

# A new framework for Green Infrastructure Implementation



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**Guildford**  
Living Lab

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@AirPollSurrey @pk\_shishodia @GuildfordLL





- **GCARE: Team & Research**
- **Green Infrastructure**
  - **Measurements & Modelling**
- **Research to Guidance**
  - **City Hall, GI Maintenance, Species selection, HedgeDate**

# GCARE....thanks to team/collaborators



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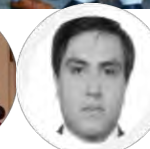
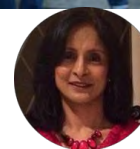
## Global Centre for Clean Air Research



*'to realise a collaborative global vision of 'clean air for all''*



## GCARE team



@AirPollSurrey

@pk\_shishodia

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[surrey.ac.uk/gcare](https://surrey.ac.uk/gcare)

# Acknowledgements..



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Thanks to our research sponsors, GCARE team and research collaborators...



ASAP-Delhi

# A start...



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Atmospheric Environment 90 (2014) 113–124



Contents lists available at [ScienceDirect](#)

Atmospheric Environment

journal homepage: [www.elsevier.com/locate/atmosenv](http://www.elsevier.com/locate/atmosenv)



The influence of roadside vegetation barriers on airborne nanoparticles and pedestrians exposure under varying wind conditions



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<sup>b</sup> Environmental Flow (EnFlo) Research Centre, FEPS, University of Surrey, Guildford GU2 7XH, United Kingdom

- **Started out of curiosity in 2014**
- **>30 peer-reviewed journal articles in top-ranked journals**
- **>£3M funding**
- **>1000 news articles (brought to attention of many..)**
- **Led to ‘guidance’, referred by councils, schools...**







- [www.surrey.ac.uk/gov](http://www.surrey.ac.uk/gov)

# Greening – how it works?



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Environment International 133 (2019) 105181



ELSEVIER

Contents lists available at ScienceDirect

Environment International

journal homepage: [www.elsevier.com/locate/envint](http://www.elsevier.com/locate/envint)



Review article

## The nexus between air pollution, green infrastructure and human health

Prashant Kumar<sup>a,b,\*</sup>, Angela Druckman<sup>c</sup>, John Gallagher<sup>b</sup>, Birgitta Gatersleben<sup>d</sup>, Sarah Allison<sup>e</sup>, Theodore S. Eisenman<sup>f</sup>, Uy Hoang<sup>g,h</sup>, Sarkawt Hama<sup>a</sup>, Arvind Tiwari<sup>a</sup>, Ashish Sharma<sup>a</sup>, K.V. Abhijith<sup>a</sup>, Deepti Adlakha<sup>i</sup>, Aonghus McNabola<sup>a,b</sup>, Thomas Astell-Burt<sup>j,k</sup>, Xiaoqi Feng<sup>j,k</sup>, Anne C. Skeldon<sup>l</sup>, Simon de Lusignan<sup>e,f</sup>, Lidia Morawska<sup>m</sup>

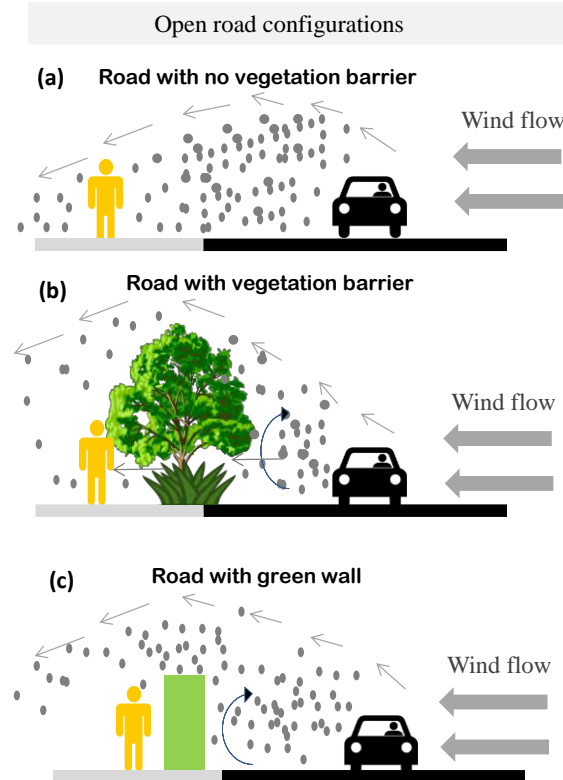
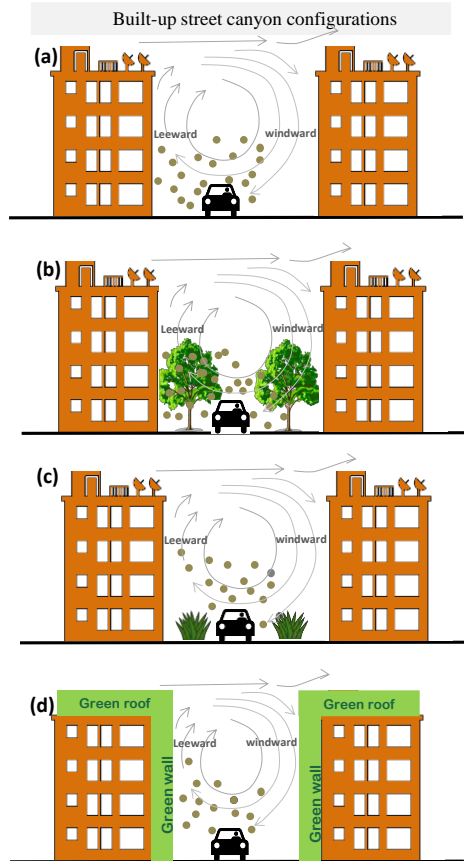


# Greening – street v/s open roads



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Abhijith, Kumar et al., 2017. *Atmospheric Environment* 162, 71-86.



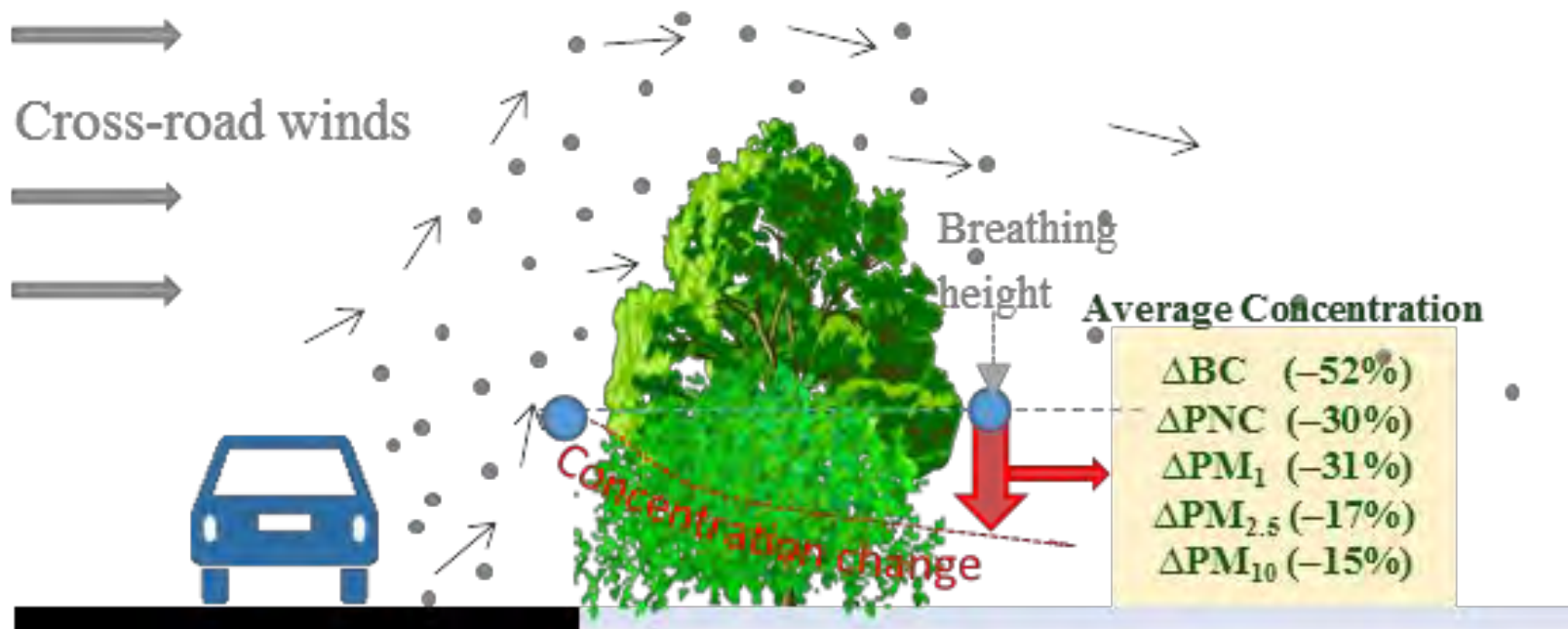
# Real-world: open-road filtration



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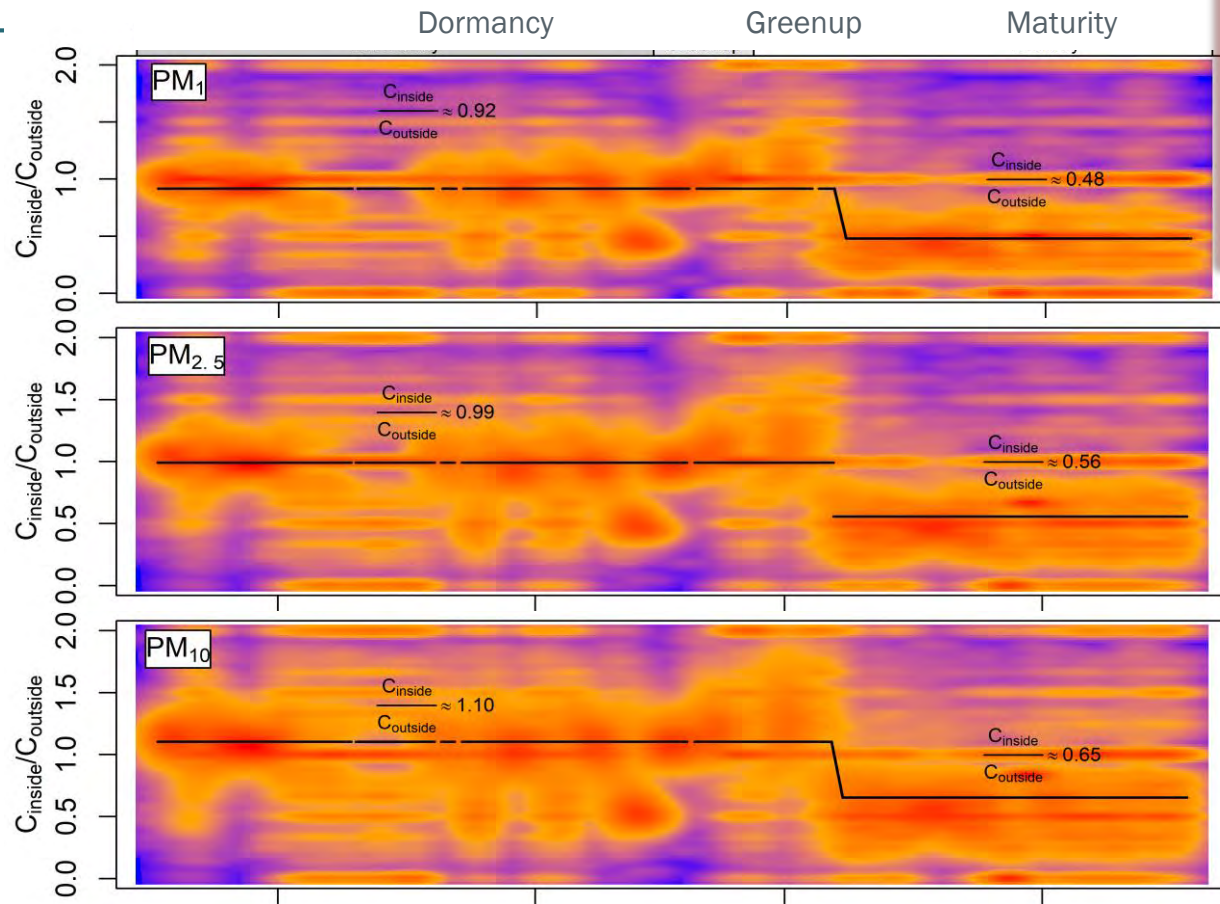
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Average  $\Delta$ pollutant concentration : Along-road > Cross-road > Cross-Vegetation



Abhijith & Kumar, 2019. *Atmospheric Environment* 201, 132-147.

# Real world: Seasonal effects...



Ottosen, Kumar et al., 2020. Sustainable Cities and Society 53, 101919.



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LAI <2.9  
Dormancy



LAI > 2.93  
Greenup



LAI ~7-8  
Greenup

# Modelling framework

## GI treatment in dispersion models



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**How can GI be considered in readily available dispersion models to allow evaluation of its impacts on pollutant concentrations and health risk assessment?**



*Tiwari, Kumar et al., 2019. Science of The Total Environment 672, 410-426.*



The screenshot shows the Mayor of London website. The header includes 'MAYOR OF LONDON' and 'LONDONAS'. Below the header is a navigation bar with four items: 'What we do', 'In my area', 'Get involved', and 'About us'. Below this is a breadcrumb trail: 'Home > What we do > Environment > Environment publications > Using Green Infrastructure'. The main content area has the title 'Using Green Infrastructure to Protect People from Air Pollution' in a large, bold, purple font. Below the title, it says 'Date published: 04 April 2019'. The text of the guide starts with 'This guide summarises the current best practice for how green infrastructure can reduce public exposure to air pollution in the urban environment. It has been produced in consultation with the Birmingham Institute of Forest Research (University of Birmingham), the Global Centre for Clean Air Research (University of Surrey) and Transport for London.'

**We brought concept of street and open-road conditions**

Link: <https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/using-green-infrastructure-protect-people-air-pollution>







## Implementing Green Infrastructure for Air Pollution Abatement

GENERAL RECOMMENDATIONS FOR  
MANAGEMENT AND PLANT SPECIES SELECTION



Prashant Kumar, KV Abhijith, and Yendle Barwise | 2019



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# Species selection framework..



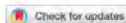
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npj | Climate and Atmospheric Science

www.nature.com/npjclimatsci

REVIEW ARTICLE OPEN



## Designing vegetation barriers for urban air pollution abatement: a practical review for appropriate plant species selection

Yendle Barwise<sup>1</sup> and Prashant Kumar<sup>1</sup>

Vegetation can form a barrier between traffic emissions and adjacent areas, but the optimal configuration and plant composition of such green infrastructure (GI) are currently unclear. We examined the literature on aspects of GI that influence ambient air quality, with a particular focus on vegetation barriers in open-road environments. Findings were critically evaluated in order to identify principles for effective barrier design, and recommendations regarding plant selection were established with reference to relevant spatial scales. As an initial investigation into viable species for UK urban GI, we compiled data on 12 influential traits for 61 tree species, and created a supplementary plant selection framework. We found that if the scale of the intervention, the context and conditions of the site and the target air pollutant type are appreciated, the selection of plants that exhibit certain biophysical traits can enhance air pollution mitigation. For super-micrometre particles, advantageous leaf micromorphological traits include the presence of trichomes and ridges or grooves. Stomatal characteristics are more significant for sub-micrometre particle and gaseous pollutant uptake, although we found a comparative dearth of studies into such pollutants. Generally advantageous macromorphological traits include small leaf size and high leaf complexity, but optimal vegetation height, form and density depend on planting configuration with respect to the immediate physical environment. Biogenic volatile organic compound and pollen emissions can be minimised by appropriate species selection, although their significance varies with scale and context. While this review assembled evidence-based recommendations for practitioners, several important areas for future research were identified.

npj Climate and Atmospheric Science (2020)3:12; <https://doi.org/10.1038/s41612-020-0115-3>



Beech hedge on a busy roadside, showing poor leaf health on the traffic-facing side (left) compared with much healthier leaves on the back side of the hedge (right).

Abhijith, K.V., Kumar, P., 2020. [Quantifying particulate matter reduction and their deposition on the leaves of green infrastructure](#). *Environmental Pollution* 265, 114884.



# Integration.. in progress..



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*Design for the Abatement of Traffic Emissions*

**+ Coming up soon...**

(not a dating app, but a tool to design your own hedge)



*Open for collaboration/partnerships...*  
*Nature-Based Solutions + Street scale greening in-progress..*

# Thank you!



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.. a platform for researchers, community & stakeholders for co-creating & co-designing  
air pollution and climate change mitigation solutions

## Contact

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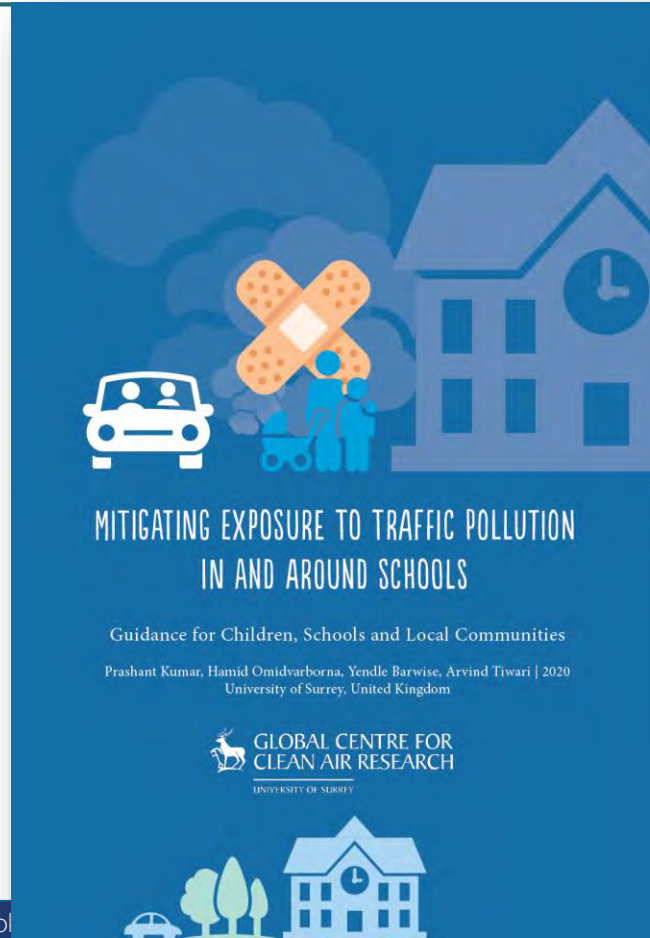
**[surrey.ac.uk/gcare](https://surrey.ac.uk/gcare)**

# Just released.. School Guidance



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**Drop me a  
line for a  
copy!**