WHAT IS ENERGY EFFICIENCY REALLY WORTH TO THE CUSTOMER?

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Introduction

Restructuring and competition are forcing many wide-ranging changes in the energy industry. One of these is an unrelenting push to move the concept of "customer focus" into actual practice.

For years the industry has taken a convenient, simplistic view of the benefits of energy efficiency programs to customers. Most, especially those who worked with customers, knew that this view was too narrow. However, a full acknowledgment of customer net benefits was believed to be too difficult for practical application.

In late 1995 the California Demand-Side Measurement Advisory Committee (CADMAC)—the monitoring and evaluation committee for the California Public Utilities Commission (CPUC)—was directed to conduct a study of the indirect costs and benefits of utility energy efficiency programs. The term "indirect costs and benefits" is used to capture all the costs and benefits left out of the standard calculation of participant net benefits.

This paper presents the findings of the pilot study conducted for CADMAC regarding the feasibility of measuring indirect costs and benefits (ICBs). Another paper accepted at this conference will identify and discuss the individual ICBs that customers experienced as a result of the program studied, a commercial lighting retrofit program.[1] This paper will focus on the project's efforts to estimate the dollar value of these ICBs.

Background

The most common test that has been used to determine whether an energy efficiency program is appropriate for utility implementation is the Total Resource Cost Test. It combines the net benefits of the program to its participants and to all ratepayers (through its rate impact), effectively "canceling out" those components that are a benefit to one group and a cost to the other.

The net benefits to program participants in this calculation are assumed to be their bill savings plus any rebate paid net of their equipment and installation costs. It has been acknowledged for many years that these components do not cover all participant program impacts.[2] The benefits and costs that have been left out are now referred to as indirect costs and benefits (ICBs).[3]

The ICBs of utility programs were identified in California's 1990 *Energy Efficiency Blueprint* as customers' transaction costs, the cost of risk, and changes in quality of energy services. Our study identified specific types of these ICBs experienced by participants in a commercial lighting retrofit program and went on to try to estimate their value.

Approach

The purpose of the study was to determine the feasibility and worth of estimating and monetizing ICBs. How big are these ICBs—especially relative to the other benefits and costs? (If they are small, maybe we don't need to bother with them.) Is it possible to estimate these ICBs with any accuracy? And if so, is their measurement worth the cost?

Due to the exploratory nature of the project we began with a set of focus groups. The purpose of the focus groups was to identify the ICBs experienced by program participants and nonparticipants. Table 1 contains the list of ICBs experienced. This information was then used to design the telephone survey.

We had initially hoped to use the survey to gather data to calculate the value of several more directly quantifiable ICBs, such as the cost of downtime during installations. However, the results of the focus groups convinced us that we were not likely to get sufficient useful information from customers through a survey to be able to do this. In the end, there was no reason for these customers to spend the time to track this data—at least not to the level of accuracy we needed.

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[1] "Shedding the Light on the Indirect Costs and Benefits of Commercial Energy Efficiency Programs" by Shel Feldman, Shel Feldman Management Consulting.

[2] See, for example, *Standard Practice for Cost-Benefit Analysis of Conservation and Load Management Programs*, California Public Utilities Commission and California Energy Commission, February 1983, for a discussion of a number of additional participant benefits and costs.

[3] In other work these costs and benefits have been called remaining market barrier costs and quality gains and losses. See, for example, Patricia Herman, *The Value Test: Its Context, Description, Calculation, and Implications*, California Energy Commission, May 1994.

Table 1: Indirect Costs and Benefits Explored in this Study

Grouping	Indirect Cost or Benefit
Barriers (leading to costs) experienced during project planning or implementation	Making proposals to upper or senior management Obtaining or setting aside funds Setting aside other organizational needs Staff time for planning renovations or retrofits Staff time for setting up contracts Finding trustworthy contractors Staff time managing retrofits or renovations Inconvenience during retrofits
Costs experienced immediately after implementation	Occupant or tenant complaints about the new lighting Cannot use old stock (existing inventory) Need to redecorate or rewire Vulnerability to code inspections Need to add task lighting
Threats to payback (risks)	The technology may not perform as expected The use of the space may change Energy costs or equipment costs may come down Newer, better equipment may become available
Threats of unanticipated consequences	Need for increased staff maintenance or attention More sophisticated staff may be needed to service and replace Increased responsibilities for disposal of hazardous wastes
Indirect benefits	Reduced lighting maintenance, purchase, and warehousing Reduced equipment failure Improved visual comfort of users and guests Fulfilling management objectives and philosophy Productivity; improved working conditions Better fit of lighting to user or customer needs Reduced discomfort due to noise and glare Improved appearance of facilities Increased attractiveness of merchandise Increased safety or security and reduced vulnerability to lawsuits

The survey began with a series of firmographic questions intended to enable us to compare the experience of ICBs to customer types. We then asked participants whether they considered each ICB in their decision making, and then asked to what extent they actually experienced each. For example, participants were asked whether improved visual comfort for their patrons or employees was considered in their decision to install efficient lighting. Then they were asked to what extent did they actually experience improved visual comfort.

Differences between the first and second set of questions indicate customers' misperceptions, lack of information, and bounded rationality regarding the ICBs of lighting—e.g., they did not consider (or expect to experience) improved visual comfort, but were now experiencing that benefit. The degree to which participants experienced each ICB was to give a rough indication of its relative size.

Nonparticipants were asked whether the same list of ICBs were part of their decision not to participate. Differences in participants' and nonparticipants' consideration of ICBs indicate the ICBs that could be addressed in program marketing to encourage nonparticipants to participate. Similarities in ICBs may give an indication that those indirect costs (benefits) are higher (lower) for nonparticipating customers than they are for participants.

Dollar Values for Indirect Costs and Benefits

The last portion of the survey contained a series of "pricing" questions intended to give a dollar threshold value for each participant's ICBs when taken as a whole. Participants were asked to first state whether they believed their company experienced positive net benefits from the installation of efficient lighting when all the costs and benefits discussed had been considered. A "yes" answer here would

indicate that the net value of the ICBs was positive, or that the net value was not so negative as to totally offset the traditional Participant Test net benefits (bill savings plus rebate minus incremental equipment costs).

Participants were next asked whether they believed net benefits would still be positive if their costs had been higher by a certain dollar amount. That is, are net benefits large enough that a certain amount could be subtracted and the remainder still be positive? This question was asked twice: once using an up-front dollar amount and once using an annual amount. The dollar amount was calculated separately for each participant based on their contribution to the net benefits of the program to all ratepayers.[4] A "yes" answer to this question would indicate that participant net benefits are larger than the dollar amount asked.

Results

One of the significant disappointments of the study was that we failed to get much information on the relative size of ICBs. Our survey design contained several approaches to obtaining this information, but our main method—a scale question—failed. We asked each participant whether they experienced each ICB "not at all," "slightly," "somewhat," or "a great deal." Almost all respondents answered either that they experienced each ICB "a great deal" or "not at all." That is, their answers gave no indication that a particular ICB was larger (i.e., experienced "a great deal") than another experienced either "somewhat" or only "slightly."

On the other hand, we were very successful with the "pricing analysis" or "willingness to pay" (WTP) questions asked. These types of questions are not without their problems, as discussed below, but their answers can provide extremely valuable information on what customers value.

The temptation with ICBs is to only measure those that are easily quantifiable or that will better program results. It is also likely that there are interacting and interrelationships between individual ICB values. Asking customers to value all ICBs (as our WTP questions implicitly do) seems to be the only way to ensure a full accounting.

We complied with the "rules" of such questions by making sure that respondents were as informed as possible (they had just gone through the list of ICBs and we had just reminded them of their estimated bill savings, equipment cost, and rebate amounts) and that they would have little reason to give a biased answer (we phrased the question so as to indicate a reasonable scenario—"what if costs were actually $X higher," but stayed away from asking whether they would have actually changed their decision.)[5]

Respondents did seem to consider each question separately and to feel they were able to judge the net benefits of the program on their company. We had only 13 "don't know" answers out of 70 respondents and answers varied in expected ways.

We were also very lucky in our choice of dollar values used in the questions. Since there are no other studies that have tried to estimate the net value of all ICBs, we did not have any idea where to begin our questioning. We were lucky in that the two or three dollar estimates embedded in the questions bounded customers' values almost half the time.

Finally, the answers given to the pricing analysis questions jibed with the net value of the indirect costs implicit in customers' energy efficiency investment criteria. If a customer's investment criterion is taken as a "short hand" way for that company to acknowledge the risks and other indirect costs of investments, the net benefits of the lighting project calculated according to that criterion can be seen as one estimate of the net benefits perceived by the customer. That is, if a company is using a five-year payback criterion for its energy efficiency investments, it is implicitly valuing the benefits of these investments beyond five years at zero in its investment decisions. It is unlikely that the company actually believes that there is no chance of benefits beyond year five. Instead, the use of this investment criterion acknowledges one or more of the following:

- The risk that the company will not see first-year or future benefits due to equipment failure, remodeling, business failure, etc.
- The fact that the company has many other higher-return investments available and a five-year payback is the minimum acceptable return.
- Investment decisions take valuable upper management time to evaluate; therefore, an investment must pay back fully in at least five years to justify (cover) its decision costs.
- The company has a high cost of funds, such that the value of benefits beyond year five is essentially zero.
- Other indirect costs.

[4]The dollar amount calculated for each participant was that participant's energy savings times his or her rate minus avoided costs plus the rebate and the participant's portion of utility administrative costs—i.e., the dollar amount that would just cover that participant's portion of the rate impact. This amount is equivalent to the dollar amount that would just wipe out that participant's Total Resource Cost net benefits. There was no way to know ahead of time the value participants placed on ICBs as a whole, therefore we chose values for the questions that would provide useful answers—e.g., even if we don't know the actual value, we know it was large enough that this participant's project is cost-beneficial.

[5]This second point—staying away from an actual change in decision—is an important one for efficiency programs, as one of the key market barriers may be ill-informed or seemingly irrational decision processes.

We calculated participant net benefits using the standard components (bill savings, rebate, equipment costs, and O&M cost savings) and discounting at the utility's cost of capital. We then subtracted the net benefits of the same components applying the company's investment criterion for each respondent who reported one. This difference is an estimate of the indirect costs implied in the investment criterion.

When we compared the dollar cost of the indirect costs implied in the investment criterion of each of the 33 customers who reported one to their answers to the pricing questions, the investment criterion amount either fell within the range (i.e., above the minimum WTP-based value for all ICBs and below the maximum, when a maximum was available) or below the minimum. This is the expected result since an investment criterion tends to capture only indirect costs, while the WTP responses were across all ICBs, and thus, included indirect benefits.

Dollar Estimates of the Net Value of ICBs as a Whole

Across the customers who answered the WTP questions, the responses of approximately half indicated that they valued their ICBs as a net negative (30 out of 55 who answered the up-front dollar questions and 23 out of the 54 who answered the annual dollar questions). That is, the maximum net value they gave to their ICBs as a whole was a negative dollar amount—i.e., the value of their indirect costs outweighed the value of their indirect benefits. The remaining half of the respondents indicated a relatively smaller net cost or possibly a net positive value. That is, the *minimum* net value they gave to their ICBs as a whole was a negative dollar value, but no maximum value was obtained.

As discussed above, a maximum dollar value for ICBs as a whole is obtained when a respondent answers "no" to a WTP question. In our study, a "no" answer meant that the respondent said that it was not likely that their company's net benefits from their lighting retrofit were large enough to cover the dollar amount asked. We did not get a "no" answer for any of the dollar values asked of roughly half of the respondents—i.e., they answered "yes" to all WTP questions. Since the highest dollar value asked was based on the minimum amount needed for cost-effectiveness to all ratepayers, respondent answers not only indicated the minimum net value of their ICBs, they also indicated whether these customers' projects were cost-effective. That is, when all costs and benefits to participants and nonparticipants are taken as a whole for these projects, a "yes" answer to all questions indicated that the benefits exceed the costs.

The remaining respondents answered "no" to at least the last WTP question (the highest dollar amount) and thus, their responses indicate the maximum net value for their ICBs, and that their projects were not cost-effective across all ratepayers.

Note that a large (or small) net negative value for ICBs does not mean that the customer was not happy—i.e., that they did not see positive net benefits from the lighting project. The standard calculation of participant net benefits usually shows large net benefits to customers. A negative net value for ICBs only means that customers' *actual net benefits are smaller than calculated using the standard test.* Only 3 out of 57 saw the net cost of their ICBs as large enough to cause their lighting projects to have been bad investments—i.e., have a negative net return.

Contingent Valuation

Although we did not plan for the use of this data in a contingent valuation (CV) model, we were pleased when our results showed promise for a future CV study. CV is a popular and sometimes controversial method used to value goods for which there is no explicit market.

The best CV studies use a double-bounded approach for the WTP questions; the dollar value (bid amount) used in the second question depends on the answer to the first. Thus, if a "no" answer is received to the first question, the dollar amount is reduced for the next question. If a "yes" answer is received to the first question the dollar amount is increased. As indicated above, we were lucky, as we could not expect our dollar amounts to bound any participants' answers.

CV studies also usually require large sample sizes—typically in the order of 1,000 to 2,000 data points. We were pleasantly surprised when a trial CV model was able to predict responses correctly in 69% of the cases (the concordant was 69%), and the "bid" and "benefits" coefficients were significant and had the right sign. Our unexpected success is likely due to the third good sign for the future of this approach—a coefficient of variation of 0.25 for the bid variable. This coefficient is likely so low because we calculated the model on a normalized version of the dollar amounts asked—i.e., each "bid" amount was normalized to that participant's net benefits excluding ICBs.

The results of the contingent valuation model estimated in this study must be taken with a large "grain of salt" because of the following: the small sample size, and the fact that the WTP questions did not follow a true double-bound pattern (we did not lower the bid amount when a "no" answer was received). Given these cautions, the contingent valuation model estimated the net value of participants' ICBs as –48.7% (–28.7% to –68.7% with 90% confidence) of participants' net benefits excluding ICBs. That is, if participants' net benefits calculated using bill savings, O&M savings, the rebate paid and equipment and installation costs was $10,000, the net value of ICBs was a net cost of $4,870 leaving net benefits to the participant including ICBs of $5,130.

Problems with "Willingness-to-Pay"-Type Analyses

While contingent valuation—and other WTP studies that ask customers to value goods—are popular, they are not without controversy. CV studies in particular have come

under intense scrutiny because they are often used to value environmental impacts.[6]

The main criticisms against these studies are that they overvalue the good studied (e.g., put a high value on damage to the environment), that there is no guarantee that the response is based on reality (i.e., is a gut reaction rather than a thought-out response), and relatedly, that a single respondent may not be able to speak for a household (or a company in our case).

It is common in all types of consumer research that self-reported willingness to pay is found to be higher than "actual" willingness to pay. In the case of ICBs, however, market tests are possible to verify willingness-to-pay results. As opposed to questions trying to value the cost of damage to a beach someone may never visit, willingness to pay for ICBs can be tested in the market. Customers choose to install efficient lighting or not. Based on the fact that significant net benefits exist for efficient lighting (even without a utility rebate according to calculations that exclude ICBs), if customers do not install this lighting on their own, there is market evidence of a large net negative value perceived for ICBs.

As to whether customer responses represent reality, there are at least two dimensions. First, do respondents have any idea of how to value the good in question. Respondents to a survey about an oil spill may not know how to value the loss or degradation of life involved. As a remedy to this problem, respondents should be given information that will help them develop their response without biasing the outcome. In terms of this study, we think that this dimension is a less significant problem. We did remind customers of their expected bill savings and costs, and our respondents were commercial business people who were asked about their own operations.

The second dimension of whether the responses represent reality has to do with whether the answer given was a gut-reaction or a well-thought-out response. Our survey did present customers with a question that they might not have thought about before—having to do with the net value of ICBs as a whole. There are several remedies to this potential problem. One is to provide the information needed to make the decision ahead of time so that the respondent has time to think about it before they answer. The second and possibly better remedy is to call respondents, say, a week later and see if their answers had changed.

Finally, is it reasonable for one respondent at a company to give a response for the company as a whole, especially when the valuation may involve costs and benefits that the respondent did not experience or was not responsible for? For example, can a facilities manager give a credible estimate of the net value of ICBs that includes employee comfort? We do not know the answer to this. Remedies for this in future studies involve warning the respondent ahead of time and having him or her obtain the needed information from colleagues, to provide information as to the likely order of magnitude for the values not directly the responsibility of the respondent, and interviewing more than one respondent at a facility.

Summary

Bill savings, equipment costs, and rebates are not the only benefits and costs participants experience in energy efficiency programs. This study has taken a first cut at attempting to measure the net value of the other costs and benefits participants experience. Using somewhat controversial willingness-to-pay-type questions, participants in a commercial lighting retrofit program indicate a likely net negative value across indirect costs and benefits. More important, however, than this specific result are the ramifications for the future of energy efficiency.

- **Indirect costs and benefits (ICBs) are real, large, and cannot be ignored.** Thirty ICBs were identified by this study and all were experienced by at least a significant minority of participants. Including the net value of ICBs as a whole in the calculation of participant net benefits will have a significant impact on results—one estimate is that including ICBs will reduce standard calculations of participant net benefits by 29% to 69%.
- **Willingness-to-pay-type questions and contingent valuation show promise for valuing ICBs.** Even with our small sample size we were able to obtain promising results from a contingent valuation model. Valuing all ICBs at once ensures that important ICBs are not left out of the calculations either due to ignorance or to an inability to separate individual ICBs from each other. This type of approach also has the benefit of allowing valuation of hard-to-quantify ICBs such as changes in quality, and obtaining the valuation of the perspective that matters—the customer.
- **The valuation of individual ICBs will aid program design.** The contingent valuation model we estimated only provided estimates of the value of ICBs as a whole. With a larger sample size it is likely that we would also be able to obtain values for individual ICBs—or at least for the key ones. This information can help guide program design in that mechanisms can be put in place to reduce large indirect costs and to emphasize large indirect benefits.
- **This study's results show promise for the direct estimation of the key value of market transformation—the removal of information-type market barriers.** The key market barriers claimed for the lack of customer adoption of seemingly cost-effective energy

[6]For critique of contingent valuation by some of the "biggest experts in the field" see Arrow, K., R. Solow, E. Leamer, P. Portney, R. Radnew and H. Schuman, 1993, "Report of the NOAA Panel on Contingent Valuation," *Federal Register*, 58, No. 10.

efficiency are information-related: lack of awareness, misperceptions or misinformation regarding risks and costs, bounded rationality, etc. A contingent valuation approach would allow direct estimation of the reduction of these barriers by allowing estimation of the value of ICBs before and after the adoption of an energy- efficient measure. The difference in the value given to these costs and benefits before the program (while experiencing market barriers) and after (while experiencing actual benefits) would give a measure of the value of reducing the barriers.