

# SECOND HAND SMOKE EXPOSURE: THE REAL TRUTH

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# Outline

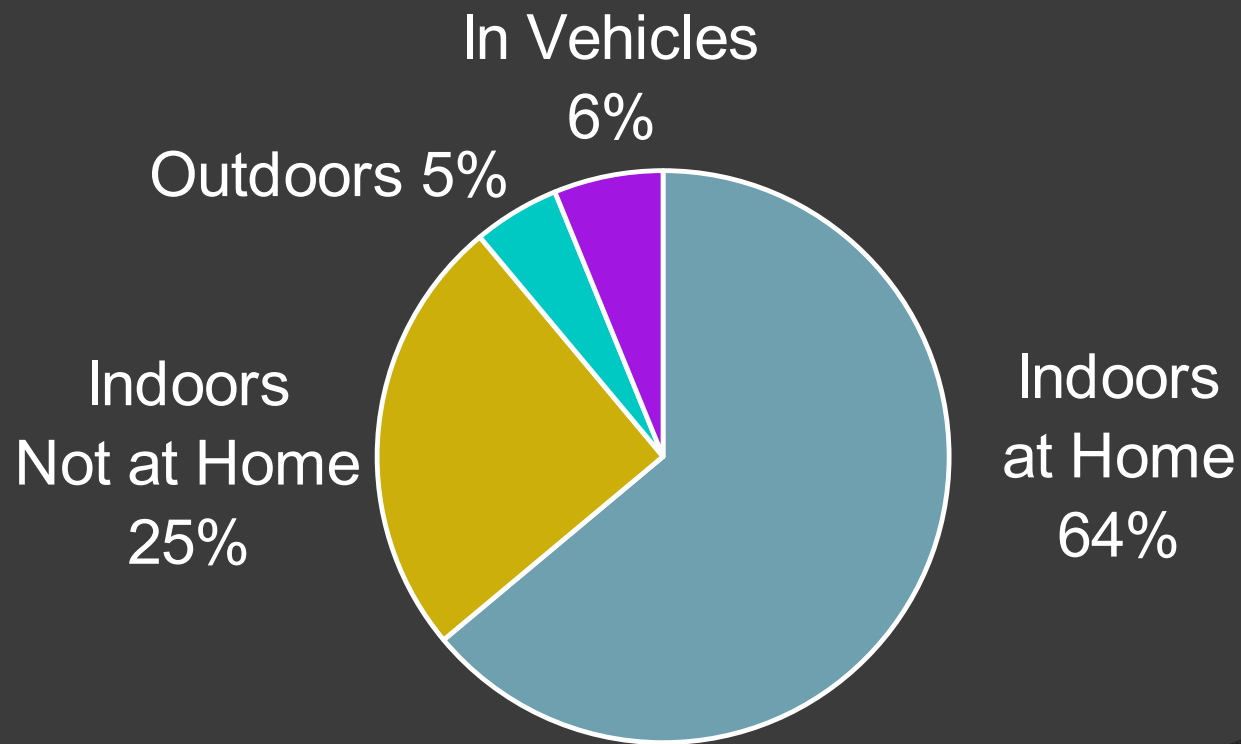
- ⊙ Basics of indoor air quality
  - Understanding importance of indoor air quality
  - Transport
  - Sources and that can impact indoor air quality
  - Resuspension
- ⊙ Second Hand Smoke (SHS)
  - ⊙ What is it?
  - ⊙ Facts about SHS
  - ⊙ Who is affected by SHS?
  - ⊙ Methods for monitoring and measuring SHS
  - ⊙ Case Studies
- ⊙ Overall conclusions

# Importance of Understanding Indoor Air Quality?

- ◎ People spend 90-95% of their time indoors
  - Work, home, automobile
- ◎ Mechanism of Transport of Pollutants Indoors
  - Tracking in, out, \*personal cloud, infiltration of pollutants
- ◎ Different sources can impact indoor air quality
  - \*Traffic combustion, \*cooking, \*cleaning, household appliances, wood stoves, gas stoves, new furniture, carpet, resuspension, \*primary and/or second hand smoke (SHS)
- ◎ \*Key is to understand your indoor environment to better protect the health of yourself and those around you.

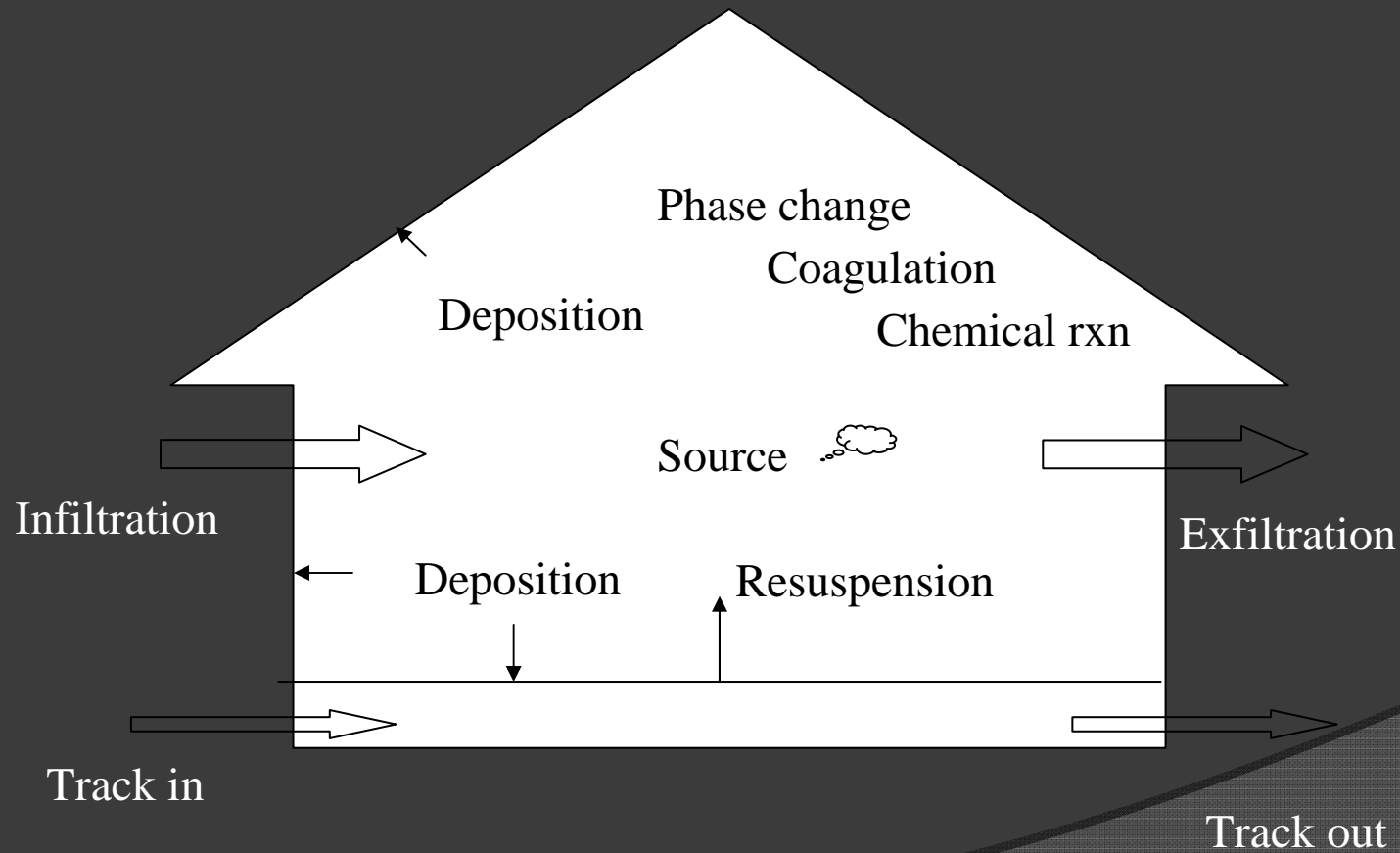


# Percentage of Time Spent Indoors, Outdoors and in Vehicles in the United States

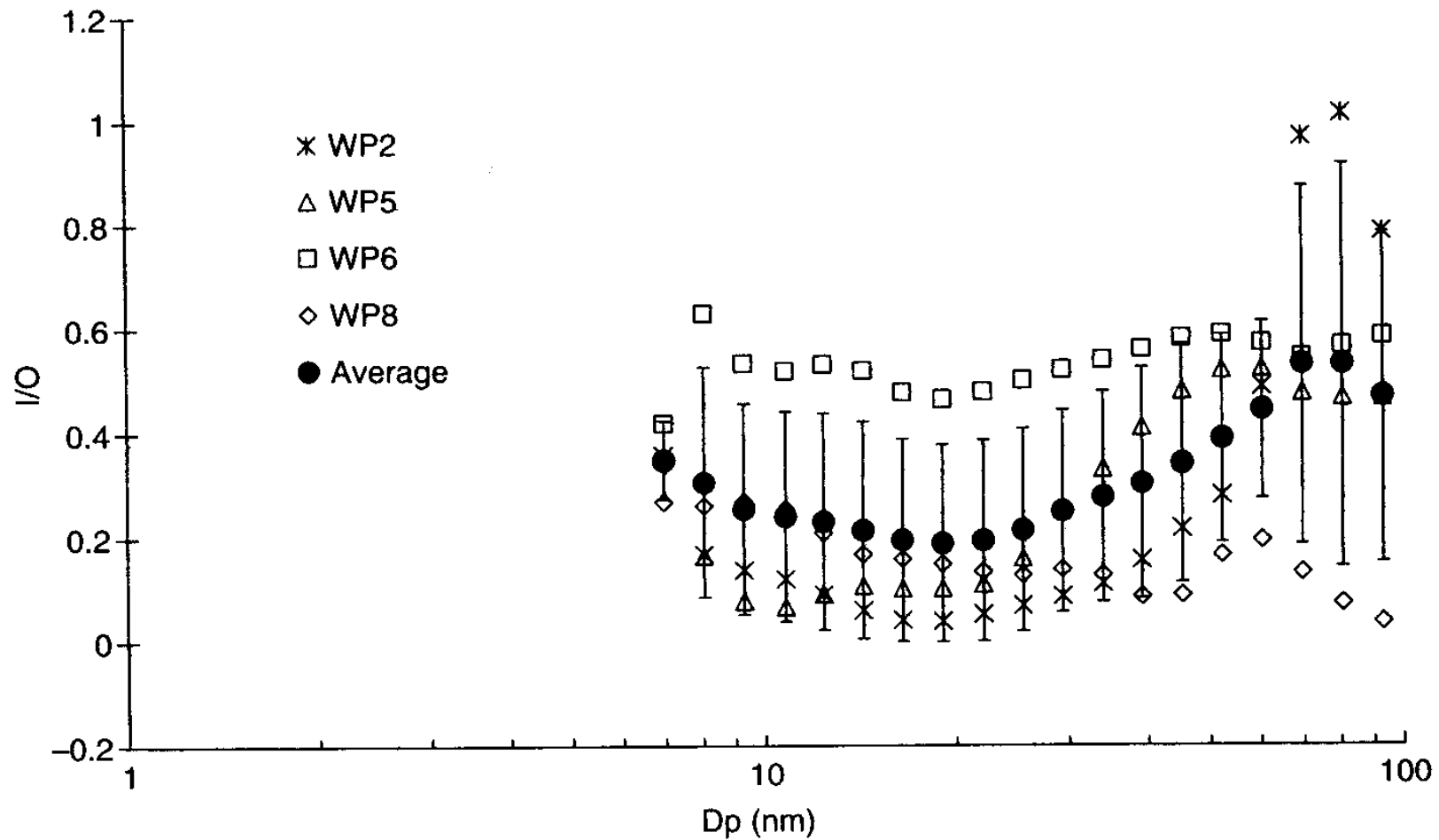


Source: (Robinson et al., 1991)

# Mechanism of Transport of Pollutants Indoors



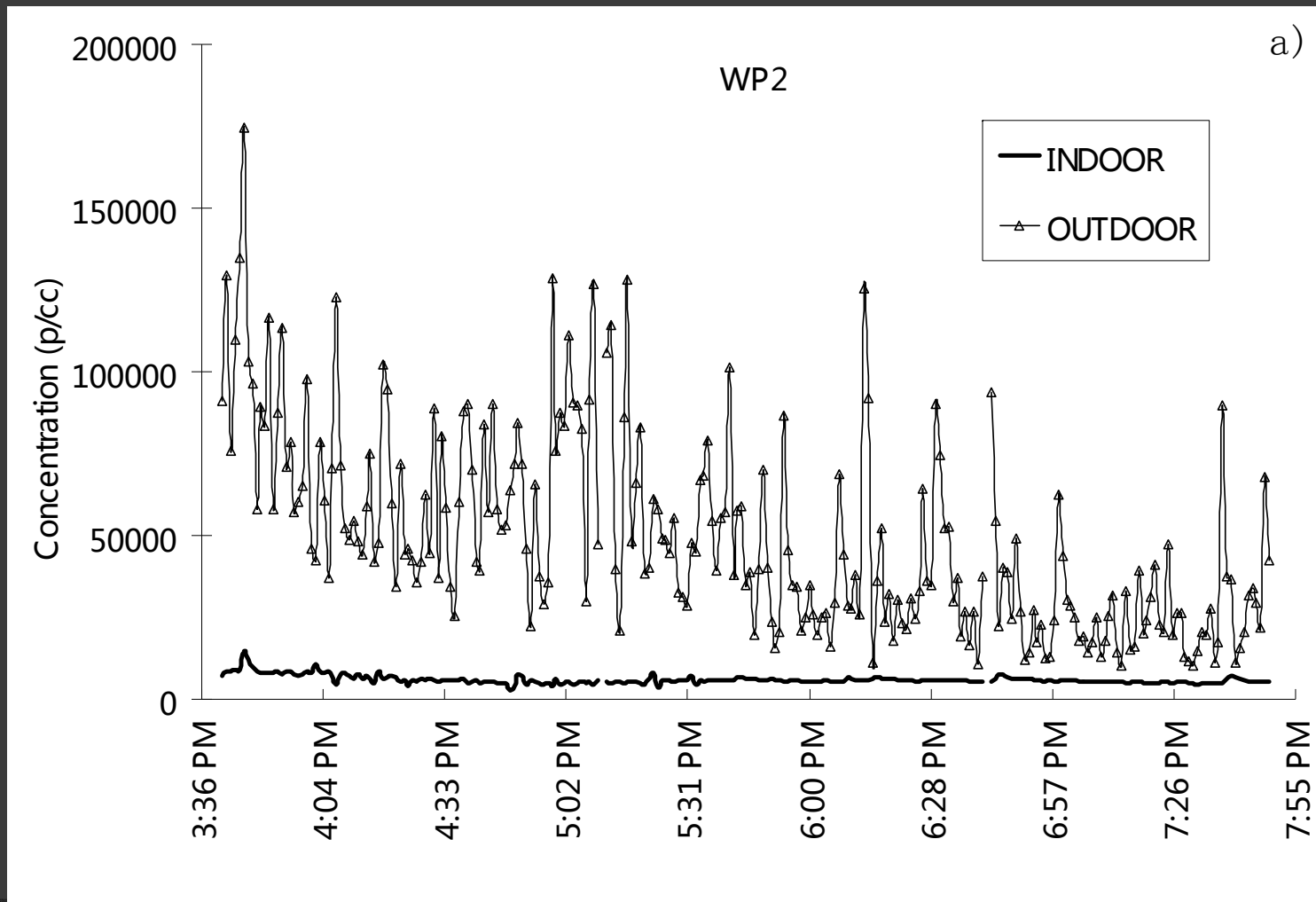
# Ambient (Combustion) Impacts on Indoor Air Quality



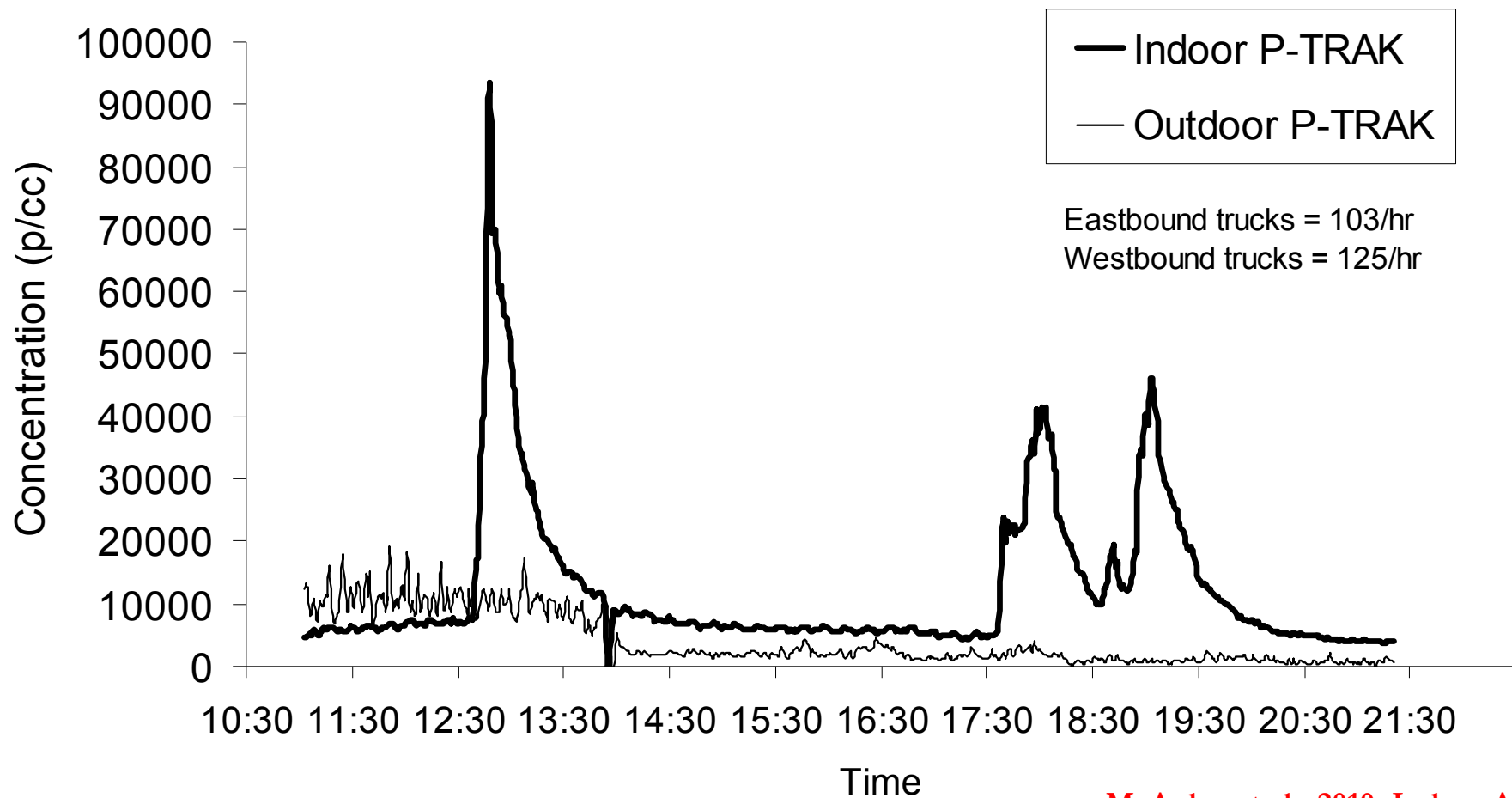
# Conditions of Varying Indoor Air Quality

- ⊙ During times of **NO** indoor sources
  - (e.g., cooking & smoking)
- ⊙ During times of indoor sources
  - (e.g. cooking and cleaning)
- ⊙ Resuspension of particles from human activity (e.g., walking) that are comprised of metals, allergens, and persistent organic pollutants

# Ultrafine Particles During No Indoor Source Episodes

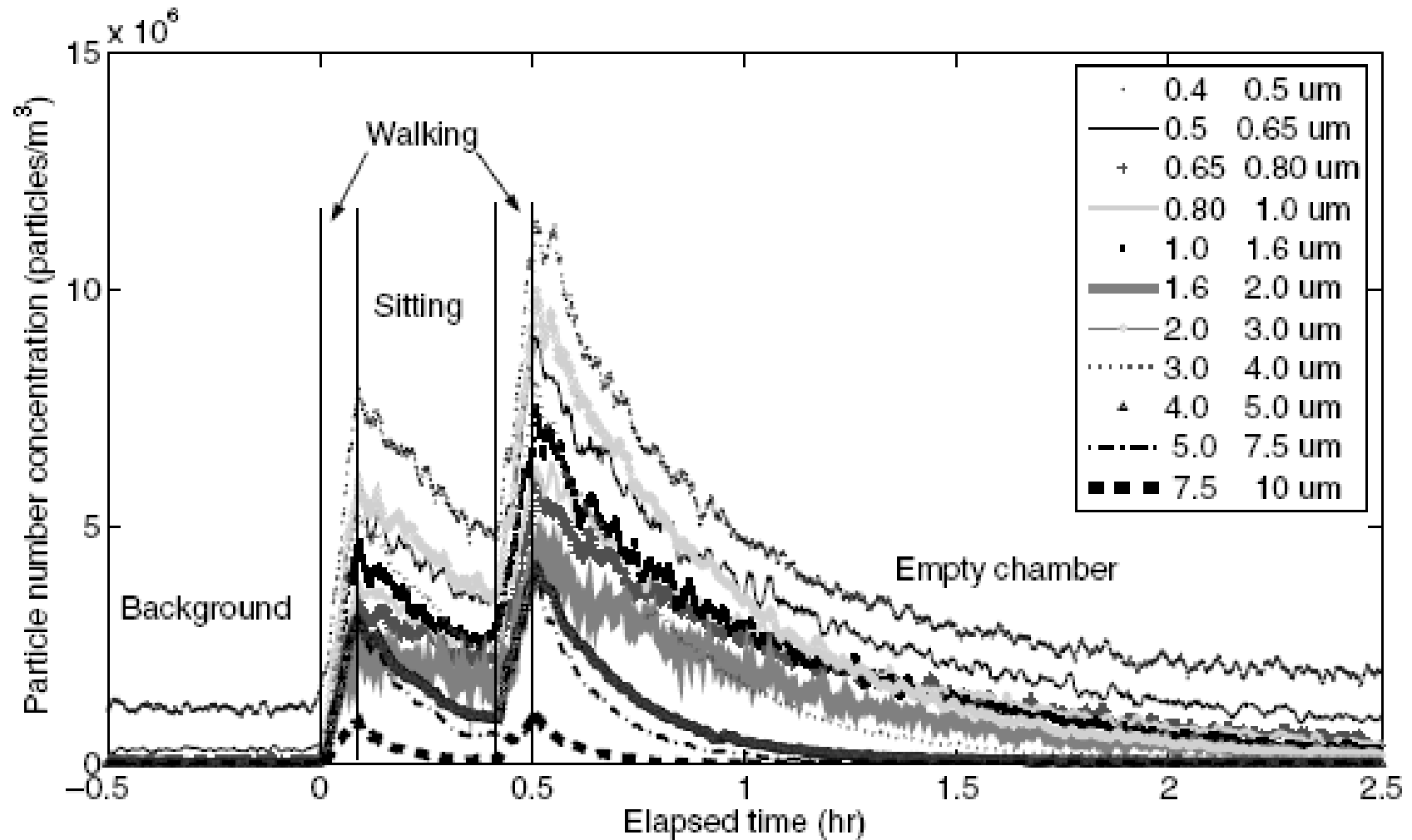


# Ultrafine Particles During Smoking and Cooking Episodes

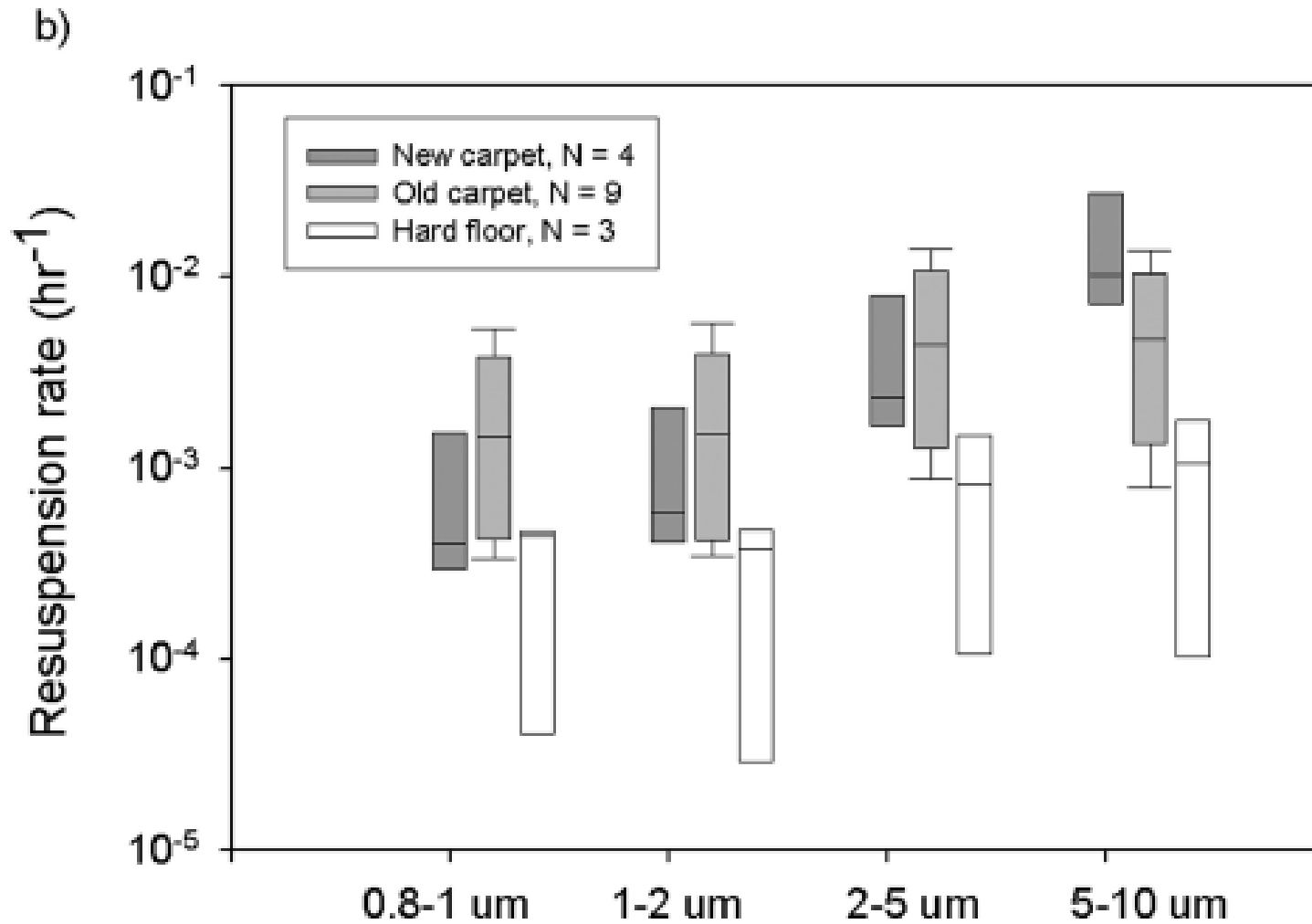


McAuley et al., 2010, Indoor Air

# Resuspension (Walking)



# Resuspension (Carpet vs. Hardwood)



# Summary of Importance of IAQ

- ⦿ Because much time is spent indoors it is very important to understand the different sources that can impact the air quality.
- ⦿ Combustion sources are a dominant source of small particles that can result in long impacts on air quality.
  - Indoor and outdoor
- ⦿ Ventilation is very important.
- ⦿ Controlling indoor air sources can help further mitigate or contribute to additional sources that can result in adverse health impacts that when combined with current sources can become very problematic.
  - (e.g., second hand smoke)

# Second Hand Smoke (SHS)

# What is Second Hand Smoke (SHS)?

- ⦿ **NUISANCE!**
- ⦿ Mixture of the smoke exhaled by the smoker and the smoke given off by the burning of the end of the pipe, cigar, or cigarette.
  - Main stream
    - combination of inhaled and exhaled smoke after taking a puff on a lit cigarette, pipe, or cigar;
  - Side stream
    - smoke coming off the end of a burning cigarette, pipe, or cigar)
- ⦿ a.k.a. Environmental Tobacco Smoke (ETS)
- ⦿ Exposures to SHS are often referred to as “involuntary” or “passive smoking.”

# Facts about Second Hand Smoke

- ⦿ Global public health concern
- ⦿ Breathing in cigar, cigarette, pipe can make you and your children sick.
- ⦿ Opening windows or using fans or air conditioners will not stop second hand smoke exposure.
- ⦿ Comprised of more than 4,000 different chemicals/compounds some of which are known carcinogens.
  - ⦿ (e.g., Benzo(a)pyrene) along with different carbonyls, VOC's, nitrosamines, nicotine , and PAH's
- ⦿ Responsible for about 3,000 lung cancer deaths per year in non-smokers (EPA, 2011).
- ⦿ Second hand smoke can cause lung and heart disease.
- ⦿ **There are no safe levels of exposure!**

# Who is Affected by Second Hand Smoke Exposure?

- ⦿ **Everyone!**
- ⦿ **Susceptible Populations**
  - Elderly
  - Immuno-compromised
  - Pre disposed breathing/heart conditions
  - Blood disorders (CO can greatly impact O<sub>2</sub> levels in the blood)
- ⦿ **Children** in many studies have been shown to be greatly impacted from exposures to second hand smoke.
  - Why?
    - In early stages of lung development
  - Current conditions can be exacerbated more rapidly and result in more pronounced acute and chronic health effects.
    - Asthma
    - Lower respiratory tract infections
    - Sudden Infantile Death Syndrome
    - Pneumonia and Bronchitis
    - Middle ear infections

Am I being exposed to Second Hand  
Smoke and what can I do to test for  
these exposures?

# Methods of Testing for Second Hand Smoke

- ◎ Physical Smell
  - If you can smell it, it is there, and you are being exposed!
  
- ◎ Ultrafine Particle Testing
  - PTRAK (TSI)
    - Can provide important background concentrations of indoor air quality during times of physical smell of SHS;
  
- ◎ PM<sub>2.5</sub> Particle Testing
  - TSI Side Pak
  - SKC Personal Exposure Monitor (PEM) Filter Measurements
  
- ◎ Nicotine Badges
  - Published method for capturing airborne nicotine to SHS
  - Specific only to nicotine and not dependent on other indoor sources
  - Captures concentrations representing long term exposures for better quantifying results.

# PTRAK™ (TSI) Particle Counter

- Easy to use and lightweight
- Extensively published **continuous** particle counter
- Captures particles in size range of 10 nm – 1,000 nm (.01  $\mu\text{m}$ -1 $\mu\text{m}$ )
- Designed for short term indoor air quality studies
- Requires recharging of reagent grade IPA every 4 hrs.
- Requires batteries for remote operation, but can also be plugged in for operation.



# PM<sub>2.5</sub> SIDEPAK AM510 Personal Aerosol Monitor

- ◉ Impactor that can be installed for sampling either PM<sub>1.0</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub>.
- ◉ Lightweight and user friendly
- ◉ **Continuous** monitoring method that requires batteries for remote operation, but can also be plugged in for operation.
- Data output provides statistics functions: max, min. and average readings, elapsed time and 8-hour TWA.



# SKC Personal Exposure Monitor (PEM)

- Very lightweight
- **Active** sampling method (i.e., requires pump) for measuring either  $PM_{2.5}$  or  $PM_{10}$ .
- Worn near the breathing zone for estimating inhalation and deposition
- Filters are pre and post weighed for calculation total mass
- EPA Referenced Method (EPA IP-10A for indoor air particles)



# Nicotine Badge

- Established in 1987 at the University of California at Berkeley and have been used internationally and published extensively.
- Used for area and personal exposure sampling for nicotine derived from cigarette, pipe, or cigar smoke.
- Very long shelf post sampling
- Very light weight and virtually undetectable
- Passive** method for air sampling (i.e., no pump required) and able to sample large coverage areas due to dispersion of ETS in the indoor air.
- Captures only airborne nicotine and is not impacted by other indoor air sources and is effective for trace levels of nicotine capture.



# CASE Study #1

# SHS Reported Exposure Case Study #1 (Phase I)

- ⦿ Multi-unit dwelling located in Boston, MA
- ⦿ Building was renovated in 1990's
  - Built originally in 1910's (no HVAC system or central heating/cooling)
  - Many old pocket doors and heating vents were still intact
- ⦿ Many open air spaces inside pocket door frame and around heating pipes.
- ⦿ Subject complained of constant exposure to SHS in her study next to the open areas of the pocket doors and heating vents.
  - Subject lived in Apartment 4A.
  - Smelled SHS in her bedroom, living room, and dining room
  - Only smoker (*according to other tenants too tenant in 1A was a very heavy smoker*) in building lived directly under her three floors down in apartment 1A.

# SHS Reported Exposure Case Study #1 (Phase I) cont...

## ◎ Phase I

- Particle number concentrations accompanied by physical smell comprised first round of sampling
  - Baseline number concentrations during no smell were conducted for all units to be sampled near doors and vents
    - Outside of 1A was conducted before and during times of SHS smell in 4A.
  - Monitoring conducted day and night for capturing patterns of smoking from 1A
  - Tenant in 2A allowed monitoring to be conducted in their units near the pockets doors and heating vents.
- ◎ Study was conducted over a period of a few days with monitoring plan set up to capture SHS in the two apartments above 1A (i.e., 4A & 2A).

\*Apartment 3A was vacant at the time.

# Results from SHS Case Study #1 (Phase I)

<b>Summary Table 9/1/2009-9/2/2009</b>	<b>Mean UFP p/cc (+/-) SD</b>	<b>*N</b>
<i>Background</i>		
4A (0215AM -0710 AM)	4,625 (+/-) 564	305
2A (19:29PM -19:55 PM)	6,921 (+/-) 900	26
<i>Indoor SHS Measurements</i>		
4A (00:38AM-00:52 AM)	11,736 (+/-) 2,336	12
2A (00:01 AM – 00:31 AM)	43,360 (+/-) 17,352	30
Outside of 1A (00:56 AM-01:00 AM)	36,970 (+/-) 13,305	4

\*Number of one-minute samples

<b>Summary Table 8/31/2009-9/1/2009</b>	<b>Mean UFP p/cc (+/-) SD</b>	<b>*N</b>
<i>Background</i>		
4A (16:15 PM-20:15 PM)	6,713 (+/-) 1,563	240
2A (20:11PM - 22:15 PM)	10,623 (+/-) 1,354	108
<i>Indoor SHS Measurements</i>		
4A	No Measurements	
2A (23:59 PM -00:07 AM)	41,079 (+/-) 14,875	8

\*Number of one-minute samples

# Results from SHS Case Study #1 (Phase II)

## ◎ Phase II

- Due to continued strong SHS smell in 4A nicotine badges were then used as board requested additional evidence.
  - Badges were placed near pocket doors and heating vents inside units and inside the bedroom and dining area in 4A.
- ◎ Unlike Phase I, tenant in 2A was not home during follow up sampling, so badges were not able to be deployed.
  - ◎ Nicotine badge was exposed in areas of concern for 2 weeks.
  - ◎ Results indicated that no nicotine was detected in the bedroom or dining areas.
  - ◎ Nicotine was found at detectable levels above the LOD (0.005 ug) near both the pocket doors and heating vents confirming SHS in the indoor air.

# Conclusions Case Study #1

- Phase I and II studies showed the impacts of smoking on indoor air quality for tenants residing above the 1A unit.
- Background particle concentrations were significantly lower during times of no SHS than during times of physical smell in 2A and 4A.
- This study confirmed that the tenant in 4A was impacted by SHS from 1A via inhalation exposure to SHS.
- Study shows how nicotine as a tracer and particles can be transported and detected several stories above the known source.
- Open spaces serve as a means for providing exposures to other tenants.

# CASE Study #2

# SHS Reported Exposure Case Study #2

- ⦿ Multi-unit condominium building located in Boston, MA
- ⦿ Building was constructed in 1930's
  - HVAC system and central heating/cooling in the building
- ⦿ No open air spaces given newer construction renovation.
  - Solid walls above and below units so no open air spaces.
  - Transport is side to side as no escape up.
- ⦿ Subject on floor 2 complained of constant SHS throughout the hallway including outside his unit from his unit up to the unit of concern (100 feet between units)
  - Building has a no smoking policy and unit of concern has been identified as the only unit to be actively smoking.
  - Only access to each floor was an elevator and stairs.
- ⦿ Four nicotine badges were deployed for capturing nicotine in the hallway with 2 badges placed inside the client's unit.
  - Badges placed in lights outside of unit in the hallway of concern up to client's unit being exposed including in the client's unit.
  - In unit, badges placed in living room and just inside doorway.

# Results from Case Study #2

- Nicotine badge analysis (4 samples) from the hallway samples confirmed strong air nicotine concentrations increasing exponentially from outside client's unit up to unit of concern.
- Air concentrations in hallway were found to be slightly less directly outside unit of concern when compared to outside other units.
  - Hallway (outside client unit = 0.05 ug, unit 0.06 ug, 0.09 ug, outside unit of concern 0.08 ug)
  - Stairs and elevator door outside unit of concern provided some means of dispersion.
- Hallway concentrations found to be an order of magnitude higher than the limit of detection (0.005 ug)
- Badges in unit were lower than hallway concentrations, but nicotine concentrations were found to be above LOD showing penetration into the client unit.

# Conclusions Case Study #2

- ⦿ Nicotine badges were able to capture sufficient concentrations for detection over the sampling period.
  - Hallway and inside unit
- ⦿ Evidence from the study was able to support the impacts from the unit of concern.
- ⦿ This study like case study #1 shows how second hand smoke can be monitored and measured at further distances from the source and therefore impact the lives and health of those in surrounding areas.

# Overall Conclusions

- ◎ It is important to understand what sources can impact your indoor air quality and how to best control them.
- ◎ What are the best means to reduce and/or eliminate excess risk to SHS exposures for yourself and/or your children?
  - Protect your indoor air quality by making all indoor areas smoke free!
  - Do not allow any friends, family, or visitors smoke in your home or car.
  - Do not allow your children to visit or ride in any car where someone is smoking.
  - If you have to smoke, think of others and smoke outside and not near entry doorways or other locations where pressure gradients can transport smoke inside.
- ◎ **Stop smoking!!**
  - **The real truth is that you are exposing those around you! Opening windows and doors is not solving the issue.**

# Clients of SHS Exposure Testing

- ⊙ Real Estate Agents
- ⊙ Landlords of single and multi unit dwellings
- ⊙ Boards of Public Health
- ⊙ Public Health Educators
- ⊙ Schools
- ⊙ Golf Course Pro Shops and lounges
- ⊙ Private and public institutions
- ⊙ Homeowners
- ⊙ Universities
- ⊙ Environmental consultants
- ⊙ Exposure research scientists

# Corporate Information

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Questions & Comments

**Thank you!**