

Non-Energy Benefits (NEBs) for a Real Time Pricing Experiment

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ABSTRACT

This paper analyzes NEBs for a residential real time pricing program, and provides information on what customers perceive as valuable from the program. Data to identify the non-energy benefits from the program was collected via surveys, and the results showed that control over bills is a highly valued benefit from these programs. The paper includes tables of results, and summarizes key findings for possible application to other programs.

The results indicate:

- NEBs can be measured, are recognized by program participants, and essentially double the value of the benefits associated with the program
- Although the primary motivation for participation in ESPP was to save money on the energy bill, the ability to have better “control over the bill” is overwhelmingly appreciated – and highly valued – by participants.
- Marketing the program on those features recognized as valuable by customers should help increase participation. In addition, the “control” and “environmental” NEBs are benefits that can continue to provide to customers value even in years when weather or other factors mitigate potential bill savings.

About the Program

The Community Energy Cooperative is a non-profit organization committed to offering its members programs and services to reduce costs of energy services, and improve neighborhood electrical reliability. To that end, the Community Energy Cooperative has collaborated with Commonwealth Edison (ComEd) to test residential customers’ response to day-ahead, market-based hourly pricing (also known as real-time pricing – RTP) through a three-year pilot program offered to the Cooperative’s members through a special ComEd tariff.

This program, the Energy-Smart Pricing Plan (ESPP), was started in January 2003, and was the first time in the nation that residential customers were given the opportunity to pay market-based electricity prices. By exposing residential customers to the market-price of electricity, customers were given the opportunity to make informed decisions about electricity use. This program used ComEd’s experimental Residential Hourly Energy Pricing (RHEP) rate. The program’s pricing was initially set on the basis of three years of data from ComEd’s commercial Real-Time Pricing (RTP) program, used prices provided from Platts Global Energy for day-ahead hourly prices. In addition to the hourly electricity price, participant bills contain an access charge, but participants receive a reduced rate so the access charge could be more representative of a distribution charge in a market-based rate. Based on historic prices, the

¹ SERA conducted the NEB work for this project as a subcontractor to Summit Blue Consulting LLC, and Micheal Ozog and Mark Thornsjo of Summit Blue were responsible for conducting the impact and process evaluation work for the program.

Cooperative estimated that participants could be expected to save about 10% of their current electric costs under this rate design even if they did not change their energy use patterns in response to the hourly energy prices.

ESPP was available to any ComEd customer willing to join the Cooperative. Initial marketing of ESPP was targeted to Cooperative members and selected neighborhoods. About half the program's participants were new Cooperative members, which reflected the marketing effort to recruit new program member/participants. Over 750 customer members enrolled. In order to aid in the impact evaluation of the ESPP, the Cooperative randomly assigned ESPP enrollees into two groups: participants, who were exposed to the hourly market prices, and a control group which received the all non-energy related incentives including the installation of an interval meter, but would not be subject to the RHEP until after the first year of the pilot. Thus, this control group was used as a participants' behavior had they not been exposed to hourly market prices.

ESPP participants were informed of the next day's hourly prices either through the Cooperative's website or by calling a toll free number. In addition, between 7 pm and 10pm, a phone call or email was used to notify participants if the next day's electricity prices would rise above 10¢ per kilowatt-hour (termed "high-price hours"). The Cooperative also developed a price protection cap to insure that ESPP participants would not be exposed to prices higher than 50¢ per kilowatt-hour.

Introduction to Non-Energy Benefits

Non-energy benefits (NEBs) include impacts – beyond energy savings – that result from the program. Although they are commonly called NEBs, they may actually include both positive and negative effects; while they are "net" effects, in practice, the majority of impacts associated with programs have tended to be positive effects.

Most of the literature on NEBs is based on direct install, measure-type, or market transformation programs. Previous research by the authors² established the convention of grouping NEBs based on categories of beneficiaries:

- **Utility NEBs:** These include Utility / ratepayer-type benefits that essentially reduce revenue requirements, including savings in a variety of administrative costs related to customer calls, bill payments / arrearages, service terminations, and related changes, as well as reductions in T&D losses, improved power quality, and other effects from the program and reduction in demand. The changes attributable to these impacts are mostly valued at utility avoided costs.
- **Societal NEBs:** Societal benefits include the value of reductions in emissions, economic stimulus, and similar public benefits that do not accrue directly to either utilities / ratepayers or to participants. The values associated with these program-caused changes vary with the type of impact.
- **Participant NEBs:** Participant impacts include non-energy effects resulting from the program, including changes in comfort, maintenance, service from the equipment, reduction in other bills (mostly from water-related measures) and a wide variety of other

²Skumatz, Lisa A., "Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E's Venture Partner Pilot Program (VPP), (coauthor), 1997 Energy Evaluation Conference, Chicago, August 1997., and Skumatz, Lisa A., "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.

factors. These are valued in terms of direct computed savings (e.g. bills, etc.), or valuations based on participant assessments of the benefits.

For many years, the valuation of benefits recognized by potential program participants was ignored because it was considered “hard to measure.” However, in the last several years measurement methods have advanced so that useful results can be generated.³ The estimation work in participant-side NEBs has provided valuable tools to:

- Identify the most attractive program features – above and beyond energy savings – that are valuable to customers. This provides useful information for program marketing and targeting; it also demonstrates the importance of various barriers and advantages to participate.
- Improve / enhance estimates of costs and benefits from the program.
- Focus the efforts on program refinement / design changes to those that will produce the most benefits to the utility and / or the participant.

With NEB information, programs can go beyond marketing on efficiency or simple bill savings; instead, programs can be valued and marketed on the basis of what is perceived as valuable to the participants – using terms that potential participants care about and that participants potentially find more compelling regarding participation and appreciation of the programs.⁴

However, the ESPP program differs from most of those for which NEBs have been calculated. It is not a “measure-based” program at its core, and it is not designed to save kWh as such, but rather to give participants the tools to manage use and reduce peak demand. For that reason, preliminary interviews with a small number of ESPP participants were needed to explore the types of (non-energy) changes that they attribute to their participation in the program. This feedback was used to design the NEB portions of the mail survey that was sent to participants.

A combination of measurement methods was used to estimate the NEBs:⁵ willingness to pay and relative valuations. We used the responses to value a variety of categories of indirect benefits – both positive and negative – associated with the program. This approach computed:

- Estimates of the “net” participant NEBs from the program, and
- Limited estimates of the benefits from the utility and societal point of view.

The utility and societal analyses were not estimated and would have been extremely limited in scope because:

- The program is not “measure” based, which is the source of many NEBs,
- Program costs / investments were not known, so drivers for “economic multipliers” and job creation were not significant in this pilot program.
- Energy savings were not the focus of this analysis, and many energy and bill savings benefits are not as easy to measure as for other programs.

³ Skumatz, Lisa A., “Comparing Participant Valuation Results Using Three Advanced Survey Measurement Techniques: New Non-Energy Benefits (NEB) Computations of Participant Value”, Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings, Asilomar, Washington, DC, August 2002.

⁴ Stoecklein and Skumatz, “Using Non-Energy Benefits (NEBs) to Market Zero and Low Income Homes in New Zealand”, *Proceedings of the 2004 ACEEE Summer Study, Asilomar, CA, August 2004.*

⁵ Skumatz, Lisa A., “Comparing Participant Valuation Results Using Three Advanced Survey Measurement Techniques: New Non-Energy Benefits (NEB) Computations of Participant Value”, Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings, Asilomar, Washington, DC, August 2002.

Estimates of the participant valued benefits are presented in the following sections.

Results

Clearly, participants value NEBs. When asked in an open-ended fashion about the most important reason for signing up for the program, the third most mentioned reason was “environmental benefits” (a classic NEB), and the fifth mentioned was reduced chance of outages, which is another traditional non-energy benefit. About 13% noted these two sources as the most important reason for participating, and another 42% noted them as the second most important reason; 53% mentioned them as third most important.

Table 1: Reasons for Participation in ESPP (unaided)

	Most Important	2 nd Most important	3 rd Most important
Previous experience with CEC’s Air Conditioner Exchange Program	10%	8%	10%
Save money on electric bill	72%	20%	4%
Environmental benefits	11%	32%	26%
Limit on how high the price is allowed to go	5%	30%	33%
Reduce the chance of electricity outages or blackouts	2%	10%	27%

To value the NEBs, we asked whether participants experienced a specific set of positive and negative benefits that we derived from our initial pre-test interviews. These NEB categories included:

- The ability to control their energy bill
- Environmental effects
- Understanding the use of various household appliances
- “Hassles” (Whether participation was quick and easy or time consuming and difficult)
- Whether the equipment they received (if any) was an improvement

Customers were asked about their estimate of the energy savings associated with participation in the program, and also a series of questions about the relative value of the set of positive and negative changes they attributed to the program. Using this information, it was possible to estimate a dollar value associated with the non-energy benefits.

Sources of Benefits

Participants were asked to name positive and negative benefits that are the result of participation in ESPP. These were open-ended responses. The following summarizes the responses.

Table 2: Positive Benefits Cited by ESPP Participants

Benefit	% of respondents
Lower bill or cost	33%
Increased awareness / knowledge	17%
Environmental	10%
Reduced energy usage	4%
More control	5%

Many participants cited benefits associated with the program. Beyond cost savings, another 17% noted benefits from increased awareness, 10% noted environmental benefits, and others

noted reduced or more efficient use of energy (less wasteful use), and improved control over their energy bill.

Table 3: Negative Benefits (Problems) Cited by ESPP Participants

Problem	% of respondents
Inconvenient (hotter temperatures, less use of the TV, etc.)	4%
Requires effort (meter reading, monitoring, etc.)	2%

Substantially fewer participants associated negative impacts with the program than positive ones. Some of the negative impacts mentioned included inconvenience or discomfort associated with reducing energy consumption. Others felt that the program required extra effort to monitor their usage.

For each of the key NEB categories, customers were asked about the impacts they experienced. Nearly all the participants felt that they had better control of their energy bill due to participation in the program. Similarly, most participants:

- Believed their participation in the program helped the environment.
- Recognized that the program changed (presumably improved) their understanding about energy use.
- Thought that participation was quick and easy.
- Reported one or more positive impacts; very few reported negative impacts.

In addition, the (roughly half of) participants that received equipment as part of the program (generally thermostats or efficient light bulbs) found the equipment to be an improvement over what they previously had in place.

Table 4: Importance of the Benefits

	Very important	Not important at all	The most important
Ability to control bill	83%	0%	77%
Effect on the environment	56%	3%	13%
Understanding about energy use	56%	4%	5%
Effort needed to participate	32%	25%	1%
Equipment received(of those receiving equipment)	67%	18%	2%

The ability to control their energy bill was very important to most of the participants; 77% of the respondents indicated that it was the most important impact. The effect on the environment was the second most important impact; although only 13% of the respondents indicated that it was the most important, a high percent indicated that the environmental impact was either very important or somewhat important. Understanding energy use was also considered very important or somewhat important by most respondents, although only 5% of the respondents felt that it was the most important. These results are consistent with the results presented in Table 1, where respondents indicated their reasons for participating in the program. The primary motivation for participation was to save money, and being able to control their energy bill is one means to doing so.

Value of NEBs

The participants are asked to evaluate all the changes (positive and negative) resulting from their participation in ESPP, and to compare the value of the non-energy changes to their energy savings from the program. Using computational approaches developed in our extensive previous research,^{6,7,8} the value of the NEBs associated with the program were computed and the range is shown in Table 5.

Table 5. Estimated NEB Values

Benefit Category	Value (\$ per month, rounded)
Ability to control bills	\$9.25 - \$20.00
Effect on the environment	\$1.60 - \$3.40
Understanding about energy use	\$0.60 - \$1.30
Effort needed to participate	\$0.15 - \$0.55
Equipment received	\$0.25 - \$0.55
Value of all NEBs per month	\$12 - \$26
Participant-estimated bill savings (value of energy savings)	\$16.85
(Value of NEB) / (Value of Energy Savings)	0.7-1.5

The results indicate that the value of the NEBs is about equal to the value of the energy savings – or essentially doubles the value of their recognized benefits from the program. Overall, the range for NEB value is 70% of their stated or estimated value of energy savings to about 150% of these savings. Note that the benefit of the single NEB representing ability to exert more control over the bill ranged from about half as valuable to about the same value as the energy bill savings they attribute to the program. The issue of “control” is very important to participants in this program.

Because this was a small “add-on” to this project, extensive research was not conducted about whether there was overlap in some of these categories; neither could we examine the value of the NEBs using a second measurement technique. However, these indicative results show that

⁶ Green BG, Shaffer GS & Gilmore MM (1993). A semantically-labeled magnitude scale of oral sensation with apparent ratio properties. *Chemical Senses*, 18, 683-702.

⁷ Skumatz, Lisa & Albrecht Stocklein (2003). Using Non-Energy Benefits (NEBs) to Market Energy-Efficient Homes in New Zealand., Draft Report, SERA, Inc., Superior, CO. Skumatz, Lisa & Stocklein, Albrecht (2003). Using Non-Energy Benefits (NEBs) to Market Energy-Efficient Homes in New Zealand.

⁸ See, for example, Pearson, Dennis and Lisa A. Skumatz. 2002. “Non-Energy Benefits Including Productivity, Liability, Tenant Satisfaction, and Others What Participant Surveys Tell Us About Designing and Marketing Commercial Programs.” Asilomar, California: *Proceedings of the 2002 ACEEE Conference*, August.; Skumatz, Lisa A., Ph.D. 1997. “Recognizing All Program Benefits: Estimating the Non-Energy Benefits of PG&E’s Venture Partner’s Pilot Program (VPP).” Chicago, Illinois: *Proceedings of the 1997 Energy Evaluation Conference*, August.; Skumatz, Lisa A., Ph.D. 2001. “Non-Energy Benefits (NEBs) — A Comprehensive Analysis And Modeling Of NEBs For Commercial & Residential Programs.” Ponte Vedra, Florida, *Proceedings of the AESP Conference*, December.; Skumatz, Lisa A. and Chris Ann Dickerson. 1998. “Extra! Extra! Non-Energy Benefits of Residential Programs Swamp Load Impacts!” Asilomar, California: *Proceedings of the 1998 ACEEE Conference*, August.; Skumatz, Lisa A., Ph.D., and Chris Ann Dickerson, 1999, “What Do Customers Value? What Benefits Utilities? Designing to Maximize Non-Energy Benefits from Efficiency Programs in the Residential Sector”, *Proceedings of the 1999 Energy Evaluation Conference*, Denver, August, 1999.; Skumatz, Lisa A., Chris Ann Dickerson, and Brian Coates, 2000, “Non-Energy Benefits In The Residential And Non-Residential Sectors – Innovative Measurements And Results For Participant Benefits”, *Proceedings of the 2000 ACEEE Summer Study*, Asilomar, CA, 2000. See ACEEE 2000, IEPEC 2001, ACEEE 2002 articles by Skumatz (SERA), solo or joint.

there is strong value above and beyond energy savings that customers associate with the ESPP program.

Conclusion

In this paper, we addressed the value of the benefits other than the direct energy savings. This is the first examination of non-energy benefits associated with real time pricing programs, and the analysis showed that:

- There are net benefits beyond energy and demand savings,
- Estimates of participant benefits from the program could be derived, and
- More information would be needed if we were to develop estimates of NEBs from the societal or utility perspectives.

These benefits include the ability to control one's bill, benefits to the environment, an increased awareness about energy usage, the effort involved in participation, and the benefits from receiving equipment.

The respondent-estimated bill savings associated with the program averaged \$16.85/month. Note that this is not a "real" dollar amount measured by the program evaluation work, but rather expresses a participant estimate of the bill savings value they believe they obtained from the program. Using this as a valuation basis, estimates show that participants, on average, found the value of the non-energy benefits (NEBs) to be about \$19 per month (ranging from about \$12-\$26). These figures mean that the NEBs essentially double program benefits perceived by program participants.

Overall, the results of the first year of this program are very positive. During a relatively cool summer with unusually low peak energy prices, participants had a strong response to high price notifications and overall demonstrated significant price elasticity of demand. Well over half of all participants showed significant response to price notifications, with most of the rest of participants showing some response. Participants overall were extremely satisfied with the program, finding it easy to understand and to participate in. They were pleased with the bill savings they experienced in the program, and they placed a high value on benefits of the program beyond their direct dollar savings.

The experience of ESPP to date shows that real-time pricing for residential customers can be an effective approach, and that a program can be designed that enables participants to understand and respond to the price patterns without placing an undue burden on them. We expect that much additional information will be obtained in the second and third years of the program, as it gains more experience and as it experiences a wider range of weather and energy prices. In addition, the results of this evaluation can contribute to further program refinements to assist participants in managing their energy use.

Although the primary motivation for participation in ESPP was to save money on the energy bill, other benefits were identified as important and were shown to have a positive dollar valuation associated with them that was approximately equal in value to the bill savings. In particular, the ability to have better "control over the bill" is overwhelmingly appreciated – and highly valued – by participants. This feature of the program seems to address a concern that residential customers may have relative to their service. Marketing the program on those features recognized as valuable by customers should help increase participation. In addition, the "control" and "environmental" NEBs are benefits that can continue to provide to customers value even in years when weather or other factors mitigate potential bill savings.