

# Benefits of High Efficiency Filtration to Indoor Air Quality

Research Division

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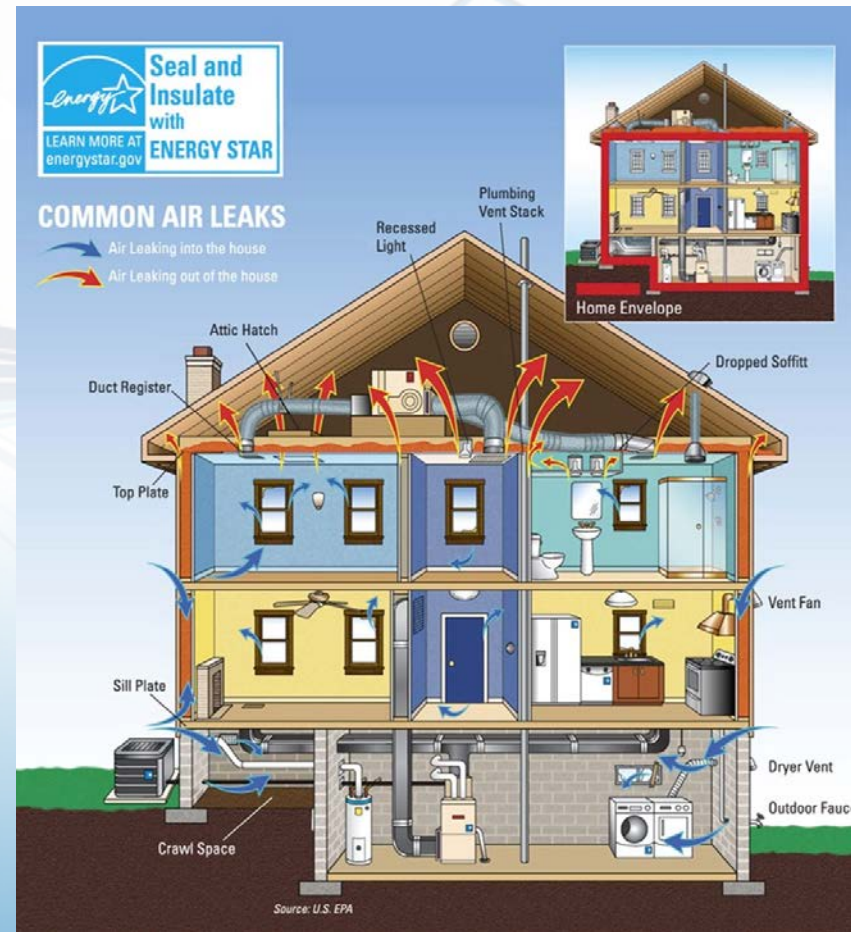


# Background

- Exposure to Indoor Pollutants
  - People spend ~ 90% of their time indoors
  - Accounts for a significant fraction of total pollutant exposure
- Vulnerable Populations
  - Children and elderly
  - People with pre-existing respiratory or cardiovascular disease

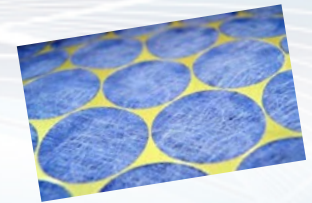
# Factors Affecting Indoor Air Quality

- Modern Construction
  - Tight building envelope
  - Low air exchange
- Sources
  - Indoor - Cooking, smoking, consumer products, building materials
  - Infiltration of outdoor pollutants
- Ventilation/High Efficiency Filtration
  - Outdoor air needed
  - Potential health benefits



# Filter Efficiency (MERV)

<b>MERV Ratings*</b>				
	<b>MERV Rating</b>	<b>Average Particle Size Efficiency (PSE), microns -- % Removal</b>		
		<b>0.3-1.0</b>	<b>1.0-3.0</b>	<b>3.0-10.0</b>
<b>Low</b>	1-4	N/A	N/A	<20%
<b>Med</b>	6	N/A	N/A	35-50
<b>High</b>	13	<75	>90	>90
	16	>95	>95	>90
<b>HEPA</b>	17-20**	≥ 99.97 - 99.999		



\* Adapted from EPA 2009; originally from ANSI/ASHRAE Standard 52.2-2007.

\*\* Not part of the official ASHRAE Standard 52,2 test, but added by ASHRAE for comparison purposes.

N/A – Not applicable to MERV rating

# Reducing In-Home Exposure to Air Pollution

P.I. Brett Singer (LBNL)

- Evaluated eight combinations of mechanical ventilation and air filtration systems
  - unoccupied home
- Study Determined
  - Reductions of particles and black carbon
  - Energy use
- Several filter efficiencies evaluated



# Sacramento Test Home



# Study Findings: Indoor Pollutant Reductions

- Four systems reduced incoming PM<sub>2.5</sub> by over 90%
- MERV 16 filters achieved the greatest reductions (~95%) for PM<sub>2.5</sub>, black carbon and UFP
- High MERV filters not an issue for airflow

# Benefits of High Efficiency Filtration to Children with Asthma

P.I. Deborah H. Bennett (UC Davis)

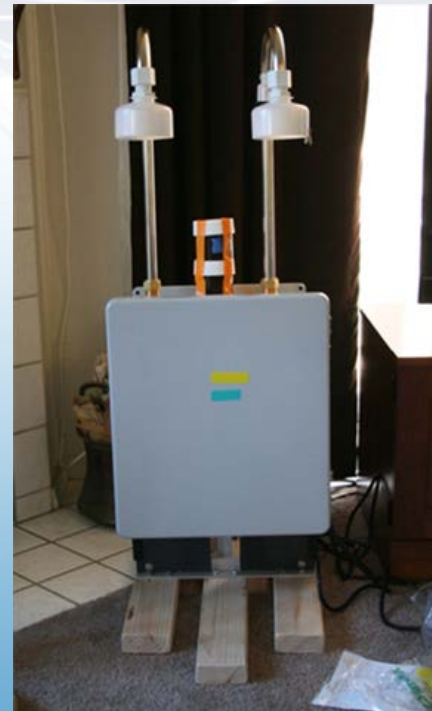
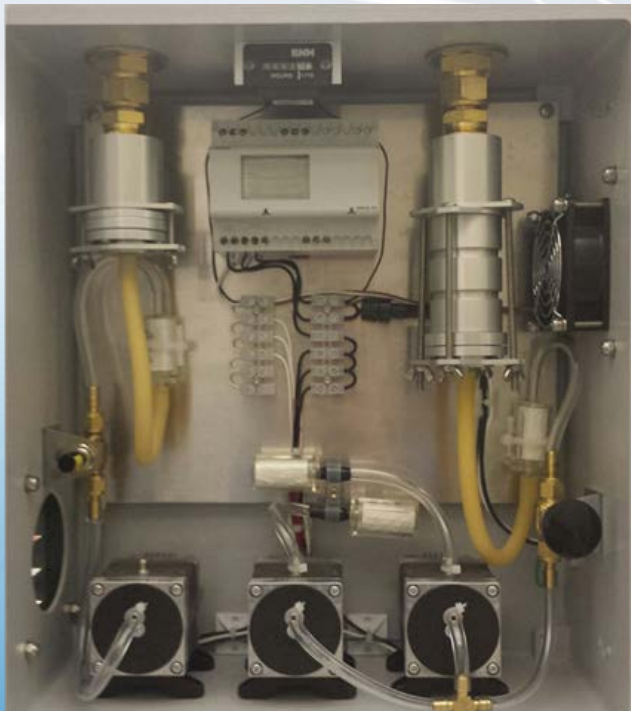
- Purpose: investigate the effectiveness of high-efficiency filtration in reducing indoor pollutant exposures and asthma symptoms
  - Participants (6-12 yrs.) with asthma
  - 172 homes enrolled
  - 1 year with high efficiency filtration, 1 year without
- Interventions – portable air cleaners or central-air system filters (MERV 16)
- Participants from high outdoor pollution areas (Fresno and Riverside)





# Air Pollution Samples Collected

- Air Pollution Samples
  - Indoor and outdoor PM<sub>0.2</sub> (UFP), PM<sub>2.5</sub>, PM<sub>10</sub>
  - Reflectance measurements (estimate black carbon)



# Health Data Collected

- Health Measurements
  - Spirometry and exhaled nitric oxide
  - Symptom diaries, recall questionnaires
  - Rescue medication use, unplanned doctor and emergency room visits, respiratory infections



# Study Findings: Filtration and PM Reductions

- For all homes, indoor PM concentrations were reduced by 34% to 52%.
  - Portable air cleaners reduced PM<sub>0.2</sub> and PM<sub>2.5</sub> by 52% and 51%, respectively
  - Central system filters reduced PM<sub>0.2</sub> and PM<sub>2.5</sub> concentrations by 34% and 37%, respectively.
  - Indoor/outdoor reflectance ratios reduced by 77%

# Study Findings: Health Effects

- Small but significant reduction in clinic visits (20%) with filtration for all asthmatics
  - The most significant reduction (43%) was observed for severe asthmatics
- No significant change in most asthma symptoms
  - Less waking at night due to asthma with high efficiency filtration

# Summary:

## Key Results and Benefits

- High-efficiency filtration effective at reducing indoor PM
  - PM reduced by 34% (older/leakier homes) to 95% (newer/tighter homes)
- Benefits
  - Minimize indoor exposures close to outdoor sources
  - Address IAQ and EJ concerns
  - Besides asthma, other respiratory and cardiovascular benefits

# Use of Study Results

- Building code strengthened to require MERV 13
- Included in *Strategies to Reduce Air Pollution Exposures near High-Volume Roadways*
- Fact Sheets for public use: *Air Cleaning Devices for the Home*
- Supplemental Environmental Projects (SEPs) policy (school air filtration)



Thank You!

