

UC Berkeley

Energy Use in Buildings Enabling Technologies

Title

Programmable Communicating Thermostats for Demand Response in California

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Publication Date

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Programmable Communicating Thermostats for Demand Response in California

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DR ETD Workshop
June 11, 2007

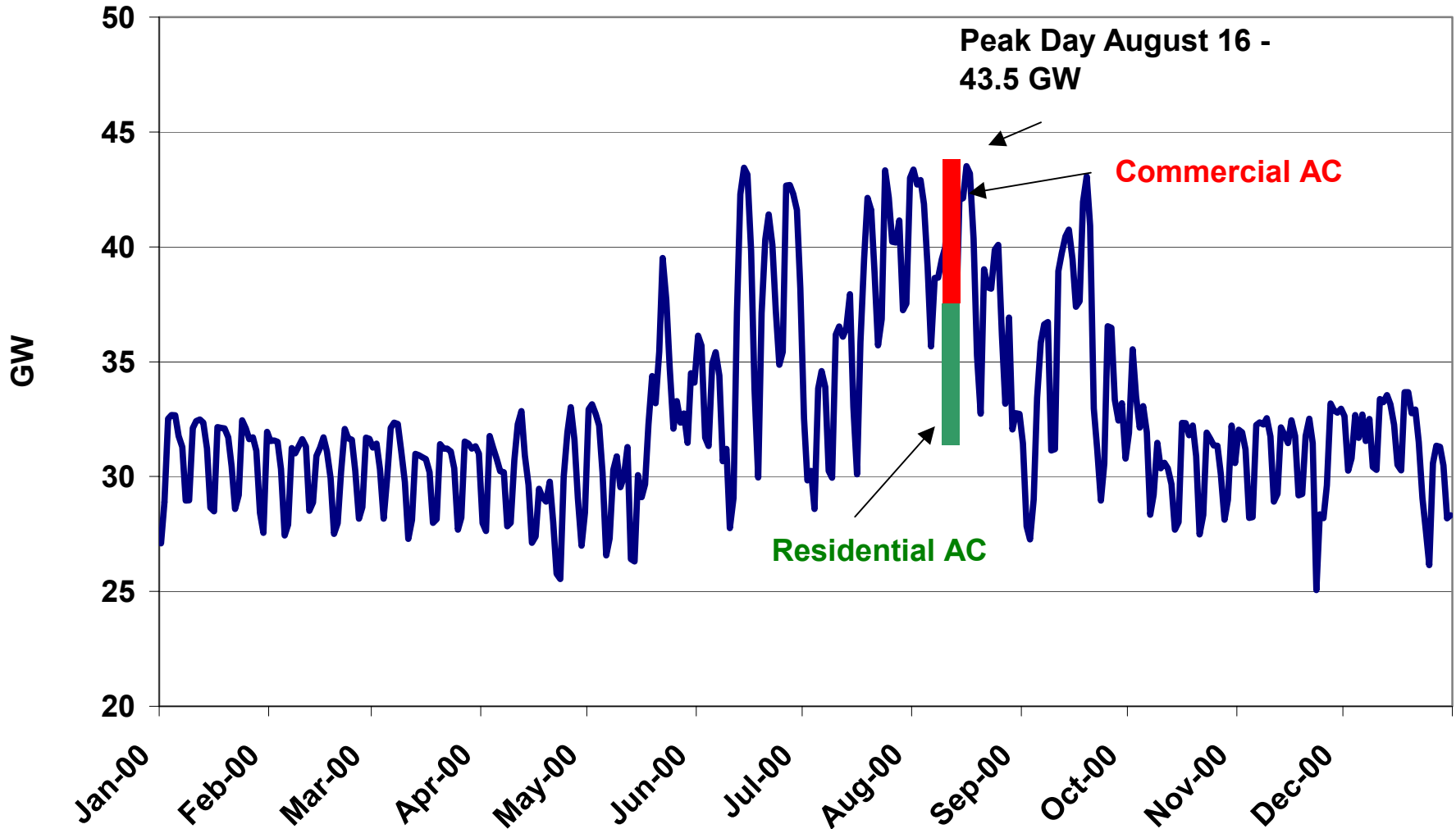


PCT Research at UC Berkeley

- PIER-funded research team:
 - PI's: D. Auslander, R. White, P. Wright
- Since 2006: support regulators and industry stakeholders by researching key technical and safety issues:
 - Strawman “minimum functionality” PCT concept and bill of materials
 - Proof-of-Concept demonstration
 - Research technical implementation issues for PCT interfaces and advise industry working group
 - Simulate aggregate effects of PCT's on electricity grid

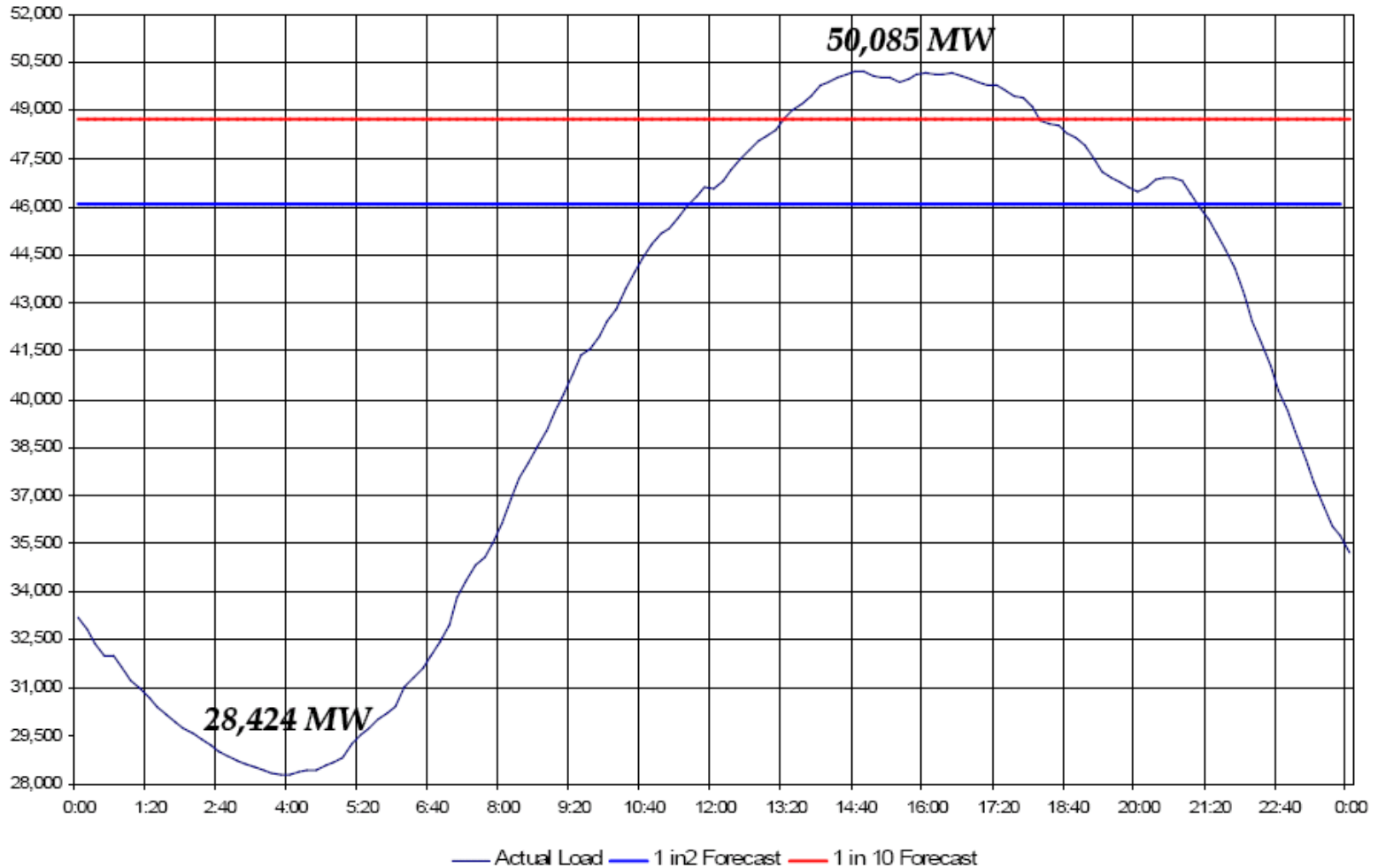


Cal ISO Daily Peak Loads January 1, 2000 - December 31, 2000





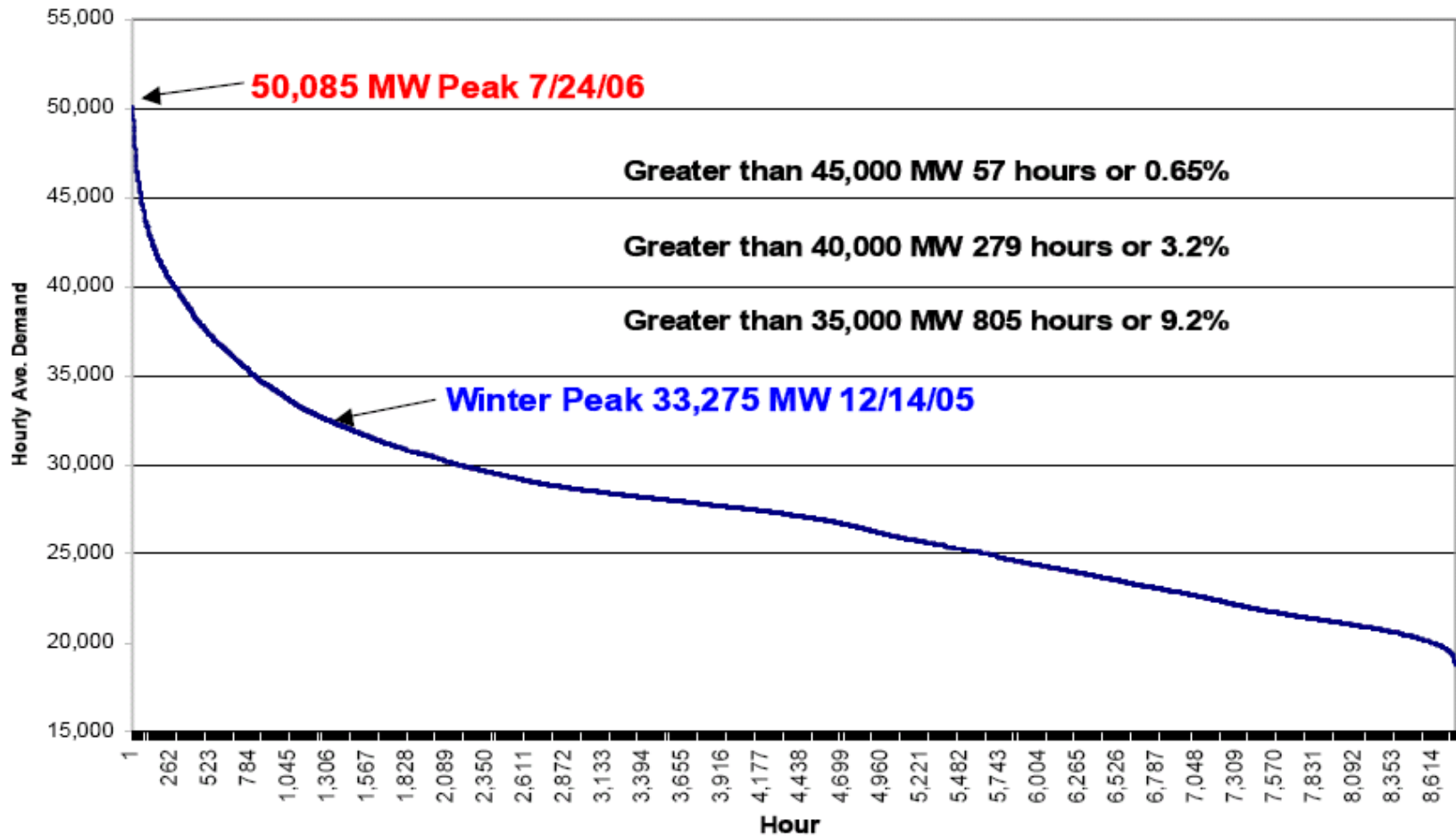
CAISO Load Curve July 24, 2006





CAISO Load Duration Curve

Sept '05 to Sept '06





PCT History

- Thermostats and load switches used to manage residential load since the 1970's
- 1-way and 2-way communication technologies: radio, paging, telephone, Internet
- Carrier released ComfortChoice PCT in 2000, widely used in residential and light-commercial pilot programs
- SCE Energy\$mart Program demonstrated potential of PCT's to curtail ~0.3 kW/ton (A/C size)





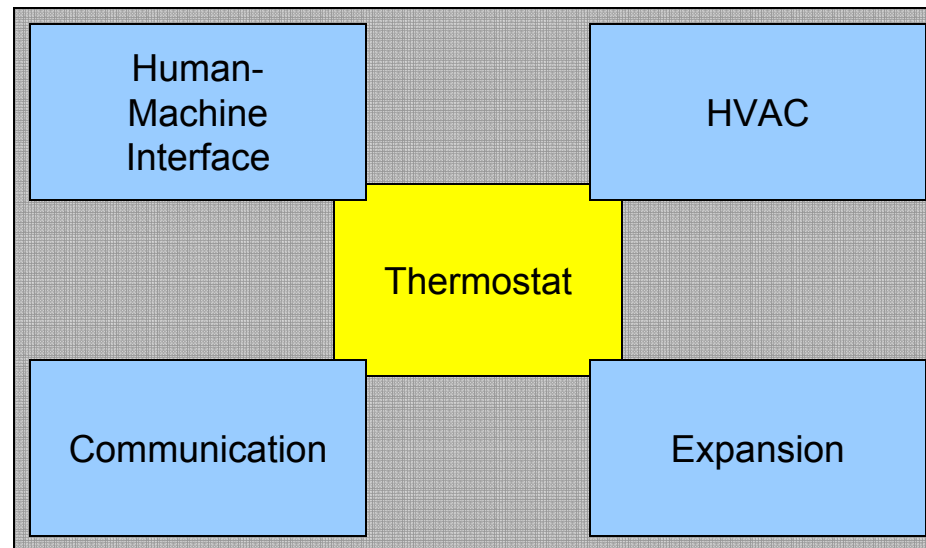
CEC's PCT Vision

- Mandate residential PCT's through 2008 Title 24 building standard
- Potential for several GW of curtailable load – “negawatts cheaper than megawatts”
- Prevent rotating blackouts, increasing public safety and equity
- Managing A/C at t-stat provides better comfort and communication to customer
- Statewide standards for “interfaces” to reduce overall cost





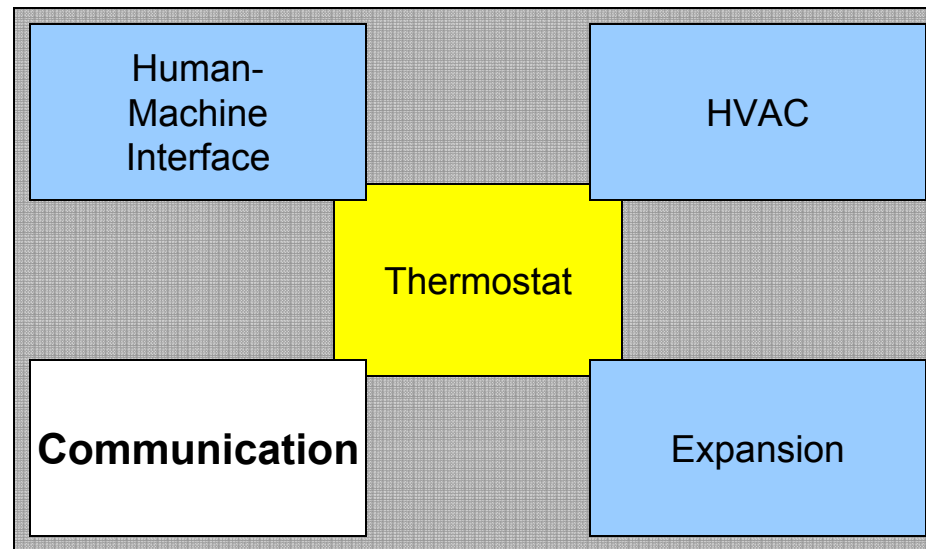
PCT Key Interfaces





PCT Key Interfaces

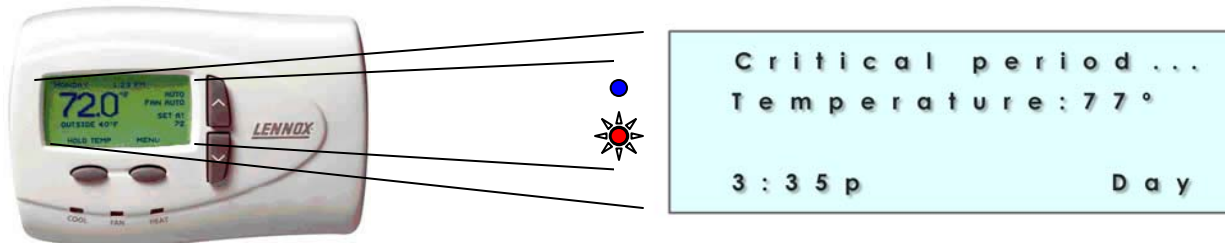
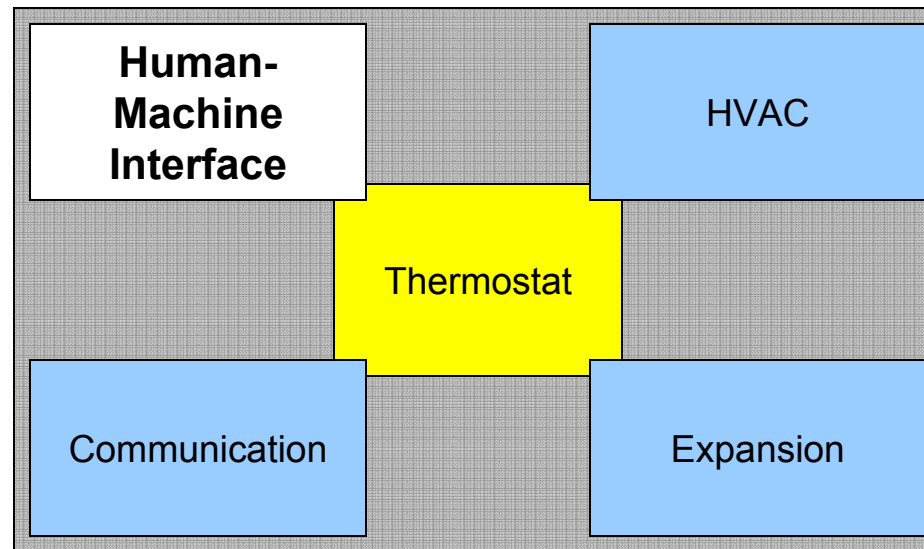
Standard 1-way receiver built-in
for DR signals





PCT Key Interfaces

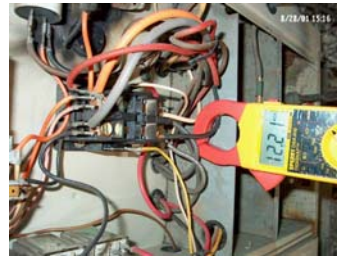
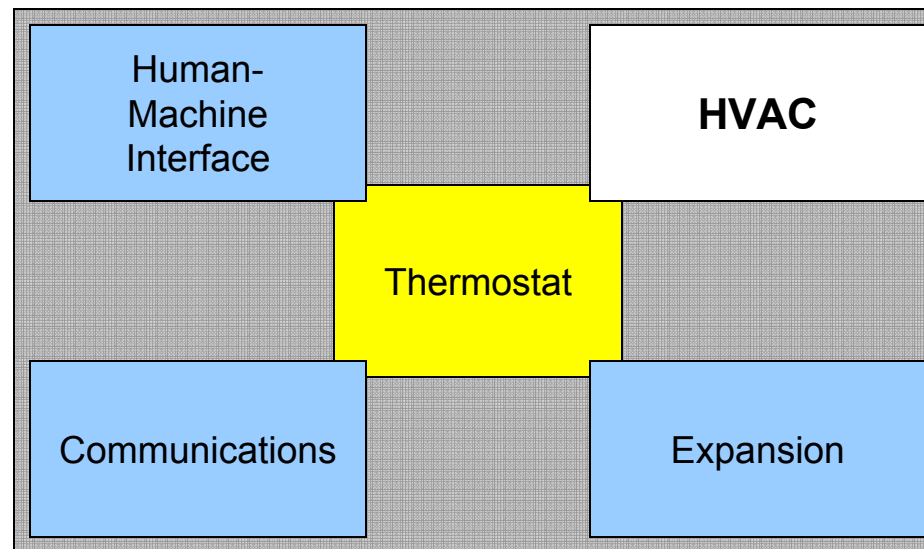
Requirements for information presented to the resident and necessary inputs (i.e. override a curtailment)





PCT Key Interfaces

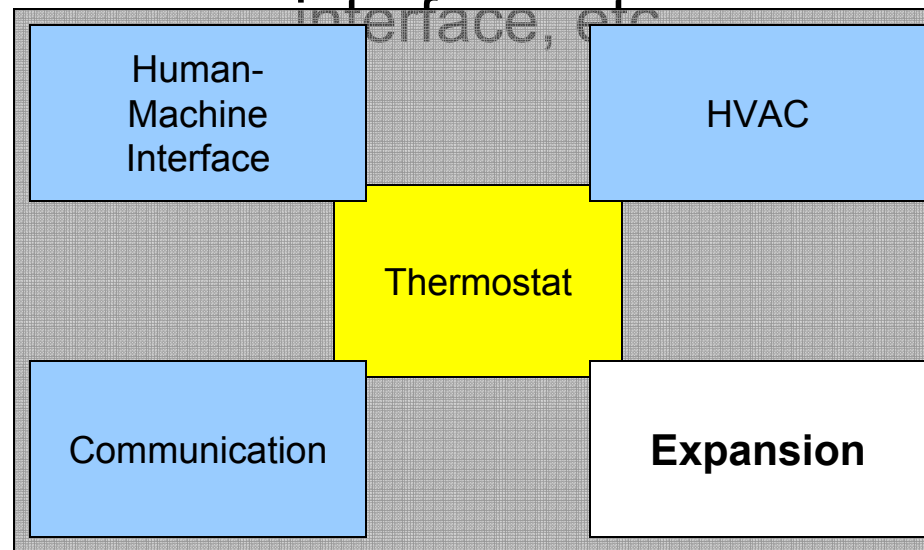
Standard statewide interface to legacy (existing) analog HVAC appliances and future digitally-controlled systems





PCT Key Interfaces

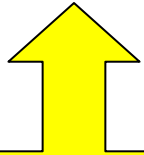
Standard port to support add-on devices: 2-way communication chip, removable memory, diagnostics





Title 24 PCT Timeline

CEC Vision and Requirements

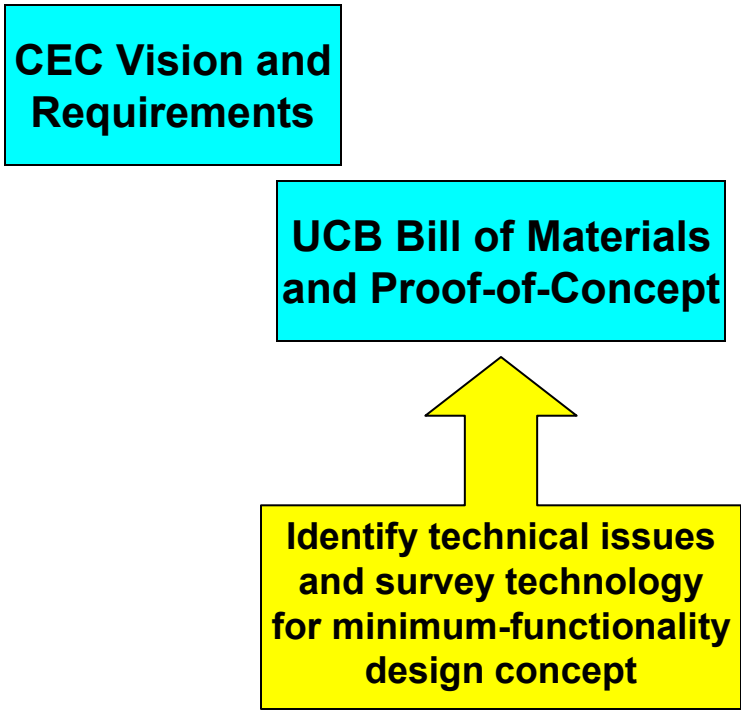


UC Berkeley to address questions about cost and feasibility

November
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2005
11 June 2007



Title 24 PCT Timeline



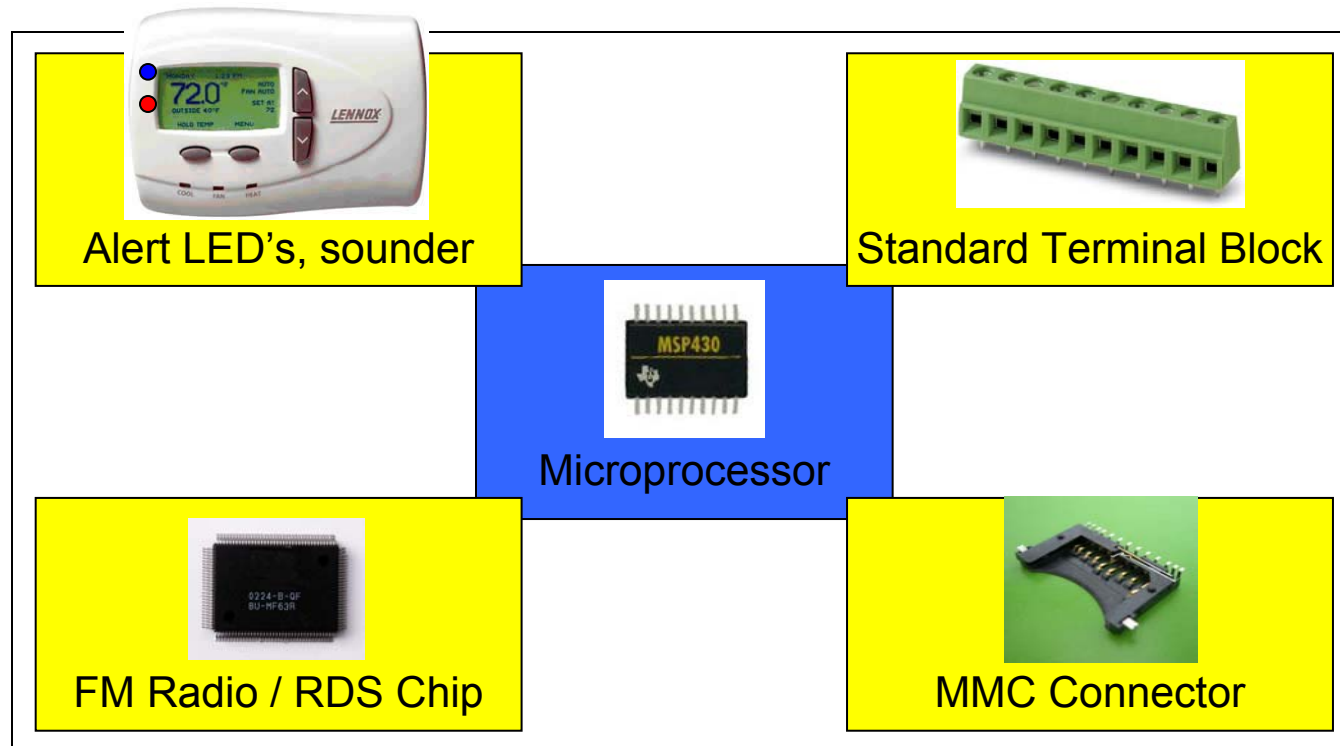
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April
2006



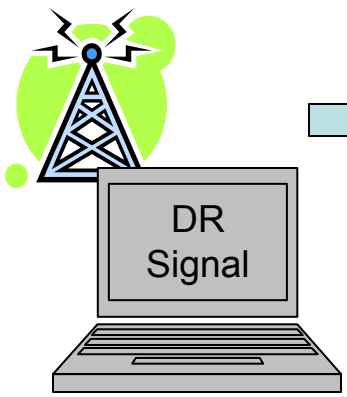
Minimum-Functionality PCT

- Bill of materials for a minimum-functionality PCT that costs less than \$20



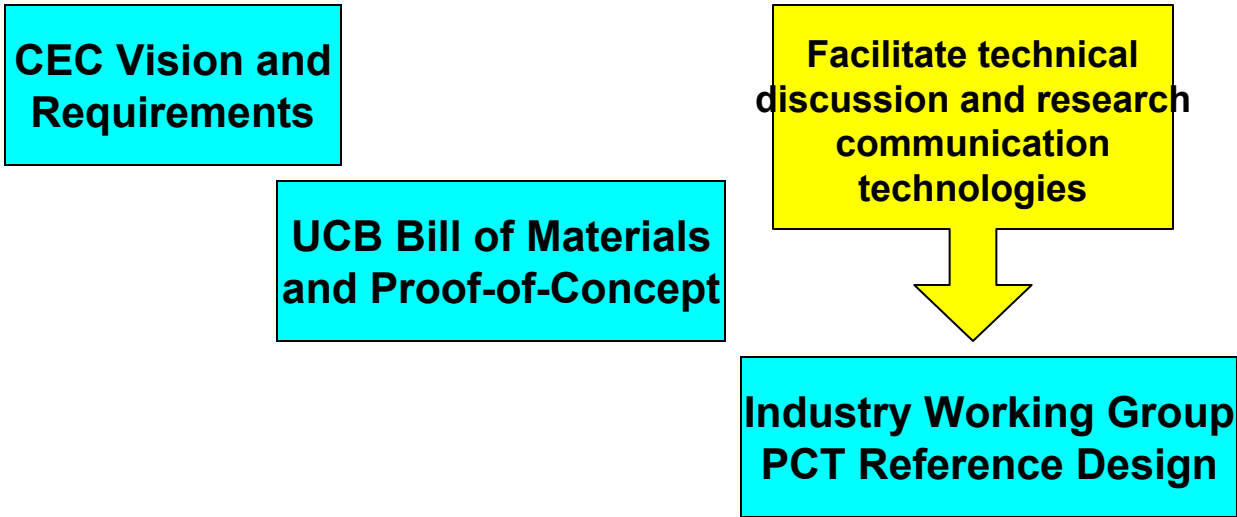


Proof of Concept Demonstration





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11 June 2007

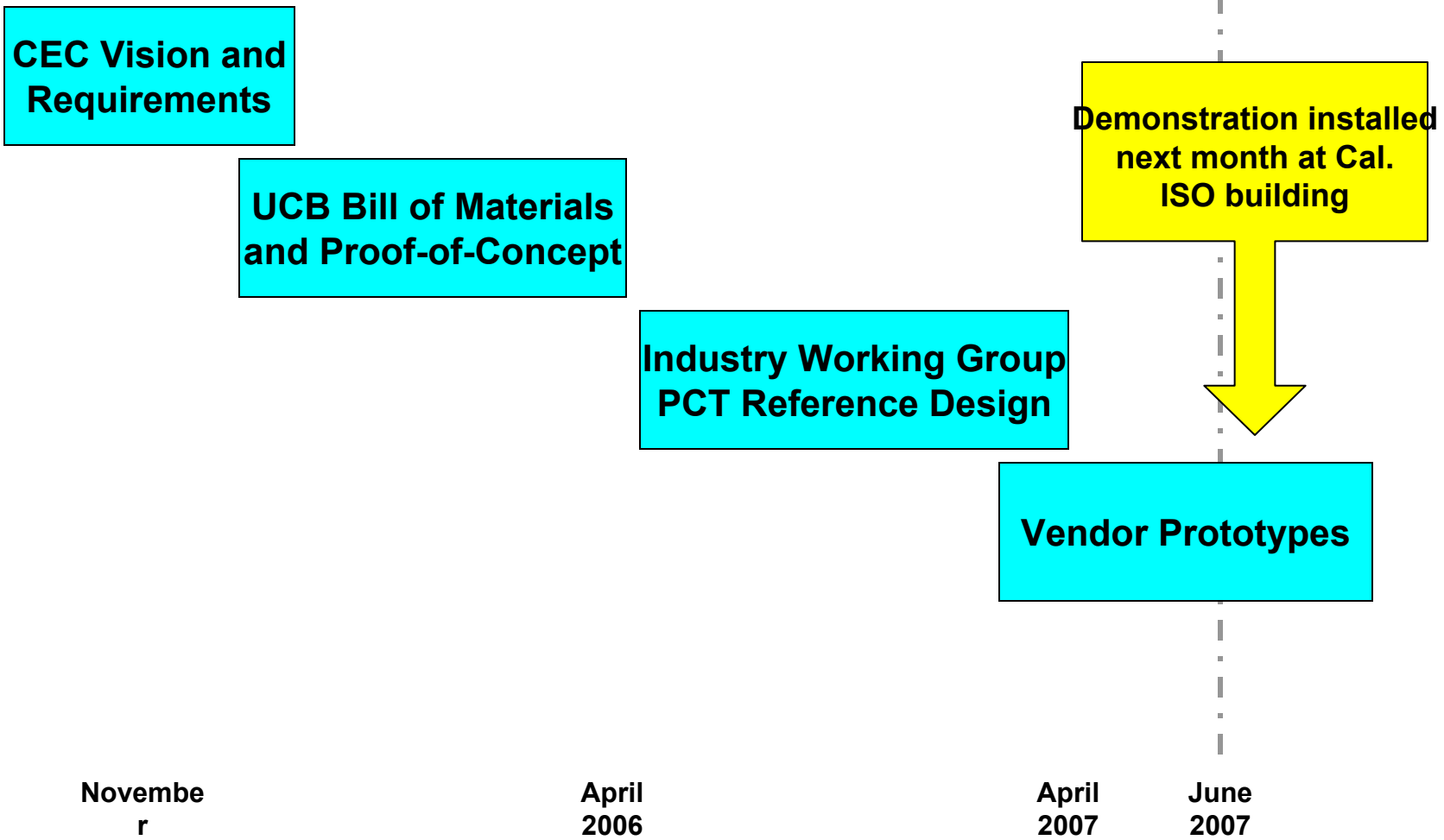
April
2006

April
2007

DR ETD Workshop



Title 24 PCT Timeline



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11 June 2007

April
2006

April
2007

June
2007



ritetemp PCT Working Model



6030 PCT Programmable Communicating Thermostat

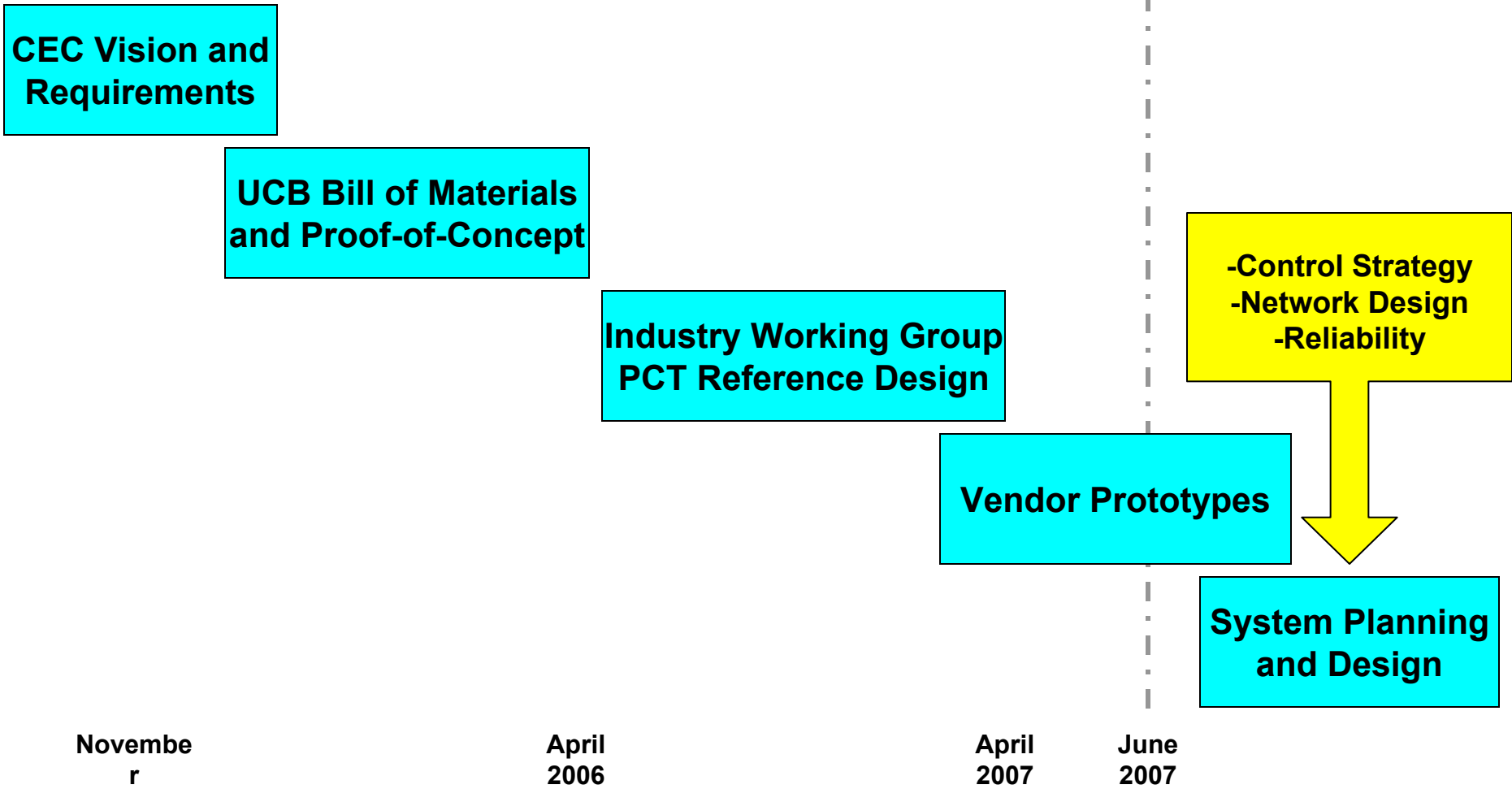


Golden Power Manufacturing's 6030PCT programmable communicating thermostat offers compliance with new energy management features in California's 2008 Title 24 building standards updates—and it's available today! The 6030PCT





Title 24 PCT Timeline



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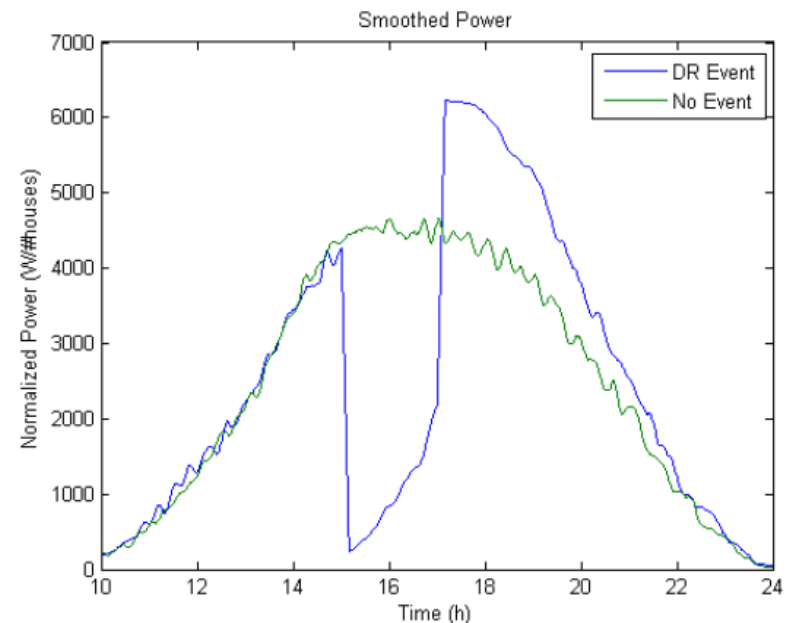
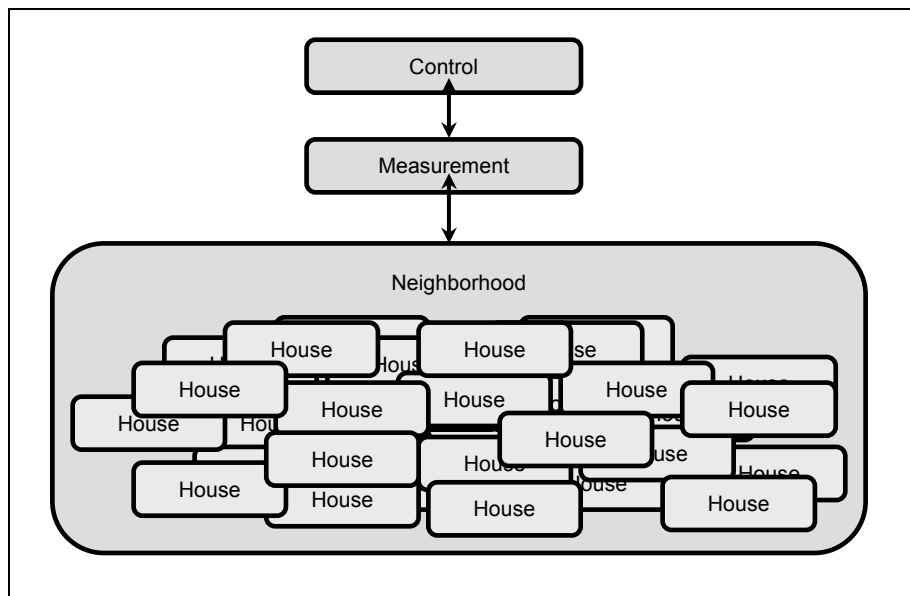
April
2007

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2007



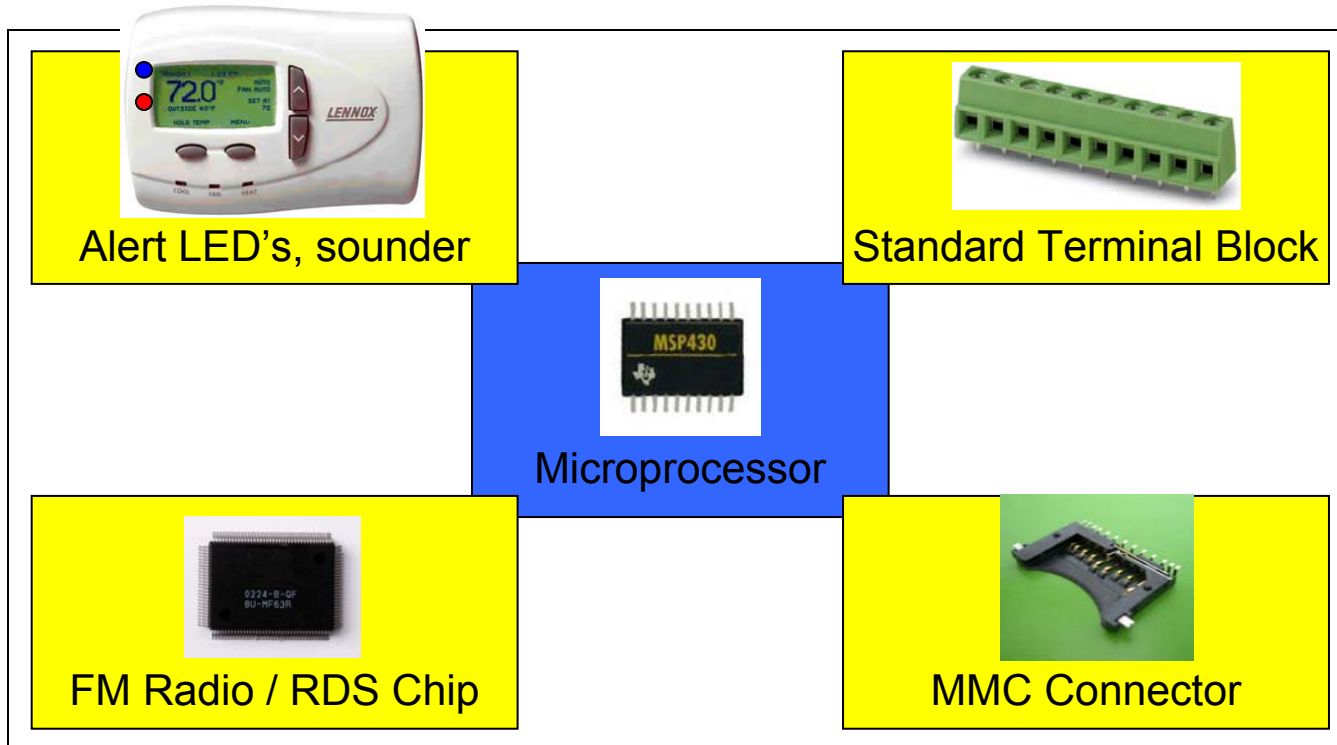
PCT Systemic Control

- Simulation tool to investigate aggregate load behavior when PCT-enabled homes respond to DR control signals





PCT Interfaces





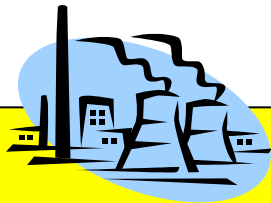
Resident Interaction



HVAC Actuation



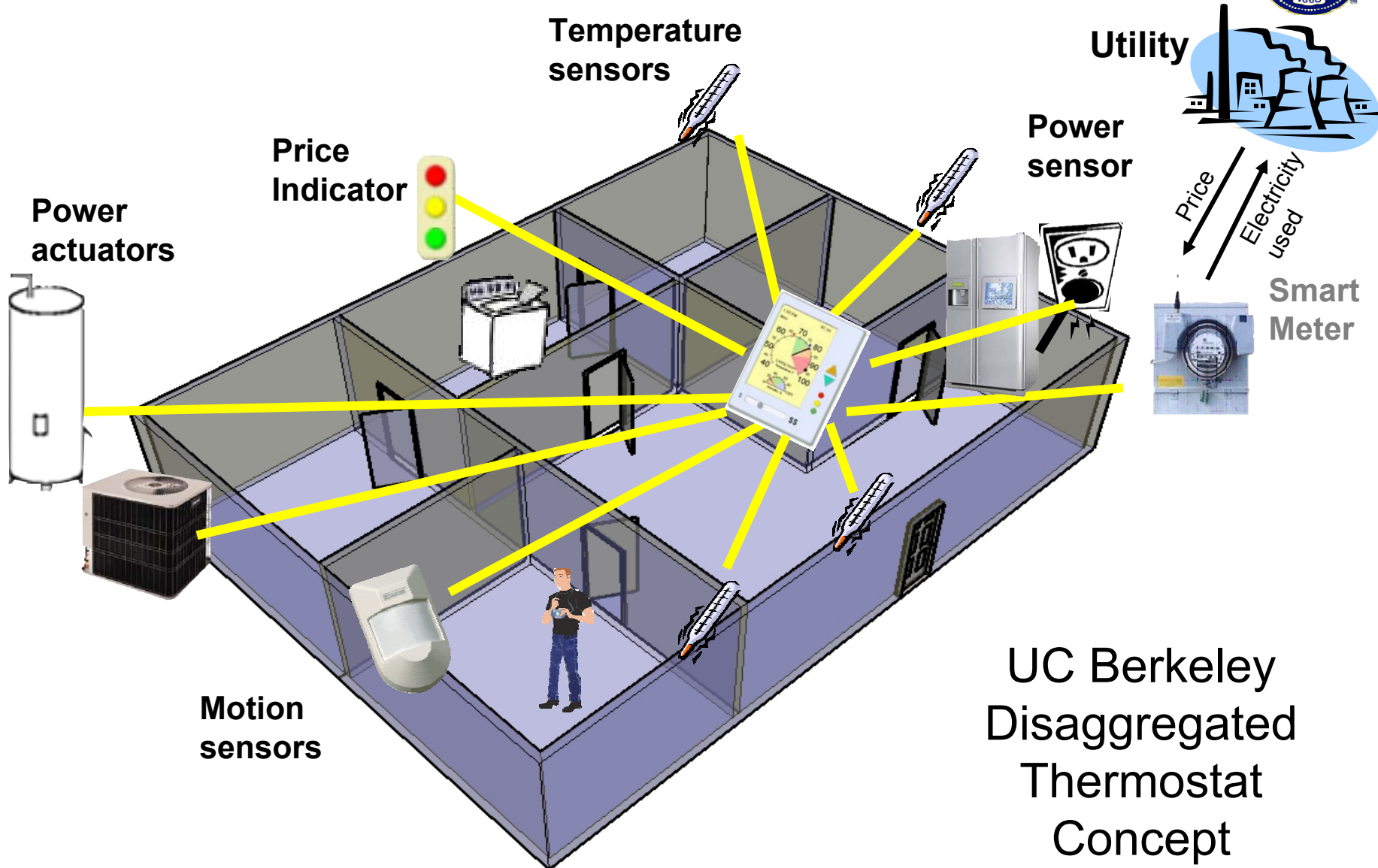
Energy Control



Utility Communication Gateway



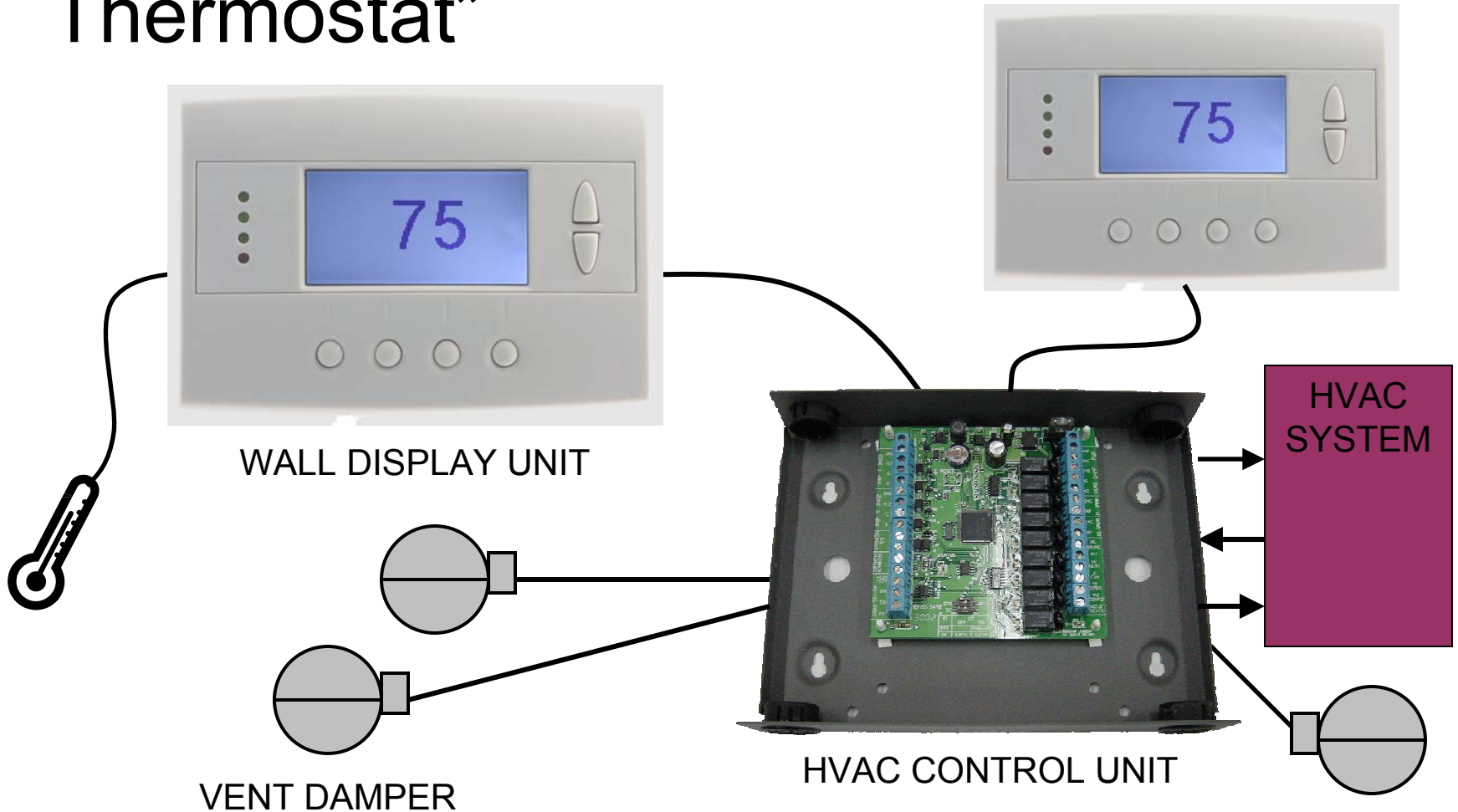
Expansion Functionality



UC Berkeley Disaggregated Thermostat Concept



RCS Multizone “Disaggregated Thermostat”





Questions?

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- Special thanks to:
 - Ron Hofmann, PIER
 - Gaymond Yee, CIEE