REGULATORY SPOTLIGHT

Estimating Energy Savings From Resource Acquisition and Market Transformation Programs

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This section focuses on the concepts and methods used to estimate savings from resource acquisition and market transformation programs. This section is not intended to cover every approach. Rather, it is intended to illustrate general concepts. It is noted earlier in this report that the line between resource acquisition programs and market transformation programs can be fuzzy. Both program types represent a market intervention and may share similar objectives. As a result, evaluation approaches used for these types of programs can overlap.

The approaches used to estimate energy savings and market impacts from resource acquisition and market transformation programs often vary due to program design and differing goals. These differences in design and implementation tend to provide different types of programmatic data and information, which can drive evaluation choices. The common view is that cost-effective portfolios of energy efficiency activities will include both resource acquisition and market transformation programs to address different market barriers and objectives that may have different time dimensions. As a result, an understanding of how evaluations can assess whether goals are being met and helping programs achieve these goals is a key component of an overall set of energy efficiency activities.

Resource acquisition programs often target and market to specific sets of customers, resulting in tracking data that identifies program participants over a specified period of time.[1] If the evaluation objective is to assess the savings that occurred among this identified set of participating customers, then statistical approaches can be used to examine changes in energy use over time for this group. Many of the evaluation methods used for resource acquisition programs are predicated on having identified program participants, and sampling and analysis procedures are designed to address this estimation problem. In addition, data on program participants can be used to address what have become known as net-to-gross (NTG) issues, where processes can be used to assess customer actions as being program-induced savings, free ridership, or spillover.

Market transformation programs, on the other hand, are designed to influence the market more broadly and often do not have identified sets of customers as participants. The data available from market transformation programs includes market metrics (e.g., equipment stocking practices and trade ally activities) and market-wide adoption of efficient technologies. Customer-specific data is often not available for use as inputs into customer-based evaluation models. Market transformation program evaluations have typically been designed to use data consistent with their implementation design and overall objectives (i.e., market metrics tracked over longer timeframes). In addition, the customer-based concepts of NTG used in resource acquisition evaluations may not fit with market transformation programs.

Differences in resource acquisition and market transformation program evaluation methods may not be due to differences in overall evaluation philosophy; instead, they are driven by differences in the types of data made available by these program designs and the objectives to be verified by an evaluation. The concepts of counterfactual baselines and causality underpin any program evaluation. No regulatory body or program implementer wants to implement a program where the effects of that program would have occurred if the program had not been offered.

1. Some programs included in resource acquisition portfolios may not identify participants through program implementation. One example is a residential mid-market lighting program where big box or hardware stores provide rebates for efficient lighting equipment funded by a program. In these programs there may be a count of the equipment rebated, but individual customers may not be identified. This can pose challenges for statistical approaches commonly associated with resource acquisition programs and has led to attempts to gather customer participant information through customer-intercept surveys or data gathered by the store in which the purchase is made. These mid-market programs represent program types that could be part of resource acquisition or market transformation portfolios.

DISTINCTIONS BETWEEN RESOURCE ACQUISITION AND MARKET TRANSFORMATION

A starting point for examining distinctions between resource acquisition and market transformation evaluations is provided in a recent report by NYSERDA.[2] The table below is drawn from this report.

	RESOURCE ACQUISITION	MARKET TRANSFORMATION
Scale	Program	Entire defined market
Target	Participants	All consumers
Goal	Near-term savings	Structural changes in the market leading to long-term savings
Approach	Save energy through customer participation	Save energy by mobilizing the market
Scope of Effect	Usually from a single program	Results from effects of multiple programs or interventions
Amount of Program Administrator's (PA's) Control	PAs can control the pace, scale, and geographic location and can identify participants in general	Markets are very dynamic, and the PAs are only one narrow set of market actors; if, how, where, and when the impacts occur are usually well beyond the control of the PAs
What is Tracked, Measured, and Evaluated	Energy savings and number of participants	Interim and long-term indicators of market penetration and structural changes, attribution to the program, and cumulative energy impacts
Timeframe for Cost-Effectiveness	Usually based on first year or cycle savings	Usually planned over a 5-10 year timeframe

2. From MTPA Working Group (2018), *Market Transformation Metrics and EM&V Coordination Report*, NYSERDA, which was derived from Keating, et al. ops cit. Table appears in the Ken Keating, 12/9/14 paper "Guidance on Designing and Implementing Energy Efficiency Market Transformation Initiatives."

RESOURCE ACQUISITION PROGRAM EVALUATION: ENERGY SAVINGS

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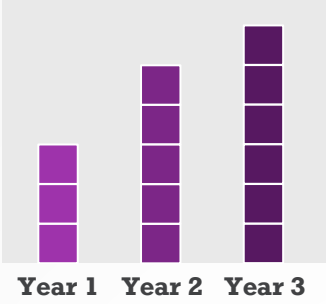

Figure provided as an example only. Not all methods follow this structure.

Estimating energy savings from typical resource acquisition programs is part of the evaluation, measurement, and verification (EM&V) of the programs. EM&V assesses the performance of energy efficiency activities and provides regulators with verified estimates of energy savings, which can be used to track progress toward goals. EM&V can also involve estimating the cost-effectiveness of energy efficiency activities. There is extensive literature on EM&V of energy efficiency programs, including information from ACEEE,[3] SEE Action,[4] the International Performance Measurement and Verification Protocol (IPMVP) from the Efficiency Valuation Organization,[5] and the Uniform Methods Project from the US Department of Energy (DOE)[6] (this list is not exhaustive). This section provides a high level overview of approaches.

Total program energy savings (assessed through impact evaluations): For utility resource acquisition portfolio evaluations, the evaluator typically will estimate savings for each program in the portfolio[7] and sum the savings for the programs to get portfolio savings. The savings goals at the program and portfolio level are often goals included in an energy efficiency plan. The utility energy efficiency plan is submitted to the regulatory agency and typically covers several years (e.g., 3-5 years). A process to estimate total program savings is outlined below:

- Review savings (ex ante) in the program files. These are savings estimated for each project in the program prior to evaluation.
- Decide on an approach to estimate evaluated savings (ex post) for the program.
  - **Deemed savings** are per-measure energy and demand savings typically provided in a Technical Reference Manual (TRM) or other savings database (e.g., Illinois has the Illinois Statewide Technical Reference Manual[8]).
  - **Measurement and verification (M&V)** can include deemed calculations from TRMs, statistical analysis, and/or computer simulation modeling. A few of these methods are detailed in the next column.

Engineering methods combined with onsite data use algorithms and/or simulation modeling supported by field data measurements on equipment installed through the program. This can include end-use kilowatt-hour metering, equipment runtimes, power measurements, and building orientation and use (where appropriate) to produce high quality savings estimates for a set of sampled sites. The sampling design then allows for extrapolation to the overall set of program participants. This method is often used when the cost of directly metering all participants pre- and post-measure installation is costly and appropriate sample sizes can provide the required program-level precision.

Statistical analyses using comparison groups is another method evaluators use. This method includes randomized controlled trials and quasi-experimental methods. The data in these analyses can come from several sources including monthly, daily, or hourly advanced metering infrastructure (AMI) data as well as site-specific end-use metering. The sophistication of the approach can depend on the types of data available and when they are available. Data available in near real-time is starting to be termed M&V 2.0 or advanced M&V, but the structure of the analyses of this data still uses the same statistical and experimental design constructs (i.e., analyses of consumption data against a comparison/ control construct).

3. ACEEE, *Evaluation, Measurement, & Verification*, https://aceee.org/sector/state-policy/toolkit/emv.
4. SEE Action, *Energy Efficiency Program Impact Evaluation Guide*, https://www4.eere.energy.gov/seeaction/publication/energy-efficiency-program-impact-evaluation-guide.
5. Efficiency Valuation Organization (EVO), *International Performance Measurement and Verification Protocol (IPMVP)*, https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp. The IPMVP protocols were originally developed for use in performance contracting. The methods focused on verifying savings for use in contracts between customers and energy service companies. However, the protocols also provide valuable insights into methods to determine energy savings for any customer-specific project.
6. DOE, Office of Energy Efficiency & Renewable Energy, *Uniform Methods Project for Determining Energy Efficiency Program Savings*, https://www.energy.gov/eere/about-us/ump-home.
7. Some program evaluations can look at synergies across programs. To the extent these synergies examine how separate programs can impact the same end-use or market, these resource acquisition program evaluations can include certain concepts of market transformation.
8. Illinois Energy Efficiency Stakeholder Advisory Group. *Illinois Statewide Technical Reference Manual*. http://www.ilsag.info/technical-reference-manual.html

- Set a baseline approach. Selecting the baseline approach is often the most challenging part of an evaluation. Baseline options include energy use of participants prior to participation, codes and standards, cross-sectional comparison of energy use for non-participants and comparable nonparticipants, or cross-section/time-series analyses where the change in energy use over time is examined for both groups of participants and non-participants. Baselines for energy use of participants prior to participation can be estimated by widget (e.g., baseline for a new efficient air conditioner) or by project (e.g., a facility's energy use prior to installing energy efficiency measures). Baselines can be assumed to be a common practice baseline, existing condition baseline, or some other baseline condition. Randomized control trials are viewed as the most reliable evaluation method and are based on randomly assigning customers to participant and non-participant groups. Where practical concerns make randomization impractical and comparison groups are constructed after or jointly with program participation, best practice quasi-experimental design approaches are used.[9]

- Prepare a sampling plan and data collection instruments for site visits depending on the approach chosen. Data could be collected via surveys or site visits. Data may also be collected directly from the customer who participated in a program, visually confirmed, or measured onsite (e.g., measure lighting hours of use).

- Estimate savings for the program based on the sample design and statistical calculations. The estimate of savings for the program is typically based on the use of a realization rate where the ex post savings (evaluated savings) are divided by the ex ante savings (claimed savings).

Total portfolio energy savings: Portfolio-level savings are the sum of all program-level savings in the portfolio.

9. Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578.http://www.nrel.gov/docs/fy17osti/68578.pdf

RESOURCE ACQUISITION PROGRAM EVALUATION: OTHER ITEMS

Estimating the project, program, and portfolio level savings is one step in the evaluation process. However, there are many other items to consider through the evaluation. A few of these are outlined here.

Attribution (NTG)

Many of the statistical methods described above are designed to provide energy savings that are viewed as attributable to the program, depending on the baseline used.[10] In contrast, some evaluation methods focus on technical savings resulting from the installation of energy efficiency measures for a sample or population of participants and may not fold in other behavioral and market considerations. These methods typically do not consider what would have happened in the absence of the program. They provide the estimated technical savings from the installed measures regardless of the influence of the program on customer actions. In these cases, a gross savings estimate is initially estimated and a NTG ratio is used to produce estimates of attributable savings. The Uniform Methods Project chapter[11] details net savings including the factors most often considered: free ridership, spillover, and market effects.

DOE's Uniform Methods Project defines gross and net savings as follows:

Gross savings: "The difference in energy consumption *with the energy-efficiency measures promoted by the program in place* versus what consumption would have been *without those measures in place*."

Net savings: "The difference in energy consumption *with the program in place* versus what consumption would have been *without the program in place*."

10. Attribution can be complex in that certain aspects of attribution such as non-participant spillover may not be captured by certain experimental designs and may need to be addressed with additional research. See Violette, Daniel M.; Rathbun, Pamela. (2017). Chapter 21: Estimating Net Savings – Common Practices: The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68578. http://www.nrel.gov/docs/fy17osti/68578.pdf
11. See Violette, Daniel M.et al. (2017). http://www.nrel.gov/docs/fy17osti/68578.pdf

RESOURCE ACQUISITION PROGRAM EVALUATION: OTHER ITEMS

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Timeframe

Impact evaluations for resource acquisition programs tend to estimate savings for program participants in a given timeframe—often in one year (or a few) of the program. While the evaluation is focused on program participants for one (or a few) year, overall program savings values used in cost-effectiveness tests consider the estimated persistence of savings over time. This is because energy efficiency savings will extend beyond the year in which the measure was installed.[12]

Other Impacts

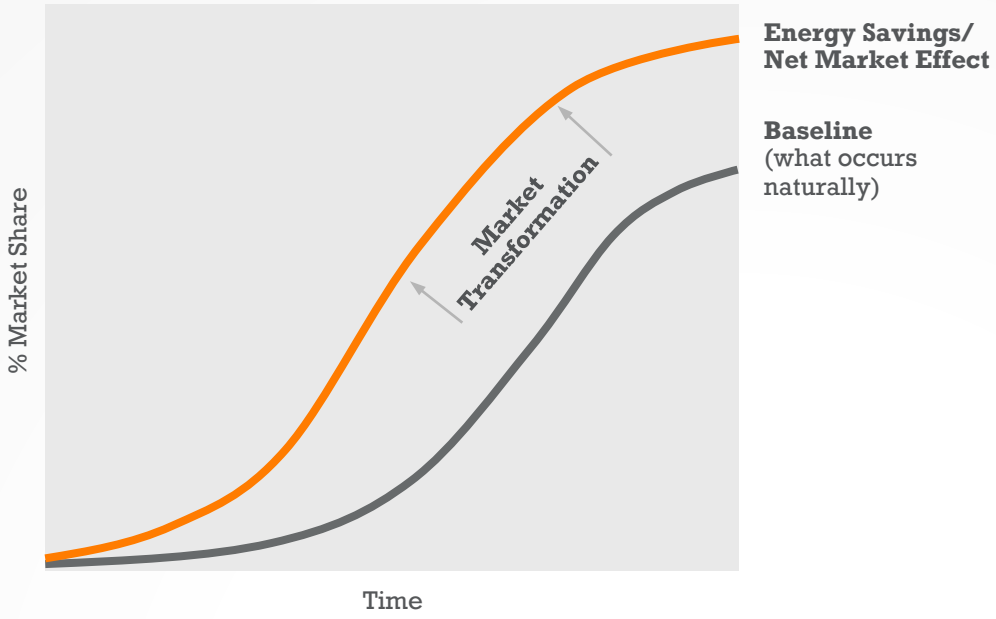
Other impacts could include non-energy impacts (e.g., comfort, reduced maintenance, health), environmental externalities like avoided greenhouse gas emissions, water savings, job creation, and utility system impacts.

Continuous Improvement

All programs should be part of a continuous improvement framework where implementation processes are reviewed and evaluated, often through a process evaluation.

12. The persistence of program savings from installed energy efficient measures can pose additional estimation challenges. A number of these are discussed in: Violette, Daniel M. (2017) Chapter 13: Assessing Persistence and Other Evaluation Issues Cross-Cutting Protocol -- The Uniform Methods Project. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68569 September 2017. https://www.nrel.gov/docs/fy17osti/68569.pdf

MARKET TRANSFORMATION PROGRAM EVALUATION: ENERGY SAVINGS



Approaches to estimating energy savings from market transformation initiatives are varied. Different approaches are used in different jurisdictions depending on the market being addressed and the goals set out for that program. A difference that often stands out between market transformation program evaluations and typical resource program evaluations is the difficulty in identifying individual customers as program participants. This somewhat defining characteristic allows for different evaluation approaches and statistical methods to be used in a resource acquisition setting. Conversely, market transformation efforts tend to be market-wide and specific end users of a new technology are not as easily identified. This has led to methods that tend to track market indicators and overall market adoption rates.

Market transformation evaluation should match the evaluation strategy in the program logic. The logic model and the intervention strategy should identify the outputs and outcomes and the metrics that define them. These interim and long-term indicators of market effects become the indicators by which progress can be measured. Examples include market share for energy efficient products and services, the saturation of energy efficient products, price of the product or service compared to less efficient alternatives, availability of efficient products and efficiency services, levels of product or service awareness, knowledge among market actors, and, ultimately, energy and demand savings.

Several organizations have recently convened working groups to discuss market transformation evaluation. Much of the information in this section is drawn from the following resources, all published in 2018:

- NYSERDA's *Market Transformation Metrics and EM&V Coordination Report*[13] (referenced in this section as the NYSERDA Market Transformation Report)
- CPUC Energy Efficiency Market Transformation Draft Staff Proposal[14] (referenced in this section as the CPUC Market Transformation Proposal)
- *ENERGY STAR® Retail Products Platform (RPP): Conditions and Considerations in Evaluating Market Transformation Programs and Evaluation Guidance for RPP* report[15] (referenced in this section as the RPP Report)

13. MTPA Working Group (2018), *Market Transformation Metrics and EM&V Coordination Report*, NYSERDA.
14. CPUC (2018), Administrative Law Judge's Ruling Seeking Comment on Market Transformation Staff Proposal, Rulemaking 13-11-005.
15. Sara Conzemius and Alexandra Dunn (2018). *ENERGY STAR® Retail Products Platform (RPP): Conditions and Considerations in Evaluating Market Transformation Programs and Evaluation Guidance for RPP.* Prepared by ILLUME Advising, LLC, for the State and Local Energy Efficiency Action Network.

Total market transformation initiative energy savings: Approaches for estimating savings from market transformation initiatives have typically varied by the organization implementing the market transformation effort. At a high level, this market-driven savings approach compares a baseline curve for the market to the actual market curve. The list below outlines an approach from New York.

The **NYSERDA Market Transformation Report** notes that the following steps are typically followed when assessing a market transformation program.

1. Define the market targeted by the program or initiative.
2. Develop and refine a program theory and logic model. This model generates hypotheses about the specific ways in which the program will accelerate the pace of development and adoption of the targeted products and practices.
3. Define market metrics that can be used to characterize the market in relation to the program theory and logic model. In the early stages of the initiative, metrics such as the number of products that receive efficiency certification and the variety of certified products on retailer shelves can be used to track market progress. These results can be used to validate or revise the program logic models and to guide changes in program design and management. As the initiative progresses, PAs will want to focus on assessing its impacts on measure adoption and energy use, as described in the next three steps.
4. Characterize the actual past and current level of development and adoption for the targeted technology, using the metrics developed in the previous step.
5. As appropriate, characterize the market baseline—that is, the level of technology development and adoption that will most likely have occurred in the absence of the program.
6. Estimate the energy savings associated with the program-induced sales. NYSERDA outlines two approaches to estimate energy savings.

Measure-/technology-specific programs: This approach uses an algorithm to assess the energy savings from market transformation progress. It would also include removing any program-incented units to avoid double counting.

Total Energy Savings = Change in Units Sold x Unit Energy Savings.

Comprehensive programs: For programs like Strategic Energy Management (SEM), the assessment may be more complex. More data is required to form inputs for an algorithm for this approach.

Total Energy Savings = Change in Adoption of Approach x Average Energy Savings from Adopting

Total market transformation initiative energy savings: Approaches for estimating savings from market transformation initiatives have typically varied by the organization implementing the market transformation effort. At a high level, this market-driven savings approach compares a baseline curve for the market to the actual market curve. The list below outlines an approach from California.

The **CPUC Market Transformation Proposal** details items a Market Transformation Development Plan should include, which would be further detailed in a Market Transformation Accord.

1. Identify a target market that is clearly defined and manageable.
2. Define target technologies, behaviors, sectors, and applications.
3. Assess product (or behavior) performance, including an assessment of energy savings potential and non-energy benefits.
4. Assess competing (not energy efficient) products and the costs and benefits associated with those products.
5. Describe the supply chain, product demand and delivery methods, the role of each market actor, and how the market operates and functions.
6. Present a preliminary assessment of market drivers and barriers.
7. Present a preliminary program theory and logic model, identifying market leverage points and intervention strategies.
8. Describe potential strategies and available or preliminary data for sizing the market and for projecting a naturally occurring adoption curve—i.e., baseline forecast for the market.
9. Describe additional research and/or market assessments needed to finalize the proposal and set an initial baseline forecast that extends over the projected timeline of the program.

Organizations in the Northwest also have a history of assessing impacts from market transformation programs. Examples from the Northwest Energy Efficiency Alliance (NEEA) and Bonneville Power Administration (BPA) are below.

NEEA APPROACH

The NYSERDA Market Transformation Report discussed the NEEA approach as part of its best practices review: "In assessing the market impact from its efforts, NEEA does not claim regional savings; instead, NEEA employs a 'co-created savings' approach. To arrive at 'co-created savings,' total regional savings are assessed using a savings rate multiplied by unit calculation. Then, baseline savings are removed from the total based on third-party research. The remaining savings are categorized as 'co-created savings' and encompass discrete savings from local utility programs and an overarching estimate of net effects. The net effects are not attributed to any particular entity but are considered created across funders through the market-wide engagement by NEEA and its partners."

BPA APPROACH[16]

BPA tracks Momentum Savings. Momentum Savings are defined as: "all the energy efficiency occurring above the Northwest Power and Conservation Council's Power Plan baseline that are not directly reported by utilities and not part of the Northwest Energy Efficiency Alliance's Net Market Effects." The general equation for Momentum Savings is:

Momentum Savings =
Total Market Savings - Total Program Savings

BPA is quantifying Momentum Savings by collecting information on how much energy efficiency is happening in the total market. It builds market models to track changes over time in energy consumption, sales trends, stock turnover, energy savings, and baselines. These models incorporate sales data from the market (e.g., distributors).

The RPP Report also details BPA's approach: "BPA analyzes both the efficient and inefficient products entering the marketplace. The data to support this analysis comes from multiple sources which characterize the building stock (the installed products consuming energy) and the product flow (the new products every year, which create change in the building stock). One critical data source is regular onsite stock assessments, which provide the physical characteristics of buildings and the technologies installed in homes. This is combined with information on the new equipment being sold annually (the product flow), generally via sales data. The combination of the stock- and product-flow data provides a bottom-up look at energy consumption and how that energy consumption changes over time."

The baseline for a market transformation initiative is for the market as a whole. Some jurisdictions use a fixed baseline for a period of time, while others use a baseline that changes over time. The CPUC Market Transformation Proposal notes that Market Transformation Accords should establish an initial forecast market baseline using a Delphi process with PAs and market actors. The paper details approaches for defining baselines and notes these baselines will serve as the basis for energy savings estimates.

The RPP report also says : "The evaluation of market-transformation programs relies heavily on establishing a baseline against which the program impacts can be measured. Unlike resource-acquisition programs, market-transformation evaluations require more upfront coordination between the evaluation and implementation teams, data-collection needs must be clarified prior to launch, metrics established, short-term, midterm, and long-term market indicators defined. Without early and closer coordination, sponsors risk developing indicators that cannot be measured or collecting data that does not meet evaluation needs. Additionally, a comprehensive market study must be conducted to establish the market's baseline conditions."

16. BPA, *Energy Efficiency Market Research & Momentum Savings*, https://www.bpa.gov/EE/Utility/research-archive/Pages/Momentum%20Savings.aspx

MARKET TRANSFORMATION PROGRAM EVALUATION: OTHER ITEMS

Estimating the energy savings from a market transformation initiative is only one way to evaluate the success of the initiative. Other items are important to consider.

For some initiatives, it may be appropriate to assume any market effect was caused by the program, while for other initiatives evaluators may need to show evidence of causality—e.g., through market actor interviews or Delphi panels. The CPUC Market Transformation Proposal notes that the "baseline reflects an estimate of how all of the non-program market forces and influencing factors would interact and evolve in the market over time if there were no Market Transformation Initiative in place." This is referred to as the counterfactual and is an important concept in both market transformation and resource acquisition evaluations.

Attribution and Causality

This is another area of overlapping interest. However, the methods and terminology developed for resource acquisition and market transformation programs have been designed to meet the needs for assessing each program type in an appropriate context. The concept of NTG is generally associated with resource acquisition programs, although the overall concept of causality is important to both resource acquisition and market transformation program types. No regulatory authority wants to spend funds on impacts that would have occurred even in the absence of a program—whether it is a market transformation or resource acquisition program.

The NYSERDA Market Transformation Report uses the terms causal or program-induced effects as opposed to NTG, which is generally used for methods based around identified program participants more commonly associated with resource acquisition programs. NYSERDA states that, by design, measuring free riders and spillover does not apply to market transformation initiatives, but the causality/attribution of the savings to the program's efforts should still be estimated.

MARKET TRANSFORMATION PROGRAM EVALUATION: OTHER ITEMS

Estimating the energy savings from a market transformation initiative is only one way to evaluate its success. Other items are important to consider.

Timeframe

The effects of market transformation initiatives are typically seen after a longer time period than resource acquisition—often 5-10+ years. Market transformation effects may last longer than resource acquisition effects as their intent is to create lasting (permanent) changes to the market.

Other Impacts

Market transformation metrics are important to outline in a logic model and measure over time. Metrics could include market awareness of a product, percentage of sales of efficiency equipment, penetration of equipment in the stock, or stocking practices among others. These metrics provide a way to gauge if the market transformation initiative is effective.

Continuous Improvement

All programs should be part of a continuous improvement framework where implementation processes are reviewed and evaluated, often through a process evaluation.

CONCLUSION

Three Portfolio Themes were derived from the Market Transformation Summit:

- Synergies exist between resource acquisition and market transformation programs.
- A holistic view of energy efficiency activities across resource acquisition and market transformation programs is important.
- Regulatory treatment of market transformation programs will need to differ from resource acquisition programs.

The evaluation of a market transformation initiative should support these themes. The evaluation should recognize that synergies exist between program types and taking a holistic view to evaluating the portfolio of programs is important. In addition, it is important to work with regulators and other stakeholders on evaluation approaches. Key takeaways include the following:

- **Evaluating portfolios with a holistic perspective is important.** A cost-effective energy efficiency portfolio will need programs targeted to specific customer segments with short-term energy reduction goals. Other programs will need to work synergistically with these programs to achieve the longer-term goals involved in transforming markets. Evaluation is needed to provide feedback that assesses the contributions from both resource acquisition and market transformation programs, including the synergies across these programs. The evaluation methods will involve both customer-centric approaches associated mostly with resource acquisition programs and market metrics and tracking for longer-term investment efforts in energy efficiency. Regulators and stakeholders will need to recognize the value of evaluations that support both resource acquisition and market transformation investments.
- **Data availability will drive the evaluation approach.** It is important to recognize that different data availability will influence the choice of the evaluation approach across programs. In some cases, a high level of rigor can be expected for evaluations focused on an identified population of program participants. For other market-based programs, information will have to be accumulated over time. As a result, expectations for evaluations focused on providing different views of the portfolio of energy efficiency activities will need to align with the purpose of the evaluation.
- **Market-based evaluations will require longer timeframes and designs that are aligned with the objectives of these programs.** It will be more difficult to develop standards and protocols for market transformation evaluations across changing technologies and market maturities. These evaluations will likely require additional planning and agreement among stakeholders as well as multi-year timeframes for execution.