

# Workshop on Potential Research Needs for the PIER Buildings End-Use Energy Efficiency Program

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# Background

- PIER Buildings Program to release *Technology Innovations Solicitation* this year (~ \$6 Million)
  - Target technologies, tools, and/or market research needs
  - Meet California's aggressive EE & GHG goals (Exec Order S-20-04 & AB 32)
  - Support future changes to the State's appliance and building EE standards
- Address holes in Buildings Portfolio
- Considering near, mid, and long term opportunities

# Purpose of Workshop

- The purpose of this workshop is to present draft research topics and to obtain public input on other potential research topics.



# Agenda (revised)

## Commercial & Residential Buildings

- Staff-identified research topics
- Public input

## Commercial Only

- Staff-identified research topics
- Public input

## Residential Only

- Staff-identified research topics
- Public input

## Appliances and Plug Loads

- Staff-identified research topics
- Public input

## Wrap up and overview of next steps



(90 minutes)

(45 minutes)

(15 minutes)

# Commercial & Residential

- Innovative Building Envelope Solutions
- Low Energy Cooling Systems
- Enabling technologies for “smart buildings”
- Lighting technologies and controls
- Understanding current building performance
- Efficient space and water heating
- Water use efficiency
- Opportunities within specific sectors
- Whole Building Systems for Mixed Use Projects
- Alternative Business Models
- Thermal and visual comfort models
- Combined Heat & Power (CHP) / Combined Cooling Heat & Power (CCHP)
- Space Heating
- Diagnostics and Communication Tools



# Commercial & Residential - Public Input

- HVAC
  - Fan energy use – Commercial duct leakage (accurate measurement techniques). Need a rating method for duct standards.
  - Electric motor efficiency and variable speed technologies (e.g. ECPM) – verification of energy savings and public education
  - Cooling condensate – capture and reuse
  - Pool / space conditioning synergies
  - Simultaneous heating & cooling – scoping study & system design problems
  - Earth tubes (intake duct that runs underground) for thermal energy storage
  - Gas powered cooling technologies
  - Waste energy stream recovery potential (DHW)
- Integrated community design (including transportation)
  - Energy delivery and controls, local fuel & energy production
  - Building load impacts of plug-in hybrid vehicles
  - Systems integration related to bldg automation and smart grid (plug-in hybrids)
- Refrigeration – walk-in, warehouse, open cases
- MicroCHP

# Commercial & Residential - Public Input

- Research platform for integrated controls development
  - AMI (metering and monitoring) and DRI (demand response infrastructure)
- Lighting
  - Rating methodologies & tools for solid state lighting
  - Super CFLs – tech development and labeling
  - Lighting technologies & controls
  - Electronic ballast & ambient operating temp (electrolytic capacitors)
- Design & Simulation Tools
  - Models for accurate thermal mass simulation
  - Building controls design – sequence of operations & low-tech guidelines to help effective development of sequences during design
  - Simulation tools & control sequences for mixed mode systems (input data and libraries of inputs, measurement methods)
  - Simulation tools for other technologies (e.g. cool ducts)
  - Code compliance tools that help bring advanced building energy saving technologies into Codes
- Streamlined and standardized retro-commissioning methods and tools (public domain calculation methods)



# Commercial & Residential - Public Input

- Market and Technology Implementation Studies
  - Bldg integration & thermal mass – phase change materials (demonstration & integration with controls, fire safety, modeling, benefits in CA context, code implications, retrofit potential, etc.)
  - Review existing data to evaluate commercial energy use that provides no service (e.g. during periods of no occupancy)
  - Future trends analysis to inform PIER research (appliances, bldg construction, tech developments, etc.)
  - Study to investigate national (& CA) climatic dependent energy standards for HVAC
- Building Performance & Loads
  - Systemic study of building loads (CHP falls in this category)
  - Bldg performance measurement and design team feedback – standardizing measurement & post-occupancy feedback to design community
  - Better measurement of savings at the building level (& utility program level?)
  - Zero energy windows
  - Technician and bldg operators training (from the CPUC's BBEES)
  - Analysis of M&V studies to determine trends & opportunities
  - Seasonal thermal storage
  - Behavioral & institutional issues – why do building operators do what they do?

# Commercial & Residential - Public Input

- FDD
  - Diagnostic tools & technology (generic and extensible) that can hit a big section of the market
  - Communication protocol (standardization)
  - Performance and validation study Optimizing and integration of kitchen ventilation
- High risk research to balance out the low risk items (potential for huge impacts)
- NOx requirements vs burner efficiency (furnaces, water heating)
- CA standards input to national standards – appropriate criteria for metrics (defense of carbon footprint and economic). Collaborate with ASHRAE
- Low cost bldg integrated water storage
- Peak-power electricity buy-back control systems such as from electric/hybrid vehicles
- Low Energy Cooling
  - Impact of climate change on LEC technologies
  - Demonstration of advance evaporative cooling & ventilation technologies for commercial bldgs
  - Cost-effective & reliable water treatment for adiabatic space cooling strategies (evaporative cooling)

# Residential Only

- Consumer behavior and energy use feedback strategies
- Market Research on High Efficiency & Solar Home Sales Potential

## Public input:

- Existing residential – statewide residential retro-commissioning program w/ packaged retrofits (also applicable to small commercial)



# Appliances & Plug Loads

- Enabling technologies for “smart buildings”
- Consumer and office electronics
- Demand Response Technologies
- Efficient Appliances (beyond Energy Star)
- Commercial / Residential Cooking Equipment
- Pool and hot-tub efficiency

# Appliances & Plug Loads - Public Input

- Test procedures for appliances
- Communication networking systems for smart appliances
  - Software and hardware
- Bottom-up approaches for small devices as part of DR
- Plug load lighting & occupancy sensors
- Home automation systems – affordable
- Dedicated dc circuiting
- Develop tools for data collection
- Beyond Energy Star for commercial cooking equip
- Timing issue – research efforts should match the standards cycles and product development cycle in order to maximize impacts (key is coordination with industry)

# Appliances & Plug Loads - Public Input

- Tools for optimum use of plug-in space conditioning
- Comprehensive plug load study – in order to target research
- Data analysis for consumers (e.g. load disaggregation)
- Integration of smart appliances to inc. distribution circuit efficacy (connections with ESI) 2-way communications for appliances and/or appliances that can passively respond to utility signals (grid-friendly appliances)
- Accelerating the replacement of old appliances (“beer fridge mitigation project”) – residential issue, not commercial
- Wireless technology opportunities in end-use monitoring



# Next Steps

- E-mail written comments by July 26 to [cdavis@energy.state.ca.us](mailto:cdavis@energy.state.ca.us)

