles Kurnik

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Subcontract Report
NREL/SR-7A30-53827
April 2013

Contract No. DE-AC36-08GO28308

Tradeoffs in Savings and EM&V Methods

- **Constraints**
  - Outputs are only as good as your Inputs
    - Input metrics may become outdated or may be based on case studies with small sample sizes
    - Large number of combinations of bldg. and measure details greatly affect potential input values of savings calculations
  - Data availability
    - Interval data vs. monthly usage
    - Sufficient pre and post retrofit data
  - Granularity of available data
    - Not seeing signal in the noise (too small of a signal or too noisy)
  - Budget & Time
  - Required confidence levels

Tradeoffs in Savings and EM&V Methods

less data, faster **PJM?** rigorous, slow

Savings calculations:

- **Wider range of predicted savings**

EM&V:

- **Less confidence in predicted savings**
- **Can be less expensive**

Savings calculations:

- **Narrower projected savings**

EM&V:

- **More confidence in predicted savings**
- **Potentially more expensive**

Likely no one size fits all approach for every measure or every area.

What is the acceptable confidence level for predicted savings in PJM markets?

Which measures will require more careful EM&V?

New Trends

- **Normalized Metered Energy Consumption (NMEC)**
  - Statistical method to control for local conditions and building characteristics (i.e. weather & occupancy) to compare pre and post retrofit interval data "apples-to-apples" (e.g. IPMVP Option C: Whole Facility - Regression Analysis)
  - Why?
    - As smart meters become more widespread, NMEC becomes less expensive and more automatable
    - Can assess peak hour savings, or other times periods of interest
  - Limitations?
    - Likely requires interval data for demand savings analysis
    - Smaller measures may require sub-metered data
    - Energy use may be noisy or not follow "predictable" patterns

Enhancing UMP Calculations

- **UMP methods document industry-accepted calcs**
- **Calculation outputs are only as good as their inputs**
  - Biases in calculations may be multiplied across entire program
- **Inputs may be based on a single prototypical building energy model (i.e. DOE prototype building models)**
  - Not all buildings fall into these categories
  - Not all "similar" buildings perform similarly
- **Inputs may just reference another TRM or a small study**
- **Improvements?**
  - More building, measure, and location-specific input values for key measures
  - More input values based on real-world, case studies with sufficient sample size for desired confidence levels

Improved Calculation Inputs

- **ResStock & ComStock**
  - DOE datasets of modeled savings
  - ~900,000 building energy models
  - Validated against measured utility data
- **Could be used for program savings predictions**
- **Could be used for more granular calculation inputs that are specific to building characteristics (i.e. EFLHs & Coincidence Factors).**

Thank You

Chuck Kurnik
chuck.kurnik@nrel.gov

Christian Jewett
Christian.Jewett@nrel.gov

Bill Livingood
William.Livingood@nrel.gov

Andrew Parker
Andrew.Parker@nrel.gov