Functional Requirements for Demand Response Ready Appliances

Karen George
Project Manager, Energy Efficiency and Demand Response Program

EnergyStar Products Partner Meeting
October 7, 2010
What is demand response ready?

The capability of end-use equipment and appliances to receive signals from a utility, such as price information, and respond automatically by modifying operation to reduce or shift demand.
What are functional requirements?

What would a _______ …

AC/HP, water heater, pool pump, clothes washer, dishwasher, refrigerator, clothes dryer, etc.

Need to do for utilities to consider it “DR-Ready”
Why are demand response ready functional requirements needed?

• Demand response is an important resource for utilities:
  – “Virtual capacity” to manage system peaks
  – Balance for intermittent, variable resources

• Why residential?
  – Customers can account for up to 40% of peak
  – Appliances/devices offer diversity
  – Appliances mass produced
  – Smart appliances entering market
### Demand Response Ready for Diverse Conditions and Situations

<table>
<thead>
<tr>
<th>Home Infrastructure</th>
<th>Dispatch Requirements</th>
<th>M&amp;V Requirements (Metrics)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart meter</td>
<td>Economic DR (price)</td>
<td>kW reduction</td>
</tr>
<tr>
<td>Gateway/Breaker-Panel</td>
<td>Emergency DR (event)</td>
<td>kWh reduction</td>
</tr>
<tr>
<td></td>
<td>Spinning reserve</td>
<td>CO₂</td>
</tr>
<tr>
<td></td>
<td>Voltage regulation</td>
<td>Time in “active DR” mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pricing Structure</th>
<th>State Presentment</th>
<th>Communication Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat (conventional)</td>
<td>In-situ display</td>
<td>Physical “socket” or card</td>
</tr>
<tr>
<td>Time of use (TOU)</td>
<td>Signal to external display device</td>
<td></td>
</tr>
<tr>
<td>Dynamic</td>
<td></td>
<td>Application layer chip (i.e. Smart Energy Profile)</td>
</tr>
<tr>
<td>Demand limiting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Automation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-program (“set &amp; forget”) (who defines defaults?)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feedback &amp; behavior-based</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Load shifting (timer)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>On/off cycling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Partial loading</td>
<td></td>
</tr>
</tbody>
</table>
Demand Response and Energy Savings

- Demand response can affect energy savings (depends on multiple factors)
- Energy savings ranging from 0% to 10% reported
  - More typically around 0% to 1%
  - More measured data needed
- Ratio of energy savings to peak demand reduction achieved by load management programs (all sectors) in U.S. averaged between 1996 and 2005:
  
  113 kWh per kW*

Functional Specifications: Clothes Dryer Example

- **Resident clock/timer** with automatic daylight savings adjustment
- **User-programmed specifications** saved to memory in event of power loss (i.e. no need to reprogram)
- **On/Off control**
  - Programmed for electricity price triggers (voluntary)
  - Programmed for time of day triggers (voluntary)
  - Programmed for response to utility event signals (voluntary)
- **Utility-controlled (DLC) cycling**
  - If dryer is operating when a DR trigger is received (whether price, time-of-day, or event signal), allow for cycle in process to complete before implementing on/off; otherwise there may be detrimental effect on the clothing
- **Modes of Operation**
  - Normal mode
  - Tumble-only mode
  - Moisture-control sensor to provide means to allow transition from Normal to Tumble-only mode while unit is in operation
  - Intermittent tumble-only mode
- **Remote controllability** via home EMS/Gateway/other device
- **Display information**
  - Event in progress
    - Utility event initiated (high price period, capacity event, etc.)
    - Actions that can or are being taken (confirmation)
      - If not currently on, inform consumer to avoid usage once event has passed (this can be manually over-ridden)
      - If currently on, indication of switch to tumble-only mode or intermittent tumble-only mode
  - Retail electricity price (if available)
  - Power draw (kW)
  - Energy consumption (kWh) over past cycle/week/month
  - Cost savings from DR actions
- **Where to display**
  - On the dryer display
  - Ability to communicate/transmit to central or dedicated display (dedicated home display, EMS) or PC/mobile device via e-mail, SMS, etc.
Next Step to Reach Consensus on Functional Requirements

Refine detailed list

- Resident clock/timer with automatic daylight savings adjustment
- User-programmed specifications saved to memory in event of power loss (i.e., no need to reprogram)
- On/Off Control
  - Programmed for electricity price triggers (voluntary)
  - Programmed for time of day triggers (voluntary)
  - Programmed for response to utility event signals (voluntary)
- Utility-controlled (OILC) cycling
  - If dryer is operating when a DR trigger is received (whether price, time of day, or event signal), allow for cycle in process to complete before implementing on/off; otherwise there may be detrimental effect on the clothing
- Modes of Operation
  - Normal mode
  - Tumble-only mode
  - Moisture-control sensor to provide means to allow transition from Normal to Tumble-only mode while unit is in operation
  - Intermittent tumble-only mode
- Remote controllability via home EMS/OTG/other device
- Display Information
  - Event in progress
    - Utility event initiated (high price period, capacity event, etc.)
    - Actions that can or are being taken (confirmation)
      - If not currently on, inform consumer to avoid usage once event has passed (this can be manually over-ridden)
      - If currently on, indication of switch to tumble-only mode or intermittent tumble-only mode
    - Retail electricity price (if available)
    - Power draw (kW)
    - Energy consumption (kWh) over past cycle/week/month
    - Cost savings from DR actions
- Where to display
  - On the dryer display
  - Ability to communicate/transfer to central or dedicated display (dedicated home display, EMS) or PC/mobile device via e-mail, SMS,

List of key, agreed upon “must have” requirements:
Plan of Action on Demand Response Ready Appliances

• Working Group Recommendations/End of Year Report
  – Address all high priority residential equipment

• Continuation in 2011:
  – Coordinate with standards groups, manufacturers and other stakeholders
    – Workshop
    – Roadmap

• Contact:
  – Karen George, 303-449-1113 (o) or 720-839-5128 (cell) kgeorge@epri.com
Together…Shaping the Future of Electricity