

Energy Efficiency and Demand Response Integration

June 3, 2019

DRAFT

Mary Ann Piette
Demand Response Research Center
Lawrence Berkeley National Laboratory

Presentation Overview

- **Background**
- **How Energy Efficiency and Demand Response are Linked**
- **California Demand Response Potential Study**
- **Demand Response Programs**
- **Summary and Future Directions**
- **Q&A**

Background

The March 15, 2017 DR scoping CPUC memo for consolidated Application (A.)17-01-012 included the following topic:

Should the Commission explore joint activities in demand response and energy efficiency by integrating funding and program implementation in a limited-manner, e.g. targeting specific controls, conducting necessary studies?

In the EE Application (A.17-01-013), the April 14th scoping memo included the following topic:

Coordination between energy efficiency and demand response portfolios.

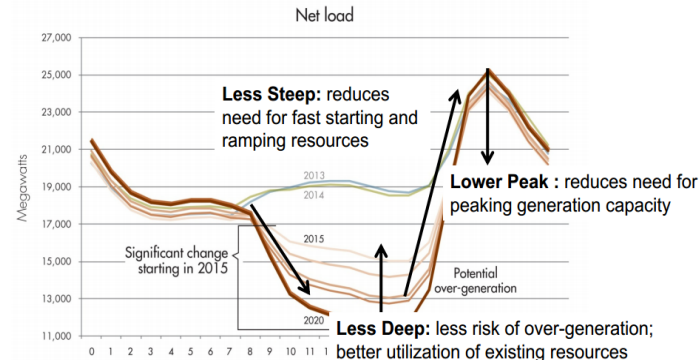
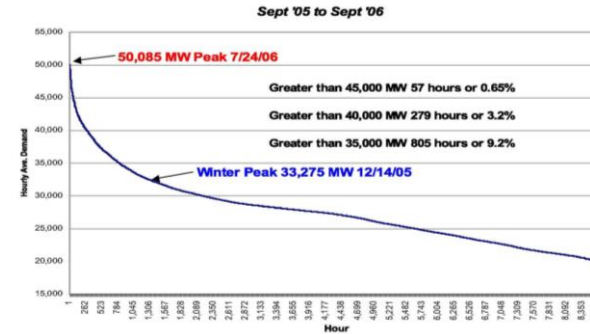
Challenges with the Grid

- Manage Peak Capacity During Hot Summer Days
- Improve Affordability of Electricity
- Improve Grid Reliability
- Enable More Renewables on Grid



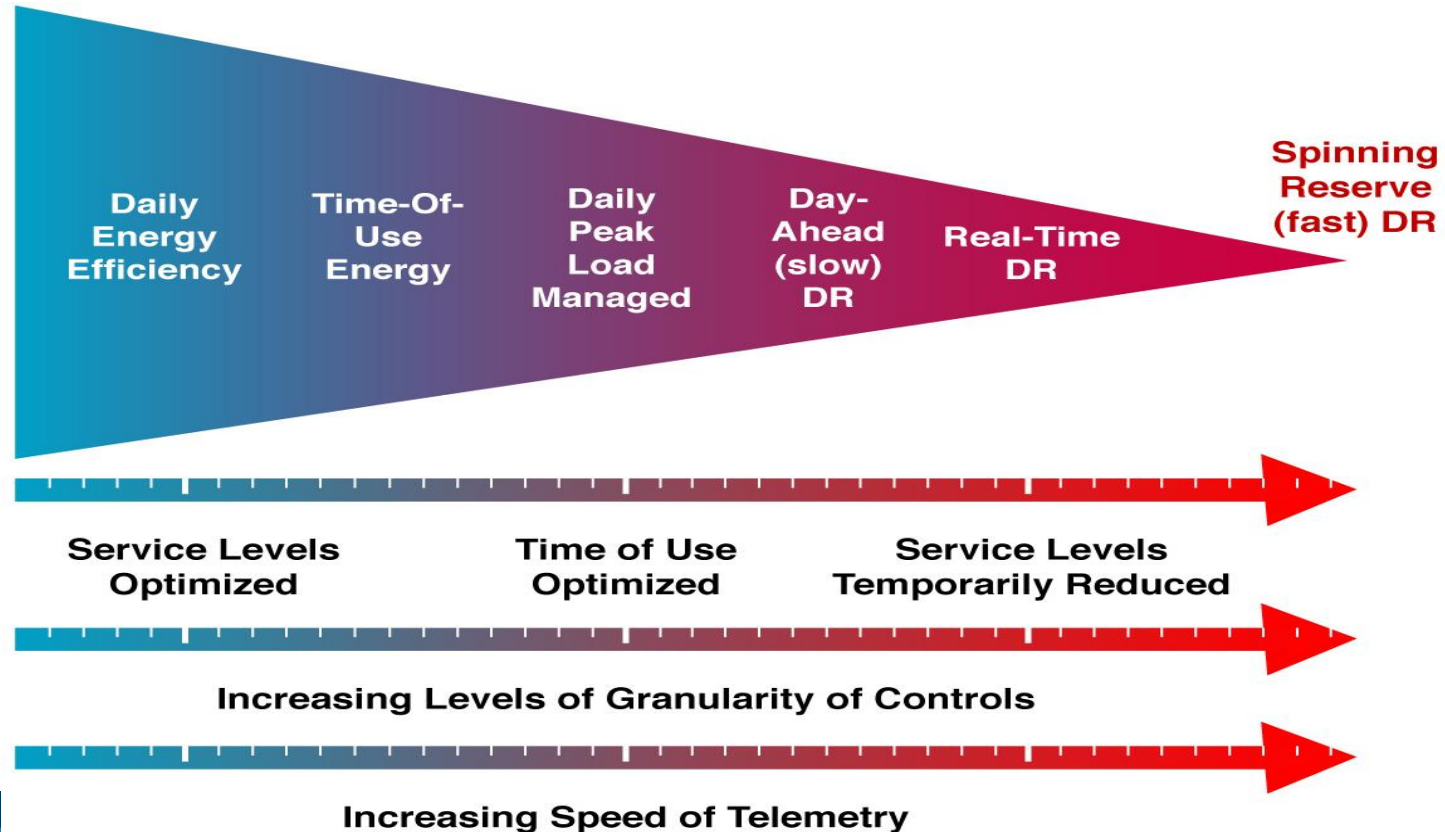
California Independent System Operator Corporation

CAISO Load Duration Curve



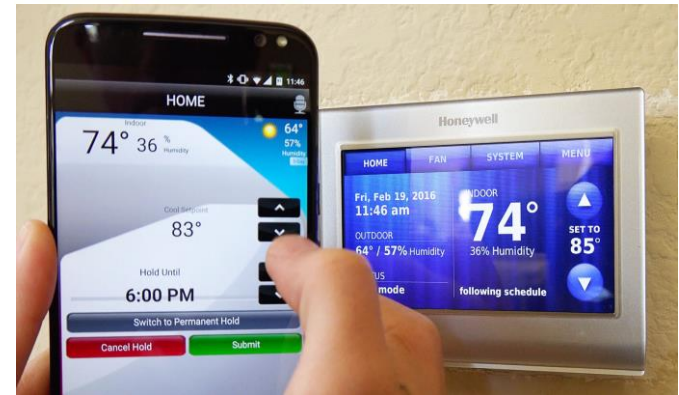
Note, this curve is being updated, it is used here to represent how we should look at what we are trying to accomplish

Linking Energy Efficiency and DR



Residential and Commercial HVAC

- ◆ **DR-enabled variable frequency drives (VFDs)** - Commercial HVAC are responsive technologies that can provide DR services.
- ◆ **Residential HVAC** - reliable end-use for delivering DR.
- ◆ **Automated control devices** - smart thermostats and Energy Management Systems can respond to price signals are promising technologies for managing HVAC.

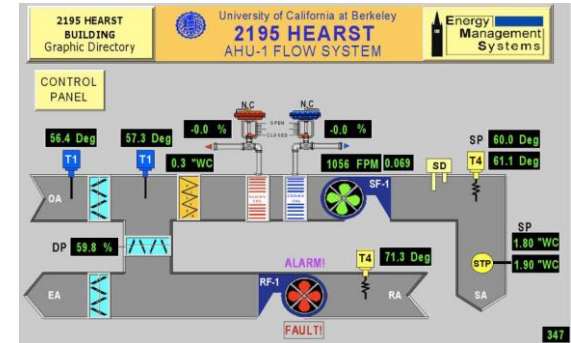


Examples of Measures that Support EE and DR

Automated DR-ready Energy Management Systems

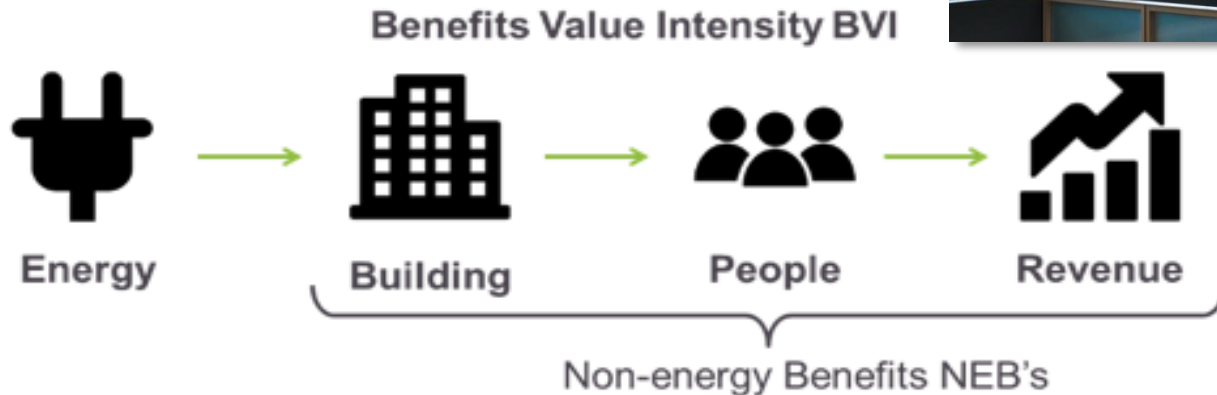
Energy management systems and building automation systems can include be DR-ready hardware and software with the most recent open data model automated DR abilities (OpenADR) in order to receive an incentive.

Commercial building energy management systems are one of the most important sources of DR in large commercial buildings. These controls occur through the Building Automation System (BAS) or Energy Management Control System (EMCS).



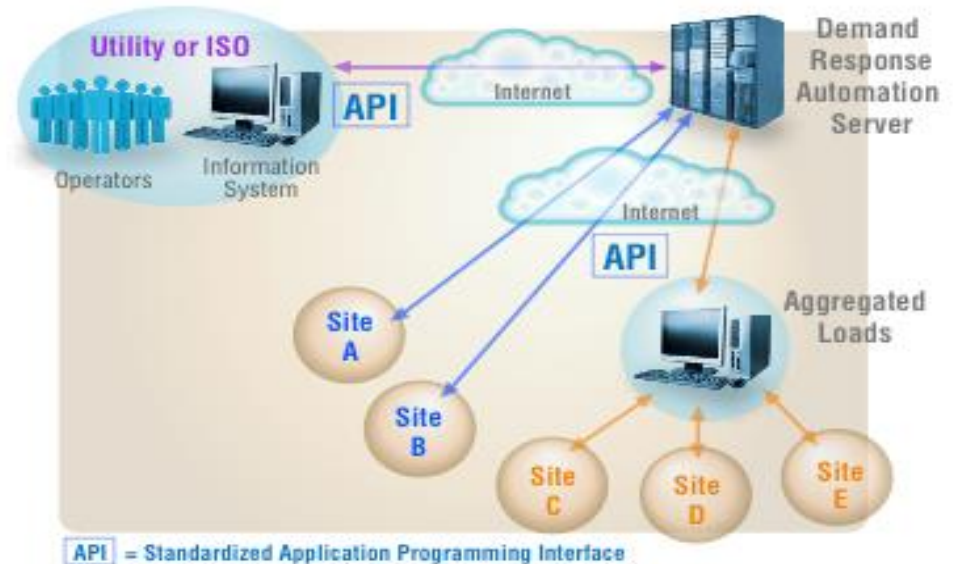
Networked Lighting Controls

Advanced NLCs technologies are evolving to use wireless communications, embedded sensors, data analytics & controls to optimize building systems in real time.

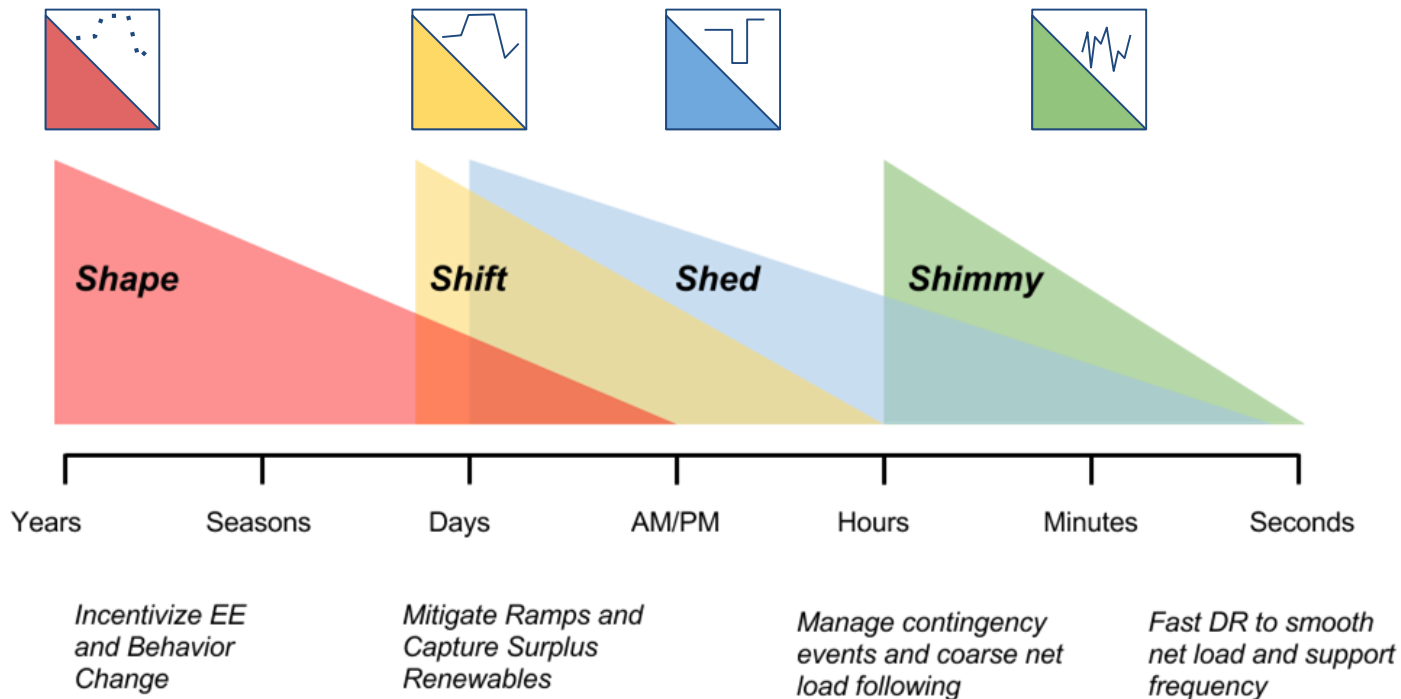


Open Automated Demand Response

- Open standard for DR communications
- Allows elec providers to communicate and send DR signals to customers
- Uses XML language and existing communications, Internet
- See <https://www.openadr.org/>



DR Services Spans Time Scales

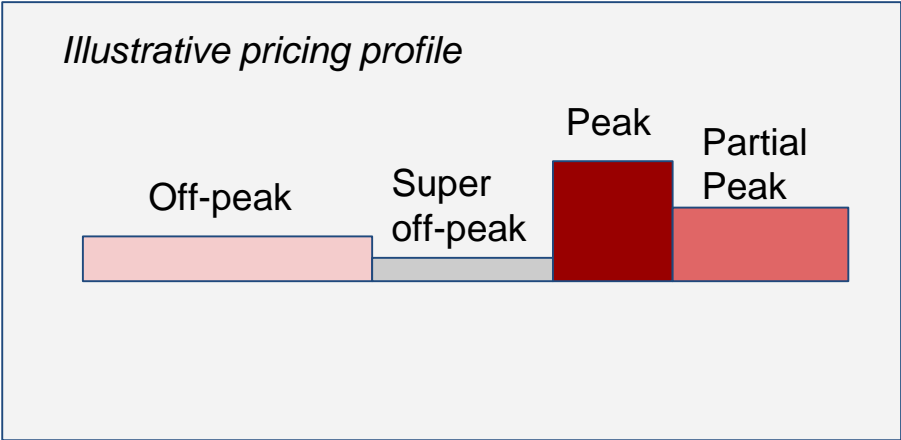


DR Service Types Address Grid Needs

Load Shapes Change with Time-Differentiated Pricing



Shape Service Type as modeled: Accomplishes Shed & Shift with prices & behavioral DR.

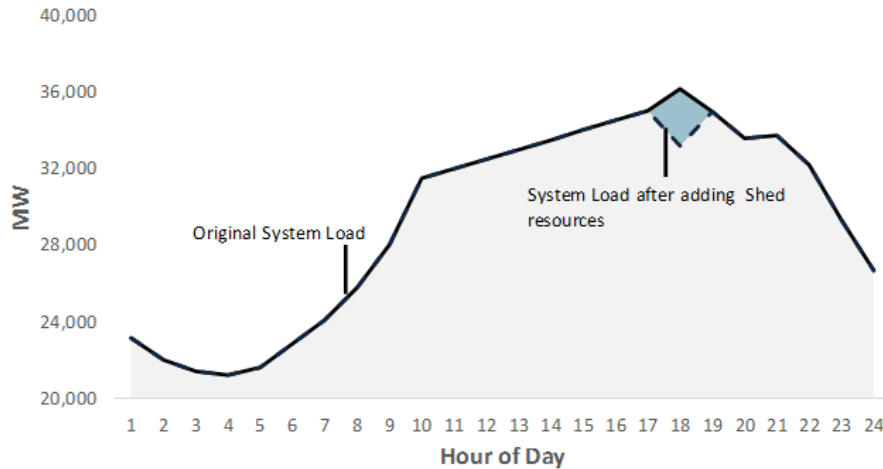


DR Service Types Address Grid Needs

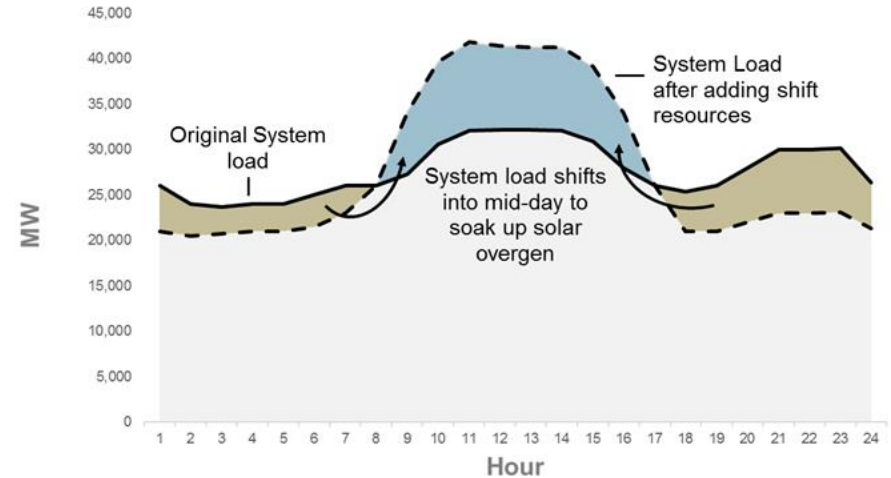
Shed & Shift



Shed Service Type: Peak Shed DR

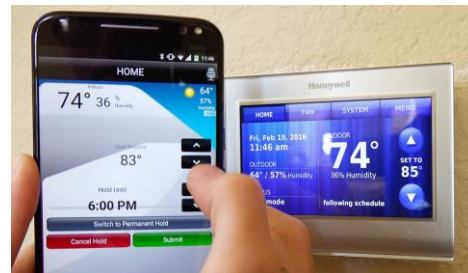


Shift Service Type: Shifting load from hour to hour to alleviate curtailment/overgeneration



End Uses and Enabling Technologies

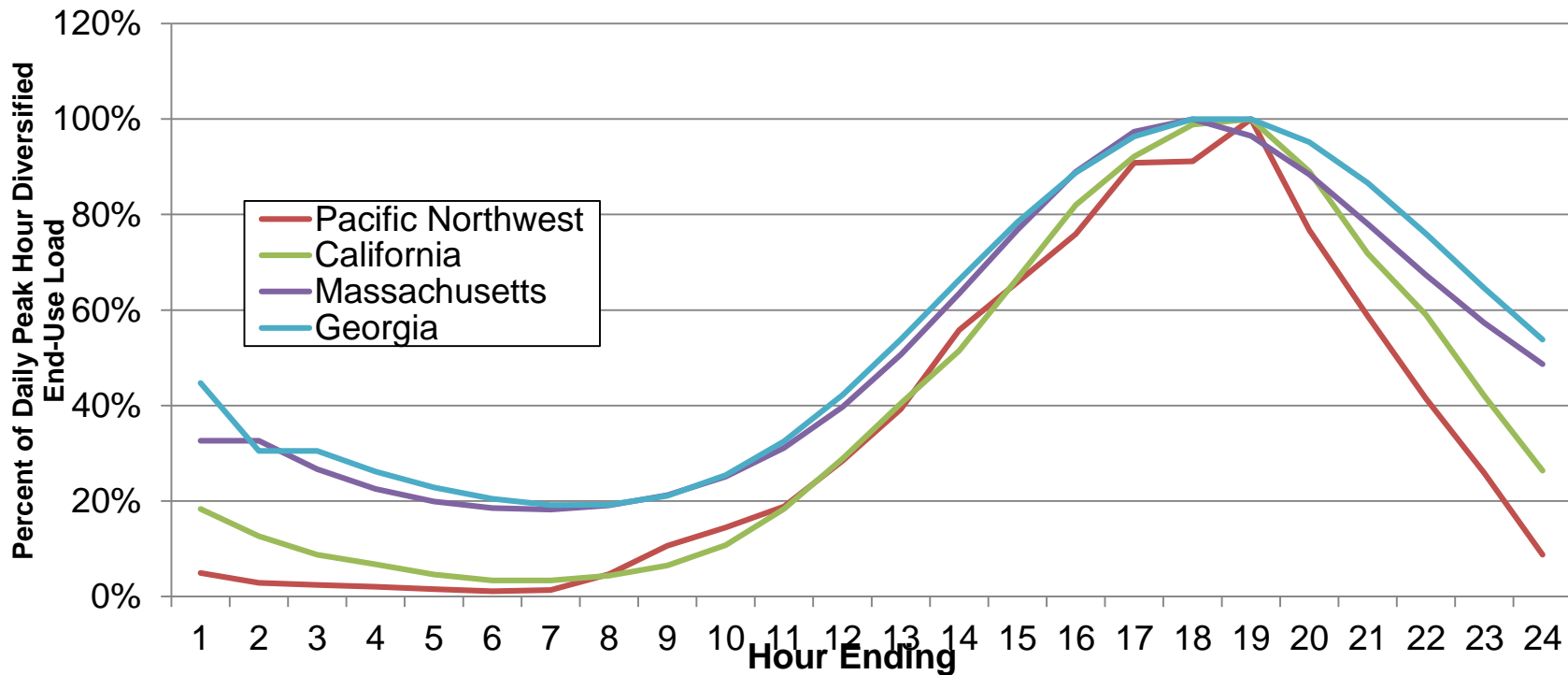
Sector	End Use	Enabling Technology Summary
All	Battery-electric and plug-in hybrid vehicles	Level 1 and Level 2 charging interruption
	Behind-the-meter batteries	Automated DR (Auto-DR)
Residential	Air conditioning	Direct load control (DLC) and Smart communicating thermostats (Smart T-Stats)
	Pool pumps	DLC
Commercial	HVAC	Depending on site size, energy management system Auto-DR, DLC, and/or Smart T-Stats
	Lighting	A range of luminaire-level, zonal and standard control options
	Refrigerated warehouses	Auto-DR
Industrial	Processes and large facilities	Automated and manual load shedding and process interruption
	Agricultural pumping	Manual, DLC, and Auto-DR
	Data centers	Manual DR
	Wastewater treatment and pumping	Automated and manual DR



Co-Benefits of EE and DR

- ◆ Some technologies may have benefits for both energy efficiency and demand response for building occupant or owner
- ◆ For example, DR-enabled lighting can also be more efficient and advanced than standard lighting.
- ◆ For technologies with known co-benefits that are readily quantifiable, LBNL attributed a portion of DR site-level enablement costs to DR, subtracting out **value** derived from other streams

Summer Residential Air Conditioning Loads Peak When California's Electric System Peaks



Source – Natalie Frick, LBNL research on Time Sensitive Value of Energy Efficiency

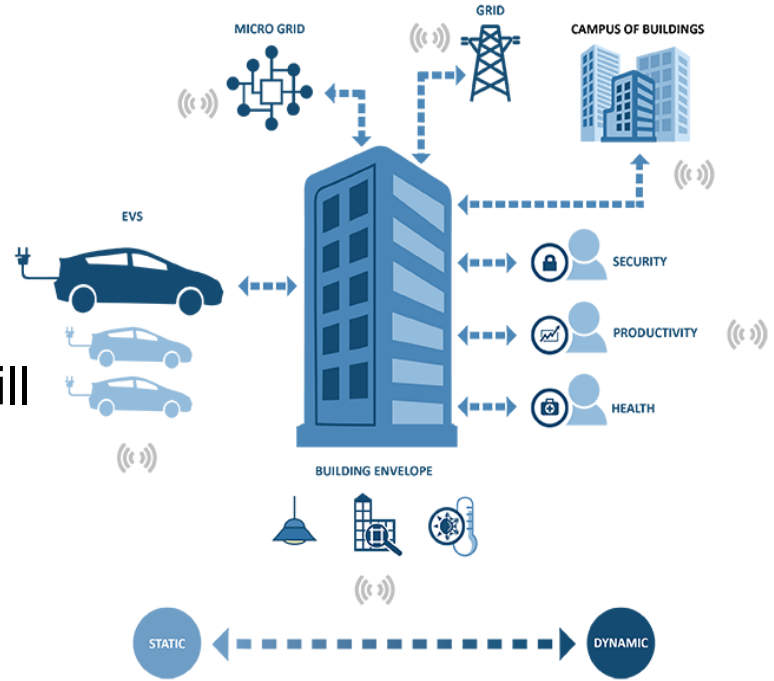
California Investor Owned Utilities Electric Demand Response Programs and Rates

DR PROGRAM OR RATE NAME	IOU	PROGRAM DESCRIPTION/CHARACTERISTICS	PROGRAM TYPE	CUSTOMER TYPE	AUTO DR INCENTIVE ELIGIBILITY
<i>DYNAMIC PRICING RATES</i>					
Time-of-Use (TOU)	PG&E, SCE, SDG&E	Electric rates which varies by set times of day and season (e.g. winter or summer).	Load Modifying	Residential and Non-Residential Customers (IOU Customers Only)	No
Peak Day Pricing (PDP) or Critical Peak Pricing (CPP)	PG&E, SCE	Customers receive a reduced rate during the summer months and incur higher prices or rates during CPP events.	Load Modifying	Residential and Non-Residential Customers (IOU Customers Only)	Yes
Critical Peak Pricing Default (CPP-D)	SDG&E	Critical Peak Pricing Default (CPP-D) is a commodity tariff that provides customers with an opportunity to manage their electric costs by either reducing load during high cost pricing periods or shifting load from high cost pricing periods to lower cost pricing periods.	Load drop, with some load shifting,	Non-Residential Customers (IOU Customers Only)	Yes
Real Time Pricing (RTP)	SCE	Hourly rates based on the time of day, season, and temperature.	Load Modifying	Residential and Non-Residential Customers (IOU Customers Only)	Yes

DR PROGRAM NAME	IOU	PROGRAM DESCRIPTION/CHARACTERISTICS	PROGRAM TYPE	CUSTOMER TYPE	AUTO DR INCENTIVE ELIGIBILITY
CAISO MARKET INTEGRATED SUPPLY SIDE DEMAND RESPONSE PROGRAMS					
Base Interruptible Program (BIP)	PG&E, SCE, SDG&E	Customers and/or third-party aggregators reduce their energy demand to an established amount or firm service level. Notification of BIP events vary by IOU (SDG&E = 20-min.; SCE = 30-min & 15-min; PG&E = 30-min)	Reliability	Large Non-Residential Customers (IOU, CCA, Direct Access Customers)	No
Agricultural & Pumping Interruptible (AP-I) Program	SCE	A utility direct load control program where a device or switch is installed at the customer's premise.	Reliability	Agricultural and Pumping Customers (IOU, CCA, Direct Access Customers)	No
Air Conditioner Cycling Program	PG&E, SCE	A utility direct load control program where a device or switch is installed at the customer's premise.	Price Responsive and/or Reliability	Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)	No
Smart Energy Program (thermostats)	SCE	A customer's registered thermostat is set or controlled to a certain temperature during DR events.	Price Responsive	Residential Customers (IOU Customers Only)	Yes (thermostat incentive program)
AC Saver Day-Ahead (thermostats)	SDG&E	Open to residential and commercial customers with a programmable communicating thermostat.	Load shed, Economic, Some Reliability	Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)	No
AC Saver Day-Of (switches)	SDG&E	Open to residential and commercial customers with a switch device installed on their AC unit.	Load shed, Economic, Some Reliability	Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)	No
Capacity Bidding Program (CBP)	PG&E, SCE (Non-Residential Only), SDG&E (Non-Residential Only)	Program in which third-party aggregators bid or nominate their DR capacity each month. PG&E and SDG&E offer program May-October; SCE offers program year-round (January-December).	Price Responsive	Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)	Yes
Demand Response Auction Mechanism (DRAM) Pilot	PG&E, SCE, SDG&E	Third-party Demand Response Providers provide DR resource adequacy resources to the Utility under a standard, non-negotiable purchase agreement.	Price Responsive and/or Reliability	Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)	Yes (PDR) No (RDRR)

Summary and Future Directions

- Linking energy efficiency and demand response can be synergistic
- Demand Side Management is moving from static energy efficiency to dynamic energy management
- Integrated demand side management will help state achieve low carbon grid



Questions and Answers