Customer Data Access – Valuing Feedback: A Strategy for Customer Engagement

NARUC Webinar

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Is there a customer engagement problem?

- "...the inauguration of smart meters with grudging and involuntary exposure of millions to billions of human beings to pulsed microwave radiation should immediately be prohibited..." [18]
- "Smart meters have no value to the customer and the customer knows that". (19)
- "The general public has no idea how much they pay for electricity or how to use less, undermining the central premise of smart meters and hindering their adoption".(20)
- "..most people do not know what devices in the home consume the most or least energy, and they do not understand their electricity bill."(21)
- "…people have absolutely no clue how to go about saving energy as a result, most of their actions are not geared toward long-term, sustainable actions to lower their energy footprint.(22)

Webinar Objectives

1. What is “data access” and how can it be structured to provide the “feedback” to support short and long-term changes in customer energy usage?
2. What guidance does prior research or experience provide in answering this first question?

What is Customer Data Access ?

The Purpose of Customer Data Access is to Provide Feedback

"… feedback is proving a critical first step in engaging and empowering consumers to thoughtfully manage their energy resources." [1]

"Feedback ….making energy more visible and more amenable to understanding and control.[6]

Why is Customer Data Access Important?

Customer education and engagement is critical to achieve smart grid efficiency, demand response, and renewable integration benefits.

- Prior research and existing pilots emphasize short-term behavior change by focusing on meter data access and in-home displays.
- Feedback to address the long-term infrastructure changes and investment necessary to make major, permanent changes in usage is not being addressed.
- The emphasis on short-term feedback creates unreasonable expectations and misdirects policy regarding hardware investment and customer education.

Myth vs. Fact

- In home displays (IHD's) are the most important vehicle for providing customers with data access.
- Studies show that customers with IHD's have been shown to reduce energy use 5% to 15%.
- Residential customers with access to near real-time meter data reduce usage more than customers with next day access.
- Studies have shown that the rate, bill design, and frequency of billing influence IHD impacts.

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F	Studies have shown that the rate, bill design, and frequency of billing influence IHD impacts.	**Most studies ignore these variables.**

Feedback Expectations

IHD's are the Solution

"The research literature shows that in-home displays …achieving savings in the range of 5–15%.." [3]

"Consumers could cut their household electricity use as much as 12 percent …if U.S. utilities use feedback tools ..[4]

IHD's are not the Solution

"The results show that the initial savings in of 7.8% after 4 months could not be sustained in the medium- to long-term. " [5]

Real time monitors " may not be suitable tools to decrease consumption unless homeowners are presented with more information on how to conserve or a cost incentive such as TOU pricing." [6]

Customer Data Access - Framework

Feedback: Four Stages[3]

- **Data.** *"A behavior must be measured, captured, and stored. "*
- **Relevance.** *"The information must be relayed to the individual, not in the raw-data form in which it was captured but in a context that makes it emotionally resonant. "*
- **Consequence.** *"The information must illuminate one or more paths ahead. "*
- **Action.** *"There must be a clear moment when the individual can recalibrate a behavior, make a choice, and act. "*

Key Question:
What approaches provide the content consistent with this framework?

Webinar Agenda

1. What information influences customer energy usage?
2. What does the research tell us?
   a) Research studies
   b) Ongoing pilots

1. What information influences customer energy usage

What are you trying to accomplish?

Customer Feedback Policy Objectives

Behavior Change

- Program thermostat
- Turn off lights
- Shorter showers
- Fewer wash loads
- Unplug electronics

Short –term, low cost, quick decisions, real-time feedback.

Price

Adaptation

- Plant shade trees
- Weather strip
- Install CFL lights
- Install timers
- Programmable Thermostat options

Near–term, medium cost, lengthy decisions, multiple info sources.

Automation

Infrastructure Change

- High-efficiency appliances
- Replace windows
- Insulate walls
- Insulate ceilings
- Install Solar PV

Long–term, high cost, protracted decisions, multiple info sources.

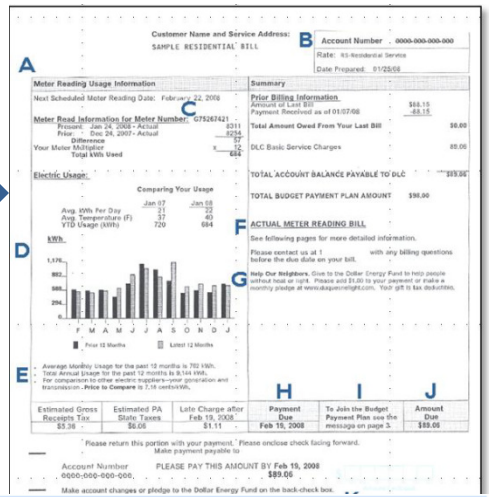
Subsidies, Incentives

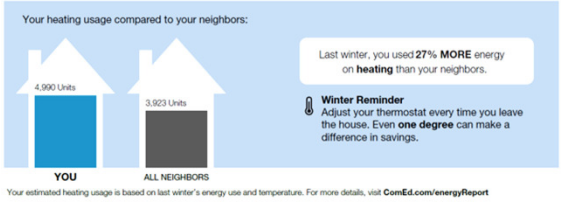
Matching Feedback to Support Customer Infrastructure Decisions

Life in Years*	
Dishwasher	9
Dryer, Electric	13
Freezer	11
Microwave Oven	9
Range, Electric	13
Refrigerator, Standard	13
Washer	10
Water Heater, Electric	11
Air Conditioner, Room	10
Air Conditioner, Central	15
Heat Pump	16

10 20

?

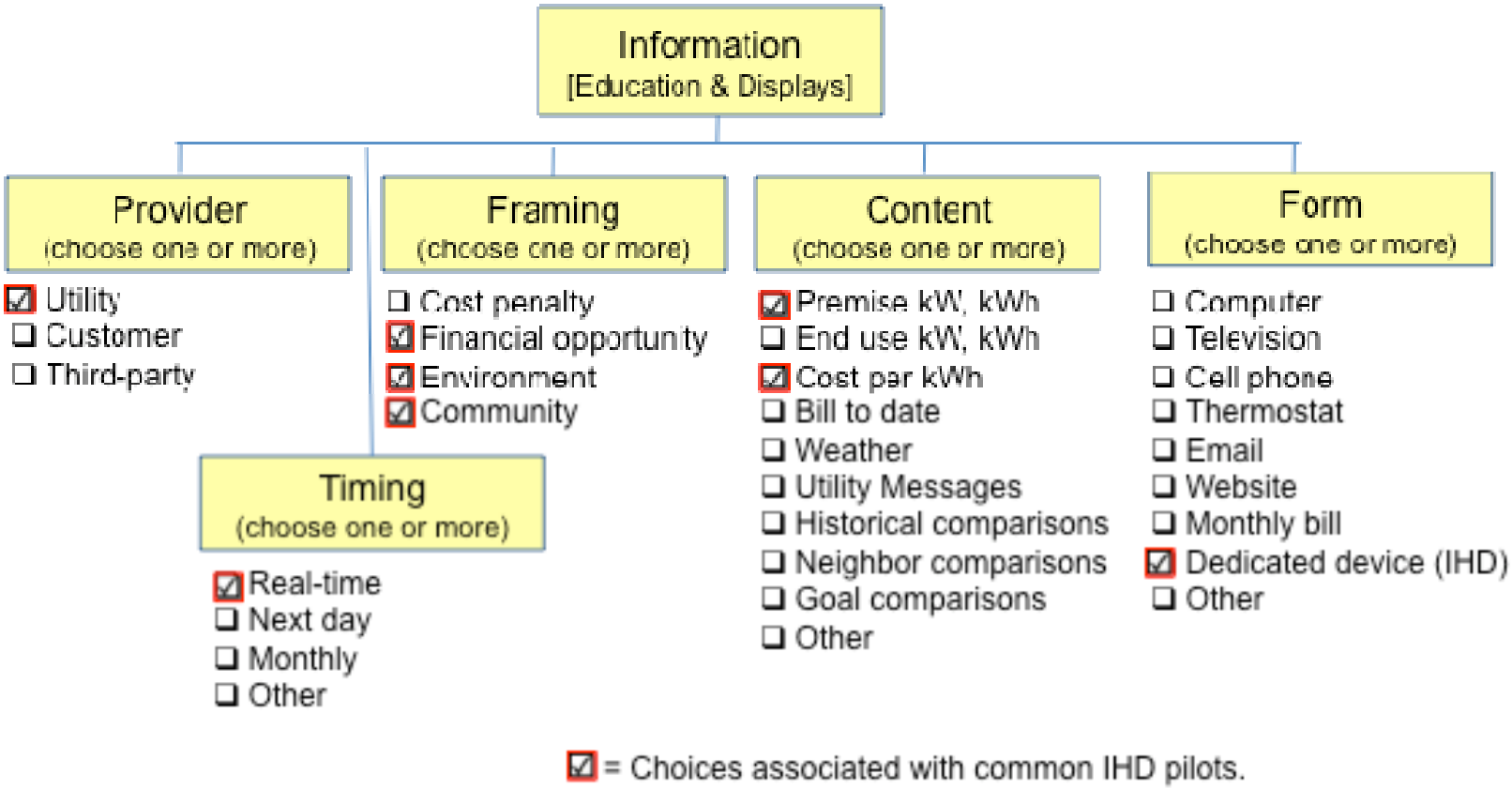




Source: Opower, http://opower.com/uploads/library/file/15/xrds_opower.pdf

* Study of Life Expectancy of Home Components, National Association of Home Builders, February 2007, http://www.nahb.org/fileUpload_details.aspx?contentID=99359

What are the research options?



* Figure 1. Information Options, DOE Smart Grid Investment Grant, Technical Advisory Group Guidance Document #2, Non-Rate Treatments in Consumer Behavior Study Designs, August 6, 2010.

What do customers need?

Customers have to understand how they use energy before they can make rational decisions to improve efficiency and change their usage patterns.

1. **What information do customers need to make rational energy decisions?**
2. **Which behavioral and infrastructure decisions best support the consumer value function?**
3. **What is the best form and medium to present the information to support these decisions?**

What Information ?

Which Decisions ?

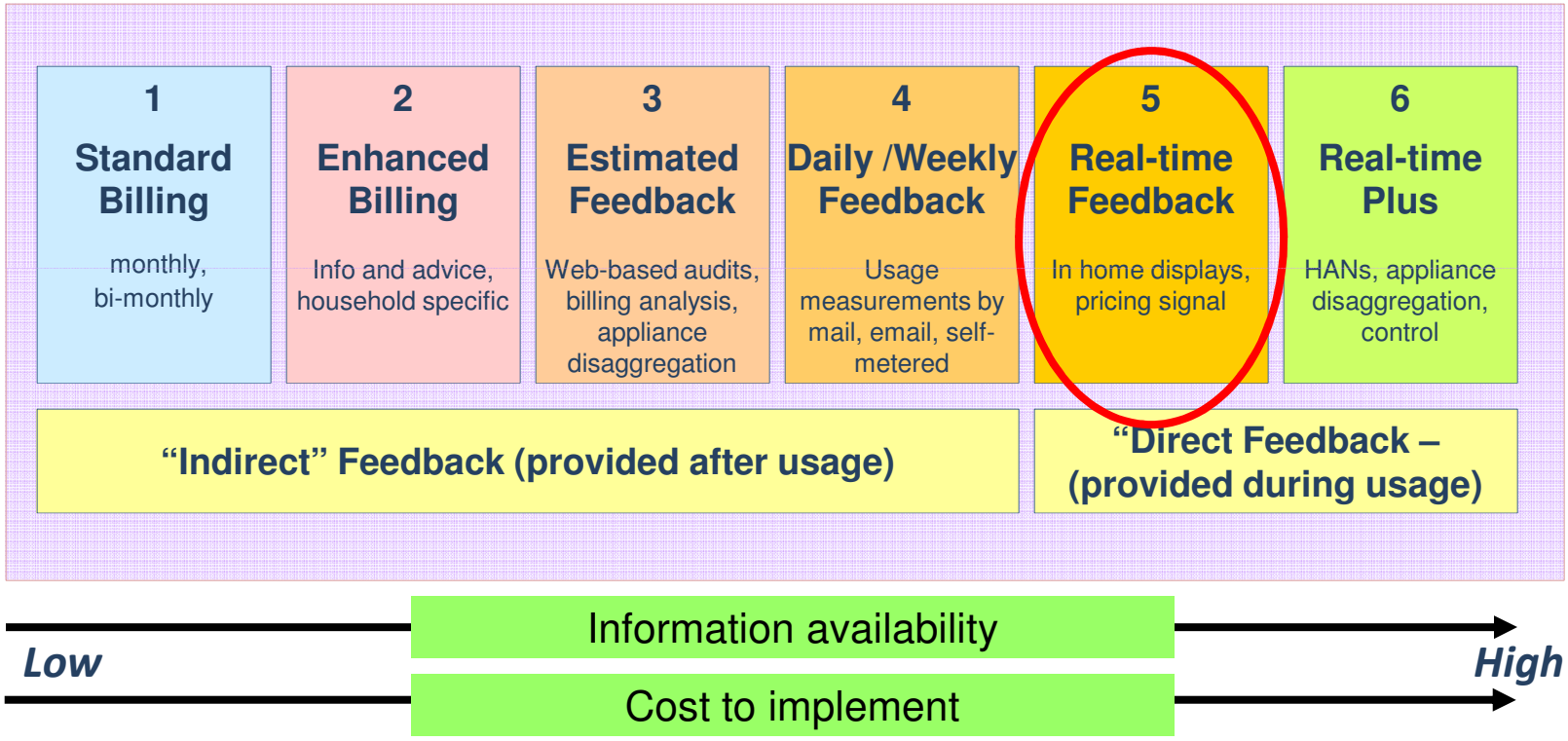
Which Delivery Channel ?

What to Measure

- **What to measure** – electricity, gas, water, carbon?
- **What level of measurement** – whole house or end-use?
- **What type of measurement** – real-time, near real-time, actual data, historical data, or social normative
- **What capability** – monitoring only or management too?
- **What medium** – stand alone, web, PC/phone applications?
- **What time frame** – days, months, years?
- **What information** – energy, demand, price, cost, technology availability, saving measures, other?

EPRI: Customer Information Continuum

EPRI Feedback Delivery Mechanism Spectrum [5]



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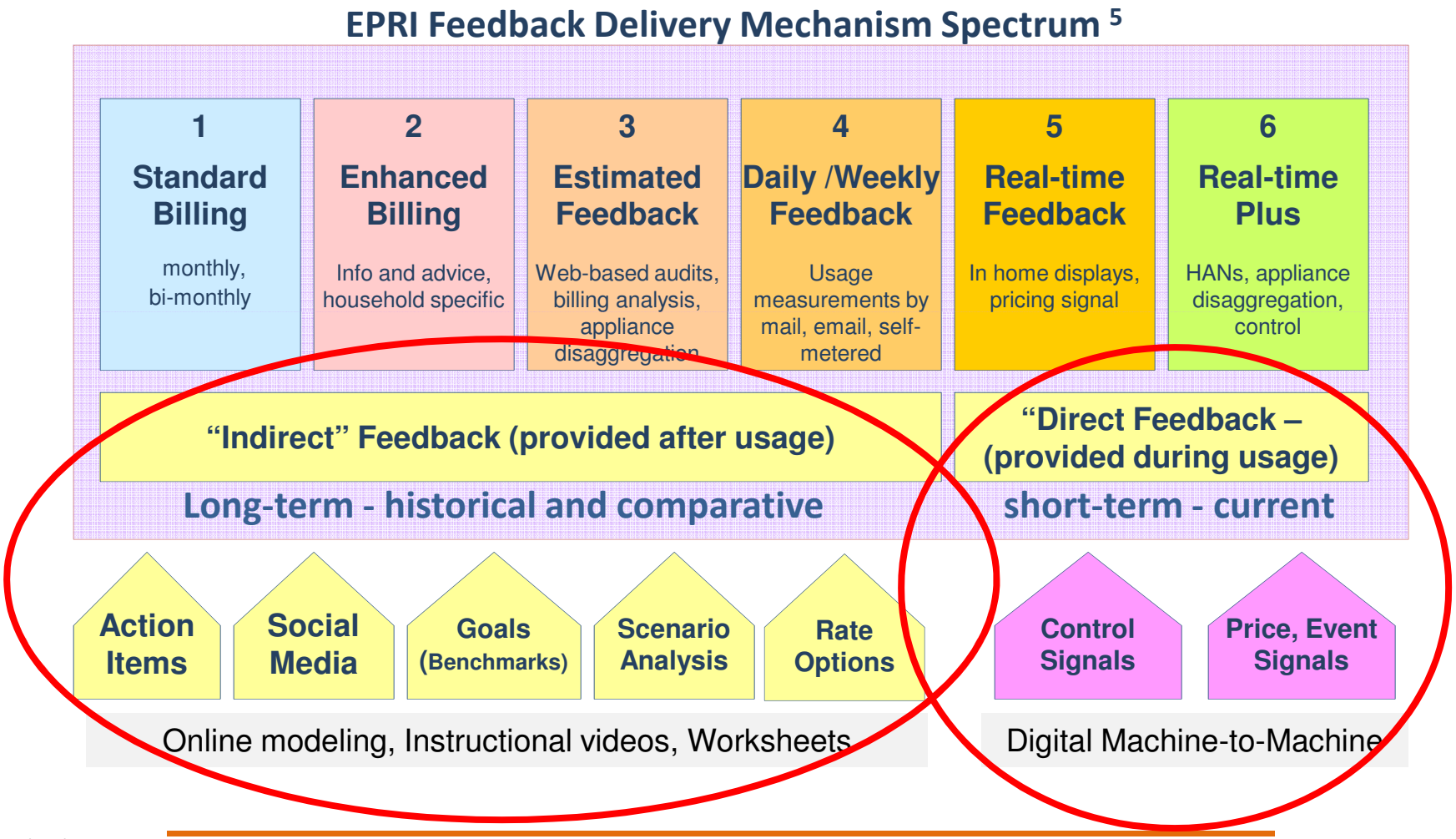


2. What does the research tell us?

- Meta studies
- Utility pilots

Key Meta Studies

- **EPRI** – Residential Electricity Use Feedback: A Research Synthesis and Economic Framework (2009).[5]
- **ACEEE** – Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity Saving Opportunities (2010).[1 *]
- **Darby** - The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays (2009).[6]
- **Fischer: Historical Feedback Studies**
- **VaasaETT [Empower Demand] -** The potential of smart meter enabled programs to increase energy and system efficiency: a mass pilot comparison (2011)[13]
- **Brattle: Recent Feedback Studies**

* See Reference #24 for updated ACEEE review of real-time feedback studies, February 2012.

EPRI: Electricity Use Feedback[5]

"…one shortcoming of some past research is it does not impose sufficient structure on the initial sample design to test for differences in feedback effect among customers with different housing, demographic, and electricity pricing circumstances."[5]

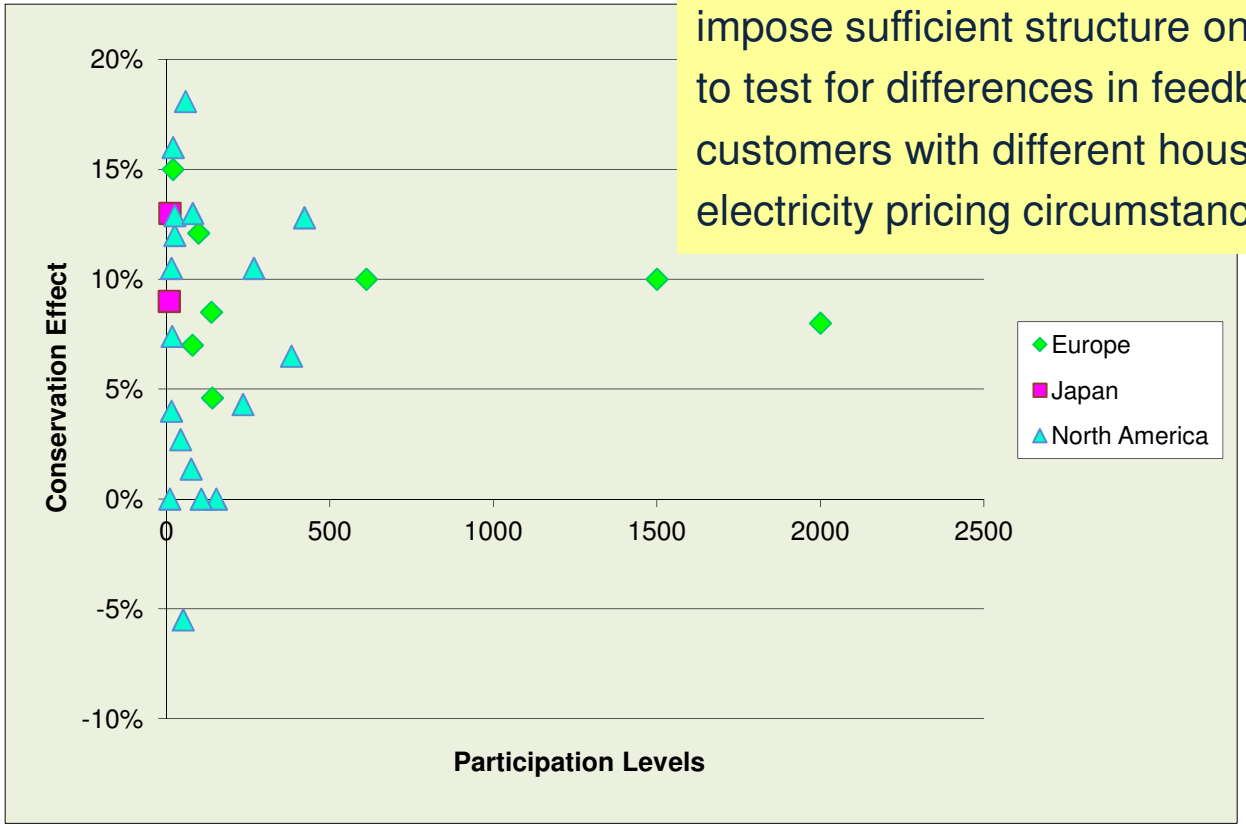
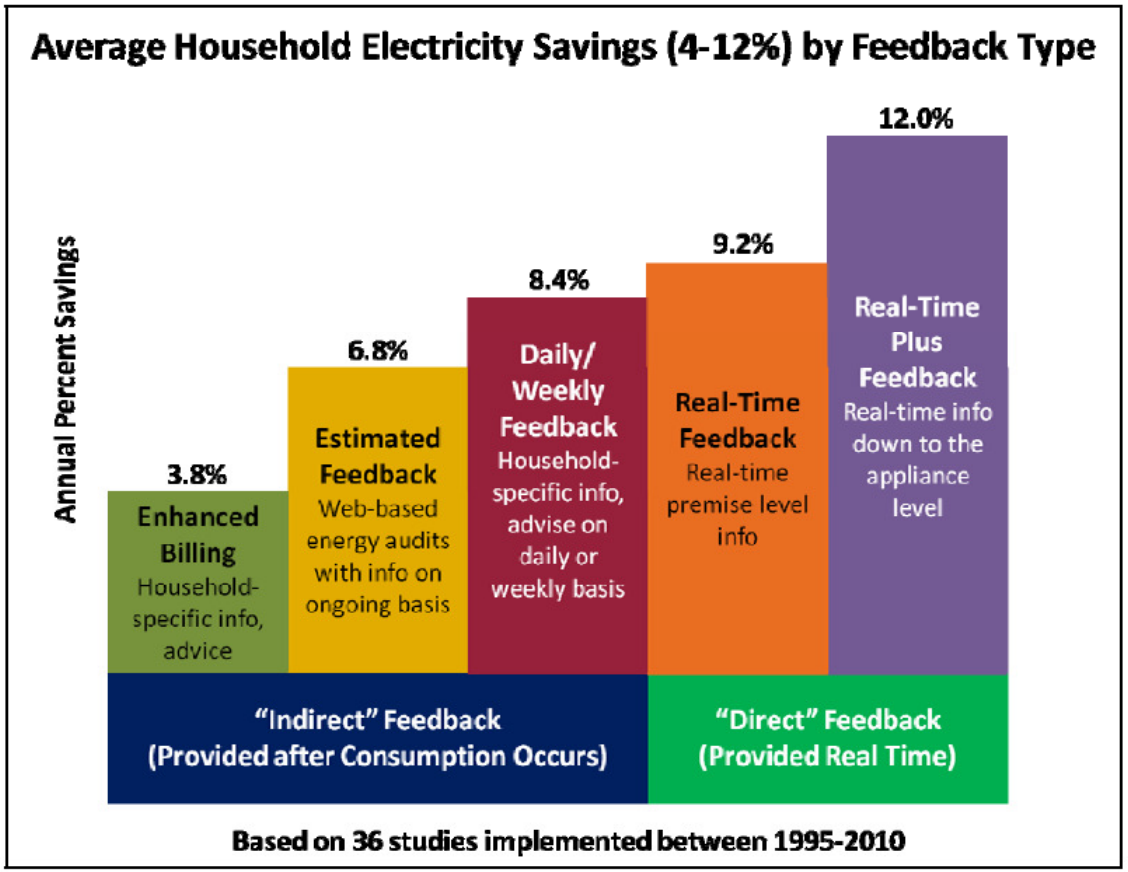


Figure 3-1. Range of study participation levels

ACEEE: Feedback Effectiveness[2]

ACEEE Meta Review



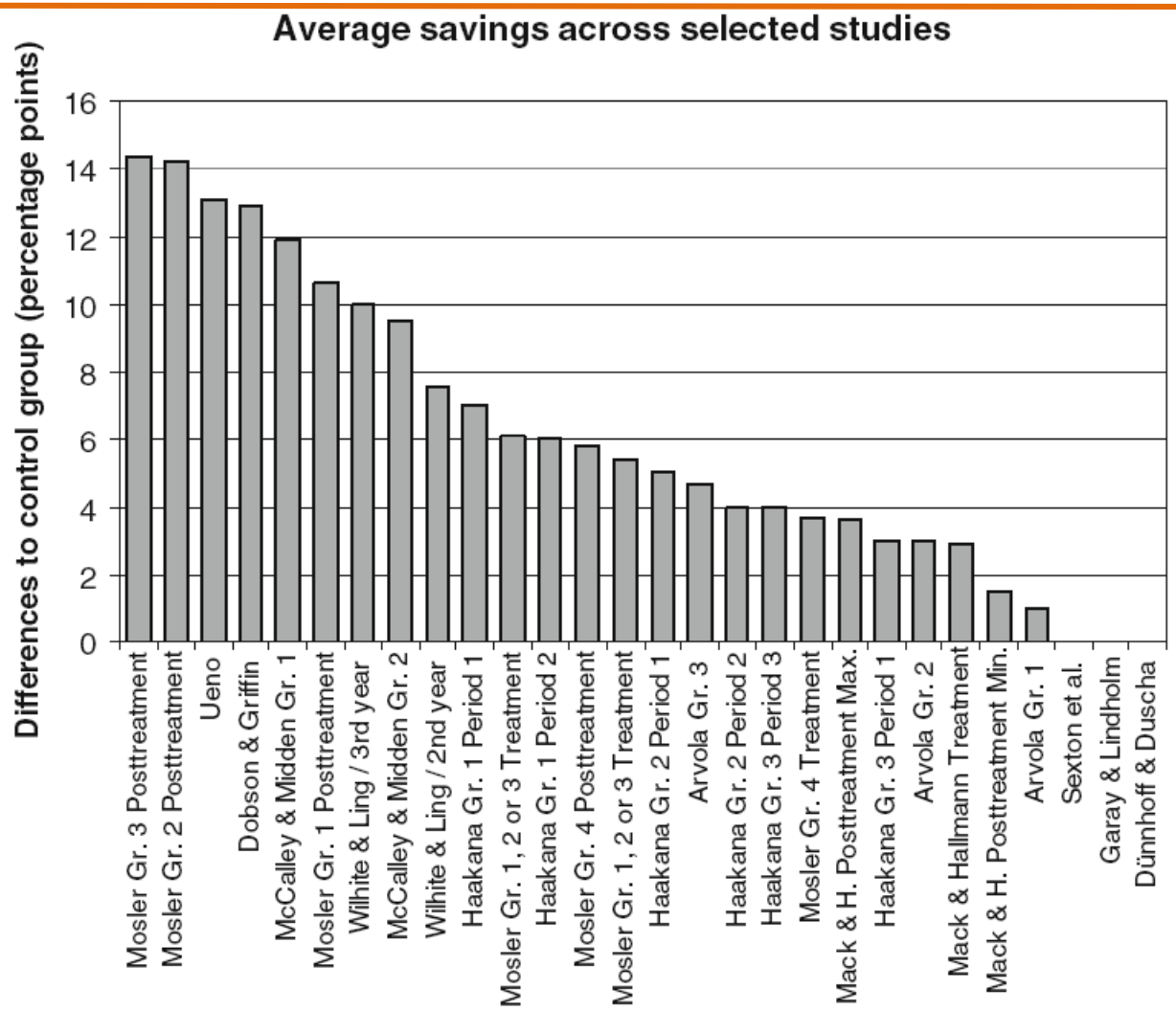
"..these estimates are dominated by studies with small sample sizes and short duration: further studies with large sample sizes and longer duration are needed before conclusions can be drawn." [2]

Darby: Behavior Change[7]

What do we know about measured savings from feedback studies?

Savings [studies N=]	Direct Feedback Studies N=21	Indirect Feedback Studies N=13	Studies 1987-2000 N=21	Studies 1975-2000 N=38
20%+	3		3	3
20% peak			1	3
15-19%	1	1	1	3
10-14%	7	6	5	13
5-9%	8		6	9
0-4%	2	3	4	6
unknown		3	1	3

Fischer: Historical Feedback Studies[9]



VaasaETT : Empower Demand [13]

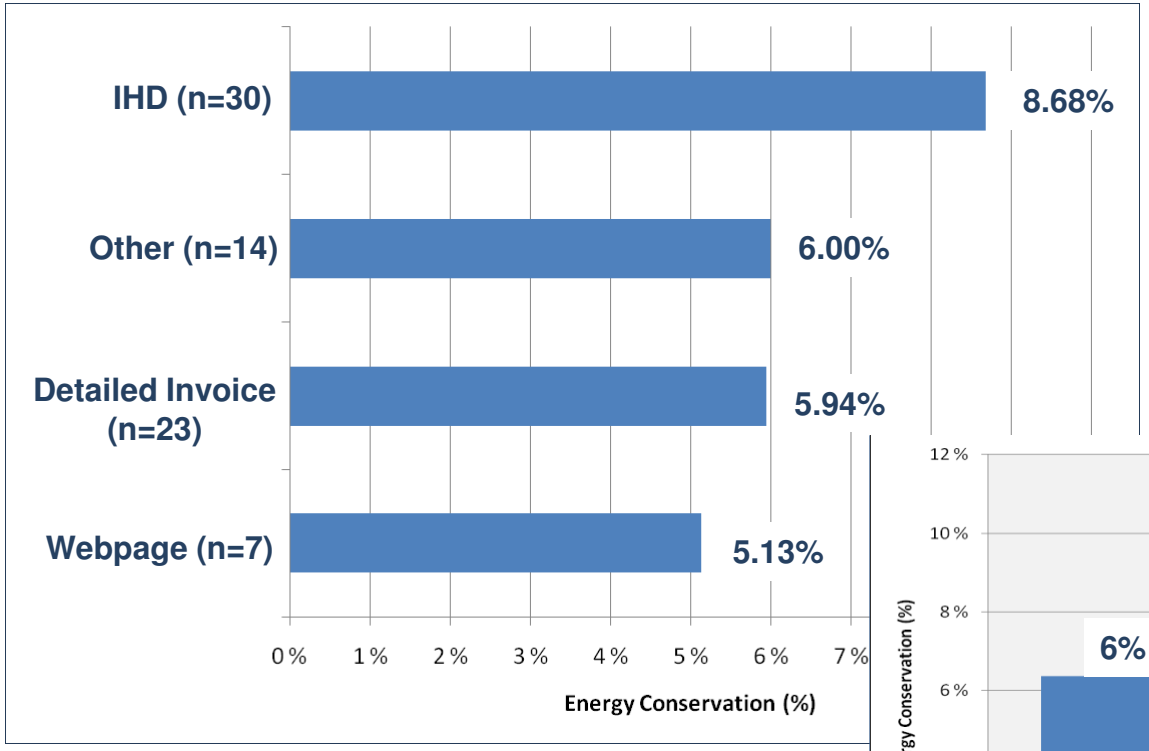
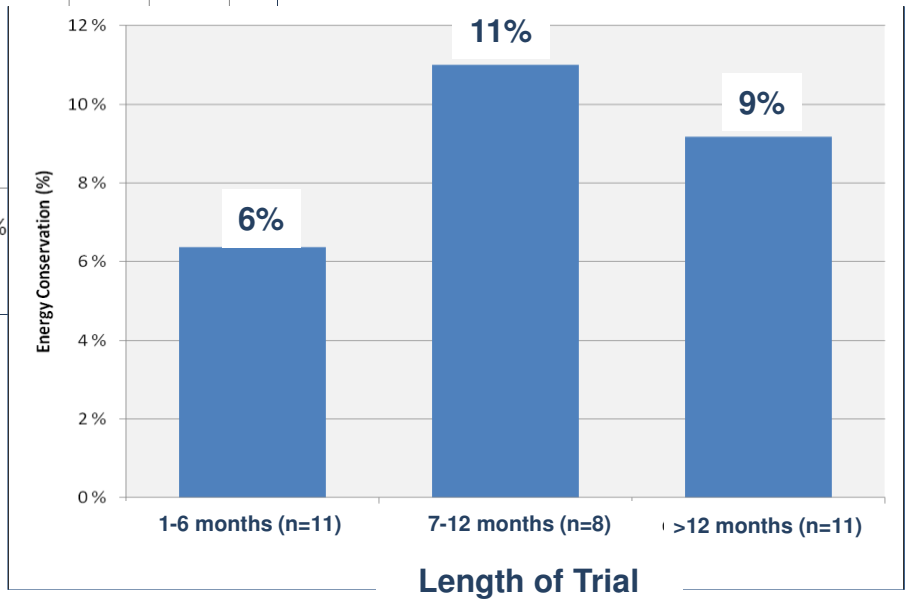
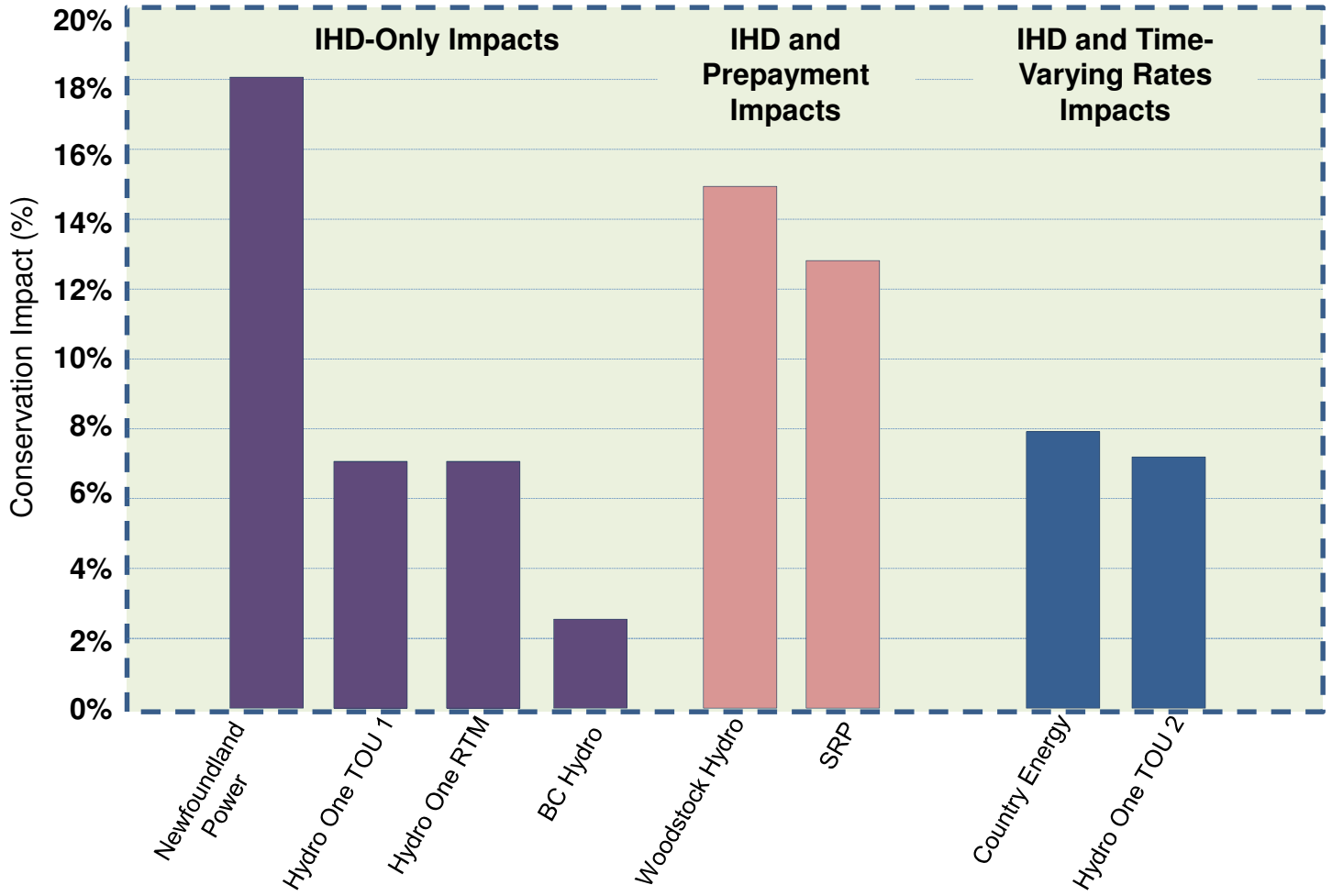


Figure 4. Overall consumption reduction as per feedback pilot type

Table 12. Duration of IHD pilots and energy conservation.



Brattle: Recent Feedback Studies [12]



Brattle: Recent Feedback Studies [12]

The Bottom Line

- Customers who actively used an IHD in the pilots reduced their electricity consumption by about 7%
- When customers both used an IHD and were on some type of electricity pre-payment system, they reduced their electricity consumption by about 14%

Key Pilot Research Studies

- ARRA Consumer Behavior Pilots (In process)
- Commonwealth Edison
- Oklahoma Gas & Electric
- SMUD Residential Information and Controls

DOE-SGIG Consumer Behavior Pilots

150,000 customers are expected to "participate" as treatment or control customers in ~10 DOE SGIG-funded projects involving AMI, dynamic pricing and consumer behavior studies

	Sierra Pacific	Nevada Power	OG&E	MMLD	CVPS	VEC	MN Power	CIC	SMUD	DECo	**Total**
Rate Treatments											
TOU	●	●							●		**3**
CPP	●	●	●	●	●		●		●	●	**8**
CPR					●			●			**2**
VPP			●			●					**2**
Non-Rate Treatments											
Education	●	●									**2**
Cust. Service						●					**1**
IHD	●	●	●		●	●	●	●	●	●	**9**
PCT			●					●		●	**3**
DLC								●			**1**
Features											
Bill Protection	●	●	●	●							**4**
Experimental Design											
Opt In	●	●	●	●	●	●	●		●	●	**9**
Opt Out								●	●		**2**

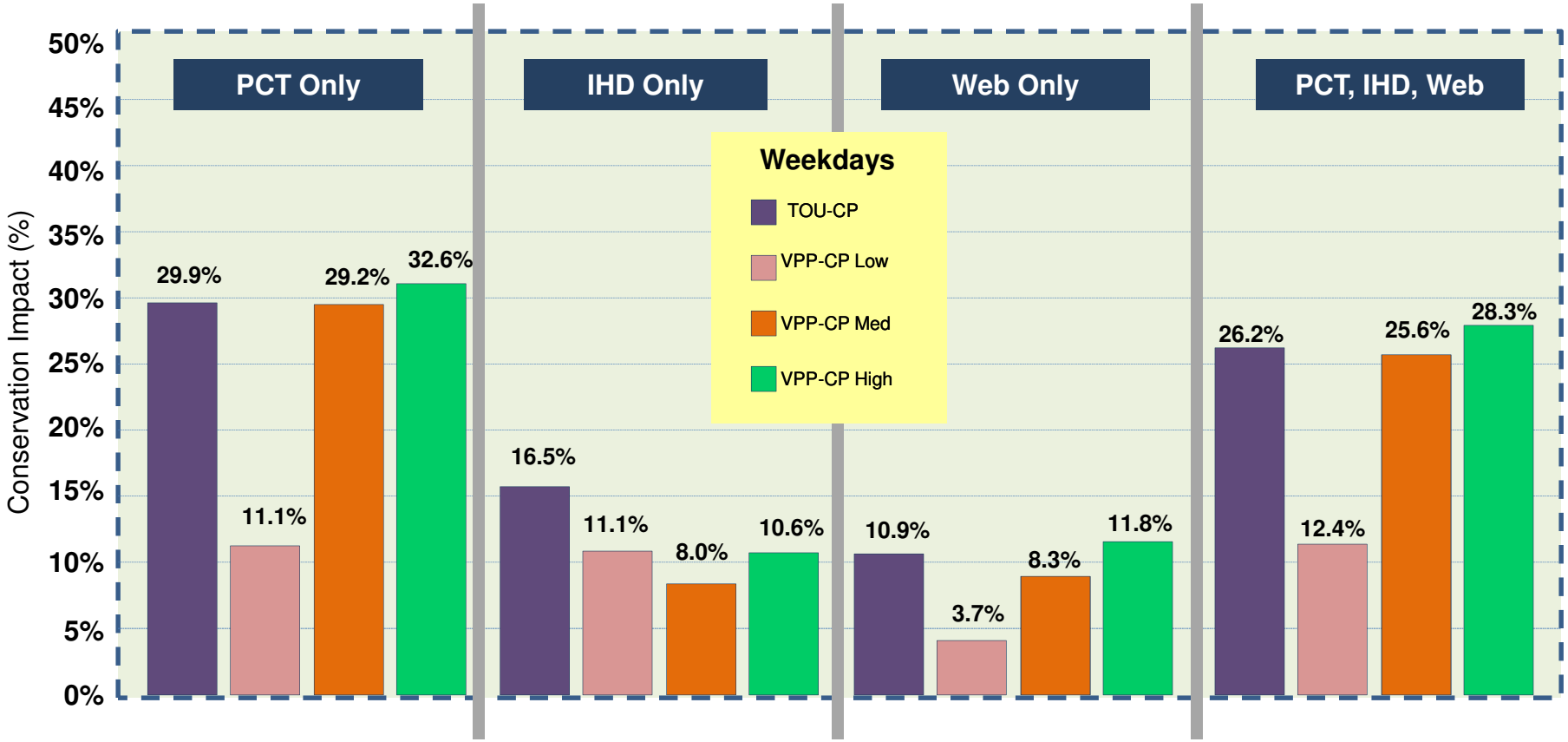
Commonwealth Edison – Pilot Results

Table 4-1.
Acquisition and Implementation of Free and Purchased Technology[4]

	Numbers			Rates	
	Offer	Acquire	Implement	Acquire	Implement
Customers Provided with Free IHD's					
L5. Basic IHD	485	485	163	100%	34%
L6. Advanced IHD	205	205	26	100%	13%
Customers Given Option to Purchase IHD's					
L5b. Basic IHD	211	5	4	2%	1%
L6b. Advanced IHD	205	4	4	2%	1%

Notes:
- Basic IHD: linked to meter, continuous usage with historical comparison
- Advanced IHD: combines usage data with access to data via internet, also combined with PCT, not fully described.
- For row L5 the 34% represents the number of customers provided free IHD's that actually installed and initialized the device. For row L5b, only 2% (5/211) of the customers chose to purchase an IHD and then only 80% (4/5) of those were installed. IHD usage

OG&E: 2010 Demand Response Study[17]



- ❑ Pre-assigned cells
- ❑ Online self-enrollment
- ❑ Best Bill Guarantee

What are the issues and limitations

- Feedback study impacts are oversold, creating unrealistic expectations
- Pilots focus on IHD hardware rather than information
- Rate design and pricing are ignored but essential for creating a customer value function
- Billing information is needed to reinforce the value function
- IHD's support short-term behavior change, not long-term infrastructure change
- Research is searching for a single solution where the market will probably require a dynamic mix of multiple treatments over extended time frames.

What policies should you consider ?

Policy Options

Behavioral Change	Adaptation	Infrastructure Change
• Data Access • Understandable Rates • Dispatchable Prices • Clear Bills ---------- • Privacy	• Evaluation Tools • Rebates • Open Markets for Technology • Standards	• Building Standards • Appliance Standards • Financial Incentives • Rate simplification and stability • Billing clarity and customization

3. SMUD Residential Information and Controls Study

Project Design

Karen Herter, Ph.D.

Herter Energy
RESEARCH SOLUTIONS

Research Team and Funding

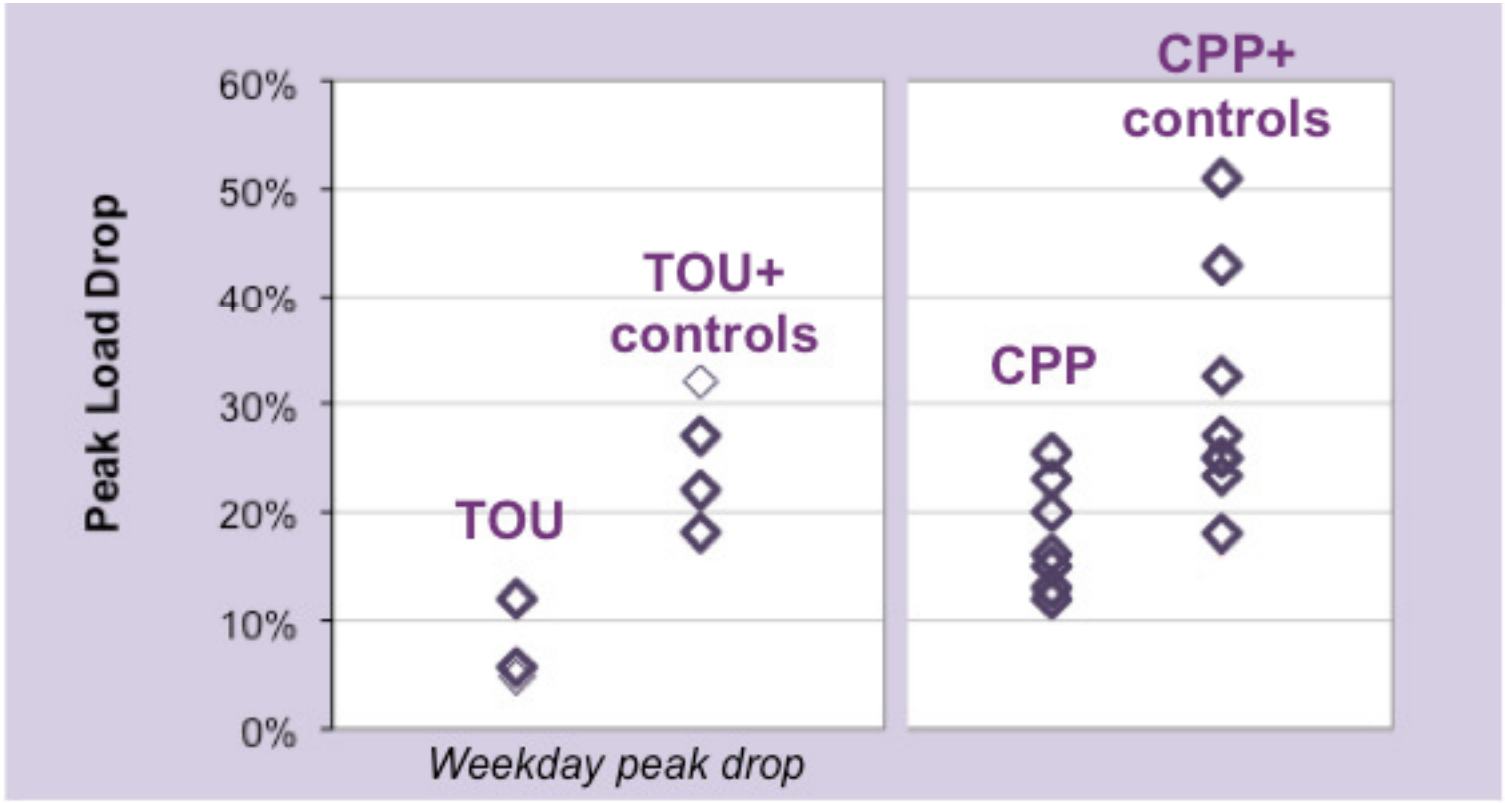
- Research Team
  - Herter Energy Research Solutions
  - Sacramento Municipal Utility District (SMUD)
- Funding
  - Sacramento Municipal Utility District (SMUD)
  - California Energy Commission Public Interest Energy Research via the Demand Response Research Center at Lawrence Berkeley Lab

Study Goals

- Build on what we already know
  - *TOU rates* are effective for shifting load every day
  - *Dynamic rates* are effective for shedding load during events
  - *Thermostat automation* enhances both of these effects
- Answer some new questions
  - Does real-time energy data enhance energy and/or peak savings?
  - Is there added value in providing real-time appliance energy data?
- **Combine** rates, automation, real-time data and enhanced customer support to…
  - capture synergies between program variables
  - provide as realistic an experience as possible
  - define results that can be translated to the real world

What we already know

Results of residential pricing studies in Ontario, California, Puget Sound, Florida, Australia, Illinois, Missouri, New Jersey, Maryland, Connecticut, Washington DC



Q: Might real-time data from new smart meters provide additional value?

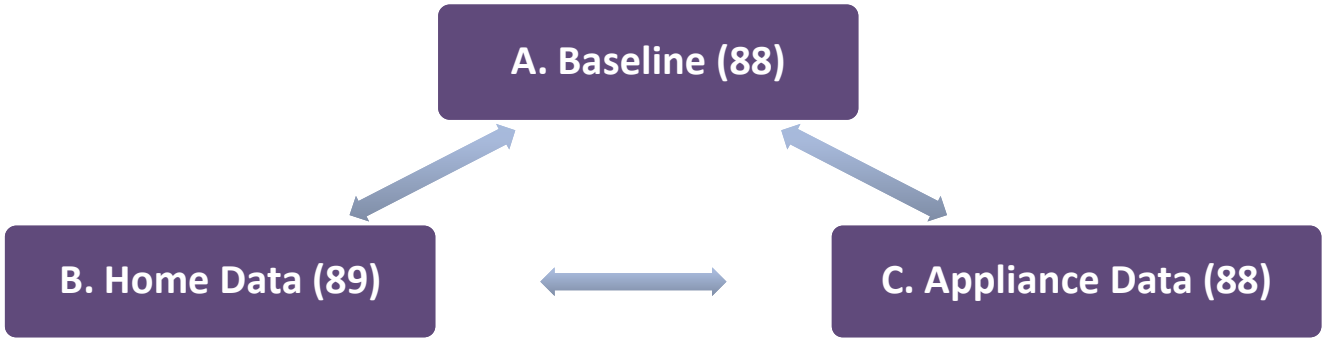
Residential Information & Controls Study

- Phase 1: 2009 Simulation Research
  - 450+ SMUD participants
  - Simulated home environment w/ TOU-CPP rate
  - Findings
    - Home data: **No savings**
    - Appliance data: **6% savings**
- Phase 2: 2012 Summer Solutions Pilot
  - 265 residential SMUD participants
  - Equipment installations in Sacramento and Folsom
  - Treatments
    - Real-time data: **Home** vs. **Appliance**
    - Incentives: **Dynamic rate** vs. **Load control**

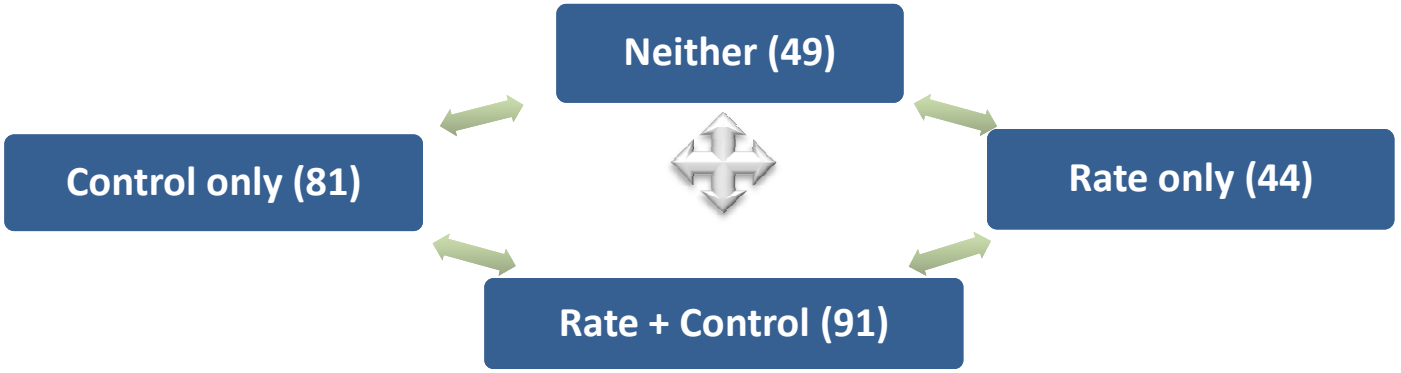
Research Design

N=265 residential customers

A. Information Treatments - randomly assigned



B. Dynamic Rate and AC Load Control - customer chosen



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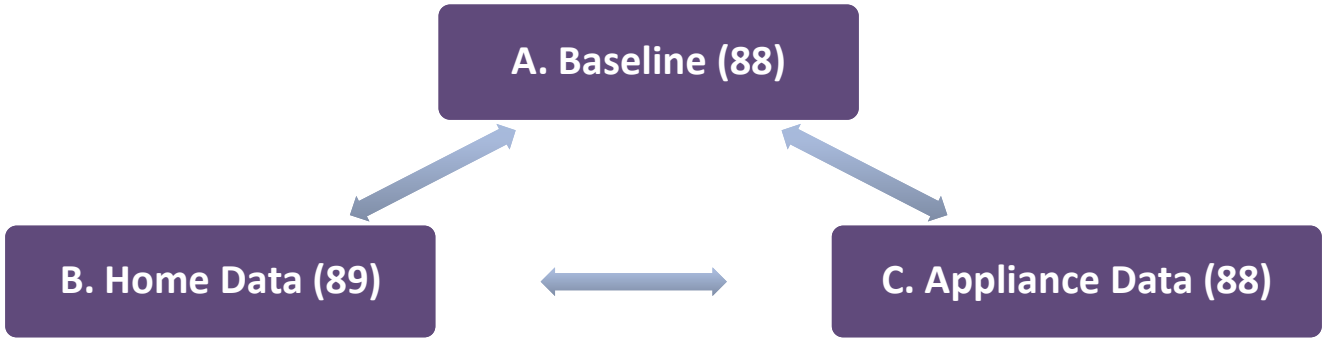

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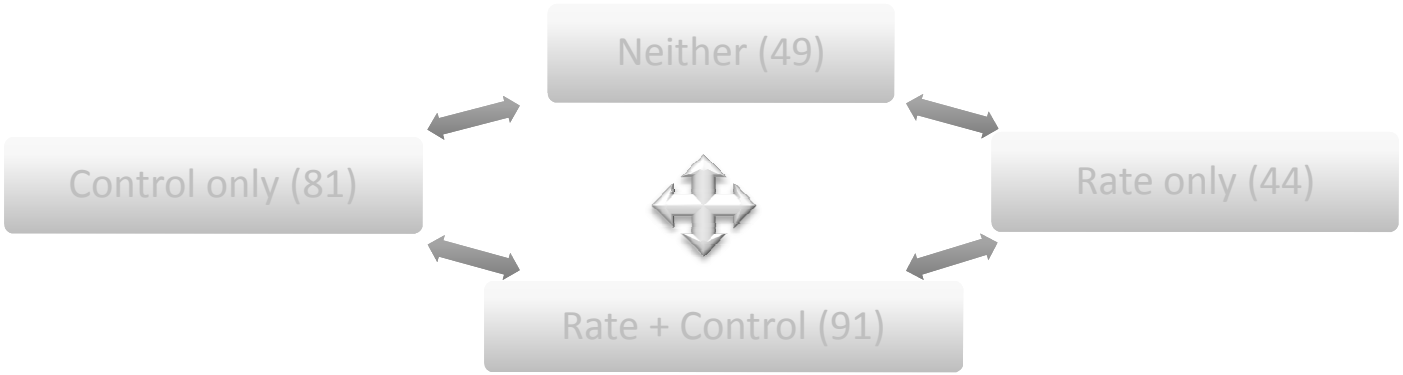
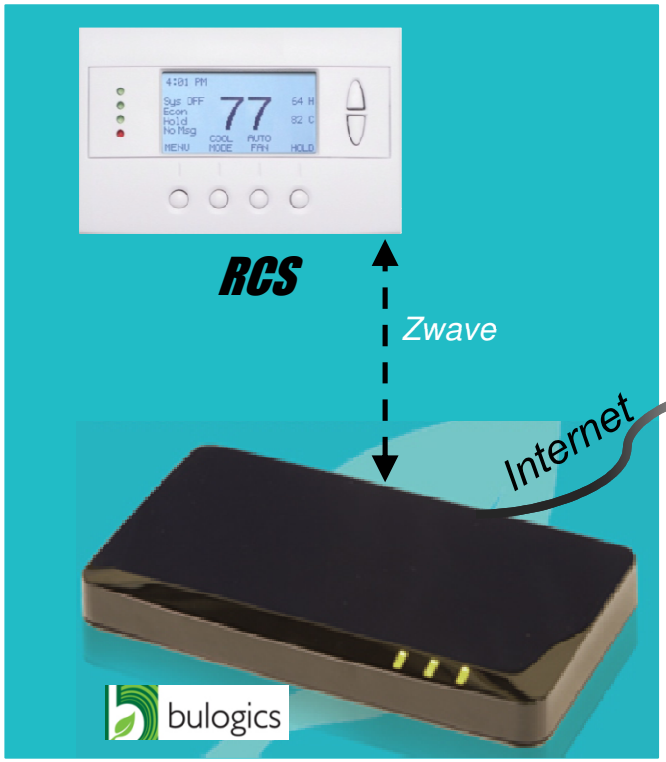


Information System A - Baseline

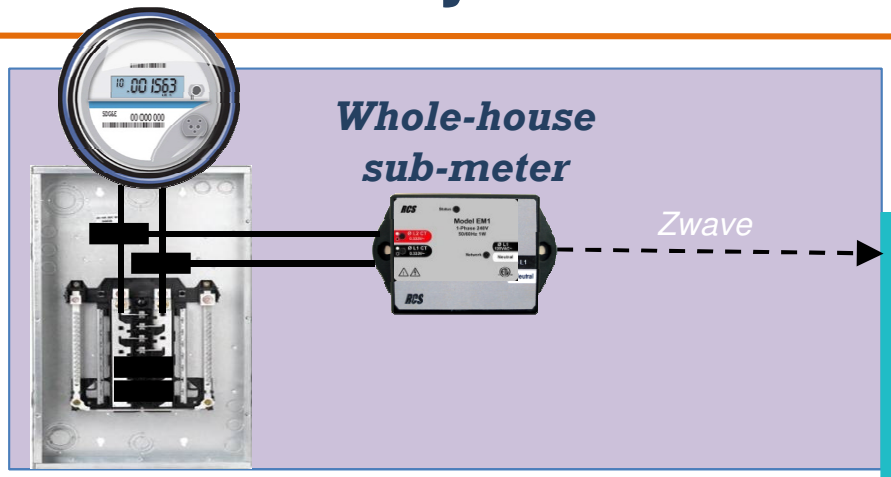
Communicating Thermostat



Gateway provides OpenADR event notification

Information System B – Home data

Site Data

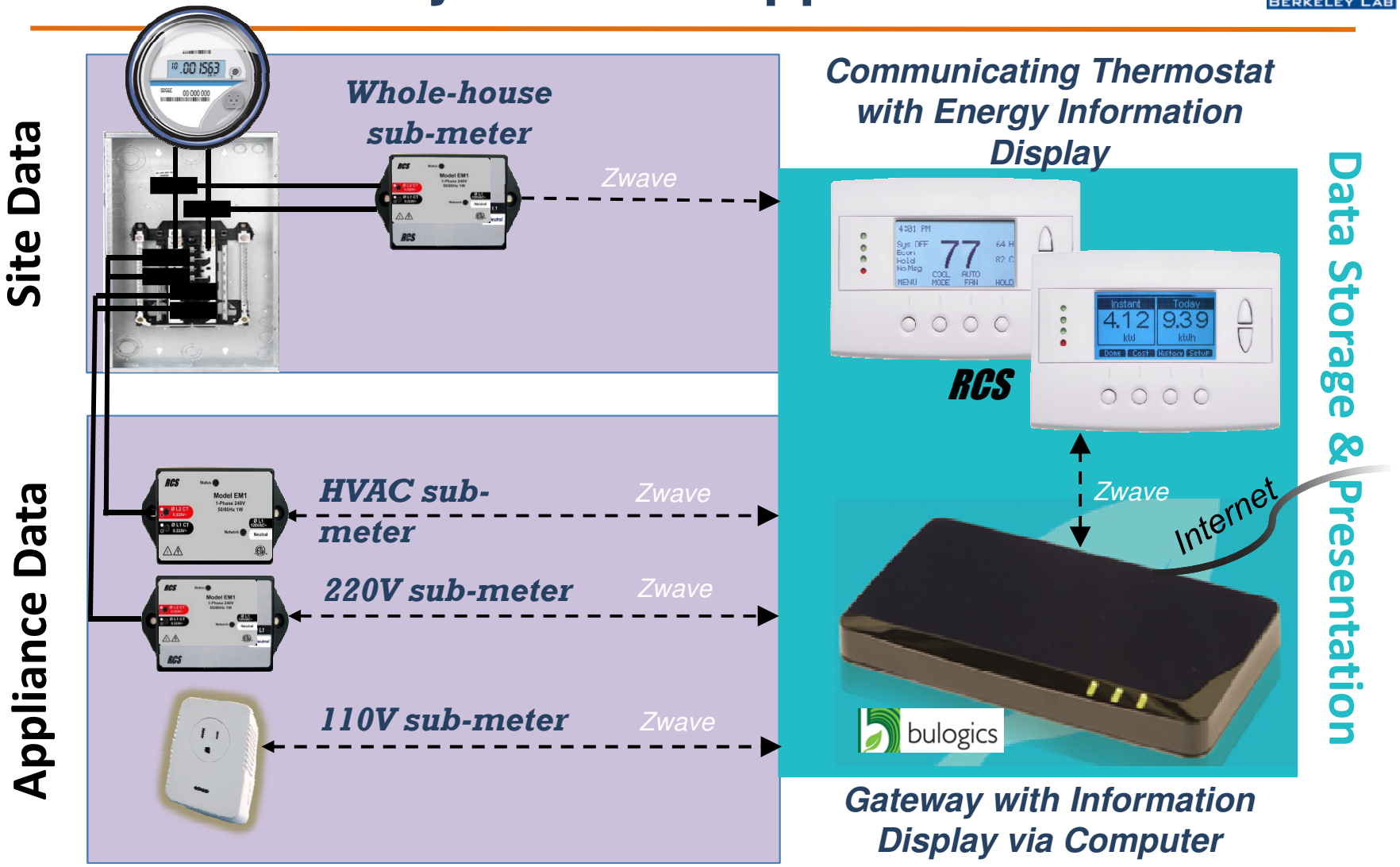


Communicating Thermostat with Energy Information Display

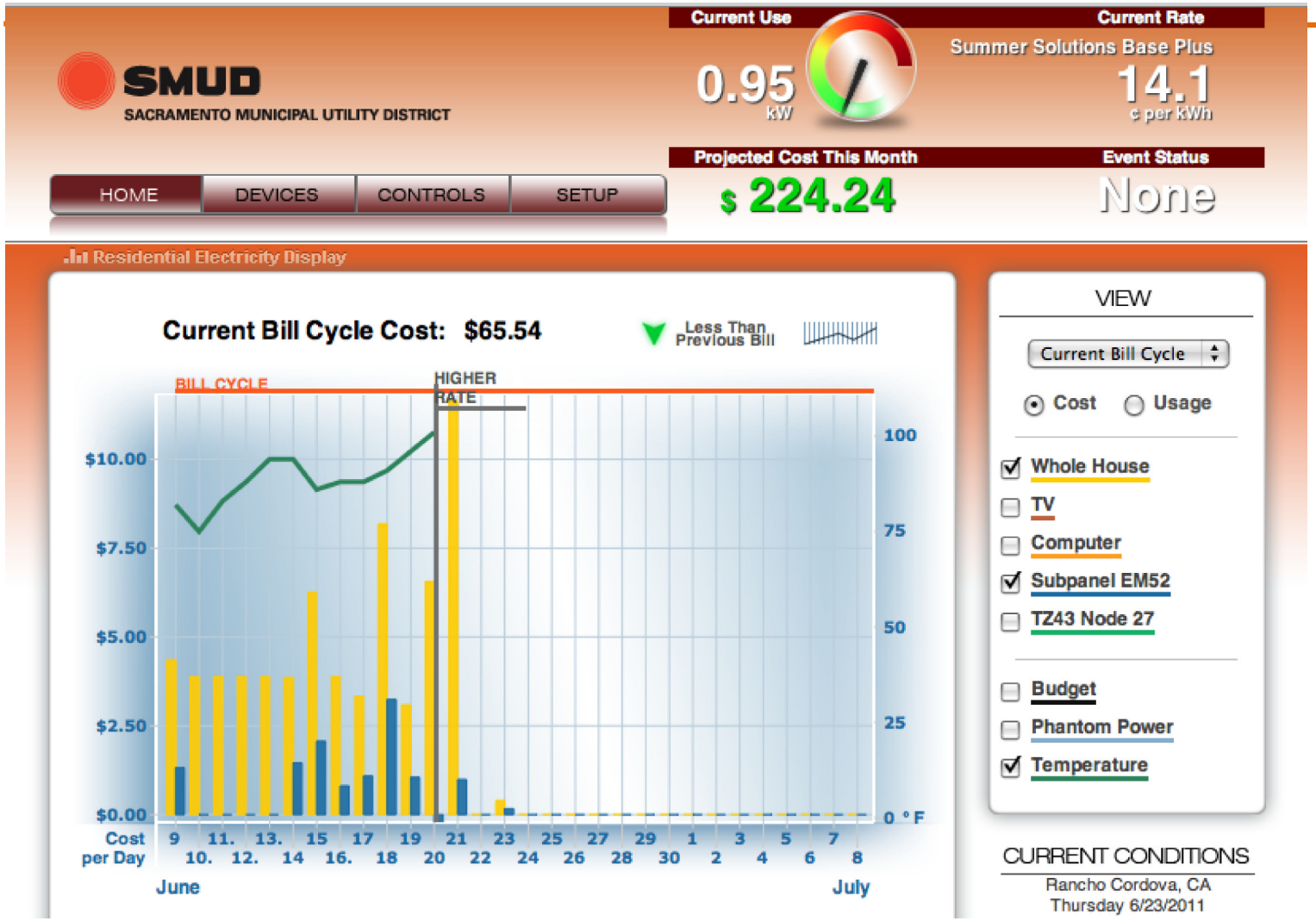
Gateway with Information Display via Computer

Data Storage & Presentation

Information System C – Appliance data



User Interface (Appliance data)



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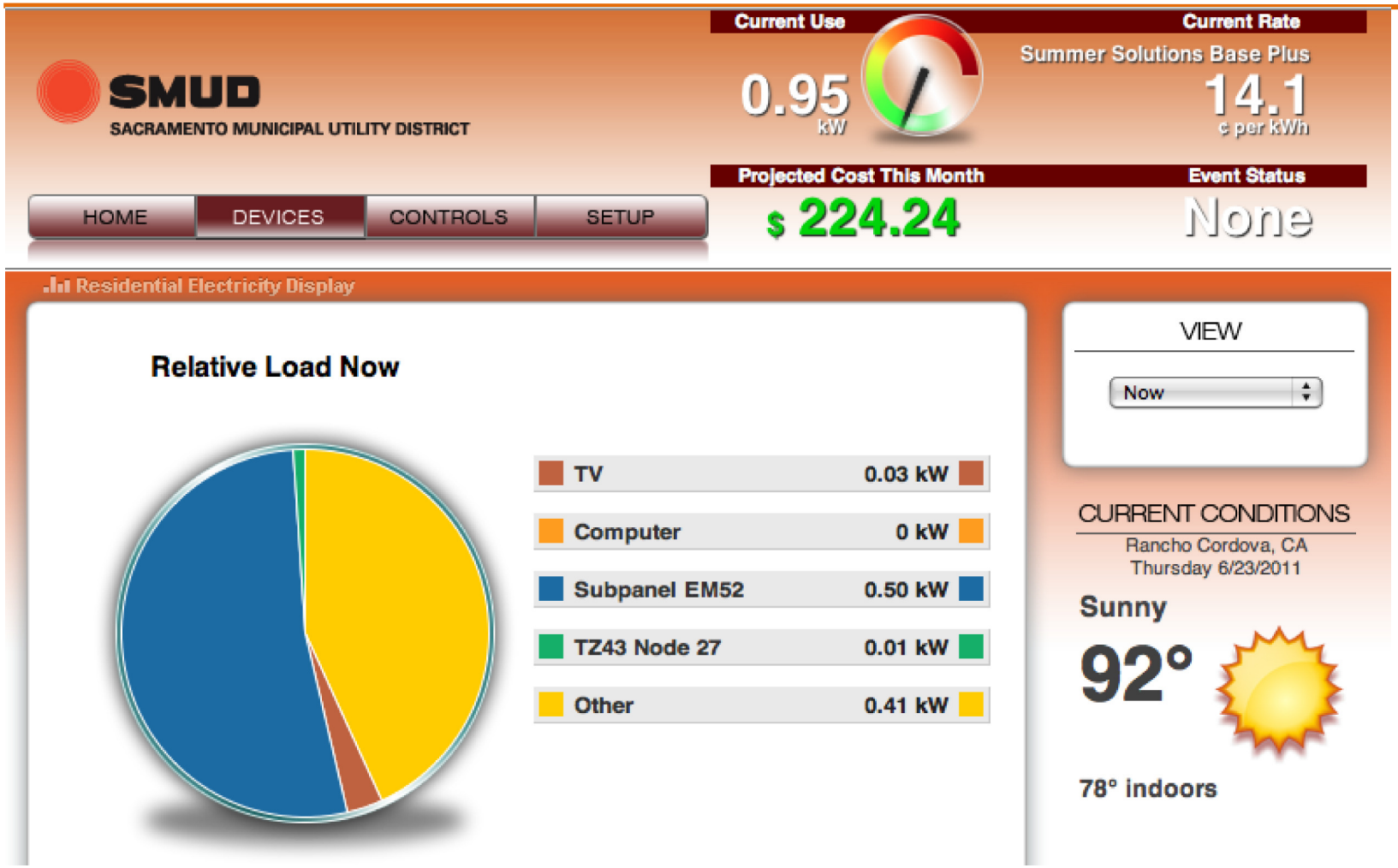

Research Design

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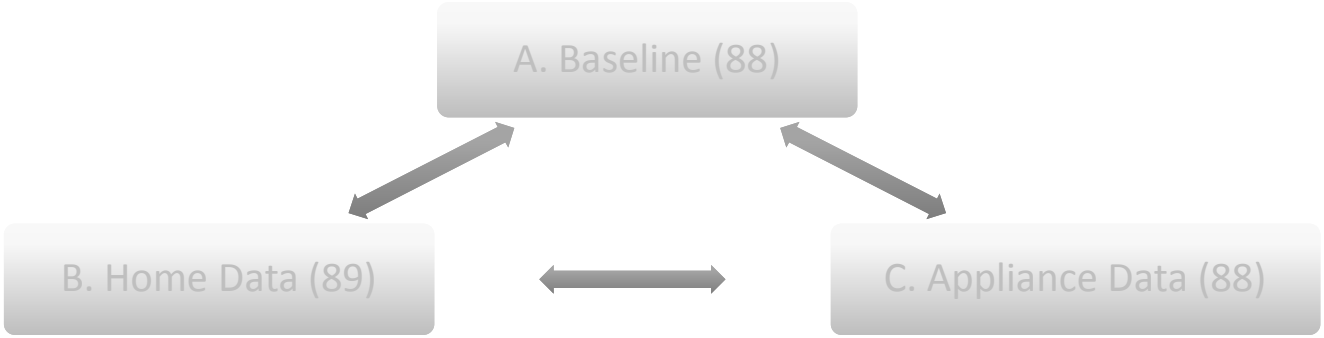

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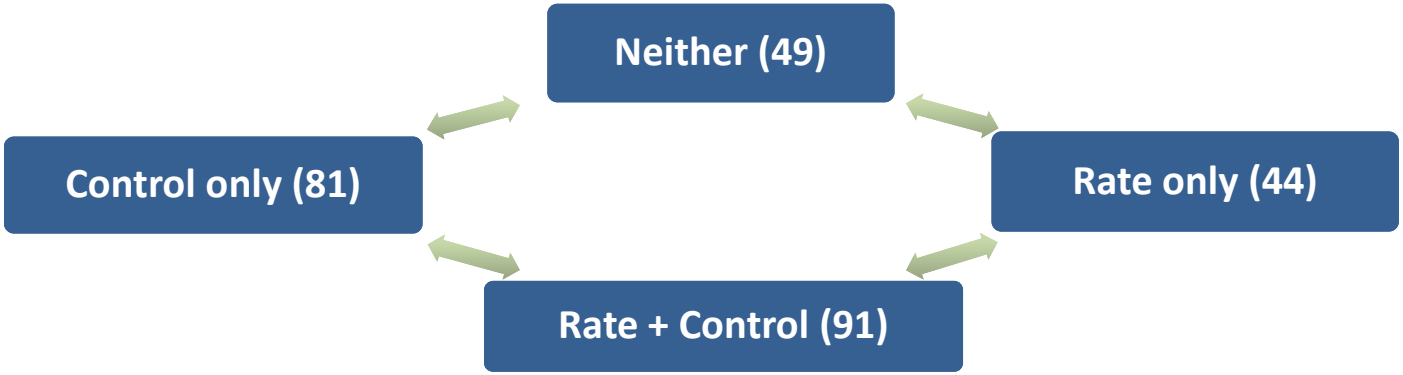
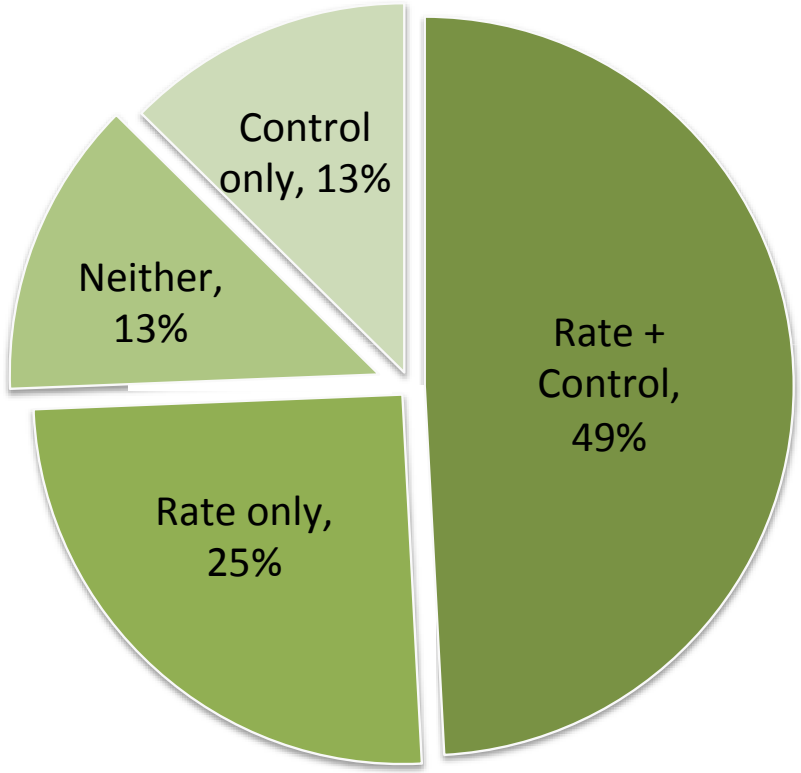


Recruitment – Program Choices

...of customers offered a dynamic Rate and/or AC Control

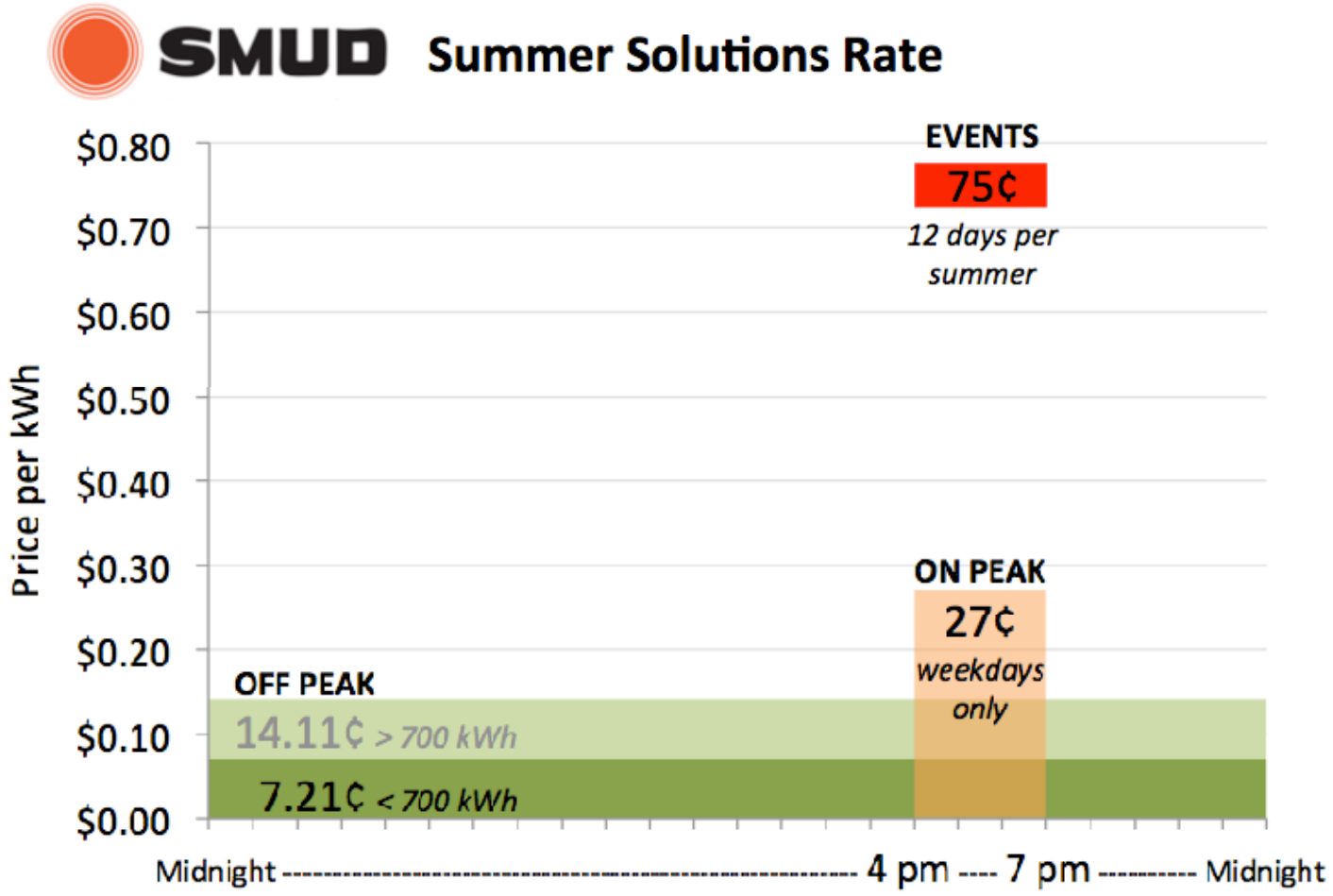
- **Rate**
  - **TOU-CPP rate, a.k.a. the "Summer Solutions rate"**
  - **Customer determines response to high-price events**
  - **12 events**
- **Control**
  - **4° set point raise during events**
  - **One override allowed**
  - **Same 12 events as TOU-CPP rate**



N=238

All participants receive one of the three randomly assigned equipment configurations, no matter their program choices

Optional TOU-CPP Rate



Hypotheses

- **For all participants**
  - Energy use is lower
  - Weekday peak demand is lower
  - Peak demand on event days is lower
  - Electricity bills are lower
- **Savings are better for customers:**
  - (a) with more information
  - (b) who chose more program options
  - (c) on the dynamic rate, compared to direct load control
  - (d) with higher energy use
  - (e) with certain self-reported behaviors
  - (f) with certain dwelling characteristics
  - (g) with certain demographic characteristics
  - (h) with higher satisfaction levels

Field Test & Findings

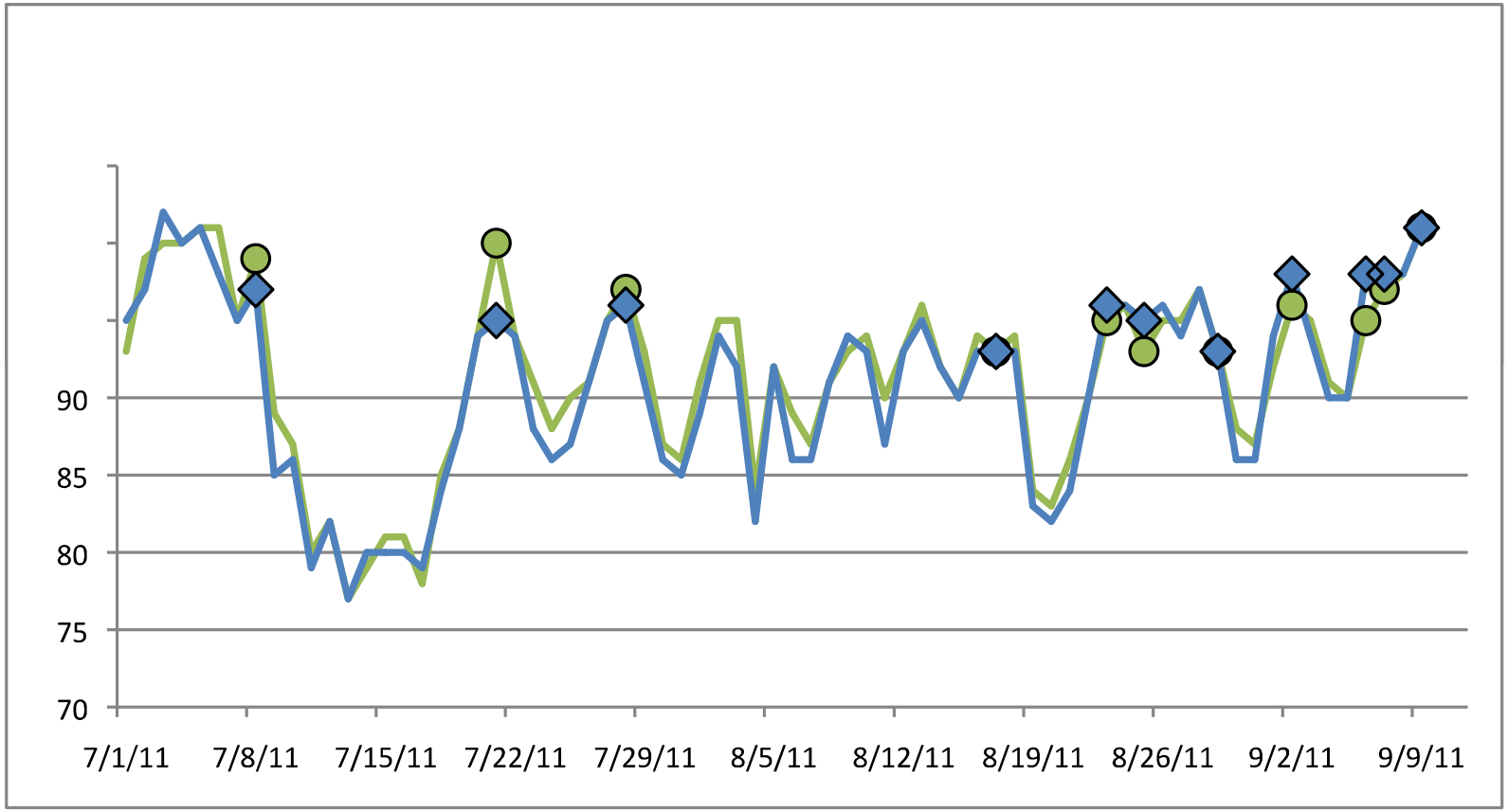
Field Study: Education and Outreach

- Installers assisted with thermostat settings
  - Encouraged all participants to automate response to critical events
- Quick Start Guide and equipment user guides
- Websites with information, tips, discussion board
- On-site energy assessments with personalized recommendations
- Summer Solutions Rate magnet
- SS rate vs. Standard bill comparison
- 24-hour advance notification of events
  - via email, thermostats, text message, phone

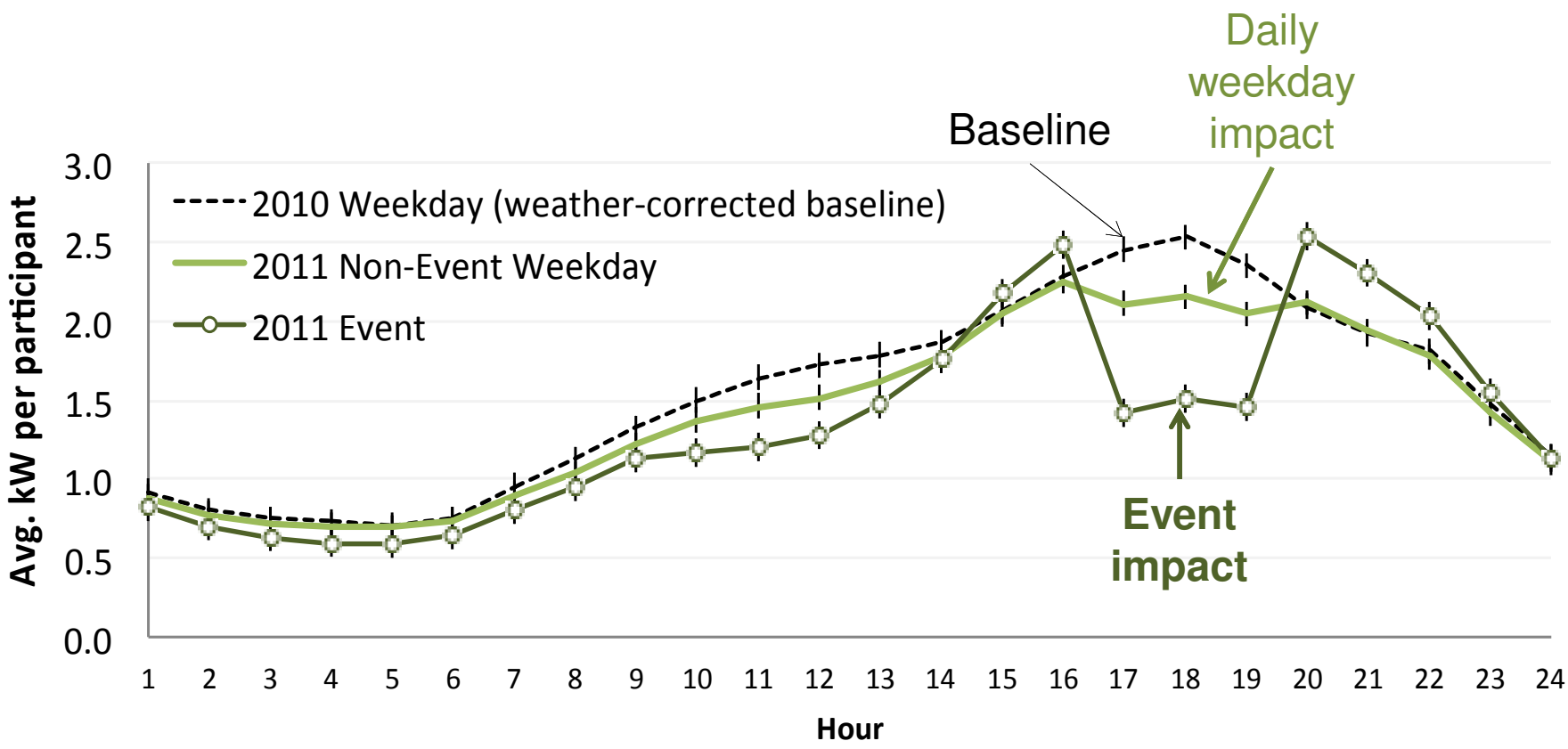
Events - Overview

- **Twelve events from July to September**
- **Notify Participants**
  - Email – including recommendations for participant action
  - Thermostat display – blinking light and message
  - Computer energy display – ACTIVE event status displayed
  - Special requests: Phone calls or text message
- **Notify Equipment**
  - OpenADR to gateway
  - ZWave from gateway to thermostat
  - Thermostat initiates Automatic Temperature Control (4˚ F) or customer-programmed response to events

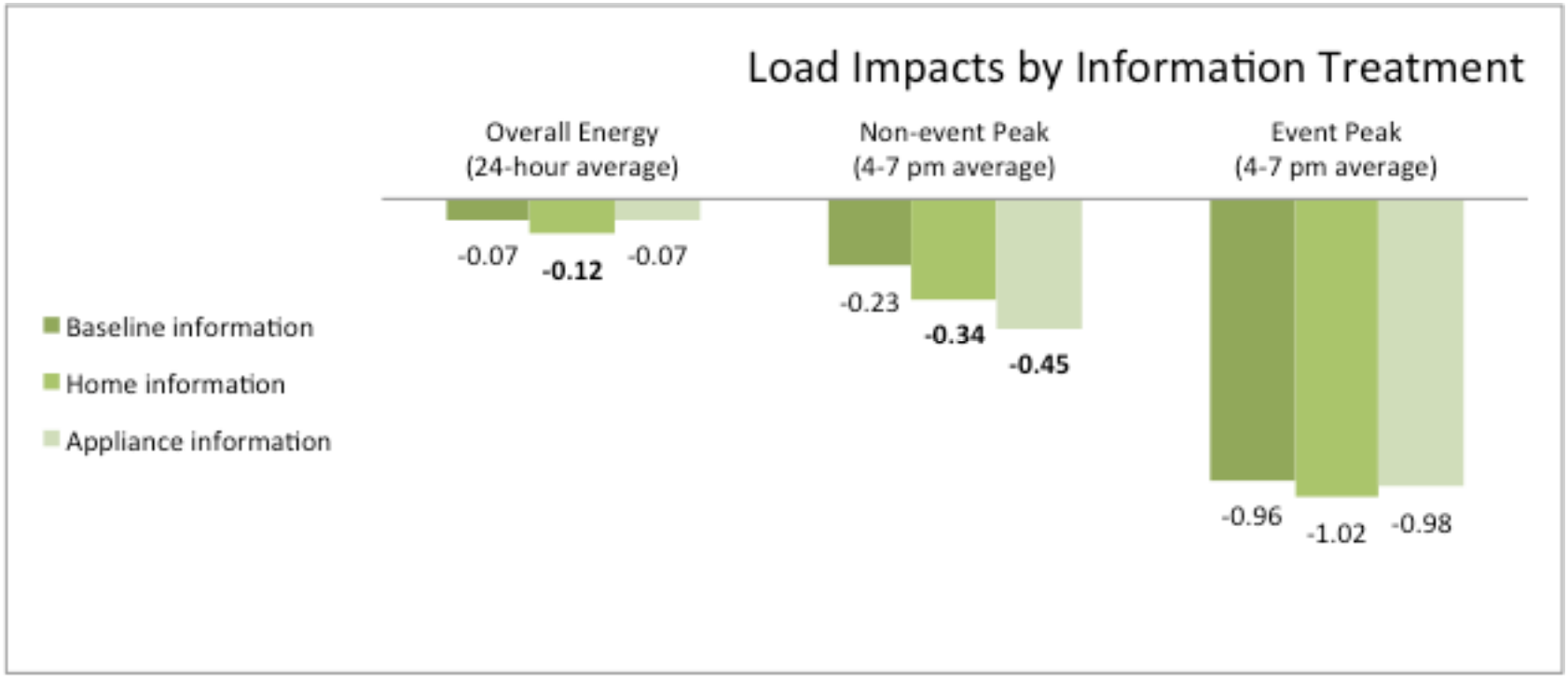
2011 Temperatures and Events



Load Impacts - 100° day

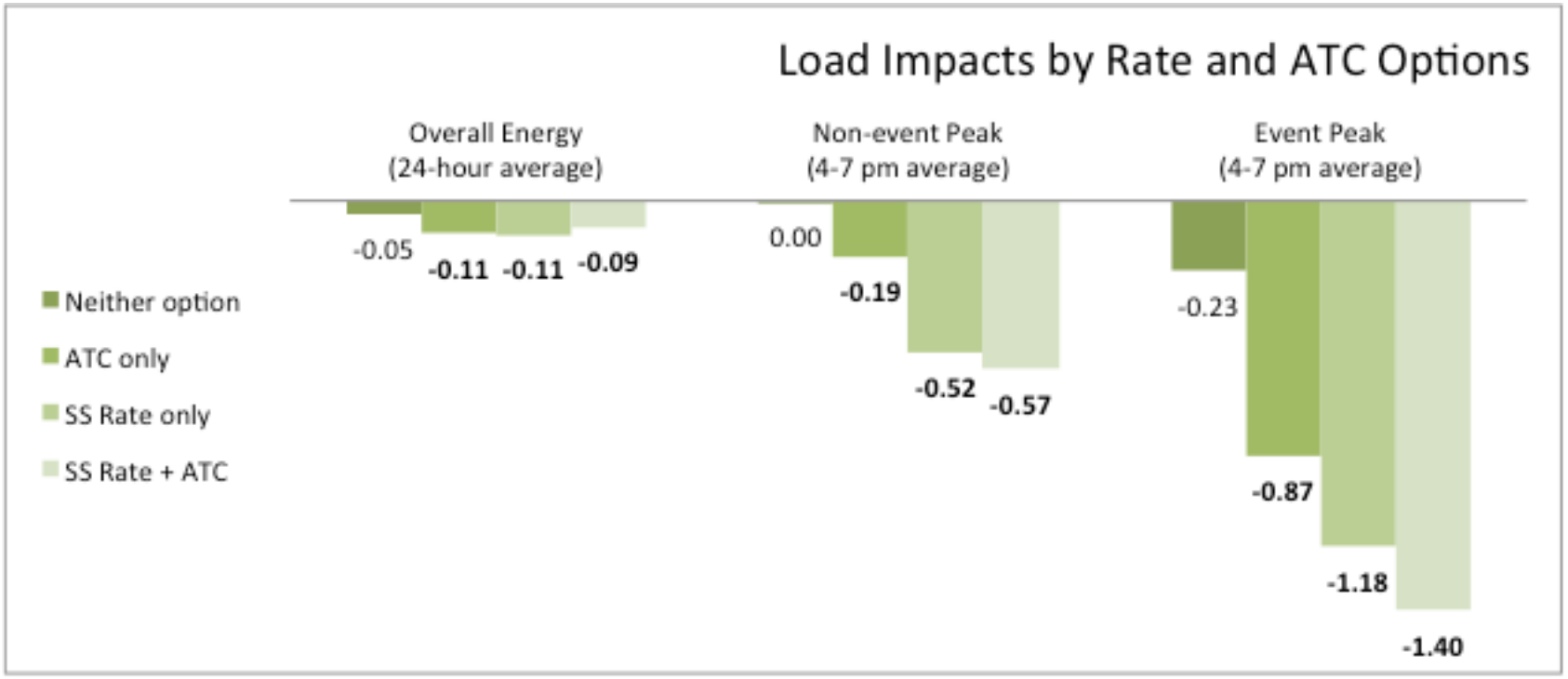


Information Effects



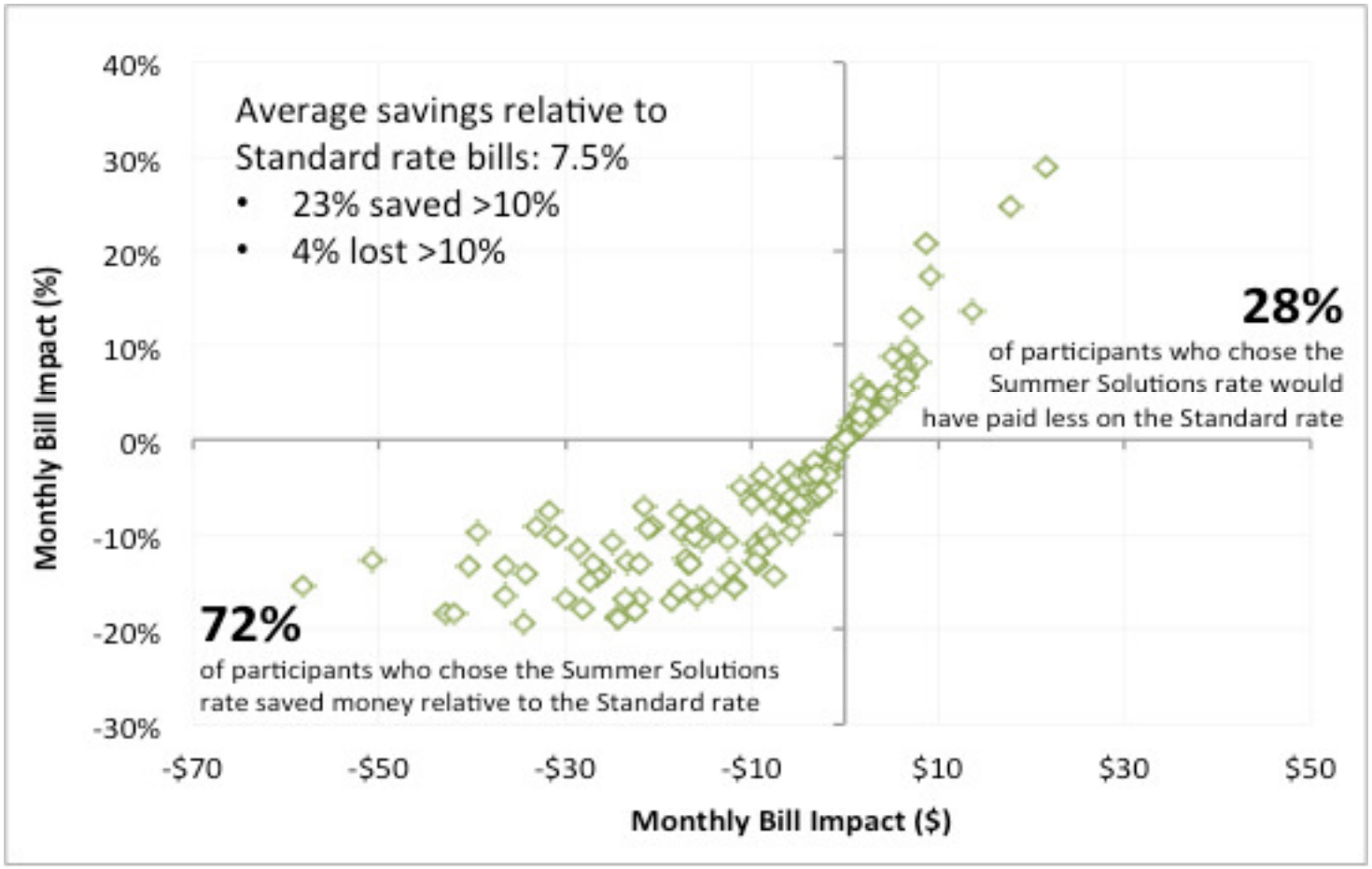
Values in bold indicate a statistically significant difference from "Baseline information"

Rate and Control Effects



Values in bold indicate a statistically significant difference from "Neither option"

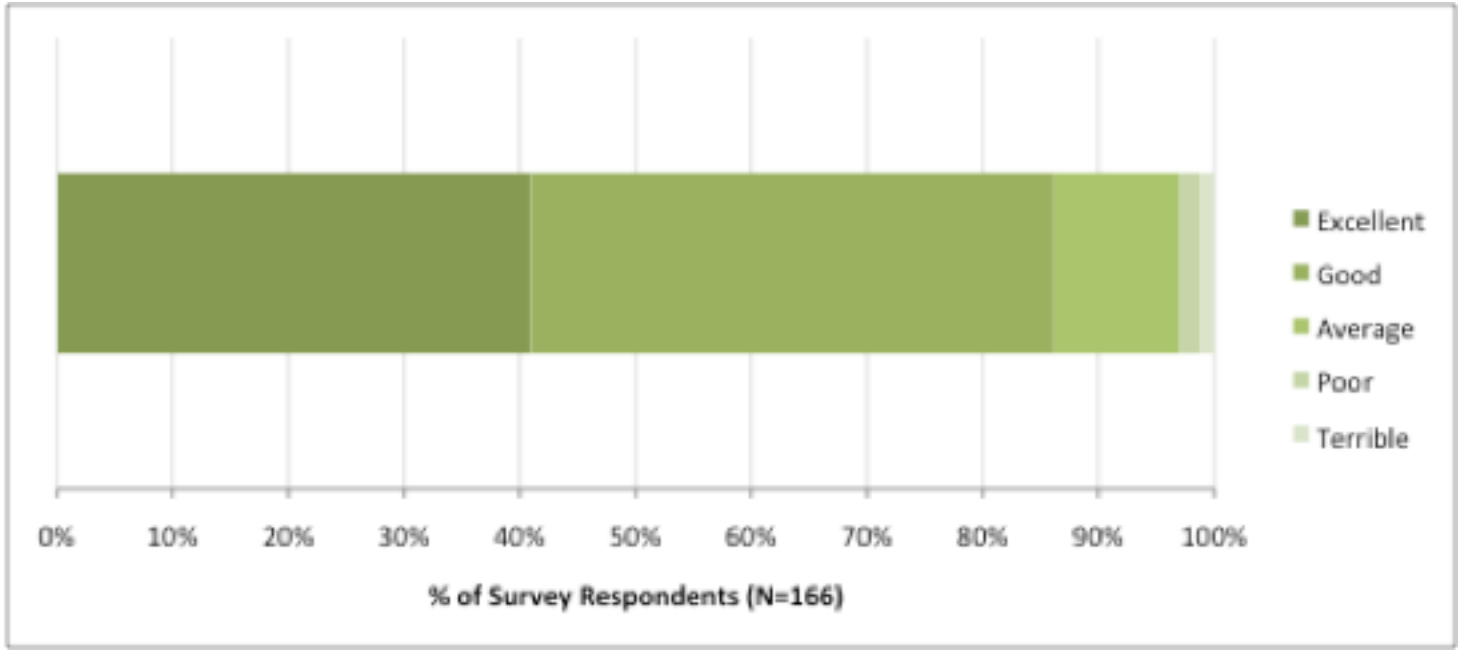
Billing Impacts



Note: These bill savings are <u>in addition</u> to those associated with energy savings

Customer Satisfaction

- 86% = Excellent or Good
  - All groups were equally satisfied
- 90% signed up again for Summer Solutions 2012
  - 5% dropped out, 5% unreachable



Hypotheses

- **For all participants**
  - Energy use is lower: **YES**
  - Weekday peak demand is lower: **YES**
  - Peak demand on event days is lower: **YES**
  - Electricity bills are lower: **YES**
- **Savings are better for customers:**
  - (a) with more information: **MIXED**
  - (b) who chose more program options: **YES**
  - (c) on the dynamic rate, compared to direct load control: **YES**
  - (d) with higher energy use: **YES**
  - (e) with certain self-reported behaviors: **YES** (pre-cooling, peak offset)
  - (f) with certain dwelling characteristics: **YES** (swimming pools)
  - (g) with certain demographic characteristics: **NO** (age, education, income)
  - (h) with higher satisfaction levels: **MIXED** (no savings for dropouts)

Recommendations

1) Dynamic Rate + Advanced Thermostat

- Offer at least one dynamic rate option, e.g. TOU-CPP
- Display rate and event status on thermostat
- Allow customers to automate precooling + peak offsets
- Real-time energy data nice, but not necessary

2) Enhanced Customer Service

- Educated customer support staff
- Free home energy assessments for participants
- Rate calculator with scenario testing

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