MA ENERGY EFFICIENCY ADVISORY COUNCIL

COST-EFFECTIVENESS SCREENING AND BILL IMPACTS

March 20, 2024

COST-EFFECTIVENESS IN MA

- **In Massachusetts, energy efficiency efforts must be cost-effective: benefits exceed costs**
  - Ensures ratepayer funding being prudently spent

> "[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))

- **Specific cost-effectiveness requirements described in Energy Efficiency Guidelines**
- **Inputs to and results of cost-effectiveness screening provided in PA Benefit-Cost Ratio (BCR) models**

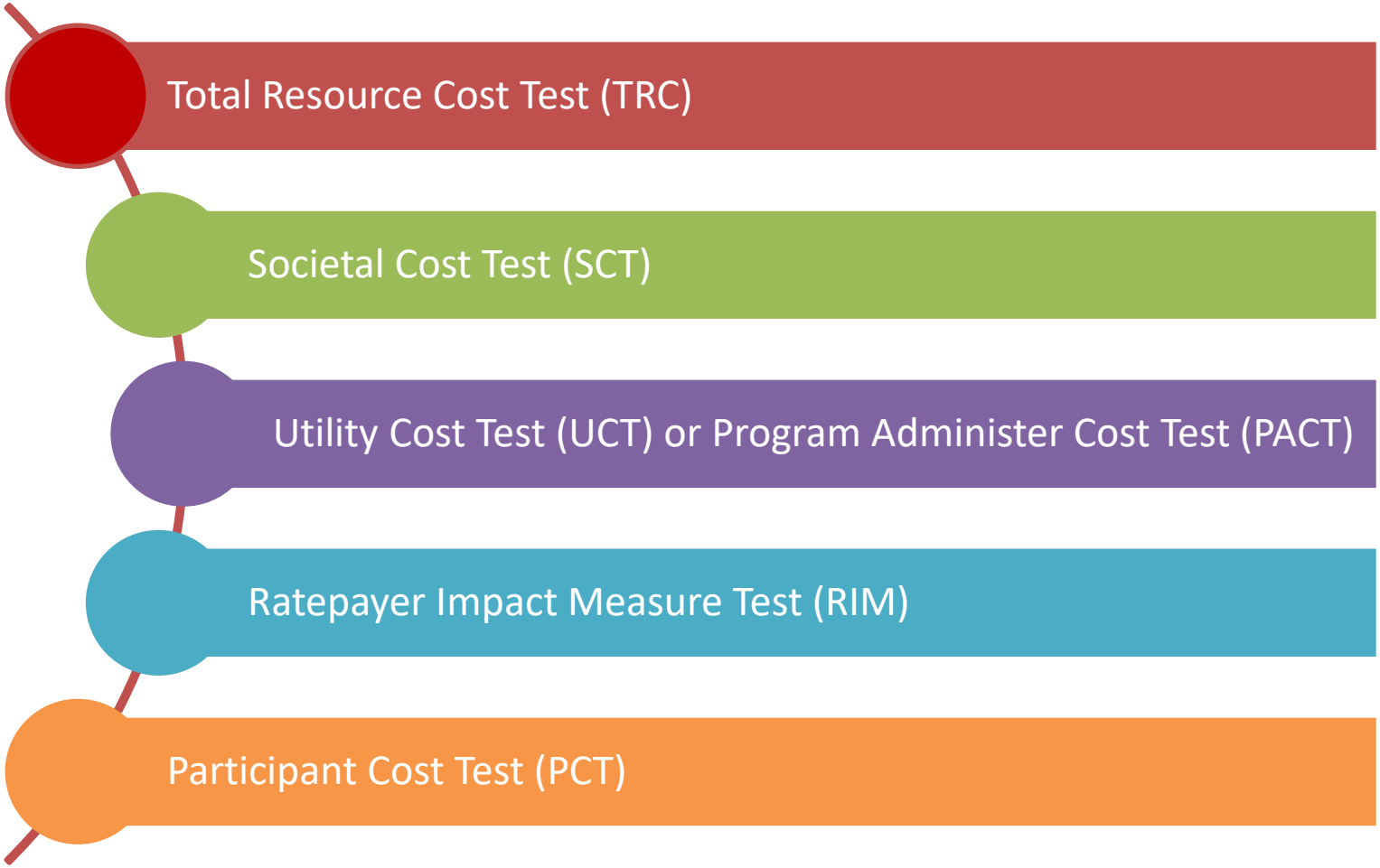
HOW DO COST EFFECTIVES TESTS DETERMINE COST EFFECTIVENESS?

- **Cost-effectiveness tests dived the total lifetime benefits of a program by the total costs of the program, to create a Benefit Cost Ratio (BCR):**

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

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

PRIMARY TYPES OF COST EFFECTIVENESS TESTS

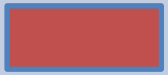


TOTAL RESOURCE COST (TRC) TEST

- **Total Resource Cost Test used to determine cost-effectiveness in MA**
  - The Total Resource Cost Test includes all benefits and costs associated with the energy system, as well as all benefits and costs associated with Program Participants" (D.P.U. Guidelines at 3.4.3)
  - "A Program Administrator shall perform cost-effectiveness screening on a sector level, as well as an Energy Efficiency Program and Core Initiative-specific basis… An Energy Efficiency Plan shall be deemed cost-effective if the cumulative present value of each sectors benefits…are equal to or greater than the cumulative present value of each sectors costs... An Energy Efficiency Program and Core Initiative should be projected to be cost-effective over the term" (D.P.U. Guidelines at 3.4.3)

TRC: COSTS AND BENEFITS

- **Electric avoided costs**
  - Energy, valued at different times
  - Capacity, value during peaking periods
  - Environmental compliance
  - Transmission and distribution
  - Effects on energy market prices (DRIPE)
- **Gas avoided costs**
  - Supply and distribution
  - Environmental compliance
  - DRIPE
- **Delivered fuel avoided costs**
- **Other resource benefits**
- **Non-Energy Impacts**
- **Social cost of carbon**



- **Program implementation costs:**
  - Program planning & 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

EXAMPLE CALCULATION: BENEFITS

Benefits = net savings supply * **avoided costs of**

9.215 kW electricity	$50 per kW electric capacity
13,823 kWh electricity	$0.08 per kWh electric energy
0 mmbtu natural gas	$10 per mmbtu natural gas
0 mmbtu other fuel	$13 per mmbtu other fuel
0 gallons water	$0.01 per gallon water
0 units non-energy	$(variable) per units non-resources

Year 1 benefits = (9.215 * $50) + (13,823 * $0.08) + ($10 * 0) + ⋯ = $1,566.59

- Benefits calculated for each year of the widget life and a discount rate is applied to determine present value of lifetime benefits

CALCULATING ATTRIBUTABLE SAVINGS

- **Impact factors: adjustments used to determine the savings attributable to program efforts**
  - Net-to-gross Ratios
  - Realization Rates

EXAMPLE CALCULATION: GROSS TO NET SAVINGS

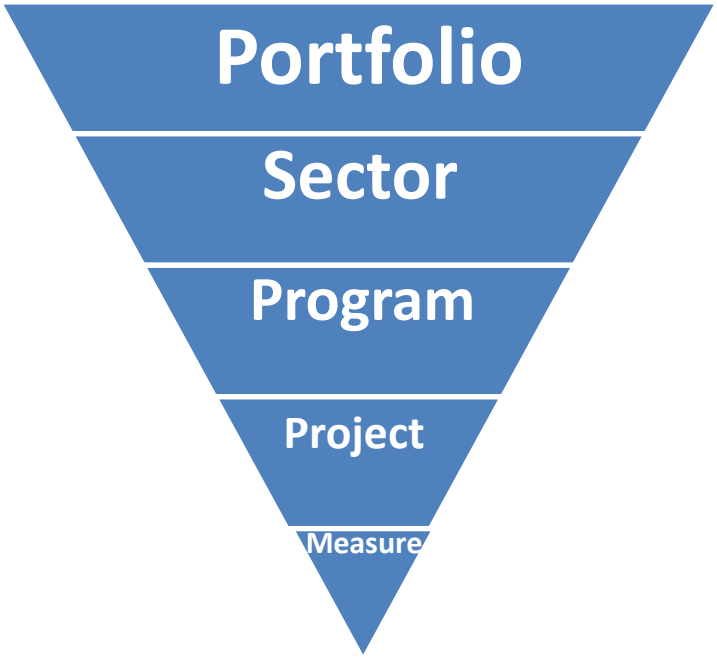
- **Assume a widget saves 10 kW and runs 1,500 hours per year, and creates no other resource or non-resource savings.**
  - Simplified net savings equations from the TRM:
    - Net kW savings = Gross kW * Realization Rate * Net to Gross Ratio
    - Net kWh savings = Gross kW * hours of use * Realization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

Net kW savings = 10kW * 0.95 * 0.97 = 9.215 kW

Net kWh savings = 10kW * 1500 hrs * 0.95 * 0.97 = 13,823 kWh

LEVEL COST EFFECTIVENESS

- **Cost-effectiveness can be done at any level**
- **EE Guidelines require sector cost-effectiveness**
  - Programs must be cost effective for 3-year planning period



SECTOR BCR EXAMPLE

Program	TRC Benefits	TRC Costs	BCR
A - Residential	**260,608,600**	**146,551,109**	**1.78**
A1 – Res New Buildings	26,906,169	9,342,881	2.88
A1a – Res New Homes & Renovations	26,906,169	9,342,881	2.88
A2 - Res Existing Buildings	233,702,431	109,673,227	2.13
A2a - Res Coordinated Delivery	122,581,939	49,023,017	2.50
A2b – Res Conservation Services (RCS)	-	8,785,000	0.00
A2c - Res Retail	92,321,367	44,759,362	2.06
A2d - Res Behavior	1,911,211	41,364	46.21
A2e - Res Active Demand Reduction	16,887,915	7,064,486	2.39
A3 - Res Hard-to-Measure	-	27,535,000	0.00

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 = 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

BASICS OF RATE IMPACTS

- **Programs are funded through a rate adder based on the primary fuel that is saved by them**
  - Electric programs are funded through a $/kWh adder
  - Gas programs are funded through a $/therm adder
  - Oil and propane savings are funded via electric programs
- **Increased program budgets directly increase the rates of those fuels**
  - Historically this has not been an issue because the energy saved resulted in average lower energy burdens
  - Electrification brings new tensions to this systems – increased electric program activity makes electrification economics worse in the short term

FUNDING SOURCE- DETAILS

2022 Total Electric Funding Sources						
Sector	**SBC**	**FCM**	**Other Funding**	**Carryover**	**EERF**	**Total**
A - Residential	36,425,267	28,595,694	-	20,845,689	236,849,600	322,716,250
B - Income Eligible	4,475,079	3,452,865	-	36,163,186	64,395,131	108,486,261
C - Commercial & Industrial	65,137,152	49,272,497	-	48,644,516	169,116,000	332,170,165
Grand Total	**106,037,498**	**81,321,056**	**-**	**105,653,391**	**470,360,731**	**763,372,676**

- System Benefit Charge is a flat $0.0025/kWh
- Forward Capacity Market funding comes from bidding in demand (active and passive) resources into ISO-NE's capacity market
- Outside funding is any external funding for the programs (RGGI is a historical example)
- Carryover is unspent funding from a previous year
- All remaining funding needs goes to the Energy Efficiency Reconciliation Factor (EERF), a variable bill adder

2022 Gas Ratepayer Funds				
Sector	**Total Program Costs**	**Performance Incentives**	**Other Funding**	**Total Ratepayer Funds**
A - Residential	213,888,930	4,337,955	-	218,226,885
B - Income Eligible	76,292,357	3,147,794	-	79,440,150
C - Commercial & Industrial	84,060,656	3,311,341	-	87,371,996
Grand Total	**374,241,942**	**10,797,089**	**-**	**385,039,031**

- All gas spending (minus carryover) is added onto bills as part of the Local Distribution Adjustment Factor (LDAF)

RATE IMPACTS – SIMPLIFIED EXAMPLE

2022 Total Electric Funding Sources						
Sector	SBC	FCM	Carryover	EERF	Total	Statewide Consumption*
A - Residential	36,425,267	28,595,694	20,845,689	236,849,600	322,716,250	6,589,328 MWh
B - Income Eligible	4,475,079	3,452,865	36,163,186	64,395,131	108,486,261	
C - Commercial & Industrial	65,137,152	49,272,497	48,644,516	169,116,000	332,170,165	3,045,921 MWh
Grand Total	**106,037,498**	**81,321,056**	**105,653,391**	**470,360,731**	**763,372,676**	

- For Residential Electric – $237M over 6.6 billion kWh results in an average rate impact of $0.0359/kWh
- For C&I Electric – $169M over 3.0 billion kWh results in an average rate impact of $0.0563/kWh
- For Residential Gas – $218M over 1.3 billion therms results in an average rate impact of $0.168/therm
- For C&I Gas – $87M over 1.6 billion therms results in an average rate impact of $0.052/therm

2022 Gas Ratepayer Funds				
Sector	Total Program Costs	Performance Incentives	Total Ratepayer Funds	Statewide Consumption*
A - Residential	213,888,930	4,337,955	218,226,885	130,204,636 MMBtu
B - Income Eligible	76,292,357	3,147,794	79,440,150	
C - Commercial & Industrial	84,060,656	3,311,341	87,371,996	166,761,018 MMBtu
Grand Total	**374,241,942**	**10,797,089**	**385,039,031**	

*IOUs only – from EIA

TAKE-AWAYS

- Increased program activity results in higher unit-energy costs
- Program must strike careful balance between ambition and bill impacts
- Many factors go into the final bill impact, and it varies by utility, year, etc

Thank You

Questions?

APPENDIX

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)

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

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

  OR

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

Standard efficiency widget = $500

Energy efficient widget = $625

Measure cost (incremental) = $125

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

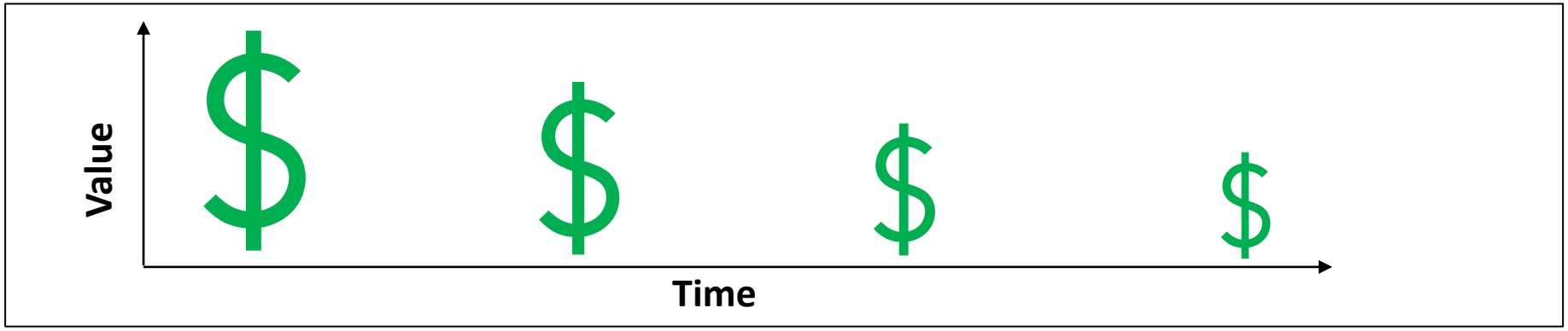
BENEFITS CONTINUED: TIME VALUE OF MONEY

- **BCRs represented the "Net Present Value" (NPV) of benefits divided by costs**
  - The value today of a stream of future money
    - One dollar today is better than a dollar in a year
- **The Discount Rate (DR) represents how much more you value today's dollar versus a future year's dollar**
  - Different cost-effectiveness tests use different DRs
    - TRC often uses societal discount rate or sometimes treasury yield
- **Efficiency requires an up-front investment, but benefits accrue over the life of the efficiency measure. Therefore:**

Higher DR → Lower BCR Lower DR → Higher BCR

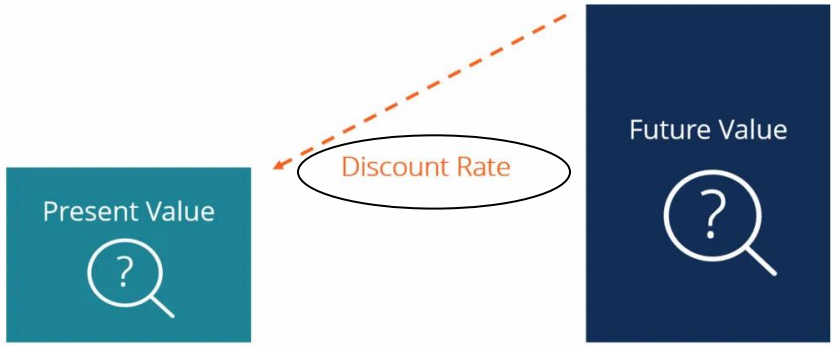
TIME VALUE OF MONEY: NET PRESENT VALUE

- Money has a time value even ignoring effects of inflation
- One dollar today is better than a dollar in a year
  - I could invest the dollar today producing a rate of return that increases the value in the future
  - The future is uncertain: If I must wait for the dollar, there's a risk that I won't get it
- "Net Present Value" (NPV) is the value today of a stream of future money



TIME VALUE OF MONEY: DISCOUNT RATES

- **The Discount Rate (DR) represents how much more you value today's dollar versus a future year's dollar**
- **Driven by perceived risk and financing costs; can be different for different entities**
- **Consumers generally have high discount rates due to perceived risk and alternative options (e.g., 10-30+%)**
- **Utilities may use their weighted average cost of capital (average interest rate on debt and equity) (e.g., 5-10%)**



- **Societal discount rates are generally quite low, reflecting a higher valuation of the future (e.g., 0-5%)**

TIME VALUE OF MONEY: APPLYING DISCOUNT RATES

- **Different tests may use different discount rates**
- **Discount rate levels can be controversial**
  - Whose perspective should they represent
  - Which value is appropriate for a given perspective
- **Efficiency generally requires an up-front investment, but the benefits accrue over time based on the life of the efficiency measure. Therefore:**
  - Higher discount rates lead to lower cost effectiveness
  - Lower discount rates lead to higher cost effectiveness

$$Present\ Value = Future\ Value_t \times \frac{1}{(1 + discount\ rate)^t}$$

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.