# Economic Valuation of Energy Resources: *Technical Assistance Opportunity for States on Enhanced Methods to Assess Utility System Value of Demand Flexibility*

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# Technical Assistance Opportunity

- With support from U.S. Department of Energy's Office of Electricity, and in collaboration with DOE's Buildings Technologies Office, SEE Action, NARUC and NASEO, Berkeley Lab is offering technical assistance to states interested in applying enhanced valuation methods in their jurisdictions.
- Assistance is based on a new SEE Action report, *Determining Utility System Value of Demand Flexibility from Grid-Interactive Efficient Buildings*.
- This webinar will:
  - Summarize seven ways to update current methods and practices for economic valuation of demand flexibility in electricity system planning
  - Describe types of technical assistance offered
  - Explain each item in the online questionnaire and answer your questions – **state responses are due July 10**
  - Provide an opportunity to ask the SEE Action report authors any technical questions you may have about the subject matter to help you assess whether this technical assistance opportunity would help advance your jurisdiction's objectives.
- For follow-up questions, contact:
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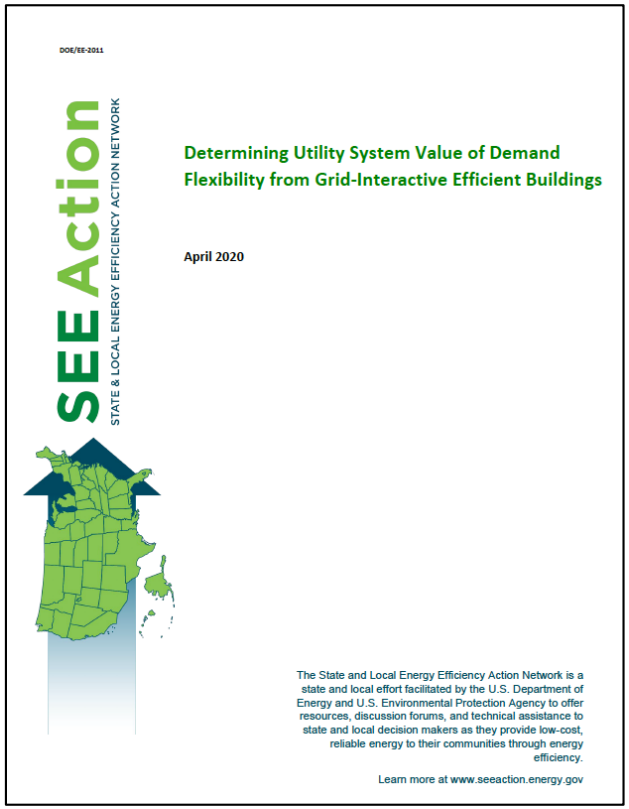
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STATE & LOCAL ENERGY EFFICIENCY ACTION NETWORK

Determining Utility System Value of Demand Flexibility from Grid-Interactive Efficient Buildings

April 2020

The State and Local Energy Efficiency Action Network is a state and local effort facilitated by the U.S. Department of Energy and U.S. Environmental Protection Agency to offer resources, discussion forums, and technical assistance to state and local decision makers as they provide low-cost, reliable energy to their communities through energy efficiency.

Learn more at www.seeaction.energy.gov

**Technical assistance funds are limited. All responses will be considered and will inform development of technical assistance topics and delivery approaches to best address needs articulated.*

# Primary Factors Impacting Value of Demand Flexibility

- There is no single economic value of demand flexibility for utility systems.
- 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.

# Primary Valuation Task

- The primary task required to determine the value of demand flexibility based on avoided cost is to *identify the alternative (i.e., "avoided")* resource and *establish its cost*.

- Methods used to establish avoided cost vary widely across the United States due to differences in:*
  - electricity market structure
  - available resource options and their costs
  - state energy policies and regulatory context

# Primary Methods of Resource Options Analysis for DERs

- **System capacity expansion and market models***
  - *Most prevalent practice* – Reducing the growth rate of energy and/or peak demand in load forecasts input into the model, then let it optimize the type, amount, and schedule of new conventional resources (generation, transmission or distribution)
  - *Less prevalent practice* - Directly competing distributed energy resources (DERs) with conventional resources in the model to determine DERs' impact on existing system loads, load growth, and load shape—and thus dispatch of existing resources—and the type, amount, and timing of conventional resource development
- **Competitive bidding processes/auctions:*** Use "market mechanisms" to select new DERs, currently limited to energy efficiency (EE) and demand response (DR)
- **Proxy resources:** Use the cost of a resource that provides grid services (e.g., a new natural gas-fired simple-cycle combustion turbine to provide peaking capacity) to establish the cost-effectiveness of DERs (i.e., determine the amount to develop) that provide these same grid services
- **Administrative/public policy determinations**: Use legislative or regulatory processes to establish development goals (e.g., Renewable Portfolio Standards and Energy Efficiency Resource Standards)

**Also used for utility-scale resource options analysis*

# Gaps and Limitations of Current Methods - 1

**Restructured Markets**

- Not all DERs are eligible to participate in markets.
- Not all utility system DER benefits are reflected in the bulk power system. Not captured:
  - Locational value of avoided/deferred T&D capacity
  - Value of distribution system losses
  - Value of resilience
- "Long-term" resource value is not recognized in some markets.
  - For example, PJM limits compensation for EE and DR to four years, regardless of measure life, assuming that the impact of these resources will be embedded in its econometric forecast after that period.

# Gaps and Limitations of Current Methods - 2

## Utilities in Vertically Integrated States

- Not all utilities (or state requirements) include all system benefits of DERs.
  - e.g., some include time-varying, locational, risk mitigation, and resilience value, while others do not
- Not all utilities (or state requirements) consistently quantify system benefits of DERs.
  - e.g., some use marginal distribution system losses to "gross up" impacts to generation and transmission system, while others use average system losses, and the accuracy of load shape data (if used) varies widely
- Resource options analysis often fails to account for the potential interaction *between* DERs (e.g., impact of EE on DR potential, impact of storage on distributed generation).
- Typical resource optimization modeling embeds DER impacts in the load forecast, so it fails to capture potential DER interactions with existing and future resources.
- Commercially available capacity expansion models have limited capability to model DERs as resource options (except perhaps DR and battery storage).

# Enhanced Valuation Methods: Seven Considerations*

1. Account for *all electric utility system economic impacts* resulting from demand flexibility
2. Account for variations in value based on *when* demand flexibility occurs
3. Account for the *impact of distribution system* savings on transmission and generation system value
4. Account for variations in value specific *locations* on the grid
5. Account for variations in value due to *interactions between DERs* providing demand flexibility
6. Account for benefits across the *full expected useful lives* (EULs) of the resources
7. Account for variations in value due to *interactions between DERs and other system resources*

**See summary implementation guidance and resources in Extra Slides.*

# Applicability of Enhanced Valuation Methods to Distribution, Generation, and Transmission Planning Analyses

| Enhanced valuation methods to account for: | Distribution System Planning | | | Generation Planning | | Transmission Planning | |
|---|---|---|---|---|---|---|---|
| | Hosting Capacity (for distributed generation capacity) | Energy Analysis (loss estimation) | Thermal Capacity (peak capacity) | Capacity Expansion Modeling | Market-Based Mechanisms | Capacity Expansion Modeling | Congestion Pricing Analysis |
| 1. All electric utility system economic impacts resulting from demand flexibility | ● | ● | ● | ● | ● | ● | ● |
| 2. Variations in value based on when demand flexibility occurs | ● | ● | ● | ● | ● | ● | ● |
| 3. Impact of distribution system savings on transmission and generation system value | ◔ | ● | ◑ | ◑ | ◑ | ◑ | ◑ |
| 4. Variations in value at specific locations on the grid | ● | ● | ◔ | ◔ | ◔ | ● | ● |
| 5. Variations in value due to interactions between DERs providing demand flexibility | ● | ◕ | ● | ◕ | ◕ | ◕ | ◕ |
| 6. Benefits across the full expected useful lives of the resources | ◑ | ◑ | ● | ◑ | ◑ | ● | ● |
| 7. Variations in value due to interactions between DERs and other system resources | ◕ | ◑ | ● | ● | ● | ● | ● |

● most applicable, ◔ least applicable

# TECHNICAL ASSISTANCE TOPICS AND SERVICES

# Example Technical Assistance Topics

- Resolving data gaps
- Addressing limits of current state/utility analytical methods and models
- Assessing potential impacts of DERs on utility system loads
- Integrating DERs in system capacity expansion models and modeling
- Translating DER valuation results into program planning and design
- Developing an action plan for improving DER valuation methods in utility system planning
- Supporting stakeholder engagement

# Example Technical Assistance Services

- Individual state consultations on active proceeding
- Building up staff capabilities
- Help updating planning or modeling guidance for utilities
- Information/education (e.g., case studies, webinars)

# QUESTIONNAIRE FOR STATES INTERESTED IN TECHNICAL ASSISTANCE

- Link to questionnaire: https://www.surveymonkey.com/r/Q2KTHS7
- We will share our screen showing the questionnaire at this link, explain each item and answer your questions.
- **State responses are due July 10.**

# Q&A WITH REPORT AUTHORS

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# EXTRA SLIDES

# New SEE Action reports on Grid-interactive Efficient Buildings

- **Introduction for State and Local Governments** *by Lisa Schwartz and Greg Leventis*
  - Describes grid-interactive efficient buildings in the context of state & local government interests
  - Describes trends, challenges, and opportunities for demand flexibility
  - Features programs integrating demand-side management for multiple grid services*
  - Provides an overview of valuation and performance assessments for demand flexibility
  - Outlines actions that state and local governments can take, in concert with utilities, regional grid operators, and building owners, to advance demand flexibility
- **Determining Utility System Value of Demand Flexibility** *by Tom Eckman, Lisa Schwartz, and Greg Leventis*
  - Describes how current methods and practices that establish value to the electric utility system of investments in energy efficiency and other distributed energy resources can be enhanced to determine the value of grid services provided by demand flexibility
- **Issues and Considerations for Advancing Performance Assessments of Demand Flexibility** *(forthcoming) by Steve Schiller, Lisa Schwartz, and Sean Murphy*
  - Summarizes current practices and opportunities to encourage robust and cost-effective assessments of demand flexibility performance and improve planning and implementation based on verified performance

*Webinar slides and audio recordings for first two reports available here (8/13/19 and 4/6/20 webinars)*

*See example in "Extra Slides"

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# Grid-interactive Efficient Buildings and Demand Flexibility

| | |
|---|---|
| Grid-interactive Efficient Building | An energy-efficient building that uses smart technologies and on-site DERs to provide demand flexibility while co-optimizing for energy cost, grid services, and occupant needs and preferences in a continuous and integrated way |

| | |
|---|---|
| Demand Flexibility* | Capability of DERs to adjust a building's load profile across different timescales |

*DERs* – Resources sited close to customers that can provide all or some of their immediate power needs and/or can be used by the utility system to either reduce demand or provide supply to satisfy the energy, capacity, or ancillary service needs of the grid

*Smart technologies for energy management* - Advanced controls, sensors, models, and analytics used to manage DERs. Grid-interactive efficient buildings are characterized by their use of these technologies.

**Also called "energy flexibility" or "load flexibility"*

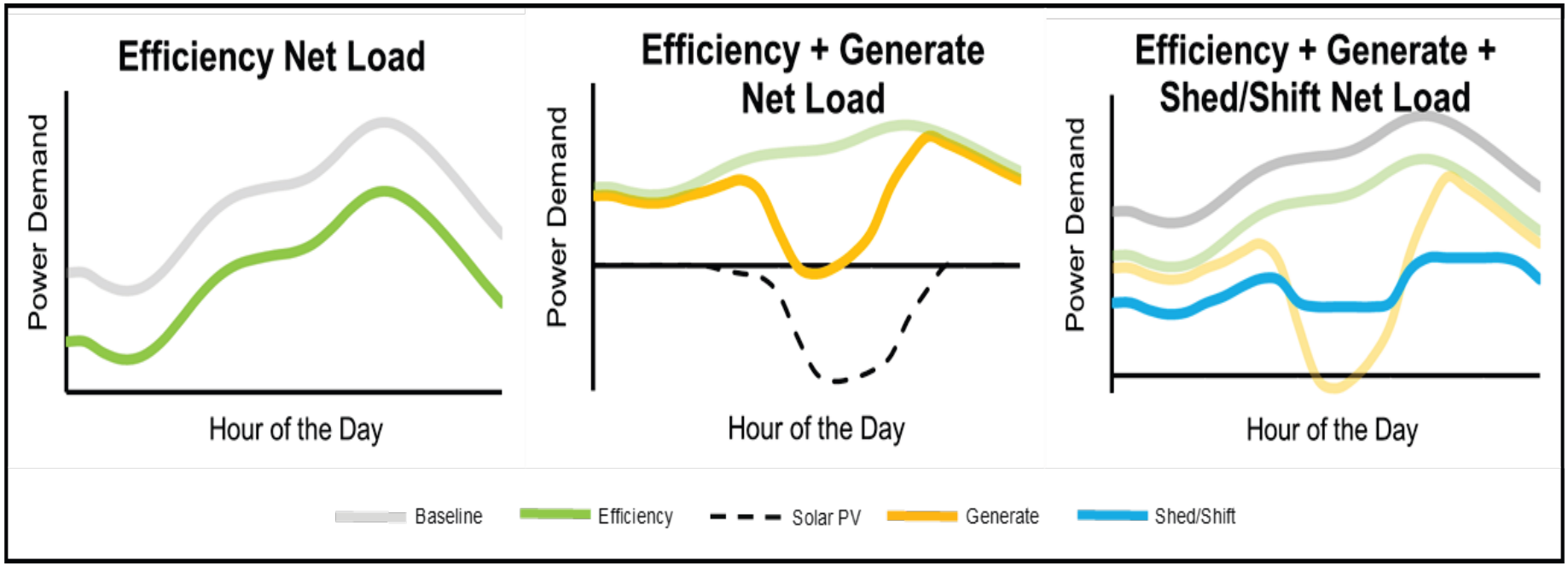
Source: Neukomm et al. 2019. *Grid-interactive Efficient Buildings Technical Report Series: Overview of Research Challenges and Gaps*. More information here.

# Demand-side Management Strategies to Manage Building Loads

- *Energy efficiency:* Ongoing reduction in energy use while providing the same or improved level of building function
- Demand flexibility:
  - *Load shed*: Ability to reduce electricity use for a short time period and typically on short notice.
  - *Load shift*: Ability to change the timing of electricity use. In some situations, a shift may lead to changing the amount of electricity that is consumed.
  - *Modulate*: Ability to balance power supply/demand or reactive power draw/supply autonomously (within seconds to subseconds) in response to a signal from the grid operator during the dispatch period
  - *Generate*: Ability to generate electricity for onsite consumption and even dispatch electricity to the grid in response to a signal from the grid

Source: Neukomm et al. 2019

# Daily Average Load Profiles for Grid-interactive Efficient Building




Source: Neukomm et al. 2019

***Left:*** *Energy efficiency alone pushes down the load curve.*
***Middle:*** *Energy efficiency plus distributed generation (in this case, solar PV) reduce overall energy use, but the building's peak load coincides with utility peaks.*
***Right:*** *Adding load shedding and shifting flattens the building load profile, providing the greatest support to the grid.*

# Summary of Valuation Enhancements and Implementation Guidance (1)

| Valuation Enhancement | Guidance |
|---|---|
| **1. Account for all electric utility system economic impacts resulting from demand flexibility** | Prioritize enhancements for analyses used to derive the value of primary utility system benefits. |
| **2. Account for variations in value based on when demand flexibility occurs** | Develop and use hourly forecasts of avoided energy and capacity costs in combination with publicly available load shape data for DERs to value demand flexibility. |
| **3. Account for the impact of distribution system savings on transmission and generation system value** | Model and calculate distribution system-level impacts (i.e., locational impacts and associated economic value) first so that results can be used to adjust inputs to analysis of bulk transmission and generation system values. |

# Summary of Valuation Enhancements and Implementation Guidance (2)

| Valuation Enhancement | Guidance |
|---|---|
| **4. Account for variations in value at specific locations on the grid** | Initiate a distribution system planning process that includes: (1) hosting capacity analysis to estimate generating DER capacity limits and identifies demand flexibility that can mitigate limits, (2) thermal limit analysis to estimate locational value of non-wires solutions, (3) energy analysis to quantify marginal distribution system losses, and (4) systemwide analysis of the avoided cost of deferred distribution capacity expansion. |
| **5. Account for variations in value due to interactions between DERs providing demand flexibility** | Start accounting for interactions between DERs. Basic analysis can assume that deployment of multiple types of DERs does not impact the existing or future electric grid in a way that alters avoided costs. Such basic analysis does not require the use of system capacity expansion models. |

# Summary of Valuation Enhancements and Implementation Guidance (3)

| Valuation Enhancement | Guidance |
|---|---|
| **6. Account for benefits across the full expected lives of the resources** | As a first step, use the EUL of DERs providing demand flexibility to calculate their economic value. However, because demand flexibility is largely based on controls, the dispatch of which is determined by the combined impact of grid operators and owner/occupant responses, EULs may be more a function of rate and program design, compared to EULs for traditional energy efficiency measures. Uncertainty regarding EULs for demand flexibility may be best addressed through program design. |
| **7. Account for variations in value due to interactions between DERs and other system resources** | Use distribution, transmission and generation capacity expansion modeling, supplemented as necessary with other methods described in section 4 of this report, to determine the impact of widespread deployment of demand flexibility for grid services. Implementing this enhancement will require customization of commercially available capacity expansion models. |