From Theory into Practice: One Utility's Experience with Applying the Value Test

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Recently, a new approach to measuring the cost-effectiveness of DSM programs has gained a lot of attention. It has been touted under many banners: the true test of the economic efficiency of DSM, incorporating customer value, a consumer surplus approach to cost-effectiveness, the "sixth test," and an "enhanced" TRC (Total Resource Cost test). This new approach has been developed separately and in collaboration by several different economists and experts in the field. In this paper we call it the Value test.

The discussion so far has focused on the theory behind this test (almost all agree it is the theoretically correct test), on worries as to whether we can calculate it (it contains several hard-to-quantify components), and on its implications (how its use may change a utility's DSM portfolio). This paper will begin with a brief overview of the theory behind the Value test and the differences between it and the standard tests. Then we will present one utility's experience with calculating and applying this test for a number of its DSM programs. This section will present in detail, and with actual examples, the types of estimations and information required to calculate the Value test. Finally, we will then present a comparison of the results of the Value test for the utility's DSM programs with the results of the more traditional Total Resource Cost (TRC), and Ratepayer Impact Measure (RIM) tests.

Introduction

You can ask any number of people in the energy industry about the coming competition and get as many answers. While few agree on the type, impact, and timing of competitive forces, all agree that the industry is changing. In response to this uncertain future we need to rethink the way we do business, our tools and our planning processes.

Traditionally, utilities and regulators have used two selection criteria with regard to demand-side management (DSM) activities and resource planning. These two criteria are the Total Resource Cost (TRC) test and the Ratepayer Impact Measure (RIM) test. These tests each reflect one of regulators' underlying goals for DSM: energy efficiency and rate minimization, respectively.

Most states' commissions have determined that of these two goals energy efficiency is the most important. This is evident from the test used to select DSM for resource planning in most states: the TRC test. Recent research, however, has revealed that the TRC test is seriously biased. It is missing certain key benefit and cost components. The use of TRC as a selection criterion when DSM was young may have been acceptable. But as more utilities depend on larger and larger amounts of this resource, we can no longer continue to make this mistake.

Barakat & Chamberlain has played a major role in the development of a new test for DSM selection that corrects the biases contained in the TRC test. This test is called the Value test.

Concerns Regarding the Value Test

The Value test was developed rigorously from the economic principles of efficiency, and no one has denied that it is the theoretically correct test. But there are several common concerns that have been raised in response to its potential widespread use.

Concern #1: "The Value Test Has Not Been Formally Adopted By Regulators." The first concern is that the Value test has not been adopted by any state commissions. This is true, but may not be true for long. There is significant interest in the Value test, and the California Public Utilities Commission and California Energy Commission have already taken concrete steps in its consideration. Also, Tennessee Valley Authority is presently using the Value test as the key selection criterion for their new resource plan.

Due to the large uncertainty regarding the effect and timing of competition, there is a serious risk to utilities in regulatory lag. The future may change before we are ready for it. The Value test can help bridge the gap between present resource planning processes and the processes required under a competitive future. Even if regulators never formally adopt the Value test, its use by utilities will allow them to look at what they could do to respond to competition. Certain forms of competition already exist in the industry (e.g., fuel switching, cogeneration). Utilities need to respond to their customers' needs or risk loosing them.

Concern #2: "The Value Test Is Just a Front for Load Building." The second concern expressed regarding the Value test is that utilities will just use it to build load. (Since the Value test recognizes all benefits and costs of DSM, a load-building program that would fail the TRC text can pass the Value test.) Economic energy efficiency means that the total costs of producing the same level and quality of an energy service have been reduced (or, alternatively, the net benefits have been increased). If customers respond to this lowered cost by increasing their use of the energy service, this can result in an increase in energy sales. Is this bad?

This is only bad if the real goal of DSM is to decrease sales. But does a goal of sales minimization make sense? It does only if you believe that the production and use of energy is inherently worse than that of any other commodity. On the other hand, if DSM's real goal is economic energy efficiency, if sales increase it will be for the right reasons.

Concern #3: "The Value Test Is Hard To Calculate." The third concern with regard to the Value test is that it will be hard to calculate. Since the Value test acknowledges all the benefits and costs to ratepayers from DSM, it contains some benefit and cost components that are perceived as being more difficult to quantify than those in the existing tests. This is not a reason to reject the Value test. If energy efficiency is the goal—efficiency in customers' use of energy—it requires "stepping over to the customers' side of the meter." Customers are not power plants. The impact of a DSM program on a customer is by definition more complex than DSM's impact on power plant use. Analysis is messy on the customer's side of the meter. If we are going to have energy efficiency as a goal, we are going to have to know more about our customers as we will be operating in their domain. On the good side, a successful response to competition will also require knowing more about customers.

We will have to change the way we think about cost-effectiveness analysis. Benefit-cost ratios reported within two decimal points' accuracy, and net benefits in exact dollar amounts–already based on questionable data–will be less important than simply knowing whether a program is good for ratepayers or not. If "cost-effective or not?" is the question, the Value test is fairly straightforward to calculate needing only the inputs to the existing tests and the data gathered to estimate those inputs. The rest of this paper is a demonstration of how the Value test was calculated for one utility using their existing cost-effectiveness analysis inputs and program evaluations.

Organization of the Paper

This paper is organized as follows. The next section gives an overview of the Value test and how it differs from the TRC test. We will then present the step-by-step analysis performed to calculate the Value test for a set of actual utility programs.

Overview of the Value Test

As discussed above, traditionally the TRC test has been used as a measure of economic energy efficiency. However, economic theory indicates that it only measures economic energy efficiency under the following four assumptions:

- Customers do not react to the program-induced rate change (zero price elasticity of demand for energy);
- All market barrier costs that kept customers from installing the DSM measure on their own are reduced to zero by the program;
- Customers use the same amount of the energy service after as before the program (zero price elasticity of demand for the energy service); and
- Customers receive the same quality of energy service before and after the program.

These are strong assumptions that are usually not true. These assumptions may have served us well in the early days of DSM, but today with DSM's increased role as a resource alternative they can cause serious biases in the mix of measures selected.

Costs and Benefits of the Value Test

The customer Value test was developed rigorously from the economic principles of efficiency (Herman 1994; Braithwait 1994; Hobbs 1991; Keller and Miedema 1991; Costello and Galen 1985). The final test equation is the sum of the value (consumer surplus) gain to customers of both the program itself and the program-induced rate impact. An economic efficient program is one that increases customer value through lowering energy service costs or increasing quality of service. Since the Value test is a complete test of economic efficiency, it allows for the relaxation of the four assumptions listed above.

Figure 1 shows how the Value test is similar to the TRC test in that both sum the impact of the program on participants and the impact of the program-induced rate change on all ratepayers. The TRC test is the sum of the RIM test and the Participant test net of freerider bill savings and equipment costs. The Value test is the sum of the value (consumer surplus) gain to participants and the value gain to all ratepayers because of the rate change. As can be seen in Figure 1, the Value test incorporates the benefits and costs of the TRC test and then adds additional benefit and cost components to account for the terms implicitly set to zero by the assumptions made by the standard tests.

The additional benefit and cost components contained in the Value test are discussed below in the same order as the four assumptions they relax.

Long Run Rate Impacts. As can be seen in Figure 1, the TRC test incorporates the program-induced rate impact by incorporating the RIM test. What both the TRC and RIM tests ignore are customers' reactions to that rate impact. These tests assume that customers will have no reaction to the rate change. If a conservation program causes rates to increase, that increase in the price of energy will cause a reduction in energy use. That reduction in energy use will itself cause another increase in rates, which will cause an additional reduction in energy use, and so on. Luckily, the changes become smaller and smaller and equilibrium is quickly achieved. If system average rates are higher than marginal costs, these additional (long run) rate impacts are a cost of the program. Note that if the DSM program caused a rate decrease, this long run rate impact would be a benefit of the program.

Market Barrier Costs. Market barrier costs (MBCs) are all the costs to the customer of DSM beyond the usual ones (i.e., equipment, installation, and O&M) included as participant costs. For example, efficient air conditioners are available on the market that can save customers $1,200 on their energy bill and cost only $500 more than the standard model. But customers are not installing these air conditioners. Why? Because they are facing costs that are not accounted for in standard practice analysis-at least $700 of market barrier costs.

What are these market barrier costs? Maybe the customer didn't know that efficient air conditioners exist; didn't

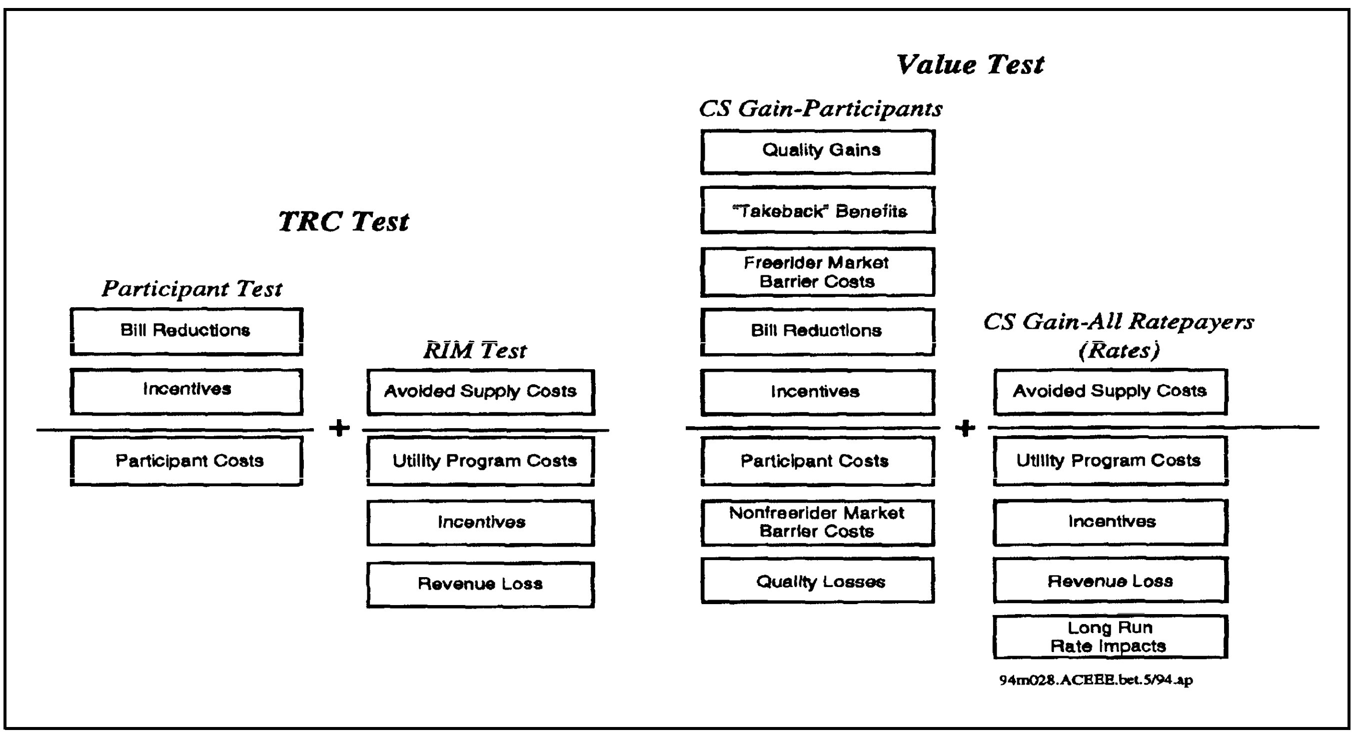

Figure 1. Both Tests Look at Participants and Rates

know how large the bill savings would be; can't find efficient air conditioners in the local store, or the local contractor didn't know about them; has a different cost of money than the utility; or simply doesn't believe that the savings will materialize-uncertainty regarding a new technology. Luckily, these are the market barriers that DSM programs are designed to overcome. At a minimum an efficient air conditioner program will let customers know that efficient air conditioners exist and that they offer particular benefits.

However, it is likely that certain MBCs will remain to be incurred at the time of program participation. Those market barrier costs that remain at the time of program participation for nonfreeriders are included as a cost in the Value test. These costs are incurred as a result of program participation. If any of these types of costs are reduced for freeriders, they can be included as a benefit of the program.

Notice that the TRC test (by leaving market barrier costs out) implicitly assumes that all market barrier costs have been reduced to zero by the program. This may be possible for a very well designed program aimed at a technology with easily overcome market barriers, but it is not likely for the majority of DSM programs.

Takeback Benefits. Customers don't necessarily use the same amount of the energy service after the program. For example, an efficient air conditioner program will cause the customers' costs of cooling go down. Because of this lower cost customers may decide that they want to purchase more cooling. This is not a failure of the program—this is an increase in value and a benefit to customers of the program. DSM programs are designed to reduce the cost of energy services. Similarly, if a DSM program causes customers to use an energy service they had not used before, such as security lighting, the value of that energy service to customers is a benefit to the program.

Changes in the Quality of Service. A lighting program that improves the lumen level in a work space, such as installing halogen bulbs and task lighting, increases the quality of lighting to customers. This is a benefit to customers. Similarly, an air conditioner cycling program that may cause some discomfort to customers reduces the quality of that energy service. This discomfort is a cost of the program.

One Utility's Experience With Applying the Value Test

In order to demonstrate the calculation of the Value test we present here a case study using actual utility programs and data. In 1993, New England Electric Service (NEES) asked Barakat & Chamberlin to apply the Value test to their 1991 DSM programs. We use that study as the basis for the remainder of the paper.

NEES's Interest in the Value Test

NEES's three retail subsidiaries (Massachusetts Electric, Narragansett, and Granite State Electric) use a variation of the standard TRC test, to determine which DSM programs to offer to their respective customers. Their objective for having Barakat & Charnberlin analyze their programs was to compare the results of NEES's in-house benefit-cost test to that of the Value test, and specifically, to understand the differences. Also, since one of the key goals of NEES's DSM programs is to transform the market for energy efficiency products, the Company wished to form a better understanding of market barrier costs and their impact on program cost-effectiveness.

NEES Programs Analyzed

The NEES programs analyzed were those offered by their subsidiary Massachusetts Electric. This paper only discusses the commercial/industrial programs analyzed. These programs are:

- Design 2000—a full-incremental-cost rebate program promoting the installation of energy efficient equipment in new buildings;
- Energy Initiative—a rebate program promoting lighting and nonlighting efficiency measures in existing buildings; and
- Small Commercial/Industrial-a direct-install lighting program offered to commercial and industrial customers under 50 kW.

Calculation of the Value Test

In this section we will go step by step through the calculation of the Value test for NEES's programs. We will start with the information contained in the TRC test and progress through the additional rate impacts for all ratepayers and the additional impacts of the program on participants and end with the Value test results.

Depending on whether the goal is to ensure economic energy efficiency for ratepayers or for society as a whole, the Value test can either exclude or include externalities. In this analysis, we assume that the goal is to ensure economic energy efficiency from the point of view of NEES's ratepayers.

Results of the TRC Test for NEES Programs. As discussed above, the TRC test acknowledges both the impact of the program on participants and on all ratepayers through rate changes as measured by the RIM test. This relationship is shown in Table 1. As can be seen, all programs fail the RIM test. That is, all programs show net benefits less than zero for all ratepayers because of rate impacts. Also, notice that programs that pass the TRC test are those that have large net benefits to participants. The net benefits to participants must be large enough to offset the impact of the program-induced rate increase to all ratepayers.

What the TRC Misses With Regard to All Ratepayers' Rate Impact. The TRC test includes the direct rate impact of the DSM program on all ratepayers. However, it does not take into account the fact that utility customers will respond to this rate impact by adjusting their energy use. If a program fails the RIM test, rates will go up. If customers' elasticity of demand for electricity is not zero, sales will drop. That sales reduction will cause another change in rates if marginal costs are different than average costs. That rate change will cause another change in sales, and so on. The amount by which the full rate impact exceeds the direct rate impact (as measured by the RIM test) is the long-run rate impact (LRRI).

We used a four-step iterative methodology to calculate the full rate impact of each program. We begin with the direct rate impact of the program (the RIM net benefits) as translated into a one time change in rates (the lifecycle revenue impact or LRI-RIM as calculated in the California Standard Practice Manual).

STEP 1: Apply elasticities to LRI-RIM. A series of short-run to long-run elasticities are applied to the one-time rate change (LRI-RIM). This produces a stream of changes in sales. The system elasticities we used were -0.1 in the first year, ramping up to -0.4 in year six and beyond. These elasticities were drawn and inferred from a variety of sources but should, in practice, be consistent with those used in the utility's sales forecast.

STEP 2: Apply rates and marginal costs to sales changes. System average rates and marginal costs are applied to the changes in sales to generate avoided supply costs and revenue loss.

STEP 3: Determine new LRI-RIM. These streams of avoided supply costs and revenue losses are present valued and a new one-time change in rates (LRI-RIM) is calculated.

STEP 4: Repeat. This set of steps is repeated up to five times or until the new rate change is essentially zero.

Table 2 shows the LRRI estimates for each program. The sum of the RIM net benefits and the LRRI is the full measure of the net benefits to all ratepayers because of the program-induced rate change. The LRRI estimates for NEES's programs are all positive because at this time NEES's system average rates were below their system average marginal costs. If a utility's system average rates were higher than system average marginal costs, the LRRI estimates would have the same sign as the RIM net benefits.

What the TRC Misses With Regard to Participants' Net Benefits. While the TRC test only misses one component of the rate impact of a DSM program on all ratepayers, it misses up to three benefit/cost components for participants. These are the remaining market barrier costs (MBCs), takeback benefits, and quality gains (or losses). Of these components in most cases, remaining MBCs will have the largest impact on the cost-effectiveness of a program. Takeback and quality can also have large impacts, but not in as many cases, and not in the case of NEES's programs. Therefore, we will quantify remaining MBCs first and then look at the Value

Table 1. TRC Results Showing Benefits to Participants and All Ratepayers ($000)

Programs	"Net" Participant	(All Ratepayers)	TRC Test Results NPV	B/C
Design 2000	$7,372	($4,082)	$3,290	2.09
Energy Initiative	$100,893	($32,160)	$68,733	2.61
Small C/I	$15,851	($6,467)	$9,383	2.12

Table 2. Net Benefits to All Ratepayers Due to Rate Changes

Programs	RIM Net Benefits	Long Run Rate Impact (LRRI)	All Ratepayer Net Benefits
Design 2000	($4,082)	$64	($4,018)
Energy Initiative	($32,160)	$499	($31,661)
Small C/I	($6,467)	$102	($6,365)

test results of these programs before going on to estimate the possible impact of the other two.

Even though MBCs seem like a nebulous concept made up of an undetermined number of costs of various types and sizes, it is possible with little effort to get a reasonable estimate of the size of those remaining. We performed this analysis using only existing standard data. We recommend a five step process as a starting point for the estimate of remaining MBCs. This process is described below and then shown in detail for one NEES program.

STEP 1: Estimate the minimum total MBC. Since the existence of MBCs is apparent because of the large difference between the bill savings and incremental measure costs of efficiency measures, these components are used to calculate the minimum estimate of MBCs. This estimate is only made for nonfreerider participants since freeriders would have incurred these costs anyway.

Table 3 shows estimates of the minimum size of the total market barrier costs facing participants on NEES's programs. For example, the data show that Design 2000 participants must have faced at least $5.2 million in market barrier costs or they would have adopted the DSM measures on their own.

STEP 2: List all MBCs known for that technology and customer class. Many studies have been performed to determine what keeps customers from installing seemingly beneficial DSM on their own. Barakat & Chamberlain mined evaluations at NEES and other utilities and our collective consciousness to list the types of MBCs known for each program.

STEP 3: Match the program design components to those MBCs they address. Barakat & Chamberlain consulted with NEES program descriptions and staff regarding the program designs and implementation of these programs. Program design components were then matched to the MBCs they were designed to reduce.

STEP 4: Estimate the percent of MBCs reduced by the program. This step is subjective, but not necessarily without accuracy. Barakat & Chamberlain used a team of DSM experts to review NEES's process evaluations. Using those and the results of similar analyses at other utilities, each team member separately estimated the percent reduction in MBCs that could be assumed for each program. These estimates were made balancing the relative size of each MBC and the programs' ability to reduce certain types of MBCs. Notice that these percent reduction estimates are only made for *participants,* not for the class as a whole. The team's estimates were remarkably similar. The percent reductions shown in Table 3 are the average of the team's estimates.

STEP 5: Calculate the remaining MBCs and subtract these costs from participant benefits. Remaining MBCs were then calculated using the following formula:

Remaining MBC = (1 - percent reduction) - minimum MBC) (1)

Remaining MBC estimates for each program are shown in Table 3.

Figure 2 illustrates the analysis performed to estimate the reduction in MBCs for the Design 2000 program. The first column lists the results of Step 2—the list of possible MBCs. The MBCs are divided into four categories: lack of information, inconvenience or hassle costs, the cost of risk and financial constraints. Barakat & Chamberlain's team then studied program documentation and listed for

Table 3. Calculation of Remaining Market Barrier Costs ($000)

Programs	Bill Reduction (Nonfreeriders)	Participant Costs (Nonfreeriders)	Minimum Market Barrier Cost	Percent Reduction Assumed	Remaining Market Barrier Cost
Design 2000	$6,372	$1,164	$5,208	40%	$3,125
Energy Initiative	$98,880	$23,792	$75,088	60%	$30,035
Small C/I	$15,194	$4,638	$10,556	85%	$1,584

MARKET BARRIER COSTS	DESIGN 2000 PROGRAM OFFERS
INFORMATION	
▪ Think they're already efficient—equate efficiency with building standards ▪ Need help identifying savings opportunities ▪ Don't know savings > > costs ▪ Hard to evaluate myriad of options ▪ Need more detailed information on product specifications	▪ Offers a wide variety of information through advertisement, direct mail, technical seminars and presentations to A/E firms, developers, and customers ▪ Technical assistance including professional engineering services to identify nonlighting options and verify actual savings Success in reduction: high
INCONVENIENCE/HASSLE	
▪ Difficult to find vendors and contractors able and willing to incorporate efficiency improvements ▪ Additional staff time to evaluate alternatives ▪ Training time for staff on new equipment	▪ Utility maintains energy efficiency design professionals for technical assistance and trains customers in the O&M of efficient equipment ▪ Projects are targeted in early stages to minimize costs Success in reduction: medium to high
RISK	
▪ Don't believe savings estimates ▪ Worried equipment won't work ▪ *Unknown technical risks can increase time and cause overruns* ▪ Reputation rides on few visible projects	▪ O&M assistance to train customers on use of efficient equipment ▪ Utility publishes case studies of actual savings achieved by participants Success in reduction: medium
FINANCIAL CONSTRAINTS	
▪ *Bids evaluated on first costs* ▪ Higher cost of funds ▪ Can't always pass on costs in a tight market ▪ Longer lag time to recoup investment ▪ Key market barrier costs	▪ Incentives cover full incremental cost Success in reduction: medium
Note: Italics indicate key market barrier costs.	

Figure 2. Analysis Performed to Estimate Reduction in Design 2000 Market Barrier Costs

each category the program design components that were intended to reduce these MBCs.

Barakat & Chamberlin believes that the two most significant MBCs for the Design 2000 program-and for most large commercial/industrial new construction programs-are first costs and the risk of overruns.

After a thorough review of Design 2000's process evaluation, the team estimated how successful the program design was in reducing the MBCs. These results are shown as high, medium, and low success scores in Figure 2. Finally, the size of the MBCs was balanced against the success of the program design to estimate that 40 percent of the MBCs of this program were reduced.

The analysis of the financial constraint category deserves further explanation. Most program designers and evaluators would agree that a program's incentive has more than one impact on participants. The most obvious impact is a dollar transfer to customers to offset their equipment costs. But an incentive often serves other purposes as well. It communicates to customers that the utility believes in and is willing to back the DSM measures and their savings with hard cash. This can reduce the cost of risk to customers.

If the practice of evaluating bids on first cost causes the benefits of energy savings to be ignored, a full incremental cost incentive removes this barrier and allows society to gain from the energy savings. The incentive has both reduced the actual dollar cost of the measures *and* removed the market barrier cost caused by this practice. The "Medium" level of reduction for the financial constraint MBCs counts the benefits of the incentive other than its dollar value. Table 4 shows the results of the Value test assuming no takeback and no change in quality. The last column shows for reference the minimum percent reduction in MBCs required for each program to pass the Value test.

Takeback Benefits. Expected demand and energy savings are most often made assuming that the customer uses the same amount of the energy service (e.g., heating, cooling) after the program as before. Actual demand and energy savings are less than expected when the participant decides to respond to the efficiency-caused lower price of the energy service and purchase more. This behavior change is called takeback, snapback or the rebound effect.

The benefits of takeback are made up of two components. The first and largest is the expected bill savings that the customer spends on takeback. This component is straightforward to calculate. It is the present value of the following over the life of the program impacts:

*Bill savings spent on takeback = (expected energy savings - actual energy savings) * rate*

The second component of takeback is the extra value gained over the price paid (consumer surplus) for the additional energy service purchased. This component is also simple to calculate but is so small we left it out of our rough estimates here. The calculation of this additional component requires as inputs the efficiencies of the standard and efficient equipment or the total load of the energy service before the program and the amount of energy taken back or the change in hours of use.

The program evaluation documentation indicated that takeback was not likely for these programs. However, for illustrative purposes Barakat & Chamberlain made an estimate of the first component of takeback for each program assuming an arbitrary 5 percent takeback. These estimates are shown in Table 5.

A five percent takeback assumption means that five percent of the expected savings were "taken back." As can be seen in Table 5, an assumption of five percent takeback does not change the cost-effectiveness of these programs, but it is large enough to double the size of the net benefits of the Design 2000 program.

Table 4. Value Test Results Assuming No Takeback and No Quality Change ($000)

Programs	"Net" Participant	Remaining Market Barrier Cost	Participant Net Benefits	All Ratepayers (Rates) Net Benefits	Value Test Net Benefits	Percent Reduction Assumed	Percent Reduction Required
Design 2000	$7,372	$3,125	$4,247	($4,018)	$229	40%	36%
Energy Initiative	$100,893	$30,035	$70,858	($31,661)	$39,197	60%	8%
Small C/I	$15,851	$1,584	$14,267	($6,365)	$7,902	85%	10%

Table 5. Impact of Takeback on Value Test Results ($000)

Programs	Bill Reduction (Nonfreeriders)	5% Takeback Assumption	Participant Net Benefits	All Ratepayer (Rates) Net Benefits	Value Test Net Benefits
Design 2000	$6,372	$335	$4,582	($4,108)	$655
Energy Initiative	$98,880	$5,204	$76,062	($31,661)	$44,401
Small C/I	$15,194	$800	$15,067	($6,365)	$8,702

Quality Change. Of the benefit and cost components missing from the TRC test this is the most difficult to estimate. This component relates not only to changes in actual quality of service, but to any other change in value not captured by the other components such as the value to participants of meeting environmental compliance standards. For the more nebulous aspects of quality (e.g., being more comfortable), this component may end up being treated like externalities. That is, until a method for quantification is agreed upon, we simply acknowledge that these effects exist, whether the impact is likely to be positive or negative, and whether it will change a program's cost-effectiveness. For example, if a program already passes and a quality gain exists, it need not be quantified since it will not change the program's cost-effectiveness.

There are two cases, however, when estimation of quality gain is relatively straightforward. The first is when a program is voluntary, but the net benefits to participants including all other components are negative. This result is illogical. A customer is not going to participate without seeing some positive net gain. In this case a minimum estimate of quality or value gain is simple. It is the dollar amount needed to take the participant net benefits to zero.

The second instance when estimating quality gain is straightforward is when you know of a specific quantifiable benefit or cost to participants that has not yet been included in the analysis. For example, say a customer switches from a traditional gas furnace to an ultra-violet technology for paint drying. As a result, the customer produces a higher quality product that commands a higher price on the market. The increase in the price received for the product is a good estimate of the quality gain to the customer from the program.

There is one additional technique that can be easily employed to aid in determining whether a program's cost effectiveness will be changed by quality gain or loss. This technique involves calculating a breakeven value for quality. This breakeven value allows the estimation process to be reduced to simply asking whether it is likely that the actual value is greater or less than the breakeven value.

For example, refrigerator turn-in programs assume that the appliances turned in were actually in use. Yet, no cost is included for the loss to these customers from no longer having this second refrigerator. In another study, Barakat & Chamberlin calculated a breakeven value for the second refrigerator of $5.50 per year (Herman and Chamberlin 1993). That is, if the second refrigerator was worth more to customers than $5.50 per year, the program was not cost-effective. A quick poll of people involved with the program indicated a strong likelihood that the value to customers would be greater than 50 cents per month. Thus, the program was declared non-cost-effective.

Therefore, even though quality gain has been considered a difficult-to-quantify benefit-cost component, it should not cause much trouble in the analysis process. For DSM programs facing quality changes there are at least three estimation technologies presented here that will cover the majority of cases. It is only in the few remaining cases where more detailed quantification will be needed.

In the analysis of NEES's programs Barakat & Chamberlin simply indicated a "QG" or "QL" next to programs if the process evaluation results indicated that a quality gain or loss was likely. Based on the evaluation results, the impact of quality change was believed to be small enough for all programs to not change program cost-effectiveness.

Other Benefits. There are two other benefit or cost components that were not considered in the NEES analysis, but should be mentioned for completeness. The first is the reduction in MBCs for freeriders. Freerider participants may also face additional costs in DSM adoption over those contained in the participant cost term. By definition, if these participants are freeriders, these costs were not large enough to prevent adoption in the absence of the program.

Just as the program reduced MBCs to nonfreerider participants, it is likely that MBC costs were also reduced for freeriders. Since these costs would have been incurred even in the absence of the program, the reduction in MBCs to freeriders is a benefit of the program.

The second benefit missing from the analysis is the impact of freedrivers or spillover. Some customers may purchase either the efficient equipment promoted by the program or additional efficient equipment as a result of the program, but without taking the incentive offered. The resulting energy savings are a benefit of the program that has not been counted because the traditional definition of a program participant is one who accepts the incentive offered.

Value Test Results as Compared to the Standard TRC and NEES's TRC Tests

Table 6 shows the final results of our analysis of NEES's programs. The Value test results assuming no takeback or change in quality are shown next to the standard TRC and NEES's TRC results. As can be seen, for this study the Value test shows all programs to be cost-effective—as do the standard and NEES's TRC tests. (NEES's TRC test differs from the standard TRC by including incentives and excluding participant costs.) The order of cost-effectiveness changes, however. Under the TRC test Energy Initiative was the strongest program. Under the Value test, the Small Commercial/Industrial program is.

The last column of the table indicates the likelihood of quality gains or losses. No program was assumed to have takeback. As discussed above, the program evaluations indicate that these impacts are not large enough to change program cost-effectiveness, therefore no further analysis time was spent on them.

Conclusions

NEES's Perspective on the Use of the Value Test

The analysis performed by Barakat & Chamberlain provided NEES with some valuable insight into the design and the overall cost-effectiveness of its DSM programs from a different perspective. However, NEES is not currently proposing nor considering a change in the benefit-cost analysis that it performs on its DSM programs.

Conclusions

The Value test corrects the biases in the existing TRC test. Its use in DSM resource selection may:

- Allow utilities to respond to competition through ensuring that DSM is providing value to customers.
- Allow regulators to ensure that ratepayer interests are upheld—both that economic energy efficiency is promoted and that rates are minimized.
- Change the way we think about resource selection. If we are going to promote economic energy efficiency, we have "stepped to the customers's side of the meter." Customers' benefits and costs do not submit well to engineering analyses and the implied precision of B/C ratios with two decimals. Simply knowing whether a program is good for customers or not should be enough.
- Make better use of the information already gathered for standard cost-effectiveness analyses. The analysis performed for NEES was based entirely on their

Table 6. Comparison of Value Test Results to TRC and RIM Tests ($000)

	Standard TRC Test Results		NEES TRC Test Results		Value Test Results		
Programs	**NPV**	**B/C**	**NPV**	**B/C**	**NPV**	**B/C**	**Additional Benefits and Costs**
Design 2000	$3,290	2.09	$2,955	1.88	$229	1.04	QG
Energy Initiative	$68,733	2.61	$75,652	3.11	$39,197	1.54	QG
Small C/I	$9,383	2.12	$10,519	2.45	$7,902	1.79	QL

Key: QG = quality gains may exist; QL = quality losses may exist.

existing cost-effectiveness results and evaluations. Of course, future evaluations should be refocused to better and more directly answer the questions posed by the Value test.

- Allow all types of DSM to be consistently evaluated using one test.

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