# Misconceptions, Mistakes and Misnomers in DSM Cost Effectiveness Analysis

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In this paper, we take a close look at the standard cost-effectiveness tests used for assessing demand-side management (DSM) investment. We examine the perspective which each test is supposedly reflecting, consider the role that perspective should have in judging DSM, identify the benefits and costs which are reflected in that perspective, and discuss how the test might be applied in a practical fashion. We also include a brief discussion of the "value" tests which have recently appeared in the literature.

We find that the issues in benefit-cost analysis can be grouped into three categories: envelope issues, feedback issues and discounting issues. Envelope issues are those that deal with which costs or actors should be included in, or excluded from, a particular cost-effectiveness perspective. Feedback issues are those that deal with indirect effects of DSM. Discounting issues are those surrounding the selection and application of appropriate discount rates.

We also find that there is often a gap between what should theoretically be and what is typically included in the different cost-effectiveness tests. Some omissions can be resolved easily, such as the full accounting of DSM administrative costs. Others are much less manageable. The elasticity of demand with respect to rate impacts, explicit accounting for the market barrier costs faced by efficiency investment, and the added or reduced value of service produced by DSM measures all have their ideal role in cost-effectiveness analysis, but are troublesome to apply in practice.

## Introduction

Over the past fifteen years, a set of standard tests has been developed to evaluate the "cost-effectiveness" of utility-sponsored DSM from a variety of perspectives. The creation and application of these tests has been driven by regulation: state utility commissions needed yardsticks by which to judge DSM programs as beneficial or otherwise. From this need, the set of "standard" cost-effectiveness tests have evolved for use in assessing the value of DSM from a number of different perspectives. In this paper, we take a close look at these cost-effectiveness tests, examining the standpoint which the test is supposedly reflecting and what role that standpoint should have in judging DSM, identifying the benefits and costs which are reflected in that perspective, and grappling with how the test might be applied in a practical fashion. We also include a brief discussion of the "value" tests which have been proposed over the past few years.

We use the California Standard Practice Manual (California Energy Commission (CEC) 1987) as the takeoff point for our discussion of the five most common cost-effectiveness tests: the Participant Test, the Utility Cost Test, the Rate Impact Measure (RIM) Test, the Total Resource Cost (TRC) Test, and the Societal Test. For each of these tests we address the following questions:

1. *What is this test supposed to measure? Why are we interested in it?* Before discussing the intricacies of a test, we first discuss what its results are used for, who is interested in the results, and why.

2. *What are the major issues which must be addressed in applying this test?* Once we have laid out the purpose of a cost-effectiveness test, we discuss the major issues which arise in its application. We find that these issues can be grouped into three categories: envelope issues, feedback issues, and discounting issues. Envelope issues are those that deal with which costs or actors should be included in or excluded from a particular cost-effectiveness perspective. Feedback issues are those that deal with indirect effects of DSM (e.g., elastic consumption reactions to DSM induced

rate changes). Discounting issues are those surrounding the selection and application of appropriate discount rates.

3. *What is the practical application of this test?* In virtually all cases, there is a gap between what theoretically should be included in a cost-effectiveness test and what can realistically be done in practice. After having discussed the more theoretical issues surrounding a cost-effectiveness test, we follow up by discussing how to go about practically implementing the test.

## Participant Test

*The Participant Test is the measure of the quantifiable benefits and costs to the customer due to participation in a program.* (CEC 1987, p 9)

The intent of the Participant Test is to determine if a utility customer is better off by participating in a program, and to a lesser degree, by how much.

The Participant Test has two roles. First, it demonstrates to a utility regulatory commission that the participating customer will benefit from the program. Second, and more important, it is an indicator of the potential success of a program. If a program or measure generates large net quantifiable benefits to the customer, then success is much more likely than if the program generates only marginal net benefits for the participant.

### Discussion

If one adheres to the California Standard Practice (CSP) definition of quantifiable benefits and costs (CEC 1987), then the Participant Test potentially can measure what it claims to measure. Bill savings are benefits. The incremental cost to the participant of the equipment (taking into account the rebate) is a cost. Any incremental operating costs (savings) associated with the DSM measure are costs (benefits).

The costs and benefits of the Participant Test are shown schematically in Figure 1. In this figure, and the ones that follow, the different actors in DSM are shown as rounded boxes: participant, sponsoring utility, government, etc. The broad dashed line represents the "envelope" of analysis for the particular test being examined. Since Figure 1 illustrates the Participant Test, the dashed envelope line surrounds the participant box. Arrows show the flow of money. *Arrows pointing out of the envelope* represent money being paid by the participant to an outside actor, and therefore are *costs* as defined by the Participant Test. The arrow from the participant to the equipment dealer points out of the envelope, indicating a cost. *Arrows pointing into the envelope* represent a flow of *benefits.* The bill savings and incentive arrows connecting the utility to the participant point into the envelope. Arrows which remain within the envelope are transfer payments, and therefore are not included in the analysis. Arrows which remain outside the envelope do not enter into the calculations.

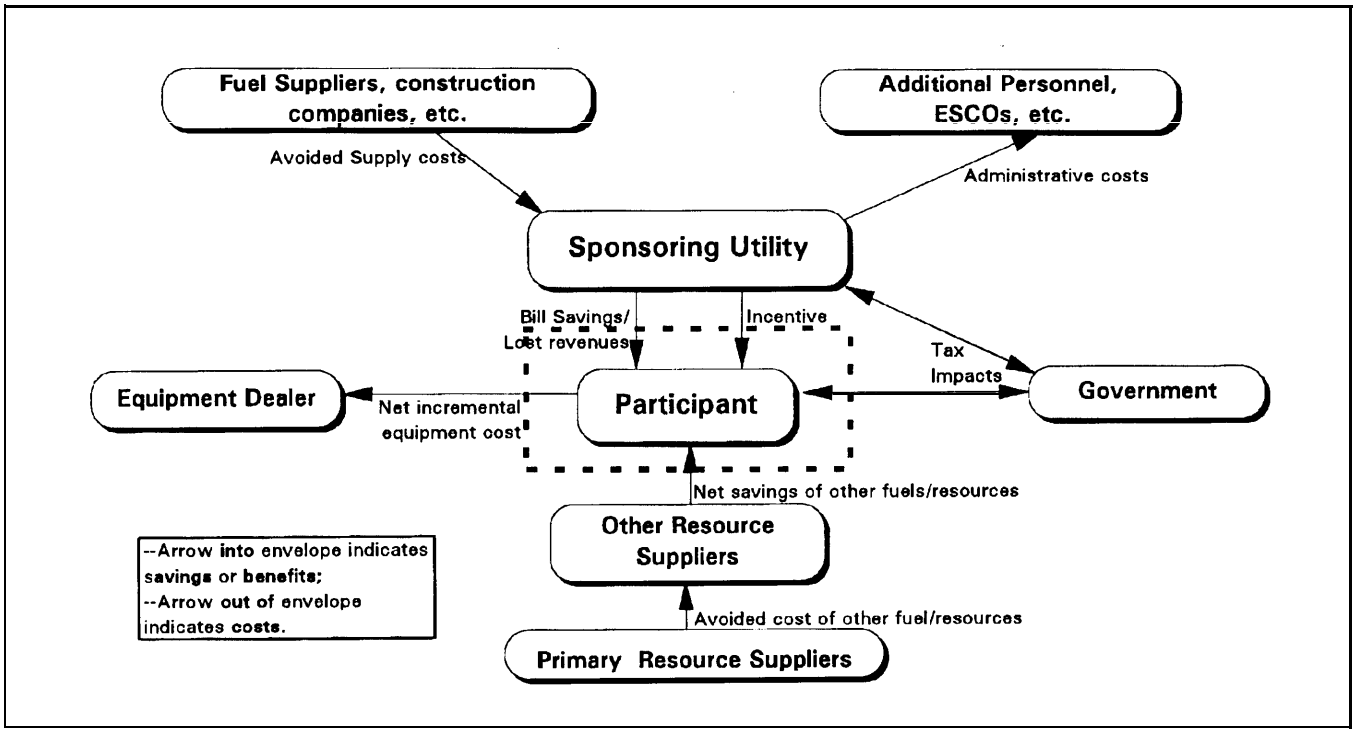


**Figure 1.** Participant Test

The primary issue in considering the participant perspective is ensuring that all quantifiable benefits and costs are accounted for. Some of the more easily overlooked costs and benefits are impacts on participant resources which are not provided by the sponsoring utility. These might include changes in cooling water demand for differing chillers, or, for a gas utility, the changes in auxiliary electric use for differing gas equipment or appliances.

Another easily overlooked cost or benefit of participation in a DSM program is its tax implications to the participant. DSM benefits are generally not taxed directly, but can affect property taxes (by increasing the assessed value of the home), personal income taxes, businesses' income taxes (who write off utility payments as a business expense), to name a few.

Moving beyond the strict restriction of "quantifiable" benefits and costs, a benefit not accounted for in the Participant Test (or other tests for that matter) is a potential increase in the value of the service provided by the DSM measure. A well weatherized home not only saves on heating bills, but is less drafty and more comfortable, too. This kind of increase in value to the participant is not accounted for in the CSP method, but is nevertheless quite real.

Market barriers to energy efficiency are the prime example of non-quantifiable costs: information costs incurred by customers as they become more familiar with the technology; risk-adverse purchasing behavior or skepticism on claimed savings; the hassle of dealing with a program or changing to a new, unfamiliar technology, etc. On the other hand, a well designed DSM program can serve to decrease many of these "transaction costs" or barriers associated with installing efficient equipment. Chamberlain and Herman (1993) include the reduction in such "unaccounted for" costs in their "value test" for DSM cost-effectiveness.

Another potential non-quantifiable cost of DSM is a *decrease* in value due to the DSM program. The compact fluorescent lamp is an example. Color rendition, time delay as the lamp warms up, and awkward lamp sizes are all "costs" paid by the program participant which are not normally accounted for in the participant cost analysis.

Since the Participant Test is generally presented as the present value of the net benefits (discounted benefits less discounted cost) or as a ratio of discounted benefits to discounted costs, the use of an appropriate discount can be very important. The sponsoring utility's weighted average cost of capital is not an appropriate proxy for consumer discount rate. What an appropriate discount rate should be from the participant perspective is a more difficult question. It can be argued that the marginal cost of capital to the participant is an appropriate discount rate. For residential customer, this is often taken to be a credit card rate, a home-equity loan rate, or, in the case of a new construction program, the mortgage rate. For commercial customers, the discount rate can be taken to be the rate at which the company can borrow money or some minimum rate of return on investment. Others argue that the rate of return on a savings account or certificate of deposit is an appropriate proxy of a consumer discount rate.

### Practical Application

Understanding the participant perspective is very important in DSM program design, but it is not a critical factor for program or measure screening. DSM programs (except load building) generally have no difficulty passing the Participant Test, often even without any utility incentives. If a measure fails the Participant Test, it is not likely to pass the TRC Test and would probably be impossible to market. Market research (e.g., focus groups), may provide better information about customer acceptance than the "Participant Test" calculation.

## Utility Cost Test

*The Utility Cost Test measures the net costs of a demand-side management program as a resource option based on the costs incurred by the utility (including incentive costs) and exclude the net costs incurred by the participant.* (CEC 1987, p 17)

The Utility Cost Test measures the impact on utility revenue requirements. In fact, it was referred to as the Revenue Requirements Test in the 1983 version of the CSP (CEC 1987, p vii). As we will discuss, the Utility Cost Test does not really reflect the interests of the utility, and therefore is of only marginal interest to utility planners. The net impact on revenue requirements of DSM is of only passing interest to commissions, which when evaluating DSM, are more interested in a program's total benefits, costs, and its impact on rates[2].

### Discussion

As shown in Figure 2, avoided resource supply and demand costs are counted as benefits in the Utility Cost Test. Costs paid by the utility for incentives, program delivery and administration are counted as costs (Figure 2). Lost revenues are by definition not included in the analysis.

Assuming that the purpose of the Utility Cost Test is to measure impact on revenue requirements, then the test measures what it is supposed to do. However, the title of the test is misleading. The perspective of the utility, as

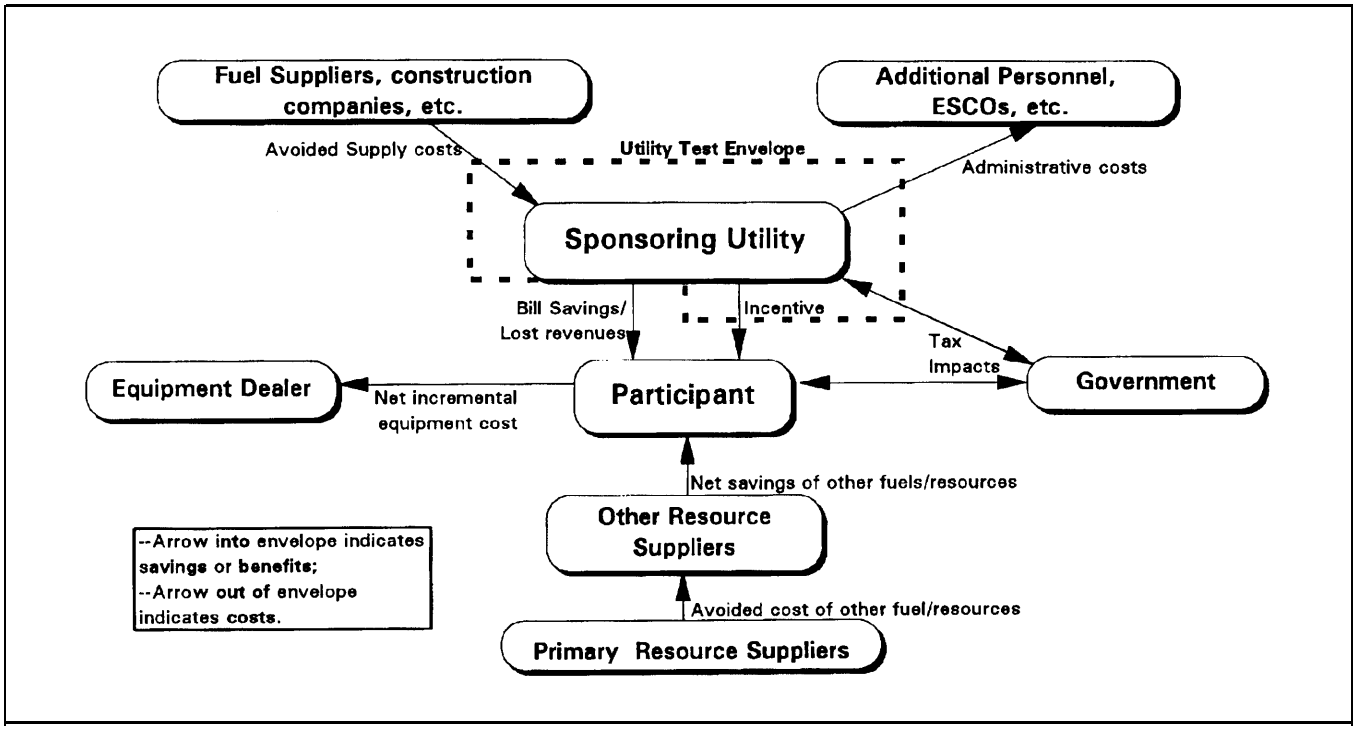


**Figure 2.** Utility Cost Test

expressed by typical utility management, is not the minimization of revenue requirements. We see a utility perspective better reflected in the interests of the utility investors, who are generally more interested in maximizing their return on investment. Minimization of revenue requirements can contribute to this, in that it eases regulatory burdens (commissions can see the utility is doing a good job) and can contribute to lower rates. However, reduced revenue requirements is not a primary or an explicit goal. Increased sales between rate cases and larger rate bases upon which to earn returns would better reflect the absolute interests of utility investors. However, we are not saying that the test should be changed to reflect the interests of the utility. Utilities already have at their disposal many more sophisticated methods of evaluating investments, including those in DSM, than what we could hope to propose.

***Avoided Supply Costs.*** On the benefits side, the avoided costs must be calculated correctly, both for the Utility Cost Test, and for their pivotal role in the more important TRC and Societal Cost Tests. In order to accurately calculate avoided costs, one must develop two optimized system plans. The first plan is without the DSM program, and the second one with a decrement to load representing the DSM program. The load decrement must be designed to reflect the characteristics (e.g., size and timing) of the DSM measure being considered. The annual differences in cost between the two plans are the costs that could be "avoided" by the DSM program. Although straightforward in concept, calculating avoided cost is quite difficult. Care must be taken to develop reasonable system plans, in order that the DSM program's effect upon the capacity and energy mix is accurately represented.

***Administrative and Delivery Costs.*** A complete accounting of costs paid by the utility to implement the program must be included. Joskow and Marron (1992, 1993) suggest that a full accounting of all the utility costs associated with DSM would result in costs much higher than are generally reported. In their 1991 survey, only two of thirteen utility DSM programs provided to their satisfaction a full accounting of DSM administrative costs. According to Joskow and Marron, the factor generally most neglected was the cost of monitoring and evaluation. If the costs to monitor and evaluate DSM programs are significant, then they should be included in the cost-effectiveness analysis. However, care must also be given that the framework of cost accounting is consistent with that used to evaluate supply resources.

## Practical Application

We believe that changing the name to better match the actual intent of the test, such as to the older Revenue Requirements Test, would be more appropriate than changing the calculation of the test to reflect a "utility perspective." While the Utility Cost Test in isolation is only marginally interesting, the inputs going into it are critical inputs to cost-effectiveness analysis from other perspectives.

## Rate Impact Measure Test

*The Rate Impact Measure (RIM) Test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program.* (CEC 1987 p. 17)

### Discussion

The RIM test is supposed to test for cross-subsidy: non-participants paying for benefits accrued by participants through higher rates. It attempts to accomplish this by comparing utility spending on DSM and lost revenues to avoided supply savings. If supply savings exceed utility spending plus lost revenues, the program passes the RIM Test; if not, it fails.

As shown in Figure 3, the RIM envelope is clearly drawn around the utility: avoided costs are benefits, incentives paid to participants are costs,. administrative and delivery costs are costs, and lost revenues are costs. The issues brought up in the discussion of the Utility Test also apply here: all costs associated with utility DSM activity and all avoided supply costs must be accounted for correctly.

The RIM Test does not provide the regulator or the utility planner with enough information discern any of the major cross-subsidy issues. The more important questions to be asked when addressing rate impacts and cross-subsidization issues are (1) whose rates are going to go up and (2) by how much? Net present values and benefit cost ratios do not provide this information. Additional data are needed: are costs expensed or rolled into rate base? Are costs going to be collected exclusively from the rate class for which the program is aimed, or spread over all ratepayers?

Additionally, the RIM Test is not even an accurate indicator of the presence of a rate impact. Consider a program whose RIM benefits-avoided costs—equal exactly its RIM costs—incentives, administration costs and lost revenues. Such a program passes the RIM test—its benefit-cost ratio equals 1.0—but still will raise rates. This is because the decrease in sales resulting from the program will result in the fixed cost component of rates being allocated over fewer kilowatt hours or therms.

### Practical Application

The application of the RIM Test, as currently applied, is an inappropriate arbiter of DSM. Public policy makers are always having to address issues of cross-subsidy: benefits accruing to some portion of the population at a cost to the whole. To put it another way, Pareto optimality is not, and for practical purposes cannot be, a strict criteria of public policy formulation. This is not to say equity and wealth distribution issues are not important; they are. Rather, they should not be the primary criteria for DSM program acceptance or rejection.

The RIM Test is too crude a tool to discern the cross-subsidy impacts of interest to regulators and utility

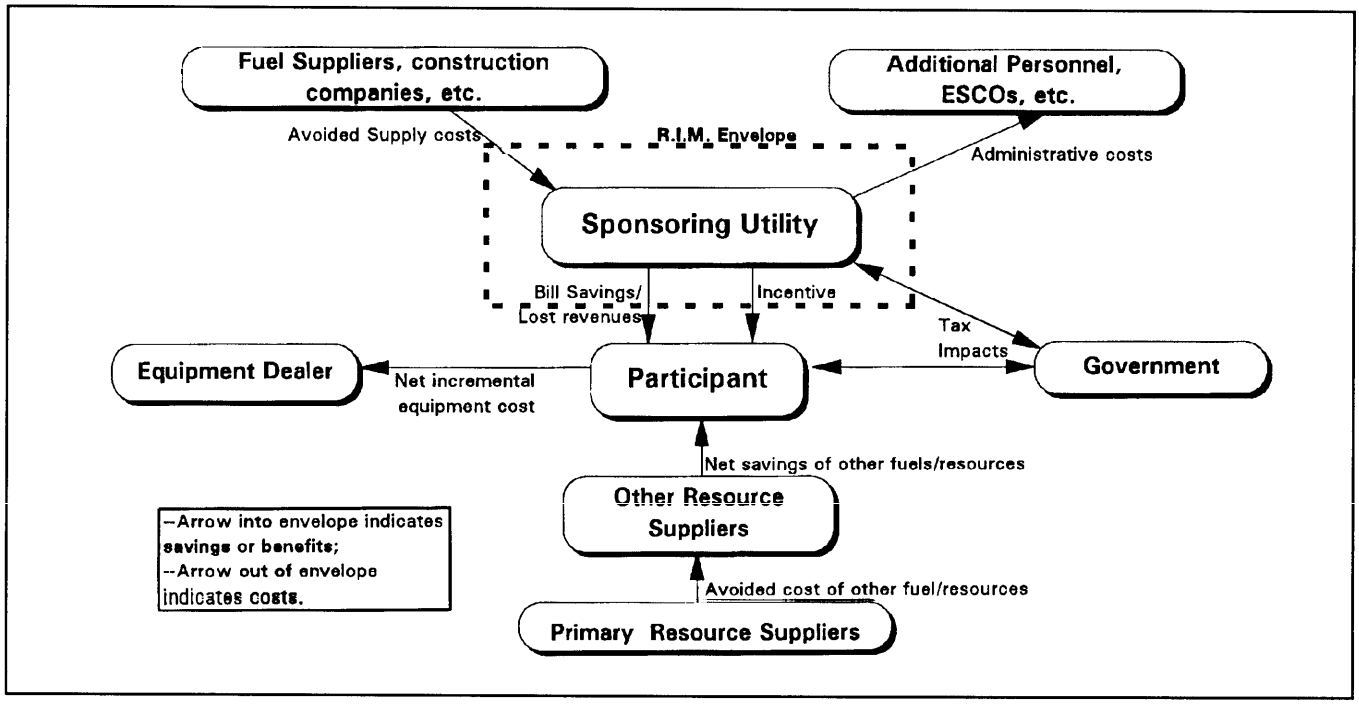


**Figure 3.** Rate Impact Measure (RIM) Test

planners, who are interested in which rates will be affected, by how much, and what this impact means for market position. Therefore, it is necessary to take the extra step and identify, as specifically as possible, who will be affected, by which rate schedules, and by how much their bills will be affected. With this information, regulators can make informed decisions on rate impacts. Utility planners, as well, can more fully assess how the DSM program will affect their product in the marketplace.

Secondly, when thinking about rate impacts, the impact of a DSM program in isolation is virtually meaningless. The retail rates associated with a utility system resource plan are an important characteristic of the plan, but they are influenced by all of the DSM programs taken together, along with myriad other variables (e.g., fuel prices, load growth, capacity expansion options and plans). By and large, it is the overall level of rates that matters to policymakers, not the incremental rate impact of DSM activities, or worse, the incremental rate impact of a single DSM program.

For example, in a recent planning exercise in Colorado, a cap of three percent was adopted as a limit upon the acceptable impact of a utility's DSM programs. The utility then rejected a DSM program with estimated present value savings of $231 million (in 1993 present value) because it exceeded the three percent cap by 0.1 percentage points in the year 2005 (Woolf 1994). We believe that the rejection of this program was inappropriate, because the utility failed to consider uncertainty or alternative program designs. These could have allowed the cost-effective program to remain in the plan, without exceeding the rate cap. Thus, even if one believes a strict rate cap to be appropriate, it should not be employed mechanically to reject otherwise attractive DSM opportunities.

## Total Resource Cost TEst

*The Total Resource Cost (TRC) Test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.* (CEC 1987, p. 25).

The TRC Test measures the sum of the RIM and Participant Tests—the perspective of the utility plus the participants. Primarily because it serves as a prelude to the Societal Cost Test, the TRC Test provides the back-bone to DSM decision making. A DSM portfolio may pass the RIM Test, but if its programs fail the TRC and/or Societal Cost Tests, the portfolio still should fail.

### Discussion

***Envelope Issues.*** The definition of the TRC Test quoted above contradicts its application in practice. The CSP definition quoted above clearly indicates that the "envelope" is drawn around the participant and the utility (or, indirectly, around the participants and non-participants). This is shown in Figure 4 as the longer dashed envelope line. Strictly interpreted, this means that

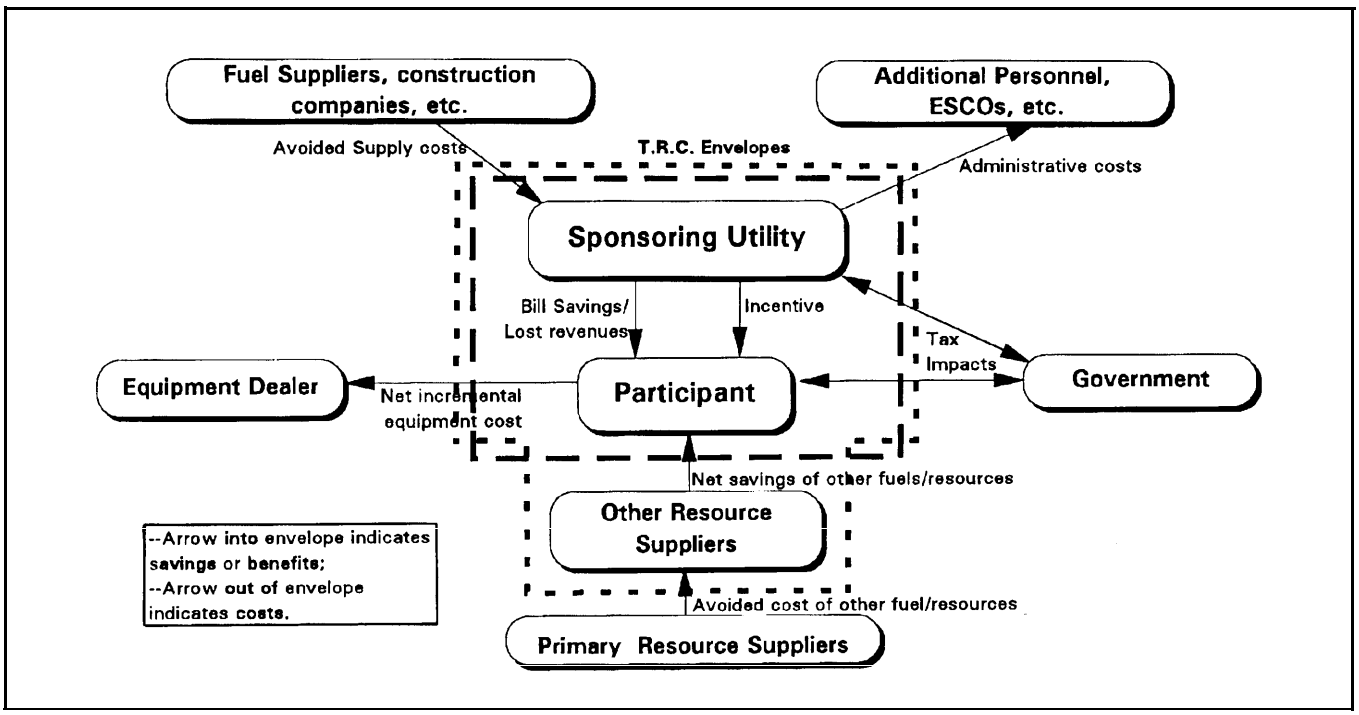


**Figure 4.** Total Resource Cost Test

all other resources affected by the program, such as water or some other fuel in the case of a fuel switching program, would be valued at the price seen by the participant/utility entity: retail rates. This is the application of the "Chapter 380" cost-effectiveness test in Maine.

However, in practice elsewhere, and in the discussion and example in the CSP manual, the avoided supply costs of the fuel not chosen (in the case of fuel switching) is used in the analysis. This is in spite of the fact that these cost are not experienced by either the utility or the participant. This is shown as the shorter dashed envelope line in Figure 4. Since avoided costs can differ significantly from tariffs (for regulated fuels) or prices (for market fuels), the choice of convention can be the difference between a measure passing or failing the TRC Test.

Using the "switched-from" fuel's avoided cost in the analysis is intuitively comfortable. It places all fuels on an equal avoided cost footing. But it begs other questions. Should water savings be valued at its avoided cost? What is the avoided cost of water? If other resources, such as a refrigerant, are reduced, should their savings be valued at some "avoided cost" or at the market price? Or even the equipment associated with the DSM measure being installed? When does pursuing this line or reasoning become ridiculous?

These avoided cost versus market cost questions introduce the second envelope issue. How are costs paid by actors other than the utility or participant accounted for in this test? Both in definition and in practice, costs paid by actors outside this envelope are treated exogenously. For example, the tax credits given by the State of Hawaii for the purchase of solar water heaters—well over $1000 per unit—are netted out of the equipment cost prior to the calculation. Given the Hawaiian electric utilities' DSM programs, Hawaiian taxpayers may potentially be paying tens of millions of dollars for DSM which will not be accounted for in the TRC Test. However, excluding tax credits is inconsistent with the use of avoided costs for outside-the-envelope-fuels.

***Discount Rate Issues.*** One potential issue arising with the TRC Test is that the two actors involved, the participant and the utility, will likely have very different discount rates. Should the costs and benefits to the participant be discounted at one rate while the costs and benefits to the utility be discounted at another? In other words, do we draw a single large envelope around both the utility and the participant, or do we take the sum of two smaller envelopes, one around the customer and one around the utility. If the latter is the case, then the implicit transfer payment of customer bill savings and utility lost revenues will no longer cancel each other out. Assuming that the customer has a higher discount rate than the utility, the present value of $40 per year of bill savings to the customer will be less than the present value of $40 per year of lost revenues to the utility.

### Practical Application

For conservation programs, many of the envelope issues do not arise. Only the sponsoring utility's resources are impacted, and there is no outside actor involved. However, for fuel switching programs, programs that affect other resources (e. g, water savings or auxiliary fuels), or programs with tax implications, the envelope issues become quite real.

In these cases where envelope issues arise, we recommend calculating the TRC Test in two ways. The first is the "All Ratepayers" test: draw the envelope around the participant and the utility (e.g., non-participant), and strictly account for only costs and benefits which directly cross the envelope. Tax credits are taken as cost reductions. Other resources are valued at their market price. Picking and choosing which outside-the-envelope costs to include leads to methodological inconsistencies and redrawing the envelope to include all of the other costs results in the Societal Test.

Even with that said, we recommend a second method more in the spirit of the present application of the TRC Test. Tax credits are taken as cost reductions, and other tax implications taken as given. Avoided costs for resources other than those provided by the sponsoring utility should be used rather than tariffs or market prices. Discretion is still needed in deciding where using avoided costs rather than actual prices is appropriate. Fuels switched away from, and if significant, water savings, should be valued at avoided costs. Reduced cooling tower chemicals should probably be valued at the cost paid, rather than at some concocted avoided resource cost.

In performing either of these variations of the TRC Test, we recommend using the utility's weighted average cost of capital as the discount rate throughout the analysis. Logical anomalies can arise when different costs or benefit streams are valued at different discount rates.

## Societal Test

*The Societal Test is structurally similar to the Total Resource Cost Test. It goes beyond the TRC test in that it attempts to quantify the change in the total resource costs to society as a whole rather than to only the service territory (the utility and its ratepayers).* (CEC 1987, p. 27)

The intent of the Societal Test is to measure the net impacts of a DSM program on society. While still

considering equity issues, the Societal Test should be the ultimate test of DSM cost effectiveness. If a DSM program benefits society as a whole, then it is reasonable to pursue it. If it harms society as a whole—that is, it incurs net costs to society—then is should not be pursued.

## Discussion

The authors have yet to see a truly comprehensive Societal Test performed, nor have they ever performed one. The best we can do here is to identify specific items which, in theory, should be included, and discuss how and to what degree can these factors can be considered in the Societal Test.

An important question to ask, and to answer, is where do you draw the envelope? Which of these factors can one reasonably include in a filing before a utility commission? In this section we will discuss each major "envelope" issue, pointing out where it might be reasonable to include it in an analysis, and where it is better left alone. (See Figure 5.)

***Tax Effects—Is the Government in the Envelope?*** The critical question to consider here is whether taxes are a transfer payment between the government (e.g., all citizens) and the entity paying the taxes. If this is the case, when the government offers a tax credit for a DSM technology like a solar water heater, the tax credit should be viewed as a transfer payment between all taxpayers to participants. The full cost of the DSM technology is included in the analysis.

Nevertheless, including the "government" in the envelope has further implications. With the government in the envelope, *all* tax effects of DSM would need to be accounted for: property tax effects, income tax effects, etc. For the utility, all the tax burdens paid by the utility are built into the revenue requirement. With the government inside the envelope, the tax effects would have to be teased out of the revenue requirements, so that no transfer payments are included as costs.

***Avoided Costs.*** Opening the envelope to include society as a whole has two implications for avoided cost. The first is the tax issue discussed above. The second implication involves the regional, pooled nature of electric supply. Are avoided costs calculated at the utility level, or at the pool level? As a practical matter, if transactions within a pool are reasonably fluid, and the power pooling agreement is reasonably structured, there will not generally be large differences in avoided cost among individual members of a pool.

***Environmental Impacts.*** Much of the discussion on the Societal Test has been on the treatment of environmental impacts. In theory, one should calculate the reduced damage from the marginal emissions saved by the DSM program. This is more easily said than done. We are not advocating any particular method of monetization

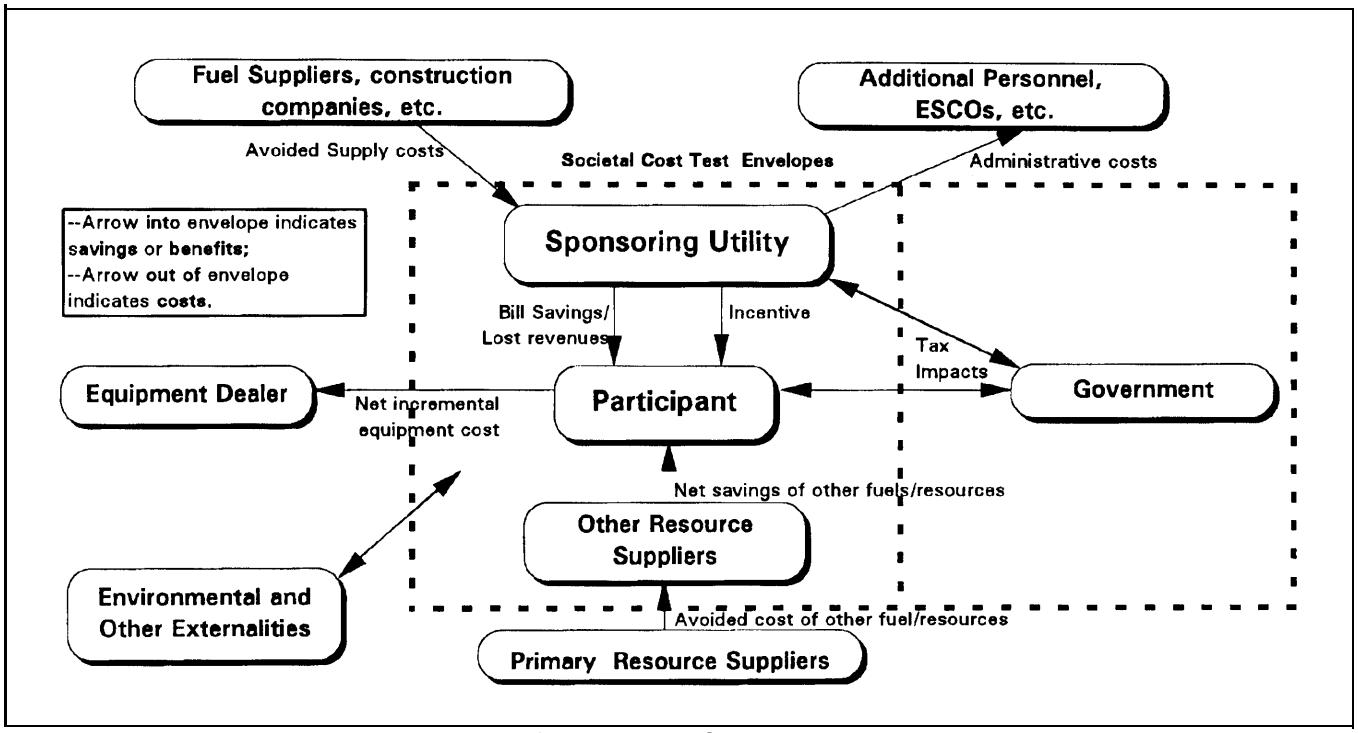


**Figure 5.** Societal Cost Test

(although the authors do have their opinions). In any event, the costs of at least the most important environmental externalities *must* be included in the Societal Test.

Environmental impacts of DSM go beyond avoided power plant emissions. DSM measures often have environmental benefits and costs of their own (EPRI 1992, Bernow et al. 1992, Hanser and Weaver 1991). To the degree possible, these impacts should be at least considered, and if found to be significant, quantified and valued in a manner consistent with that used for valuing environmental impacts on the supply side.

***Market Barrier Costs.*** The purpose of the utility sponsoring a DSM program in the first place is to overcome the market failures associated with investment in energy efficiency. Therefore, one can argue that a portion of the delivery costs and rebates/incentives is counteracting the various transaction costs felt by consumers (information costs, hassle costs, uncertainty, etc.) These costs can be seen as transfer payments between the utility and the participant, staying inside the Societal Test envelope, and therefore removed from the Societal Test analysis.

If this is the case, what fraction of these costs are overcoming market barriers? Some of the administrative and delivery costs do not overcome any market barriers. The costs spent on customer tracking, monitoring and evaluation are real costs, imposed by regulation, and are not overcoming any market barriers. Customers do not all face the same barriers. Some face minimal barriers; others greater ones. Clearly, costs spent educating the educated customer are real and not a transfer payment from utility to participant.

These costs are very amorphous and vary from customer to customer and program to program. Therefore, more as a practical matter than a theoretical one, we recommend counting administration and delivery costs as "crossing the envelope" and should be included in the Societal Test.

***Increased or Reduced Customer Value.*** In theory, the added (or reduced) value associated with DSM program should be included in a societal cost effectiveness analysis, including snap-back effects. The difficulty is quantifying these costs/benefits. Again, because these costs are amorphous, and vary significantly from customer to customer and program to program, we believe it is impractical to try to include them in an analysis.

***Social Discount Rates.*** In analyzing DSM, it is typical to have an initial investment followed by a stream of benefits occurring over the operating life of the measure. In order to express the future benefits on a comparable basis to the costs, the "present value" of the benefits is computed. For a societal perspective on DSM, it would appear obvious that a societal discount rate be used, in order to reflect society's rate of time preference. This rate will tend to be lower than the utility's cost of capital and lower than the individual discount rates of most of the utility's customers.

In practice, the use of a societal discount rate in a utility planning context raises a number of interesting difficulties (see, for example, Cator 1993). These are, however, questions directed to the appropriateness of the societal perspective for utility policy making, as much as they are directed to the discount rate per se. We believe that for a societal perspective analysis, a societal discount rate should be used.

***Dealing with Uncertainty.*** A deciding factor in many of our opinions as to whether to include a cost or a benefit in the Societal Test is pragmatism. Many of the factors which should theoretically be included in a Societal Test are subject, to a greater or lesser degree, to the values and opinions of the analyst performing the calculations. For example, how big are the market barriers to energy efficiency? There are nearly as many views on this as there are economists thinking about the issue.

However, uncertainty is a poor reason not to try to account for some of the more difficult issues. The valuation and monetization of environmental externalities are prime examples of this. Even though there is a lively debate in the energy planning an policy community on how to value environmental impacts in utility planning, many states are moving ahead in setting policies, even though they do not have complete knowledge or consensus among interested parties.

## Some Other Cost-Effectiveness Tests

Recently, some tests have been developed to represent notions of customer value which go beyond these standard cost-effectiveness tests. These tests include a "Most Value Test" proposed by Hobbs (1991), a "Value Test" proposed by Chamberlain and Herman (1993), and a "Net Economic Benefits" test proposed by Braithwait, Caves and Hanser (1993).

What these tests have in common is the intent of basing DSM cost-effectiveness analysis upon what Braithwait, et. al. refer to as "traditional measures of changes in economic benefits and costs." Specifically, they attempt to quantify the impacts of DSM upon "consumer surplus" as defined in welfare economics.

Within the abstract realm of welfare economics, the policy objective of maximizing consumer surplus is a sound one.

In application, however, the value tests face some practical difficulties. Pigou (1920) welfare economics, quoted Leonardo da Vinci, "Theory is the general; experiments are the soldiers" and then pointed out that "economic science has already well-trained generals, but, because of the nature of the material in which it works [living and free men], the soldiers are hard to obtain." (p. 9) Unfortunately, three-quarters of a century later, we are still long on theory and short on data. The application of economic science to utility system planning remains constrained by practical considerations and lack of data. Specifically, values for some of the variables necessary for the application of the value tests are quite uncertain.

For example, the Value Test proposed by Chamberlain and Herman is equivalent to the TRC Test in the case where the following four conditions are satisfied: "no free riders, no take back, all unaccounted for costs are eliminated by the program, and the price elasticity of demand for electricity is zero." (p 236). It is in the relaxation of these four conditions that the Value Test takes on its theoretical attractiveness, but also becomes difficult to apply. For example, quantification of the value of the "take-back triangle" depends not only upon the amount of take-back, but on the "slope of the demand curve" of an individual participant for the energy service being saved (e.g., BTUs of cooling). Accounting for "unaccounted-for costs" requires explicit quantification of the costs of the customer "becoming aware of the existence of energy efficient equipment", the costs "customers incur in gathering enough information . . . to make an informed decision", the costs of making sure the equipment is "installed and operating", the differential financing cost (i.e., the "amount by which the participant's cost of capital exceeds the utility's cost of capital"), and "all of the costs implied by customer perceptions of risk." (p 233)

Finally, the Value Test's analysis of "iterative rate effects" requires an estimate of price elasticity, another controversial topic. The price elasticity of electricity depends upon many factors including time frame, location, available substitutes, and customer inclinations. For residential electricity demand elasticity, Bohi (1981) concluded that:

> A great deal of effort has been expended on the analysis of residential demand for electricity, but it is evident that understanding of the characteristics of consumption behavior is less than complete. There is unanimous agreement that the price of electricity is important and that price has an inverse relationship with consumption. Beyond that, there is considerable disagreement about the responsiveness of consumption behavior. (p 77)

Bohi found that "[t]here are relatively few studies of commercial electricity demand" (p 79) and that" [t]he considerable instability in the industrial components, both across industries and over time, indicates that the overall estimates are subject to aggregation and locational biases." (p 90)

Advocates of value tests must also recognize the need for a consistent "objective function" for use in the various aspects of IRP. Hobbs, to his credit, also applies his Most Value Test to analysis of supply planning and environmental externalities (Hobbs and Heslin 1991).

While these obstacles to the application of innovative "value tests" for DSM planning are considerable, we should not let such practical difficulties stand in the road of progress. Planners and theoreticians who wish to broaden the TRC Test are well advised to think carefully about the territory to be annexed. We believe that incorporating environmental costs into utility IRP, including DSM cost-effectiveness analysis, ought to be a higher priority than attempting to quantify changes in consumer surplus .

## Conclusions

We see the Participant Test as useful to demonstrate to a commission that a DSM program or measure is beneficial to the participant, but that the test really cannot capture the participant perspective.

We find the Utility Cost Test to be misnamed. The test measures the impact on revenue requirement, which is only a small part of a "utility perspective." Because we see regulators being more interested in the total costs of a program and in overall rate impacts, we do not see the results of this test as particularly relevant or useful.

Understanding the rate implications of a utility activity, including a DSM plan, is important. But the RIM test, when expressed as an NPV or as a benefit-cost ratio, provides little useful information. When considering rate impacts, it is better to look at which rates will be affected, and by how much, rather than rely on RIM Test results.

We do not believe that the RIM Test should be the primary arbiter of DSM. Public policy makers are always having to address issues of equity. Pareto optimality (no-losers) should not be the guiding criteria in utility regulatory policy.

The stated perspective of the TRC Test is that of the participant and the utility as a unit. In practice, this definition tends to be stretched, particularly in the case of programs which affect multiple fuels.

We believe that the Societal Test should be the primary criteria for DSM cost-effectiveness. However, the test is evolving, as commissions, utilities, and advocates grapple with some of the more difficult issues surrounding a societal perspective. We believe that at minimum, the Societal Test should include monetized environmental impacts and be conducted at a social discount rate. If other factors such as rate feedback are considered, the full IRP perspective should be taken, and the factors applied to the evaluation of supply-side investment, too.

The "value" tests are interesting in that they approach the cost-effective analysis from a welfare economics perspective. We find this approach theoretically interesting, but because they rely on parameters which are highly uncertain and difficult to qualify, we are concerned about their practical applicability in the near term.

## Endnotes

1. For indoor air quality reasons, particularly tight weatherization might require special ventilation and air exchange equipment at additional cost (EPRI 1992).

2. When addressing supply side investment, the focus has been on the minimization of revenue requirements, which implies lower average rates.

3. For an interesting discussion of the RIM test, the role of the Pareto optimality criteria, and the formulation of public policy see Deegan 1993.

4. Chamberlain et al. correctly point out that these costs can be "eliminated through good program design". (p 235)

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