Metering the Unmetered Resource: Evaluation Methods for Achieving Diverse Energy-Efficiency Policy Objectives

Q&A

List of Questions

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1. Q: Are there any established and well accepted estimates for the percentage incidence of "free-ridership"?

A: Free-ridership is a measure of what program participants would have installed or undertaken on their own if a given energy efficiency program had not been available. Free-ridership is a function of the type of measure, market maturity, energy efficiency program structure, and exogenous influences. Estimates of free-ridership, and a related measure, spillover, can be expected to change over the life of an efficiency program. (Spillover refers to measures installed and/or activities undertaken that were influenced by the program, but not directly assisted by it. Spillover can occur both among program participants, as when they choose to do more than they are rebated for, and among non-participants.) Many of the technical reference manuals that are cited in CEE's Guide to the Evaluation Guides include free-ridership estimates used by program administrators. Program administrators considering using a reference value for free-ridership should take into account the comparability between the conditions under which a published value were derived and their own program conditions.

One example of an established and accepted approach to measurement of free-ridership and spillover for commercial and industrial resource acquisition programs is a participant survey methodology applied by program administrators in Massachusetts and parts of Connecticut. The methodology is discussed in a report, *Standardized Methods for Free-Ridership and Spillover Evaluation –Task 5 Final Report (Revised) 2003* by National Grid USA. Results using this methodology are presented in program administrators' annual reports of program performance. The values will be updated in 2008.

2. Q: Are there any methods for bringing environmental impacts into the overall evaluation and calculation of cost and benefits?

A: Chapter Six of the National Action Plan for Energy Efficiency's *Model Energy Efficiency Program Impact Evaluation Guide* describes approaches for calculating avoided air emissions, including greenhouse gases, from energy efficiency, and discusses considerations for selecting a calculation approach. As for including environmental impacts in cost-benefit calculation, this depends on what is allowed by each state's regulators. Marian Brown addresses this in more detail in the webinar (slides 58 through 64, in Part 2).

3. Q: Are there any thresholds for determining if "market transformation" has taken place?

A: According to Tom Eckman of the Northwest Power and Conservation Council, a market has been transformed when the less efficient alternative is either unavailable, unprofitable, or

illegal. By tracking long-term indicators of program outcomes, or "ultimate" market effects, evaluators can gauge progress towards the full transformation of a market.

It is critical to the evaluation of market transformation-focused programs to distinguish between indicators of program *activity* and indicators of *market progress*. Examples of indicators of program activity (also known as "outputs") include project management-related milestones such as "number of seminars held," "number of seminar attendees," or "number of brochures distributed." Indicators of market progress toward long-term project goals include the expected effects of a program in terms of attitude, behavior, or market condition, and should be identified and chosen according to the project's logic model or market transformation theory. Examples of indicators of market progress include the percent of the target audience that is aware of or engaging in a particular behavior (such as "percent of seminar attendees that can articulate the behavior to be changed" or "percent of market actors that have changed product or messaging in response to seminars"), or change in price or availability of a product or service. Tracking of progress towards long-term goals and ultimate outcomes such as these is advisable for more than just those programs that are explicitly focused on market transformation, since all programs can be expected to affect the market in some way.

The webinar addresses market transformation program evaluation, market effects tracking, and tracking of long-term indicators of market progress in slides 44 through 53. For much more detailed guidance on evaluating market transformation programs, see the manuals *A Framework for Planning and Assessing Publicly Funded Energy Efficiency* and *Impact Evaluation Framework for Technology Deployment Programs*.

4. Q: What differences might we expect between a "market transformation" program for electricity and one for natural gas?

A: The methods for measuring progress towards market transformation for electric programs and for gas programs are the same. See the manuals *A Framework for Planning and Assessing Publicly Funded Energy Efficiency* and *Impact Evaluation Framework for Technology Deployment Programs* for much more detailed guidance on evaluating market transformation programs.

5. Q: Short of monitoring customers who have purchased energy efficient appliances, are there cost effective ways to gather energy savings data other than simply making assumptions about the efficiency of the appliances?

A: Developing an energy savings estimate does not always require monitoring. Depending on the rigor needed for a particular evaluation, sampling of program participants may not be even be required. A common approach when the evaluation budget is tight, or a program evaluation does not require a results with a high degree of certainty, is to make extrapolations about energy savings using information on a variety of important factors taken from appropriate existing data sources. For example, one relatively inexpensive way to estimate the impact of residential lighting programs is to use secondary data from states with similar demographic, climatic and housing conditions to estimate the percent of household sockets in

which compact fluorescent bulbs are installed and the average hours of use of sockets in different rooms, and combine this with data on bulb sales. A relatively inexpensive way to estimate energy savings data for a program that promotes energy efficienct clothes washers would be to gather demographic and other characteristics about purchasers and combine these with baseline appliance saturation information to construct energy savings estimates that are roughly representative of participation in the program. The demographic characteristics and other data should include household size, whether the household has a dryer, what fuel is used to heat water, the type of washer that was purchased, and possibly also the age and condition of an existing appliance or reasons for the purchase.

Deemed savings sources, such as California's Database for Energy Efficient Resources (DEER) database, are important resources for this approach, but by no means the only resources. CEE's Guide to Evaluation Resources page lists some additional resources. Where secondary product sales and shipment data are available, program administrators can supplement these with additional data collection to obtain a more complete picture for their service territory or state. Reviewing evaluations of similar programs can help in identifying appropriate approaches and potential sources of relevant data. Together, CEE's Market Assessment and Evaluation Clearinghouse and the California Measurement Advisory Council (CALMAC) publications database house many of the evaluation reports produced in the U.S. and Canada over the last decade, and are good places to go to find relevant reports.

6. Q: Are there any objective methods for determining adequate funding levels for an effective program in a given area?

A: While determining adequate funding is outside the scope of the webinar, information about individual program funding levels and the savings delivered from existing programs are often reported in the annual reports filed by many energy efficiency program administrators. Portfolio- and program-level cost-effectiveness, including costs/kWh or therm of savings delivered, are frequently included in these reports. The National Action Plan for Energy Efficiency also offers some general guidelines on this topic in Chapter 6 of the report.

7. Q: Is some sacrifice of cost efficiency in the early stages of the program necessary for "market transformation"? (E.g., Cutting edge technologies that are more expensive now, but considered key to future efforts).

A: It takes time to change a market. Market transformation programs are designed with the expectation that progress will be comparatively slow at first, but as the market changes over time the program will yield increasingly cost-effective savings. When the less efficient alternative is either unavailable, unprofitable, or illegal, the market transformation program can be ended—yet savings will continue to accrue. With this design, it is important to ensure that the evaluation includes appropriate long-term as well as short- and intermediate-term indicators of progress towards program goals. The shorter-term indicators offer a way to measure progress towards intermediate goals in the time before significant progress is made towards the ultimate goal of market transformation, as measured by the longer-term indicators. Program administrators and regulators should bear in mind the longer time frame

that is likely to be needed for market transformation programs to become cost-effective, and take into consideration progress made towards intermediate goals and trends in long-term indicators when assessing cost-effectiveness of market transformation programs. In addition, evaluation of market transformation programs should not focus too heavily on short-term indicators of progress, lest program administrators focus on achieving short-term goals to the detriment of the longer-term goal of transformation of the market. The webinar addresses tracking of progress towards market transformation goals in slides 44 through 53.

8. Q: Should regulators break the "throughput incentive" for electric utilities through rate designs like decoupling, which has become increasingly common in the gas business? Is it realistic to expect electric utilities to become agents for the promotion of energy efficiency and conservation without breaking the "throughput incentive"? If so, how exactly do we change the business model and transform electric utilities into agents for the promotion of energy efficiency and conservation if they have the opportunity to expand profits by selling more kWh?

A: Rate design is a policy matter and is outside the scope of the webinar. However, the National Action Plan for Energy Efficiency offers guidance on this subject in its report on *Aligning Utility Incentives with Energy Efficiency Investment*. According to the National Action Plan for Energy Efficiency, this report "describes the financial effects on a utility of its spending on energy efficiency programs, how those effects could constitute barriers to more aggressive and sustained utility investment in energy efficiency, and how adoption of various policy mechanisms can reduce or eliminate these barriers. The Report also provides a number of examples of such mechanisms drawn from the experience of utilities and states."

9. Q: Have there been any studies/assessments on the success of indirect energy saving measures such as education and energy audits? (For example, the percent of people who receive energy audits that act on the information they receive.)

A: Yes, there have been. One frequently referenced study is the evaluation of the DOE's Compressed Air Challenge (CAC) program. The CAC evaluation tries to show how education leads to changes in behavior which result in an average level of energy savings. The Northwest Energy Efficiency Alliance (NEEA) has evaluated the Industrial Efficiency Alliance (IEA), an initiative that combined training with demonstration projects, employee awareness programs and engagement with facility/production management. The most recent market progress evaluation report details NEEA's attempts to quantify energy savings for IEA. While the evaluation is a work in progress, it shows clearly that there are energy savings associated with this project, but that quantifying energy use by the end-user is quite challenging. The Building Operator Certification Program is another example of an education program that is available in many parts of the U.S. that has been evaluated, and for which energy savings impacts have been estimated. Examples of evaluations of Building Operator Certification programs are included in the CEE Market Assessment and Program Evaluation Clearinghouse.

Two of the documents described in CEE's Guide to the Evaluation Guides describe or include discussion of methods to quantify energy savings from programs that rely on

behavior change: DOE's *Impact Evaluation Framework for Technology Deployment Programs* and the California Public Utilities Commission's *California Evaluation Framework* (2004).

10. Q: Could you provide a brief description and example of "regression analysis" and "multi-stage regressions"?

A: In our context, regression analysis is used to explain the influence of independent variables (e.g., production, floor space, frequency of audits) on a dependent variable (usually energy use). Regression analysis allows the evaluator to normalize energy intensity (energy use per unit) and determine the change in energy intensity before and after the program's "intervention." In an industrial setting, the energy intensity would likely be energy per unit of output, while in a commercial context energy intensity would likely be energy use per unit of area (floor space).

An example of this is the Prism Engineering Monitoring, Tracking & Recording (MT&R) approach that is currently in use by BC Hydro and is under review by the NEEA. This approach uses a set of Excel spread sheets to provide an analysis of change in normalized energy intensity over time. Descriptions of this approach are available online.

Another example of a common use of regression analysis in energy efficiency program evaluation is the use of weather normalization in estimating average annual energy consumption. This allows "pre" and "post" period consumption levels to be compared while controlling for differences in weather. For residential programs that address household energy consumption, PRISM software is often used.

11. Q: Are there any other training opportunities coming up with this type of beginner evaluation information?

A: The International Energy Program Evaluation Conference (IEPEC) and the Association for Energy Services Professionals (AESP) both offer workshops in energy efficiency program evaluation in conjunction with their conferences. IEPEC's conference is held every other year in August, while AESP's is held annually in January. The next IEPEC conference is scheduled for August 2009. While not specific to efficiency programs, The Evaluator's Institute offers short-term professional development courses for practicing evaluators. These are held every few months in different parts of the U.S. The American Evaluation Association also offers classes in program evaluation in conjunction with its annual conference in November and lists ongoing evaluation training opportunities around the world.

12. Q: Please provide an example of customer well-being (referred to on slide 8).

A: Energy efficiency programs can help states achieve more than just energy savings goals. Programs may also pursue, be credited for, or reflect in their design other, non-energy-related priorities that regulators deem appropriate. Customer well-being is sometimes among these

priorities, although it is not always explicit. Improved air quality through reduced emissions could be considered both an environmental goal and a customer well-being goal, since poor air quality is hazardous to customers with respiratory ailments such as asthma. Saving money for ratepayers could be considered another example of customer well-being, as could increasing home comfort through weatherization. Process evaluations frequently explore levels of satisfaction with efficiency measures and other aspects of program delivery. These results can also be used as empirical indicators of customer well-being.

13. Q: How does behavior theory factor in with program effectiveness?

A: Ideally, behavior theory should factor implicitly or explicitly into the program design as well as the evaluation. In reality, behavior is not always explicitly considered in the program design, and sometimes not in the evaluation. However, program administrators and regulators seem to be increasingly aware of and interested in applying findings from behavior research to the design and evaluation of programs. For example, more program administrators are looking to apply to energy efficiency programs lessons learned from social marketing (which has had success in reducing rates of smoking and increasing seat belt use, and is common among public health programs).

From an evaluation perspective, behavior needs to be included because the level of savings achieved depends on how people install or use the measure in question. There are some measures that are notorious for being affected by behavior, such as programmable thermostats, dimmable lights, and commercial energy management systems. In these cases, people aren't always trained how to use the equipment properly, or the assumptions about how people use the equipment have not taken behavior into account. The installation of central air conditioning is another such area. If CAC is not installed properly with energy efficiency in mind, the equipment will work harder to cool and will not save all the energy that was anticipated. As these examples show, behavior needs to be addressed in order both to determine what is needed to achieve the savings and to accurately assess the savings that were achieved.

14. Q: Is there a method other than surveys to measure indirect energy savings? (In reference to Slide 24 of the webinar.)

A: The measurement of indirect savings is addressed in slides 44-53. It involves identifying appropriate market indicators to track progress towards market transformation from indirect approaches.

15. Q: When is it appropriate to base savings estimates on the efficiency level of equipment that is commonly available in the market, and when should the savings be based on the actual customer equipment that is being replaced?

A: The practice at Southern California Edison is to assume that customers are replacing equipment at the end of its useful life, and not before. The savings in this case is the difference between the efficiency level of equipment that is commonly available in the

market and the high-efficiency equipment (for which an incentive may have been provided). The only situation in which it would be appropriate to use the difference between the efficiency level of the actual equipment being replaced and that of high-efficiency equipment is when the customer is changing out the equipment before the end of its useful life. In this case, for the remaining life of the old equipment a substantial energy savings is obtained. After this useful life, the customer is saving only the difference between the efficiency of equipment commonly available in the market and high-efficiency equipment.

16. Q: Are there specific guidelines for the duration of savings attributed to a particular program? For example, with a CFL incentive program, should we assume that customers will replace these bulbs with comparable bulbs in five years, or do we only attribute savings to the first five years or the life of the bulb?

A: It is customary to only attribute the savings to the life of the bulb and not make a determination about what the customer will do the next time they have a free choice. The exception to this would be if you installed a CFL fixture or a ballast, in which case the customer has no choice other than to replace it with another CFL. In terms of incandescent bulbs, the conservative assumption is that the customer might not choose another CFL if a rebate is not offered with it. Ideally, however, you would conduct a study to find out what's happening during the period when the replacement decision is being made, which in the case of the example offered would be five years after the CFL was originally rebated. In New England, some program administrators and evaluators are conducting a study of savings persistence for residential programs that involve CFL installation to better estimate the useful life of CFL bulbs.

17. Q: What is the value of information derived from surveys as opposed to information obtained from statistical or engineering methods?

A: The information gathered from surveys is commonly used as input to either statistical or engineering methods of estimation. For a statistical analysis, telephone, on-site or mail surveys can be included as information about how a customer is using the equipment. These surveys help explain the energy usage. An example of the use of surveys in the engineering case is investigating the use of CFLs. Installing a CFL is a small measure that yields small savings. The key to developing a good engineering estimate of the savings from this measure would be an accurate estimate of the number of hours the bulbs are operated. In this case, you'd look at the difference in energy use multiplied by the number of hours that the light bulb is on. This piece of information is typically learned from conducting a survey.

18. Q: Where can one find end-use information to model a prototype residence and associated energy usage characteristics of a particular area? For example, insulation levels, percent of residences with central air, fuel type, windows and orientation, duct and building envelope, tightness, age of heating/cooling system, average number of occupants, and operating base load information such as lighting schedules? We need this to establish a baseline to project savings.

A: Good primary data are available from the DOE Residential Energy Consumption Survey (RECS). The new (2005) RECS should be available soon. The Energy Information Agency (EIA) makes a great deal of detailed information publicly available. The information is state-specific. There is a lot of difference among the states with respect to things like age of housing or fuel of choice, and you should look for state-specific data for variables such as these. The granularity of data available at the state level will vary tremendously depending on the variable of interest. Another place to look for this information is in residential new construction baseline studies. Massachusetts and New Jersey have both conducted such studies within the past five years. Another option is to look to building energy codes as a starting point for characterizing baseline conditions.

19. Q: What types of additional external benefits beyond energy and capacity are being included now in the societal and utility cost-benefit calculations? For example, are things like T&D losses, air quality improvements, reduced carbon footprints, employment created, customer comfort, and others being included? How would one go about collecting data to quantify such benefits?

A: There are many different non-energy benefits that can be quantified for different end uses. For example, with high efficiency washing machines water and detergent savings can be quantified as non-energy benefits. Among agricultural customers, modifications or replacements made for energy efficiency purposes can reduce fertilizer input among agricultural customers, and this can be quantified as a non-energy benefit. Through creative reading of the legislation, a fairly broad array of items has been included in cost-benefit calculations for electric programs in Massachusetts. For example, program administrators have been able to serve oil-heated homes in some programs through categorizing a significant portion of the benefits as non-electric benefits. For low-income customers, Massachusetts programs can quantify the value of a healthier environment and take credit for the non-energy benefits of providing a healthier environment, which contributes to fewer sick days and fewer days keeping the kids at home. Massachusetts programs are also trying to quantify customized non-energy benefits among commercial and industrial customers by identifying savings to waste streams by better processes and productivity gains. Mike Sherman of the Massachusetts Division of Energy Resources is familiar with these efforts and available to discuss them with webcast participants.

An example of a first stab at trying to quantify non-energy benefits related to sustainability is a pilot study conducted by The Cape Light Compact of Massachusetts. The study was of "green" residential new construction, and included in-depth interviews with builders and suppliers as well as occupants of the "green" homes. The results for "green" construction were compared with those of similar local new construction that was not "green." A report is available.

20. Q: What are the components of market characterization and related studies?

A: In the Pacific Northwest, which has a long history of running market transformation programs, market characterization studies are not a stand-alone activity. At NEEA, which conducts market transformation programs for the region, market characterization is

incorporated into all of their evaluation activities as part of their periodic "Market Progress Evaluation Reports" (MPERs). Market characterization typically includes a comprehensive review of the market in terms of key actors, secondary sales data (if available), and outline of salient trends that impact the market place. For example, NEEA is currently conducting research on ductless heat pumps (also known as mini split heat pumps) to assess the potential Northwest market adoption of commercially available products and to develop a market intervention strategy intended to overcome barriers to market adoption. Therefore the research is planned around interviews with relevant market actors for both the supply chain and demand side (manufacturers, distributors, HVAC contractors/installers, builders and home owners). The research will identify key manufacturers both in the U.S. and internationally, the different types of available products, and typical price ranges. It will look at the various distribution channels and how the product is sold. It will also identify awareness of, perceptions of, and barriers to adoption of ductless heat pumps among these key market actors.

The typical data collection tools used in market characterization include qualitative phone interviews, focus groups and/or quantitative surveys. The latter helps establish a baseline against which trends or changes in the market place can be compared over time. Whatever secondary data are available are also used whenever possible.

Market characterization studies can also be useful in program planning and market research. Some states, such as Wisconsin and Vermont, approach market characterization studies from this perspective, conducting a study for each sector (e.g., residential facilities, commercial facilities) and for particular segments of interest within sectors (e.g. multifamily housing, small commercial, large industrial) in preparation for new programs. Market characterization studies can also cross over into the realm of technical potential studies conducted to help understand a particular market. The market characterization approach can help in assessing technical specifications, for example by clarifying how the cost of standard and high efficiency equipment relate to each other. Market characterization and technical potential studies can be defined broadly or narrowly depending on the goals of the study.

21. Q: When evaluating market indicators for tracking, what is the appropriate level at which to obtain and/report the data? At the statewide level, service territory level, regional level, or some other level?

A: It's always best to request data for the smallest level of geographic area for it is available. This lets you aggregate the data to meet your analysis needs.

That said, obtaining geographically detailed, robust tracking data for market indicators can be very difficult indeed. A highly desirable market indicator is "market penetration," sometimes also known as "market share" in this industry—that is, the percent of *all* sales in a product category that are high efficiency. Typically these data need to come from retailers and/or manufacturers—and they won't release it without a compelling reason as well as an assurance of confidentiality, which means that the data need to be given to a third party for aggregation. It also often means that the smallest aggregation at which the data can be

released is at the state level. Sometimes these data can be purchased from third parties that collect the data from retailers and aggregate them.

When data can be obtained, it needs to be assessed on a variety of important factors in order to understand what conclusions can be drawn from it, since no data source will be perfect. For example, do the data represent the entire market, or only reports from a subset of manufacturers or retailers? If the latter, what percentage of the market is represented? For what major market channels through which products move are sales or shipments reported? Frequently program administrators or evaluators add to whatever data are available by collecting supplemental data in the state or service territory of interest. Wisconsin and California both carry out periodic research to supplement available sales or shipment data.

CEE has nurtured relationships with industry associations for a number of years, which has led to obtaining market penetration data for member use in at least one case (industrial motors). CEE has also been working with DOE and EPA to communicate program administrators' specific needs for ENERGY STAR market penetration data.

22. Q: Is it correct that the rebate should be deducted from the measure purchase cost if the rebate is excluded from the program cost? (This question is in reference to Slide 63.)

A: No. The rebate cost is excluded from the program cost in the traditional Total Resource Cost Test, but the measure purchase and installation cost must be included in full, *not* reduced by the rebate amount. If the rebate amount was deducted both from the total program cost and from the measure cost, then the full, real cost that customers and the utility are paying, in combination, would be understated.

23. Q: Where can I find more information on cost calculations, especially for gas utilities?

A: The *California Standard Practice Manual* provides a description of the various cost-effectiveness calculations. The National Action Plan for Energy Efficiency is planning to release a manual on cost-effectiveness calculation in 2008; look for it on the Guides and Papers page of the National Action Plan website.

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