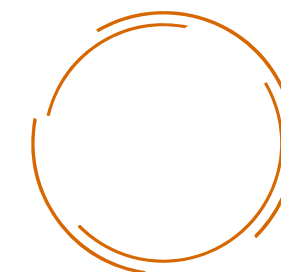


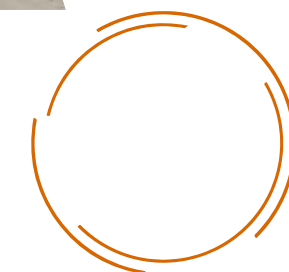
Better Air Quality & Ventilation

1

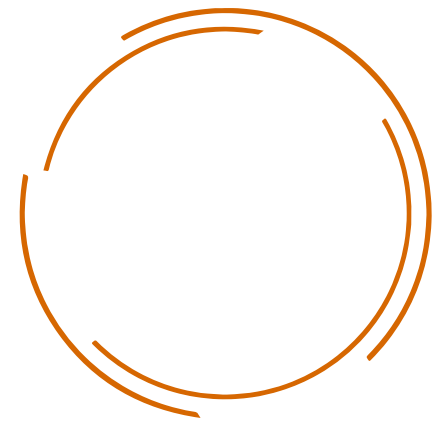


**Air Quality
Matters**
Simon Jones

Welcome



**Air Quality
Matters**
Simon Jones



Air Quality Matters

Simon Jones

AMIEEnvSc, AMIAQM, WELL AP, Fitwel

- Founder - Air Quality Matters
- Host - Air Quality Matters Podcast
- Chair - IEA Industry Advisory Committee AIVC
- Scientific Committee and Guest Board Member AIVC
- Advisory Board - UKCMB
- Member - BESA Health and Wellbeing
- Member - CIBSE Natural Ventilation Group
- Member - Expert Group (Ventilation) Irish Government

Air Quality Matters

Simon Jones

Better Ventilation and Air Quality in our Homes

- Welcome
- What the evidence tells us

Chapter 2

- Air
- Defining Air Quality
- Condensation Damp and Mould
- Common Pollutants
- Control



Why we
care

Acceptable

AIR QUALITY

80 Years
70 Indoors
55 At home
25 sleeping



Acceptable

AIR QUALITY

The
cost.



Acceptable

AIR QUALITY

The
cost.



Acceptable

AIR QUALITY

The
cost.



Air pollution is the largest single environmental risk.

It is associated with the premature deaths of 28,000 – 36,000 people each year and affects the poorest in society the most. Estimates of the costs of air pollution to human health in the UK are in the region of £20 billion per year.

In the United States alone, cardiovascular disease and other respiratory conditions caused by breathing in air pollution were estimated to cause 107,000 premature deaths and \$820 billion in annual healthcare costs.

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AIR QUALITY

The

cost.

According to the Asthma + Lung UK 5.4 Million people currently live with asthma, a disease we know is significantly exacerbated by poor indoor environments.



Asthma costs the US economy more than \$80 billion annually

It is estimated to affect ~~300~~ 350 million people in Europe, approximately 10% of all Europeans. The direct costs of asthma care in Europe is estimated at ~~17 billion~~ 17 billion per year.

Although the disease is often mild, asthma sadly still kills: there were an estimated 13 asthma deaths in England and Wales in 2017 alone

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AIR QUALITY

The
cost.
Poor housing and ventilation

Studies consistently show a link between
poor respiratory health and housing
conditions

Damp & Mould
Overcrowding
Poor Ventilation
Cold Homes
Other pollutants



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AIR QUALITY

The
cost.

In a 2022 report, the National Institute for Occupational Safety and Health Centers for Disease Control and Prevention estimated that around 47% of all homes in the United States have some mold or dampness.

It is estimated over 80 million people live in homes with damp, condensation and mould in European homes.



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AIR QUALITY

The
cost.

VENTILATION IN HOMES



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AIR QUALITY

The
cost.

One of the most striking findings from a recent UK survey is that 71% of homes did not have ventilation provisions that met the current building standards

Across Europe the figures are not much better.

- Between 22% and 55% have flow rates below regulations
- Between 55% and 75% of users operate the systems at lower rates than they should
- 50% of balanced systems are out of balance or malfunctioning.



Acceptable

AIR QUALITY

The
cost.

So why have we been getting this so wrong?

- We don't think about the impacts of IAQ on our health.
- Up until recently, it has been expensive to see the air we breathe.
- We have assumed that because a standard exists, somehow the supply chain will deliver.
- We have delivered ventilation mostly by specification of product not performance

We need to rethink our perspective on ventilation and air quality.

The Air We Breathe

WHAT IS AIR QUALITY



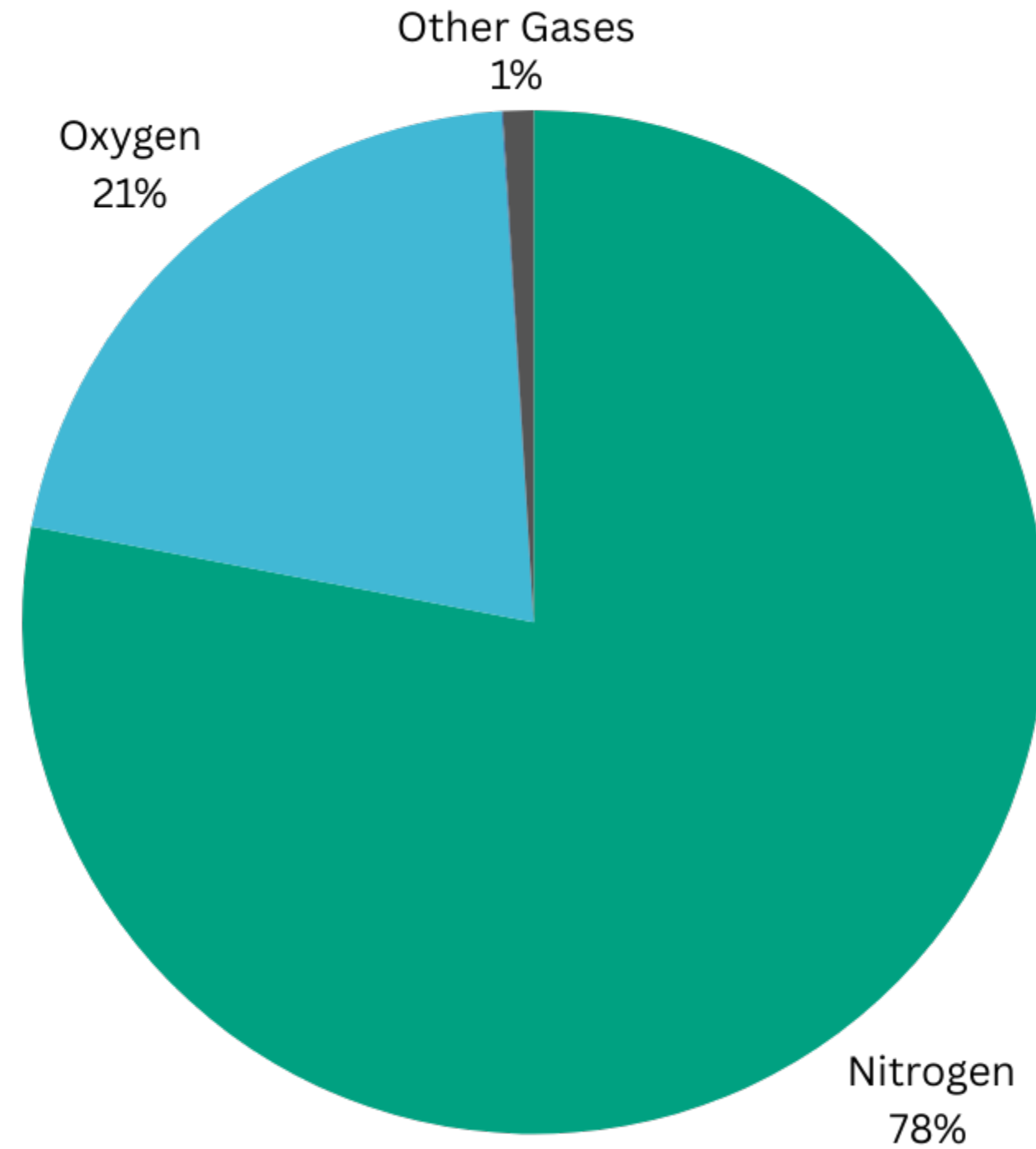
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AIR QUALITY



Acceptable

AIR QUALITY



Carbon Dioxide .04%
420PPM

Acceptable

AIR QUALITY

How Long is 1 Million Seconds



Carbon Dioxide .4%
420PPM

Acceptable

AIR QUALITY

How Long is 1 Million Seconds

**12
Days**



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AIR QUALITY

How Long is 1 Million Seconds

12

Days

How long is 1 Billion Seconds

32

years



PPB

PPM

μg

Bq

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AIR QUALITY

NO₂	1-hour mean	200 (WHO, 2010) (WHO, 2005)
	24-hour mean ^(f)	25 (WHO, 2021)
	Annual	40 (WHO, 2010), 10 (WHO, 2021)
PM₁₀	24-hour mean ^(f)	50 (WHO, 2005), 45 (WHO, 2021)
	Annual	20 (WHO, 2005), 15 (WHO, 2021)
PM_{2.5}	24-hour mean ^(f)	25 (WHO, 2005), 15 (WHO, 2021)
	Annual	10 (WHO, 2005), 5 (WHO, 2021)
CO₂	'Occupied period'	1,000 ppm (BB101 and CIBSE)
CO	15-minute mean	100,000 (WHO, 2010)
	1-hour mean	35,000 (WHO, 2010)
	8-hour mean	10,000 (WHO, 2010)
	24-hour mean ^(f)	4,000 (WHO, 2021)
O₃	8-hour mean ^(f)	100 (WHO, 2005), 100 (WHO, 2021)
	Peak season ^(g)	60 (WHO, 2021)
TVOC^(c)	8-hour mean	300 (ADF, (MHCLG, 2010a)
Acrolein^(d)	N/A ^(d)	0.1-0.5 (WHO, 2002) ^(d)
Formaldehyde	30-minute mean	100 (WHO, 2010)
	Annual	10 (PHE, 2019)
Benzene	Not applicable	Carcinogen; no safe level. Excess lifetime risk of leukaemia at 1 µg/m ³ is 6x10 ⁻⁶ (WHO, 2010)

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AIR QUALITY

So what is good air quality

air in which there are no known contaminants at harmful concentrations, as determined by cognizant authorities, and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.” ASHREA 62.1

satisfactory indoor air quality for human respiration in occupied areas of a building

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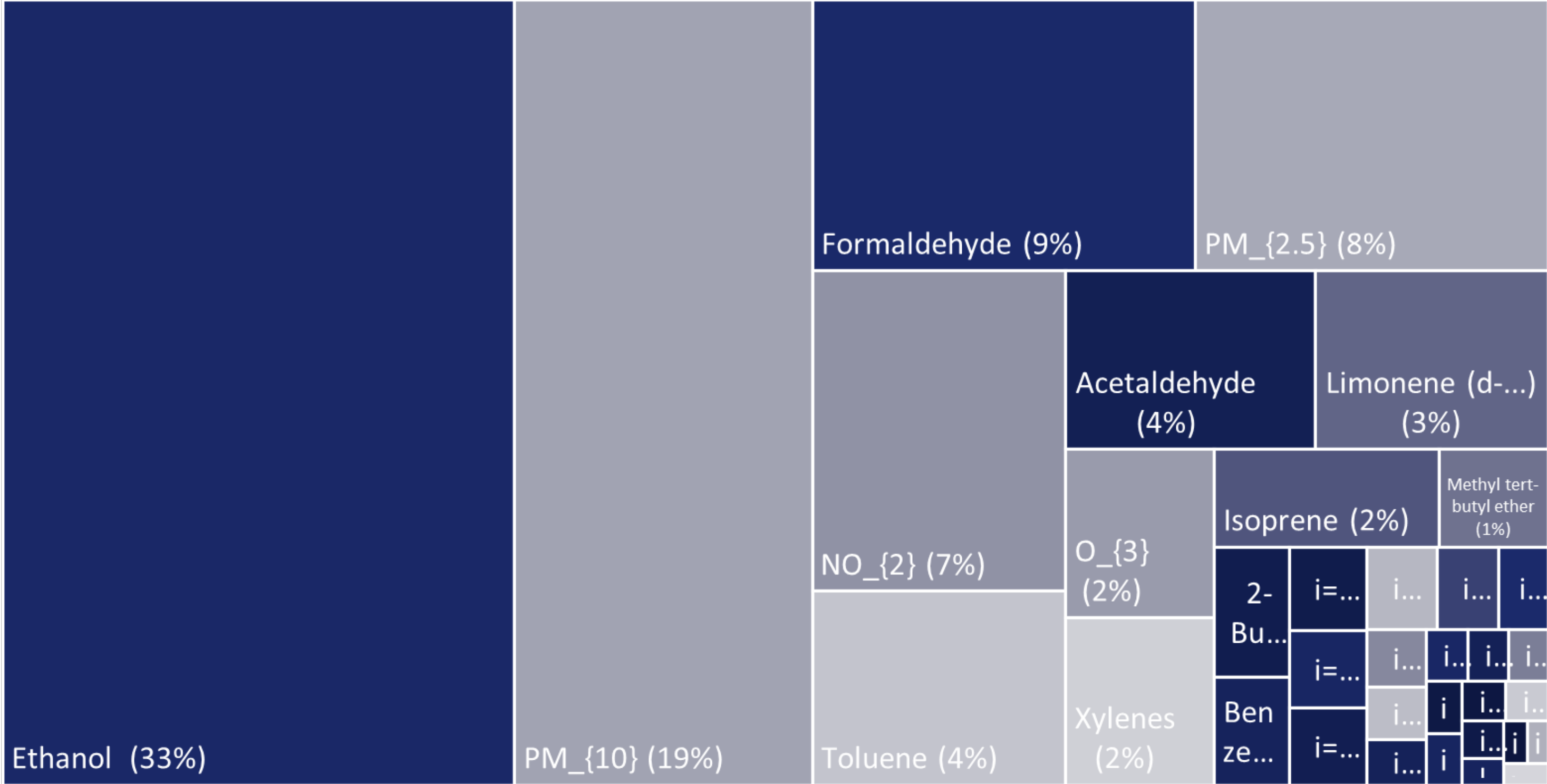
AIR QUALITY



Acceptable

AIR QUALITY

Representative dwelling concentrations: median treemap



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AIR QUALITY

Volatile Organic Compounds (VOCs)

Explanation: Volatile organic compounds (VOCs) are chemicals that easily become vapors or gases. They are found in many products, including paints, varnishes, cleaning supplies, and even some building materials. Common VOCs include formaldehyde, benzene, and toluene.

Health Effects: VOCs can cause a variety of health problems, ranging from eye, nose, and throat irritation to more severe effects like liver and kidney damage and even cancer. Long-term exposure can affect the central nervous system and lead to serious chronic health issues. It's important to ensure good ventilation when using products that release VOCs.



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AIR QUALITY

Terpenes

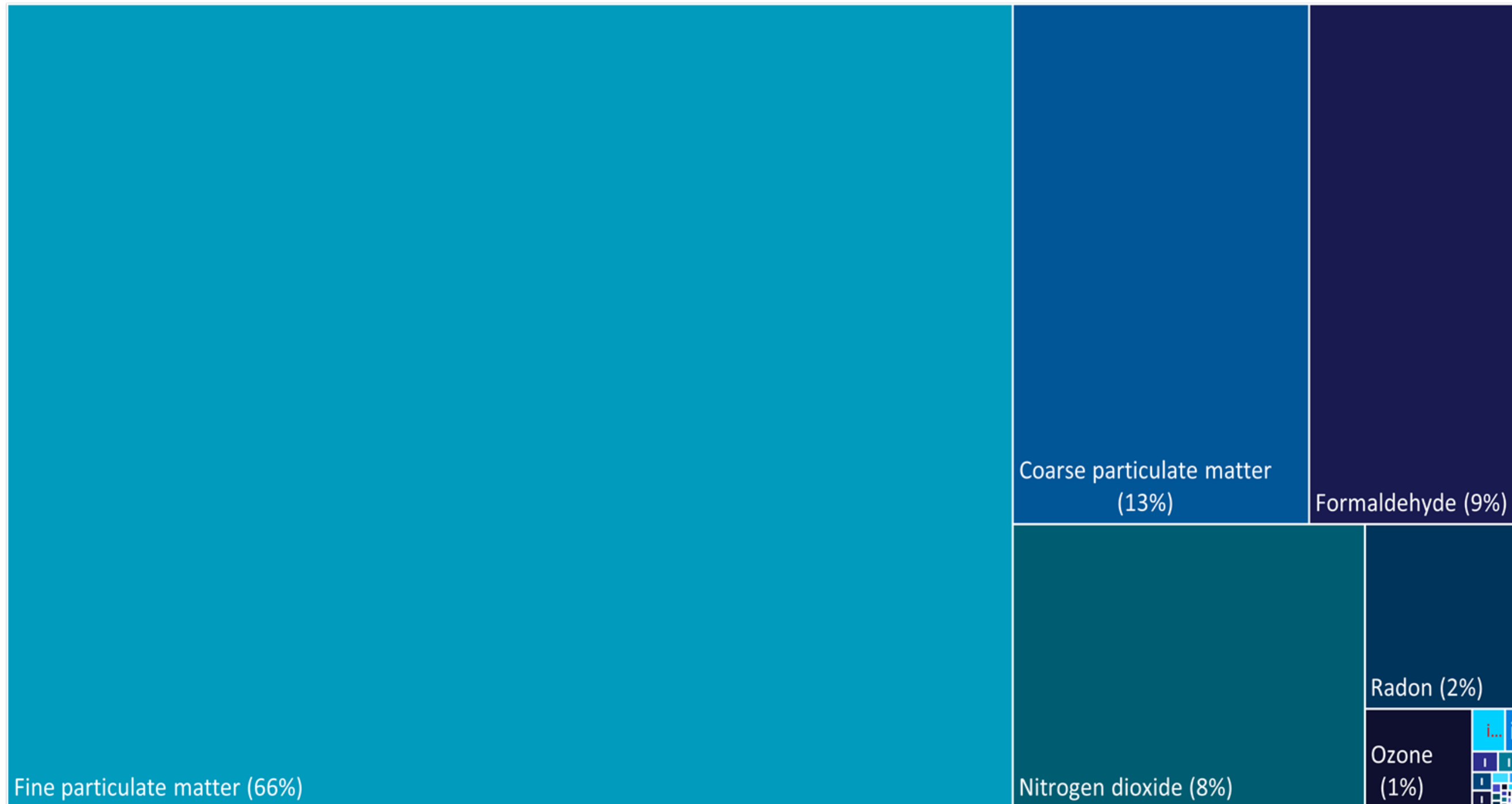
Explanation: Terpenes are organic compounds found in many plants, particularly conifers. They are commonly used in household products such as cleaners, air fresheners, and personal care products for their pleasant scents. Terpenes can react with ozone to form secondary pollutants.

Health Effects: Terpenes are organic compounds found in many plants, particularly conifers. They are commonly used in household products such as cleaners, air fresheners, and personal care products for their pleasant scents. It's important to use terpene-containing products in well-ventilated areas to minimize exposure.



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AIR QUALITY



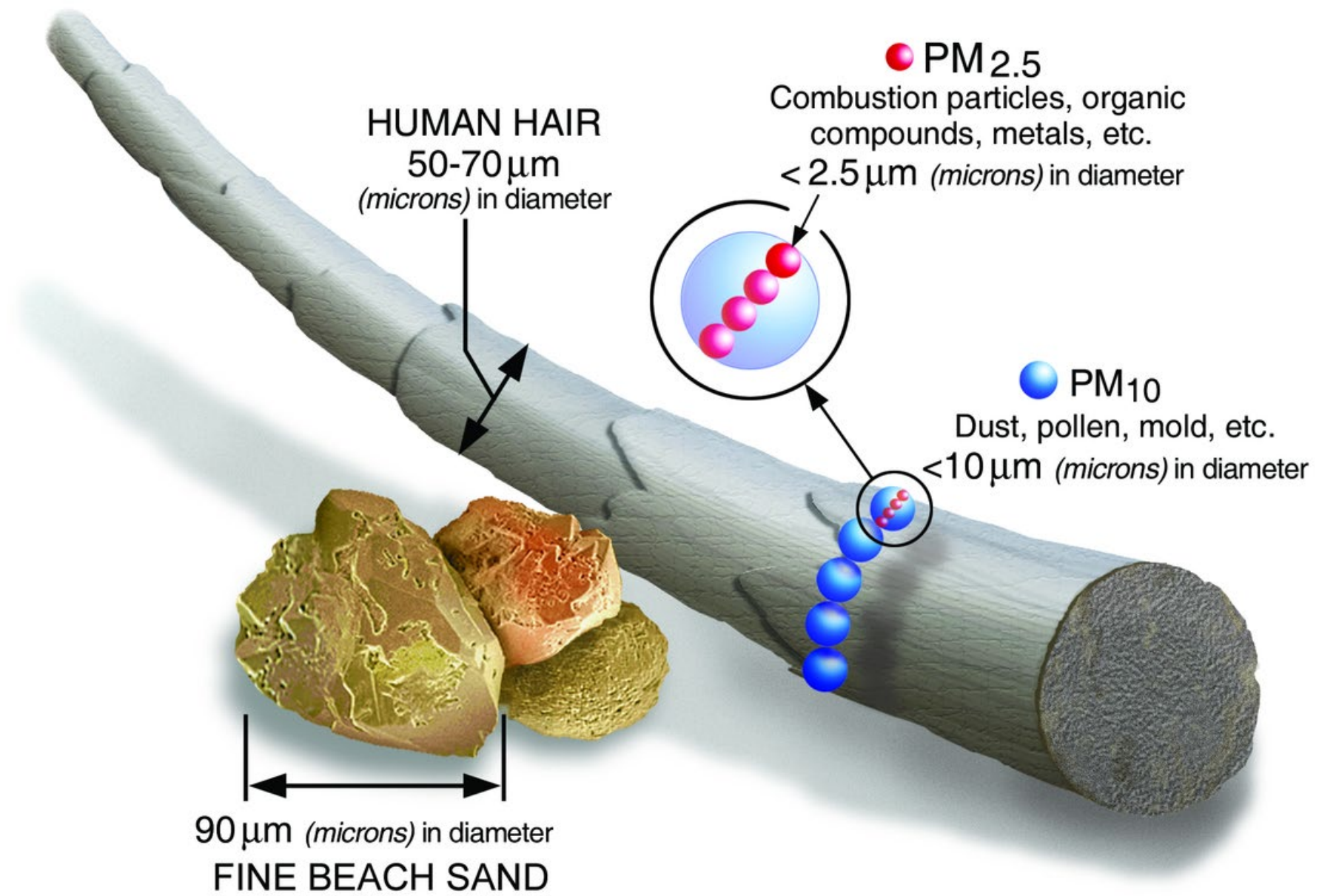
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AIR QUALITY

Particulate Matter (PM)

Explanation: Particulate matter (PM) consists of tiny particles in the air, such as dust, dirt, soot, and smoke. These particles can come from various indoor activities like cooking, smoking, and burning candles. They can also come from outdoor sources like traffic and industrial emissions and enter the home.

Health Effects: When you inhale these tiny particles, they can penetrate deep into your lungs and even enter your bloodstream. This can cause a variety of health issues, including respiratory and cardiovascular diseases, cancers, and even cognitive problems like reduced ability to think clearly. Long-term exposure can also lead to chronic health conditions such as diabetes and low birth weight in infants.



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AIR QUALITY

Nitrogen Dioxide (NO₂)

Explanation: Nitrogen dioxide (NO₂) is a harmful gas that comes from burning fuels like gas and diesel. Inside homes, it mainly comes from gas appliances like cookers. When you breathe in high levels of NO₂, it can cause inflammation in your lungs, making it harder to breathe. It also makes you more likely to catch respiratory infections and react to allergens.

Health Effects: Long-term exposure to NO₂ has been linked to serious health problems like lung cancer, low birth weight in babies, diabetes, and possibly even dementia. Short-term exposure can make your airways inflamed, increasing the risk of infections and allergies. Therefore, it's important to minimize exposure, especially for people with respiratory issues.



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AIR QUALITY

Formaldehyde

Explanation: Formaldehyde is a strong -smelling gas used in building materials and products. It is found in products like pressed wood furniture, glues, and coatings. Burning fuels and certain cooking methods can also release it .

Health Effects: Exposure to formaldehyde can cause irritation of the eyes, nose, and throat, as well as skin rashes.

It has been classified as a probable human carcinogen, meaning long -term exposure can increase the risk of cancer. It's important to minimize exposure by using products with low formaldehyde emissions and ensuring proper ventilation.



Acceptable

AIR QUALITY

Carbon Dioxide (CO₂)

Explanation: Carbon dioxide (CO₂) is a natural part of the air we breathe, produced by respiration and combustion processes. Indoors, high levels of CO₂ can accumulate in poorly ventilated spaces, especially in buildings with many people or where fuels are burned for heating or cooking.

Health Effects: While CO₂ itself is not highly toxic, high concentrations can indicate poor ventilation, which can lead to discomfort and decreased cognitive function.

People might feel tired, have headaches, or experience difficulty concentrating. Very high levels can cause serious health issues like shortness of breath and increased heart rate.



Moisture Balance

CONDENSATION DAMP AND MOULD



Moisture Balance

- The concept that a building's healthy balance point is the target.
- Each will have a different balance point based on the building, its use and systems within it.
- There are multiple factors that can upset this balance and consequences to changing elements of it.



Moisture Balance

CONDENSATION DAMP AND MOULD

Leaks (Internal)	Lack of Ventilation	High or Over Occupancy
Water Penetration	Poor Ventilation design	Poor heating use
Cold Bridging	Poor Zoning	High Moisture activity
Poor Insulation	Poor Heating Control	Poor Ventilation use
Interstitial Condensation	Lack of Heating	System interfering
Building design	Dead zones	Lack of understanding

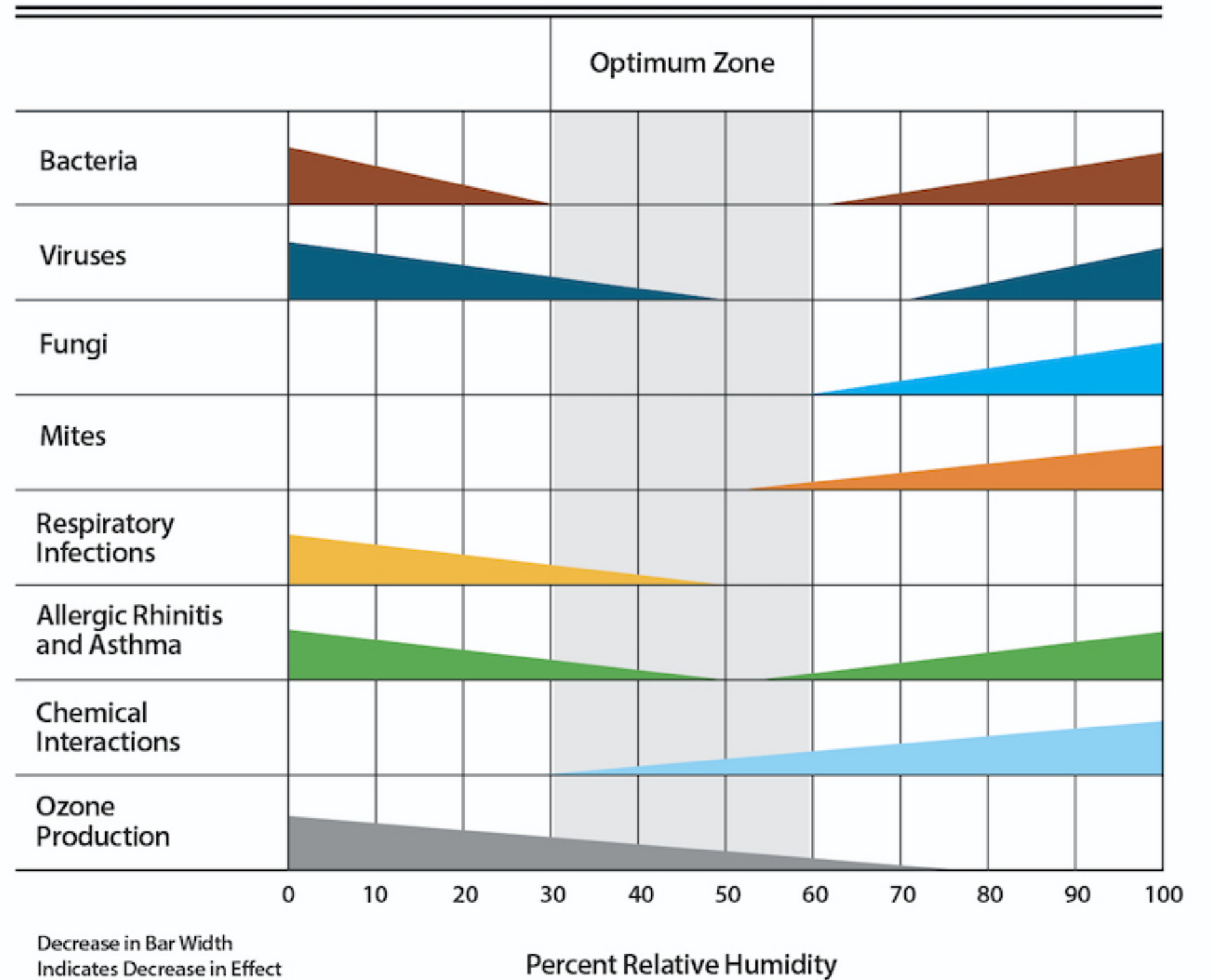
Moisture Balance

CONDENSATION DAMP
AND MOULD



Moisture Balance

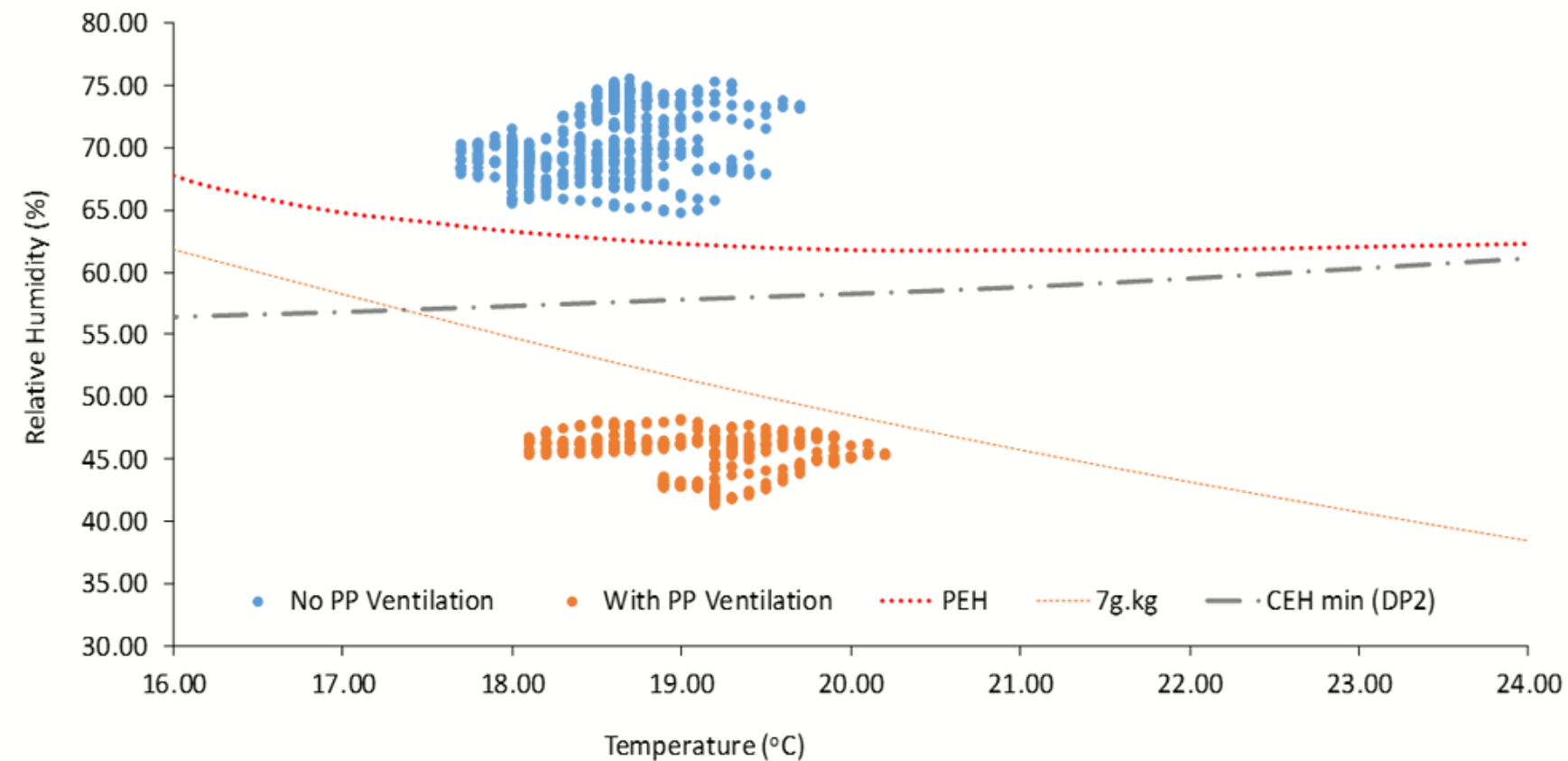
CONDENSATION DAMP AND MOULD



Moisture Balance

CONDENSATION DAMP AND MOULD

By maintaining humidity levels below the CEH, it's possible to create an environment that is inhospitable to dust mites, thereby reducing their prevalence and mitigating associated allergies.



Population Equilibrium Humidity refers to the specific relative humidity level at which the population of dust mites remains stable. It is the humidity level where the birth and death rates of dust mites are balanced, leading to a stable population.

Dust mites thrive in environments with a relative humidity of around 70 - 80%.

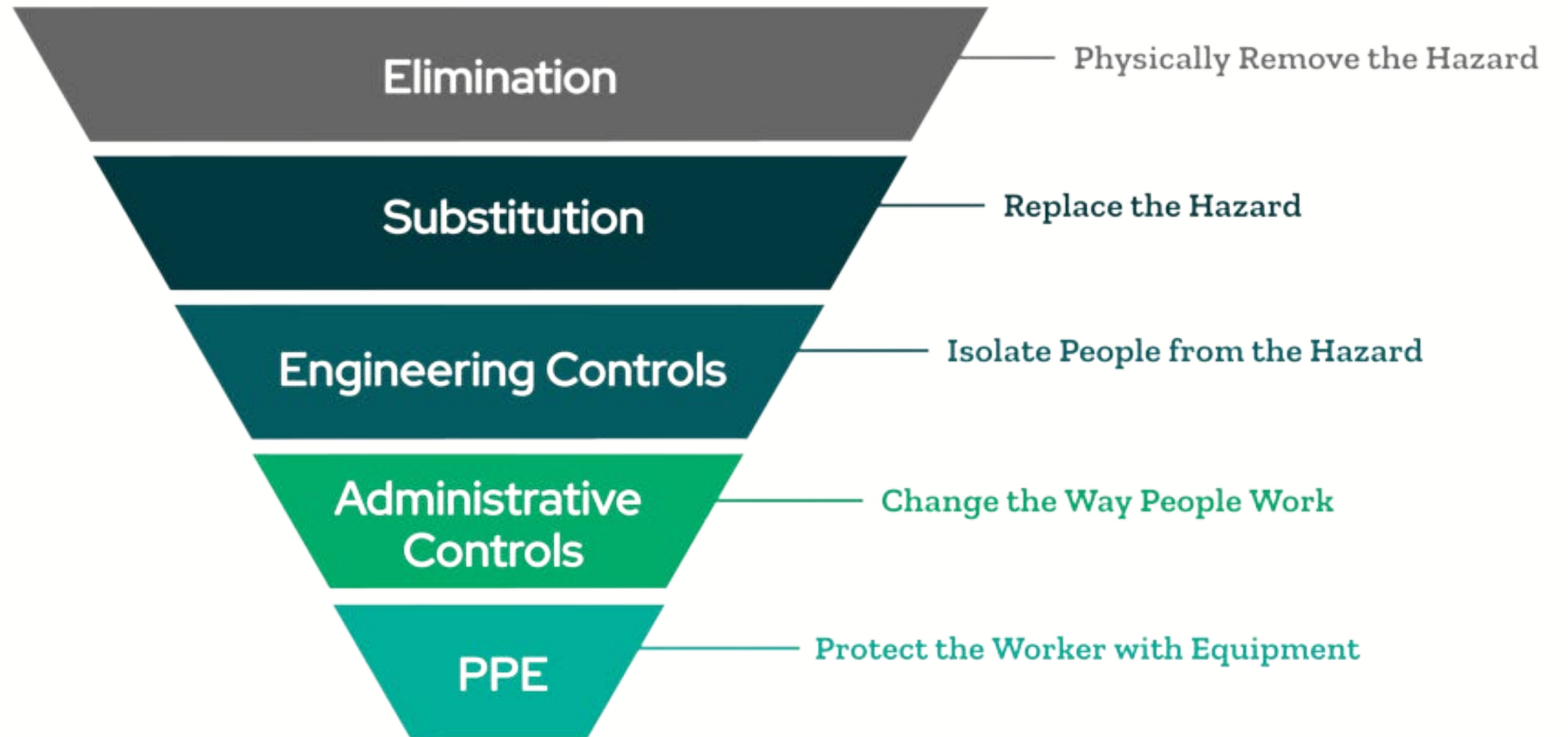




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AIR QUALITY

Hierarchy of Controls

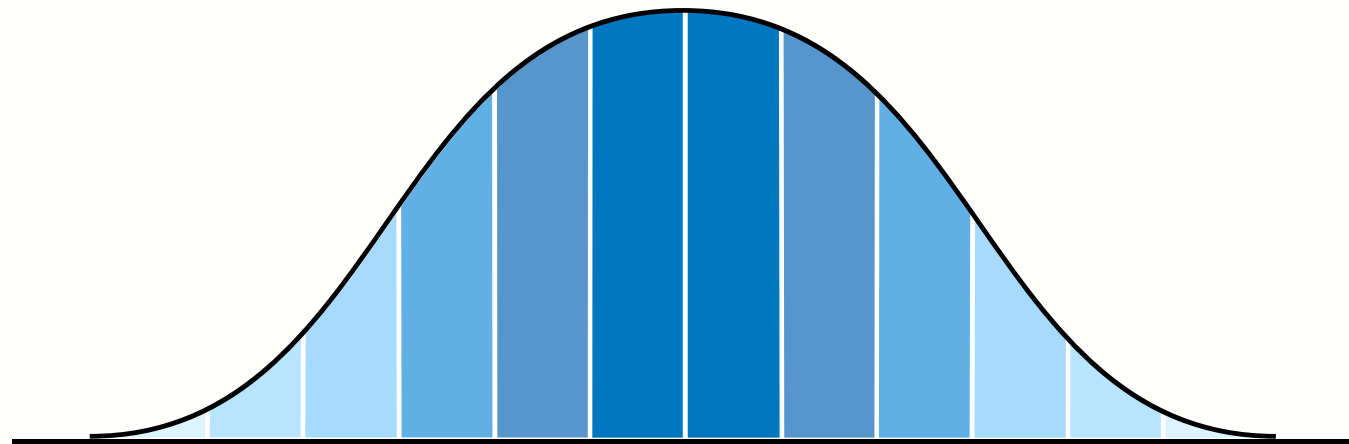


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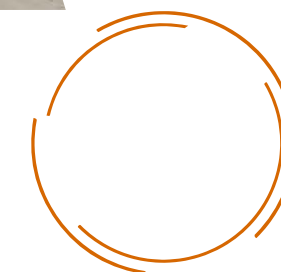
AIR QUALITY

The
cost.

Unseen problem A Story



Thank you



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