

Cost-Effectiveness Testing for Energy Efficiency Programs

Background, Current Status and Recommendations for Best Practices Going Forward

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American Council for an Energy-Efficient Economy

Presentation to:

Better Buildings Residential Network Peer Exchange

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SOME HISTORY BEHIND B/C TESTING FOR EE

- Energy Efficiency as a utility resource was a disruptive concept
- Opposition to energy efficiency requirements by utilities and other powerful parties (e.g., industrial customers)
- High “burden of proof” placed on energy efficiency as a resource
- Scrutiny disproportionate to any other utility expenditure
- The legacy continues today

e.g., comparison of energy efficiency to other “alternative resources”

- ❖ All but one state requires benefit-cost testing for energy efficiency
- ❖ Only 27% required B/C testing for load management programs
- ❖ Only 21% required B/C testing for renewable energy programs

[NOTE: utilities are regulated at the state level. So each state establishes its own benefit-cost test policy]

PURPOSES OF BENEFIT-COST TESTING FOR UTILITY ENERGY EFFICIENCY PROGRAMS

- To **help ensure that ratepayer dollars are prudently spent** (in this case, defined as the “**benefits**” being equal to or greater than the “**costs**” i.e., a B/C ratio of 1.0 or greater)
- To **help prioritize** amongst resource/program options (i.e., larger B/C ratios deliver more benefits per dollar)*

* Of course, other factors also influence selection of programs (e.g., equity across customer groups)

INFORMATION SOURCES:

1) ACEEE 2020 NATIONAL EM&V SURVEY*

- Surveyed all states with ratepayer funder EE programs (44 state completed the survey)
- Primary contacts were regulatory staff—2ndary were key stakeholders

* National Survey Of State Policies And Practices For Energy Efficiency Program Evaluation

<https://www.aceee.org/research-report/u2009>

Study also incorporated: *Database of Screening Practices* (DSP) from National Energy Screening Project (NESP) which provides detailed data on cost-effectiveness testing

<https://www.nationalenergyscreeningproject.org/state-database-dsesp/>

2) ACEEE 2020 REPORT ON NATURAL GAS UTILITY ENERGY EFFICIENCY COST-EFFECTIVENESS*

- Inspired by challenges gas EE programs have faced in recent years with extremely low natural gas market prices
- Reviewed general status of gas utility EE cost-effectiveness around the nation
- Did a more detailed review of the top 10 states in gas energy efficiency savings from the ACEEE **State Scorecard** report

***Sustaining Utility Natural Gas Efficiency Programs in a Time of Low Gas Prices**

<https://www.aceee.org/white-paper/2020/10/sustaining-utility-natural-gas-efficiency-programs-time-low-gas-prices>

TRADITIONAL APPROACHES TO B/C TESTING: THE 5 “CALIFORNIA” TESTS*

- The *Participant* test [PART]
- The *Utility or Program Administrator* test [UCT or PACT]
- The *Total Resource Cost* test [TRC]
- The *Societal* cost test [SCT]
- The *Ratepayer Impact Measure* test [RIM]

* *From the California Standard Practice Manual*

COMPONENTS OF THE 5 TRADITIONAL TESTS

	Partic.	RIM	TRC	SCT	UCT/ PACT
Benefits					
Primary Fuel(s) Avoided Supply Costs		✓	✓	✓	✓
Secondary Fuel(s) Avoided Supply Costs			✓	✓	
Primary Fuel(s) Bill Savings (retail prices)	✓				
Secondary Fuel(s) Bill Savings (retail prices)	✓				
Other Resource Savings (e.g. water)	✓		✓	✓	
Environmental Benefits				✓	
Other Non-Energy Benefits			Rarely	In Theory	
Costs					
Program Administration		✓	✓	✓	✓
Measure Costs					
Program Financial Incentive		✓	✓	✓	✓
Customer Contribution	✓		✓	✓	
Utility Lost Revenue		✓			

3 KEY PROBLEMS WITH TRADITIONAL B/C TESTING

- The TRC test*, as generally applied, is fundamentally **imbalanced** ...it includes all customer costs for an energy efficiency project, but ignores all of the customer *'non-energy benefits'* from the project.
- States frequently do not adequately account for all of the **utility system benefits** that energy efficiency provides
- The standard tests do not capture or address **other energy-related policy goals** a state may have

.....

** Note: a Societal Test can have the same imbalance, if not properly calculated*

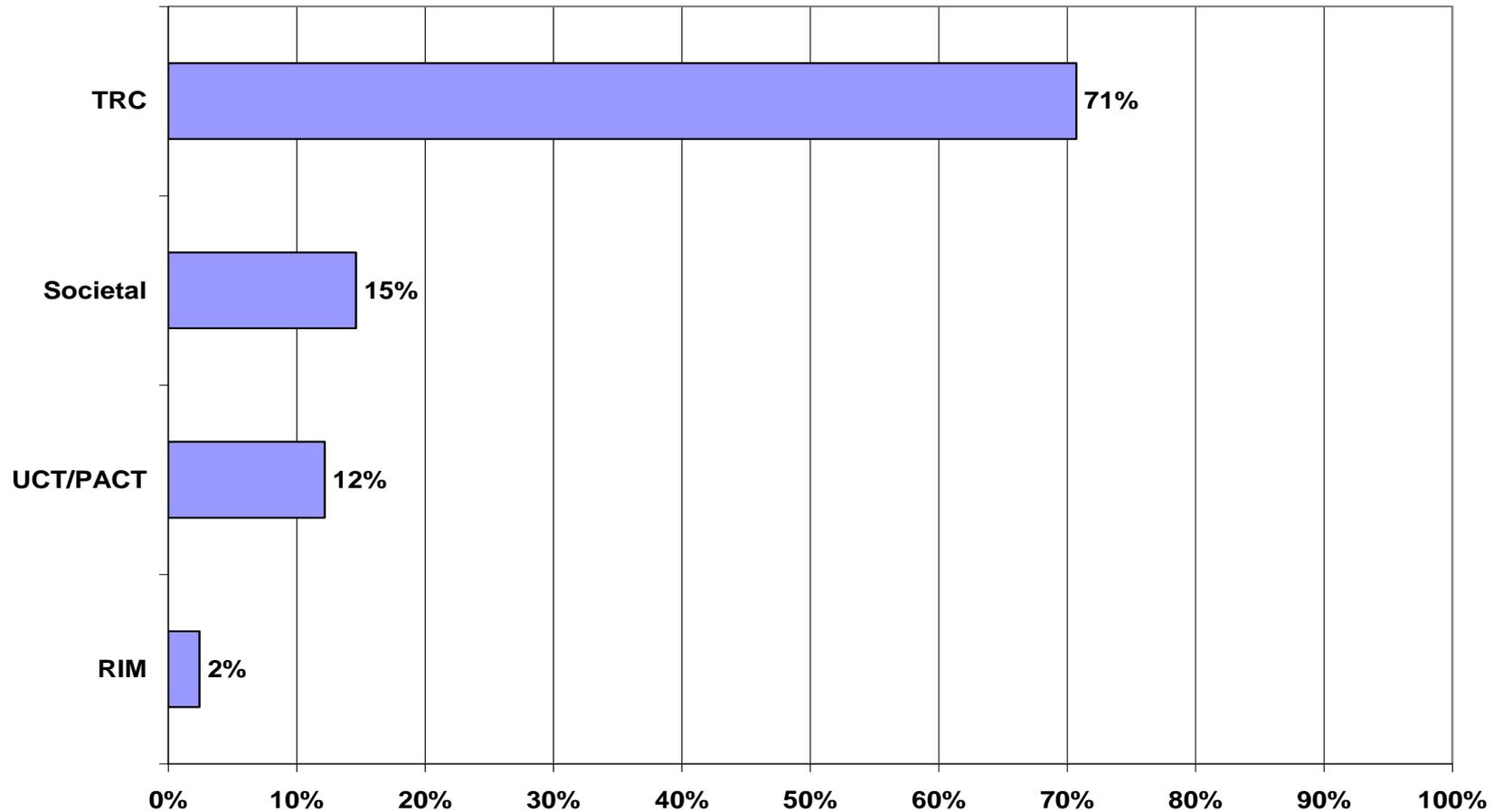
CONCERNS ABOUT THE 'IMBALANCE' IN THE TRC

TRC= (utility costs + participant costs) vs. utility benefits only

- **Not conceptually logical** – customers invest their money in EE projects for a variety of benefits - - not solely to save energy. Why include all costs they incur but exclude many benefits in a B/C calculation?
- **Systematically biased against EE** – these extra 'customer' costs are not considered when selecting supply-side options (e.g., purchased power, distributed generation, customer-sited renewables, etc.)
- **Out-of-step with common practice in program design and marketing** (which often emphasizes NEBs)
- **Will result in 'screening out' programs** that would be cost-effective from a utility resource perspective

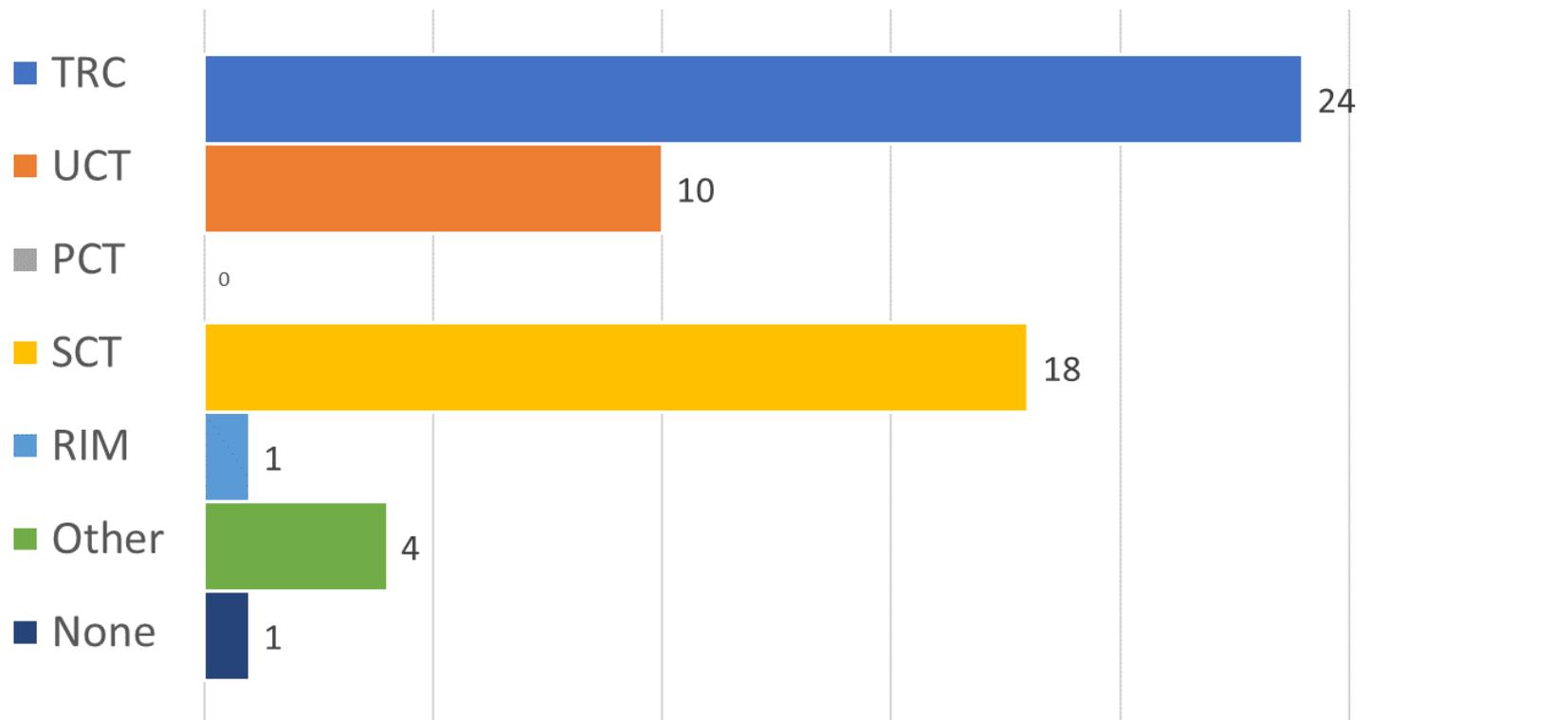
PRIMARY B/C TEST USED BY STATES IN 2011

(n=43)



CURRENT USE OF PRIMARY B/C TESTS AMONG STATES

Primary cost-effectiveness test



UTILITY SYSTEM BENEFITS OFTEN UNDER-VALUED

- All **costs** typically included (administration, rebates, eval., etc.)
- Energy and capacity benefits typically included (albeit inconsistently)
- **But many other benefits often not included or under-valued**
 - Avoided T&D costs often excluded or under-valued
 - Reserve margin benefits often omitted
 - Avoided environmental compliance costs often excluded
 - Wholesale price suppression effects not commonly captured
 - Risk mitigation benefits rarely included
 - Lower credit/collection costs rarely included
 - Line loss reductions commonly understated
 - Higher at peak than rest of year – only sometimes addressed
 - Should use marginal loss rates, but average losses used instead

Result: Efficiency typically under-valued in all screening tests.

LOW-INCOME PROGRAMS = A SPECIAL CATEGORY

- Benefits included in a typical comprehensive low-income weatherization program:
 - Energy use reduction
 - Home repair
 - increased comfort
 - Indoor air quality (mold, allergens, radon, CO, etc)
 - Poisons (house cleaners, lead, etc)
 - Safety (furnace, housing structure, electrical, etc)
- The value of these “non-energy” benefits typically exceeds the value of the “energy” benefits (e.g. see the 2014 ORNL study:
<https://www.energy.gov/sites/prod/files/2015/09/f26/weatherization-works-retrospective-evaluation.pdf>)
- While these benefits are rarely quantified by states, nearly all states have special provisions for low-income energy efficiency programs

SUMMARY

- Benefit-cost testing can be informative, and useful for decision-making....if properly done
- Use of benefit-cost tests for assessing ratepayer-funded energy efficiency programs is essentially universal in the states
- Reliance upon TRC for cost-effectiveness screening is still very widespread (much due to legacy and entrenched practice)
- The TRC test (as commonly applied) has some serious shortcomings
- Utility system benefits often under-valued in all of the B/C tests
- The standard tests don't capture related state policies
- These and other concerns about benefit-cost testing are leading to a re-examination of this issue in the industry and the regulatory community (e.g., see the *NSPM for DERs*)

RECOMMENDATIONS: BEST PRACTICES IN EE COST-EFFECTIVENESS ASSESSMENT

- Ensure that the test is ‘symmetrical’
- Appropriately value all utility system benefits and costs (e.g., include peak demand savings and avoided T&D costs, include time and locational value of the savings, marginal line losses, etc.)
- [IF INCLUDING PARTICIPANT COSTS] Include appropriate non-energy benefits (e.g., health, comfort, safety, O&M savings, etc.)
- Base decisions on other costs and benefits on relevant state policies
- Provide for special treatment of low-income programs (e.g., exemption from passing the B/C test)
- Appropriately value environmental benefits (including CO₂)
- Apply cost-effectiveness requirements at the portfolio level
- Use a low-risk or societal discount rate
- Include assessment of the risk of future natural gas price increases

Thank you!

For any follow-up questions:
Contact: mgkushler@aceee.org

Passing The Test: How Are Residential Efficiency Cost Effectiveness Tests Changing?

And how the National Standard Practice Manual (NSPM) is Changing Benefit-Cost Analysis of EE and Other Distributed Energy Resources

Julie Michals – E4TheFuture
February 11, 2021

Better Buildings Residential Network Peer Exchange

About NESP and the NSPM

National Energy Screening Project (NESP): stakeholder organization open to all organizations and individuals with an interest in working collaboratively to improve benefit-cost analysis (BCA) of energy efficiency (EE) and other distributed energy resources (DERs)

Products include:

- NSPM for EE (2017)
- NSPM for DERs (2020)
- Database of Screening Practices (DSP)

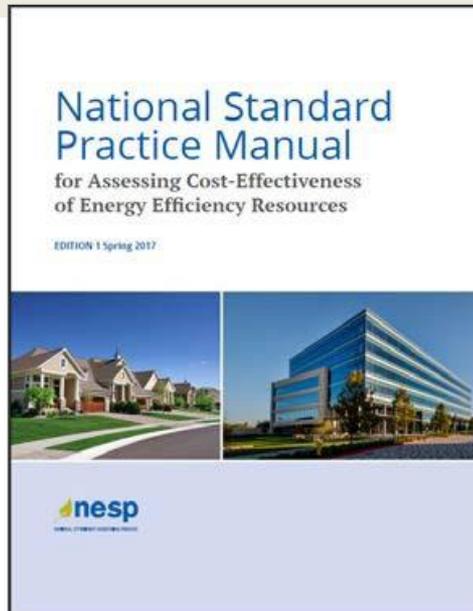
NESP managed by E4TheFuture, with state outreach via key partners, and funded by E4TheFuture with support from US DOE.

NSPM guidance documents informed by extensive Advisory Group with diversity of perspectives and affiliations.

<https://nationalenergyscreeningproject.org/>

NSPM for EE

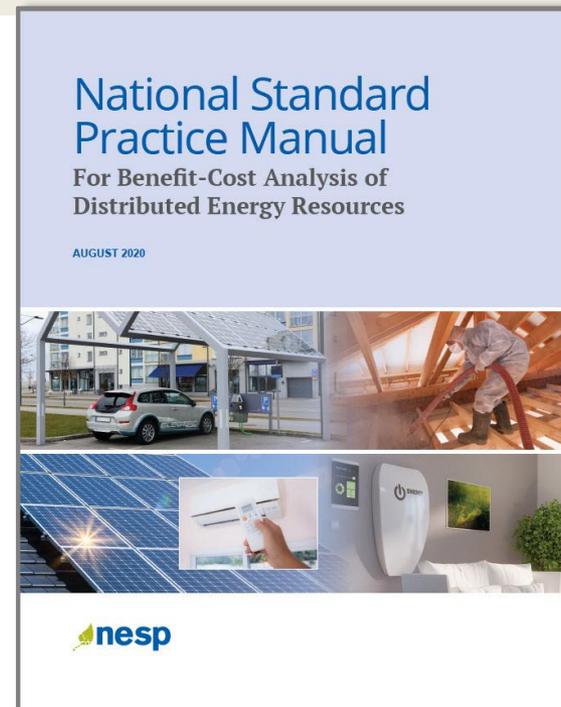
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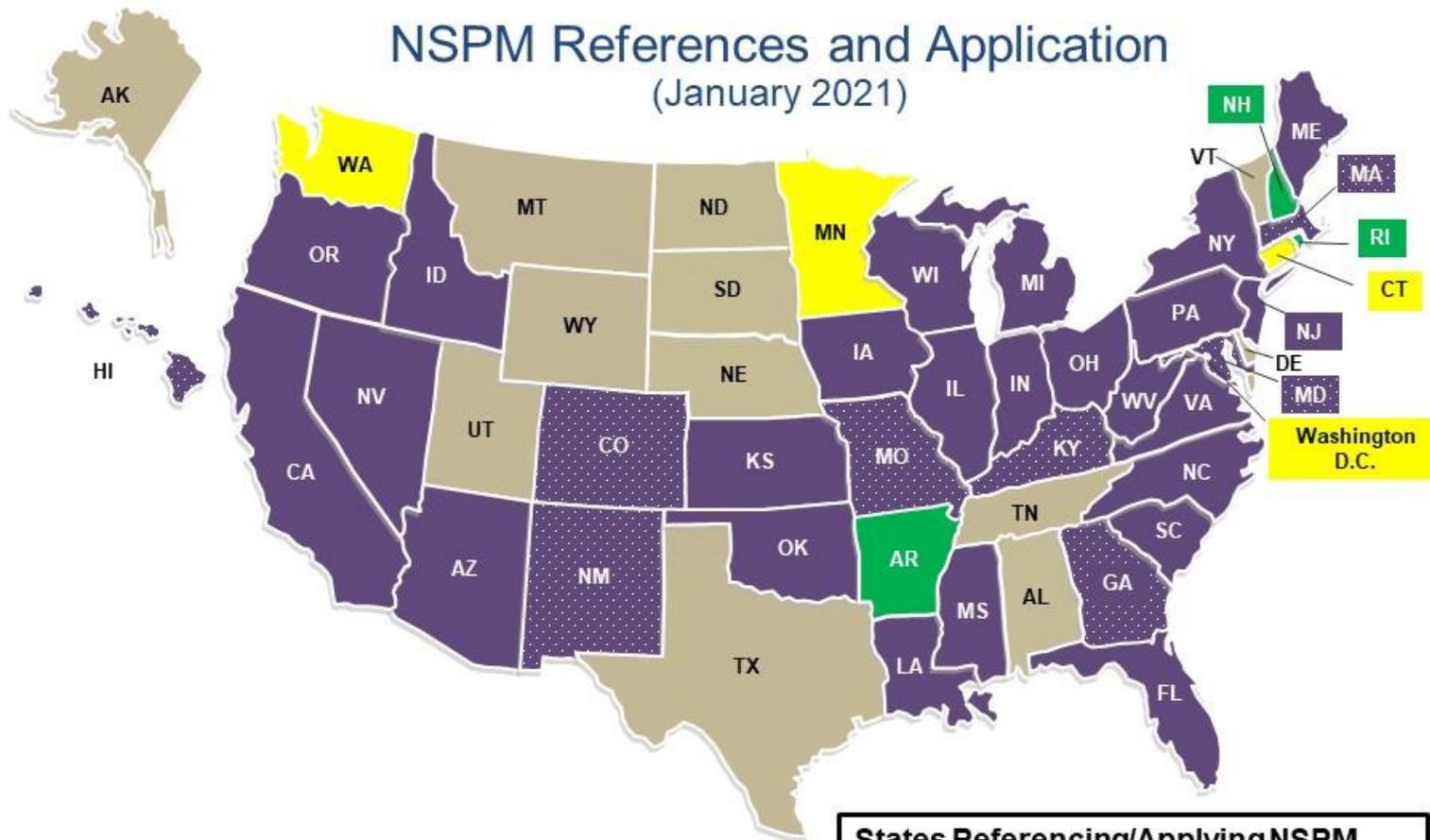
The NSPM for DERs incorporates and expands on the NSPM for EE. See [comparison](#)

NSPM for DERs

August 2020



NSPM References and Application (January 2021)



States Referencing/Applying NSPM	
3	PUC order approving use of the NSPM
4	NSPM application in process
31	NSPM references made in utility plans, PUC dockets, and/or other jurisdictional documents
•••••	NSPM references made in past quarter.

NSPM for DERs - Contents

Executive Summary

1. Introduction

Part I: BCA Framework

2. Principles
3. Developing BCA Tests

Part II: DER Benefits and Costs

4. DER Benefits and Costs
5. Cross-Cutting Issues

Part III: BCA for Specific DERs

6. Energy Efficiency
7. Demand Response
8. Distributed Generation
9. Distributed Storage
10. Electrification

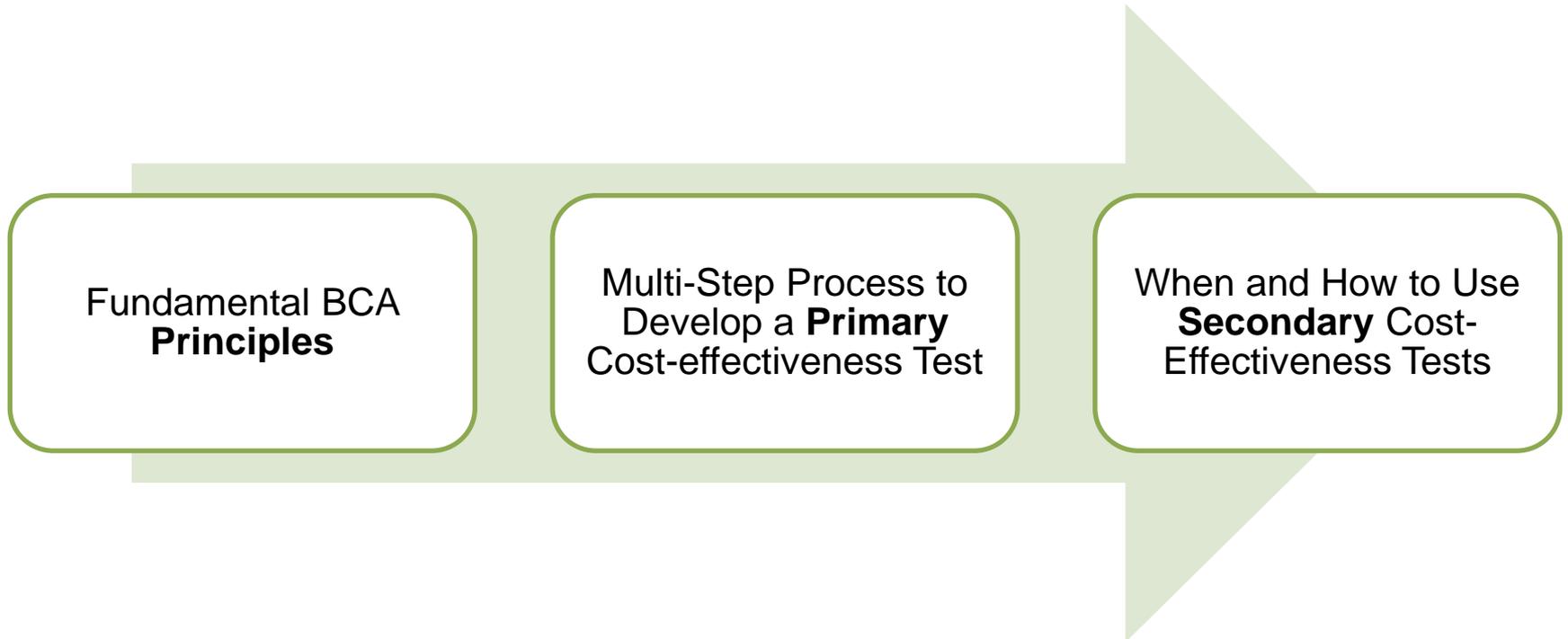
Part IV: BCA for Multiple DERs

11. Multiple On-Site DERs
12. Non-Wires Solutions
13. System-Wide DER Portfolios
14. Dynamic System Planning

Appendices

- A. Rate Impacts
- B. Template NSPM Tables
- C. Approaches to Quantifying Impacts
- D. Presenting BCA Results
- E. Traditional Cost-Effectiveness Tests
- F. Transfer Payments
- G. Discount Rates
- H. Additional EE Guidance

NSPM BCA Framework



NSPM BCA Principles

1. Recognize that DERs can provide energy/power system needs and should be compared with other energy resources and treated consistently for BCA.
2. Align primary test with jurisdiction's applicable policy goals.
3. Ensure symmetry across costs and benefits.
4. Account for all relevant, material impacts (based on applicable policies), even if hard to quantify.
5. Conduct a forward-looking, long-term analysis that captures incremental impacts of DER investments.
6. Avoid double-counting through clearly defined impacts.
7. Ensure transparency in presenting the benefit-cost analysis and results.
8. Conduct BCA separate from Rate Impact Analyses because they answer different questions.

Principles are not mutually exclusive.

EE and Other DER Benefits & Costs

Utility-system Impacts are foundational – Always include

Type	Utility System Impact
Generation	Energy Generation
	Capacity
	Environmental Compliance
	RPS/CES Compliance
	Market Price Effects
	Ancillary Services
Transmission	Transmission Capacity
	Transmission System Losses
Distribution	Distribution Capacity
	Distribution System Losses
	Distribution O&M
	Distribution Voltage
General	Financial Incentives
	Program Administration
	Utility Performance Incentives
	Credit and Collection
	Risk
	Reliability
	Resilience

Non-Utility System Impacts – Inclusion depends on applicable policy goals & objectives

Type	Host Customer Impact
Host Customer	Host portion of DER costs
	Host transaction costs
	Interconnection fees
	Risk
	Reliability
	Resilience
	Tax incentives
	Non-energy Impacts
Low-income non-energy impacts	

Type	Societal Impact
Societal	Resilience
	GHG Emissions
	Other Environmental
	Economic and Jobs
	Public Health
	Low Income: Society
	Energy Security

DER Benefits & Costs (cont.)

Host Customer Impacts

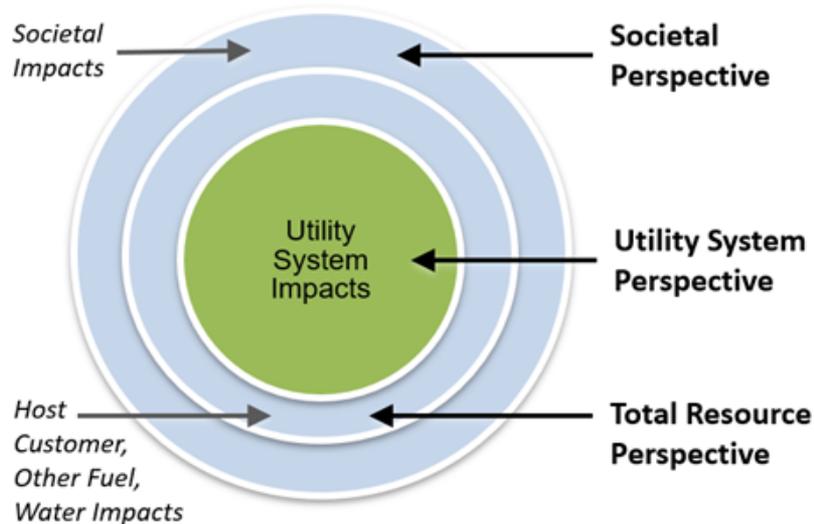
(inclusion depends on policy goals)

Type	Host Customer Impact	Description
Host Customer	Host portion of DER costs	Costs incurred to install and operate DERs
	Host transaction costs	Other costs incurred to install and operate DERs
	Interconnection fees	Costs paid by host customer to interconnect DERs to the electricity grid
	Risk	Uncertainty including price volatility, power quality, outages, and operational risk related to failure of installed DER equipment and user error; this type of risk may depend on the type of DER
	Reliability	The ability to prevent or reduce the duration of host customer outages
	Resilience	The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions
	Tax incentives	Federal, state, and local tax incentives provided to host customers to defray the costs of some DERs
	Non-energy Impacts	Benefits and costs of DERs that are separate from energy-related impacts
	Low-income non-energy impacts	Non-energy benefits and costs that affect low-income DER host customers

Host Customer NEI	Summary Description
Transaction costs	Costs incurred to adopt DERs, beyond those related to the technology or service itself (e.g., application fees, time spent researching, paperwork)
Asset value	Changes in the value of a home or business as a result of the DER (e.g., increased building value, improved equipment value, extended equipment life)
Productivity	Changes in a customer's productivity (e.g., changes in labor costs, operational flexibility, O&M costs, reduced waste streams, reduced spoilage)
Economic well-being	Economic impacts beyond bill savings (e.g., reduced complaints about bills, reduced terminations and reconnections, reduced foreclosures—especially for low-income customers)
Comfort	Changes in comfort level (e.g., thermal, noise, and lighting impacts)
Health & safety	Changes in customer health or safety (e.g., fewer sick days from work or school, reduced medical costs, improved indoor air quality, reduced deaths)
Empowerment & control	The satisfaction of being able to control one's energy consumption and energy bill
Satisfaction & pride	The satisfaction of helping to reduce environmental impacts (e.g., one of the reasons why residential customers install rooftop PV)

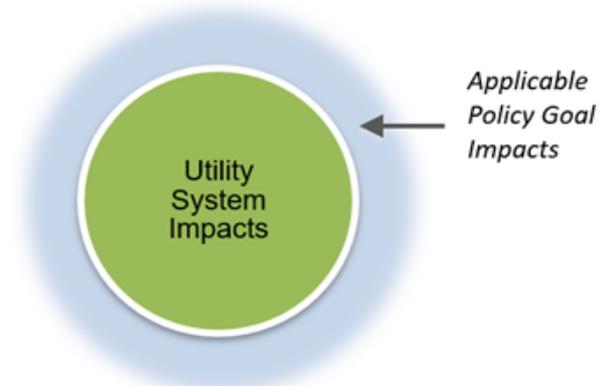
Comparison of NSPM Regulatory Perspective to Traditional Perspectives

Traditional Perspectives



- Three perspectives define the scope of impacts to include in the most common traditional cost-effectiveness tests.

NSPM for DERs Regulatory Perspective



- Perspective of public utility commissions, legislators, muni/coop boards, public power authorities, and other relevant decision-makers.
- Accounts for utility system plus impacts relevant to a jurisdiction's applicable policy goals (which may or may not include host customer impacts).
- Can align with one of the traditional test perspectives, but not necessarily.

Comparison of JST to Traditional Tests

Test	Perspective	Key Question Answered	Categories of Benefits and Costs Included
Jurisdiction-Specific Test	Regulators or decision-makers	Will the cost of meeting utility system needs, while achieving applicable policy goals, be reduced?	Includes the utility system impacts, plus those impacts associated with achieving applicable policy goals
Utility Cost Test*	The utility system	Will utility system costs be reduced?	Includes the utility system impacts
Total Resource Cost Test	The utility system plus host customers	Will utility system costs and host customers' costs collectively be reduced?	Includes the utility system impacts, plus host customer impacts
Societal Cost	Society as a whole	Will total costs to society be reduced?	Includes the utility system impacts, plus host customer impacts, plus societal impacts such as environmental and economic development impacts

*Also referred to as the Program Administrator Cost (PAC) Test.

Use of Secondary Tests

NSPM provides guidance on **when and how to use secondary tests.**

While a jurisdiction's primary test informs whether to fund or otherwise support DERs, secondary tests can help to:

- inform decisions on how to prioritize DERs;
- inform decisions regarding marginally non- and/or cost-effective DERs; and
- encourage consistency across DER types.

NSPM Case Studies

Case Study examples

National Standard
Practice Manual

CASE STUDY:
Arkansas



National Standard
Practice Manual

CASE STUDY:
Minnesota



National Standard
Practice Manual

CASE STUDY:
Rhode Island



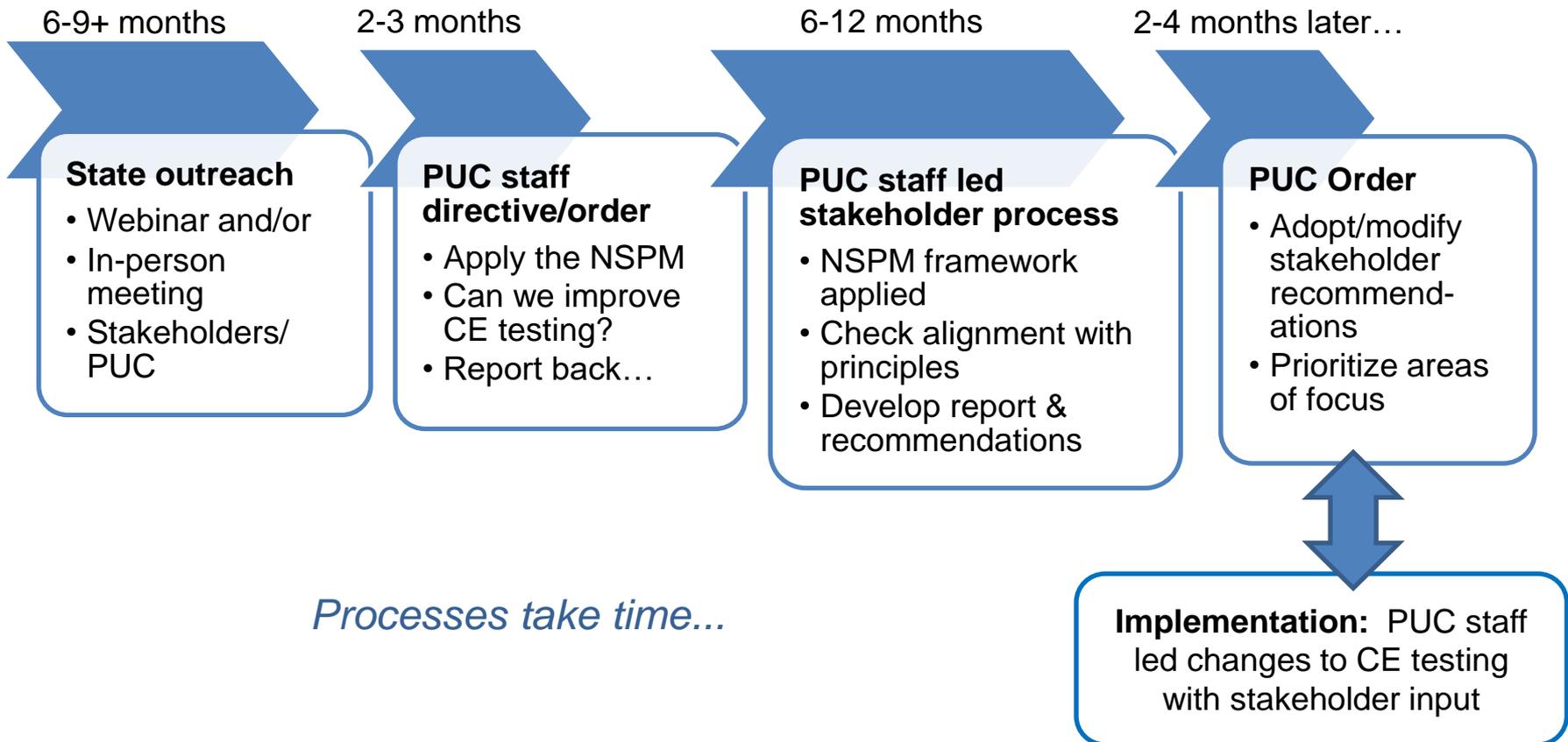
National Standard
Practice Manual

CASE STUDY:
New Hampshire



State process for applying NSPM

What we are generally seeing...



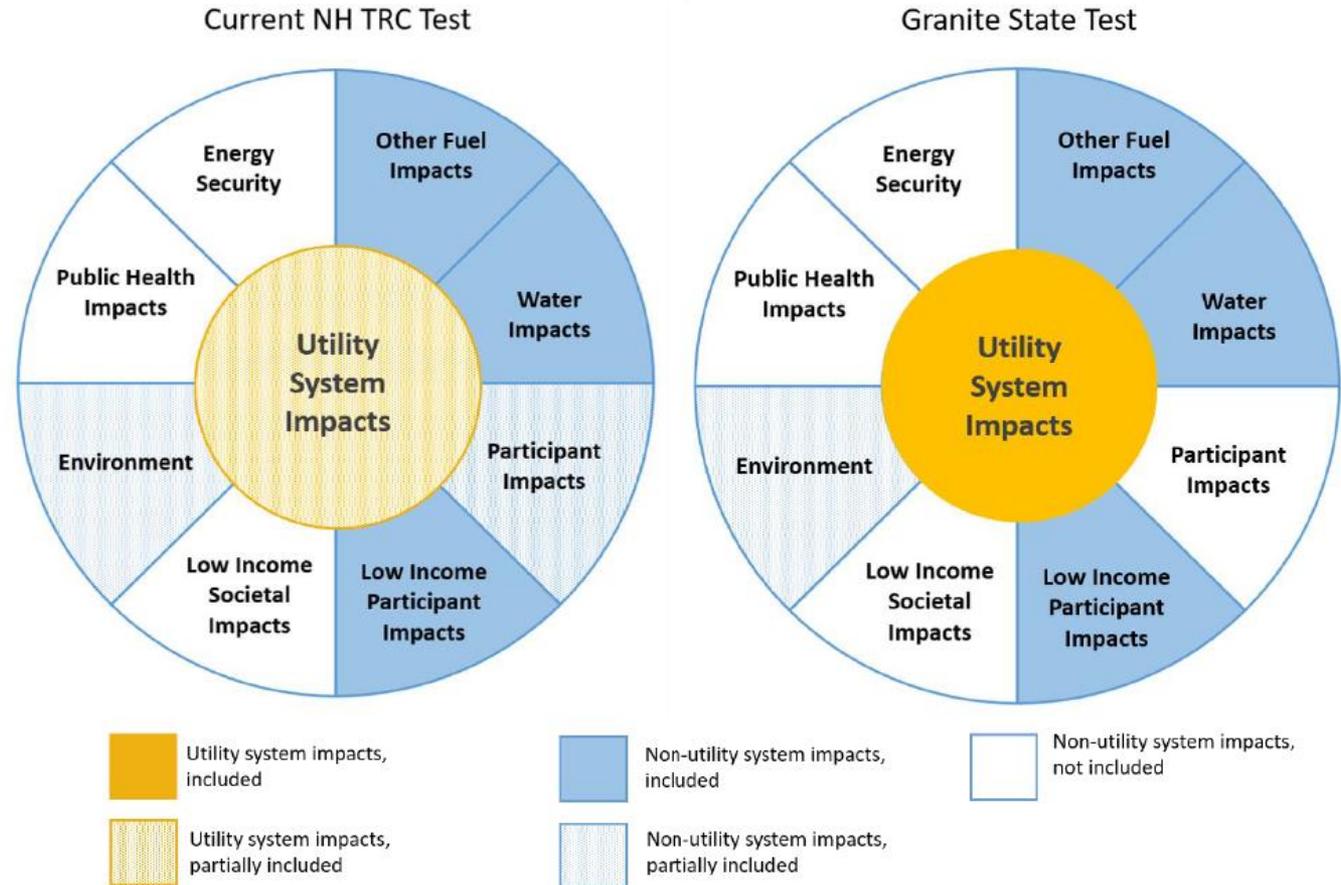
New Hampshire – NSPM Review and Application

- **Late 2018 - Informational meetings** with PUC staff and stakeholders on the what/why/how on NSPM...
- **March to Oct 2019 - PUC staff embark on NSPM 7-step process** with state Benefit-Cost Working Group and consulting support (Synapse Energy Economics). Working group involves PUC staff, utilities, consumer advocate, various NGOs
- **Oct 2019 - Synapse issues final report** reflecting BC Working Group review and input. Report submitted to commission.
- **Dec 2019 - Commission Order** Approving Benefit Cost Working Group Recommendations (Order 26,322), with changes to cost-effectiveness testing practices to go into effect January 2021

New Hampshire – Primary Test

Before and After NSPM

Figure 1. Current and NH TRC test and Granite State Test impacts



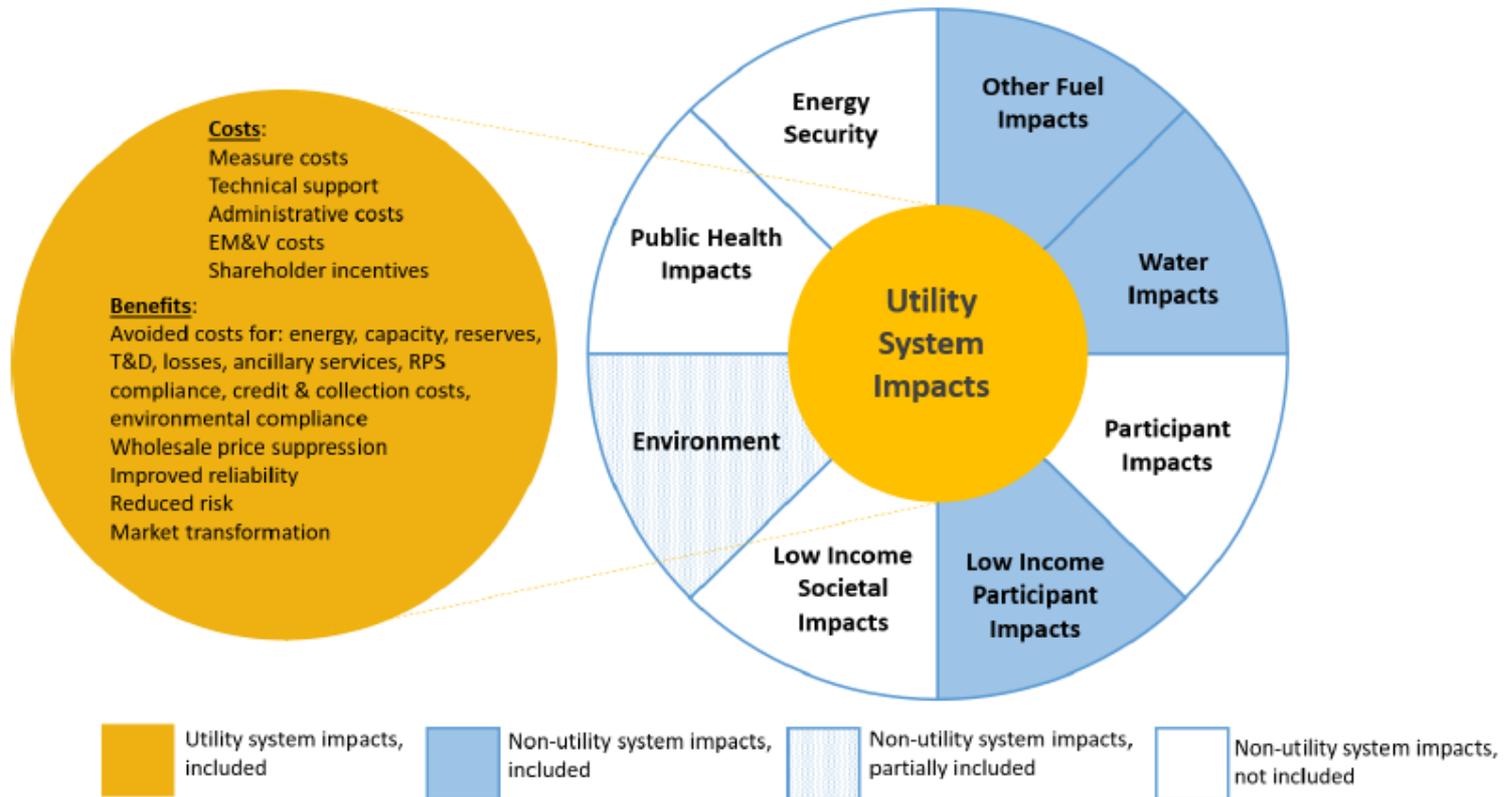
Source: 2019 B/C Working Group discussions.

Notes: The utilities partially account for participant non-energy benefits through a percentage adder in the current New Hampshire TRC Test. The utilities partially account for environmental externalities through a New Hampshire-specific fossil fuel proxy.

New Hampshire – Utility System Impacts

a closer look...

Figure 4. Granite State Test impacts



Source: 2019 B/C Working Group discussions.

Note: The utilities partially account for environmental externalities through a New Hampshire-specific fossil fuel proxy.

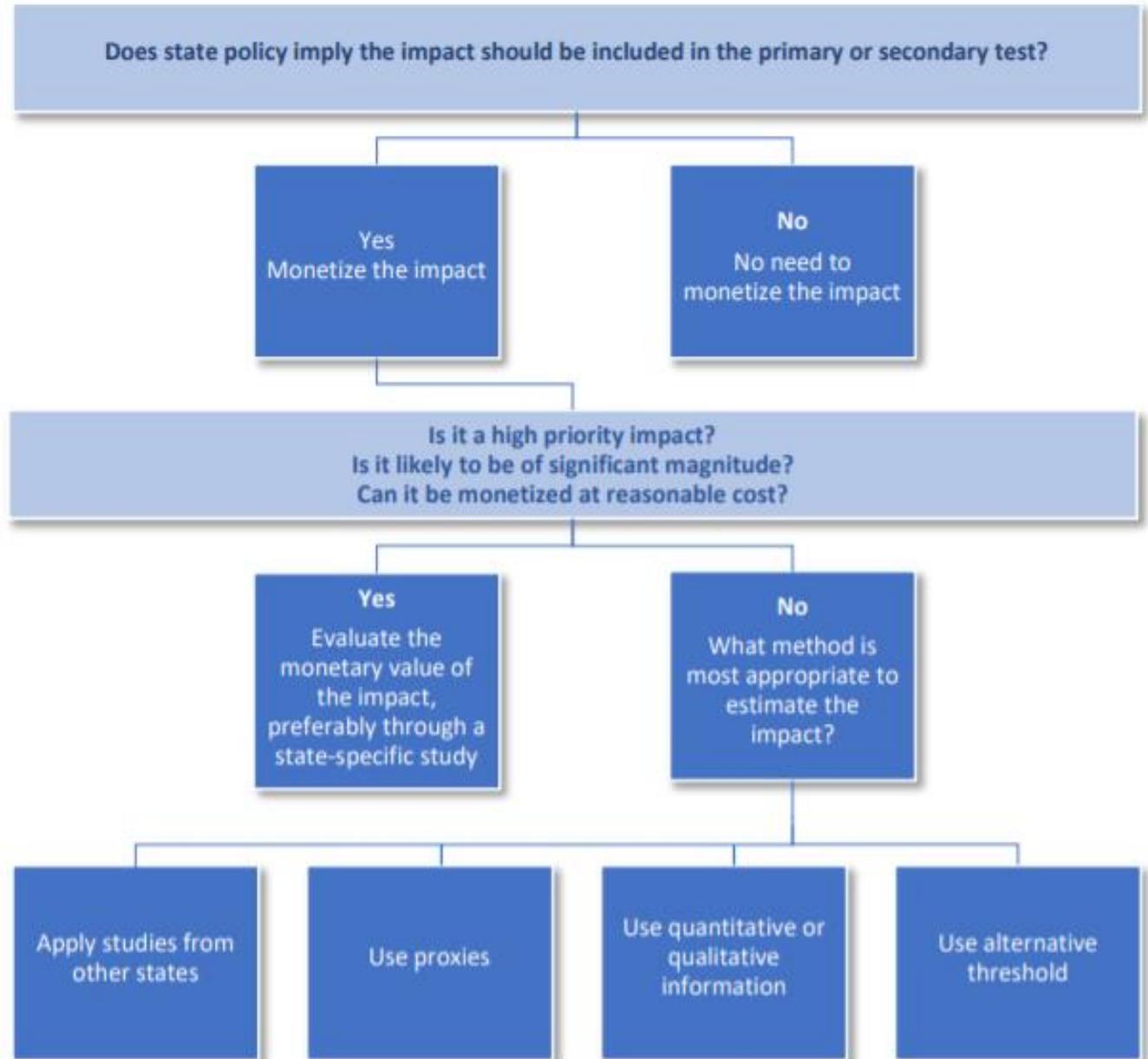
Ensure Symmetry of Benefits & Costs

Illustrative Example: Treatment of Host Customer Costs and Benefits

Costs and Benefits	Asymmetry	Symmetry	
	A. Host Customer Costs Included , Benefits Excluded	B. Host Customer Costs and Benefits Both Included	C. Host Customer Costs and Benefits Both Excluded
DER Costs			
Utility System Costs:			
- Rebate/Incentive	\$1,875	\$1,875	\$1,875
- Administrative Costs	\$1,500	\$1,500	\$1,500
Host Customer Costs:	\$5,625	\$5,625	not included
Total Costs Accounted for:	\$9,000	\$9,000	\$3,375
DER Benefits			
Utility System Avoided Costs	\$6,000	\$6,000	\$6,000
Host Customer Non-Energy Benefits	not included	\$4,000	not included
Total Benefits Accounted for:	\$6,000	\$10,000	\$6,000
Net Benefit/Cost	(\$3,000)	\$1,000	\$2,625
Benefit-Cost Ratio (BCR):	0.67	1.11	1.78
Treatment of Host Customer Impacts	X Asymmetrical	✓ Symmetrical	✓ Symmetrical

New Hampshire

Determining how to account for EE Impacts



A few words on the NSPM for DERs
(and broader application beyond EE...)

DER Benefits & Costs

Utility System Impacts – whether a benefit/cost can depend on various factors...

Type	Utility System Impact	EE	DR	DG	Storage	Electrification
Generation	Energy Generation	●	●	●	●	●
	Capacity	●	●	●	●	●
	Environmental Compliance	●	●	●	●	●
	RPS/CES Compliance	●	●	●	●	●
	Market Price Effects	●	●	●	●	●
	Ancillary Services	●	●	●	●	●
Transmission	Transmission Capacity	●	●	●	●	●
	Transmission System Losses	●	●	●	●	●
Distribution	Distribution Capacity	●	●	●	●	●
	Distribution System Losses	●	●	●	●	●
	Distribution O&M	●	●	●	●	●
	Distribution Voltage	●	●	●	●	●
General	Financial Incentives	●	●	●	●	●
	Program Administration Costs	●	●	●	●	●
	Utility Performance Incentives	●	●	●	●	●
	Credit and Collection Costs	●	●	●	●	●
	Risk	●	●	●	●	●
	Reliability	●	●	●	●	●
	Resilience	●	●	●	●	○

● = typically a benefit
 ● = typically a cost
 ● = either a benefit or cost depending on application
 ○ = not relevant for resource type

Key Factors that Affect DER Impacts

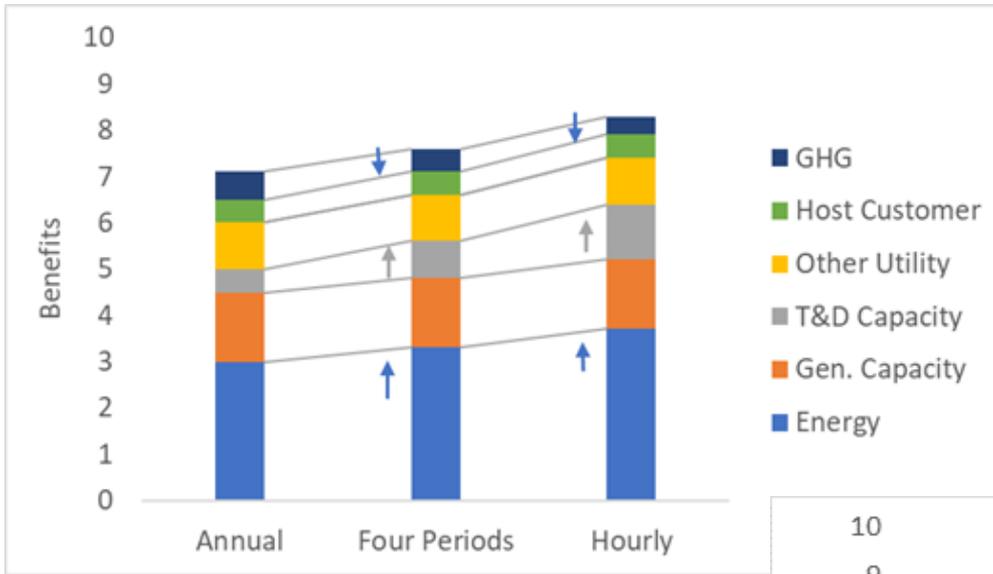
Depends on specific DERs and use cases:

- DER technology characteristics, operating profile
- Resource ownership/control
- Temporal and locational impacts
- Interactive effects
- Behind-the-Meter versus Front-of-the-Meter

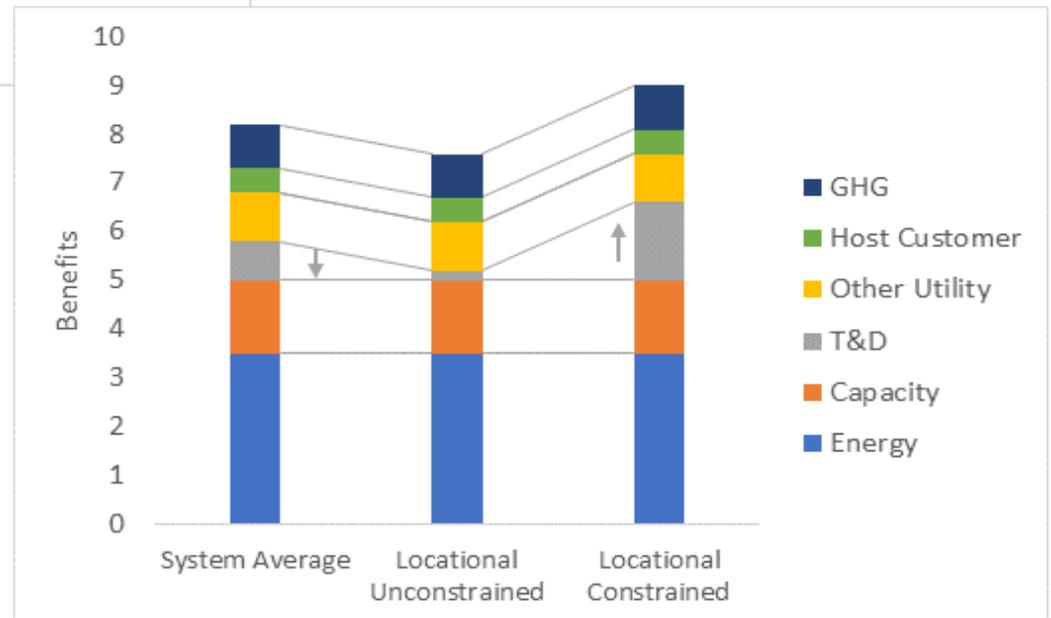
Cross-Cutting Considerations

- Air Emission Impacts
- Transfer Payments and Offsetting Impacts
- Variable Renewable Generation Impacts
- Wholesale Market Revenues
- Free Riders and Spillover Impacts
- Discount Rates

Temporal Impacts on EE Benefits Hypothetical Example

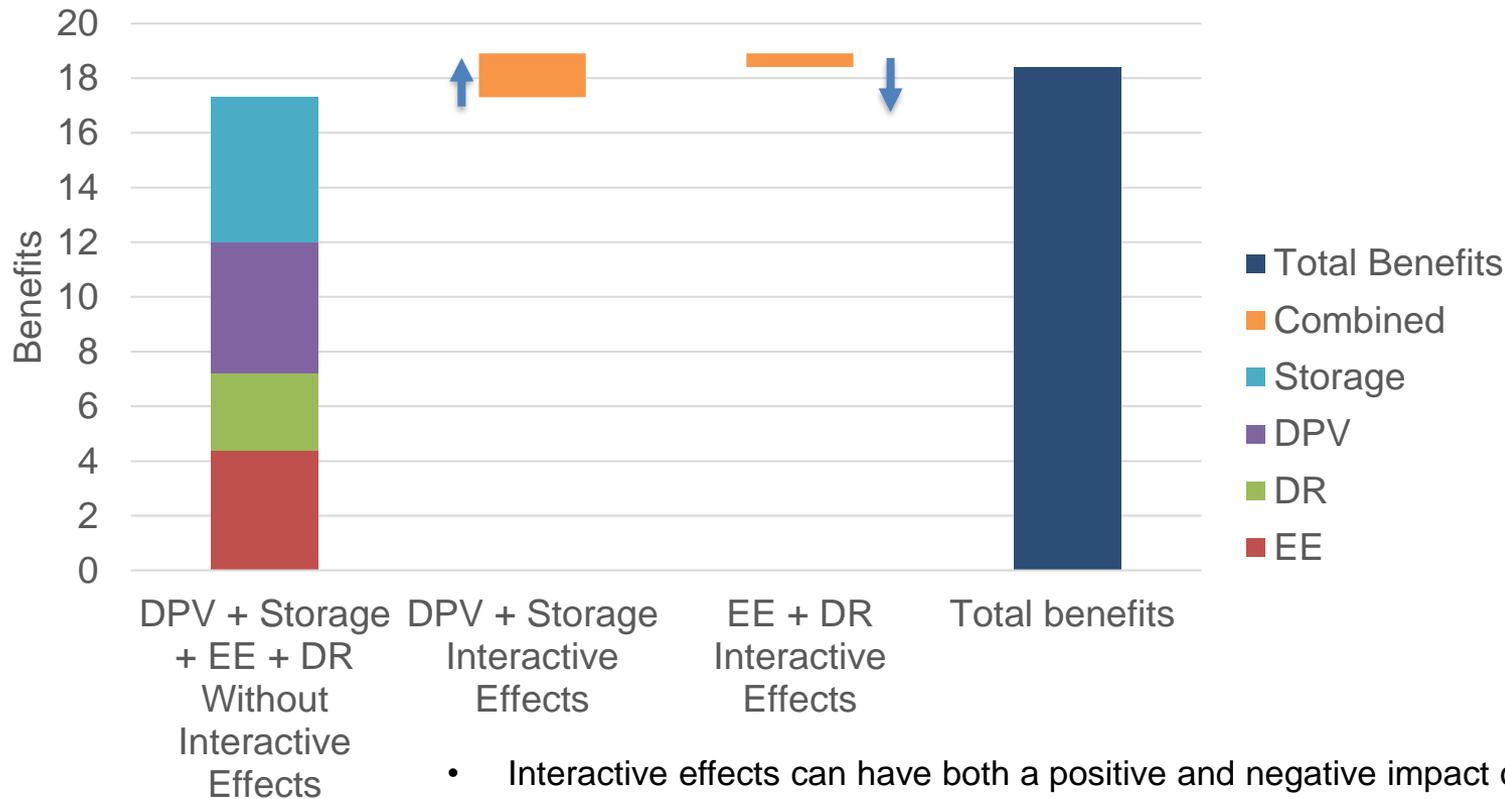


Location Impacts on DR Benefits Hypothetical Example



Multiple On-site DERs

Example of GEB Interactive Effects



- Interactive effects can have both a positive and negative impact on BCA; e.g., positive interactive benefits between DPV and DS, yet negative interactive effects between EE and DR.
- In analyzing combined net interactive effects, total benefits are higher overall than without interactive effects, but not as high as if only DPV and DS interactive effects were accounted for.
- It is key to ensure that BCAs fully capture the net potential interactive effects.

For More Information:

Check out [NESP Events](#) for BCA/NSPM topical webinars

Visit the [Database of Screening Practices](#) (DSP) to access comprehensive information about cost-effectiveness testing practices for electric and natural gas EE programs

Stay informed with the [NESP Quarterly Newsletter](#)

Questions?

Julie Michals, Director of Valuation – E4TheFuture
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Better Buildings Residential Network Peer Exchange

Passing The Test: How Are Residential Efficiency Cost Effectiveness Tests Changing?

Arkansas NSPM Case Study

Sherry McCormack

Manager, Energy Efficiency & Consumer Programs

Southwestern Electric Power Company



Who We Are

- 543,000+ customers
- 1,750 employees
- 33,696 square miles of service area

Overview

- Conducted during 2017-2018 by Parties Working Collaborative (PWC), which includes
 - AR investor owned electric and gas utilities
 - APSC Staff
 - Attorney General's Office
 - Audubon Society
 - Evaluators
- Filed with Arkansas Public Service Commission Oct. 26, 2018 in Docket No. 10-100-R

Findings & Resulting SWEPCO Actions

- Inconsistencies with APSC guidance around Total Resource Cost Test
 - Various approaches to quantifying utility system impacts
 - Avoided T&D costs
 - Average line loss rates versus marginal line loss rates
 - Treatment of incentives paid to free riders
 - Choice of discount rates
- Impact to SWEPCO's reporting
 - Changed from no inclusion to zero dollars
 - Requested marginal line loss included in line loss study
 - Discount rate no longer updated annually – WACC approved in most recent general rate case will be used

Inconsistencies Noted Between AR Cost Effectiveness (CE) Analysis & NSPM Principles

- Categories of utility system impacts not addressed
 - Avoided ancillary service costs
 - Avoided credit and collection costs
 - Risk mitigating value of efficiency resources
- Asymmetrical application of participant impacts
 - Inclusion of all costs but excluding some NEBs
- Incorporation of assumptions regarding carbon costs

Inconsistencies Noted Between AR CE Analysis & NSPM Principles – Actions Taken

- Avoided ancillary service costs
 - Quantification not warranted; recommendation of no change
- Avoided credit and collection costs
 - Monitoring cost studies underway in other jurisdictions
- Risk mitigating value of efficiency resources
 - Recommend no change

Inconsistencies Noted Between AR CE Analysis & NSPM Principles – Actions Taken (cont'd)

- Asymmetrical application of participant impacts, including the inclusion of all costs but excluding some NEBs
 - No additional asymmetrical applications found except those associated with low-income energy efficiency programs
 - Three NEBs are currently quantified and reported by utilities
 - Other fuels – electricity, natural gas, liquid propane energy savings
 - Public water and wastewater
 - Avoided and deferred equipment replacement costs

Inconsistencies Noted Between AR CE Analysis & NSPM Principles – Carbon Costs Status

- Incorporation of assumptions regarding carbon costs
 - Directive was to propose consistent mechanism for illustrating rate and bill impacts of modeling low, medium, and high carbon cost scenarios on the cost effectiveness of a utility's EE programs
 - Carbon cost calculators are currently under consideration by the APSC

Next Steps

- More consistent inputs to annual cost effectiveness analysis
- New reporting tool for three-year plans
 - Provides additional consistency for stakeholder review

Thank you!

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