SOUTHERN CALIFORNIA EDISON®
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Residential IDSM and ZNE

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Emerging Products

Cal Plug Workshop
November 5, 2013

Today's Discussion

- SCE Plug Load Roadmap
- ZNE Homes
  - High Performance Retrofit – San Bernardino
  - High Performance Tract Home – ISGD
  - High Performance New Home – Ontario
- Testing of DR Capable Appliances
- Future Plug Loads

EMERGING TECHNOLOGIES PRODUCT AREA:

Plug Loads & Electronics

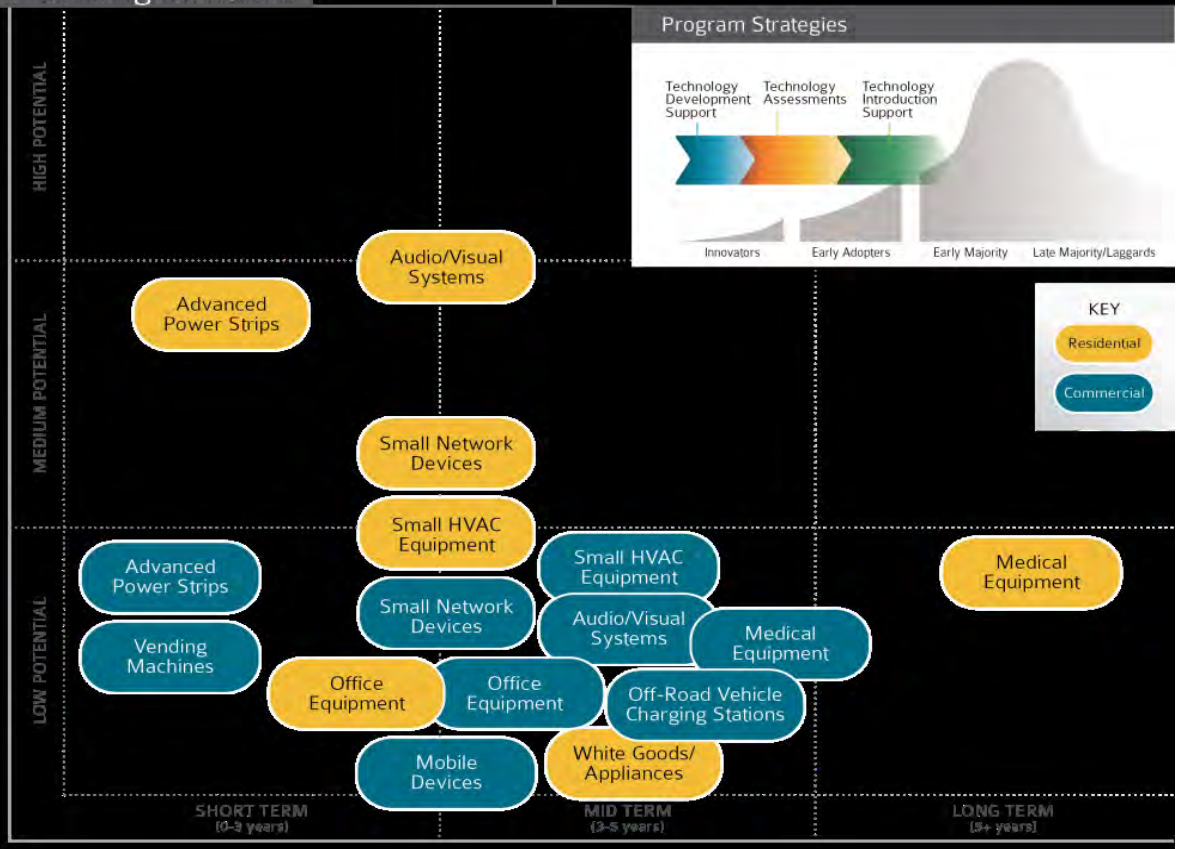
Drivers

- Customer and Shareholder Value
- Regulatory and Policy Drivers
- IDSM Potential
- Need for New Products and Measures
- Market Status and Realities

Gaps and Barriers

- Pace of Technology Advancement
- Behavior Dependent
- Market Intelligence
- Value Proposition
- Interoperability and Communication Protocols

Promising Solutions



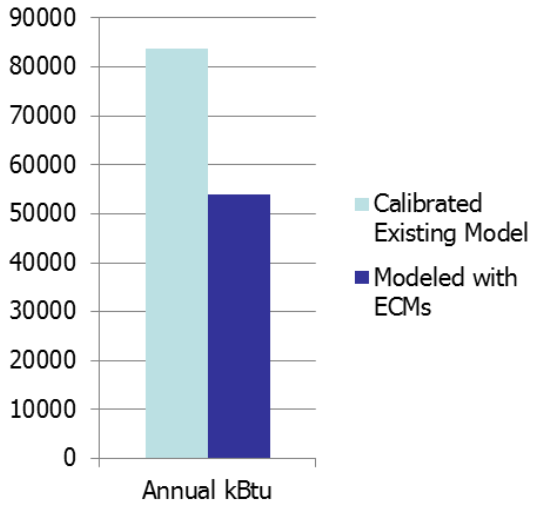
Program Strategies

KEY

- Residential
- Commercial

High-Performance Home Retrofit

- Goal: Identify and understand barriers for a deep-energy retrofit of a typical single-family home
  - Explore opportunity for ZNE for a typical construction in Southern California
    - Many homes were built in the mid century as part of the post-war housing boom
    - Homes are spread through a variety of climate zones and demographics (e.g. low-income)
- Perform analysis of existing conditions and building energy use
  - Calibrated Existing Model (83,688 kBtu)
  - Modeled with ECMs (53,891 kBtu)
- Identify a set of energy efficiency measures that will achieve ZNE or near including determination of PV requirements



High Performance Home Retrofit

- Design & Installation
  - Building Envelop Upgrades
    - Cool Roof, Radiant Barriers, Low-E Window, Insulation, Air Sealing
  - Electrical and LED Lighting Upgrades
  - New Energy Star® Rated Appliances
  - Tankless domestic hot water system
  - VRF HVAC System with zone control installed
  - 3.25KW Solar PV system with Micro-inverter

High Performance Tract Home Retrofit

- Goal: Identify and understand barriers for a deep-energy retrofit of a group of homes in a tract develo
- Explore ZNE opportunities of 9 Tract Homes
  - Early 2000's Vintage
  - Climate Zone 8
  - 2 Models:
    - Plan C (2-story 2,580 sq. ft.)
    - Plan D (3-story 3,155 sq. ft.)

- Part of the Irvine Smart Grid Demonstration (ISGD)
  - Joint project between the ARRA of 2009, the DOE, and Southern California Edison
  - Project interests include understanding the interaction of multiple technical elements within the house and within the electric grid system
  - Explore ZNE through home upgrades, state-of-the-art industry energy components, solar panels and energy storage

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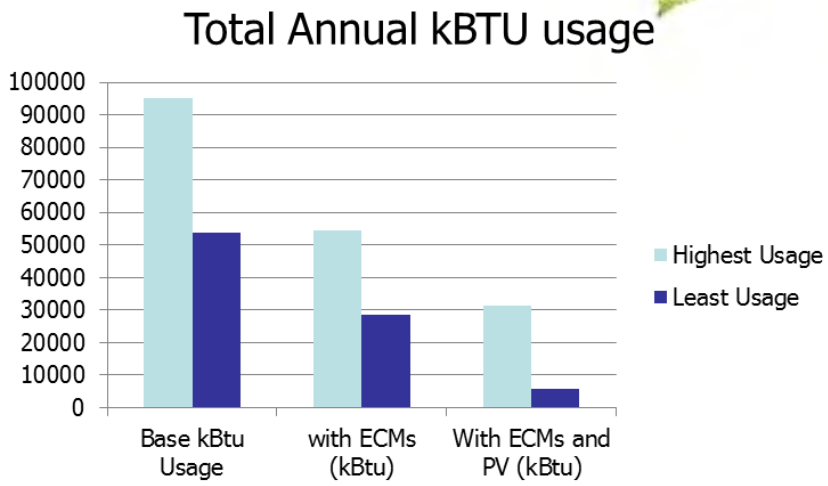
High Performance Tract Home Retrofit

- Comprehensive whole building retrofit includes
  - LED Lighting
  - Heat pump
  - 96% efficient condensing domestic hot water heater
  - Solar hot water heater
  - Duct Sealing
  - Added Attic Insulation
  - ENERGY STAR® appliances
  - Air-Sealing the Building Envelope
- Design phase completed
  - Energy modeling and simulation completed
- Implementation phase begun



- High end total kBtu Usage:
  - Modeled Base = 95,175 kBtu
  - Modeled with ECMs = 54,403 kBtu
  - Modeled with ECMs and 4.05kW PV System = 31,166 kBtu
- Low end total kBtu Usage :
  - Modeled Base = 53,875 kBtu
  - Modeled with ECMs = 28,529 kBtu
  - Modeled with ECMs and 4.05kW PV System = 5,643 kBtu

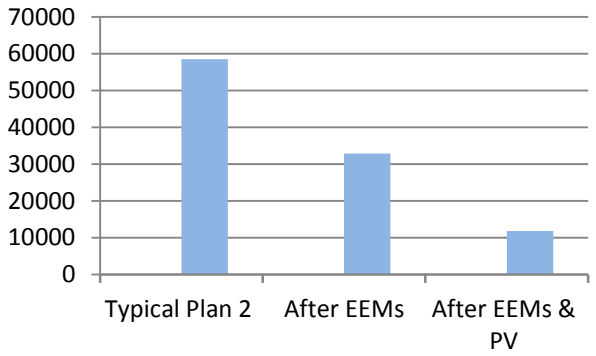
High Performance New Construction Production Home

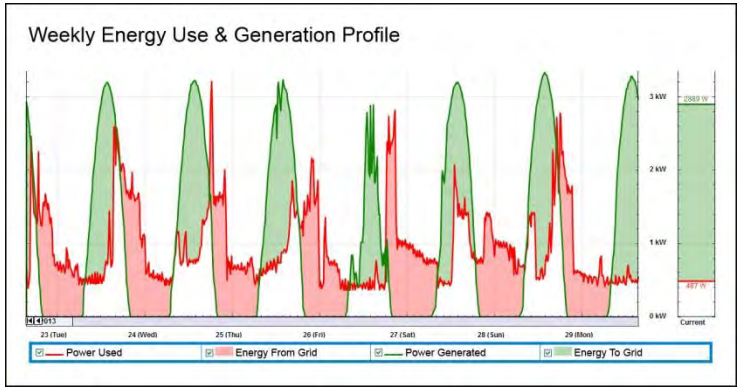
- Goal: Identify ZNE opportunities and understand barriers for design and construction of a new production home
  - Market Intelligence
  - Demonstration of best practices & education
  - Insights into the homebuilder's understanding of the local market, key decision makers, supply chains, and their building & costing expertise

High Performance New Construction Production Home

- Total incremental cost to Builder: ~$33K
  - Mini-split ductless AC units, LED lighting & ceiling fans,, Fresh air ventilator, High performance windows, Foam insulation in cavity and on exterior, Airtight envelop (advanced framing and sealing) Tankless condensing water heater, High efficiency appliances, In home TV-integrated energy display
  - Solar electric system
- Sold halfway through construction for ~$350K
  - Total incremental cost to homebuyer: $18K
- Builder Next Steps:
  - To seek further ZNE applications and sees this project as a “concept design” for 2020+
  - To use select ZNE measures as standard for new homes under 2013 code
  - Will work with specific vendors to reduce incremental costs
- Hosted a Builders Forum at the project site
- Data collection ongoing

Simulated Energy Use kBTU/Yr



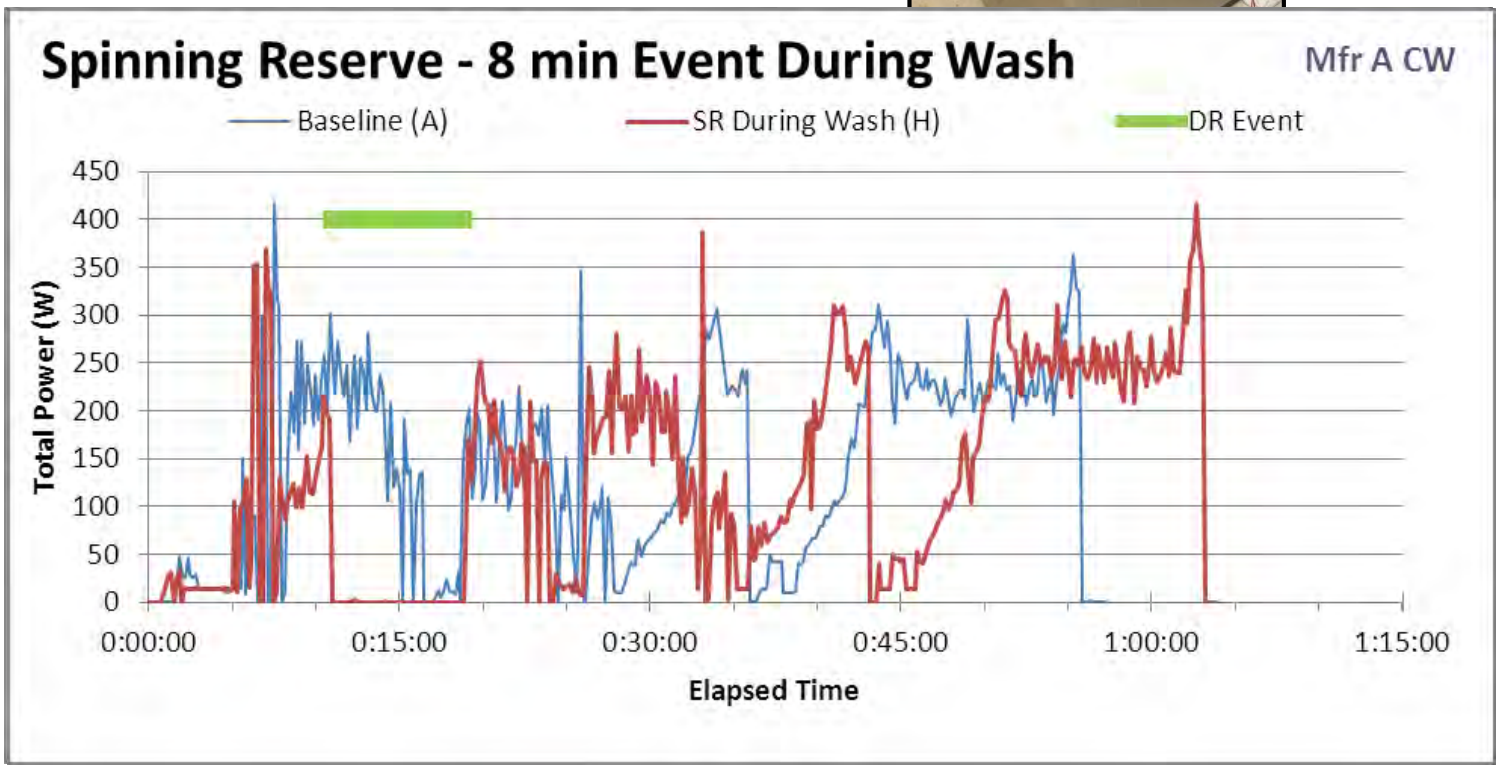


Testing of DR Capable Appliances

- New DR-capable appliance development
- Engage manufacturers to learn about their approach to DR
- Performance uncertainty
  - Different types of DR events
  - Will units respond? How?
  - What kW reduction is achieved?
- Capture appliance performance data in laboratory environment
  - Baseline(s)
  - Impact of various DR events
  - Feed into Irvine Smart Grid Demonstration
- Multiple appliances from multiple manufacturers

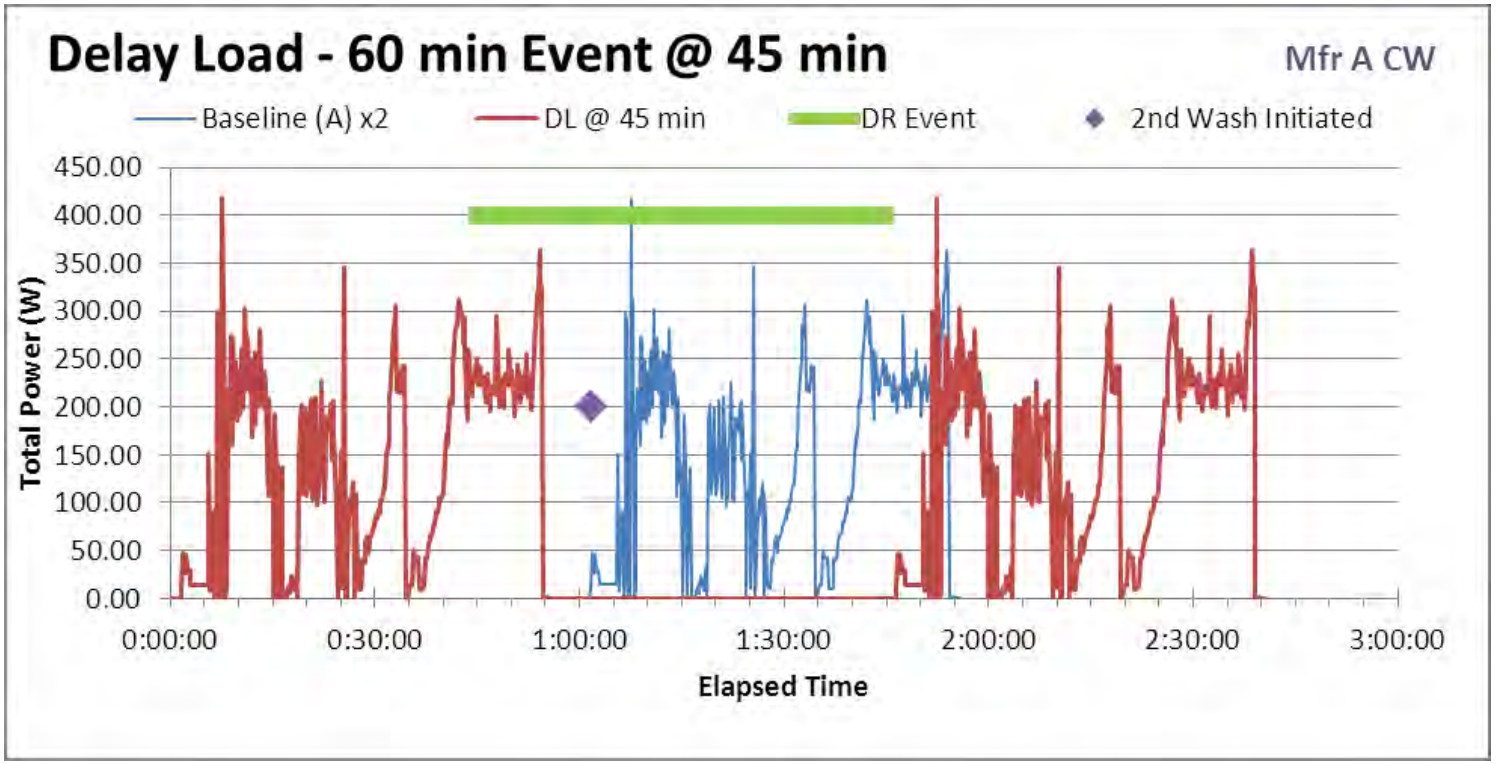
Clothes Washers – Mfr A

- **SR event – reduce load by 50%**
  - Shift all load past event
  - Slight increase in energy



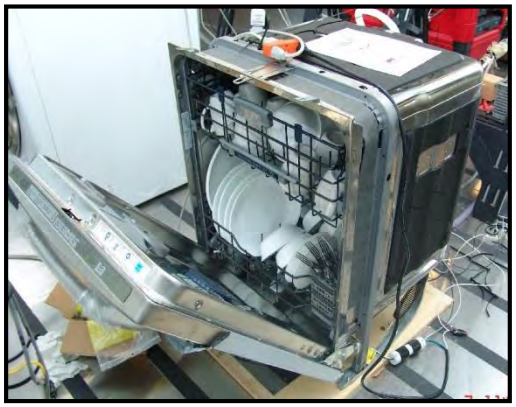
Clothes Washers – Mfr A (cont)

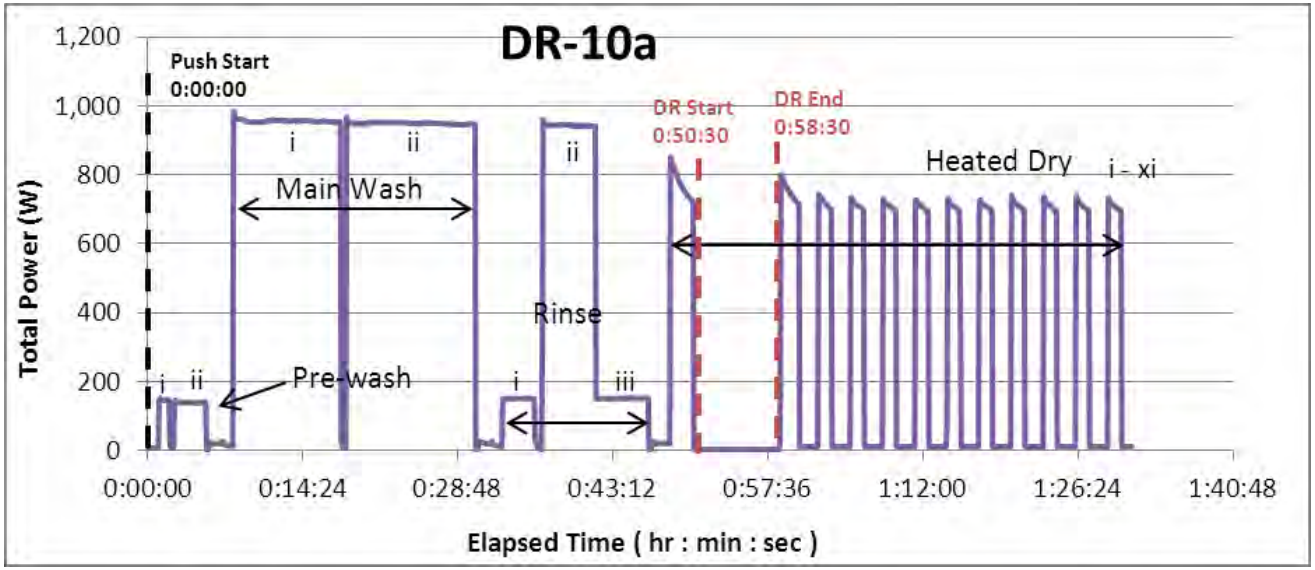
- **DL event – delay start beyond event**
  - Wash in progress, no change
  - New wash delayed until event cleared



Dishwashers – Mfr B

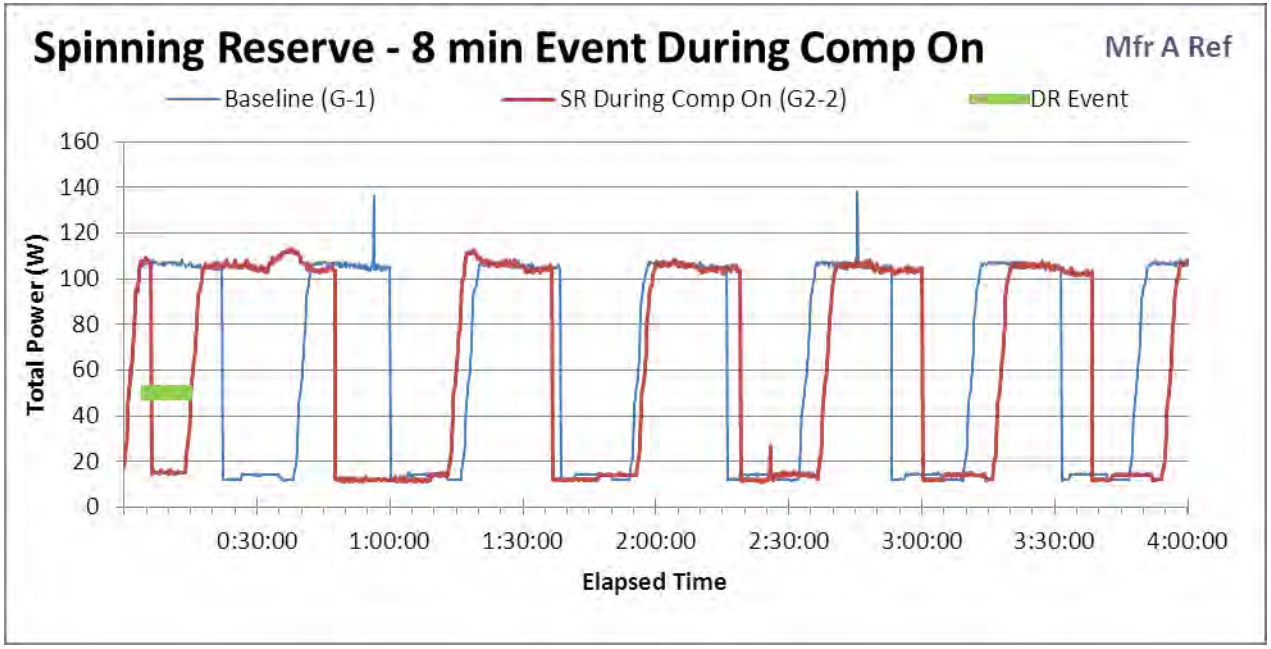
- **High price event**
  - Delay start, no impact to wash in progress
- **Critical price event**
  - High price response + delay/eliminate heated dry
  - Could have no impact depending on timing





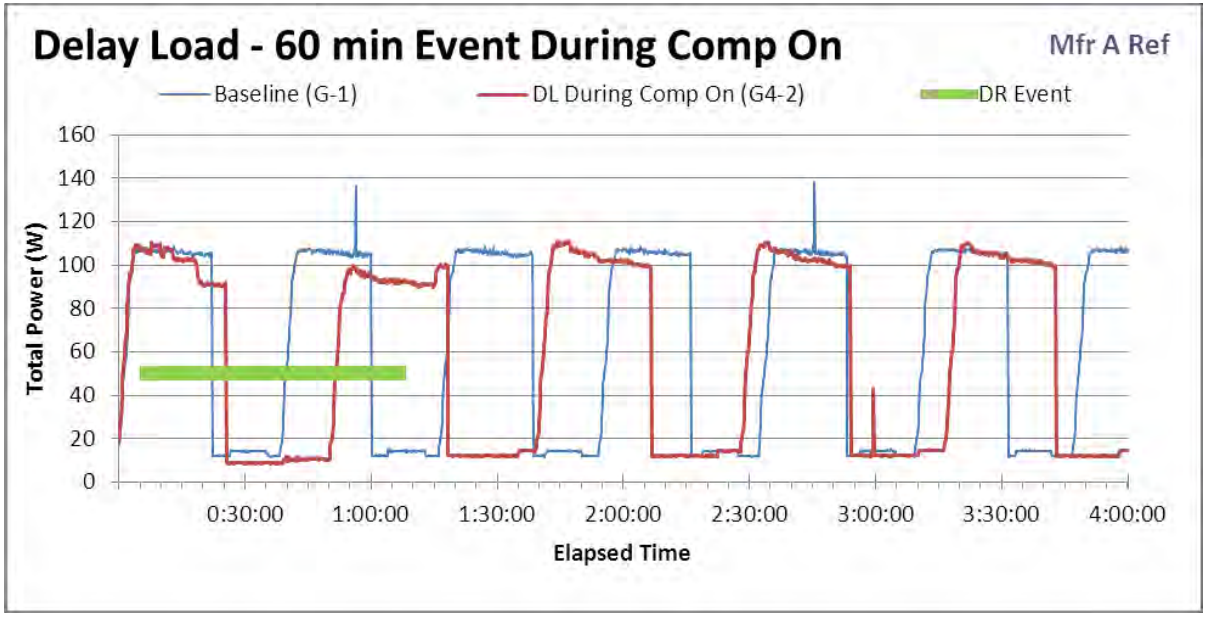
Refrigerators – Mfr A

- Concurrent EE/DR not allowed
- Communication issues
- **SR event – 50% of avg daily load, unless consumer-initiated function**
  - Compressor and ASH turn off



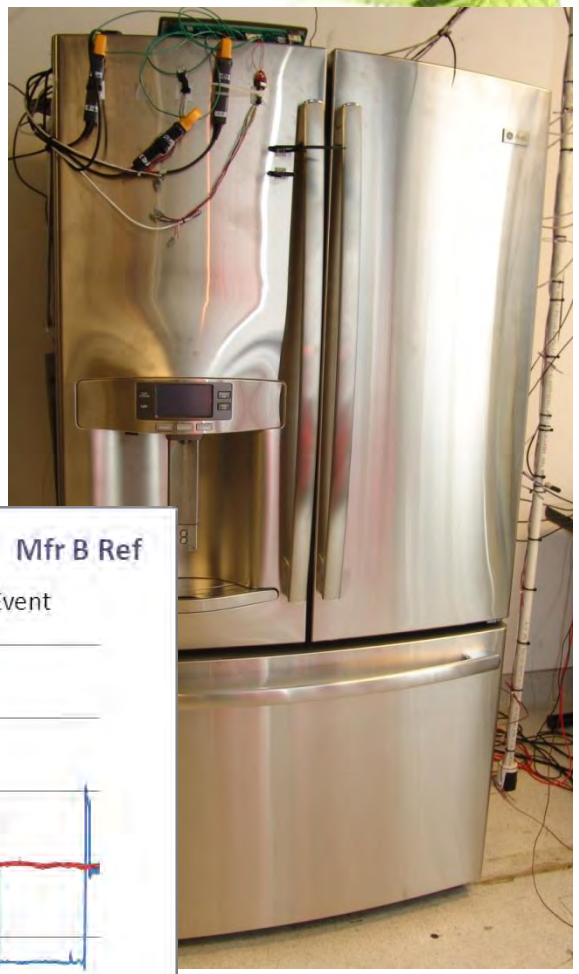
Refrigerators – Mfr A

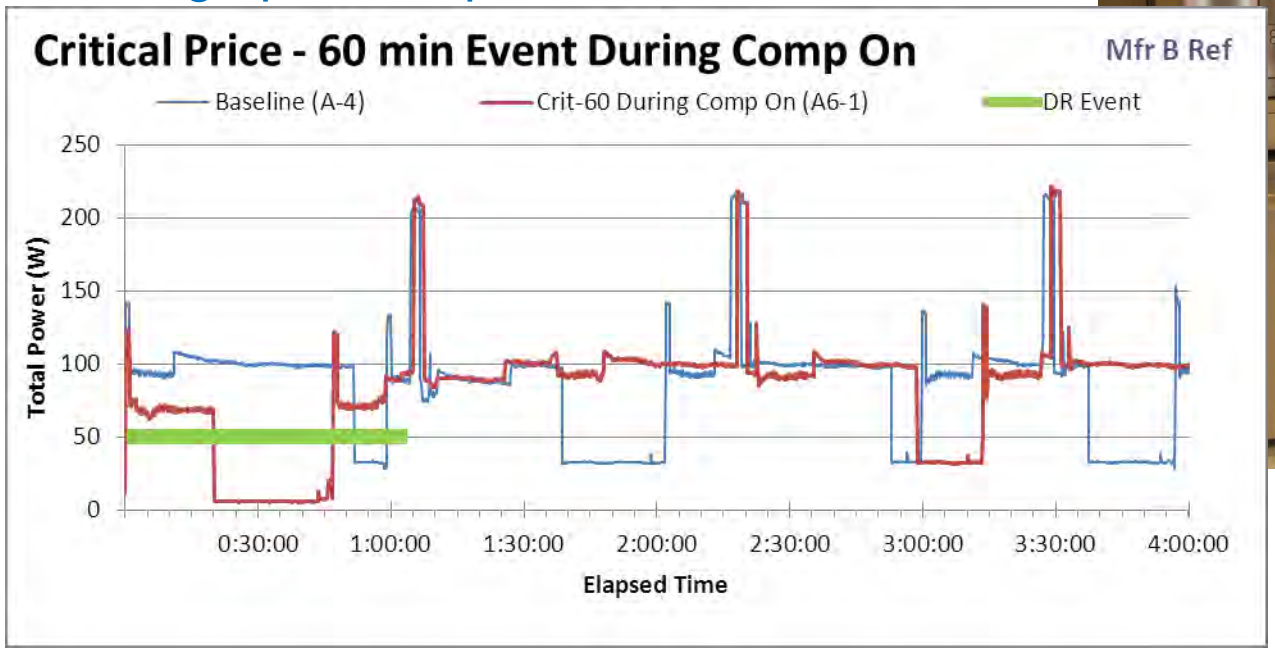
- **DL event – shift defrost and either shift ice making or reduce by 9.6 W**
  - Reset freezer temp
  - Delay ASH on
  - Delay defrost ?
  - Change ice maker fan operation



Refrigerators – Mfr B

- **High price event**
  - Defrost is delayed up to 4 hours
  - Freezer temp raised 5°F
- **Critical price event**
  - High price response + ASH are disabled





Utility Perspective

- Responses fall in 3 categories:
  - Higher wattage for short duration
  - Lower wattage for long duration
  - No response

- Need to consider device saturation and usage profiles
  - Reduction depends on what part of cycle, duration of event, device status (on/off)

- Cost effectiveness externalities
  - Impact of communication pathways
  - Cost of integrating mfr cloud-based solutions

Energy Star "Connected"

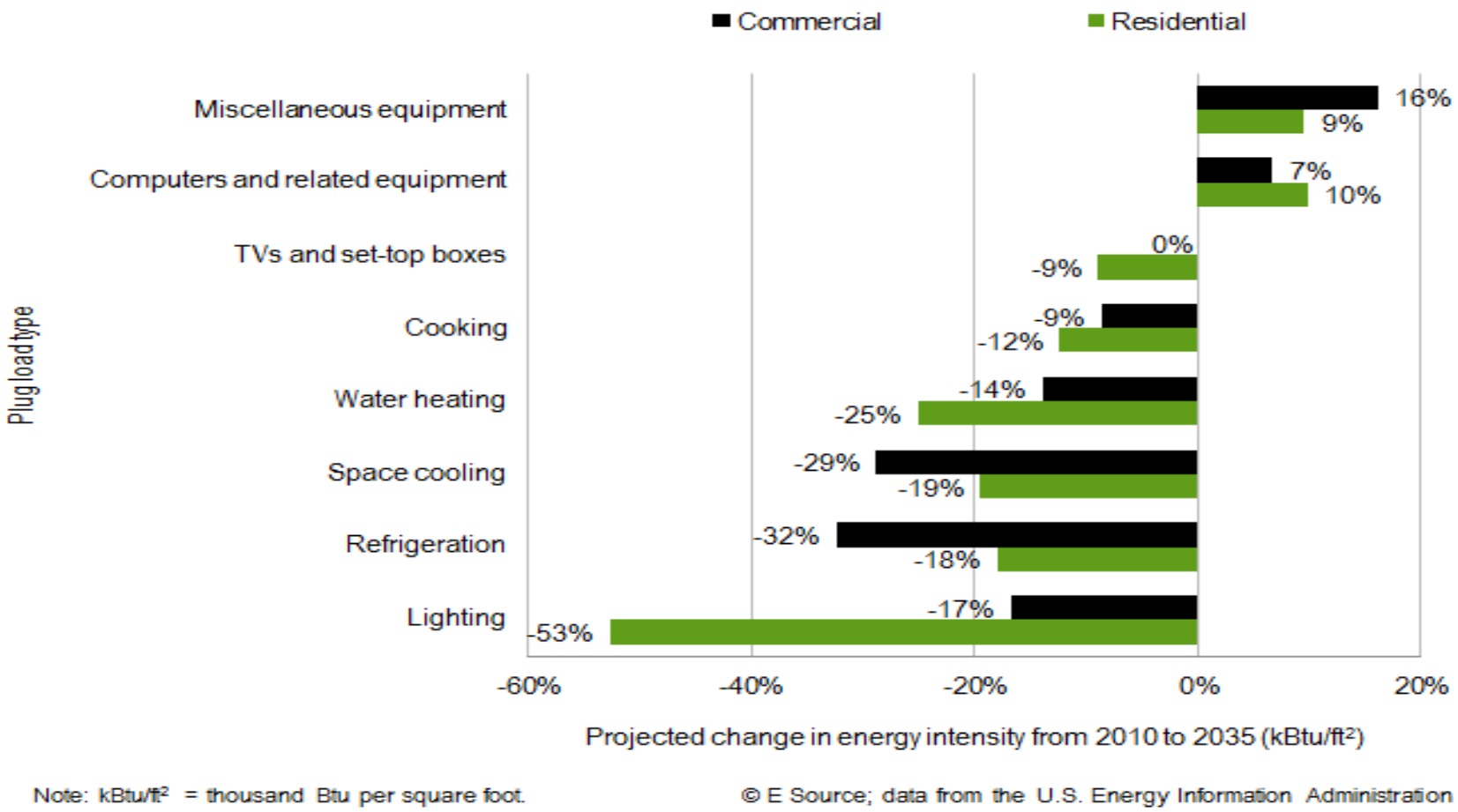
- Incorporating Connected capability into new specifications
  - Refrigerators – Final draft released in April
  - Clothes Washers
  - Dishwashers
  - Room AC
  - Pool Pumps
- 5% energy credit
- Allows cloud-based communication
  - Not required to go through Smart Meter
- Specs and Test Methods still need work

UC Irvine…

- SCE and Cal Plug begins evaluation for using set top box to display energy information.

- CUSA – Center for Unconventional Security Affairs - Social Gaming and Influencing “Energy Usage” Behavior

Plug Loads 2010- 2035



Note: kBtu/ft² = thousand Btu per square foot.

© E Source; data from the U.S. Energy Information Administration

Questions?