EM&V Roadmap to Quantifying Challenging Non-Energy Impacts

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Abstract

Non-energy impacts (NEIs) provide policy makers, program administrators, and program participants with substantial near-term benefits that can greatly enhance the cost-benefit justification of energy efficiency programs. With increased attention to total-benefit reporting, this panel provides an opportunity to pause for a moment and ask a few questions about non-energy impacts. This paper discusses a range of topics concerning the validity and regulatory acceptance of NEIs, tools used to quantify NEIs, and their place in the evaluation and marketing of energy efficiency programs.

Introduction

An increasing number of states in the U.S. have begun to allow investor owned utilities (IOUs) and energy efficiency program administrators (PAs) to include non-energy impacts as potential benefits in portfolio cost-effectiveness analysis. In 2008, the Green Communities Act (GCA) was passed into law in Massachusetts, which directed all gas and electric PAs to seek out and implement all cost-effective energy efficiency measures that are less expensive than supply. The Massachusetts PAs, per direction from the Department of Public Utilities, use the Total Resource Cost (TRC) test to determine cost-effectiveness.

Traditionally, the PAs have quantified and included other resource benefits such as oil, propane and water savings in their cost-effectiveness analysis, which aligned with the GCA's mandate that energy efficiency programs be cost-effective. Prior to 2010, some of the PAs had also included certain non-energy impacts in their estimation of total benefits as part of a cost-effective energy efficiency portfolio, but the PAs were not consistent in their approach or application, and documentation on the NEIs was outdated. In 2010, in its 2010-2012 Three Year Plan Order, the Massachusetts Department of Public Utilities (DPU) ordered the PAs to conduct a more thorough analysis through evaluation studies. The DPU, with few exceptions, approved these studies. This allowed the PAs to include non-energy impacts as program-attributable benefits, provided those benefits could be documented and quantified. Before granting approval, however, the DPU reviewed the proposed benefits to ensure they were incurred by either the customer or the utility, in line with the state's policy on conducting a TRC test to determine cost effectiveness. This process identified a number of key challenges for implementing the total-benefit approach[i] to program evaluation.

This paper reviews a range of different types of challenging NEIs in terms of quantification methods, including some that were considered too controversial or subjective to be used in an analysis. The MA PAs and the evaluation team tackled each challenge and were able to quantify

a number of challenging NEIs and incorporate them into a cost effective energy efficiency portfolio.

Overview of NEIs

Non-Energy Impacts (NEIs) include any effects attributable to energy efficiency programs apart from energy savings.[ii] Non-energy benefits (NEBs) frequently refer to positive NEIs. Negative NEIs, also known as non-energy costs, reflect ways that energy efficient measures result in adverse effects. For example, combined heat and power systems increase operations and maintenance costs due to the additional equipment. NEIs are further categorized into participant, utility, and societal NEIs.

- *Participant benefits (or NEIs)* – "Monetary and non-monetary benefits (positive or negative) that directly benefit a program partner, stakeholder, trade ally, participant, or the participant's household." Examples include lower operations and maintenance costs, health benefits, or increased sales or revenue."[iii]

- *Utility benefits (or NEIs)* – Monetary and non-monetary benefits (positive or negative) that directly benefit the utility administering the program. Examples include lower bill arrearages and benefits associated with having to discount fewer kWh and therms for low-income customers.

- *Societal benefits (or NEIs)* – "Those that benefit society at large and can be provided via monetary savings to the energy provider that can be passed on to the society at large via energy price reductions or lower price increases, or benefits that directly benefit the society at large."[iv] Examples include reduced carbon emissions, and decreased SOx and NOx emission.

Applications of NEIs

Estimating NEIs provides utilities, regulators, and customers with valuable information when designing, promoting, implementing and evaluating energy efficiency programs. Hall et al (2003) reviewed the current and potential uses of NEIs and identified several recommended applications of NEIs, including the following:

- *Program marketing/targeting* – Positive NEIs represent opportunities for customers to decrease costs for maintenance, administration, and waste management. Similarly, NEIs identify sources of greater revenues from added sales or production increases, as well as increased amenities such as improved lighting conditions, reductions in noise pollution, or an intrinsic desire to "do the right thing." Program implementers and utilities can use information provided by NEI research to help promote energy efficiency programs and target customers who are most likely to realize such benefits.

- *Benefit/cost analysis (BCA) for customers* – Potential customers (particularly Commercial and Industrial (C&I) customers) use BCA to evaluate capital investment

decisions, such as the installation of new energy efficiency equipment. Whether customers conduct a formal BCA, or they intuit the result based on intricate knowledge of their business, positive NEIs offer additional information that implementation contractors and utilities can offer to aid this decision making process. Documented positive NEIs provide valuable information for BCA tests performed by customers, allowing them to offset capital investment costs with benefits derived from reduced operations and maintenance, administrative, or waste handling costs, or added sales and revenue. In cases where the energy savings alone provide minimal to marginal benefits, positive NEIs have the potential to reverse the results of a BCA for C&I customers.

- *Program refinement* – Understanding which NEIs may or may not result from a program can help inform the PAs in their design.
- *Portfolio development* – Centralized agencies, such as the Massachusetts Department of Energy Resources or Department of Environmental Protection, are concerned with the overall economic or environmental impact on society across a range of programs. While some programs may not represent substantial energy savings alone, they may provide greater societal benefits. NEIs offer important information regarding societal impacts, or externalities that may reflect a more accurate accounting of the overall impact of EE programs on the state than energy savings alone.
- *Regulatory cost-effectiveness testing* – A more recent application of NEIs is as an element of a Total Resource Cost test for cost effectiveness. These benefit cost models are submitted as part of broader energy efficiency plans or reports to regulatory agencies.

In Massachusetts, the use of NEIs in regulatory cost-effectiveness testing has been approved by the Massachusetts Department of Public Utilities. Consequently, MA program Administrators (PAs), in coordination with DNV GL, NMR, and the Tetra Tech program evaluation team, launched a series of evaluation studies to document and quantify NEIs associated with a wide range of commercial and industrial and residential programs. The evaluation team employed a range of techniques to provide the MA PAs with a comprehensive view of NEIs and their sources. In the process of executing these studies and obtaining regulatory approval for the resulting NEIs, the PAs were confronted with a number of important methodological and theoretical challenges that should be considered as organizations move forward with NEI research.

Challenges in measuring NEIs

The Massachusetts Program Administrators (MA PAs) and the evaluation team confronted seven distinct challenges, outlined below, in quantifying NEIs and obtaining regulatory approval for their use in regulatory cost-effectiveness testing. The evaluation team first provided a general description of the challenge, presented the concerns associated with the challenge, and then described the steps that the MA PAs took to address the concern.

1. *Do we believe these values anyway? – Self-reports verses engineering based studies*

While survey respondents may be able to identify that NEIs exist, how can we be sure they're able to accurately quantify these NEIs? Using NEIs obtained from self-reports is a well-documented and often cited concern. Further, research has found inconsistent reporting of the same NEIs for a given measure type. For example, reduced labor costs associated with less frequent changing of light bulbs is an NEI one would expect to find at most sites. Because interview respondents have difficulty conceptualizing differences in operations relative to a hypothetical baseline that is new, but not energy efficient, self-reported NEIs from customers or other market actors may not provide meaningful results if respondents are asked to state values explicitly. Further, NEIs assessed on new construction projects are typically determined by design engineers during the project or facility design phase, most particularly for heating and cooling measures, further complicating use of self-reports.

The analysis conducted by the evaluation team found that a self-reported approach to obtain NEIs estimates was appropriate for Commercial and Industrial (C&I) retrofit measures, provided respondents were responding to questions about actual cost and revenue changes with which they are familiar. The team employed a self-report based approach for estimating NEIs associated with retrofit measures only.[v] The interview guide broke down NEIs into cost and revenues associated with different business functions about which respondents were knowledgeable. The team then asked respondents to describe the changes that occurred and used deeper probes to extract detailed information which was used to compute cost and revenue changes. This approach restricted NEIs to changes directly related to observable costs and revenues. Such changes were more readily quantified by respondents as they pertained to observable changes to their day-to-day operations.

For C&I new construction measures, the evaluation team did not use a self-report NEI approach because respondents were unlikely to be able to conceptualize cost and revenue changes relative to a hypothetical baseline that they did not have experience with.[vi] Therefore, the evaluation team used an engineering cost-estimating approach to determine NEIs, and limited the analysis to impacts on operations and maintenance costs. While in-depth interviews were not used to obtain NEI estimates, the evaluation team did conduct a limited number of interviews with building owners, engineering firms, and public officials to inform the analysis and provide specific values of parameters needed in the engineering analysis. A limitation to the engineering-based approach is it prevented estimation of NEIs not captured by life-cycle cost differences. Although previous research showed that other sources of NEIs, such as changes in productivity, revenue, and comfort, may also result from energy efficiency measures, the evaluation team did not pursue these impacts as the engineering-based approach did not lend itself to their estimation.

Through a separate study, the analysis found that a self-reported NEI approach was also effective in identifying NEIs associated with a number of residential energy efficiency measures such as weatherization, installation of light bulbs, and heating equipment. Examples of the NEIs reported include increased property value and thermal comfort, reduced equipment maintenance costs and

positive health benefits. For residential measures, a two-step approach was used to identify and quantify these NEIs. First, the evaluation team conducted occupant surveys with a number of low-income and standard income households. The occupant survey addressed the following issues:

- Whether the participant believed their home, because of the energy efficiency improvements, provides a particular NEI
- Annual value placed on each NEI in relation to energy bill savings. Values could be expressed in dollars or as a percentage of bill savings.
- Total individual value of NEIs – There is potential overlap among the individual NEIs (such as comfort and health), and the sum of the individuals was almost always (if not always) higher than the 'total' NEI value. We scaled the individual NEIs so that they summed to the total. For example if someone said $100 comfort, $50 health, $50 noise and then $100 total, the scaled values were $50 comfort, $25 health, $25 noise. While the total value approach is a more conservative approach, it avoids double counting
- Changes in household health since the energy efficiency improvements were installed
- Demographic and housing characteristics

Second, computation of dollar values for a specific NEI by measure began with calculating the average portion of bill savings attributed to each measure for an individual NEI. As a first step, the evaluation team determined whether a measure reasonably contributes to an individual NEI. For example, air sealing, heating systems, insulation and programmable thermostats all are examples of measures that increase levels of thermal comfort. Next, the team calculated the average percentage of bill savings for each measure that contributes to an NEI. For example, air sealing represents, on average, 8% of the bill savings of measures that contribute to thermal comfort, while heating systems represent 39% of those bill savings; combined, the measures sum to 100% of the bill savings associated with each NEI. Last, the evaluation team multiplied the average percentage of bill savings by the average NEI value to estimate an NEI value for each measure.

2. *Don't we already count these impacts? – Avoiding double counting*

NEI studies often separate impacts into different categories and attempt to monetize these categories separately. While this research technique can be beneficial in ensuring that researchers are accounting for all impacts resulting from the installed measures, it also creates concern over double counting impacts across categories. The following examples are only a few ways that double counting NEIs may potentially overstate programmatic impacts:

- *Labor Cost Savings* – Including the same labor costs for multiple business functions in an evaluation such as labor associated with operations and maintenance (equipment repair) and labor associated with administrative activities such as ordering parts or filling out paperwork.

- *Health Benefits* – Health benefits may overlap with other benefits in at least two ways. For example, there may be an implied causal relationship in the respondent's mind between two NEIs, so that it would be redundant to "pay for" each separately. For example, if a respondent thinks that increased comfort (i.e., fewer drafts) leads to improved health, the respondent might think that both NEIs are valuable, but when combined, the NEIs are less valuable in total because when the respondent 'pays' for fewer drafts the respondent also benefits from fewer colds/viruses. Alternatively, two or more NEIs could be conceptually or experientially similar, so that they share at least some of their perceived meaning. For example, a respondent might perceive comfort, fewer illnesses, and reduced noise as all being different but somewhat overlapping aspects of an overall sense of "well-being," such that the various aspects, when taken separately, add up to more than the overall sense of well-being.

- *Increased Revenue* – Self-reported NEI studies must take precautions to ensure that respondents do not report revenue or sales changes in addition to production changes. Some measures may result in increased productivity which can be monetized if average prices are known and costs can be removed. However, respondents may also indicate that revenue itself increased separate from these production increases.

For the Commercial & Industrial Retrofit study, the approach used by the evaluation team utilized self-reported responses to a series of questions to derive estimates of the same mutually exclusive NEI categories developed by Roth and Hall (2007).[vii] Using energy industry experts to conduct interviews allowed the team to probe more deeply to identify the specific relevant business impacts because interviewers were familiar with how the installed measures may impact a facility. The questions were structured to prevent possible double counting across categories by presenting related categories sequentially (e.g. three and four) for easier respondent recall. Interviewers followed structured probes to extract information to estimate NEIs, similar to the engineering-based approach used in the Optimal Energy study.[viii] These probes allowed respondents to express the NEIs in familiar terms (i.e. number of hours saved to change light bulbs and wages) rather than asking respondents to approximate values for abstract concepts such as the impact of energy efficient lighting on operations and maintenance costs. In addition, the interviewer protocols were designed to confirm that costs or savings included in one category were not included in any other categories.

Table 1 presents the general probes for each NEI section. The goal of these probes was to quantify the NEIs of each measure into the monetary and resource impacts of the installed measures.

Table 1. Non-Energy Impact Categories

NEI Category	Probes						
	Labor[1]	Parts / Materials	Training	Fuel[2]	Water	Fees / Permits	Other
Operations & maintenance	✓	✓	✓	✓			✓
Administration	✓		✓				✓
Materials handling	✓						✓
Materials movement	✓	✓		✓			✓
Other labor	✓		✓				✓
Spoilage/Defects	✓	✓					✓
Water usage					✓		
Waste disposal	✓	✓				✓	✓
Fees						✓	✓
Other costs							✓
Sales							✓
Rent revenues							✓
Other revenues							✓

[1] Labor included internal and external labor and included probes for assessing fully loaded costs.

[2] Fuel included: natural gas, no. 2 distillate, no. 4 fuel oil, propane, wood, and kerosene.

Using this approach, the evaluation team estimated NEIs associated with cost savings and revenue increases. One critique of this approach is that the costs savings used to compute NEIs were not "cashed in." In other words, the workers were still employed by the facility, so their hourly costs were still incurred. However, this argument does not reflect the fact that workers who are not spending time maintaining the energy efficient equipment are free to perform other duties, thereby increasing the operational efficiency of the facility.

For the residential study, double counting was avoided by scaling the value of individual NEIs to a total value estimated by the respondent. After providing values for the individual NEIs, respondents were asked to assign an annual value to the total impact of all the NEIs together (except for any changes in property value). Each respondent's individual NEI values were scaled in proportion to the respondent's estimate of the total impact of all the NEIs in order to account for any overlap in NEIs or over-estimation of the individual NEIs.

3. *What about non-energy costs? – Maintaining objectivity in evaluation*

Early NEI studies focused exclusively on positive non-energy impacts, or non-energy benefits (NEBs). However, NEIs can be negative as well as positive. Some measures, such as combined-heat and power (CHP) systems are added equipment requiring increased operations and maintenance. Geothermal heat pump systems require an annual check of the manifold, periodic flushes with acid water to clear out mineral deposits, and certain additional maintenance items on the heat pump such as maintaining the strainers. These activities reflect additional maintenance relative to a ground-source heat pump.

For evaluators, including both negative NEIs as well as NEBs is critical to maintaining objectivity in NEI studies. While positive NEIs provide additional source of benefits for energy efficiency programs, negative NEIs can be used to identify barriers to installing measures. Knowing these barriers can help program implementers develop new services to offset annual cost differences and increase program participation. Awareness of negative NEIs can also help in program planning, shifting program design away from measures with overall negative economic benefits (energy savings + NEIs) and reallocated toward measures with positive economic benefits. For example, HVAC measures, such as high-efficiency boilers, require significantly more annual maintenance than do standard efficiency boilers.

The analysis performed by the evaluation team included both positive and negative NEIs. Results from the C&I retrofit study limited negative NEIs to CHP measures. This is likely due, in part, to the use of self-reports for NEI estimation. Because this technique required a highly detailed view of all life-cycle cost differences between the energy efficient and baseline technologies, it was well suited for isolating negative as well as positive impacts. The engineering analysis of new-construction measures identified negative NEIs in 5 of 15 custom gas measures, 2 of 17 prescriptive gas measures, and 1 of 10 custom electric measures. [ix]

The engineering-based approach did not include production or revenue increases or other NEIs that are difficult to quantify, which may be partly responsible for the prevalence of negative NEIs in this study. For example, **Error! Reference source not found.** shows NEIs associated with new construction lighting measures, which consist largely of differences in replacement and maintenance costs due to the longer lifetime of efficient bulbs. There were additional benefits with lamp replacement when fewer efficient lamps were needed to provide the same lumens as the baseline lamp. While not currently used for benefit-cost reporting, these data could be valuable in promoting different lighting technologies and also used in potential future analysis of NEIs associated with the upstream lighting program.

Table 2. Lighting NEIs by Lamp Type

Measure Type	Measure Subtype	Ratio (NEI/kWh)	Statistically Significant?	2013 Weighted Amortized NEI
Custom Lighting	LEDs	$ 0.010	No	$2,735
	Other Lighting	$ 0.011	Yes	$8,960
	Performance Lighting	$ 0.006	Yes	$7,186
Prescriptive Lighting	LEDs	$ 0.038	Yes	$278,240
	Performance Lighting	$ 0.019	No	$41,598
	T5 Lighting	$ 0.008	Yes	$18,915
	High Bay LEDs	$ 0.042	Yes	$35,646
	T8 Lighting	$ -	N/A	

Controversial NEIs

This section reviews classes of NEIs that are controversial in terms of their use in regulatory cost-effectiveness testing. The evaluation team considered four groups of NEIs that are less straight-forward.

1. *Hard to quantify NEIs – Which soft benefits should be counted?*

Much of the NEI literature focuses on impacts that are more subjective than operational cost savings or production increases. The 2011 Residential and Low-Income Non-Energy Impacts (NEI) Evaluation study conducted by NMR and the MA PAs employed a survey-based approach to capture a number of these "less tangible" impacts such as:

- *Light quality improvements* – Higher light quality associated with LEDs and other energy efficient lighting technologies were found to result in non-energy benefits. The wealth of studies surrounding this phenomenon, providing substantial evidence that improved lighting may, in fact, increase worker productivity, student performance, and the wellbeing of residential customers. However, the appropriate means for measuring and monetizing those changes are less straightforward. While the surveys of program participants found that respondents assign a positive value to the lighting quality and lifetime of program-sponsored energy efficient lighting ($49 for Non-Low Income participants and $56 for Low Income participants), the O&M benefit, such as those described above, is a more reliable and straightforward estimate of lighting NEIs. Values associated with increased light quality were not quantified. As there is greater uncertainty concerning how increased lighting quality translates into a precise monetized benefit, the PAs opted to exclude these impacts, focusing research funds on impacts whose quantification was more tangible.

- *Decreased noise/quieter equipment* – Many energy efficiency measures result in quieter homes and working environments as equipment is often quieter and building shell improvements such as new windows and insulation can reduce outside noise[x] [xi]. Techniques for valuing these impacts are fairly limited. The evaluation team's research found that participants were able to express a willingness to pay for this noise reduction as a percent of their energy bill. However, basing these values on a self-reported hypothetical cost creates uncertainty over whether participants would actually pay more for measures that result in a quieter home. One approach to circumvent this issue is to use hedonic price models of property or appliance sales to isolate the value consumers place on reduced noise. However, such a study would require data on home or appliance sales with variation in the ambient noise level.

2. *Unrealized impacts – Prove it!*

Self-reported NEI studies indicate that survey respondents often identify increased property values as a potential NEI. The evaluation team's survey research of owners and managers of low-income rental housing who had participated in the PAs programs found that rental units increased in property value. Respondents were asked if the value of their property had increased

as a result of participating in the PAs programs, and if so, to estimate the increase in value. The value represents a respondent's estimate of the increase in property value attributable to participation in the program. Similarly, the evaluation team found, through a survey of low-income program participants who owned their homes, owner-occupied home values also increased.

While the tenants, landlords, and owners may believe their property is worth more, the proof is really in the pudding. Most people approach the real estate market with high hopes of how their investments in their castle will be in demand once it is on the market. The question is, "would they actually charge or pay more for rent, or sell their home or building for more because it was energy efficient?" Answering this question requires a more data-intensive exercise, such as a hedonic price model that employs actual sales data. While there is evidence that these values are not zero, absent such analysis, estimates of property value changes should be based on actual property sales and not speculation over property value changes.

3. *What is the role of societal benefits? –Whose benefits are these anyway?*

In the U.S., because energy efficiency programs are administered at the local or state level, many societal impacts are not deemed relevant to the local policy maker. This is because many of these impacts will occur outside the jurisdiction of the regulatory agency.

For example, energy conservation in one area, such as a specific state like Massachusetts, will result in decreased energy consumption in Massachusetts. However, much of the power generation typically occurs outside Massachusetts. Therefore, environmental benefits from SOx and NOx reductions which constitute a primary societal impact are most directly realized outside the regulator's jurisdiction. While local citizens may express a willingness to pay for a cleaner environment elsewhere, it is unlikely that local regulators will use benefits that do not directly impact their constituents to justify program expenditures that do directly impact them. The societal impacts that are mostly likely to receive regulatory approval are those that directly impact the local society. In Massachusetts, the Department of Public Utilities has explicitly stated that NEIs must directly benefit either the customer or the utility, and societal benefits are not allowed as part of its Total Resource Cost test. Three specific NEIs that were studied as part of the 2011 Residential and Low-Income NEI evaluation were disallowed, because they were considered to be societal benefits, and not benefits directly realized by either the participant or by the utility.[xii] [xiii]

- *Appliance Recycling*- To the extent that appliance turn-in programs ensure that hazardous materials are disposed of properly and that the materials comprising old appliances are recycled, beneficial societal non-energy impacts can be derived in the form of 1) avoided landfill space, 2) avoided use of raw or virgin materials in the production of new goods through the use of recycled components, and 3) avoided release of ozone-depleting substances and greenhouse gases into the atmosphere. Federal law and regulations do,

however, require the proper disposal or storage of refrigerant, mercury, PCBs, and used oil, which means that the sponsors cannot claim the environmental and health benefit associated with avoiding the release of these materials, because they would have already been properly managed, barring illegal activity.

- *National Security* - The most notable benefit comes from reducing the need for energy imports, thereby enhancing national security. In areas where fuel oil or kerosene are commonly used to heat homes, comprehensive weatherization programs have the greatest effect in reducing the amount of imported energy consumed.

- *Economic Development Benefits* – Benefits that quantify the positive impacts on employment, tax revenues, earnings and economic output due to energy efficiency programs. These benefits have been well-established, with particular focus on the impact on low-income customers.[1]

4. *How far do we take health benefits? – Impacts depend on population and program influence*

Energy efficiency improvements in a home have a wide range of impacts beyond energy and energy bill savings, including health benefits. Low-income populations and non-low-income populations may realize different benefits and different values of the same benefit in part because of differences in income and other demographic factors.

The MA PAs and NMR derived values of health benefits from surveys of program participants. In order to account for potential differences between low-income and non-low-income populations, participants in low-income programs were surveyed independently of the non-low-income program participants and their respective NEI values were estimated independently.[xiv]

The PAs are currently investigating other health related NEIs that are focused primarily on avoided medical costs. Similar to the participant NEIs associated with C&I retrofit and new construction programs, these avoided cost health impacts are objectively quantified based on medical costs avoided. With one exception, the avoided loss of life for fires and CO poisonings, the PAs have not attempted to address impacts pertaining to the valuation of avoided illness and loss of life. Techniques to measure such impacts are inherently more controversial as they require the valuation of wages forgone and ultimately human lives. These benefits are well-established in environmental impact literature. Techniques used to assess the value of a life focus largely on loss of earning, impacts on employment, tax revenues, earnings and economic output due to energy efficiency programs. The PAs have not pursued these impacts as such research raises concerns over disparate impacts for low- and high-income customers, and concerns over social equity.

[1] Benefits that quantify the positive impacts on employment, tax revenues, earnings and economic output due to energy efficiency programs. These benefits are well-established, with particular focus on the impact on low-income customers.

Summary

The Massachusetts Program Administrators treated the study of non-energy impacts similarly to the evaluation of energy savings to best identify, quantify and receive regulatory approval of these impacts. Each study mentioned in this paper was conducted through the Massachusetts statewide evaluation framework. This process ensured that: 1) all energy efficiency program administrators would conduct the analysis and apply the results consistently, 2) the evaluation contractor performing the study was a competitively procured, independent third party and 3) adequate oversight and input was provided by an independent expert evaluation consultant to the Energy Efficiency Advisory Council. Following this framework allowed the program administrators and external stakeholders to come to a consensus prior to submitting the studies as part of any regulatory proceedings to seek approval.

The Program Administrators had to respond to a number of questions regarding the application of these study results by both the Department of Public Utilities and the Massachusetts Attorney General's office. Ultimately, the results of the studies were approved, with the exception of three non-energy impacts that the Department determined were societal in nature and could not be directly attributed to either the participant or the utility. The approval of these impacts was in line with the pursuit of all cost-effective energy efficiency, and allowed the PAs to take a more holistic approach to implementing energy efficiency products and services.

Conclusions

Despite some of the unique challenges that NEIs present, it is possible to identify and quantify a wide range of both positive and negative impacts through robust evaluation efforts. These impacts are real, quantifiable, and an integral part in understanding the total benefits or costs associated with energy efficiency projects and services. Program Administrators can and should consider these impacts as a tool to better inform customers' decisions about pursuing energy efficiency, enhance or refine program design, and to deliver a more diversified, cost-effective portfolio.

References

[i] The Massachusetts DPU defines total benefits as the sum of the net-present value of benefits resulting from capacity savings, energy savings, resource savings (fuel oil, propane, water), and non-energy impacts.

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