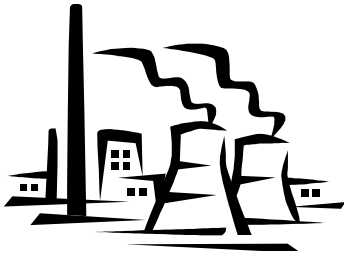
"Best practices for developing cost-effective evaluation, measurement, and verification plans: Lessons learned from 12 northern California municipal utilities"

David Reynolds, Northern California Power Agency
Email: david.reynolds@ncpa.org
Katherine Johnson, Johnson Consulting Group
Email: kjohnson@johnsonconsults.com
Gary Cullen, Summit Blue Consulting,
Email: gcullen@summitblue.com

Johnson CONSULTING GROUP

What is a Public Power Utility?

- Public power utilities not-for-profit electric systems owned and operated by the people they serve through a local or state government.
- Governed by elected or appointed citizen boards.
- Total of 2,010 Public Power Utilities in the US
  - 1,843 are operated by cities and towns;
  - 109 are operated by political subdivisions, such as public utility districts;
  - 43 are joint action agencies (a consortium of public power systems, usually located within a single state);
  - 15 are utilities established by states

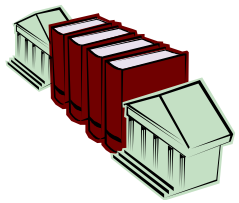


Johnson CONSULTING GROUP

Overview

California Senate Bill 1037 (Kehoe), signed into law in September 2005, established several important policies regarding energy efficiency.

- Created a statewide commitment to cost-effective and feasible energy efficiency
- All utilities consider energy efficiency before investing in any other resources to meet growing demand.
- Assembly Bill 2021 (Levine) added supplemental provisions in 2006, including the need to verify energy efficiency program results.



Johnson CONSULTING GROUP

NCPA Participating Utilities

NCPA is a joint powers agency that provides support for electric utilities operations of seventeen member communities and districts in Northern and Central California. Participating utilities in the E, M&V approach:

- Alameda Power & Telecom
- City of Biggs
- City of Gridley
- City of Healdsburg
- City of Lompoc
- City of Ukiah
- Lodi Electric Utility
- Plumas-Sierra Rural Electric Cooperative
- Redding Electric Utility
- Turlock Irrigation District
- City of Shasta Lake (Non-NCPA member)
- Lassen (Non-NCPA member)

Johnson CONSULTING GROUP

CA Public Municipal Utilities Reporting Requirements

- Identify all potentially achievable cost-effective electricity efficiency savings
- Establish realistic annual savings targets
- Report annually the energy and demand targets
- Report program cost effectiveness reporting using standard tests defined in the California Standard Practices Manual and the National Action Plan for Energy Efficiency

Guiding Principles of NCPA's Approach to Energy Efficiency

- Social and Environmental Responsibility
- Operational Energy Efficiency
- Demand-side Energy Efficiency
- Cost-effective Energy Efficiency

Johnson CONSULTING GROUP

NCPA Program/Member Characteristics

- **Varied Utility Size**
  - Small utilities with 500 customers to large utilities with 100,000+ customers
- **Varied Funding Levels**
  - From slightly under $50K funding in the City of Lompoc, to approximately $3.7 million in Silicon Valley Power (SVP), with the average funding level of $249,000 annually
- **Varied Experience with Energy Efficiency Programs**
  - Some NCPA utilities have maintained energy efficiency programs for years while others are just starting.
- **Overall Project Goal**
  - Develop an E, M&V framework to properly document the results achieved through these programs.
  - Included both process and impact evaluations

Johnson CONSULTING GROUP

Definition of Process and Impact Evaluations

The American Evaluation Association defines evaluation as "*assessing the strengths and weaknesses of programs, polices, personnel, products and organisations to improve their effectiveness.*"

- **Process evaluation** describes and assesses program materials and activities.
- **Impact evaluation** examines the long-term effects from a program, including those unintended effects.

Johnson CONSULTING GROUP

Types of Data Collection Activities

Types of Data Collection Activities for Process and Impact Evaluations

Records Review
- Review of program database
- Review of marketing materials
- Determine program process flow

Literature Review
- Review of secondary materials
- Review of engineering estimates and approved databases
- Review of free ridership/free drivership rates

Focus Groups
- Small group discussions with customers, trade allies, or both

In-depth interviews with key stakeholders (decision-makers)
- Program staff
- Outside consultants
- Industry representatives

Surveys
- Participating customers only
- Non participating customers only
- Surveys of both groups
- Surveys of trade allies

Site Visits
- On- site observation of program operations/customers
- On-site verification of equipment operation

Johnson CONSULTING GROUP

Successful and Cost Effective Elements of a Process Evaluation

- Review the database tracking system to streamline program reporting
  - Enhanced regulatory compliance reporting process by standardizing templates/reports
- Review measures targeted in utility's residential and commercial energy efficiency program portfolios
  - Identify most cost-effective measures and which ones had achieved market transformation

Johnson CONSULTING GROUP

Example of Types of Data Captured

Measure	Measure Group	Number of Participants by Measure	Units per Installation	Units	Measure Fuel	Savings - Gas (Therms)	Savings - Electricity (kWh)
Custom	Custom	2	1,153,936	kWh	Electric	0	1,153,936
Heat Pump, Water Source < 11.2	HVAC	1	0	ton	Electric	0	0
Exit Sign New Exit Sign	Lighting	1	34	fixture	Electric	0	11,696
Hard-Wired Flourescent > 27 watts	Lighting	1	554	fixture	Electric	0	368,410
Hard-Wired Flourescent 5-26 watts	Lighting	1	154	fixture	Electric	0	43,120
Int. HID 0-35 watts	Lighting	1	81	fixture	Electric	0	20,817
Int. HID 36-70 watts	Lighting	1	24	fixture	Electric	0	12,360
Occupancy Sensor Wall or ceiling-mount lighting	Lighting	2	34	sensor	Electric	0	26,350
Occupancy Sensor Wall-box lighting sensor	Lighting	2	117	sensor	Electric	0	30,537
Pre.T5 or T8 w/ Elect. Ballast 4 ft.	Lighting	3	5,532	lamp	Electric	0	309,792
Reflec. w/Lamp Removal 4 ft.	Lighting	1	482	lamp removed	Electric	0	76,638
Motor 1 hp	Motor	1	1	motor	Electric	0	112
Motor 100	Motor	1	6	motor	Electric	0	91,476
Motor 5 hp	Motor	1	1	motor	Electric	0	336
Motor 50 hp	Motor	1	2	motor	Electric	0	19,876
Motor 60 hp	Motor	1	1	motor	Electric	0	10,009
Var. Freq. Drives Var. Freq. Drives	Motor	5	250	horsepower	Electric	0	188,250
Comm. Boiler Dom. Hot Water Heat (<300k Btuh, T1)	Hot Water	1	250	1k Btuh	Gas	17	0
Comm. Boiler Dom. Hot Water Heat (>=300k Btuh, T2)	Hot Water	1	1,500	1k Btuh	Gas	1,476	0
Comm. Boiler Hot Water Space Heat (>=300k Btuh, T2)	HVAC	1	500	1k Btuh	Gas	360	0
TOTAL		**29**				**1,853**	**2,366,262**

Johnson CONSULTING GROUP

Review Program Procedures and Inter-Relationships

- Review marketing materials used to recruit customers to participate in the energy efficiency programs.
  - Identified additional messages that the NCPA utilities may want to include in future program marketing efforts.
- Supplemented by interviews with program staff on the following topics:
  - Program process flow and inter-relationships
  - Program metrics including current enrollment, customer satisfaction, and savings estimates
  - Marketing and outreach activities
  - Areas for improvement

Johnson CONSULTING GROUP

Successful and Cost-Effective Elements of an Impact Evaluation

Establish Good Quality Participation Data

- Conducted a coordinated review of the program files and databases
- Identified the type (deemed or custom calculated) and source of claimed energy savings
- Provided estimates of impacts by site and the review would also identify contact information at each site

Johnson CONSULTING GROUP

Match the Data Collection Strategy to the Data Needs

- On-site data collection is expensive and time consuming
  - So most saving estimates are derived from the deemed saving values
  - Some form of installation verification is needed; either on-site, by telephone, or through invoice reviews
- More complex measures, those installed under non-residential custom program, may more rigorous evaluation techniques.
  - May include an engineer reviewing the submitted custom calculations and assumptions, short term metering, or with specific weather sensitive measures

Apply the Appropriate Analytic Approach

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations using spot or short-term measurements, and/or historical data	Constant performance	• Verified installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	• Verified installation • Nameplate or stipulated performance parameters • End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multi-variate regression analysis.	Variable performance	• Verified installation • Utility metered or end-use metered data • Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering	Variable performance	• Verified installation • Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models • Utility billing records, end-use metering, or other indices to calibrate models

Johnson CONSULTING GROUP

Assignment of IPMVP EMV& Protocols to a Sample of Program Measures

Measure Category	IPMVP Option				Comments
	A	B	C	D	
High-Efficiency lighting equipment	✓				Constant performance, low uncertainty in performance parameters
Lighting controls (occupancy sensors)	✓				
Lighting controls / daylighting		✓		✓	Can be analyzed with either end-use metered data set or simulation model
High-Efficiency HVAC equipment		✓		✓	Pre-/post-installation metering can be used alone or to prepare inputs to simulation models
HVAC Diagnostics		✓		✓	Datasets such as outputs from diagnostic tools may be used as analysis inputs
HVAC Quality Installation		✓		✓	Datasets such as outputs from diagnostic tools may be used as analysis inputs
High-efficiency motors	✓				
Variable speed drives		✓			
Building envelope measures				✓	
Weatherization			✓	✓	Billing record analysis is often used; since measures are envelope, simulation modeling is also effective
New construction whole house performance			✓		
Refrigeration measures		✓	✓		
Process measures			✓		
Appliances	✓	✓			
Water heaters and hot water measures	✓				

Johnson CONSULTING GROUP

Key Lessons Learned/Best Practices

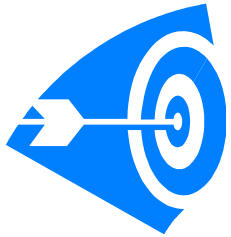
Use Established Industry Protocols

- The resurgence of interest in the development, deployment, and evaluation of DSM programs has led to a greater standardization of industry requirements.
- Leveraged other existing work such as the National Action Plan Guidelines and the IMPVP E, M&V protocols and California Energy Efficiency Evaluation Protocols.

Johnson CONSULTING GROUP

Target the Most Important Programs

Evaluation Priorities by Utility	Residential Programs	Commercial Programs
Alameda Power & Telecom		√
City of Biggs	√	
City of Gridley	√	
City of Healdsburg	√	
City of Lompoc	√	
City of Ukiah	√	
Lassen	√	
Lodi Electric Utility		√
Plumas-Sierra Rural Electric Cooperative	√	
Redding Electric Utility	√	
Shasta Lake	√	
Turlock Irrigation District		√



Johnson CONSULTING GROUP

Allow Time in the Process for Mutual Education and to Build Trust

Small utilities face a steep learning curve when tackling program evaluation for the first time.

- CPA and the Summit Blue team developed a series of workshops and planning meetings.
  - Allowed the utilities to learn about evaluation concepts while helping the evaluation team to understand the unique aspects of each individual utility.
  - Led to better understanding by all on how to develop effective evaluation plans.

Johnson CONSULTING GROUP

Review, Streamline, and Integrate Data Collection and Data Tracking Systems

- Utility data collection and data tracking systems are typically set up to meet program administrator needs for internal reporting.
  - Essential to review and make recommendations for integrating evaluation-specific data collection into the program implementation process.
  - Not only will this reduce the costs of future program evaluations, it is also very likely to reduce costs of program implementation.
- Several utilities have already implemented the suggested changes in advance of the next program evaluation.
- These E,M&V activities provided an excellent learning opportunity and better managed programs

Being Small Does Not Require Sacrificing Quality

- Small utilities can work together to collaboratively implement E,M&V for their energy efficiency programs.
  - Standardize around the EPA's ENERGY STAR Equipment Standards
  - Create a common database (DEER) with stipulated savings
  - Developing multi-year evaluations

- A common misconception in developing E,M&V programs is that the process has to be expensive.
  - For this collaborative effort, the evaluation team was able to identify cost-effective alternatives that met their needs without sacrificing the quality of the work or the validity

Johnson CONSULTING GROUP

Conduct Evaluations Across Multiple Utility Territories

NCPA utilities will consider pursuing a collaborative effort across their entire service territories as a way to cost effectively evaluate the following energy efficiency program measures that are not large enough to warrant separate E,M&V efforts.

- **Residential CFL Lighting:** These utilities plan to conduct a joint CFL lighting impact evaluation study to better assess current CFL savings estimates in a similar manner.
- **Residential Audits**: Several NCPA member utilities are considering participating in a larger impact evaluation.

Johnson CONSULTING GROUP

Report Findings Consistently to Facilitate Information Sharing

These E, M&V reports needed to offer reporting consistency for NCPA as a whole,

- The team developed a consistent, albeit somewhat generic, outline that was then modified for each utility report.

Johnson CONSULTING GROUP

Conclusion

- Utilize readily available and industry-accepted resources to optimize evaluation efforts
- Prioritize and target programs for evaluation
- Allow time to educate and build trust
- Review, streamline, and integrate data collection and data tracking systems
- By working together to collectively implement E, M&V utilities can produce consistent results and achieve economies of scale, while still allowing for tailored solutions to meet individual utility needs.
- Report findings in a consistent manner to facilitate information sharing

"Best practices for developing cost-effective evaluation, measurement, and verification plans: Lessons learned from 12 northern California municipal utilities"

David Reynolds, Northern California Power Agency
Email: david.reynolds@ncpa.org
Katherine Johnson, Johnson Consulting Group
Email: kjohnson@johnsonconsults.com
Gary Cullen, Summit Blue Consulting,
Email: gcullen@summitblue.com

Johnson CONSULTING GROUP