Active Demand Reduction Update

Massachusetts Energy Efficiency Advisory Council
November 20, 2019
Introduction

Residential – Updates since March 2019
  - Residential – 2019-2021 Program Design
  - Residential – Summer 2019 Performance

C&I – Updates since March 2019
  - C&I – 2019-2021 Program Design
  - C&I – Summer 2019 Performance

2019 Summer Activity Evaluation Timeline

Winter 2019/20 Plans

Plan to seek DPU Approval for Daily Dispatch
Demonstrations Have Transitioned to Full Offerings

2016-2018
- PAs explored and implemented demonstration offerings
- PAs collaborated with DOER, AG, and LEAN through Demand Savings Group (outlined in the 2016-2018 Term Sheet) and the EEAC Demand Reduction Subcommittee (expired in March 2017, per charter) to research and develop demonstration projects to inform 2019-2021 Three-Year Plan program designs

2019-2021
- PAs completing demonstration offerings and will implement statewide offerings at scale under programs approved by DPU
- PAs have established the Demand Coordinating Committee under the MC structure, like MTAC, SW Marketing, or others
- Future coordination will occur through the RMC/C&IMC (similar process for all programs and initiatives)
The system peak continued to decline in 2019 and did not come close to approaching the all-time peak in 2006.
In large part due to energy efficiency’s passive demand reduction, Energy Efficiency has substantially reduced the energy demand of the entire ISO-NE system and makes up 80% of the entire delta between Gross and Net demand through 2028. Massachusetts represents 55% of this reduction, roughly 1,500 MW.
The PAs called multiple events and hit the system peak.
Recruited resources performed during system peak

System Peak
What is a MW? It depends…

- **Planned MW** – filed in 2019-2021 Three Year Plan
- **Enrolled MW** – An ex ante, estimate based on customer recruitments ahead of summer activity multiplied by a estimate of expected response based on experience
- **Performed MW** – an ex post gross average demand reduction calculation based on the event and customer baseline prior to an event, used for customer settlement
- **Evaluated MW** – an ex post gross average demand reduction using evaluation-determined regression baseline establishment and customer/event performance, used for reporting and benefit calculation

Standardizing nomenclature for consistent understanding
### 3 Options to Participate - Residential

<table>
<thead>
<tr>
<th>Program Parameters</th>
<th>Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermostat</strong></td>
<td>![Thermostat Image]</td>
</tr>
<tr>
<td>• 13 to 17 events per summer</td>
<td></td>
</tr>
<tr>
<td>• 3 hours per event</td>
<td></td>
</tr>
<tr>
<td>• $25 for signing up</td>
<td></td>
</tr>
<tr>
<td>• $20 per year for staying in the program</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Battery</strong></th>
<th>![Battery Image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 30 - 60 events per summer,</td>
<td></td>
</tr>
<tr>
<td>• 2 - 3 hours per event</td>
<td></td>
</tr>
<tr>
<td>• $225/kW-summer</td>
<td></td>
</tr>
<tr>
<td>• $50/kW-winter</td>
<td></td>
</tr>
</tbody>
</table>

*Per Order: Daily Dispatch Demonstration for 2019 – expect to reach full offering for 2020*

<table>
<thead>
<tr>
<th><strong>Electric Vehicle</strong></th>
<th>![Electric Vehicle Image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2 to 8 events per summer</td>
<td></td>
</tr>
<tr>
<td>• 3 hours per event</td>
<td></td>
</tr>
<tr>
<td>• Eversource – Charger Control – R&amp;D</td>
<td></td>
</tr>
<tr>
<td>• National Grid – Vehicle Control – Claiming Savings</td>
<td></td>
</tr>
</tbody>
</table>
Customer Experience – Communicating Tstasts

- Customer Recruitment
  - Fully-Integrated with relevant EE delivery channels
    - Digital
    - Cross-Program Promotion (eg. through RCD)
  - PA efficiency programs seed technology in customers’ homes to be controlled during DR events
  - **Consistent Finding**: OEM Channel direct to customer marketing for communicating Tstats drives the majority of customer recruitment

- Customer receives notification of events typically on their device or through their OEM device application
  - Events dispatched through PAs Demand Response Management Systems (DRMS)
Demonstration Status for 2019 per DPU order

Customer Recruitment
- Only through storage integrators (5 currently supported)
- Limited opportunity for cross-program promotion at this time
- Limited value streams for customers investing in storage limits customer value and confidence of payback
  - No current substantive monetary customer value to storing solar
    - Net metering treats the whole grid system like a battery
    - No Energy Arbitrage Value – no TOU rates for Resi customers
    - No ICAP charges for Resi customers
    - No monthly demand charges for Resi customers
    - Might be possible for ISO-NE FCM participation
- PA Daily Dispatch – only a demo and currently lacks long term certainty
- Backup in outage if designed to island – but finite resource
- Program Cost-effectiveness ≠ Customer Cost-effectiveness

Customer receives notification of events typically through their OEM device application
- Events dispatched through PAs Demand Response Management Systems (DRMS)
2019 Summer Performance – Residential
### Summer Residential Events

**National Grid**
- 12 Tstat Targeted Dispatch Events
- 27 Storage Daily Dispatch Events

**Eversource**
- 7 Tstat Targeted Dispatch Events
- 1 EV Charging Event (R&D)

**Unitil**
- 12 Tstat Targeted Dispatch Events
- 60 Storage Daily Dispatch Events (demo run daily Aug-Sept)
### Summer Residential Performance

#### Table: Performance by Utility and Dispatch Type

<table>
<thead>
<tr>
<th>PA</th>
<th>Sector</th>
<th>Dispatch Type</th>
<th>Participants</th>
<th>Unit</th>
<th>2019 Planned (MW)</th>
<th>2019 Enrolled (MW)</th>
<th>2019 Performed (MW)</th>
<th>2019 Evaluated (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Grid</td>
<td>Resi</td>
<td>DLC</td>
<td>9,300 tstats</td>
<td>5.20</td>
<td>6.50</td>
<td>6.70</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>National Grid</td>
<td>Resi</td>
<td>Storage - Daily</td>
<td>40 accts</td>
<td>-</td>
<td>0.18</td>
<td>0.18</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Eversource</td>
<td>Resi</td>
<td>DLC</td>
<td>7,500 tstats</td>
<td>2.00</td>
<td>3.7</td>
<td>4.6</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Unitil</td>
<td>Resi</td>
<td>DLC</td>
<td>56 tstats</td>
<td>0.09</td>
<td>0.02</td>
<td>0.03</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

#### Chart: Avg. Participation Across All Events

- **Eversource**: 22% Full Participant, 16% No Connectivity, 25% Failed, 52% System Off/Heat Mode, 11% Opt-Out
- **National Grid**: 28% Full Participant, 11% No Connectivity, 25% Failed, 52% System Off/Heat Mode, 11% Opt-Out
- **Unitil**: 22% Full Participant, 11% No Connectivity, 28% Failed, 52% System Off/Heat Mode, 11% Opt-Out

### Early Findings:

- The percentage of thermostats that achieved full participation in the program (excluding customers with no thermostat connectivity, AC systems in off or heat mode, and customers that opted out) ranged from 52% to 60%.
- Opt-outs, systems being off or in heating mode, and connectivity are all a reality of direct load control (DLC) offerings and to be expected.
- Based on a survey of participating customers, the most common motivation for customer participation was to save money on energy bills, followed by receiving participation incentives.
- Out of the survey respondents who were home for events, roughly 70% noticed a change in temperature during events and 50% found the event temperature less comfortable than normal.
- The vast majority (>85%) of survey respondents reported that they are likely or very likely to participate in the program again in the future.
2019-2021 C&I Program Design
# 3 Options to Curtail – C&I

<table>
<thead>
<tr>
<th>Program Parameters</th>
<th>Typical Application</th>
</tr>
</thead>
</table>
| **Targeted Dispatch** | - 3 - 8 events per summer  
  - 3 hours per event  
  - All PA: Curtailment $35/kW-summer  
  - Eversource only: Targeted Storage $100/kW-summer |
| **Daily Dispatch** | - 30 - 60 events per summer,  
  - 2 - 3 hours per event  
  - $200/kW-summer |
| **Winter Dispatch** | - 5 events per winter  
  - 3 hours per event  
  - $25/kW-winter |

*Per Order: Demonstration for 2019 – expect to reach full offering for 2020*
<table>
<thead>
<tr>
<th>Targeted Dispatch</th>
<th>Daily Dispatch</th>
<th>Winter Dispatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Usually Manual</td>
<td>• Usually Automatic</td>
<td>• Usually Manual</td>
</tr>
<tr>
<td>• Temperature setback ~3F</td>
<td>• Batteries</td>
<td>• Snowmaking</td>
</tr>
<tr>
<td>• VFD speed limiting</td>
<td>• Flywheels</td>
<td>• Industrial Processes</td>
</tr>
<tr>
<td>• Early setback</td>
<td>• Thermal Storage</td>
<td>• Generators</td>
</tr>
<tr>
<td>• Process Changes</td>
<td>• Industrial Freezers</td>
<td></td>
</tr>
<tr>
<td>• Rarely Lighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Generators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Combined Heat and Power</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Basics of Targeted Dispatch

- Typically 3 – 6 events per summer
- 3 hours per event
- Between 2 – 7pm
- Customers/CSPs are notified the day before.
- Weekdays
- Not Holidays
- Paid by performance: $35/kW-summer
Basics of Daily Dispatch
Demonstration for 2019

• Typically 30–60 events per summer
• 2 - 3 hours per event
• Between 2 – 7pm
• Customers/Vendors are notified the day before.
• Weekdays
• Not Holidays
• Events called in June, July, August, and September, but mostly in July and August
• Paid by performance: $200/kW-summer
Events are still typically 3 hours long, but now they can happen dynamically between 2pm and 7pm based on forecast.

Option 1:

Option 2:

Option 3:
Customer Experience – C&I
Targeted & Daily Dispatch

- Customer Recruitment
  - Fully-Integrated with relevant EE delivery channels
    - Managed Accounts using PA Staff
    - Curtailment Service Providers (CSPs)
  - DR is one of many solutions and services PAs make Customers aware of and incentivize
  - PA EE programs seed technology in customers facilities to be controlled during DR events

- Daily Dispatch Specific Issues
  - Due to demo status implementation is limited
  - Limited opportunity for cross-program promotion at this time
  - Limited value streams for customers investing in storage limits customer value and confidence of payback
    - PA Daily Dispatch – only a demo and currently lacks long term certainty
    - Backup in outage if designed to island – finite resource
    - Wider array of value than Resi – still some mutually exclusive
    - Program Cost-effectiveness ≠ Customer Cost-effectiveness
  - Customer receives notification of events typically from CSPs
    - Events dispatched through PAs Demand Response Management Systems (DRMS) to CSP operations center

![Example of a 200kW/400kWh Lithium Ion Battery over 5 years]

May not be able to combine with these.

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Easy</th>
<th>Medium</th>
<th>Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA only</td>
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<td></td>
<td></td>
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<td>MA only</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MA only</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

23
2019 Summer
Performance – C&I
Summer C&I Events

National Grid
• 1 C&I Targeted Dispatch Event

Eversource
• 3 C&I Targeted Dispatch Events
### Summer C&I Performance

<table>
<thead>
<tr>
<th>PA</th>
<th>Sector</th>
<th>Dispatch Type</th>
<th>Participants</th>
<th>Unit</th>
<th>2019 Planned (MW)</th>
<th>2019 Enrolled (MW)</th>
<th>2019 Performed (MW)</th>
<th>2019 Evaluated (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Grid</td>
<td>C&amp;I</td>
<td>Targeted</td>
<td>414 accts</td>
<td></td>
<td>66.00</td>
<td>82.00</td>
<td>76.92</td>
<td>-</td>
</tr>
<tr>
<td>Eversource</td>
<td>C&amp;I</td>
<td>Targeted</td>
<td>181 accts</td>
<td></td>
<td>30.00</td>
<td>36.7</td>
<td>23.0*</td>
<td>-</td>
</tr>
<tr>
<td>Eversource</td>
<td>C&amp;I</td>
<td>Storage - Daily</td>
<td>1** accts</td>
<td></td>
<td>0.50</td>
<td>0.50</td>
<td>0.4</td>
<td>-</td>
</tr>
<tr>
<td>Eversource</td>
<td>C&amp;I</td>
<td>Storage - Targeted</td>
<td>2 accts</td>
<td></td>
<td>0.50</td>
<td>1.70</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>Unitil</td>
<td>C&amp;I</td>
<td>Targeted</td>
<td>3 accts</td>
<td></td>
<td>0.20</td>
<td>0.95</td>
<td>0.85</td>
<td>-</td>
</tr>
</tbody>
</table>

*Several accounts still awaiting analysis
**1 project accounted for 0.50 MW. *This was the total that was filed for Eversource in 2019
Preparing for Winter 2019/20
Basics of Winter Dispatch

- Max of 5 events per winter
- Targeting System Peak
- 2 or 3 hours per event
- Time of day – 2pm to 7pm

- Customers/CSPs are notified the day before.
- Weekdays; No Holidays
- December, January, February, March
- Paid by performance $25/kW-winter
What resources do we expect to be available
  - C&I Targeted and Daily Dispatch resources

How much MW is new vs existing summer MW?
  - PAs anticipated many existing summer MW would be re-rated for winter performance, new technology agnostic resources could be enrolled at summer participating customers facilities

Are new customers being enrolled for winter?
  - The PAs anticipate the majority of participants will come from the summer participant pool. New Customers can begin to participate, if they also plan to participate in summer, however, PAs expect new participants, not already enrolled in summer, would be unlikely to enroll just for winter.

What are PAs currently doing?
  - Recruiting customers to participate and establishing the processes and expectations for winter dispatch
2019 Summer Activity Evaluation Timeline
Evaluation data collection run in parallel with summer programmatic activity to the extent possible and did not wait for year end

Aim to have Evaluated MW performance earlier than normal

Residential

- Communicating Tstats – Draft January, Expected Completion February 2020
- Daily Dispatch Storage – Draft December, Expected Completion January 2020

C&I

- Targeted Dispatch – Draft January, Expected Completion February 2020
- Daily Dispatch Storage – Draft December, Expected Completion January 2020
Seeking Daily Dispatch
Full Approval
Department did not approve full scale, statewide deployment of daily dispatch because it found it was an untested form of dispatch

Department found merit in exploring the potential for daily dispatch through demonstration offerings
  • National Grid, Eversource, and Until filed a budget for each plan year, in February 2019, to test the daily dispatch
  • The Compact will file a budget for daily dispatch as part of the request for approval of full scale daily dispatch

Program Administrators must submit a “compliance filing” to the Department, including the results of the demonstrations, before the PAs can implement statewide and at full scale
  • Until the DPU approves:
    • the demonstration offering budgets may not exceed the planned budget level for daily dispatch
    • the PAs can not offer the five-year incentive lock for daily dispatch
Gather Evaluation Results
- Final results should be available end of January

Council Resolution
- February EEAC meeting
- PAs hope Council will pass a Resolution supporting all PAs to offer daily dispatch, the already filed budgets, and the Compact’s proposed budgets

PA Compliance Filing with Department
- Filed in the Three-Year Plan dockets in March
- Filing will include final evaluation, testimony, and request to approve the budgets already filed for National Grid, Eversource, and Unitil, as well as the Compact proposed budget
- While the Program Administrators hope the Department will approve the offering before the summer, there is no deadline for such approval
  - National Grid and Eversource will continue their daily dispatch demonstrations at the proposed 2020 daily dispatch budget levels until the Department’s final decision
Thank you
Statewide Active Demand – Planned Summer

Active Demand Summer Capacity (MW)

- Residential
  - 2019
- C&I
  - 2019
- Residential
  - 2020
- C&I
  - 2020
- Residential
  - 2021
- C&I
  - 2021

- CLC
- Unitil
- Eversource
- National Grid
Statewide Active Demand – Planned Winter

Active Demand Winter Capacity (MW)

- Residential
  - 2019
- C&I
  - 2019
- Residential
  - 2020
- C&I
  - 2020
- Residential
  - 2021
- C&I
  - 2021

Legend:
- Unitil
- Eversource
- National Grid
# 2019-2021 Plan Proposal for Active Demand Reduction - Statewide

## Sector/Season/Dispatch Type

<table>
<thead>
<tr>
<th></th>
<th>Sum of Max Net kW</th>
<th>Sum of Incentive (Total)</th>
<th>Sum of Incentive (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A - Residential</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Load Control</td>
<td>8,305</td>
<td>11,515</td>
<td>14,273</td>
</tr>
<tr>
<td>Storage Daily Dispatch, discharge (savings) Summer</td>
<td>0</td>
<td>1,913</td>
<td>2,946</td>
</tr>
<tr>
<td><strong>Storage System and Performance, discharge (savings) Summer</strong></td>
<td>0</td>
<td>1,250</td>
<td>1,539</td>
</tr>
<tr>
<td>EV Load Management (Summer)</td>
<td>393</td>
<td>488</td>
<td>596</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Load Control</td>
<td>8,698</td>
<td>15,167</td>
<td>19,354</td>
</tr>
<tr>
<td>Storage Daily Dispatch, discharge (savings) Winter</td>
<td>0</td>
<td>1,913</td>
<td>2,946</td>
</tr>
<tr>
<td><strong>Storage System and Performance, discharge (savings) Winter</strong></td>
<td>0</td>
<td>1,250</td>
<td>1,539</td>
</tr>
<tr>
<td>EV Load Management (Winter)</td>
<td>393</td>
<td>488</td>
<td>596</td>
</tr>
<tr>
<td><strong>B - Income Eligible</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage System and Performance, discharge (savings) Summer</td>
<td>0</td>
<td>289</td>
<td>385</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage System and Performance, discharge (savings) Winter</td>
<td>0</td>
<td>289</td>
<td>385</td>
</tr>
<tr>
<td><strong>C - Commercial &amp; Industrial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruptible Load</td>
<td>93,317</td>
<td>124,858</td>
<td>159,885</td>
</tr>
<tr>
<td>Storage Daily Dispatch, discharge (savings)</td>
<td>0</td>
<td>10,100</td>
<td>17,100</td>
</tr>
<tr>
<td>Storage Targeted Dispatch, discharge (savings) Summer</td>
<td>500</td>
<td>5,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Custom</td>
<td>1,000</td>
<td>2,903</td>
<td>5,403</td>
</tr>
<tr>
<td>Storage System and Performance, discharge (savings) Summer</td>
<td>0</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruptible Load</td>
<td>15,310</td>
<td>32,202</td>
<td>44,722</td>
</tr>
<tr>
<td>Storage Daily Dispatch, discharge (savings)</td>
<td>0</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>Storage Targeted Dispatch, discharge (savings) Winter</td>
<td>2,520</td>
<td>7,100</td>
<td>11,100</td>
</tr>
<tr>
<td><strong>Total Summer</strong></td>
<td>103,515</td>
<td>158,508</td>
<td>212,319</td>
</tr>
<tr>
<td><strong>Total Winter</strong></td>
<td>16,656</td>
<td>36,142</td>
<td>50,188</td>
</tr>
</tbody>
</table>
## 2019-2021 DPU Order for Active Demand Reduction

<table>
<thead>
<tr>
<th>Initiative/Offering</th>
<th>CLC</th>
<th>Eversource</th>
<th>National Grid</th>
<th>Unitil</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential DLC - Tstat</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>CLC can pursue once agreement with Eversource and approval from DPU</td>
</tr>
<tr>
<td>Residential DLC - WH</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>no one is pursuing</td>
</tr>
<tr>
<td>Residential - Daily Dispatch</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X*</td>
<td>demo for 2019, per order, assume full offering in 2020-2021; summer &amp; winter (targeted); CLC deferred</td>
</tr>
<tr>
<td>Residential DLC - EVs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>Eversource Demo, National Grid DLC claimed savings</td>
</tr>
<tr>
<td>C&amp;I Interruptible - Targeted</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>CLC can pursue once agreement with Eversource and approval from DPU; summer &amp; winter (targeted)</td>
</tr>
<tr>
<td>C&amp;I - Daily Dispatch</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>demo for 2019, per order, assume full offering in 2020-2021; summer &amp; winter (targeted); CLC deferred</td>
</tr>
<tr>
<td>C&amp;I Storage - Targeted Dispatch</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>summer &amp; winter (targeted)</td>
</tr>
<tr>
<td>C&amp;I ADR Custom - TBD</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>TBD</td>
</tr>
</tbody>
</table>

* Unitil will consider moving forward in 2020-2021 pending evaluation results due in the Spring of 2020 and any other constraints.

**Order Highlights:**
- **Statewide Proposals**
  - All Approved, except Daily Dispatch Storage
  - Full scale deployment not allowed, PA may use a portion of the proposed on daily dispatch demo offering and seek approval
  - Five Year Commitments Approved
  - Higher Incentive Levels for Daily Dispatch is Appropriate
- **Compact**
  - DPU recognizes CLC efforts/creativity, but CVEO and enhanced storage offer not approved; may not offer active demand until an agreement between Eversource and Compact is reached.
- **Gas Demand Response**
  - Gas PAs must continue to review the potential for cost-effective savings from gas demand response offerings, and as part of the next 3YP include detailed testimony and exhibits addressing such continued study and the feasibility of gas demand response offerings.
2019 Demonstration Activity & Findings – Residential
# Residential Demo Design Summary

<table>
<thead>
<tr>
<th>Demo</th>
<th>PA</th>
<th>Design/ Approach</th>
<th>Customer Segment Targeted</th>
<th>Dispatch Criteria</th>
<th>Programmatic Benefits Targeted</th>
<th>Est. Spend</th>
<th>Cost range ($/kw-yr)</th>
<th>Participant Count</th>
<th>Est. MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected Solutions - DLC</td>
<td>National Grid</td>
<td>Direct load control of cooling equipment using communicating thermostat</td>
<td>Residential and income eligible customers with communicating t-stats and cooling equipment</td>
<td>Summer, 3–4 hour events, between 1-6pm, no holidays or weekends</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE</td>
<td>~$1.5 mil/yr</td>
<td>~$250/kw-yr</td>
<td>11,000</td>
<td>6</td>
</tr>
<tr>
<td>Residential Direct Load Control</td>
<td>CLC</td>
<td>Unchanged - A/C setpoint adjustments targeting ISO peak hour</td>
<td>Residential and income eligible customers with communicating t-stats and cooling equipment</td>
<td>Big 7-hour DR events called, all in July &amp; August between 2 – 7 pm</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE</td>
<td>~$30,000/yr</td>
<td>~$250-500/kw-yr</td>
<td>91</td>
<td>0.045</td>
</tr>
<tr>
<td>Residential Storage/ Solar PV</td>
<td>Unutil</td>
<td>pairing solar customers and storage to assess customer acceptance</td>
<td>residential customers with solar PV</td>
<td>Summer system peaks, Winter dispatch</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE + Winter Energy</td>
<td>~$50,000/total</td>
<td>&gt;~$2,000/kw-yr</td>
<td>2-4</td>
<td>0.008</td>
</tr>
</tbody>
</table>
2019 Demonstration Activity & Findings – C&I
### C&I Demo Design Summary

#### Connected Solutions - C&I
- **PA:** National Grid
- **Design/Approach:** Technology agnostic manual or automatic curtailment demand reduction, dispatched through Curtailment Service Providers (CSPs).
- **Customer Segment Targeted:** Large Commercial & Industrial customers with interval meters.
- **Dispatch Criteria:** Summer, 3-4 hour events, between 1-6pm, no holidays or weekends.
- **Programmatic Benefits Targeted:** Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE.
- **Est. Spend:** $3-4 mil/yr
- **Cost range ($/kw-yr):** $50/kw-yr
- **Participant Count:** 276
- **Est. MW:** 60

#### Batteries
- **PA:** Eversource
- **Design/Approach:** Summer: long duration daily dispatch and short duration targeted dispatch. Winter: Price dispatch.
- **Customer Segment Targeted:** Lithium Ion batteries.
- **Dispatch Criteria:** Summer daily: 5 hour dispatch during summer peak hours. Summer targeted: 1 – 3 hour dispatch when system peak hours predicted. Winter: Price > $500/MWh.
- **Programmatic Benefits Targeted:** Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE.
- **Est. Spend:** $2.5 mil/yr
- **Cost range ($/kw-yr):** $598 to $943/kw-yr
- **Participant Count:** 2
- **Est. MW:** 0.25

#### Thermal Storage (ice storage and phase change)
- **PA:** Eversource
- **Design/Approach:** Uses thermal storage to reduce load from existing AC or refrigeration equipment.
- **Customer Segment Targeted:** Cold Storage & HVAC load.
- **Dispatch Criteria:** Daily dispatch daily during summer peak hours.
- **Programmatic Benefits Targeted:** Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE.
- **Est. Spend:** $1.95 mil/yr
- **Cost range ($/kw-yr):** $224/kw-yr
- **Participant Count:** 2
- **Est. MW:** 0.03
<table>
<thead>
<tr>
<th>Demo</th>
<th>PA</th>
<th>Design/Approach</th>
<th>Customer Segment Targeted</th>
<th>Dispatch Criteria</th>
<th>Programmatic Benefits Targeted</th>
<th>Est. Spend</th>
<th>Cost range ($/kw-yr)</th>
<th>Participant Count</th>
<th>Est. MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software signaling of Building Management System (BMS)</td>
<td>Eversource</td>
<td>Customized plans to reduce facility load through software, e.g., pre-cooling and reducing maximum speed HVAC variable speed air handlers</td>
<td>Large Commercial &amp; Industrial customers with interval meters</td>
<td>System triggered when customer nears 5% of their monthly peak, or when system peak hours are predicted</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE</td>
<td>$2 mil/yr</td>
<td>N/A</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>Manual Load Curtailment</td>
<td>Eversource</td>
<td>Technology agnostic manual curtailment demand reduction. Delivered through Curtailment Service Providers (CSPs)</td>
<td>Large Commercial &amp; Industrial customers with interval meters</td>
<td>Summer: 1-4 hour events, between 2-7pm, no holidays or weekends, Winter: Price &gt; $500/MWh</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE</td>
<td>$1 mil/yr</td>
<td>$81 /kw-yr</td>
<td>59</td>
<td>8.4</td>
</tr>
<tr>
<td>Wi-fi thermostats</td>
<td>Eversource</td>
<td>Direct load control of cooling equipment using communicating thermostat, Samll Commercial customers with communicating tstats and cooling equipment</td>
<td>Summer, 3-4 hour events, between 1-6pm, no holidays or weekends</td>
<td>Targeting System Peak – avoided capacity, Tx, Dx, capacity DRIPE</td>
<td>N/A</td>
<td>$0.2 mil/year</td>
<td>N/A</td>
<td>1</td>
<td>N/A</td>
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</tbody>
</table>