

# **National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (NSPM for DERs)**

**Overview of Guidance and  
Key Concepts**

**July 2021**

# About NESP

**The National Energy Screening Project (NESP)** is a stakeholder organization that is open to all organizations and individuals with an interest in working collaboratively to improve cost-effectiveness screening practices for 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 work is managed by E4TheFuture, with coordinated state outreach via key partners.

NESP work is funded by E4TheFuture and in part by US DOE.

<https://nationalenergyscreeningproject.org/>

# Overview of Presentation

1. Why an NSPM for DERs?
2. Part I - NSPM BCA Framework
3. Part II – DER Impacts and Cross-Cutting Issues
3. Part III – Guidance on BCA for Specific DER Technologies
4. Part IV – Guidance on BCA for Multiple DERs
5. NESP 2021 Projects and Resources

## Why an NSPM for DERs?

- Traditional cost-effectiveness tests often do not address pertinent jurisdictional/state policies.
- Traditional tests are often modified by states in an ad-hoc manner, without clear principles or guidelines.
- DERs are treated inconsistently in many BCAs or valuations (i.e., in context of programs, procurement, pricing mechanisms, distribution planning, IRP, etc.)
- DERs are often not accurately valued.
- There is a lack of transparency on why tests are chosen and how they are applied.

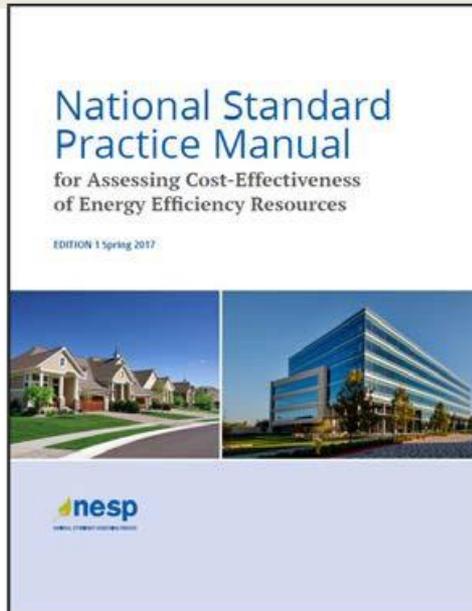
# NSPM for DERs - Background

- Managed and funded by E4TheFuture (with support from US DOE via LBNL)
- Multiple co-authors
  - Extensive understanding of regulatory economics
  - Specialized expertise with different DERs
- Advisory Group
  - 45+ individuals
  - Diversity of perspectives
  - Input on Manual outline and drafts
- NSPM for DERs builds on NSPM for EE (2017)

*NSPM is a 'living document' and will be updated and improved over time, adding case studies, addressing gaps, etc. contingent upon funding.*

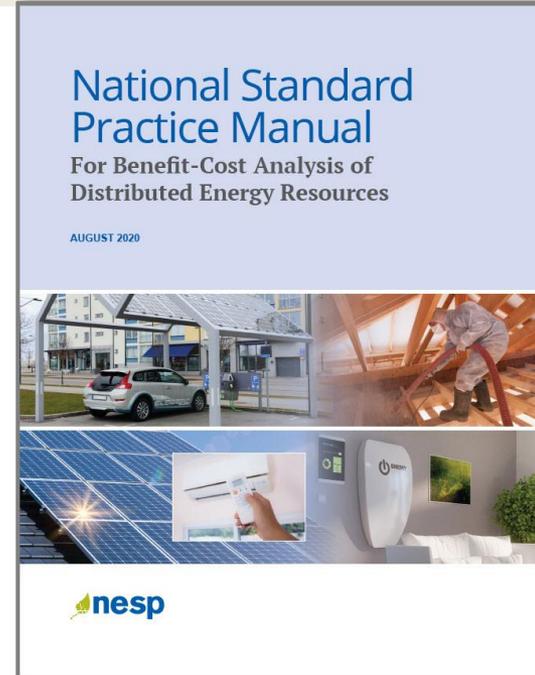
## NSPM for EE

May 2017



## NSPM for DERs

August 2020



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

NSPM for EE (2017)	→ NSPM for DERs (2020)
'Resource Value Framework'	'NSPM BCA Framework'
'Resource Value Test'	'Jurisdiction-Specific Test' (JST)
6 Principles	8 Principles
7-step process to develop primary test	5-step process to develop primary test
Single DER analysis	Single- and multi-DER analyses
DERs covered: energy efficiency only	DERs covered: EE, DR, DG, DS, Electrification

# NSPM for DERs - Advisory Group



Name	Affiliation	Name	Affiliation
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Cyrus Bhedwar	Southeast Energy Efficiency Alliance	Lauren Gage	Apex Analytics
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# NSPM Consulting Team & Partners

## Consulting Team

- Synapse
- ICF
- SEPA
- Energy Futures Group
- Rabago Energy
- Schiller Consulting

## Project Coordination

- E4TheFuture

## Partners

- MEEA
- NEEP
- SEEA
- SWEEP
- NECEC
- BPA
- ACEEE
- AEE
- CEDMC

# NSPM for DERs – Audience and Uses

**Audience:** All entities overseeing/guiding DER decision (PUCs, SEOs, utilities, DER reps, evaluators, consumer advocates, and others)

**Purpose:** Guidance for valuing DER opportunities to inform policies and strategies that support state goals/objectives, such as:

- expanding EE/DR plans, strategies, and programs to a broader set of DERs;
- evaluating and planning for non-wires/pipes solutions;
- incorporating DERs into distribution system planning;
- achieving electrification goals, including EV goals;
- achieving environmental and carbon emission objectives.

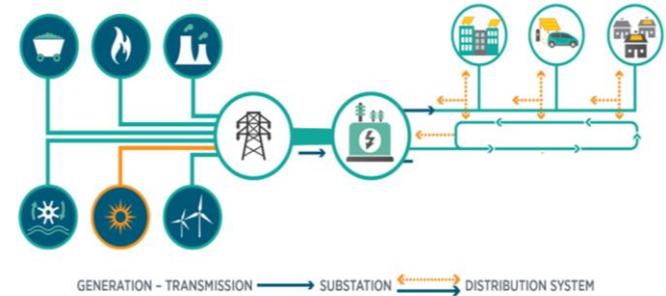
## **Applies to:**

- **Programs:** initiatives and policies implemented by utilities or other entities to encourage adoption of DERs
- **Procurements:** initiatives to procure DERs, whether built by a utility or procured from third-party vendors, e.g., competitive procurement
- **Pricing Mechanisms:** such as those designed to compensate DERs for their value to grid or to achieve other policy objectives (e.g., time-of-use rates, peak time rebates, critical peak pricing)

# Three Tiers of DER Analysis

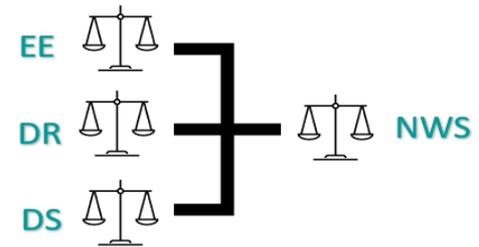
## Level Three: Multiple DERs + Utility System

- Assessing **multiple DER types** relative to a **dynamic set** of alternative resources; goal to optimize both DERs and utility-scale resources



## Level Two: Multiple DERs\*

- Assessing **more than one DER type** at the same time, relative to a **static or dynamic** set of alternative resources



## Level One: Single DER\*

- Assessing **one DER type** in isolation from other DER types, relative to a **static** set of alternative resources



Adapted from LBNL 2020 and US DOE Solar Energy Technologies Office

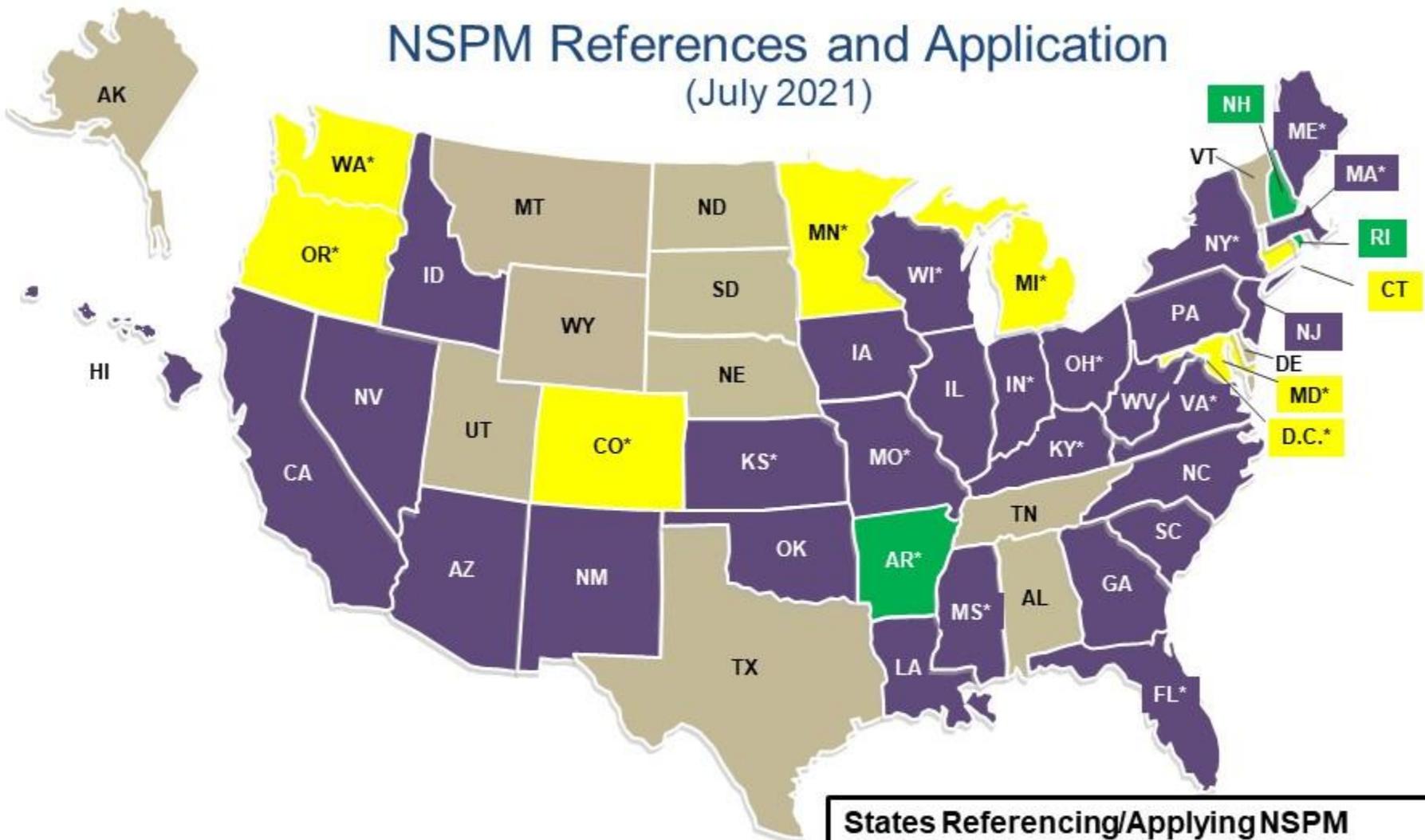
\* NSPM addresses primarily Levels 1-2

# NSPM Applies to Various Regulatory Contexts/Mechanisms:

Contexts	Application	Goal of Benefit-Cost Analysis	Role of Costs and Benefits
<b>Programs</b>	EE, DR, NEM, including EM&V	Determine whether to implement program	Compare program benefits to program costs
<b>Procurement</b>	DERs, NWAs, NPAs, PPA contracts	Determine the ceiling price, i.e., the price to beat	Ceiling price should equal the benefits (avoided costs) of the procurement
<b>Pricing</b>	Rate design, TOU	Estimate long-run marginal costs	Long-run marginal costs should equal the benefits (avoided costs) of modifying consumption.
	DER compensation	Determine the value of the DER	The value of DER is the sum of the benefits (avoided costs) of the DER
<b>Planning</b>	Optimize DERs	Identify optimal DER portfolio	Optimal DER portfolio determined by comparing portfolio benefits to portfolio costs.
	DP, IDP, IRP, IGP	Identify optimal resource scenario	Optimal resource scenario determined by comparing scenario benefits to scenario costs.
	GHG Plans	Achieve GHG goals at low cost	Optimal GHG plan determined by comparing plan benefits to plan costs.
	State Energy Plans	Identify plan to meet state goals	Optimal state energy plan determined by comparing plan benefits to plan costs.
<b>Infrastructure Investments</b>	Grid Mod, AMI, EV Infrastructure, Resilience Measures	Determine whether to make investment	Compare investment benefits to investment costs.

*Definitions, assumptions and values of costs and benefits should be consistent same across all regulatory contexts/mechanisms*

# NSPM References and Application (July 2021)



## States Referencing/Applying NSPM

- 3** Has applied the NSPM
- 8** Applying NSPM or under PUC consideration
- 28** NSPM references made in utility plans, PUC dockets, and/or other jurisdictional documents
- \*** NSPM references made in most recent 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

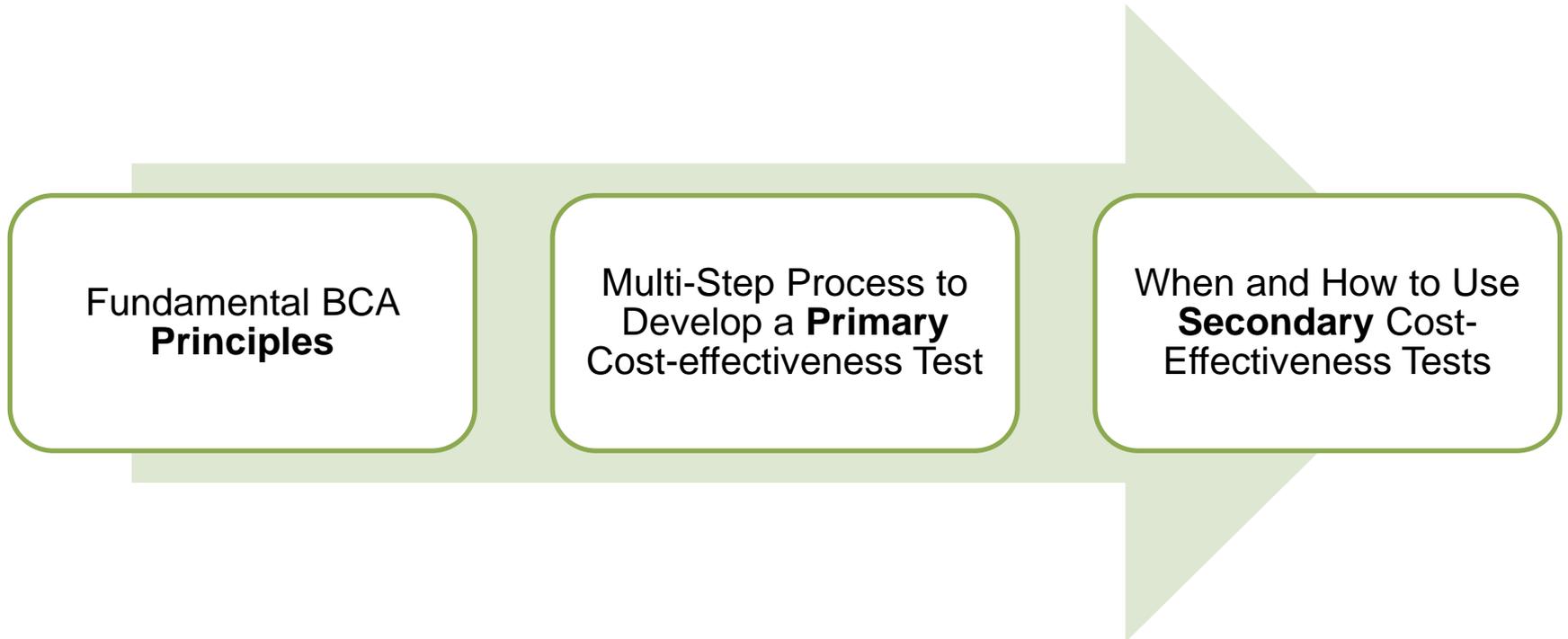
## **Appendices**

- 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 for DERs – PART I**

## **The NSPM Benefit-Cost Analysis Framework**

# NSPM BCA Framework



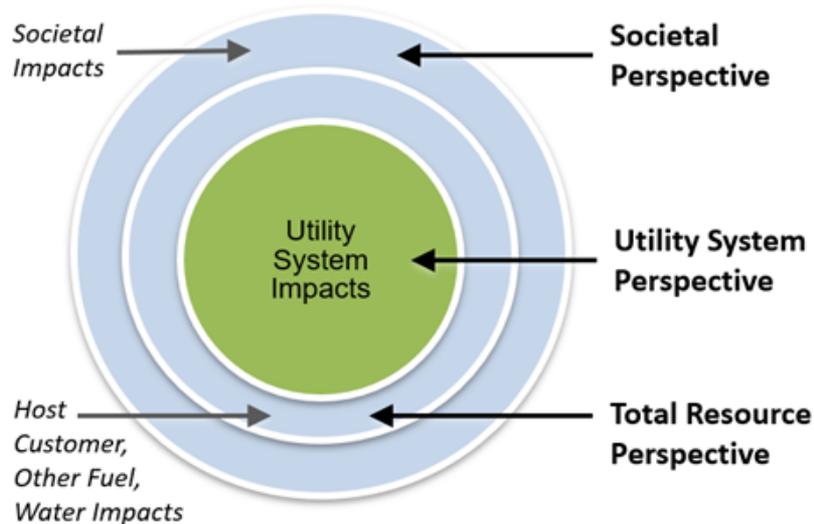
# NSPM BCA Principles

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.*

# Cost-Effectiveness Perspectives

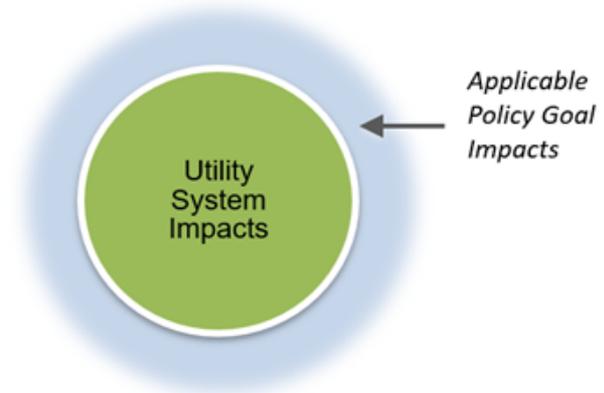
## Traditional Perspectives



- 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.

# Defining Your Primary BCA Test

*What question does a Primary Test answer?*



*Which resources have benefits that exceed costs and therefore merit utility acquisition or support on behalf of their customers?*

# Defining Your Primary Cost-Effectiveness Test

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## **STEP 1** Articulate Applicable Policy Goals

Articulate the jurisdiction's applicable policy goals related to DERs.

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## **STEP 2** Include All Utility System Impacts

Identify and include the full range of utility system impacts in the primary test, and all BCA tests.

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## **STEP 3** Decide Which Non-Utility System Impacts to Include

Identify those non-utility system impacts to include in the primary test based on applicable policy goals identified in Step 1:

- Determine whether to include host customer impacts, low-income impacts, other fuel and water impacts, and/or societal impacts.
- 

## **STEP 4** Ensure that Benefits and Costs are Properly Addressed

Ensure that the impacts identified in Steps 2 and 3 are properly addressed, where:

- Benefits and costs are treated symmetrically;
  - Relevant and material impacts are included, even if hard to quantify;
  - Benefits and costs are not double-counted; and
  - Benefits and costs are treated consistently across DER types
- 

## **STEP 5** Establish Comprehensive, Transparent Documentation

Establish comprehensive, transparent documentation and reporting, whereby:

- The process used to determine the primary test is fully documented; and
  - Reporting requirements and/or use of templates for presenting assumptions and results are developed.
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## STEPS 1-3: Articulate Policy Goals and Identify Relevant Impacts

*Example Goals: as articulated in statute, regulations, decisions, etc.*

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**Common Overarching Goals:** Provide safe, reliable, reasonably priced electricity and gas services; support fair and equitable economic returns for utilities; promote customer equity; protect/reduce energy burden for low-income and vulnerable customers.

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**Resource Goals:** Reduce electricity and gas system costs; develop least-cost energy resources; improve system reliability and resiliency; reduce system risk; promote resource diversity; increase energy independence; reduce price volatility; provide demand flexibility.

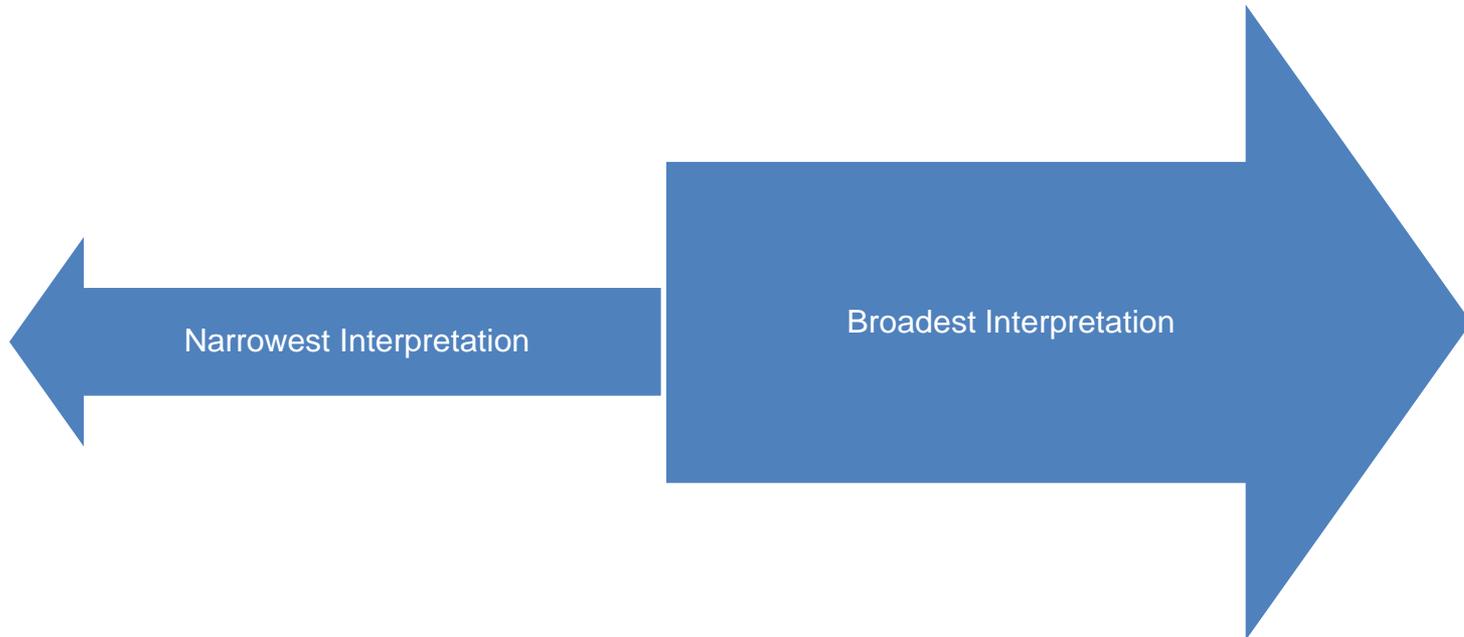
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**Other Applicable Goals:** Ensure stable energy markets; reduce environmental impact of energy consumption; promote jobs and local economic development; improve health associated with reduced air emissions and better indoor air quality.

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## Articulate Policy Goals and Identify Relevant Impacts

*Broad or narrow interpretation of applicable goals  
(or something in-between)?*



# Articulate Policy Goals and Identify Relevant Impacts

## Hypothetical Simplified Example

Jurisdiction's Applicable Policies Statutes, Regulations, Plans, Orders, etc.	Electric Utility System Impacts	Goals Reflected in Policies			
		Other Fuels	Reduce GHG Emissions	Create Jobs	Protect Low Income Customers
<b>Net Metering</b>	DG	DG	DG	DG	
<b>IRP Regulations</b>	All DERs	All DERs	All DERs		All DERs
<b>EE/DR Statute</b>	EE, DR	EE, DR	EE, DR		EE, DR
<b><i>What impacts would you account for in your Primary Test?</i></b>					
<b>Option 1: Broadest</b> interpretation of Policy Goals	X	X	X	X	X
<b>Option 2: Narrowest</b> interpretation of Policy Goals	X	X	X		
<b>Option 3: Somewhere in- between</b> broadest and narrowest	X	X	X		X

See [Template Policy Inventory Tables](#)

## STEP 4:

# Ensure that Impacts are Properly Addressed

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Ensure that the impacts identified in Steps 2 and 3 are properly addressed, where:

- Benefits and costs are treated symmetrically;
  - Relevant and material impacts are included, even if hard to quantify;
  - Benefits and costs are not double-counted; and
  - Benefits and costs are treated consistently across DER types
-

# Ensure Symmetry of Benefits & Costs

## Illustrative Example: Treatment of Host Customer Costs and Benefits

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

# Develop Methodologies and Inputs to Account for All Relevant Impacts (Including Hard-to-Quantify Impacts)

Approach	Application
Jurisdiction-specific studies	Best approach for estimating and monetizing relevant impacts.
Studies from other jurisdictions	Often reasonable to extrapolate from other jurisdiction studies when local studies not available.
Proxies	If no relevant studies of monetized impacts, proxies can be used.
Alternative thresholds	Benefit-cost thresholds different from 1.0 can be used to account for relevant impacts that are not monetized.
Other considerations	Relevant quantitative and qualitative information can be used to consider impacts that cannot or should not be monetized.

## STEP 5:

### Establish Comprehensive, Transparent Documentation

- Development of primary test - process should be transparent to all interested stakeholders
- Stakeholder input can be achieved through a variety of means:
  - Rulemaking process
  - Generic jurisdiction-wide docket
  - Working groups or technical sessions
- Address objectives based on current jurisdiction policies
  - Flexibility needed to incorporate evolution of policies over time
- Review of policy goals may require consultation with other government agencies
  - Environmental protection
  - Transportation
  - Health and human services
  - Economic development

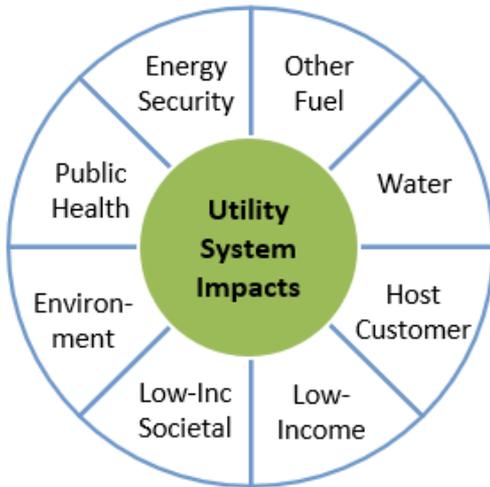
# Jurisdiction Specific Test (JST) Compared with Traditional Tests

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

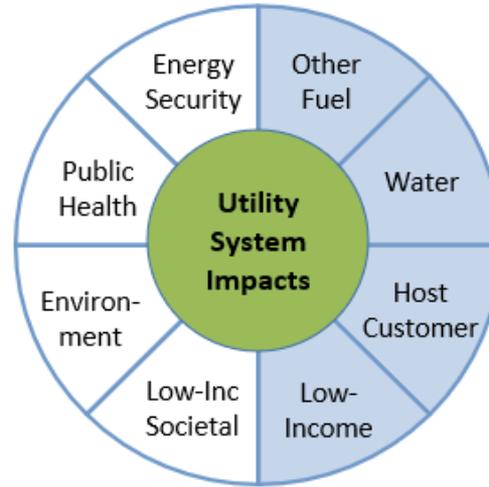
# Primary Test = Jurisdiction Specific Test (JST)

*Hypothetical JSTs as compared to traditional tests*

JST 1 = UCT/PACT



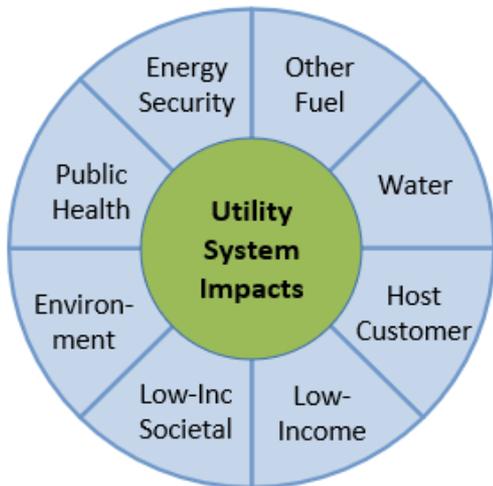
JST 2 = TRC Test



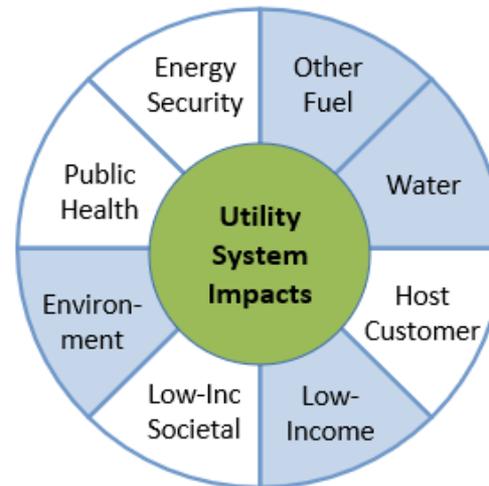
UCT = Utility Cost Test (or PACT = Program Admin Cost Test)  
 TRC = Total Resource Cost Test  
 SCT = Societal Cost Test

-  All utility system impacts included
-  Non-utility system impacts included
-  Non-utility system impacts *not* included

JST 3 = SCT



JST 4 ≠ traditional CE test \*



*\*JST 4 includes a different set of non-utility system impacts based on its applicable policies. JSTs may or may not align with traditional tests.*

# Use of Secondary Tests

NSPM provides guidance on **when and how to use secondary cost-effectiveness 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 (based on priority goals/objectives, as well as different considering perspectives (e.g., host customer/participant, utility);
- inform decisions regarding marginally non- and/or cost-effective DERs; and
- encourage consistency across DER types.

# Conduct BCA Separately from Rate Impact Analysis (Principle #8)

The two analyses answer different questions

	Benefit-Cost Analysis	Rate Impact Analysis
<b>Purpose</b>	To identify which DERs utilities should invest in or otherwise support on behalf of their customers	To identify how DERs will affect rates, in order to assess equity concerns
<b>Questions Answered</b>	What are the future costs and benefits of DERs?	Will customer rates increase or decrease, and by how much?
<b>Results Presented</b>	<ul style="list-style-type: none"> <li>• Cumulative costs (PV\$)</li> <li>• Cumulative benefits (PV\$)</li> <li>• Cumulative net benefits (PV\$)</li> <li>• Benefit-cost ratios</li> </ul>	<ul style="list-style-type: none"> <li>• Rate impacts (c/kWh, %)</li> <li>• Bill impacts (\$/month, %)</li> <li>• Participation rates (#, %)</li> </ul>

*The Rate Impact Measure (RIM) Test combines the two analyses and therefore makes it difficult to answer either question*

## Components of BCA and Rate Impact Analyses

	Include in Benefit-Cost Analysis	Include in Rate Impact Analysis
Utility system impacts	✓	✓
Host customer impacts	depends on policy goals	x
Social impacts	depends on policy goals	x
Lost revenues	x	✓
Increased revenues	x	✓
Net metering bill credits	x	✓

*See NSPM for DERs Appendix A on Rate Impact Analyses*

# Rate Impacts $\neq$ Cost-Effectiveness

- They include different things...
  - **Cost-effectiveness:** total new costs vs. total new cost savings
  - **Rate impacts:** include past/sunk costs, no value to avoided energy costs
- ...to answer very different questions:
  - **Cost-effectiveness:** Do total costs go down? By how much?
  - **Rate impacts:** Do rates go up?
- Costs can go up even if rates go down (and vice versa)
  - $1100 \text{ kWh} * \$0.10/\text{kWh} = \$110$
  - $900 \text{ kWh} * \$0.11/\text{kWh} = \$ 99$
- Bottom line: DER rate impacts are concern about equity, not cost
  - Equity between DER program participants and non-participants

# Rate Impacts = Equity Issue

- A legitimate consideration for how much DER, which DER
  - Separate from (or in addition to) cost-effectiveness
- But should be quantified, considered in context
  - Magnitude of rate impact
  - % of customers with rate impact, but no offsetting savings (non-participants)
  - Magnitude of EE benefit
- Example: Synapse 2014 Study of Vermont EE Programs
  - 20-year time horizon for aggressive EE
  - 95% of Res customers participate, see ~7% avg. bill reduction
  - 5% of Res customers non-participants, 4-5% bill increase

} Is this trade-off acceptable?
- Are trade-offs made for DER investments same as those made on supply investments? If different, why?
  - for substation upgrade, do all customers pay or just those driving the need?

# Rate, Bill and Participant Impacts

A thorough understanding of rate impacts requires an analysis of three important factors:

- **Rate impacts**, provide an indication of the extent to which rates for all customers might increase.
- **Bill impacts**, provide an indication of the extent to which customer bills might be reduced for those customers that install DERs.
- **Participation impacts**, provide an indication of the portion of customers that will experience bill reductions or bill increases.
  - Participation impacts are also key to understanding the extent to which customers are adopting DERs based on DER policies.

# Consider Both BCA and Rate Impact Analysis

## *Illustrative example: Energy Efficiency Portfolio*

Sometimes it is necessary to make tradeoffs between reduced costs and higher rates.

Benefit-Cost Analysis	Net Benefits (mil PV\$)	85
	Benefit-Cost Ratio	2.1
Rate Impact Analysis	Rate Impacts (%)	1.3
	Bill Impacts Participants (%)	-3.4
	Participation Rate (%)	68
	Participation Low-Income (%)	56
Additional Considerations	GHG Goal Achieved (%)	28

← significant net benefits...

← but rates increase...

← but many customers participate and see lower bills.

← and there is a big impact on key policy goal

# Consider Both BCA and Rate Impact Analysis

## *Illustrative Example: Demand Response Portfolio*

Sometimes there are no tradeoffs.

Benefit-Cost Analysis	Net Benefits (mil PV\$)	15	← some net benefits...
	Benefit-Cost Ratio	1.4	
Rate Impact Analysis	Rate Impacts (%)	-0.1	← and rates decrease...
	Bill Impacts Participants (%)	-1.2	
	Participation Rate (%)	24	
	Participation Low-Income (%)	13	← but fewer customers participate...
Additional Considerations	GHG Goal Achieved (%)	3	← and not much impact on key policy goal

# Accounting for “Energy Equity/Justice” in BCAs

## Energy Equity Metrics:

- Overlap with rate and bill analysis;
- Overlap with benefit-cost analysis; and
- Are addressed by many other metrics outside of above analyses

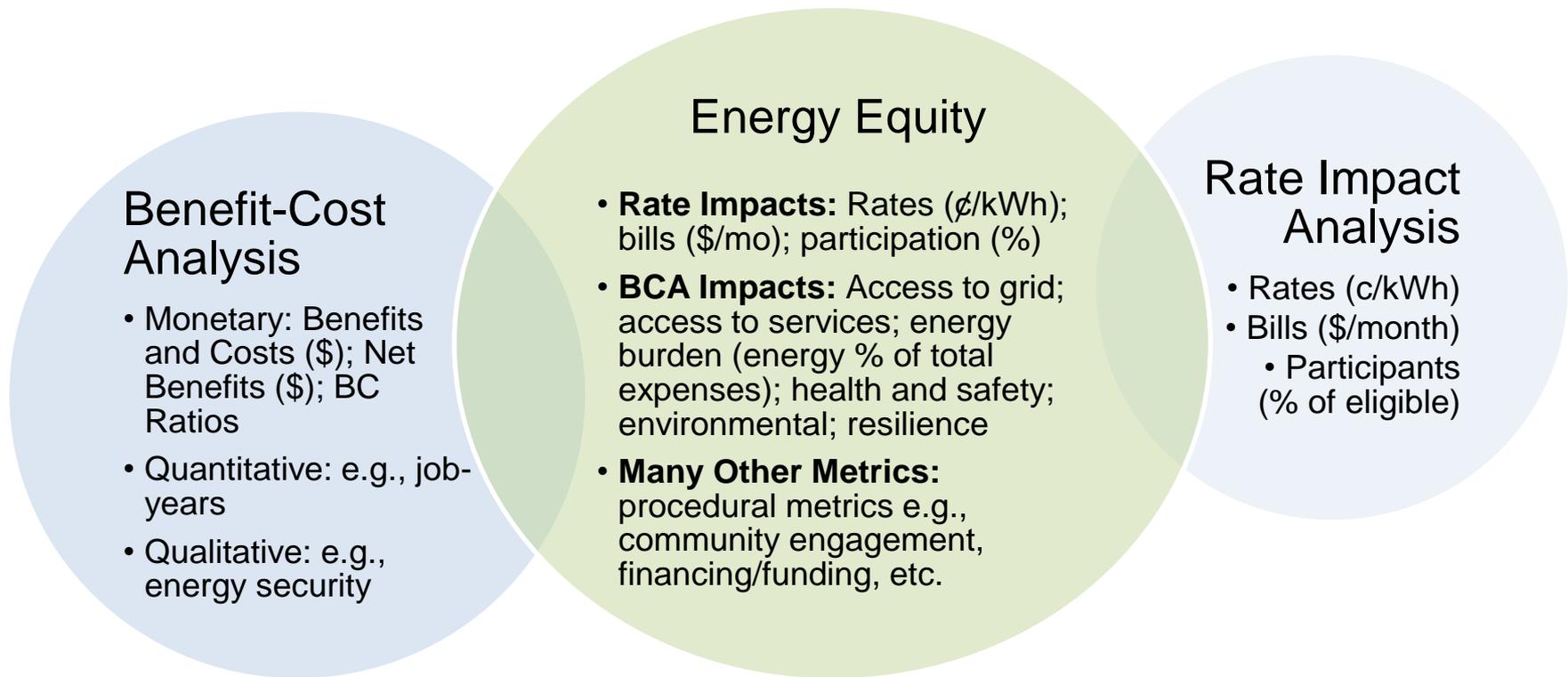
## Key Questions/Considerations:

- *How should equity considerations be used to make decisions about utility DER and other resource investments?*
- *How can double counting be avoided?*
- *How can NSPM provide additional guidance in this area?*

*Plus, ensure coordination with relevant national energy equity efforts to define and quantify key metrics appropriately*

# Energy Equity Metrics in BCA vs Rate Impact Analysis

*Energy equity* analysis addresses equity in all aspects of the energy system, including its benefits, burdens, costs, and participation. Functionally equivalent to *energy justice*.



## **NPSM for DERs - PART II**

### **DER Impacts and Cross-Cutting Issues**

# DER Benefits and Costs (Impacts)

## Utility System Impacts

- Electric
- Gas
- Other Fuels

## Non-Utility System Impacts

- Host Customer
- Societal

# Electric Utility System Impacts

*(foundational to any BCA test – always include)*

Type	Utility System Impact	Description
<b>Generation</b>	Energy Generation	The production or procurement of energy (kWh) from generation resources on behalf of customers
	Capacity	The generation capacity (kW) required to meet the forecasted system peak load
	Environmental Compliance	Actions to comply with environmental regulations
	RPS/CES Compliance	Actions to comply with renewable portfolio standards or clean energy standards
	Market Price Effects	The decrease (or increase) in wholesale market prices as a result of reduced (or increased) customer consumption
	Ancillary Services	Services required to maintain electric grid stability and power quality
<b>Transmission</b>	Transmission Capacity	Maintaining the availability of the transmission system to transport electricity safely and reliably
	Transmission System Losses	Electricity or gas lost through the transmission system
<b>Distribution</b>	Distribution Capacity	Maintaining the availability of the distribution system to transport electricity or gas safely and reliably
	Distribution System Losses	Electricity lost through the distribution system
	Distribution O&M	Operating and maintaining the distribution system
	Distribution Voltage	Maintaining voltage levels within an acceptable range to ensure that both real and reactive power production are matched with demand
<b>General</b>	Financial Incentives	Utility financial support provided to DER host customers or other market actors to encourage DER implementation
	Program Administration	Utility outreach to trade allies, technical training, marketing, and administration and management of DERs
	Utility Performance Incentives	Incentives offered to utilities to encourage successful, effective implementation of DER programs
	Credit and Collection	Bad debt, disconnections, reconnections
	Risk	Uncertainty including operational, technology, cybersecurity, financial, legal, reputational, and regulatory risks
	Reliability	Maintaining generation, transmission, and distribution system to withstand instability, uncontrolled events, cascading failures, or unanticipated loss of system components
	Resilience	The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions

# Gas Utility System and Other Fuel Impacts

Type	Gas Utility System
Energy/Supply	Fuel and Variable O&M
	Capacity (e.g., local storage)
	Environmental compliance
	Market price effects
Transportation	Pipeline capacity
	Pipeline losses
Delivery	Local delivery capacity
	Local delivery line losses
	Local delivery O&M
General	Financial incentives
	Program admin costs
	Performance incentives
	Credit and collection costs
	Risk, reliability, resilience

Type	Other Fuels*
Other Fuels	Fuel and O&M
	Delivery Costs
	Environmental Compliance
	Market Price Effects

\*Other fuels include oil, propane, wood, and gasoline

# Host Customer Impacts

(Inclusion depends on policy goals)

Host Customer Impact	Description
Host portion of DER costs	Costs incurred to install and operate DERs
Interconnection fees	Costs paid by host customer to interconnect DERs to the 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 can 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 (NEIs)	Benefits and costs of DERs that are separate from energy-related impacts

## Breakout of Host Customer Non-Energy Impacts (NEIs)

Host Customer NEI	Description
Transaction costs	Costs incurred to adopt DERs, beyond those related to installing or operating the DER itself (e.g., application fees, customer time spent researching DERs, paperwork, etc.)
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., 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, reduced medical costs, improved indoor air quality, reduced deaths)
Empowerment & control	Satisfaction of being able to control one's energy consumption and energy bill
Satisfaction & pride	Satisfaction of helping to reduce environmental impacts (e.g., key reason why residential customers install rooftop PV)
Power/ Quality	Refers to the ability of electrical equipment to consume the energy being supplied to it e.g., improved electrical harmonics, power factor, voltage instability and efficiency of equipment.
DER Integration	The ability to add current and future DERs to the existing electric energy grid.
Reduced Utility Bills	Only relevant if using a <i>Participant Cost Test</i>

# Societal Impacts

*(Inclusion depends on policy goals)*

Type	Societal Impact	Description
Societal	Resilience	Resilience impacts beyond those experienced by utilities or host customers
	GHG Emissions	GHG emissions created by fossil-fueled energy resources
	Other Environmental	Other air emissions, solid waste, land, water, and other environmental impacts
	Economic and Jobs	Incremental economic development and job impacts
	Public Health	Health impacts, medical costs, and productivity affected by health
	Low Income/Vulnerable Populations: Society	Poverty alleviation, environmental justice, reduced home foreclosures, etc.
	Energy Security	Energy imports and energy independence

# DER Utility System Impacts

Impact can be a benefit or cost or will 'depend' on key 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

# DER Host Customer Impacts

*Impact can be a benefit or cost or will ‘depend’ on key factors*

Type	Host Customer Impact	EE	DR	DG	Storage	Electrification
Host Customer	Host portion of DER costs	●	●	●	●	●
	Interconnection fees	○	○	●	●	○
	Risk	●	○	●	●	●
	Reliability	●	●	●	●	●
	Resilience	●	●	●	●	●
	Tax Incentives	●	●	●	●	●
	Host Customer NEIs	●	●	●	●	●
	Low-income NEIs	●	●	●	●	●

● = typically a benefit for this resource type; ● = typically a cost for this resource type; ● = either a benefit or cost for this resource type, depending upon the application of the resource; ○ = not relevant for this resource type

# DER Societal Impacts

*Impact can be a benefit or cost or will 'depend' on key factors*

Type	Societal Impact	EE	DR	DG	Storage	Electrification
<b>Societal</b>	Resilience	●	●	●	●	●
	GHG Emissions	●	●	●	●	●
	Other Environmental	●	●	●	●	●
	Economic and Jobs	●	●	●	●	●
	Public Health	●	●	●	●	●
	Low Income: Society	●	●	●	●	●
	Energy Security	●	●	●	●	●

● = typically a benefit for this resource type; ● = typically a cost for this resource type; ● = either a benefit or cost for this resource type, depending upon the application of the resource; ○ = not relevant for this resource type

# Key Factors that Affect DER Impacts

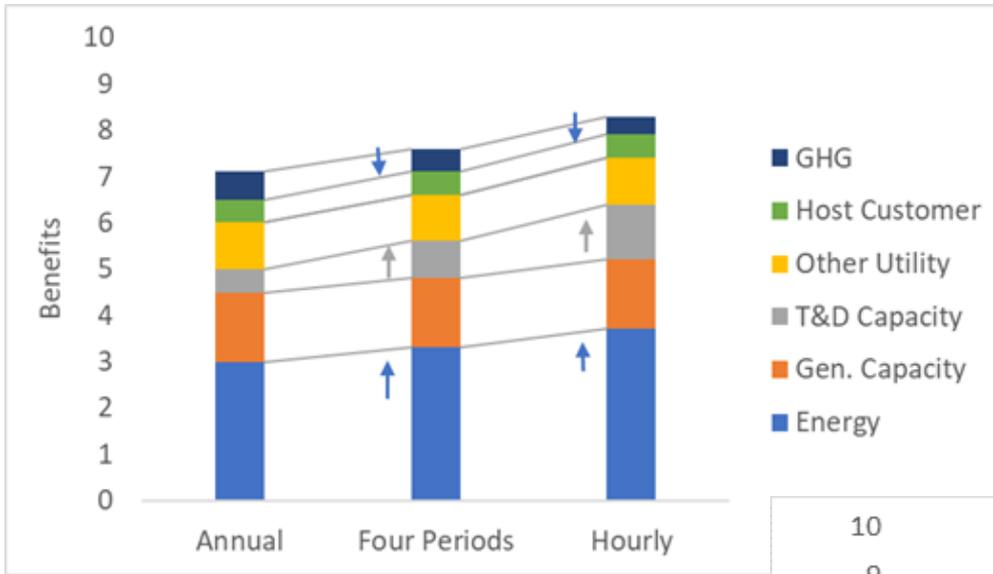
*Depends on specific DERs and use cases:*

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

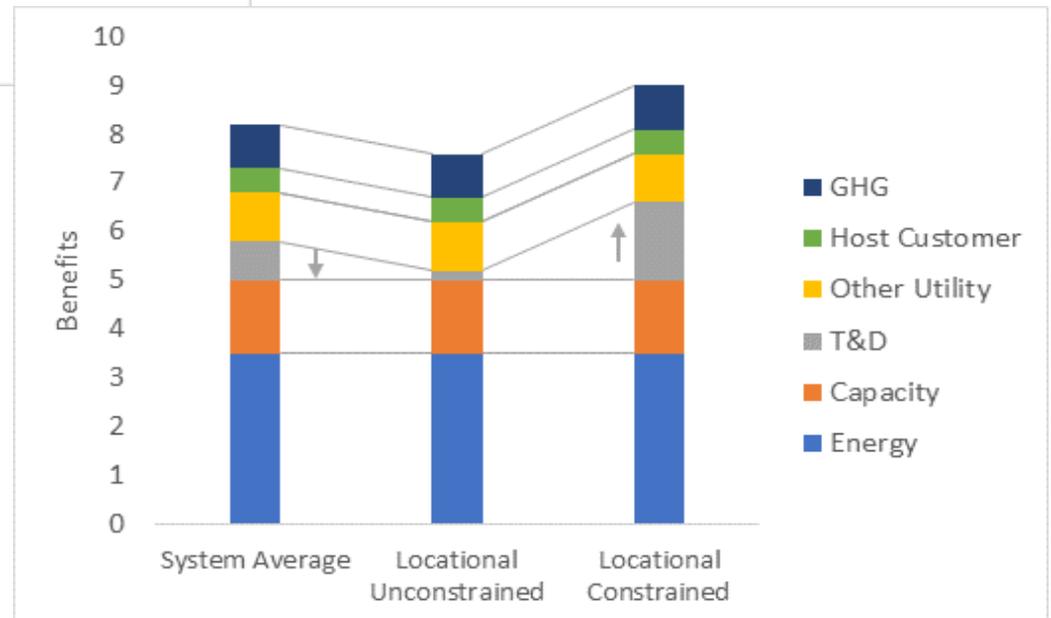
## Cross-Cutting Considerations

- 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



## **NSPM for DERs – PART III**

### **Guidance on BCA for Specific DER Technologies**

# NSPM for DERs

## DER-Specific Chapters

- Energy Efficiency Resources
- Demand Response Resources
- Distributed Generation Resources
- Distributed Storage Resources
- Electrification

Each chapter covers:

- Benefits and costs of the specific resource
  - Utility System
  - Host Customer (if relevant to jurisdiction's goals per NSPM principles)
  - Societal (if relevant to jurisdiction's goals per NSPM principles)
- Key factors that affect impacts
- Common challenges in estimating benefits and costs

# Energy Efficiency Utility System Impacts

- = typically a benefit for this resource type;
- = typically a cost for this resource type;
- = either a benefit or cost for this resource type, depending upon the application or use case of the resource;
- = not relevant for this resource type.

[Similar tables for host customer and societal impacts]

Type	Utility System Impact	Benefit or Cost	Notes/Typical Applicability
Generation	Energy Generation	●	Always a benefit because EE reduces electricity generation
	Generation Capacity	●	A benefit because EE can reduce generation peaks; exceptions are EE measures that do not reduce system capacity requirements
	Environmental Compliance	●	A benefit because EE reduces electricity generation
	RPS/CES Compliance	●	Always a benefit because EE reduces electricity sales
	Market Price Response	●	Always a benefit in jurisdictions with wholesale energy and/or capacity markets
	Ancillary Services	●	Can be a modest benefit
Transmission	Transmission Capacity	●	A benefit because EE can reduce transmission peaks; same exceptions as for generation capacity
	Transmission Line Losses	●	Always a benefit because EE reduces transmission volumes
Distribution	Distribution Capacity	●	A benefit because EE can reduce distribution peaks; same exceptions as for generation capacity
	Distribution Line Losses	●	Always a benefit because EE reduces distribution volumes
	Distribution O&M	●	Always a benefit because EE reduces distribution volumes
	Distribution Voltage	●	A benefit for conservation voltage regulation programs
General	Financial Incentives	●	Always a cost, where relevant
	Program Administration Costs	●	
	Utility Performance Incentives	●	
	Credit and Collection	●	A benefit because customer savings make bill payment easier, especially for low-income programs
	Risk	●	Always a net benefit because EE is lower risk than supply-side resources
	Reliability	●	A benefit (if not already captured in avoided generation and/or avoided T&D categories)
	Resilience	●	A benefit where relevant – e.g. when large portions of a system need reconstruction, a history of efficiency investments reduces amount of capacity that requires reconstruction

# Energy Efficiency Chapter

## Example: Key BCA Considerations

- EE resources include technologies, services, measures, or programs that reduce end-use energy consumption by host customers.
- The temporal and locational benefits of EE can vary considerably across seasons and during different hours of the day, and as well as by the physical location on the energy distribution network.
- Some electric EE resources will reduce other fuel consumption resulting in other fuel benefits, and others will increase other fuel consumption resulting in other fuel costs.
- EE resources can offer significant reductions in air emissions. As with all DERs, estimates of air emission impacts should account for the time period when the EE resource operates and the marginal emission rates of the utility system at that time.
- Addressing the impacts of EE resources throughout their full effective useful life requires properly defining counterfactual (baseline) conditions for both savings and costs, particularly with respect to early-replacement projects.
- EE resources will typically create lost revenues which may lead to increased rates, depending upon the magnitude of: lost revenues, utility system costs, and utility system benefits. Rate impacts should not be included in BCAs, but should instead be accounted for in rate, bill, and participation analyses.

# Distributed Storage Example - Chapter Contents

## Headings

Pages

Results

- ▲ 9. Distributed Storage Resources
  - 9.1 Summary of Key Points
  - 9.2 Introduction
  - 9.3 Benefits and Costs of Distributed Storage Resources
- ▲ 9.4 Key Factors that Affect Distributed Storage Impacts
  - 9.4.1 Technology Characteristics
  - 9.4.2 Technology Operating Profile
  - 9.4.3 Other Fuel Impacts
  - 9.4.4 Host Customer Non-Energy Impacts
  - 9.4.5 Air Emissions Impacts
  - ▷ 9.4.6 Interconnection Location and Process
  - ▷ 9.4.7 Compensation Mechanisms
  - 9.4.8 Resource Ownership and Control
- ▲ 9.5 Common Challenges for Determining Storage Benefits and Costs
  - 9.5.1 Determining the Operating Profile
  - 9.5.2 Determining the Counterfactual Host Customer Baseline
  - 9.5.3 Accounting for Provision of Multiple Services
- 9.6 Lost Revenues and Rate Impacts

# Distributed Storage Utility System Impacts

- = typically a benefit for this resource type;
- = typically a cost for this resource type;
- = either a benefit or cost for this resource type, depending upon the application or use case of the resource;
- = not relevant for this resource type.

[Similar tables for host customer and societal impacts]

Type	Utility System Impact	Benefit or Cost	Notes, or Typical Applicability
Generation	Energy Generation	●	A cost because storage technologies generally require more energy to charge than what they discharge
	Generation Capacity	●	A benefit, depending upon the storage use case and the electric utility's ability to affect the operation of the storage device; otherwise, a cost if storage device charges during peak periods
	Environmental Compliance	●	A benefit or cost depending upon system environmental profile during charging and discharging times
	RPS/CES Compliance	●	A cost because storage technologies generally require more energy to charge than what they discharge
	Market Price Response	●	A benefit or cost depending upon market conditions during charging and discharging times
	Ancillary Services	●	A benefit or cost depending upon the storage use case and the electric utility's ability to affect the operation of the storage device
Transmission	Transmission Capacity	●	Potentially benefits depending upon the storage use case and the electric utility's ability to affect the operation of the storage device; otherwise, potentially costs if storage device charges during transmission peak periods
	Transmission Line Losses	●	
Distribution	Distribution Capacity	●	Potentially benefits depending upon the storage use case and the electric utility's ability to affect the operation of the storage device; otherwise, potentially costs if storage device charges during distribution peak periods
	Distribution Line Losses	●	
	Distribution O&M	●	
	Distribution Voltage	●	
General	Financial Incentives	●	Typically costs to the extent they are relevant
	Program Administration Costs	●	
	Utility Performance Incentives	●	
	Credit and Collection Costs	●	A benefit because customer savings make bill payment easier, especially for low-income customers
	Risk	●	Potentially benefits depending upon the storage use case and the electric utility's ability to affect the operation of the storage technology during peak or emergency periods
	Reliability	●	
	Resilience	●	

## **NSPM for DERs – PART IV**

### **Guidance on BCA for Multiple DERs**

# NSPM for DERs

## Multi-DER Chapters

### Chapters:

- Multiple on-site DER types – such as grid-integrated efficient buildings (GEBs)
- Non-wires solutions (NWS) - Multiple DER types in a specific geographic location
- System-wide DER Portfolios multiple DER types across a utility service territory
- Dynamic system planning practices that can be used to optimize DERs and alternative resources (IGP, IDP, IRP)

### Content in each Chapter:

- Summary of key points
- Description of how the multiple DER types might be used together
- Discussion of key factors in determining benefits and costs for each approach
- Guidance on how to address common challenges in determining benefits and costs in multi-DER use cases
- Case studies (not all chapters)

# BCA for Multiple On-site DERs

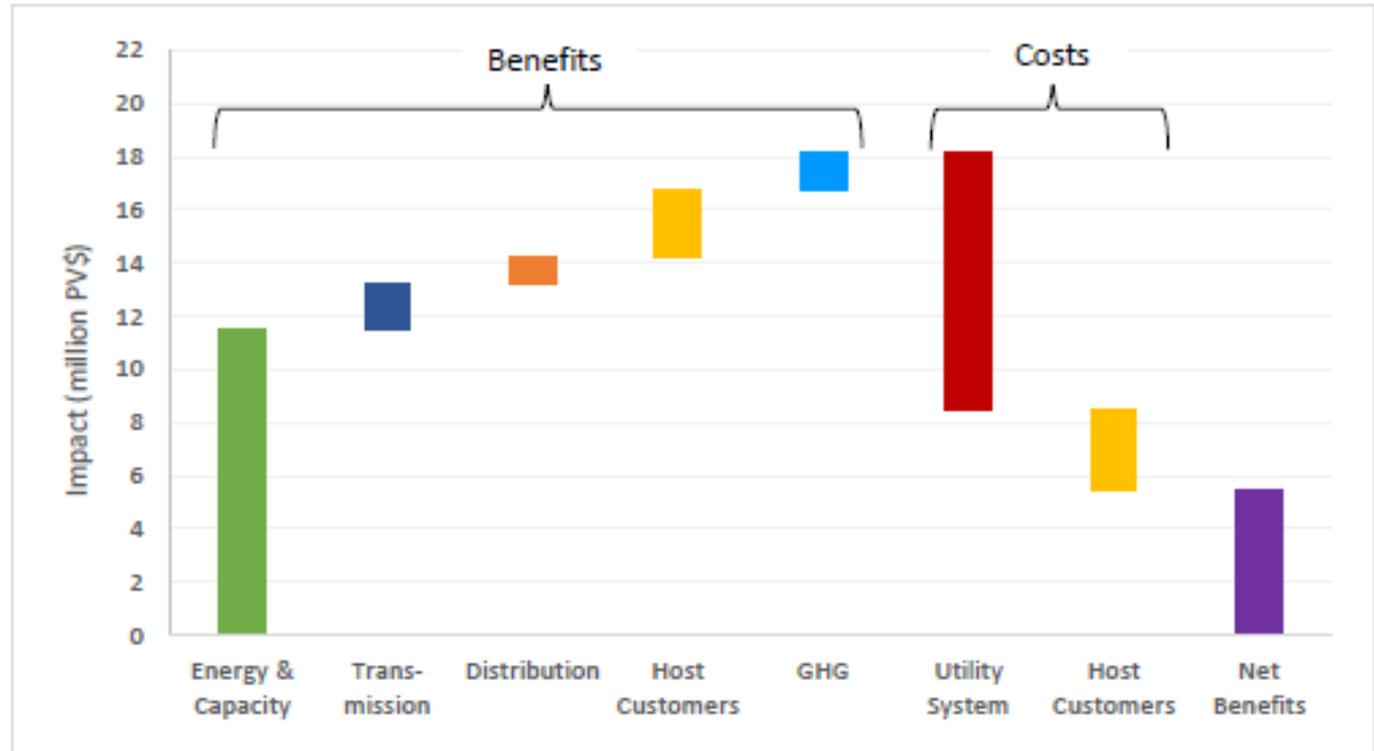
- Multiple on-site DERs span residential, commercial, and community levels, including buildings, facilities, campuses, etc.
  - Emerging focus: grid-interactive efficient buildings (GEBs), also relevant to microgrids and smart communities/neighborhoods.
- Factors that affect BCA of multiple on-site DERs: types of DERs deployed and their capabilities, specific locational and temporal impacts, who owns/operates DERs, interactive effects between DERs.
- Major types of interactive effects:
  - Impact on marginal system costs, where significant penetration of DERs in one area affects avoided costs of other DERs in that same area
  - Energy and capacity, where one DER affects kWh or kW impacts of other DERs e.g., EE measure lowers host customer load but also reduces DR kW potential
  - Enabling effects, where one DER makes it easier or more cost-effective to adopt other DERs - e.g., combined solar plus storage, where adding storage to solar project can help firm up PV output profile and store any excess generation for later discharge.

# Multiple On-site DERs

## Case Study: Commercial Grid-Interactive Efficient Building (GEB)

Assumes utility program leverages commercial GEBs to provide demand flexibility and integrate clean resources during system peak hours to meet the jurisdiction's GHG emissions reduction goal.

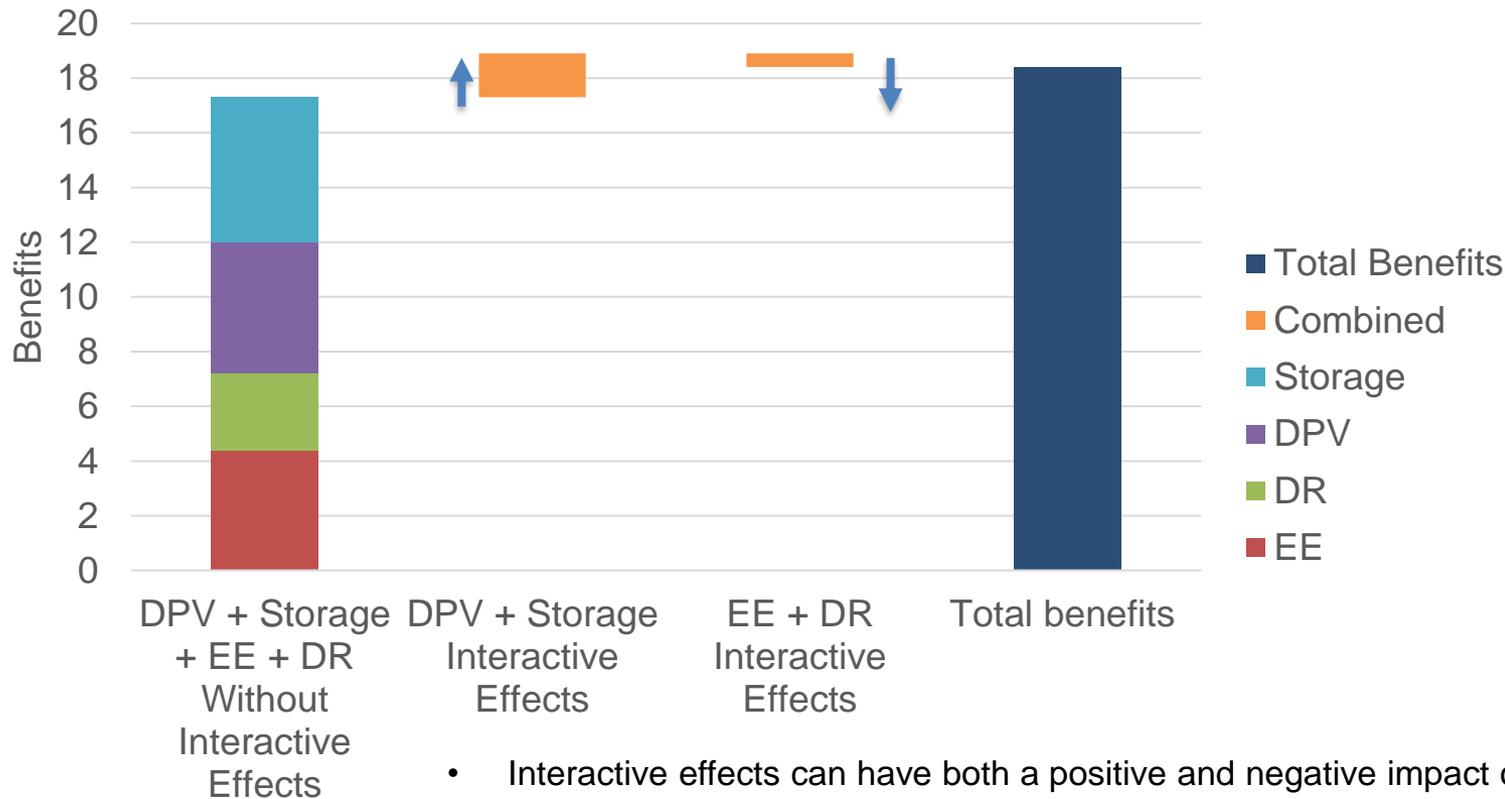
GEB program uses EE, DR, DPV and DS.



- Distribution system peak is non-coincident with the overall system peak.
- Most benefits for GEB program center on energy and capacity benefits, since GEBs operate during overall system peak.
- GHG benefits also captured, since that impact is included in the Jurisdiction-Specific Test.

# 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.

# Non-Wires Solutions

## BCA Considerations and Challenges

### Considerations

- Geo-targeting of DERs in high-value location
- Characteristics of traditional infrastructure project (type, timing, etc.)
- NWS technology characteristics
- Impacts beyond the targeted T&D deferral

### Challenges

- Deriving granular locational and temporal values
- Accounting for option value
- Interactive effects between DERs
- Evaluating and measuring NWS impacts
- Accounting for system reliability and risk

The assessment of NWS cost-effectiveness depends on **where** the program or DERs are located, **when** they provide services, and the resulting benefits and costs.

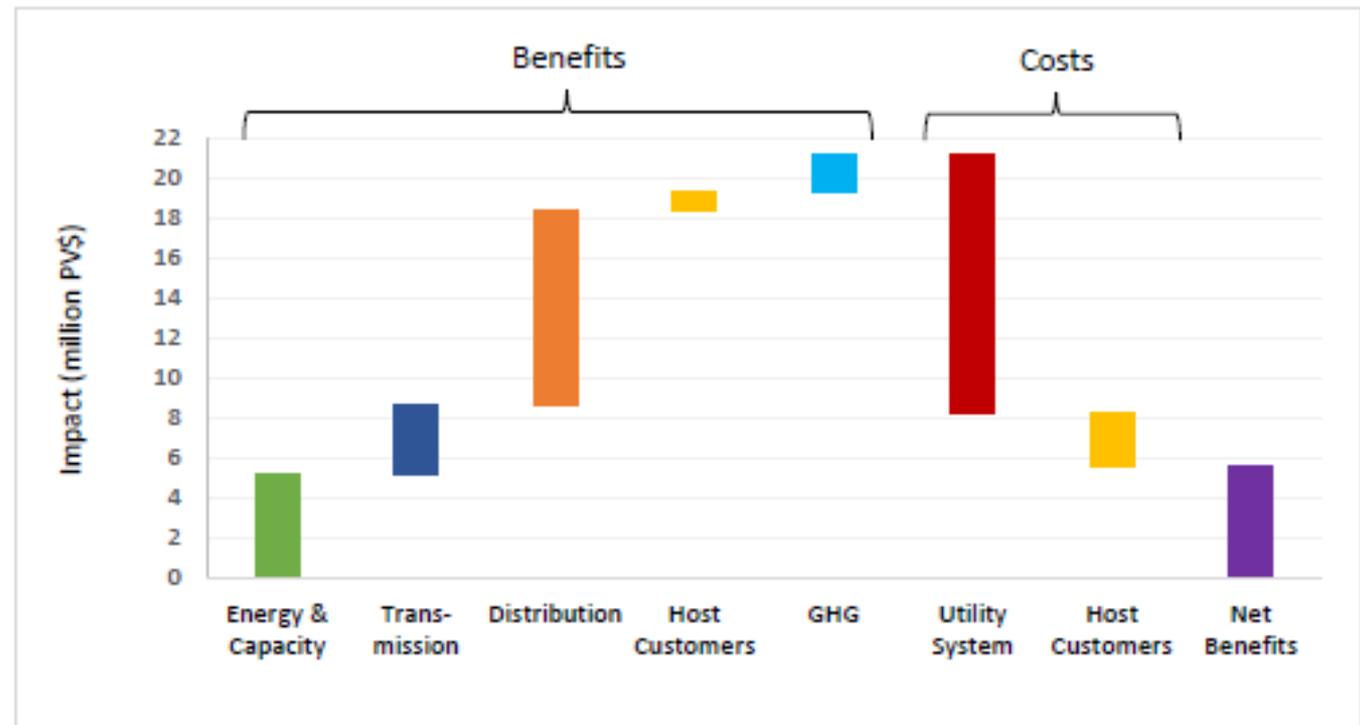
# Non-Wires Solutions

## Case Study – NWS Distribution Need

DERs: EE lighting and controls; DR Wi-Fi-enabled thermostats; DPV; and DS (thermal and battery storage)

- Assumes non-coincident with overall system peak (e.g., constrained distribution feeder peaks at 1-5pm, while system peaks at 5-9pm)
- Assumes system-peak hours entail higher marginal emissions rates than NWS = delivers GHG benefits.
- Assumes DER operating profiles where:

- Storage charges and discharges during system off-peak hours
- DR reduces and shifts load during system off-peak hours
- Solar contributes to distribution and some system-peak needs
- EE has a general downward trajectory on usage



# System-Wide DER Portfolios

How should any one utility optimize all DER types?

- What to do in the absence of integrated distribution system planning?

Ideally, each jurisdiction should use a single primary BCA test for all DER types

- May require reconciling different policy goals for different DER types

Then, the jurisdiction should identify planning objectives such as:

- Implement the most cost-effective DERs
- Encourage a diverse range of DER technologies
- Encourage customer equity
- Achieve GHG goals at lowest cost
- Avoid unreasonable rate impacts
- Implement all cost-effective DERs
- Achieve multiple planning objectives

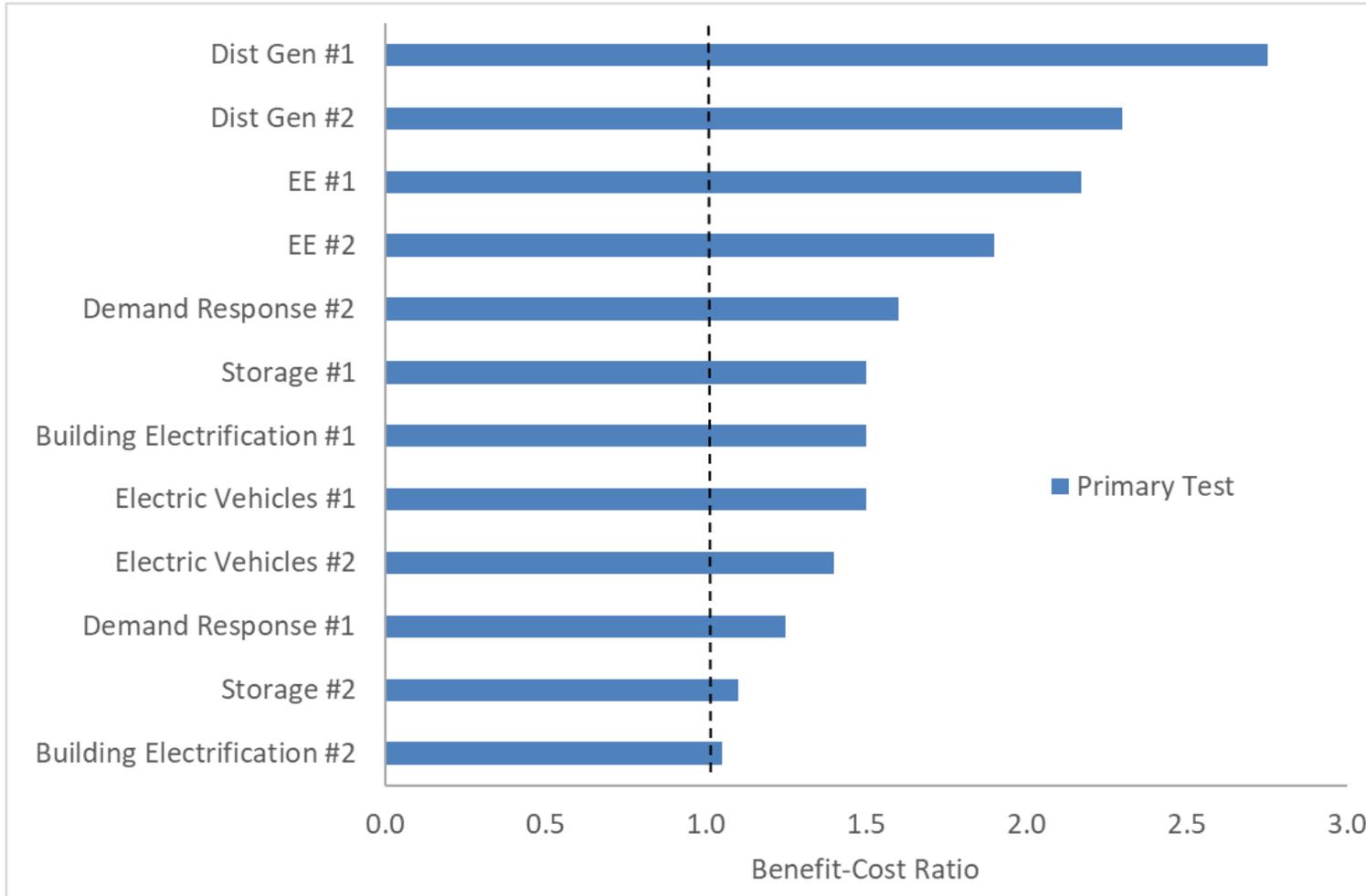
# Prioritizing Across DERs

Consider:

- 1. Should the utility implement all these DERs?*
- 2. If not, which DERs should be maintained, and which should be rejected?*
- 3. How to ensure that key policy goals are being met?*
- 4. How to ensure that customers are not paying too much for policy goals?*
- 5. How to ensure that any rate impacts are reasonable?*

# Example of Prioritizing DERs (1)

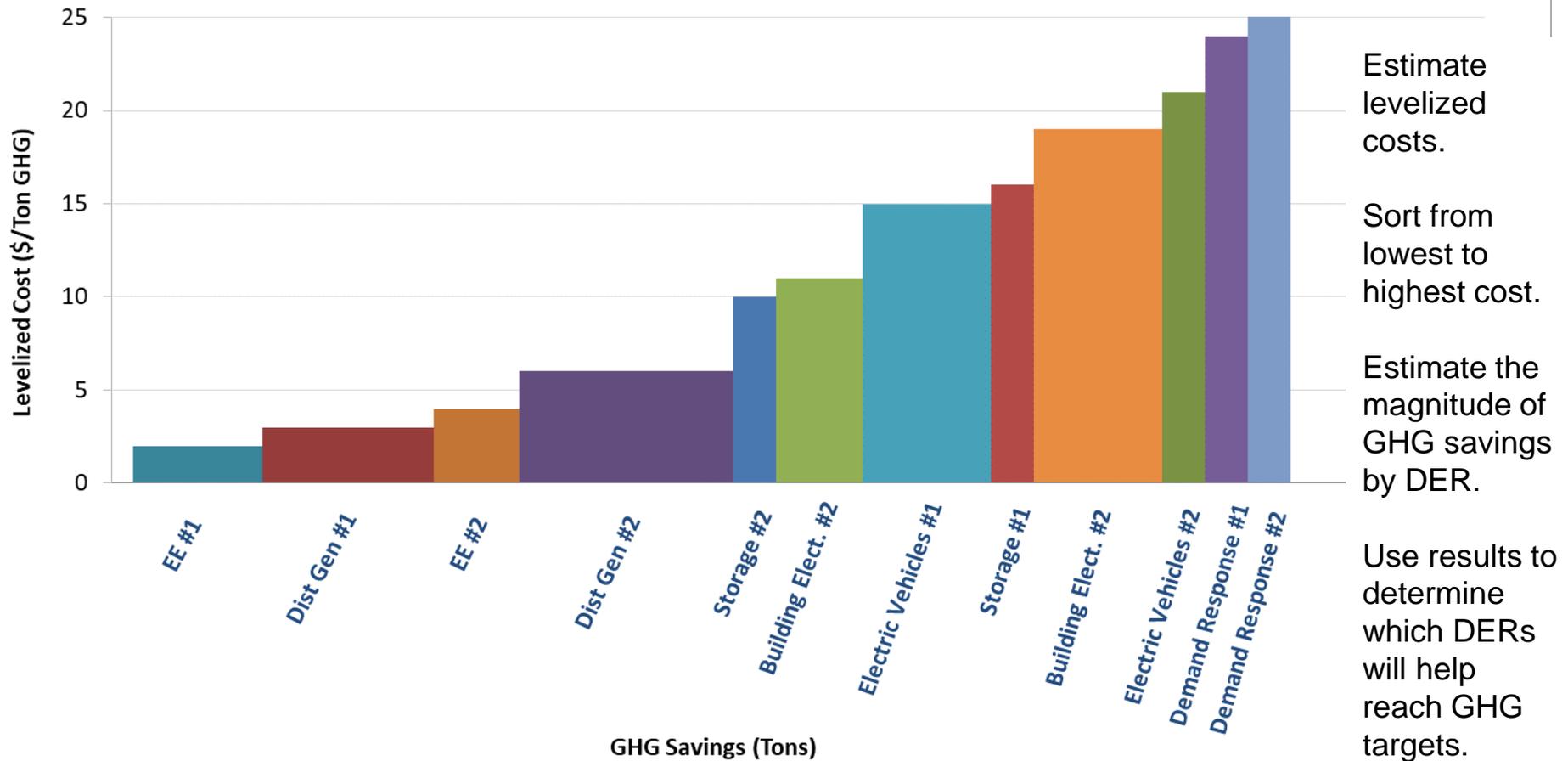
Objective: to implement the most cost-effective DERs



Sort by benefit-cost ratio and pick those DERs with the highest ratios

# Example of Prioritizing DERs (2)

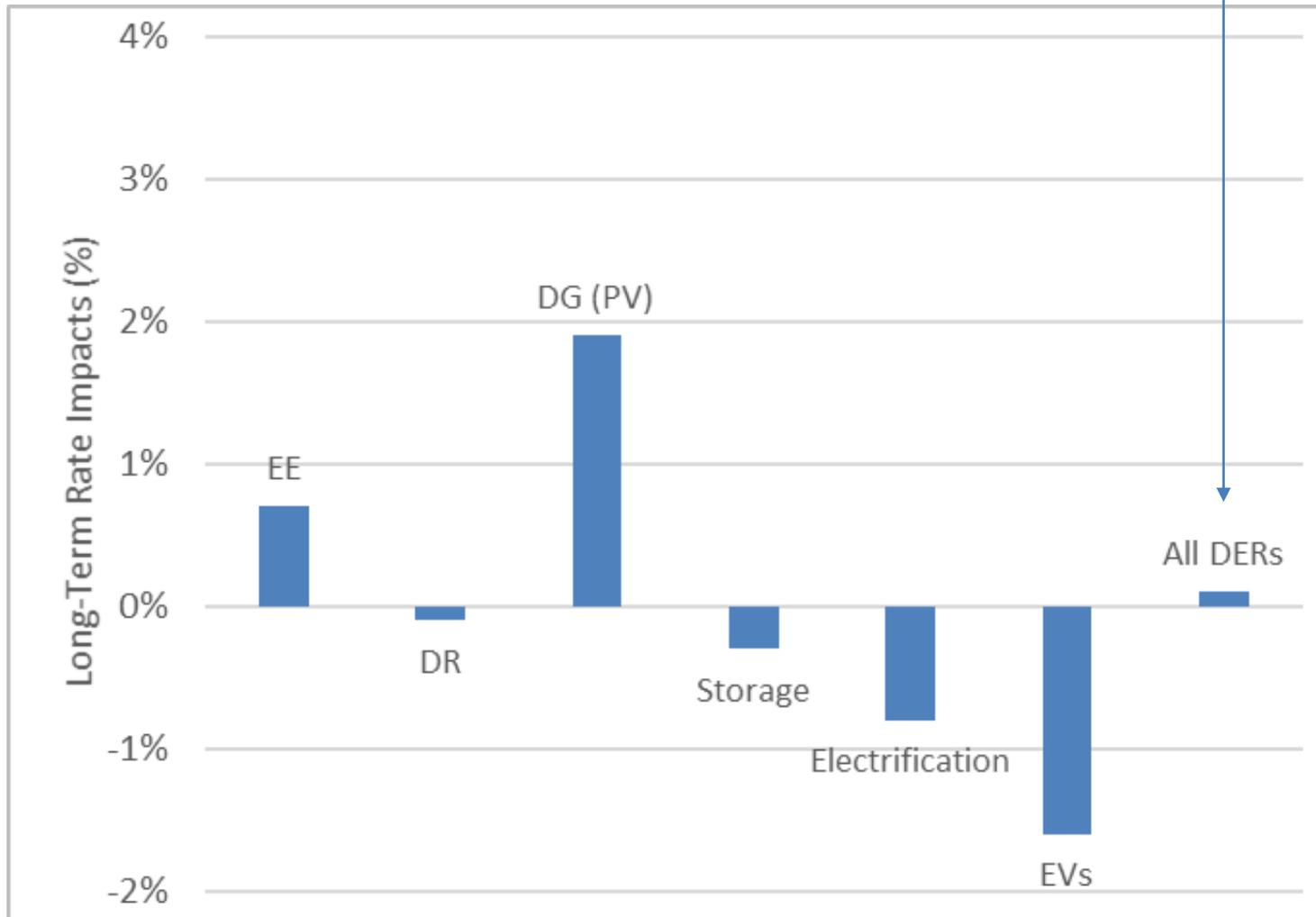
Objective: to achieve GHG goals at lowest cost



# Example of Prioritizing DERs (3)

## Objective: Avoid unreasonable rate impacts

Rate impact analyses should account for combined effect of all DER types



# Dynamic System Planning

- The scope of utility system planning is expanding to manage the increasing complexity of the electricity system, while addressing evolving state policy objectives, changing customer priorities, and increased DER deployment.
- Dynamic system planning involves assessing *multiple DER types* relative to a *dynamic set* of alternative resources, with goal of optimizing DERs and utility-scale resources
- Each of these types of planning practices **uses some form of BCA** for comparing and optimizing different resources.

Type of Utility System	Planning Practice	Planning Practice Accounts for:			
		Distribution System	DERs	Transmission System	Utility-Scale Generation
Distribution-only & vertically-integrated	Traditional distribution planning	✓	-	-	-
	Integrated distribution planning	✓	✓	-	-
Vertically-integrated	Transmission planning	-	-	✓	-
	Integrated resource planning	-	✓	-	✓
	Integrated grid planning	✓	✓	✓	✓

# NSPM for DER - 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

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

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

***Questions?***

Contact [NSPM@nationalenergyscreeningproject.org](mailto:NSPM@nationalenergyscreeningproject.org)