Measuring Participant Perspective Non-Energy Impacts (NEIs)

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ABSTRACT

Non-energy impacts (NEIs) of energy efficiency programs experienced by program participants are frequently measured through surveys. The Relative Valuation (RV) method, which is loosely based on behavioral and environmental economics to gauge the value of non-market goods, has commonly been used in recent studies.

The data for this paper were collected from 213 low-income and 209 non-low-income participating households via computer-assisted telephone interviewing (CATI) in the spring of 2011 in Massachusetts. NEI values were derived by asking respondents to estimate the value of the NEI, either in dollars or as a percentage of their bill savings. After valuing individual NEIs, respondents were asked to estimate the "total value" of all NEIs.

This paper will examine four methodological and measurement issues that arise when estimating NEIs using the RV method.

- The sum of the individual NEIs was substantially higher than the "total value" of NEIs, suggesting the existence of embedding effects or part-whole bias.
- Estimated NEI values were highly correlated with respondents' bill savings, raising the question of whether the correlation is due to the "anchor effect" of the bill savings stated in the question or whether higher bill savings produce more valuable NEIs.
- The mean value of responses given in dollars was substantially higher than responses expressed as a percent of bill savings, indicating that response format significantly impacts estimated NEI values.
- Substantial percentages of respondents provided NEI values to a follow-up question rather than the initial question, effectively increasing response rates.

Introduction

Energy efficiency improvements in a home have impacts beyond energy and energy bill savings. These non-energy impacts (NEIs) are widely recognized but difficult to quantify effects of energy efficiency programs. NEIs have traditionally been characterized by the perspective of the party to whom a particular NEI accrues, including utilities, participants, and society. For example, utilities can realize a number of financial savings because program participants often have lower energy bills, which can decrease the likelihood that customers experience difficulties with paying their utility bills. Program participants may benefit through reduced water usage from water saving measures, through increased comfort after a retrofit, or through health or safety benefits associated with energy efficiency upgrades and technologies. Finally, society may realize environmental benefits and positive economic impacts from energy efficiency programs.

In this paper, we focus on NEIs experienced by program participants and quantified through surveys.

Much of the research on participant NEIs has relied on participant self-reports garnered from surveys. For many participant NEIs, self-report is the only possible source of data, as their values are based on the participants' own perceptions. These perceptual, less tangible, NEIs represent the extent to which participants experience a particular intangible impact of a program, such as "increased comfort."

In addition, there are many participant NEIs, such as "increased property value" or "reduced equipment maintenance." that could be estimated using non-survey data (e.g., by tracking sales data, interviewing real estate experts, tracking equipment maintenance costs, etc.), but are often addressed in surveys for practical reasons, such as the lack of available data and the relative ease and low cost of including questions on surveys that are already being used to measure perceptually-based NEIs.

In this paper, we use the results from a recent NEI study to examine four methodological and measurement issues that arise when estimating NEIs using the Relative Valuation (RV) method. The four methodological and measurement issues are as follows:

1) embedding effects or part-whole bias
2) anchoring effects
3) differences in values responses expressed as dollars compared to percentage of bill savings
4) the impact of providing follow-up questions to increase response rates.

The first three issues pertain to potential measurement error in attempts to estimate NEIs. Measurement error, the discrepancy between the underlying, unobserved variables and the observed responses, arises when a respondent's answer is inaccurate, imprecise or cannot be compared to others. Measurement error can be attributed to survey design or it can arise because of a respondent's inability or lack of desire to provide accurate information (DeVellis 1991; Dillman 2000; Fowler & Mangione 1990). The fourth issue, providing follow-up questions, is not about measurement error but rather suggests a method for increasing response rates for NEI valuation questions that are often difficult for respondents to answer.

Commonly Used Survey Methods Used to Estimate Participant NEIs

Several different types of survey methods have been used since researchers began monetizing participant NEIs as part of program evaluations in the 1990's. These methods are loosely based on methods used in behavioral and environmental economic research that were developed in order to gauge the value of non-market goods (i.e., goods or attributes of goods that are not ordinarily directly exchanged for money, such as the value of the existence of a wilderness area or the value of the preservation of endangered species).

One of the most direct methods of monetizing an NEI is Willingness to Pay (WTP), by which respondents are asked how much they would pay to obtain an NEI or a group of NEIs. Unfortunately, this method tends to result in high non-response rates, wildly divergent values across respondents, and much higher values than are typically obtained by other methods.[1]

The Conjoint Analysis (CA) survey method, commonly used in marketing research, essentially involves assessing the value of various hypothetical attributes of a product through multiple questions asking respondents to choose between two hypothetical products, or through scenarios with different combinations of the attributes in question. In some of these pairs, a monetary value replaces one of the attribute bundles. These preferences are then analyzed to obtain the monetary value of each of the attributes.[2] The primary disadvantage of this method for NEI research is that the results reflect the value of NEIs under hypothetical, idealized circumstances, as opposed to value of the NEIs as actually experienced. Another disadvantage of the CA method is that it requires a more lengthy and complex set of survey questions, reducing the number of NEIs that can be evaluated.

The Relative Valuation (RV) method, used in this study, involves asking respondents the value of the NEI relative to a starting point. In NEI survey research thus far, the bill savings from a program has been used as this starting point. Respondents estimate the value of the NEI, either in terms of a verbally labeled scale (Labeled Magnitude Scaling) or in percentage or dollar terms (direct scaling or self-reported percentages). For example, an RV survey might ask respondents whether they have experienced changes in the noise level in their home as a result of the program, whether these changes are positive or negative, and whether the value of these changes is higher than, lower than, or about the same as the bill savings from the program (or, for negative changes, how much the value detracts from the bill savings). A follow-up question would ask how much more or less than the bill savings, expressed either as a percentage of bill savings (i.e., self-reported percentages) or as "somewhat" or "very much" more or less than bill savings (i.e., labeled magnitude scaling). Respondents answer labeled magnitude scaling questions more quickly than the self-reported percentage, but analyzing the data requires an extra step of translating the verbal labels into values using standard equivalence equations.

Respondents generally find RV questions easier to answer than WTP questions. The results tend to be more consistent within and across studies (although the ranges of values obtained by this method are still quite wide both within and across studies and programs). A potential disadvantage is that, across programs, NEI values tend to be correlated with the value of bill savings, which might reflect the fact that higher "anchors" in such survey questions tend to result in higher values, a robust finding in recent survey research (Kahneman & Sugden 2005). Thus, it is not clear whether higher bill savings results in higher NEI values or whether instead the effect of bill savings on NEI values is an artifact of the survey method, and not reliable evidence that programs with higher bill savings tend to result in more valuable NEIs. Also, when studies have asked respondents to value NEIs relative to bill savings without telling them the average savings amount for the program, results have been less consistent across participants, possibly because different respondents were assuming different levels of bill savings, thus using

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[1] For example, Skumatz and Nordeen (2002) asked respondents to value overall NEIs using WTP and two other types of questions, allowing the results from the different methods to be compared directly. Only 39% of respondents answered the WTP question, and the average value obtained through the WTP questions was roughly ten times that obtained through the other methods. Across respondents, WTP values ranged from $0 to $70,000.

[2] For a thorough review of *Conjoint Analysis* see Wobus, et al. (2009).

different values as an anchor with which to decide the value of NEIs. Nevertheless, because this method yields higher response rates and more consistent results than the other methods that have been used, Relative Valuation is the most frequently used method in NEI research.

NEI Survey of Program Participants

We surveyed 213 low-income households and 209 non-low-income households via computer-assisted telephone interviewing (CATI) from April 11, 2011 through May 10, 2011. The sample was developed from data provided by the Massachusetts Program Administrators (PAs).[3]

In order to examine potential differences in participant NEI values due to the types of measures installed, the NMR team stratified the residential and low-income residential samples according to the measures installed in their homes, with the three strata representing homes retrofitted with shell measures, or with heating and cooling measures, or with shell plus heating and cooling measures.[4] Using PA data of the estimated energy savings associated with each efficiency measure installed, NMR estimated annual bill savings for each program participant in the sample. [5]

Survey respondents were asked to estimate an annual value for six individual NEIs and a single one-time NEI they experienced in their homes.[6] The survey used a *relative valuation* method, asking respondents to value each NEI in relation to their annual energy bill savings, either as a dollar amount or as a percentage of energy savings. Each respondent was told an estimate of their annual energy bill savings based on the measures the participant had installed with the PAs' programs. The NEIs asked about in the survey include: [7]

- Thermal comfort
- Noise (from equipment or outside home)
- Property value (homeowners only)
- Equipment reliability/maintenance
- Durability of home
- Overall impact of NEIs (excluding one-time change in property value)

The survey first asked homeowners if they believed their home had a particular NEI, and whether it was positive or negative. Taking the thermal comfort NEI as an example, respondents

[3] The sample was drawn from participants in several PA programs, including low-income retrofit programs (single and multi-family programs), a residential cooling and heating program, a residential heating and hot water program, and non-low-income retrofit programs (i.e., Mass Save, weatherization, multi-family retrofit programs)

[4] To be included in the shell stratum, a respondent had to have air sealing or insulation installed. To be included in the heating and cooling stratum, a respondent had to have a heating system, such as furnaces or boilers, or an air conditioning system installed. To be included in the shell plus heating and cooling stratum, a respondent had to have at least one shell measure and one heating and cooling measure installed. Installed measures that were neither shell nor heating and cooling did not affect classification of respondents into strata. (for more details see NMR, 2011).

[5] Bill savings were estimated by using a population weighted average of gas and electric rates reported on the Web site of the Executive Office of Energy and Environmental Affairs of Massachusetts (Office of Energy and Environmental Affairs Energy Market Data)

[6] The NEI of property value as asked in terms of a one-time change in value

[7] Two other NEIs (lighting and health effects) were also included in the survey; however, because of small sample sizes and large numbers of respondents saying "no difference," these are not included in this paper (see NMR 2011 for more details).

were asked if they believed their home, because of the energy efficiency improvements, was more comfortable than before, less comfortable, or no different in its comfort level (in terms of temperature and draftiness). Those who believed there was a change in comfort were asked to place a value per year on the change, with a choice of expressing the value in dollars or as a percentage of energy savings. NEI values for those who believed there was no change in the comfort level of their home were set to zero.

Assigning monetary values to intangibles such as comfort is not an easy task. Respondents who experienced the NEI but initially were unable to estimate a value for the NEI were asked again to estimate a value. Using thermal comfort as an example, respondents were further prompted with the following questions:

> *"Compared to energy bill savings, would you say increased comfort is worth nothing, about a one fourth of energy bill savings, about a half of energy bill savings, about three-fourths of energy bill savings, about equal to energy bill savings, or more than energy bill savings? If the latter, how much more?"*

The NEIs for respondents who still could not provide an answer were treated as missing in the calculation of average NEI values.

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.

The individual NEI values were scaled in the following way: Each NEI value was represented as a proportion of the sum of that respondent's individual NEI values. This proportion was then applied to the respondent's reported estimate of the total impact of all the NEIs, yielding the scaled value for each NEI.[8] The scaling factor is specific to each respondent and varies widely throughout the sample. For example, if a respondent said their total NEI value was $300, while reporting their health NEI as $300 and their thermal comfort NEI as $100, the scaled NEI values for this respondent would be a health NEI of $225 and a thermal comfort NEI of $75. The specific NEI values for this same respondent would be much different if the respondent reported their total NEI value to be $1000 or $100.

As shown in Table 1, the most highly valued annual-value NEI by the non-low income (NLI) respondents is thermal comfort, with a mean annual value of $125 (nearly $300 before scaling to total impact values) and reduced equipment maintenance, with a mean annual value of $124 (nearly $200 before scaling).[9] Reduced noise and increased durability of the home were valued the least, each with a mean value of less than $50 annually. Respondents assigned a far higher value to expected increase in property value, a one-time impact, than those for the annual-value NEIs, with a mean of nearly $2,000.[10]

The low-income (LI) respondents show a similar pattern to that of the NLI respondents (Table 1). Among the annual-value NEIs, increased thermal comfort was given the highest value,

[8] When the respondent failed to give a value when asked for Total NEI value the scaling was based on the sum of the respondents individual NEI values.

[9] Two other NEIs (lighting and health effects) were also included in the survey; however, because of small sample sizes and large numbers of respondents saying "no difference," these are not included in the results shown here.

[10] As noted earlier, property value represents a one-time benefit while the remaining NEIs are annual benefits.

with a mean annual value of $101 (over $200 before scaling), and reduced equipment maintenance, with a mean annual value of $54 (over $100 before scaling). Similar to the NLI group, for the LI group reduced noise and increased durability were given the lowest values, with means of less than $60 annually. Again, the expected increase in property value (a one-time impact) was valued more highly than the annual NEIs, with a mean of nearly $1,000.

Table 1. Mean NEI Values[1]

		Non-Low-income (NLI)		Low-income (LI)	
NEI	**Sample Size**	**Unscaled Value**	**Scaled Value**	**Unscaled Value**	**Scaled Value**
Comfort	165 (NLI); 172 (LI)	$272	$125	$205	$101
Noise reduction	183 (NLI); 193 (LI)	$53	$31	$63	$30
Property value[2]	157 (NLI); 143 (LI)	$1,998	NA	$949	NA
Equipment Maintenance[3]	117 (NLI); 122 (LI)	$175	$124	$116	$54
Durability	173 (NLI); 185 (LI)	$57	$49	$78	$35
Total NEIs	208 (NLI); 208 (LI)	$472	$261	$431	$242

[1]The values reported in this table are weighted to strata and income group. In addition, cases that are at least three times the standard deviation of percent bill savings of the total scaled NEI value are excluded. The following weights were applied to the non-low-income population: a weight of 1.53 for the heating and cooling strata, a weight of 1.40 for the shell strata a weight of 0.10 for the shell plus heating and cooling strata. For the low-income sample, the following weights were applied: a weight of 1.22 for the heating and cooling strata, a weight of 0.98 for the shell strata a weight of 0.79 for the shell plus heating and cooling strata.
[2]Property Value was not scaled because, as a one-time NEI value, it was excluded from the survey question about total annual value of NEIs. Property value was limited to respondents who own their home.
[3]Equipment maintenance was only asked of respondents who installed heating or cooling equipment.

Methodological and Measurement Issues

Next, we examine four methodological and measurement issues that arise when estimating NEIs using the RV method.

Sum of Individual NEIs Compared to Total NEIs

As illustrated in Table 1 above, we found that the sum of the individual NEIs exceeds the value of the "total NEIs." Other recent NEI research has also found that if participants are asked to estimate the value of individual NEIs (i.e., thermal comfort, sense of environmental responsibility, etc.) and then asked to estimate the overall value of all of the individual NEIs together, the sum of the individual values often exceeds the overall value of the NEIs substantially. For example, an evaluation of NYSERDA's ENERGY STAR Homes program (Barkett et al. 2006) found that the sum of the individual NEI values is about 250% of bill savings, five times the average value obtained from the question about the overall value of all the NEIs (roughly 50% of bill savings).

In this section, we explore the possible reasons for the commonly found discrepancy between the sum of individual NEI values and total NEI values reported by respondents and suggest a method for correcting this discrepancy. A potential explanation for this discrepancy between the sum of NEI values and the total NEI value, suggested by Behavioral Economics research and theory, is conceptual overlap among the individual NEIs.

Potential overlap can be conceptualized in two ways. First, when asking respondents to estimate the value of non-market goods with multiple parts or components, the stated value of the whole is often less than the value of the sum of the parts. This is often referred to as 'part-whole bias' when the values of the individual parts are not adjusted for the value of the whole (Bateman et al. 1996; Brown & Duffield 1995). Second, when estimating the values of several related things, the stated value of the total is often less than that of the sum of the individual items, often referred to as an "embedding effect" (Baron & Greene 1996; Brown et al. 1995). There could be any number of explanations for this, but in the case of NEIs it is likely that there is "overlap" among the various NEIs asked about, such that respondents do not conceptualize the individual NEIs as being completely distinct and therefore their values are not additive.

Overlap could be occurring among NEIs in a few different possible ways. One way is if there is 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 fewer drafts lead to fewer colds and viruses, 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. Finally, one NEI can be considered a subset of another NEI, such that the value of one "contains" the value of another. For example, longer lighting life and even durable home could be perceived as part of "reduced equipment maintenance," such that the value of equipment maintenance includes the value of the other two.

If conceptual overlap between the NEIs is occurring, this suggests that respondents are essentially overestimating the individual NEIs. Some reports have corrected for this divergence between the sum of the NEI values and the overall NEI value by presenting NEI values that are scaled down proportionately, so that they sum to the overall NEI value (e.g., Skumatz & Gardner 2005). As noted earlier, we used this method in the current study. Without scaling, individual NEIs would have been overestimated by as much as $147 (comfort for NLI respondents) and overall NEIs would have been overestimated by $211 for NLI respondents and $189 for LI respondents; see Table 1 for differences between the un-scaled and scaled NEI values.

Relation Between NEI Values and Respondent Bill Savings

Estimated NEI values were highly correlated with respondents' bill savings, raising the question of whether the correlation is due to the anchor effect of the bill savings stated in the question or whether higher bill savings produce more valuable NEIs (see Table 2, below).

The "anchor effect" is a cognitive bias that occurs when people's numerical estimates or judgments are biased toward a starting value—even when the starting value is unrelated to what is being estimated (Tversky & Kahneman 1974). For example, in one demonstration of the anchor effect participants were asked to estimate various quantities expressed in percentages (e.g., the percent of African countries in the United Nations). Before giving the estimate, they spun a "wheel of fortune," generating a number between 1 and 100. Results showed that people's estimates were strongly biased toward the number on the wheel—the mean estimates of those who spun low numbers were much lower than the mean estimates of those who spun high

numbers. Thus, the starting value, even though it was completely randomly generated, strongly affected subsequent estimates.

When respondents are asked to estimate a value for non-market goods (such as NEI values) with no upper limit, respondents have difficulty answering the question and responses tend to be wildly divergent (Skumatz 2002). In order to constrain the range of responses to NEI questions and make the questions easier to answer, evaluators often use an "anchor" as a starting point to which values can be compared. Traditionally, the anchor used in these questions is the average bill savings from the program. For example, instead of simply asking, "What is the annual dollar value of the increased comfort of your home?" respondents are told an estimate of the program average annual bill savings, and are asked, "Compared to [amount of average bill savings], what is the annual dollar value of the increased comfort of your home?" In other cases, respondents are not told their estimated bill savings and are asked, for example, "Is the value of the increased comfort in your home higher, lower, or the same as your bill savings from the program? How much more (or less)?" In either case, because there is an initial starting point used in the question, responses might be subject to the anchor effect; that is, they might be biased by the value of the bill savings (whether stated by the interviewer or estimated/assumed by the respondent). Indeed, across programs NEI values tend to be correlated with bill savings. However, the presence of an anchor effect within a single program cannot be detected in these studies because either the stated bill savings (the "anchor") is the same across participants or, when the amount of savings is not stated in the question, we do not know the amount of savings that respondents are estimating or assuming.

In the present study, the bill savings stated in the question varied across participants, depending on the measures they installed through the program. This variation allowed us to detect the presence of a possible anchor effect by calculating the correlation between stated bill savings and the NEI values estimated by participants. Indeed, we found that the bill savings stated in the question was highly correlated with respondents' NEI value estimates (Table 2).

Table 2. Correlation Between NEI Values and Estimated Bill Savings

NEI	Correlation to Estimated Bill Savings
Comfort	0.27 **
Noise reduction	0.43**
Property value	0.10*
Equipment Maintenance	0.35**
Durability	0.13**
Total NEIs	0.13**

* Significant at p-value < 0.05
** Significant at p-value < 0.01

It is possible, however, that this correlation between stated bill savings and NEI values is not an artifact of the method or evidence of bias. Another possible explanation for this correlation is that the amount of bill savings might actually be related to the "true" value of NEIs. That is, program participants with more comprehensive or energy-saving measures installed through the program might have accrued more non-energy benefits. For example, whereas someone who had only attic insulation installed and realized $100 in annual energy bill savings might be slightly more comfortable than before, another participant who installed attic

and wall insulation, air sealing and a new HVAC system and realized $500 in annual energy bill savings might be a great deal more comfortable.

It is important for NEI survey research that these two explanations of the relationship between stated bill savings and NEI values be teased apart. If estimates are biased because of the "anchor effect," this should be taken into account in reporting NEI values of programs, and survey methods assessing NEI values possibly need to be adjusted. By the same token, if it is the case that greater bill savings are actually related to the "true" value of NEIs, this is also important to know. In order to assess which explanation is correct, it would be necessary in future basic research to vary the stated bill savings for program participants with the same installations. A high correlation between bill savings and NEI values in such a research design would suggest that NEI values are subject to an "anchor effect" bias, whereas a low correlation would suggest that the relationship between stated bill savings and NEI values both across and within programs is based on a true, meaningful relationship between the two values.

NEIs Estimated in Dollars Compared to Percent of Bill Savings

In NEI surveys, respondents are often asked to estimate NEI values compared to bill savings either in terms of dollars or as a percent of bill savings, depending on the particular survey. There is no *a priori* reason to think that one method will yield more accurate values than the other, or that one is easier than the other for respondents to answer.

In the current study, respondents were given both options. For example, respondents were asked whether they experienced increased comfort in their home. If they agreed that they did, the interviewer queried, "Compared to the [X amount of your bill savings], how much would you say this increased comfort is worth, either in terms of dollars or as a percent of bill savings?" This design allowed us to compare the two types of responses—both whether there was a difference in the percent of respondents who chose to express values in dollars versus percent of bill savings, and whether the average values differed for the two formats.

Results of this analysis show that a greater proportion of respondents expressed NEI values as percent of bill savings than in terms of dollars for each of the six NEIs asked about (see Table 3). Thus, expressing NEI values as a percent of bill savings seems to be easier and more natural for participants.

Table 3. NEIs Estimated in Dollars Compared to Percent of Bill Savings[1]

NEI	Responded in Dollars (% of Respondents)	Responded in Percent of Bill Savings (% of Respondents)	Mean value of responses expressed in dollars[2]	Mean value of responses expressed in percent of savings[2]
Comfort	73 (17%)	175 (42%)	$988 (sd=1409) *	$350 (sd=808) *
Noise reduction	22 (5%)	84 (20%)	$488 (sd=468)	$322 (sd=440)
Property value	98 (23%)	123 (29%)	$6,732 (sd=7476) *	$253 (sd=389) *
Equipment Maintenance	58 (14%)	95 (23%)	$528 (sd=730) *	$323 (sd=482) *
Durability	37 (9%)	104 (25%)	$942 (sd=1198) *	$257 (sd=471) *
Total NEIs	100 (24%)	206 (49%)	$1,308 (sd=1972) *	$288 (sd=471) *

[1] The table reports data for respondents who were able to estimate NEI values in dollar amounts or as a percentage of bill savings. The remaining respondents indicated that they did not experience the NEI or were not able to estimate a value of the NEI.
[2] Zero responses were excluded from calculations of the means
* Significantly different at the 90% confidence level.

In addition, the mean value of responses given in dollars was substantially higher than responses expressed as a percent of bill savings for each of the NEIs, indicating that response format significantly impacts estimated NEI values. One potential reason for this result is that a percentage is usually conceptualized as a value from 1-100. Therefore, when respondents are asked to express a value in terms of a percent of bill savings they may be less likely to express a value higher than bill savings (i.e., a percent higher than 100) than when they are asked to give a dollar value, which neither biases respondents to give a value higher nor lower than bill savings.

One way to adjust NEI questions in order to correct this downward bias in responses expressed in percent of bill savings would be to first ask whether the NEI value is higher or lower than bill savings; if higher, ask the respondent to estimate how much higher in terms of a percent (e.g., 10% higher). The survey questions in the current study included such a follow-up question for those who had failed to express a value in response to the first NEI question.

Responses to Initial and Follow-up NEI Question

As noted earlier, respondents can have difficulty estimating the value of non-market goods such as NEIs. For example, only 39% of respondents to an early NEI study using the WTP format were able to provide NEI values (Skumatz & Nordeen 2002). By using the Relative Valuation method and providing a follow-up question that prompted respondents to estimate the value of an NEI they had experienced, substantial percentages of respondents were able to provide NEI values to a follow-up question rather than the initial question, effectively increasing response rates (Table 4).

Table 4. Percentage of Respondents Who Provided NEI Values to First NEI Question Compared to Second NEI Question [1]

NEI	Provided NEI value in response to 1st question	Provided NEI value in response to follow-up question	Did not experience NEI	Total valid responses
Comfort	32%	27%	25%	83%
Noise reduction	16%	9%	68%	93%
Property value	40%	12%	23%	75%
Equipment Maintenance	26%	10%	23%	60%
Durability	22%	11%	56%	90%
Total NEIs	51%	22%	10%	83%

[1] The table reports data for respondents who were able to estimate NEI values in dollar amounts or as a percentage of bill savings. The remaining respondents indicated that they did not experience the NEI or were not able to provide a value.

Conclusions

In this paper, we have documented four methodological issues pertaining to the measurement of participant-based NEIs through surveys—the discrepancy between the sum of individual NEI values and respondent-reported "total" NEI values, the difference in NEI values when expressed as dollars versus as a percent of bill savings, the correlation between bill savings and NEI values, and the increase in response rates resulting from asking a follow-up question. Although it has been recognized for some time that these relatively "intangible" NEIs are valuable impacts from programs, evaluators had not attempted to quantify them in monetary terms until relatively recently (Skumatz 2002). Thus, as of yet there is no methodological "gold standard;" researchers are still experimenting with and refining methods for measuring them.

In continuing to refine methods for monetizing survey-based NEIs, it is important to consider the issues and results we have documented in order to generate values without bias, measurement error, or low response rates. For example, our research suggests that there is substantial overlap among residential NEIs. Scaling the value of individual NEIs proportionately to a 'total NEI' value is one strategy which can correct for possible overestimates of individual NEIs. Further, because of potential bias from the anchor effect, additional research examining the correlation between bill savings and NEI values is needed. Similarly, additional research examining the impact of response format will help determine if responses estimated as a percentage of bill savings are underestimated or if, conversely, responses estimated in dollars are overestimated.

Overall, the RV method remains a promising method to monetize participant NEIs. Applying our findings and further research will help refine RV methods and reduce potential measurement errors. As confidence in the ability of survey methods to generate reliable and valid results increases, these important benefits of programs, although difficult to quantify, will become more widely recognized.

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