Benefit Cost Test: A Framing Document

Kansas Corporation Commission
Workshop on Energy Efficiency
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Objectives:

- Decide which programs and measures to include in an energy efficiency portfolio.[1]
- Alternatively, benefit cost tests can inform decision-makers, who will use an array of information to decide which programs to implement.
- Contribute to decision on whether a prospective energy efficiency portfolio is providing a sufficient return on investment

Background Document Included Here:
Guide to Resource Planning, Chapter 5, National Action Plan for Energy Efficiency.[2]

Additional Points
In weighing the results of the benefit cost tests, the utility and the Commission may try to assure that the outcome reflects the priorities of the state. A state may be particularly interested in energy efficiency for its comprehensive environmental benefits – in this case, societal test results may weigh more heavily. Conversely immediate rate competitiveness with other jurisdictions is important, a state may rely more on the ratepayer impact measure (RIM) test, though many programs that are less expensive than new generation resources fail to pass the RIM test.[3]

The benefit cost test used should match the aggressiveness of the state policy to promote energy efficiency. A savings goal (by a governor or appearing in a statute) might call for a high bar in energy efficiency savings, representing a high value on these savings, perhaps to avoid expensive generation investments or emissions. This goal should be matched, then, by a benefit cost test that will also tend to value energy efficiency highly, as the societal test does. A budget-limited portfolio of energy efficiency programs may do just fine with tests that screen fewer programs.

Clarity regarding the Commission's expectations regarding benefit cost tests will serve to make administration of energy efficiency programs, and their evaluation, more cost and

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[1] Definitions: An energy efficiency measure is a single change in equipment or process that produces a savings in energy use. A motor replacement is a measure. An energy efficiency program is the full plan employed by a program administrator to convince a customer or group of customers to implement a measure or a group of measures. A motor replacement program might includes a plan for finding customers with inefficient motors, getting their attention, providing information and perhaps incentives to switch, assuring that a supply of efficient motors in available, and measuring and verifying savings as replacements occur. An energy efficiency portfolio is the group of programs offered by an energy efficiency program administrator.

[2] http://www.epa.gov/cleanenergy/documents/resource_planning.pdf

[3] It is worth a moment to consider that generation is generally not asked to pass the RIM test.

time efficient. At the same time, continuous improvements based on experience that are implemented prospectively serve to assure that consumers are getting the maximum net benefits from the programs.

The California Standard Practice Manual offers a standard reference for benefit cost tests, which can be modified. Some states settle on a particular test that is valued above others, while others use a balanced assessment of many or all of the California tests.

What Ratio of Benefits to Costs Can Program Administrators Expect?
Portfolio ratios around 2 are typical across the country. Program ratios may vary from just over 1 to an upper end of the range of 7 depending on the intensity of benefits (how inefficient is business as usual?) and costs (how much work and infrastructure are needed to convince the customer to make the switch?).

Programs for low income customers often receive special attention, and in these situations, a lower benefit cost test threshold may be acceptable. This lower threshold is reasonable to several reasons. First, it may be a societal imperative to assure that a suitable set of effective programs are available to this group of customers. Second, the costs to reach and influence these customers are often higher than they would be to reach more affluent residential customers.

A Few States Are Organized to Procure All Cost Effective Energy Efficiency. What Does This Mean?
First, the state regulator will have established some convention about which benefit cost tests will be used. In Vermont, the societal test is used (so the amount that qualifies is very high). The regulator also has to decide if all cost effective means all programs with ratios greater than 1, or if some buffer to cover the prospect of cost overruns or lower savings is needed. The regulator determines what level of effort (which programs, with budgets and savings forecasts for each) is cost effective. The cost of this effort is put into rates and the programs are implemented. Most states are budget limited today, and so do not achieve all cost effective savings.[4] Several states, however, have recently set ambitious savings goals where it is likely that programs that procure all cost effective energy efficiency will be necessary to meet those goals.[5]

Making Program Decisions Using the Tests
A clear understanding of the purpose of the tests and they way they are used by decision-makers is important, especially when budgets are limited. One state could run benefit cost tests and choose the programs with the highest ratios until available funds are used up. Another state might divide the programs among customer classes (low income residential consumers might be a distinct class for this purpose), rank the programs by benefit cost ratio within each customer class, allocate funds to each class, and again choose the programs with the highest ratios until all funds are used up. In these two cases, the tests are a hard threshold.

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[4] States that do endeavor to procure all cost effective energy efficiency now are Vermont and California.
[5] These states include Illinois, Maryland, New York and Massachusetts.

Another state might array all this information and additional goals and choose programs in a more customized way. For example, states may apply a longer term strategy concerning the market transformation of a particular objective (supporting multi-family housing, or a key industry) and include programs with a lower ratio than other programs in a given program year. In another example, fuel switching from electric to gas might exceed the threshold ratio, but the regulator may exclude this program, not wanting to encourage more gas use right now. In these cases, the benefit cost test results are important but not conclusive in deciding the ultimate line up of programs. Rather, decision-makers must weigh the information included in the benefit cost tests and apply judgment in choosing the programs that will be implemented.

5: Determining Cost-Effectiveness

This chapter provides a discussion of the various tests used to determine the cost-effectiveness of energy efficiency programs and portfolios. Each test reflects various stakeholder perspectives on the impact of energy efficiency. A discussion on the importance of discount rates is also provided.

High-Level Summary	Key Questions for Utilities and Regulators
• There are several tests for evaluating energy efficiency's cost-effectiveness, each reflecting a different stakeholder perspective on the impact of energy efficiency. • The utility cost test (UCT), also called the program administrator cost test, is consistent with least cost utility resource planning. The UCT compares the utility costs and benefits of energy efficiency. • The total resource cost (TRC) test is typically used to define what is cost-effective from a regulatory perspective. The TRC test compares all of the direct costs that both utilities and customers pay with the regional benefits received from energy efficiency. • Other tests are used to evaluate impacts of energy efficiency on other stakeholders and include such perspectives as the impact on retail rates, participating customers, and society.	• What perspective(s) should we use to determine cost-effectiveness?[1] The utility cost test (UCT), also called the program administrator cost test, is consistent with least cost utility resource planning. The UCT compares the utility costs and benefits of energy efficiency. • Have we defined the appropriate costs and benefits to get the right program trade-offs? Other tests are used to evaluate impacts of energy efficiency on other stakeholders and include such perspectives as the impact on retail rates, participating customers, and society. • Are we using the correct discount rate? • Do we have a Standard Practice Manual for determining cost-effectiveness of energy efficiency to ensure that the criteria used are transparent to stakeholders?

5.1 Overview

For this discussion, we use the criteria developed by the California Energy Commission and CPUC for defining cost-effectiveness: the California Standard Practice Manual.[2] This manual publicly and transparently sets the state standard for determining cost-effectiveness, and helps to further the development and use of consistent definitions of categories, programs, and program elements. Other states now also refer to the California Standard Practice Manual as the source of their own cost-effectiveness criteria. The benefit of having such a standard practice manual is that it both encourages transparency and consistency. The California criteria include five major tests. While other jurisdictions may modify cost-effectiveness definitions to suit their needs, these five tests are generally inclusive of the different perspectives that most jurisdictions consider.

- **Participant cost test (PCT).** Measures the economic impact to the participating customer of adopting an energy efficiency measure.

- **Ratepayer impact measure (RIM).** Measures the impact on utility operating margin and whether rates would have to increase to maintain the current levels of margin if a customer installed energy efficient measures.
- **Utility cost test (UCT).** Measures the change in the amount the utility must collect from the customers every year to meet earnings target, e.g. change in revenue requirement. In a number of states, this test is referred to as the program administrator cost test (PACT). In those cases, the definition of the "utility" is expanded to program administrators (utility or third party).
- **Total resource cost test (TRC).** Measures the net direct economic impact to the utility service territory, state, or region.
- **Societal cost test (SCT).** Measures the net economic benefit to the utility service territory, state, or region, as measured by the TRC, plus indirect benefits such as environmental benefits.

A common misperception is that there is a single best perspective for evaluation of cost-effectiveness. Each test is useful and accurate, but the results of each test are intended to answer a different set of questions. The key questions answered by each cost test are shown in Table 5-1. Note that throughout this discussion we use the term "utility." In some jurisdictions that term should be expanded to include third-party administrators of the energy efficiency programs.

Table 5-1. Questions Addressed by the Various Cost Tests

Cost Test	Questions Addressed
Participant Cost Test	Is it worth it to the customer to install energy efficiency? Is the customer likely to want to participate in a utility program that promotes energy efficiency?
Ratepayer Impact Measure	What is the impact of the energy efficiency project on the utility's operating margin? Would the project require an increase in rates to reach the same operating margin?
Utility Cost Test (Also Called Program Administrator Cost Test)	Do total utility costs increase or decrease? What is the change in total customer bills required to keep the utility whole (the change in revenue requirement)?
Total Resource Cost Test	What is the regional benefit of the energy efficiency project including the net costs and benefits to the utility and its customers? Are all of the benefits greater than all of the costs (regardless of who pays the costs and who receives the benefits)? Is more or less money required by the region to pay for energy needs?
Societal Cost Test	What is the overall benefit to the community of the energy efficiency project, including indirect benefits? Are all of the benefits, including indirect benefits, greater than all of the costs (regardless of who pays the costs and who receives the benefits)?

Table 5-2. Benefits and Costs of Various Test Perspectives

Tests and Perspective	Energy Efficiency Benefits	Energy Efficiency Costs
Participant Cost Test	Incentives from utility and others, plus reduction in electricity bill	Participants' direct cost of participation
Ratepayer Impact Measure	Avoided supply costs (production, transmission, and distribution) based on net energy and load reductions	Utility program costs (including administration costs plus incentives to participants) plus net lost utility revenues caused by reduced sales
Utility Cost Test (Also Called Program Administrator Cost Test)	Same as above	Utility program costs (including administration costs plus incentives to participants)
Total Resources Cost Test	Same as above plus benefits that do not affect the utility (e.g., water savings, fuel oil savings)	Utility program costs (excluding incentives to participants) plus net participant costs (prior to any cost reduction due to incentives from the utility)
Societal Cost Test	Same as above plus externality benefits; excludes some tax credit benefits	Same as above

Consideration of Non-Monetary Costs and Benefits

The five cost tests presented above do not explicitly recognize changes in customer non-monetary costs and benefits such as comfort. Generally, energy efficiency programs provide the same service (lighting, refrigeration, cooling, heating) as the inefficient base units they replace, so there is no appreciable change in non-monetary costs or benefits. For other types of programs there can be positive and negative impacts on comfort. For example, the cost of lower comfort during a demand response event that turns off air conditioning should be included. Conversely, the benefit of increased comfort of low-income participants with better heating and insulation should be included. Customer value of service studies can be used to monetize the value of customer comfort as well as the value of avoiding an outage.

The TRC test, which measures the regional net benefits, is the appropriate cost test from a regulatory perspective. All energy efficiency that passes the TRC will reduce the total costs of energy in a region. Thus, regulators of most states use the TRC as the primary cost test for evaluating their energy efficiency programs. The TRC cost test includes only direct costs and benefits, not externalities or non-monetized factors. Regulators who want to consider these factors in the cost test can use the SCT, which does include externalities. The TRC and SCT do not differentiate who pays for the energy efficiency and who receives the benefits. Therefore, the other cost tests are used to evaluate the impact on specific stakeholders.

The UCT is the appropriate cost test from a utility resource planning perspective, which typically aims to minimize a utility's lifecycle revenue requirements. Adoption of an energy efficiency measure that is cost-effective according to the UCT will reduce the utility revenue requirement relative to traditional utility procurement. The UCT and TRC cost tests are related, and most measures that are cost-effective from the TRC

are also cost-effective from the utility perspective. If two measures have the same net benefits from a TRC perspective, but different incentive levels, using the UCT to choose between them will favor the measure with lower incentives, since the costs to the utility are lower to implement this measure.

Table 5-2 lists the specific benefit and cost components in each test for economic screening. Note that the term "net" in Table 5-2 refers to values that are reduced by the net-to-gross ratio (NTGR). Thus, the test focuses on the costs and benefits attributable solely to the program activities.

5.2 Use of Discount Rates

The choice of discount rate can have a large impact on the cost-effectiveness results for energy efficiency. As each cost-effectiveness test compares the net present value of costs and benefits for a given stakeholder perspective, its computation requires a discount rate assumption.

A discount rate measures the time value of money. When expressed in percent per year (say, 10%), it converts a future year's monetary amount (say, $1,100) to an equivalent amount in today's dollars (that is, $1,000 = $1,100 ÷ (1 + 0.1)). In the context of an energy efficiency investment, spending money today to install a measure makes economic sense if the cost today is less than the sum of discounted benefits in future years. Thus, the higher the discount rate, the greater the future benefits are discounted and the harder it is for an energy efficiency investment to be cost-effective.

As each perspective portrays a specific stakeholder's view, each perspective comes with its own discount rate. Thus, the five cost-effectiveness tests listed in Table 5-2 can have different discount rates. Using the appropriate discount rate, the cost-effectiveness tests correctly calculate the net benefits from making an investment in energy efficiency.

Three kinds of discount rates are used, depending on which test is being calculated. For the PCT, the discount rate of an individual is used. For a household, this is taken to be the consumer lending rate, since this is the debt cost that a private individual would pay to finance an energy efficiency investment. It is typically the highest discount rate used in the cost-effectiveness tests. However, since there are potentially many different participants, with very different borrowing rates, it can be difficult to choose a single appropriate discount rate. Based on the current consumer loan market environment, a typical value may be in the 8% to 10% range; this is notwithstanding that a credit card rate can often exceed 20%. For a business firm, the discount rate is the firm's weighted average cost of capital (WACC). In today's capital market environment, a typical value would be in the 10% to 12% range; even though it can be as high as 20%, depending on the firm's credit worthiness and debt-equity structure.

Table 5-3. The Use of Discount Rates in Cost Tests

Tests and Perspective	Discount Rate Used	Illustrative Value	Present Value of $1 a Year for 20 Years	Today's Value of the $1 Received in Year 20
Participant Cost Test	Participant's discount rate	10%	$8.51	$0.15
Ratepayer Impact Measure	Utility WACC	8.5%	$9.46	$0.20
Utility Cost Test	Utility WACC	8.5%	$9.46	$0.20
Total Resources Cost Test	Utility WACC	8.5%	$9.46	$0.20
Societal Cost Test	Social discount rate	5%	$12.46	$0.38

For the SCT, the social discount rate is used. The social discount rate reflects the benefit to society over the long term, and takes into account the reduced risk of an investment that is spread across all of society, such as the entire state, or region. This is typically the lowest discount rate. For example, California uses 3% real discount rate (~5% nominal) for evaluation of cost-effectiveness of the Title 24 Building Standards.

Finally, for the TRC, RIM, or UCT/PACT, the utility's WACC is typically used as the discount rate. The WACC takes into account the average cost of borrowing of the utility, and is the same rate used to borrow money for other utility resource investments on the supply-side. The WACC is typically between the participant discount rate and the social discount rate. The correct application of discount rates to the five SPM cost-effectiveness tests is shown in Table 5-3. For example, California currently uses 8.6% for evaluation of the investor-owned utility energy efficiency programs.

Using these illustrative values for each cost test, Table 5-3 shows the value of receiving $1 per year for 20 years from each perspective. This is analogous to the value of not having to purchase $1 of electricity per year. From a participant perspective assuming a 10% discount rate, this stream is worth $8.51; from a utility perspective it is worth $9.46; and from a societal perspective it is worth $12.46. The effect of discount rate increases over time. The value today of the $1 received in the 20th year ranges from $0.15 from the participant perspective to $0.38 in the societal perspective, more than twice as much. Since the present value of a benefit decreases more over time with higher discount rates, the choice of discount rate has a greater impact on energy efficiency measures with longer expected useful lives.

5.3 Resources for Determining Cost-Effectiveness

Title/Description		URL Address
California	**The California Standard Practice Manual: Economic Analysis of Demand Side Programs and Projects.** This manual describes cost-effectiveness procedures for conservation and load management programs from four major perspectives: participant, RIM, PACT, and TRC. A fifth perspective, the societal test, is treated as a variation on the TRC test.	<http://calmac.org/publications/MCS_Final_Report.pdf> <www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF>
Oregon	**Cost-Effectiveness Policy and General Methodology for the Energy Trust of Oregon.** This report describes the Energy Trust of Oregon's policy for analyzing the cost-effectiveness of its energy efficiency investments. This policy encompasses three generic perspectives: consumer, utility system, and societal.	<www.energytrust.org/library/policies/4.06_CostEffect.pdf>
All States	**Tools and Methods for Integrated Resource Planning: Improving Energy Efficiency and Protecting the Environment.** This report provides information on calculating and analyzing the cost-effectiveness of energy conservation measures against supply-side options, as well as methods for IRP.	<www.uneprisoe.org/IRPManual/IRPManual.pdf>

5.4 Notes

1. This key question is based on the National Action Plan for Energy Efficiency recommendation to "make a strong, long-term commitment to implement cost-effective energy efficiency as a resource" and options to consider.

2. For more details, including specific formulas for each cost test, download the California Standard Practice Manual: <www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF>.