



Energy Efficiency Program Planning: Total Resource Cost Test

Guidelines for Determining Cost Effectiveness of
Energy Efficiency Programs in Massachusetts

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Background on Energy Efficiency Planning in Massachusetts

- The Commonwealth has a long standing tradition that energy efficiency efforts must be cost effective: benefits exceed costs.
- “[Energy] needs shall first be met through all available energy efficiency and demand reduction resources that are cost effective....” (G.C.A. at 21(a))
- “The Department will rely on the Total Resource Cost Test to determine cost-effectiveness. The Total Resource Cost Test includes all benefits and costs associated with the energy system....” (D.P.U. Guidelines at 3.4.3)
 - “Energy system” refers to entire resource system, and those costs and benefits that accrue to all ratepayers – participants and non-participants.

How Does the TRC Test Determine Cost Effectiveness?

- TRC test is applied by dividing the total lifetime **benefits** of a program by the total **costs** of the program, to create a Benefit Cost Ratio (BCR):

$$\text{BCR} = \frac{\text{Total benefits (\$)}}{\text{Total costs (\$)}}$$

If the BCR is	it is considered	because
≥ 1.0	cost effective	benefits exceed costs
< 1.0	not cost effective	costs exceed benefits

TRC Test: **Benefits**

- **Benefits** = \$ value of avoided supply costs and non-resource impacts resulting from a program over the lifetime of the measure (Guidelines at 3.4.4)
 - Benefits accrue from:
 - Avoided energy, valued at different times (summer/winter and on/off peak)
 - Avoided capacity, based on its value during peaking periods
 - Avoided transmission
 - Avoided distribution
 - Effects on energy market prices, or DRIPE (electric), included in energy and capacity avoided costs
 - Reductions in all costs associated with reduced customer arrearages, service terminations, and reconnections

TRC Test: **Benefits** continued

- **Benefits** are calculated using net savings of:
 - Electric energy (kWh)
 - Electric capacity (kW)
 - Natural gas (mmbtu)
 - Fuel & water resources (mmbtu oil, kerosene, etc.; gallons of water; etc.)
 - Non-resources (include LI benefits, O&M savings, etc. as defined by D.P.U. Guidelines at 3.4.4.1(b)(ii) and 3.4.4.2(b)(ii))
 - Environmental benefits included in energy avoided costs:

“...include related environmental compliance costs that are reasonably projected to be incurred in the future because of state or federal laws, rules and/or regulatory requirements that are currently in effect, or are projected to take effect in the future”

Guidelines at 3.4.4.1(a)(v) and 3.4.4.2(a)(iii)

TRC test: **Costs**

- **Costs** = \$ value of all costs (Guidelines at 3.4.5)
 - Program implementation cost:
 - Program planning and administration
 - Marketing and advertising
 - Program participant incentive
 - Sales, technical assistance and training
 - Evaluation, measurement, and verification
 - Performance incentive cost
 - Program participant cost:
 - Measure cost minus program participant incentive

Participant Costs

- Participant cost = measure cost - participant incentive

- Measure cost is equal to:

- Incremental cost of the energy efficient alternative over the standard efficiency product/service for new construction or time of replacement programs, because customer would have paid for the standard efficiency alternative anyway

Standard efficiency widget = \$500

Energy efficient widget = \$625

Measure cost (incremental) = \$125

OR

- Total cost of the efficiency product/service for retrofit programs

No new widget = \$0

Energy efficient widget = \$625

Measure cost (total) = \$625

Assume incremental cost of widget is \$125 and participant incentive is \$50:

Participant Cost = \$125 - \$50 = \$75

Program Cost Effectiveness

- Programs must be cost effective for 3 year planning period (Guidelines at 3.4.3.1 and D.P.U. 08-50-A at 23)
- Program BCRs include:
 - All lifetime benefits and all costs associated with all program measures
 - Plans must include sufficient information to determine measure cost-effectiveness (Guidelines at 3.4.3.3)
 - In aggregate, measures must accrue sufficient benefits for the overall program to be cost-effective
 - Other costs associated with the program

Program BCR example

	Lifetime Benefits	Costs	$\frac{\text{Lifetime Benefits}}{\text{Costs}}$	BCR
Measure A	\$125	\$75	$\frac{125}{75}$	1.67
Measure B	\$200	\$200	$\frac{200}{200}$	1.00
Measure C	\$150	\$100	$\frac{150}{100}$	1.50
PP&A, marketing, etc.		\$50		
Total Program	\$475	\$425	$\frac{475}{425}$	1.12

Sector Cost Effectiveness

- Sectors must be cost effective
 - All benefits and all costs associated with all programs in the sector
 - Other costs associated with pilot programs, hard to measure efforts, and general administration expenses
 - Such efforts “might not have immediate energy savings or whose energy savings may be difficult to quantify” and therefore cannot be included in benefits calculations (Guidelines at section 2(11) and 3.4.3.2)
 - In aggregate, programs must have sufficient benefits for the overall sector to be cost-effective



Sector BCR example

National Grid Gas

Total Resource Cost Test, 2011			
Sector	Lifetime Benefits	Costs	B/C Ratio
New Construction & Major Renovations	\$3,117,152	\$2,364,748	1.3
Heating and Water Heating	\$32,962,261	\$10,041,026	3.3
MassSAVE	\$0	\$2,546,829	0.0
Weatherization Program	\$20,738,239	\$13,178,803	1.6
Multifamily Retrofit	\$10,603,565	\$3,056,781	3.5
Behavioral/Feedback Program	\$3,311,622	\$2,536,257	1.3
Deep Energy Retrofit	\$0	\$864,416	0.0
Building Practices and Demo	\$0	\$258,868	0.0
Energy Analysis: Internet Audit Program	\$0	\$316,876	0.0
Community based pilots	\$0	\$147,916	0.0
Workforce Development	\$0	\$0	0.0
Statewide Marketing & Education	\$0	\$137,825	0.0
EEAC Consultants	\$0	\$346,166	0.0
DOER Assessment	\$0	\$208,124	0.0
Sponsorships & Subscriptions	\$0	\$158,818	0.0
Residential	\$70,732,839	\$36,163,454	2.0



Getting Back to Benefits:

Benefits = avoided supply costs and non-resource impacts
* net savings

- What are avoided costs of supply? - non-resource impacts?
 - Avoided costs of supply are all costs associated with decrease in energy use resulting from the energy efficiency program
 - Non-resource impacts (previously called NEBs) are other benefits, such as O&M reductions, low-income service benefits, etc. (Guidelines at 3.4.4.1(b)(ii), 3.4.4.2(b)(ii))
- Represented by cost factors of \$ value per unit savings:
 - \$ value per kW of electricity
 - \$ value per kWh of electricity
 - \$ value per mmbtu of natural gas
 - \$ value per mmbtu of fuel resources or gallons of water
 - \$ value per unit of non-resources

Back to Benefits continued:

Benefits = avoided supply costs and non-resource impacts
* net savings

- What are net savings?
 - Gross savings modified by impact factors
 - Gross savings = savings resulting from a technology represented by:
 - kW and kWh of electricity
 - mmbtu of natural gas
 - mmbtu of other fuel resources
 - gallons of water and/or sewage
 - units of non-resources
 - Impact factors = adjustments such as spillover and free-ridership to determine the savings attributable to program efforts

Putting it back together – an example

- **Assume a widget saves 10 kW and runs 1,500 hours per year, and creates no other resource or non-resource savings.**
 - Simplified net savings equations from the TRM:
 - Net kW savings = Gross kW * Realization Rate * Net to Gross Ratio
 - Net kWh savings = Gross kW * hours of use * Realization Rate * Net to Gross Ratio
 - Assume net to gross ratio of 97% (from evaluation) and realization rate of 95% (from evaluation)

$$\text{Net kW savings} = 10\text{kW} * 0.95 * 0.97 = 9.215 \text{ kW}$$

$$\text{Net kWh savings} = 10\text{kW} * 1500 \text{ hrs} * 0.95 * 0.97 = 13,823 \text{ kWh}$$

Example Calculation of Benefits

<p>Benefits = net savings *</p> <p>9.215 kW electricity</p> <p>13,823 kWh electricity</p> <p>0 mmBtu natural gas</p> <p>0 mmBtu other fuel</p> <p>0 gallons water</p> <p>0 units non-resources</p>	<p>avoided costs of supply</p> <p>\$50 per kW electric capacity</p> <p>\$0.08 per kWh electric energy</p> <p>\$10 per mmBtu natural gas</p> <p>\$13 per mmBtu other fuel</p> <p>\$0.01 per gallon water</p> <p>\$(variable) per units non-resources</p>
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$$\text{Year 1 benefits} = (9.215 * \$50) + (13,823 * \$0.08) + (\$10 * 0) + \dots = \$1,566.59$$

- The benefits are calculated for each year of the widget life and present valued using a discount rate (calculated per D.P.U. Guidelines) to determine lifetime benefits

Net Benefits

- What are net benefits and why do we care?
 - Net benefits = total lifetime benefits - total costs
 - When planning and assessing an entire energy efficiency portfolio, net benefits can indicate the magnitude of each sector's contribution to the total economic value of the efforts

Massachusetts Three Year Gas and Electric Energy Efficiency Plans				
	Lifetime Benefits	Costs	BCR	Net Benefits
Residential	\$1,727	\$650	2.66	\$1,077
LI	\$485	\$209	2.32	\$276
C&I	\$3,759	\$1,275	2.95	\$2,484
Total	\$5,971	\$2,134	2.80	\$3,837

All values in \$ millions.

Who, What, When, How...?

- Who: all PAs
- What: follow a standard practice using a systematic screening tool to assess cost effectiveness per DPU guidelines
- When: during program planning for 3 Year Plan and, if necessary, mid-term modification
- How: in addition to what has already been presented:
 - EM&V results are included in the impact factors during planning
 - Avoided Cost study is conducted every 2 years; regional effort; provides consistent values for avoided costs throughout all New England states

Key Take-Aways for Cost Effectiveness in EE Program Planning:

1. Cost effectiveness is determined using a Total Resource Cost (TRC) Test
2. TRC Test calculates a benefit cost ratio (BCR)
3. $BCR = \text{ratio of total lifetime benefits and total costs}$
4. Benefits = value of the savings from program participation
5. Costs = all costs to the PA and the Participant that result from the program