

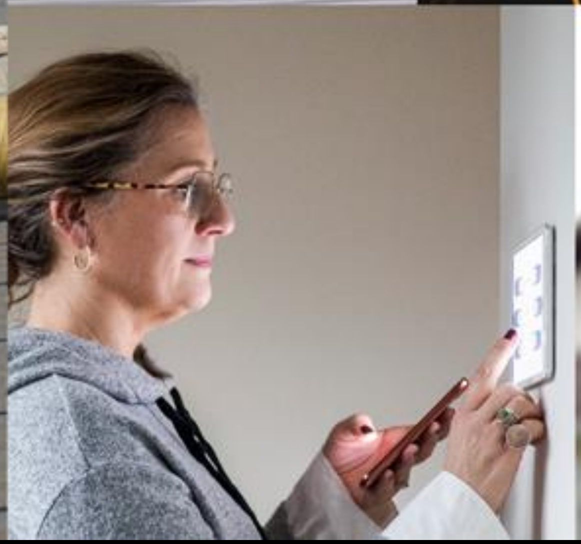


How utilities can evaluate the cost-effectiveness of DERs

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09/08/2022

Steve Fine

VP, Distributed Grid Strategy +
ICF Climate Center Senior Fellow

Steve has over 30 years of experience working at the confluence of energy, environment, and economics to evaluate and design workable solutions to our biggest energy challenges.

Lines will be muted.

Submit questions in the chat box.

We're recording!

How did we do?

Tell us what you want to hear next.

Some ground rules

We design robust future-focused solutions in response to industry, policy, and environmental changes.

And we've been carbon neutral since 2007.

50
years of energy work

1K+
energy experts

Top 50
utilities in North America

200+
energy efficiency programs

All major
federal agencies

All major
energy NGOs

35+
years of climate science, impacts, and adaptation

100+
climate change experts

ICF's energy + climate footprint

Today's presenters and agenda

Julie Michals

Director of Valuation, E4TheFuture

Kate Strickland

Manager, Utility and Regulatory Strategy, SEPA

David Pudleiner

Energy Engineer, Building Energy Analytics, ICF

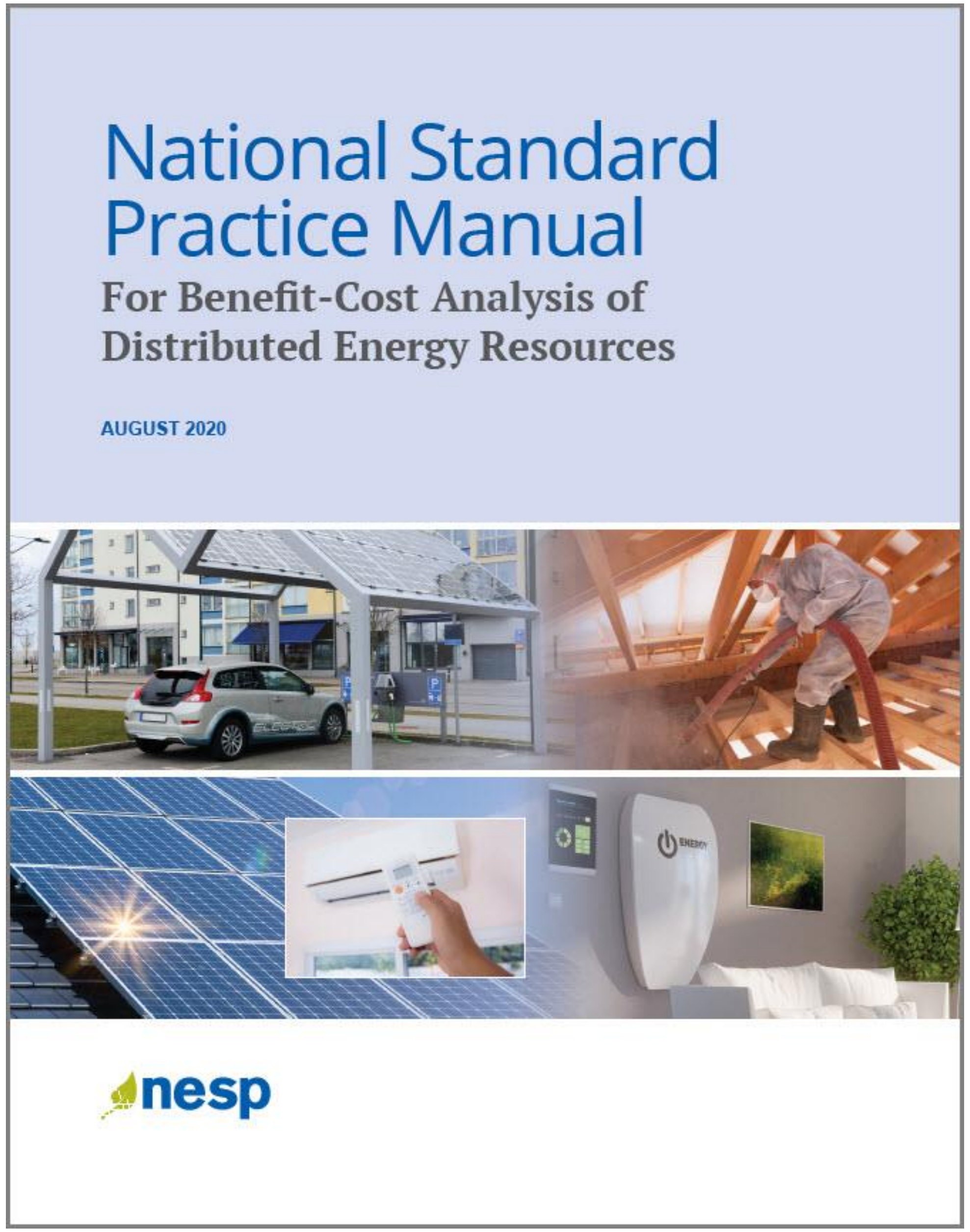
- About the National Standard Practice Manual (NSPM)
- Case studies background
- Deep dive into case studies:
  - Residential managed EV charging in the Midwest
  - Commercial solar and storage-controlled dispatch in the West
  - Residential grid-interactive efficient buildings in the Mid-Atlantic

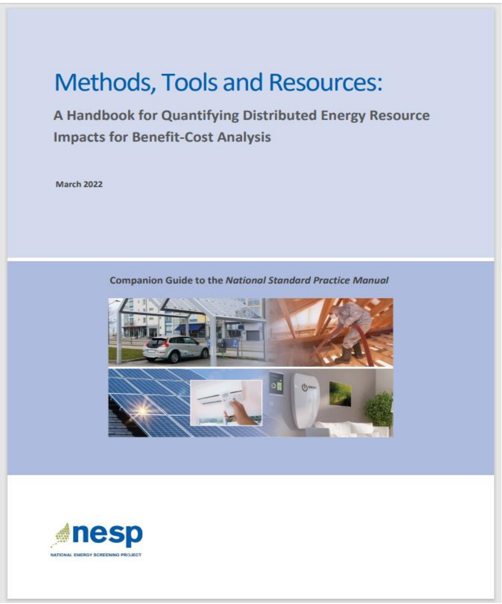
NSPM for DERs and supporting resources

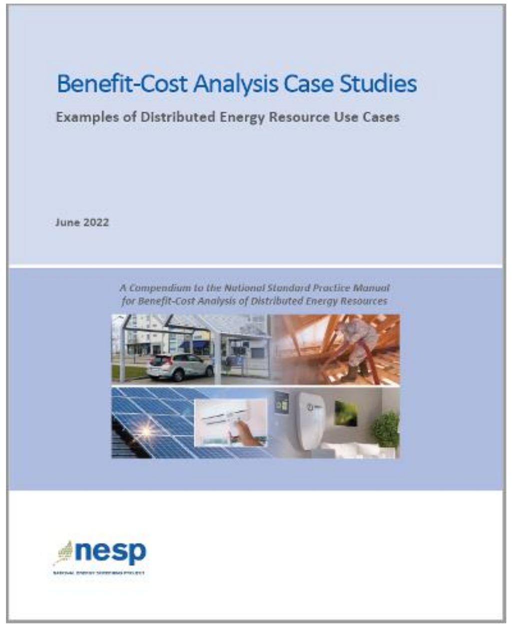
National Energy Screening Project (NESP) – stakeholder organization that works to improve cost-effectiveness screening practices for distributed energy resources (DERs).

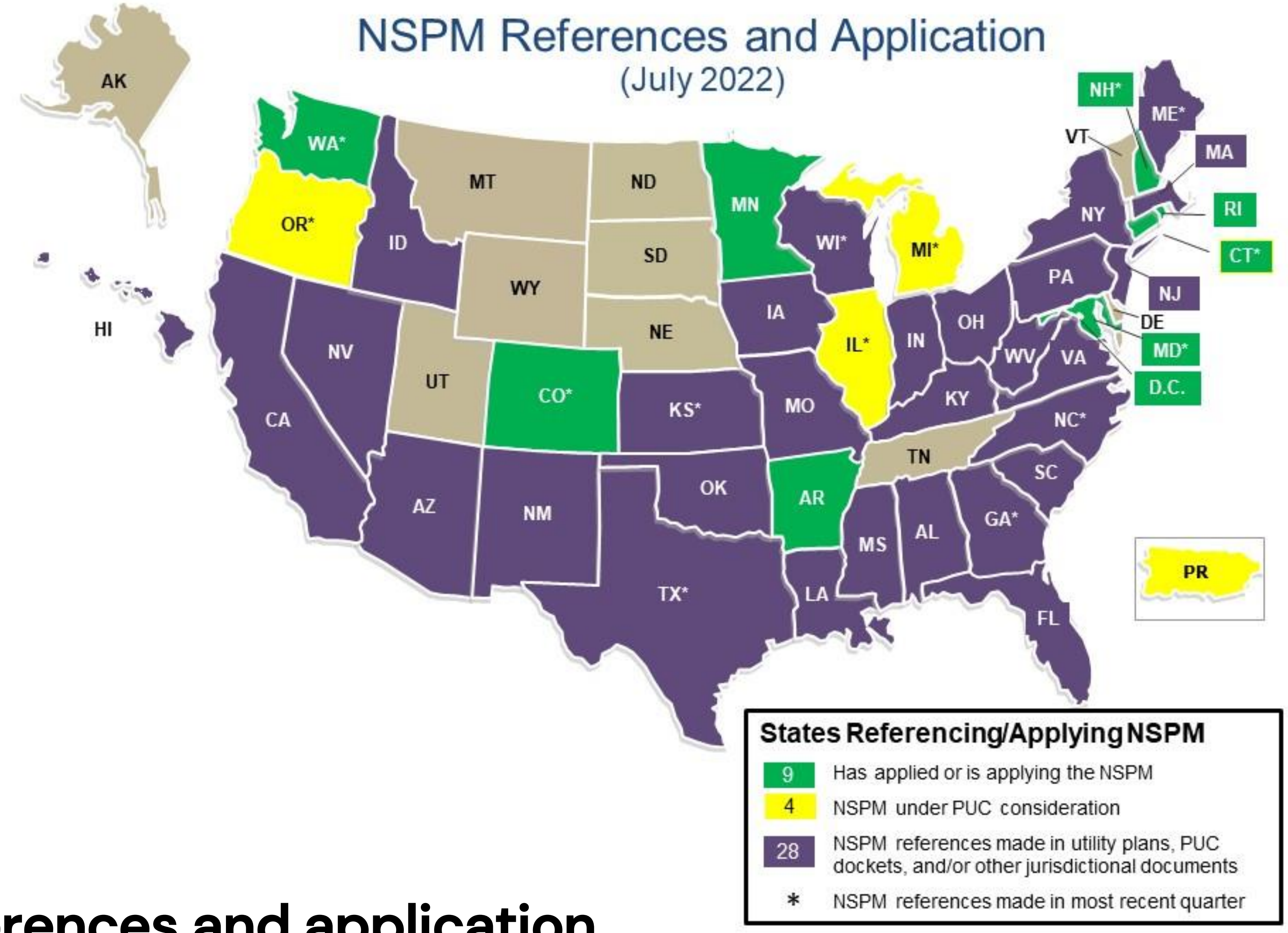
NSPM for DERs:

- Comprehensive framework for cost-effectiveness assessment of DERs
- Set of policy-neutral, non-biased, and economically-sound principles, concepts, and methodologies to support single- and multi-DER benefit-cost analysis (BCA)
- Provides guidance on ***what*** inputs to include in BCA tests
    - The MTR Handbook provides guidance on ***how*** to determine those inputs to those BCA tests
    - *New* BCA Case Studies demonstrates application of NSPM and MTR Handbook guidance









NSPM references and application

Fundamental BCA **Principals**

Multi-step process to develop a **primary** cost-effectiveness test

When and how to use **secondary** cost-effectiveness tests

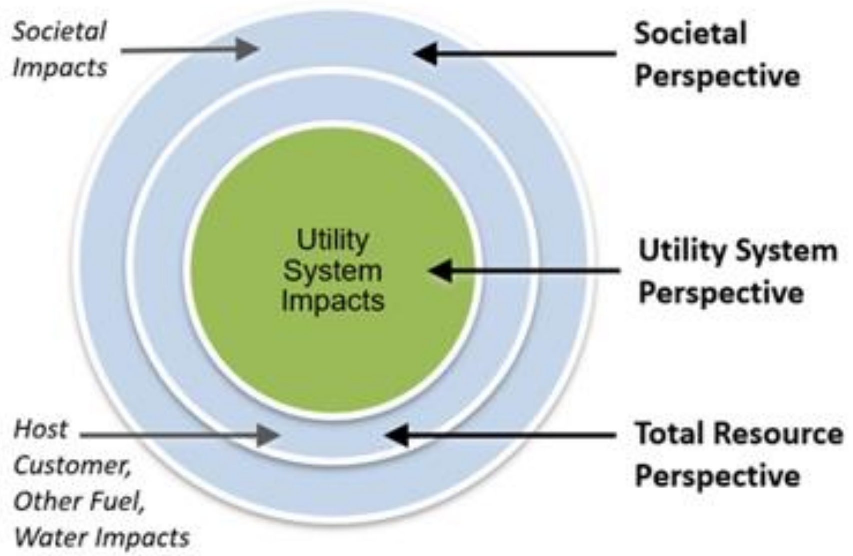
NSPM benefit-cost analysis framework

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.

NSPM BCA principles

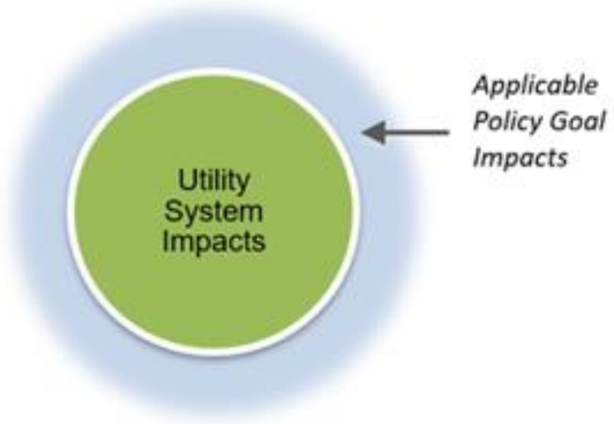
NSPM for DERs

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.

Cost-effectiveness testing perspectives

(and the Jurisdiction Specific Test or JST)

NSPM principle #1: Consistency in BCA across DERs

Importance of consistency

- Consistent BCA framework reduces risk of either over or under-investing in a resource (or combination thereof)
- Siloed approach to valuing different DERs can be complex and overwhelming for commissions, utilities, and stakeholders
- Allows for analysis of multiple-DER initiatives

Consistency still allows for unique characteristics of each DER

- A consistent BCA framework does not require all impacts to apply to all DERs
  - The framework accounts for differences in DER technologies and use cases
- Policy framework should be comprehensive, but all policies may not apply to all DERs
- It may not be possible to develop quantitative values for each DER.
  - Impacts may need to be addressed qualitatively due to data limitations

Category	Type	Impact	EE	DR	EV
Electric Utility system impacts	Generation	Energy generation	Benefit	Will depend if DR only shifts load or impacts consumption	Cost
		Capacity	Benefit	Benefit	Cost or Benefit if paired with demand flexibility, TOU rates
		RPS/CES compliance	Benefit	N/A if no change in sales	Cost (increased electricity sales)
		Market price effects	Benefit	Benefit	Energy = cost Capacity = benefit if paired with demand shifting
		Ancillary services	N/A	Benefit	Cost or benefit if V2G enabled
	General	Risk	Benefit	Benefit	Cost due to increased electricity consumption
		Reliability	Benefit	Benefit	Cost without DR/time shifting. V2G could great benefit.
		Resilience	N/A	Benefit	N/A except for V2G mode that creates a benefit
Societal impacts	Societal	Greenhouse gas emissions	Yes	N/A or could be cost depending on timing	Yes
		Public health (critical air pollutants)	Yes	N/A or could be cost depending on timing	Yes
		Economic development and jobs	Yes	N/A	Yes
		Energy security	Yes (for other fuels)	N/A	Yes
Host customer impacts	General	Measure costs (host)	Cost	N/A	Yes
		Interconnection fees	N/A	N/A	Yes
		Other fuel (oil, propane, gasoline)	Yes (for other fuels)	N/A	Yes
		Tax incentives	Depends on measure	N/A	Yes (depends on vehicle type)
		Asset value (property value)	Benefit (ex. weatherization)	N/A	Yes
		Productivity (includes O&M)	Yes	Potential Cost	Yes
	Low-income	Comfort	Yes	N/A	No
		Health & safety	Yes	N/A	No
		Mobility	N/A	N/A	Yes (depends on type of program)

Sample impacts and DER use cases

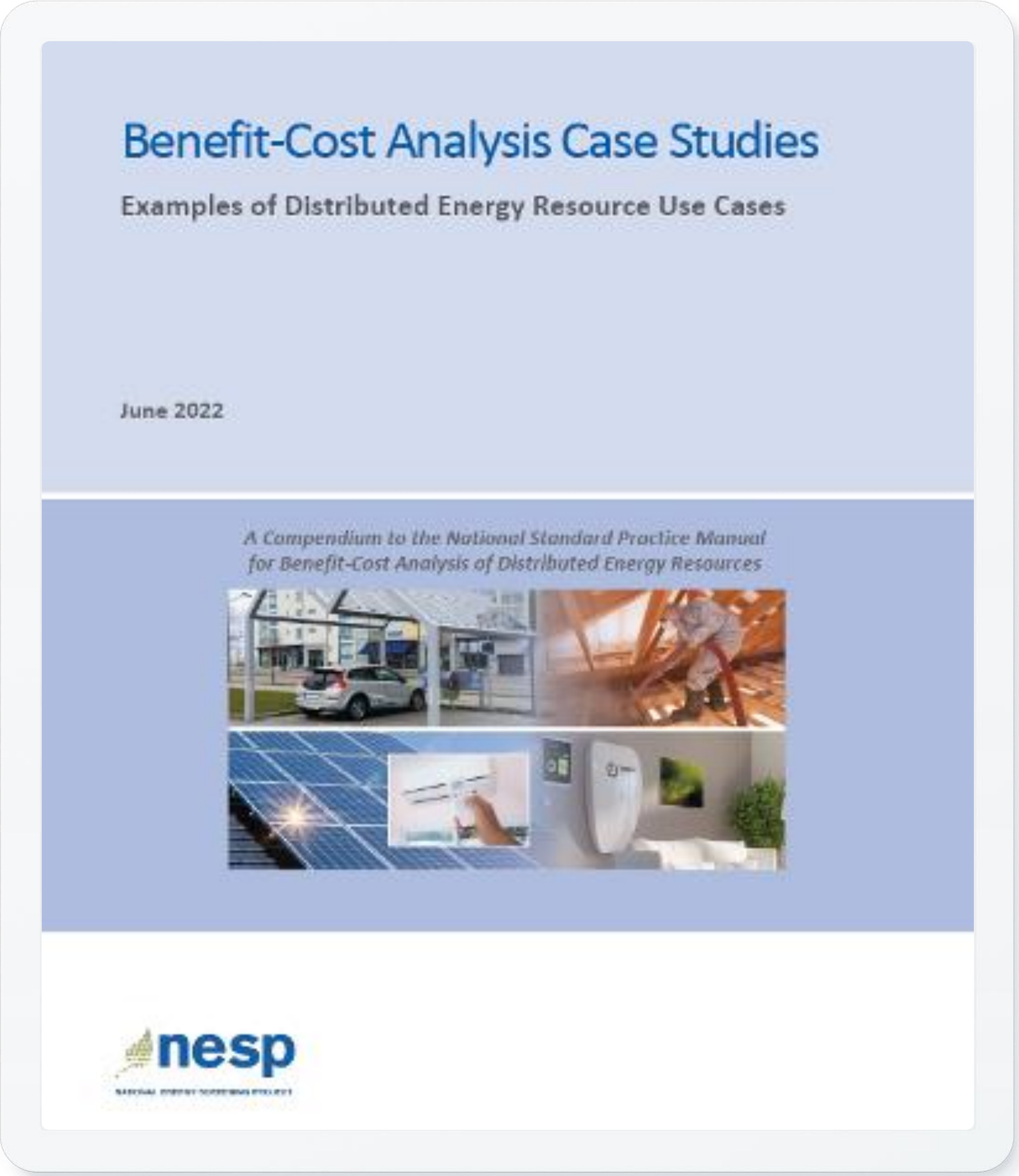
NSPM guidance application to real-world use cases: BCA case studies (2022)

Benefit-cost analysis case studies: examples of distributed energy resource use cases

Three use cases covered:

1. Residential EV managed charging in the Midwest
2. **Commercial solar + storage-controlled dispatch in the west**
3. Residential grid-interactive efficient building (GEB) retrofit in the Mid-Atlantic

Available at:
https://www.nationalenergyscreeningproject.org/resources/case-studies/



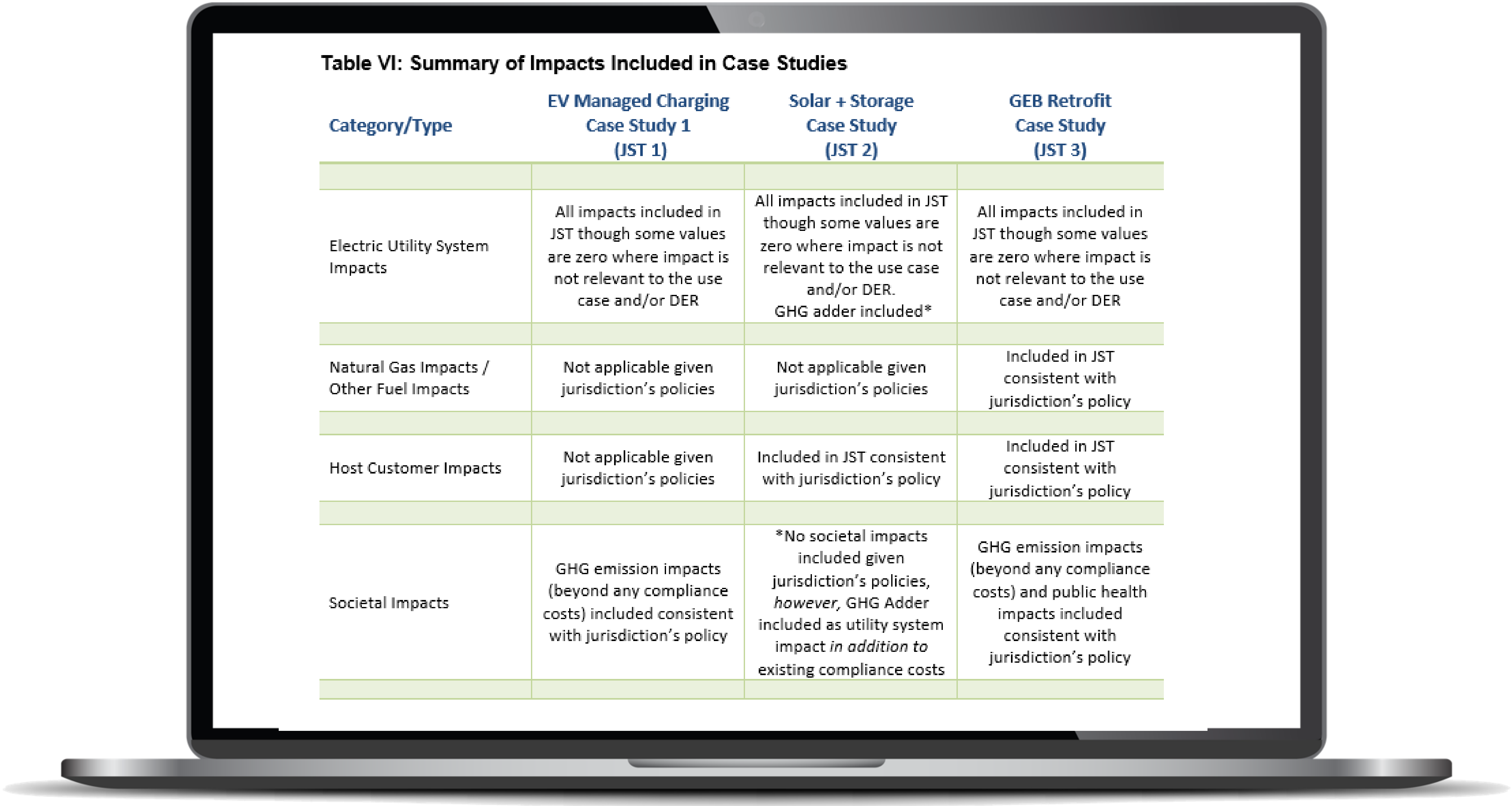


Table VI: Summary of Impacts Included in Case Studies

Category/Type	EV Managed Charging Case Study 1 (JST 1)	Solar + Storage Case Study (JST 2)	GEB Retrofit Case Study (JST 3)
Electric Utility System Impacts	All impacts included in JST though some values are zero where impact is not relevant to the use case and/or DER	All impacts included in JST though some values are zero where impact is not relevant to the use case and/or DER. GHG adder included*	All impacts included in JST though some values are zero where impact is not relevant to the use case and/or DER
Natural Gas Impacts / Other Fuel Impacts	Not applicable given jurisdiction's policies	Not applicable given jurisdiction's policies	Included in JST consistent with jurisdiction's policy
Host Customer Impacts	Not applicable given jurisdiction's policies	Included in JST consistent with jurisdiction's policy	Included in JST consistent with jurisdiction's policy
Societal Impacts	GHG emission impacts (beyond any compliance costs) included consistent with jurisdiction's policy	*No societal impacts included given jurisdiction's policies, *however*, GHG Adder included as utility system impact *in addition to* existing compliance costs	GHG emission impacts (beyond any compliance costs) and public health impacts included consistent with jurisdiction's policy

Summary of case studies JST

Reference case

- Small commercial customers install stand-alone rooftop solar PV, customer is on TOU rate

DER case

- Small commercial customers receive a state government and utility incentive to install a BESS, so customers decide to install the BESS in combination with a rooftop PV system, customer is on TOU rate

Policy scenario

- State incentive program to encourage DER deployment, including energy storage
- Aggressive state-level GHG emissions reductions targets
- GHG adder included as Utility System Impact and also existing compliance costs to capture GHG requirements
- Host customer impacts included in JST

Utility scenario

- Investor-owned utility in a Western state that does not have an RTO
- High avoided energy and capacity costs
- Significant renewable energy, including solar PV, as part of the generation mix, in addition to grid reliability constraints (e.g., public safety power shutoffs (PSPS)

Commercial solar + storage case study

Applicable value streams

Electric Utility System Impacts
Avoided energy costs
Avoided generation capacity costs
Avoided transmission costs
Avoided distribution costs
Avoided ancillary services
Avoided environmental compliance costs (cap & trade compliance costs)
Avoided environmental compliance costs (GHG adder)
Avoided environmental compliance costs (GHG rebalancing)
Reduced risk
Program administration
Utility financial Incentives

Host Customer Impacts
Increased reliability
Federal Investment Tax Credit (ITC)
State financial incentive
BESS interconnection costs

Host Customer Impacts
Depreciation tax write-off
Operations & Maintenance (O&M) costs
Battery Energy Storage System (BESS) net capital cost

N/A because of JST formulation

Societal Impacts
All societal impacts

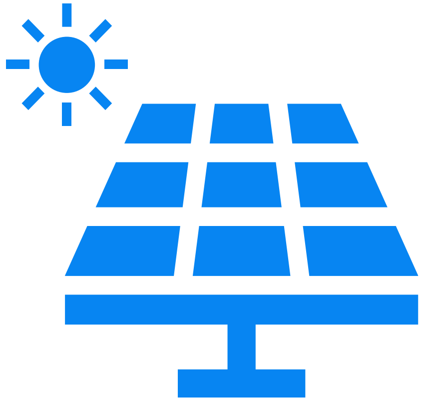
N/A because of DER use case examined

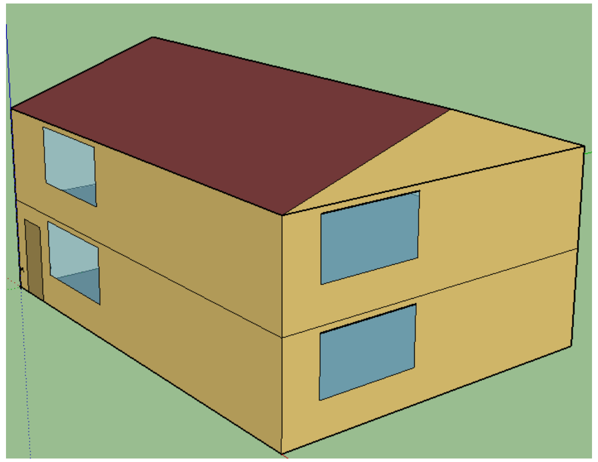
Electric Utility System Impacts
Avoided credit and collection costs
Increased reliability
Increased resilience
Avoided RPS costs
Utility performance incentives
Wholesale price suppression effects

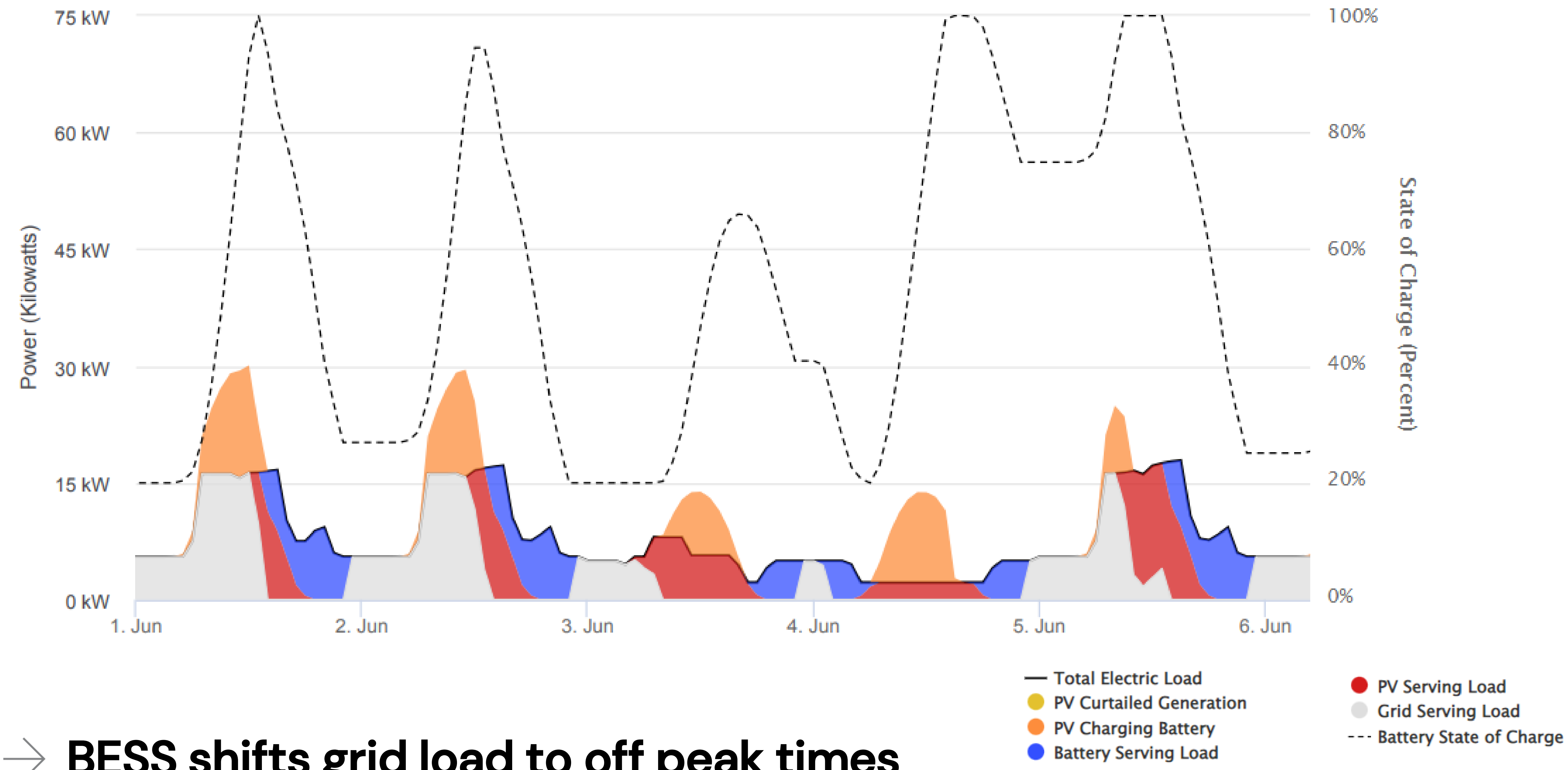
Identification of relevant value streams

Modeling BESS impact with NREL ReOpt

- Modeled hourly load shape impacts of BESS system using NREL’s Renewable Energy Optimization (REopt) platform
- Baseline building assumed: 5,500 sqft small office from DOE prototype buildings
  - Existing 20 kW solar PV array
- TOU Tariff: $0.40/kWh peak, $0.21/kWh off peak
- BESS system: 14 kW, 86 kWh system
  - $41,202 per system cost

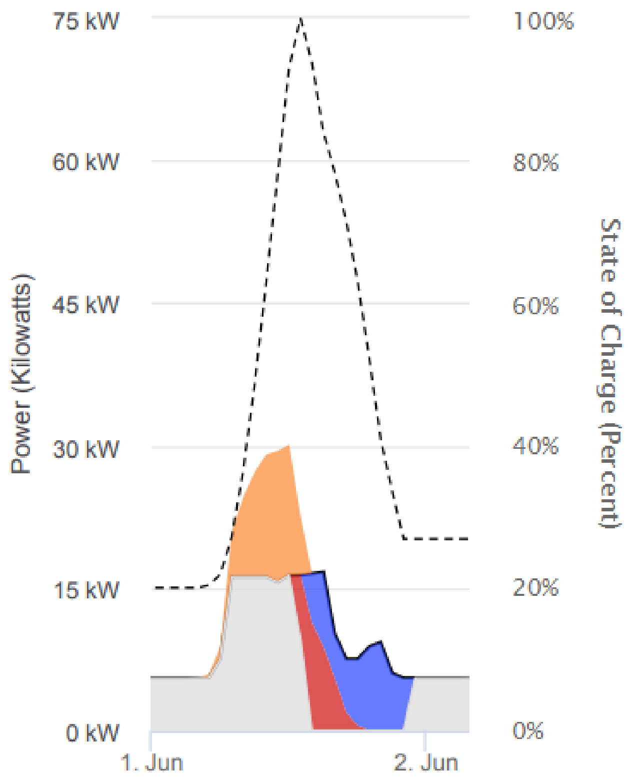






→ BESS shifts grid load to off peak times

$$Increased\ reliability = \Delta\mathrm{CLL} * VoLL$$



- $\Delta CLL\ (kWh)$: *Average change in customer lost load due to expected outages*
  - Based on SAIFI, CAIDI, average BESS SOC, and average building load data; assuming no contribution from PV
- $VoLL\ \left(\frac{\$}{kWh}\right)$: *Value of Lost Load to the customer*
  - Estimated as \$151/kWh based on New England Avoided Energy Supply Component (AESC) study[1]

Methodology for valuing host customer reliability improvement

[1] Synapse. 2021 Avoided Energy Supply Components for New England.

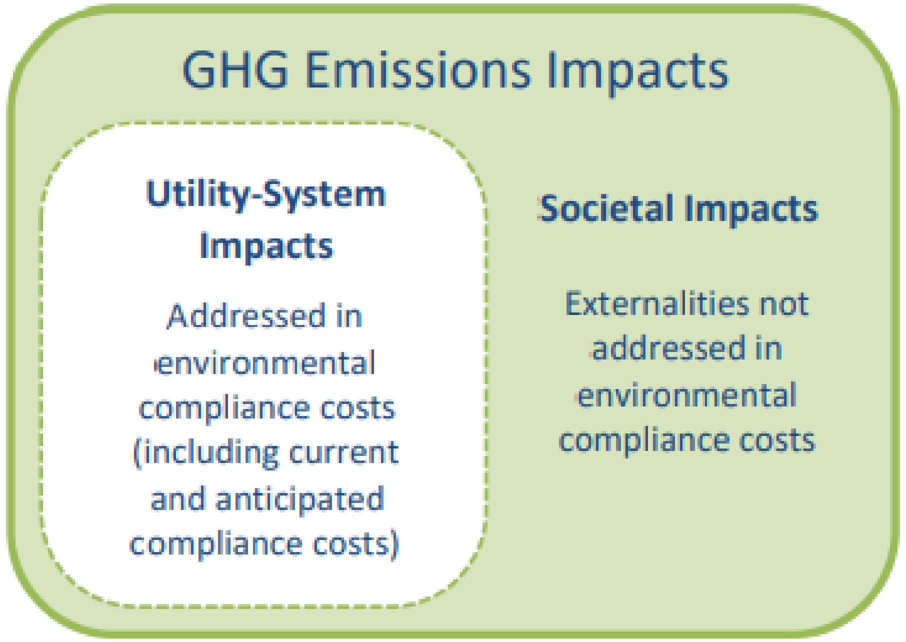
Incentives and depreciation

- Assumed Federal Investment Tax Credit (ITC) at 26% of BESS capital cost
- State financial incentives modeled as equal to half of California Self Generation Incentive Program (SGIP) incentive levels ($175/kWh)
- Depreciation: 21% of BESS capital cost after subtracting 50% of ITC
- Recently passed Inflation Reduction Act bolsters incentives for storage

- Whether societal impacts are relevant depends on utility planning & policy
    - If planning is in line with policy, there is no need for societal valuation

- This case study valued GHG emissions from only the utility system perspective, due to policy and data inputs for utility planning data being aligned

- GHG emissions impacts were calculated on an hourly basis



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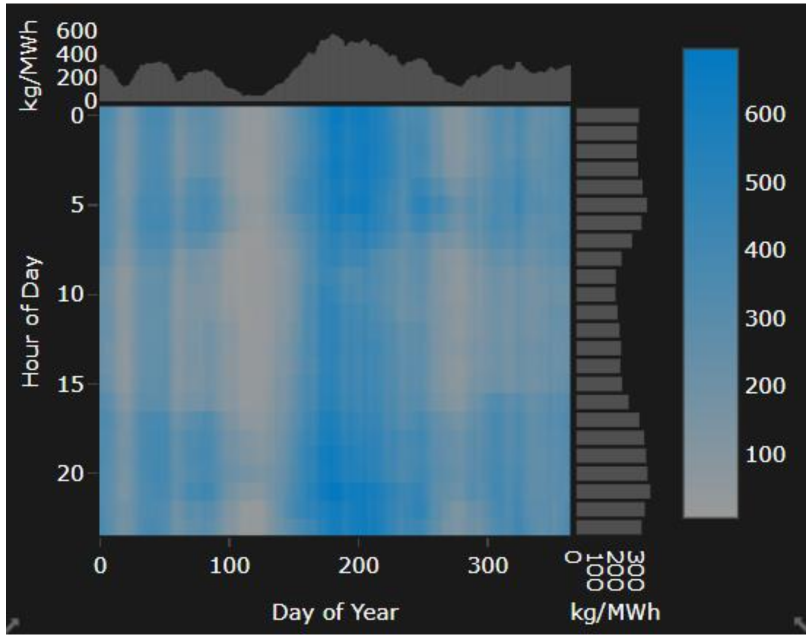

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GHG modeling: Utility system cost vs. societal cost

1 NESP MTR Handbook
[2 Screenshot from NREL Cambium Viewer](#)

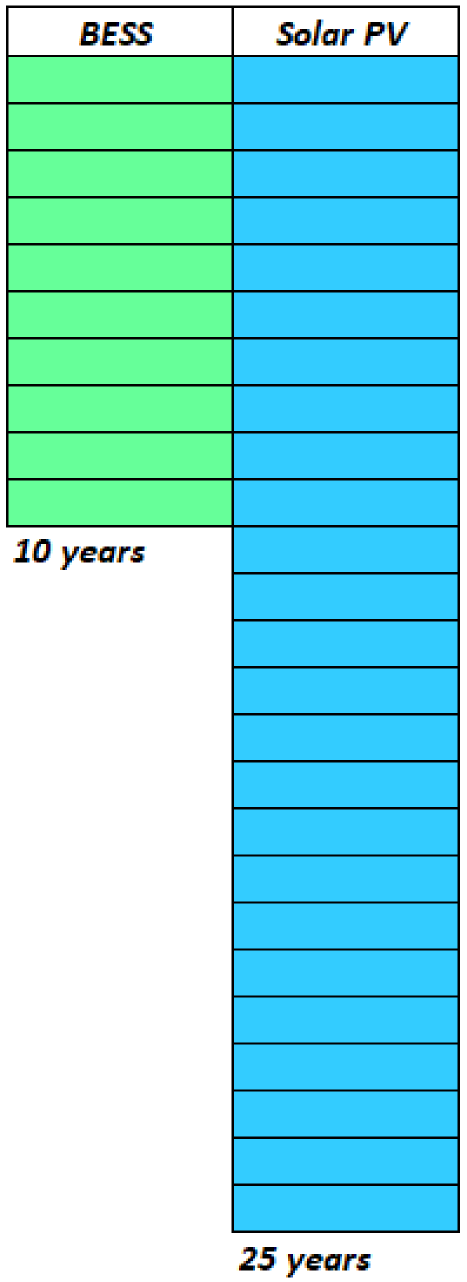
Handling measure lives and interactive impacts

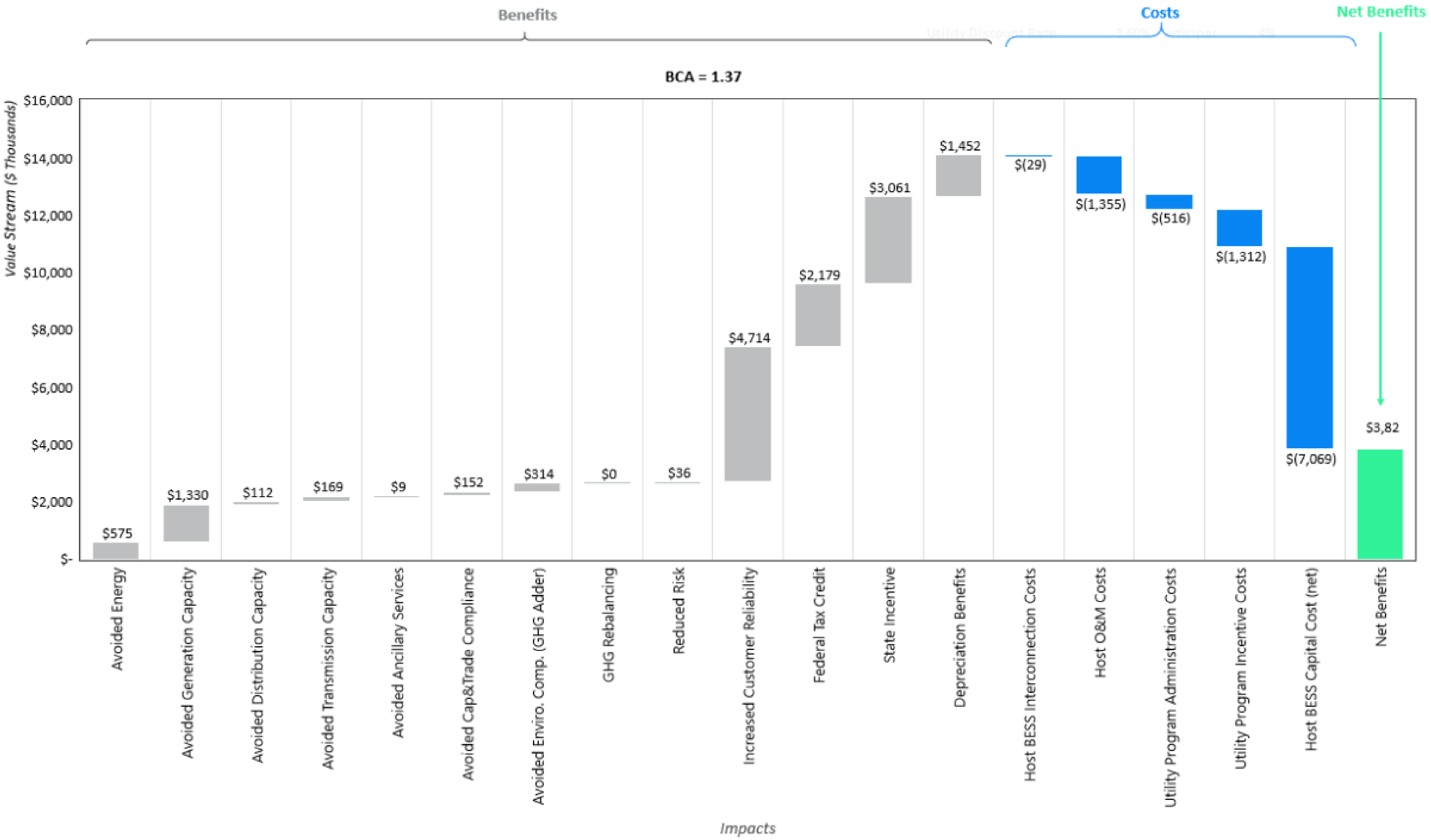
For this case study, assumed baseline of customer already having PV system, but alternative relative baseline is co-installation of these systems

When modeling multiple resources, need to account for differences in measure lives

Two ways to address this:

1. Use multiple load shapes to model the load impacts for different measure combinations
2. Annualize costs and standardize measure lives so that one load shape can be used





Customer reliability is the single largest benefit

Value of lost load, customer minutes out

- Estimates by customer type vary significantly

BESS capital costs

- Cost of storage fallen significantly in past decade, projected to continue to fall

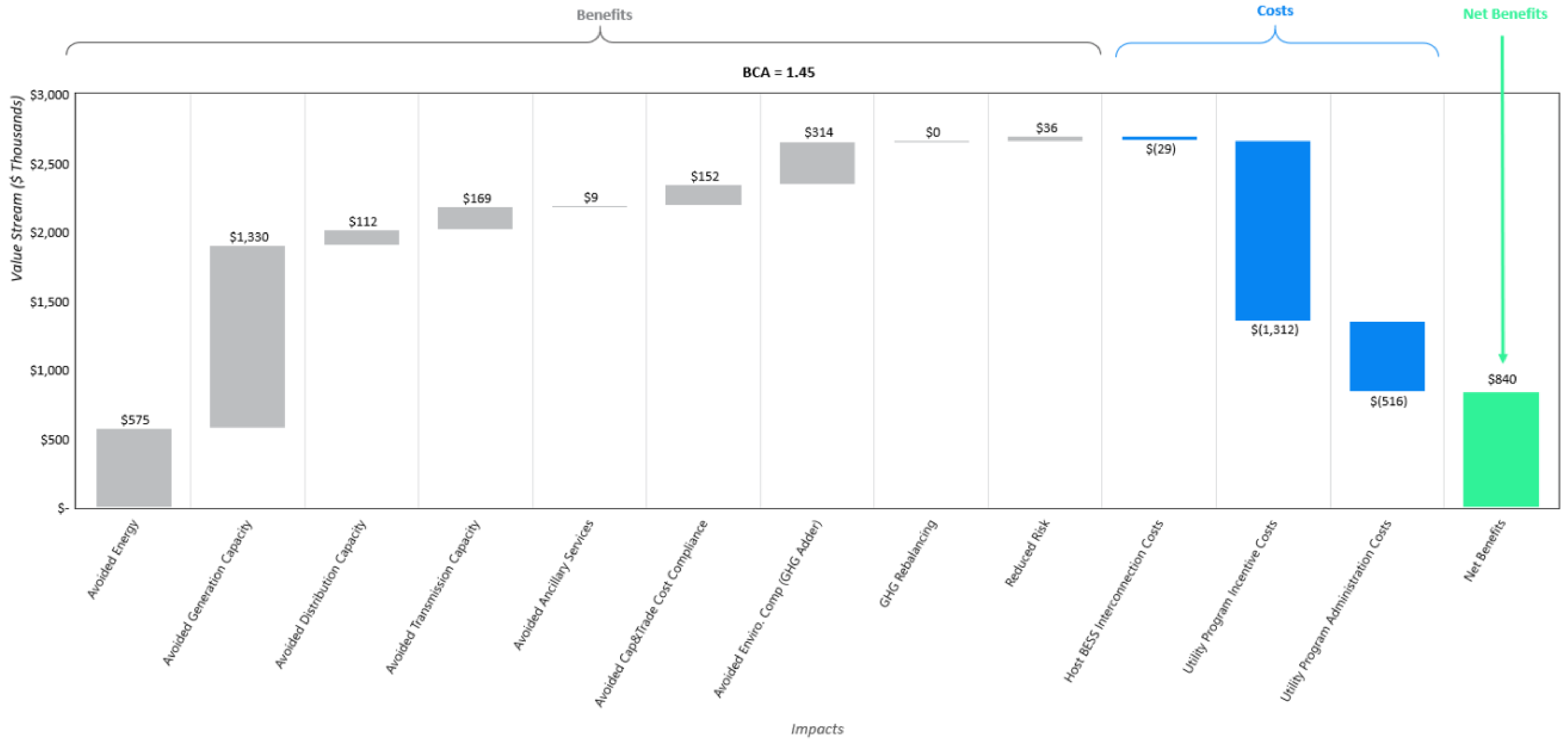
Inclusion of host customer impacts

- The 5 most influential value streams are host customer costs and benefits

Tax credits and financial incentives

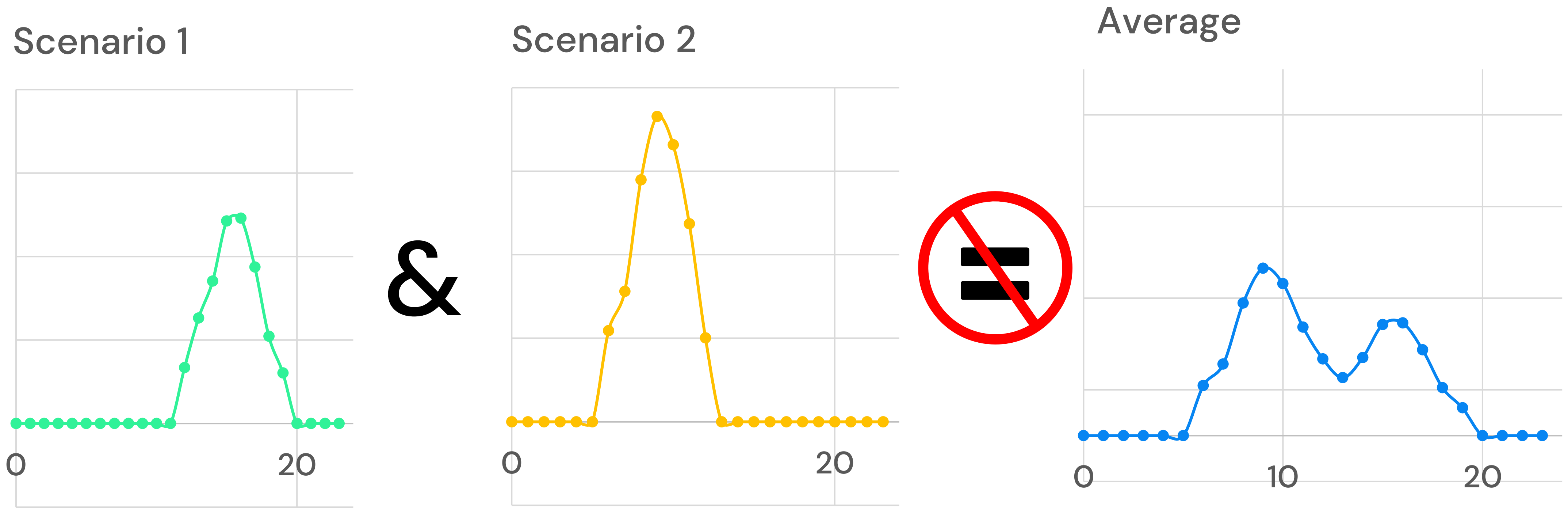
- Without these the JST would be less than 1

Sensitivity of the results: What are the most influential factors?



Results with the host customer impacts removed

- Storage (and all dispatchable resources) have potential value in their flexibility
- No deterministic analysis will accurately capture this value without approximation, requires a probabilistic accounting methodology



→ **Future research: Utilizing multiple load shapes to value flexibility**

Additional case studies: EV managed charging & Residential GEB

	EV managed charging	Residential GEB
Reference case	Residential customer on flat rate charging EV when they desire	Residential SF home with gas furnace, central AC, and no smart devices
DER case	Customer receives incentive from utility for LV2 charger and switching to TOU	Ceiling insulation, reduced air leakage, ASHP, smart thermostat with DR program participation
Policy scenario	Include GHG impacts in JST	Include host customer, natural gas, GHG and public health impacts in JST
Utility scenario	• An IOU in the Midwest that is connected to MISO • Relatively low avoided energy and capacity costs • Generation mix with significant coal baseload	• Municipal utility in the Mid-Atlantic, connected to PJM • Moderate avoided energy and capacity costs • Generation mix comparable to PJM market mix

Questions?

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