Energy Efficiency and Demand Response Integration

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DRAFT

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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
Linking Energy Efficiency and DR

- Daily Energy Efficiency
- Time-Of-Use Energy
- Daily Peak Load Managed
- Day-Ahead (slow) DR
- Real-Time DR

- Spinning Reserve (fast) DR

Service Levels Optimized
Time of Use Optimized
Service Levels Temporarily Reduced

Increasing Levels of granularity of Controls
Increasing Speed of Telemetry
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).
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

- **Shape**: Incentivize EE and Behavior Change
- **Shift**: Mitigate Ramps and Capture Surplus Renewables
- **Shed**: Manage contingency events and coarse net load following
- **Shimmy**: Fast DR to smooth net load and support frequency
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.

*Illustrative pricing profile*

- Off-peak
- Super off-peak
- Peak
- Partial Peak
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

<table>
<thead>
<tr>
<th>Sector</th>
<th>End Use</th>
<th>Enabling Technology Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Battery-electric and plug-in hybrid vehicles</td>
<td>Level 1 and Level 2 charging interruption</td>
</tr>
<tr>
<td></td>
<td>Behind-the-meter batteries</td>
<td>Automated DR (Auto-DR)</td>
</tr>
<tr>
<td>Residential</td>
<td>Air conditioning</td>
<td>Direct load control (DLC) and Smart communicating thermostats (Smart T-Stats)</td>
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<tr>
<td></td>
<td>Pool pumps</td>
<td>DLC</td>
</tr>
<tr>
<td>Commercial</td>
<td>HVAC</td>
<td>Depending on site size, energy management system Auto-DR, DLC, and/or Smart T-Stats</td>
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<tr>
<td></td>
<td>Lighting</td>
<td>A range of luminaire-level, zonal and standard control options</td>
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<tr>
<td></td>
<td>Refrigerated warehouses</td>
<td>Auto-DR</td>
</tr>
<tr>
<td>Industrial</td>
<td>Processes and large facilities</td>
<td>Automated and manual load shedding and process interruption</td>
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<tr>
<td></td>
<td>Agricultural pumping</td>
<td>Manual, DLC, and Auto-DR</td>
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<td></td>
<td>Data centers</td>
<td>Manual DR</td>
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<td></td>
<td>Wastewater treatment and pumping</td>
<td>Automated and manual DR</td>
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</table>
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
<table>
<thead>
<tr>
<th>DR Program or Rate Name</th>
<th>IOU</th>
<th>Program Description/Characteristics</th>
<th>Program Type</th>
<th>Customer Type</th>
<th>AutoDR Incentive Eligibility</th>
</tr>
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<tbody>
<tr>
<td>Time-of-Use (TOU)</td>
<td>PG&amp;E, SCE, SDG&amp;E</td>
<td>Electric rates which varies by set times of day and season (e.g. winter or summer).</td>
<td>Load Modifying</td>
<td>Residential and Non-Residential Customers (IOU Customers Only)</td>
<td>No</td>
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<tr>
<td>Peak Day Pricing (PDP) or Critical Peak Pricing (CPP)</td>
<td>PG&amp;E, SCE</td>
<td>Customers receive a reduced rate during the summer months and incur higher prices or rates during CPP events.</td>
<td>Load Modifying</td>
<td>Residential and Non-Residential Customers (IOU Customers Only)</td>
<td>Yes</td>
</tr>
<tr>
<td>Critical Peak Pricing Default (CPP-D)</td>
<td>SDG&amp;E</td>
<td>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.</td>
<td>Load drop, with some load shifting,</td>
<td>Non-Residential Customers (IOU Customers Only)</td>
<td>Yes</td>
</tr>
<tr>
<td>Real Time Pricing (RTP)</td>
<td>SCE</td>
<td>Hourly rates based on the time of day, season, and temperature.</td>
<td>Load Modifying</td>
<td>Residential and Non-Residential Customers (IOU Customers Only)</td>
<td>Yes</td>
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<tr>
<td>DR Program Name</td>
<td>IOU</td>
<td>Program Description/Characteristics</td>
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<tr>
<td>Base Interruptible Program (BIP)</td>
<td>PG&amp;E, SCE, SDG&amp;E</td>
<td>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&amp;E = 20-min.; SCE = 30-min &amp; 15-min; PG&amp;E = 30-min)</td>
<td>Reliability</td>
<td>Large Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>No</td>
</tr>
<tr>
<td>Agricultural &amp; Pumping Interruptible (AP-I) Program</td>
<td>SCE</td>
<td>A utility direct load control program where a device or switch is installed at the customer’s premise.</td>
<td>Reliability</td>
<td>Agricultural and Pumping Customers (IOU, CCA, Direct Access Customers)</td>
<td>No</td>
</tr>
<tr>
<td>Air Conditioner Cycling Program</td>
<td>PG&amp;E, SCE</td>
<td>A utility direct load control program where a device or switch is installed at the customer’s premise.</td>
<td>Price Responsive and/or Reliability</td>
<td>Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>No</td>
</tr>
<tr>
<td>Smart Energy Program (thermostats)</td>
<td>SCE</td>
<td>A customer’s registered thermostat is set or controlled to a certain temperature during DR events.</td>
<td>Price Responsive</td>
<td>Residential Customers (IOU Customers Only)</td>
<td>Yes (thermostat incentive program)</td>
</tr>
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<td>AC Saver Day-Ahead (thermostats)</td>
<td>SDG&amp;E</td>
<td>Open to residential and commercial customers with a programmable communicating thermostat.</td>
<td>Load shed, Economic, Some Reliability</td>
<td>Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>No</td>
</tr>
<tr>
<td>AC Saver Day-Of (switches)</td>
<td>SDG&amp;E</td>
<td>Open to residential and commercial customers with a switch device installed on their AC unit.</td>
<td>Load shed, Economic, Some Reliability</td>
<td>Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>No</td>
</tr>
<tr>
<td>Capacity Bidding Program (CBP)</td>
<td>PG&amp;E, SCE (Non-Residential Only), SDG&amp;E (Non-Residential Only)</td>
<td>Program in which third-party aggregators bid or nominate their DR capacity each month. PG&amp;E and SDG&amp;E offer program May-October; SCE offers program year-round (January-December).</td>
<td>Price Responsive</td>
<td>Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>Yes</td>
</tr>
<tr>
<td>Demand Response Auction Mechanism (DRAM) Pilot</td>
<td>PG&amp;E, SCE, SDG&amp;E</td>
<td>Third-party Demand Response Providers provide DR resource adequacy resources to the Utility under a standard, non-negotiable purchase agreement.</td>
<td>Price Responsive and/or Reliability</td>
<td>Residential and Non-Residential Customers (IOU, CCA, Direct Access Customers)</td>
<td>Yes (PDR) No (RDRR)</td>
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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