Benefit-Cost Analysis of Distributed Energy Resources

DOE Energy Innovator Fellows Boot Camp

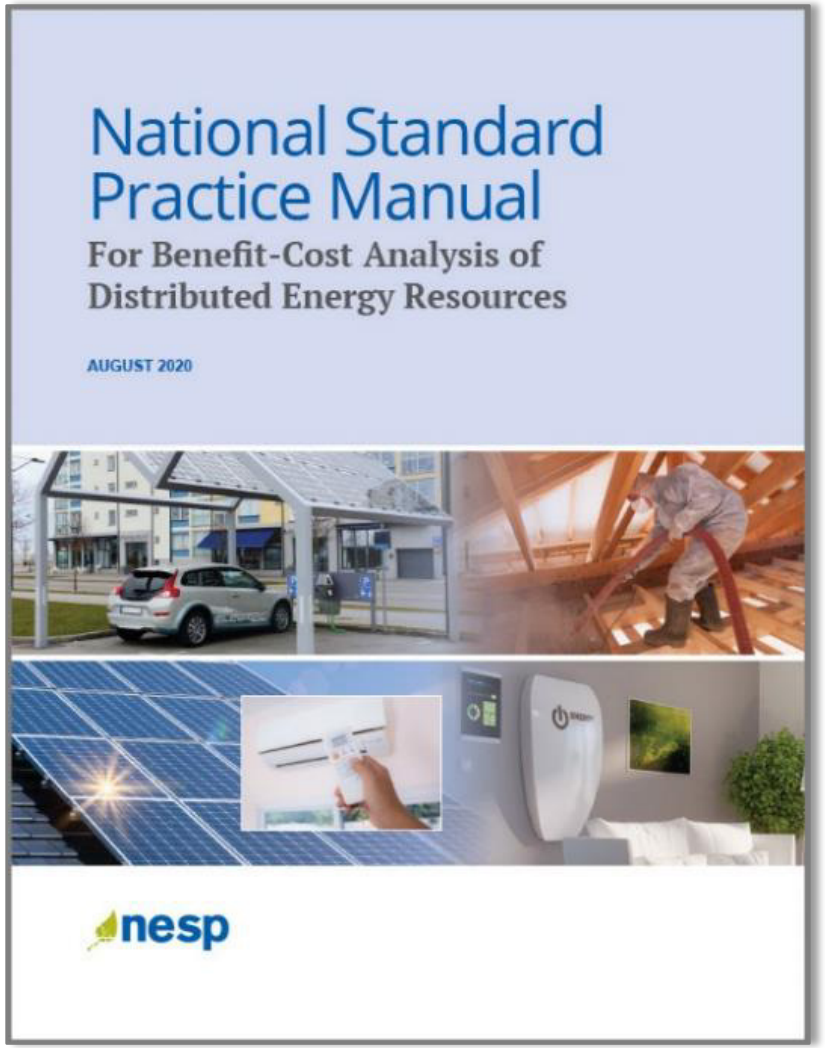
Steve Schiller, Berkeley Lab affiliate

October 8, 2025

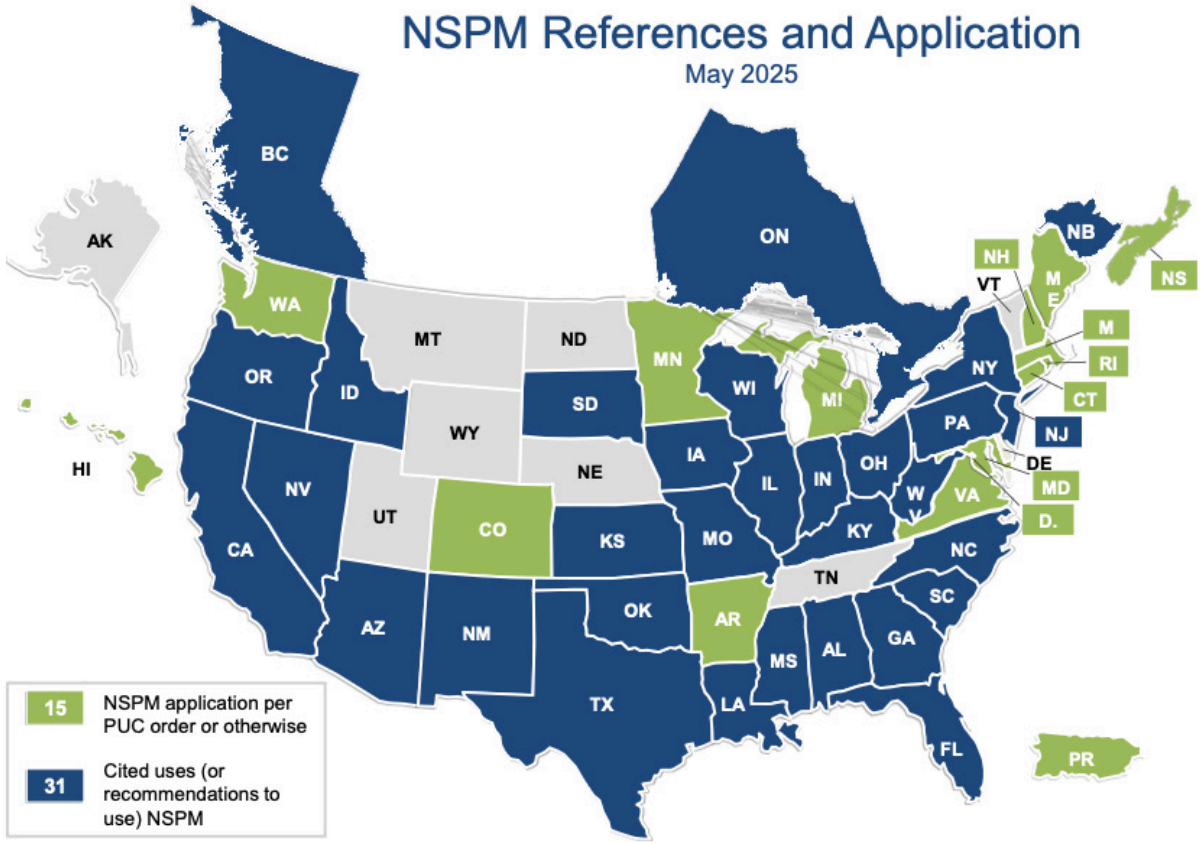
This work was funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, under Contract No. DE-AC02-05CH11231.

Acknowledgments

- Material in this presentation is from a professional certification training course developed by the National Efficiency Screening Project (NESP™).
- The certification is associated with the use of the National Standard Practice Manual (NSPM).
- The U.S. Department of Energy and Berkeley Lab supported development of the NESP materials. Steve Schiller is one of the co-authors of the NSPM and trainers for the NSPM certification course.



The NSPM Is Becoming the Primary Guidance Resource for DER Benefit-Cost Analyses in the U.S.



NESP™ provides a range of resources and services to improve cost-effectiveness screening practices for DERs.

- **National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources**
  - Current version is 2020, 2025 version forthcoming
  - Builds on traditional tests defined in the 2001 California Standard Practice Manual
- Other NESP™ resources
  - Methods, Tools and Resources: A Handbook for Quantifying DER Impacts for Benefit-Cost Analysis
  - Database of Screening Practices – details on state BCA practices for energy efficiency
  - See NESP website for additional resources
- NESP provides technical assistance to states in applying the NSPM in different regulatory contexts – examples available at State NSPM Case Studies

Definitions

Benefit-Cost Analysis (BCA)

A systematic approach for assessing the cost-effectiveness of investments by *comparing the benefits and costs of alternative options*

- One option ***without*** the proposed investment ("baseline" or "reference" case) and one or more options ***with*** the proposed investment ("DER" case(s))
- **Over the life** of proposed investment

As compared to what? The fundamental question of BCAs (and life)

Benefit-Cost Test

- Typically, a single indicator that compares costs and benefits
- Expressed as:
  - **Benefit-Cost Ratio (BCR)**

$$\text{Benefit-Cost Ratio} = \frac{\text{NPV of benefits (dollars)}}{\text{NPV of costs (dollars)}}$$

  - **Net Present Value (NPV) –** Depending on the discount rate, greater value is placed on benefits and costs in earlier or later years

Another BCA Approach Is Integrated Resource Planning

- **Integrated Resource Planning (IRP) processes involve dynamically optimizing costs, performance, and other attributes of all resource options using:**
  - Optimization models, scenario analyses, and sensitivity/scenario analyses
  - Significant data collection and analysis efforts
  - Potentially integrated analyses that incorporate elements of distribution system planning and integrated electric/gas planning
- **BCA tests and IRP practices have some common and unique attributes**
  - Both focus on the long-term and can use similar inputs for future costs of resources
  - IRPs allow for more sophisticated analyses
  - **Big difference:** BCA uses fixed avoided cost assumptions, usually allowing for more granular analysis of DER programs, program designs, and specific types of DERs

BCAs Reflect a Perspective

- BCAs look at investments from one or more perspectives, or points of view
- Perspectives related to DER BCAs include:
  - Program participant (energy consumer)
  - Utility (gas, electric, both)
  - Investor, contractor, manufacturer
  - Society or segment of society (community)
  - Regulator

Regulatory Perspective

Definition: The perspective of those that oversee resource investment choices

- Guided by energy and other applicable objectives
- "Regulator" refers broadly to any entity that oversees and guides DER analyses, including:
  - Governors and legislatures
  - Public utility commissions
  - Public utility and co-op boards
  - Tribes
  - Regional grid operators
  - Federal government

BCA Test for Regulatory Perspective

The NSPM sets forth principles and guidance on how to:

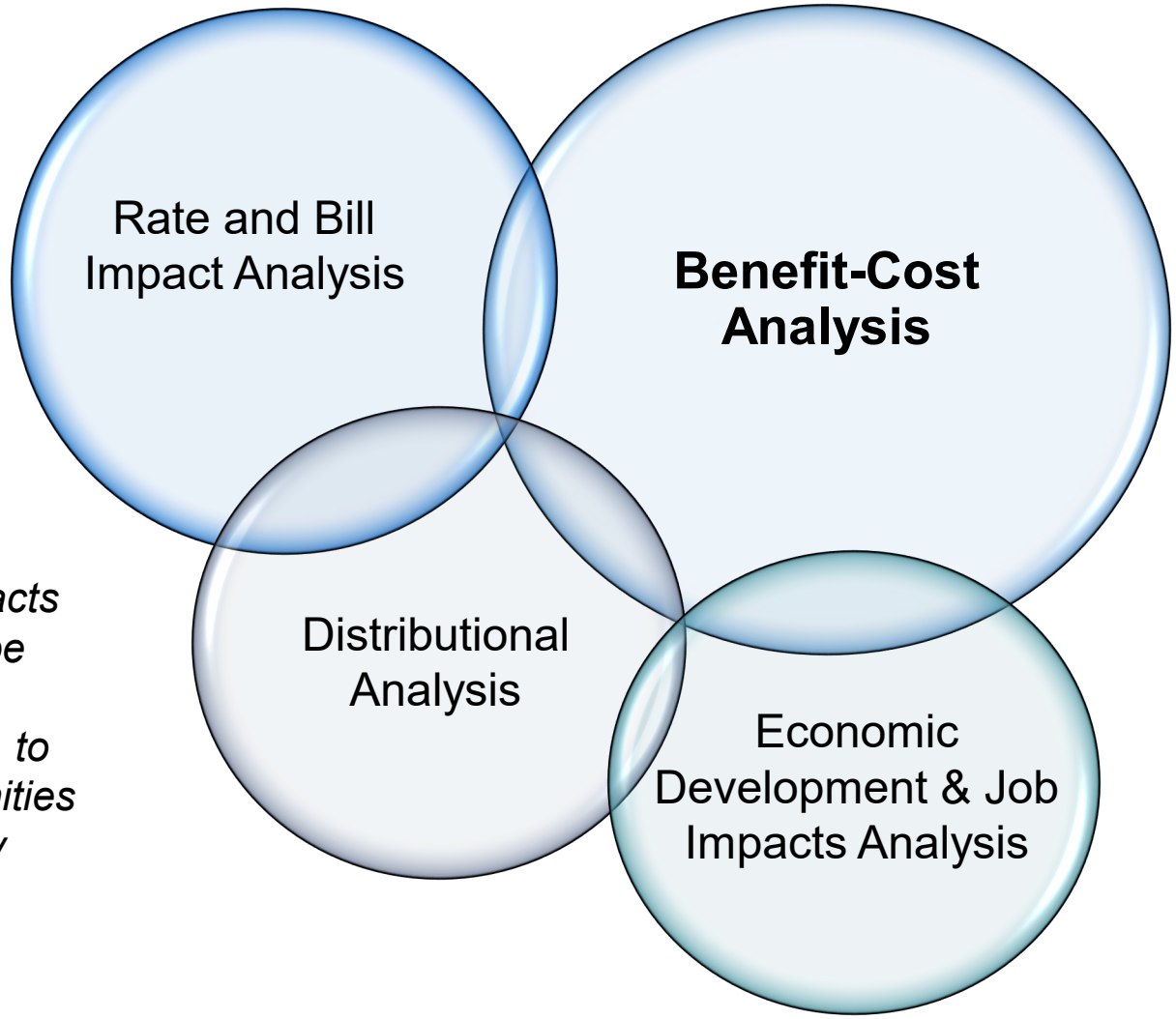
- Build a jurisdiction's own BCA test (or modify an existing test)
- One that is right for your perspective, i.e., your state's objectives (priorities)

Jurisdiction-Specific BCA Test (JST)

- The JST answers the question, **Will the cost of meeting utility system needs, *while achieving the jurisdiction's applicable objectives*, be reduced?**
- The JST may include secondary tests to help with assessing cost-effectiveness
- Additional tests also may inform DER investment decisions

Analyses That Can Complement BCA

Rate and Bill Impact Analysis: *Will rates go up or down (e.g., for all customers, participants or non-participants)?*



Benefit-Cost Analysis: *Will costs go up or down due to DER investment? BCAs indicate NPV of benefits or costs **on average** across utility customers.*

DA: *How will the impacts of DER investments be allocated to different customer groups e.g., to underserved communities **relative** to other utility customers?*

Economic Development Analysis: *Will local (state, regional, etc.) economies or specific economic indicators (e.g., jobs) improve or not due to DER investment?*

But First, Before We Get to Building a JST

Detour on Traditional Cost-Effectiveness Tests

Test	Perspective	Key Question Answered	Impacts Accounted For
Utility Cost	The utility system	Will utility system costs be reduced?	Includes the benefits and costs experienced by the utility system
Total Resource Cost	The utility system plus participating customers	Will utility system costs plus program participants' costs be reduced?	Includes the benefits and costs experienced by the utility system, plus benefits and costs to program participants
Societal Cost	Society as a whole	Will total costs to society be reduced?	Includes the benefits and costs experienced by society as a whole
Participant Cost	Customers who participate in a program	Will program participants' costs be reduced?	Includes the benefits and costs experienced by the customers who participate in the program
Rate Impact Measure	Impact on rates paid by all customers	Will utility rates be reduced?	Includes the benefits and costs that will affect utility rates, including utility system benefits and costs plus lost revenues

2020 NSPM, from 2001 California Standard Practice Manual

NSPM's Fundamental BCA Principles (1)

1. **Compare DERs with other energy resources and treat them consistently**.
2. Align cost-effectiveness test with jurisdiction's **applicable objectives.**
3. Ensure **symmetry** across costs and benefits.
4. Account for all **relevant, material impacts** even if hard to quantify.
5. Conduct **forward-looking, long-term analysis** that captures incremental impacts of DER.

Fundamental NSPM BCA Principles (2)

6. Avoid **double-counting** through clearly defined impacts.
7. Ensure **transparency** in presenting benefit-cost analysis and results.
8. Conduct **BCA separate from Rate Impact Analyses** as they answer different questions.

New principle being considered for 2025 NSPM version, to replace Principle #8:

Decision making may require complementary analyses of additional impacts that address other important questions or concerns.

Developing a JST– Applying the NSPM BCA Framework

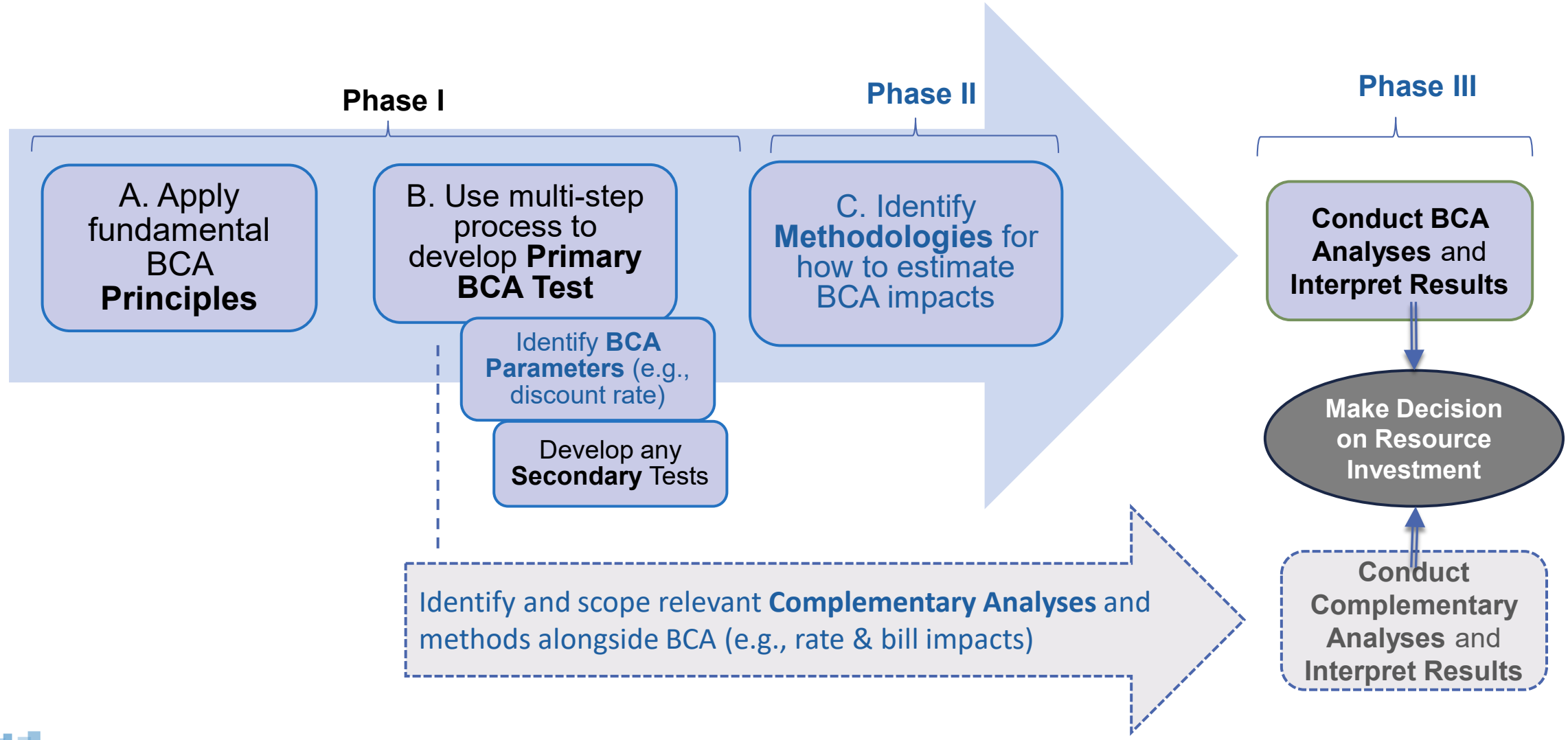
NSPM principles are applied in a manner that considers each jurisdiction's approach to energy resources. This can result in different JSTs for different jurisdictions.

The NSPM does not recommend any specific cost-effectiveness tests. Instead, it supports BCA practices that align with a jurisdiction's own goals and objectives.

The Primary Test answers the question: *Which resources have benefits that exceed costs and, therefore, merit potential acquisition or support?*

Secondary cost-effectiveness tests can be used to provide additional information, represent different perspectives, and answer other questions.

Investment Decision Framework: BCA + Other Analyses



Multi-step Process to Develop BCA Test(s) – JST

STEP 1: Articulate Jurisdiction's Applicable Goals and Objectives Related to DERs

STEP 2: Include All Utility System Impacts

STEP 3: Decide Which Non-Utility System Impacts to Include

- 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

- Benefits and costs are treated symmetrically
- Relevant and material impacts are included, even if they are hard to quantify
- Benefits and costs are not double-counted

STEP 5: Establish Comprehensive, Transparent Documentation

Other Considerations for Establishing BCA Tests

- **Sensitivity Analysis**
- **Updating Tests and Impact Values**
- **Geographic Boundary Considerations**
- Use of Secondary Tests
- Discount Rates
- Assessment Levels

Potential Uses of Secondary Tests

Primary BCA test is the "go-to" reference that informs whether a DER investment has benefits greater than costs.

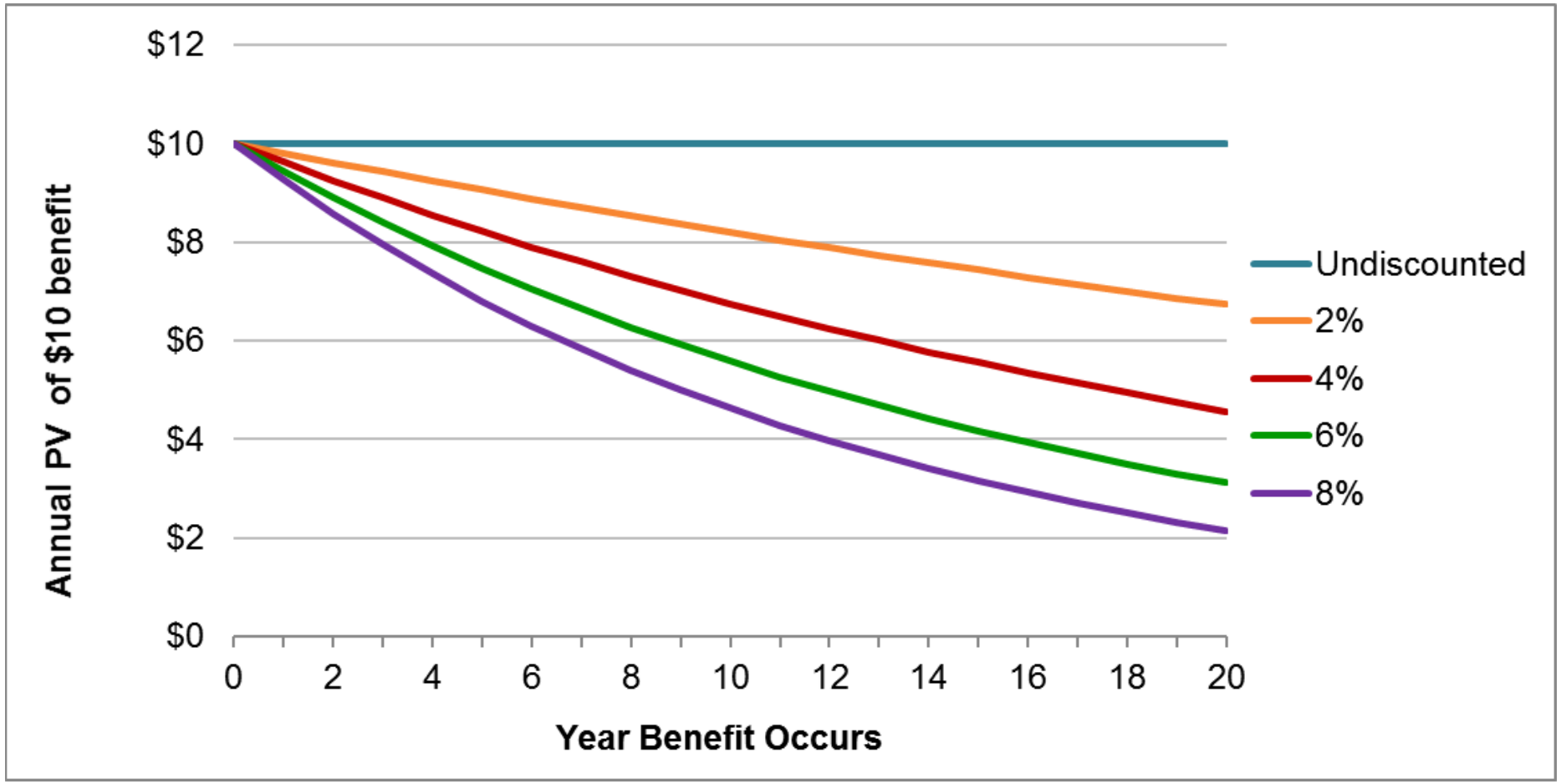
Secondary tests include categories of impacts excluded from the primary JST or vice versa.

Might include one or more of the traditional tests referenced in a prior slide

Secondary tests help inform decisions on:

- Whether to support marginally cost-effective DERs — for example:
  - DER has 0.95 BCR under JST, but much higher BCRs under secondary tests
  - DER has 1.05 BCR under JST, but much lower BCRs under secondary tests
- *How much* should be invested in DER initiatives? (Determining whether DERs merit investment is different than answering the question of how much)

Implications of Different Discount Rates



The higher the discount rate, the lower the value of future benefits and costs

BCA Assessment Level Approaches

(also referred to as “screening” levels)

- Measure level
- Project level
- Program level
- Sector level
- Portfolio level

There is value in assessing cost-effectiveness at all levels

The key question is the level at which an investment must be cost-effective to receive regulatory or utility approval (i.e., the level at which things should be “screened out”)

Example DER Electric Utility System Impacts:
Cost, Benefit, or "It Depends'"

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	●	●	●	●	●

Source: NSPM 2020

Each impact is described as a benefit, a cost, or either, depending on the most common applications or use cases for the applicable DER technology. There might be some less-common applications where a cost could be a benefit, or vice versa.

● = *typically a benefit*
● = *typically a cost*
● = *either a benefit or cost depending on application*

Example DER Host Customer and Societal Impacts: Cost, Benefit, or "It Depends"

Source: NSPM 2020

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	●	●	●	●	●

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

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

Chat Box Discussion

Are there goals and objectives in your jurisdiction that define which impacts to include in a DER BCA test? What are examples of host customer and societal impacts to include?

Example Host Customer Impacts

- Host portion of DER costs
- Host transaction costs
- Interconnection fees
- Reliability
- Resilience
- Financial incentives
- Host customer non-energy impacts (NEIs)
- NEIs for lower income customers

Example Societal Impacts

- Resilience to extreme weather events
- Air pollutant emissions
- Economic development and jobs
- Public health
- Energy affordability
- Energy security

Please add your thoughts in the chat box to share with other Fellows

Determining Values of Impacts to Include in BCA Tests

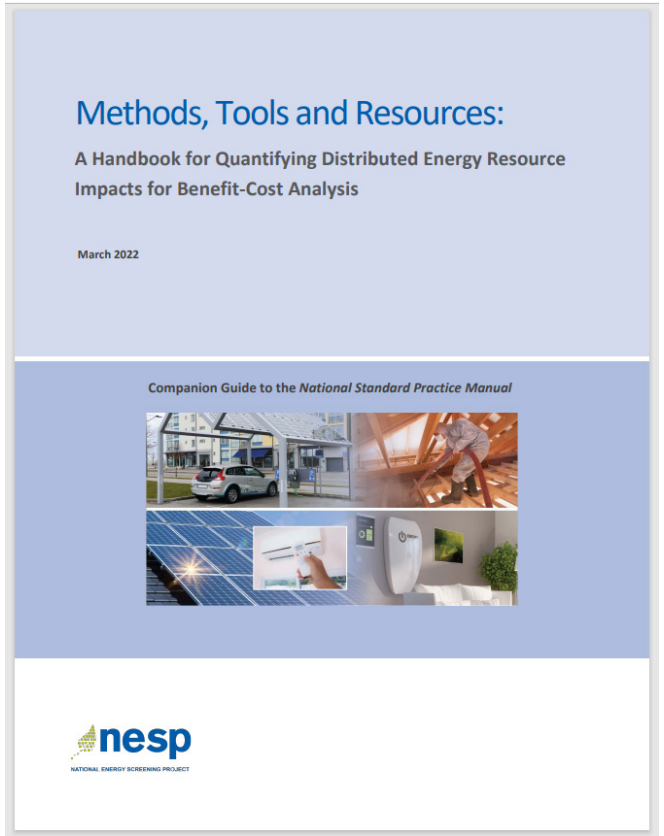
Magnitude of impacts can vary significantly across DERs and applications

Key factors that determine magnitude

- DER technology characteristics
- DER technology use case (i.e., operating profile)
- Resource ownership/control
- Temporal and locational impacts
- DER located behind-the-meter versus front-of-the-meter
- Interactive effects
- Average versus marginal values

Handbook for Quantifying DER Impacts – Methods, Tools and Resources

- NSPM provides guidance on ***what*** impacts to include in BCA tests
- MTR Handbook provides guidance on ***how to*** quantify or account for the impacts



Approaches to Developing Numerical Values for Impacts

Approach	Application
Jurisdiction-specific studies	Best approach for estimating and monetizing relevant impacts
Studies from other jurisdictions	Often reasonable to extrapolate from studies in other jurisdictions when local studies are not available
Proxies	If there are 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 be monetized

Summary of BCA for DER Programs

- BCA is a systematic approach for assessing the cost-effectiveness of investments by *comparing the benefits and costs of alternative options*
- BCA is not necessarily the only basis for DER investment decisions – complementary analyses can be useful
- BCAs reflect a perspective — e.g., jurisdiction, utility, consumer
- As a utility system resource, DER BCAs include all relevant and material utility system impacts
- BCAs can include other impacts (participant and societal) as dictated by relevant objectives
- Account for relevant and material impacts, even if they are hard to quantify
- The National Standard Practice Manual sets forth principles and guidance on how to build or modify your own BCA test
- Many other resources and examples can support BCA efforts

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Contacts

Steve Schiller: SRSchiller@lbl.gov
Lisa Schwartz: lcschwartz@lbl.gov

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Acknowledgements

This work was funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, under Contract No. DE-AC02-05CH11231.

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