



The Health effects of Indoor Air Quality



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Environmental Health Fund e-meet
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Why is indoor air quality so important?

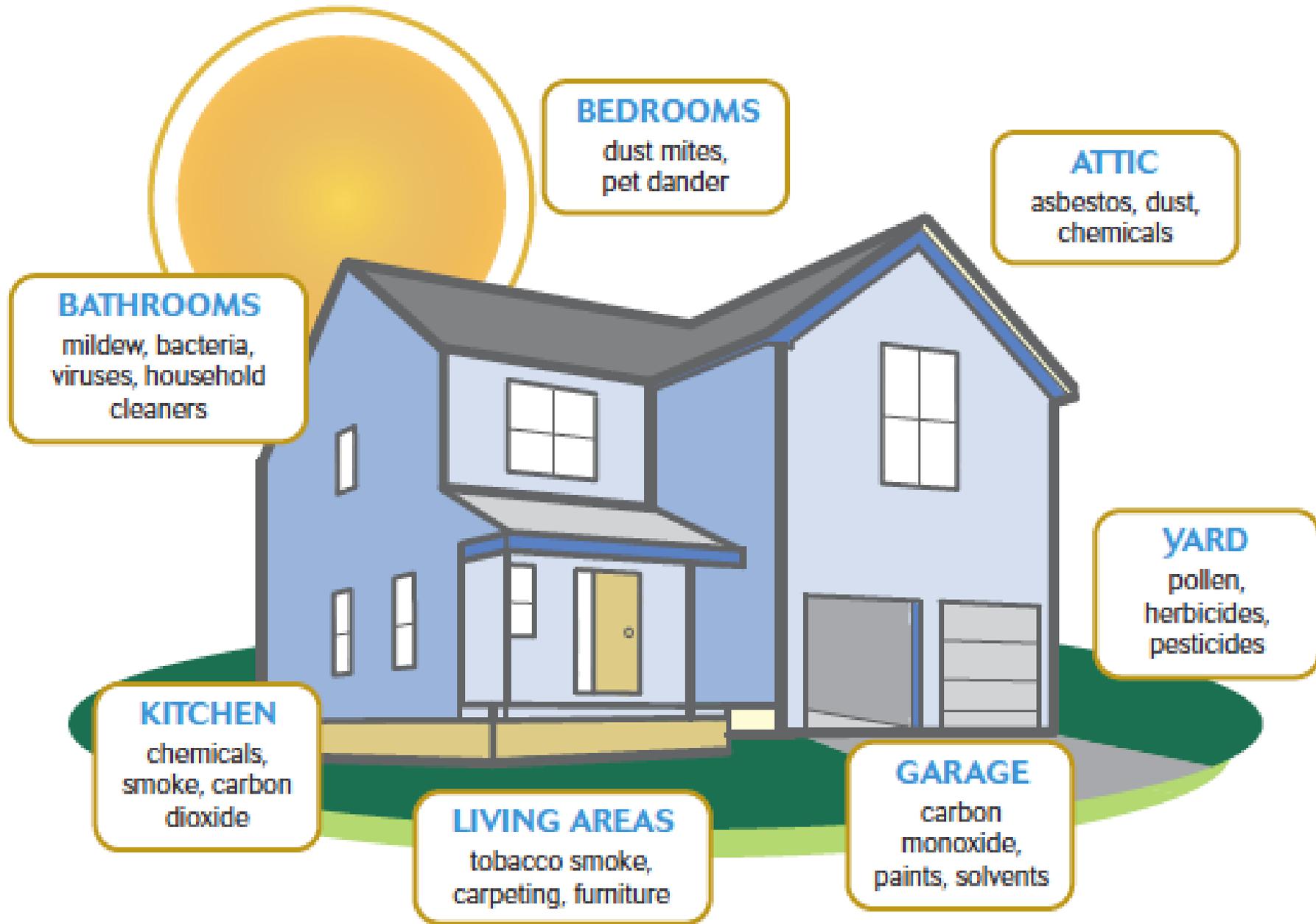


- 70-90% of our time is spent *indoors*

At homes or other public or private indoor environments such as offices, shopping centers, schools, theatres, restaurants,...

- Each of these indoor environments contain *different* sources and types of pollution



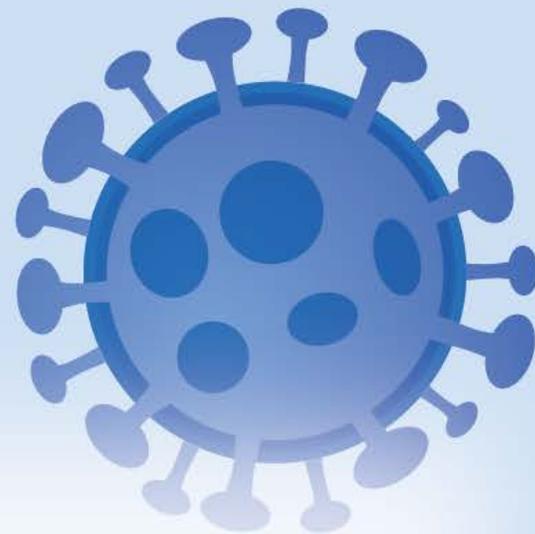


Environmental Tobacco Smoke (ETS)

- Classified environmental tobacco smoke as a **class A carcinogen**,
- Responsible for approximately **3,000 lung cancer deaths** and **62,000 heart disease deaths** annually in U.S. in **non-smokers**.
- ETS includes toxic gases, particulate matter and radiogenic species.



COVID-19





Household air quality in *developing* countries and Impacts on health

- ~4.0 million people a year die *prematurely* from illness attributable to the household air pollution. Among these deaths:
- 27% are due to pneumonia
- 18% from stroke
- 27% from ischemic heart disease
- 20% from chronic obstructive pulmonary disease (COPD)
- 8% from lung cancer





Global Burden of Disease

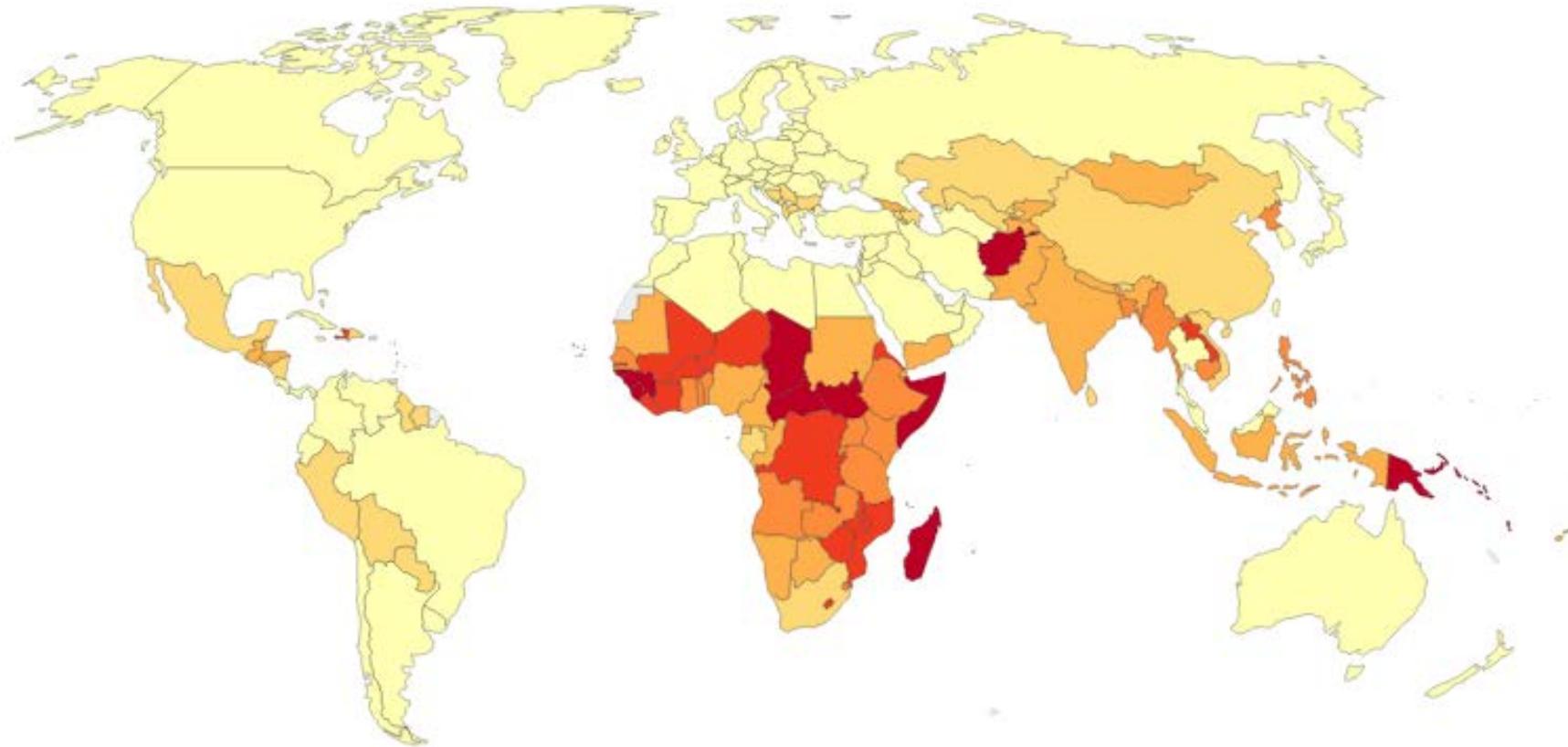
- In 2020 the GBD report shows that the largest declines in risk exposure from 2010 to 2019 were among a set of risks that are strongly linked to social and economic development, *including household air pollution*;
- Yet, the largest increases in risk exposure were for ambient particulate matter pollution

Global burden of 87 risk factors in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*. 17 October 2020.



Death rates from indoor air pollution, 2017

Death rates from indoor air pollution are measured as the number of deaths per 100,000 individuals.

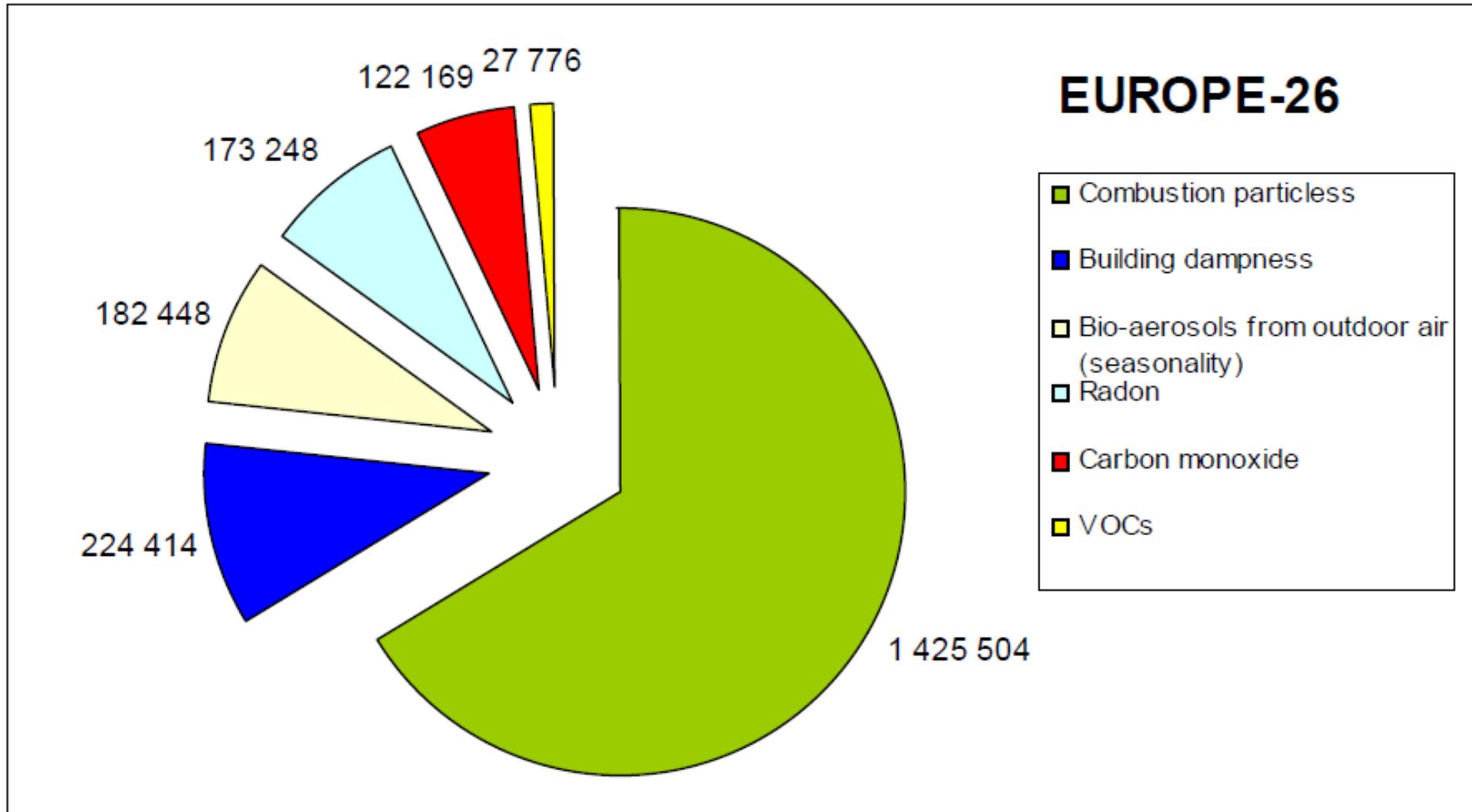


Source: IHME, Global Burden of Disease

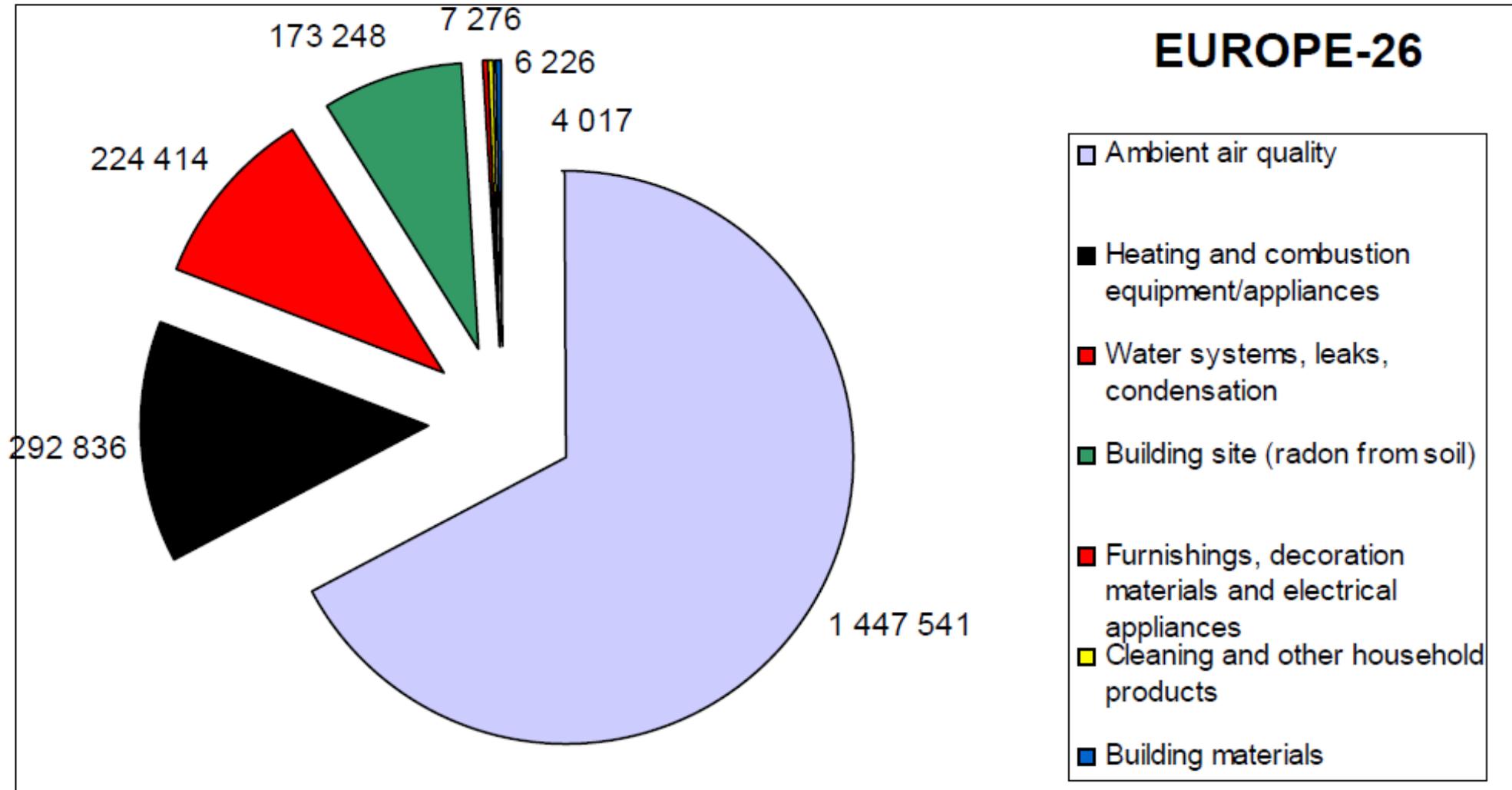
Note: To allow comparisons between countries and over time this metric is age-standardized.

OurWorldInData.org/indoor-air-pollution/ • CC BY

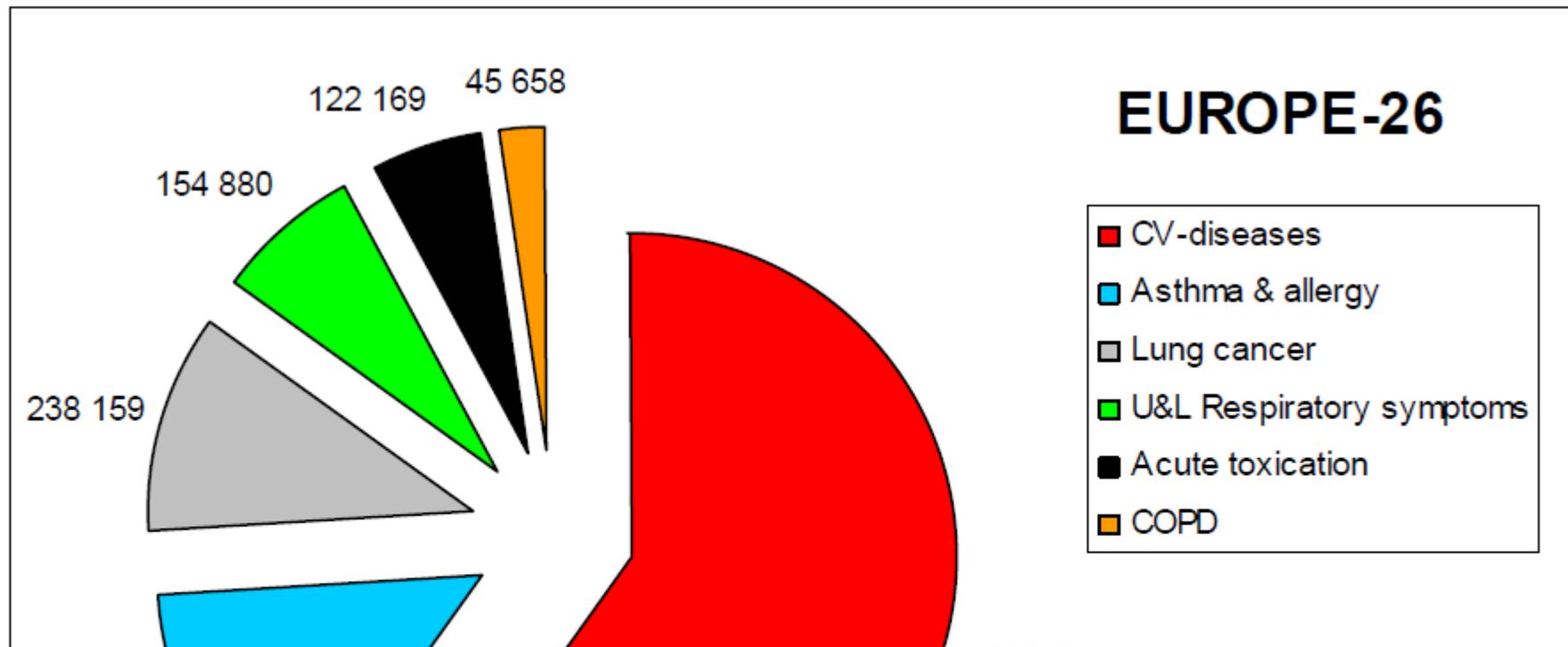
The Indoor Air Quality associated Burden of Disease attributed to the **key exposure agents**.



The Indoor Air Quality associated Burden of Disease attributed to the **key sources of exposure**

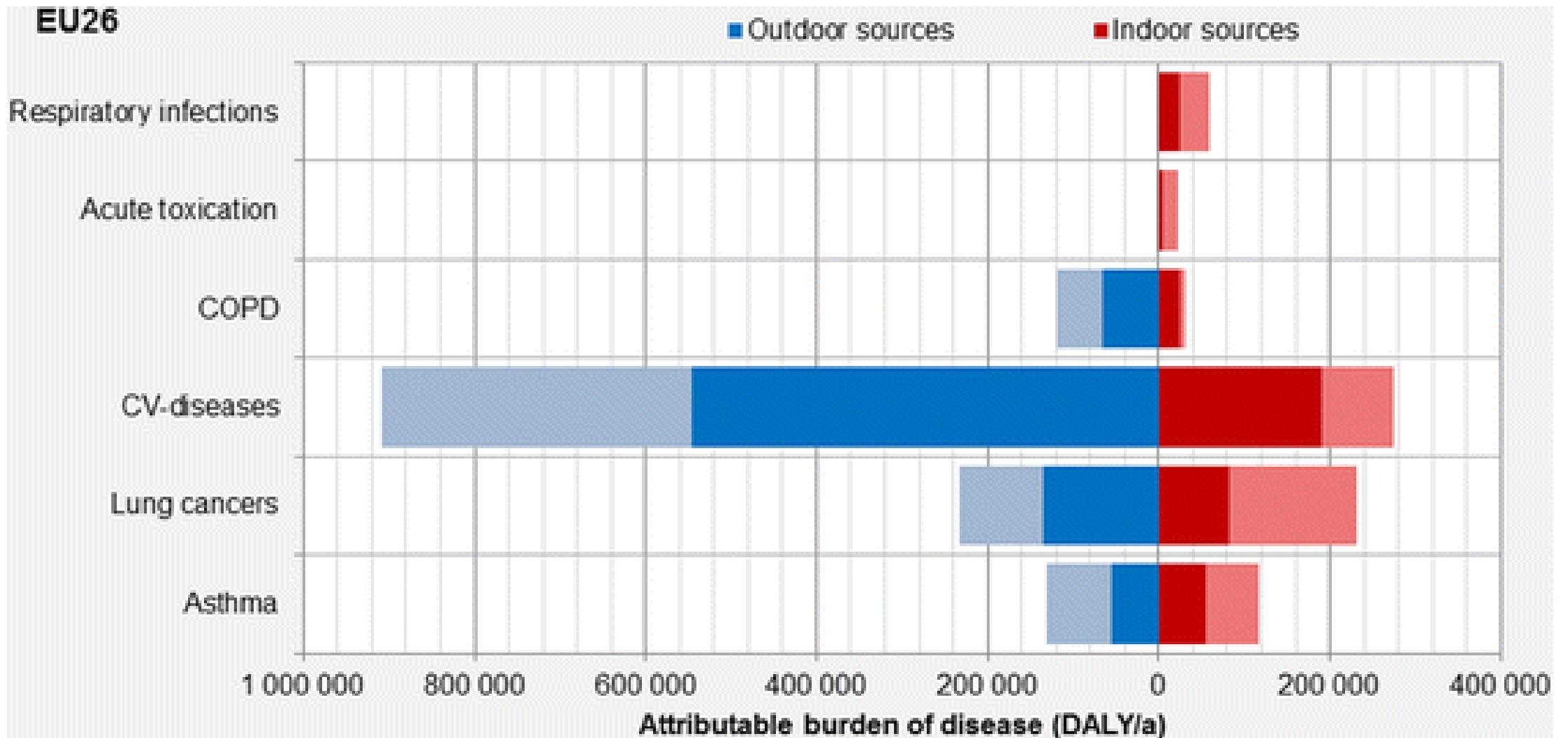


The Indoor Air Quality associated Burden of Disease attributed to the **key health outcomes**



The annual burden of disease caused by indoor air pollution, including polluted outdoor air used to ventilate indoor spaces, is estimated to correspond to a loss of over 2 million healthy life years in the European Union (EU).







Studying the health effects of indoor air quality

- Exposure assessment
 - Outdoor/indoor measurements
 - Modeling
 - **Health effect assessment** – how to measure the effect?
 - Questionnaires
 - Serum
 - Urine
 - Saliva
 - Metabolome
- Biomonitoring





Housing-related health effects likely to arise through direct or indirect effects of **climate change**

- i) indoor temperatures,
- ii) indoor air quality,
- iii) indoor allergens and infections, and
- iv) flood damage and water contamination

A better understanding of how current and emerging building infrastructure design, construction, and materials may affect health in the context of climate change is needed.

Long-term, energy efficient building design interventions, ensuring adequate ventilation, need to be promoted.





Indoor air quality and ventilation

The combination of controlling the indoor air sources and selecting appropriate ventilation rate might be effective to reduce health risks.

If indoor sources cannot be removed or their emissions cannot be limited to an accepted level, ventilation needs to be increased to remove remaining pollutants.





Impact of short-term exposure to fine particulate matter air pollution on urinary metabolome: A randomized, double-blind, crossover trial

- Metabolomics is a novel tool to explore the biological mechanisms of the health effects of PM_{2.5} air pollution.
- Aim: To assess the alternation in urine metabolomics in response to short-term PM_{2.5} exposure.





Impact of short-term exposure to fine particulate matter air pollution on urinary metabolome: A randomized, double-blind, crossover trial

Methods:

A randomized, double-blind, crossover trial of **9-day**

Real or Sham ***indoor air purification*** was used among **45 healthy college students** in Shanghai, China.

Urine samples were collected immediately at the end of each intervention stage and were analyzed for **metabolomics**





Impact of short-term exposure to fine particulate matter air pollution on urinary metabolome: A randomized, double-blind, crossover trial

Results:

- The personal PM_{2.5} exposure in the **real-purified** scenario was **50% lower** than in the **sham-purified** air scenario (28.3 μg/m³ VS 56.9 μg/m³).
- Found significant **differences of urinary metabolic profile** in the **real** and **sham** air purification groups.
- Identified a total of 40 differentiated metabolites that were significantly associated with PM_{2.5} exposure including 16 lipids, 5 purine metabolites, 2 neurotransmitters, and 3 coenzymes.





Thank You

