Connected Criteria

Grid communications for ENERGY STAR Products

NARUC-NASEO Grid Connected Buildings Call, July 27, 2020
Abigail Daken, ENERGY STAR HVAC and Connected Product Manager
Why is this part of ENERGY STAR?

- Opportunity for insight into and control of energy use
- Growing load
- Efficiency critical – strong role for ENERGY STAR
- Rising grid importance of insight into and control of loads

Continue to serve our partners as demand-side management evolves.
EPA’s vision of the future

- In our SHEMS work, developed a coherent vision of the future (20 years?):
  
  Smart Home Energy Management Systems will seamlessly optimize energy use, storage, and production in the home for multiple priorities of cost, environmental impact, and convenience, while providing excellent customer experience.

- Partly in response to expected grid conditions:
  - Growing share of generation from intermittent renewables
  - Consumer cost of energy use will vary with time

- In the short term, large loads will remain worthwhile targets for load flexibility on their own

- Over time, as markets evolve, the SHEMS specifications and the criteria in the other specifications will evolve to support this vision
Diverse drivers & energy implications

<table>
<thead>
<tr>
<th>Example products</th>
<th>What connectivity provides</th>
<th>Driver of market adoption</th>
<th>Energy Implication and/or Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool pumps, water heaters</td>
<td>Flexibility of large loads, no consumer impact</td>
<td>Grid services</td>
<td>Enable cleaner grid</td>
</tr>
<tr>
<td>Electric vehicle chargers, HVAC</td>
<td>Flexibility of large loads, some consumer impact</td>
<td>Grid services</td>
<td>Enable cleaner grid; protect consumer interest</td>
</tr>
<tr>
<td>White goods, HVAC</td>
<td>Convenience and quality of maintenance</td>
<td>Blended: consumer, brand owner, grid</td>
<td>Better maintenance saves energy</td>
</tr>
<tr>
<td>Door locks, window sensors</td>
<td>Safety and security</td>
<td>Consumer interest</td>
<td>Added load; occupancy info?</td>
</tr>
<tr>
<td>Color changing lights, smart speakers</td>
<td>Additional functionality</td>
<td>Consumer interest</td>
<td>Added load</td>
</tr>
</tbody>
</table>
## Appliances

<table>
<thead>
<tr>
<th>Example products</th>
<th>What connectivity provides</th>
<th>Driver of market adoption</th>
<th>Energy Implication and/or Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>White goods, HVAC</td>
<td>Convenience and quality of maintenance</td>
<td>Blended: consumer, brand owner, grid</td>
<td>Better maintenance saves energy</td>
</tr>
</tbody>
</table>

- Balanced approach seeks energy savings, smart home integration, consumer convenience, and grid services where opportunity arises
  - Consumer amenity now, possibility of use for grid services in the future
  - A few (dryers) may be valuable DR resources in themselves; most will be more valuable when integrated into whole home solution
  - Opportunity for convenience and energy savings through remote monitoring
- Status: Test method for room AC completed 2019; Connected criteria adjusted as specifications’ energy efficiency criteria are revised
Large loads

<table>
<thead>
<tr>
<th>Example products</th>
<th>What connectivity provides</th>
<th>Driver of market adoption</th>
<th>Energy Implication and/or Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool pumps, water heaters</td>
<td>Flexibility of large loads, no consumer impact</td>
<td>Grid services</td>
<td>Enable cleaner grid</td>
</tr>
<tr>
<td>Electric vehicle chargers, HVAC</td>
<td>Flexibility of large loads, some consumer impact</td>
<td>Grid services</td>
<td>Enable cleaner grid; protect consumer interest</td>
</tr>
</tbody>
</table>

- Increase access to resources for grid balancing through ENERGY STAR specs
  - Optional connected criteria focus on grid service potential
  - Coordinated for interoperability as much as is practical
  - Connectivity also drives efficiency through consumer energy awareness and better maintenance and operation
- Status: Residential central AC and heat pumps in process; residential water heaters in process (expect models on market by end of 2020); electric vehicle chargers Draft; Pool pumps revision launches in 2020
Small loads with eager consumers

<table>
<thead>
<tr>
<th>Example products</th>
<th>What connectivity provides</th>
<th>Driver of market adoption</th>
<th>Energy Implication and/or Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door locks, window sensors</td>
<td>Safety and security</td>
<td>Consumer interest</td>
<td>Added load; occupancy info?</td>
</tr>
<tr>
<td>Color changing lights, smart speakers</td>
<td>Additional functionality</td>
<td>Consumer interest</td>
<td>Added load</td>
</tr>
</tbody>
</table>

- **Bring energy savings along for the ride**
  - As the market for IoT products and systems grows, EPA will help drive and optimize energy savings through their use.
  - Criteria include energy reporting, standby power limits, and compatibility with smart home systems
**Interoperability is key**

- For utilities: load control system talks to multiple companies’ connected products
  - Less costly to implement grid response program
  - More choice for consumers/contractors
- For manufacturers: do not need a custom solution for every utility’s grid response program
  - OpenADR favored by utilities that are playing around, or when cloud connection needed aside from grid services
  - CTA-2045 favored for large scale deployment, particularly for products (e.g. WH) where connectivity otherwise unneeded
- For consumers: in connecting to smart homes
  - Increases consumer choice
  - Simplifies set up and makes continued connection more likely
  - Energy info most useful when comprehensive
Other opportunities connectivity provides

- For controls, demonstration of savings through analysis of actual use
  - Savings result from control of other loads: complex interaction of technology, design, and user choices
  - Analyzed and aggregated data from users’ homes reveals demonstrates savings are achieved and persist
  - Data submitted for certification, and twice a year ongoing
- Energy savings through better installation, maintenance, and operation
  - Many specifications include consumer alert criteria (e.g. fridge door open, furnace filter needs cleaning, etc.)
  - Over time, hope to emphasize these capabilities in specs with high potential, e.g. central AC
- The holy grail: early notice of incipient failure, e.g. for water heaters, avoids emergency replacement for consumer convenience and to allow time for choice, delivery and installation of higher efficiency option
A Quick Note on Security

EPA understands there can be security risks associated with smart products and systems. Recognizing that this is not our area of expertise, we do not intend to take the lead on developing security standards in the smart home market. To the extent that sound security standards arise, EPA may point to them in ENERGY STAR specifications as appropriate.
Backup slides, if folks ask questions
How interoperability shows up in the specifications

- Large loads (mostly in progress):
  - Limited DR protocols (OpenADR, CTA-2045, others for EV chargers), specific responses to specific signals within the protocols
  - Connected thermostats are not specific, b/c business models vary too highly
- Appliances:
  - Use of open standards for DR, energy reporting, but not specified which ones
  - Specific DR responses for some, not tied to specific signals in protocols
  - Proprietary standards allowed for remote access
- SHEMS:
  - Must provide automatic detection, control, and sharing of energy and occupancy data for base bundle of devices
  - Smart home service provider is responsible for system integration, and for maintaining system capability
## ENERGY STAR Connected Criteria

<table>
<thead>
<tr>
<th></th>
<th>Connected T'sts</th>
<th>SHEMS</th>
<th>Lighting</th>
<th>Room Air Purifiers</th>
<th>Refrigerators &amp; Freezers</th>
<th>Clothes Washers</th>
<th>Clothes Dryers</th>
<th>Dishwashers</th>
<th>Room A/C</th>
<th>EVSE</th>
<th>Pool Pumps</th>
<th>Ice Makers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Consumption Reporting</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔*</td>
</tr>
<tr>
<td>Operational Status Reporting</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔*</td>
</tr>
<tr>
<td>Remote Management</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔*</td>
</tr>
<tr>
<td>Demand Response</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Connected Capability not Optional</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capabilities or DR Summary</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DR Test Method</td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

*Products that meet the Smart Grid Interoperability Panel (SGIP) standards are understood to have incorporated energy consumption reporting, operational status reporting and remote management into the foundation of their connectivity.*
Proposed CAC/HP connected criteria

- Demand response as per 1380
  - DR responses: moderate shed, deep shed, grid emergency
  - Protocol requirements (CTA-2045 and/or Open ADR; may be in cloud)
  - Control (aka thermostat) may be included when testing connected functionality
- Additional information (energy reporting) standard practice for ENERGY STAR specifications
- DR certification will eventually rely on testing
  - Goal: no testing necessary beyond that for AHRI 1380, so that 1380 certification will suffice to show DR compliance
  - Reminder: DOE lead agency for ENERGY STAR test methods – ultimately up to them whether this makes sense
- Non-DR elements certified through examination of product and documentation (typical for connected criteria in other ENERGY STAR specs)
Proposed WH connected criteria

- As per Draft 2 released November 26
- Protocol requirements same as in 1380
  - OpenADR (cloud or on premise) and/or CTA-2045
  - Controller can be part of system providing DR functionality
- DR requests more extensive that in 1380
  - Moderate and deep shed, off mode
  - Moderate or advance load up (accept more power now)
  - Minimum energy shift criteria (in lab conditions), tested in DR test
- ENERGY STAR spec includes mapping of responses to protocol signals, similar to what is in 1380, since this doesn’t exist elsewhere for WH
- Compatible with other existing WH DR specs: subset of E* connected products should meet NEEA AWS, CEE Initiative, CA T24 JA13, etc.
- DOE developing DR test method simultaneously, now testing units to Draft 1 Test Method