

## Functional Requirements for Demand Response Ready Appliances

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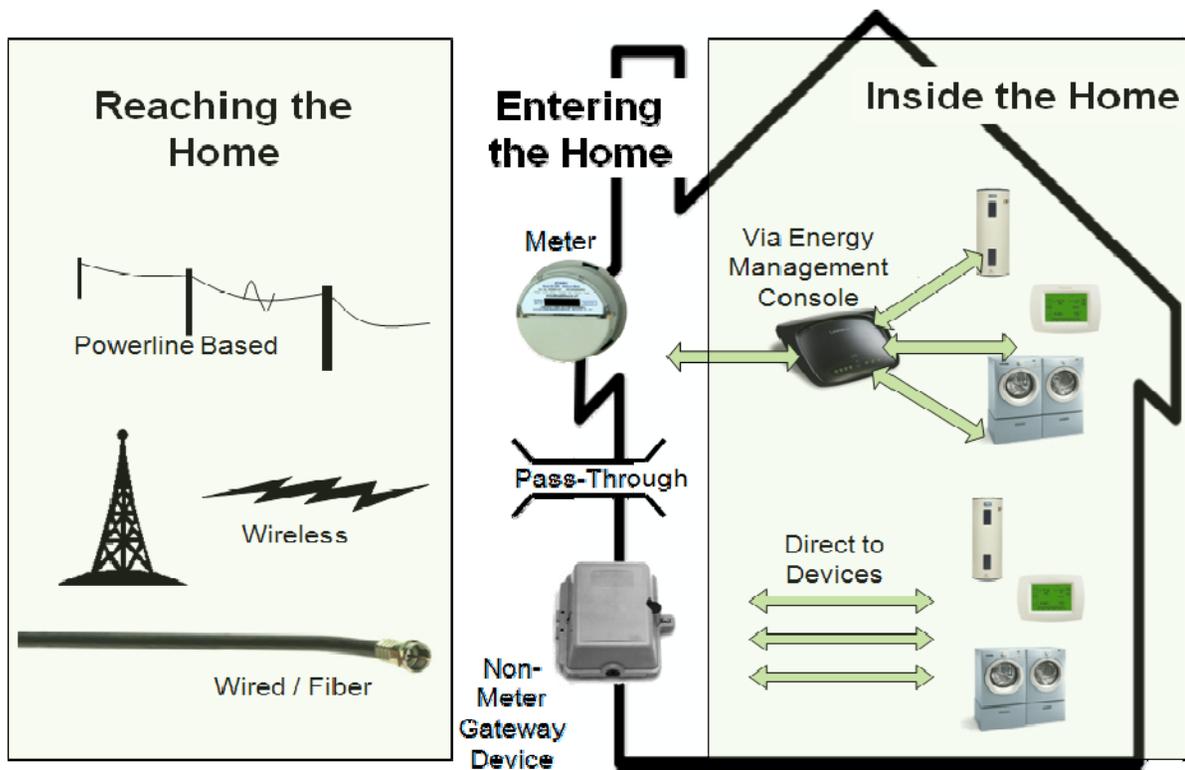
Project Manager, Energy Efficiency and  
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**EnergyStar Products Partner Meeting**

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 \_\_\_\_\_ ...*

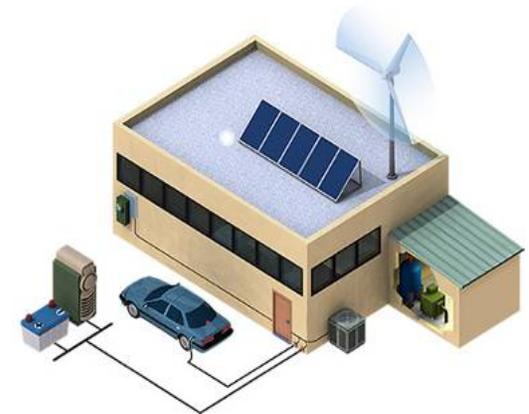
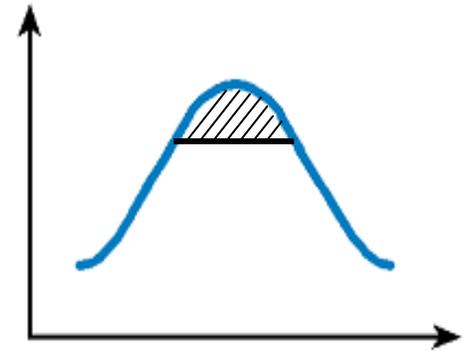
AC/HP, water heater, pool pump,  
clothes washer, dishwasher,  
refrigerator, clothes dryer, etc.

*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

## Home Infrastructure

Smart meter

Gateway/Breaker-Panel

## Pricing Structure

Flat (conventional)

Time of use (TOU)

Dynamic

Demand limiting

## State Presentment

In-situ display

Signal to external display device

## Dispatch Requirements

Economic DR (price)

Emergency DR (event)

Spinning reserve

Voltage regulation



## Automation

Pre-program ("set & forget")  
(who defines defaults?)

Feedback & behavior-based

## M&V Requirements (Metrics)

kW reduction

kWh reduction

CO<sub>2</sub>

Time in "active DR" mode

## Communication Method

Physical "socket" or card

Application layer chip  
(i.e. Smart Energy Profile)

## Functionality

Load shifting (timer)

On/off cycling

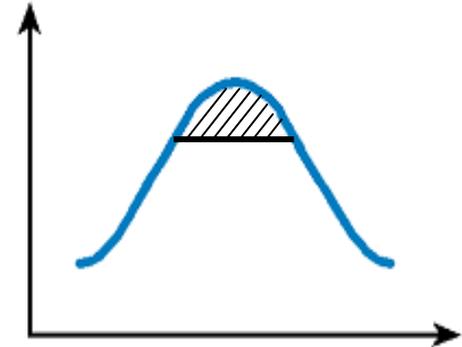
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# Demand Response and Energy Savings

- 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\***

\* From *Electric Power Annual 2005*, Energy Information Administration, U.S. Department of Energy, Washington, DC: 2006. Table 9.4.



# Functional Specifications: Clothes Dryer Example



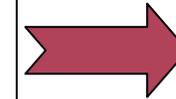
- **Resident clock/timer** with automatic daylight savings adjustment
- **User-programmed specifications** saved to memory in event of power loss (i.e. no need to reprogram)
- **On/Off control**
  - Programmed for electricity price triggers (voluntary)
  - Programmed for time of day triggers (voluntary)
  - 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
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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:
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or 720-839-5128 (cell) [kgeorge@epri.com](mailto:kgeorge@epri.com)





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