State Indicators for Advancing Demand Flexibility and Energy Efficiency in Buildings – Part I

Demand Response and Energy Efficiency Targeted to Reduce Peak Electricity Demand

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Contents

Also see infographic at the link immediately above

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Glossary

Demand flexibility (DF): Capability provided by DERs to reduce, shed, shift, modulate or generate electricity; also called energy flexibility or load flexibility.

Demand response (DR): Change in the rate of electricity consumption in response to price signals or specific requests of a utility.

Demand-side management (DSM): The modification of energy demand by customers through strategies, including EE, DR, distributed generation, energy storage, electric vehicles, and/or time-of-use pricing structures.

Distributed energy resource (DER): A resource 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.

Energy efficiency (EE): Ongoing reduction in energy use to provide the same or improved function.

Grid-interactive efficient building (GEB): 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.

Peak demand: The maximum load during a specified period of time.

Source: [A National Roadmap for Grid-Interactive Efficient Buildings]

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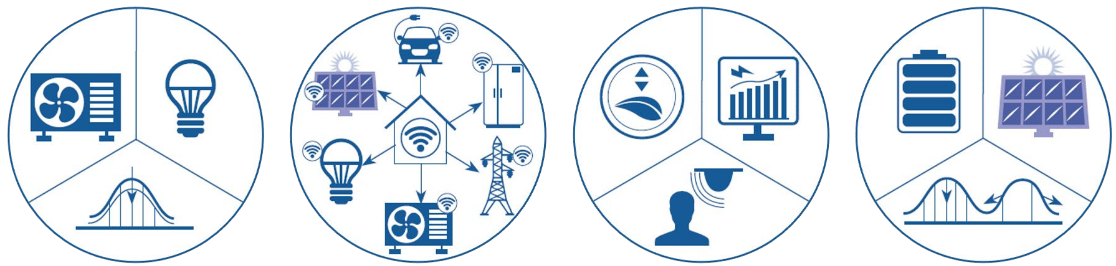
Project Purpose and Focus

- Identify objectives and key indicators for state activities that advance demand flexibility (DF) in buildings — legislation, utility regulatory proceedings, executive orders, and programs
- Illustrate progress to date
  - Illustrative examples, not an all-inclusive list
- Identify trends, gaps, and opportunities
- Focus on two types of distributed energy resources
  - *Demand response (DR)* — primarily incentive-based, dispatchable programs (e.g., direct load control, interruptible rates, demand bidding/buyback, and emergency DR), with some indicators for time-based rates **(Part I)**
  - *Energy efficiency (EE)*
    - Targeted to reduce peak demand or integrate with demand response **(Part I)**
    - Traditional EE — annual reductions in electricity and natural gas consumption **(Part II)**
- States can use these indicators to assess the status of their policies, regulations, and programs and consider paths to enable greater building DF and EE to meet their own energy and related goals.

Context (1)



EFFICIENT
Persistent low energy use minimizes demand on grid resources and infrastructure

CONNECTED
Two-way communication with flexible technologies, the grid, and occupants

SMART
Analytics supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences

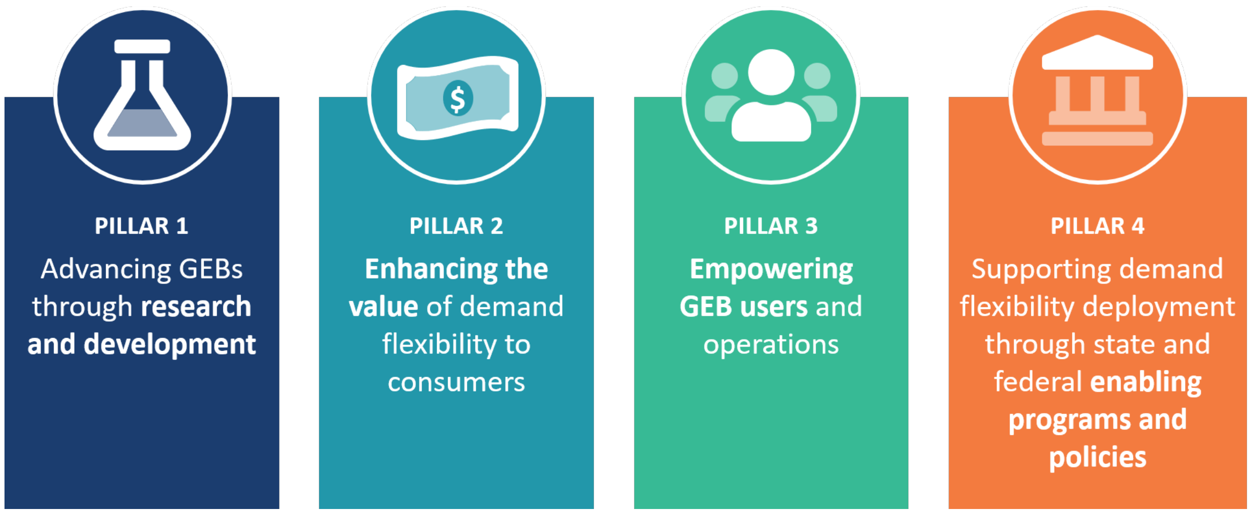
FLEXIBLE
Flexible loads and distributed generation/ storage can be used to reduce, shift, or modulate energy use

- Buildings account for >70% of consumption and carbon emissions in the U.S. power sector. Grid-interactive efficient buildings (GEBs) combine EE and DF to remake buildings into a clean and flexible resource.
- By 2030, GEBs could save up to $18 billion per year in U.S. power system costs ($100B-$200B by 2040)* and reduce power sector carbon emissions by 6%.

*Among the benefits not captured in these estimates:
- Avoided or deferred need for distribution capacity
- Reduced need to build renewable energy facilities to meet state portfolio requirements
- Additional consumer benefits like greater choice and control and, in some cases, improved building comfort
- Higher cost savings in a future with significant electrification of heating and transportation as EE and DF reduce the need for supporting grid infrastructure

Context (2)

- DOE's goal for GEBs: Triple EE and DF in U.S. buildings by 2030, compared to 2020
- The GEBs Roadmap includes recommendations to support GEB adoption and overcome barriers, organized in four pillars. This state indicators project relates primarily to Pillar 4, supporting DF deployment through state and federal **enabling programs and policies**.*



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**See Appendix A*

Objectives for State Actions*

- Environmental
  - Reduce energy waste
  - Meet clean energy, climate, and electrification goals
  - Improve integration of variable renewable energy
- Reliability/resilience
  - Reduce peak demand
  - Modernize electricity systems to enable DERs, grid flexibility
- Economic
  - Keep electricity costs down
  - Reduce utility disincentives to EE and DF adoption by decoupling utility revenue from utility retail sales
  - Encourage utility investments in EE, DF, and electrification through alternate cost recovery methods and performance-based incentives
  - Improve performance of existing EE and DR programs and rate designs and test new ones
  - Facilitate participation of DER aggregators
  - Improve DER consideration in utility system planning
- Other objectives
  - Improve building energy performance
  - Provide DF incentives to consumers through programs and rate designs
  - Accelerate adoption and use of technologies that enable DF, EE, and electrification
  - Integrate EE and DR goals with other state policies (e.g., jobs)

**Reasons expressed in legislation, regulatory proceedings, and executive orders*

Typology of State Demand Flexibility Indicators (1)

Building energy codes
- Value EE measures based on when savings occur
- Provide credit for DF measures through compliance paths
- Include grid-interactive requirements and open standards for communication and automated load management
- •Allow use of a carbon emissions-based metric for compliance, based on predicted energy consumption and CO_2 emission factors
- •Incorporate new ASHRAE standards (e.g., 90.1, 189.1)

Appliance and equipment standards
- Include provisions for equipment capable of automated load management in response to a signal from the utility, aggregator, or regional grid operator

Resource standards
- EE resource standards (EERS) include peak demand targets or a multiplier for energy savings during peak demand hours
- States requiring utilities to acquire all cost-effective EE account for the time-sensitive value of EE
- DR is included in EERS or is eligible to meet clean energy standards
- Load management standards encourage shifting electricity use to times with lower carbon emissions
- Storage requirements include thermal technologies

Utility planning
- Integrated resource planning considers DF measures and time-sensitive value of EE
- Electricity system planning accounts for interactions between DERs and between DERs and other resources
- Distribution system planning considers EE, DR, and other DERs as non-wires alternatives
- Utilities provide access to system level data to support customer and third-party solutions
- Planning for DR is coordinated with the regional grid operator
- Utility planning related to DF includes equity strategies

Utility programs
- EE program goals include peak demand reduction
- Cost-effectiveness assessments of EE programs consider time-sensitive value of savings
- EE program performance metrics include carbon emissions
- Requirements for DR programs include DR/DF potential studies
- DR program goals include significant increases in peak demand savings over time
- Requirements are established for new utility programs to reduce peak demand
- Programs for utility customers address equity
- Pay for performance programs reduce peak demand through EE + DF
- DR programs regularly tracked and evaluated
- Locational value informs incentive rates for EE and DR
- Programs address multiple DERs to achieve DF
- Utility programs are coordinated with state and local government programs and electricity markets

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Typology of State Demand Flexibility Indicators (2)

Advanced metering infrastructure and metering data

- Grid modernization plans provide a business case for AMI deployment, with costs and benefits monetized to the fullest extent possible
- AMI is in place, or deployment has been approved, for most utility customers
- Customers and their designated third party have granular and timely access to meter data
- Utilities provide energy management tools on web portal or customer mobile devices

Rate design

- Demand charges for commercial customers are applied only to peak demand periods, or charges are higher during peak demand periods
- Time-based rates provide strong price signals for peak demand reductions
- Retail rates are more reflective of hourly system costs and location
- •Robustness of approved programs is regularly tracked and evaluated

State programs

- •State EE incentive and financing programs incorporate DF or new DF mechanisms are established
- State lead by example programs demonstrate enabling technologies for DF and widely share results
- Benchmarking and transparency programs track and report on metrics for energy use, energy savings, peak demand reduction, and DF
- •Home energy rating programs include DF measures
- •State RD&D programs test approaches for increasing DF and quantifying benefits and costs

State energy planning

- DF is included as an explicit means to reach broader state energy goals in state master energy plans, resilience plans, renewable energy goals, decarbonization goals, and electrification plans

Related state policies and regulations

- Utilities and other program administrators have an opportunity to earn financial incentives for achieving or exceeding peak demand reduction and DF targets
- Revenue decoupling is in place for electric utilities
- Climate change policies consider the role of DF in reducing GHG emissions from buildings
- Grid modernization policies and regulations consider DF

See Appendix B for a detailed list of state demand flexibility indicators by category.

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EXAMPLE STATE ACTIONS ILLUSTRATING PROGRESS TO DATE

See Appendix C for example local actions.

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Thanks to E9 Insight and Natalie Mims Frick for help identifying some of these examples.

Building Energy Codes

- Code values EE measures based on when savings occur
  - CA's Title 24 building energy code includes a Time Dependent Valuation (TDV) compliance metric (section 100.2). The maximum energy consumption that a proposed building, or portion of a building, can be designed to consume is based on the TDV. The TDV energy calculation is used to compare proposed designs to their energy budget under the performance compliance approach. TDV multipliers vary for each hour of the year and by energy type, climate zone, and building type.
- Compliance paths provide credit for DF measures
  - Under CA's 2019 residential building energy code (section 150.1(b)), builders can use EE, DR, thermal storage, and energy storage to reduce the size of the required solar PV system by 40% or more, while maximizing benefits to homeowners, the grid, and the environment. The allowable reduction is based on TDV of modeled energy consumption of the building, accounting for its DF measures and solar generation.*
- Code includes grid-interactive requirements and open standards for communication and automated load management
  - Appendix D of CA's 2019 nonresidential code requires that certain types of buildings are DR ready.

*Additional Title 24 standards:
— Occupant Controlled Smart Thermostats (Appendix JA5)
— Heat Pump Water Heater Demand Management (Appendix JA13)
— Demand Management (Section 110.12)

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Appliance and Equipment Standards

- Equipment capable of automated load management in response to a signal
  - CA (SB 49, 2019) requires the adoption and periodic updating of cost-effective appliance standards to facilitate deployment of flexible demand to reduce greenhouse gas (GHG) emissions associated with wasteful energy consumption. Among the priorities are appliances that are interoperable or open source. (See California Energy Commission (CEC) proceeding)
  - WA requires new electric storage water heaters to include a grid-communications port that meets CTA-2045 or similar communication standards.
  - OR adopted a similar requirement, pursuant to an executive order to accelerate EE in the state's built environment and directing establishment of new appliance standards that promote load management strategies. The CTA-2045 standard is now in statute (HB 2062, 2021).

Resource Standards (1)

- EE resource standards (EERS) include peak demand targets
  - CO, IL, TX — e.g., CO (HB 1227, 2017) required the Public Utilities Commission (PUC) to set goals for DSM programs to achieve ≥5% peak demand reduction from 2019-2028, compared to a 2018 baseline
- States account for time-sensitive value of EE
  - New England states rely on public Avoided Energy Supply Costs to assess cost-effectiveness of demand resources down to an hourly level
  - FL requires PSC to set EE targets for energy and peak demand savings (new rulemaking underway)
- DR included in EERS or eligible to meet clean energy standards
  - NV Portfolio Energy Credits (AB 3, 1997) provide a 2.0 multiplier for EE saved during peak periods
  - MN counts load management* and beneficial electrification** toward higher energy savings goal under Energy Conservation and Optimization (ECO) Act of 2021
  - DF is eligible for MA's Clean Peak Energy Standard, requiring retail electricity providers to use qualifying clean resources, including reductions in load, to meet a portion of peak load — focusing on periods of highest electricity demand net of renewables output
  - CA's 2021 joint agency report on achieving 100% clean energy by 2045 includes analysis of a "high flexibility" scenario with improved ability to shift demand to times of surplus supply for ~$1B savings/yr
  - MI's energy waste reduction standard (SB 438, 2016), focused on EE, allows load shifting and renewable energy to meet up to 10% of the standard

**…an activity, service, or technology that changes the timing or the efficiency of a customer's use of energy that allows a utility or a customer to: (1) respond to local and regional energy system conditions; or (2) reduce peak demand for electricity or natural gas.*
***Results in net reduction of source energy on a fuel-neutral basis, net reduction of GHG emissions, cost-effective, and improves utility's system load factor*

Resource Standards (2)

- Load management standards encourage shifting electricity use to times with lower carbon emissions
  - CA proposed amendments to load management standards are designed to support the state's goal for carbon-free electricity supply
- Storage requirements include thermal technologies
  - Thermal technologies* are eligible for CO's storage procurement requirements (HB 1270, 2018)

**A technology that stocks thermal energy by heating or cooling a storage medium so that the stored energy can be used later, either for heating and cooling applications or for power generation*

Utility Planning (1)

- Integrated resource plans (IRP) consider DF measures and time-sensitive value of EE
  - Oregon PUC requires modeling EE and DR on a par with other resources (Order 07-047)
  - In 2017, MN PUC required the state's largest utility to acquire at least 400 MW of DR by 2023 and conduct a cost-effectiveness study on acquiring another 1,000 MW of DR (~20% of the utility's system peak) by 2025; more recently, the PUC required additional DR evaluation (also see Xcel Energy's 2020-2034 plan and related Docket 19-368)
  - SC (HB 3659, 2019) requires utilities to include EE and DR in IRPs and provide opportunities for customer measures to reduce or manage electricity consumption to reduce utility peak demand and other drivers of electric utility costs
  - HI PUC requires demand-side resources to be treated on a consistent and comparable basis with supply-side resources, in part by developing supply curves for EE, modeling supply curves as portfolio options that compete with supply-side options, and explicitly analyzing cost and risk (Order 37419; Order 37730)
- Planning accounts for interactions between DERs and other resources
  - WA (SB 5116, 2019) requires electricity supply to be carbon-neutral by 2030 and carbon-free by 2045; the state also requires modeling DERs on a par with other resources, assessing DER impacts on utility loads and operations, and incorporating distribution planning into IRPs

Utility Planning (2)

- Distribution planning considers EE, DR, and other DERs
  - Several states consider locational value of DERs for non-wires alternatives (NWAs) — e.g., CA, CO, DE, DC, HI, ME, MI, MN, NV, NY, RI (Schwartz, 2020; Frick et al. 2021)
- Utilities provide access to system level data — NY, CA, DC
- Utility planning for DR is coordinated with regional grid operator
  - CA SB 1414 (2014) requires regulated utilities to include DR in resource adequacy (RA) and long-term procurement plans. The CPUC also must appropriately value DR and establish RA requirements for utilities, including DR, in coordination with CAISO. (See 2022 requirements)
    - Event-based utility DR programs receive capacity credit only if integrated into the CAISO market or embedded in CEC's base case load forecast (CPUC Decision 15-11-042). RA capacity from utility DR programs is allocated to load-serving entities as DR credits that are counted towards their RA requirements, as determined by CAISO (Decision 09-06-028).
  - IL (Public Act 099-0906) requires retail DR products to satisfy DR requirements of the regional grid operator, including any applicable capacity or dispatch requirements

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Utility Planning (3)

- Utility planning related to DF includes equity strategies
  - WA (SB 5116, 2019) requires utilities to file reports demonstrating how “all customers are benefiting from the transition to clean energy.” WUTC’s rules require utility plans to:
    - Provide “analysis of whether the forecasted distribution of benefits and reductions of burdens accrued or are reasonably expected to accrue to highly impacted communities, vulnerable populations, and all other customers”
    - “Describe how the utility intends to reduce risks to highly impacted communities and vulnerable populations associated with the transition to clean energy”

Other state equity policies affect utility regulation (beyond planning)

- MA (Bill S.9, 2021) requires the DPU to include equity among six priorities for meeting statewide GHG emission limits (in addition to safety, security, reliability of service, affordability, and reductions in GHG emissions)
- CO (21-272, 2021) requires the PUC to adopt rules for “all of its work” to “…consider how best to provide equity, minimize impacts, and prioritize benefits to disproportionately impacted communities and address historical inequalities”
- OR (HB 2475, 2021) adds the following to factors the PUC may consider for classifying utility services for retail rates: “differential energy burdens on low-income customers and other economic, social equity or environmental justice factors that affect affordability for certain classes of utility customers”
- ME (HP 1251, 2021) requires equity considerations to be incorporated in decision-making at the PUC and other state agencies

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See Farley, et al. 2021

Utility Programs (1)*

- EE program goals include peak demand reduction
  - CA's Database for Energy Efficient Resources defines peak period for EE savings calculations (see current definition)
  - Connecticut 2022-2024 Conservation Load Management Plans include peak demand reduction
- Cost-effectiveness assessments of EE programs consider time-sensitive value of savings**
  - CA PUC Avoided Cost Calculator
  - MA Benefit-Cost Ratio Models

- EE program metrics include carbon emissions
  - CPUC's Total System Benefit metric optimizes energy and peak demand savings goals, plus GHG benefits of EE, in a single metric
  - Several other states include avoided carbon emissions in avoided costs and cost-benefit analysis — e.g., New England states (Avoided Energy Supply Costs)
- Requirements for DR programs include potential studies
  - Load flexibility study for Xcel Energy's service area in MN
  - MI DR potential studies
  - Dominion Energy South Carolina DSM potential study
  - CA DR potential study phase 3 focused on potential for dispatchable load -shifting DR

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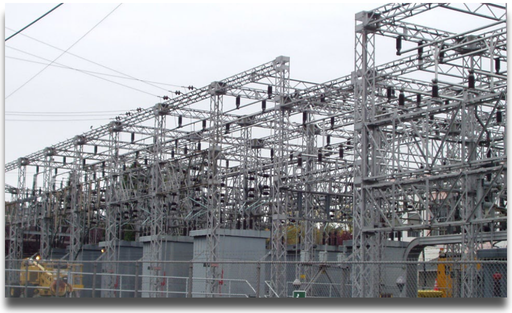
*Including third-party administrators
**See Frick and Schwartz (2019)

Utility Programs (2)

- DR goals include significant increases in peak demand savings over time
  - CO PUC established increasing DR goals: 465 MW in 2019, 476 MW in 2020, 489 MW in 2021, 503 MW in 2022, and 520 MW in 2023
  - AL PSC approved up to 200 MW of additional DSM and DER programs to address peak demand needs of Alabama Power customers, in addition to 1,200 MW of active DSM options
- New utility programs required to reduce peak demand
  - VA S966 directed utilities to design new programs to shift loads
  - HI Commission issued a policy statement and order on DR programs and subsequently approved Hawaiian Electric's new DR programs
  - AZ Commission required APS to file an aggregated distributed demand-side resources tariff (EE, DR and storage) and compensate aggregators for resulting benefits including capacity, demand reduction, load shifting, locational value, voltage support, and ancillary and grid services (see RFP to help inform tariff)
  - Active DR programs for all market sectors are among the new programs CT DEEP approved in the utilities' 2021 updated Conservation and Load Management Plan
- Programs for utility customers address equity
  - OR PUC requires equity performance metrics and reporting for EE programs
  - CT DEEP proposed actions and recommendations to support equity for EE programs
- Pay for performance programs
  - ConEd/NYSERDA Business Energy Pro
  - CT DEEP directed utilities to focus on pay for performance structures for DR programs

Utility Programs (3)

- DR programs are regularly tracked and evaluated — e.g., MD utilities, GA Power, and ComEd required to report quarterly and SC utilities annually; TX Technical Reference Manual is updated annually, ensures consistent definition of peak demand reduction across utilities and measures, and provides consistent energy values for evaluation
- Locational value informs incentive rates for EE and DR
  - Portland General Electric's Smart Grid Testbed is evaluating a wide range of DER technologies and customer value propositions for DF, focused on three distribution substations representative of its service area
  - NY cost-effectiveness guidelines include locational value
  - NY dynamic load management programs are designed to maintain distribution system reliability
    - ConEd programs for Commercial System Relief (21hr notice) and Distribution Load Relief (2 hr notice)



- Programs address multiple DERs to achieve DF
  - In MA, EE funds can be spent on active demand reduction (EE, DR, batteries)
  - In VT, EE funds can be used to reduce GHG emissions through thermal and transportation efficiency
  - In CA (R. 20-05-012), a portion of distributed solar incentives is allocated to heat pump water heaters, including a set-aside for vulnerable households, to shift load to off-peak periods
  - GA and AL Smart Neighborhood™ projects demonstrate integrated EE, DR, and storage technologies
  - Hawaiian Electric is using Grid Services Purchase Agreements to aggregate, forecast, and coordinate DERs like PV, battery systems, and grid-enabled water heaters for energy, capacity, reserves, and frequency control to keep electric grids stable and reliable

Utility Programs (4)

- Utility programs are coordinated with state and local government programs and wholesale electricity markets
  - Ameren's Income Qualified Initiative provides energy audits, installs EE measures and advanced thermostats, and provides whole-house retrofit services for state weatherization participants (evaluation plan)
  - ComEd provides data for customers to comply with local benchmarking requirements
  - New England EE and DR program administrators bid into ISO-NE forward capacity markets
  - CPUC established a Load Shift Working Group to develop proposals for new models for DR to integrate into CAISO markets (see final report)
  - Louisiana PSC established a policy for third-party aggregators in order to:
    - Promote retail DR programs and rate schedules, including utilities contracting with aggregators and utilities bidding DR in RTO markets
    - Promote participation of DR in RTO wholesale markets and programs in a manner that preserves the Commission's jurisdiction, authority, and ability to regulate and monitor those efforts
    - Reasonably maximize access to cost-effective demand-side resources within LPSC's jurisdiction
    - Retain for retail ratepayers the benefits created by DR mechanisms that delay or reduce the need for new generating capacity or purchased power agreements

AMI and Meter Data

- Grid modernization plans provide a business case for AMI deployment
  - e.g., Hawaiian Electric Company application and Hawaii PUC order
- AMI is in place, or deployment has been approved, for most utility customers
  - 107 million smart meters deployed by year-end 2020, covering 75% of U.S. households (Institute for Electric Innovation 2021; see DOE (2020) AMI in Review for status by state and utility)
  - Example DF-related deployment: As directed by NJ Energy Master Plan, Atlantic City Electric's AMI application (Docket EO20080541) includes programs to "enable customers and utilities to take advantage of technology to manage energy consumption, enhance opportunities for demand response and load shifting, and respond to price signals." The utility intends to incorporate AC load shifting capabilities.

- Access to meter data by customers and their designated third party
  - Texas' statewide online data portal, Smart Meter Texas™
  - Hawaii PUC order (2020) specifies data sets available to customers, data hosting policies, third-party access, a data access and privacy framework, and customer usage data available through a customer portal
- Energy management tools on web portal or mobile device
  - PEPCO's Gateway Hub enables customers to use their cell phone to control and monitor their smart home (e.g., smart thermostat, plugs and switches) from any location

Rate Design

- Offer time-based rates with strong price signals and opt-out offerings
  - CA adopted default time of use (TOU) rates for residential customers — e.g., see SDG&E TOU pricing plans
  - CO adopted default TOU rates for PSCo residential customers (Schedule 33), with a seasonally differentiated flat opt-out rate (Schedule 34)
  - PEPCO Peak Energy Savings Credit provides $1.25/kWh saved below customer's average energy use on peak demand days; no enrollment required
- Consider rates more reflective of hourly system costs
  - PSCo voluntary critical peak pricing rate for commercial customers (Schedule 45)
  - ComEd Hourly Pricing is based on wholesale market prices
- For large commercial customers, set demand charges only for peak demand period (or higher charges during peak)
  - Rocky Mountain Power demand charges for large commercial customers (Schedule 8)

State Programs (1)

- Lead by example
  - Participation in utility programs and RTO/ISO markets*
    - CA requires state agencies to participate in utility DR programs and recommends that facilities with appropriate energy management systems participate in Automated DR
    - TN Department of General Services, Nashville Electric Service, and Enel X jointly implement DR programs in state office buildings
      - During a DR event, the buildings adjust temperature set-points, shut off non-essential lighting, curtail air-conditioning, and reduce electricity use by other equipment
    - VA state agencies, universities, K-12 schools, local governments, and municipalities can participate in PJM's demand response program. The Department of Mines, Minerals and Energy selected a state curtailment provider that assists with DR program participation. Enabling technologies include building automation systems, emergency generation, lighting and HVAC.
    - MA Division of Capital Asset Management and Maintenance contracts with a DER aggregator for three offerings for state, local, or quasi-governmental entities to reduce energy costs:
      - Active demand capacity resources - Electricity reductions bid into ISO-NE forward capacity market (resources also can participate in Day-Ahead and Real-Time markets)
      - On-peak demand resources - Electricity reductions from non-dispatchable sources (e.g., EE, distributed generation) that bid into ISO-NE forward capacity market
      - Capacity tag - Reducing demand on peak days reduces bills for next capacity year (utility product)

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*Source: Frick (2020)

State Programs (2)

- Track and report on metrics for energy use, energy savings, peak demand reduction, and DF
  - MA's Energy Savings Optimization Program tracks and records electricity data, allows performance of assets to be reviewed in real time, and assists facility managers to make improvements before the end of a billing cycle.
  - VA's Lead by Example Energy Dashboard compiles, tracks, measures, and displays state agencies' energy use to highlight EE champions and best practices and pinpoint areas for needed EE measures toward achieving the state's energy goals.

- Benchmarking and transparency programs track and report on metrics for energy use, energy savings, peak demand reduction, and DF
  - For large buildings (≥50,000 sq ft), CO (HB 1286, 2021) requires reporting of annual maximum electricity demand and, if available through the benchmarking tool, monthly peak electricity demand — in addition to energy use and intensity and GHG emissions (direct and indirect)

State Energy Planning

- DF is an explicit means to reach broader state energy goals
  - Executive Order 28 required the NJ Board of Public Utilities (BPU) to update NJ's Energy Master Plan to achieve 100% clean energy by 2050. The plan includes DF strategies:
    - Pilot alternative rate designs to manage EV charging and encourage customer controlled DF
    - Pilot and implement modified rate design to encourage customer-controlled DF, manage EV charging, and support DR programs
    - Develop DR-ready building codes for new multi-unit dwellings and commercial construction
    - Explore establishment of distribution-level retail DR programs that can complement wholesale electricity markets
  - MA's statewide energy efficiency plan includes "active demand reduction"
  - Executive Order 80 required development of a NC Clean Energy Plan
    - Among the recommendations is better utilization of load flexibility to meet clean energy goals

Related State Policies and Regulations (1)

- Utilities and other program administrators can earn financial incentives for achieving or exceeding peak demand reduction targets
  - MN (HF 124, 2021) authorizes incentive plans for utilities to encourage investments in load management as well as EE; addresses net benefits from integrated load management/EE actions
    - Also in MN, Xcel filed a DR financial incentive for Commission consideration (Docket 17-401); Xcel recently applied for performance incentive for load flexibility programs (Docket 20-421)
  - MI provides utility financial incentives for DR based on non-capitalized costs for achieving DR capacity growth targets and demonstrating DR for NWA solutions (e.g., see Case No. U-20164 and Case No. U-21080)
  - MA Green Communities Act provides for performance incentive mechanisms for electric efficiency investment plans. MA Department of Public Utilities (DPU) approved incentives for achieving active demand reductions exceeding threshold performance levels for 2019-21 plans.
  - NH provides incentives for utilities that achieve ≥65% reduction in summer or winter peak demand through EE and "Active Demand Savings" (see recent settlement)
  - NJ (P.L. 2018, ch 17) directed BPU to establish performance incentives for peak demand reductions (BPU order)
  - NM (HB 291, 2019) required Public Regulation Commission to adopt utility "profit incentive" for cost-effective EE and load management programs with satisfactory performance to make them financially more attractive than supply-side resources; incentives adopted in Case 20-00087-UT
- Revenue decoupling is in place for electric utilities in 19 states (Lowry and Makos, 2021)

Related State Policies and Regulations (2)

- Grid modernization policies and regulations consider DF
  - NM (HB 233, 2020) requires the Department of Energy, Minerals, and Natural Resources to develop a grid modernization roadmap and grant program in part to support projects that "meet energy demands through a flexible, diversified and distributed energy portfolio," including AMI, intelligent grid devices, technologies to enable DR, storage, and microgrids
  - Legislation proposed in NY would establish a grid modernization program that prioritizes deployment of smart technologies, including smart appliances and consumer devices, EVs, electricity storage, peak-shaving technologies, AMI, and other technologies
- Climate change policies consider role of DF in reducing GHG from buildings
  - OR (HB 2021, 2021) requires utilities to develop Clean Energy Plans, concurrent with IRPs, that specify annual EE and DR goals to meet GHG emissions targets (100% below baseline emissions by 2040, with interim targets)
  - CA (AB 3232, 2018) requires the CPUC to assess the potential to reduce GHG emissions from buildings ≤40% below 1990 levels by Jan. 1, 2030; the CEC must prepare a Building Decarbonization Assessment, in consultation with the CPUC, California Air Resources Board, and CAISO
  - WI Executive Order 38 establishes a goal of 100% carbon-free electricity consumption by 2050 and directs utilities and state agencies to work in partnership towards achieving the goal. The PSC's Roadmap to Zero Carbon investigation (Docket No. 5-EI-158) in part addresses the utilities' announced goals and clean energy plan recommendations developed through the executive order. Issues include enhanced DR to support load management, electrification, and storage.
  - NY integrated building electrification with EE programs, including accelerated heat pump deployment (see plan and manual), are designed to help achieve the state's goals for reducing GHG emissions

TRENDS AND GAPS

Trends (1)*

- A few states are beginning to incorporate DF in building energy codes and appliance and equipment standards.
- A growing number of states are including EE's time-varying and peak demand reduction value, as well as DR, in EE resource standards. Some states are including DR in clean energy standards.
- Utility planning requirements are slowly evolving to enhance valuation of EE and DR for meeting resource needs for the bulk power system.
- The number of states requiring utilities to file distribution system plans for PUC review, including consideration of non-wires alternatives (EE, DR, storage, distributed generation, and managed vehicle charging), is rapidly increasing.
- Formal coordination of utility DR planning and programs with regional grid operators remains nascent in most areas; however, CA PUC and regional PUC organizations (e.g., NECPUC, OMS) regularly engage in RTO/ISO meetings and proceedings.
- A number of states recently adopted equity policies affecting utility regulatory decision-making. These policies are an important step toward ensuring equitable distribution of the benefits of DF.

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**a prevailing tendency or inclination*

Trends (2)

- Integration of utility programs for EE and DR is increasing in tandem with peak demand reduction goals, but at a slow pace.
- Improvements are underway in a number of states related to assessing the cost-effectiveness, potential, tracking, and performance of EE and DF, reflecting enhanced methodologies and additional metrics, such as time and locational value and GHG emissions.
- Availability of AMI, data access, and time-varying rates is increasing.
- States are beginning to explore the role of DF in meeting other energy goals — e.g., decarbonization, grid modernization, electrification and renewable energy. Related energy plans, policies, and regulations are beginning to reflect DF's potential contributions.
- The number of states with revenue decoupling for electric utilities has remained relatively stable in recent years.
- A growing number of states are refining EE and DR performance incentives for utilities to target demand reduction when and where it is most valuable.

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Gaps (1)*

- Building energy codes and appliance/equipment standards
  - Changes in building energy codes and appliance standards to address time-varying value of EE and DF, open standards for communication, and automated load management are nascent. Lack of standards discourages innovation in technologies and services.
- Resource standards
  - Most EE resource standards do not address EE’s contribution to peak demand reduction or account for the time-varying value of EE.
  - Most resource procurement requirements do not specify DR/DF.
- Utility planning
  - Most utility integrated resource plans do not analyze EE and DR in a manner comparable to analysis of supply-side resources.
  - Most states do not require transparent distribution system planning, including analysis of non-wires alternatives, and those that do lack experience in reviewing filed plans.
  - Utility plans traditionally have not included equity strategies in a systematic way.
  - Utility resource and program planning is not well-coordinated with regional grid operators.

an incomplete or deficient area

Gaps (2)

- Utility programs
  - EE program goals often do not include peak demand reduction, EE and DR programs remain largely siloed, and multi-DER programs (e.g., EE + DR + storage) are rare.
  - The customer value proposition for DF is not well understood.
  - Cost-effectiveness for EE programs and portfolios do not fully account for all potential benefits or account for time and locational value.
  - Potential assessments for DR are not regularly performed.
  - DR programs typically are targeted to a narrow set of potential grid services.
  - Most DR programs are for load shedding, not load shifting — important for integrating variable renewable energy resources and managing increased electrification.
  - Equitable distribution of program benefits often is not considered in program design, evaluation, and reporting.
- AMI, meter data, and rate design
  - Most customers do not have access to granular energy usage data, time-varying rates, or automated equipment and services.
  - Participation rates in most time-varying rates are low.
  - Most retail rate designs are not sufficiently granular in time and do not vary by location.

Gaps (3)

- State programs
  - EE incentive and financing programs typically do not include a full range of potential DR measures or use metrics that encourage DR/DF measures.
  - Most state lead-by-example programs focus on annual energy savings rather than peak demand reduction or load-shifting.
  - Energy-saving performance contracting does not incorporate demand savings.
- State energy planning, policies, and regulations
  - DF would help states achieve their energy goals, but most states do not consider time-sensitive value of EE or DF in their energy plans, policies, and regulations.

OPPORTUNITIES FOR DOE TO ASSIST STATES

Opportunities for DOE to Assist States (1)

- Technical assistance for building code agencies, PUCs and state energy offices
  - Among the topics: grid-interactive provisions for codes and standards; methods for capturing the full value of EE and DF in utility planning and procurement for bulk power system and distribution system needs; retail tariffs to foster DER aggregation and expand grid services provided; coordination with regional grid operators on DER aggregation; data access for customers and their designated third parties; methods for establishing avoided costs and assessing cost-effectiveness for EE and DF; incorporating DF in utility resource standards and procurement requirements; integrating DF in benchmarking and transparency policies and building performance standards
- Education and information-sharing
  - Training — e.g., workforce training on advanced building technologies and operations
  - Case studies — e.g., state and utility programs incorporating DF
  - Guidance documents — e.g., model standards and protocols for DF
  - Webinars and conferences
  - Through partnerships with NARUC, NASEO, NASUCA, NGA, and NCSL
- Grants and financing
  - Grants to states to seed or supplement revolving loan funds, for loan loss reserves, to leverage private capital, or to improve financing terms for underserved populations
  - Federal loan loss reserve for state and utility programs that foster DF + EE + electrification, with a focus on underserved populations

Opportunities for DOE to Assist States (2)

- Federal tax credits for DF measures to leverage state and utility incentives
- Convening stakeholders — e.g., to develop approaches for:
  - Evaluation, measurement, and verification for next-generation DF*
  - Including demand savings in energy-saving performance contracting
  - Advancing electrification-retrofit readiness to expand DF resource potential
  - Designing DF compensation mechanisms for programs with a savings-to-income ratio (e.g., Pay As You Save®)
- RD&D
  - Integrating DERs at individual buildings vs. larger-scale DERs for multiple building loads
  - Locational value of DF
  - Consumer value proposition
  - Customer adoption and operational decisions
  - Financing — e.g., review existing state EE financing mechanisms to determine how well they currently support DF measures and issue recommendations, explore efficient means of financing DF-ready equipment + electrification-ready retrofits

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*See Berkeley Lab's May 6, 2021, memo to DOE

For More Information (1)

- ACEEE (2018). The Role of Energy Efficiency in a Distributed Energy Future
- ACEEE (2020). Performance Incentive Mechanisms for Strategic Demand Reduction
- Deason et al. (2018). Electrification of buildings and industry in the United States: Drivers, barriers, prospects, and policy approaches
- DOE (2021). A National Roadmap for Grid-interactive Efficient Buildings
- Farley et al. (2021) Advancing Equity in Utility Regulation
- Frick et al. (2019). Peak Demand Impacts From Electricity Efficiency Programs
- Frick and Schwartz (2019). Time-Sensitive Value of Efficiency: Use Cases in Electricity Sector Planning and Programs
- Frick (2020). "Incorporating Demand Flexibility into State Energy Goals." Presentation to NASEO-NARUC Grid-Interactive Efficient Buildings Working Group
- Frick (2020). "Technical Assistance for States: Grid-interactive Efficient Buildings." Presentation to NASEO-NARUC Grid-Interactive Efficient Buildings Working Group
- Frick et al. (2021). Locational Value of Distributed Energy Resources
- Frick et al. (2021). "Still the One: Efficiency Remains a Cost-Effective Electricity Resource"
- Gerke at al. (2020). The California Demand Response Potential Study, Phase 3: Final Report on the Shift Resource through 2030
- Langevin et al. (2021). U.S. Building Energy Efficiency and Flexibility as an Electric Grid Resource (preprint)

For More Information (2)

- NASEO (2019). "Grid-interactive Efficient Buildings: State Briefing Paper
- NASEO (2021). State and Local Building Policies and Programs for Energy Efficiency and Demand Flexibility
- NASEO (2021). Wringing More Value from Building Energy Operations and Upgrades: Monetizing Demand Flexibility in Public and Institutional Facilities
- Potter et al. (2018). Barriers and Opportunities to Broader Adoption of Integrated Demand Side Management at Electric Utilities: A Scoping Study
- Satchwell et al. (2020). A Conceptual Framework to Describe Energy Efficiency and Demand Response Interactions
- SEE Action Network (2020). Grid-Interactive Efficient Buildings: An Introduction for State and Local Governments
- SEE Action Network (2020). Determining Utility System Value of Demand Flexibility From Grid-interactive Efficient Buildings
- SEE Action Network (2020). Performance Assessments of Demand Flexibility from Grid-Interactive Efficient Buildings: Issues and Considerations

Also see the library for the NARUC-NASEO Task Force on Comprehensive Electricity Planning:
https://www.naruc.org/taskforce/comprehensive-electricity-planning-library/

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APPENDIX A.
GEBs Roadmap Recommendations to Support DF Deployment Through Enabling Programs and Policies

RECOMMENDATIONS FOR ACCELERATING GEB ADOPTION

Pillar 4: Supporting GEB Deployment through State and Federal Enabling Programs and Policies

RECOMMENDATION 1

Lead by Example

- Integrate demand flexibility in initiatives for corporate partnerships
- Promote demand flexibility for ESPC
- Participate in demand response and energy efficiency programs and markets
- Broaden building energy tracking requirements in public buildings

RECOMMENDATION 2

Expand Funding and Financing Options for GEB Technologies

- Evaluate financing and funding mechanisms and determine if new financial assistance mechanisms are needed
- Identify how requirements of existing financing and funding mechanisms for EE can be modified to include demand flexibility
- Promote partnerships between utilities and entities that receive public funding

PILLAR 4: SUPPORTING GEB DEPLOYMENT THROUGH STATE AND FEDERAL ENABLING PROGRAMS AND POLICIES

RECOMMENDATION 3

Expand Codes and Standards to Incorporate Demand Flexibility

- Determine aspects of demand flexibility that may be considered for codification
- Combine grid-interactive requirements and open standards for automated communication with energy efficiency requirements
- Provide technical assistance to government entities and professional organizations responsible for codes and standards development

RECOMMENDATION 4

Consider Implementing Demand Flexibility in State Targets or Mandates

- Conduct research to assess cost-effective and achievable demand flexibility potential for a given jurisdiction or service territory
- Consider implementing peak reduction standards
- Consider establishing statewide or utility-specific demand flexibility procurement requirements

APPENDIX B.
Detailed List of State Indicators for Advancing Demand Flexibility

State Indicators – Detailed List (1)

- **Building energy codes**
  - Codes value EE measures based on when savings occur.
  - Compliance paths provide credit for DF measures.
  - Codes include grid-interactive requirements and open standards for communication and automated load management.
  - A carbon emissions-based metric can be used for compliance, based on predicted energy consumption and CO_2 emission factors.
  - Codes incorporate new ASHRAE standards (e.g., 90.1, 189.1).
- **Appliance and equipment standards**
  - Standards include provisions for equipment capable of automated load management in response to a signal from the utility, aggregator, or regional grid operator.

State Indicators – Detailed List (2)

- **Resource standards**
  - Energy efficiency resource standards (EERS) include peak demand reduction targets or a multiplier for energy savings during peak demand hours.
  - States that require utilities to acquire all cost-effective EE, in lieu of an EERS, account for time-sensitive value of EE.
  - DR is included in EERS or is eligible to meet clean energy standards.
  - Load management standards encourage shifting electricity use to times with lower carbon emissions.
  - Storage requirements include thermal technologies.

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State Indicators – Detailed List (3)

- **Utility planning**
  - Integrated resource planning considers DF measures and the time-sensitive value of EE in capacity expansion modeling and potential resource portfolios.
  - Electricity system planning accounts for interactions between DERs, and between different types of DERs and other resource options.
  - Distribution system planning considers EE, DR, and other DERs as non-wires alternatives.
  - Utilities provide access to system level data to support customer and third-party solutions.
  - Utility planning for DR is coordinated with the regional grid operator (where applicable).
  - Utility planning related to DF includes equity strategies.

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State Indicators – Detailed List (4)

- **Utility programs**
  - EE program goals include peak demand reduction, clearly defined.
  - Cost-effectiveness assessments of EE programs consider time-sensitive value of savings.
  - EE program performance metrics include carbon emissions.
  - Requirements for DR programs include DR/DF potential studies.
  - DR program goals include significant increases over time in potential peak demand savings.
  - Requirements are established for new utility programs to reduce peak demand.
  - Programs for utility customers address equity.
  - Pay for performance programs are established for peak demand reduction from EE and DF.

State Indicators – Detailed List (5)

- **Utility programs** (continued)
  - Robustness of approved DR programs is regularly tracked and evaluated.
  - Locational value informs incentive rates for EE and DR measures.
  - Programs address multiple DERs (EE, DR, distributed generation, storage, managed vehicle charging) to achieve DF — e.g., budgets, joint or coordinated staff, and metrics for evaluating cost-effectiveness of integrated programs.
  - Utility programs are coordinated with state and local government programs and wholesale electricity markets to avoid double-counting and conflicting rules, roles, and responsibilities.

State Indicators – Detailed List (6)

- **Advanced metering infrastructure and meter data**
  - Grid modernization planning requires development of a business case for AMI deployment, with costs and benefits monetized to the fullest extent possible.
  - AMI is in place, or deployment is approved, for most utility customers.
  - Customers have granular and timely access to meter data and can designate access by an approved third party.
  - Utility provides energy management tools on web portals or customer mobile devices.

State Indicators – Detailed List (7)

- **Rate design**
  - Demand charges for commercial customers are applied only to the peak demand period, or charges are higher during the peak demand period.
  - Time-based rates provide strong price signals for peak demand reductions (i.e., large differential between off- and on-peak rates).
  - Retail rates are more reflective of hourly system costs (e.g., critical peak pricing, real-time pricing) and location (e.g., to defer distribution system upgrades).
  - Robustness of approved programs is regularly tracked and evaluated.
    - Availability of pilots and retail rates (opt-in, opt-out and default) to all customer classes
    - Level of customer enrollment (% participation by customer class)
    - Customer retention and satisfaction
    - Penetration of enabling technologies (e.g., smart thermostats, in-home displays, building automation systems, storage) by customer class

State Indicators – Detailed List (8)

- **State programs**
  - State EE incentive and financing programs incorporate DF, or new DF mechanisms are established.
  - State lead-by-example programs demonstrate enabling technologies for DF and widely share results.
    - Energy-saving performance contracting programs promote DF.
    - Government buildings participate in utility programs and RTO/ISO markets.
    - State buildings regularly track and report on metrics for energy use, energy savings, peak demand reduction, and DF. As a next step, performance standards for state buildings incorporate these metrics.
  - Benchmarking and transparency programs for privately owned buildings regularly track and report on metrics for energy use, energy savings, peak demand reduction, and DF.
  - Home energy rating programs include DF measures.
  - State RD&D programs test approaches for increasing DF and quantifying benefits and costs.

State Indicators – Detailed List (9)

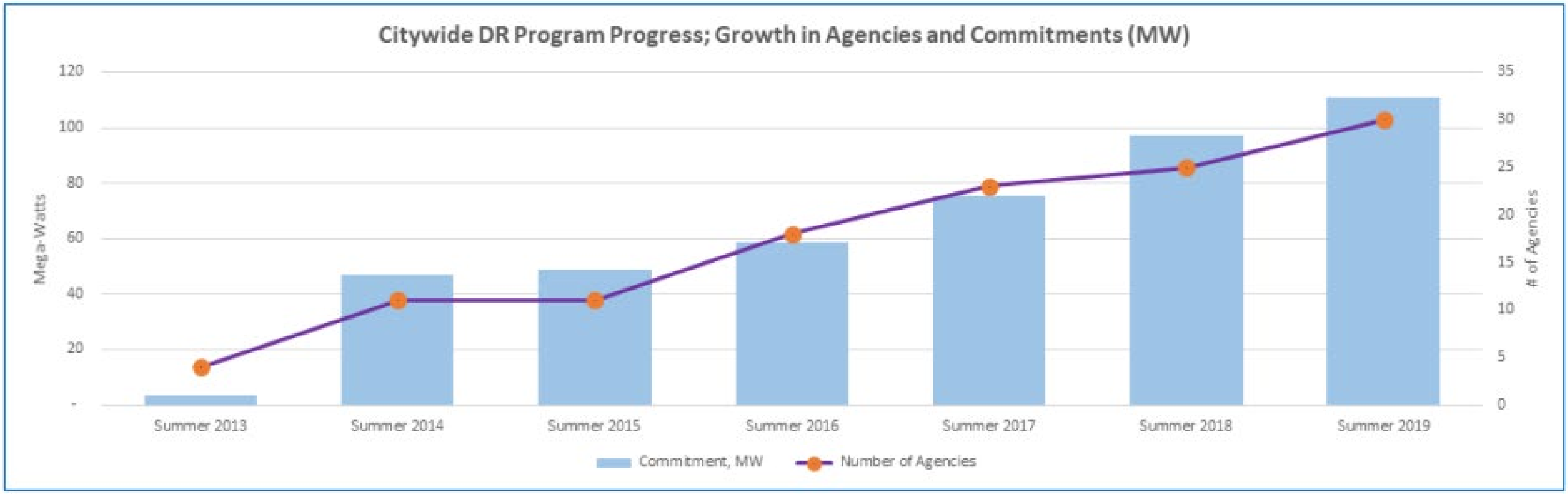
- **State energy planning**
  - DF is included as an explicit means to reach broader state energy goals — e.g., state master energy plans, resilience plans, renewable energy goals, decarbonization goals, and electrification plans.
- **Related state policies and regulations***
  - Utilities and other program administrators have an opportunity to earn financial incentives for achieving or exceeding peak demand reduction and DF targets.
  - Revenue decoupling is in place for electric utilities.
  - Climate change policies consider the role of DF in reducing GHG emissions from buildings.
  - Grid modernization policies and regulations consider DF.

**In addition, state actions related to cybersecurity, data access and privacy, and resilience should consider potential conflicts with EE and DF goals.*

APPENDIX C.
Example Local Actions

Local Government Examples (1)

- New York City Department of Energy Management launched a citywide DR program in 2013.
- From 2013-2018, city agencies earned more than $50 million from DR revenues.
- Each year additional agencies and capacity have participated in the program.
- In summer 2019, the estimated load reduction was 110 MW (see chart).
- The city hired NuEnergen to implement DR programs. Buildings must have real-time meters with communicating capabilities and have curtailable load.



https://www1.nyc.gov/site/dcas/agencies/demand-response.page

Source: Frick 2020

Local Government Examples (2)

- The Montgomery County (MD) Division of Facilities Management works with Enel X to reduce electricity consumption during PJM DR events.
  - In addition, the county's building automation system provides automated energy management, controlling HVAC and lighting to remotely adjust temperatures and schedules.
  - The Building Automation System also provides safety and operational efficiencies through control of fire alarm operations and troubleshooting mechanical system issues from the operations center, reducing mechanic calls.

Source: Frick 2020

Local Government Examples (3)

- New York City's benchmarking and transparency law* uses GHG emissions in tons of CO2e/sq ft as the primary metric for compliance.
  - The utility electricity emissions coefficient for the first compliance period (2024-2029), "at the owner's option, shall be calculated based on time of use in accordance with referenced emissions factors promulgated by rules of the department." The Department of Buildings has discretion to establish different limits, metrics, and methods of calculation for 2030 and beyond, opening additional opportunities for time-differentiation and DF through the policy. (Source: Sobin, 2021)

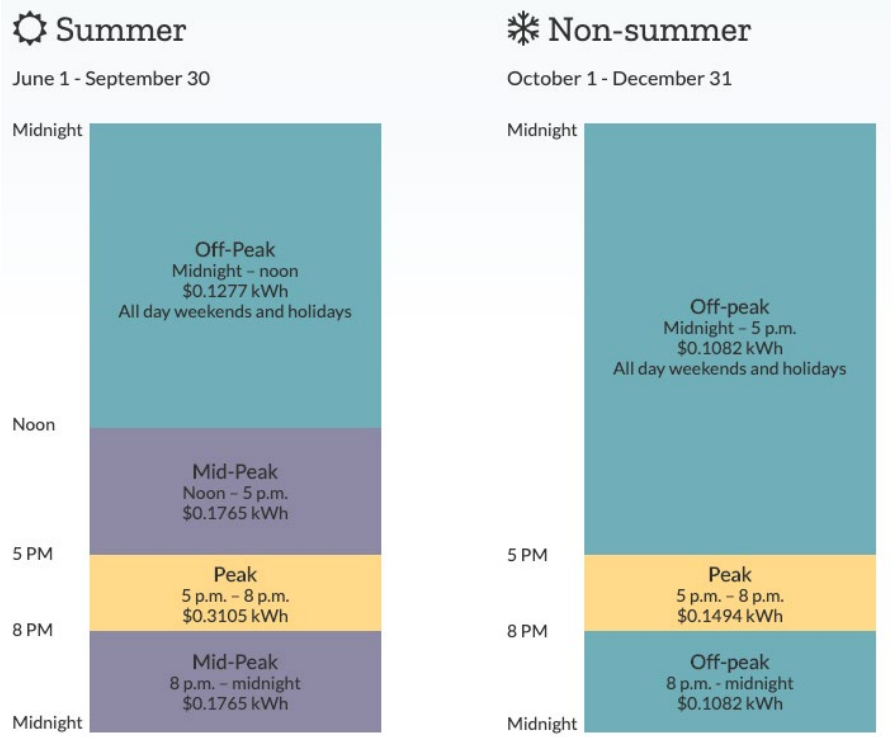
City of New York, Local Law No. 97, https://www1.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf and City of New York, Local Law No. 147, https://www1.nyc.gov/assets/buildings/local_laws/ll147of2019.pdf

Local Government Examples (4)

- LA100 Equity Strategies – Los Angeles Department of Water and Power is using research, led by the National Renewable Energy Laboratory, and robust stakeholder engagement to identify how the city's transition to 100% clean energy — with high levels of electrification — will improve energy justice, including reduced energy burdens, increased access to energy services like cooling, and improved quality of life.

Local Government Examples (5)

- SMUD shifted its EE program performance metric from energy savings to avoided carbon emissions.
- SMUD also established default TOU rates for residential customers following a pilot program that tested consumer response to a variety of rate, technology, and participation approaches. Customers can opt out of the TOU rate to a higher priced, fixed rate schedule.



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