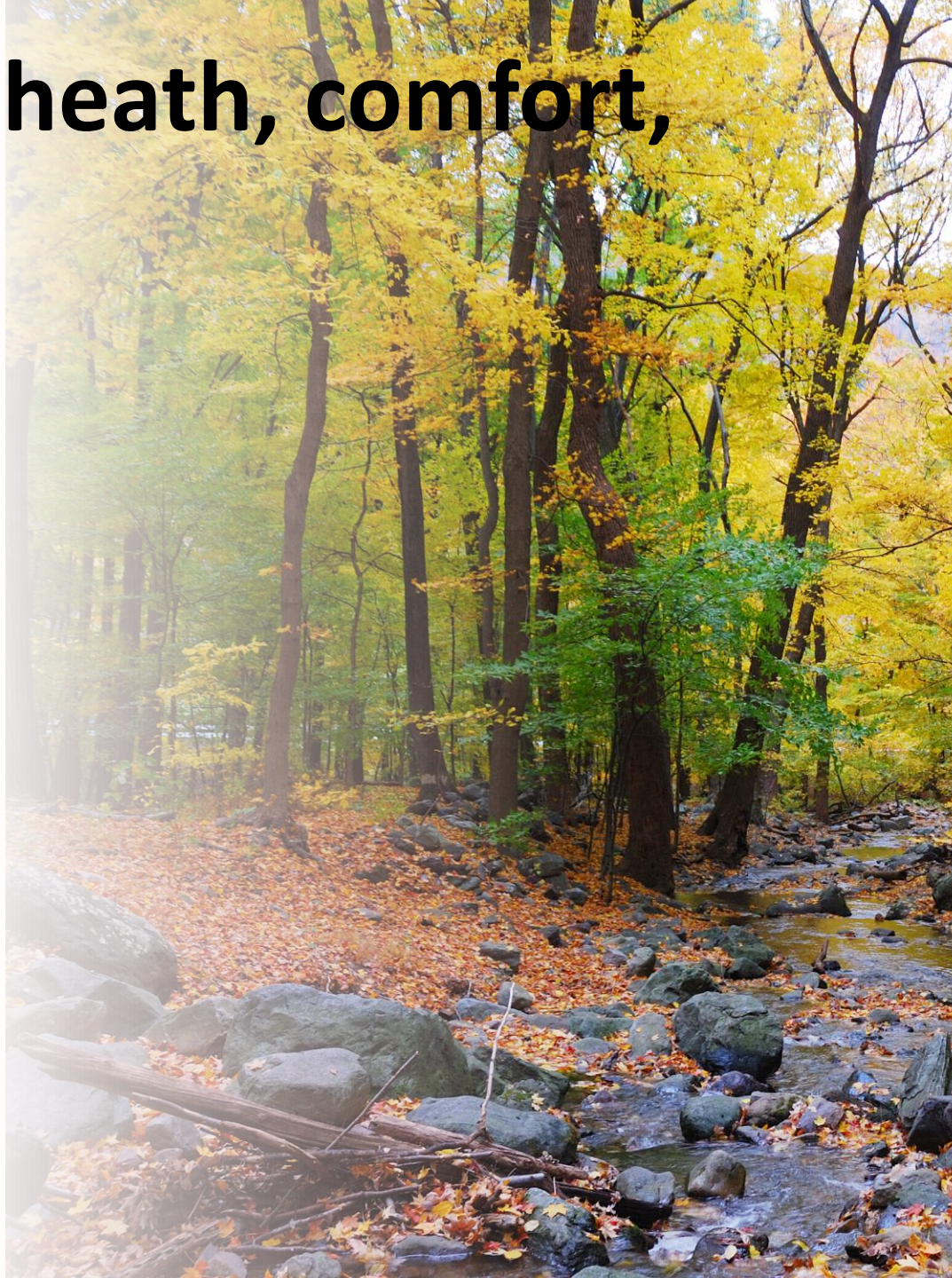
Healthy Air, Healthy Spaces

Indoor Air Quality from a Regulator's Perspective

Katriona MacNeil,
Occupational Hygienist

Safety Matters @ Work
Workers Compensation Board of PEI

Air quality is essential for heath, comfort, and productivity.



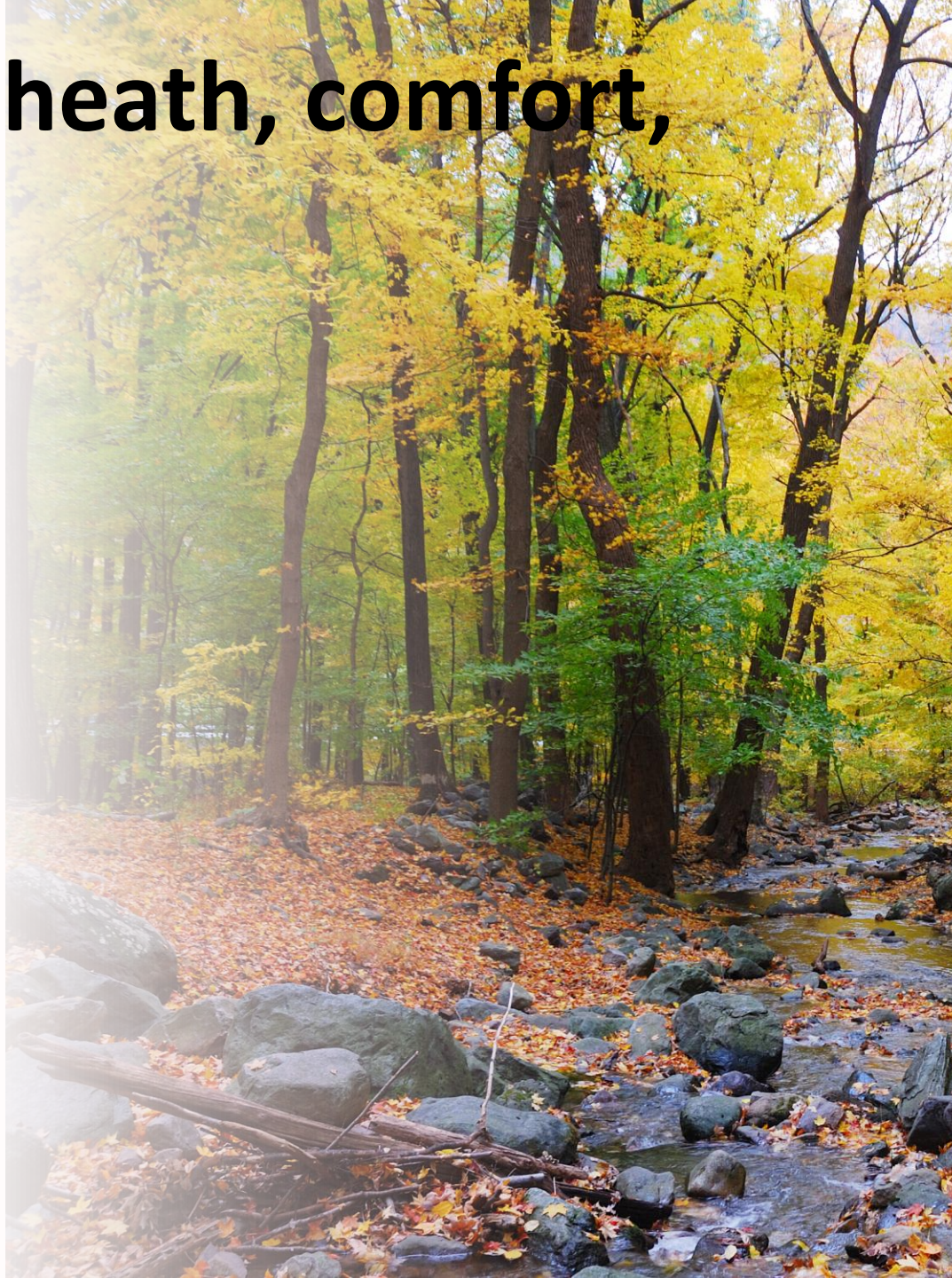
Presentation Outline

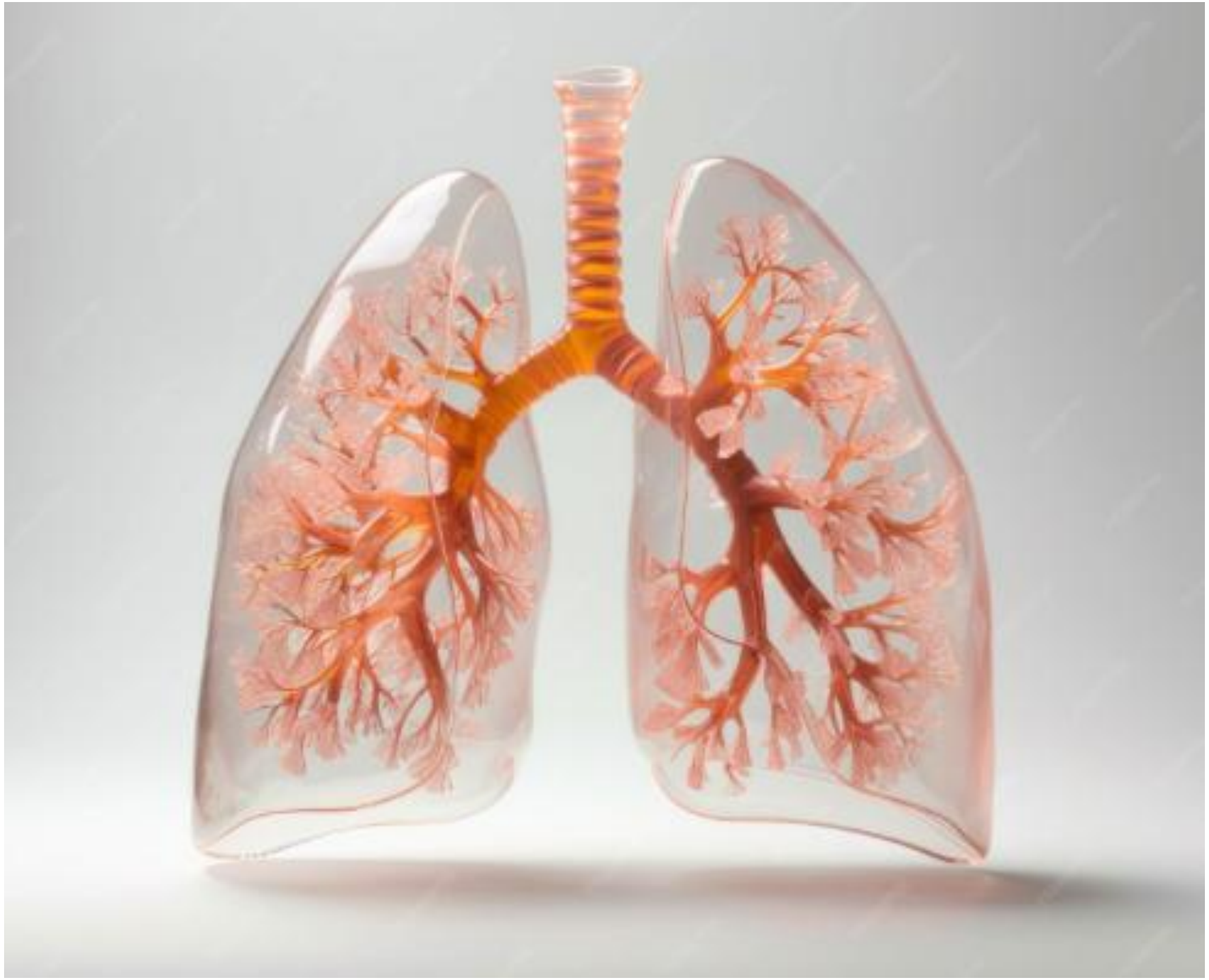
- Air quality and **indoor** air quality
  - We spend 90% of our day indoors
  - Outdoor air, is it healthier than indoor air?
    - Pollution, wildfires, pollen
- **Health** – contaminants and their health impacts
  - Asbestos, radon, mould, volatile organic compounds (VOC)
  - **Regulated** and non-regulated

Air quality is essential for heath, comfort, and productivity.

Presentation Outline continued:

- **Comfort** – parameters that effect comfort and productivity
  - Carbon dioxide (CO_2), *carbon monoxide (CO)*, temperature, humidity, particulate matter (PM)
- Heating, ventilation, and air conditioning systems
  - Regulated and non-regulated.



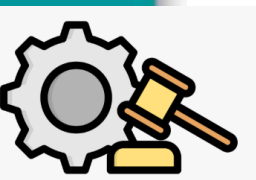


IAQ and contaminants - Asbestos

- Naturally occurring fiber
- Used in building materials and textiles (<1980s)
  - Banned in 1986
- Inhaled fibers can cause disease
  - Lung cancer, asbestosis, mesothelioma
- Buildings built before 1990

IAQ and contaminants - Asbestos

- No immediate health effect
- Latency period between exposure and health effect
- Requirement (buildings built pre-1990, or if asbestos containing material is suspected):
- **OHS Regulations (asbestos in the workplace)**
  - **Sample!!! (competent person)**
  - **Inventory**
  - **Asbestos Management Plan**



IAQ and contaminants - Asbestos

THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO ASBESTOS IN CANADA

470
Lung cancers due to workplace asbestos exposure in construction

Approximately 1,900 lung cancers and 430 mesotheliomas are attributed to occupational exposure to asbestos each year in Canada, based on past exposure (1961-2001). Of these, approximately **470 lung cancers** and **100 mesotheliomas** are estimated to occur among workers in the construction industry.

Occupational Cancer Research Centre

CAREX CANADA

Mesothelioma Cases by Occupation From 2006-2022 (US Statistics), Y. Goa et al.

Manufacturing	30.1%
Construction	18.5%
Educational services	8.8%
Health care and social assistance	8.7%
Professional, scientific and technical	8.6%
Military	7.9%
Public administration	7.9%
Other services	7.9%

Asbestos.com
Brought to you by The Mesothelioma Center

The Gazette

MONTREAL NEWS

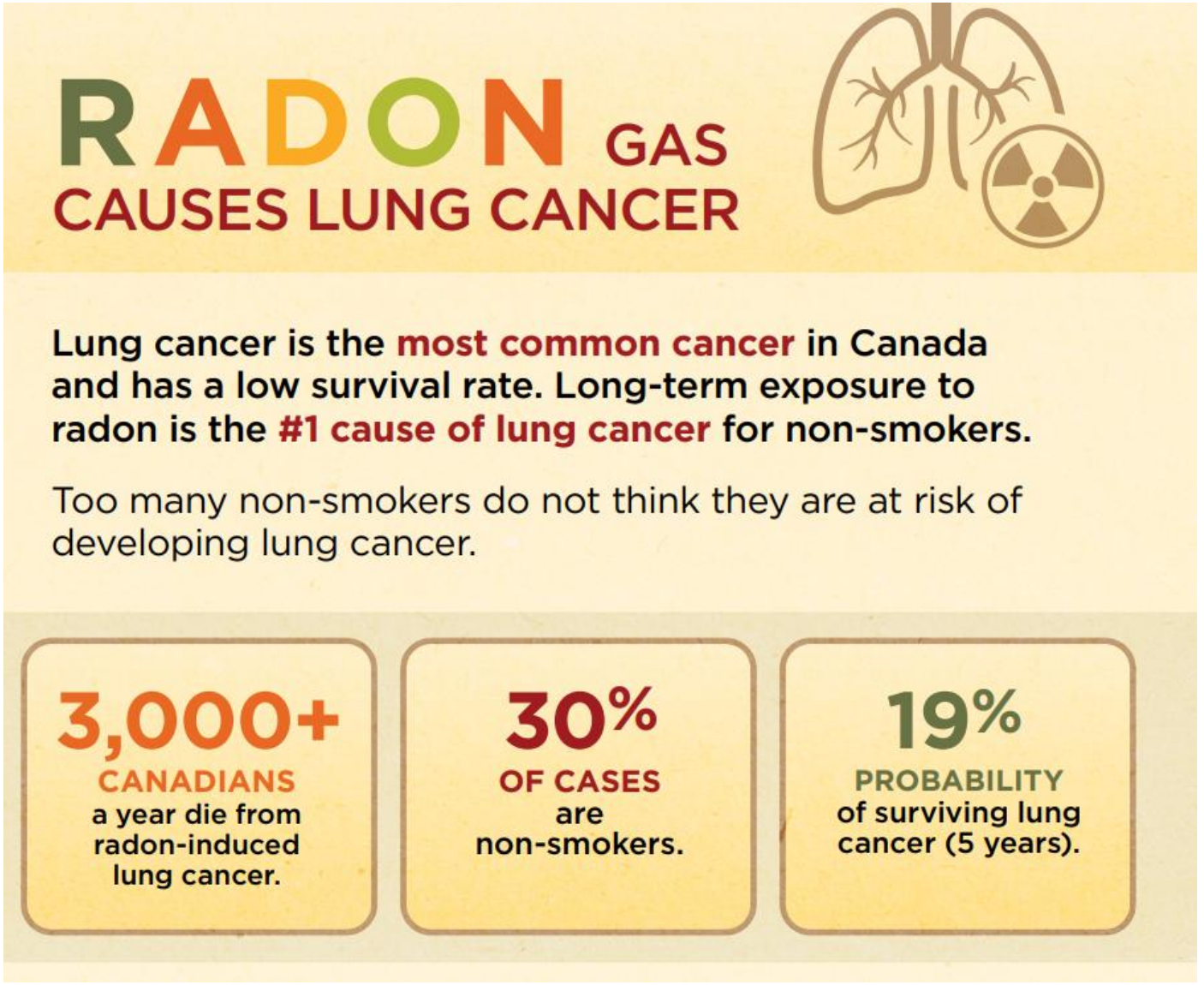
Worker's illness tied to asbestos exposure raises alarm at Montreal federal offices

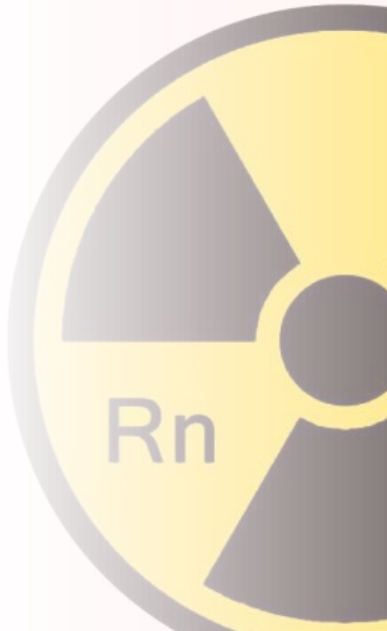
Authorities say the building is safe and continues to operate as normal.

IAQ and contaminants - Radon

- Natural occurring radioactive gas
  - Breakdown of uranium in soil and rock
- Radon enters buildings/homes through cracks in foundations, basements, pipes, etc.
- Depending on building and pressurization, radon can build up to dangerous levels
  - Radon decay products pummel your lungs

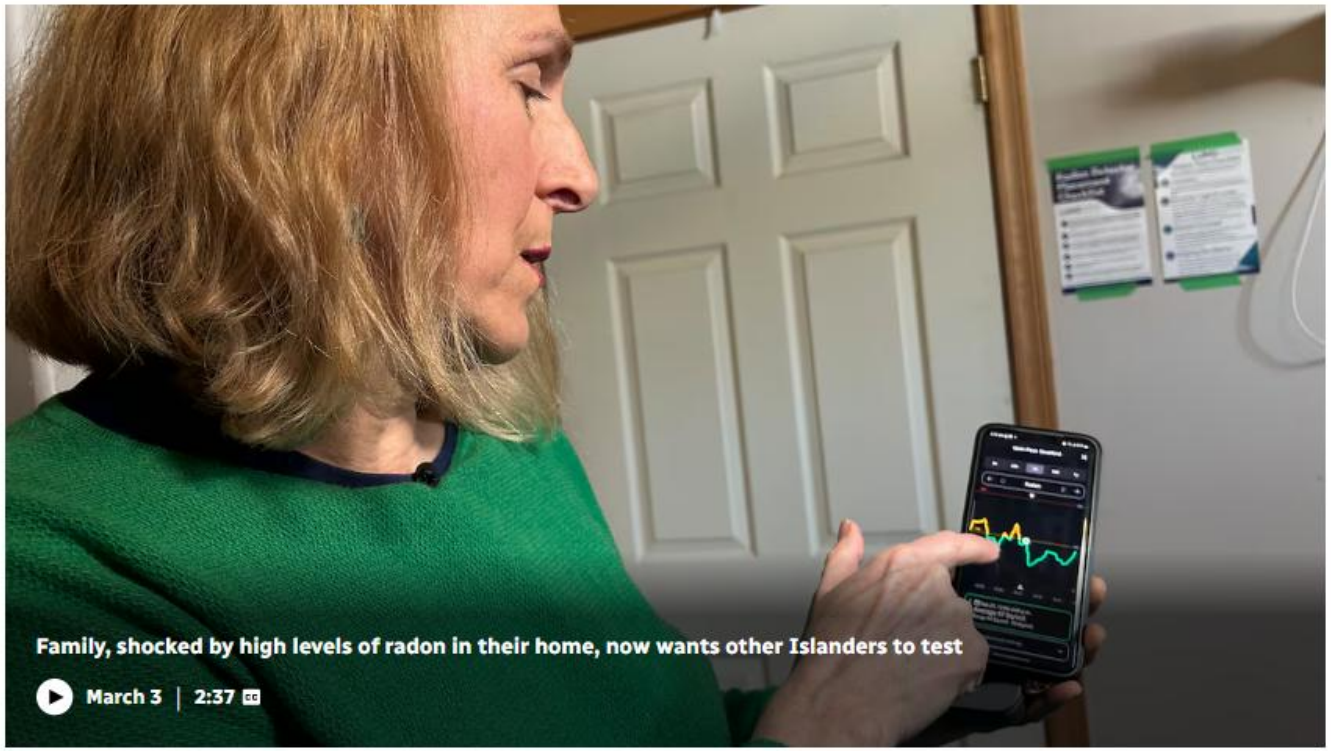
IAQ and contaminants - Radon





Terminally ill woman raises awareness over radon testing

Angela Stief Lea is pictured inside her Havelock home her family built 26 years ago. The 57-year-old physiotherapist was recently diagnosed with terminal cancer attributed to high levels of radon gas inside her home. She's now raising public awareness about radon home testing. PHOTO BY BARBARA SIMPSON /Brunswick News



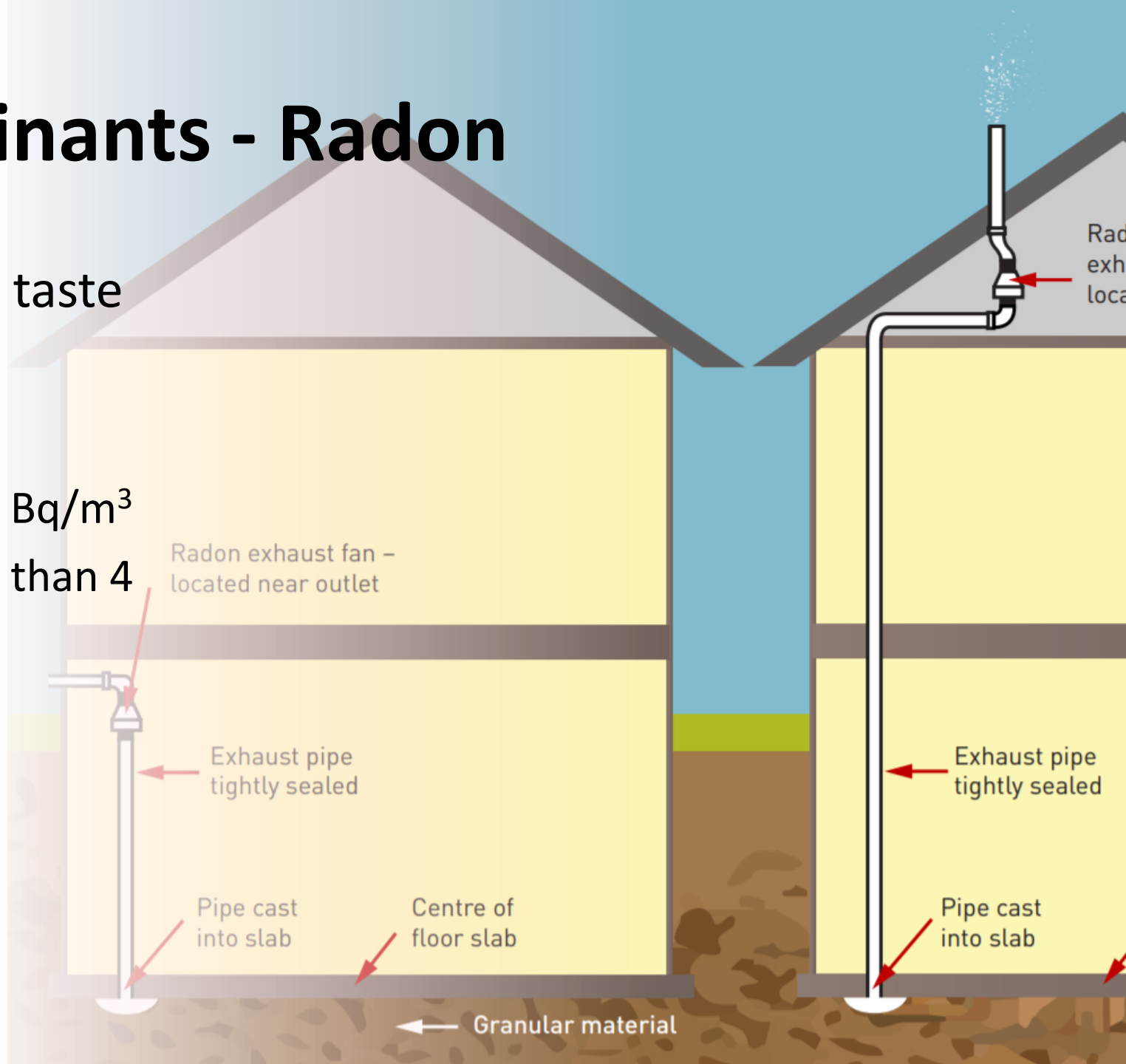
Family, shocked by high levels of radon in their home, now wants other Islanders to test

March 3 | News | 2:37

A family in Stratford, P.E.I., tested for radon in their house, and the results showed high levels of the invisible, toxic gas. They're now taking steps to mitigate the issue, and pushing for others to check their homes. CBC's Stacey Janzer has more.

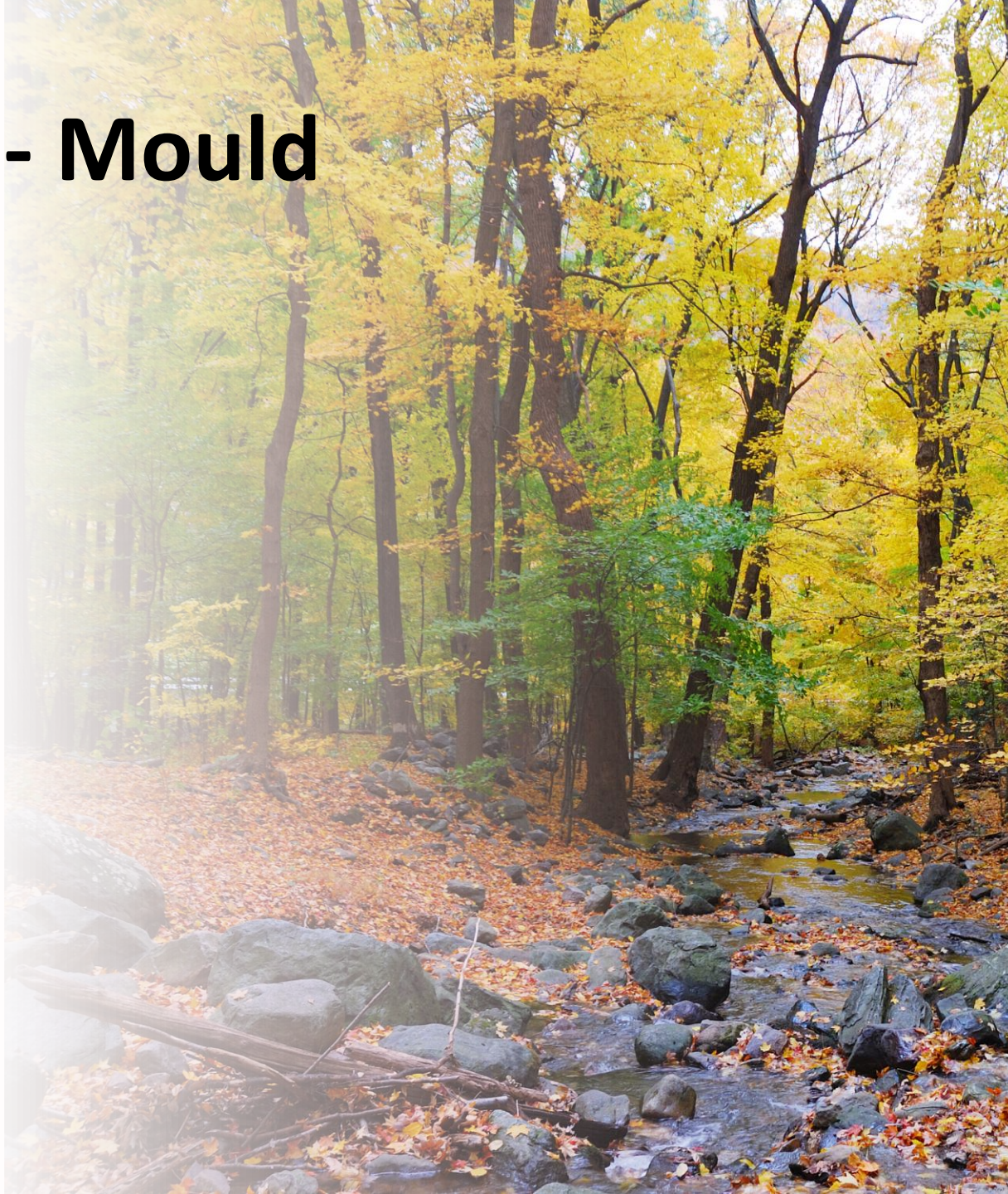
IAQ and contaminants - Radon

- You cannot see, smell, or taste radon
- **TEST!!!**
  - Health Canada limit = 200 Bq/m^3
  - Spaces occupied for more than 4 hours a day
  - Long-term test kits
  - Direct read instruments
  - Radon specialists
    - Testing and mitigating



IAQ and contaminants - Mould

- Natural part of environment
  - Moist places, soil, plants, decaying matter
- Kingdom Fungi, some fungi produce mould spores
- Ubiquitous
- Inhalation of mould, spores, fungi aerosols may cause:
  - Runny nose, eye irritation, cough, congestion, aggravation of asthma, headache



IAQ and contaminants - Mould

- Health Canada does not recommend sampling to assess human health risk because:
  - No dose-response relationship
  - Huge variation in mould species
  - Individual susceptibility
- Address water/moisture and remediate or abate

Canadian Construction Association

Mould guidelines for the Canadian construction industry

GUIDE

IAQ and contaminants – Volatile Organic Compounds (VOC)

- VOC (or TVOC) is a general term for a group of chemicals commonly found in both indoor and outdoor air
  - Higher in indoor air; 1000s of types of VOC
- Sources of VOC include:
  - New furnishings, cleaning products, personal hygiene products, paints, air fresheners, etc.
- VOC can be used as an indicator in IAQ investigations
- No regulatory limit
  - Guidance TVOC below 500 µg/m^3 daily average

IAQ and contaminants – Volatile Organic Compounds (VOC)

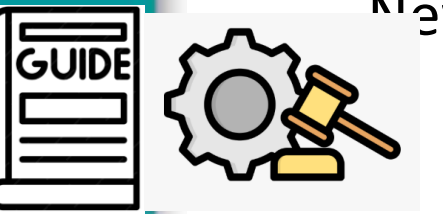
- There are exposure limits for specific chemicals that fall into the general classification of VOC
  - Limits apply to industry exposures
  - Not stringent enough to apply to an office environment
- Health effects may include:
  - Eye, nose and throat irritation
  - Coughing, sneezing, shortness of breath
  - Headaches, dizziness
  - Asthma attack

IAQ and contaminants – Volatile Organic Compounds (VOC)

- Environmental Health Association of Quebec (Rohini Peris)
  - ~70% less TVOC levels in scent-free spaces (Rohini Peris)
  - Barriers to successful policies – lack of education, monitoring, enforcement
  - Not just personal hygiene products
    - Arm's length policy
  - Multiple Chemical Sensitivity

IAQ and contaminants – formaldehyde & fragrance

- Formaldehyde
  - Headaches, carcinogen
  - Can be measured
- Regulatory limit is designed for industry
  - Exposure limit 0.1 ppm 8-hour Time Weighted Average
  - As low as possibly for IAQ
- Sources:
  - New materials, new computers



- Fragrance
  - 1000s of chemicals designed to give products unique smell
  - Some VOC but other chemicals too, aldehydes, esters, ketones, essential oils)

Scent Free Policy!!!

Fragrances may be composed of several different ingredients:

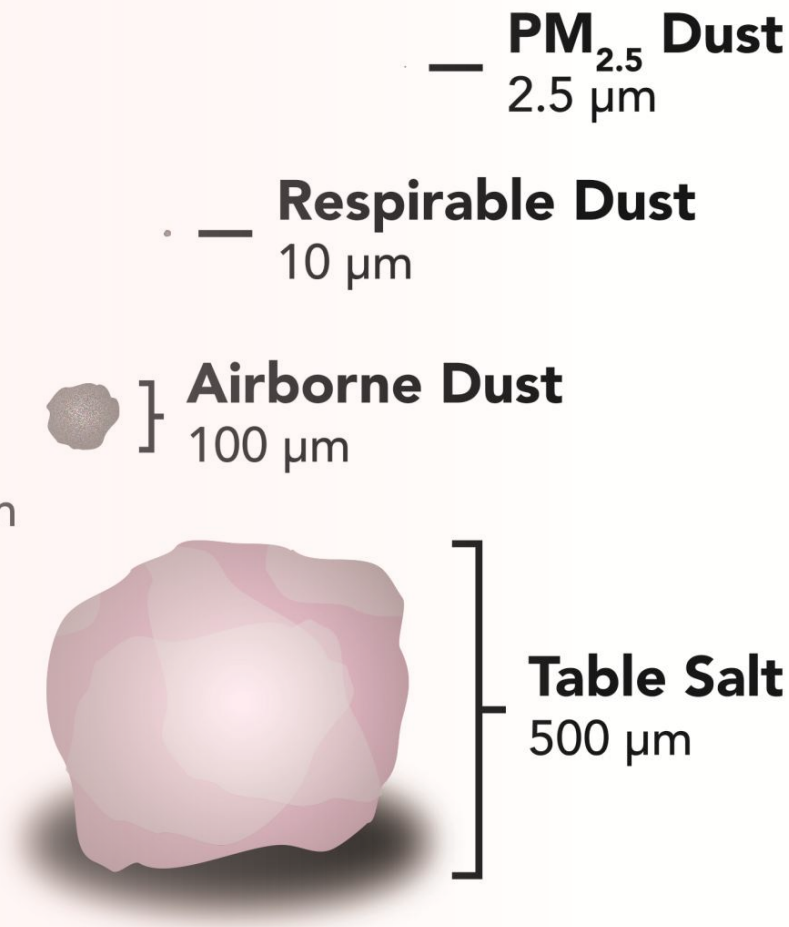
As noted below, these specific ingredients may not be identified on the cosmetic product label. The European Commission, which has conducted extensive research on fragrance allergens, lists the following 26 fragrance ingredients listed as allergens in Annex III of the European Union Cosmetics Directive:

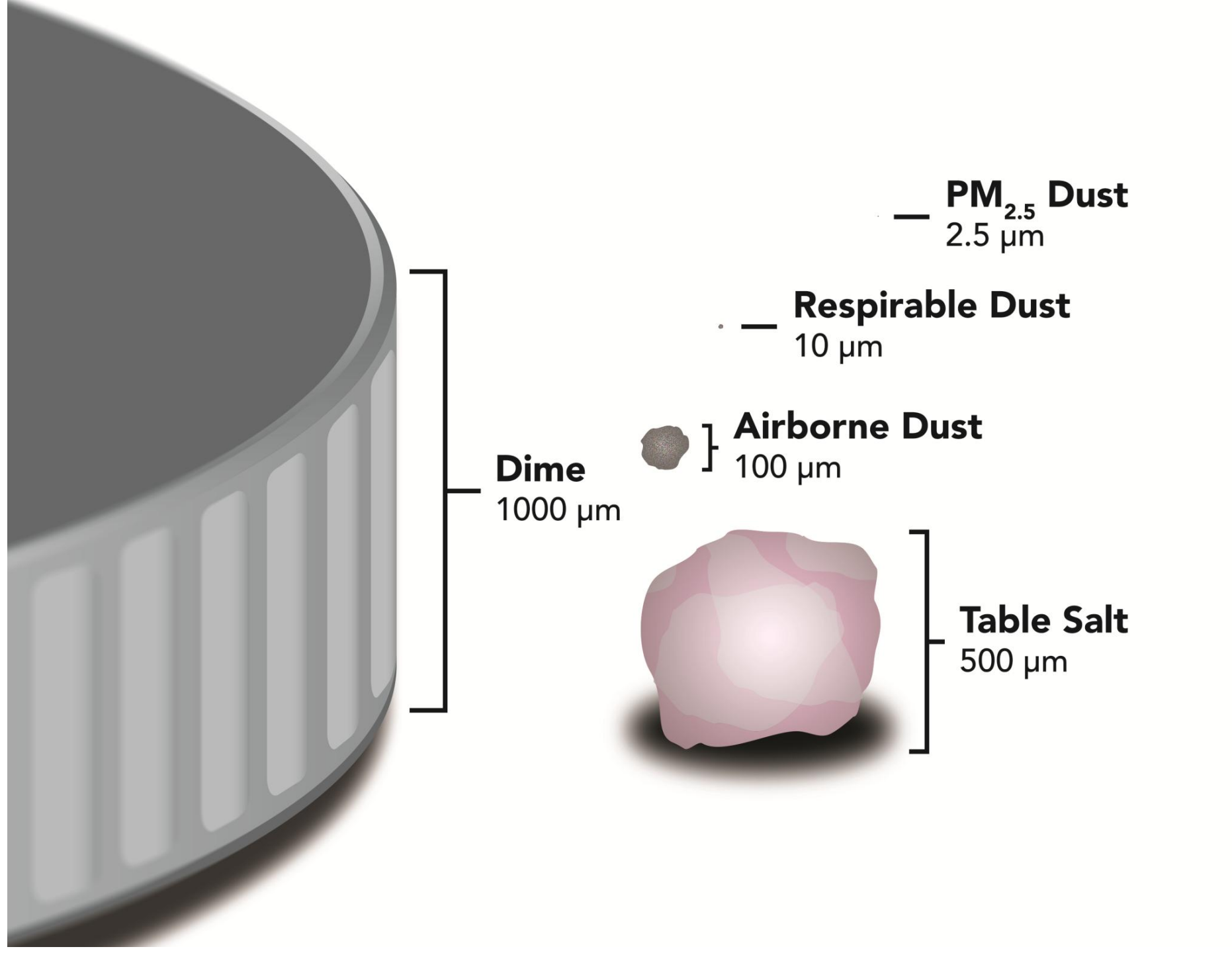
- Amyl cinnamal
- Amylcinnamyl alcohol
- Anisyl alcohol
- Benzyl alcohol
- Benzyl benzoate
- Benzyl cinnamate
- Benzyl salicylate
- Cinnamyl alcohol
- Cinnamaldehyde
- Citral
- Citronellol
- Coumarin
- Eugenol

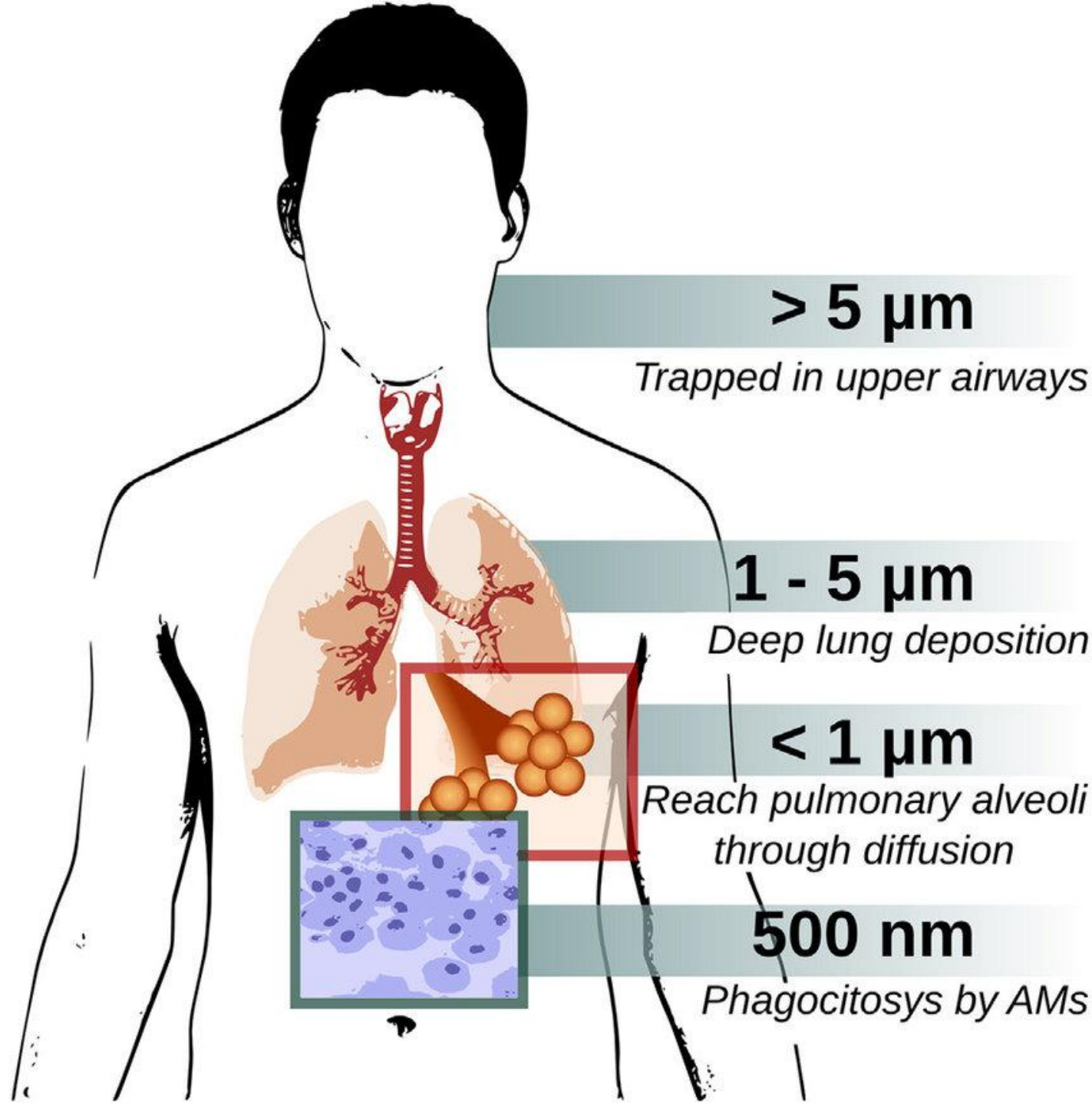
https://www.fda.gov/cosmetics/cosmetic-ingredients/allergens-cosmetics

IAQ and contaminants – Particulate Matter

- Particulate matter
  - Limits apply to industry exposures
  - Not stringent enough to apply to an office environment.
- Health effects may include:
  - Eye, nose and throat irritation
  - Headaches
  - Loss of coordination and nausea




PM2.5 Dust
2.5 µm
Respirable Dust
10 µm
Airborne Dust
100 µm
Dime
1000 µm
Table Salt
500 µm

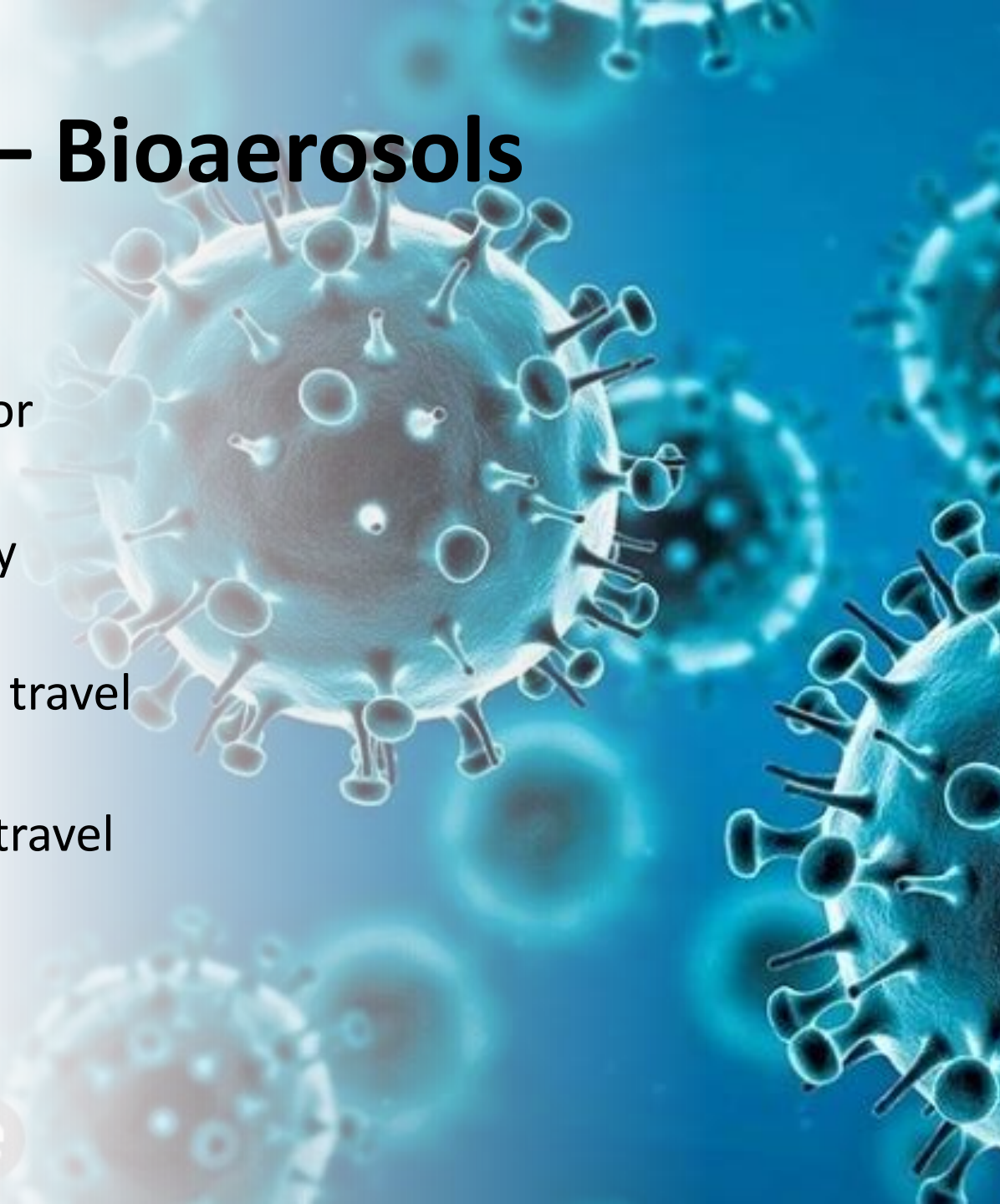

> 5 µm
Trapped in upper airways
1 - 5 µm
Deep lung deposition
< 1 µm
Reach pulmonary alveoli through diffusion
500 nm
Phagocitosys by AMs

Respiratory Audit Tool – Adapted from Video Plus Sensor incorporated (VPSi)

Particulate Matter (PM) Category	Typical Sources	Guideline	Health effect
$PM_{1.0}$	Ultrafine combustion particles	No formal guideline	• Deep lung penetration (alveoli) and potential systemic effects • May enter blood stream, cardiovascular issues, asthma, and systemic inflammation
$PM_{2.5}$	Vehicle exhaust, industrial emissions, smoke	**15** µg/m^3 daily (WHO guideline)	• Lower respiratory tract, triggers immune response, aggravates asthma and bronchitis • Linked to heart and lung disease
PM_{10}	Dust, pollen, construction debris	**45 µg/m^3** daily (WHO guideline) **30 to 100 µg/m^3** (building*)	• Irritates upper respiratory tract, triggers asthma • Upper airways and bronchi, causes coughing, sneezing, exacerbates allergies, respiratory infections

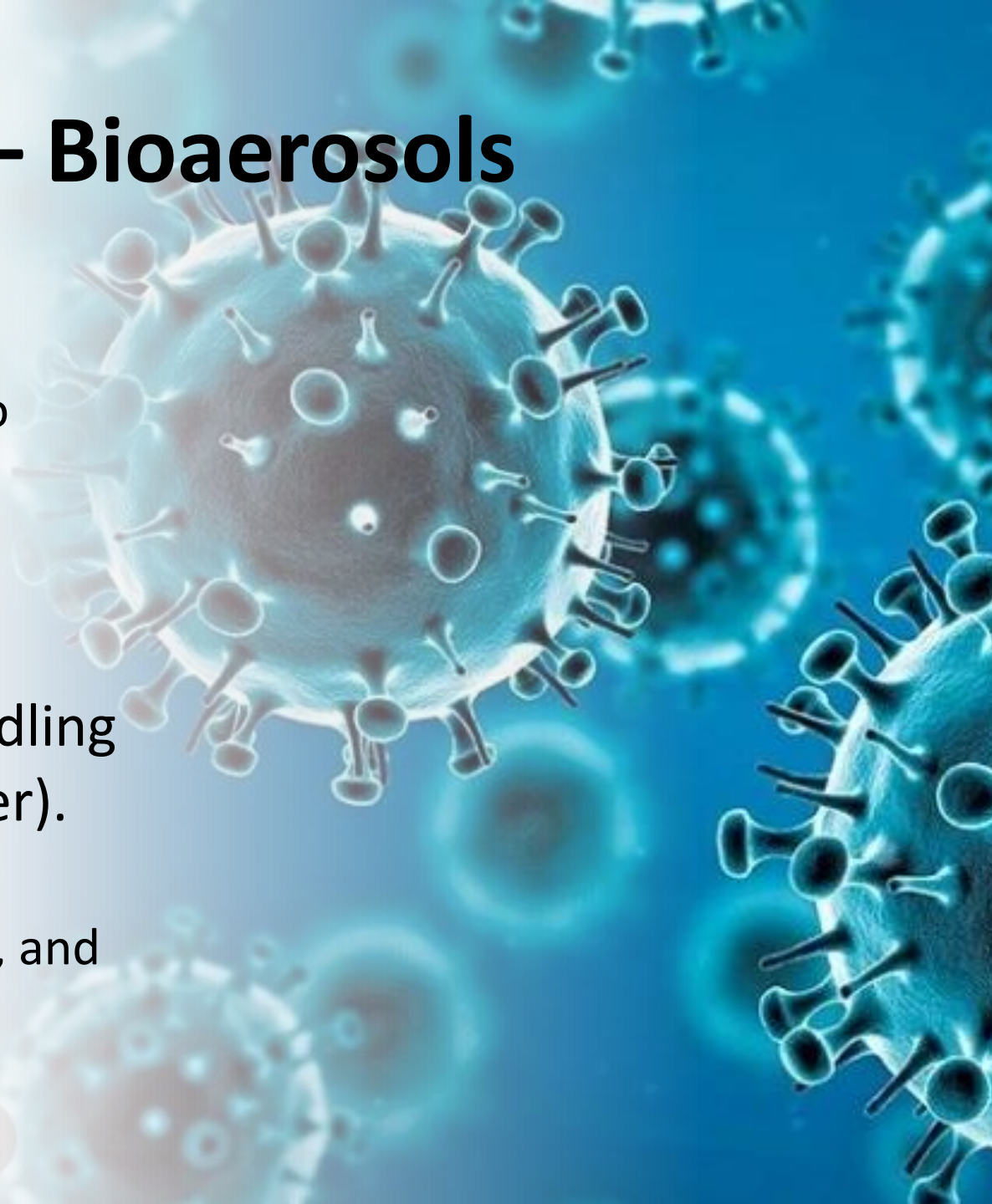
IAQ and contaminants – Bioaerosols

- COVID-19 (SARS-CoV-2)
  - Transmission through direct, indirect, or close contact with infected people
  - Respiratory droplets (saliva, respiratory secretions)
  - Respiratory droplets (>5 to 10 um) will travel 1m
  - Droplet nuclei or aerosols (≤5um) will travel further
- Person becomes infected and sick



IAQ and contaminants – Bioaerosols

- Ventilation is our friend
  - Recommended increased ventilation to reduce virus transmission risk
  - Five air changes per hour (CDC 2023)
- Open doors, open windows
- Improve filtration within the air handling system (E.g., MERV-13 filter or higher).
  - Filters can capture (and reduce) air circulation of viruses, smoke, allergens, and outdoor air pollution

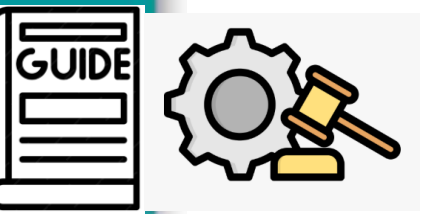


IAQ and comfort parameters - Temperature

- **Summer** - 24.5°C; range 23-26°C (CCOHS)
  Winter - 22°C; range of 20-23.5°(CCOHS)
- 20°C for light work performed while sitting (PEI OHS Regulations)
  - Stress, fatigue, and reduced productivity
  - Increase off-gassing from building materials, furniture, and electronics
  - Combined with humidity, microbial growth
  - Reduced fresh air exchange if building tightly sealed

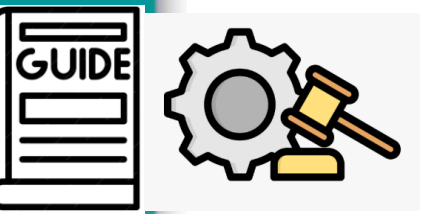
IAQ and comfort parameters - Temperature

- **Heat Stress Alert System (HARS)**
  - PEI Public Health developing a system for heat preparedness
- **OHS Regulations**
  - TLV heat stress plans, WBGT Thermometer
  - OHS heat stress prevention guide



IAQ and comfort parameters - Humidity

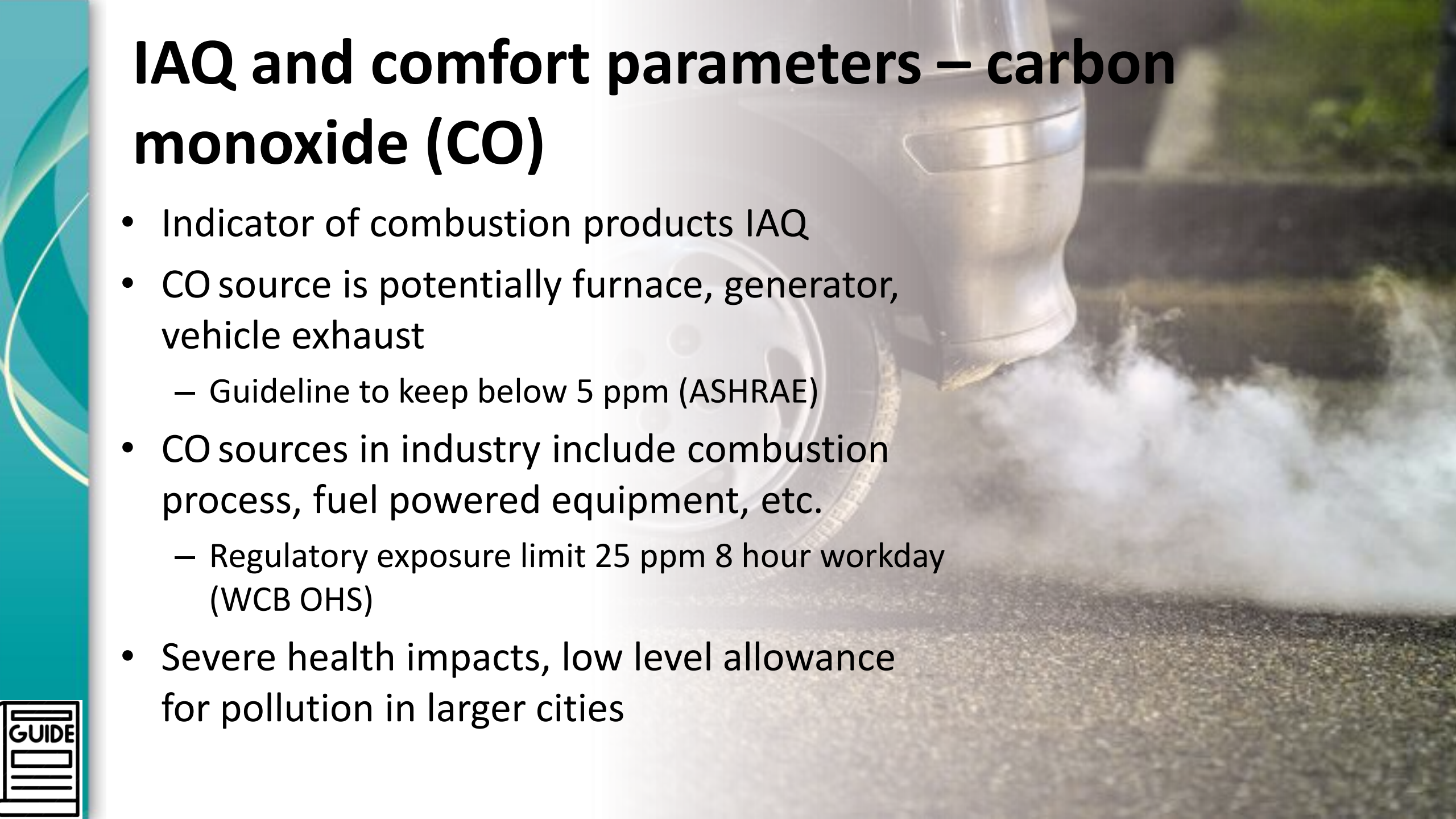
- **Summer** 50%; **Winter** 35% (Health Canada)
- Range of 25% to 60% (ASHRAE)
- Minimum of 30% (PEI OHS Regulations)
  - Too low can lead to dry eyes, nose, skin, nose bleeds
  - Too high can lead to an environment that supports microbial growth, condensation on surfaces, and difficulty sweating when combined with higher temperatures



IAQ and comfort parameters – carbon dioxide (CO_2)

- Proxy for measuring the adequacy of air exchanges in occupied buildings
- CO_2 source is people in IAQ
  - Guideline to keep below 1000 ppm (ASHRAE)
- CO_2 sources in industry include dry ice, welding gas, fermentations, carbonation, etc.
  - Regulatory exposure limit 5000 ppm (WCB OHS)
- Health impacts may include fatigue, difficulty concentrating

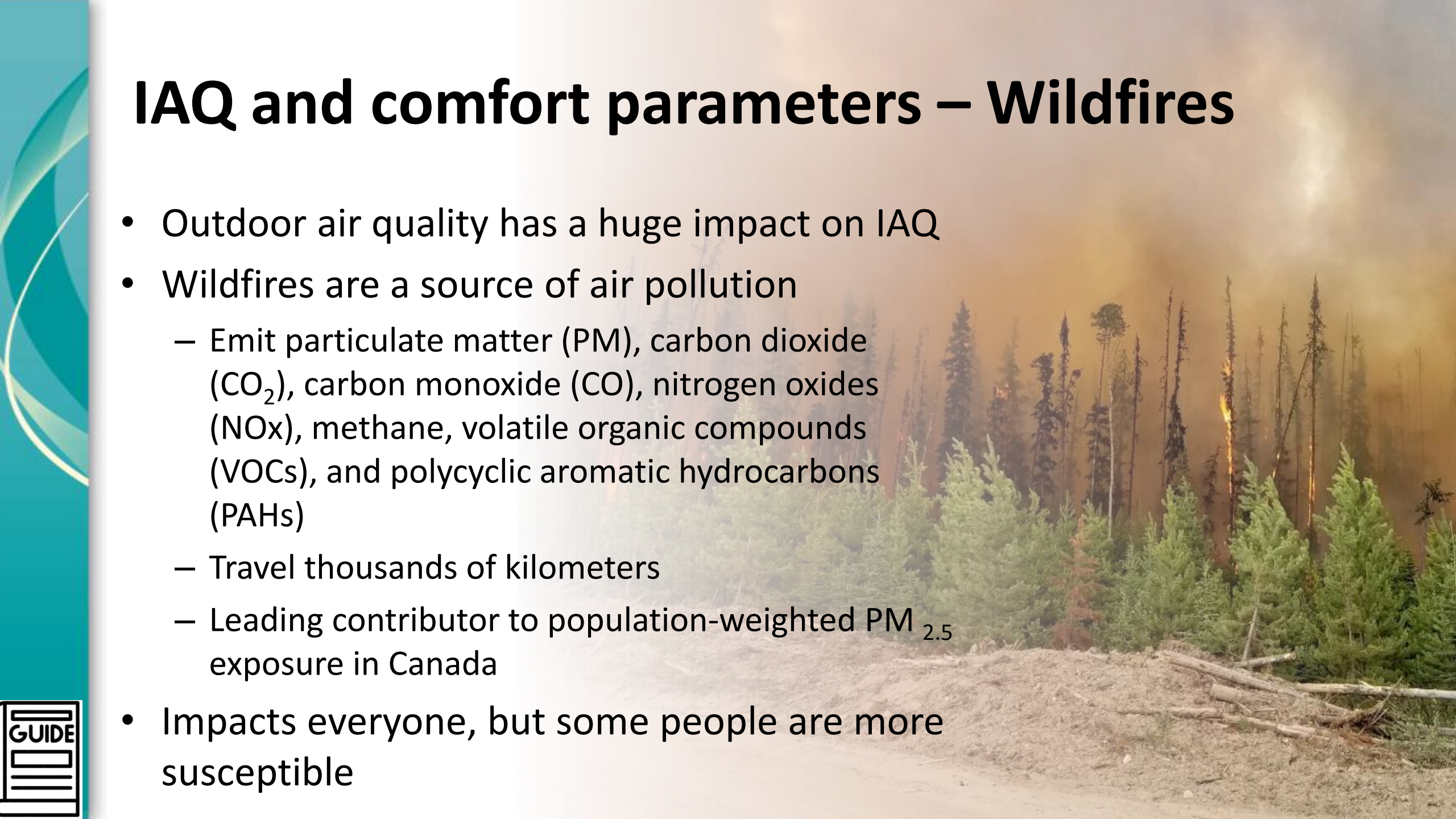
IAQ and comfort parameters – carbon monoxide (CO)



- Indicator of combustion products IAQ
- CO source is potentially furnace, generator, vehicle exhaust
  - Guideline to keep below 5 ppm (ASHRAE)
- CO sources in industry include combustion process, fuel powered equipment, etc.
  - Regulatory exposure limit 25 ppm 8 hour workday (WCB OHS)
- Severe health impacts, low level allowance for pollution in larger cities

IAQ and comfort parameters – Wildfires

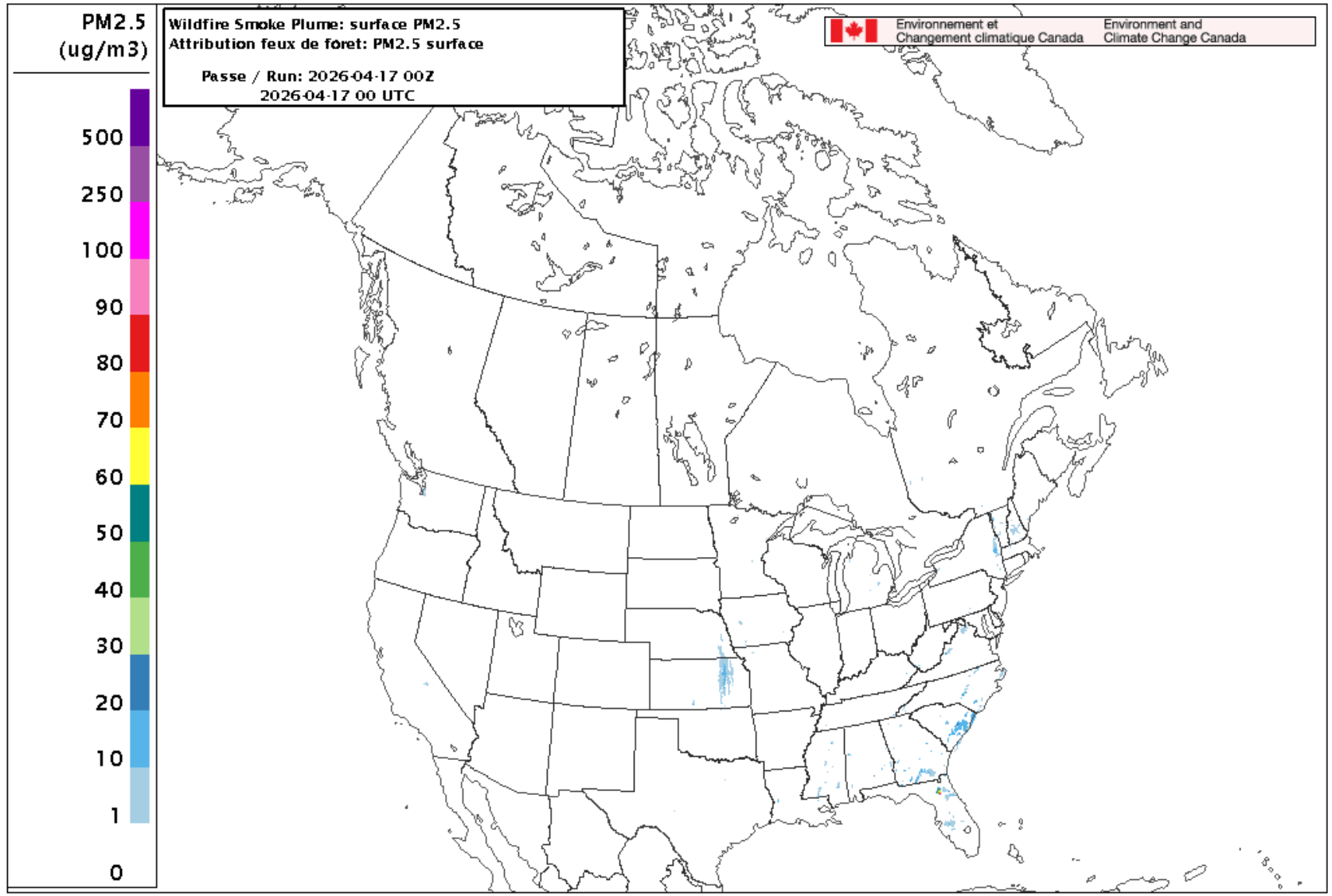
- Outdoor air quality has a huge impact on IAQ
- Wildfires are a source of air pollution
  - Emit particulate matter (PM), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), methane, volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs)
  - Travel thousands of kilometers
  - Leading contributor to population-weighted $PM_{2.5}$ exposure in Canada
- Impacts everyone, but some people are more susceptible



Wildfire Smoke Fine Particulate Matter PM2.5 - 72h Hourly Maps at Ground Level - 00 UTC

Click a Canadian region to zoom in

12 UTC



Local Time: Atlantic Daylight Time 2026-04-16, 21:00 ADT

IAQ and comfort parameters – Wildfires

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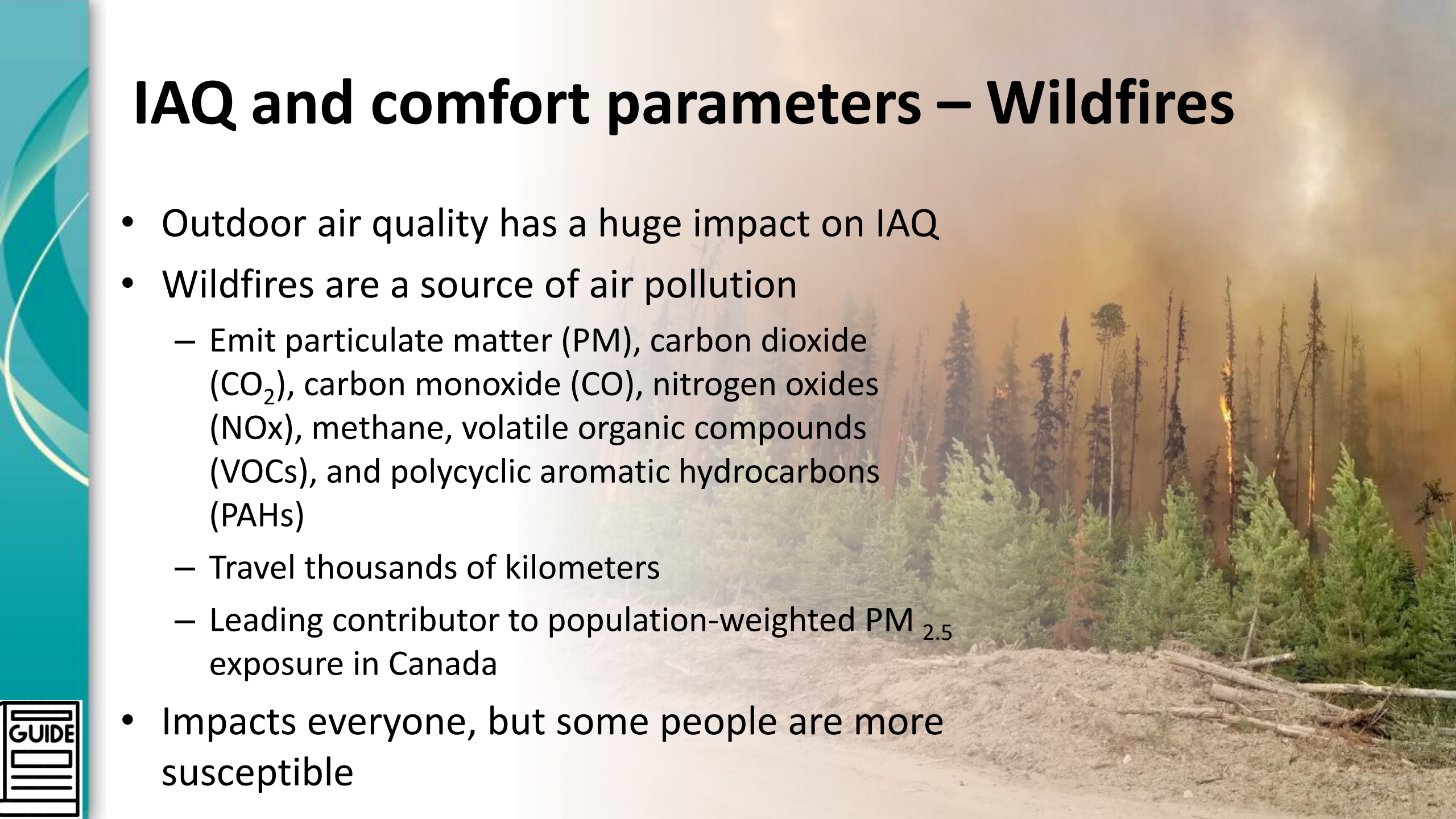
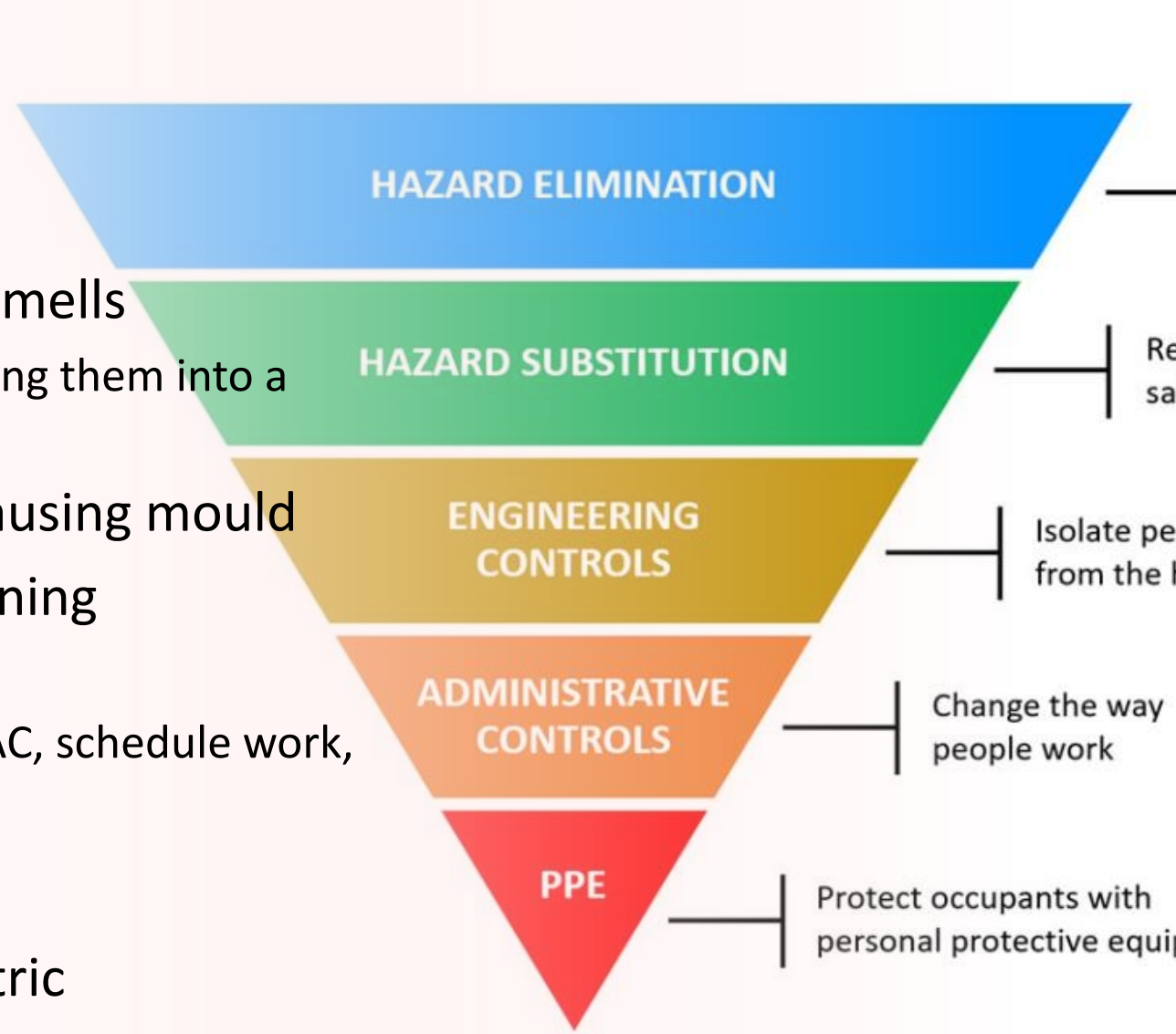
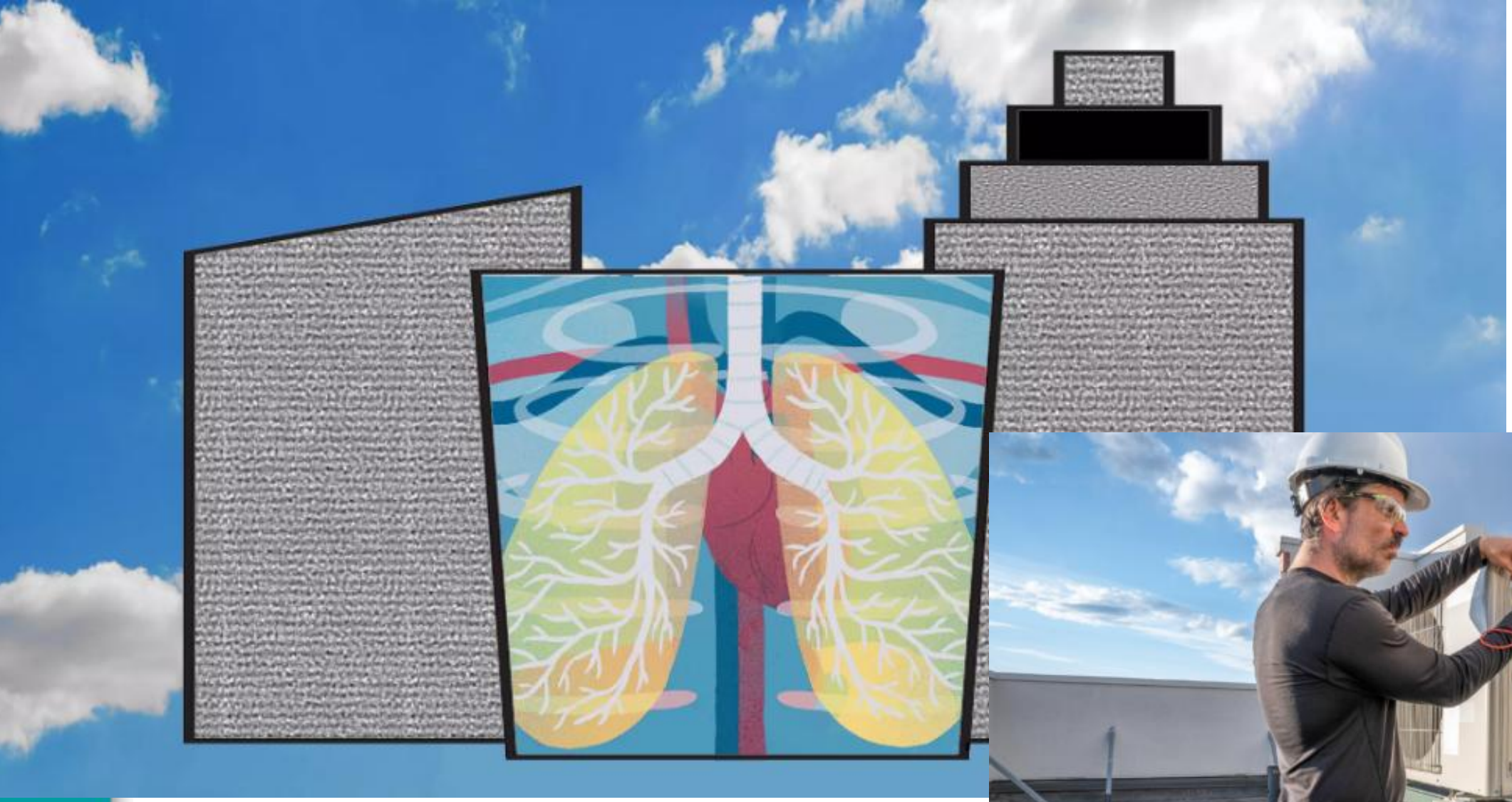


Strategies

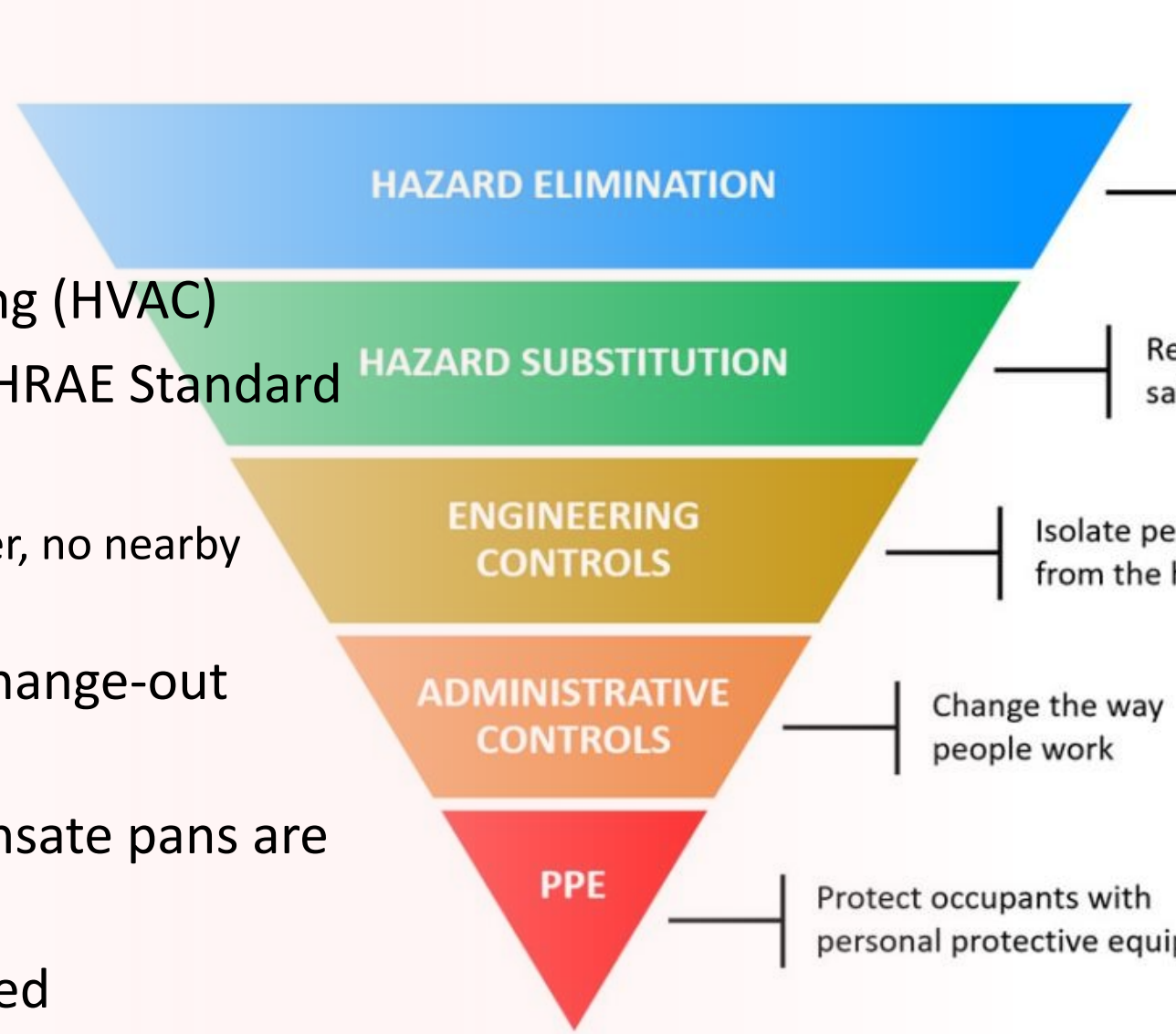
- **Eliminate:**
  - Sources of VOC, fragrance, strong smells
    - Off-gas new furnishings prior to bringing them into a building
  - Water ingress and high humidity causing mould
  - Dust (asbestos?!), VOC by pre-planning renovations
    - Barriers to workers areas, protect HVAC, schedule work, remove occupants
- **Substitute:**
  - Gas powered equipment with electric
  - Cleaning products, building materials with low emission alternatives





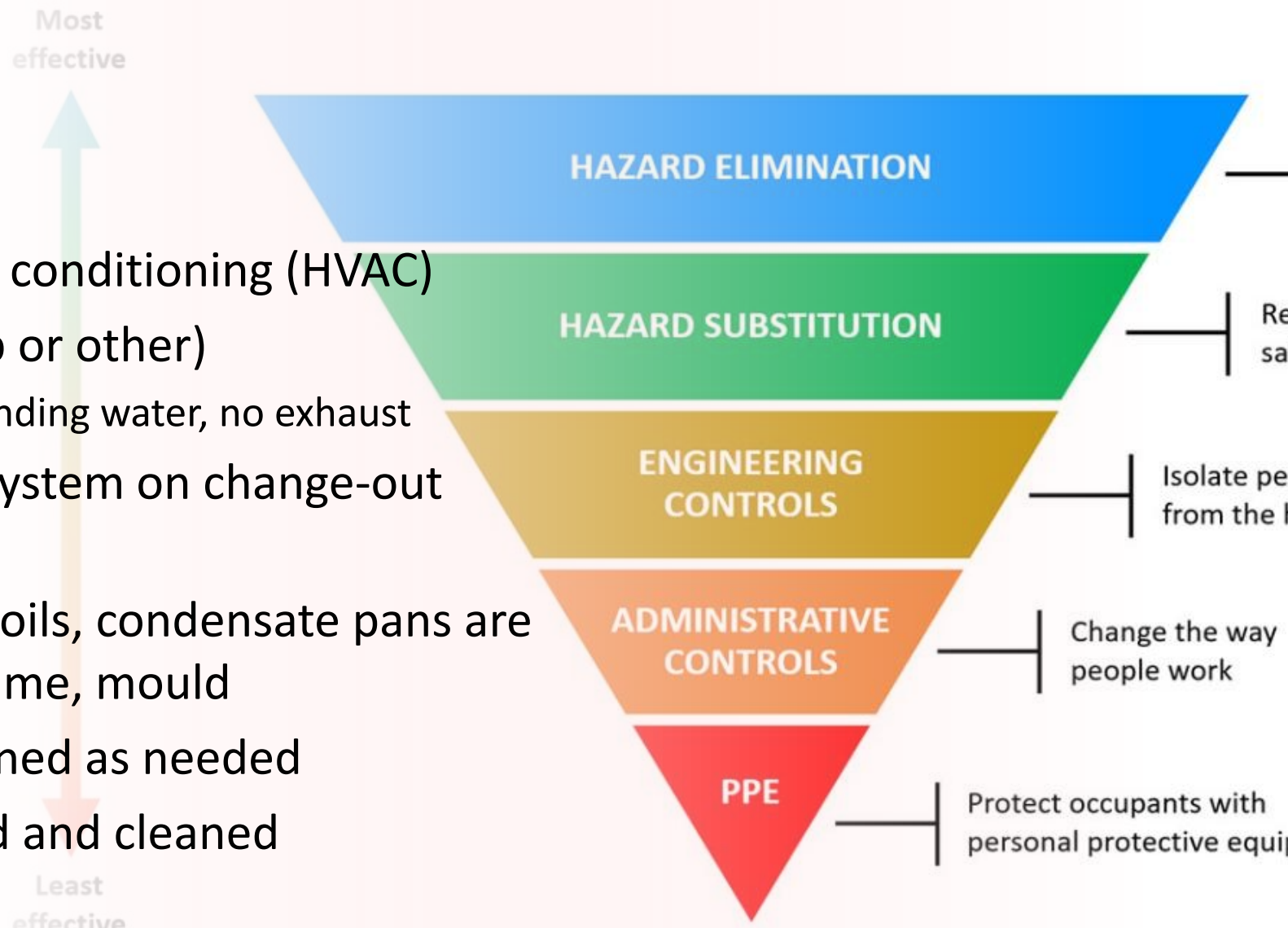
Strategies

- **Engineering Controls**
  - Heating, ventilation, air conditioning (HVAC)
  - Designed for the space and per ASHRAE Standard
  - Main air intake (rooftop or other)
    - Clean, free from debris, standing water, no nearby exhaust
  - Filters throughout the system on change-out schedule
  - Air handling unit fans, coils, condensate pans are clean, no dirty water, slime, mould
  - Ducting inspected, cleaned if needed



Strategies

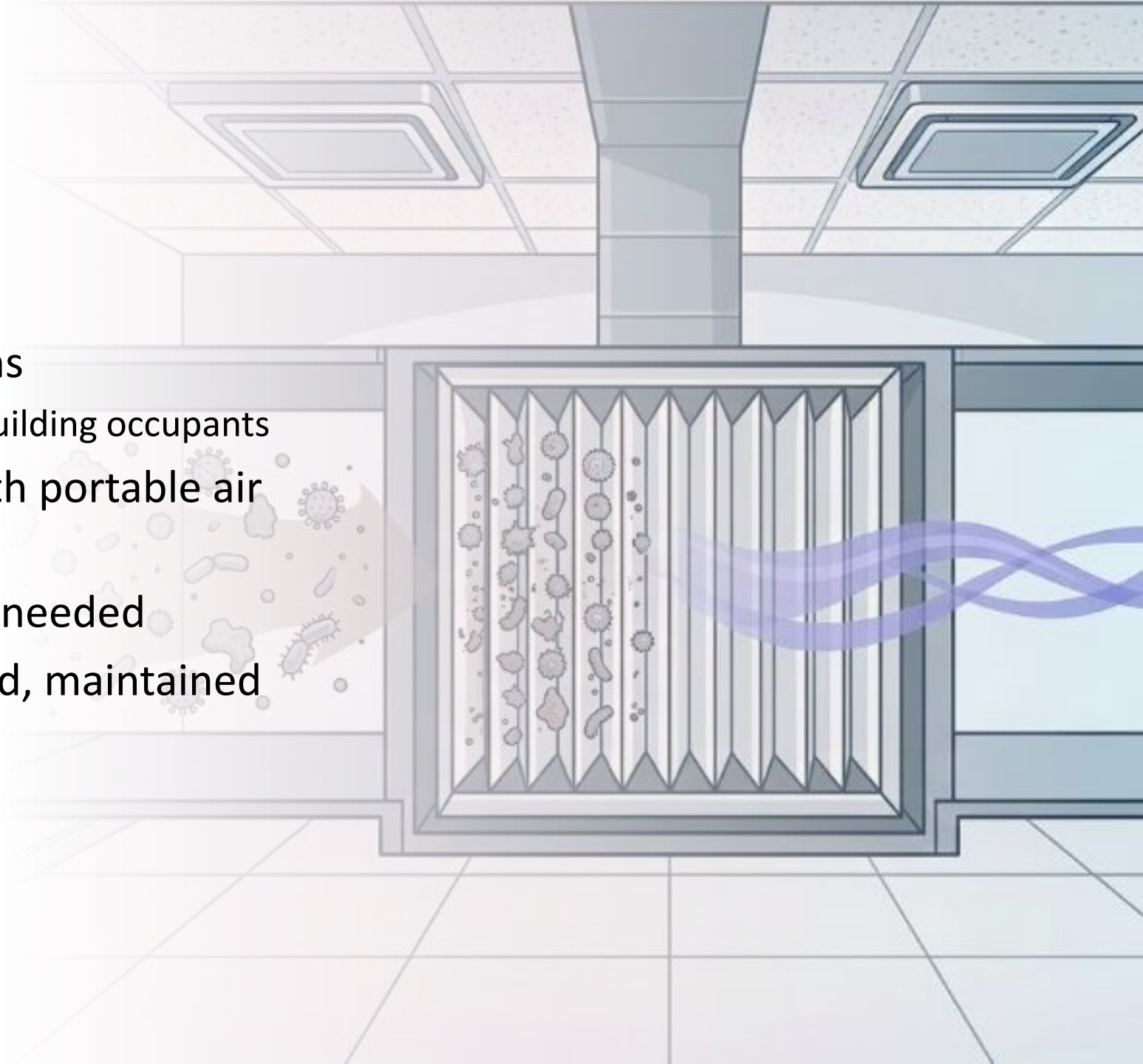
- **Engineering Controls**
  - Heating, ventilation, air conditioning (HVAC)
  - Main air intake (rooftop or other)
    - Free from debris, no standing water, no exhaust
  - Filters throughout the system on change-out schedule
  - Air handling unit fans, coils, condensate pans are clean, no dirty water, slime, mould
  - Ducting inspected, cleaned as needed
  - Heat pumps maintained and cleaned
  - Humidity controlled




After
Before

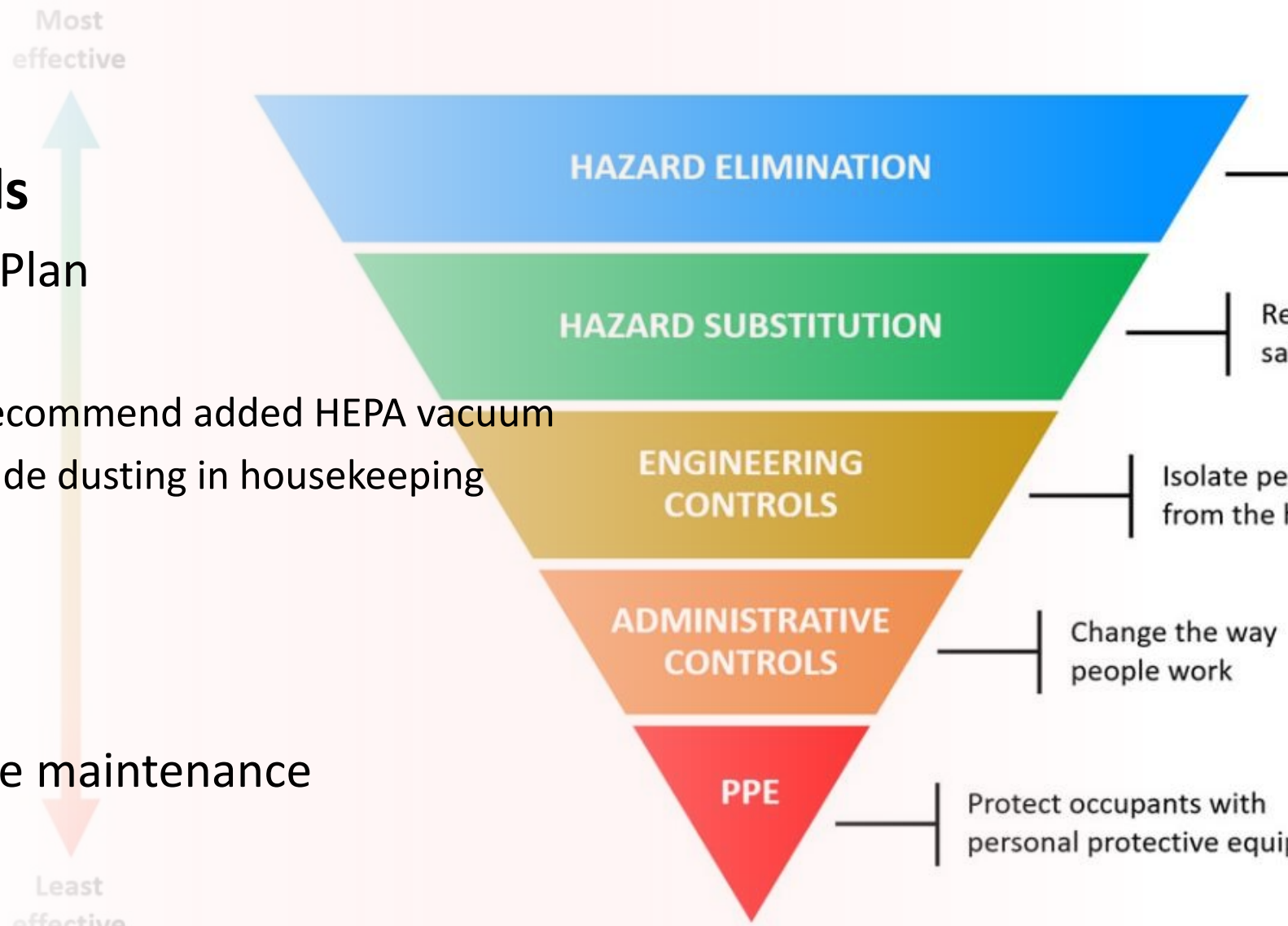
Strategies

- **Engineering Controls**
  - Considered in renovations
    - Attention to increase in building occupants
  - Supplement filtration with portable air cleaners
  - Mitigate for radon when needed
  - Ensure system is designed, maintained to a standard



Strategies

- **Administrative Controls**
  - Asbestos Management Plan
  - Housekeeping
    - Dust in environment? Recommend added HEPA vacuum
    - Diffusers/exhausts, include dusting in housekeeping
  - Scent Free Policy
  - Smoke Free Policy
  - Plan renovations
  - Documenting preventive maintenance



Resources

- Health Canada - Guidance on Improving Indoor Air Quality in Office Buildings (2025)
- Canadian Centre of Occupational Health and Safety (CCOHS) air quality publications
- American Society for Heating Refrigeration and Air Conditioning Engineers (ASHRAE) standards
- Guide for mould in Canadian construction industry

- Building codes
- Radon testing/mitigation
- OHS Legislation
  - Asbestos management
  - Employee Reporting
  - Employer investigation and response
- Qualified people
  - HVAC personnel
  - Consultants (industrial hygiene for air quality)


Thank-you!