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WM-NET ZERO

A Health-centred Systems Approach Towards Net-Zero:
Transforming Regional Climate Mitigation Policies

Modelling the impact of bus electrification on air quality and associated health effects in the West Midlands, UK



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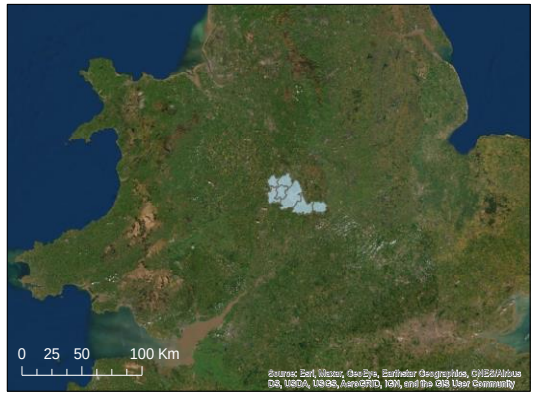
The WM-NetZero project is supported by Wellcome Trust (227150_Z_23_Z) under the *Advancing climate mitigation policy solutions with health co-benefits in G7 countries* scheme.

Air pollution and bus electrification

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A Health-centred Systems Approach Towards Net-Zero: Transforming Regional Climate Mitigation Policies

- **Urban air pollution**: Biggest environmental risk to human health
- **Global push for cleaner public transport**: Emphasis on public transport for green goals
- **UK Department for Transport**: Zero Emission Bus Regional Areas (ZEBRA) programmes for local transport authorities
- **National Express West Midlands**: £150 million investment 300 electric buses for West Midlands by 2024 (WMCA, 2023)
- **Benefits of electric buses**: Zero tailpipe emissions; Reduced noise pollution; Lower operational costs.



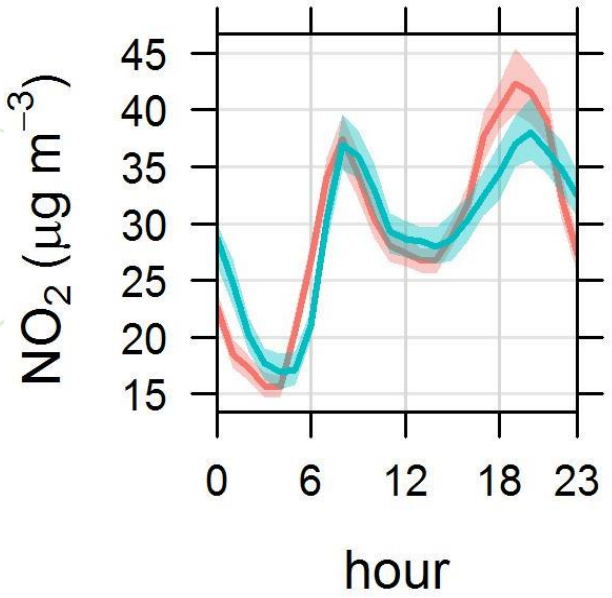


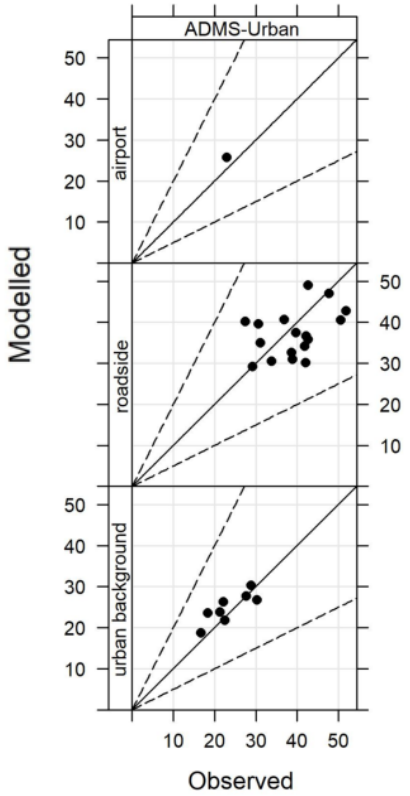
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WM-Air model configuration

- ADMS-Urban model (CERC).
- Model baseline year: 2019.
- Meteorology, background levels as observed.
- Advanced canyon and urban canopy.
- Emissions: Point, Road, and Grid.
- CERC Model Evaluation Toolkit.

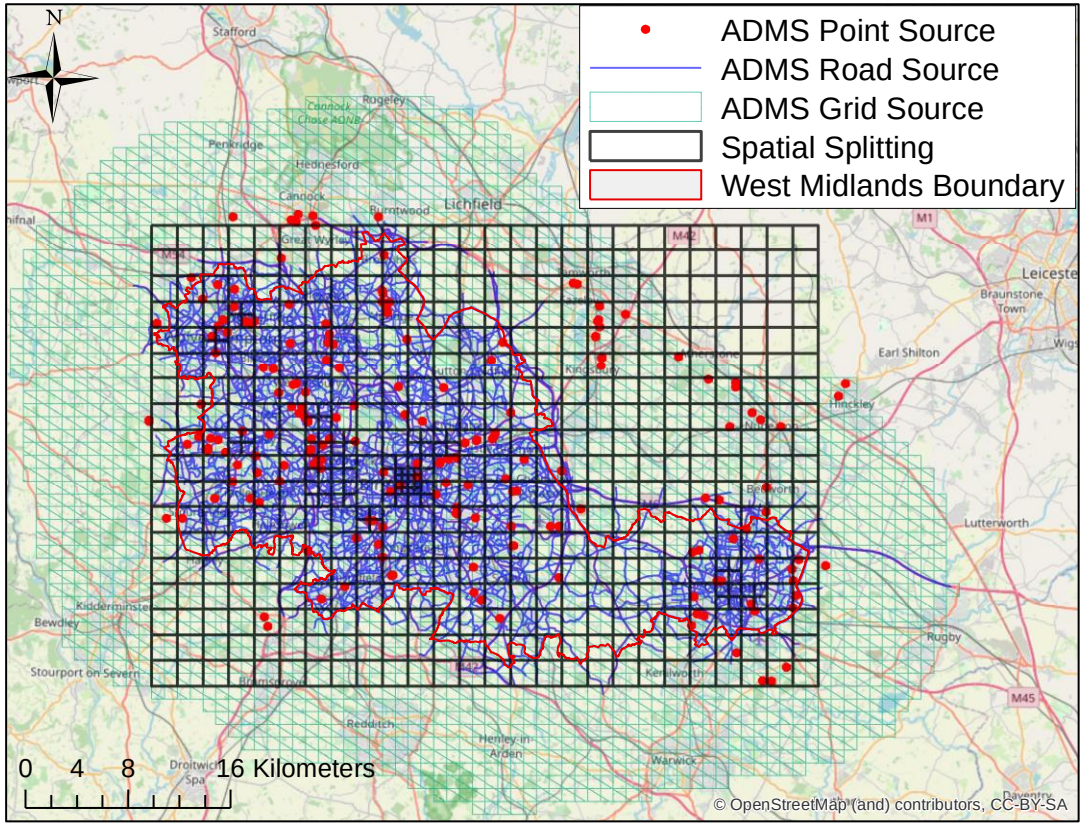
Bristol Road (Roadside)





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(Zhong et al, 2021, https://doi.org/10.3390/atmos12080983,
Zhong et al, 2024, https://doi.org/10.1016/j.uclim.2024.101961)

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Scenarios: Bus electrification

WM-NET ZERO

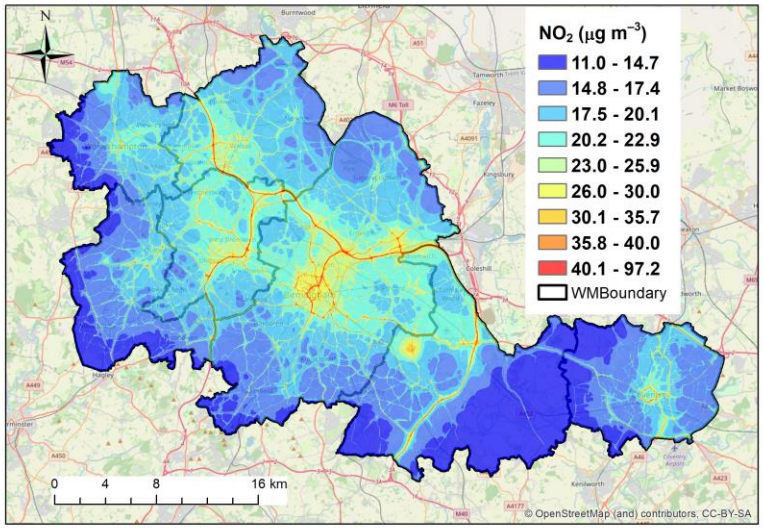
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Modelling scenarios	Note
Base case (2019 BAU)	2019 NAEI emissions; traffic fleet and emission factors; Met; Background.
20% Bus electrification	Bus electrification by 20%; other conditions kept same as Base case
40% Bus electrification	Bus electrification by 40%; other conditions kept same as Base case
60% Bus electrification	Bus electrification by 60%; other conditions kept same as Base case
80% Bus electrification	Bus electrification by 80%; other conditions kept same as Base case
100% Bus electrification	Bus electrification by 100%; other conditions kept same as Base case

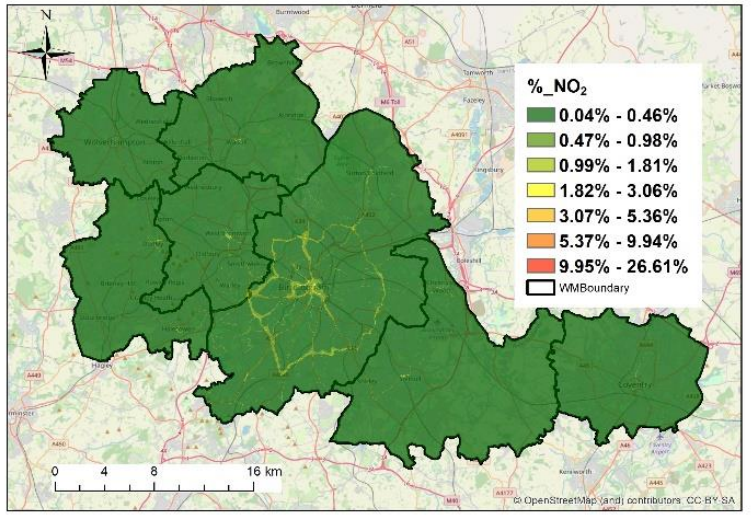
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Impact of bus electrification on NO_2 (Relative changes)

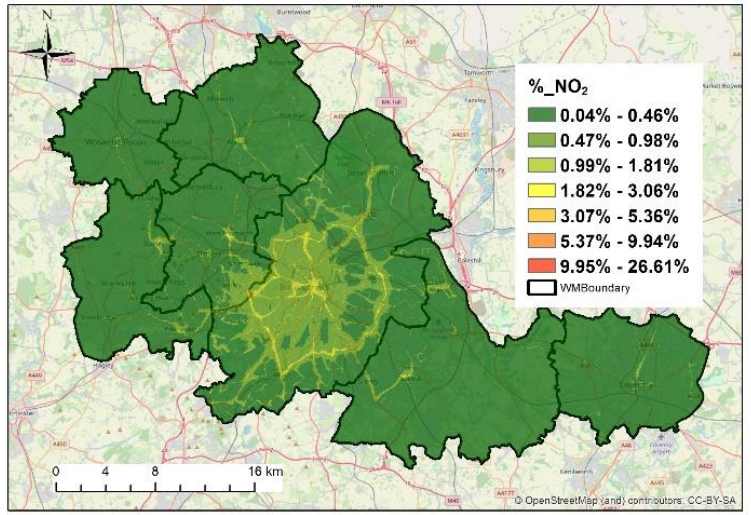
Base case (2019 BAU)



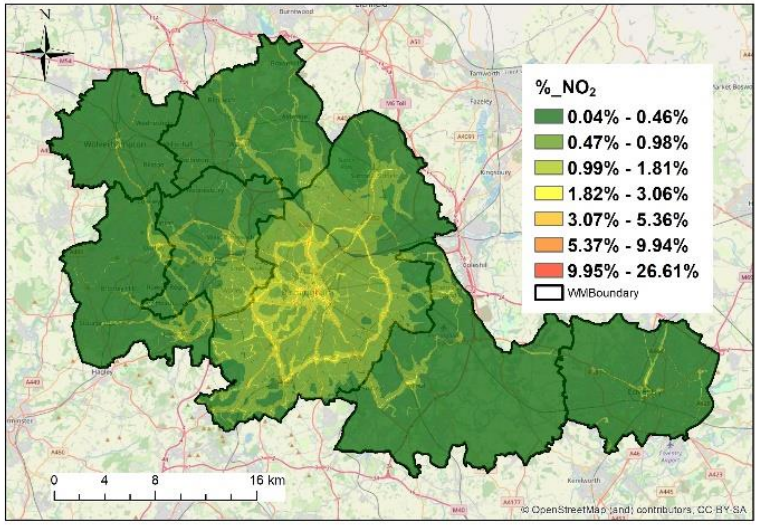
20% Bus electrification



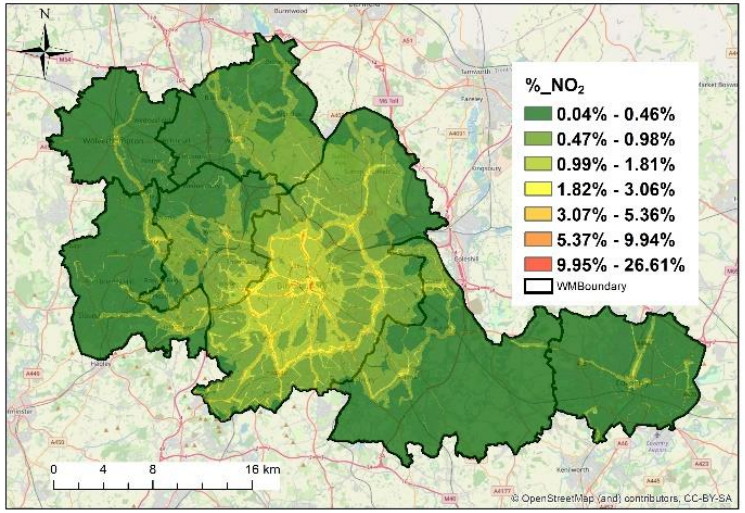
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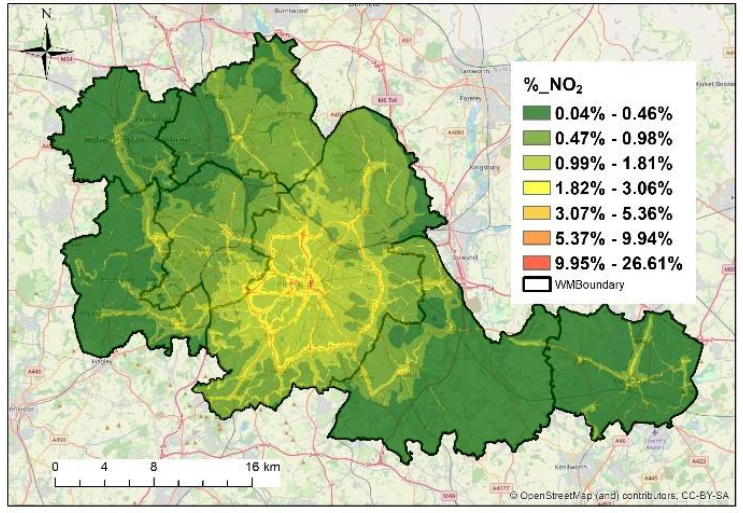
60% Bus electrification



80% Bus electrification

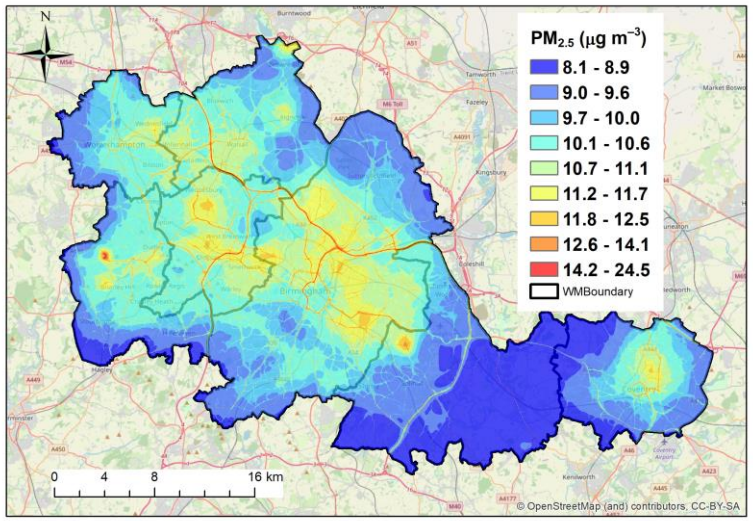


100% Bus electrification

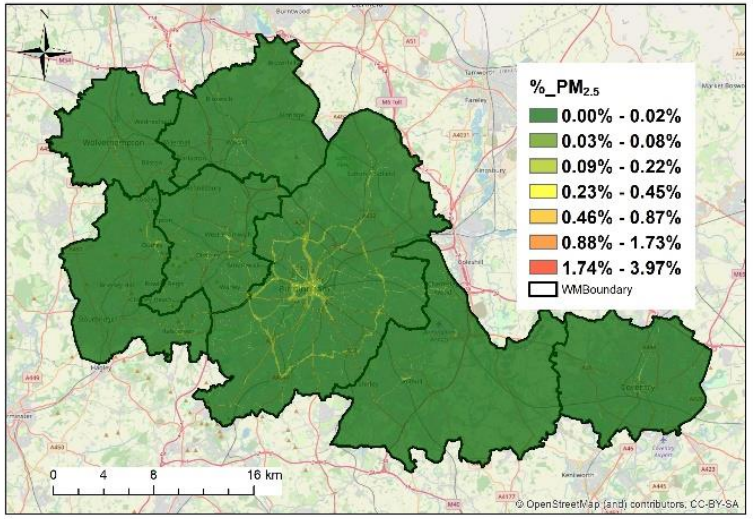


Impact of bus electrification on $PM_{2.5}$ (Relative changes)

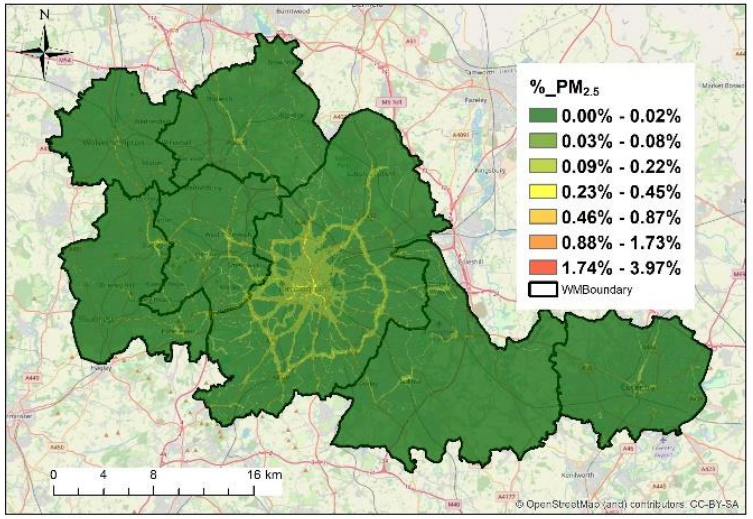
Base case (2019 BAU)



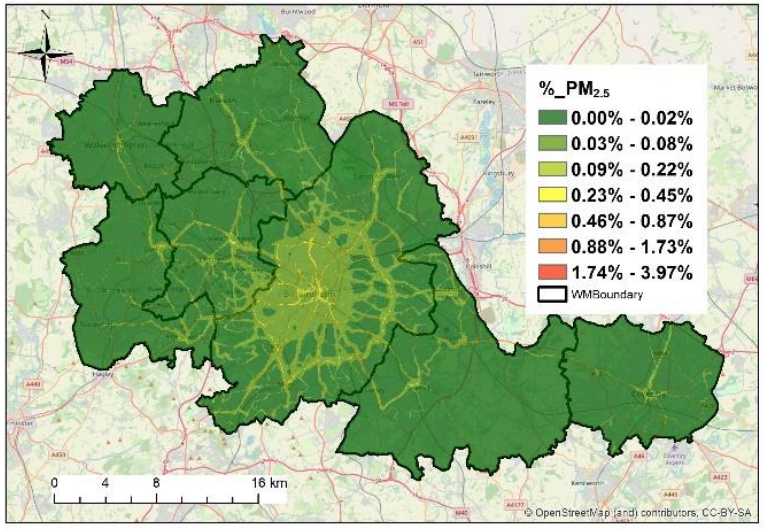
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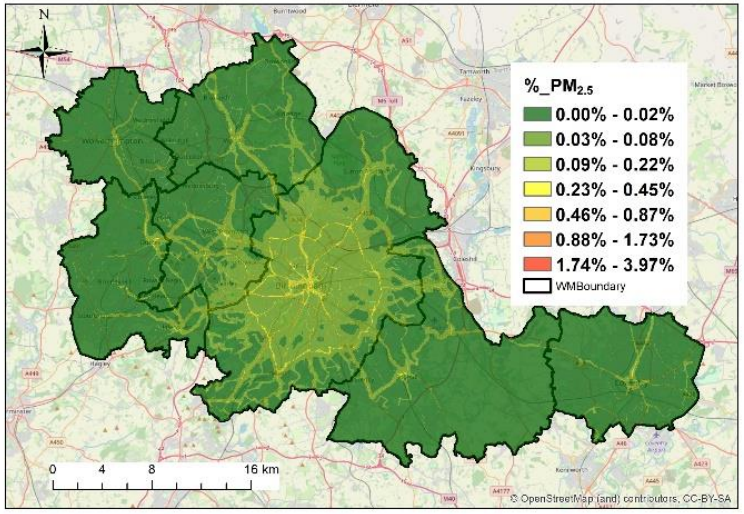
40% Bus electrification



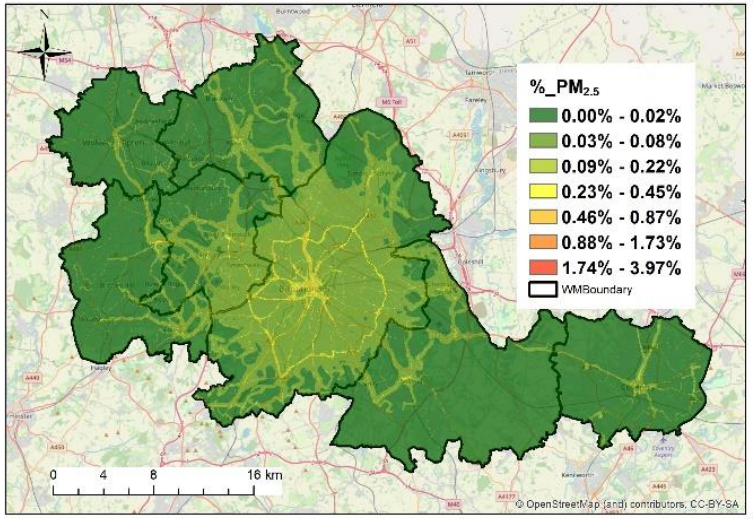
60% Bus electrification



80% Bus electrification



100% Bus electrification



Air quality Life Assessment

WM-NET ZERO

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Ward-level air quality Life Assessment Tool (AQ-LAT) (Hall et al. 2024)

WM-Air AQ-LAT

Step One: Select District, Ward, Discount Rate and Time Horizon

District	Birmingham	
Ward	Acocks Green	
Time Horizon	10 years	Maximum: 30 years
Discount Rate Costs	3.5%	Default: HM Treasury Green Book rate 3.5%
Discount Rate QALYs	1.5%	Default: HM Treasury Green Book rate 1.5%

Acocks Green

PM2.5 annual average concentration at baseline (2019)	10.77 µg/m3
NO2 annual average concentration at baseline (2019)	19.49 µg/m3

Step Two: Either customise local air quality target, OR use a pre-selected scenario

PM2.5 Target (µg/m3)	5.00	Values change automatically if scenario selected
NO2 Target (µg/m3)	10.00	Values change automatically if scenario selected
Target Population (%)	100 %	Values change automatically if scenario selected

OR

Pre-selected air pollution scenarios *Pre-selected scenarios apply to entire ward override with slider if required	WHO AQG level (annual average) NO2 (10µg/m3) & PM2.5 (5µg/m3) Confirm pre-selected scenario selection

Step Three: Run your calculations

Environmental Pollution 356 (2024) 123871

Contents lists available at ScienceDirect

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol



Regional impact assessment of air quality improvement: The air quality lifecourse assessment tool (AQ-LAT) for the West Midlands combined authority (WMCA) area☆

James Hall [a], Jian Zhong [b], Sue Jowett [a], Andrea Mazzeo [b,c,d], G. Neil Thomas [c], John R. Bryson [e], Steve Dewar [f], Nadia Inglis [g], Mark Wolstencroft [h], Catherine Muller [b], William James Bloss [b], Roy M. Harrison [b,i], Suzanne E. Bartington [c,*]

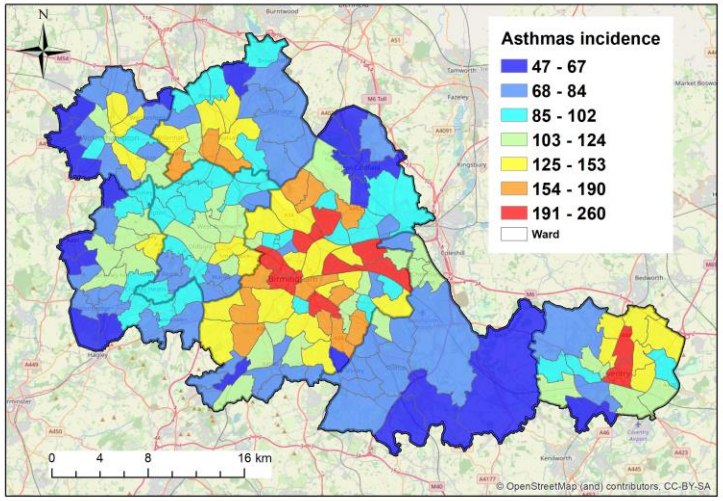
[a] Health Economics Unit, Institute of Applied Health Research, University of Birmingham, Edgbaston Park Road, Birmingham, B15 2TT, UK
[b] School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston Park Road, Birmingham, B15 2TT, UK
[c] Institute of Applied Health Research, University of Birmingham, Edgbaston Park Road, Birmingham, B15 2TT, UK
[d] Lancaster Environment Centre (LEC), Lancaster University, Bailrigg Campus, Lancaster LA1 4YW, UK
[e] Department of Strategy and International Business, Birmingham Business School, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
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[h] Birmingham City Council, Victoria Square, Birmingham, B1 1BB, UK
[i] Department of Environmental Sciences, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, Jeddah, Saudi Arabia

https://doi.org/10.1016/j.envpol.2024.123871

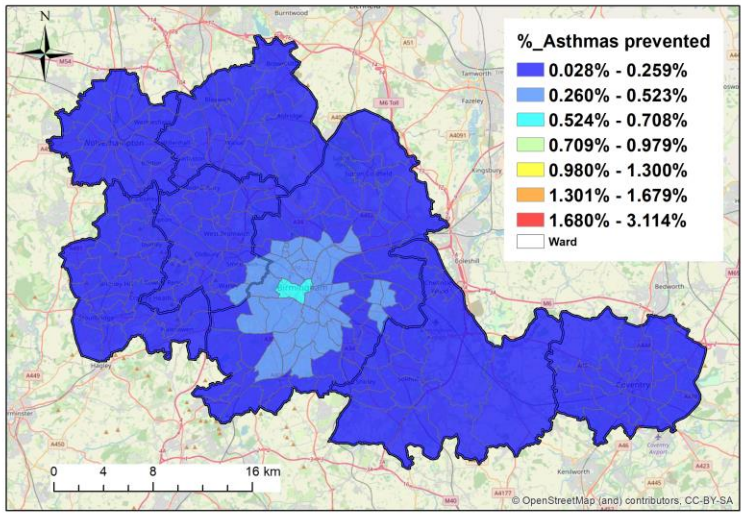
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Impact on attributable new asthmas cases over 10 years

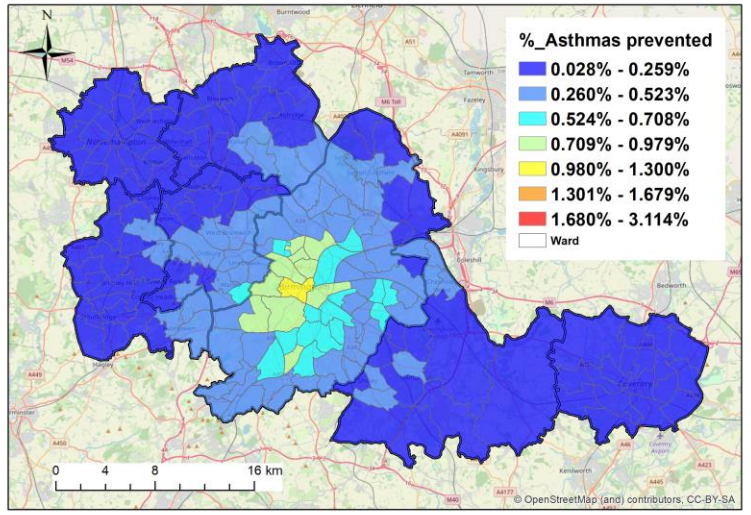
Base case (2019 BAU)



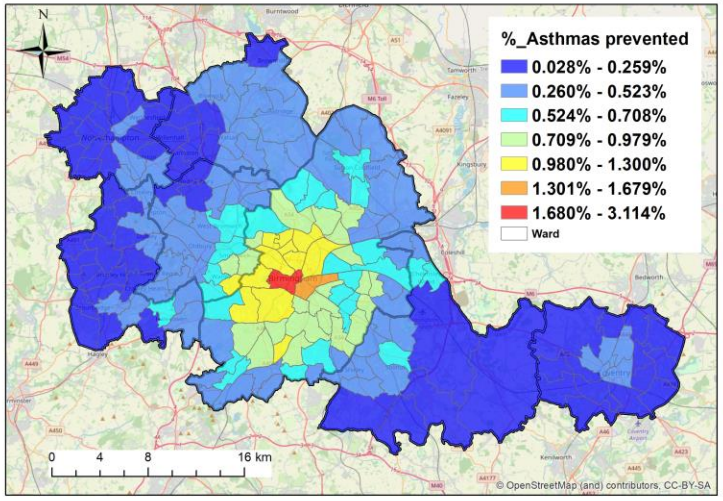
20% Bus electrification



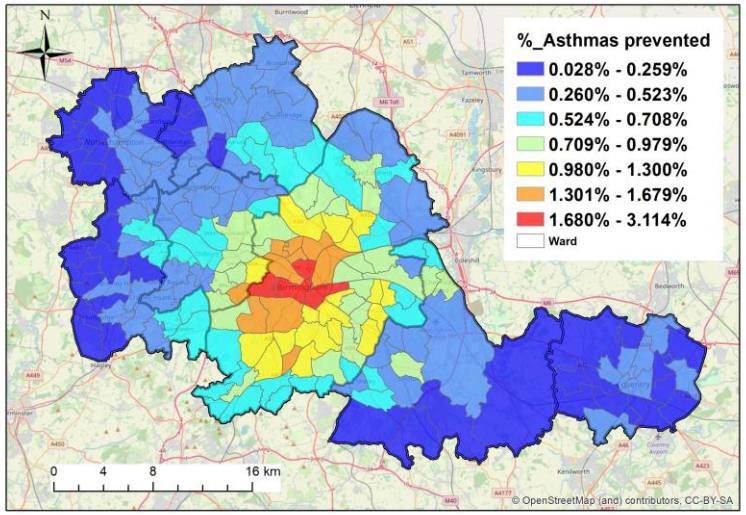
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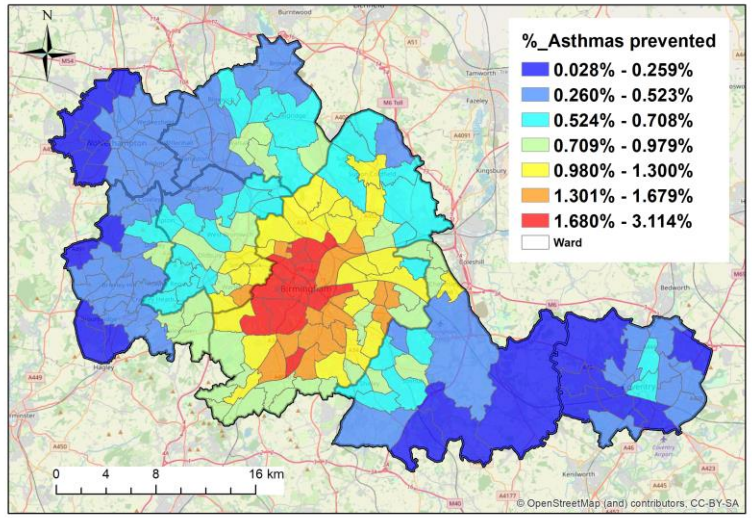
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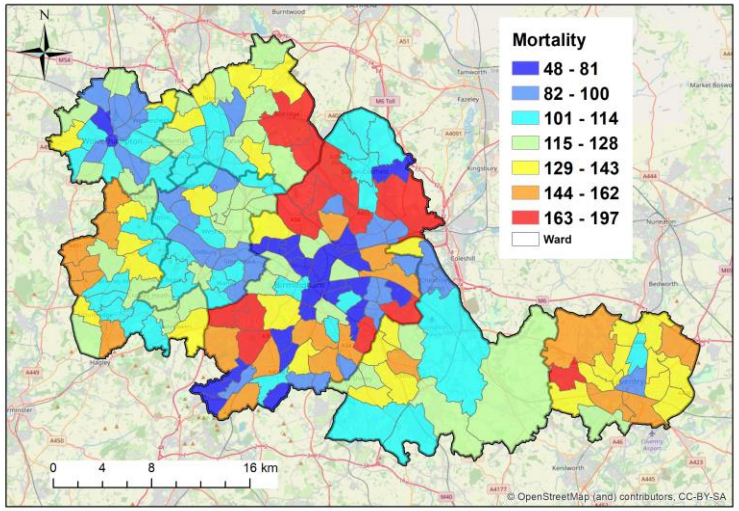


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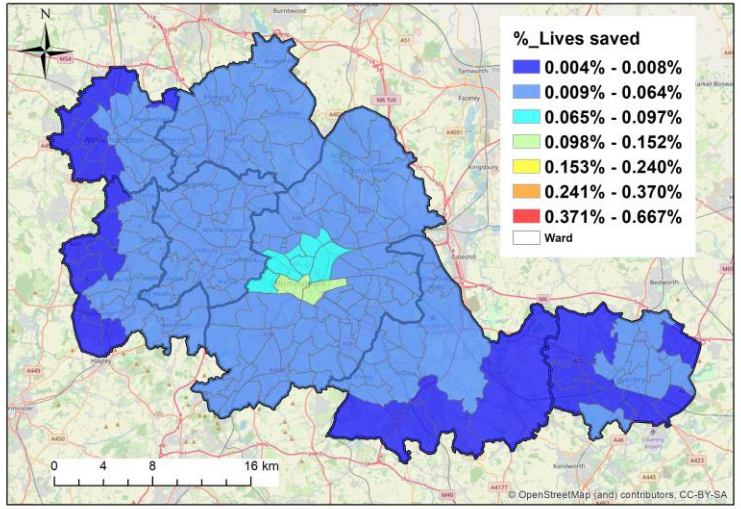


Impact on attributable mortality over 10 years

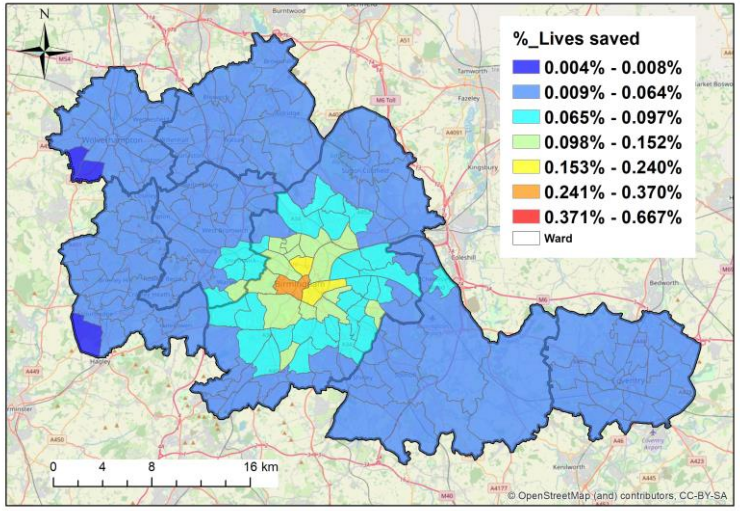
Base case (2019 BAU)



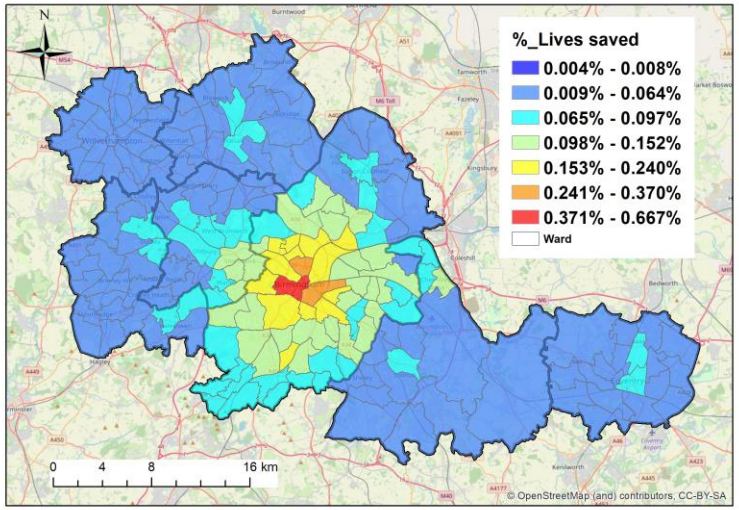
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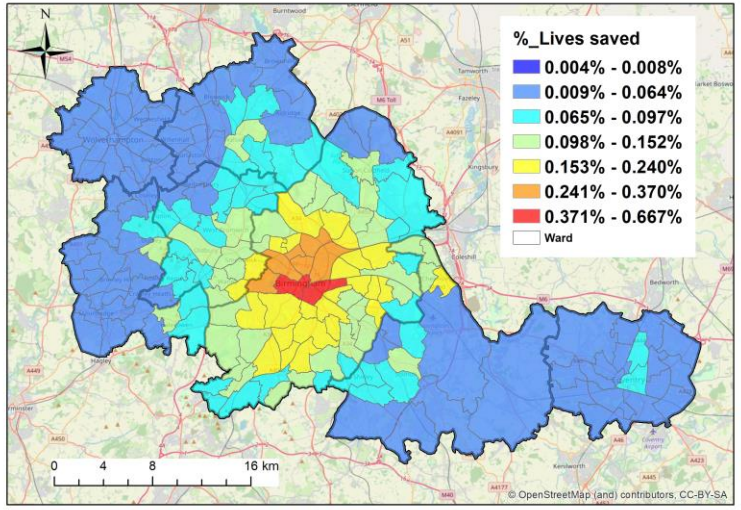
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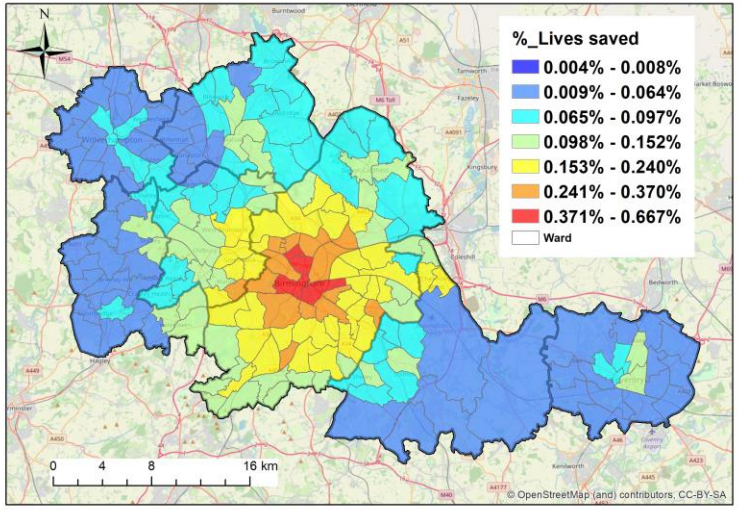
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80% Bus electrification



100% Bus electrification



WM-NET ZERO

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Email: *jian.zhong@greenwich.ac.uk*



Thank you for your attention!

- Bus electrification improves air quality.
- NO_2 reduction up to 26%.
- $PM_{2.5}$ reduction up to 4%.
- Attributable new asthmas case reduction up to 3.1%.
- Attributable mortality reduction up to 0.7%.

Get involved and stay connected

X: https://x.com/WMNetZero
LinkedIn: linkedin.com/company/wm-net-zero
E-mail: wm-netzero@contacts.bham.ac.uk
Website: https://wm-netzero.org.uk/
Mailing List: eepurl.com/iN7L2U

WM-AIR

#WMNetZero

CLEETS Clean Energy and Equitable Transportation Solutions NSF-UKRI Global Center

https://www.youtube.com/watch?v=Z5C2p509thc

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