Program will start at 10:00 am

ETCC QUARTERLY MEETING: *CUTTING EDGE RESIDENTIAL EFFICIENCY*

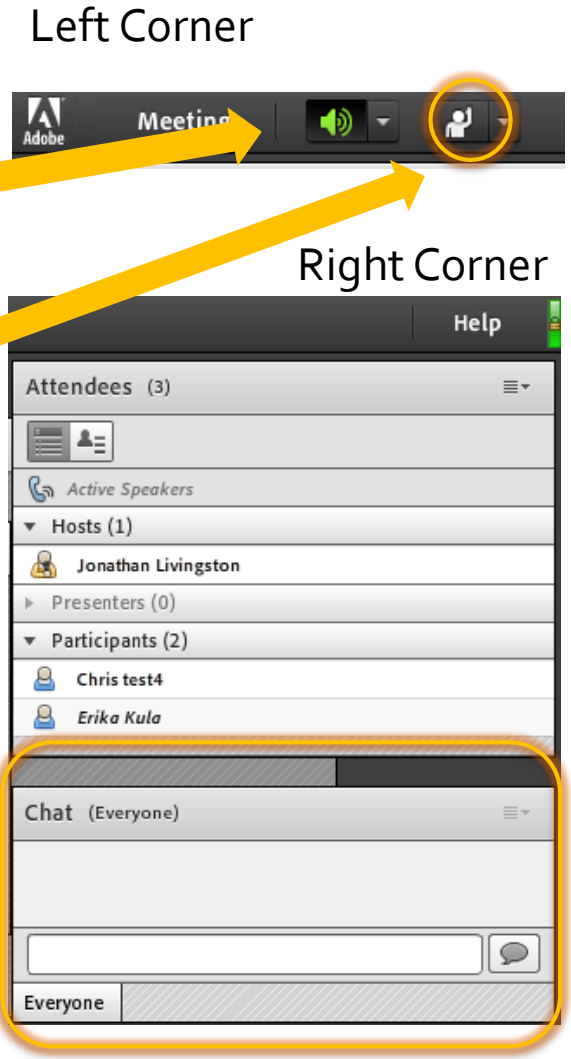
July 15, 2014
Sacramento, CA
HOSTED BY: Sacramento Municipal Utility District

WELCOME!!

Before we get started….
housekeeping and safety

WEBINAR PARTICIPANTS

- Quick logistics
  - Phone lines are muted, so if no sound is coming from your speakers, click here
  - Speaker check: select "raise" hand in the control panel to confirm you are able to hear
  - Please use question field to ask questions during Q&A or if any technical issues



HOUSEKEEPING

- Please turn off or silence your phone, and step outside for any non-program conversations
- Slides will be posted to www.etcc-ca.com
- Don't forget to fill out evaluations!

SAFETY MESSAGE

- In the event of an emergency:
  - Earthquake
  - Fire
  - Other evacuation
- Meeting point
- 911
- CPR

INTRODUCTIONS

Special Welcome to:

- LADWP - now a member of the ETCC Leadership Team
- ETCC Advisory Council members
  - Inaugural Advisory Council meeting on July 16th - THANK YOU Advisors – we're looking forward to tapping your impressive expertise!

TODAY'S AGENDA

10:00 AM	Welcome, Safety and ETCC Updates
10:15 AM	Market & Policy Drivers
11:30 AM	Cutting Edge Innovations
12:15 PM	LUNCH (provided)
1:15 PM	Emerging Technologies Program Support of Residential Sector – *panel presentations and interactive dialogue*
2:30 PM	Wrap Up

(partially) IN-PERSON ONLY

EMERGING TECHNOLOGIES COORDINATING COUNCIL (ETCC)

The ETCC supports the advancement of energy efficiency and demand response initiatives through its leadership, impact and influence in the emerging technology domain. It pursues this objective through strategic stakeholder engagement and effective and efficient coordination among ETCC members.

Members include:

Southern California Edison, An Edison International Company

Pacific Gas and Electric Company

SMUD Sacramento Municipal Utility District, The Power To Do More.

State of California Energy Commission

Southern California Gas Company, A Sempra Energy utility

SDGE, A Sempra Energy utility

LA DWP Los Angeles Department of Water & Power

Public Utilities Commission, Eureka, State of California

EMERGING TECHNOLOGIES PROGRAM MISSION

"…to increase energy efficiency market demand and technology supply through evaluation of *emerging* and *underutilized* advanced technologies to increase customer savings…"

Emerging Technologies → **Programs** → **Codes and Standards**

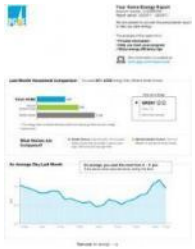
Zero Net Energy

LED Lighting

HVAC

EE Rebates

Home Energy Report

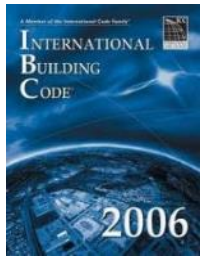


Retail and Manufacturer Strategy

Contractor Training and outreach

Appliance Standards

Building Codes



ET PROGRAM DESIGN

Technology Development Support

- Provide resources to transform early-stage technologies / concepts into saleable products
- Develop forward-looking product specifications
- Provide outreach to early-stage entrepreneurs, investors, and analysts (TRIO)

Technology Assessment

- Evaluate performance claims
- Generate energy savings and cost data required for regulatory approval of a new EE measures

Technology Introduction Support

- Conduct scaled field placements to foster market traction
- Build demonstration showcases to create visibility / market awareness
- Conduct third-party solicitations using competitive bidding (TRIP solicitation)

UPCOMING ETCC EVENTS

Date	Event	Location
Oct 20-22	ET Summit: Accelerating Innovation in Energy Efficiency	Parc 55 Hotel, San Francisco
Nov 5th	ETCC Q4 Meeting (Ag/Industrial)	SCG Territory, exact location TBD

To sign up for the ETCC Insight newsletter, check the box on the sign-in/registration sheet or sign up online at: www.etcc-ca.com/subscribe

Check the ETCC website for updates: http://www.etcc-ca.com/calendar

Q3 ETCC Meeting
Sacramento, CA
July 15, 2014

What is the ET Summit?

2-day interactive conference on energy efficiency and demand response emerging technologies

Accelerating Innovation in Energy Efficiency
October 20 -22 | Parc 55 Hotel | San Francisco

The ET Summit is the place to connect, engage and uncover new business opportunities with more than 500 industry leading entrepreneurs, technology developers, investors, implementers, researchers, utilities, regulators and property owners/managers

Hosted by the Emerging Technologies Coordinating Council (ETCC)

Los Angeles Department of Water & Power | Pacific Gas and Electric Company | SMUD | SDGE A Sempra Energy utility | Southern California Gas Company A Sempra Energy utility | Southern California Edison

ET Summit Highlights

CROSS-CUTTING BREAKOUT SESSIONS ACROSS WIDE SPECTRUM OF TOPICS

CENTRALLY LOCATED INNOVATION SHOWCASE

THOUGHT LEADERS SPANNING MULTIPLE AREAS OF EXPERTISE

Local ET Industry Tours

parc
A Xerox Company

FLEXLAB
FACILITY FOR LOW ENERGY EXPERIMENTS IN BUILDINGS

Food Service Technology Center PG&E

CLTC
CALIFORNIA LIGHTING TECHNOLOGY CENTER

WCEC
WESTERN COOLING EFFICIENCY CENTER

Opening Night @ The Exploratorium

Track Topics

- Energy Savings through Behavior and Decision-Making Strategies
- Innovative Customer Engagement Strategies
- Achieving Deeper Savings Via Integrated Solutions
- The Changing Energy Landscape
- Enabling Smarter Energy Management
- Overcoming Market and Technology Barriers

Key ET Summit Information

Website: www.etsummit.com

Sign up for ETCC distribution list at www.etcc-ca.com/subscribe for email updates

Book your hotel room at the Parc 55 Hotel via the ET Summit website to receive the discounted group rate!

Sponsorship Opportunities still available:
Please contact sponsor@etsummit.com

Contact Information

Thank you!!

For questions, contact

info@etsummit.com

Mananya Chansanchai
415-973-7383
m7ce@pge.com

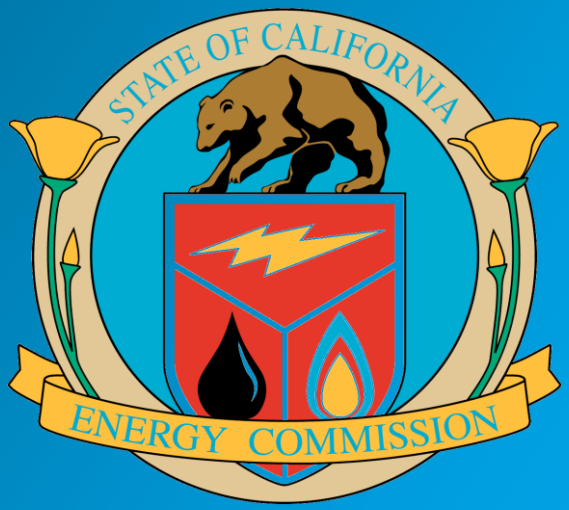
POLICY & MARKET DRIVERS

Mazi Shirakh, Title 24 group, California Energy Commission

David Springer, Principal | Davis Energy Group

Devin Rauss, Project Manager, DSM Strategic Planning | Southern California Edison

Vikki Wood, Energy Efficiency & Renewables | Sacramento Municipal Utility District



2016 Building Energy Efficiency Standards

Coordinating Council - 2016 Building Standards Forum

Mazi Shirakh, PE
Project Manager, Building Energy Efficiency Standards

July 15, 2014

Content

1. Authority and Standards Update Policy Drivers
2. 2016 Standards Update Schedule
3. Standards Update Process
4. Residential Updates – Vision and Measures
5. Life Cycle Costing (LCC) and Time Dependent Valuation (TDV)

Authority & Process

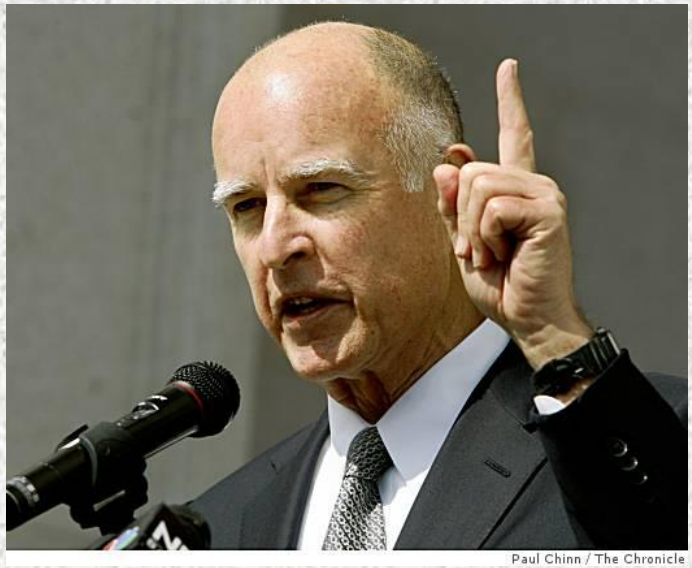
Public Resources Code (PRC 25402): Reduction of wasteful, uneconomic, inefficient or unnecessary consumption of energy

- (a)(1) Prescribe, by regulation, lighting, insulation climate control system, and other building design and construction standards that increase the efficiency in the use of energy and water…
- Warren Alquist Act Signed into law in 1974 by Governor Ronald Reagan

- Residential and Nonresidential Building Standards first adopted in 1978 and updated every 3-4 years
- The Standards are required to be cost effective
- The Standards include mandatory and prescriptive requirements, as well as performance approach
- The Standards are developed in an open public process

Policy Drivers For Building Standards

- Governor's “Clean Energy Jobs Plan”
- Zero Net Energy: Residential by 2020 and Nonresidential by 2030
- CARB Climate Change Scoping Plan
- California Long Term Energy Efficiency Strategic Plan


Paul Chinn / The Chronicle

JERRY BROWN Clean Energy Jobs Plan

More Efficient Buildings Also Result In:

- Green Job Creation
- Higher Paying Jobs
- Investment By Entrepreneurs
- Global Competitiveness

Require the manufacturing, design, installation, monitoring and maintenance of efficient systems and technologies, resulting in:

"Most new jobs should and will be created in the private sector, but government can play an important role in establishing a favorable climate for job creation." *Governor Jerry Brown*

Title 24
2016
Standards

JERRY BROWN Clean Energy Jobs Plan

Goals For Efficiency Standards for New Buildings:

- Establish a plan and timeline to make new homes and commercial buildings "Zero Net Energy"
- Highly efficient structures that use onsite renewable energy for all their electricity and natural gas needs
- Design new more efficient buildings that use half the energy they compared to the 2008 Standards home

"Energy Efficiency is the cheapest, fastest, and most reliable way to create jobs, save consumers money and cut pollution from the power sector." *Governor Jerry Brown*

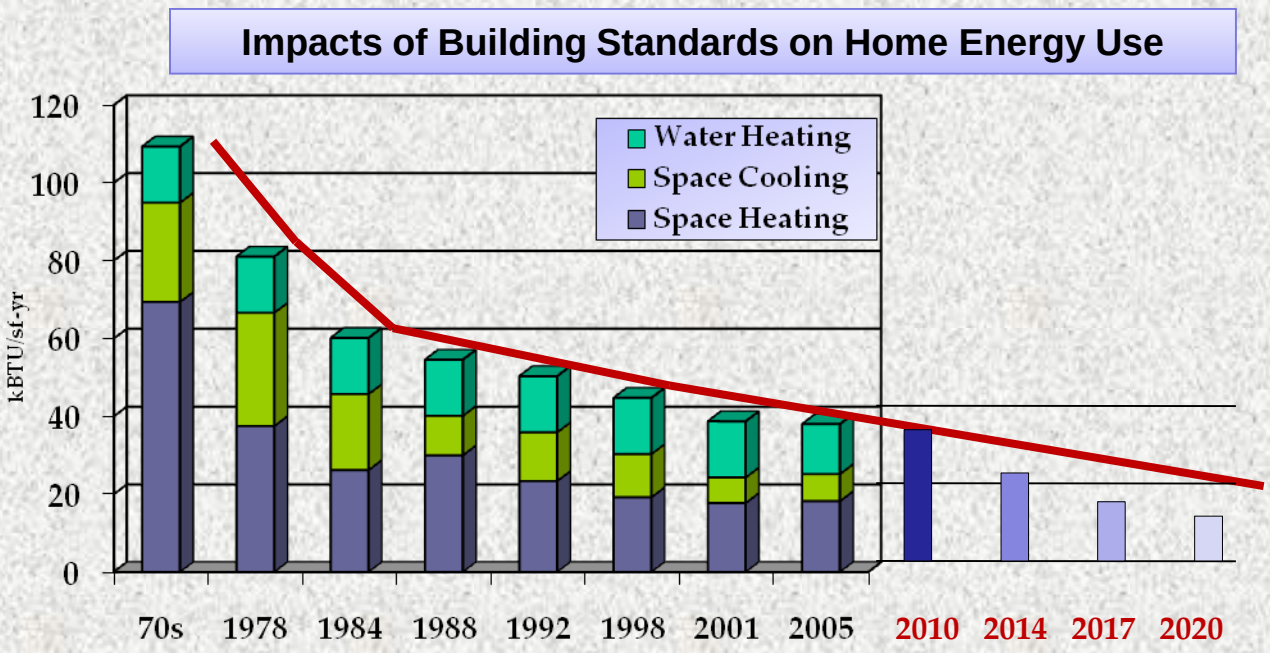
Standards Development Public Review

For 2013 Standards:

- An open and public process
- Convened more than 45 Industry stakeholder groups over several months to inform them of potential changes to the standards and to consider their input
- Held 15 Staff Workshops
- Responded to more than 2,000 public comments

Zero Net Energy Standards

- Achieve additional energy savings from building components regulated under Title-24 to reach ZNE goals
- Integrate onsite generation into building code to accomplish ZNE



2016 Standards Update Schedule

April 4, 2014	CBIA/CEC Standards Forum
May 2014	IOU CASE Stakeholder Meetings
June – Aug 2014	CEC Staff Public Workshops
October 2014	Draft 2016 Standards
January 2015	Release 45-day Language
April 2015	Release 15-Day Language
May 2015	Adoption at Business Meeting
January 1, 2017	Effective Date of the Standards

Dates in blue indicate the calendar week targeted - the event is not scheduled for this particular date

2016 Standards Staff Workshop Schedule

Staff Workshops	April 29 10:00 Hearing Room A	June 12 9:00 Hearing Room B	June 24 9:00 Hearing Room A	July 9 (NOTE: This is a Commissioner Workshop) 09:00 Hearing Room A	July 21 10:00 Hearing Room A	July 23 10:00 Hearing Room B (This may become a PM meeting)	August 6 10:00 Hearing Room A
Measures	TDV LCC	Opaque envelope U-factors HVAC and WH Equipment Efficiency Thermally Driven Cooling Door and Windows Switch Controls Fan efficiency Direct digital Controls HVAC Economizer Modifications Elevator Lighting and HVAC Controls Escalator and Moving Walkway Speed Controls	Residential Lighting Nonresidential Indoor Lighting Power LPDs Nonresidential Lighting Control and Partial On Occupancy Sensors Outdoor lighting LPAs Outdoor lighting controls, Including Bi-level controls	TDV LCC	HPAD/DCS Minimize Duct Losses Residential High Performance Walls Tankless Water Heaters Res HVAC Field Verification and Diagnosis	Residential ACM Nonresidential ACM PV Credit Whole House Fan Credit	CalGREEN

Dates in blue indicate the calendar week targeted - the event is not scheduled for this particular date

Title 24
2016
Standards

2016 Standards Update Process

Standards Update Includes the Following Phases:

Pre-Rulemaking

1. Stakeholder Meetings - IOU/POU CASE Teams
2. Staff Workshops – Draft Standards

Rulemaking:

1. 45-day language
2. 15-Day language
3. Adoption Business Meeting

2016 Standards Update Process

Pre-Rulemaking

Stakeholder Meetings - IOU/POU CASE Teams

1. Held throughout the state by the utilities
2. Invite diverse group of stakeholders
3. One or two meetings per topic area
4. Present the CASE measure and seek comments
5. Consider the comments and modify the CASE reports
6. Submit all CASE reports to the Commission for staff workshops
7. The utility sponsors include, PG&E, SCE, SDG&E, So Cal Gas, SMUD, and LADWP

2016 Standards Update Process

Pre-Rulemaking - Continued

Staff Workshops

1. Held by staff at the Energy Commission
2. Open to the public
3. Generally one workshop per measure, sometimes two
4. Invite diverse group of stakeholders
5. Seek public comment on measures
6. The result will be the 2016 draft Standards

2016 Standards Update Process

Rulemaking :

Presided Over By The Lead Commissioner

1. 45-day language hearing
2. 15-day language hearing

Adoption Business Meeting – Entire Energy Commission

2016 Standards Vision

2016 Standards Approach Is A Departure From The Past

1. Not focused on a specific measure(s)
2. Define ZNE goals and energy use index (EUI) target
3. Provide the builders a range of options to meet the ZNE goals
4. Builders and manufacturers can come up with additional solutions with the same efficiency potentials for meeting the ZNE goals
5. Different builders based on their preferences choose unique prescriptive solutions or compliance options that work for them
6. Free market will settle on the most promising solutions
7. Create “buildable” prescriptive packages that builders can use to meet ZNE goals without using performance path – possible relaxation of west-facing glass limit

The rest of the day will demonstrate how this approach works

2016 Standards Range of Options

The builder may choose one option described in A or B below:

A. High Performance Attics (HPA) with following features:

i. Roof deck insulation equivalent to R-6 continuous insulation (CI) with RB, either above or below deck. Insulation choices may include CI, spray foam, batt, or blown-in, and SIP panels

ii. Highly reflective roofs or combining reflective roofs with roof deck insulation

iii. Or other solutions suggested by the industry

B. Or, one of the following prescriptive alternatives to HPA:

i. Ducts in conditioned space (DCS)

ii. Sealed attics

iii. Ductless systems

iv. Or other solutions suggested by the industry

2016 Standards Range of Options

And Choose one of the following High Performance Walls (HPW) options – U-Factor (Approx 0.048) equivalent to R15 + R9 CI using one of the following strategies:

1. 2x6 @ 16” OC with R-9 CI

2.2x6 @ 24” OC with R-5 CI

3.Staggered studs with batt insulation or spray foam

4.Structurally Insulated Panels (SIPs)

5.Or other solutions suggested by the industry

2016 Standards Range of Options

Or choose the compliance option below as an alternative to HPA or HPW:

- Photovoltaic tradeoff compliance option

2016 Standards Other Measures

Tankless Water Heaters

Basis of Prescriptive Package – Energy Factor of 0.82

High Efficacy Lighting

1. All high efficacy lighting in kitchens throughout the house
2. All recessed downlights high efficacy
3. Allow luminaires with medium base socket as high efficacy if the socket is populated with a Cal high quality LED lamp at the time of inspection

2016 Standards – Life Cycle Costing

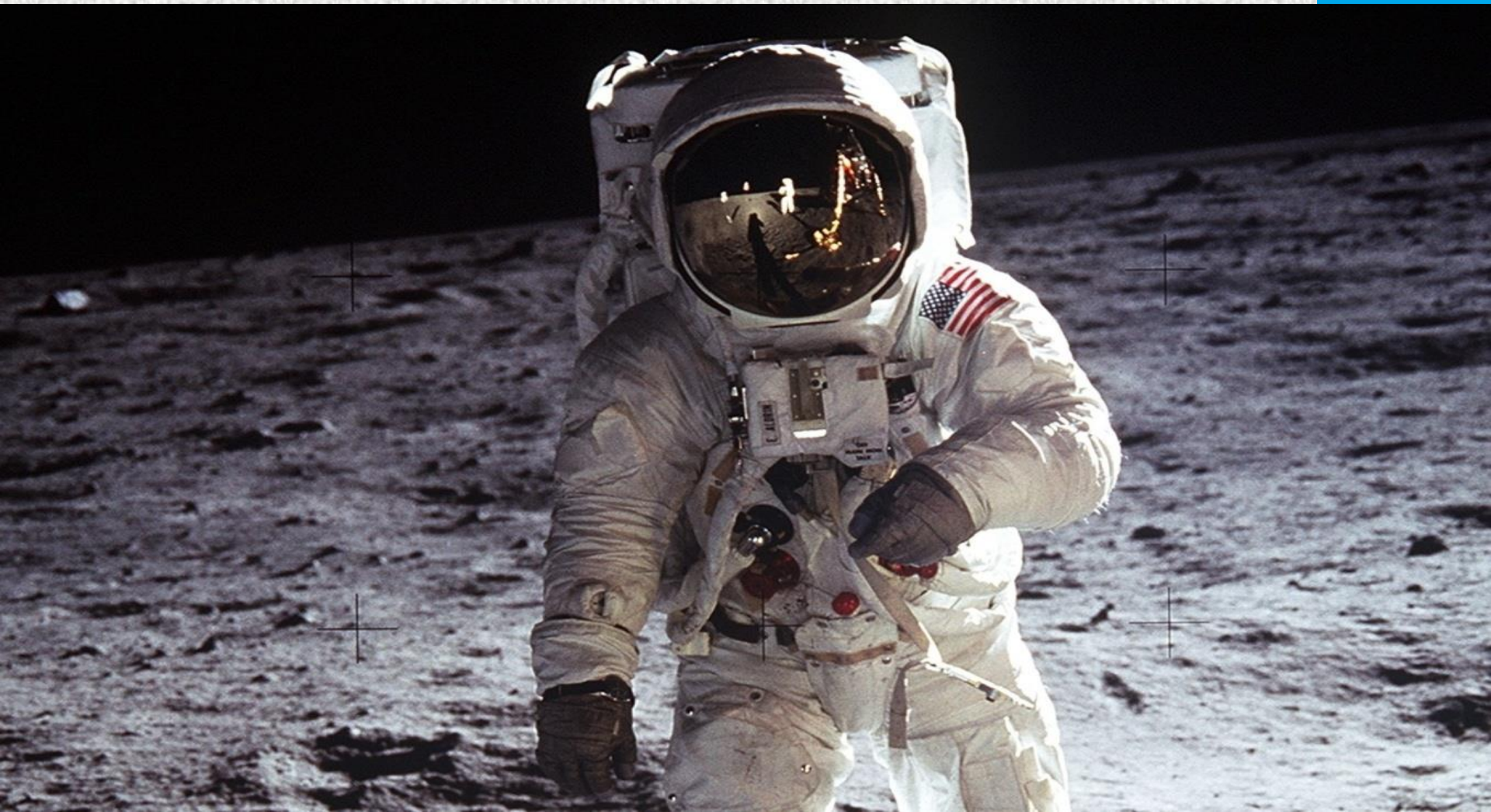
Standards measures must be cost effective

1. Using Life Cycle Costing Methodology (LCC)
   - i. Discounted cash flows for costs and benefits
   - ii. Accounts for maintenance costs/benefits
   - iii. Appropriate discount rates and life of measures - 30 years for residential measures

2. Time Dependent Valuation (TDV)
   - i. Value of gas and electricity changes depending on the season and the time of day
   - ii. 8,760 TDV multipliers for each hour of the year
   - iii. Favors measures that save energy during high demand periods

The ZNE Challenge: Cold Ducts In Hot Attics

And, finally the old cliché: *A nation that can put a man on the moon, should be able to figure out how to reduce the hot attic temperatures in our cooling climate zones*



Questions?

DAVIS ENERGY GROUP
INCORPORATED

ETCC

Quarterly Meeting
Cutting Edge Residential Efficiency

The New Title 24 Prescriptive Measure for Ventilation Cooling:

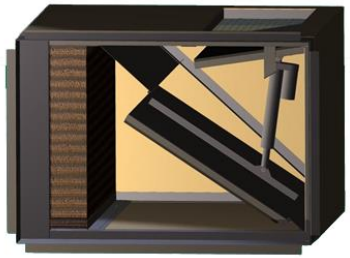
- Technologies & research
- Standards provisions and assumptions
- TDV impacts

July 15, 2014

Vent Cooling System Types

- Whole house fans
  - Dedicated fan
  - Manually controlled
  - Windows opened for outside air source

- Integrated systems
  - Share HVAC fan
  - Automatic control
  - Ducted & filtered outside air



Current Products

- Whole house fans
  - Lots available, 1000's installed
  - Selection of larger fans with insulated dampers is limited
- Central fan systems
  - Beutler SmartVent (>20,000 installed)
  - FAMCO (some CA installations)
  - NightBreeze (>200 installed)

Research

WHOLE HOUSE FAN EVALUATION PROJECT

FINAL REPORT

Prepared by

Davis Energy Group
123 C Street
Davis, CA 95616

for

Sacramento Municipal Utility District
P.O. Box 15830
Sacramento, CA 95852

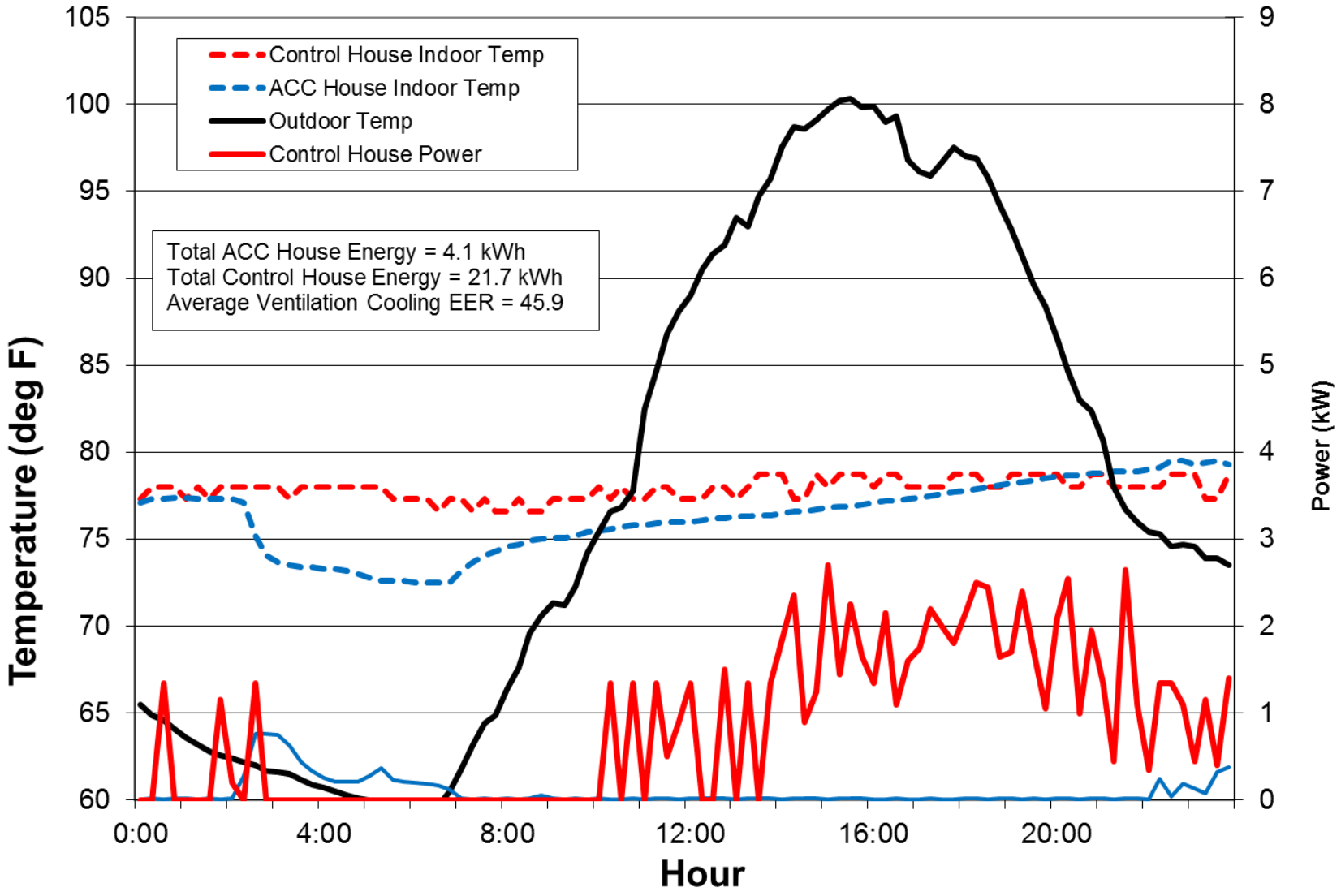
Project Manager
Dwight McCurdy
Office of Demand Side Planning

September 1988

“Alternatives to Compressor Cooling”

- Initiated in1994 by CIEE, continued with PIER funding until 2004
- Objective: reduce peak load from residential air conditioning
- Outcomes
  - Demonstrated demand reduction and energy savings
  - Semi-commercialization of integrated variable speed system

ACC Testing


Control House Indoor Temp
ACC House Indoor Temp
Outdoor Temp
Control House Power
Total ACC House Energy = 4.1 kWh
Total Control House Energy = 21.7 kWh
Average Ventilation Cooling EER = 45.9
Temperature (deg F)
Power (kW)
Hour
105
100
95
90
85
80
75
70
65
60
9
8
7
6
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Matrix 2007 (for PG&E)

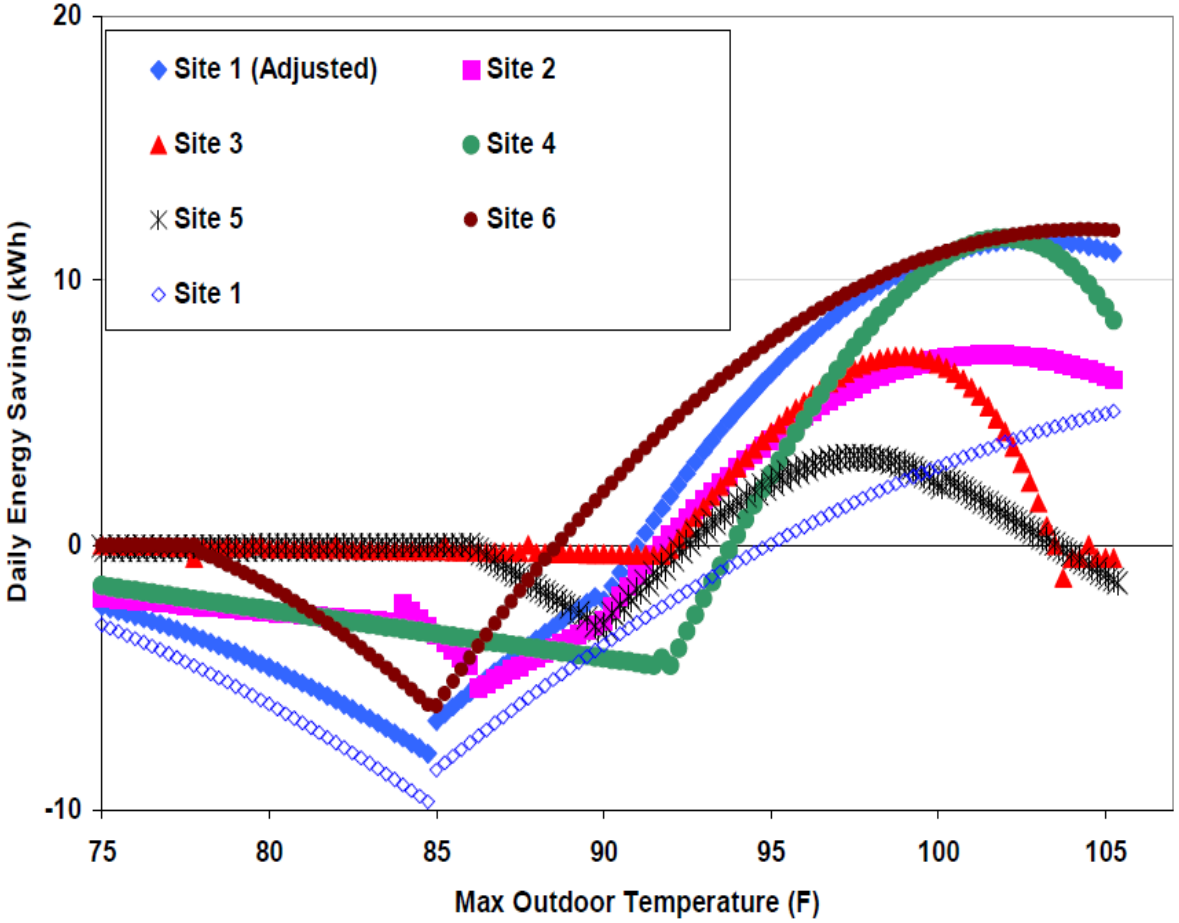


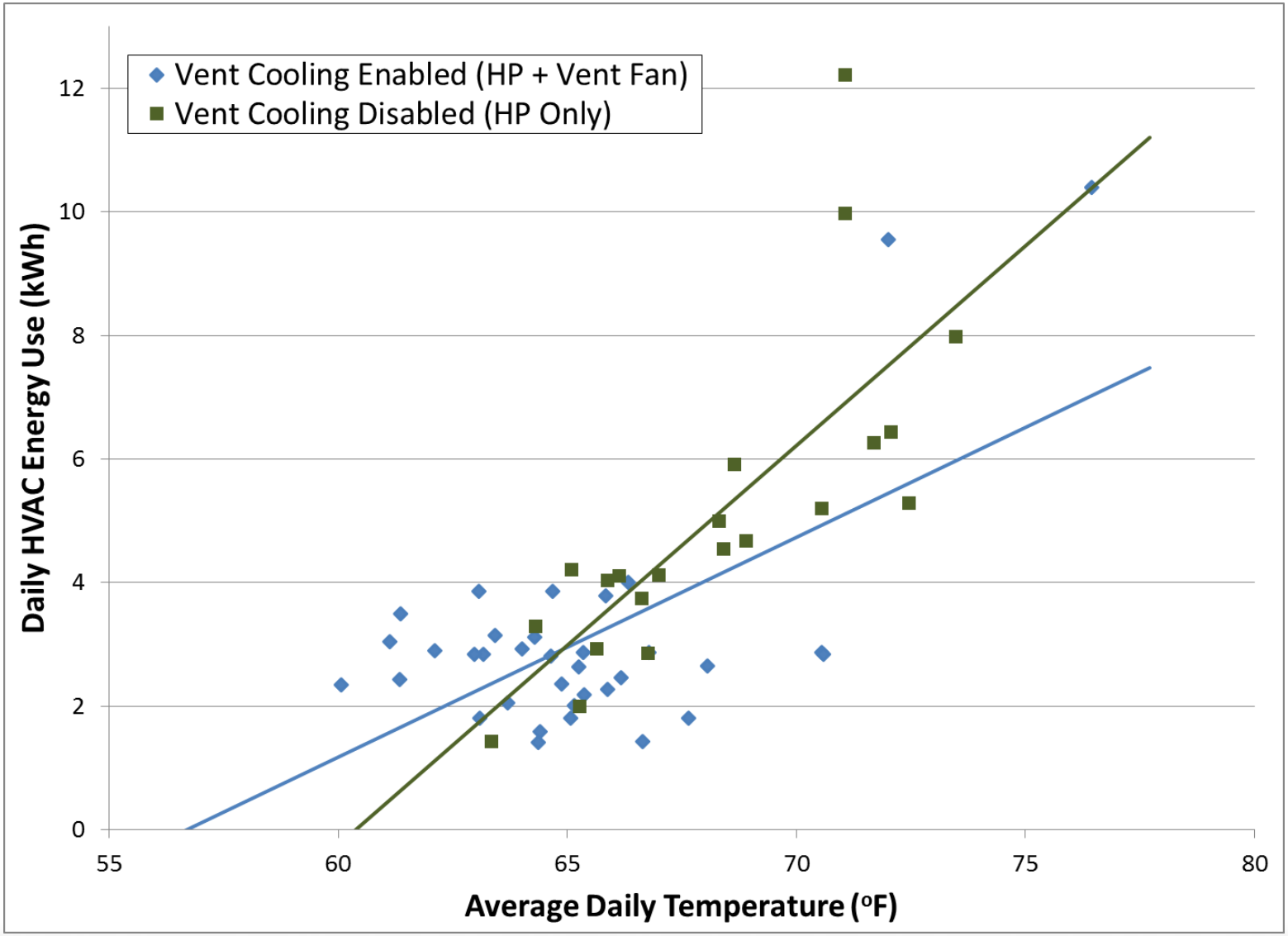
Figure 22. Daily Energy Savings Vs. Daily Maximum Temperature

For days hotter than 92˚

12-6 PM demand reduced
49.9 - 51.8%

Energy use reduced
13.8 - 30.4%

DOE Building America 2013



CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE)

Draft Measure Information Template – Night Ventilation Cooling Compliance Option

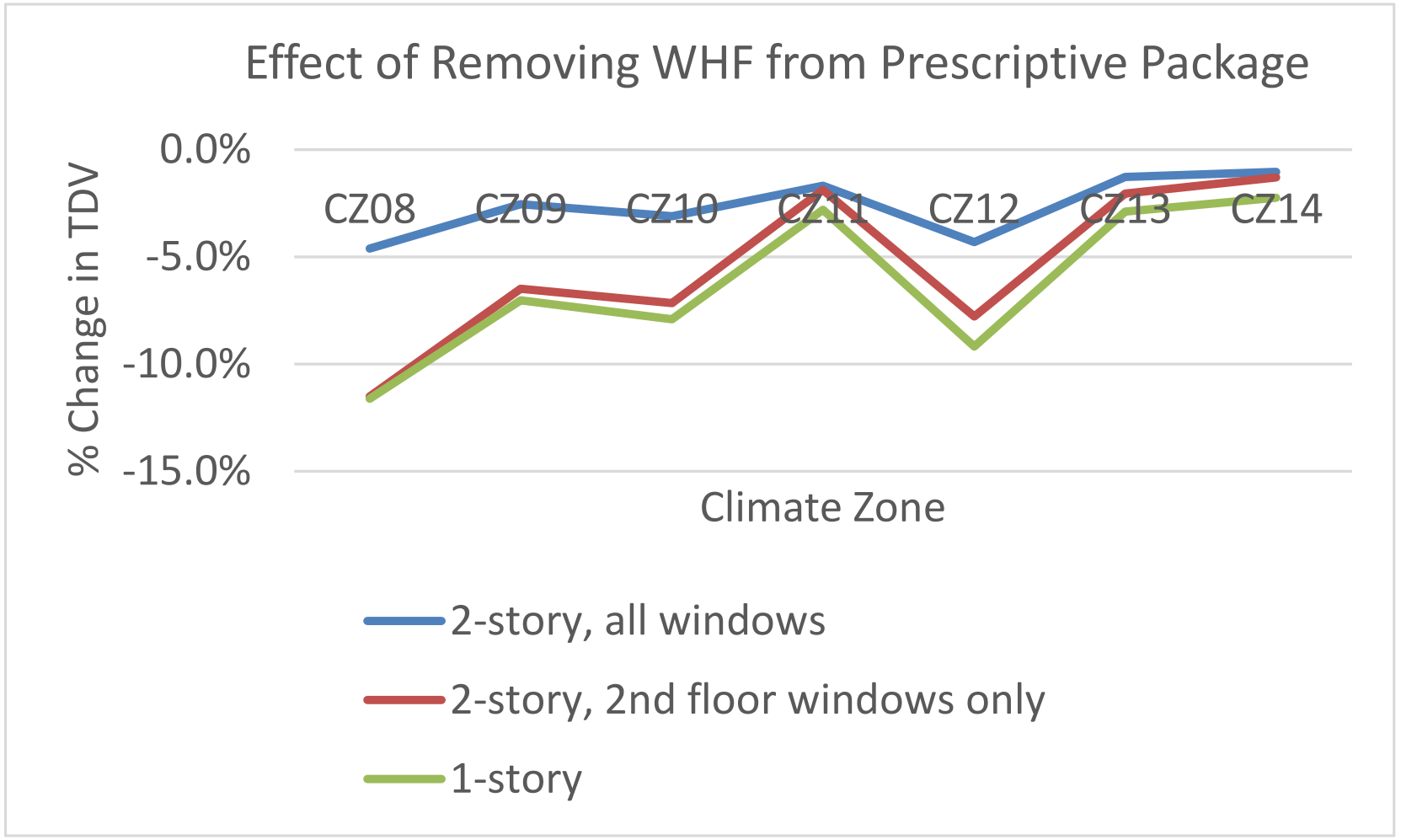
2013 California Building Energy Efficiency Standards

California Utilities Statewide Codes and Standards Team May 2011

ACM Assumptions – Natural Ventilation

- Windows closed between 11 PM and 6 AM and while it is warmer outside than inside or mode is “heating”
- Current assumptions: All windows open 5%
- Proposed assumptions: Only 2nd floor windows open 5%

Impact of Natural Vent Assumptions



ACM Assumptions – Whole House Fans

- Airflow rate as entered in compliance documents
- Fan power default = 0.1 W/cfm
- Effectiveness reduced to 25% of airflow (2 cfm/ft^2 reduced to 0.5 cfm/ft^2) to account for imperfect behavior
- Operates on the same schedule as windows

ACM Assumptions – Central Fan Systems

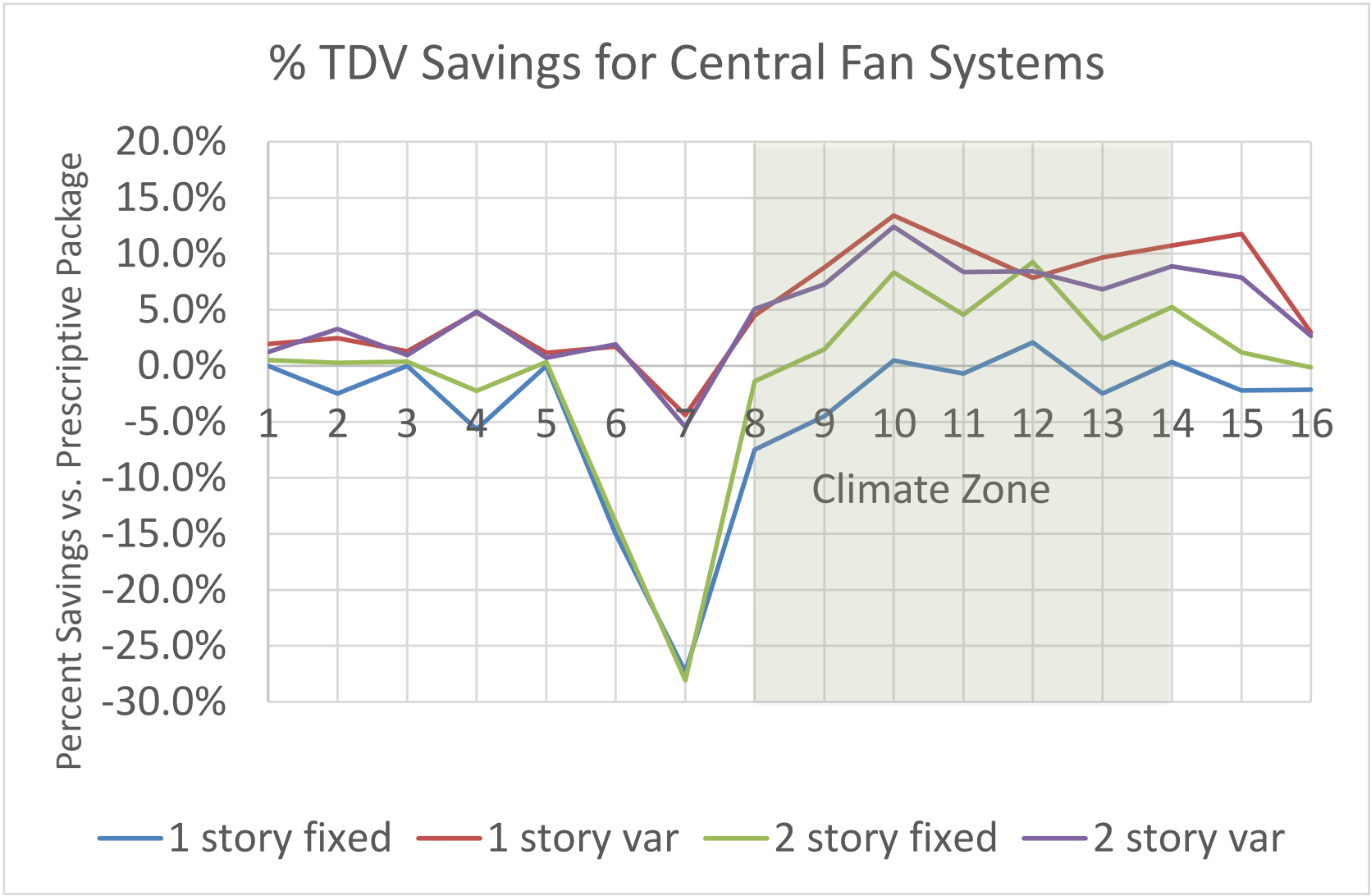
- Airflow rate as entered in compliance documents (~400 cfm/ton)
- Fan power
  - Fixed speed: default 0.58 W/cfm or as entered and field verified
  - Variable speed: same as fixed except reduced based on daily average outdoor temperature
- Effectiveness 100%
- Operates when:
  - 5˚ cooler outdoors than indoors
  - Indoor temperature higher than 68˚
  - 24-hour average outdoor temperature ≥ 68˚

Eligibility Criteria

- Whole house fans
  - Meet combustion safety requirements
  - Listed in CEC Appliance Database
  - Attic vent area of 1 ft^2 per 375 cfm
- Central fan systems
  - Damper meet duct leakage requirements
  - HERS verification of airflow and fan watt draw (0.58 W/cfm)
  - Outdoor temperature sensor & damper diagnostic
  - Documented variable speed motor with 75% turndown and control strategy*

    *Variable speed systems only

Central Fan System Savings



Utility and Customer Opportunities

- Demand response programs based on combined ventilation and air conditioner pre-cooling
- CAHP incentives in IOU service territories
- Improved IAQ and customer comfort
- Improved security offered by central fan systems
- Central fan systems operate automatically (not influenced by behavior)

QUESTIONS???

David Springer
Davis Energy Group
springer@davisenergy.com
(530) 753-1100 Ext. 26

Thank you!

Policy & Market Drivers: Plug Loads, Behavior, and Integrating with the Grid

ETCC Q3 Meeting
July 15, 2014

Devin Rauss
Southern California Edison
DSM Strategic Planning

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Overview

- Evolving Energy Efficiency Trends
- SCE Plug Load Activities
- SCE Behavioral Activities
- Grid Integration
- Next Steps

Evolving Energy Efficiency Trends

Early Years

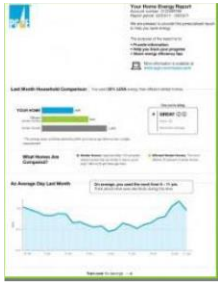
Energy Audits

Energy Savings Tips

Standard Rebates

Today

Robust Data Tools and Home Energy Reports



Market Interventions: Retail, Distribution, Wholesale

Deeper Savings

Partnerships

Continuing Trends

Zero Net Energy

Whole Building

Big Data

Water-Energy Nexus

Locational Targeting

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Utility Plug Load Activities

Change Behaviors

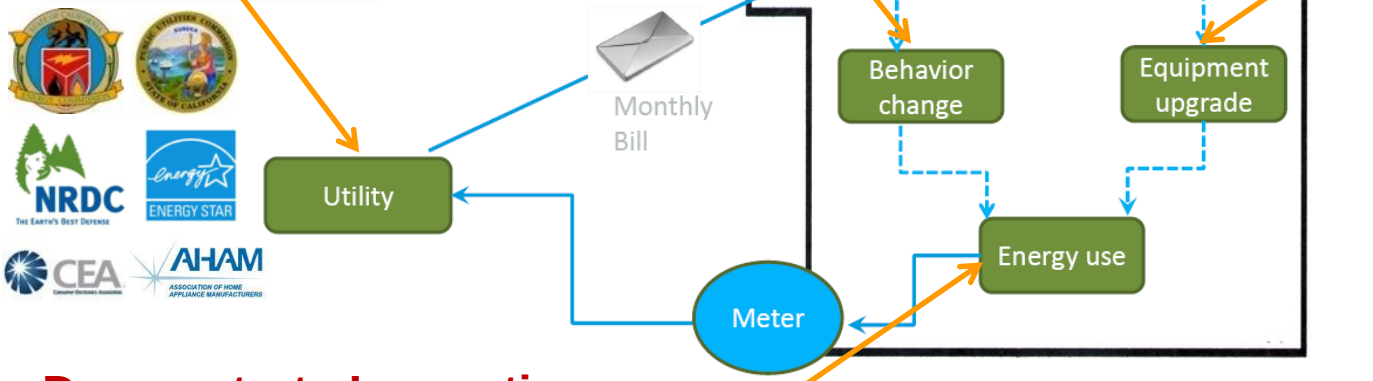
Educate customers about their energy use

Diversify Offerings

Pursue all cost-effective DSM opportunities to target energy savings without impacting user experience

Advocate Policies

Identify new and impactful areas for policy and advocacy



Demonstrate Innovation

Support development of customer facing energy management solutions

- Build upon Edison SmartConnect™ capabilities

CEE FORUM

TOPICS

- Televisions
- Computers
- Monitors/Displays
- Set-top Boxes
- Power Strips
- Game Consoles
- Imaging Equipment
- Audio/Video Equipment
- Other Products
- Recycling
- Low Power Modes/Standby

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Existing Plug Load Policy Frameworks / AB 2529

- **CLTEESP**
- **Research & Technology Action Pan**
- **Codes & Standards Action Plan**
- **ZNE Action Plans**
- **AB 758**
- **2013-2014 Program Implementation Plans (PIPs)**
- **…**

- Although plug load policy frameworks exist, there is no single comprehensive statewide plug load goal framework:
  - Aggregate HH goal: CLTEESP's goal to reduce consumption by 20% by 2015 and 40% by 2020 though *universal demand for highly efficient homes and products*
  - Plug Load goal: Plug loads will grow at a slower rate and then decline through *technological innovation* spurred by market transformation and customer demand for energy efficient products

- AB 2529 (Williams) has been introduced through NRDC to establish long-term (2030) goals for "plug-in equipment":
  - 25% reduction per residential household
  - 40% reduction per sq. ft. of commercial space

- AB 2529 requires development of a baseline study for residential and commercial plug-in equipment energy use in 2014 within one year of the bill's passage

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

Potential Unified Strategy Framework

$$PL = f(UEC \times OH \times Q) + ET$$

Definition	• Unit Electricity Consumption	• Operating Hours by mode	• Quantity of devices plugged in	• Enabling Technologies
Examples	• Watts	• On-Power • Standby-Power • Off	• # of active devices • # of inactive devices	• PCTs, IHDs, HEMs, HANs, Home Automation
Market Trends	↑ (UHD TVs) ↓ (Game Consoles) ↔ (Refrigerators)	↑ (Smart TVs) ↓ (TV viewing) ↔ (Toasters)	↑ (Tablets, 2nd Refrig) ↓ (Desktop PCs) ↔ (TVs)	↑ Pay-TV Channel ↓ Barriers to Entry ↔ Value Proposition
Potential Strategies	• Replace inefficient equipment • Increase product efficiency • Support code advocacy • Improve power factor	• Reduce standby losses • Increase auto power down • Address consumer behaviors	• Remove inefficient, unnecessary equipment • Integrate/consolidate equipment	• Increase customer awareness/adoption • Enable EE benefits from automation • Tap into behavioral benefits (e.g., smart phone)

SCE's Current Portfolio of Offerings Targeting Energy Use Behavior

- **Residential behavior activities**
  - Comparative Home Energy Report Trial (Residential)
  - HEES Enhancement Energy Reports
  - Home Energy Advisor (Residential)
  - Budget Assistant (Residential/DR)
  - Life Style Package (Residential)
  - Disaggregated Billing Trial with employees (ETP)
  - Home Energy Management Trial with system integrators (ETP)
  - Gamification Trial (ETP)
- **Non residential behavior activities**
  - Business Energy Advisor (Small Commercial)
  - Non-Residential Audit Programs and RCx Audit (C/I/A)
- **Other cross-cutting**
  - WET Centergies
  - Sector specific training and education (BPI, HVAC, etc.)
- **Purchase behavior programs**
  - All existing rebate and resource programs

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Integrating Plug Load Studies and Behavior Programs

- Opportunities
  - Energy use feedback motivates adoption + correct use of smart appliances
  - Some evidence of positive feedback effects
  - New channels for providing behavior programs

- Challenges
  - Measurement protocol
    - Exp. design required for behavioral programs
    - Challenging for studies involving equipment (opt-in by nature)
  - Code/Voluntary developments
  - Programs can't directly promote specific products

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Integrating with the Grid

- Growing interest in treating DSM as a reliability resource
  - AB 327
  - SCE's Preferred Resources Pilot
  - SCE's Local Capacity Requirements RFO
  - CAISO EE and DR Roadmap

- Behavior and plug loads innovation can support increased use of DSM as a resource:
  - Improved automation and communications
  - Improved understanding
  - Improved persistence of savings

Q&A

Devin Rauss

Southern California Edison

Devin.Rauss@sce.com

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

SMUD's Multifamily Summer Solutions Study

Vikki Wood
ETCC Quarterly Meeting
July 15, 2014

Powering forward. Together.

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Background

- Collaboration with Benningfield Group on a CEC grant
- Measure energy and load savings of:
  - A dynamic rate
  - Real-time whole house energy use information
  - HVAC automation
- Determine whether smart controls and displays should be considered for Title 24 building energy standards
- Provide a TOU-CPP rate
- Provide a gateway energy management system
  - Automate HVAC with a PCT linked to the TOU-CPP rate
  - Provide energy use and cost information with an IHD

Study Objectives

- Compare energy, demand, and bill impacts in the multifamily sector under 3 randomly applied technology treatments
  - TOU-CPP rate only (baseline)
  - TOU-CPP rate with in-home display
  - TOU-CPP rate with in-home display and PCT
- Determine participation rates of the various options
- Correlate impacts with customer demographics, dwelling characteristics, and energy using behaviors

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Technology Description

- Dispatched signals through SSN HCM
- Deployed
  - Energy Aware IHD
  - Energate Pioneer PCT
  - Digi X-Bee Pro ZB Wall Router
- Provisioned on site by installer
- Notified customers 24-hours in advance through phone, SMS, email and PCT and IHD displays

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Study Design

Study Component	Description
Comparisons	• Treated vs. recruited-and-denied/dropped customers in comparison group • 2012 vs. 2013 summer hourly loads
Peak Events	• 12 events called 4-7pm weekdays from June through September 2013 • Notification through SSN
Program Treatments	• Rate Only = TOU-CPP rate only • Rate + IHD = TOU-CPP rate with IHD • Rate + IHD + PCT = TOU-CPP rate with IHD and PCT • Comparison group of customers who signed up after treatment group closed or who dropped prior to the beginning of the study
Automation	• Customer Control = χ°F default event offset that could be changed at any time

Treatment	Sample Size	Comparison Group Size
Rate Only (Baseline)	94	83
Rate + IHD (Information)	88	91
Rate + IHD + PCT (Automation)	75	72
Total Sample	257	246

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Measurements

Source	Data	Use(s)
SMUD Customer Data	Name, address, phone number, rate, programs, etc.	Power analysis Screening and recruitment
Installation Survey	Dwelling characteristics	Evaluation: Energy, load impacts
	Pre-treatment behaviors	Evaluation: Behavior changes
	Demographic data	Comparison to population
Post-Summer Survey	Satisfaction, comfort	Evaluation: Satisfaction, comfort
	Summer behaviors	Evaluation: Behavior changes
Billing Data	Hourly electricity use	Evaluation: Energy, load impacts
Weather Data	Daily temperature forecasts	Event scheduling
	Historical hourly temperatures	Evaluation: Energy, load impacts

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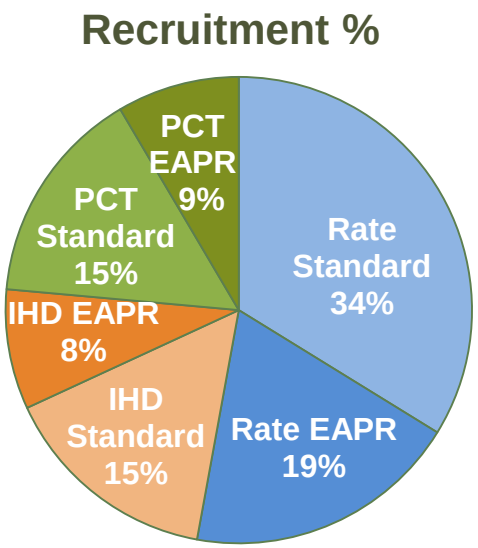
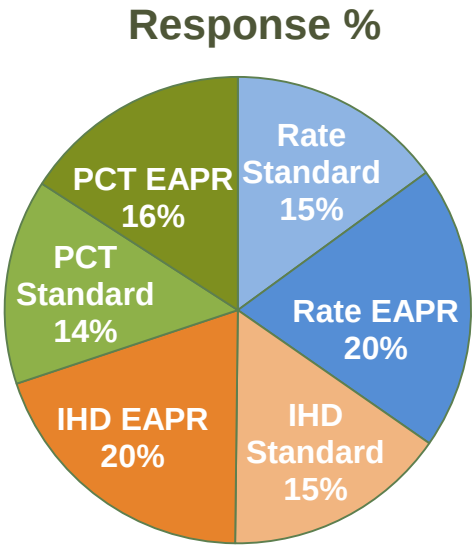
Findings

Recruitment & Response Rates

- Recruited a total of 548 customers: 257 participants and 246 comparison group customers
- Had to double recruitment in the Rate Only group to achieve the same response as the IHD and PCT groups
- EAPR response rates were double those of standard rate groups
- Response rates double with technology offer





Treatment	Response Rate	
Rate Standard	2.0%	3.0%
Rate EAPR	4.8%	
IHD Standard	4.7%	6.9%
IHD EAPR	11.0%	
PCT Standard	4.4%	5.9%
PCT EAPR	8.6%	
Total	548	4.6%

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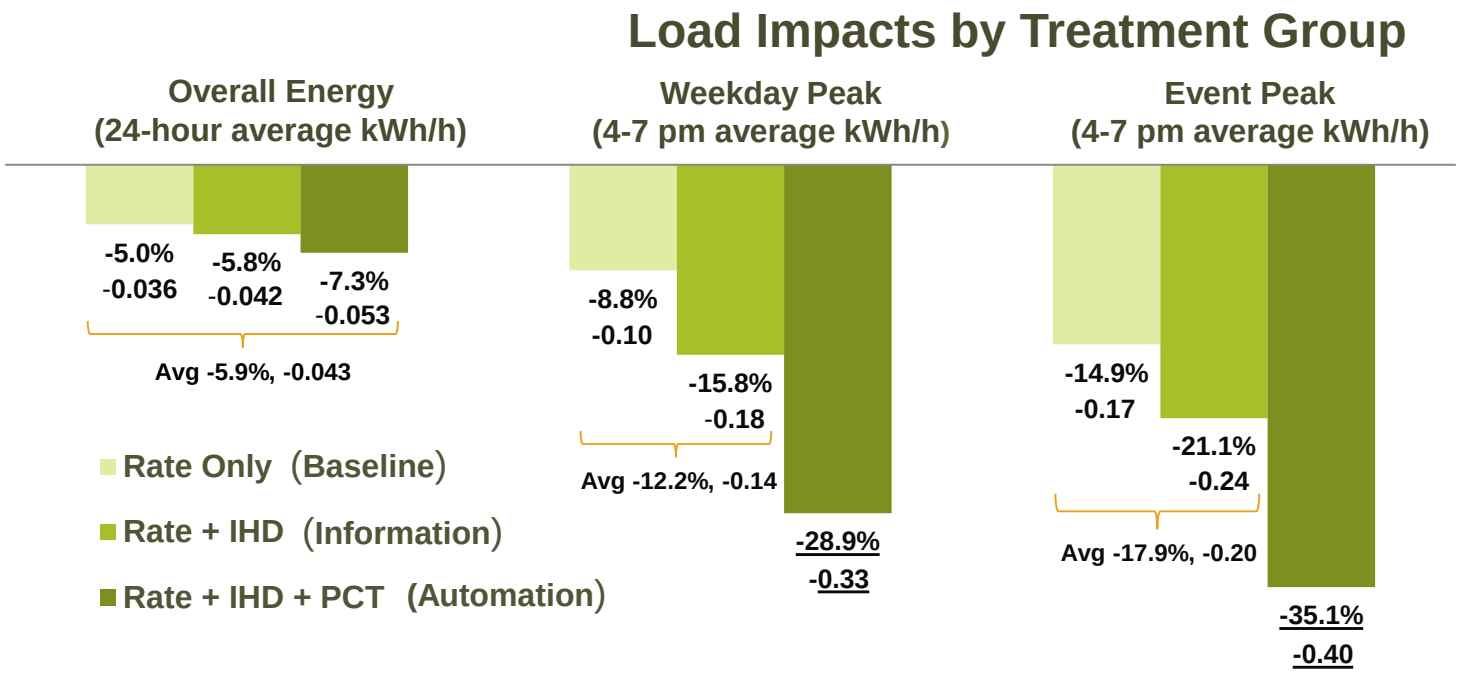
Energy and Load Impacts
by treatment groups

- Impacts for Rate Only group not significantly different from the Rate + IHD group, thus real-time information had no effects
- PCT treatment group savings (customer automated response) more than double peak savings (but not energy savings) of the Rate Only or IHD groups



Savings in bold are significantly different from standard rate; underlined are significantly different from other groups

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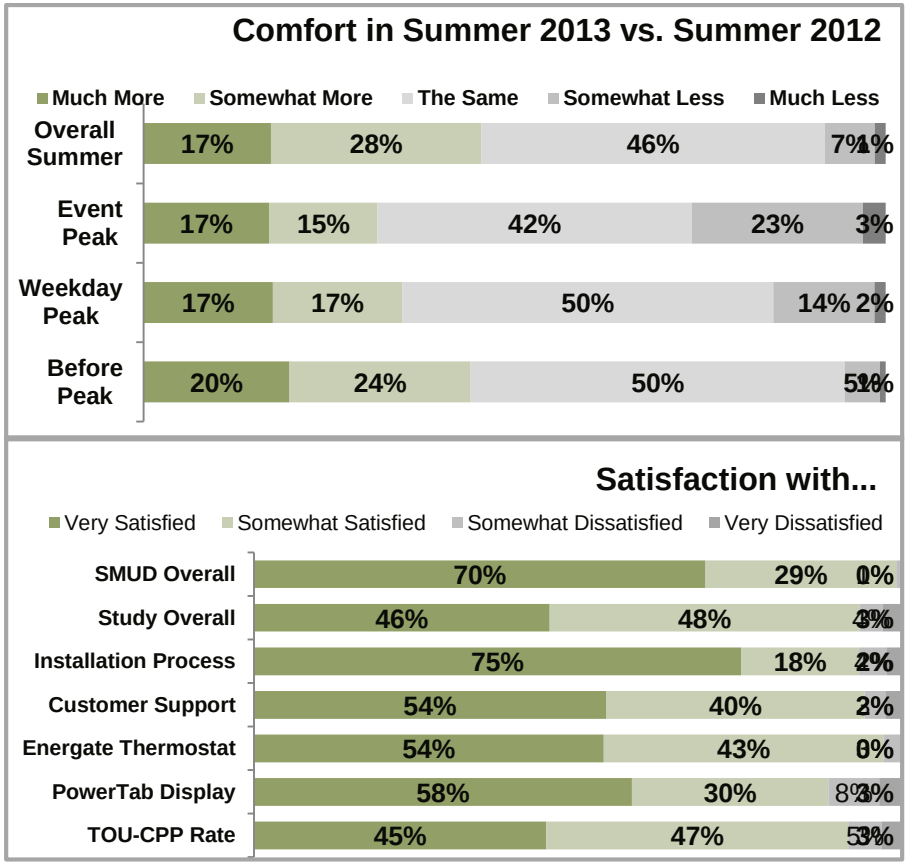
Comfort and Satisfaction

- Participants were generally more or equally comfortable during study in 2013 than during 2012 summer
- Comfort was 91% overall, but less during peaks:
  - 26% were less comfortable during event periods
  - 16% less comfortable during weekday TOU periods
- 94% satisfied with the study overall
  - Nearly all participants were satisfied with all aspects of the program
  - Participants were most satisfied with the installation process
- Low income more satisfied overall than non-low income



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Additional Findings

- With encouragement, the majority of customers set their thermostats
  - 21% of customers had programmed their thermostats to a schedule prior to the study vs. 12% for SF
  - With the help of installers, 82% set their thermostats, 69% to achieve energy savings
  - 90% looked at their thermostat at least daily
- Participants with PCTs who saved more energy paid **less** attention to their household's electricity use in 2013 than in 2012. *This could reflect reliance on the PCT to manage energy use*

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Conclusions

- Average energy savings 6%; weekday peak savings 17%; event savings 23%
- Customers prefer technology with rate to rate only
- The addition of real-time data provided no increase in either energy or peak savings
- The addition of automation provided no increase in energy savings but a 17 % increase in peak savings
- Customers were generally comfortable and satisfied with TOU-CPP rates and DR technology
- Low income customers signed up at double the rate and were more satisfied

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Lessons Learned

- The equipment is not market ready—all of the service calls and technical support site visits were related to equipment or connectivity problems
  - IHDs: 75% had connectivity problems, 39% persistent
  - PCTs: 26% had connectivity problems, 14% persistent
- Providing real-time and aggregate pricing data is difficult, and there is no open source platform for use with multiple vendors
- Helping customers to set their thermostats to automatically respond to price events is crucial

79

Policy Recommendations

- Programs and codes that encourage the development and installation of reliable, interconnected and easy to use automation devices should be implemented
- Time-based and dynamic rates that encourage the reduction of energy use during peak times, both daily and on critical days, should be developed and implemented
- Interventions that encourage and facilitate customers to program their connected devices to save energy in response to time-based and dynamic rates should be developed, tested and implemented

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Next Steps

- Directly test the value of automation in single-family dwellings
- Determine cost-effectiveness of DR in the multifamily sector
  - If cost-effective, develop programs tailored to multifamily
- Work with equipment manufacturers to develop reliable devices

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Questions?

Vikki Wood
vikki.wood@smud.org
916-732-6278

Analysis Methodology

- **Load and Energy Impacts:** Estimated overall energy impacts, non-event impacts and event peak impacts using fixed-effects models regressing 2013 hourly summer electricity use on year, hour, temperature, event day and treatment group relative to modeled baselines using 2012 pretreatment data and corrected for exogenous effects using a recruit-and-deny control group
- **Bill Impacts:** Estimated energy impacts for individual customers using fixed-effects models incorporating the same variables above, and calculating the average monthly dollar savings based on rate
- **Demographics and Dwelling Characteristics:** Surveyed participants at the time of equipment installation in late spring 2013
- **Energy Use Behaviors, Comfort, Satisfaction:** Surveyed participants at the end of 2013 summer

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CUTTING EDGE INNOVATIONS

Denver Hinds, Project Manager | Sacramento Municipal Utility District

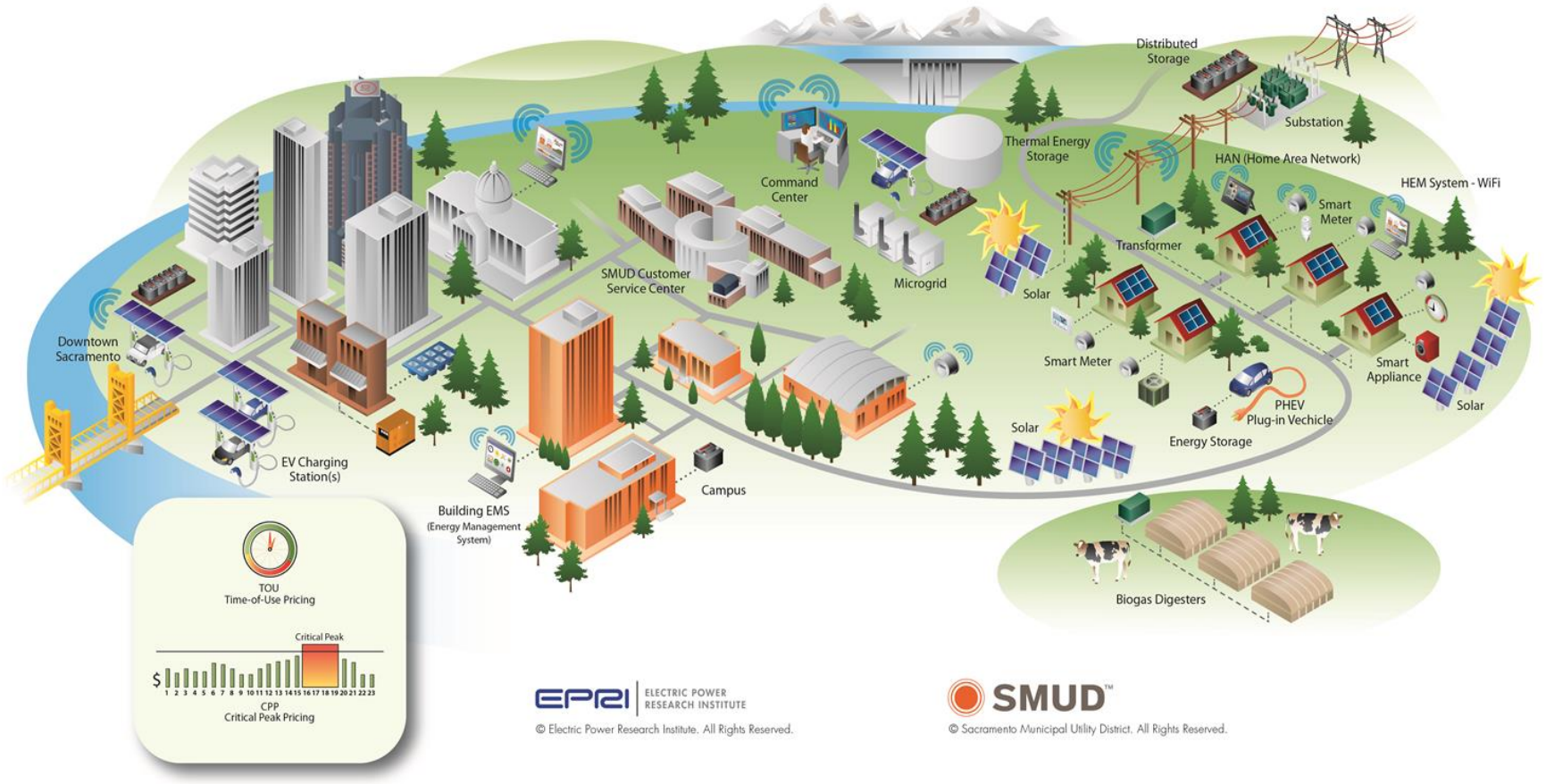
Christopher Dymond, Product Manager | Northwest Energy Efficiency Alliance

Smart Energy Device Evaluation and Testing

ETCC Quarterly Meeting
July 15, 2014

Denver Hinds
SMUD PM, HAN Technology

Smart Grid Vision



EPRI ELECTRIC POWER RESEARCH INSTITUTE

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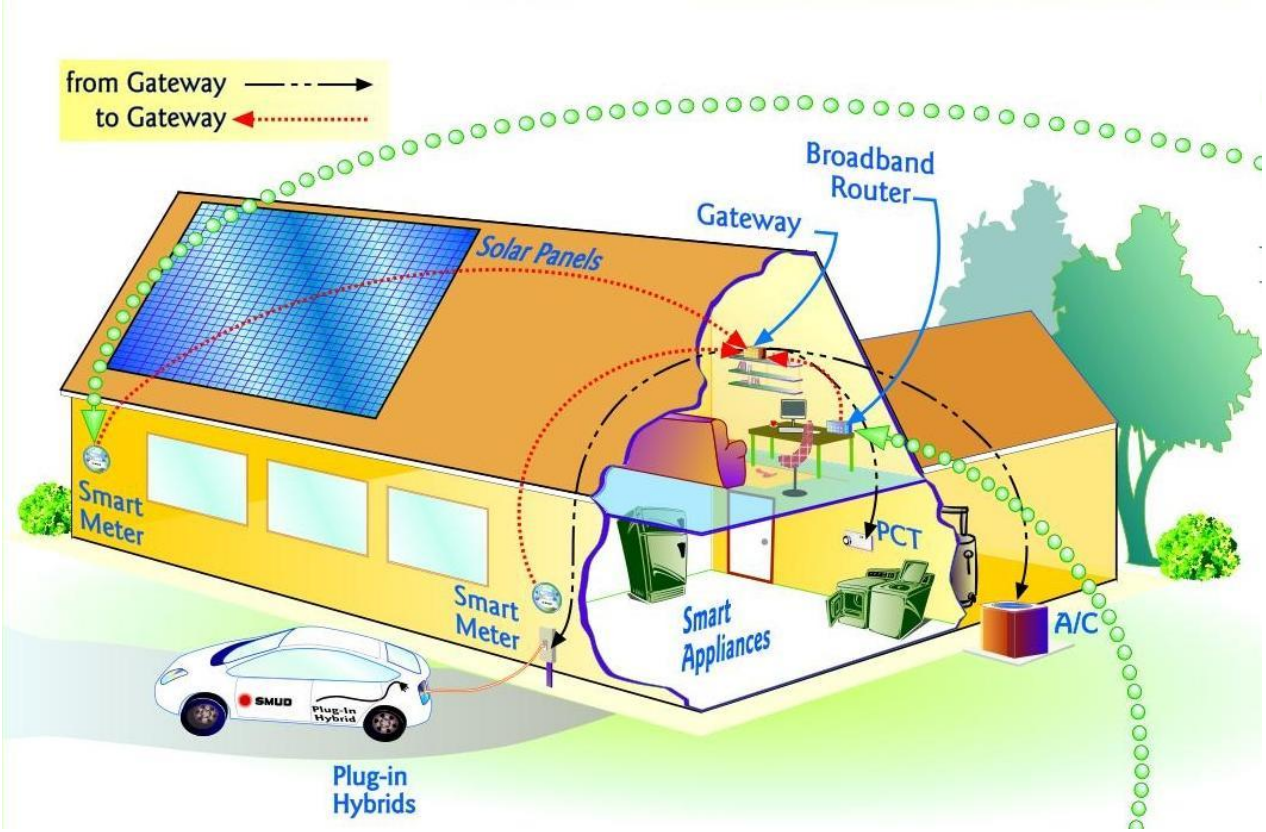
Smart Energy Customer



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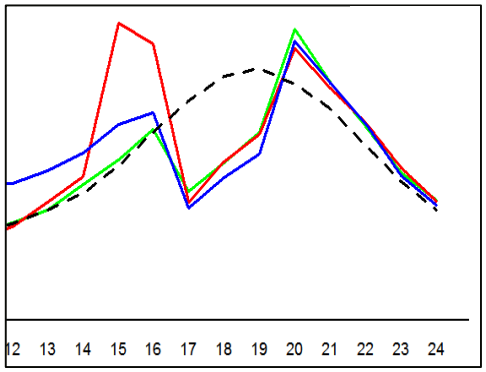
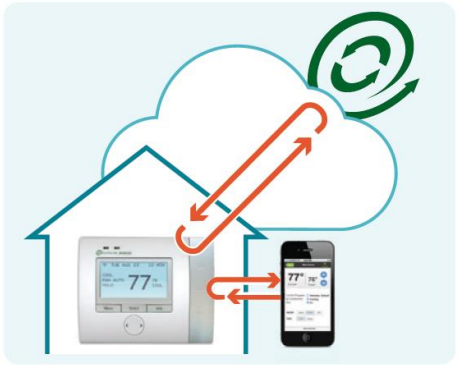
SMUD R&D Customer Program Areas

- Demand Response
- Energy Efficiency
- Electric Transportation
- Energy Storage
- Distributed Generation





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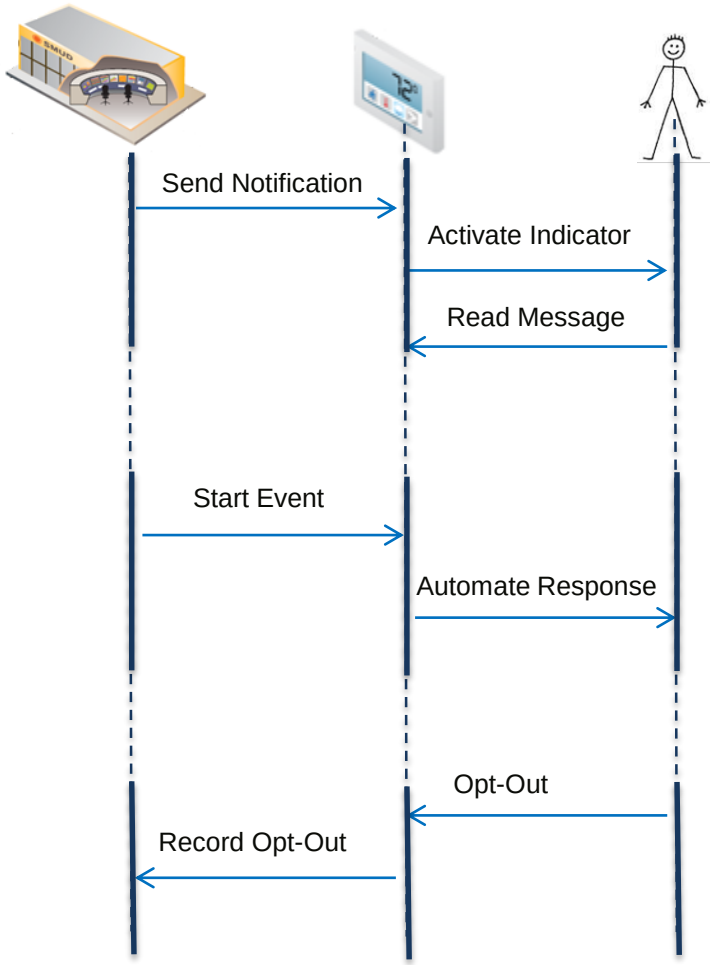
Test Plan Development

1. Program objectives
2. User roles
3. Use cases
4. Functional requirements
5. Technical requirements
6. Risks
7. Solicitation
8. Validation and verification
9. Usability



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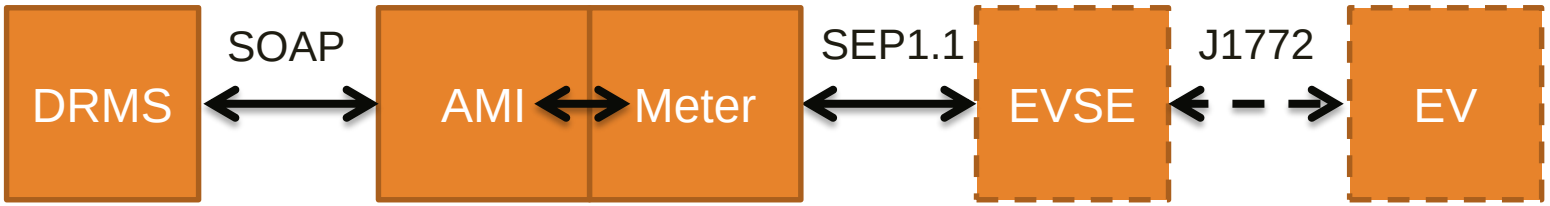
Testing Protocol

1. Unit Testing
   - Standards compliance
   - Network interoperability
   - Technical validation
   - Functional verification
2. System Testing
   - End-to-end program simulations
   - Performed by program staff
3. Program support and troubleshooting



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Testing Facilities

- Unit Testing – Contract facility
  - Certification test harnesses
  - RF isolation chamber
  - Protocol, interface & certification expertise

- System Testing – SMUD Lab
  - Workstations
  - AMI environment
  - Customer environment
  - Functional test harnesses
  - Packet sniffers, protocol analyzers, end use appliances
  - Repository of test cases and results

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Stages of Deployment

- Developing a Vision
  - Open, innovative services
  - Rapid development, agility and continuous improvement
  - Customer retail devices and partnerships
- Technology Assessment
  - EV Charging
  - Smart inverter
  - AC cycling upgrades
  - Sub-metering
- Field Demonstration
  - Special Pricing Options
  - Smart Thermostat
  - EV Innovator
- Program Roll-outs
  - Powerstat
  - IHD Checkout

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Energy Efficient Clothes Dryers

Christopher Dymond, Sr. Product Manager

July 15th 2014 – ETCC Quarterly meeting, Sacramento CA

NORTHWEST ENERGY EFFICIENCY ALLIANCE

Outline

Background

- Savings Potential, Barriers & Opportunity
- Federal Test Procedure
- Field Data

Lab Data

Program Support Actions Needed

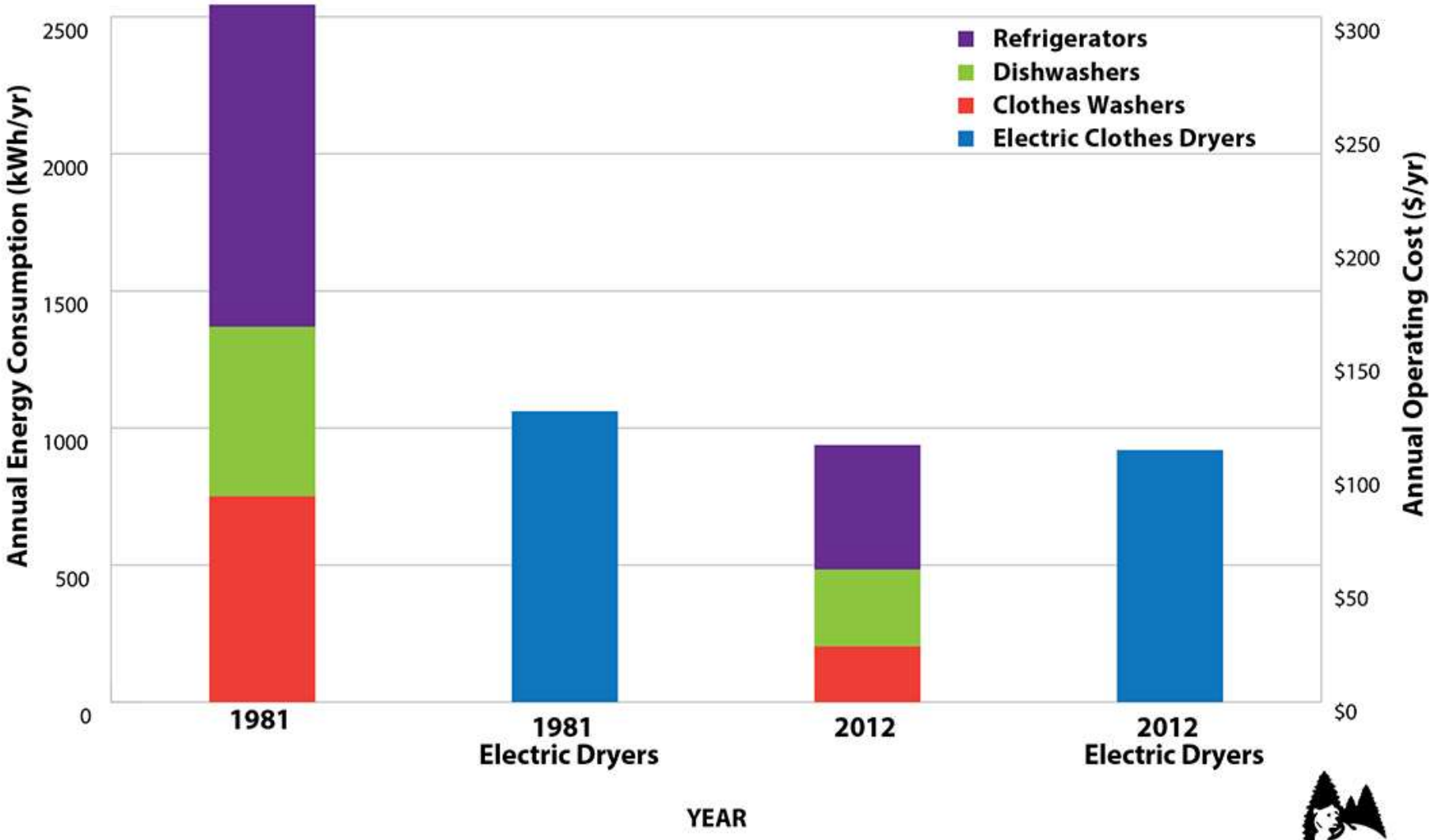
- Supplemental Test
- Field Testing
- Performance Baseline
- Multi-Tiered Specification

Future

- CO2 based washing
- Combined “laundry” evaluation

Energy Use Comparison

Figure 1. Annual energy consumption of electric clothes dryers vs. other major home appliances, 1981 and 2012



Source: Data for refrigerators, dishwashers, and clothes washers from the Association of Home Appliance Manufacturers on new purchases. Data for dryers estimated from a collection of field studies conducted over the past four years by Ecova and others.

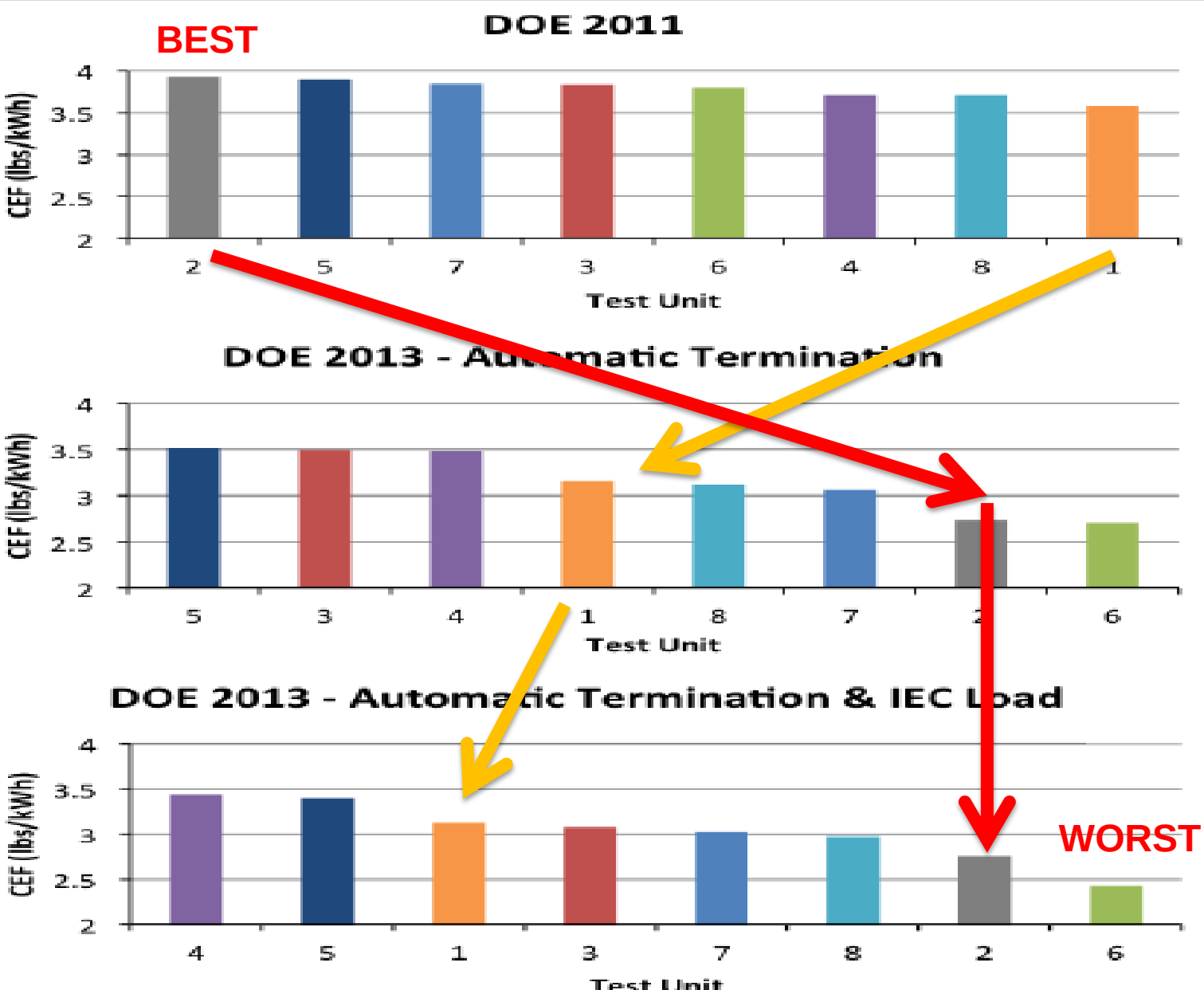
NRDC
THE EARTH'S BEST DEFENSE

Test Procedure Relative Ranking

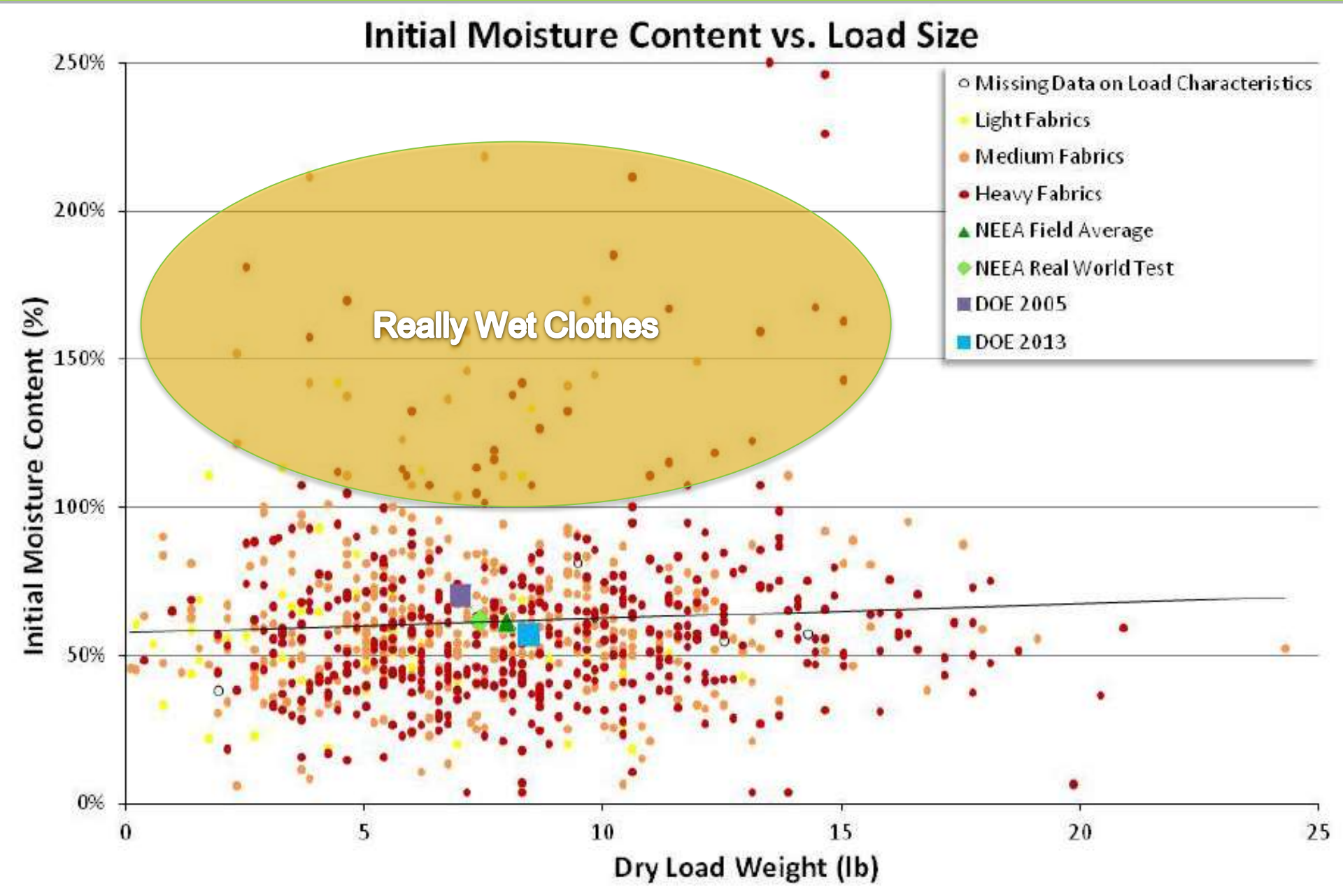
DOE 2011

DOE 2013

"Real World"



NEEA Field Data Showed Huge Diversity



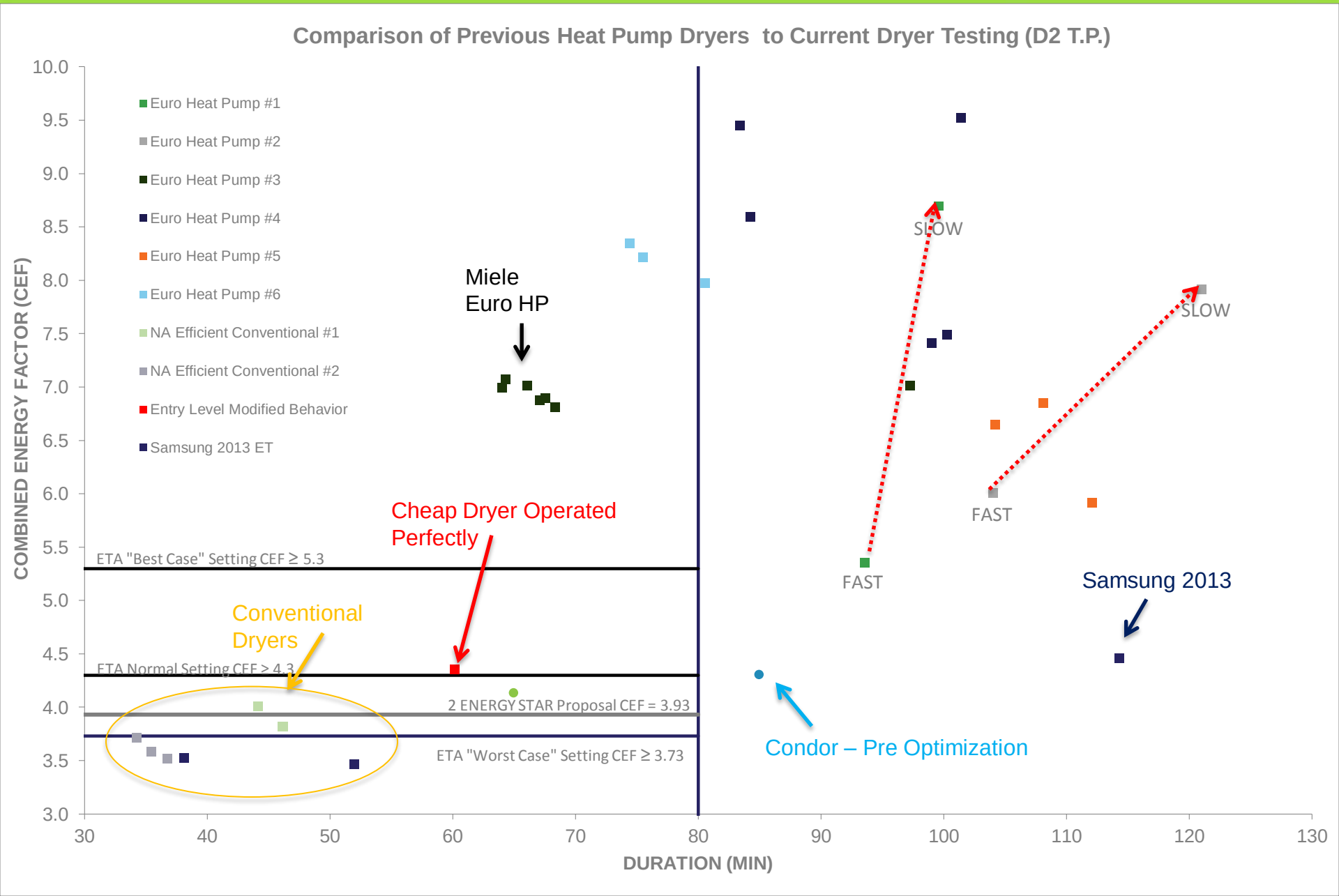
Field Testing vs Test Conditions

DOE 2013 D2 Test Conditions

		Temp				
		Low	Medium	High	Total	Avg. Load Weight in Each Category (lbs)
Load Weight*	0-6.5 lbs	6.6%	17.4%	16.5%	40.5%	4.3
	6.6-10.5 lbs	3.0%	20.8%	13.1%	36.9%	8.5
	10.6-25 lbs	3.0%	12.9%	6.7%	22.6%	13.1
	Total	12.6%	51.1%	36.3%	100%	

*Load weight represents the net weight of the dry load going into the washer

Lab Data - D2 Test Procedure



NEEA & PG&E's "Supplemental Test"

Concept: Combine D2 test results with additional tests runs using real clothing in multiple operational modes.

Benefit

- Increased accuracy of relative ranking
- Correlation to field results
- Eliminates optimization for just one test condition with non-realistic clothing type

Small Realistic load = 4.3 lbs

Latest Lab Result Comparison

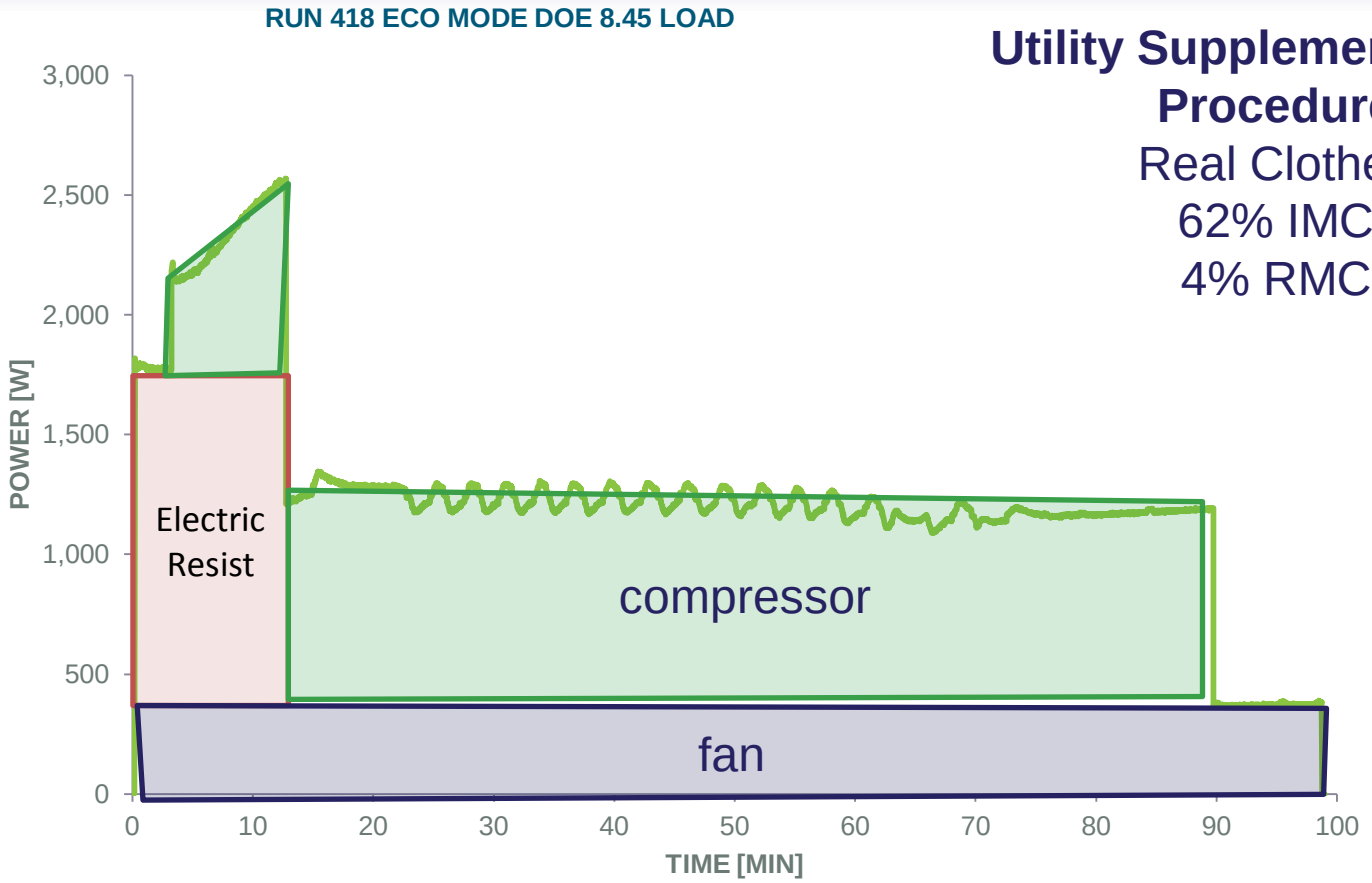
Normal Cycle Normal Temp Normal Dryness	**Combined Energy Factor** (lbs/kWh)			**Drying Time** (minutes)		
	DOE	Realistic	% change	DOE	Realistic	% change
Miele HP	6.9	4.6	-34%	67	93	38%
Whirlpool Conventional	3.6	2.6	-28%	35	63	76%
Hornet	NDA		-19%	NDA		15%
Condor			-31%			57%

Hornet and Condor Products are pre-algorithm finalization

CONFIDENTIAL

neea

2014 HP Dryer Lab Test Results



Utility Supplemental Test Procedure

Real Clothes

62% IMC

4% RMC

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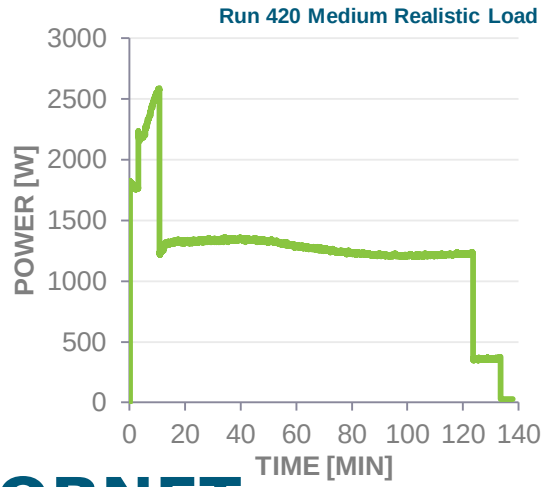
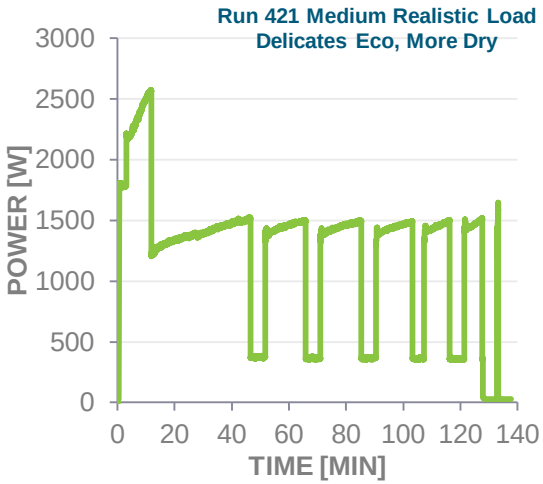
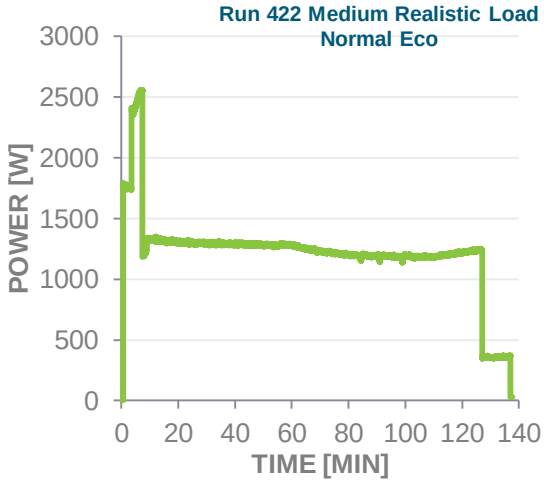
Lab Test Results – 2 New Hybrid Dryers

CONDOR







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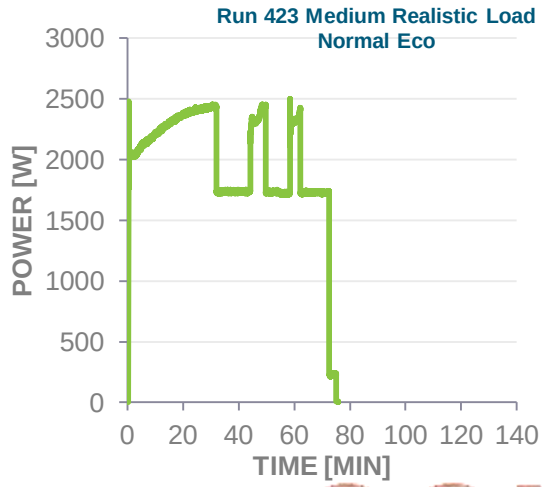

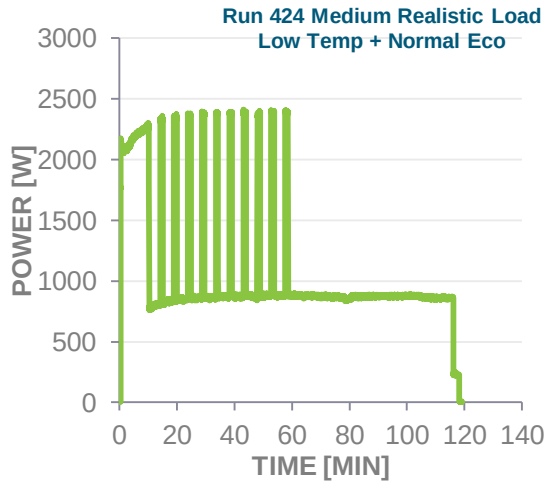

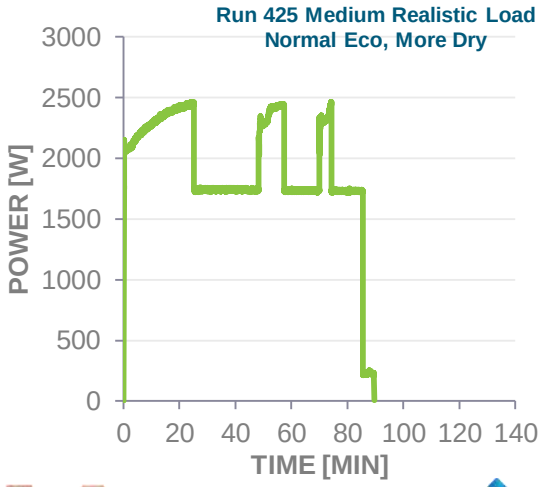

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ET Activities 2014 & 2015

Lab Testing of Heat Pump Dryers

D2 and Supplemental Test Procedures w/real clothes tested in 4 modes – small, large, fast, eco

Performance Baseline

Use D2 Test protocol on dryers that are not ENERGY STAR

Field Testing

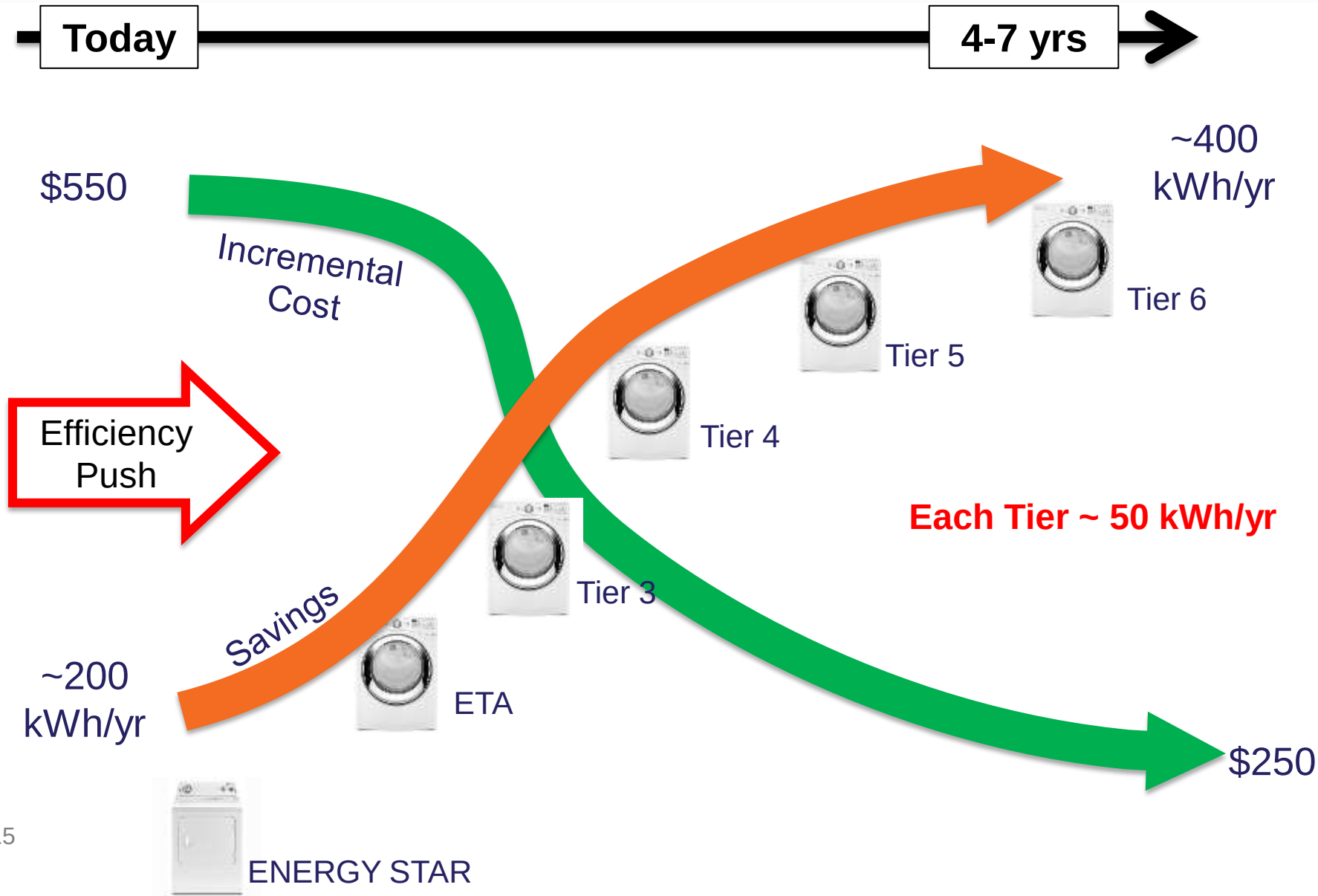
Common Field Test Protocol

Calibrate lab to field and improve spec

Consumer Research – questionnaires of early adopters

Multi-Tiered Performance Spec

Dryer Market Transformation



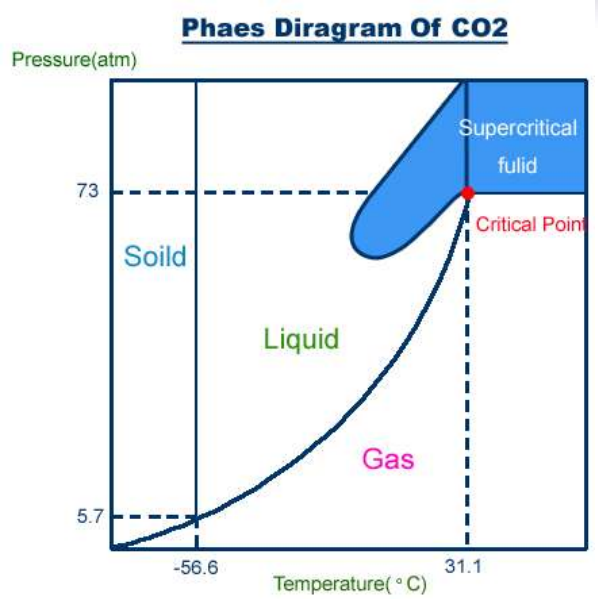
Future Laundry Tech

CO2 Clothes Washing

Radio Frequency Drying

Laundry Pair Performance

“Smart” Home Integration



Closing Messages

1. Save incentive $$ for Tier 2+ Products

2. Help craft a Multi-Tiered Specification

3. Collaborate on Field Testing & Performance Baseline

Questions

Questions?

Christopher investigates if American's can use European sized dryers

Questions & Comments

Filling the Energy Efficiency Pipeline

Accelerating Market Adoption

Delivering Regional Advantage

Christopher Dymond
Sr. Product Manager
cdymond@neea.org
(503) 688-5454 – work (503) 428-2787 – mobile

LUNCH

Program will resume at 1:15 pm

PLEASE FILL OUT EVALUATIONS!

EMERGING TECHNOLOGIES PROGRAM SUPPORT OF RESIDENTIAL SECTOR

Panelists

Obadiah Bartholomy, Manager, Energy Efficiency & Renewables | SMUD

Teren Abear, Project Manager, Emerging Technologies Program | SCE

Mananya Chansanchai, Senior Product Manager, Emerging Technologies Program | PG&E

Abdullah Ahmed, Manager, Emerging Technologies Program | SoCal Gas

Kate Zeng, Manager, Emerging Technologies Program | SDG&E

Virginia Lew, Energy Efficiency Research Office Manager | CEC

Moderator

Jonathan Livingston, Principal | Livingston Energy Innovations

OBADIAH BARTHOLOMY

Sacramento Municipal Utility District

SMUD RESIDENTIAL EE R&D

- SolarSmart™ Homes of the Future
  - Elliot Homes – Innovations at Empire Ranch, Folsom CA
    - All solar subdivision, 2 X 6 framing, 18 SEER/14.5 EER AquaChill evaporively cooled condenser AC, EV ready garage receptacle, 80% Source Energy Savings compared to code built home
  - Northwest Land Park
    - All solar subdivision, Magnesium Oxide SIP panel construction for R40 walls/R50 Roof, all LED lighting, green switches for dedicated plugloads, 'net zero' energy design
  - 2500 R St
    - All solar subdivision, Designed to be zero peak energy consumption, net zero energy, net zero carbon, 40% below T24 and LEED certified, Combined PV and battery storage with variety of use-case tests, smart thermostat, online customer portal, TOU-CPP Dynamic Pricing with PV Net Metering

SMUD VISION OF RESIDENTIAL R&D

- Defining ZNE by our desired outcomes
  - Lifetime carbon reduction
  - Renewable integration
  - Electric vehicle enabling
  - Demand response capable
  - Prepared for TOU/CPP rates
  - Zero peak demand
- Major focus on connected devices, interactivity between customer devices and utility resource needs

CALIFORNIA ENERGY COMMISSION

Virginia Lew

CALIFORNIA ENERGY COMMISSION EXAMPLES OF RESIDENTIAL RD&D ACTIVITIES

- **Develop and demonstrate technologies and strategies**
  - Residential retrofits
  - Alternate cooling methods
  - Water heating and distribution
  - Residential programmable thermostats and displays
  - Advanced envelope systems for factory built homes
  - Home Energy Efficient Design-models and tools
- **Advance and inform codes and standards**
  - Lighting, HVAC, Water heating, Cool roofs
- **Evaluate impacts of indoor air quality**
  - Air tightness and ventilation
  - Healthy zero net energy homes

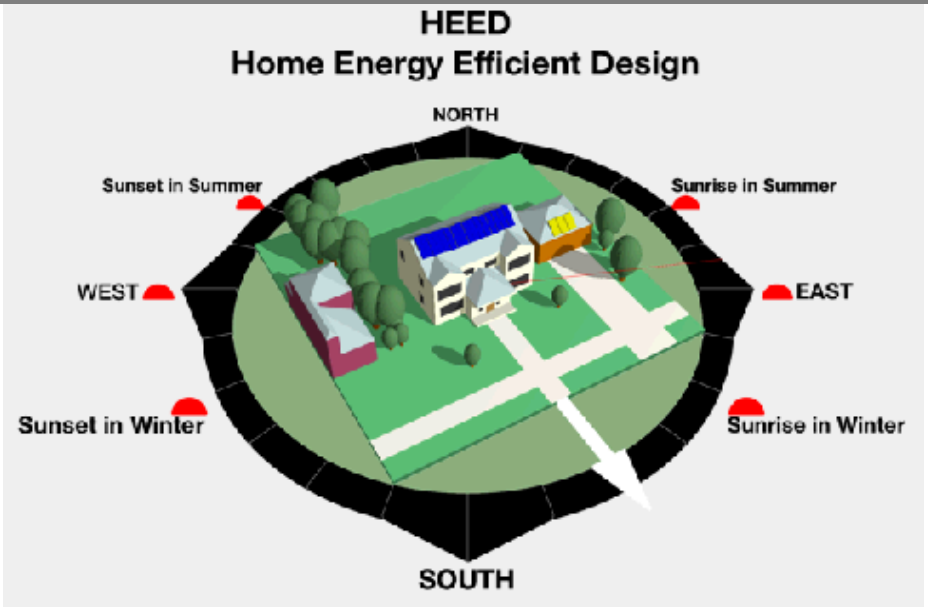
CALIFORNIA ENERGY COMMISSION CENTRAL VALLEY RESEARCH HOMES

- Examined cost-effective ways to improve the efficiency of residential homes (1948, 1953, 1996 and 2005) in Stockton
- Results to date
  - Retrofits included envelope and HVAC efficiency upgrades (insulation, envelope sealing, whole house fans)
  - Cooling related energy savings ranged from 47 to 78%

CALIFORNIA ENERGY COMMISSION HOME ENERGY EFFICIENT DESIGN TOOLS

WWW.ENERGY-DESIGN-TOOLS.AUD.UCLA.EDU/HEED/

- Tool for California homeowners, builders, contractors and architects to design comfortable and energy efficient homes.
  - New construction and retrofits
  - Create a home that meets the 2013 Prescriptive Compliance Method



- Updated to 2013 California Energy Code, effective on July 1, 2014:
  - automatically designs a reference code compliant home for any climate
  - creates a second home that is about 15% better
  - test various design alternatives and see their Energy Use Intensity
  - Creates and compares up to nine different design alternatives-approach ZNE

HEED Tutorial: http://www.energy-design-tools.aud.ucla.edu/tutorials
Contact: Murray Milne, Professor, UCLA, milne@ucla.edu; (310)454-7328

CALIFORNIA ENERGY COMMISSION RESIDENTIAL RD&D BARRIERS AND OPPORTUNITIES

- **Existing Homes** ≈ 60% of the state's housing stock built before 1978
  - Retrofit barriers: cost and economic payback, longevity of home ownership, lack of knowledge by building owners and financial decision makers; how to assess cost-effectiveness of building retrofits
- **New Construction** – High performance and ZNE homes
  - Barriers: limited research and information on the best approaches for meeting the ZNE/high performance efficiency goals; lack of prescriptive packages of cost effective designs with proven energy performance; need for large scale demonstrations to document energy savings and economics
- **Opportunities**:
  - Electric Program Investment Charge (EPIC) and Natural Gas RD&D Programs
    - Develop innovation technologies to overcome barriers and reduce equipment cost.
    - Identify other non-technological strategies, monitoring and verification to document savings, and inform future codes/standards
    - EPIC Triennial Investment Plan and Natural Gas Research Budget Plans
    - www.energy.ca.gov/research/

PACIFIC GAS & ELECTRIC

Mananya Chansanchai

PG&E RESIDENTIAL EE SEGMENT STRATEGY

Holistically provide solutions to residential and multi-family customers across three main areas:

Existing

Behavior	Retail	Buildings
• Home Energy Reports • Online Energy Checkup	• Plug Load and Appliances (PLA) products (clothes washers, water heaters, etc.) • Appliance recycling	• Energy Upgrade California • HVAC Quality Maintenance • Residential New Construction & ZNE

Split Incentive Challenge for multi-family sector: Interests of property owners and tenants do not always align as it relates to energy efficiency

What innovative services can we offer that can bring value to both the renter and the owner?

PG&E: CURRENT RESIDENTIAL ET PROJECTS

Zero Net Energy (ZNE) & ZNE-Ready

- Monitoring 3 single-family homes, 3 multi-family sites
- Collecting data for T24 CASE studies

Connected Devices & Controls

- "Smart" tstats and behavioral messaging
- Controls embedded LED lamps
- PLA: Advanced Power Strips (bundling) and Retail Plug Load Portfolio Trial

Water Energy Reports

- Partnership with local muni water district
- Examining potential energy savings impacts

PG&E RESIDENTIAL EE PRODUCT DEVELOPMENT

Clothes Dryers

- Heat pump dryers and heat exchanger technology
- Tiered model incentive to encourage EE for both conventional dryers and heat pump dryers

Consumer Electronics

- High Performing Game Consoles
- Set Top Boxes (Leveraging SCE efforts)
- New PLA approaches (bundling and "whole store")

Home Energy Management Systems

- Launching study on market characterization and savings methodology
- Leveraging academic researcher to perform secondary assessment to classify technologies

SOUTHERN CALIFORNIA EDISON

Jerine Ahmed

Topics

- **Residential ETP Recent Project Activity**
  - Sample of Few Active Residential Projects
- **Residential Sector**
  - Barriers and Challenges
  - Path Forward

Sample of Few Active Residential Projects

- ZNE Tract Home Retrofit
- ZNE New Production Home
- Deep Retrofit in Low Income Multi-family Housing
- Game Based Energy Efficiency Programs
- Analysis of Next Generation HAN/BAN Systems
- Variable Capacity Space Conditioning Systems
- High Performance Home Design Market Studies
- Demonstrating Grid Integration of ZNE Communities
- Residential ZNE Retrofit - Lessons Learned
- Field Testing of HAN/BAN Systems for FDD

Barriers, Challenges and Path Forward

Barriers/Challenges

- Performance uncertainties, lack of performance data
- Cost of new technology or Hidden Costs
- Limited early adopters of technology, Complexity of systems
- Product or Service Unavailability of New Technologies
- Market Intelligence
- Lack of customer interest, product knowledge

Path Forward

- Demonstration of best practices through lab and field tests
- Ensure efficient technologies are adopted and mainstreamed into programs
- Influence of the Finance Industry
- Collaboration with stakeholders
- Utilize emerging technologies program to nurture the pipeline of products
- Undertake studies to provide critical intelligence
- Disseminate information in a meaningful manner

SOUTHERN CALIFORNIA GAS

Abdullah Ahmed

SOCALGAS PROJECT LIST

CURRENT

1. Smart Gas Home Showcase
2. Energx Fractional HP Recirculation Pump VSD
3. Combination Boiler Reset Controller Performance Test
4. Compact Inline Gas Monitor & Appliance HAN Integration
5. Residential Hot Water Circulation and Controls
6. i-O-Stat Efficient Furnace Fan Controller Lab Testing
7. Sub-metering for MFR Apt. Buildings
8. Nest Thermostat Scaled Field Placement
9. Advanced Thermostat Scaled Field Testing with EPRI
10. Testing Dettson Compact Furnaces for ZNE Homes
11. Combo System - Tankless Water Heaters & Hydronic Coils
12. Enovative Hot Water Solutions for Crossflow & Loop Balancing
13. Water-Energy Nexus: Hot Water Analytics
14. LINC Beechwood Apts PIER Near NZE Demo
15. Ilios Gas Engine Driven Water Heater
16. Eternal Tankless Water Heater Home Test

Note: Item 2 & 6 above are completed recently

FUTURE

1. Quality Insulation Installation (C&S)
2. Comfort Model in CA Simulation Engine and Validation (C&S)
3. No Ducts in Unconditioned Space (C&S)
4. High R-Value Walls (C&S)
5. Indoor Air Quality of ZNE Ready Homes (C&S)
6. Advanced Envelope Design (C&S)
7. Earth Networks Optimization Service
8. Dettson Water Heater with Gas FDD
9. EcoDrain Heat Recovery
10. IceBook Residential Gas Cooling
11. ShowerMinder Shower Timer Home Tests
12. MFR HW Recirculation Demand Controls
13. Daikin Altherma Hybrid Water Heater
14. ZNE Demonstration Homes
15. ZNE Community Based Demonstration

SOCALGAS VISION & STRATEGY

Vision for where we see res sector going

- New Construction – stricter building codes and ZNE goals will require innovative solutions to meet challenges
- Existing Homes – deep energy retrofit options needed
- ZNE, T20 & T24 regulations will require integrated solutions incorporating distributed generation (DG) & energy efficiency (EE)
- Customers need affordable natural gas options

Our engagement strategy

- Collaborating with manufacturers, builders, & contractors
- Leverage funding with peer utilities, PIER, DOE, etc.
- Be one-step ahead, instead of lagging behind

SAN DIEGO GAS & ELECTRIC

Kate Zeng

SDG&E KEY RESIDENTIAL ET PROJECTS

- EPRI Residential VCHP and multi-family HPWH
- Residential Load Disaggregation (multi-vendor NILM evaluation)
- Shower Monitor and Alarm System
- CSI Low Cost Solar PV and Residential ZNE Demonstration
- Res Tier 2 Advanced Power Strips
- Remote residential building envelope scorecard

SDG&E VISION OF RESIDENTIAL ET EFFORTS

- Align with the State's long-term energy efficiency plan and Residential Customer Programs goals and strategies
- Challenges and Opportunities:
  - Pace of energy efficiency evolution continues aggressively
  - Increasingly stringent C&S
  - Deep energy retrofits are typically limited due to customer capital constraints
    - Generally viewed as expense, not an investment – even with guidance
  - Not typically cost effective, most programs are portfolio balancing in nature
  - Major driver for adoption = Comfort > Energy
    - Both challenge and opportunity
  - Opportunities in Behavior Management with targeted marketing due to improved load analytics
    - Challenges with attribution/persistence for behavior programs
- Integrated Efforts:
  - Enable ZNE as the path to the future
  - IDSM with EE and DG or DR
    - Major PCT Rollout (Goal of 15k+ customers)
  - Water-Energy Nexus

INTERACTIVE DIALOGUE

- Attendee questions about presentations

- Interactive dialogue between audience members and ETCC panelists

UPCOMING ETCC EVENTS

Date	Event	Location
Oct 20-22	ET Summit: Accelerating Innovation in Energy Efficiency	Parc 55 Hotel, San Francisco
Nov 5th	ETCC Q4 Meeting (Ag/Industrial)	SCG Territory, exact location TBD

To sign up for the ETCC Insight newsletter, check the box on the sign-in/registration sheet or sign up online at: www.etcc-ca.com/subscribe

Check the ETCC website for updates: http://www.etcc-ca.com/calendar

SESSION WRAP-UP

PLEASE FILL OUT EVALUATIONS!