

# Healthy Homes: Exposure to Unvented Combustion Gases

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# Healthy Homes: Exposure to Unvented Combustion Gases

PIER Energy Related Environmental Research Program

## Goals

- Advance understanding of indoor air pollutant exposures from unvented and improperly vented combustion appliances to reduce risk
- Examine effect of gas quality on pollutant emissions from advanced technology residential water heaters



## Major Tasks

- Protocols and pilot exposure study
- Exposure study and analysis
- Advanced water heater emissions & fuel effects

## Anticipated Outcomes

- Data to support population level risk assessment
- Quantitative information on risk factors
- Emissions data for advanced water heaters



# Specific objectives

- Develop approaches to quantify exposures to unvented combustion gases and to identify key sources.
- Quantify combustion-associated pollutant levels in large number of occupied CA homes under normal operation.
- Investigate and quantify factors that contribute to exposures of unvented combustion gases.
- Document the developed approaches and results in a technical publication.

# Background

- Improved epidemiological studies showing increasingly clear connection between NO<sub>2</sub> and asthma severity
- Homes with gas appliances shown to have higher NO<sub>2</sub>
- Increasing evidence of CO effects at exposure levels below standard screening levels
- Emission rates and exposures vary widely
- Large uncertainties about distribution of exposures, frequency of venting problems, high emitting appliances
  - Data on in-use appliances by NYSEARCH: results not released to the public as of summer 2010

# Major Pollutant Sources

Source	CO	NO2	HCHO	Ultrafine particles	PM2.5
Gas combustion	✓	✓	✓	✓	
Cooking (food prep)			✓	✓	✓
Hot surfaces (heated dust)				✓	✓
Candles / incense	✓	✓	✓	✓	✓
Ozone + terpene chemistry			✓	✓	✓
Material emissions			✓		
Outdoor air		✓	✓	✓	✓

# Task 2.1 Protocols & Pilot Exposure Study

- Form technical advisory committee (TAC)
- Develop protocols to quantify combustion-related air pollutant levels in homes
  - Identify factors; vulnerable groups
  - Measurement and monitoring plan
  - Questionnaire and sampler design
  - Recruitment plan and materials
  - Deployment plan: mail-out, home visits
  - Comments by TAC, approval by CCM
  - Approval of all materials by LBNL Human Subjects Committee
- Conduct pilot implementation to obtain data
  - 100 homes via mail-out, 20 via visit
  - Assess best methods, challenges

# Natural Gas Appliances of Interest



# Known or Suspected Factors

## Physical Factors

- High emission rates from bad combustion
- Improper, blocked venting
- Cracked furnace heat exchanger
- Appliance quality (socioeconomics)
- Over-tight: back drafting / spillage

## Socioeconomics

- Low income
- Seniors
- Renters

## Activity Factors

- Cooking frequency
- Kitchen exhaust use
- Window opening

# Preliminary Data Collection Plan

- Mail-out / basic
  - 1-week monitoring
  - Pollutant concentrations
    - CO, NO<sub>2</sub>, NO<sub>x</sub>
    - HCHO some homes\*
  - Questionnaire
    - Activities that can impact exposures
  - Furnace activity (T)
  - CO peaks
    - Subject to verification
  - Temperature and RH
- Home visit extras
  - Time-resolved CO
  - Cooking burner use
  - Physical assessment of combustion sources
- Supplemental\*
  - Web-based surveys
  - Additional monitoring
    - Cooking burners
    - Kitchen fan

\*As funds permit

# Preliminary Recruitment Plan

## Potential partners

- Renter associations
- Senior assistance
- Low income services
- Homeowners associations

## Leverage other efforts

- CA Dept. of Public Health
- Weatherization program
- CEC multifamily project
- DOE survey of ventilation and IAQ

## Multimedia communication

- Express interest with mail-in card, phone number or web-site.
- Communications about sampling schedule via phone, e-mail, text, twitter, etc.
- Outreach via existing lists, publications, bulletin boards, etc.

# Task 2.2 Exposure Study and Analysis

- Update protocols for full exposure study
  - Revise protocols based on pilot experience;
    - Resubmit for Human Subjects renewal / extension
- Conduct full exposure study
  - Expand recruitment to get statewide sample with mail-out
  - Expand visits to more of state
  - Budget for minimum of 150 homes via mail-out; 20 via visit
  - Intent is to reach more homes; totals will depend on recruitment cost and assessed value of mail-out screening vs. home visit
- Analysis and reporting
  - Extrapolate results to statewide exposure estimates

# Task 2.3 Advanced Water Heater Emissions

## Goals:

- Determine baseline pollutant emission factors for advanced technology residential water heaters
- Quantify effect of fuel Wobbe number on emissions

## Methods:

- Laboratory study using methods from current LNG study
  - Evaluate 12-14 devices on baseline and higher WN fuel
- TAC guidance and coordination on priority devices

<b>Technologies</b>		
Advanced On-Demand	Ultra-low NO <sub>x</sub>	Hybrid (Tank/On-demand)

