



Future mobility beyond COVID-19:
two steps forward, one step back for clean air and public health

18th January 2022



Prof Frederic Coulon
Principal Investigator

Cranfield University

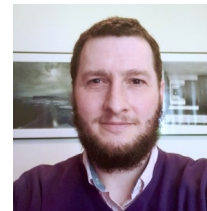


Dr Zaheer Nasar
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Principal Investigator

University of Birmingham



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Innovation Network Manager



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UK transdisciplinary network led by Cranfield University (including four universities, UKHSA, Dstl and 15 partners) to understand the complexity and connectivity among people, biological particulate matter (BioPM) exposure and health impacts

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UK-wide Clean Air network, led by the University of Birmingham in collaboration with nine universities and over 20 cross-sector partners to optimise the air quality and health outcomes of transport decarbonisation



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Top-level briefing

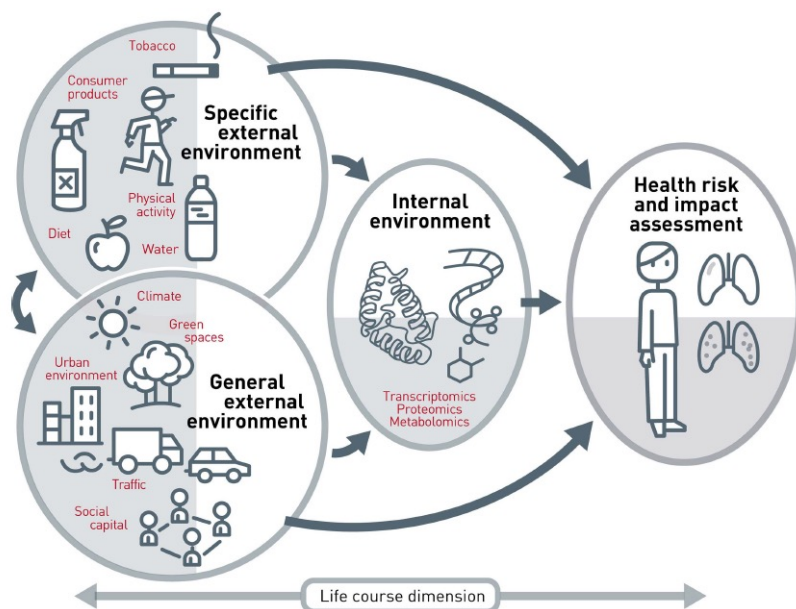
3x Perspectives

Open discussion

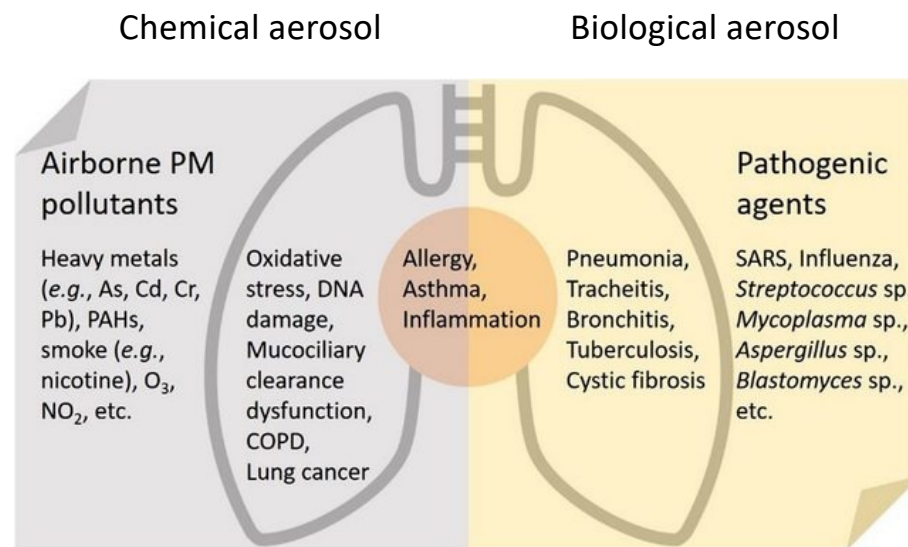


Exposome concept

The totality of exposure individuals experience over their lives and how those exposures affect health



Vrijheid, 2014, Thorax, 876-878

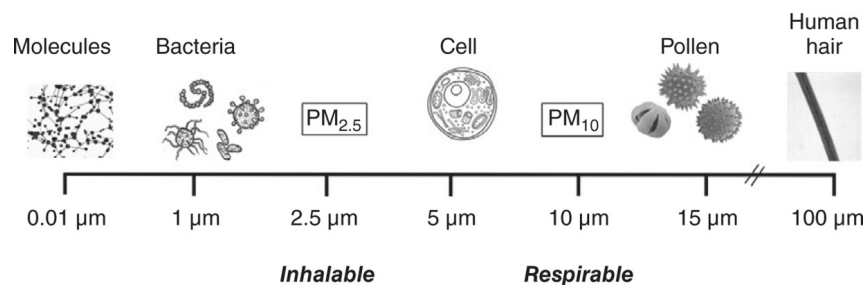
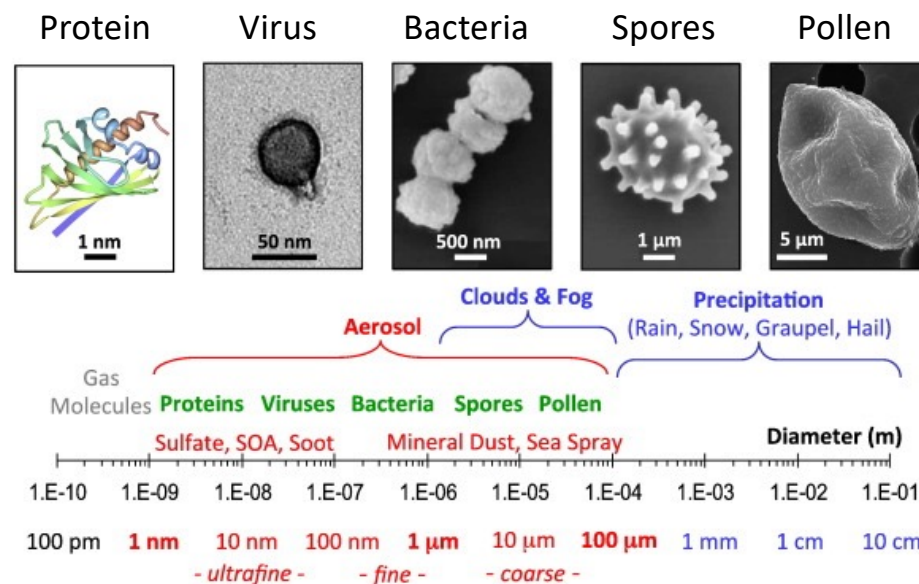
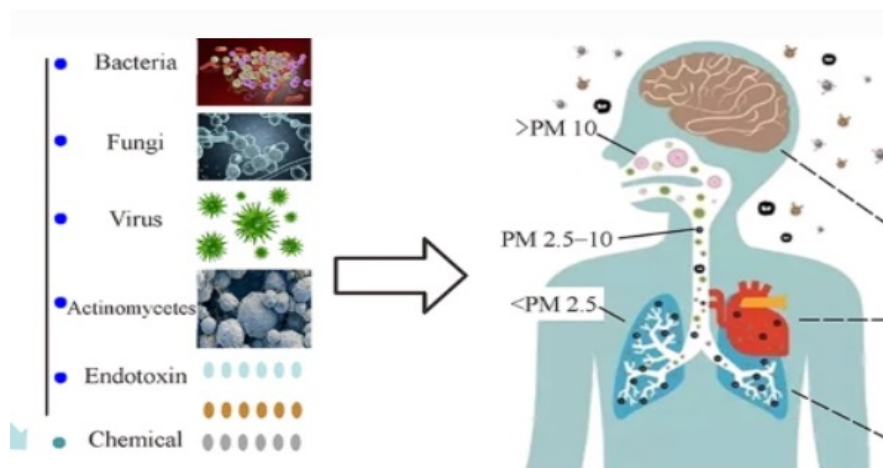


He et al., 2021. Environ Geochem Health

However contribution of aerosols of biological origin is often overlooked



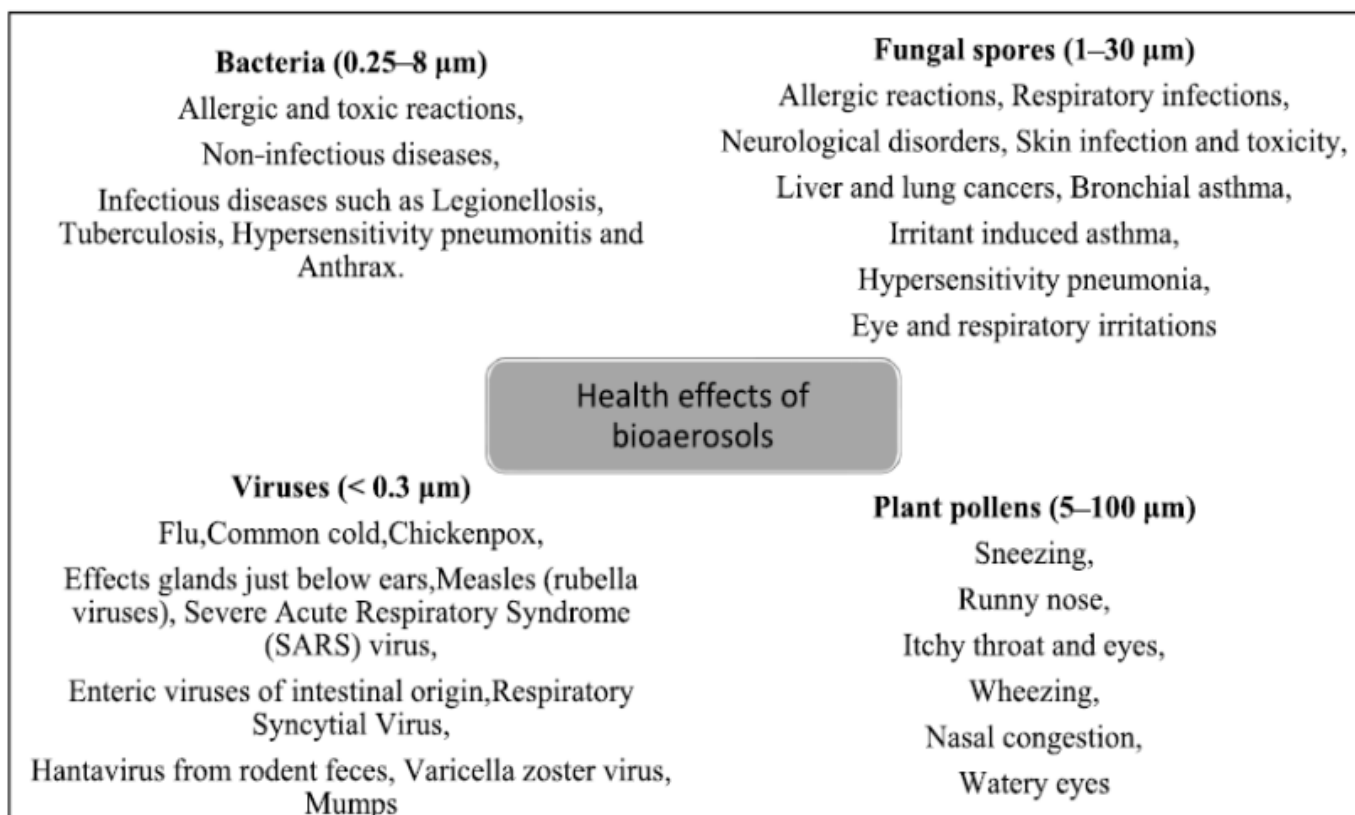
What are aerosols of biological origins (bioaerosols)?



Fröhlich-Nowoisky et al. 2016. Environ Geochem Health



Overview of symptoms and conditions linked with bioaerosols



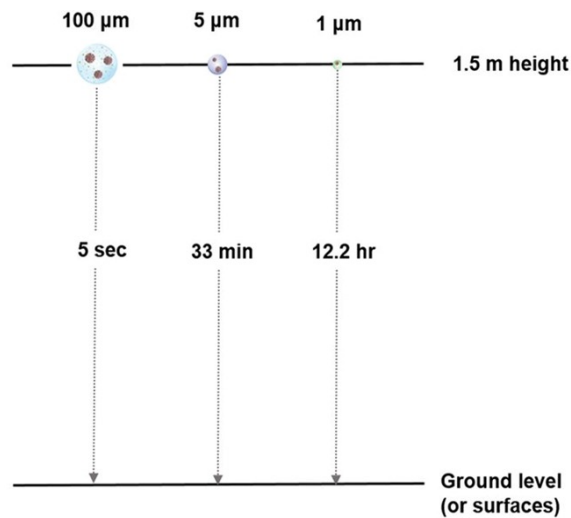
Kathiriya et al., 2021. Env. Technol. Innovation, 101287



Chemical and Biological aerosol particles – why size matters?

Airborne transmission of respiratory viruses

Chia C. Wang*, Kimberly A. Prather*, Josué Sznitman, Jose L. Jimenez, Seema S. Lakdawala, Zeynep Tufekci, Linsey C. Marr



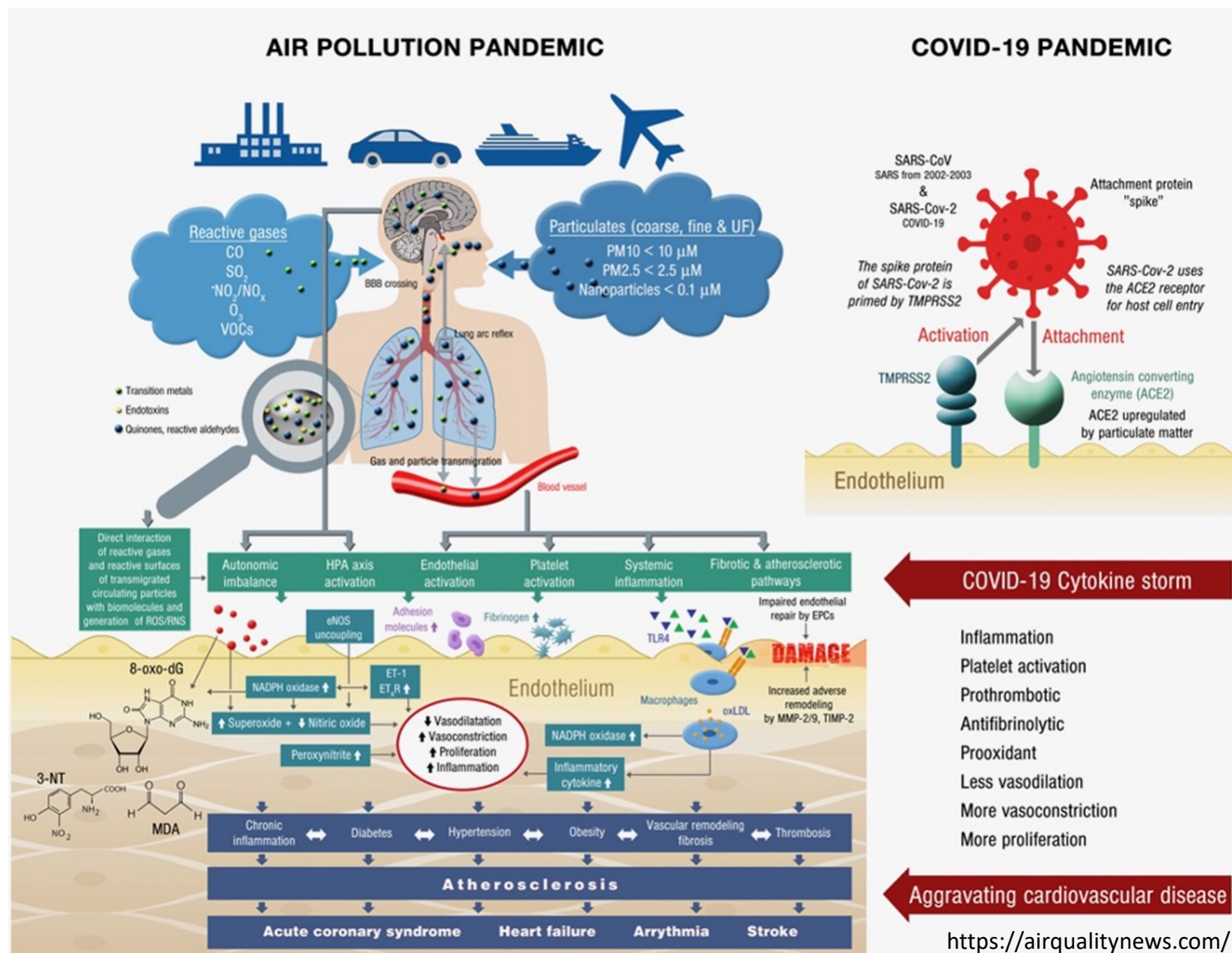
Wang et al., *Science* **373**, 981 (2021) 27 August 2021

Bioaerosols <1 µm within and beyond 1 m can float in air for hours



<https://www.visualcapitalist.com/>

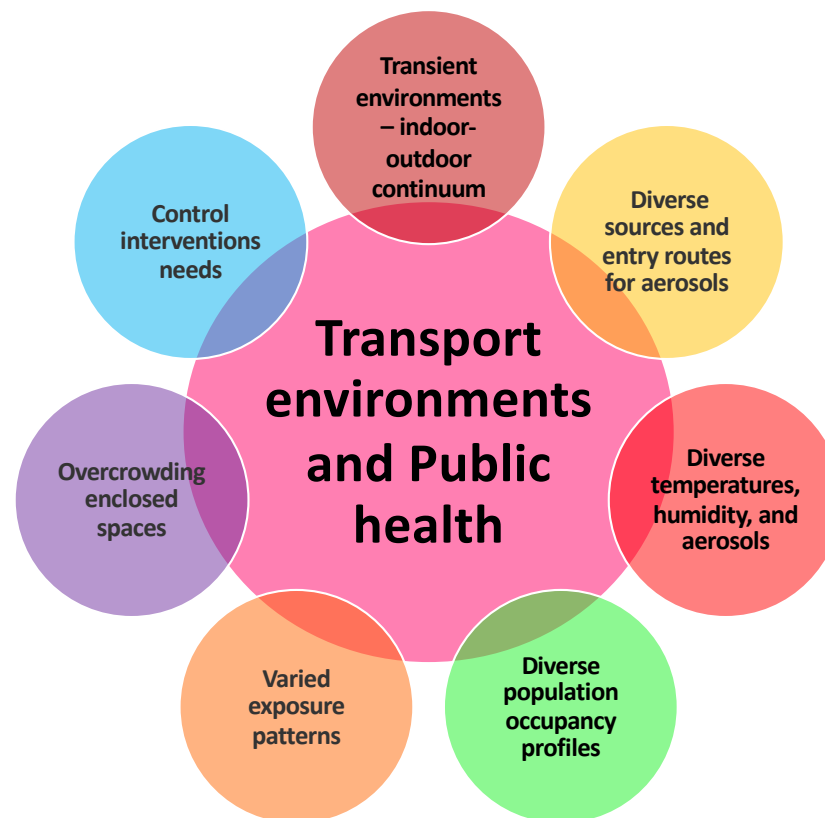




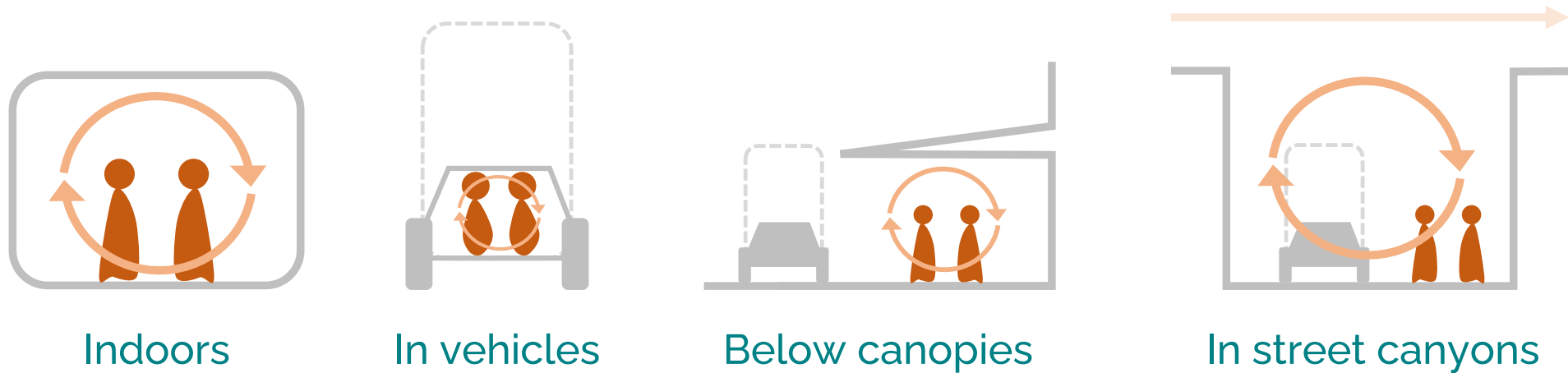
COVID-19 pandemic re-emphasizing the importance of considering both chemical and biological aerosols and how those affect health



Public space & public transport/infrastructure - vital role

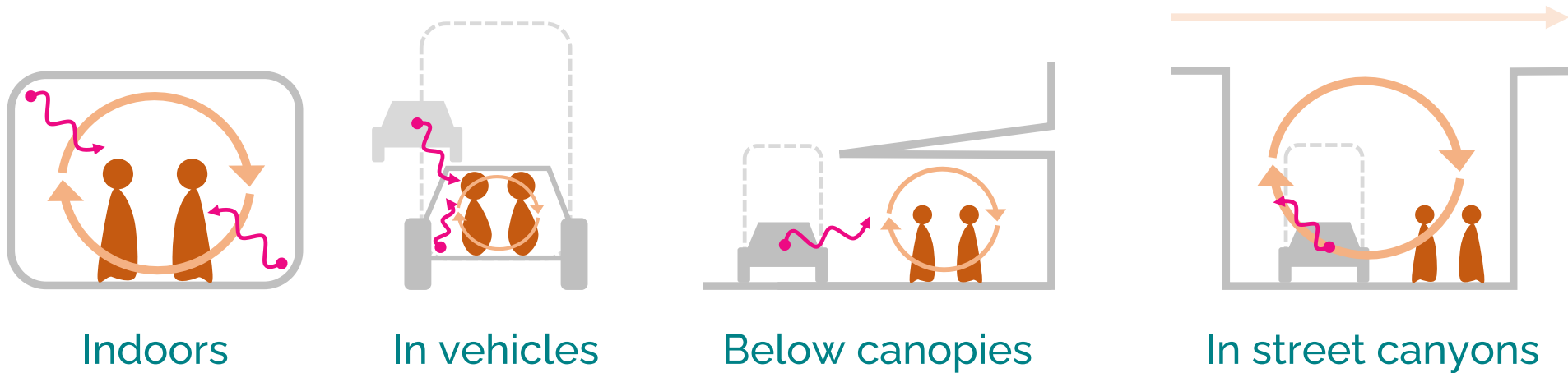


Spaces trapping air (in principle) present greater risks (1 of 2)



Trapping of air → Accumulation of bio. and chem. aerosols → Higher exposure

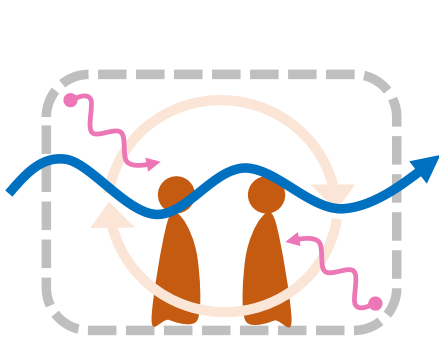
Spaces trapping air (in principle) present greater risks (2 of 2)



Trapping of air → Accumulation of bio. and chem. aerosols* → Higher exposure

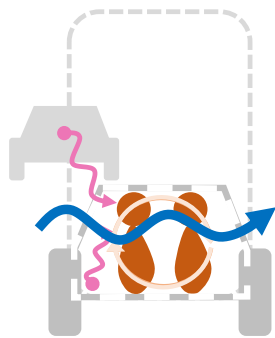
*Need to think about indoor & outdoor sources

Increasing ventilation (generally) reduces risks



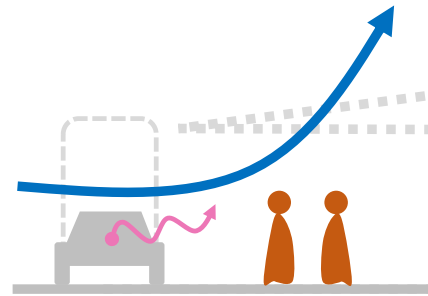
Indoors

Improve
ventilation



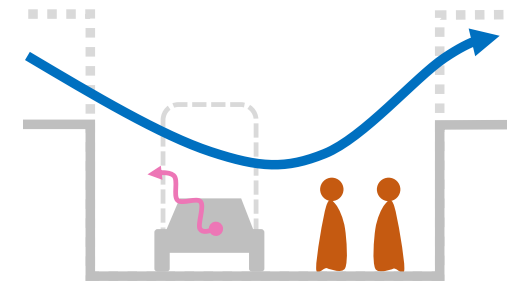
In vehicles

Add ventilation
& filtration?



Below canopies

Remove the canopies



In street canyons

Avoid building street canyons

Ventilation → Reduced accumulation of aerosols → Reduced exposure

But we can do much more: *Reduce, Extend, Protect**

**First Steps in Air Quality for Built Environment Practitioners, Ferranti et al. (2019)*



1. **Reduce sources** (i.e., reduce emissions)
2. **Extend pathways** (i.e., separate people from sources)
3. **Protect people** (particularly the most vulnerable)



3x Perspectives



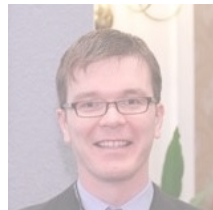
Phil Southall

Managing Director,
Oxford Bus Company



Ali Bell

Head of External Communications,
UK Bus, National Express



James Wright

Lead Air Quality Specialist,
Rail Safety and Standards Board



TRANSITION / BioAirNet Workshop

18 January 2022

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bus company

Thames Travel

carousel

CitySightseeing
Oxford



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Concerns following COVID

- 1) Customer Confidence
- 2) Customer and Colleague Safety
- 3) Company Finances (Cap Ex and Patronage)
- 4) Increase in Car Traffic



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 carousel

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Customer Confidence

- Consistent negative government messaging not supported by evidence – no evidence that using buses is any less safe than other public settings. Project 'TRACK' initiated by DfT to conclude by March 2022
- Obtained 'We're Good to Go' accreditation from Visit Britain...but does it make a difference?
- Wearing of Face Coverings – has varied throughout pandemic depending on government messaging, but has been as high as near 100%



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Customer and Colleague Safety

- Enhanced Cleaning initially but special anti-microbial surface treatments latterly – all adding to our costs
- Fitment of COVID screens on all vehicles to provide a barrier between customer and driver.
- Issuing of PPE to colleagues – wipes, masks, gloves and sanitiser
- Devices fitted to all vehicle windows to ensure adequate ventilation on vehicles without it being too cold – TfL statistic that air is replaced 20 times an hour with windows open but 3 times an hour with windows closed.



Company Finances

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 **carousell**

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...We had grown patronage across our businesses to 73% of pre-COVID levels

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Company Finances

- Patronage entirely influenced by government messaging
- Patronage reduced to 6% of normal at height of first lockdown, only recovered to 73% of normal before 'Plan B' introduced in December 2021
- Coronavirus Bus Service Support Grant (CBSSG) given up until 31 August 2021 – bridged gap between revenue and costs but no profit allowed – not sustainable for a commercial enterprise
- Bus Recovery Grant paid since 1 September 2021 – blended rate that depends on mileage operated and recovery rate (assumes circa 80 to 85%) and profit allowed.
- No funds to invest in buses and other cap-ex



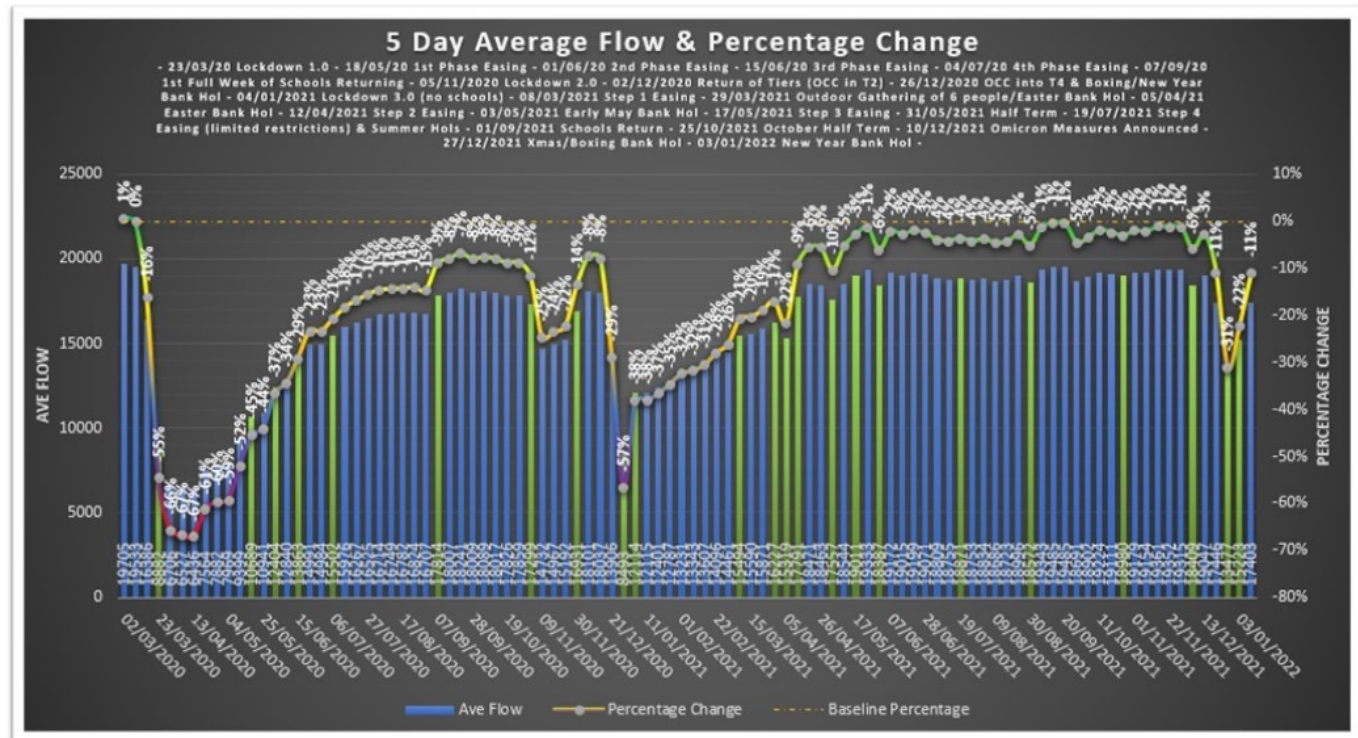
Increase In Car Traffic

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Increase In Car Traffic

- Concern about travelling on Public Transport leading to more people travelling by car
- Main car park in Oxford since the end of lockdown one has returned to 99% of normal whilst Park and Ride has never got above 60%
- Short term car parking costs need to be increased as 'browsing' has gone due to it not being a pleasurable experience. Not competitive against P&R
- EEH study concluded that if working from home 2 days a week on average, peak traffic should reduce by 10 to 12%. This hasn't happened so must conclude a switch from public transport to car – not good for environment.



3x Perspectives



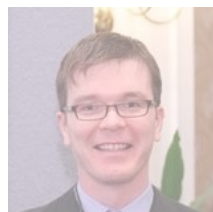
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Challenges and opportunities for public transport

Ali Bell – National Express West Midlands

National Express – our sustainability goals

We have bought our last diesel bus.

Our entire 1,600-bus fleet will be zero-emission by 2030.

The national white coach fleet will be zero-emission by 2035.



Then...



Electric buses

19 buses at Birmingham Yardley Wood garage
on the 6 route to Solihull

10 electric buses at Coventry on route 9/9A

Each vehicle has its own two-gun charger -
15% to 100% in 4 hours using AC

Zenobe manages the smart charge system

Training our drivers to drive differently

They do 200km per charge

**In their first year, these 29 buses stopped
1500 tonnes of CO2 going into the
atmosphere.**



Hydrogen buses

Brand-new luxury specification

Made by Wrightbus in Northern Ireland

Only produce pure water vapour from their tailpipes - no exhaust, no fumes

These 20 hydrogen buses will save 631kg of poisonous NOx emissions per year.

They will prevent 1,560 tonnes of carbon from going out into the atmosphere.

Can run for 300km on a single tank.

18.6kg/km

They can be fully refuelled in 7-10 minutes.

Drivers have to be specially trained.



The future

Coventry All Electric Bus City

- 130 double deckers - 2023
- 40 single deckers coming later

Garage built in 1986 – needs total conversion
from diesel fuelling to electric charging

250kw per day from the solar panels on the
garage roof - stored in two big batteries
and released overnight to charge buses

Even the garage van will be electric!



The future



What works	What doesn't	Questions
Patchwork of pragmatic partnerships Cross-party political support Pressure on sectors to hit targets	Tech optimism	When is the tipping point? Be ready!

3x Perspectives



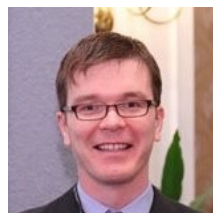
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Air Quality Strategic Framework

The Air Quality Strategy Framework was launched in June 2020. This sets the future path for rail to significantly reduce harmful pollutant emissions that could affect passengers, staff and the general public. Underpinned by a collaborative research programme, the framework will ensure that rail remains as one of the cleanest forms of transport in the UK

<https://www.rssb.co.uk/en/Research-and-Technology/Sustainability/Air-quality>

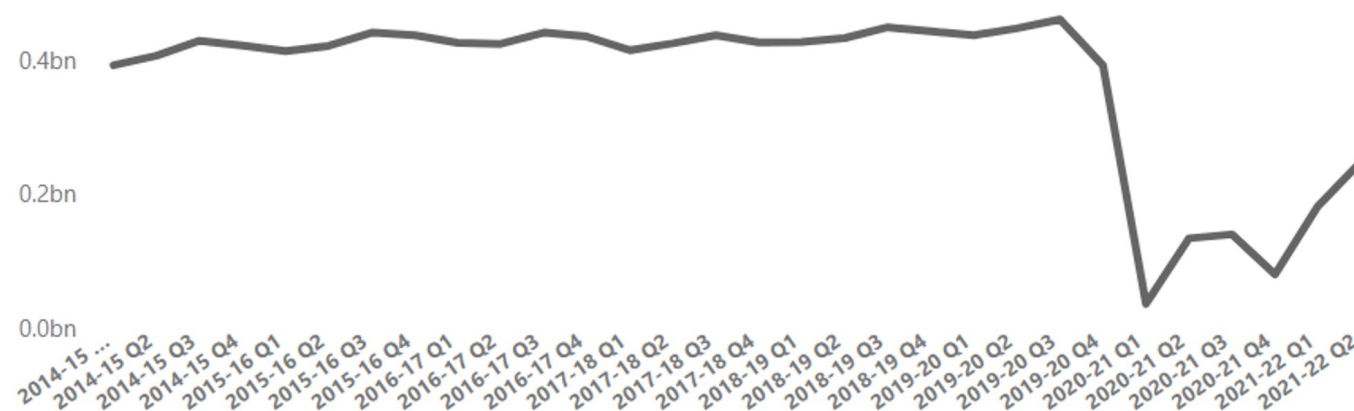
Updated version due end Feb to include interim targets and more defined commitments

This focuses mainly on PM, NOx, diesel fumes



How has COVID Impacted Rail?

Passenger journeys by financial quarter



- Journey numbers may not return to pre-pandemic levels
- Increased leisure travel but more w.f.h likely to impact commuting in long term

Links between Traditional/ Chemical AQ and Biological/COVID AQ

- Those exposed to poor AQ, more susceptible to severe impact from COVID
 - Likely to be due to impaired lung performance
- Many solutions to improve AQ can help COVID
- E.g. efforts to improved aircon filtration in rail likely to help both issues

Air Cleaning Devices

- COVID has presented a business opportunity for various air cleaning devices
 - Issue of clean air brought more into peoples minds
- Many devices available which claim to clean ambient air to reduce pollution / pathogens
- Few being trialled in rail but unlikely to have significant impact on large volumes of air in enclosed stations. May be more beneficial in smaller discrete environments such as waiting rooms etc
- Much better to reduce emissions at source

Superpowered moss

The CityTree is an advanced natural air filter, combining nature with digital technology.

It uses the natural ability of living moss that eats fine dust found in air, removing it from the air around it and replacing it with cleaner, cooler air.

Various species of moss grow within CityTree and can absorb and metabolise up to 82% of fine dust, remove moisture from the air and produce clean oxygen.



Pollution on some new UK trains '13 times one of London's busiest roads'

Nitrogen dioxide levels far exceed average recorded on traffic-clogged Marylebone Road, according to a study



**Compares
peak/max from
rail vs average
from road**

Summary

- Despite lack of evidence of risk, demonstrating efforts to improve all forms of AQ is vital to ensure passengers return
- Opportunities for easy wins to help both issues
- Public transport should work together in common interest
- AQ research may highlight areas for improvement but messaging is important to avoid unnecessary concern

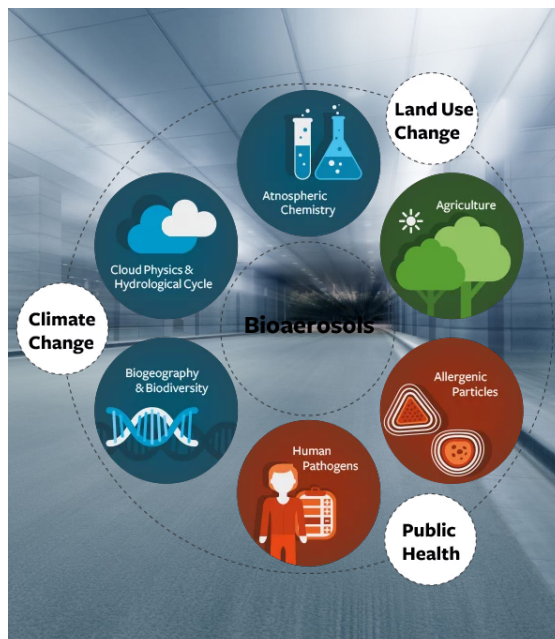
Find out more

- <https://www.rssb.co.uk/sustainability/air-quality>

Open discussion



Workshop Discussion



The way we design, construct, operate, manage and behave inside different transport environments can influence exposure to chemical and biological aerosols as well as creating new exposure pathways.

- *What are the knowledge gaps regarding the role of public transport micro-environments in influencing chemical and biological aerosol exposures?*
- *Which existing practices in design, construction, use and management of these environments could be modified to reduce citizen exposure?*
- *What research should be undertaken with industry/public sector partners to address these knowledge gaps?*
- *How could this topic knowledge be communicated to public transport users/the wider general public?*

Environ Sci Pollut Res (2016) 23:15757–15766
DOI 10.1007/s11356-016-7064-8



SHORT RESEARCH AND DISCUSSION ARTICLE

Airborne biological hazards and urban transport infrastructure: current challenges and future directions

Zaheer Ahmad Nasir¹ • Luiza Cintra Campos² • Nicola Christie² • Ian Colbeck³



Workshop Outputs and Next Steps

Planned Outputs:

- Statement of industry needs and opportunities
- Academic scoping paper
- Feedback to UK Clean Air Programme

Forthcoming Events:

- **TRANSITION Discovery & Innovation Summit (Online) | 10 February 2022 | 14:00-16:30**

Showcasing findings from TRANSITION-funded Clean Air Research projects:

- Measuring Exposure in Different Transport Modes
- Characterising Changing Travel Patterns in the COVID-19 Era
- Progressing Real-Time Source Identification
- Minimising Public Exposure at the Roadside

Register at www.transition-air.org.uk/events/summit2022

- **BioAirNet Research/Industry Placement Awards**

Spend time with a UK-based academic or industrial partner organisation for the accumulation of new knowledge, skills or training

- **BioAirNet Travel Bursaries** – More info at www.bioairnet.co.uk/funding

Attend and travel to/from national and international events and meetings

Follow network activities on Twitter: @BioAirNet @TRANSITION_Air



Thank You

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