Ex-Post Verification and Cost-Effective Delivery of Energy-Efficiency Programs

(How to Produce Value without Breaking the Bank on Verification)

Energy Evaluation Europe
2021 Virtual Conference

March 10-11 and 15-16, 2021

https://energy-evaluation.org

Introduction and Background

- The appropriate role of ex-post, infield verification of energy efficiency (EE) programs has been debated on both sides of the Atlantic.
- This discussion often revolves around views that infield verification of energy savings:
  - is expensive,
  - ex-ante engineering-based approaches are generally pretty good and may be good enough, and
  - the monies would be better spent on delivering more EE measures and technologies.
- In general, it seems like more resources are spent on ex-post verification in North America than in Europe.
- The role of ex-post verification was elevated in discussions at the Fall 2019 International Energy Program Evaluation Conference (IEPEC) held in the United States.
- Similarly, when evaluators from North America travel to evaluation conferences in Europe, we often wonder at the relatively few ex-post verification studies being conducted in Europe.
- One goal of this paper is to bridge this discussion by presenting beliefs and assumptions that underlie investment in ex-post verification efforts as a way to better understand different views.

Defining the Role of Ex Post Verification

- Two sets of influences stand out as being important for the North American evaluation community regarding the role of ex-post verification:

1. Lessons learned and methods used in early landmark evaluation efforts:
   - Evaluation of the National U.S. DOE Weatherization Assistance Program (WAP) – 1978 to 1992.
   - Hood River Conservation Project (Hood River) – 1983 to 1989.
   - Both were large-scale, pathbreaking evaluations that developed estimates of energy savings through audits and engineering analyses, but also conducted ex-post verification using pre-/post energy use data.
2. Stakeholder debates and views on the reliability of savings estimates from EE/DR programs.
   - Some stakeholders are skeptical of the savings estimates from EE/DR programs as this information feeds into larger debates on how EE should be delivered in a market-based economy.
   - For example, stakeholders might see government entities or utilities providing EE programs as having incentives to claim large savings, when actual savings may be more modest?
     - Utilities make money by selling kWh, why should they work hard to conserve energy?
       (however, this can be mitigated by decoupling earnings from kWh sales, and/or direct financial incentives)

Evaluation of the U.S. Weatherization Assistance Program (WAP)

- Congress created the Weatherization Assistance Program (WAP) in response to the oil embargos and energy crises of the 1970s and 1980s.
- From 1978 to 1992, the WAP represented the U.S.'s largest investment in energy efficiency with over $4 billion in program expenditures across a 10-year period.
  - Focused on single and multi-family housing using energy audits to direct measure installation.
  - Funded by the U.S. DOE and implemented by State Energy Offices supported with training/best practices.
  - Initial evaluation efforts largely used activity metrics (e.g., # of measures installed with deemed savings).
- From 1986 to 1990 – several infield verification studies focused on specific customer segments.
  - One such project metered 66 occupied, low-income homes in Wisconsin and compared the ex-post verified savings with the pre-installation audit estimates.
  - Verified savings were much lower than projected savings and, generally, were lower by more than 50%.
- National WAP Evaluation (1992 - 1994) – covered 350 State WAP offices, 15,000 installations, and site-specific pre/post-energy consumption data for 4,800 weatherized dwellings.
  - Realized actual savings were well below projected savings, but the evaluation produced additional lessons learned and new recommendations.

Evaluation of the Hood River Conservation Project

- The Hood River Project was a “direct install” EE program implemented between 1985 and 1989.
  - It was intended to test “the reasonable upper limits of a residential retrofit program” by installing as many cost-justified retrofit measures in as many homes as possible.
  - The Hood River Project was unique in that a detailed evaluation plan was developed including engineering-based estimates as well as the use of site-specific pre-/post-energy-use data.
    (This was “the evaluator’s dream project”)
- The 3-year evaluation found that “deep savings” were produced and the program was cost-effective.
- On the other hand, it also found that evaluated ex-post savings averaged only 43% of what was predicted.
- Talented engineers relatively unconstrained by budget and methods were not able to predict energy savings in line with the ex-post verified savings, i.e., they expected savings to be twice the amount found.
  - It is difficult to anticipate and account for all the diversity that occurs across sites in terms of baseline conditions, measure installation, customers’ usage patterns, and confounding factors such as changes in home occupancy or the use of supplemental heating sources (e.g., firewood).

Other Foundational Evaluation Efforts

- While the WAP and Hood River evaluations were unique in scope, other large-scale evaluations also began:
  - Including state-wide evaluations spanning multiple utilities, 3 to 5-year time frames, and portfolios of EE programs (e.g., California, Wisconsin, New Jersey, Michigan, among others).
  - These additional efforts expanded the "lessons learned" to new program variants and new EE/DR technologies (e.g., efficient appliances, motors, lighting, etc.)
- Some common themes for performing infield verification studies cost-effectively included:
  - The critical importance of accurate program tracking systems with site-specific initial estimates of savings that can be used to leverage program data and samples for verification.
  - The integration of evaluation within program design, delivery and implementation to lower costs; and, to gather pre-/post-participation data on site conditions and energy use.
  - **A key Lesson** -- If data needed for evaluation are not collected as part of program implementation, that data may be lost forever – you can't go back and reconstruct the data.

Budgeting for Ex-Post EM&V

- The Consortium for Energy Efficiency (CEE) tracks evaluation budgets for each State in the U.S. and each Province in Canada for electric/gas programs. The 2018 survey shows:
  - Evaluation budgets for U.S. States averaged 2% of DSM Expenditures (EE and DR).
  - However, States viewed as leaders in DSM tended to have slightly higher evaluation budgets, i.e., closer to 3% or 4% -- possibly indicating their perceived value of evaluation.
  - These budgets include impact evaluation, as well as process evaluation and market research.
- At these expenditure levels, if an evaluation can improve program cost-effectiveness by 3% to 5%, it can pay for itself.

Comments:

- *Many of these budgets are for evaluations of portfolios of programs over a 3 to 5-year window.*
- *These comprehensive evaluations may have more opportunities for cost-effective approaches across sectors.*
- *There are economies of scale in evaluation – evaluating a program with 5,000 participants may not cost much more than an evaluation of a program with 500 participants*

Findings

- Factors influencing the North American view on the value of ex-post EM&V includes:

1. A history of evaluation that uses ex-post, infield data collection on energy savings.
    - Many of the energy-engineering professionals that worked on these landmark evaluations went on to become leaders in evaluation, and formed the backbone of evaluation in the U.S. and Canada.
    - Lessons learned about the difficulty in projecting savings, given the hard to capture diversity of circumstances in the field. **(In our profession, nothing is as humbling as field work)**
2. Evaluations tied to utilities receiving financial incentives from meeting EE and DR goals had higher "burden-of-proof" requirements to be met.
3. The pressures on evaluation findings from EE program and conservation skeptics.
4. This environment incented evaluators to develop cost-effective approaches to EM&V, as part of an overall approach to producing convincing evaluations of delivered programs.
5. Blending high-quality engineering and technology insights within a statistical framework is one way to produce evaluations that are convincing and credible to skeptical stakeholders.

Findings (cont.)

- Infield verification of energy savings supports quality EE program delivery and implementation:
  - Over the years, there have been a number of quality issues with EE programs.
  - This lack of quality can produce cost-effectiveness leakages that are as high as 20 to 30 percent of program expenditures.
    - *Quality issues can range from simple non-performance by contractors, to poor installation work, to a variety of shortcuts that might reduce costs but may also lower energy savings.*
  - Promoting quality in program delivery and implementation maybe be the most under-rated aspect of infield verification of energy savings, and ex-post EM&V.
- A Caveat: In North America, there have been some unique regulatory and institutional pressures pushing evaluators to focus on high levels of accuracy and rigor in savings estimates, and these pressures may not exist elsewhere.

Contact Information

Dan Violette

Daniel M. Violette, Ph.D.
Director and Senior Advisor, Apex Analytics, LLC
danv@apexanalyticsllc.com
Phone: 303-903-3035 (cell)