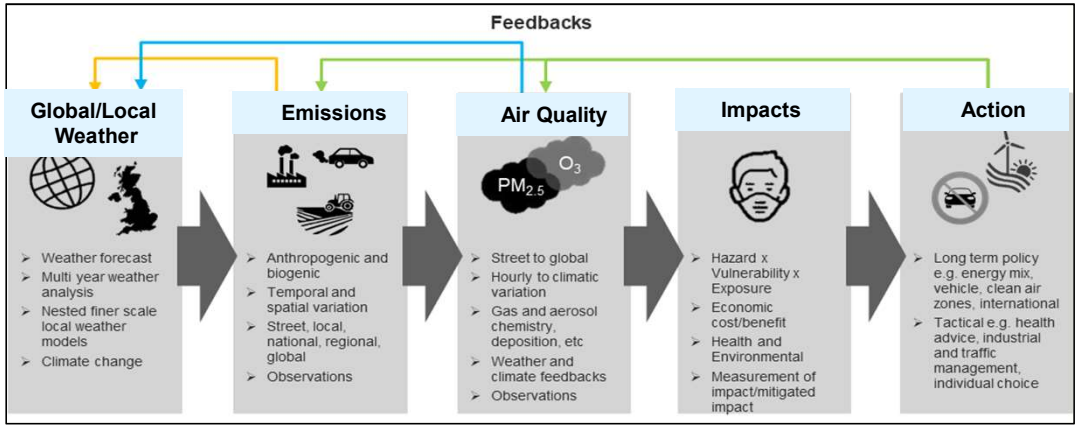
Met Office NPL National Physical Laboratory Department for Environment Food & Rural Affairs Department of Health & Social Care Department for Transport

Coordination and realising impact

Strategic Priorities Fund (SPF) Clean Air Programme

Professor Sir Stephen Holgate,
UKRI Clean Air Champion
Faculty of Medicine,
University of Southampton

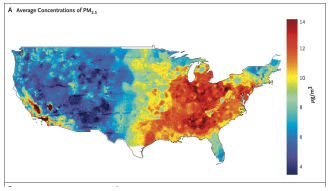


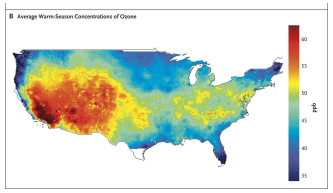
UNIVERSITY OF Southampton

Clean Air Programme

Air Pollution and Mortality in the Medicare Population

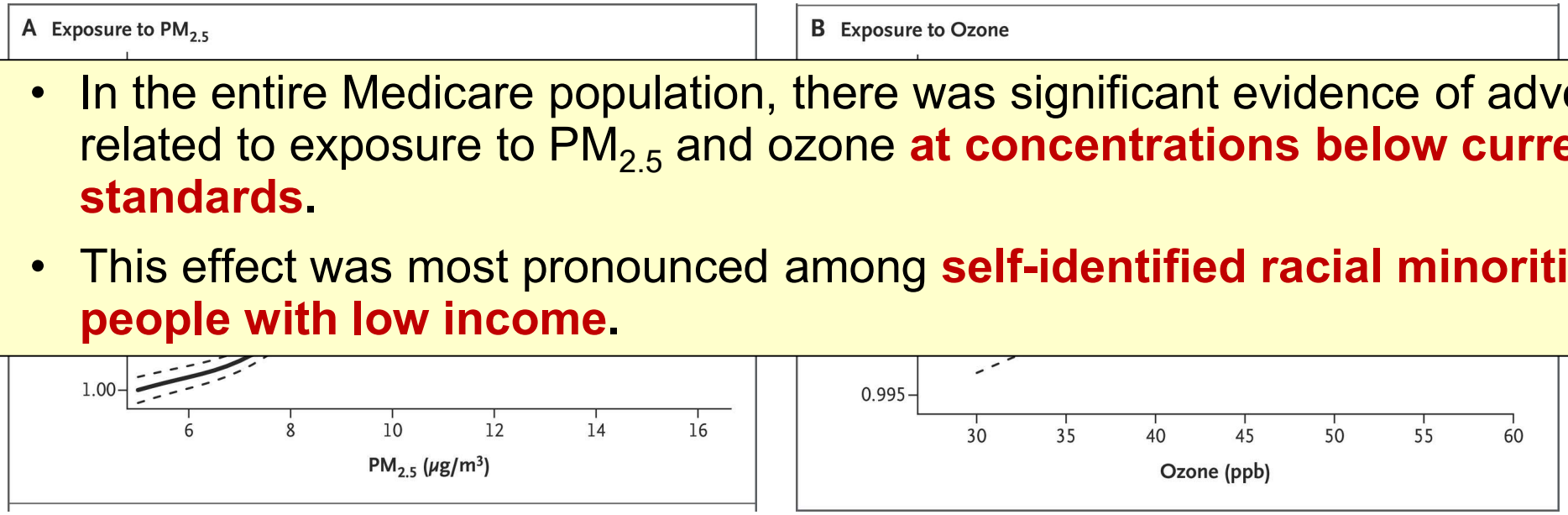
Di Q, et al. N Engl J Med. 2017; 376: 2513-22





Average $PM_{2.5}$ and Ozone Concentrations in the USA 2000-12

An open cohort of all Medicare beneficiaries (**60,925,443) persons**) in with 60,310,521 person-years of follow-up.



- In the entire Medicare population, there was significant evidence of adverse effects related to exposure to $PM_{2.5}$ and ozone **at concentrations below current national standards**.
- This effect was most pronounced among **self-identified racial minorities and people with low income**.

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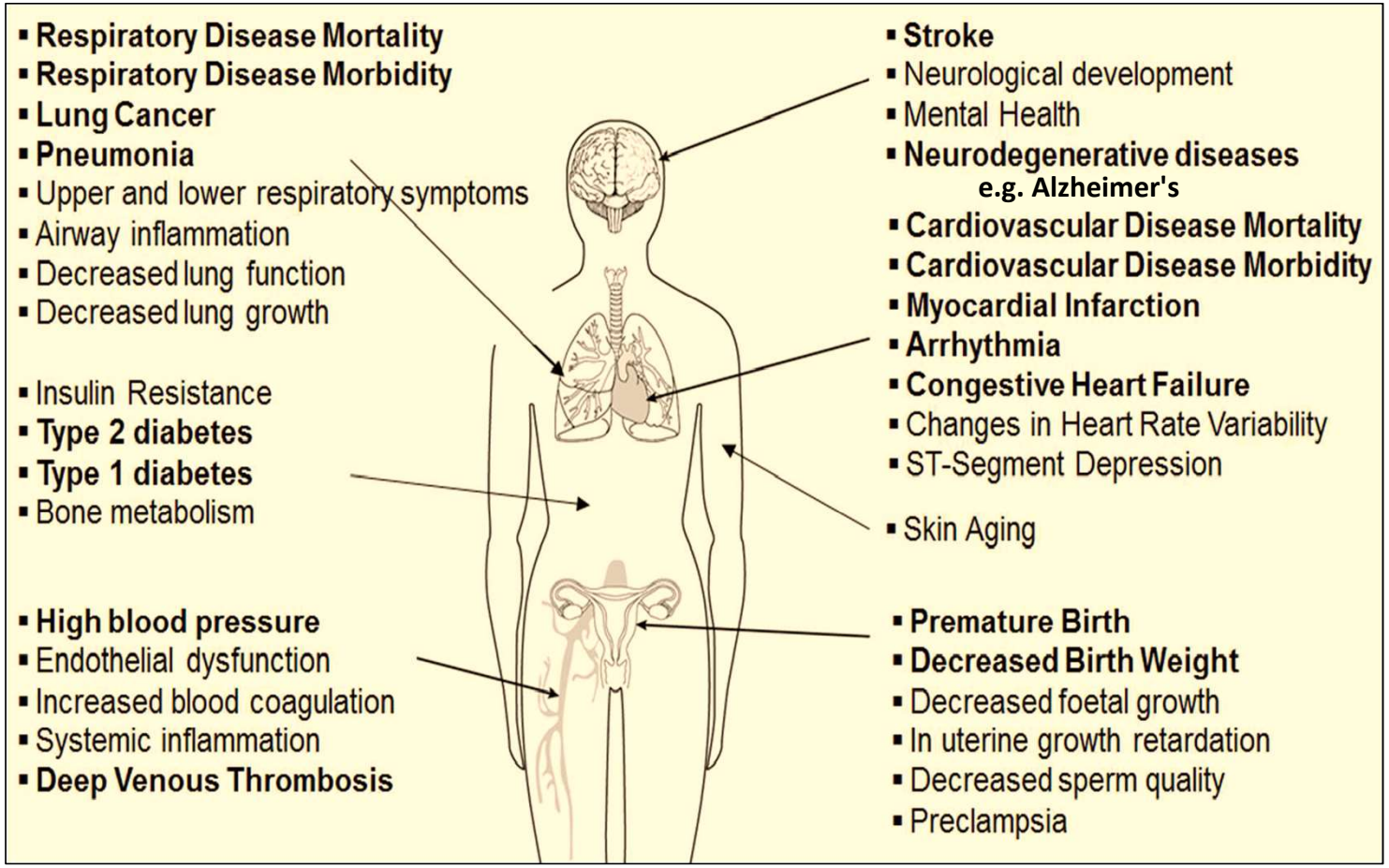
Overview of diseases, conditions, and biomarkers affected by outdoor air pollution

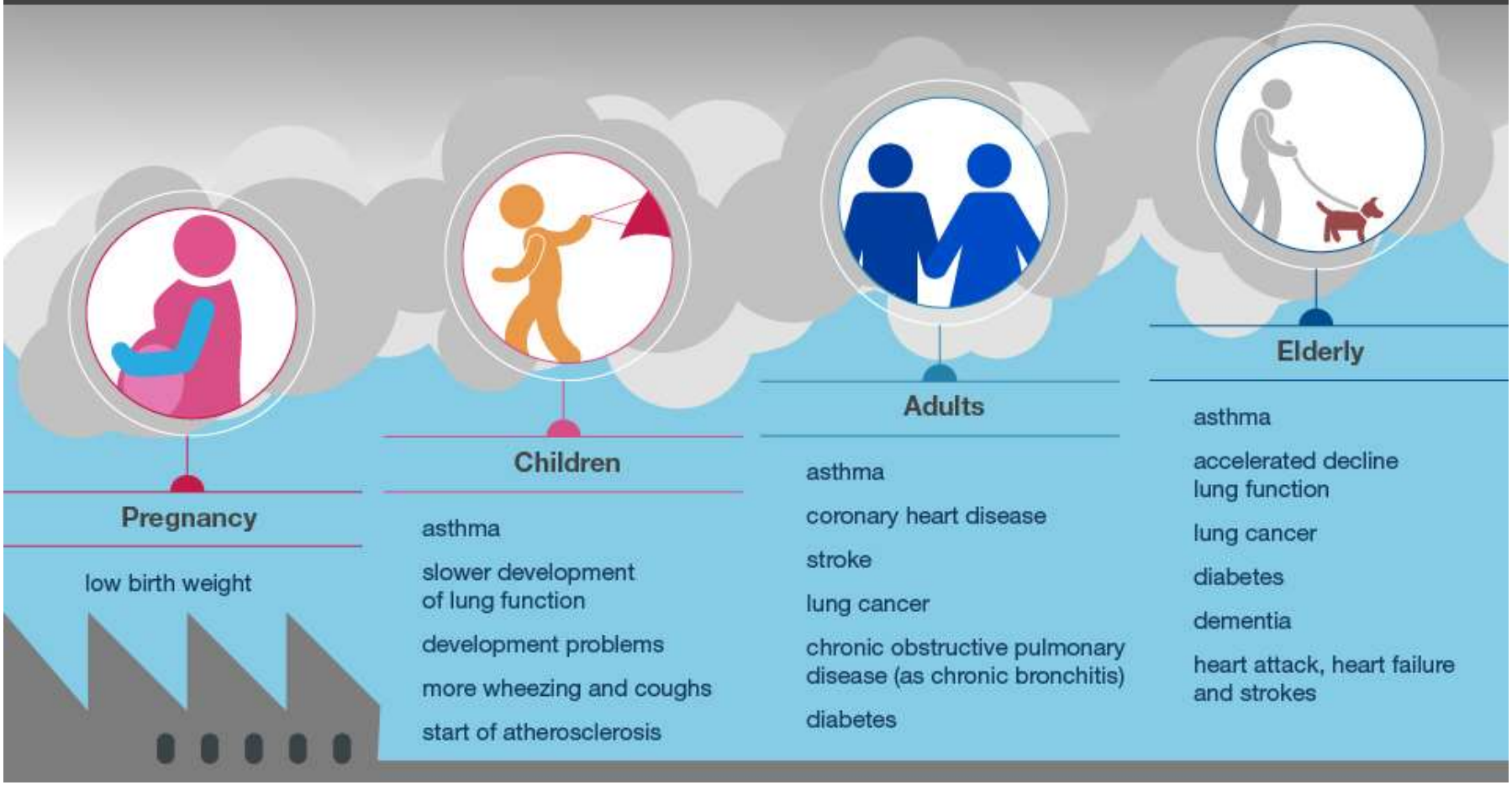
Conditions currently included in the Global Burden of Disease categories are shown in **bold**

What Constitutes an Adverse Health Effect of Air Pollution? An analytical framework

A ERS & ATS Policy Statement: Aug 2016
Thurston GD, et al. Eur Respir J. 2017; 49: pii: 1600419.



Air pollution affects people throughout their lifetime



First death linked to air pollution Ella Kissi-Debrah: how a mother's fight for justice may help prevent other air pollution deaths

- 2nd Inquest - South Thames Assistant Coroner Dec 16th 2020:
- The first matter that I think it important to include is that, on the balance of probabilities, air pollution made a material contribution to Ella's death.
- The second matter is that she was exposed to levels of NO_2 and PM in excess of WHO guidelines. The level of air pollution she was exposed to was, therefore, excessive.
- In my discretion, I think it important also to record that there was a recognised failure to reduce the level of NO_2 which possibly, contributed to her death; and also the lack of information given to Ella's mother which, possibly, contributed to her death.
- The reason for exercising my discretion to include those matters is as follows: **1) The overwhelming public interest in this case; 2) The complexities of the issues; 3) The implications for other people and other cases.**

2018 - SPF Clean Air – Two Waves

Clean Air Programme

Wave 1 - Clean Air: Analysis & Solutions (2018-22)
Developing solutions to air pollution to help policymakers and businesses protect health and work towards a cleaner economy. (£20.5m)

Wave 2 - Clean Air: Addressing the Challenge of the Indoor/Outdoor Continuum (2020-24)
The programme aims to equip the UK to proactively tackle new air quality challenges related to changing emissions and exposure patterns, in order to protect human health and support clean growth. (£22m)

Air quality dependencies and basis for Clean Air systems analysis framework

Failure of engagement and ownership of the health problems by medical community

Clean Air Programme

Communication barriers between physical and biological/health scientists

Lack of public understanding

Little motivation for behaviour change

X X X X

Feedbacks

Global/Local Weather	Emissions	Air Quality	Impacts	Action
➢ Weather forecast ➢ Multi year weather analysis ➢ Nested finer scale local weather models ➢ Climate change	➢ Anthropogenic and biogenic ➢ Temporal and spatial variation ➢ Street, local, national, regional, global ➢ Observations	➢ Street to global ➢ Hourly to climatic variation ➢ Gas and aerosol chemistry, deposition, etc ➢ Weather and climate feedbacks ➢ Observations	➢ Hazard x Vulnerability x Exposure ➢ Economic cost/benefit ➢ Health and Environmental ➢ Measurement of impact/mitigated impact	➢ Long term policy e.g. energy mix, vehicle, clean air zones, international ➢ Tactical e.g. health advice, industrial and traffic management, individual choice

X

Lack of interfaces to promote innovations

X

Industry/economic pushback

Capability/Linkages limited, fragmented and not aligned: Street ⟺ Global a particular challenge

Wave 1 - Clean Air: Analysis & Solutions

AIMS

- Developing **solutions** to air pollution to help policymakers and businesses **protect health** and work towards a **cleaner economy.**
- Drive forward new **multidisciplinary** research and innovation.
- Leverage existing UK investments and enable a **challenge-focussed** interdisciplinary community to work together for the first time.
- Inform **implementation of the Clean Air Strategy/Environment Bill** and related strategies.
- Develop new solutions to reduce emissions and protect public health, whilst **avoiding perverse consequences.**

Multidisciplinary policy-relevant research

1. **APEx:** An Air Pollution Exposure model to integrate protection of vulnerable groups into the UK Clean Air Programme (Ben Barratt, MRC CEH)

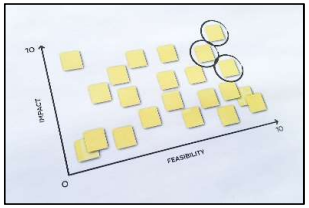
2. **ANTICIPATE**: Actively anticipating the unintended consequences on air quality of future public policies (Nigel Gilbert, CECAN)

3. **DREaM:** Component-Specific Air pollutant Drivers of Disease Risk in Early to Midlife: a pathway approach (Ian Mudway, MRC CEH)

4. **OSCA:** Integrated Research Observation System for Clean Air (Hugh Coe, NERC Air pollution supersites)

5. **QUANT:** Quantification of Utility of Atmospheric Network Technologies. (Pete Edwards, NCAS)

Clean Air Champions provide a solution-focused approach to air pollution research and its uptake



Strategy

1) **Map competences** and **dimensions** of currently funded air pollution projects - overlay these to identify effective activities or gaps to target.

2) **Unify key researchers** and **stakeholders** around visionary missions using horizon. scanning, workshops, sandpit sessions to scenario simulations.

3) **Uncover** and **challenge** barriers/obstacles and **produce** interdisciplinary solutions.

4) **Create** an "**opportunities ideas portfolio**" leading to innovations to test.

5) **Translate** ideas into **practical interventions** targeted at the right people.

6) **Develop** a **professional** and **public communications** strategy using the best available evidence and exemplars.

2017 – Ribble Cycles surveyed 1,060 UK adults

The average person in Britain spends just 8 per cent of their time outside on a week-day, meaning less than two hours a day out of doors.

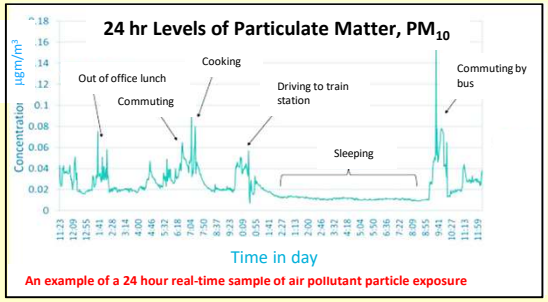
Most of this time is spent walking to the shops or the car, but men are slightly better at getting out than women, at 28 minutes more per weekday.
Brits also admit to spending 1 hour 37 minutes per day less outside during winter in comparison to summer.

- Taking pets for a walk (17%)
- Walking to the shop at lunchtime (16%)
- Walking to and from the car (15%)
- Walking to work from my bus/train (14%)
- Going for a run (6%)
- Walking the kids to school (5%)
- Smoking (4%)
- Cycling to work (2%)

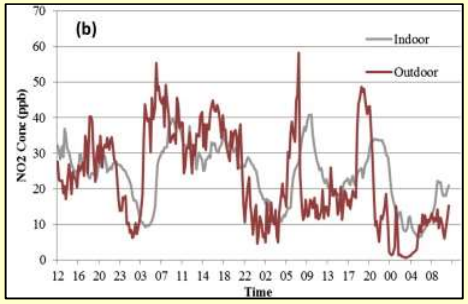
‘The Indoor Generation'

Wave 2 - Clean Air:
Addressing the Challenge of the Indoor/Outdoor Continuum

The scientific, technical, behavioural and policy approaches used to assess and manage exposure to air pollution need radical change to reflect the indoor/outdoor continuum of exposure.



An example of a 24 hour real-time sample of air pollutant particle exposure



The Indoor Generation

Human exposure to air pollution occurs in the home, at school and in workplaces, whilst travelling, and during leisure activities.

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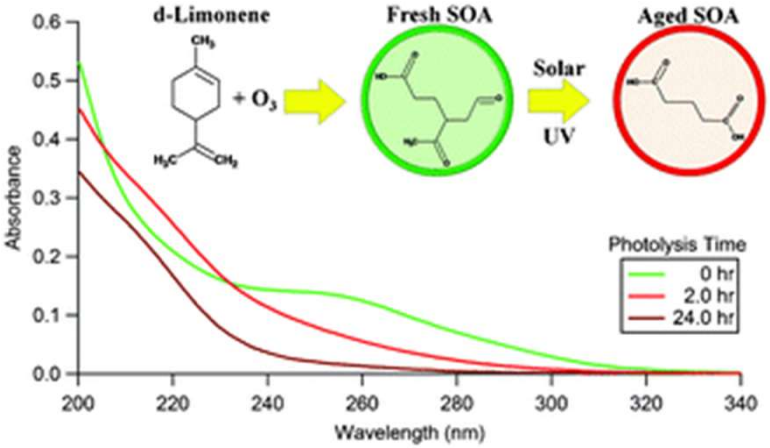
An indoor chemical cocktail: The chemistry that determines human exposure to indoor pollutants is incompletely understood - Gligorovski S, Abbatt JPD. Science 2018: 359; 632-3



- Recent work has highlighted the wealth of **chemical transformations** that occur indoors to generate **Secondary Organic Aerosol (SOA)**.
- This chemistry is associated with 3 of the top 10 risk factors for negative health outcomes globally: **household air pollution from solid fuels, tobacco smoking, and ambient particulate matter pollution**.
- **Highly oxidised organic compounds** arise via auto-oxidation mechanisms initiated by either ozone or radical attack.
- Reaction with a single oxidant molecule can form multiple oxygenated functional groups on an organic reactant within seconds, changing it from a volatile gas to a molecule that will condense to form **secondary organic aerosol (SOA) particles**.

Wave 2 - Clean Air:

Addressing the Challenge of the Indoor/Outdoor Continuum

OUTPUTS

- **Networks** to build the interdisciplinary community.
- **Interdisciplinary research and innovation consortia** to generate new knowledge and tools to influence policy and regulation.
- **Business-led innovation** projects to develop a new clean air products and services for indoor environment.
- **Continued coordination, integration** and impact activities (including UKRI Clean Air Champions).

Clean Air Networks

- **Indoor/outdoor Bioaerosols Interface and Relationships Network – BioAirNet:** Frederic Coulon - Cranfield University
- **Air Pollution Solutions for Vulnerable Groups (CleanAir4V):** Christian Pfrang - University of Birmingham
- **Breathing City: Future Urban Ventilation Network:** Catherine Noakes - University of Leeds
- **Tackling Air Pollution at School:** Paul Linden - University of Cambridge
- **The health and equity impacts of climate change mitigation measures on indoor and outdoor air pollution exposure (HEICCAM):** Ruth Doherty - University of Edinburgh
- **Optimising air quality and health benefits associated with a low-emission transport and mobility revolution in the UK:** Suzanne Bartington - University of Birmingham
- **Metrology Network**: National Physical Laboratory

Clean Air Consortia

Preparing for Future Clean Air Challenges: Interdisciplinary research and innovation consortia

Up to £10m will be available to fund approximately 3-4 consortia at £2-3.3 m each.

Some factors to consider:

1. Understanding and characterising indoor air pollution and its influence on outdoor air quality.
2. Understanding the toxicology and health effects of future exposure and emission scenarios.
3. Understanding airborne biological materials and their impacts on health.
4. Influencing behaviours and practices related to emissions and exposures.
5. Interventions in the built environment.

People will change their behaviour only if they see the new behaviour as easy, rewarding, empowering and normal