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### Title

Better Buildings Residential Energy Efficiency Cost-Effectiveness Tool Version 2.0:

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# Better Buildings Residential Energy Efficiency Cost-Effectiveness Tool Version 2.0 Introduction and Demonstration

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*This cost-effectiveness tool and documentation were originally prepared by Energy and Environmental Economics, Inc. (E3), for the U.S. Department of Energy's Office of Building Technologies. Enhancements and revisions to the tool (Version 2.0) were devised and implemented by Snuller Price, Eric Cutter and Kiran Chawla of E3 and Ian Hoffman of Lawrence Berkeley National Laboratory.*

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# Preview

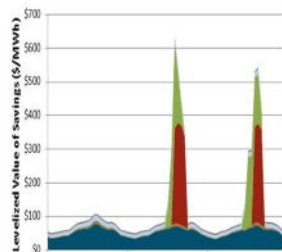
- Policy context and need
  - Why assess cost effectiveness
  - Uses of the BB Residential CE Tool
  - New thinking on cost-effectiveness policy and practice
- Fundamentals of economic screening for energy efficiency
  - Basics of cost-effectiveness screening
  - Five traditional tests – what they tell us
- [Better Buildings Residential Cost-Effectiveness Tool, v2.0](#)
  - Structure
  - Inputs
  - Building from measures to programs to a portfolio
  - Charting and reading results
  - Use cases
- Questions

# Why cost-effectiveness analysis?

- **Policymakers can weigh costs and benefits of diverse resources**
  - Where are ratepayer dollars best invested given multiple policy objectives
  - Assessing program administrator budgets, performance
- **Resource planners**
  - Where does EE rank economically in the resource mix
  - What cost and performance risk to assign to EE
- **Program administrators**
  - Assess demand-side potential
  - Test pathways to achieving a savings target
  - Rank resources and develop EE portfolio, budgets
  - Assess performance

# Better Buildings Residential CE Tool

- Uses common, established cost-effectiveness methodology
  - CPUC Standard Practice Manual – prevailing guidance on CE screening since 1993
- Transparent analysis of costs and benefits using publicly available data
- Provides a publicly available tool



Avoided  
Cost



Nominal Dollars	
Adjusted Avoided Cost Values	2012
Monthly Generation Capacity Allocation	
Monthly T&D Capacity Allocation	
Adjusted Generation Capacity Value (\$/kW-Yr)	\$167.56
Adjusted T&D Capacity Value (\$/kW-Yr.)	\$77.59
Adjusted On-Peak Avoided Energy Cost (\$/MWh)	\$82.99
Adjusted GHG Value (\$/MWh)	\$9.21
Impacts	

Program  
Impacts



	BIP
Benefit/Cost Ratio	
TRC	3.15
PAC	2.40
RIM	2.39
PCT	1.33
Load Impacts (MW)	222

Cost-  
Effectiveness  
Results

# Potential uses of BB CE Tool in policy and practice

## ➤ Regulatory review and approval

- Quantify net benefits of EE and other distributed energy resources
- Weigh investment in EE programs

## ➤ Program administrators (PAs)

- Portfolio and program design
- Identification of more cost-effective programs and measures
- Review third-party programs

## ➤ All Stakeholders and Decision Makers

- Stakeholder engagement and support
- Scenario and sensitivity testing, e.g.,
  - Changes in cost-effectiveness policy
  - Changes in fuel prices

# New thinking on CE screening policy and practice

## ➤ National Efficiency Screening Project

- ~40 experts, broad array of stakeholder perspectives
  - PAs, contractors/trade allies, program implementers, advocates
- Aimed at addressing critiques of traditional CE tests

<http://www.nationalefficiencyscreening.org/>

### ○ Resource Valuation Framework

- Principles for choosing primary test
- Symmetry between costs and benefits
- Selection of test(s), discount rates and benefits should reflect goals
  - Inclusion of hard-to-quantify benefits

### ○ National Standard Practice Manual – coming soon

- Expected to provide principles, concepts, and methodologies for sound, comprehensive, balanced assessment of *all* distributed energy resources, with detailed guidance on energy efficiency screening



# Cost Effectiveness Basics and the Better Buildings Residential Energy Efficiency CE Tool, Version 2.0

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Eric Cutter  
Kiran Chawla



Energy+Environmental Economics

# Cost effectiveness basics

CE testing assesses whether an energy efficiency program or portfolio has lower cost and/or greater benefit than current and prospective energy supply

**Step 1** Evaluate the costs of EE program

**Step 2** Evaluate the change in costs of your preferred supply plan. These are the “avoided costs,” the monetized benefits of implementing your program

**Step 3** Compute the difference (or ratio)

More formally, net present value difference of benefits and costs...

<i>Net Benefits (difference)</i>	Net Benefits <sub>a</sub> (dollars)	= NPV $\sum$ benefits <sub>a</sub> (dollars) - NPV $\sum$ costs <sub>a</sub> (dollars)
<i>Benefit-Cost Ratio</i>	Benefit-Cost Ratio <sub>a</sub>	= $\frac{\text{NPV } \sum \text{ benefits}_a \text{ (dollars)}}{\text{NPV } \sum \text{ costs}_a \text{ (dollars)}}$

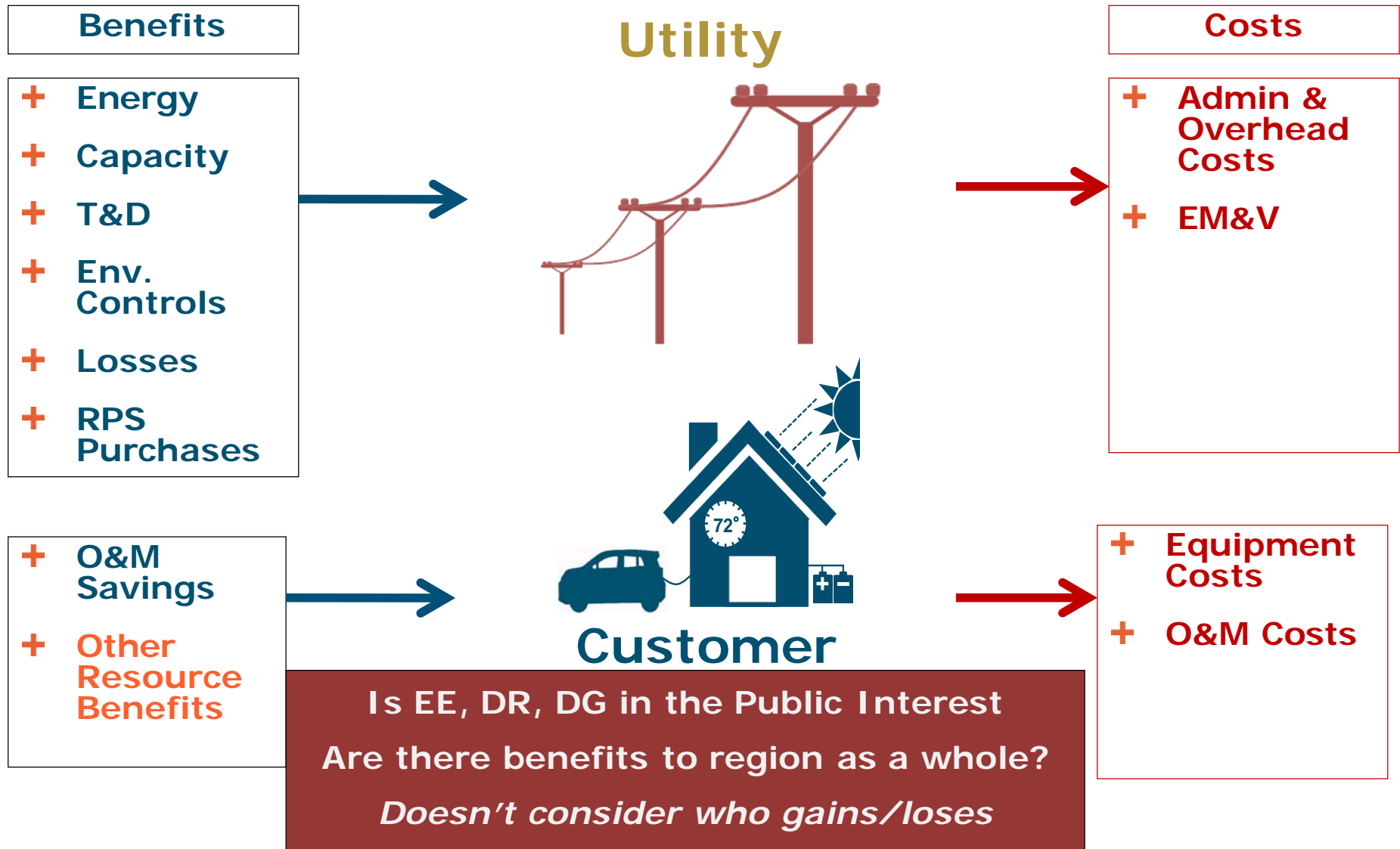
# Definition of Traditional Cost Tests

Cost Test (CA SPM)		Key Question Answered	Summary Approach
Total Resource Cost	TRC	Will the total costs of energy in the utility service territory decrease?	Comparison of program administrator and customer costs to utility resource savings
Participant Cost Test	PCT	Will the participants benefit over the measure life?	Comparison of costs and benefits of the customer installing the measure
Utility/Program Administrator Cost Test	UCT/ PAC	Will utility bills increase?	Comparison of program administrator costs to supply side resource costs
Ratepayer Impact Measure	RIM	Will utility rates increase?	Comparison of administrator costs and utility bill reductions to supply side resource costs
Societal Cost Test	SCT	Is the utility, state, or nation better off as a whole?	Comparison of society's costs of energy efficiency to resource savings and non-cash costs and benefits

# Primary and Secondary Tests

- TRC test is the primary test used by most commissions ( $\sim 2/3$ )
  - If the TRC is positive, what can we say about the distribution of costs and benefits?
- Some states use SCT in place of or in addition to TRC
  - Value water savings, air quality/health benefits, participant benefits
- Some states use TRC/SCT hybrids
  - Societal discount rate, societal benefit adder or select added benefits
- Increase in states using PACT/UCT
  - Cost effectiveness from a utility/system perspective
- PCT, RIM typically secondary tests - infrequently used to accept/reject portfolios but can inform dialogue about program design and distribution of costs and benefits
  - PCT – cost effectiveness for participants
  - RIM – economics for non-participants

# Total Resource Cost Test is most common primary test



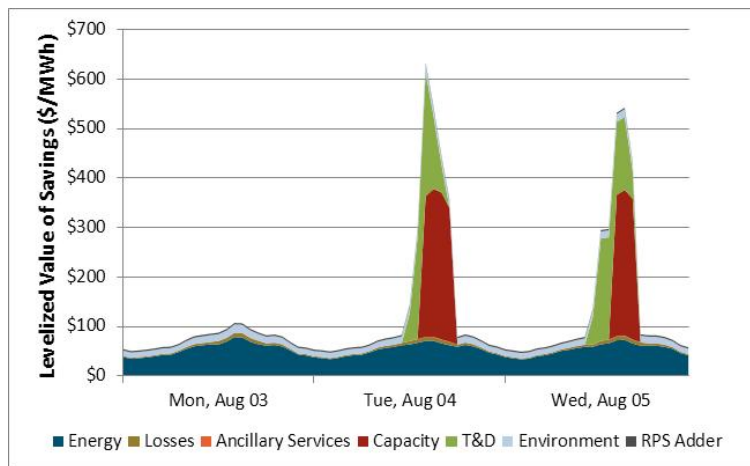
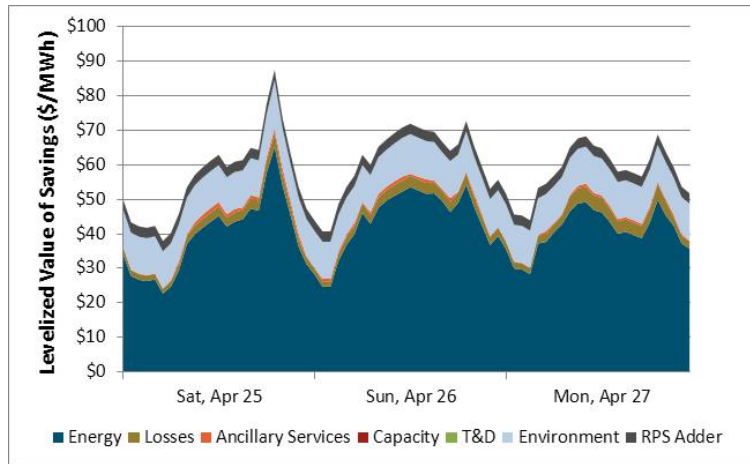
# Discount rates are a key input

- Two discount concepts
  - Reflect the opportunity cost of investing in lieu of other activities.
  - Reflect the relative weight of the economic welfare of different households or generations over time.

Tests and Perspective	Discount Rate Used	Illustrative Value	Present Value of \$1/yr for 20 years	Today's value of the \$1 received in Year 20
Participant Cost Test (PCT))	<b>Participant's discount rate</b>	<b>10%</b>	<b>\$8.51</b>	<b>\$0.15</b>
Ratepayer Impact Measure (RIM)	<b>Utility WACC</b>	<b>8.5%</b>	<b>\$9.46</b>	<b>\$0.20</b>
Utility/PA Cost Test (UCT/PACT)	<b>Utility WACC</b>	<b>8.5%</b>	<b>\$9.46</b>	<b>\$0.20</b>
Total Resource Cost Test (TRC)	<b>Utility WACC</b>	<b>8.5%</b>	<b>\$9.46</b>	<b>\$0.20</b>
Societal Cost Test	<b>Social discount rate</b>	<b>5%</b>	<b>\$12.46</b>	<b>\$0.38</b>

# Calculating benefits (“avoided costs”)

## Three-Day Avoided Cost Snapshots



- Energy
- Losses
- Ancillary Services
- Capacity
- Transmission & Distribution
- Environment

# CE Tool structure

## Initial Inputs

- Retail Rates
- TOU Periods
- Energy Cost
- Capacity Cost
- Natural Gas Cost
- Water Cost

## Program Builder

- EE Measures
- Utility Incentives
- EE Programs

## Portfolio Builder

- Select Programs
- Overhead Costs

## Report

- Portfolio impacts
- Cost-test ratios
- Cost-test charts
- Sensitivity Analysis



# Selecting a test, refining costs and benefits

SPM Cost Test Selection					
	PCT	PAC	RIM	TRC	SCT
Calculate?	TRUE	TRUE	TRUE	TRUE	TRUE

Benefits Selection				
	Electricity	Natural Gas	Fuel Oil	Water
Utility's calculations	TRUE	TRUE	FALSE	FALSE
Participants perspective	TRUE	TRUE	FALSE	TRUE
Total Resource Calculations	TRUE	TRUE	TRUE	FALSE
Societal Cost Test Calculations	TRUE	TRUE	TRUE	TRUE

- Select what cost tests to use
- Select what resources to include in cost tests
  - Based on utility type and resources considered

# Discount rates

Start Date	1/1/2017
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Financial Assumptions	
	Input
Inflation Rate	3%
Utility Discount Rate (Nominal)	6%
Societal Discount Rate (Nominal)	3%
Participant Discount Rate (Nominal)	7%
Real Escalation Rate - Electricity	2%
Real Escalation Rate - NG	2%
Real Escalation Rate - Fuel oil	2%
Real Escalation Rate - Water	2%

- Discount rates for utility, participant and societal perspective
- Escalation rates by fuel type

# Energy efficiency load shapes

TOU Period	TOU Code	Number of hours	None	Flat	Example	Res:Indoor_CFL_Ltg	Res:RefgFrzr_HighEff	User_Defined: Load_4	User_Defined: Load_5
Summer On-Peak	S1	1696	0%	19%	26%	24%	25%		
Summer Off-Peak	S3	1976	0%	23%	20%	19%	25%		
Winter On-Peak	W1	2352	0%	27%	22%	31%	24%		
Winter Off-Peak	W3	2736	0%	31%	33%	26%	26%		

Input year date		Input Year TOU		Samples				
Date			None	Flat	Example	User_Defined: Load_11	User_Defined: Load_12	
1/1/2015	W3		0.00E+00	1.14E-04	2.30E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.26E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.34E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.38E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.36E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.28E-04			
1/1/2015	W3		0.00E+00	1.14E-04	2.74E-04			
1/1/2015	W3		0.00E+00	1.14E-04	1.82E-04			
1/1/2015	W3		0.00E+00	1.14E-04	7.75E-05			
1/1/2015	W3		0.00E+00	1.14E-04	3.79E-05			
1/1/2015	W3		0.00E+00	1.14E-04	3.68E-05			
1/1/2015	W3		0.00E+00	1.14E-04	5.92E-05			
1/1/2015	W3		0.00E+00	1.14E-04	5.92E-05			

➤ Time of use or hourly rates

# Wholesale electricity costs

Wholesale Inputs							
Annual Input	All Inputs are in Nominal Dollars						
Monetized Electricity Benefits							
Avoided Cost Time Period Definition	Generation Energy Avoided Cost	Generation Energy Avoided Cost	Generation Energy Avoided Cost	Generation Energy Avoided Cost	Additional Monetized Avoided Costs	Generation Capacity Avoided Cost	T&D Capacity Avoided Cost
TOU	Generation Avoided Cost, Summer On Peak, \$/MWh	Generation Avoided Cost, Summer Off Peak, \$/MWh	Generation Avoided Cost, Winter On Peak, \$/MWh	Generation Avoided Cost, Winter Off Peak, \$/MWh	Additional Avoided Cost (\$/MWh)	Annual Capacity Value (\$/kW-year)	Annual T&D Value (\$/kW-year)
Present	\$90	\$75	\$83	\$70	\$10	\$30	\$1
Average Annual Escalation	0%				0%	0%	0%

- Wholesale electricity costs by time of use
- Annual escalation
- Annual system capacity and T&D capacity value (\$/kW-Yr.)

# TOU period definitions

			TOU Hourly Definition				
Month Number	Month	Season	Hour		Winter		Summer
					Weekday	Weekend	Weekday
1	January	Winter	1		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
2	February	Winter	2		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
3	March	Winter	3		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
4	April	Winter	4		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
5	May	Summer	5		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
6	June	Summer	6		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
7	July	Summer	7		Winter On-Peak	Winter Off-Peak	Summer On-Peak
8	August	Summer	8		Winter On-Peak	Winter Off-Peak	Summer On-Peak
9	September	Summer	9		Winter On-Peak	Winter Off-Peak	Summer On-Peak
10	October	Winter	10		Winter On-Peak	Winter Off-Peak	Summer On-Peak
11	November	Winter	11		Winter On-Peak	Winter Off-Peak	Summer On-Peak
12	December	Winter	12		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			13		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			14		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			15		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			16		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			17		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			18		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			19		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			20		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			21		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			22		Winter On-Peak	Winter Off-Peak	Summer On-Peak
			23		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak
			24		Winter Off-Peak	Winter Off-Peak	Summer Off-Peak

- Select period for each hour ending (HE) 1-24 for Winter and Summer

# Wholesale – other resource costs

Natural Gas Avoided Cost	Fuel Oil Avoided Cost	Water Avoided Cost	Electricity-Societal Cost	Natural Gas-Societal Cost	Fuel Oil-Societal Cost	Water-Societal Cost
Annual \$/Therms	Annual \$/Gallon	Annual \$/Thousand Gallons	Annual \$/MWh	Annual \$/Therms	Annual \$/Gallon	Annual \$/Thousand Gallons
\$0.86	\$1.20	\$0.80	\$0.50	\$0.80	\$1.00	\$1.00
0%	0%	0%	0%	0%	0%	0%

- Natural gas
- Fuel oil
- Water
- Additional societal costs

# Retail electric rates

Retail Inputs, Electric				
Customer Class 1	Residential			
TOU	Summer On Peak Rate	Summer Off Peak Rate	Winter On Peak Rate	Winter Off Peak Rate
Rate (\$/kWh)	0.15	0.15	0.15	0.15
Customer Class 2	Commercial			
TOU	Summer On Peak Rate	Summer On Peak Rate	Winter On Peak Rate	Winter Off Peak Rate
Rate (\$/kWh)	0.15	0.15	0.15	0.15
Customer Class 3	Customer type 3			
Annual	Flat Rate Value			
Rate (\$/kWh)	0.15			
Customer Class 4	Customer type 4			
Annual	Flat Rate Value			
Annual	0.15			
Summer/Winter				
TOU				
Customer Class 5	Customer type 5			
Summer/Winter	Summer Rate	Winter Rate		
Rate (\$/kWh)	0.15	0.08		

➤ Select rate type in drop down

- Annual
- Summer/Winter
- TOU (2 seasons, 2 periods)

# Retail rates - other

Retail Rate Projections, Non Electric				
Index	Customer Type	Marginal Natural Gas Rate (\$/therms)	Marginal Fuel Oil Rate (\$/gallon)	Marginal Water Rate (\$/thousand gallons)
1	Residential	\$0.80	\$2.80	\$2.20
2	Commercial	\$0.90	\$2.81	\$2.21
3	Customer Type 3	\$1.00	\$2.82	\$2.22
4	Customer Type 4	\$1.10	\$2.83	\$2.23
5	Customer Type 5	\$1.20	\$2.84	\$2.24

- Same five customer classes as for electric rates
- Enter customer type



# Building programs and a portfolio

Summary of Programs						
Program Type	Customer Type	Additional Program level Incentive	Estimated Total Cost	Fed Tax, Other Incentives	Other Utility Incentive	Total Incentive
Residential Lighting (POS)	Residential	\$ -	\$ 90	\$ -	\$ 30	\$ 30
Residential Appliance Rebates/(POS) Discounts	Residential	\$ -	\$ 1,366	\$ -	\$ 414	\$ 414
Whole-Home Retrofit	Residential	\$ -	\$ 7,483	\$ -	\$ 1,200	\$ 1,200
Residential HVAC/Water Heating Rebates	Residential	\$ -	\$ 9,509	\$ -	\$ 2,546	\$ 2,546
New Home Construction	Residential	\$ -	\$ 2,456	\$ -	\$ 385	\$ 385

- Up to five programs
- Enter program
- Select customer type for each program

# Program measures - impacts

Residential Lighting (POS)										
		Measure Life	Annual Gross Savings Estimate/unit	Net to Gross	Annual Net Savings Estimate/unit	Annual Gross Savings Estimate/unit	Net to Gross	Annual Net Savings Estimate	Annual Savings Estimate	Annual Savings Estimate
Name	Number of Units	Years	Electric; kWh		Electric; kWh	NG; Therms		NG; Therms	Oil; Gallons	Water; Thousand Gallons
CFL 15 WATT INT BARE SPIRAL 1PK	1	3	124.2	0.5	67.1	-0.7	0.5	(0.4)		
CFL 20 WATT INT COVERED MULTI-PK	1	9	27.3	0.5	14.7	-0.7	0.5	(0.4)		
CFL 14 WATT INT COVERED MULTI-PK	1	3	115.9	0.5	62.6	-0.7	0.5	(0.4)		

- Enter measures
- Number of units
- Years of savings
- Annual impacts
- Net-to-gross ratios

# Program measures - costs

Residential Lighting (POS)						
	Incremental Measure Cost	O&M Costs	Federal Tax or Other Incentives	Utility Incentives		Net Capacity Savings in Peak Season (overrides shape selection for capacity calculation)
Name	\$/Unit	\$/Unit-Year	\$/Unit	\$/Unit	Pre-Loaded Electric Shape Selection	kW
CFL 15 WATT INT BARE SPIRAL 1PK	\$5.03			\$1.33	None	0.03
CFL 20 WATT INT COVERED MULTI-PK	\$5.41			\$1.75	Res:Indoor_CFL_Ltg	0.00
CFL 14 WATT INT COVERED MULTI-PK	\$5.56			\$1.78	Res:Indoor_CFL_Ltg	0.02

- Incremental measure cost
- O&M costs
- Incentives
- Load Shape

# Programs and portfolio - costs

Installation Schedule and Incentive Budget by Program Type			
	Year 1	Year 2	Year 3
Residential Lighting (POS)	6		
Residential Appliance Rebates/(POS) Discounts	1		
Whole-Home Retrofit	1		
Residential HVAC/Water Heating Rebates	4		
New Home Construction	1		
Incentive Budget	\$ 12,358	\$ -	\$ -

Per Install Overhead Costs			
	Year 1	Year 2	Year 3
Residential Lighting (POS)	6.84		
Residential Appliance Rebates/(POS) Discounts	70.59		
Whole-Home Retrofit	73.65		
Residential HVAC/Water Heating Rebates	260.59		
New Home Construction	11.81		

Non-Incentive Portfolio Budget (\$)			
	Year 1	Year 2	Year 3
a. Administrative Costs			
b. Marketing/Outreach		\$ -	\$ -
c. Direct Implementation (non incentive)			
d. EM&V		\$ -	\$ -
Total Administration Budget	\$ -	\$ -	\$ -
Total Variable Overhead Budget	\$ 1,239	\$ -	\$ -
Total Budget	\$ 13,597	\$ -	\$ -

- Program installs by year
- Per install overhead
- Portfolio costs

# Program TRC costs and benefits

Residential Lighting (POS)								
		Annual Gross Savings Estimate/unit	Annual Net Savings Estimate/unit	Annual Gross Savings Estimate/unit	Annual Net Savings Estimate	Incremental Measure Cost	O&M Costs	Federal Tax or Other Incentives
Name	Number of Units	Electric; kWh	Electric; kWh	NG; Therms	NG; Therms	\$/Unit	\$/Unit-Year	\$/Unit
CFL 15 WATT INT BARE SPIRAL 1PK	1	124.2	67.1	-0.7	(0.4)	\$5.03		
LED SURFACE/PENDANT/TRACK/ACCENT/RECESSED DWNLT INSTALL < 10W LED	1	0.7	0.5	0.0	(0.0)	\$12.68		
Total		526	352	-5	-3	\$129.70	\$ -	\$ -

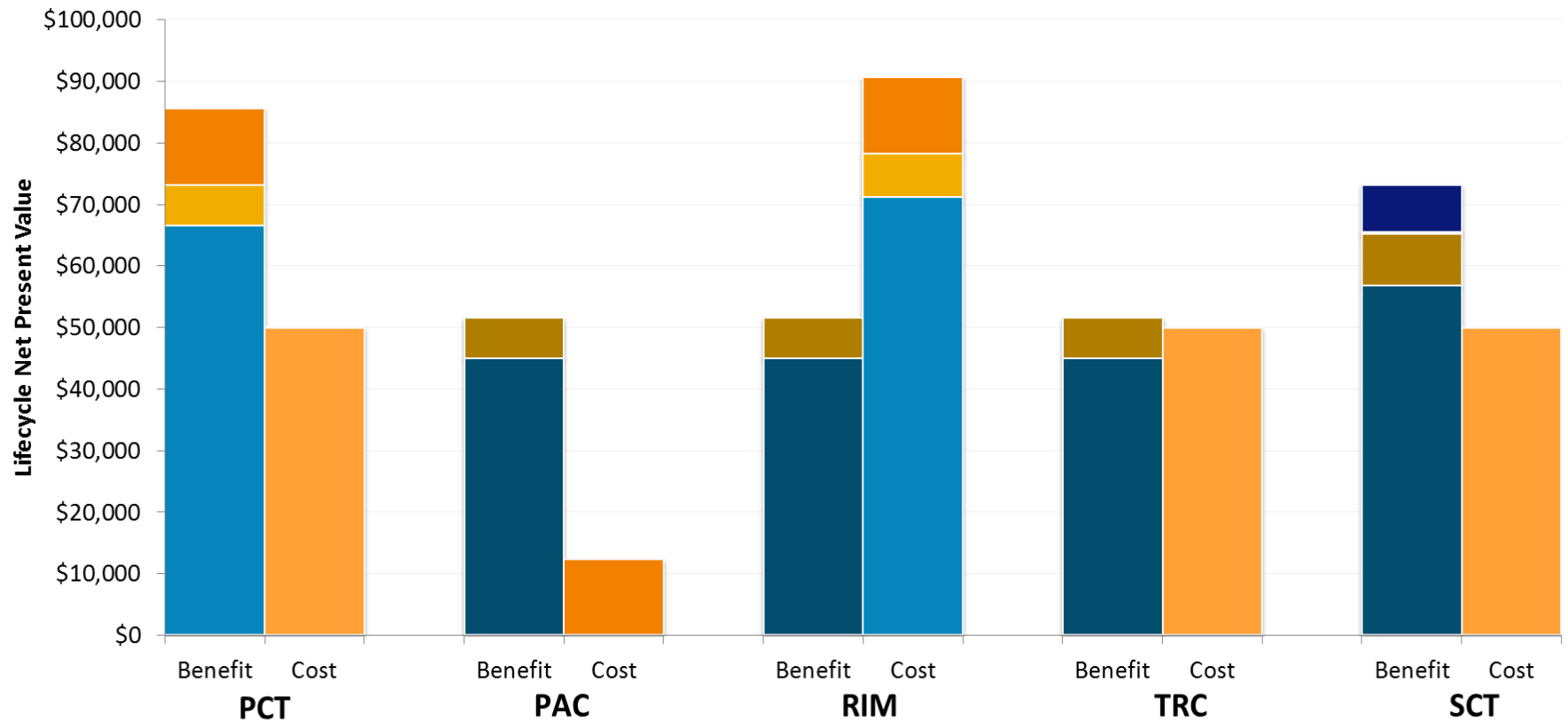
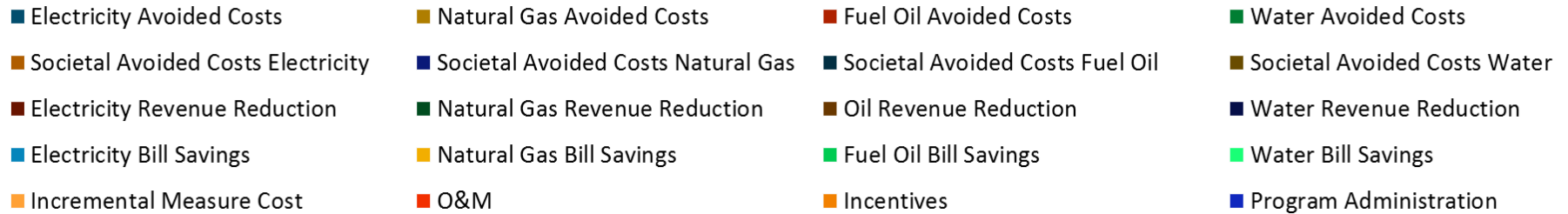
Residential Appliance Rebates/(POS) Discounts								
		Annual Gross Savings Estimate	Annual Net Savings Estimate	Annual Gross Savings Estimate	Annual Net Savings Estimate	Incremental Measure Cost	O&M Costs	Federal Tax or Other Incentives
Name	Number of Units	Electric; kWh	Electric; kWh	NG; Therms	NG; Therms	\$/Unit	\$/Unit-Year	\$/Unit
ENERGY EFFICIENT TELEVISIONS ENERGY STAR V5.1+20% - 36" - 39"	1	67.8	6.8	-1.7	(0.2)	\$ 30.00		
REFRIGERATOR: BOTTOM FREEZER WITH ICE >= 16.5 CU. FT.	1	132.8	93.0	-4.9	(3.4)	\$ 145.29		\$ 75.00
			-		-			
Total		1902	1033	-8	-2	\$ 1,366.04	\$ -	\$ 375.00

# Program- and portfolio-level results

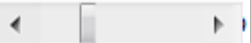
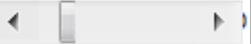

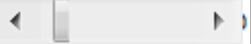



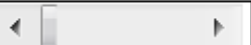





Program Cost Effectiveness					
	PCT	PAC	RIM	TRC	SCT
Residential Lighting (POS)	3.39	5.64	0.53	1.85	1.84
Residential Appliance Rebates/(POS) Discounts	1.41	2.29	0.47	0.69	0.78
Whole-Home Retrofit	0.93	4.41	0.71	0.71	1.64
Residential HVAC/Water Heating Rebates	1.93	4.29	0.56	1.15	1.52
New Home Construction	0.55	1.83	0.50	0.29	0.50

Portfolio Cost Effectiveness					
	PCT	PAC	RIM	TRC	SCT
B/C Ratio	1.72	4.18	0.57	1.03	1.47
Total Costs	\$ (49,882)	\$ (12,358)	\$ (90,668)	\$ (49,882)	\$ (49,882)
Total Benefits	\$ 85,564	\$ 51,619	\$ 51,619	\$ 51,619	\$ 73,213
Net Benefits	\$ 35,682	\$ 39,262	\$ (39,048)	\$ 1,738	\$ 23,332

# Portfolio-level results chart



# Sensitivity Analysis

Cost-effectiveness Sensitivity Analysis		Calculate Sensitivity	Store Current Inputs as Defaults	
<b>Discount Rates</b>			<b>Current Input</b>	<b>Default Input</b>
Utility Discount Rate			6.1%	6.1%
Societal Discount Rate			3.0%	3.0%
Participant Discount Rate			7.0%	7.0%
<b>Escalation Rates</b>				
Retail Electricity Rate Escalator			2.0%	2.0%
Natural Gas Rate Escalator			2.0%	2.0%
Fuel Oil Rate Escalator			2.0%	2.0%
Water Rate Escalator			2.0%	2.0%
<b>Administration Costs and Incentives</b>				
Administration Costs			\$0.0	\$ -
Residential Lighting (POS) 'Additional Project Level Incentive'			\$0.0	\$ -
Residential Appliance Rebates/(POS) Discounts 'Additional Project Level Incentive'			\$0.0	\$ -
Refrigerator Recycling 'Additional Project Level Incentive'			\$0.0	\$ -
Residential HVAC/Water Heating Rebates 'Additional Project Level Incentive'			\$0.0	\$ -
New Home Construction 'Additional Project Level Incentive'			\$0.0	\$ -



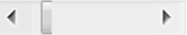
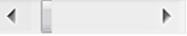
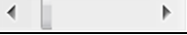

# Use cases for demonstrating the calculator

1. Persistence of low or moderate fuel prices
  - The user can test how benefit to cost ratios change by inputting lower fuel prices and corresponding escalators
2. Shift from a single-fuel to a multi-fuel program
  - The tool allows for modeling dual fuel programs as well as incorporation of electric and natural gas impacts of selected measures
3. Changes in cost-effectiveness screening policy
  - The tool enables analysis across multiple tests and some variants of the TRC and SCT
  - User can add non-energy benefits if those become a part of new cost-effectiveness screening policies

# Case 1. Persistence of low or moderate fuel prices

- The persistence of low or moderate gas prices reduces avoided system costs and thus the benefits of an efficiency program
- With the tool, the user can test the impacts of various fuel prices on benefit-to-cost ratios

Retail Rate Projections, Non Electric				
Index	Customer Type	Marginal Natural Gas Rate (\$/Therms)	Marginal Fuel Oil Rate (\$/gallon)	Marginal Water Rate (\$/thousand gallons)
1	Residential	\$0.80	\$2.80	\$2.20
2	Commercial	\$0.90	\$2.81	\$2.21
3	Customer Type 3	\$1.00	\$2.82	\$2.22
4	Customer Type 4	\$1.10	\$2.83	\$2.23
5	Customer Type 5	\$1.20	\$2.84	\$2.24

Escalation Rates		
Retail Electricity Rate Escalator		2.0%
Natural Gas Rate Escalator		2.0%
Fuel Oil Rate Escalator		2.0%
Water Rate Escalator		2.0%

- The tool also can be used to bundle measures and programs, some more susceptible to lower fuel prices than others, to see the effect on the portfolio benefit-to-cost ratio
- Also can be used to shift the mix of measures and programs to optimize cost effectiveness

# Case 2. Shift from single-fuel to multi-fuel program

- Can demonstrate the value of an electric program administrator partnering with a natural gas program administrator to implement measures with benefits with respect to each fuel
  - For instance, the clothes washer below shows both electric and gas savings

Residential Appliance Rebates/(POS) Discounts								
		Measure Life	Annual Gross Savings Estimate	Net to Gross	Annual Net Savings Estimate	Annual Gross Savings Estimate	Net to Gross	Annual Net Savings Estimate
Name	Number of Units	Years	Electric; kWh		Electric; kWh	NG; Therms		NG; Therms
ENERGY EFFICIENT TELEVISIONS ENERGY STAR V5.1+20% - 36"- 39"	1	7.0	68	0.1	6.8	-1.7	0.1	-0.2
REFRIGERATOR: BOTTOM FREEZER WITHOUT ICE >= 16.5 CU. FT.	1	14.0	73	0.7	50.8	-2.0	0.7	-1.4
EFFICIENT VARIABLE SPEED POOL PUMP AND MOTOR - CUSTOMER	1	10.0	1169	0.6	643.0		0.6	0.0
REFRIGERATOR: SIDE FREEZER WITH ICE >= 23 CU. FT.	1	14.0	179	0.7	125.0	-5.4	0.7	-3.8
HIGH EFF CLOTHES WASHER - LEVEL 3 - MEF >= 2.4 WF <= 4.0	1	11.0	144	0.7	101.1	9.6	0.7	6.7

- Conversely, the tool also allows for the explicit incorporation of negative impacts or interactive effects that certain measures may have
  - For instance, a measure implemented for electric savings may increase heating needs and hence the direct use of gas

## Case 3. Changes in cost-effectiveness screening policy

- The tool allows different cost test calculations beyond those strictly defined under the TRC by:
  - Using a PACT along with the standard TRC test;
  - Using a societal cost test including a range of non-energy benefits
- In addition, using a lower threshold for the benefit-cost test ratios could incorporate qualitative benefits not explicitly monetized in the analysis

# Resources and contacts

## Better Buildings Residential Energy Efficiency Cost Effectiveness Tool, v2.0

[CE Calculator \(spreadsheet\)](#)

[Instructions](#)

[FAQ](#)

[Glossary](#)



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