

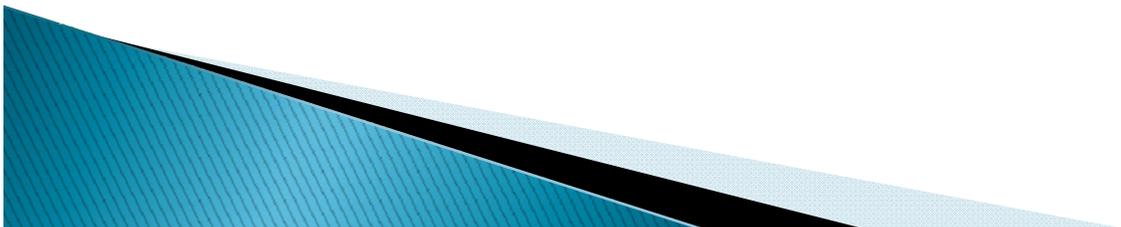
Research Gaps and Potential Research Topics: Residential Buildings

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PIER Workshop on IEQ Research Roadmap Update
July 28, 2011, Sacramento, CA

Research Gaps: *Benchmarks Needed for IEQ and Its Major Determinants*

- ▶ Single Family: Low-E and Retrofit
- ▶ Multifamily Homes: New and Low-E
- ▶ Manufactured and Modular Housing
- ▶ Assisted Living and Rest Homes

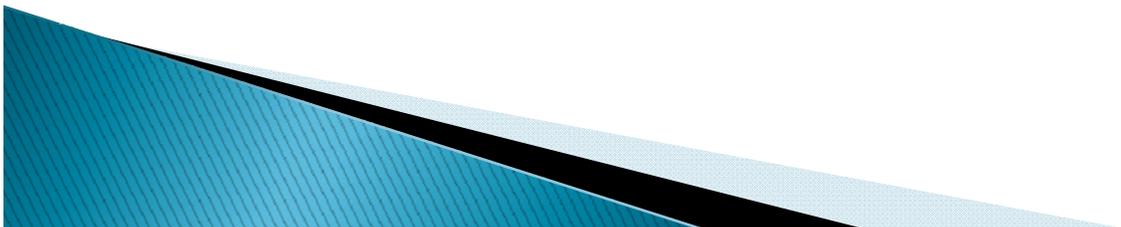


Potential Research Areas: *Determinants of IEQ*

- ▶ Ventilation Design and Performance
- ▶ Operation and Maintenance (O&M)
- ▶ Thermal Comfort
- ▶ Air Cleaning and Filters
- ▶ Indoor Pollutant Sources
- ▶ Human Behavior
- ▶ Quality Control / Quality Assurance

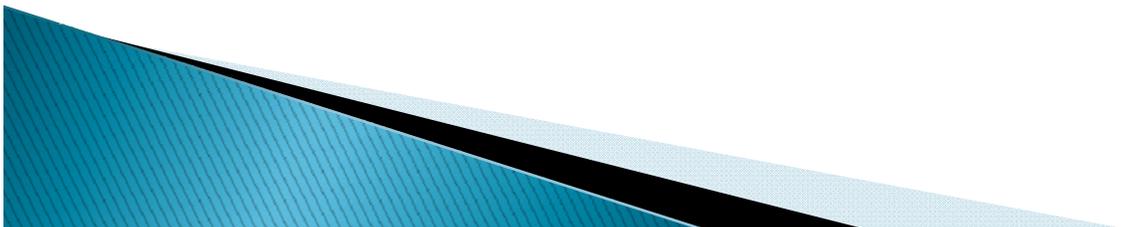
Ventilation Design & Performance

- ▶ Design ventilation systems for adequate air flow and mixing within the building
- ▶ Minimize drafts, noise, and odors
- ▶ Vent cooking appliances and high moisture areas to the outside
- ▶ Avoid depressurization of attached garages and building shell



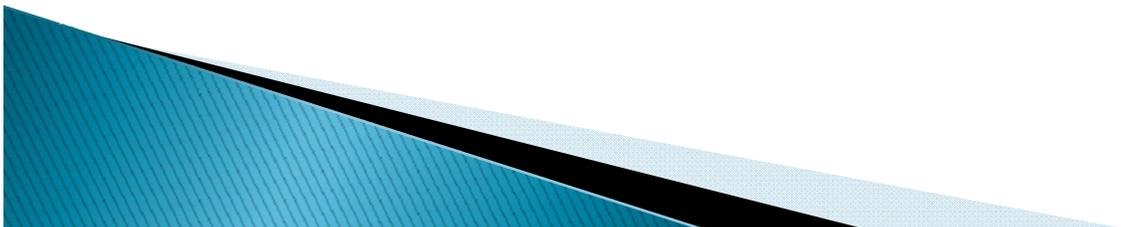
Ventilation Design & Performance (contd.)

- ▶ Optimize system for building types and different climates
- ▶ Improve performance of ventilation systems in new and retrofit applications
- ▶ Improve modeling, based on field monitoring of home performance
- ▶ Evaluate life cycle costs, integrated with whole building design



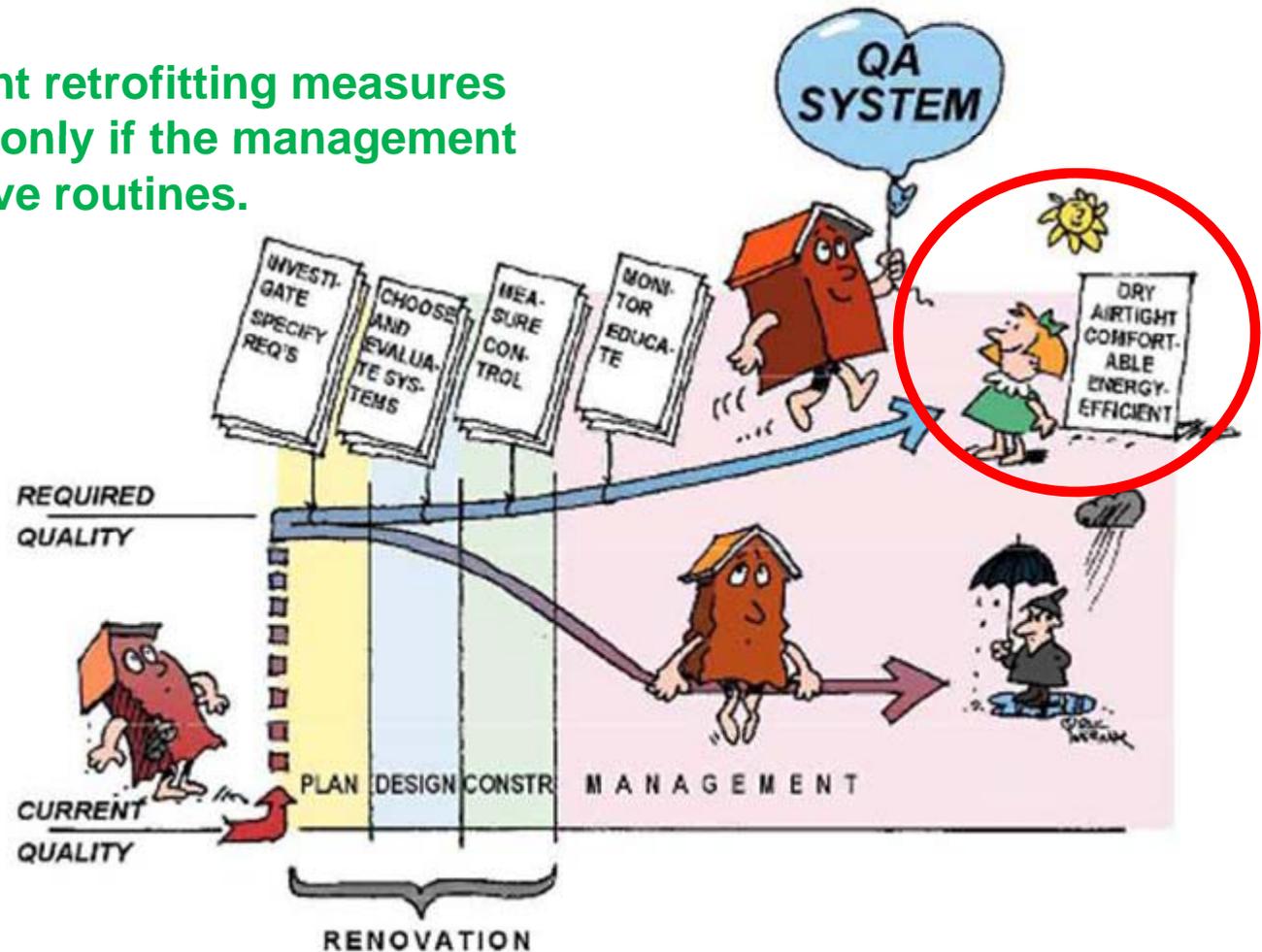
Operation and Maintenance

- ▶ User friendly controls and fail-safes
- ▶ Flow rates and operation schedules
- ▶ Dirty filters and ductwork
- ▶ Poor maintenance access
- ▶ Lack of maintenance
- ▶ Best Practice Guidelines: Installation, Commissioning, O&M



Operation and Maintenance: *QA is Key to Meeting Performance Targets*

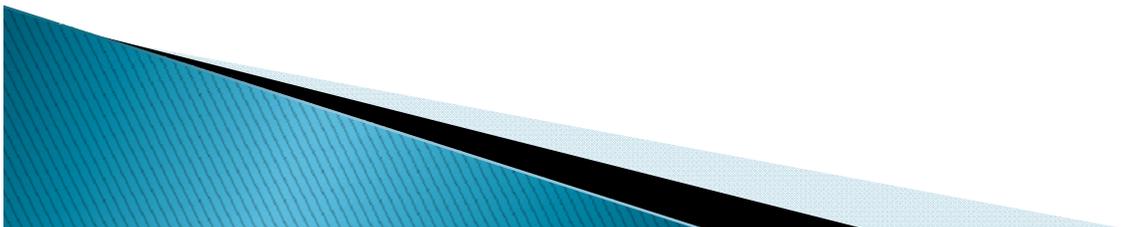
Energy improvement retrofitting measures will be long-lasting only if the management is guided by effective routines.



Source: Mjornell and Kovacs. SQUARE QA System in Swedish Pilot Project.
<http://www.iee-square.eu/InformationPublications/Presentations.asp>

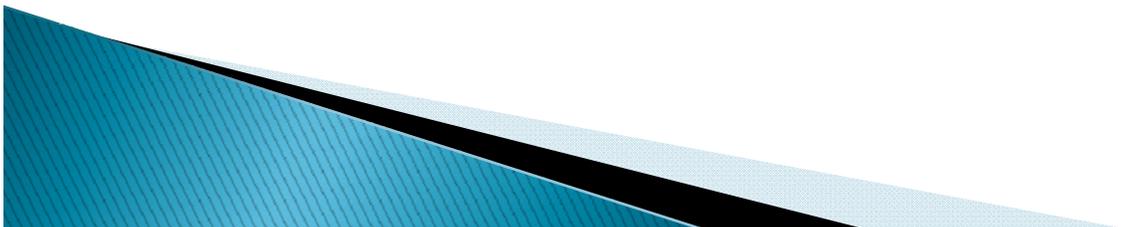
Thermal Comfort: *Design & Performance*

- ▶ Performance vs. models
- ▶ Climate-optimized designs: heating, cooling, moisture control
- ▶ Ventilative cooling
 - Night cooling
 - Purge ventilation
 - Dynamic HVAC controls
- ▶ Evaporative Cooling
- ▶ Natural ventilation
- ▶ Hybrid (natural and mechanical) ventilation



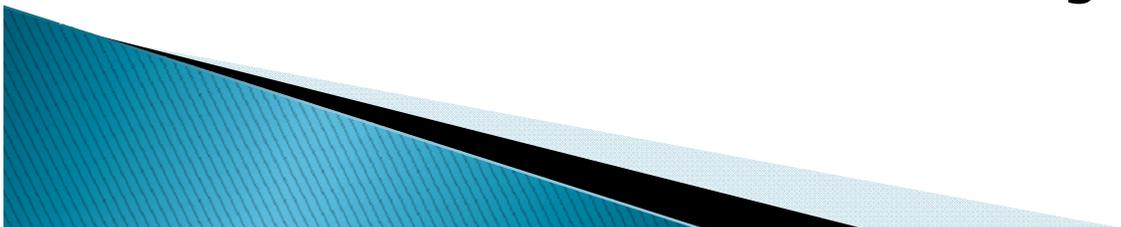
Thermal Comfort: *Prevention of Overheating in Low E Homes*

- ▶ By-pass / economizer for HRV
- ▶ Movable exterior shading
- ▶ Small heat pumps (mini-split)
- ▶ Thermal mass
- ▶ Overhead fans
- ▶ Radiant heating and cooling
- ▶ Interior heat limits



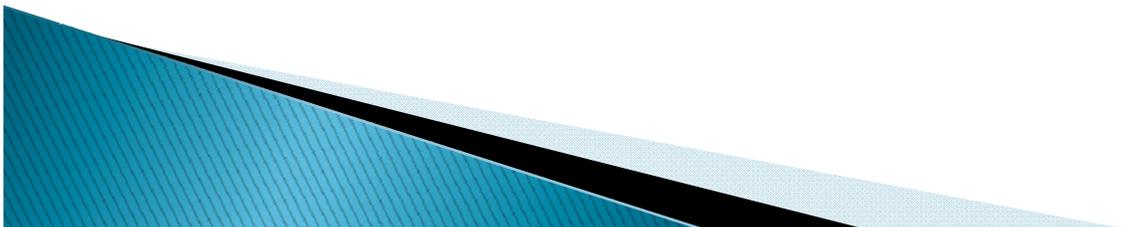
Thermal Comfort: *Multi-factorial Issues*

- ▶ Interaction of thermal comfort, IAQ, and perceived IAQ
- ▶ Resilience / adaptation for heat waves, wildfires, power outages, and severe storms
 - Conservative assumptions for climate change over building lifetimes (50–100 years)
 - Integrating whole building and community design
 - Making homes ready for PV and solar hot water
 - Interconnection with neighborhood grids



Air Cleaning and Filters

- ▶ Filtration upgrades in high pollution areas (roadways, rail yards, etc.)
- ▶ Central air filter performance: leakage, service life, maintenance access
- ▶ Filter capacity for increased levels of outdoor ozone and pollen
- ▶ Pollutant emissions from filters
- ▶ Life cycle performance of portable air cleaners
- ▶ Ozone emissions of electronic air cleaners over time



Summary

- ▶ There is a wide array of information gaps on IEQ and its determinants, and of potential research topics.
- ▶ Ongoing studies will address some information needs for California.
- ▶ Decision-makers and occupants at every stage of a building's life need information on how to achieve good IEQ.
- ▶ What information do decision-makers need to
 - Control moisture, indoor pollutant sources, temperature and humidity?
 - Build tight, ventilate right, and filter right?
 - Improve human health, comfort, and performance?

Take a Deep Breath



Source: R. Allen. Presentation at ISEE Conference, August 26, 2009, Dublin, Ireland.

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