Top Smart Thermostats for Preference and Usability

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RESEARCH SOLUTIONS

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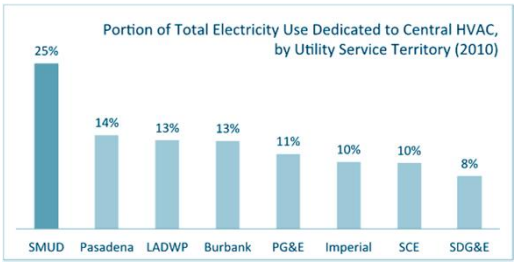
Powering forward. Together.

SMUD

Why Thermostats Matter

- Thermostats manage ~25% of annual electricity use at SMUD
- Residential AC is responsible for >30% of SMUD peak



Source: California Energy Commission, 2009

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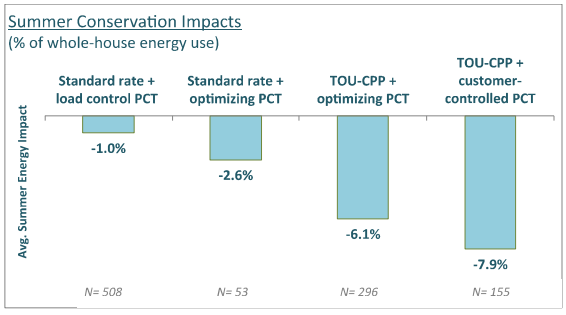
Why Smart Thermostats Matter



Source: Herter Energy, SMUD's Load Impact Calculator

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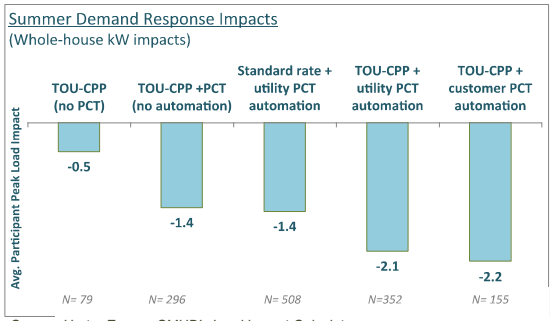
Why Smart Thermostats Matter



Source: Herter Energy, SMUD's Load Impact Calculator

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Thermostats Tested (2013)

Lux Smart Temp (Non-communicating)

Honeywell FocusPro (Non-communicating)

RCS TZ-45

Radio Thermostat CT30

Nest

Computime CTW218

Carrier Comfort Choice Touch

Ecobee Smart Si

Energate Foundation

Energate Pioneer Z100

Cooper-Honeywell Utility Pro

Emerson Smart Energy

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Research Questions

1. How do thermostats compare in terms of:
   - Efficiency (time-on-task)
   - Preference (of two tested thermostats)
   - Satisfaction (ratings of standard features)
2. How do participants rate advanced features?

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Methodology

- 12 thermostats tested
  - 10 communicating "smart" thermostats (6 with apps)
  - 2 standard non-communicating thermostats
- Simultaneous multi-user, paired-comparison test
  - 163 participants x 2 units per participant = 326 tests
  - >95% of possible ordered pairs tested
- 90-minute sessions
  - Video recording of thermostat tests
  - Surveys
  - Group discussions

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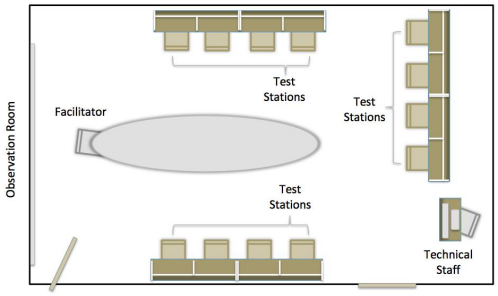
Laboratory Layout



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Efficiency = Time on Task

	The same 7 tasks were performed for each thermostat
1	Identify the current indoor temperature
2	Set to cool. Identify the current target cooling temperature
3	Change the current target cooling temperature to 79
4	Identify the scheduled cooling temperature for Saturday at 8 am
5	Set to heat. Identify the current target heating temperature
6	Change the current target heating temperature to 63
7	Identify the scheduled heating temperature for Saturday at 8 am

$$\text{Task Efficiency} = 2s / (1+e^{t})$$

Where

- s = Success = {0 for failed tasks; 1 for completed tasks)
- t = Time-on-Task = time to complete the task, in minutes.

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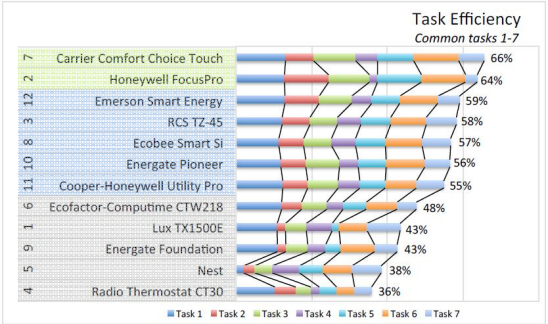
Results: Efficiency



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Preference

Imagine that the thermostat in your home suddenly dies and your mechanic offers a choice between the thermostats you just reviewed - at the same price. Please circle the thermostat you would choose to have installed.

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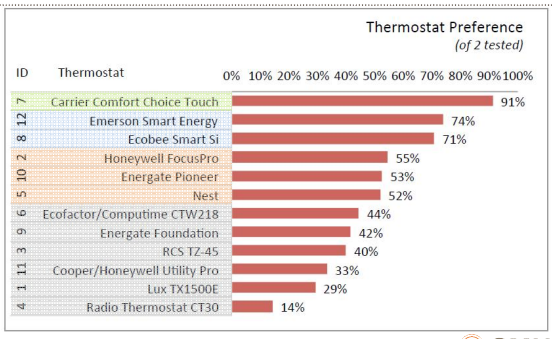
Results: Preference



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Satisfaction (with Standard Features)

1	Rate EASE OF USE and UNDERSTANDING
a	Information on the screen
b	Buttons, dials and switches
c	Meanings of words and symbols
d	Menu navigation
e	Overall ease of use
2	Rate how the thermostat FEELS and SOUNDS
a	Buttons
b	Touchscreen
c	Dials
d	Switches
e	Overall feel and sound
3	Rate how the thermostat LOOKS
a	Layout of the screen and buttons
b	Size of the screen
c	Color(s)
d	Readability of the smallest text
e	Overall appearance of the thermostat

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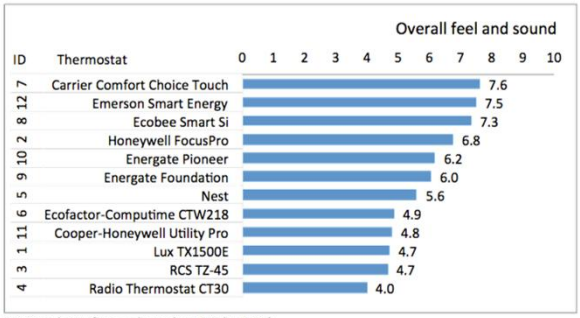
Results: Satisfaction



Statistical significance bounds: ± 2.6 (α=0.01)

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Regression of Standard Features Ratings on Efficiency and Preference

Screen	• Color display → higher Preference scores • Larger screen → higher Efficiency scores
Feel and Sound	• Higher Feel & Sound ratings → higher Preference
Participant Characteristics	• Youth → higher Efficiency scores • Home owners → higher Efficiency scores
Smart Phone App	• Not significant in predicting efficiency or preference • Rated higher by younger users
Appearance	• Not significant
Number of Buttons	• Not significant

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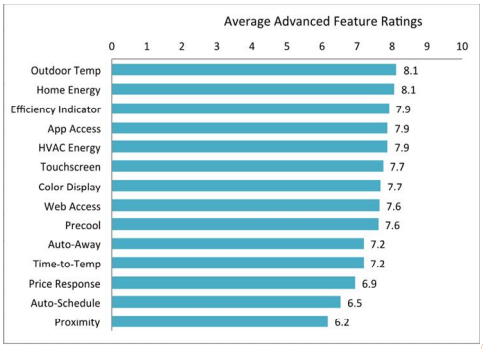
Perceived Usefulness of Potential Advanced Features



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Top Ranking Smart Thermostats 2013

1. Carrier Comfort Choice Touch

1. Emerson Smart Energy

1. Ecobee Smart Si

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Thermostats being Tested (2015)


ecobee3


Honeywell Lyric


Honeywell RTH9320WF


Emerson Sensi


Venstar ColorTouch


Trane XL824


Lux GEO


Carrier Cor


Nest 3rd generation


Schneider Wiser Air


American Standard AZone950


Allure Eversense

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U.S. Department of Energy Disclaimer

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Questions?

Full report available at:

www.herterenergy.com/pdfs/Publications

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