

Attributable effects from information and outreach programs: Net to gross, NEBs, and beyond

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Abstract

Education, outreach, advertising, and training programs provide particular difficulties in evaluation, as they focus on modifying behaviors and purchases rather than directly installing measures. This paper summarizes the results of a literature review of more than 80 studies evaluating strengths and weaknesses of evaluation work on outreach and education programs. Then, the paper presents the results of several applications of advanced evaluation techniques that are being applied to outreach, education, and training programs.

This paper provides the results from detailed net-to-gross (NTG) and non-energy benefits (NEB) evaluations of outreach, training, and education programs, including:

- A training and education geared toward commercial architects and engineers;
- Two similar programs geared toward residential builders and remodelers;
- Residential appliance-related education and outreach programs (Energy Star®); and
- An information-based university program.

We provide information from detailed evaluations of the share of energy savings and attributable effects that are due to the program's efforts (net-to-gross ratio), and the non-energy benefits (NEBs) recognized by participants. These results augment the usual evaluation studies, and provide insights that

can guide informational, outreach, and training programs to maximize their effectiveness. The attribution and NEB results provide a fuller picture of the benefits from the program, support more sophisticated benefit-cost analysis, provide direction for maximizing program "bang for the buck", and help support program decision-making and marketing.

Literature Review on Impacts from Outreach / Education Programs

The first phase of our work involved a broad-based literature review and interviews on results from evaluations of other outreach / evaluation programs. We interviewed more than 70 professionals and reviewed more than 80 different papers related to evaluating energy and environmental outreach / education programs in an effort to discern overall trends in the effectiveness of education as it pertains to conservation-based outcomes. The interviews provided information and leads on published reports and other useful contacts. In addition, they provided an opportunity to learn about past and on-going work, a chance to discuss opinions on directions these types of evaluation are taking, suggestions on promising techniques, and other topics. Our contacts and literature were not limited to energy. We reviewed work in energy-efficiency, environmental and conservation work, recycling and hazardous waste, advertising/marketing, and other fields we thought might have similar advertising / education programs and evaluation challenges.¹ The results from the energy program and advertising

1. We did not review literature in cognitive and consumer psychology, learning, or detailed behavioral literature. For a more detailed summary of this review, see Skumatz and Green, ACEEE 2000.

Table 1. Summary of Findings / Lessons from Evaluations for Outreach / Education Programs in Energy, Recycling, and Advertising

Field	Evaluation measurement methods, results, and "gaps"
Energy studies	Vast majority of studies on energy education relied on the same basic techniques – pre- and post-billing analysis, usually with a control group (another community) or treatment group that didn't receive the education portion. Some work on influences beyond demographics (self-efficacy). Limited work assessing differences between outreach methods. Impacts: 0-12 % savings – most 4-7 %; higher (13-15 %) from feedback programs. Also find increases in program satisfaction. BUT small sample problems in most of the studies.
Recycling	Some pre- and post- campaign measurement of recycling rates, often without control groups. Some community-based social marketing work. Limited work on outreach methods encouraging one-on-one outreach. → Increases of 2-12 % diversion; increases in diversion of target materials (0-50 %), other effects (household hazardous waste) BUT most analyses primitive.
Advertising and Marketing	Use a variety of focus group and survey methods to examine success at points in the decision-making process, including recall, intention, etc. Track quality of copy; strong correlation between intention and purchase reported. Much tracking of numerics like advertising exposures, etc. (but less on effects). Pre/post-campaign scanner data are used, often "controlled" by data tracking agencies that purport to address baseline issues. Comparisons between special groups of communities that have been randomly assigned different cable feeds that allow inclusion / exclusion of ads from groups within same community. → intent and recall studied / measured, but little quantitative work on impacts on actual <u>purchase</u> or behavior change (largely "rules of thumb").

/ outreach portions of this review are summarized in Table 1. Overall, the results are presented in Table 1. Of course, the gross impacts of some large-scale programs have been measured in more detail (billing analyses for Energy Star® programs, etc.); however, some of the major weaknesses found in the literature survey are summarized in Table 1.

Most importantly, very few of the studies addressed two key aspects of program effects – the share of total gross savings that are attributable to the program, and the indirect / omitted program effects deriving from outreach programs – the positive and negative non-energy benefits (NEBs) from the program.

Measuring Net to Gross (NTG) Analysis and Non-Energy Benefits (NEBs)

This paper addresses two aspects of program effects from a set of education, outreach, and training programs: net to gross (NTG) ratio, and Non-energy benefits. Each is described below.

DEFINING AND ESTIMATING NET-TO-GROSS (NTG)

The net factor takes the calculated savings (termed gross savings) for the energy efficiency measures that were installed under the program and subtracts from these gross savings the energy savings that are due to actions that participants would have taken anyway, i.e., actions that were not induced by the program. Commonly termed the free-rider effect, this subtraction is meant to correct for energy efficiency measures that would have been installed at the project even if the project had not participated in the program.² Spillover effects capture program effects and impacts that go beyond the measures installed through the program at the specific project sites. This includes additional energy efficiency (EE) measures installed at project jobs, EE installed because stocking practices changed in

the market due to the program's outreach, and other induced, rather than direct, installations.

We develop estimates of these factors – free ridership and spillover – using detailed interviews with samples of program participants and non-participants. Using a battery of questions, participants are asked about their likelihood of purchasing similar energy efficient equipment had the program's influence not been present. We also ask corroborating information about the importance of the program's incentives, the likely timing of their investment without the program, and other questions designed to identify that portion of the program's gross savings that would have occurred even without the program (free ridership). Detailed interviews with both participants and non-participants serve as the basis for the free ridership estimates. To estimate spillover, participants are asked a variety of questions about the degree to which they have purchased more energy efficient models (or applied energy efficiency design principles) at jobs beyond the program; non-participants are asked about the degree to which the program's influence on the market has caused them to install or adopt energy efficiency measures and practices (Skumatz et.al. 2004).

The overall net-to-gross multiplier is estimates these combined attributes of the program – net impacts at participating projects and spillover impacts that result from the program but occur at other projects or otherwise are missed by the program's accounting for energy savings. As a result, overall net program impacts are based on the development of a net-to-gross (NTG) ratio. When the NTG ratio is multiplied times the estimated gross program impacts, as accounted for by savings from installed measures recorded in program records, the result is an estimate of program impacts that are attributable to the program (i.e., impacts that would not have occurred without the program).

ESTIMATING NON-ENERGY BENEFITS (NEBS)

Certainly, energy savings, awareness, market share and other metrics provide direct indicators of program effects; a significant body of work has been developing around recognizing and measuring non-energy benefits (NEBs). NEBs include a variety

2. Or for outreach programs, if the person had not been influenced by program advertisements or other interventions.

Table 2: Total NEB and NTG Results for a Sample of Outreach, Training, and Education Programs

Program	Sector	Type / Intervention	NEB as multiple of energy savings	NTG Ratio
New Construction	Commercial	Builder training	1.0	1.3-1.4
Technical Assistance	Commercial	Technical Assistance	0.85	0.9-1.1
Energy Star New Homes	Residential	Builder training	1.1	1.1-1.2
Home Performance with Energy Star	Residential	Contractor training	1.0	1.1-1.3
Energy Star® Refrigerator	Residential	Appliance outreach	0.25	0.85-0.95
Energy Star® Dishwasher	Residential	Appliance outreach	0.65	0.85-0.95
Energy Star® Clothes washers	Residential	Appliance outreach	0.45	0.85-0.95
Energy Star® CFL	Residential	Appliance outreach	0.90	0.85-0.95
Energy Star® CFL Light fixture	Residential	Appliance outreach	0.30	0.85-0.95
Energy Star® Room Air Conditioner	Residential	Appliance outreach	0.70	0.9-0.95
Energy Star New Homes®	Multifamily	Builder training	0.65	n/a

of program impacts – *positive and negative* – that result from the program. The NEBs results in this paper are expressed in “net” terms – including both positive and negative impacts. The literature tends to sort these benefits into three “perspectives” (Skumatz 2001):

- Utility / Agency NEBs: Net benefits accruing to the utilities or program-sponsoring agency, including fewer billing-related calls and other follow-ups, lower bad debt from unpaid bills, lower T&D losses, and other benefits, which result in lower revenue requirements for the agency, and are appropriately valued at the agency’s marginal cost and discount rates.
- Societal NEBs: Net benefits beyond those accruing to the utilities / agencies or directly to participants, including economic multipliers or job creation benefits, reduced environmental impacts from emissions, and other benefits valued at societal costs and discount rates.
- Participant NEBs: Positive and negative impacts that are realized and recognized by program participants. For ENERGY STAR® programs, these tend to include comfort, decreased water usage, personal satisfaction, environmental benefits, and other benefits for system owners. These effects are measured using valuation methods appropriate to the owner.

This paper focuses on NEBs for the third category – participant NEBs.³ Many of these participant benefits are hard to measure (e.g. “comfort”); however, it is important to estimate dollar values for these benefits in order to allow comparison with direct energy benefits, and to provide more comprehensive information for scenario analysis within cost-effectiveness assessments of the program. An extensive literature has worked to develop and compare measurement methods to estimate dollar values for participant NEBs (Skumatz, 2002). The method used in this paper has proven more successful than willingness to pay (WTP) or other approaches. Based on this research, several steps were used to derive the dollar estimate of participant NEBs. A list of categories of NEBs that are relevant to the program was assembled, using information from literature and past research. For each of the NEB categories, respondents were

asked whether the energy-efficient equipment or design features led to a positive or negative effect or no effect compared to standard equipment or design features. The same battery of questions was asked for the overall or total of all the individual NEB categories. Finally, for those NEB categories with an effect (either positive or negative), respondents were asked about the relative value of the NEB relative to a known value. The value of the overall / total NEBs were also asked, and the data were used to compute the dollar value of NEBs and the value relative to energy savings. The use of energy savings provides a short-cut for expressing the value of NEBs because it shows the direct effects on payback and benefit-cost ratios (Skumatz 2002, 2005).

Net Impact Indicators for Education, Training, and Outreach Programs

The NEB and NTG results for a variety of outreach, training, and education programs are shown in Table 2.^{4 5 6}

Results show even education / outreach programs can have strong impacts.

- NEBs: The programs show strong non-energy benefits – effects that are commonly omitted from the analysis of attributable program effects. Each of the comprehensive programs (construction and remodel-oriented programs) show NEBs near or exceeding the dollar value of the energy savings due

3. Benefits from key components of the societal benefits are being estimated in another part of NYSERDA's evaluation activities. For information on societal benefits for other residential (and other) programs, see Imbierowicz and Skumatz (2004), Skumatz and Dickerson (1998).

4. Program. We have also evaluated combined weatherization and education programs; however, separating that portion of the effects due to each “measures” is not straightforward. For work in this area, see Gardner and Skumatz, 2006.

5. NEB as multiple of energy savings. These results reflect the results of scores of studies the authors have conducted. The figures in this column reflect the average value of the participant-value NEBs divided by the energy savings from the program. We use survey-based responses using two valuation approaches: relative value or labeled magnitude scaling (asking respondents about the value of the NEBs relative to a numeraire for which we have a dollar value), and willingness to pay / willingness to accept / contingent valuation approaches. These methods of computing NEB values are described in detail in Bicknell and Skumatz 2004, and particularly in Skumatz 2002.

6. NTG Ratio. These NTG ratios are derived from NTG analyses conducted by the authors. NTG is measured the following way. Then, a net to gross (NTG) analysis is needed (see Skumatz, et.al. 2004 for a detailed discussion of techniques for this analysis). NTG work uses survey techniques, difference of differences, or other methods to identify 1) “free riders”, or those participants that would have installed the measure even without the influence of (or incentive from) the program (decreases savings attributable to the program), and 2) spillover, or additional savings the program did not “count” or incentivize that its influences caused in the marketplace indirectly. Both participants and non-participants can contribute to spillover, which tends to increase the attributable savings. The survey methods were described earlier in this paper. The combination of these two effects represents the NTG ratio, the percentage applied to program-installed gross savings that are attributable to the program.

to the program. This implies that the payback and benefit cost ratios that exclude NEBs are only half as strong as the metrics including NEBs. For the Energy Star® appliance outreach / advertising programs, we find the NEBs range from about quarter to two thirds of the value of the energy savings from the measure. CFLs are the outlier, with NEBs almost as high as the energy savings.

- NTG: A net-to-gross (NTG) ratio of 1 means that the net savings attributable to the program are just equal to the gross savings; that each kWh of installed savings from program records were installed because of the program. The appliance programs had NTG ratios somewhat lower than one – some share of the purchases would have been made anyway, even without the program's influence. The construction and remodel programs had considerably higher NTG ratios. Because free ridership is rarely zero, this implies that there was considerable spillover attributed to these programs. Interviews with builders made it clear that the lessons learned in the programs were carried over to buildings that were not registered with the program. Also, builders believed that other builders that had not gone through the training (non-participants) were incorporating efficient techniques and measures because 1) the market was competitive and required incorporation of some improved energy efficiency practices; and 2) more efficient equipment was being stocked by dealers. The conclusion was that, for many of these education, training, and outreach initiatives, the program was having an effect on the broader marketplace.

The following section includes more detailed information on the NEB results associated with the commercial new construction, residential new construction and remodeling programs, and the appliance programs.

NEBs from Energy Star® Energy Efficient Appliance Outreach Program

Energy Star® appliance programs have been offered by numerous utilities and are promoted nationally. *Figure 1* and *Figure 2* shows the share of the total NEB values (provided in *Table 2*) accruing to each of the major NEB categories for each appliance as reported by residents that purchased ENERGY STAR® appliances. The results show that:

- The NEB multiplier was positive for all appliances, indicating that the value of the overall NEBs compared to the energy savings associated with that appliance is positive.
- NEBs are important to respondents: Nearly all NEB categories have some positive valuation for each measure. Environmental benefits, satisfaction with the appliance, appliance performance, and the value of appliance lifetimes all show high values.
- ENERGY STAR® dishwashers have the highest valued NEBs for any of the measures, followed by clothes washers and CFLs.
- The NEB value of CFLs almost equals their energy savings; lighting fixtures and refrigerators have lower values relative to the energy savings.

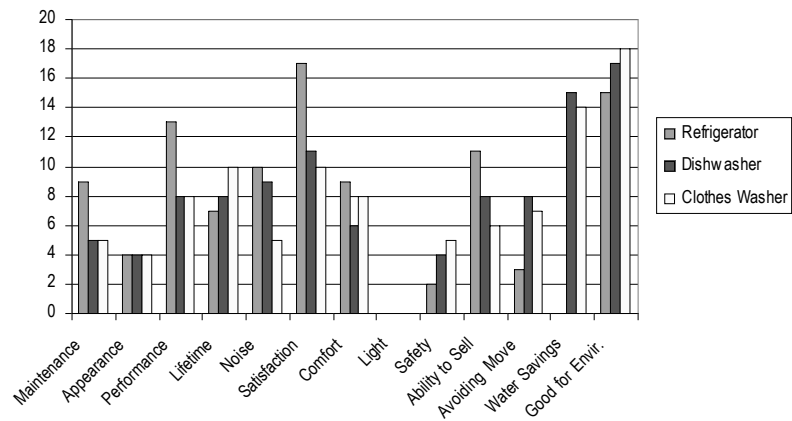


Figure 1. Distribution of NEBs for Energy Star® Appliances Program – Share of Total Participant NEBs by Category

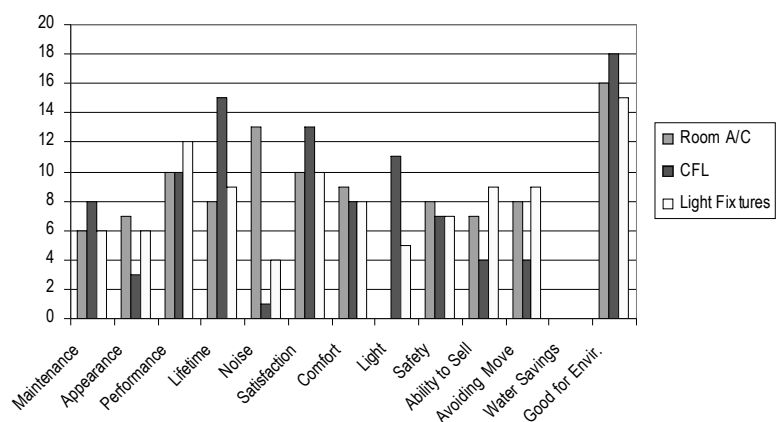


Figure 2. Distribution of NEBs for Energy Star® Appliances Program – Share of Total Participant NEBs by Category

- Dishwashers have the highest NEBs, with the highest benefits recognized in “doing good” for the environment, water savings, satisfaction with the new appliance, and lower noise levels. Clothes washer NEBs are the next most valuable,⁷ with the highest NEBs recognized in doing good for the environment, water savings, satisfaction, and appliance lifetime effects. Reduced noise levels were important NEBs for room air conditioners.
- ENERGY STAR® light fixtures do not seem to register with important or valuable NEBs, with the value representing only 5 % of the energy savings recognized from these measures.
- Those appliances most perceived to help improve the home's value (or that most ease the selling of the home) include refrigerators and light fixtures.

7. Although it might have been expected that clothes washers would have led to larger NEBs, it may be that respondents use dishwashers more often, forgot about (or did not value highly) the soap and clothes longevity benefits (they were not prompted about these benefits) or there may be other reasons for this result. This finding will be explored in future work by the author.

- The NEBs show owners value program's benefits in terms of better appliance performance, as well as less tangible benefits like environmental impacts and personal satisfaction.
- The NEB analyses indicate the ENERGY STAR® products program has led to significant benefits that are recognized by participants. These benefits were quantified for the first time as part of this study, and therefore, are not currently recognized by the program accounting but could be used for sensitivity analyses in future benefit-cost work.

In summary, the most highly valued NEBs categories vary by appliance; however, marketing on the environment would score well with all. More specifically, performance and maintenance would “connect” for refrigerators; water savings and noise reduction for dishwashers; and water savings & lifetime benefits for washing machines. These might be more effective approaches than marketing on “energy efficiency” – and may be easier to “sell” as well. In addition, air conditioner marketing could emphasize comfort and lower noise. Compact fluorescents (CFLs) could be marketed on maintenance, lifetime, and amount of light. Energy efficient lighting fixtures could be marketed for their effect on upgrading the home (appearance, ability to sell the home) and improved performance. These features / effects may be more effective than marketing on efficiency.

Net NEBs Results From the Energy Star® Residential New Construction and Remodeling Programs

Homeowners and builders were asked the NEBs associated with the new construction program; residents and contractors were asked the remodeling program. The results provide approximate findings from programs in several parts of the US. In each case, the programs focus on training efforts, and on encouraging incorporating of Energy Star® appliances and efficient building techniques and whole house approaches in new construction and remodeling. As shown in Table 2, the NEBs for the residential remodeling and new construction programs were similar. In both cases the multiplier was estimated at or above 1.0 times the energy savings.

Figure 3 shows the detailed results, breaking down the total NEB value by NEB category. The results show:

- NEBs are important to respondents: The most important categories of NEBs included environmental benefits, personal satisfaction, and comfort associated with having the installed measures. Many also cited ease of selling the home, improved ability to stay in their home, and equipment performance as important.
- Resident / owners value benefits highly: Owners recognized / reported overall NEB valuations about equal to the energy savings associated with the installation of the measures. Nearly one-third of these (internally held) values were from environmental benefits, personal satisfaction and comfort they valued.

The results showed residential contractors and builders believe residents gain significant (additional) value from the NEBs from new homes or remodels. Specifically, the highest value benefits from these responses include: comfort, resident sat-

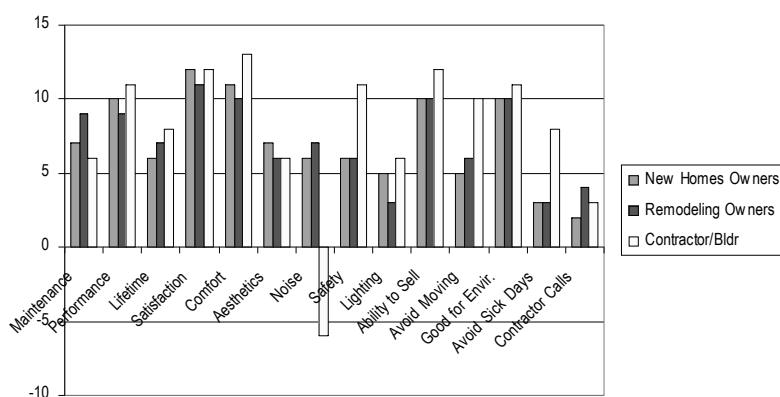


Figure 3. Comparison of Distribution of Net NEB Values between Homeowners and Specifiers – Share of Total Participant NEBs by Category

isfaction, and ease of selling the home. “Doing good” for the environment, building safety, and equipment performance are also assigned high value. Overall (as shown in Table 2), specifiers estimate that the value of the NEBs on an annual basis just exceed the value of the energy savings (multiplier = 1.1).

However, the results also imply that there are some barriers to some of the efficiency measures and approaches. Clearly, some of the specifiers feel there are negative effects in terms of noisier equipment, questionable effects on measure lifetimes from new measures, and concerns about lighting quality. The noise concerns were significant enough to have a negative NEB associated with that category.⁸ Other negatives just offset some of the positive values provided in those categories.

Comparison of Results for Owners and Specifiers

We compared the distribution of perceived NEB values for homeowners versus the contractors and builders that have key decision-making roles in terms of which measures are installed in the homes. These figures are provided in Table 3. One striking finding is the similarity in results across the NEBs categories recognized by builders / contractors compared to homeowners. There were no major disparities between perceived importance and values assigned to NEBs categories between project advisors (builders and contractors) compared to owners. However, while the relative benefits are fairly similar for the groups, there were a few important differences in values – that is, contractor / builders did not perfectly match the perception of the people to whom they were making equipment and design recommendations. In particular:

- Contractors and builders were skeptical about the noise from the new measures and design features. In fact, they viewed noise as a negative impact, compared to a more positive perception by homeowners. This may bear further investigation in future research.
- Contractors and builders were somewhat less positive about the maintenance costs than were homeowners. However, contractors and builders ascribed or recognized slightly

8. The noise results have not yet been explored to determine if they result from the noise of remodeling work that participants have attributed to the program, or whether the program homes or program job homes are perceived to be noisier.

Table 3. Use of Non-Energy Benefit in Decision-Making for Builders and Contractors for ENERGY STAR® Homes and Home Performance with ENERGY STAR® Projects

	All respondents	Builder participants	Builder Non-participants	Contractor participants
Do building owners (homeowners) recognize NEBs? (1=virtually never, 5=always recognize)	3.45 (21 % =5)	3.90 (33 % =5)	2.77 (5 % =5)	3.65 (24 % =5)
How often do specifiers use NEBs to inform home owners and developers? (1=virtually never inform; 5=always inform)	3.69 (21 % =5)	3.29 (14 % =5)	3.44 (17 % =5)	4.32 (31 % =5)
Are NEBs an important factor contributing to spillover? (1=not at all important, 5=very important)	4.18 (25 % =5)	4.29 (28 % =5)	3.59 (5 % =5)	4.72 (53 % =5)

more value to higher performance for the energy efficient measures and practices than did residents.

- However, contractors and builders were more likely to value NEBs from the following categories slightly more highly than the homeowners: safety of the home, the ability to control bills and stay in the home, and the ability to more easily sell the home. They were also more likely to expect the home to lead to fewer sick days than the homeowners.

Overall, the results indicate that contractors and builders ascribed higher NEB values to the program homes relative to the home's energy savings than did the residents themselves. This stands to reason because the programs tend to make concerted efforts to make contractors and builders aware of the health and safety benefits of meeting the home performance and Energy Star® homes standards.⁹

Whether Homes Program NEBs Affect Contractor / Builder Recommendations and Decision-making

In addition to asking about NEB values, the specifiers were also asked whether NEBs were used in their recommendations and decision-making regarding building or remodeling measures or practices. The results, contained in *Table 3*, show that participating builders / developers are more likely to believe that NEBs are recognized by homeowners than are non-participants (3.7 compared to 2.8). Most also imply that specifiers use NEBs in their work discussing project options with homeowners, particularly contractors. The results show that these benefits are also more commonly stressed by participants. Contractors and builders were also asked about the role of NEBs in spillover. Spillover was defined as:

- Decisions to add more or higher efficiency energy efficient measures or practices to the new home or remodeling job than required / encouraged by the program (for participants), or
- Changes to their building / construction practices to improve energy efficiency on other homes they work on outside the program (for participants and non-participants).

9. This may be complicated by some self-selection bias. Builders with greater interest in energy efficiency, or those with empathy or recognition of NEBs from energy efficiency measures may be more likely to sign up for the program. However, the program also includes training that emphasizes health, safety, and other NEBs from efficiency measures and practices.

The respondents were asked if they believe some of the NEBs were important in their decisions to take additional actions beyond the program. The results show that the respondents believe that NEBs are important contributors to spillover (scores more than 4 and almost 5 from contractors). The scores were high, and especially high for participants. This implies that NEBs are a driver for spillover, and are recognized as such.^{10, 11, 12}

NEBs for Commercial “High Performance” Building Outreach / Training Program

This program worked to increase the use of high performance building design and equipment in commercial buildings in the US. The project involved technical assistance and training for new commercial construction. Its primary objective in conducting this research is to understand attitudes, awareness, decision-making, and current practices concerning high performance building design. The program focuses on educating about and encouraging use of:

- High efficiency HVAC,
- Energy efficiency (EE)-based siting, envelope, and orientation,
- Daylighting, daylighting controls, and daylighting architectural features like light shelves, etc.
- Sustainable materials,
- Indoor air quality reducing practices and measures,
- And whole-building-based approaches, among other messages.

This program illustrates the additional information that can be provided when interviews are conducted with an array of program decision-makers and “specifiers”. Developers, owners, architects and engineers involved in the program were interviewed. Each respondent was asked whether they noted or perceived positive or negative changes, or no effect, from each of a

10. In future research, we may expand the research to ask a similar question about energy savings as a spillover driver and compare the results. It would be interesting to compare which is the more important driver for spillover – energy savings or NEBs.

11. Contractor participants. Insufficient contractor non-participants were available from the survey to provide results separately.

12. All respondents answer to the question whether they recognize NEBs. This reports the percent of respondents that replied using the value shown (e.g. 5=always recognize). In this case, 21% of all respondents stated that building owners / homeowners always recognize NEBs.

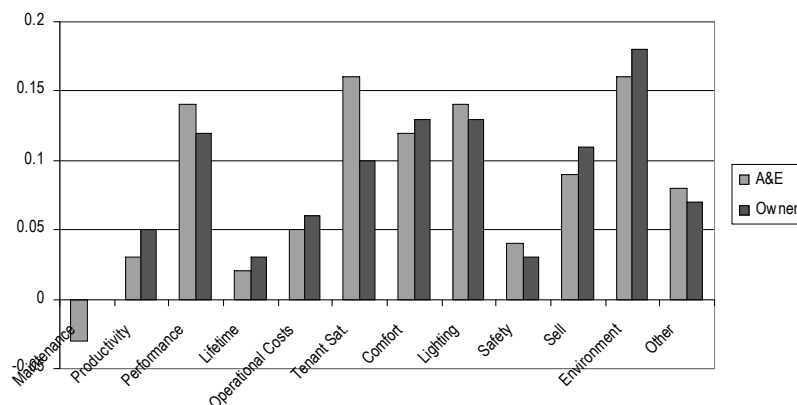


Figure 4. Estimated NEB Values for the High Performance Contractor Training Program, by Actor (Expressed as ratio relative to energy savings from the program)

Table 4. Summary of Barriers and Selling Points for Commercial High Performance Training Program

	Developer	Owner	Architect	Engineer
Barriers – Negative NEB	Equipment maintenance	Equipment maintenance Low (but not negative) ease of selling or leasing	Equipment maintenance	Equipment maintenance Low (but not negative) non-energy operating cost
Barrier – High % negative perceptions	Equipment maintenance	Equipment maintenance	Equipment maintenance	Equipment maintenance
Selling Points	Eqpt. performance, ease of selling/leasing, Comfort, Quality of light, Tenant satisfaction	Tenant satisfaction Equipment performance Comfort, Quality of Light Productivity	Tenant satisfaction Comfort Appearance Productivity	Appearance, Quality of Light, Tenant satisfaction Ease of selling / leasing Comfort, Non-energy operating costs

list of possible NEBs that pre-test interviews indicated were associated with the program's eligible / encouraged equipment.

Figure 4 presents a summary of the results on the direction of NEBs effects (negative or positive, with "no effect" as the remainder).

- Many of the respondents reported positive effects in the NEB categories, and the reports of positive effects were spread across all actors. Those NEB categories with highest positives were improved quality of light, comfort, tenant satisfaction, equipment performance, and productivity. Ease of selling/leasing the building, non-energy operating costs and quality of light were also positively perceived.
- Architects were most strongly positive about tenant, comfort, quality of light, and productivity effects. A&E actors tended to be less positive about equipment performance benefits than other actors.
- The NEB factors with highest reports of negative effects are maintenance and non-energy operating costs. For both, architects and engineers were more negative than other groups.

The program's NEBs include both positive and negative effects. For this program, all respondent types suggested that negative perceptions of maintenance of "high performance" measures – and concerns about whether their janitorial staff and local contractors could adequately maintain the equipment or obtain replacement parts – tended to decrease their interest in imple-

menting the package of measures.¹³ Equipment maintenance considerations were a negative influence affecting implementation for all actors, with owners least concerned.¹⁴ The detailed NEB analysis identifies one key barrier to widespread incorporation of the program measures into new buildings – perceptions of troublesome (in-house or contracted) maintenance associated with EE equipment. Education, training, or data to address these concerns could aid in addressing this concern held by various decision-makers. Alternatively, enhanced warranties, rebates, or other strategies could be used to address these negative perceptions or barriers.

Given that this program solicited feedback from both owners / developers and architects / engineers, we can also compare the NEB perceptions between the two groups – owners and specifiers. Architects and owners were more positively influenced by potential productivity, tenant satisfaction, and comfort benefits than other groups. The most important drivers for developers were equipment performance and ease of selling or leasing the building. Owners, however, were most influenced by in-house issues like comfort, tenant satisfaction, productivity, and quality of light. A&E differed in the degree of influence they assigned to several NEB categories. In particular comfort, tenant satisfaction, and productivity considerations were lower

13. Translated into dollars, NEBs provide a value (in \$) for the level of the maintenance barrier. This dollar amount – and the distribution of the dollars – can be used to craft an intervention to address the barrier. Warranties, rebates, or other strategies can be used, and the dollar value can be used to induce 50% or any other percent of the actors to "get past" the barrier and become accepting of the technology.

14. And owners may also be least experienced or may have less responsibility for these problems, although the degree to which the "specifying" A&E "live" with the equipment or track its performance after the fact is unknown.

for engineers; architects were less influenced by equipment performance and maintenance. Improved equipment performance and tenant satisfaction are strong positive factors in the decision whether to install these EE measures. Productivity improvements were also generally noted by owners.

Architects and engineers are more negative about equipment maintenance, equipment performance, and non-energy operating costs than the owners and developers. Given the importance of these factors, this may imply that A&E firms are more conservative about the degree to which they recommend EE equipment, and thus, less is installed than might otherwise happen.¹⁵ Therefore, *if* these perceptions are not appropriate or “accurate” given true performance of the technology in the field, targeted education – in terms that A&E accept – may be a useful addition to the program. However, *if* the perceptions are true, then the program may need to add maintenance training to the program and/or identify certified maintenance firms, work to make sure parts for the equipment are readily available, “buy up” the warranties, or make other program changes to address the issue.

Summary and Implications

Outreach, training, and education programs pose complexities in evaluation. Identifying attributable program effects requires enhanced research efforts, and this paper summarizes the results from work specifically examining net to gross (NTG), and non-energy benefits (NEBs).

The NTG results show that for many of these education / outreach programs, the programs could take credit for the majority or all of the program-tracked savings or measures; that is, their NTG ratios were near a value of 1.0. The construction and remodel programs had the highest NTG ratios. These programs have considerable spillover, and builders indicate that the lessons learned in the programs were carried over to many projects. In addition, builders that had not gone through the training (non-participants) were incorporating efficient techniques and measures because 1) the market was competitive and required incorporation of some improved energy efficiency practices; and 2) more efficient equipment was being stocked by dealers. The conclusion was that, for many of these education, training, and outreach initiatives, the program was having an effect on the broader marketplace.

The often-omitted effects called non-energy benefits (NEBs) were also analyzed. The results show that there were strong NEBs associated with these programs. These values can be included in benefit-cost analysis, in program marketing, in assessing program barriers, and in program design and targeting. Key findings are summarized below:

- **NEB values are important relative to energy savings:** The results from the appliance measures show individual NEB estimates on the order of 30 %-90 % of the energy savings associated with the individual measures. The results also demonstrate that the estimates of overall net non-energy benefits for the construction and remodel programs approximately equal the energy savings associated with program

participation. For many of the outreach and training -based programs, the NEBs double the value of the program (and halve the investment payback) to building owners.

- **Energy is not the only important benefit that appeals to owners and specifiers / decision-makers:** As mentioned, NEBs have significant value to program participants. The most valuable categories of benefits vary based on the program and measures; however, key NEBs include “doing good” for the environment, equipment performance, lifetimes (especially for CFLs), personal satisfaction from the measures, and ease of selling their home. The NEBs for the “homes” programs show that participants value the program’s benefits in terms of factors including improved ability to sell their home, as well as less tangible benefits like environmental impacts and personal satisfaction from the measures. Contractors and builders associate negative impacts with some program measures – particularly noise, and possibly concerns about maintenance costs. The commercial programs show especially strong NEBs perceived from tenant satisfaction, equipment performance, improved comfort, and improved lighting in the building.¹⁶ The perception or actual existence of negative effects could represent barriers the program can address in the future. The major example of a negative NEB was the maintenance concerns expressed in association with the commercial new construction program. Knowing this is a problem can suggest to program managers that this issue may need to be addressed by modified program interventions.
- **Perceptions of NEBs for Specifiers and Owners can Differ.** For the homes programs, contractors and builders also believe that residents realize valuable NEBs from project work. The estimated value from these respondents as a multiple of energy savings (1.09) is similar to that provided directly by participants (1.0) – indicating they have a fairly good handle on what residents perceive in terms of NEBs. In addition, there is strong agreement in the distribution of these NEBs between categories, indicating that the contractors and builders may have a fairly good feeling for the pulse for their market. However, for the commercial program, we see fairly distinct differences between the “specifier” perceptions of NEBs associated with new EE equipment than the NEB values expressed by owners. Generally, for this program, owners are more open to the new technologies than are the specifiers (particularly the engineers). This may suggest that the market is “underinvesting” in EE relative to what owners might be willing to accept. Additional education may be helpful in helping address this issue.
- Specifiers use NEBs in their recommendations and decision making. Contractors and builders believe homeowners recognize NEBs, and they use them to inform homeowners when making program-related choices. Specifiers also believe that NEBs are important contributors to spillover from the programs.

The results of the detailed NEB analysis provide key information on factors beyond energy savings that are valued by

15. On the other hand, architects are more positive about comfort, appearances, and ease of selling / leasing than owners.

16. Lighting and daylighting were focus areas of the program’s training.

participants – factors that may prove to be strong methods to attract additional program participants into the programs. While this has been repeatedly demonstrated for measure-based programs, we find high value associated with education / outreach programs as well. The quantified estimates of the various NEBs and their relative values are available to program implementers and provide useful input for outreach messages for the programs and associated practices and measures. The results indicate that programs could do well to “sell” measures and participation on benefits that appeal to owners and that they have indicated have value to them rather than relying on marketing that stresses energy efficiency.

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