Cost-Effectiveness Testing Of Demand-Side Management Programs

There is wide agreement that cost-effective DSM is desirable. Yet what does cost effective mean? This is an important question to ask because DSM programs often affect different parties in different ways. A program may be very attractive for customers who participate but less so for those who do not. Fully evaluating a DSM program requires understanding the impacts from more than one perspective. This chapter explains cost-effectiveness and describes the tests used to evaluate programs.

COST-EFFECTIVENESS TESTS[1]

There is no single tool or cost-effectiveness test which tells a utility or commission everything that is needed to decide whether or how best to undertake a DSM program. What is available to planners and policy makers is a group of tests, each of which is designed to examine the costs and benefits of a DSM program from a particular perspective. Because each test says something unique about the program, the tests are meant to be used in parallel to understand the full impacts of a program and to design (or re-design) a program. The use of these tests, along with a flexible process for program approval and modification, will enhance the acceptability and value of a DSM program.

The results of each test are expressed as a Net Present Value (NPV) of DSM benefits and costs. A positive NPV, regardless of its magnitude, signifies a cost-effective investment. Test results are also represented as a ratio of present value benefits divided by present value costs. Any benefit/cost ratio of 1.0 or more means that a program is cost effective from the point of view of that particular test.

Five pieces of information are used in the five tests. These are:

- energy or demand savings
- avoided costs
- DSM costs
- retail prices
- environmental costs

The cost-effectiveness tests mix and match these key inputs. The five tests are described below together with the perspective they represent, a description of the benefits and costs they consider and how each test is best used.

Total Resource Cost (TRC)

This test measures the net benefits of a program, exclusive of externalities, from the point of view of the utility and its ratepayers as a whole. With the addition of externalities,

[1] This paper briefly describes each cost-effectiveness test. Details on how to run these tests can be found in the California Standard Practices Manual (1987).

this test is called the societal cost test (see below).

Costs Measured

- Utility program costs (including incentives paid to participants)
- Participant costs (net of any financial incentive paid by the utility)
- Increased supply cost (load building)

Benefits Measured

- Avoided supply costs of utilities and participants, including generation, transmission, distribution and non-electric costs

Best Use

States face a policy decision in choosing which test — the TRC or the SC — should be used to determine from the outset whether or not a program makes economic sense. For states that do not consider externalities, this test determines whether a program makes economic sense by identifying whether it increases or decreases the total direct cost of meeting energy service needs. If a program fails this test, it should not be pursued. Programs that pass this test, if implemented, will result in a lower total cost.

Societal Cost (SC)

This test is the same as the TRC, except that it includes environmental externalities and other external, societal costs. It measures the net benefits of a program from the point of view of the utility and its ratepayers as a whole.

Costs Measured

- Utility program costs (including incentives paid to participants)
- Participant costs (net of any financial incentive paid by the utility)
- Increased supply cost (load building)
- Environmental and other societal costs

Benefits Measured

- Avoided utility and participant supply costs, including generation, transmission, distribution and non-electric costs
- Environmental and other societal savings

Best Use

For states that consider externalities, this test determines whether the program being evaluated makes economic sense by identifying whether it increases or decreases the total social cost of meeting energy service needs. A program that fails this test should not be pursued.

Rate Impact Measure Test (RIM)

This test measures the impact on the utility's average retail prices over the lifetime of a DSM program.

Costs Measured

- Utility program costs (including incentives paid to participants)
- Decreased revenues resulting from load reductions
- Increased supply cost (load building)

Benefits Measured

- Avoided utility and participant costs, including fuel, generation, transmission, distribution and non-electric costs
- Increased revenues (load building)

Best Use

This test is used to assess the average cost impacts to non-participant ratepayers over the life of the program. The test serves as a warning. If a program fails, it needs to be looked at more closely to see what mo-

difications, if any, can be made. Two observations about this test deserve special note. First, the test provides information on **average** lifetime price impact and not the price impacts in a given year to a specific customer class which is often of particular interest. Second, even in the best situation, where DSM costs are zero, this test will show that costs exceed benefits whenever retail prices exceed avoided cost, as occurs in most places in the country today. This test will show that at 0¢ DSM fails when compared to a 5¢ power supply.

Participants Test (PT)

This measures the quantifiable benefits and costs to a participating customer.

Costs Measured
- Participants' incremental costs[2]
- Bill increases (load building)

Benefits measured
- Participant bill reduction
- Incentive paid by utility or third party
- Federal, state and local tax benefits, if any
- Operations and maintenance savings

Best Use
The purpose of the test is not to determine whether or not a program is worthwhile. Instead, it is used to evaluate and adapt program design, market the program and set a contribution level for participants. For instance, a high benefit/cost ratio means higher customer contributions can be asked for with out sacrificing market penetration.

[2] Incremental costs are the difference between the cost of the efficient option chosen and the less efficient option not selected.

Utility Test (UT)

By measuring the impact of the program on utility revenue requirements, this test reveals how the program will affect electric bills and, therefore, how it will impact utility revenues.

Costs Measured
- Utility program costs (including any incentives paid to participants)
- Increased supply costs (load building)

Benefits Measured
- Avoided supply costs, including generation, transmission and distribution costs

Best Use
Like the PT, this test is not meant to serve as a tool to decide whether or not to go forward with a program. Instead, it is valuable in identifying what incentives should be made available to the utility in order for the program to be attractive to them.

USING TEST RESULTS FOR PROGRAM ACQUISITION AND MODIFICATION

Utilities should run all five tests in order to get as clear a view as possible of the costs and benefits. Often state commissions will designate in their IRP Rules or Orders which tests should be conducted and which tests should be given precedence. For most states, the results from the TRC or the SC test are a threshold because these look at whether the program reduces costs in a manner that is consistent with the utility's overall IRP objective. If these tests indicate that a program makes sense economically, the results of the RIM may be examined to determine the rate

impact on non-participants, and the UT will indicate the revenue impact on the utility.

Because these tests are designed to look at the impact from a single program, it is important not to lose sight of the total distribution of costs and benefits from the entire DSM effort. When looking at the DSM effort as a whole, there may be reasons to run programs with relatively low benefit/cost ratios. For instance, a low income program might look marginal on its own but in a larger context, when trying to distribute benefits evenly among ratepayers, it may make sense.

There are options for programs that while attractive from an all ratepayer or societal perspective, expose non-participants to unacceptable rate impacts. Tailored program adjustments should be made to relieve whatever features place an unfair burden on the non-participant. The results of the tests can be used to think about what modifications make sense to make a program (or programs) more cost effective from all perspectives. Adaptation strategies to consider include the following:

Additional Programs

A look at all DSM programs may show that only certain customers and customer classes are being served. Offering programs to all customer classes more evenly distributes the cost and benefits faced by all customers.

Program Redesign

Redesigning the program to streamline administration can reduce costs and improve cost effectiveness. Marketing costs can be cut when trade allies are involved in program marketing. Benefits will increase if ways can be found to increase energy savings. For single measure programs, additional energy efficiency measures can be offered with only minimal impacts on program administration costs.

Cost Recovery

If a large rate impact on customers is anticipated, cost recovery can be re-configured or extended over a greater number of years (the expected life of the installed measures) to lessen the financial hardship.

Cost Allocation

Rate design can be changed so that the targeted rate class pays a larger share of the actual program costs. This is equitable for participants in a particular customer class, but non-participants in the same rate class may be even worse off.[3]

Participant Pays

By having participants cover a portion of the DSM costs, the cost to the utility and in turn to the non-participating ratepayer is smaller. When this is done, however, the possibility that there will be fewer participants and less savings should be recognized right from the start.

Budget Adjustments

If utility avoided costs are low in the early years of a DSM program but rise in later years, the program can initially be throttled

[3] For a complete discussion on DSM cost allocation see Centolella (1993).

back, then steadily accelerated to reach full size at some later date.

EVALUATING A COMMERCIAL LIGHTING PROGRAM

Tables 1 and 2 below, adapted from an actual case, shows how a utility used the five tests to evaluate a commercial lighting program.

Running the five tests using this data illustrates how the benefit/cost ratios vary depending upon one's economic perspective. This example shows that while the lighting program is cost-effective, it does not pass the rate impact test. To reduce the rate impact, a utility could consider lowering the incentives paid to participants. To minimize the impact on non-participants without altering the average rate impact, more of the program cost could be recovered from participants.

On the positive side, the impact from this decision would lower program costs, improve the already positive cost-effectiveness from the UT perspective and make the RIM test less negative. Such a shift would not change the value of the program from either the TRC or SC perspective. On the negative side, such a move could reduce the numbers of participating customers which, in turn, would reduce savings. It is up to the utility, with guidance from the commission, to decide what final balance should be struck.

In balancing cost and rate impacts, one commission took the position that after program modifications were made to minimize rate impacts to non-participants, a DSM program that satisfied the TRC test and failed the RIM test could be continued or implemented without commission approval provided that the utility's present value of revenue requirement per kWh did not increase by more than one percent over the duration of the program.

Table 1

Commercial Lighting Program Costs and Benefits

Code	What Code Represents	Present Value (PV) Millions $
A	Program costs (planning, design, administration, customer incentives, evaluation)	10.0
B	Customer share of costs	4.0
C	Lost revenue, net of avoided fuel costs	44.0
	Benefits	
D	Customer bill savings	44.0
E	Avoided cost of alternatives	28.0
F	Avoided environmental externalities (≈10% of avoided cost)	3.0

Table 2

Test Conducted	PV Cost	Inputs Used	PV Benefits	Inputs Used	Net PV	Benefit/ Cost Ratio
Participants (PT)	-4	b	+44	d	+40	11.0
Ratepayers (RIM)	-54	a,c	+28	e	-26	0.5
Utility (UT)	-10	a	+28	e	+18	2.8
Total Revenue Cost (TRC)	-14	a,b	+28	e	+14	2.0
Society Cost (SC)	-14	a,b	+31	e,f	+17	2.2

WHAT ELSE IS IMPORTANT TO KNOW ABOUT COST-EFFECTIVENESS TESTS?

There remain some other aspects that require further discussion.

Constant End Use

All tests assume a constant end use, amenity level and production level. The tests can be applied to situations where these assumptions are not a given but to do so requires special attention.

Non-Energy Benefits

Cost-effectiveness tests do not capture the non-energy benefits offered by DSM programs, including improvements in quality and increased amenities. Again, special care needs to be applied to programs that have significant non-energy benefits. One approach makes sure that direct customer contributions cover the program costs that are not energy related.

Load Building And Fuel Switching

These tests when carefully applied can be used to calculate the impact of load building and fuel switching. This is done by first identifying an energy service need, such as space heating, then identifying the full cost (capital and operating) and benefits of each space heating technology.

CONCLUSION

Cost-effective DSM lowers costs, improves the environment and reduces risk and uncertainty. Although cost-effective DSM always lowers bills, it may or may not lower unit prices. Is, then, a DSM program that raises rates but lowers bills a good idea? When the program offers customers energy services at the lowest possible cost, the answer is most often yes. Toward this end, Eric Hirst (1991) urges that "the large reductions in total costs not be foregone because of small increases in electricity prices." But there is no single formula that says that a five percent decrease in

electricity costs over the next 20 years justifies a one percent increase in electricity prices. It is up to every commission to consider these questions and offer policy guidance.

To make sure, though, that there are not big winners and big losers, programs can be modified so that one set of customers does not benefit at the expense of the utility and non-participating customers. This flexibility will enable DSM programs to provide cost-effective energy services while minimizing the impact on rates.

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Cheryl Harrington
David Moskovitz
Tom Austin
Carl Weinberg
Edward Holt

THE REGULATORY ASSISTANCE PROJECT
177 Water Street, Gardiner, Maine 04345-2149
Telephone (207)582-1135 FAX (207)582-1176
e-mail: rapmaine@aol.com