# Differences in the Valuation of Non-Energy Benefits According to Measurement Methodology: Causes and Consequences

*Lisa A. Skumatz, Ph.D. and John Gardner*
*Skumatz Economic Research Associates*

## Abstract

Until recently, planners, administrators and evaluators largely ignored the non-energy benefits of energy-efficiency programs because accurate measurement of those costs and benefits can be elusive. Despite the potential consequences of inaccuracies in the measurement of non-energy benefits, the consequences of omitting them are more severe: the assumption that all effects not causally related to reduced energy use or spending on energy are equal to zero can drastically underestimate the value of energy-efficiency initiatives to program participants and non-participants alike.

This realization has led many agents and organizations to seek estimates of the non-energy benefits that may obtain as a result of the efficiency initiatives that they propose. To date, research into non-energy benefits has suggested that such benefits comprise a substantial proportion of overall program value, often exceeding the dollar value of the energy savings.

Despite the growing recognition of the importance of non-energy benefits to program valuation and planning efforts, estimates of non-energy benefits vary widely based on the valuation methodology used to obtain them. Most non-energy benefits estimation work centers around survey methods. Broadly, the two competing methodologies are (a) willingness-to-pay and willingness-to-accept approaches, especially contingent valuation, in which respondents are essentially asked what they might pay in exchange for the non-energy benefits that they have received, and (b) scaling methods, in which respondents are asked to give, either in absolute or relative terms, the value of the non-energy benefits that they have experienced relative to another more readily valued good – in many cases the energy savings associated with the program itself.

In this paper, we summarize the different approaches to measuring non-energy benefits, including variations within approach categories, and present broad comparisons of numerical results as obtained through examples of research utilizing each method. We discuss the potential causes of the quantitative and qualitative differences in the results obtained through the different valuation approaches and present implications of the results.

## Introduction

Non-Energy Benefits, or NEBs, are a class of impacts that accrue to parties involved in the use of energy-efficient equipment. NEBs include a variety of impacts that result from the use of energy-efficient equipment, and in particular, participation in programs that aim to promote energy efficiency through the installation of such equipment. Although the literature calls then non-energy benefits, they are the "net" of both positive and negative impacts that may be attributable to the use of efficient equipment. As developed by Skumatz,[1] NEBs cluster into three primary categories:

[1] Skumatz, Lisa A., Ph.D. and Rob Bordner, "PG&E's Venture Partner's Pilot (VPP) Program Evaluation: Process Evaluation, Performance Indicators, and Estimates of Non-Energy Benefits", Skumatz Economic Research Associates, Inc., prepared for PG&E, San Francisco, California, March 1996.

- **Utility NEBs:** These are utility and ratepayer benefits that result in reduced revenue requirements, including: (a) savings through a variety of administrative and carrying costs, such as those related to changes in arrearages and service terminations and (b) reductions in transmission and distribution losses when fewer kWh are distributed through the system. The changes attributable to these impacts are mostly valued at utility avoided costs for the relevant labor category.
- **Societal NEBs:** Societal benefits or public benefits include program results such as economic stimulus or the value of reductions in greenhouse gas omissions and other pollutants. The values associated with these program-attributable changes vary with the specific societal impact under consideration.
- **Participant NEBs:** These benefits extend beyond energy savings and include, *inter alia*, improvements in comfort, lighting quality, residential satisfaction, equipment maintenance and safety issues. While many of the indirect benefits may be difficult to measure, they can be translated into dollar terms and incorporated as net program benefits accruing to participants.

While benefits from each of the above categories can occur for any business or household that purchases and uses energy-efficient equipment, the recognition of NEBs as a valid class of effects that occur due to the use of such equipment is particularly important for program evaluators. A consumer that has purchased a new energy-efficient appliance, they reap non-energy benefits in two ways. First, they experience the features of that appliance that are not inextricably linked to energy efficiency. These features might include aesthetic features of the appliance. Second, they experience features beyond energy-efficiency that could not have existed on that appliance if it was a standard-efficiency model. In private market transactions, only the second category counts as a true non-energy benefit. However, when public or private programs either install efficient equipment for businesses and households, or induce them to purchase that equipment with a rebate or other incentive, features arising in the first category may be considered non-energy benefits, because they were introduced to their recipients through an efficiency promotion program.[2] Because they take on such a unique and important role in the valuation of energy demand management programs, this paper focuses on idiosyncrasies in the measurement of participant non-energy benefits.

NEBs have become widely recognized as a program aspect that must be considered as apart of any holistic attempt to value energy-efficiency programs, both public and private.[3] Simply including NEBs in the cost-benefit calculations, instead of relying solely on energy savings as a metric for program effectiveness and value, can shed a dramatically different light on the usefulness of such programs. Failure to include NEBs in the program valuation process represents an error that may lead to suboptimal public policy decision-making. A less transparent concern is the extent to which inaccurate measurement of NEBs, or accurate measurement of poorly defined NEBs, may similarly distort the policymaking process.

This paper summarizes common NEBs valuation techniques and compares their results. Section 2 presents common techniques for measuring NEBs, including within-technique variations that may cause

---

[2] Whether benefits arising in the latter category should be considered by program evaluators as attributable to efficiency programs is an open question. SERA values energy efficient equipment relative to standard equipment in its empirical work.

[3] Schwietzer, Martin and Bruce Tonn. "Non-Energy Benefits from the Weatherization Assistance Program: A Summary of Findings from the Recent Literature." Oak Ridge National Laboratory. 2002. <http://weatherization.ornl.gov/download_files/Con-484-april02.pdf>. Skumatz, Lisa A., "Non-Energy Benefits – A Comprehensive Analysis and Modeling of NEBS for Commercial and Residential Programs", AESP Conference Proceedings, 2001.

significantly different quantitative outcomes. Section 3 presents comparisons form empirical work undertaken by SERA. Section 4 concludes with applications to public policy.

## NEBs Valuation Techniques

Current non-energy benefits valuation work tends to center around two primary techniques: contingent valuation and scaling. Each method presents its own advantages and drawbacks.[4]

### *Scaling Techniques*

At their core, scaling techniques for measuring NEBs are simple. They all involve asking program participants express the value of the NEBs that they experience relative to a numeraire with which they are familiar. Given that this work is most often undertaken in the context of the evaluation of programs that aim to provide program participants with savings on their energy bills, an obvious choice for this numeraire is the energy savings itself. One advantage to using energy savings as the reference point for measuring NEBs is that, in the context of a survey regarding the measures installed as part of the relevant program, participants have already been asked to discuss their energy savings, as well as other issues regarding the program's effect on energy use, and they are more likely to be mentally familiar with the issue than they might be otherwise.

Direct scaling asks participants to express the benefits that they experience as a percentage of their energy savings. This approach is advantageous in that it easily produces participant-level energy savings multipliers that should, at least in theory, more accurately reflect the value of the NEBs that each participant received. It also produces answers to a higher degree of standardization. Although energy savings may differ among participants, there can be no disagreement regarding what is meant when a respondent reports that they experienced non-energy benefits on the order of ten percent of their energy savings.

Direct scaling does, however, present some drawbacks. Though having benefits expressed as a percentage of energy savings is desirable for many reasons, survey respondents may find it difficult to estimate that percentage at all, let alone with any reassuring degree of accuracy. The latter problem may be dealt with statistically by assuming a normal distribution error in respondent replies. The former, however, can seriously disrupt program analysis – it is extremely important to present participants with survey questions that they can actually answer.

Relative scaling attempts to resolve that problem. Relative scaling questions once again ask respondents to value the non-energy benefits that they experience relative to their energy savings. However, they do not require interviewees to choose exact percentages. Rather, they ask them to express the benefits qualitatively relative to their energy savings. The relative answers are then translated into average percentages or ratios using empirical research. The tradeoff between relative and direct scaling questions is obvious. One presents a harder-to-answer question to respondents, but potentially offers more accuracy; the other presents an easier-to-answer question, but is less directly translated into a dollar value.

Regardless of the specific type of scaling question used, the technique is very successful in producing meaningful and interpretable responses. One potential drawback of both question formats is the

[4] For early work, see Skumatz, Lisa A., Ph.D., "Comparing Participant Valuation Results Using Three Advanced Survey Measurement Techniques: New Non-Energy Benefits (NEB) Computations of Participant Value", Skumatz Economic Research Associates, Inc., Proceedings of the ACEEE Summer Study, ACEEE, Washington DC, 2002.

assumption that respondents actually experienced energy savings. In cases where program participants claim that there were no noticeable changes in their energy bills, scaling-based NEBs valuation needs to use a different comparator.[5] Nevertheless, empirical research indicates scaled NEBs values are, in general, much more stable than those obtained through the techniques primary competitor: contingent valuation.[6]

### *Contingent Valuation Techniques*

The contingent valuation approach to measuring NEBs involves, despite the variant used, asking program participants to place a dollar value on the benefits that they experienced. Contingent valuation has also been used to measure the value of environmental damage in litigation and is, for obvious reasons, the subject of some controversy. The appropriateness of contingent valuation has been widely debated in the environmental economics literature.

There are two basic variations of the contingent valuation method. The first, Willingness to Pay (WTP), asks participants to estimate how much (usually in dollars annually) they would be willing to pay for the NEBs that they claim to have experienced. As the name implies, Willingness to Accept (WTA) asks them to estimate how much they would accept in compensation if they were divested of those same benefits. Empirically, WTP and WTA values tend to fall near one another, although there is considerable theory and evidence that WTA values average higher than their counterparts.[7]

In addition, WTP and WTA questions can be phrased as either discrete referendum-style questions in which respondents are asked whether they would pay (or accept) a predetermined amount (this value is usually determined through either open-ended pre-testing or values obtained in similar studies) or as open-ended questions in which respondents are simply asked to estimate the dollar value with no prompt. Such questions are easier for respondents to answer than open-ended questions because most consumers have little experience placing an exact dollar value on commodities that they have never purchased directly. In addition, responses to yes/no WTP and WTA questions can transformed into median values by applying a logistic regression method. This technique, though, is sensitive to the values that are chosen to be asked of respondents. Careful pre-testing must be conducted to ensure that the price prompts given are in a reasonable range. Moreover, when budgets are small or when sample universes are limited, adequate pre-testing may not be possible.

In such cases, open-ended contingent valuation questions may be posed. Evidence from surveys clearly shows that NEBs valuation responses given in the open-ended format tend to vary widely and exceed values obtained through any other technique. In addition, many respondents find it too difficult to even estimate a value, particularly when the benefit that they are considering is at the level of whole-building savings or larger.

All types of contingent valuation approaches to measuring NEBs are subject to some degree of bias. Economists believe that WTP and WTA questions may either (a) lead respondents to believe that they

---

[5] A variation of this effect is the variable savings scenario. When efficiency programs are homogenous in the measures that they install and the locations in which they install them, average deemed energy savings generally suffice when multiplying scaling answers to obtain dollar-valued savings. However, when either factor differs significantly from participant to participant, average savings may drastically distort the value of NEBs, particularly when extreme scaling responses coincide with extreme savings estimates. Unfortunately, individual-level energy savings data may be difficult or impossible to obtain, potentially diluting the accuracy of NEBs valuation using the scaling technique.

[6] For additional corroboration, see Skumatz, 2002, *op. cit.*

[7] Horowitz, John and K.E. McConnell. 2002. "Willingness to Accept, Willingness to Pay and the Income Effect." October, 2002.

have entered a bargaining situation in which they have an incentive to misrepresent the true value of the good in question or (b) appear so hypothetical that respondents do not seriously consider the true value to them of the benefit that is under consideration, leading to highly variable replies.

## Comparative NEBs Valuation Results

SERA has conducted non-energy benefits evaluation work for many energy-efficiency programs, both public and private, large and small. Below are comparisons of the valuation results for two programs, including:[8]

1. An energy efficient lighting program sponsored by a state utility commission and administered through a private contractor that offered free upgrades to compact fluorescent light bulbs as well as reduced fees for other lighting measures; and
2. A state and federal government funded low-income weatherization assistance program that implemented various measures depending on the household, including weather stripping, insulation and appliance replacement.

### *Non-Energy Benefits Studied*

Table 1 presents a breakdown of (a) the types of non-energy benefits reviewed by each study and (b) the share of aggregate (program total) NEBs that each category comprised. This table illustrates not only the breadth of the impacts of NEBs for participants in energy efficiency programs, but the extent to which effects that are only nominally related to energy use, such as the overall comfort of one's home, doing good for the environment or the amount of noise emitted by an appliance may be considered beneficial to a program participant.

The programs under comparison here were chosen because they are funded by various government and private agencies and organizations, all with the same goal of increasing the installation of different types of energy efficiency equipment. In addition, in the empirical work conducted to assess each program, participants were asked a similar combination of scaling and contingent valuation questions, making the results (relative to program size and scope) comparable across programs.

**Table 1. Non-Energy Benefits by Category and Program**

| Weatherization Program | | | | Lighting Program | |
|---|---|---|---|---|---|
| NEB | % of Total | NEB | % of Total | NEB | % of Total |
| Comfort | 16% | Impacts on environment | 2% | Equipment maintenance | 6% |
| Ability to pay bills | 8% | Sick days | 1% | Equipment lifetime | 7% |
| Light quality/quantity | 7% | Water bill costs | 3% | Quality of light | 14% |
| Noise inside home | 6% | Health: chronic conditions | 3% | Quantity of light | 13% |
| Noise outside home | 5% | Health: other illnesses | 2% | Building safety | 4% |

[8] Note that these two examples were chosen because they are recent, and they show variations in the results. The results identified in the second program example are more typical of results found in our previous research. See Skumatz 2002 *op.cit*., which covers other weatherization programs and finds similar results with contingent valuation results much higher and more volatile than results based on the comparison methods. For other results, see Skumatz, Lisa A., and John Gardner, "Methods and Results for Measuring Non-Energy Benefits in the Commercial and Industrial Sectors", SERA, Conference Proceedings for ACEEE Industrial Conference, ACEEE, Washington DC, 2005., Bicknell, Charles and Lisa Skumatz, "Non-Energy Benefits in the Commercial Sector: Results from Hundreds of Buildings", Conference Proceedings of ACEEE Summer Study, ACEEE, Washington DC, 2004, Fuchs, Leah, Lisa A. Skumatz, and Jennifer Ellefsen, "Non-Energy Benefits (NEBs) from Energy Star®: Comprehensive Analysis of Appliance, Outreach, and Homes Programs", Conference Proceedings from ACEEE Summer Study, ACEEE, Washington DC, 2004, and the reports cited in those studies.

| Weatherization Program | | | | Lighting Program | |
|---|---|---|---|---|---|
| **NEB** | **% of Total** | **NEB** | **% of Total** | **NEB** | **% of Total** |
| Equipment maintenance | 7% | Health: headaches | 2% | Impact on sales / productivity | 4% |
| Home aesthetics | 6% | Health: Medical care costs | 2% | Noise | 5% |
| Understanding of energy use | 11% | Health: Medication costs | 0% | Understanding of energy use | 3% |
| Likelihood of moving because of energy costs | 0% | Home safety | 8% | Flicker | 7% |
| Equipment performance | 5% | | | Doing good for the environment | 27% |
| Calls to utility | 2% | | | Sick days | 0% |
| Payment/shutoff notices | 3% | | | Satisfaction with program | 10% |
| | | Total | 100% | Total | 100% |

### *Scaling Results*

Table 2 summarizes the results from scaling methods applied to the projects described above. Both mean and median values are reported to deemphasize potential outliers in characterizing the overall level of benefit associated with each program.

**Table 2. Scaling Valuation Characteristics**

| | Mean | Median | n |
|---|---|---|---|
| Energy-efficient lighting | | | |
| Relative scaling | $1,373 | $1,887 | 98 |
| Direct Scaling | $1,742 | $1,887 | 81 |
| Low-income weatherization | | | |
| Relative scaling | $74 | $80 | 338 |
| Direct scaling | $106 | $102 | 231 |

The median values for both methods exceed mean values for the lighting program, but this is deceptive. The energy efficient lighting program that we studied had both full and partial participants, receiving commensurate levels of assistance.

**Figure 1. Histogram of Energy-Efficient Lighting Program NEBs, Relative Scaling**

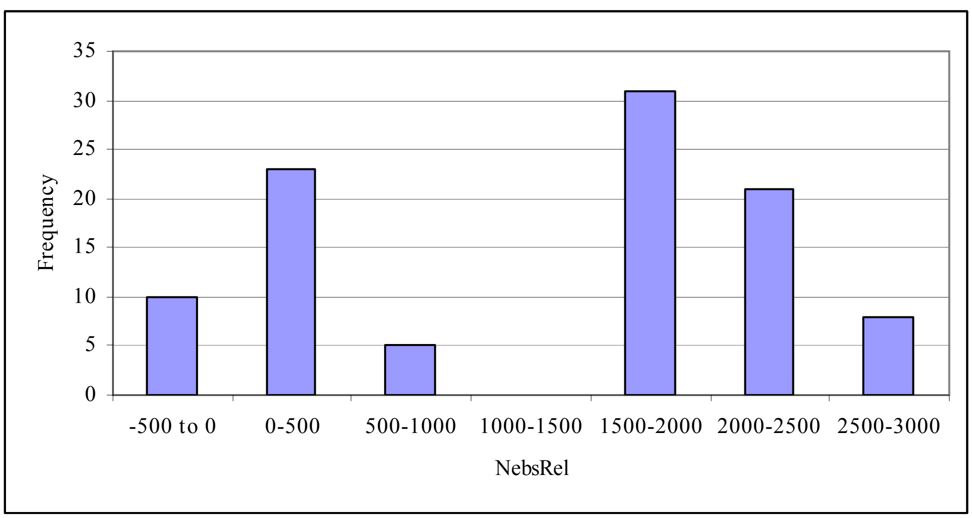


**Table 3. Lighting Program Valuation Characteristics by Group**

| | Relative scaling | | | Direct scaling | | |
|---|---|---|---|---|---|---|
| | **Mean** | **Median** | **n** | **Mean** | **Median** | **n** |
| Partial participants | $212 | $186 | 38 | $150 | $186 | 34 |
| Full participants | $2,109 | $1,887 | 60 | $2,427 | $2,170 | 47 |

Table 2 and
Table 3 make it clear that both methodologies are sensitive to outliers. Still, there is no predominate trend towards either relative or direct scaling producing consistently higher or lower results across projects or groups. In fact, although the multipliers used to perform the direct scaling valuations were chosen independently before the surveys were administered, the relative and direct scaling series' correlate highly for both programs ( $r = .84$, $p \approx 0$ for the lighting program; $r = .65, p \approx 0$ for the weatherization program). This consistency suggests, at the least, that the values chosen correspond closely to those implied by interviewees when replying to relative valuation questions.

Both the relative and direct scaling results provided above come from questions that ask respondents to value the combined non-energy benefits that they experienced, relative to their energy savings. However, in each case, the combined valuation question was preceded by a series of questions designed to elicit characteristic-specific non-energy benefits, such as those presented in Table 1. The questions used to accomplish this benefit decomposition are each a microcosm of the overall NEBs valuation questions; a particular benefit category (e.g., less noise from household appliances) is identified, and participants are asked whether they experienced any change in that particular area. If they did, they are asked to value that change in terms of their energy savings.

**Table 4. NEBs Summed Over Categories**

| | **Mean** | **Median** |
|---|---|---|
| Lighting: Sum of relative scaling NEBs | $5,361 | $2,755 |
| Weatherization: Sum of relative scaling NEBs | $278 | $239 |

A natural test of the joint accuracy of the component-wise and combined NEBs valuation techniques is whether the sum of the individual non-energy benefits is similar to the total provided for combined benefits. As Table 4 demonstrates, this is clearly not the case. Total average NEBs for the lightinig program are $5,361 after summing through categories, but only $1,373 when valued together. Similarly, the sum of by-category benefits for the weatherization program is $278, but only $76 when taken as a whole. Although the sums do not match up, there is a strong correspondence between the component-wise and combined non-energy benefits figures.

There are some mathematical limitations to the relative scaling methodology – because the values that are used as multipliers are not explicitly chosen by respondents, there is no guarantee that the whole will not be less than the sum of the parts. The comparisons between relative and direct scaling presented above, however, demonstrate that total values taken from relative scaling-based valuation are not far from those obtained through direct scaling, where respondents themselves choose the exact percentages at which benefits should be valued relative to energy savings.

The component-aggregate disparity demonstrated described in Table 4, therefore, may result from respondents implicitly adjusting their internal values in order to accurately map the component-wise benefits that they experienced from the energy efficiency measures installed in their homes to relative value scale with which they have been presented. There is some evidence to suggest that this is the case.

The following graphic plots the relationship between directly scaled non-energy benefits from the lighting program and benefits as calculated by summing the relative values for each category. After removing one extreme outlier, a consistent linear relationship appears between the two series. The data produced by the two valuation techniques are highly correlated ($r = .72, p \approx 0$), with a slope coefficient of .11 (also statistically significant).

The same is true for the weatherization program, for which direct-scaled and summed-relative non-energy benefits have a correlation coefficient of .35 ($p \approx 0$), and a slope coefficient of .07, which is also statistically significant. Furthermore, for both the lighting and weatherization programs, a substantial amount (52% and 12%, respectively) of the variation in direct-scaled NEBs can be explained by variation in summed, component-wise relative-scaled benefits.

The confluence of evidence suggests that summed component-wise NEBs and their aggregate (both relative and direct) scaled components move in lock step, and that while the meaning of labels such as "more valuable" may change depending on the size and the scope of the non-energy benefit being considered by the respondent, the general sense of which benefits are greater compared to energy savings is real.

**Figure 2. Energy Efficient Lighting Program: Summed and Direct NEBs**

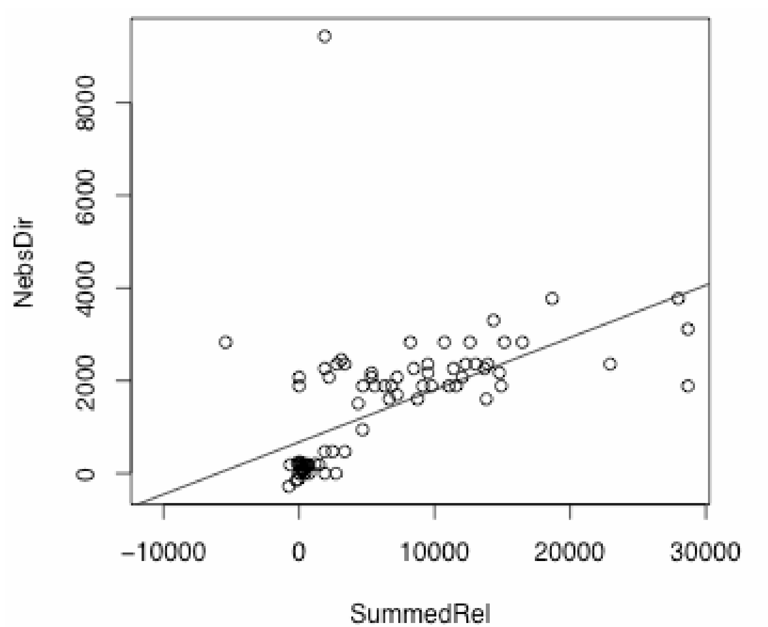
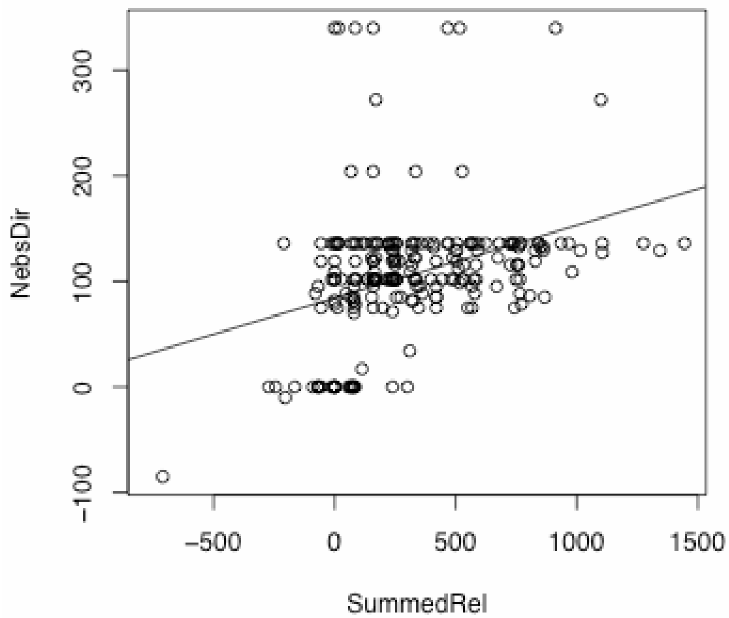


**Figure 3. Weatherization Program: Summed and Direct NEBs**




### *Contingent Valuation Results*

Table 5 summarizes the contingent valuation results (both willingness to pay and willingness to accept) for both programs.

**Table 5. Contingent Valuation Results**[9]

| | Willingness to pay | | | Willingness to accept | | |
|---|---|---|---|---|---|---|
| | Mean | Median | n | Mean | Median | n |
| Lighting program | $803 | $300 | 70 | $807 | $325 | 70 |
| Partial participants | $431 | $120 | 20 | $435 | $120 | 20 |
| Full participants | $952 | $500 | 50 | $955 | $500 | 20 |
| Weatherization program | $664 | $250 | 43 | $734 | $200 | 109 |

| | Relative scaling | | | Direct scaling | | |
|---|---|---|---|---|---|---|
| | Mean | Median | n | Mean | Median | n |
| Lighting program | $1,373 | $1,887 | $1,373 | $1,742 | $1,887 | 81 |
| Partial participants | $212 | $186 | 38 | $150 | $186 | 34 |
| Full participants | $2,109 | $1,887 | 60 | $2,427 | $2,170 | 47 |
| Weatherization program | $74 | $80 | 338 | $106 | $102 | 231 |

The most obvious trend in Table 5 is the disparity between WTP and WTA values. In general, WTA values are higher, no matter how they are measured or asked. This issue has been addressed in the environmental valuation literature for some time.[10] Perhaps more surprising is that, in the survey administered to lighting program participants, the WTP and WTA questions were asked in direct succession, meaning that some respondents estimated how much they would pay for the benefits, then gave higher answers for how much they would sell the benefits for, and gave higher answers to the latter

[9] Scaling results shown for comparison.
[10] Horowitz, John and K.E. McConnell. 2002. "Willingness to Accept, Willingness to Pay and the Income Effect." Journal of Economic Behavior and Organization, 51, 537-45, October, 2002.

question, even though they had just indicated their optimal purchase price.[11] Also of note is the pronounced difference in values when evaluated at the series' mean and median. Probably because contingent valuation responses require program participants to supply actual dollar values, WTP and WTA results are very sensitive to outliers.

Of greater interest for program evaluators is the disparity between contingent valuation responses and scaling responses. The contingent valuation and scaling responses differ substantially for each program. Moreover, while contingent valuation responses are greater than scaling responses for the weatherization program, the converse is true for the lighting program.[12]

Table 6 and Table 7 present correlation matrices for the non-energy benefits metrics discussed throughout this paper. Correlations between any contingent valuation and scaling metric have been bolded.

**Table 6. Lighting Program: NEBs Metrics Correlation Matrix[13]**

| | NebsRel | NebsDir | WTPYear | WTAYear |
|---|---|---|---|---|
| NebsDir | 0.8451 | | | |
| WTPYear | **0.0671** | **0.0206** | | |
| WTAYear | **0.0666** | **0.0196** | 0.9999 | |
| SummedRel | 0.6387 | 0.5220 | **0.0922** | **0.0911** |

**Table 7. Weatherization Program: NEBs Metrics Correlation Matrix**

| | NebsRel | NebsDir | WTAYear | WTPYear |
|---|---|---|---|---|
| NebsDir | 0.65312 | | | |
| WTAYear | **0.09473** | **0.38921** | | |
| WTPYear | **0.12255** | **0.02755** | 0.0112 | |
| SummedRel | 0.49436 | 0.34517 | **0.07093** | **0.07701** |

Plainly, none of the contingent valuation and scaling measures correlate highly for either program.[14] Although economic theory can explain why respondents might have incentives to either overstate or understate their true values, those misstatements should, theoretically, still be based on actual values. The alternative explanation is that, when estimating dollar values, those interviewed simply have no idea what dollar amount the benefits that they experience might be worth.

To construct an accurate answer to this question, we need viable external estimates of non-energy benefits. To date, few studies have taken alternative approaches to measuring such benefits. However,

---

[11] This was not an issue in the weatherization program's survey; WTP and WTA questions were separated by other questions.

[12] Note that the preponderance of evidence from earlier studies sides with the results found for the weatherization program here. That is, most of the previous work shows the contingent valuation-derived results are generally larger and more volatile than the comparison-derived values. See Skumatz, 2002, op.cit. The results for the lighting program here are different from most of the previous work.

[13] Variable mnemonics: NebsDir refers to direct-scaled NEBs, NebsRel refers to relative-scaled NEBs, WTPYear refers to willingness to pay for NEBs in dollars per year, WTAYear refers to willingness to accept in exchange for NEBs, and SummedRel refers to NEBs valued by summing the dollar values of the NEBs categories presented in Table 1.

[14] However, note that the correlation between the relative and direct scaling methods (in Table 6) are relatively closely correlated. This implies that the speedier method of asking verbal relative scales for responses to the questions – rather than the slower tactic of asking for specific percentages associated with each NEB category.

prior empirical work undertaken by SERA has shown that contingent valuation responses to non-energy benefits questions tend to be highly volatile and often suggest unreasonably high dollar values.[15]

## Conclusion

This paper has presented theoretical and empirical perspectives on the use of scaling and contingent valuation techniques for estimating the non-energy benefits of energy-efficiency programs. Scaling and contingent valuation are the most prevalent techniques in use today for measuring NEBs, literally constituting the state of the art. Each method, at some level, requires survey respondents to supply subjective estimates of the value of the non-energy benefits that they have experienced (but note also that many of the benefits themselves have some subjective or perception-based elements). Each measurement method has its own pros and cons.

Contingent valuation is the most direct of the non-energy benefits estimation methods. It literally requires that program participants specify – in dollar terms – the value of the non-energy benefits that they have received. Value specification at such an abstract level is difficult for many respondents, and leads to benefits estimates that are highly variable and sensitive to outliers. At the same time, contingent valuation requires fewer assumptions. Energy savings estimates need not be supplied, and respondents can provide non-energy benefits responses even if they perceived little or no cost savings on energy.

Scaling techniques for measuring non-energy benefits attempt to work around the impediment that may be posed by asking participants to supply dollar values. Rather, it asks them to value benefits relative to something with which they are hopefully intimately familiar: the energy savings that they experienced by installing high-efficiency equipment. Field work shows that this is a relatively faster survey to administer as well – and the verbal scaling approach is even more rapid to administer than the direct percentage approach.[16] The drawbacks of scaling methods include the necessity of accurate energy savings estimates, respondent difficulty in specifying accurate percentages, and the ambiguity associated with applying predetermined multipliers to relative scaling questions.

Ultimately, both valuation methods suffer from the same overarching problem: the difficulty of creating non-energy benefits estimates independently of participant interviews. Though energy efficient equipment is sold in the marketplace, it is sold at a price that presumably encompasses both its energy efficiency and non-energy features. Some of these features vary from model to model, and SERA has used statistical approaches to decompose the proportions of each model's value that obtains due to those features to try to draw correlations and further illustrate approaches to measuring value.[17] However, some equipment characteristics, particularly those that cannot be observed until the product is in use, do not lend themselves to measurement and cannot be directly disaggregated from the total value of the product. For these characteristics, interview-based metrics such as scaling and contingent valuation are the only means by which estimates of their relative value can be obtained.

---

[15] See Skumatz, Lisa. 2002. "Comparing Participant Valuation Results Using Three Advanced Survey Measurement Techniques: New Non-Energy Benefits (NEB) Computations of Participant Value." Proceedings of the ACEEE Summer Study on Energy Efficiency, ACEEE, Washington DC, 2002. P. 8,307.

[16] And years of comparisons of "direct" versus "verbal" scaling methods by previous SERA research shows that the two derive closely correlated results.

[17] See Gardner, John, and Lisa A. Skumatz, Ph.D., "Decomposing Price Differentials Due to ENERGY STAR® Labels and Energy Efficiency Features in Appliances: Proxy for Market Share Tracking?", Skumatz Economic Research Associates, Inc., Proceedings of ECEEE Conference, Mandileu France, 2005.

The overall lack of external information about the value to consumers of benefits such as increased health, improved home aesthetics, reduced equipment noise, and the like raises the need for laboratory or controlled-experimental data to which other valuation techniques can be compared. While equipment manufacturers may perform such tests, the data are not made publicly available. In the absence of reliable test data, proxy techniques for total non-energy benefits may provide a consistent and justifiable means for comparing results from different approaches to non-energy benefits valuation. As the set of issues and assumptions presented in this paper suggests, however, proxy methods suffer from their own deficiencies and must be applied with careful attention to the best techniques.

Although non-energy benefits valuation techniques cannot provide precise valuations, there is strong and repeated evidence that these benefits exist and are significant and valued by consumers and program participants. As such, program evaluators and policymakers should not ignore non-energy benefits. Public and private programs that promote energy efficiency create a host of positive effects that reach beyond reduced energy use. Program participants experience, among other things, better equipment performance, reduced equipment maintenance costs, increased home and business comfort, as well as a sense of satisfaction from contributing to conservation.[18] In addition, social benefits such as economic growth and job creation, as well as utility benefits such as reduced transmission costs and fewer shutoffs arise due to energy efficiency programs.

These NEB benefits may be difficult to express in highly precise dollar terms, but they are recognized by their recipients as real and valuable. It is important to incorporate estimates of non-energy benefits into program decision-making, especially when they involve expenditures of public funds. While precision is difficult to deliver in association with estimates of indirect benefits, the level of precision needed to avoid making "wrong" program decisions (which, it may be argued, is an appropriate criterion) is far from demanding. The methods discussed in this paper have been used to derive reasonable, defensible estimates of these important omitted program impacts.[19] Despite the potential consequences of inaccuracies in the measurement of non-energy benefits, the consequences of omitting them are more severe: the assumption that all effects not causally related to reduced energy use or spending on energy are equal to zero can drastically underestimate the value of energy-efficiency initiatives to program participants and non-participants alike. Using "best" estimation methods can provide estimates sufficient to avoid underestimating important program impacts.

[18] Low income participants gain another set of benefits that are related to lessening of hardship and other factors that would be nearly impossible to measure directly, but can be addressed using the comparative approaches discussed in this paper.

[19] NEBs analysis has a number of other applications as well. See Skumatz, Lisa A., and John Gardner, "Methods and Results for Measuring Non-Energy Benefits in the Commercial and Industrial Sectors", SERA, Conference Proceedings for ACEEE Industrial Conference, ACEEE, Washington DC, 2005. This paper also addresses other aspects of best estimation methods.