

# Cumulative Impacts:

Linking regional, local, and household air pollution



Image Source: BAEHC



Silent Spring Institute  
Communities for a Better Environment  
Brown University  
University of California at Berkeley



## Pollution Sources in the San Francisco Bay Region



**Your health is  
affected by ....**

## **Regional Air Pollution**

Image Source: Bay Area  
Environmental Health Collaborative





Your health is also affected by ...

## Neighborhood Air Pollution



and ....

## Indoor air pollution inside the home



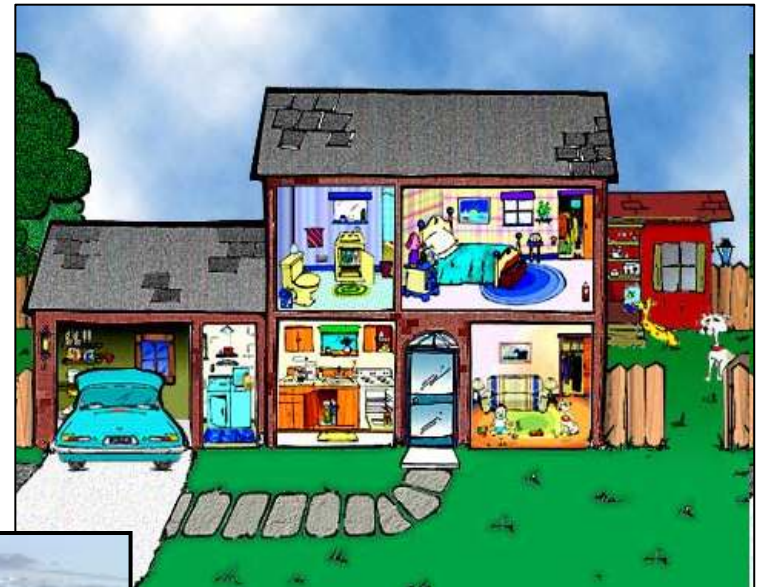


# What are the cumulative impacts of multiple pollutions sources?

Region



Home



Neighborhood



# ***The Household Exposure Study***



# What did we do?

*Tested for chemicals in and around the home*

Outdoor Air



Indoor Air



House Dust





**We tested for pollutants that come from local, outdoor sources**





# We tested for pollutants that come from household products



# Where did we do our testing?

40 **Richmond** Homes

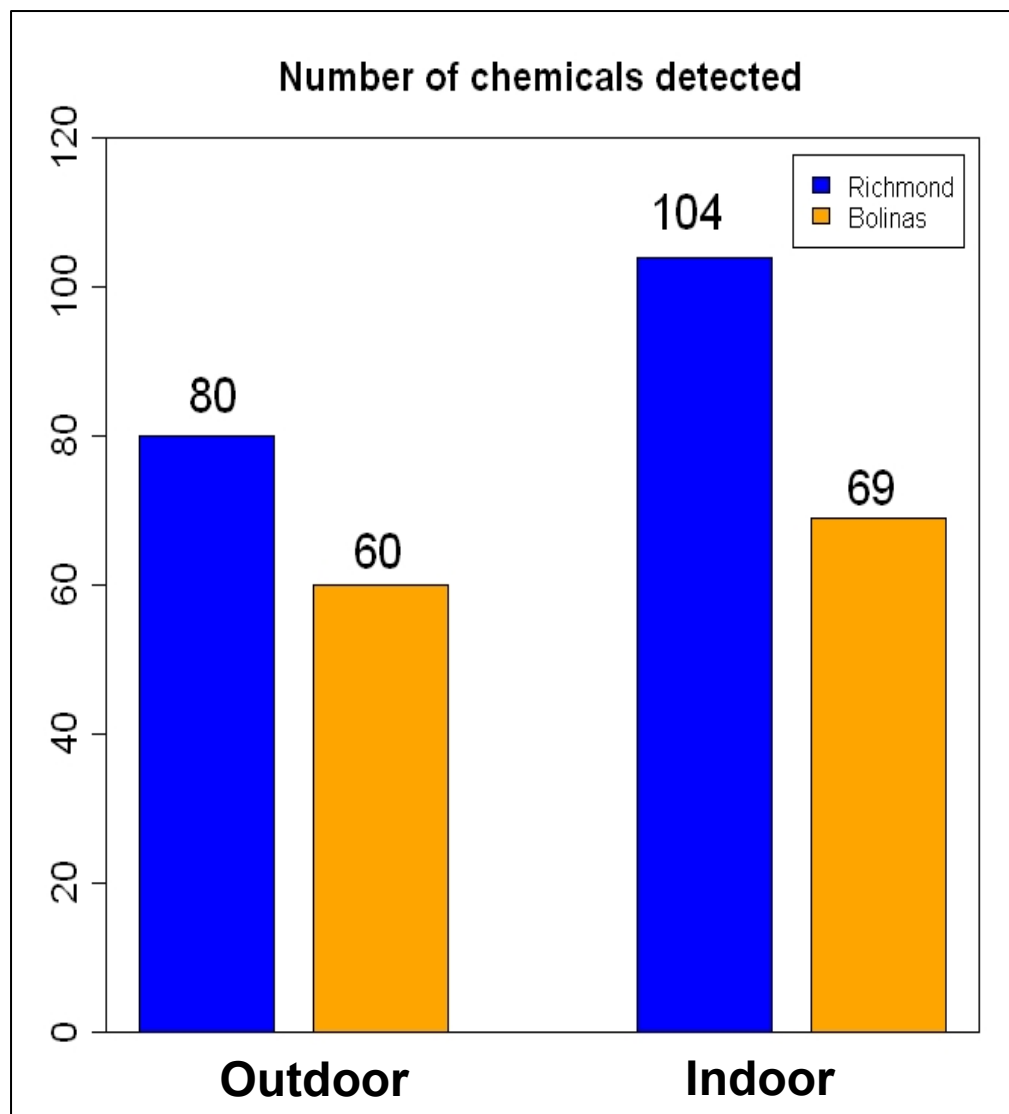


10 **Bolinas** Homes





# What did we find?



- 153 chemicals tested
- More chemicals in Richmond than Bolinas
- 80 chemicals in Richmond outdoor air
- 104 chemicals in Richmond indoor air



# Particulate Matter (PM2.5)

Sources: traffic, industries, smoking, cooking

Health effects: heart and respiratory problems

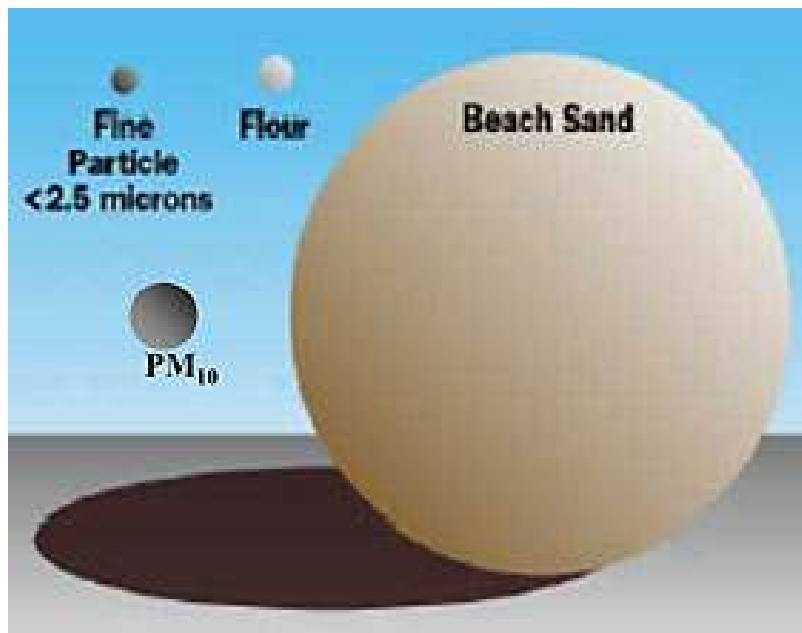


Image source: U.S. EPA, Office of Research and Development

PM travels deep into the lung

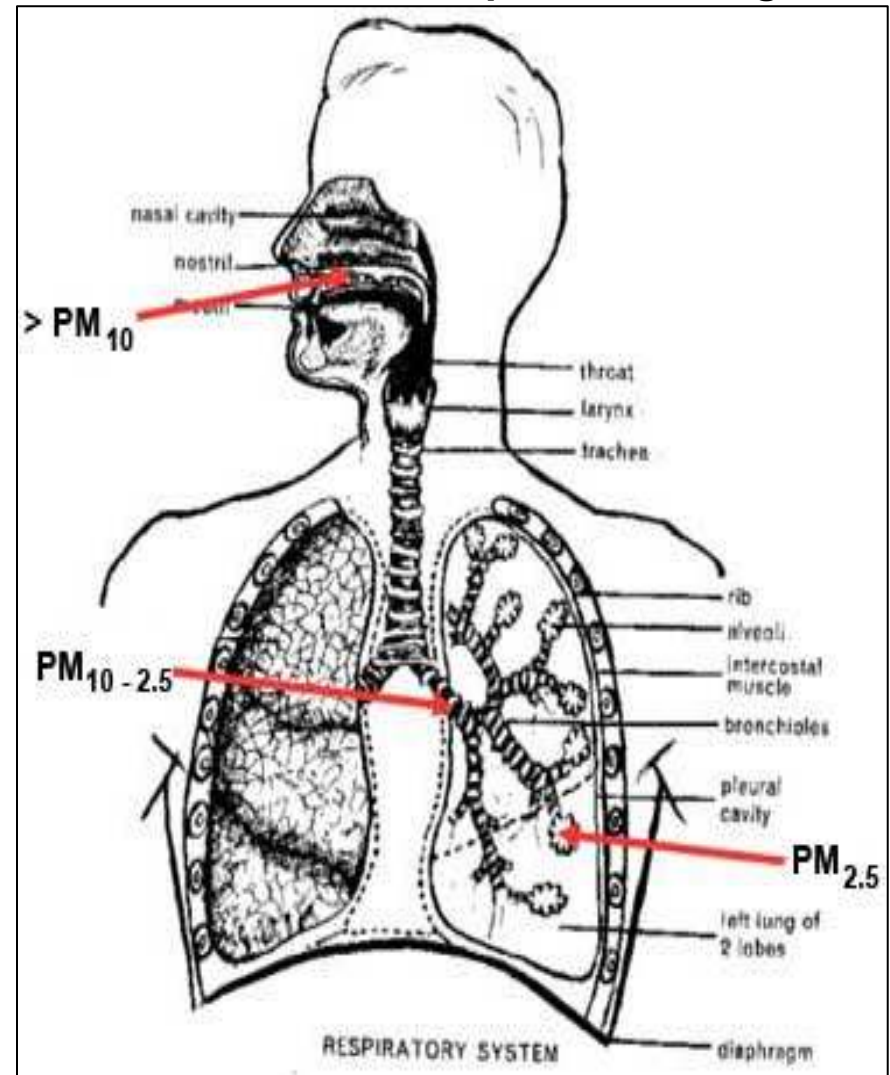
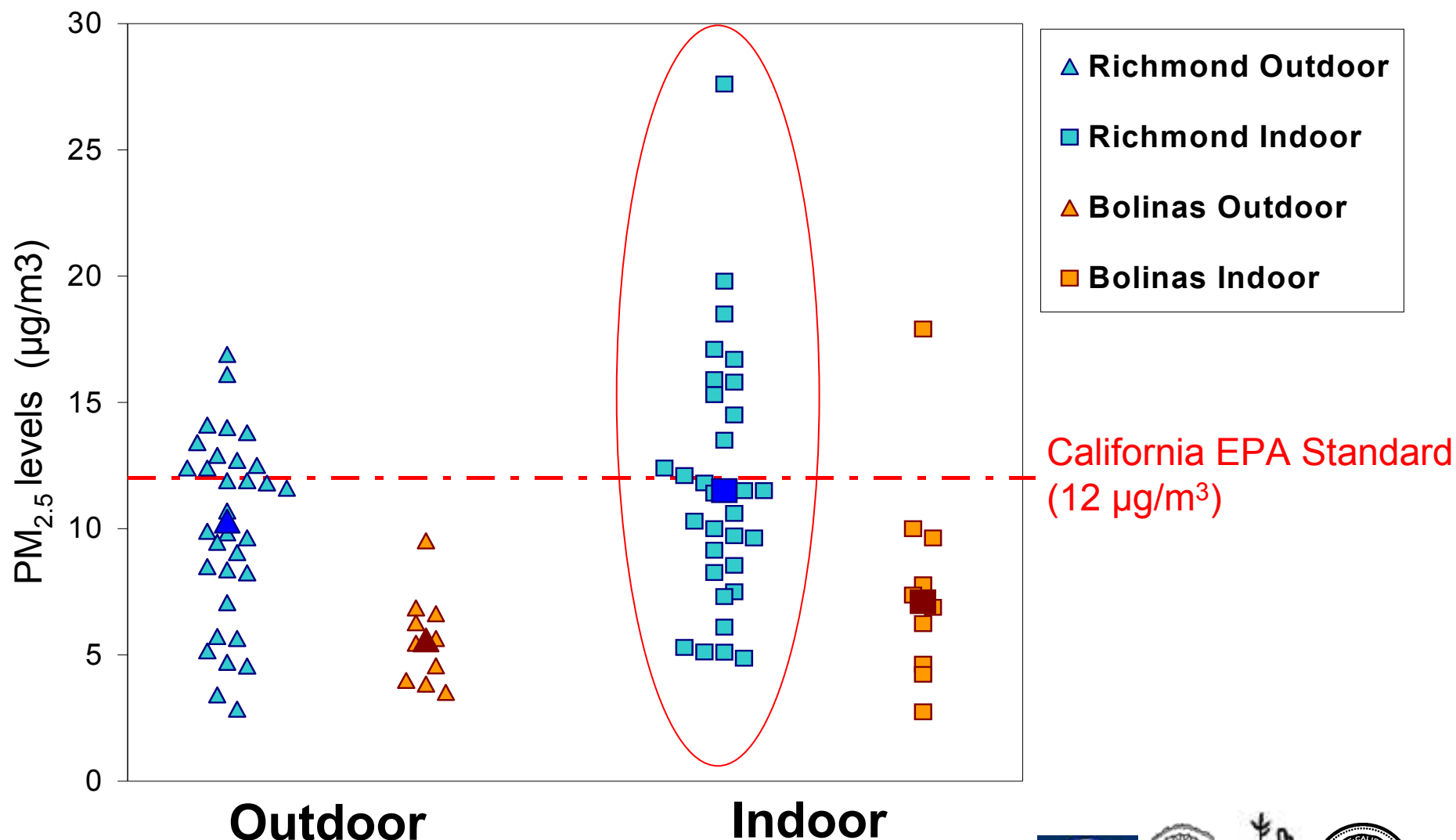


Image source: Minnesota Pollution Control Agency



# We found unhealthy levels of PM<sub>2.5</sub> in nearly half of Richmond homes



Dark symbols represent median level for each group



# ***Outdoor Air Pollution***





# Pollution sources have distinct chemical profiles

## Crude Oil Combustion Sources

### Traffic



### Petroleum Refinery



Vanadium

Nickel

### Shipping



# Identifying Pollution Sources in Richmond **Outdoor** Air

	<b>“Crude Oil Combustion”</b>
<b>Vanadium</b>	1.00
<b>Nickel</b>	0.97
<b>Zinc</b>	0.18
<b>Manganese</b>	0.07
<b>Lead</b>	-0.02
<b>Phenanthrene</b>	0.32
<b>Fluorene</b>	0.26
<b>Organic carbon</b>	-0.09
<b>Elemental carbon</b>	0.01
<b>Nitrates</b>	0.11
<b>Sulfates</b>	0.04

Use statistical method called factor analysis to see which *pollutants group together*

Pollutants with high numbers (0.4-1.0) in each column likely come from a common pollution source

Tight clustering of vanadium and nickel in Richmond air samples suggest presence of *crude oil combustion*



## Major Emission Sources in Richmond **Outdoor** Air

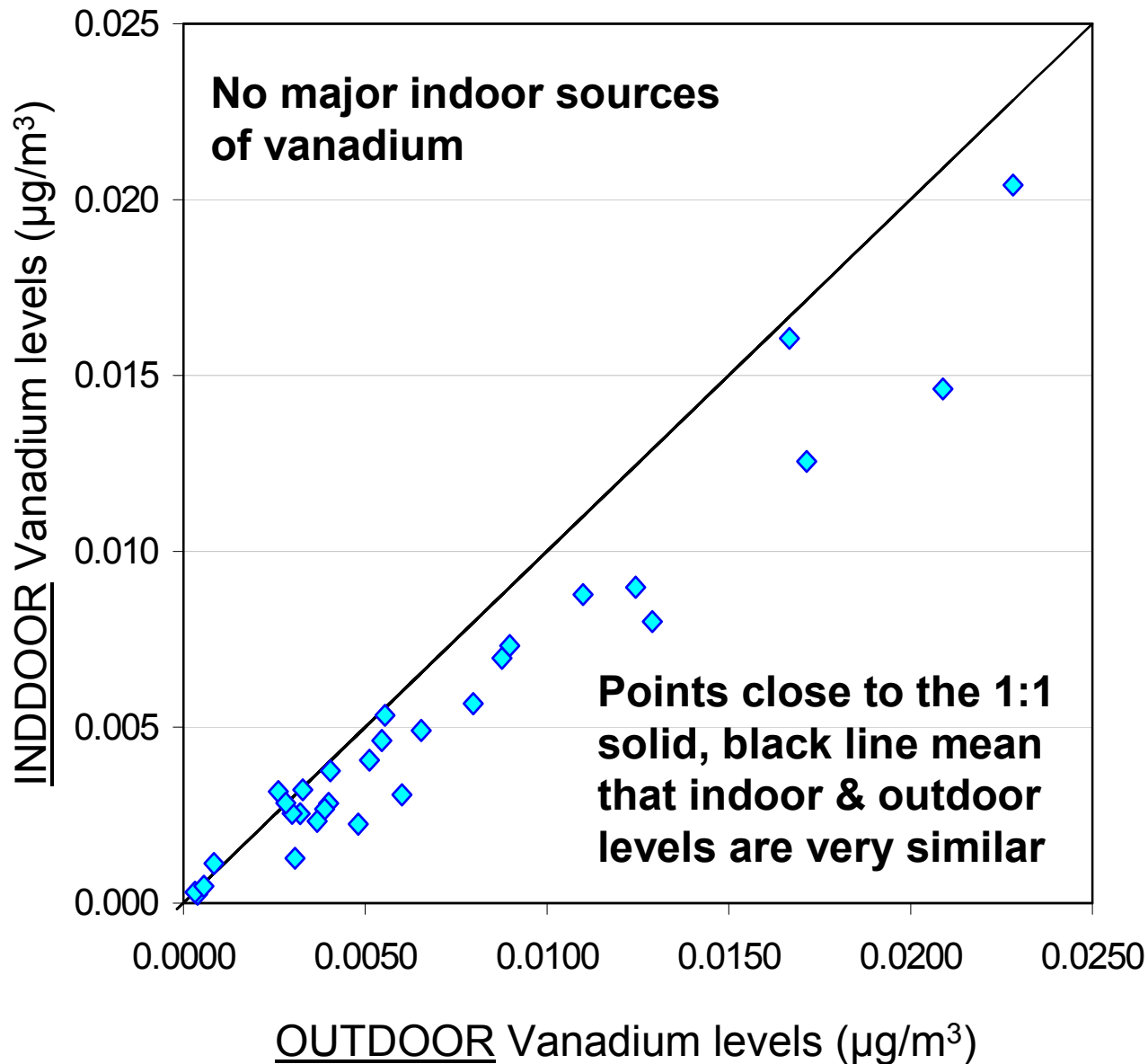
	<b>“Crude Oil Combustion”</b>	<b>“Local Industry”</b>	<b>“Traffic”</b>	<b>“Regional Pollution”</b>
<b>Vanadium</b>	1.00	-0.03	-0.03	0.08
<b>Nickel</b>	0.97	0.03	0.02	0.05
<b>Zinc</b>	0.18	0.59	-0.03	-0.02
<b>Manganese</b>	0.07	0.78	0.12	0.02
<b>Lead</b>	-0.02	0.56	0.45	-0.14
<b>Phenanthrene</b>	0.32	0.23	0.53	-0.05
<b>Fluorene</b>	0.26	0.09	0.68	-0.02
<b>Organic carbon</b>	-0.09	0.01	0.65	0.02
<b>Elemental carbon</b>	0.01	0.15	0.45	0.23
<b>Nitrates</b>	0.11	0.31	-0.09	0.75
<b>Sulfates</b>	0.04	-0.24	0.06	0.88

Colored cells indicate compounds that group together





## Indoor vs. Outdoor Vanadium



**Pollutants from outdoor sources are migrating indoors**



*How does Richmond outdoor  
air quality compare to other  
cities in California?*



	PM2.5	Sulfates
<b>Richmond</b>		
<b>Bolinas</b>		
Bakersfield		
Calexico		
Fresno		
Los Angeles		
Riverside		
Sacramento		
San Jose		



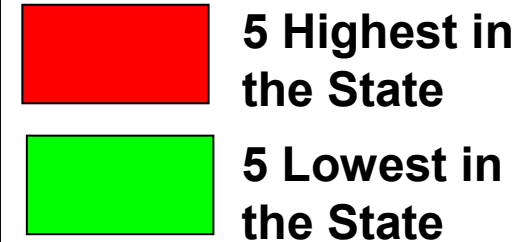
*Many CA cities have higher levels than Richmond of PM2.5 and sulfates*

Rankings based on median concentration using data from study homes and 14 Cal-EPA monitors





	Vanadium	Nickel
<b>Richmond</b>		
<b>Bolinas</b>		
Bakersfield		
Calexico		
Fresno		
Los Angeles		
Riverside		
Sacramento		
San Jose		



*Richmond levels of vanadium and nickel are among the highest in the state*

Rankings based on median concentration using data from study homes and 14 Cal-EPA monitors



# *Indoor Air Pollution*

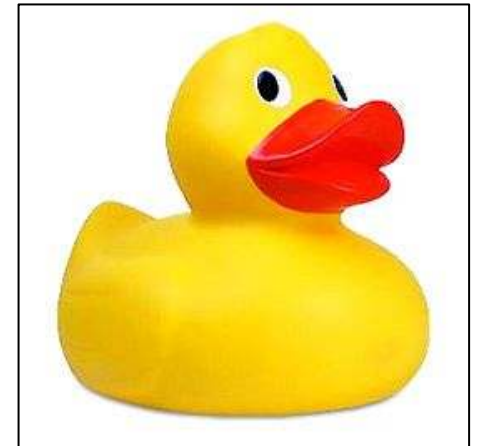


# Phthalates

*found in 100% of Richmond homes*

## Sources:

- Fragrances
- Nail polish/Cosmetics
- Vinyl (PVC) products
- Plastic toys



## Health Effects:

- Mimic bodies' hormones
- Alter male reproductive development
- Linked to asthma and allergies





# PAHs

*found in 100% of Richmond homes*

## Outdoor Sources



Industry

Traffic



## Indoor Sources



Cigarette &  
incense smoke

Grilling food



Health Effects: Cancer; reproductive harm



# Pesticides: *A changing landscape*

## Banned Pesticides

DDT (banned in 1972)  
found in **90%** of  
Richmond homes

## Limited Use

Chlorpyrifos found in **half**  
of Richmond homes

## Current Use

Permethrins found in  
**nearly every**  
Richmond home

Health Effects: Harm to brain development; cancer



# Phenols

*Nonylphenol found in 100% of Richmond homes*

## Sources:

- Detergents
- Paints
- Plastics
- Pesticides

## Health Effects:

- Mimic bodies' hormones
- Cause reproductive harm in animal studies



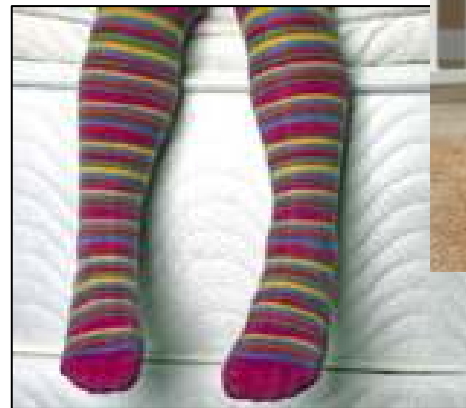


# PBDE flame retardants found in 100% of Richmond homes

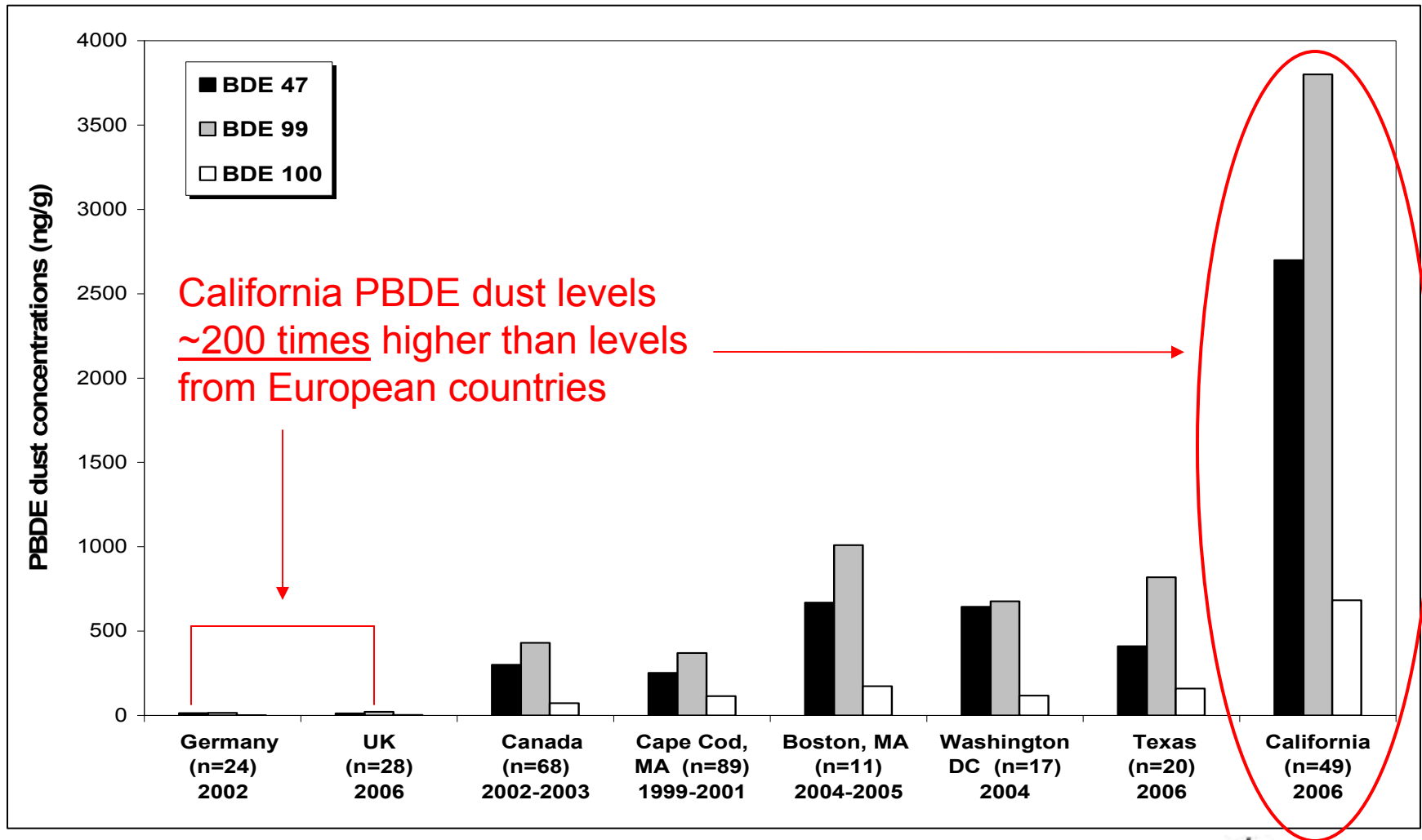
Sources: furniture,  
electronics, carpet padding,  
and baby products

Health Effects: Disrupt thyroid  
and can affect the  
developing brain

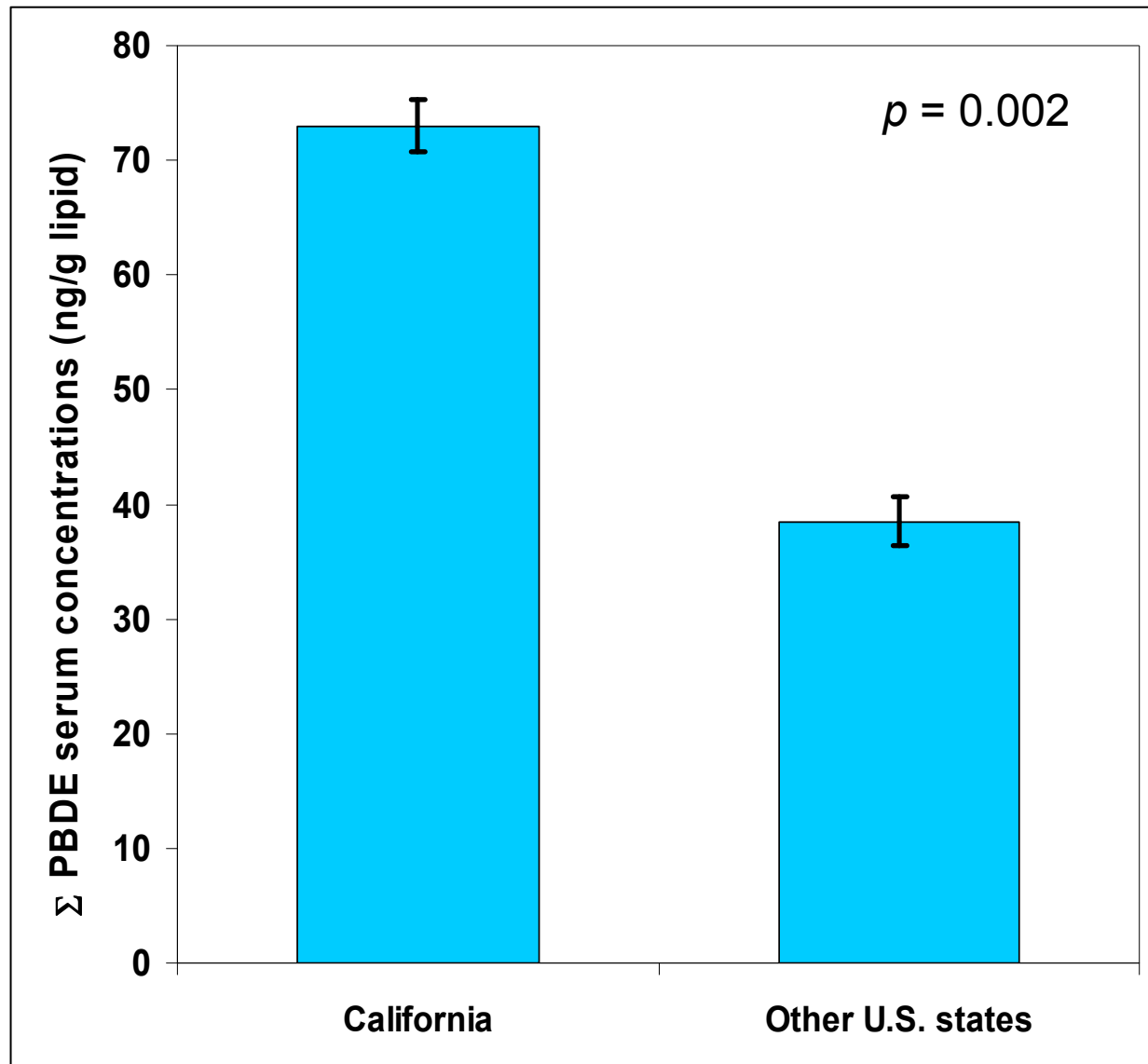
© Leona Kanaskie



# Median PBDE house dust concentrations across North America and Europe



# In our bodies: PBDE blood levels in California nearly two fold higher than rest of the U.S.



Analysis conducted with NHANES national survey data from the Centers for Disease Control (n=1771)





# “Poster Child” for Chemicals Policy

- Penta-BDE banned in CA
- Persistent in homes
- Substitutes problematic
- More flammability standards being considered

***We need a different approach***



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PRESS RELEASE

## Californians Have Toxic Flame Retardants in Their Blood at Levels Twice the National Average, According to New Peer-Reviewed Study

State and Federal Governments Consider Imposing New Fire Standards that Would Expand Use of Flame Retardants

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## Californians have higher levels of flame-retardant PBDEs in their blood

Researchers find that residents not only have more of the chemicals in their blood than people elsewhere, but that levels in California homes can be 10 times higher.



# CAPITOL WEEKLY

THE NEWSPAPER OF CALIFORNIA GOVERNMENT AND POLITICS

## Leno asks Governor to ban controversial fire retardants by executive order

By [Malcolm MacLachlan](#) (published Tuesday, October 07, 2008)

# Environmental Justice Lessons

- More pollutants and higher concentrations in Richmond.
- Outdoor pollutants penetrate indoors
- Indoor concentrations are often higher than outdoor
- Heavy oil combustion leaves a distinctive footprint in homes. Richmond is more affected than others in CA.



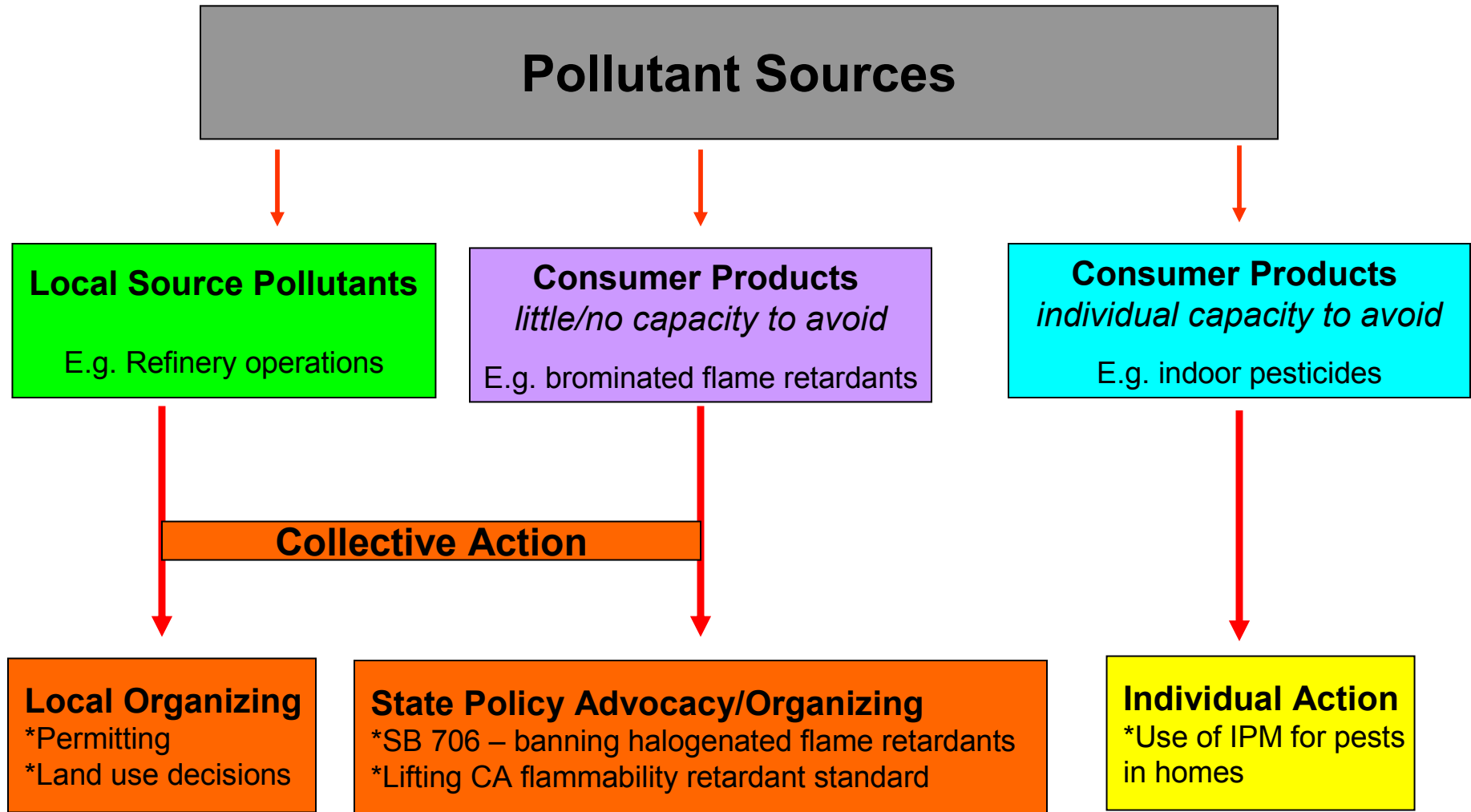


# Indoor Pollutants Lessons

- Many chemicals in every home
  - Few differences between Richmond and Bolinas
- Banned and current use pesticides in nearly every home
- High levels of PBDE flame retardants
  - Likely due to CA strict fire safety standard.



# Linking Household Exposure Study to Paths for Individual and Collective Action





# Thanks to Our Team

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## Advisory Council

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