Benefit-Cost Analysis for Grid-Interactive Efficient Buildings (GEBs) and Other Distributed Energy Resources (DERs)

Applying the National Standard Practice Manual for DERs

Presentation to NASEO-NARUC GEBs Working Group

Julie Michals – E4TheFuture
Kate Strickland – Smart Electric Power Alliance

May 4, 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 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/

NSPM Consulting Team & Partners

Consulting Team

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

Partners

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

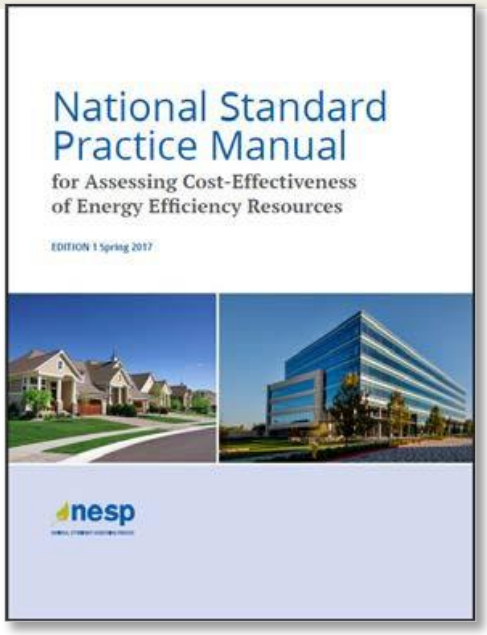
NESP Advisory Group – over 45 industry experts and representatives: https://www.nationalenergyscreeningproject.org/home/advisory-group/

Agenda Today

- NSPM for DERs – Background and Scope
- NSPM BCA Framework
- Guidance on BCA for GEBs and Illustrative Example
- 2021 Forthcoming NSPM Resources

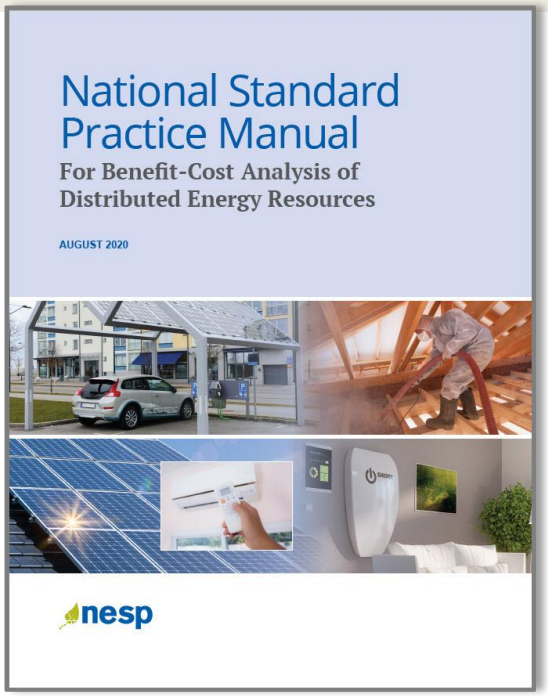
NSPM Background and Scope

NSPM for EE
May 2017



The NSPM for DERs incorporates and expands on the NSPM for EE. See comparison

NSPM for DERs
August 2020

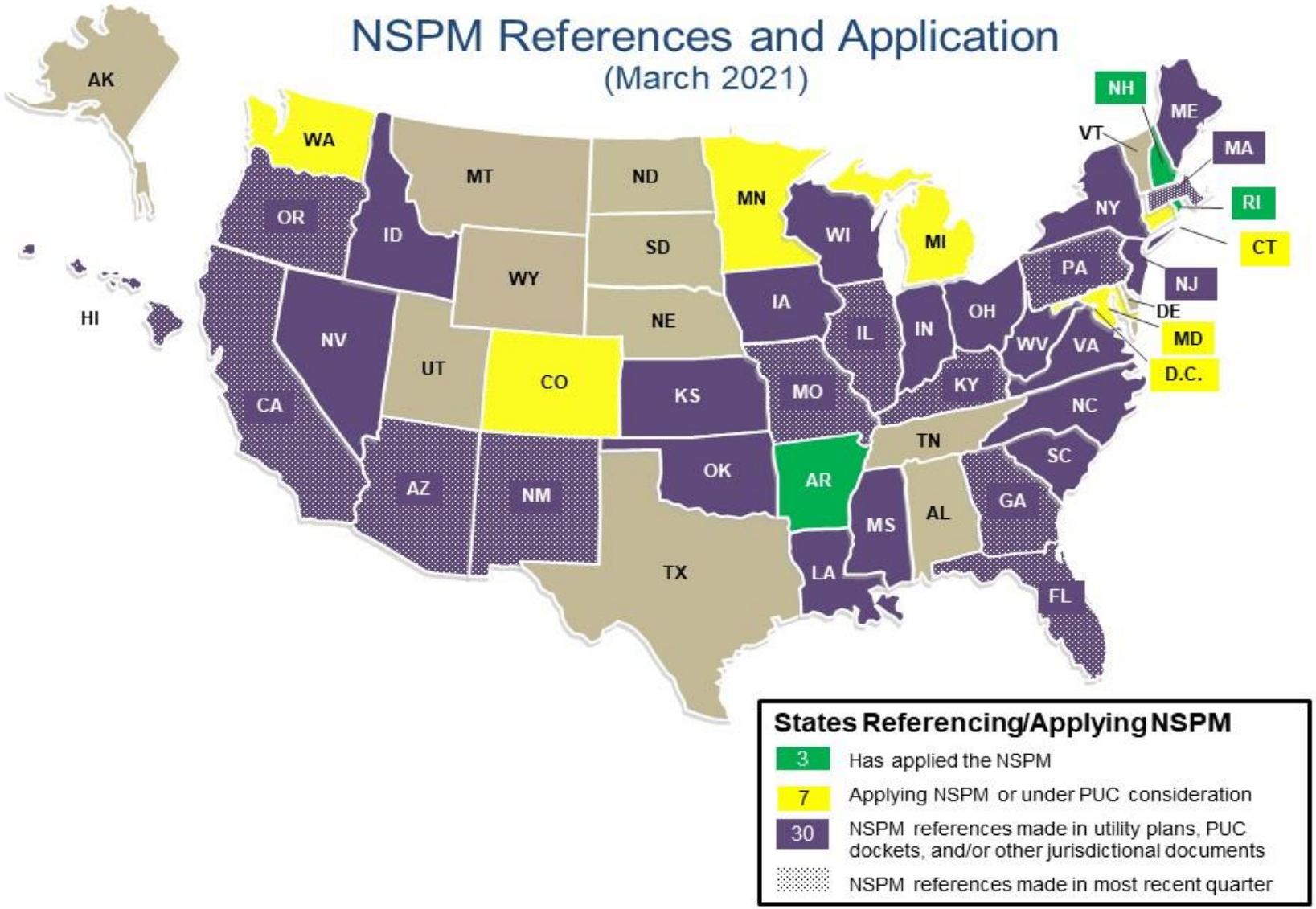


NSPM for DERs – Audience and Uses

Audience: All entities overseeing/guiding DER decision - PUCs, SEOs, utilities, DER reps, evaluators, consumer advocates, others

Purpose: Guidance for valuing DER opportunities to inform policies and strategies such as:

- Expanding EE/DR plans, strategies, and programs to broader set of DERs
- Evaluating and planning for non-wires/pipes solutions
- Incorporating DERs into distribution system planning
- Achieving jurisdictional policy goals and objectives, e.g.
  - Environmental and carbon emission reductions
  - Electrification goals, including in buildings and EVs
  - Economic development
  - Energy security
  - etc.


NSPM References and Application
(March 2021)
AK
HI
WA
OR
CA
ID
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AZ
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NE
KS
OK
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GA
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MA
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CT
NJ
DE
MD
D.C.
States Referencing/Applying NSPM
3 Has applied the NSPM
7 Applying NSPM or under PUC consideration
30 NSPM references made in utility plans, PUC dockets, and/or other jurisdictional documents
NSPM references made in most recent quarter

Polling Question #1

Generally, how familiar are you with cost-effectiveness tests or benefit-cost analysis of energy resource investments in states?

Polling Question #2

Generally, how familiar are you with the NSPM for DERs?

NSPM for DERs – TOC

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 Framework

NSPM provides a ‘process’ that jurisdictions can use to develop (or modify existing) CE testing practices for a range of DERs or some combination of them.

NSPM BCA Principles

1. Recognize that EE and other DERs can provide energy or power system needs, and therefore should be compared with other energy resources and treated consistently for benefit-cost analyses.
2. Align primary test with 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 the DER investment.
6. Avoid double-counting through clearly defined impacts.
7. Ensure transparency in presenting the analysis and the results.
8. Conduct BCA separate from Rate Impact Analyses because they answer different questions.

Example Policy Goals

Common Overarching Goals: Provide safe, reliable, low-cost electricity and gas services; protect low-income and vulnerable customers; maintain or improve customer equity.
DER Resource Goals: Reduce electricity and gas system costs; develop least-cost energy resources; improve system reliability and resilience; reduce system risk; promote resource diversity; increase energy independence (and reduce dollar drain from the jurisdiction); reduce price volatility; increase demand flexibility.
Other Applicable Goals: Support fair and equitable economic returns for utilities; provide reasonable energy costs for consumers; ensure stable energy markets; reduce energy burden on low-income customers; reduce environmental impact of energy consumption; promote jobs and local economic development; improve health associated with reduced air emissions and better indoor air quality; promote environmental justice.

NSPM Guides Jurisdictions on Defining its Primary Cost-Effectiveness Test

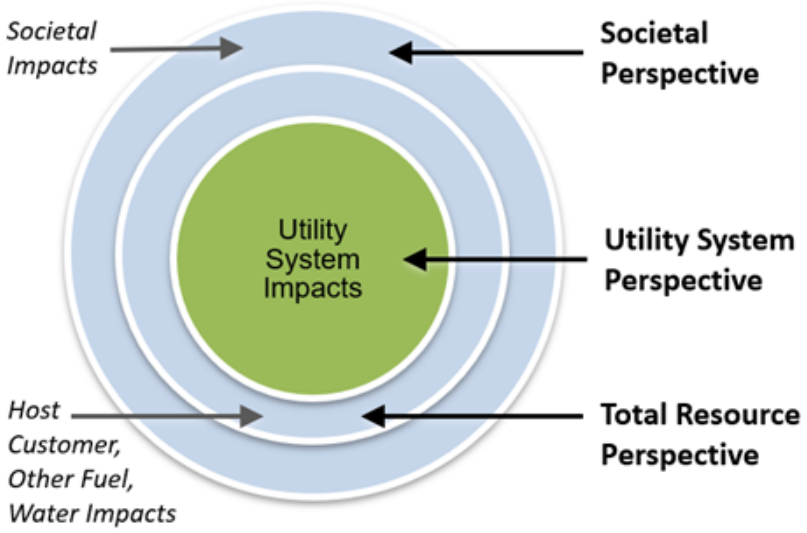
…to answer the question:

Which resources have benefits that exceed costs and therefore merit acquisition or support?

The “Regulator” Perspective

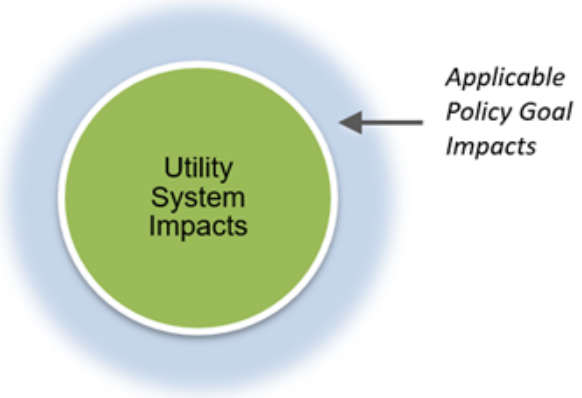
NSPM for DERs

Traditional Perspectives



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

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.

State Energy Office Perspective

- Example: SEO building manager trying to decide whether to invest in GEBs in 10+ buildings
  - *What are the relevant owner/occupant costs and benefits of GEBs to consider?*
- Participant Cost Test (PCT) is starting point (in the same way that utilities start with the Utility Cost Test)
  - PCT is different from UCT, TRC, SCT, and JST because test is not used to inform decisions regarding *utility* investments.
  - PCT can be used by SEOs for deciding how to spend their money.
  - Accounts for reduced bills and owner/occupant non-energy impacts
- NSPM provides information on range of host customer impacts to consider, and factors that affect impacts
- SEO can decide whether to include additional 'societal' impacts based on the state's policy goals e.g., climate change goals, public health, economic development, etc.

Chapter 4: DER Benefits & Costs

Utility-system Impacts are foundational (if BCA involves utility investment…)

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

Participant/Host Customer and Other Societal Impacts – inclusion depends…

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 (more detail)

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)

Key Factors that Affect DER Impacts

Depends on specific DERs and use cases, such as:

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

DER Benefits and Costs

Utility System Impacts

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	●	●	●	●	○

Potential Benefit, Cost or Depends?

● = *typically a benefit*
● = *typically a cost*
● = *either a benefit or cost depending upon the application*
○ = *not relevant*

DER Benefits & Costs

Host Customer Impacts

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

DER Benefits & Costs

Societal Impacts

Type	Societal Impact	EE	DR	DG	Storage	Electrification
Societal	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 DER type*

Demand Flexibility: Example Benefits

Benefit	Utility System	Building Owners/ Occupants
Reduced operation & maintenance costs	✓	-
Reduced generation capacity costs	✓	-
Reduced energy costs	✓	-
Reduced T&D costs	✓	-
Reduced T&D losses	✓	-
Reduced ancillary services costs	✓	-
Reduced environmental compliance costs	✓	-
Increased resilience	✓	✓
Increased DER integration	✓	✓
Improved power quality	-	✓
Reduced owner/occupant utility bills	-	✓
Increased owner/occupant satisfaction	-	✓
Increased owner/occupant flexibility and choice	-	✓

Adapted from *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations* Table 2, Woolf et al. 2021, https://eta-publications.lbl.gov/sites/default/files/gmlc_bca_final_report_20210202.pdf

Factors Impacting Value of Demand Flexibility

- There is no single economic value of demand flexibility for utility systems or consumers or even society
- The value of a single “unit” (e.g., kW, kWh) of grid service provided by demand flexibility is a function of:
  - the *timing* of the impact (temporal load profile),
  - the *location* in the interconnected grid,
  - the *grid services* provided,
  - the *expected service life* (persistence) of the impact, and
  - the *avoided cost of the least-expensive resource alternative* providing comparable grid service.
- Demand flexibility valuation methods and practices should account for these variations.

Source: *Determining Utility System Value of Demand Flexibility From Grid-interactive Efficient Buildings*, Tom Eckman and Lisa Schwartz, 2020
https://eta-publications.lbl.gov/sites/default/files/geb_valuation_seeaction_webinar_slides_20200406.pdf

Polling Question #3

Which **utility system impacts** do you think are most challenging to quantify and where guidance on methods/options for calculating would be valuable for your work?

Polling Question #4

Which **non-utility system impacts** do you think are most challenging to quantify and where guidance on methods/options for calculating would be valuable for your work?

NSPM Guidance on BCA for GEBs and Illustrative Example

NSPM for DERs – BCA Guidance for GEBs

- 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. Multiple on-site DERs span residential, commercial, and community levels, including buildings, facilities, campuses, etc.

- **Key Factors Impacting BCA**
  - Integration and Cross-Coordination of Program Design
    - Location
    - Measurement and verification
    - Market integration (e.g., program administration, DER aggregation/communication, inverter interface, and cybersecurity)
    - Codes and standards development
  - Determining All Host Customer Impacts
  - Existing Infrastructure Investments, Visibility & Control

NSPM for DERs – BCA Guidance for GEBs

- **Key Challenges Impacting BCA**
  - Types of DERs deployed and their capabilities
  - Specific locational and temporal impacts
  - DERs ownership/operation
  - Interactive effects between DERs

Guidance: The benefits and costs of multiple DERs per site should be estimated using enough locational and temporal detail to adequately represent the DER operating patterns and consequent benefits and costs.

NSPM for DERs – BCA Guidance for GEBs

- **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.

NSPM for DERs – GEB Illustrative Case Study

Use case: Commercial GEB

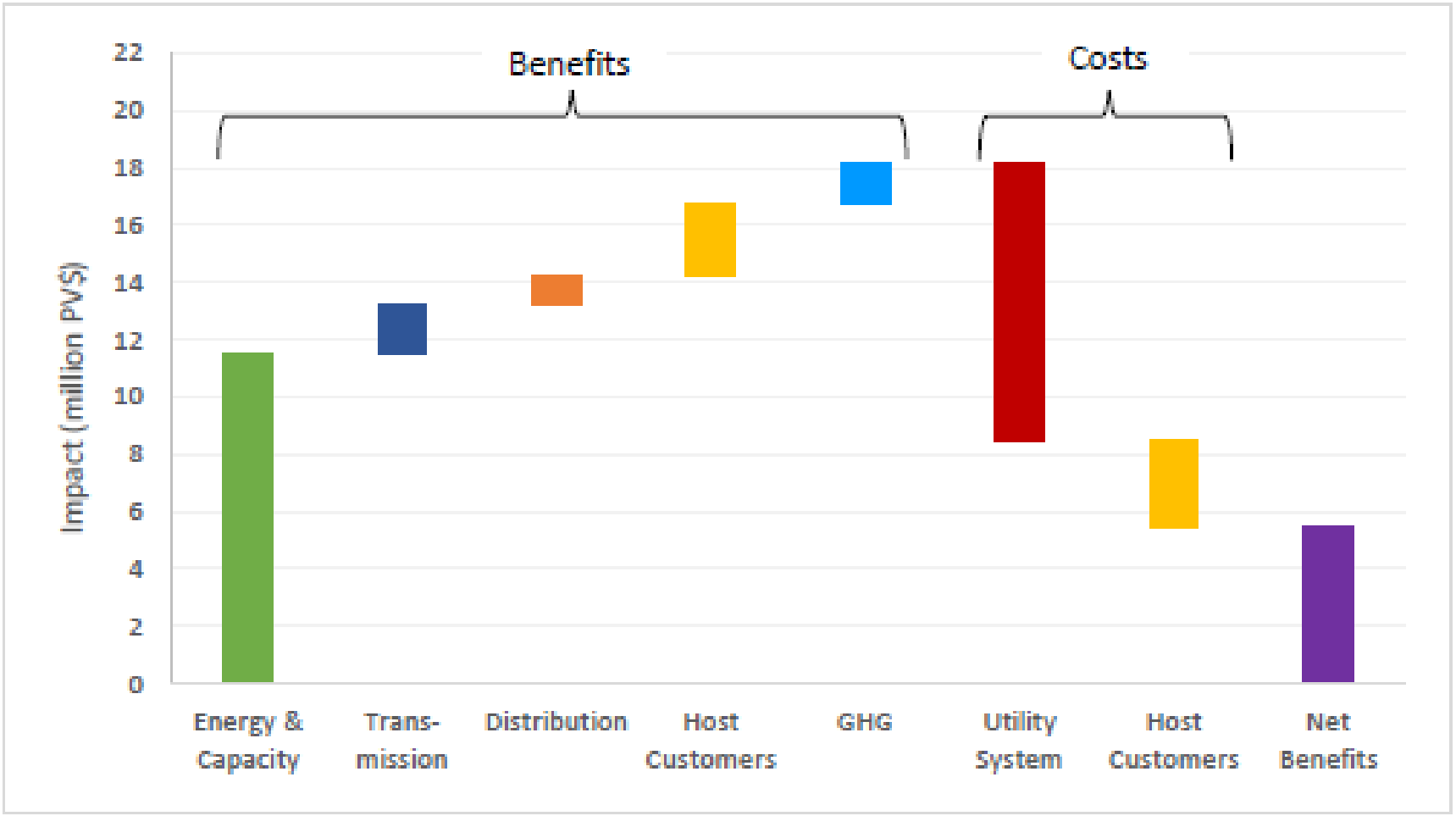
- **DER Types**: BTM DERs:
  - Energy efficiency
  - Demand response
  - Distributed photovoltaics
  - Distributed storage systems

- **The Jurisdiction-Specific Test**:
  - Hypothetical jurisdiction's primary BCA test includes utility system impacts, host customer impacts, and GHG impacts.

- **Key Assumptions:**
  - 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.

NSPM for DERs – GEB Illustrative Case Study

Figure 11 - 3: Example of GEB Cost-Effectiveness



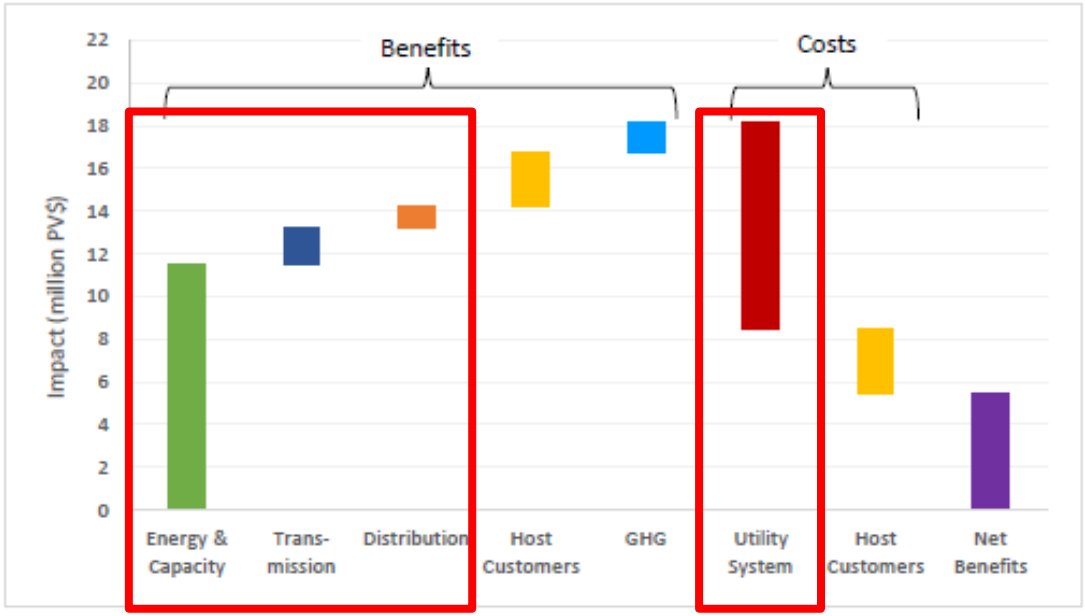
Source: *NSPM for DERs, chapter 11* (2020)

NSPM for DERs – GEB Illustrative Case Study

Table 11-1. Net Benefits and Costs of GEB Case Study: Utility System Impacts

Type	Utility System Impact	Cost or Benefit
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	○
	DG tariffs	○
	Credit and Collection Costs	●
	Risk	●
	Reliability	●
	Resilience	●

● = a benefit for this example. ● = a cost for this example. ○ = not relevant for this example.



Source: *NSPM for DERs, chapter 11* (2020)

NSPM for DERs – GEB Illustrative Case Study

Table 11-2. Net Benefits and Costs of GEB Case Study: Host Customer Impacts

Type	Host Customer Impact	Cost or Benefit
Host Customer	Host portion of DER costs	●
	Host transaction costs	●
	Interconnection fees	●
	Risk	●
	Reliability	●
	Resilience	●
	Host Customer NEIs	●

Table 11-3. Net Benefits and Costs of GEB Case Study: Societal Impacts

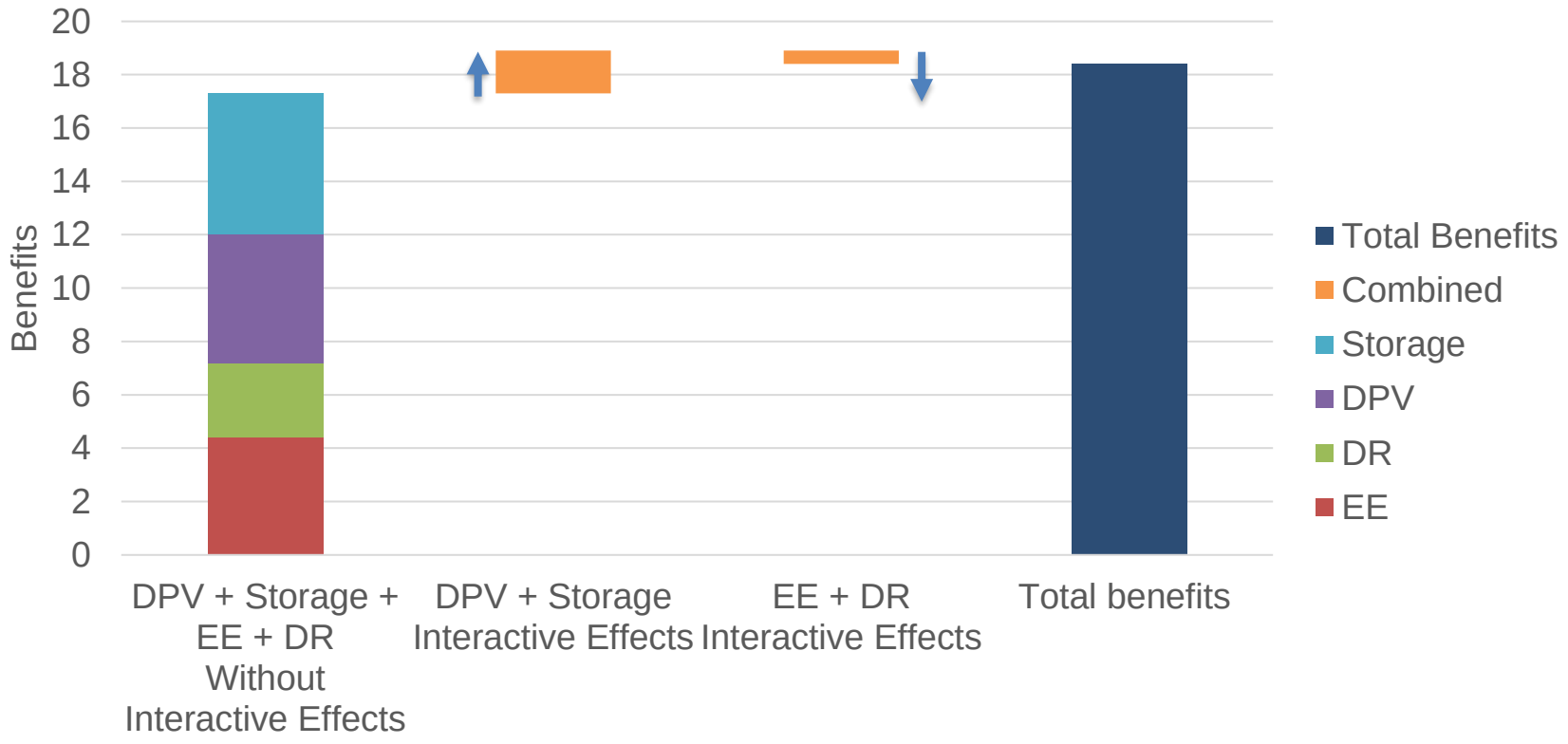
Type	Societal Impact	Cost or Benefit
Societal Impacts	GHG Emissions	●
	Other Environmental	○
	Resilience	○
	Economic and Jobs	○
	Public Health	○
	Low Income: Society	○
	Energy Security	○

● = a benefit for this example. ● = a cost for this example. ○ = not relevant for this example.

Source: *NSPM for DERs, chapter 11* (2020)

NSPM for DERs – GEB Illustrative Case Study

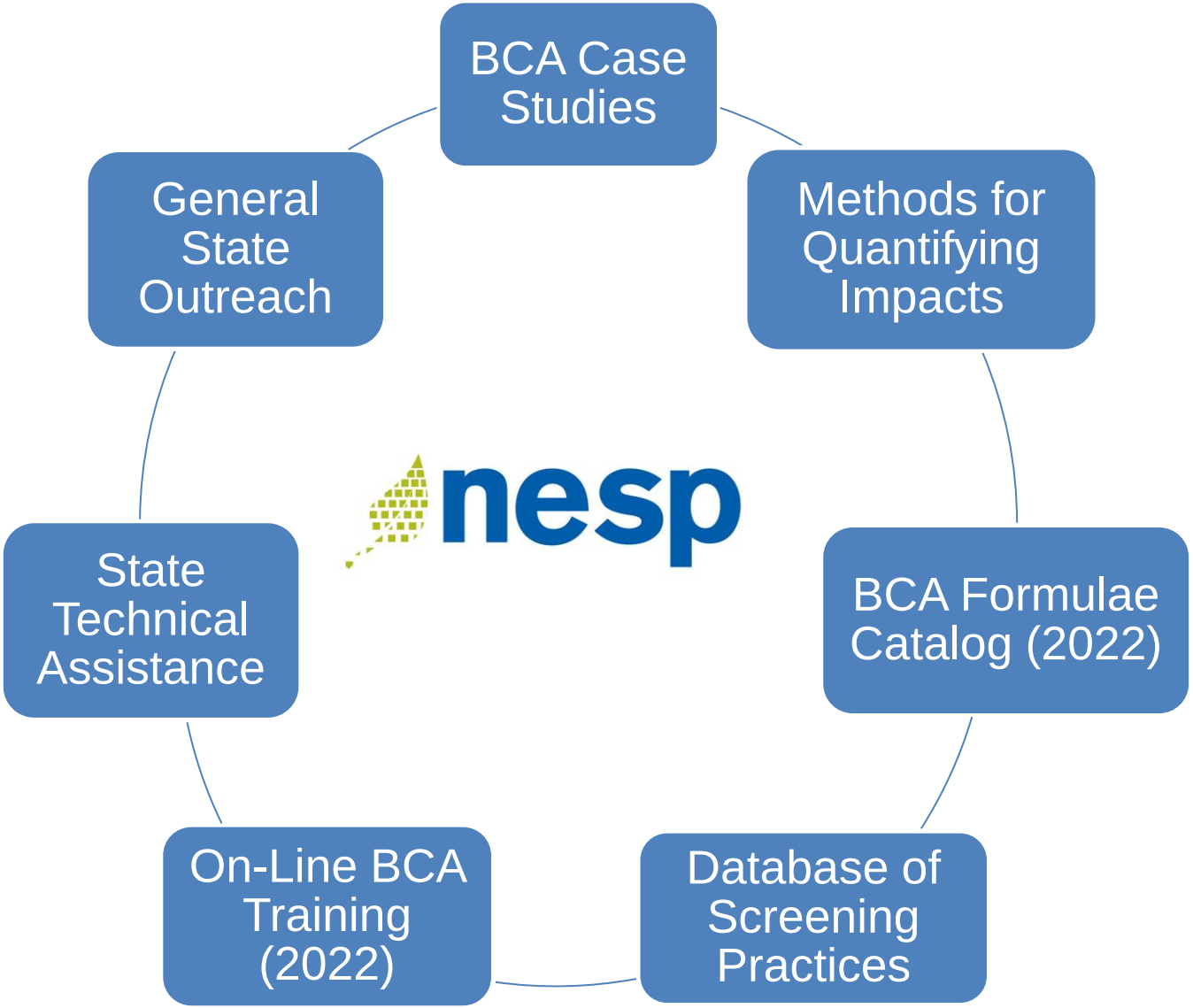
Table 11- 4: Example of GEB Interactive Effects



Source: *NSPM for DERs, chapter 11* (2020)

NESP 2021 Project Areas

2021 Project Areas



2021 - BCA Case Studies

Project Objectives:

- Identify illustrative BCA of leading DER use cases to develop 3 case studies
- Informed by real-world use cases generalized into detailed hypothetical/illustrative examples
- Demonstrate application of the NSPM BCA Framework and how DER use cases drive DER assessment.
- Illustrate approaches to accounting for impacts in BCA when certain data is unavailable (e.g., primary research/study, use of proxy value/percent adder, qualitative assessment, etc.)
- Complete by December 2021

Scope - BCA Case Studies

Use Case Parameters:

- Based on / informed by existing regionally-diverse projects and available data
- Mix of single and multiple DER types, including EE/DR
- Commercial and residential (including low-income) applications.
- Identify core examples of utility-system and non-utility impacts, with varied key factors (ie., interactive effects, locational value, etc.)

Potential DER Use Case Examples

(to be further developed/validated):

Single DERs:

- Distributed Generation (DG)
- Energy storage (ES)
- Electric vehicles (EVs)

Multi-DERs:

- Solar + Storage
- Bring-Your-Own Device (BYOD)
- GEBs
- NWS

Polling Question #5

Which BCA use cases would be most valuable for your work (including outside of GEB-focus)?

Question for Chat Box Response

Please share leading GEB real-world project examples

Complementary Effort:

SEPA Integrated Energy Efficiency/Demand Flexibility Study

Project Scope
The project focuses on how utility integrated energy efficiency/demand flexibility programs can promote grid-interactive efficient buildings (GEBs) by investigating successful projects, key learnings, existing business model challenges and regulatory barriers, and case studies.

Project Partners
SEPA is conducting this industry-leading study in partnership with Lawrence Berkeley National Laboratory (Berkeley Lab) and the U.S. Department of Energy's (DOE) Building Technology Office.

What's Next & How You Can Participate
Convene experts for focus groups and interviews to:

- Discuss successful projects, key learnings, and existing business model challenges and regulatory barriers
- Explore the future of GEBs including perspectives on the role of the utility, solution providers, and regulators, and ways the industry can promote GEBs

Be in touch

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For more information:

NSPM for DERs and supporting resources:

http://www.nationalenergyscreeningproject.org/

Stay informed with the NESP Quarterly Newsletter

Questions?

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