Demand Flexibility Technology, New Programs and Emerging Policies

Mary Ann Piette
Lawrence Berkeley National Laboratory

Integrated Distribution System Planning
Training for Western States
February 26, 2021
Presentation Outline

► Introduction to Grid-Interactive Efficient Buildings
► Utility Programs Using Advanced Automation
► Use of Open Standards
► California Load Management Standards
► Where Are We Headed?
1. **Efficiency**: minimize load
2. **Load shed**: reduce load at peak demand times (event-based)
3. **Load shift**: Store energy for use during peak (routine or event-based)
4. **Modulate**: Increase/decrease loads or generation when called upon
5. **Generation**: behind the meter energy supply such as PV
Grid-Interactive Efficient Buildings Support an Electric Grid with More Renewables

Efficient Components

- LED Lighting
- Facades
- HVAC
- Plug Loads
Grid-Interactive Efficient Buildings Support an Electric Grid with More Renewables

- Efficient Components
  - LED Lighting
  - Facades
  - HVAC
  - Plug Loads

- Integrated Building Systems
Grid-Interactive Efficient Buildings Support an Electric Grid with More Renewables
### Examples of Demand Response Programs in California from Investor Owned Utilities

<table>
<thead>
<tr>
<th>DR Program</th>
<th>Program Type</th>
<th>Notification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Modifying Programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Peak Pricing</td>
<td>Manual or Auto-DR</td>
<td>Day-ahead and Emergencies</td>
</tr>
<tr>
<td>Real-Time Pricing (RTP)</td>
<td>Manual or Auto-DR</td>
<td>Day-ahead (temperature in Downtown LA)</td>
</tr>
<tr>
<td>Supply Side Programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity Bidding Program (CBP)</td>
<td>Manual or Auto-DR</td>
<td>Day-ahead or Day-of</td>
</tr>
<tr>
<td>Base Interruptible program (TOU-BIP)</td>
<td>Manual or Aggregated</td>
<td>15 or 30 min based on customer option</td>
</tr>
<tr>
<td>Summer Discount Plan (SDP) Enhanced Plan</td>
<td>Direct Load Control (DLC)</td>
<td>No notification time</td>
</tr>
</tbody>
</table>

3 Current Communication Standards

► OpenADR2.0A/B: communications data model, with transport & security mechanisms, facilitates information exchange between 2 end-points, electricity service provider & customer. Software application.


► SEP2.0/IEEE 2030.5: Defines mechanisms for exchanging application messages, exact messages exchanged including error messages, security to protect application messages. Software application.
OpenADR Overview

- Server is virtual top node (VTN)
- Client is virtual end node (VEN)
- Over 160 manufacturers support OpenADR
Cloud Interface

- OpenADR 2.0 a or b enabled
- Retail or Operator provided or bring your own thermostat
- Cloud interface
- No resource constraints
- Feedback supported
CTA-2045 Appliance Family

- Water Heaters
- Pool Pumps
- PTAC – Packaged Terminal AC
- EV Chargers
- Heat Pump HVAC
Examples of CTA-2045, OpenADR in Laws, Regulations and Programs

<table>
<thead>
<tr>
<th>State</th>
<th>Regulation</th>
<th>Date of Implementation</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA</td>
<td>SB 5115 HB 1444</td>
<td>January 1, 2021</td>
<td>New electric water heaters CTA (Heat pump 1/21, Electric resistance 1/22) 40 – 120 Gal</td>
</tr>
<tr>
<td>OR</td>
<td>EO 2020-04</td>
<td>January 1, 2022</td>
<td>New electric water heaters CTA (Heat pump &amp; Electric resistance 1/22)</td>
</tr>
<tr>
<td>Energy Star National</td>
<td>Connected Appliances</td>
<td>TBD</td>
<td>Energy Star connected appliances need OpenADR or CTA-2045-A or equivalent standard at appliance or in cloud.</td>
</tr>
<tr>
<td>Energy Star National</td>
<td>Connected Appliances</td>
<td>Water Heaters</td>
<td>Connected device specification in progress</td>
</tr>
<tr>
<td>National</td>
<td>AHRI 1380</td>
<td>2019</td>
<td>DR-ready Variable Capacity HVAC systems rated to 65,000 Btu/hr or less shall have CTA-2045-A or OpenADR 2.0 or both.</td>
</tr>
<tr>
<td>National</td>
<td>AHRI 1430*</td>
<td>2021</td>
<td>DR-ready commercial water heaters to have a CTA-2045</td>
</tr>
<tr>
<td>CA</td>
<td>Title 24</td>
<td>2016</td>
<td>OpenADR required for Commercial HVAC, lighting and electronic message centers</td>
</tr>
<tr>
<td>CA</td>
<td>Title 24, JA13</td>
<td>July 8, 2020</td>
<td>NEEA Tier 3 v7, which requires a CTA-2045 port (New Construction)</td>
</tr>
</tbody>
</table>

Source of data: Skycentrics. *AHRI spec in draft form
Structure of OpenADR Incentive Payments for Commercial and Industrial Programs

**ADR Incentive Payments to Customers and Vendors, All IOUs**

- **Customer Paid**: 60.0 MW, 695 Service Accounts, 78 Customers
- **Vendor Paid**: 191 MW, 1516 Service Accounts, 319 Customers

Examples of Performance by Technology

Mean Event Performance Percentage by Control Technology

California Senate Bill 49 Energy: Appliance Standards and State Water Project Assessment

► Energy efficiency standards to manage energy loads to help maintain electrical grid reliability.
► Require California Energy Commission (CEC) to adopt and periodically update standards for appliances to facilitate deployment of flexible demand technologies and require standards be cost effective and prioritize appliances with specified attributes.
► CEC to consult with CPUC and load-serving entities to align flexible demand appliance standards with DR programs and to incentivize flexible demand appliances.
Load Management Standards Rulemaking

- **STATE GOAL**: Carbon-free electricity generation by 2045 (SB100)
  - **Problem**: Some carbon-free supplies are inherently inflexible, variable
  - **Solution**: Encourage flexibility in the demand

- **CEC Proposed Plan**
  1. Create the Statewide MIDAS Price Portal (19-OIR-01)
  2. Investigate load management strategies to reduce GHG emissions (AB 3232)
  3. Create standards for flexible demand appliances (SB 49)
  4. Update Load Management Standards as needed
CEC Vision - Proposed Price Communication System

California Energy Commission

Load Serving Entities

Aggregators & Automation Manufacturers

DR Devices

Price and GHG Responsive Devices & Vehicles

Nearly every vehicle has an FM receiver

Smart plugs
- Thermostats
- Energy management systems
- Electric vehicle supply equipment
- Batteries
- Water heater controls
- Electric vehicles
- Refrigeration
- Pool pump and hot tub controls

LSEs = IOUs, POUs, CCAs, Etc.
GHG = Greenhouse Gas emissions
Source: CEC Existing Buildings Office
Upcoming Events on Load Management Standards

• Draft report will be posted on the **CEC Docket 20-OIR-01**
• Workshop is being planned for March or April

Note the **Order Instituting Rulemaking** is applicable to
- Investor owned utilities
- Municipal utilities
- Community choice aggregators
California Load Flexibility Research and Deployment Hub (CalFlexHub)

CalFlexHub Ecosystem

- Disadvantaged and Low-Income Communities (DAC)
- Technical Advisory Committee (TAC)
- Technology Innovators
- Equity Advisory Committee (EAC)
- Service and Financing Providers
- Policymakers and Program Implementers
- Building and Home Owners, and Facility Managers
- Utilities, Community Choice Aggregators
- Software and Communication Providers
- Hardware Manufacturers
- Field Demonstration Partners

Hub Portfolio Management

- Technology Assessment and Prioritization
  - Identify, analyze, and screen innovations
- Research and Development
  - Develop and validate early-stage innovations
- Demonstration and Deployment
  - Refine solutions and validate/performance in field
- Performance Evaluation
  - Quantify potential impact of solutions using key performance metrics

Flexibility Solutions Adopted by Industry and Building Stock at Scale

BERKELEY LAB
CALIFORNIA ENERGY COMMISSION
Several evolving standards can be used to automate demand response.

Many states have requirements for communicating devices and systems.

California is exploring the use of digital tariffs to communicate price and requirements for appliances.

For the future – we need:
- Cost-benefit data from programs
- Persistence of savings/participation rates
- Stable incentives and programs, with simple enrollment methods
Questions States Can Ask

► What steps can be taken to promote interoperability for demand flexible loads?
► What interoperable automation standards are the most important to invest in?
► How can building codes and state load management standards complement utility programs?
► How do planned or proposed grid modernization efforts contribute to integrating flexible loads?
For More Information Contact
Mary Ann Piette
mapiette@lbl.gov
510 486 6286
APPENDIX
OpenADR 2.0 Application

*Figure Source: OASIS Energy Interop Draft Standards (http://www.oasis-open.org/committees/energyinterop/)*
Realizing the Vision: DOE Building Technologies Office GEB initiative

**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-optimizes efficiency, flexibility, and occupant preferences

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