Demand Flexibility as a Utility System Resource

Natalie Mims Frick
Berkeley Lab

Integrated Distribution System Planning Training for Midwest/MISO Region
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Agenda

- What is demand flexibility?
- Why is demand flexibility important?
- Examples of technologies that promote demand flexibility
- Opportunities for states
- Examples of states and utilities advancing demand flexibility today
- Resources for more information

What is demand flexibility?

What is demand flexibility?

- Distributed energy resources (DERs) are energy efficiency, demand response (DR), distributed generation, distributed energy storage, electric vehicles (EVs) and combined heat and power.
- Demand flexibility (also called energy or load flexibility) is the capability of DERs to adjust demand profiles across different timescales.
  - 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

Value of demand flexibility

- Traditionally, the economic value of energy efficiency, demand response, and other DERs has been determined using the "avoided cost" of conventional resources that provide the identical utility system service.
- 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.
- The underlying economic principle of this approach is that the *value* of a resource can be estimated using the *cost of acquiring the next least expensive alternative resource* that provides comparable services (i.e., the *avoided cost* of that resource).
- The value of demand flexibility can be determined in the same way, by *identifying the alternative ("avoided")* resource and *establishing its cost*.

Source: *Determining Utility System Value of Demand Flexibility From Grid-Interactive Efficient Buildings*

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.

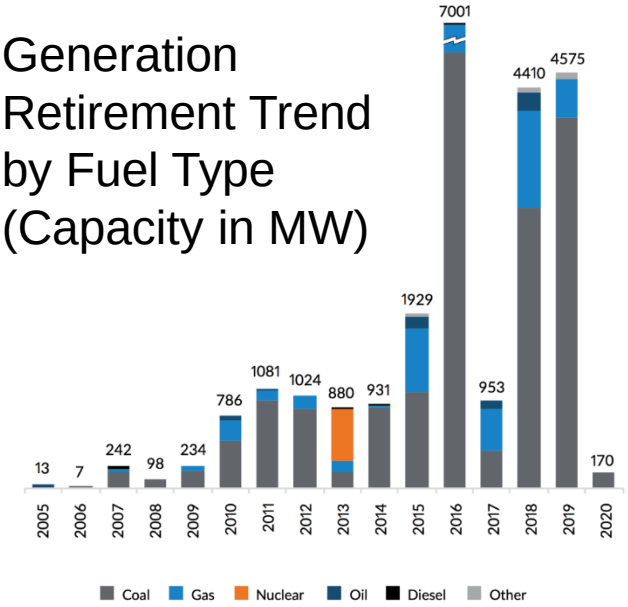
Source: *Determining Utility System Value of Demand Flexibility From Grid-Interactive Efficient Buildings*

Why is demand flexibility important?

The electricity system is changing, requiring changes in grid operations and greater consideration of loads as a flexible resource.

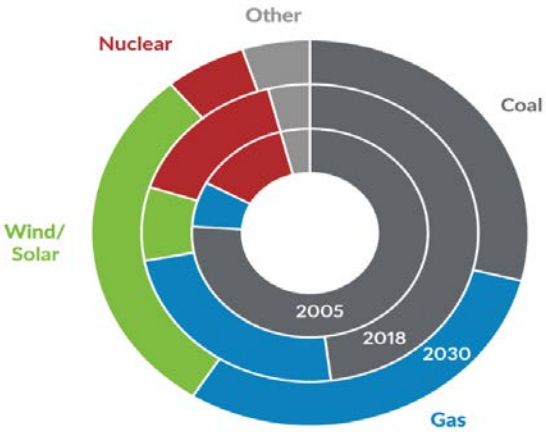
GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Generation Retirement Trend by Fuel Type (Capacity in MW)

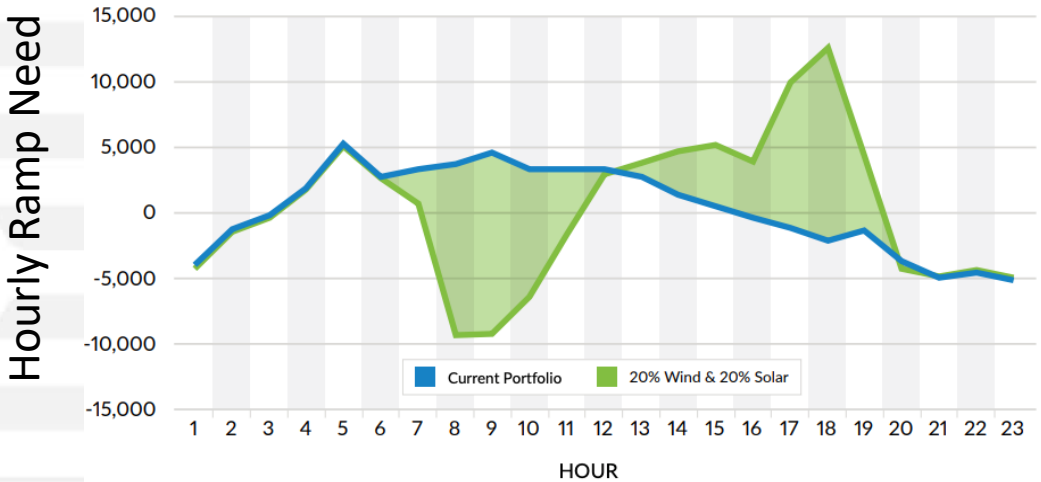


MISO Energy Mix Transition from 2005 to 2018 to 2030

Notes: based on utility announcements and state integrated resource plans. Chart reflects ratio of generation.

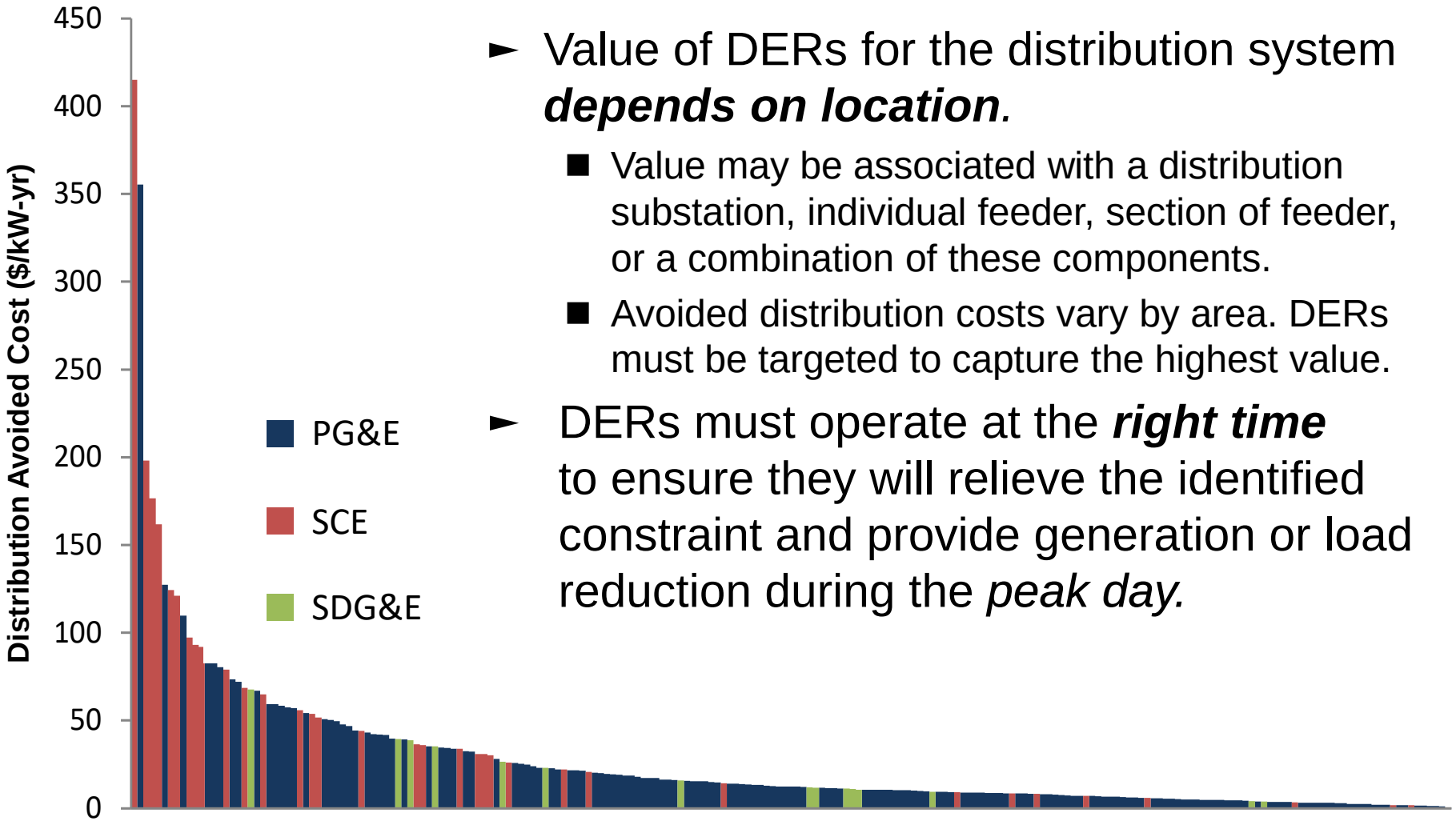


The evolving portfolio requires increased and more dynamic ramp capabilities.



Sources: MISO December 2019, MISO March 2019

DERs must be in the right place and operate at the right time to meet system needs.



- Value of DERs for the distribution system ***depends on location***.
  - Value may be associated with a distribution substation, individual feeder, section of feeder, or a combination of these components.
  - Avoided distribution costs vary by area. DERs must be targeted to capture the highest value.
- DERs must operate at the ***right time*** to ensure they will relieve the identified constraint and provide generation or load reduction during the *peak day.*

E3 study for California using utility distribution planning information

Example grid services that demand flexibility can provide and potential avoided costs

Grid Services	Potential Costs Avoided (or Deferred)
Generation	
Energy	Power plant fuel, operation and maintenance (O&M), and startup and shutdown costs
Capacity	Capital costs for new generating facilities and associated fixed O&M costs
Ancillary Services	
Contingency Reserves	Power plant fuel and O&M costs
Frequency Regulation	Power plant fuel and O&M costs
Ramping	Power plant fuel, O&M, and startup and shutdown costs
Delivery	
Non-Wires Solutions	Capital costs for transmission & distribution (T&D) equipment upgrades
Voltage Support	Capital costs for voltage control equipment (e.g., capacitor banks, transformers)

MISO state energy goals and activities*

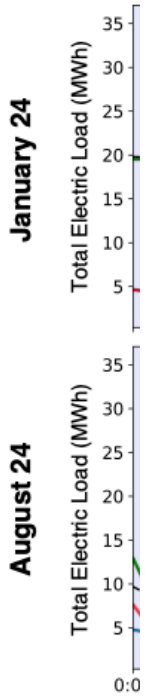
	EE	RE	Storage
AR	For 2020-2022, savings targets are 1.20% of 2018 baseline sales for electric utilities	-	Net metering docket includes storage as a resource
IL	ComEd- 21.5% cumulative savings by 2030; Ameren – 16% cumulative savings by 2030; Natural gas - 1.5% of sales by 2019	25% by 2026	Nextgrid proceeding (2018) recommended action on energy storage legislation and regulation; Clean Energy Jobs Act
IN	-	*10% by 2025*	-
IA	Savings targets for rate-regulated electric and gas utility	105 MW	-
KY	*Reduce projected 2025 consumption by 18%*	-	-
LA	Incentive mechanism for Entergy New Orleans if achieve 75-125% of goal	-	-
MI	1% prior year sales for electricity; 0.75% for natural gas	15% by 2021 with solar multiplier;	Open PUC docket on interconnection rules including storage; Storage must be evaluated in integrated resource planning
MN	Electricity and natural gas - 1.5% of retail sales annually	26.5% by 2025 (IOUs); 31.5% by 2020 (Xcel)	Dep't of Commerce +E3 conducting cost-benefit study of storage
MO	*1.9% of total annual energy; 1.0% annual peak demand*	15% by 2021	Draft PSC rules on DER analysis, including storage
MS	-	-	-
MT	-	15% by 2015	-
ND	-	*10% by 2015*	-
SD	*10% by 2015*		-
TX	30% reduction in peak demand growth, then 0.4% reduction of each company's prior year peak demand annually	5,880 MW by 2015. Multiplier for solar or customer-sited renewables	-
WI	1.2% annual retail revenue	10% by 2015; *100% by 2050*	-

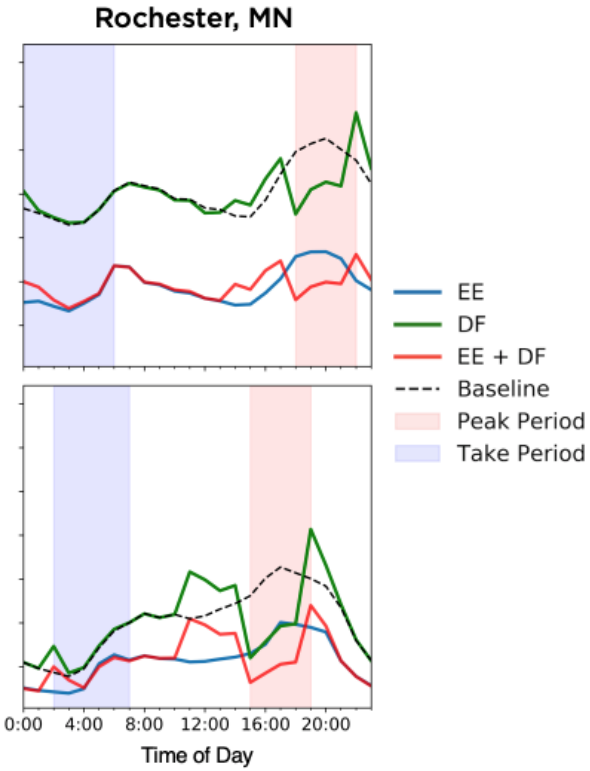
*As of 2/2020. Not intended to be comprehensive. Sources: MEEA, DSIRE, NCSL., PNNL. State goals are shown in *italics*.

Examples of technologies that promote demand flexibility

Residential demand flexibility measures and impact

DF Measure	Approach
Water heater	*Pre-heat to 140°F during take period (second take period, if applicable), then return to 125°F setpoint.*
Thermostat	*Pre-cool/pre-heat by 3°F starting 4 hours before the peak, then set-back/set-up of 4°F relative to original setpoint during peak period. Thermostat DR setpoints take precedence over EE thermostat setpoints.*
Clothes washer, Clothes dryer, Dishwasher	*Baseline schedules are generated as normal (randomly based on distributions). Then event clusters during peak are shifted after peak if possible, if not then before peak if possible, if not then left as-is.* *No change in total energy use.*
Pool pump	*All energy use during peak period is removed and added uniformly to energy use during the (first) take period.* *No change in total energy use.*
Electronics	*Of peak period electronics energy usage:* • *11% is shifted to the 2 hour period following the peak, representing discharging batteries during peak.* • *4% is removed, representing zero standby power consumption (i.e., advanced power strip controls).* *Total energy use decreases.*



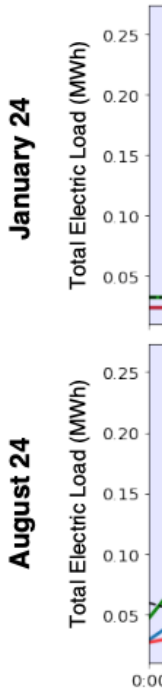


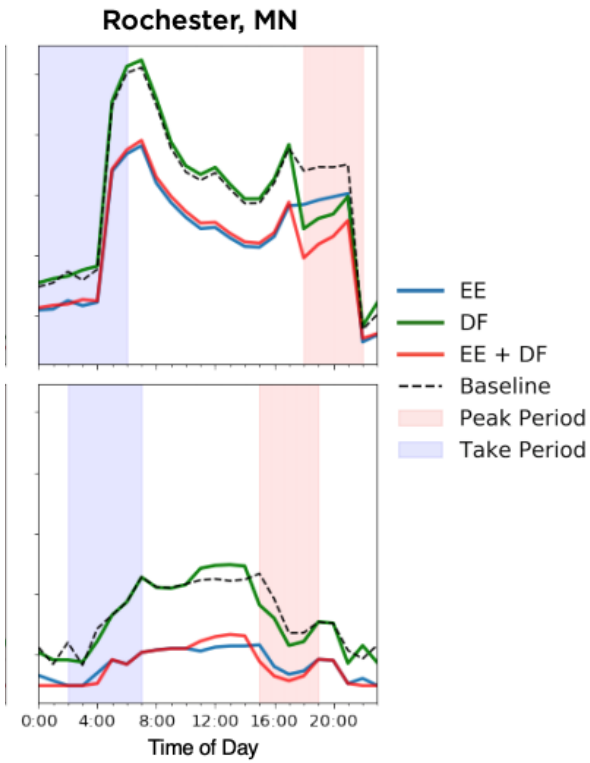
Source: Langevin et al. 2020

Commercial demand flexibility measures and impact

Commercial measure scenario load impacts (medium office)

DF Measure	Approach
Lighting	*Reduce lighting loads by 30% for occupied spaces and 60% for unoccupied spaces during the peak hours.*
Plug loads	*Reduce plug loads by 20% for occupied spaces and 100% for unoccupied spaces during the peak hours.*
Global temperature adjustment	*Increase global temperature by 5°F in the summer and decrease by 2°F in the winter. The adjustment occurs during peak hours.*
Pre-cooling	*Pre-cool by 2°F four hours before the peak period. Passive pre-cooling applies to the Medium Office, Stand-Alone Retail, and Warehouse prototypes.*
Ice storage	*Implement a 6.7 COP charging chiller and ice storage on the HVAC plant loop. Charge ice storage 12AM to 6AM. Discharge ice storage during the peak period. The active ice storage option applies to the Large Hotel and Large Office prototypes.*





Source: Langevin et al. 2020

Opportunities for states to advance demand flexibility

Key Actions States (and Local Governments) Can Take to Advance Demand Flexibility	Gov. Office	PUC	SEO	Other Agencies*	City/County	Utilities	RTO/ISO	Bldg. Owners**
1. Gather Information and Identify Opportunities								
Consider how demand flexibility can support goals	●	●	●	●	●	●	●	●
Inventory options and select opportunities for early action	●	●	●	●	●	●	●	●
Participate in pilot projects and share best practices		●	●	●	●	●		●
2. Develop and Implement Strategies in Integrate Demand Flexibility								
Develop a roadmap to advance demand flexibility	●	●	●	●	●	●	●	●
Develop mechanisms to allow building owners, operators, and occupants to earn compensation for providing grid services		●	●			●	●	●
Conduct outreach and education about opportunities and benefits		●	●	●	●	●	●	●
3. Accelerate Adoption								
Assess and remove barriers to advancing demand flexibility in buildings for grid services	●	●	●	●	●	●	●	●
Update economic valuation methods for DERs as energy assets for utility programs, plans and procurements		●				●		●
Establish practices for robust and cost-effective assessments of demand flexibility performance for utility programs and electricity markets		●	●	●	●	●	●	●
Regularly assess and report on progress	●	●	●	●	●	●	●	●

*For example, state departments of general services, codes, environment, economic development, and transportation, and financing authorities.
**Opportunities for owners and operators of privately owned buildings to support state and local activities.

Source: *Grid-Interactive Efficient Buildings: An Introduction for State and Local Governments*

Update economic valuation methods for DERs that provide demand flexibility

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

Source: *Determining Utility System Value of Demand Flexibility From Grid-Interactive Efficient Buildings*

Establish practices for robust assessment of demand flexibility performance

State and local governments can play important roles to support reliable and cost-effective performance assessments for demand flexibility as well as for energy efficiency.

Types of Actions	State and Local Government Roles			
	Regulate Jurisdictional Utilities	Operate Demand Flexibility Programs	Establish Codes and Standards	Operational Responsibilities for Public Buildings
Encourage assessments and share results	X	X		X
Adopt current best practices	X	X	X	X
Support advances in assessment practices	X	X		
Improve access to data from existing utility billing meters	X	X		
Consider improvements in metering infrastructure and related standards and protocols (including for utility service connections)	X	X	X	

Source: *Assessing Demand Flexibility Performance of Grid-Interactive Efficient Buildings*

Examples of states and utilities encouraging demand flexibility today

Lisa Schwartz, Berkeley Lab, contributed to this section.

Resource standards

- Resource standards
  - Include resources that can reduce demand during seasonal peak demand periods (e.g., "demand response resources" are eligible in Massachusetts' Clean Peak Energy Standard)
  - Include peak demand targets for energy efficiency resource standards (e.g., Colorado, Illinois, Ohio and Texas) - See Berkeley Lab's *Time-Sensitive Value of Efficiency: Use Cases in Electricity Sector Planning and Programs*
  - For states that require utilities to acquire all cost-effective energy efficiency in lieu of an energy efficiency resource standard, account for efficiency's time-sensitive value (in addition to report cited immediately above, see *Impacts of High Variable Renewable Energy Futures on Electric-Sector Decision Making: Demand-Side Effects*)

Massachusetts Clean Peak Standard

- In August 2020, Massachusetts Department of Energy Resources promulgated regulations establishing the Clean Peak Energy Portfolio Standard. Policy goals include reducing peak electricity demand and emissions and low cost.
- In 2020, load-serving entities must meet 1.5% of eligible retail sales with clean peak energy. The annual percentage will increase by 1.5% per year through 2050. The peak period is defined by season (see top table).
- Eligible resources: new and existing renewable energy, qualified energy storage system that is primarily charged from renewable energy (see bottom table) and demand response.
- Multipliers adjust the number of clean peak energy credits for each MWh of energy generated during the peak period. For example, there is a seasonal summer/winter 4x multiplier. Resources that generate during the hourly monthly system peak receive a 25x multiplier. Some resources have a multiplier of less than one.

Seasonal Peak Periods

Season	Months	Peak hours
Winter	Dec 1 – Feb 28	4 – 8 pm
Spring	March 1 – May 14	5 – 9 pm
Summer	May 15 – Sep 14	3 – 7 pm
Fall	Sep 15 – Nov 30	4 – 8 pm

Energy Storage Charging Periods

Season	Wind	Solar
Winter	12 – 6 am	10 am – 3 pm
Spring		8 am – 4 pm
Summer		7 am – 2 pm
Fall		9 am – 3 pm

Utility and market programs

- Utility efficiency programs
  - Integrate efficiency programs with demand response programs — e.g., budgets, joint or coordinated staff, metrics for evaluating cost-effectiveness of integrated programs; see Potter, Stuart and Cappers, 2018.
  - Establish pay for performance programs for peak demand reductions; see Best, Fisher, Wyman 2019.
- Utility and market demand response programs
  - Participation in DR programs or time-based rates are an opportunity for customers to reduce electricity bills and emissions and provide grid services.
  - Automation and use of third party aggregators are opportunities to simplify participation in DR programs.
  - Many utilities in the MISO region have smart thermostat demand response programs that *shed* load. Few, if any, have used them to *shift* load to integrate variable renewable energy, reduce air pollutant emissions or achieve other energy goals.
  - MISO demand response services can be grouped into two categories – economic (high energy prices) and emergency (capacity shortage).

MISO demand response resources and capability

DR resource	Explanation	DR Type	MW		
			2017	2018	2019
Load Modifying Resources (LMR) – Behind the meter generation	LMR are obligated to curtain in an emergency and are used to satisfy the planning reserve margin. BTM assets that do not have direct interconnection to MISO	Emergency	3,822	4,496	4,480
LMR-DR	Primarily legacy interruptible demand from regulated utility programs	Emergency	6,112	7,137	7,684
DRR Type I	Provide a fixed, pre-specified quantity of energy or contingency reserve through physical interruption.	Economic	620	621	811
DRR Type II	Provide varying levels of energy or operating reserves on five minute basis.	Economic	0	3	13
Emergency DR	Resource that are called in emergencies but are not obligated to offer and do not satisfy MISO's planning reserve margin	Emergency	941	674	624

Source: Potomac Economics

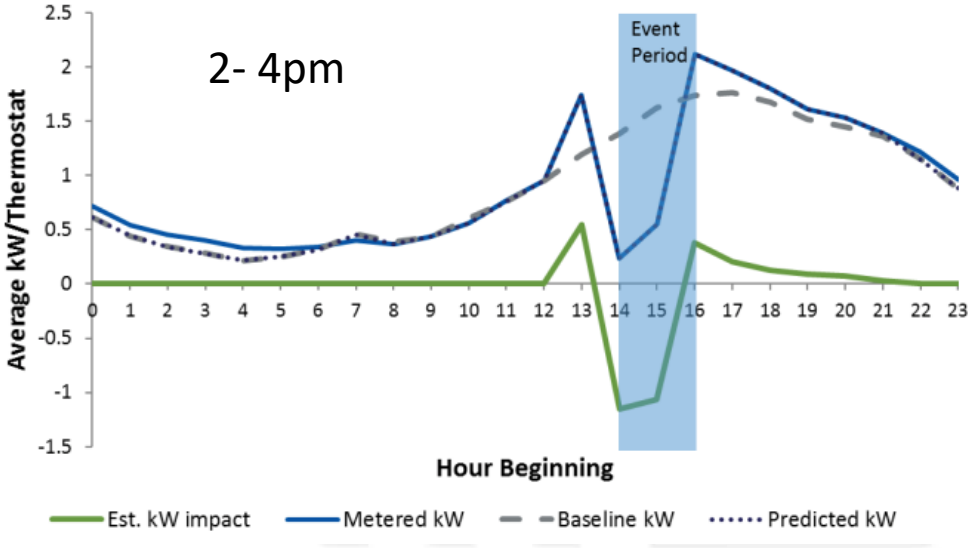
Massachusetts: ISO-NE demand resources and capacity tag

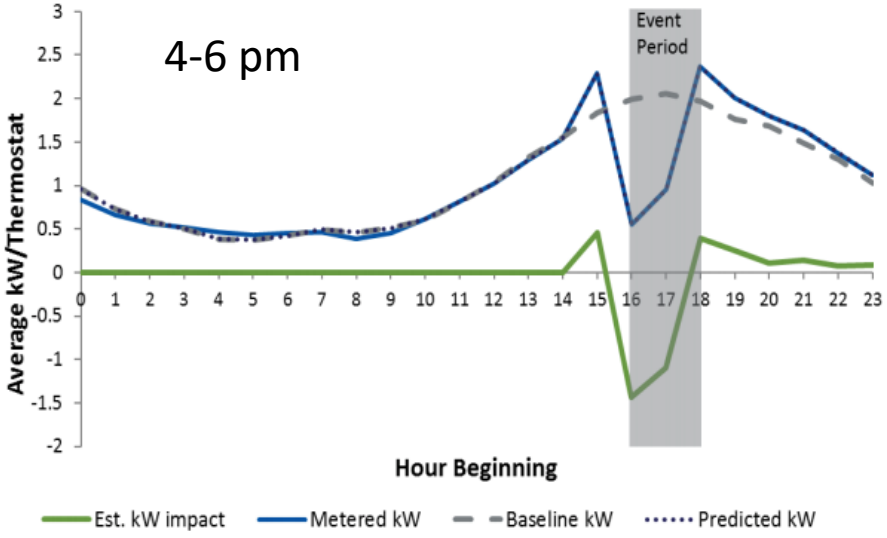
- The Massachusetts Division of Capital Asset Management and Maintenance has a contract for three offerings to state, local or quasi-governmental entities to use to reduce their energy costs.
  - Active demand capacity resources: electricity reductions that are bid into the forward capacity market and activated by the ISO. These resources can also participate in Day-Ahead and Real-Time markets.
  - On-peak demand resources: electricity reductions from non-dispatchable passive sources (e.g., efficiency, distributed generation, combined heat and power) bid into the forward capacity market with a supply obligation.
  - Capacity tag: During peak days, the amount of capacity used at a facility determines capacity assignment. Reducing demand during those days reduces bills for the next capacity year. This opportunity is between the utility and facility and is not an ISO-NE product.
- A third party bids the savings into ISO-NE.
- Participating facilities in Massachusetts save about $500,000/year using these programs.

Source: MA DCAMM

Vectren Smart Cycle program

- Vectren's Smart Cycle demand response program provides customers with a free Nest thermostat and $5 monthly bill credit (up to $20).
- In 2018, Vectren called ten events in July, August and September that each lasted two hours.
  - Eight events were from 2-4 pm and two events were from 4-6 pm.
  - During events homes were pre-cooled for one hour in advance and then the setpoint was raised three degrees. Occupants can override setpoint change.
  - Estimated kW impact is 858 kW and 973 kW for hour 1 and 2 of the events.





Entergy Smart Direct Load Control program

- From noon – 7 pm, a signal is sent to a smart thermostat to increase temperature by 2-4 degrees. Events typically last four hours.
- The program runs from June 1 – September 30 annually.

Initial Incentive Amount

	Direct Installation or ship/self install	Bring your own qualifying device	T-stat from another Entergy program
Residential	$225 value	$50	$25
Small business	$225 value	$100	$525

Additional Annual Incentive Amount

	No event opt out	1 event opt out	2-3 event opt out	4+ event opt out
Residential	$40	$40	$25	$0
Small business	$100	$100	$50	$0

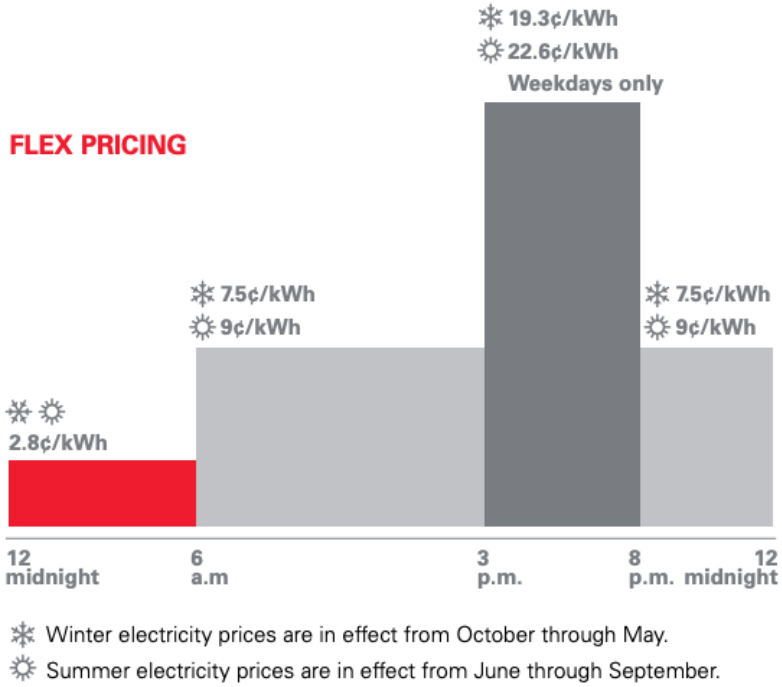
Source: Entergy

Rate design

- Rate design
  - Offer time-based rates with strong price signals (e.g., large differential between off- and on-peak rates); consider rates more reflective of hourly system costs (e.g., critical peak pricing, real-time pricing); consider opt-out offerings that yield far higher participation than opt-in
  - For default rates for large commercial customers, establish demand charges only during the peak demand period, or higher charges during the peak demand period

Minnesota electricity rates

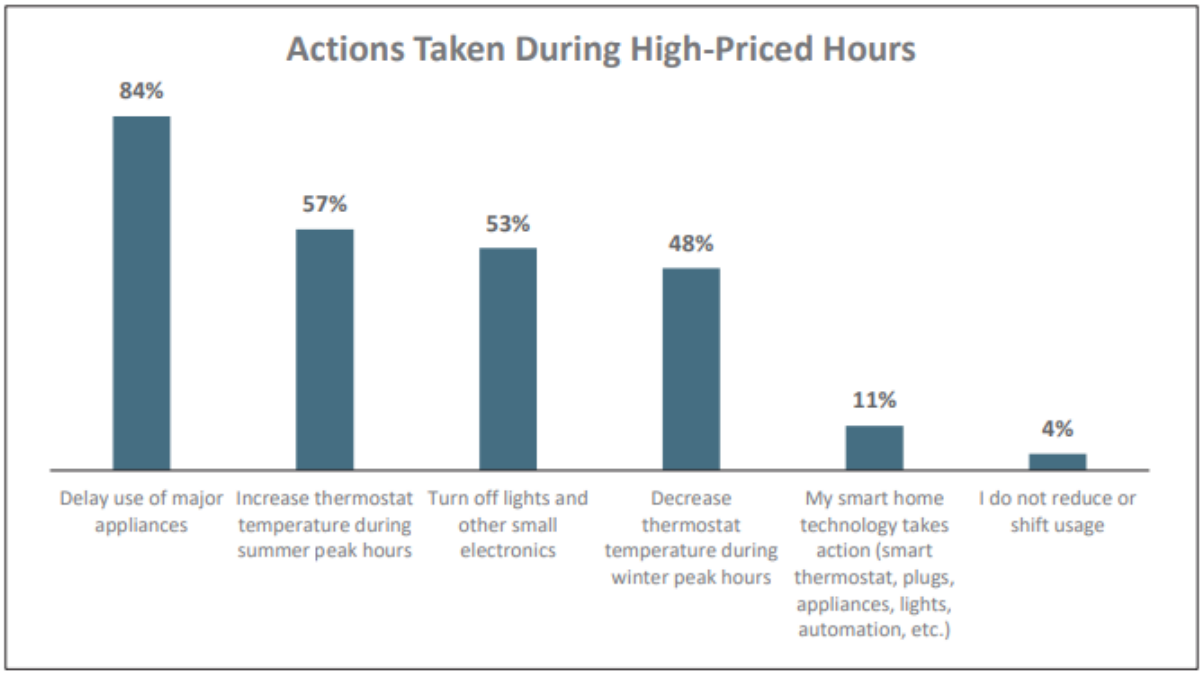
- The Minnesota PUC approved Xcel's residential time-of-use (TOU) pilot in 2018. Xcel will launch the Flex Pricing Pilot in November 2020.
- In March 2020, the Minnesota PUC required Xcel to "file a proposal to revise its General Time of Day Service rate to be **more reflective of hourly system costs and to send price signals that will reduce peak demand and increase system utilization**." (emphasis added)
  - Xcel filed a petition for General Service TOU rates in January 2020 and Minnesota Department of Commerce Staff recommended approval of the petition with modifications in August.
  - Xcel proposed to allow a limited number of participants, primarily EV owners, to use the rate prior to it opening to the general public in 2024.



Source: Xcel Energy

ComEd Hourly Pricing program

- Program participants have access to hourly PJM wholesale market prices.
- Participants shift their energy usage to reduce their electricity bills, including when PJM prices are negative.
- ComEd offers a variety of tools to assist participants including air-conditioning cycling programs, load guard, hourly pricing alerts, and a dashboard and app to see day-ahead prices.



Source: ComEd

Performance incentives

- Performance incentives
  - Provide an opportunity for utilities and program administrators to earn financial incentives for achieving or exceeding specified peak demand savings targets (e.g., HI, MA, MI, NY, RI and VT; see Relf, Baatz and Nowak, 2018.
  - Develop performance metrics that encourage the utility to develop opportunities for customers to align their load with grid needs (see Gold, Myers, O'Boyle and Relf, 2020).

Minnesota performance metrics

- Investigation into Performance Metrics for Xcel Energy to identify and develop performance metrics that better align customer load with carbon-free resources and reduce peak demand, among other goals
- Commission order in April approved metrics, including those for cost-effective alignment of generation and load
  1. Demand response, including capacity available (MW, MWh) and amount called (MW, MWh per year)
  2. *Amount of demand response that shapes customer load profiles through price response, time varying rates or behavior campaigns (MW and MWh)**
  3. *Amount of demand response that shifts energy consumption from times of high demand to times when there is a surplus of renewable energy generation (MW and MWh)*
  4. Amount of demand response that sheds loads that can be curtailed to provide peak capacity and supports the system in contingency events (Actual load relief during an event by hour as compared to the delta between actual and estimated load that would have occurred without interruption)
  5. Metrics that measure the effectiveness and success of items 2-4, above, individually and in aggregate (load factor for load net of variable renewable generation)

**Italics indicate future metrics*

Executive actions and state energy plans

- Governor Pritzker's Eight Principles for a Clean and Renewable Illinois Economy identify his support for demand flexibility-related objectives including:
  - Giving the Illinois Commerce Commission "the ability to identify and impose standards **for controlling demand on the electricity grid.** Utility companies should be required to engage additional demand response tools based on peak periods, which will help reduce costs, lessen stress on the grid, and create opportunities for consumers to shift their usage patterns" (emphasis added)
  - Requiring an integrated distribution system plan designed to "**optimize utilization of electricity grid assets** and resources" (emphasis added) among other objectives.
- New Jersey's 2019 Energy Master Plan identifies seven strategies to achieve a state goal of 100% clean energy by 2050.
  - Strategy 3.2.2. Pilot alternative rate designs to manage EV charging and **encourage customer controlled demand flexibility** (emphasis added)
  - Strategy 5.3.3. Pilot and implement modified rate design to **encourage customer-controlled demand flexibility**, manage EV charging and support demand response programs (emphasis added).

Building energy codes

- Building energy codes - Require that equipment and systems are capable of varying their electricity demand in response to signals from building operators, DER aggregators, utilities or regional grid operators through some form of automation.
  - California Senate Bill 49 (2019) - Standards for cost-effective deployment of flexible demand technologies for appliances
  - California 2019 residential building energy code (Title 24) - Demand flexibility code provisions allow builders to use energy efficiency, demand response, thermal storage, and energy storage technologies to reduce the size of the solar PV system by 40% or more, while maximizing benefits to homeowners, the grid, and the environment. The reduction is based on time-dependent valuation of modeled energy consumption of the building, accounting for generation from the solar PV system and the building's demand flexibility measures. (See section 7.3 of the code here and response to code FAQ #4)
  - California 2019 nonresidential building energy code - Requires that certain buildings are demand response-ready

Example policies and regulations based on ongoing research, Lisa Schwartz, Berkeley Lab

Questions states can ask

- What state or utility goals will demand flexibility help advance?

- What state policy and regulatory gaps can be filled to advance demand flexibility?
  - Can state programs be modified to include demand flexibility?
  - Are utilities considering demand flexibility in their demand-side management portfolios?
  - How are utilities valuing demand flexibility?
  - What performance metrics are necessary to measure demand flexibility?
  - Are existing utility incentive mechanisms sufficient to advance demand flexibility?
  - Do current rate designs encourage consumers to align their consumption with electricity grid needs?

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- Supported by U.S. DOE Building Technologies Office
- Inform states about GEB technologies and applications
- Identify opportunities and impediments
- Identify and express state priorities, concerns, interests
- Recognize temporal and locational value of EE and other DERs
- Enhance energy system reliability, resilience, and affordability

Inform state planning, policy, regulations, and programs

More information here. Additional states (public utility commissions and state energy offices) are welcome to join.

Resources for more information

- State and Local Energy Efficiency (SEE) Action Network. *Grid-Interactive Efficient Buildings: An Introduction for State and Local Governments*. Prepared by L. Schwartz and G. Leventis, Lawrence Berkeley National Laboratory. 2020.
- SEE Action Network. *Determining Utility System Value of Demand Flexibility From Grid-Interactive Efficient Buildings*. Prepared by T. Eckman, L. Schwartz, and G. Leventis, Lawrence Berkeley National Laboratory. 2020.
- SEE Action Network. *Assessing Demand Flexibility Performance of Grid-Interactive Efficient Buildings*. Prepared by S. Schiller, S. Murphy, and L Schwartz, Lawrence Berkeley National Laboratory. 2020.
- T. Woolf, B. Havumaki, D. Bhandari, M. Whited, and L. Schwartz. *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments.* Lawrence Berkeley National Laboratory. Forthcoming.
- Satchwell, A., P. Cappers, J. Deason, S. Forrester, N. Frick, B. Gerke, and M.A. Piette. *A Conceptual Framework to Describe Energy Efficiency and Demand Response Interactions.* Lawrence Berkeley National Laboratory. Forthcoming.
- *Developing and Evaluating Metrics for Demand Flexibility in Buildings: Comparing Simulations and Field Data*. Forthcoming.
- Time and locational sensitive value of efficiency
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Contact information

Natalie Mims Frick

nfrick@lbl.gov

510-486-7584

Visit our website at: http://emp.lbl.gov/

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Potential barriers to states advancing demand flexibility

Potential Barrier	Potential Actions to Address Barriers									
	Lead by Example	Studies and Pilots	Enhanced Analytical Methods/ Practices	Model Standards and Protocols	Building and Product Programs	Financial Incentives for Utilities	Energy Planning	Building Codes and Appliance Standards	PUC Actions	Other State Actions
Consumer value proposition not well known	•	•			•		•		•	
Potential not well characterized	•	•	•				•		•	
Insufficient DSM program integration	•	•	•		•	•	•		•	•
Lack of coordination across programs	•	•			•		•		•	•
Constraints on third-party aggregation									•	•
Split incentives					•			•		
Misaligned compensation for consumers					•		•		•	•
Misaligned compensation for utilities		•				•	•		•	•
Deficient economic valuation methods			•		•	•	•		•	
Lack of integration across utility planning processes							•		•	
Inadequate benefit-cost methods			•				•		•	
Metrics and assessment needs	•	•	•	•						
Data access/data privacy concerns				•					•	•
Barriers to entry in markets		•	•							

Source: *Grid-Interactive Efficient Buildings: An Introduction for State and Local Governments*