What Do Customers Value? What Benefits Utilities? Designing To Maximize Non-Energy Benefits From Efficiency Programs In The Residential Sector

Lisa A. Skumatz, Ph.D., Skumatz Economic Research Associates, Inc. (SERA), Seattle, WA
Chris Ann Dickerson, Pacific Gas and Electric Company, San Francisco, CA

ABSTRACT

This paper presents the results of two projects examining the non-energy benefits (NEBs) associated with residential demand-side management (DSM) programs. The research updated previous work in several ways. The model and estimates were modified to incorporate enhanced research on environmental benefits. We used an innovative technique to conduct phone surveys to provide stronger results on the participant-side non-energy benefits from programs. Greater flexibility was introduced into the model to allow costs and benefits to be modeled over multiple year horizons and to bring all benefits and costs to present value terms. Finally, the model incorporated a broader range of residential programs, including both single- and multi-family programs, as well as new construction programs. Some of the programs were low income assistance, and others were financing programs, rebates, and other designs. The programs allowed a variety of measure types, including: lighting, appliances, weatherization, and education.

Quantitative results derived from the draft model are presented to provide indicative information on the relative sizes of benefits from different program types and program elements. The relative values of benefits as seen from three different perspectives – utility (and ratepayer), societal, and participant – are provided to demonstrate the usefulness of this approach in assessing costs and benefits, and in planning programs that can maximize total or targeted benefits, given a program budget.

Introduction

In conjunction with the evaluation of several PG&E residential demand side management (DSM) programs, the authors conducted a quantitative assessment of the programs' non-energy benefits. The projects covered a variety of residential conservation programs – including programs targeted at the residential sector, as well as programs targeted at the multi-family and low income sectors. This article updates research and modeling work focused on the Venture Partners Pilot Program (VPP) (Skumatz, 1996, and Skumatz and Dickerson, 1996, 1997). For space considerations, this article will concentrate on updated estimates and literature and new results. This paper updates the previous NEB work with four major enhancements:

- literature survey work concentrating on updating environmental/economic benefits, and participant benefits estimates;
- primary research to develop estimates of participant perceptions of value of non-energy benefits from program elements;
- primary and secondary research to develop and tailor estimates for program-specific (and customer class-specific) non-energy benefits; and
- construction and refinement of a spreadsheet-based scenario analysis model for use in program design, refinement, and evaluation.

The programs analyzed covered an assortment of audiences and program types. Information on programs offered between 1994 and 1998 were modeled to compare the relative non-energy benefits between different types of programs. Residential programs for the single and multi-family sectors included:

- **Refrigerator Rebate Program**: This program offered residential customers rebates when they purchased a new energy efficient, CFC-free refrigerator that exceeded Federal Appliance Standard. The program also included a smaller effort that provided incentives directly to salespersons.
- **Air Conditioner Rebate Program:** This program offered rebates for the purchase of high efficiency central air conditioners.
- **Lighting Rebate Program**: This program offered rebates for purchases of efficient lights for common areas of multi-family buildings.
- **Financing Program**: A pilot residential third-party low interest loan program designed to address price-related barriers to high efficiency measures for single family dwellings.

Low income programs were also modeled, including:[1]

- **Venture Partners Pilot Program (VPP)**: A pilot low income weatherization and education program.
- **Low Income Weatherization Program**: A program offering free weatherization of homes, energy education services, and energy efficient refrigerators. Mandatory weatherization efforts include attic insulation, water heater blankets, energy efficient showerheads, door weather-stripping, caulking, and minor home repairs that affect infiltration. Non-mandatory measures were also offered through the program.

Table 2 includes the results from a subset of these modeling efforts. The study reviewed the literature and developed a methodology to determine credible categories of non-energy benefits associated with residential programs. The methodology and quantitative estimates developed served several purposes:

- to identify and quantify the broad range of non-energy benefits associated with the program;
- to formally recognize and estimate the benefits from three separate perspectives: utility / ratepayer, participant, and society;
- to provide information and a modeling approach to allow internalization of non-energy benefits into program decisionmaking; and
- to use the results to develop a filter to help target marketing to those customers with greatest potential for benefit from the program.

The following presents a summary of the literature review and the results of the modeling effort.

Literature Review

Although a number of sources in the literature address non-energy benefits in a conceptual way--usually itemizing the list of topics that might qualify as non-energy benefits--few have conducted applied research and developed quantitative estimates to identify the size of these benefits. Certainly,

[1] In another project, we also examined the non-energy benefits associated with a non-DSM program called "REACH", a program that provides bill-payment assistance to low income customers "in crisis", and is funded by shareholder contributions. See Skumatz and Bordner (1998).

for a number of years, programs have been approved on the basis of energy benefits alone. However, recent changes in industry avoided costs and increased interest in market transformation are leading to an increasing attention on incorporating what was always a logically appropriate component of the benefits and cost analysis --non-energy benefits.

Understanding the magnitude of all program benefits, including non-energy benefits, can help utilities maximize overall benefits from a particular program, or help select between alternative programs, holding program costs constant. By identifying all program benefits--not only to the utility, but also to customers and society—utilities (and policymakers) can conduct more complete benefit cost analyses, can develop programs that improve service to customers by maximizing benefits from programs, and can emphasize the benefits of those services to customers.

The authors conducted a review of the literature and interviewed a number of energy professionals active in this area to develop updated quantitative estimates of the non-energy benefits associated with a variety of DSM programs. Much of the literature in the area of non-energy benefits focuses on conceptual issues as to what might qualify as a non-energy benefit, and with a few exceptions, concentrates on the theoretical level. Many have addressed potential categories of non-energy benefits for DSM programs in general and some have tailored the information for specific program target groups (e.g., low-income residential, with extensive work on cost of arrearages), some work on weatherization programs, and limited work on other programs, including appliance and education programs. With several exceptions, few have stepped beyond the conceptual level and assigned specific quantitative estimates of non-energy benefits. Space constraints made a comprehensive review of the literature impossible, and much was reviewed and cited in previous publications on the VPP program (Skumatz, 1996, Skumatz and Dickerson, 1996, 1997). However, the references include a listing of literature used in the preparation of this paper, and a more comprehensive paper is available from the authors.

Two early pieces stand out in their comprehensive, quantitative approach. This study owes a debt to the interest sparked by these works. Brown, et.al. (1993) conducted a very comprehensive, quantitative analysis of the national energy and non-energy benefits associated with a low income weatherization assistance program. This study attempted to derive estimates of an array of non-energy benefits, including effects on housing, comfort, health, safety, arrearages, employment, and externality effects.

In one of the most comprehensive and applied early efforts on non-energy benefits, Magouirk (1995) quantified avoided costs and benefits from Public Service Colorado's Energy Savings Partners Program, a low income weatherization program offered by this gas and electric utility. The study found that the program generated significant non-energy benefits. Pre- and post-treatment changes in non-energy benefits attributable to the weatherization were examined and quantified in total and per-household terms. The study looked at a wide variety of non-energy benefits, including reduced arrearages, gas assistance calls, financial and insurance liabilities, collection costs, and other benefits.

A recent study, conducted by the National Consumer Law Center (Howat and Oppenheim, 1999), used the VPP work by the authors and a number of other publications to develop a non-energy benefits "avoided cost adder" to support a more comprehensive approach to calculating costs and benefits for DSM programs. This work was directed at providing input to regulatory and collaborative proceedings in Massachusetts. The study provided estimates for a number of utility and societal benefits, determining that avoided cost multipliers of between 1.70 and 3.50 could be justified with fairly conservative assumptions.

Environmental Updates

Further examination of the benefits that DSM programs could have on the environment was a particular focus of this round of work. In our 1996 efforts, we were not successful in identifying many sources that could provide quantitative estimates of the environmental or economic benefits from DSM programs. At that point, because there was little available, and because of time and budget considerations, we used multiplicative factors provided by the Northwest Power Planning Council (15% and 10% multipliers).

Although the effects on the environment are important to include, we found that developing estimates quickly becomes very complex because the effects *depend* on so many factors. For instance, emissions, although relatively easily quantifiable in terms of tons of emissions by factor, depend on which type of power source one is assuming is reduced (oil, coal, etc.). Secondly, even if the type of plant, or a mix of plants is selected, valuing the emissions depends on crucial location-specific factors like the specific air basin and its associated weather conditions, the existing levels of pollution, the number of people living in the area that might experience health effects, and so on.

The State of California conducted work on these issues (CEC, 1992, 1994). These efforts incorporated policy and analytical work by staff of the California Energy Commission, as well as extensive air modeling and valuation work by consultants (RER, 1994). The work provided estimates at a very micro- level, including emissions by factor by type of plant for over 14 separate air basins in California.

Other work reviewed and used includes emission figures from the Enbridge Consumer's Gas in Ontario, which provided values for air pollutants; and carbon emission figures from the UK Electricity Association Review (van Lookeren, 1999), and numerous other sources.

An extremely useful source was a brief memo report by Woolf (1999), prepared for the Massachusetts regulatory process. This report summarized the CO_2 emissions from natural gas facilities, adopted a conservative value of $25/ton for the CO_2, and determined that a 15% to 30% environmental and economic adder to avoided cost would be a very conservative range. Work for Boston Edison (Biewald, et. al., 1995) was also very useful and comprehensive.

Probably the single most concise and comprehensive analysis was by Galvin (1999), which was also prepared for the Massachusetts regulatory process. This study examined environmental benefits from (1) reduced air pollution, including criteria gases, greenhouse gases, and heavy metals; (2) reduced water impacts; (3) reduced land use impacts, and (4) economic benefits from increased employment, economic activity, and fuel dependence issues. The study reviewed work by the California Board for Energy Efficiency, and other work. It also cited a number of sources for per-ton "valuation" figures. After a line-by-line analysis, the study determined that the environmental benefits alone could range from a low of a 15.4% adder to avoided electric supply costs to a high of over 650%. The total economic and environmental adders were estimated at between 32.5% and 720%, with a midpoint of 376%.

Because the range for these benefits was so large, we estimated benefits from the PG&E programs using both the conservative multiplier and the midpoint to identify the effects on the distribution of non-energy benefits, as well as estimates derived from other sources. The results included in this paper are based on midpoint estimates from the Galvin work.

Customer Side Benefits

Another area of concentration was to try to develop estimates of the wide variety of non-energy benefits experienced by program participants. Although a number of researchers hypothesized the various types of benefits that might be experienced, the literature search turned up virtually no quantitative work in this area. In our previous modeling efforts for the Venture Partners Pilot (VPP) program, we attempted to estimate the impacts from a few important categories of participant benefits using "reasonable" assumptions, and now we were interested in exploring possible ways to develop more refined estimates of important auxiliary participant benefits. Arguably the most direct method of assessing the value of non-energy benefits to customers would be to ask them directly. However, the most direct form of the question (e.g., "what is the dollar value of the reduction in drafts in your home after it was weatherized") can be difficult for people to answer and can lead to unreliable results. We developed a modified approach for obtaining customers' self-reported valuation of non-energy benefits, and found promising results.

Our basic idea was to ask customers to characterize the value of the non-energy benefits *relative to* the energy savings on their monthly energy bill. We found that customers were quite willing to talk about these benefits and able to answer our questions about relative values. Because we had estimates of the average bill savings from each of the programs, we could then attribute a dollar value to the non-energy benefits after the fact.

A small sample of participants from each of the studied programs was contacted by telephone. As a first step, respondents were asked to enumerate the non-energy benefits they recognized from the program, then asked whether they valued that benefit *more than or less than* the bill savings benefit from the program. Then, for each of the benefits they mentioned plus a list of 30 benefits we had prepared ahead of time, we asked respondents to tell us *"how much more [less] valuable"* they felt the benefit was to them than the bill savings they experienced (or expected) as part of the program. These answers gave us a specific value multiplier to use in the non-energy benefits model (e.g., "about half as valuable as the bill savings," or "about three times as valuable as the bill savings," "about the same as the bill savings," etc.) As a final step, we asked whether, in total, the non-energy benefits associated with the specific measure were more valuable, less valuable, or about the same value as the energy savings. This last item let us "scale" responses if customers provided a higher sum through the individual items.

We also asked respondents a question about the relative *importance* of each benefit. We reviewed the list of benefits and for each item asked respondents to indicate how important the benefit was to them on a scale of 1-5 (with 5 being a very important benefit). Totaling these numbers enabled us to develop a "score" for each type of benefit and to compare the relative importance of the benefits associated with each program. Following a similar procedure, we also asked about negative effects of the program, which were usually "none", but did provide a few interesting comments.

The survey was small scale, but illustrated some of the benefits that residents recognized from these programs, and provide preliminary quantitative estimates of participant-side benefits to use in the model. The results are summarized in Table 1.

Modeling Approach

The model previously developed for the VPP work applied a two step process to estimate benefits: multiplying the potential *value* of a change or improvement in a non-energy benefit times the expected change in *incidence* or occurrence in the factor based on program participation. That is, we

developed an estimate of how valuable the savings or benefit was per occurrence, and then scaled it by the impact the program was expected to have on the occurrence of that benefit. Non-energy benefits were then summed by perspective, and paybacks and other program metrics were calculated.

Table 1: Percent of Points Allocated to Non-Energy Benefit Categories
By Type of Measure / Program
(source: SERA surveys)

Measure Type	Central A/C	Window measures	Refrigerators	Various Weatherization Measures	Multifamily Lighting
Types of benefits, and percent of total "importance" points attributed to the NEB category.	▪ Higher value in house, house nicer (13%) ▪ More features, bigger, `faster (13%) ▪ Save money, lower bill, use less energy (12%) ▪ House less drafty – more comfort (10%) ▪ Quieter (6%)	▪ Higher value in house / house nicer (19%) ▪ Save money / lower bill / use less energy (14%) ▪ Feel good about environment (13%) ▪ House less drafty / more comfort (10%) ▪ May not have to move (6%) ▪ Less worried about bills(6%)	▪ More features, bigger (total 16%) ▪ Save money / lower bill, use less energy (15%) ▪ Quieter (8%) ▪ Kitchen nicer (8%) ▪ Expect less repair (7%) ▪ Environmental (6%)	▪ Insulation was ranked in order with less drafty, environmental, save money, and higher house value. ▪ CO2 monitors – very strong feelings of improved safety ▪ Weather-stripping and caulking: greater comfort and fewer drafts (12%), quieter (12%). ▪ Greater awareness / learned strategies from weatherization programs (10%). ▪ Lower bill (11%)	▪ Building is nicer got 9% of points ▪ Replacing less frequently got 9% ▪ Better safety was ranked with high value, and got 8% of the points ▪ Bill savings was ranked high by this sector (8%) ▪ Environmental benefits ranked only 5% in this sector
Range for participant assessments of total value of these NEBs in relation to bill savings. Other notes also included.	1 to 3 times as valuable as the bill savings. Other comments included "quieter". Several interviewees were invalids and valued comfort highly.	1 to 4 times as valuable as the bill savings. Other comments included that windows open (no longer painted shut), are easier to clean, and reduce upholstery fading .	1-2 times as valuable as bill savings. Negatives included more stooping to get into refrigerator (freezer on top bigger)	1-1.5 times as valuable as the bill savings for most measures. Better water flow was commented for bath/ faucet replacements	1 to 2 times as valuable as bill savings. Several respondents rated increased safety much from improved common area much higher than others.

The estimates for each of the program types included a wide array of "benefit areas". These are listed in Table 2. The range for the overall estimates was derived from a combination of the literature listed in the references section, primary research and surveys conducted by the authors, and research into environmental benefits contained in the global climate change literature. Where possible, information tailored for both low income and standard residential and multifamily programs was collected. However, developing an overall model that would support estimates for a variety of program types required setting values for model inputs based on the answers to the following types of questions.

1. Does this benefit apply to this program's customer group or this measure? – covering both which customer group is targeted, and which measures are included in the program. This choice concerns whether the benefit applies the program for that target customer class, or whether the program's design includes an element that provides that particular benefit (e.g. a lighting program wouldn't be expected to provide insurance benefits from reduced gas leaks);

2. Does it provide the same level of benefit? This choice focuses on whether the size of the benefit per participant differs for one group compared to another (arrearage benefits may be lower per participant for general residential customers than for low income customers); and
3. What are the savings for this program? We used information from the impact evaluations from the Utility's Annual Summary Reports on DSM programs to gather estimates of therm and kilowatt-hour savings per customer.
4. Basic information on participants, costs, and measures were input.

The authors applied this methodology to several dozen specific program effects, and developed both ranges (based on a range of alternative program and impact assumptions) and point estimates of the dollar value of non-energy benefits for a variety of utility residential programs. Given that energy savings are specified in dollar terms, identifying the non-energy benefits in dollar terms allowed us to identify the total of all benefits (energy and non-energy) of the program.

Table 2 summarizes the results produced by the preliminary model we developed. Information is provided on the beneficiary (or "perspective") and by key benefit categories. In some areas, estimates were not developed, and we have left those blank. For space considerations, we could not include all the program types that we modeled for the full project in the Tables for this article.

Results

The research presented here demonstrates that non-energy benefits are strong contributors to overall benefits associated with DSM and other programs offered by utilities. Importantly, customers feel these benefits. The preliminary surveys showed customers had no difficulty naming benefits they had realized from the programs, and these results are incorporated into the model and estimates. Table 2 also presents the summary of the ratios of non-energy benefits to energy benefits. These results indicate that the payback period calculations incorporating non-energy benefits are on the order of one-fourth to one-sixth as long as payback periods based on energy savings alone. Results from this preliminary model suggest:

- Customer benefits from these programs were always at least twice as great as the direct energy savings, coming from a combination of comfort valuation, fewer illnesses, and significant water savings for some of the more extensive weatherization efforts
- The program types with weatherization measures showed strong customer-side benefits. This is consistent with the positive comments received during the surveys. Given that they led to the highest energy savings, these programs also had the most value in terms of reducing greenhouse gases, etc.
- Utility (and ratepayer) benefits from individual appliance rebate programs were fairly low, but the program costs for these programs are also low. In each case, the utility benefits represented less than 10% of the non-energy benefits estimated for the program.
- Payback periods for the non-energy benefits was generally very short.
- The environmental benefits were large; however, these benefits tend to be very diffused and accrue to society, rather than individual actors.
- The low income programs (which were also both weatherization programs) showed on the order of $4/participant benefit to the utility (and ratepayers) in terms of lower arrearages and other financial and customer service benefits. Not surprisingly, these exceeded the similar categories of benefits for the broader customer programs.

Table 2: Estimates of Non-Energy Benefits from Residential Program Types

RESIDENTIAL PROGRAM NON-ENERGY BENEFITS (NEB) CALCULATION MODEL

Developed for PG&E by Skumatz Economic Research Associates, Inc., Seattle, WA

PROGRAM NAME / TYPE	***Venture Partners***	***Refrigerator Rebate***	***A/C Rebates***	***Financing Program***	***Low Income Weatherization***
SCENARIO / PROGRAM SETTINGS					
General Residential Program (1=yes, 0=no)	0	1	1	1	0
Low Income Program (1=yes, 0=no)	1	0	0	0	1
Multifamily Program common areas (1=yes,0=no)	0	0	0	0	0
Multifamily Program tenant areas (1=yes, 0=no)	0	0	0	0	0
Assumed number of Participants	715	30,197	4,708	5,099	46,443
kWh Savings per participant (to be specified)	6,402	152	275	375	250
Therm savings per participant (to be specified)	19.0	0.0	0.0	1.3	20.5
Period for program benefits -- number of years benefits last	10.0	10.0	10.0	10.0	10.0
Economic multiplier (point estimates use 35%)	17% - 53%	17% - 53%	17% - 53%	17% - 53%	17% - 53%
Environmental multiplier (point estimates use 340%)	16% - 667%	16% - 667%	16% - 667%	16% - 667%	16% - 667%
Participant perceived value (scaled from participant survey)	1.2	1.0	1.0	1.0	1.2
Bill Savings per Participant	$84.82	$18.05	$32.74	$45.54	$44.21
Avoided Energy Cost per Participant	$43.26	$9.20	$16.70	$23.23	$22.55
NON-ENERGY BENEFITS ESTIMATES (range for annual estimated benefits)					
UTILITY AND RATEPAYER PERSPECTIVE					
Bad Debt/Credit					
Red'n in size of bad debt written off	$1.00 - $4.00	$0.05 - $0.19	$0.09 - $0.34	$0.12 - $0.48	$0.52 - $2.08
Decreased no. of accounts written off bad debt	$1.00 - $3.00	$0.05 - $0.14	$0.09 - $0.26	$0.12 - $0.36	$0.52 - $1.56
Fewer notices	$0.00 - $0.15	$0.00 - $0.01	$0.00 - $0.01	$0.00 - $0.02	$0.00 - $0.08
Reduced customer calls	$0.00 - $0.25	$0.00 - $0.01	$0.00 - $0.02	$0.00 - $0.03	$0.00 - $0.13
Fewer shutoffs and reconnections for delinquency	$0.25 - $1.00	$0.01 - $0.05	$0.02 - $0.09	$0.03 - $0.12	$0.13 - $0.52
Reduced collection costs					
Carrying cost of reduction in arrearages (interest)	$0.50 - $7.50	$0.02 - $0.35	$0.04 - $0.64	$0.06 - $0.89	$0.26 - $3.91
Gas Emergency Items					
Red'n in emergency gas service calls	$10.00 - $20.00	$0.00 - $0.00	$0.00 - $0.00	$0.36 - $0.72	$5.27 - $10.54
Red'n in flex connector replacements (1-time allocated)	$0.00 - $5.00	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.18	$0.00 - $2.63
Fewer emergency calls from flex connectors	$0.00 - $2.00	$0.00 - $0.00	$0.00 - $0.00	-	-
Self insurance savings to utility (per hh basis)	$0.00 - $0.15	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.01	$0.00 - $0.08
Other					
Transmission and distribution savings	$4.33 - $4.33	$0.92 - $0.92	$1.67 - $1.67	$2.32 - $2.32	$2.25 - $2.25
Rate subsidies avoided	$5.00 - $32.00	$0.07 - $0.48	$0.14 - $0.86	$0.19 - $1.20	$2.61 - $16.68

Table 2: Estimates of Non-Energy Benefits from Residential Program Types, continued

	Venture Partners	Refrigerator Rebate	A/C Rebates	Financing Program	Low Income Weatherization
SOCIETAL PERSPECTIVE					
Economic and Environmental					
Health andSafety (CO2)	$0.00 - $0.15	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.07
Other externalities	$0.00 - $0.50	$0.00 - $0.11	$0.00 - $0.19	$0.00 - $0.27	$0.00 - $0.26
Economic impact (direct and indirect employment)	$7.35 - $22.93	$1.56 - $4.88	$2.84 - $8.85	$3.95 - $12.31	$3.83 - $11.95
Environmental preservation	$6.92 - $288.54	$1.47 - $61.39	$2.67 - $111.37	$3.72 - $154.92	$3.61 - $150.39
Water and Transfer Payment Savings					
Water and wastewater (avoided)	$2.00 - $45.00	$0.00 - $0.00	$0.00 - $0.00	$0.07 - $1.61	$1.05 - $23.71
Reduced public transfer savings (unemployment)	$0.00 - $10.00	$0.00 - $0.47	$0.00 - $0.86	$0.00 - $1.19	$0.00 - $5.21
PARTICIPANT PERSPECTIVE					
Participant Non-Energy Benefits					
Water/sewer savings	$8.00 - $110.00	$0.00 - $0.00	$0.00 - $0.00	$0.29 - $3.94	$4.22 - $57.97
Housing stock (reduced evictions, health, fire)	$0.00 - $1.00	$0.00 - $0.24	$0.00 - $0.43	$0.00 - $0.41	$0.00 - $0.53
Housing stock value, neigh. preservation (1 time, annualized)	$0.00 - $150.00	$0.00 - $35.46	$0.00 - $64.33	$0.00 - $60.85	$0.00 - $79.05
Reduced mobility (education)	$0.00 - $100.00	$0.00 - $4.73	$0.00 - $8.58	$0.00 - $11.93	$0.00 - $52.12
Reduced transactions costs (limited measures)	$0.00 - $5.00	$0.00 - $1.18	$0.00 - $2.14	$0.00 - $2.03	$0.00 - $2.90
Fewer Illnesses	$0.00 - $150.00	$0.00 - $35.46	$0.00 - $64.33	$0.00 - $60.85	$0.00 - $79.05
Fewer service terminations					
VOS study	$0.00 - $50.00	$0.00 - $2.36	$0.00 - $4.29	$0.00 - $5.97	$0.00 - $26.06
Cost to re-start	$0.00 - $1.00	$0.00 - $0.02	$0.00 - $0.04	$0.00 - $0.06	$0.00 - $0.52
Lost rental value	$0.00 - $0.15	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.01	$0.00 - $0.08
Estimated value of non-energy benefits (comfort, etc.) From survey (reported value multiplier times bill savings)	$48.77 - $97.54	$9.02 - $18.05	$16.37 - $32.74	$23.11 - $46.22	$27.13 - $54.27
SUMMARY OF NON-ENERGY BENEFITS (point estimates for programs, annual)					
to Utility	$34.06	$1.34	$2.44	$3.78	$17.81
to Society	$212.30	$34.92	$63.35	$89.68	$110.89
to Customer	$260.63	$32.95	$59.78	$75.91	$140.09
Total Non-energy benefits	$506.98	$69.21	$125.57	$169.36	$268.80
Percent of Total Non-Energy Benefits by Perspective					
to Utility	7%	2%	2%	2%	7%
to Society	42%	50%	50%	53%	41%
to Customer	51%	48%	48%	45%	52%
Indicator Ratios -- NEBs as ratio of Energy Savings					
Total Customer Benefits (energy and NEB)/Energy Savings	4.1	2.8	2.8	2.7	4.2
Total Benefits (energy and all NEB)/ Energy Savings	7.0	4.8	4.8	4.7	7.1
Total NEBs to Energy Savings	6.0	3.8	3.8	3.7	6.1
Estimated Energy Benefits					
Annual bill savings	$84.82	$18.05	$32.74	$45.54	$44.21
Savings in Avoided cost terms	$43.26	$9.20	$16.70	$23.23	$22.55

Estimates of overall benefits may be especially important to consider with changes in avoided cost, interest in market transformation, industry restructuring, and other major shifts affecting the industry – as well as the issues raised by global climate change concerns and the international protocols and goals. Historically, program decisions were made based on expected energy savings from a program, compared to the costs. Given historical avoided cost, numerous programs were implemented based on these criteria. Our analysis indicates that when a more complete benefit cost analysis is conducted, incorporating appropriate non-energy benefits, paybacks and other program indicators show significant improvement – and in some cases, we found that the benefits from non-energy sources swamped those provided through direct reductions in energy use.

Summary

In this research, efforts were made to move beyond "conceptual" lists of benefits. The paper uses a combination of information from the literature, program-specific information, primary data collection, and other assumptions to derive estimates and identify ranges for more than two dozen categories of non-energy benefits. In addition, the calculation approach and model developed allows the utility to easily examine the impact of changes in program or impact assumptions on the estimate of benefits. These impacts can be examined from the utility / ratepayer, participant, or societal perspective, and the effect on program payback and other metrics can be examined easily. We modified the modeling approach developed for the earlier VPP work to allow us to estimate the non-energy benefits from a wide variety of program types.

The research also shows that important benefits accrue not only to the utility and its ratepayers, but the results indicate that customers realize large benefits above and beyond the basic energy savings they enjoy from programs. These benefits could potentially play an important role in program targeting and outreach. The scenario and modeling approach described within the paper can be used to optimize programs by examining program design alternatives to maximize benefits to customers, society, and the utility and its ratepayers, keeping program costs constant. Finally, based on the results of the estimation process, we have identified areas that would be most fruitful for future research in the area of non-energy benefits. As part of the remaining project efforts, we anticipate conducting additional work including:

- Refining the customer participant survey to gather additional data on perceptions of the relative value of non-energy benefits from program efforts. This survey approach showed good promise for getting reasonable estimates of benefits. Customers seemed to be comfortable providing "relative" values, and we can "benchmark" using the average energy savings for the program participants.
- Tabulating the "negatives" cited in the participant surveys and including relevant assessments.
- Modeling additional programs, including education/information programs.
- Refining the estimates of environmental and economic impacts from the programs. These areas showed the potential for strong benefits, but still had associated uncertainties or large ranges.
- Making additional refinements in estimates of utility / ratepayer benefits to assure that these are being accounted for as completely as possible.

References

Biewald, et. al., "Non-Price Factors of Boston Edison's Demand Side Management Programs: A Review of the Societal Benefits of Energy Efficiency", prepared by Tellus Institute for Boston Edison Settlement Company, Boston, Massachusetts, August 3, 1995.

Brown, M., L. Berry, and R. Balzer, "National Impacts of the Weatherization Assistance Program", ORNL/CON-326, NTIS Report DE93018884, May, 1993.

California Energy Commission, "Electricity Report", Sacramento, California, 1993 and 1995.

Enbridge Consumers Gas, "Final Report of the Collaborative on Externalities for Natural Gas Integrated Resource Planning in Ontario", North York, Ontario, September 1995.

Galvin, G. Max, "Examination of Components of an Environmental / Economic Benefit Adder", Optimal Energy, Burlington, Vermont, April 1999.

Howat, John, and Jerrold Oppenheim, "Analysis of Low-Income Benefits in Determining Cost-Effectiveness of Energy Efficiency Programs", National Consumer Law Center, Boston, Massachusetts, April 14, 1999.

Magouirk, J.K., "Evaluation of Non-energy Benefits from the Energy $avings Partners Program *1995 Energy Program Evaluation Conference, Chicago*: 155-175, 1995.

Pacific Gas and Electric Company. "Annual Summary Report on Demand Side Management Programs", various years, San Francisco, California.

Regional Economic Research, Inc., "The Air Quality Valuation Model", Prepared for the California Energy Commission, Sacramento, California, November 29, 1994.

Sandberg, Tea Alopaeus, "Promoting and Quantifying Non-Energy Benefits – A Method to Achieve Energy Efficiency in Sweden", EM, The Swedish National Energy Administration, 1998 ACEEE Conference, Asilomar, California, August, 1998.

Skumatz Economic Research Associates (SERA, Inc.), "Process Evaluation of Venture Partners Pilot Program", prepared for Pacific Gas and Electric Company, March 1996, Seattle, Washington, March, 1996.

Skumatz, Lisa A., Ph.D. and Robert Bordner, "PG&E's REACH Program Evaluation", prepared for Pacific Gas and Electric Company, February 1998.

Skumatz, Lisa A., Ph.D.,"Recognizing All Program Benefits: Estimates of Non-Energy Benefits from the Customer Perspective", Skumatz Economic Research Associates, Inc., Seattle, Washington, Research Paper Series 9699-3, 1996.

Skumatz, Lisa A., Ph.D., "Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E's Venture Partner's Pilot Program (VPP)", 1997 Energy Evaluation Conference, Chicago, Illinois, 1997.

Skumatz, Lisa A., Ph.D. and Chris Ann Dickerson, "Extra! Extra! Non-Energy Benefits of Residential Programs Swamp Load Impacts!", 1998 ACEEE Conference Proceedings, Asilomar, California, August 1998.

Van Lookeren, Philip, March Consulting Group (UK), personal communication with author, May, 1999.

Woolf, Tim, "Environmental Benefits of Efficiency Programs", memorandum to DTE-100 Cost-effectiveness working group on behalf of Cape Light Compact, Cambridge, Massachusetts, March 31, 1999.