White Paper

Don't Sell Yourself Short on Non-Energy Benefits

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Shareables

1. Getting non-energy benefits (NEBs) of efficiency programs included accurately and comprehensively in cost-benefit tests can make or break program effectiveness.
2. The value of whole-home energy retrofit NEBs in single-family homes is estimated to equal 50% to 300% of energy cost savings, much more than the simple 10%-25% adders frequently applied.
3. There are two approaches for determining NEB values, but each requires significant expertise to be done efficiently and effectively and avoid pitfalls.

Executive Summary

Accounting for the NEBs of energy efficiency (EE) is crucial for electric utilities who need to make the business case for investments in energy efficiency while demonstrating that such investments also serve the public interest. Some states require utilities to include NEBs in efficiency program cost-effectiveness analysis, the most common approach being a simple and conservative "adder" to energy benefits. But the adder approach lacks rigor and results in inaccurate and often artificially low benefit figures — as much as two to ten times lower than research-based figures.

In order to get more accurate and effective NEB figures, ICF uses one of two approaches, based on an individual utility's priorities and constraints.

The first involves applying NEB values from secondary data sources, which is more rigorous and effective than using adders but requires less time and cost than primary research. However, there are significant adjustments for local conditions that must be carefully applied to get the right results. The second is to conduct targeted primary research, which is the most accurate, but a more intensive undertaking. Our approach to primary research involves prioritizing the NEBs that are most suitable for a specific program or portfolio based on four key factors, which can help utilities manage their resources more effectively and achieve results with less cost and time.

This paper discusses the benefit and challenges of including NEBs in the cost effectiveness analysis, followed by a discussion of two approaches that can be used for developing NEB estimates. We conclude with recommendations for utilities to consider as they plan to quantify NEBs associated with their energy efficiency programs.

What are Non-Energy Benefits (NEBs)?

For residential efficiency programs, NEBs include:

- **Participants:** improved occupants' health, safety, and comfort, increased building system durability, lower maintenance costs, increased property value, and others.
- **Utilities:** reduced bill arrearages, bad debt write-offs, and reduced reliance on low-income household energy assistance.
- **Societal** increased economic development, jobs, and environmental benefits.

Getting NEB Assessments Right: Progress and Challenges

Many utility energy efficiency programs are struggling to remain cost-effective in low avoided cost environments[1] and because of increasing codes and efficiency standards. Overall, the penetration of EE measures has captured significant existing potential and made the next increment of efficiency harder to achieve. That is why accounting for NEBs in cost-effectiveness tests and getting an accurate NEB estimate can make a big difference. A number of studies have confirmed that NEB values can be significant: for example, the value of whole-home energy retrofit NEBs in single-family homes is estimated to equal 50% to 300% of energy cost savings.[2] Energy policy is increasingly trending in the direction of supporting full, accurate, and consistent evaluations of efficiency program benefits, including NEBs: about a third of regulators now require NEBs to be accounted for in energy efficiency program evaluations in some form.[3]

But there remain significant challenges to getting NEBs accurately assessed and included in cost-benefit measures. While some states now do require utilities to include specific NEBs in energy efficiency program cost-effectiveness analysis, those required NEBs typically include only values that are easier to quantify, such as reduced water utility bill costs and deferred equipment replacement costs, meaning that they miss some substantial sources of value.[4]

[1] See ICF White Paper "Turning Locational Value into Real Dollars" for a discussion on how locational value analysis can enhance avoided cost estimates and support strategies for targeting efficiency effectively. https://www.icf.com/perspectives/white-papers/2017/turning-locational-value-into-real-dollars

[2] Christopher Russell, Brendon Baatz, Rachel Cluett, and Jennifer Amann. Recognizing the Value of Energy Efficiency's Multiple Benefits, December 2015, ACEEE Report IE1502.

[3] Many states still do not require utilities to incorporate NEBs in their cost-effectiveness analysis at all. In these cases, an analysis of NEB values can still be highly beneficial for utilities looking to work with regulators on including appropriate NEBs that align with state policy goals.

[4] For example, the Arkansas Public Service Commission (PSC) recently ruled that NEBs (i.e. water saving, avoided cost of gas, and deferred replacement cost) must be accounted for in measure, program, and portfolio Total Resource Cost (TRC) tests. See Arkansas TRM version 6.0 Volume 1, Evaluation, Measurement and Verification Protocols, August 31, 2016.

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Most states that include NEBs only require utilities to tack-on a conservative NEB "adder" for the purposes of cost-effectiveness testing, which ranges from 10 to 25% of energy benefits and due to its imprecision and simplicity also likely misses a meaningful proportion of benefits.[5]

So if utilities can apply a more comprehensive and accurate approach to quantifying NEBs, they can recognize and capture more of the real value of their efficiency programs and deploy more effective programs. In ICF's work with utility clients across North America, we apply two basic methods[6] for assessing NEBs:

- The first is to leverage existing studies that have already quantified NEBs elsewhere though primary research,[7] and use them to derive NEB values in a utility's own service territory. However, as described below, care must be taken when using values from other regions, as NEB values can vary significantly across states due to differences in building characteristics and climate. To translate these values accurately, ICF uses a specific process and key factors that should be considered when using secondary data to estimate NEBs.
- The second is to conduct targeted primary research and/or direct measurement, for which we recommend that program administrators first identify the most suitable NEBs with highest impacts. This can be a more time-consuming and laborious approach — albeit one that is sometimes required by regulators — but can result in well-supported figures appropriate to the service territory.

Each of these approaches is described in more detail below:

Developing NEB Estimates through Secondary Data Sources

NEBs estimates can be derived from secondary data sources when they are quantified through primary research for similar energy efficiency measures or programs in other regions. While not as accurate as primary research, the rigor of this approach still aligns better with industry standards than using adders. And because it can significantly lower the time and cost needed to develop NEB estimates, this method is well-suited to utilities and states interested in accounting for NEBs within set time or budget constraints.

NEBs values collected from secondary data sources should not be directly applied to programs. The values need to be carefully reviewed and adjusted based on regional differences. For example, NEBs values for efficient heating systems in cooler climates should not be directly applied to similar measures in warmer climates because their estimates will be overstated.

[5] Simple NEB adders are used because quantifying NEBs though primary research or direct measurement often requires extensive data collection and analysis, and therefore, could be expensive and time-consuming. 10% and 15% are the most commonly used figures among states adopting this approach. For example, the Colorado PSC ordered utilities to use a 25% adder for low-income programs and a 10% for all other electricity efficiency programs in their cost-effectiveness calculations.

[6] The approaches in this paper are developed based on ICF's analysis of NEBs associated with participants of low-rise residential energy efficiency programs. The approaches could be expanded for other NEBs categories (e.g. utility benefits), other sectors (e.g. commercials), and DER technologies (e.g. solar PV).

[7] However only a few states, such as Massachusetts and California, have conducted primary research to quantify the monetary values of all NEBs, including those that are harder to quantify such as increased comfort.

The most common secondary data sources are utility evaluation studies of NEBs associated with specific energy efficiency programs. For example, Massachusetts Program Administrators[8] established monetary values for a host of different NEBs associated with their energy efficiency programs.[9] Rhode Island then relied on Massachusetts' benefit valuation work, as they have similar program types, while the State of Maryland calculated comfort benefits for its residential whole-building program based on findings from an evaluation of a similar program in Massachusetts.[10]

In order to make this approach as accurate as possible, ICF carefully reviews and adjusts secondary data for our clients based on regional differences. Exhibit 1 presents a variety of factors that should be considered when using secondary data sources.

EXHIBIT 1: ADJUSTMENT FACTORS TO CONSIDER WHEN USING SECONDARY DATA SOURCES

Weather Conditions

- Perhaps the most important factor
- Measures that run longer and more frequently impact durability and maintenance costs
- Measures to increase comfort more valuable to residents in extreme climate who pay more for energy.

Home Characteristics

- Impacts from age, size, condition, exterior surface area, number of occupants, number of appliances, water usage
- Personal comfort harder to achieve in houses that are older or larger

Economic Conditions

- Cost of living and household income level could play a role in how occupants value NEBs
- Savings and improvements can be more valuable where utility spending and cost of living are high.

Inflation

- When NEBs values were derived matters: NEB values derived from secondary sources need to be adjusted for inflation.

Utilities should prioritize the measure NEBs that are most suitable for their programs or portfolio when planning to conduct primary research. This will help them manage their resources more effectively and achieve results with less cost and time. The suitableness of the NEBs is defined based on four criteria.

Developing NEB Estimates through Targeted Primary Research

In some cases, utilities may be required by regulators to develop NEB values specific to their energy efficiency measures, or they may be able to derive better figures for NEBs through their own primary research and/or direct measurement. In such cases, we recommend that utilities first prioritize the NEBs that are most suitable for their programs or portfolio.

To rank the measures for primary research, we propose a multi-attribute utility (MAU) model, which can be used to develop Primary Research (PR) scores, as shown in Exhibit 2. The PR score is estimated for each measure based on four criteria (which can also be ranked based on program priorities): (1) measure NEB prominence (highest NEB impact) (2) existing data quality (3) reliability of data collection method, and (4) cost of data collection method.

[8] NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation

[9] NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation

[10] Christopher Russell, Brendon Baatz, Rachel Cluett, and Jennifer Amann (2015). Recognizing the Value of Energy Efficiency's Multiple Benefits, ACEEE Report IE1502.

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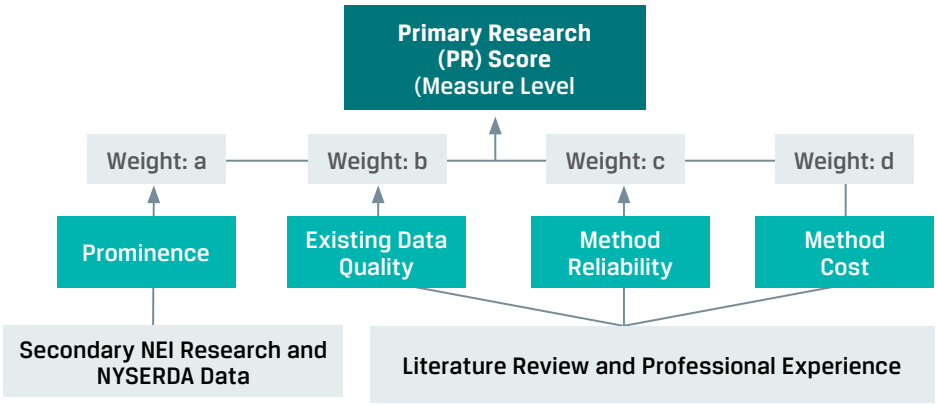
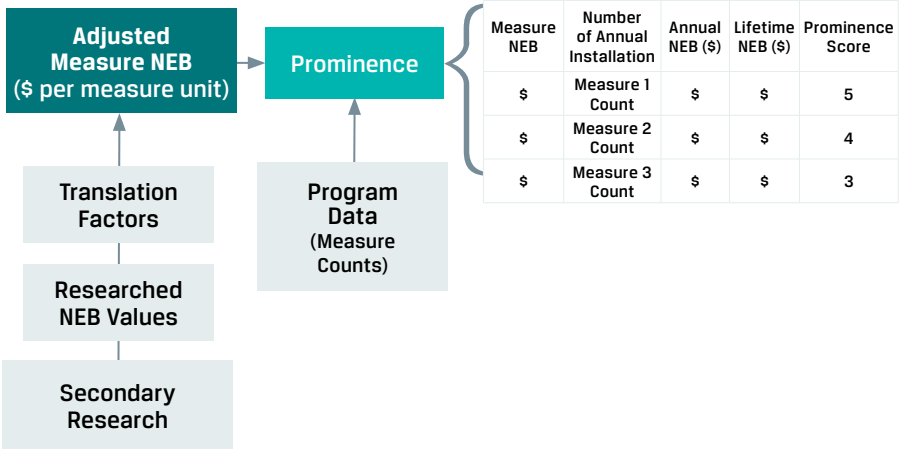
EXHIBIT 2: THE OVERALL PR SCORE CALCULATION APPROACH



Measure Prominence Score

The Prominence Score represents the NEB value of a measure within a specific energy efficiency program or portfolio. It is an indicator of 'how valuable' this measure is for a particular program. Measures with high scores are those that can have the largest impact on the program evaluations, as a result these measures could provide the largest increase in the benefits to program. Measures with lower scores may add less benefit to that specific program or portfolio, even though may have high NEB values.

EXHIBIT 3: THE OVERVIEW OF PROMINENCE SCORE CALCULATION



Measure NEB	Number of Annual Installation	Annual NEB ($)	Lifetime NEB ($)	Prominence Score
$	Measure 1 Count	$	$	5
$	Measure 2 Count	$	$	4
$	Measure 3 Count	$	$	3

Exhibit 3 shows the overview of the Prominence Score calculation. Prominence scores should be calculated based on lifetime NEB values which are tiered relative to the magnitude of lifetime impact for each measure compared with each of the other measures within each program. Adjusted measure NEB value could be estimated using the data from secondary sources as well as the translation factors described in the previous section. The number of annual installations can be developed based on program performance data and would be specific to the program that is evaluated. This would determine if a measure NEB has a large impact on the particular program.

NEB Existing Data Quality

Existing Data Quality is an indicator of the quality of NEB data available in secondary sources. If secondary research on the measure NEB is already well documented, there may be less need for new programs to develop primary research NEB values. For example, if several high-quality evaluation studies have quantified the lighting quality benefits associated with LED, and there is a low variance between the estimated values among all studies, lighting quality will get a lower score in this category as conducting primary research to quantify its NEBs might be less valuable.

NEB Data Collection Methods Reliability and Cost

The reliability and robustness of the data collection methods used to develop NEB values could also be important. NEBs have generally been evaluated using survey-based approaches such as Contingent Valuation Survey Analysis or Conjoint Survey Analysis. These approaches typically rely on responses from program participants regarding the NEB values, and therefore, the validity of their results could be in question and may not meet the regulators' scrutiny. The methods that involve direct calculation or measurement are preferred methods for quantifying NEBs, when possible. For example, avoided or deferred equipment replacement cost is an NEB that can be quantified directly using costs and useful lives of baseline and efficient equipment.

Below is a list of methodologies that could be utilized in primary research for quantifying NEBs. Generally, the methods that involve direct calculation or measurement could be presumed to produce more robust and defensible estimates, and therefore, may have higher reliability scores. This means that the NEBs that can be quantified through more reliable methods are preferred as they are more likely to meet regulatory requirements.

- Direct Calculation: simulation and performance data
- Collected Data Analysis: government / industry / historical data, pictures and videos
- Created Records: case studies and reporting
- Interviews: structured / open-ended interviews, and focus group / panel of experts interviews
- Surveys / Questionnaires: contingent valuation survey analysis and conjoint survey analysis
- Hybrid Approach: one or more of the above

Criteria Weights and the PR Calculation

To estimate the Primary Research score, each of the four criteria could be weighted differently as they may not be equally important for program administrators when prioritizing the measure NEBs. For example, Prominence score could have the highest weight due to the fact that if a measure had no prominence in an energy efficiency program, it would not be a priority no matter how good the data methods and costs are. Further, the existing data quality could have the second highest weight due to the fact that if a measure already has very good NEB data, it would not be a priority to collect more NEB data no matter how good the data methods and costs are.

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Gaining Confidence in Your Benefits

The most common approach for including NEBs in the energy efficiency program cost-effectiveness analysis, using a simple and conservative "adder" to energy benefits, undervalues NEBs significantly. The two approaches discussed in this paper for developing NEB values help program administrators assess NEBs more efficiently and effectively and achieve results with less cost and time based on their priorities and constraints. ICF recommends the first approach, using secondary research while accurately adjusting the values for key factors such as climates or building characteristics when utilities have time and budget constraints and are not required by regulators to conduct primary research. When utilities are required to conduct primary research to develop NEB values that are specific to their own service territories, ICF recommends the second approach, conducting a targeted primary research, which involves identifying the most suitable NEBs based on factors such as level of impacts, existing data quality, reliability and cost of data collection method.

About the Authors

Dr. Alireza Bozorgi is a Technical Specialist with the Distributed Energy Resource Analytics team at ICF where he supports a variety of projects including Demand Side Management (DSM) potential studies for various utilities and states, energy efficiency program design and cost-effectiveness analysis, DSM portfolio planning, as well as development of various DSM planning tools and building energy assessment tools for clients and ICF's energy efficiency program implementation teams.

Dr. Bozorgi has attended several national and international conferences, such as ACEEE, AESP, BECC, IEECB, ARCC, and ARES, and presented research papers. Prior jointing ICF, Dr. Bozorgi worked in the building industry as an architect, construction manager, and residential real estate developer for about five years.

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