CBI Economics

Breathing life into Greater Manchester

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CLEAN AIR FUND

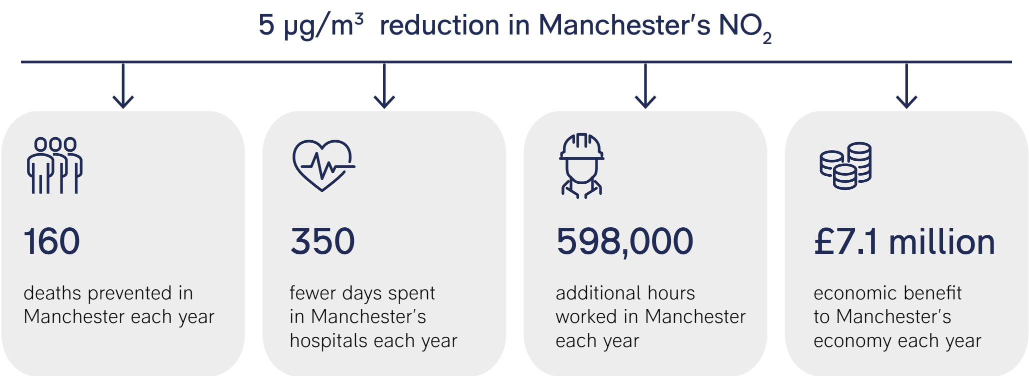
The economic benefits of reducing nitrogen dioxide in Greater Manchester

Summary

CBI Economics analysis quantifies the potential gains to the health of Greater Manchester's workforce, and to the local economy, that could be achieved through a reduction in nitrogen dioxide (NO_2) levels via the proposed Clean Air Zone (CAZ). Just a small reduction in NO_2 of 5 $\mu g/m^3$ (16%) could prevent almost 160 deaths and save more than 350 days spent in Greater Manchester's hospitals due to respiratory conditions each year.[2]

Moreover, adding over 598,000 working hours each year through increased workforce participation could provide an economic boost of more than £7.1m in Gross Value Added (GVA).[3]

Figure 1 Economic and health benefits associated with reducing NO_2 in Greater Manchester



Source: CBI Economics analysis

Air quality matters to the health of our citizens and ultimately to our economy

Air pollution impacts human health and the productivity of the UK workforce, which in turn impacts the economy. Analysis conducted by CBI Economics in 2020 estimated that clean air in line with the World Health Organisation's (WHO) guidelines could deliver a £1.6bn boost to the UK economy each year.[4]

Evidence shows a key link between NO_2 and health outcomes. Reducing NO_2 therefore has a key role to play in realising this economic potential. NO_2 exposure leads to both short-term and long-term health impacts, exacerbating respiratory conditions such as asthma, possibly increasing the likelihood of lung cancer, stroke, and cardiovascular disease, and has been linked to adverse birth outcomes.[5] This comes at a cost to the healthcare system. Public Health England estimates that between 2017 and 2025 the total cost to the NHS and social care system due to NO_2 alone will reach £61m.[6,7]

The role of Clean Air Zones

Vehicles are the largest contributor to NO_2 pollution at roadsides, contributing 80% of the total. This means higher levels of NO_2 are typically focused in high traffic areas within city centres. Targeted local action, in addition to a national strategy, is therefore a key part of the government's solution to tackling NO_2 levels in the UK.[8]

While the government has considered a range of policy options, the evidence concludes that CAZs are the most effective measure to reduce NO_2 levels within the legal limits in the shortest possible time.[9] As a result, the government has mandated several cities to implement CAZs, including Greater Manchester.

Nitrogen dioxide levels in Greater Manchester

The UK has statutory limit values for the annual and 1-hour mean concentrations of NO_2, set at 40 μ g/m³ and 200 μ g/m³ respectively.[10] Analysis by Ricardo Energy and Environment (Ricardo) finds that while average NO_2 concentrations in Greater Manchester comply with the annual limit value, the maximum annual concentration across locations in Greater Manchester exceeded this by almost 50% (19 μ g/m³). This exceedance is driven predominantly by nine locations, increasing to 22 locations when including those just below the limit value.[11] Clean Air Greater Manchester estimate that 152 stretches of roads are in breach of the limit values, including Regent Road in Salford, Deansgate in Manchester and St Peter's Way in Bolton.[12]

Table 1 Statutory limit values and compliance assessment for NO_2 in Greater Manchester

Pollution measure	UK statutory limit value	Average NO_2[13]	Maximum NO_2[14]	Locations >40.4 μg/m³	Locations >36 μg/m³	Compliance assessment
NO_2 annual mean	40 μ g/m³	31 μ g/m³	59 μ g/m³	9	22	Non-compliant
NO_2 1-hour mean	200 μ g/m³	N/A	130 μ g/m³	N/A	N/A	Compliant

Source: Analysis by Ricardo

Greater Manchester's proposed Clean Air Zone

Since 2010, the ten boroughs in Greater Manchester have been mandated by the Government to reduce their NO_2 concentrations in line with limit values, in the shortest possible time.[15] As part of this, Greater Manchester Combined Authority produced a feasibility study for a CAZ B, C and D in the city-region, which found higher roadside concentrations than originally stated by the government. Their preferred option is a CAZ C.[16]

The proposed CAZ C will cover the entire administrative boundary of the region except for strategic roads and motorways such as the M602. Transport for Greater Manchester's aim is that a coordinated approach across all ten boroughs will reduce the risk of displacement effects, where high pollution areas are simply shifted to another location, and to ensure consistent guidelines across Greater Manchester.[17]

Figure 2 Greater Manchester proposed Clean Air Zone boundary

Source: CBI Economics analysis

Evidence from feasibility studies conducted across a range of cities suggests that introducing a CAZ D, which covers a broader range of vehicles than a CAZ C could reduce NO_2 concentrations by 5 μ g/m^3. This means Manchester would achieve compliance with national limits up to four years earlier than expected through the introduction of a CAZ D.[18,19]

However, Greater Manchester's feasibility study estimated a much higher average reduction in NO_2 from a CAZ D at 9.5 μ g/m^3.[20] This is because, in general, the larger the CAZ area, the greater the overall reduction across the city region. Greater Manchester, unlike many other cities looking to implement a CAZ, has taken a different approach in proposing a CAZ across all ten local authorities rather than Manchester's city centre. In addition, Greater Manchester is proposing to introduce a CAZ C rather than a CAZ D. Therefore, although the impact in NO_2 of a CAZ D can be reasonably assumed to be higher than 5 μ g/m^3, a higher value was not used in the analysis to ensure a consistency in approach between Greater Manchester and the seven other cities analysed as part of this study, as well as reflecting the less strict CAZ C being proposed.[21] Therefore this analysis is based on the estimated reduction in NO_2 associated with a CAZ D.

CBI Economics analysis estimates that lower NO_2 levels could prevent at least 4% of Greater Manchester's deaths associated with respiratory conditions each year

Greater Manchester has a young and thriving economy. Around two thirds (64%) of Greater Manchester's population are of working age compared to an average of 62% in England and Wales.[22] Of these, 74% are currently in employment, and therefore improving the health of Greater Manchester's workers could result in a significant gain to the local economy.[23]

Evidence shows the impacts of poor air quality fall disproportionately on the elderly, who are more likely to be outside the working population. In Greater Manchester 94% of deaths associated with respiratory diseases fall within the over-65 age bracket.[24] The remaining 6% of deaths are among working-age residents with long-term conditions, 50% of which are economically inactive or unemployed.[25]

In Greater Manchester, 15% of all deaths and 8% of hospital admissions in 2019 were due to respiratory conditions.[26] A further 24% of deaths in 2019 were due to circulatory and heart conditions, and 7% due to malignant cancers, all of which are to an extent attributable to air pollution.[27] Reducing NO_2 levels could therefore prevent some premature deaths and reduce hospital admissions.

CBI Economics analysis finds that a 5 μ g/m^3 reduction in NO_2 in Greater Manchester could, at a minimum, prevent between 72 to 155 deaths each year, and save over 350 days spent in hospital due solely to NO_2 exposure.[28] This represents less than 1% of all Greater Manchester's deaths and 4% of deaths associated with respiratory conditions.[29]

The final health benefits of reducing NO_2 are likely to be far greater

As it was not possible to quantify all impact channels, the resulting health benefit is expected to go far beyond this.[30] The reasons for additional health benefits is due to the following:

- **A greater reduction in NO_2 is expected in Greater Manchester under a CAZ D than assumed in this analysis:** The size of the NO_2 reduction estimated by Manchester's feasibility study is almost twice as large (9.5 μ g/m³) as the 5 μ g/m³ change assumed in CBI Economics' analysis. To ensure a consistent approach across the cities analysed, the average value of 5 μ g/m³ was applied to all cities to capture the high degree of variation among the CAZs that have been assessed.[31] However, applying the larger reduction to Manchester would result in larger reductions in hospitalisations and deaths than has been accounted for in this analysis.
- **A larger share of the UK's population will be exposed to cleaner air than just those living in Greater Manchester:** Most of the city-region's residents work within Greater Manchester, however, this analysis does not capture those individuals who enter the CAZ area for work, study, or leisure. Around 553,000 (52%) workers who live outside of Greater Manchester commute into the city-region for work.[32] In addition, the city-region can see on average 68m visitors each year from outside of Manchester, 94% of which are UK day visitors.[33] A much larger group of the UK's population would therefore be exposed to cleaner air than the analysis is able to capture.[34]
- **Improving air quality will reduce a host of primary health conditions associated with air pollution:** The main conditions associated with air pollution are respiratory conditions, cardiovascular disease, and lung cancer, but there is emerging evidence of associations with low birth weight and Type 2 diabetes.[35,36] These conditions may be more closely linked with other pollutants, such as $PM_{2.5}$, but NO_2 exposure is likely to play a role within a wider mix of air pollutants. As this analysis is only focused on respiratory conditions, it underestimates the overall impact of lower NO_2 on all health outcomes related to air pollution.
- **Improving air quality will reduce health conditions where air pollution is a secondary factor:** Exposure to air pollution can also suppress lung function growth in children, and in adulthood it can accelerate the decline in lung function with age.[37] This increases the risk of death from other primary conditions. For example, COVID-19 patients that already suffer from long-term respiratory conditions are at greater risk of death.[38] As a result, improvements in air quality will have knock-on impacts on other health outcomes in addition to those direct impacts captured by the analysis.

- **Reducing emissions from vehicles is expected to lead to a reduction in other pollutants:** Evidence suggests NO_2 is emitted with other pollutants, especially $PM_{2.5}$, which makes it difficult to determine NO_2 as the attributable pollutant to health outcomes.[39] In addition, road transport has been linked to other pollutants including $PM_{2.5}$, PM_{10} and ground level ozone, which means CAZs could lead to a reduction in other pollutants.[40] These reductions could therefore provide further health benefits not captured by this analysis. Since $PM_{2.5}$ is the largest determinant of health outcomes due to air pollution, this omission could be significant.[41,42]

CBI Economics analysis estimates that bringing NO_2 within legal limits will add £7.1m to Greater Manchester's economy each year through increased workforce participation

Despite a disproportionate impact of air pollution on non-working residents, there is still expected to be a large impact on the working population. Analysis by CBI Economics shows that a healthier workforce in Greater Manchester could result in an additional 278,000 to 598,000 hours worked.[43]

Assuming full employment, meaning that these extra hours can be put to immediate use, this could increase the total production in the economy by an additional £7.1m in GVA from preventing these health outcomes. To put this in context, the city's new Innovation Activities Hub is estimated to cost £4m and will provide reskilling and training opportunity to local residents.[44] The economic benefits accrued from the introduction of a CAZ can therefore enable further development works in the area.

The final economic benefit to Greater Manchester is likely to be much larger

The resulting economic benefit is expected to go beyond £7.1m GVA not only because the resulting health impacts are expected to be larger than it is possible to quantify, but also for the following reasons:

- **The resulting days lost from work in the event of a hospital admission will be higher than just the days spent in hospital:** An individual will likely have been suffering prior to requiring hospital treatment, and will also likely require time to recover, increasing the days lost from work above just the time spent in hospital. However, this analysis only quantifies the impact of a reduction in NO_2 on the time spent in hospital due to limited availability of academic evidence.[45]
- **The value of unpaid work not carried out as a result of conditions related to NO_2 emissions cannot be estimated:** Activities taken outside of formal employment are estimated to be a significant contributor towards the UK economy: the ONS estimated unpaid work at 60% of GDP in 2016.[46] For example, activities such as volunteering and unpaid social care also add value to the local economy but are not captured in this analysis. There are an estimated 462,000 volunteers and board members across Greater Manchester, who donate 1.1m hours per week.[47] As a result, cost benefit analyses on air pollution often seek to include this as an impact pathway for quantification.[48]

This evidence demonstrates that a coordinated approach to its CAZ, involving all ten local authorities, has the potential to deliver a large and permanent reduction of NO_2 in Greater Manchester, and this new analysis finds that this has the potential to generate important economic benefits to its residents. With just a small 5 $\mu g/m^3$ reduction in NO_2 estimated to provide an additional £7.1m in GVA and prevent almost 160 deaths, it is evident that lower NO_2 levels can be an engine for a healthier and more prosperous city.

References

1. This change is based on an estimate of the 2019 annual average NO_2 level for Greater Manchester of 31 $\mu g/m^3$, estimated by Ricardo.
2. The number of deaths and hospitalisations will not stay the same as the years go on because of changes in population size and age structure as the deaths prevented accumulate over time. However, given this is a static analysis, the population and employment levels are assumed constant.
3. Real Gross Value Added (GVA) - Chained Volume Measures (2016 prices), i.e. accounting for the effect of inflation by using 2016 prices as the reference case. The figures refer to 2018. GVA is the value generated by any unit engaged in the production of goods and services. This includes the compensation of employees (wages and salaries, bonuses etc.), taxes (less subsidies) on production, and gross operating profits (including self-employment earnings) associated with the production a given level of output.
4. Breathing Life into the UK Economy, September 2020, CBI Economics commissioned by the Clean Air Fund.
5. Bengtson, M (2020) The effect of nitrogen dioxide on low birth weight in women with inflammatory bowel disease: a Norwegian pregnancy cohort study
6. PHE (2018) Estimation of costs to the NHS and social care due to the health impacts of air pollution
7. However, caution should be used when interpreting these figures. Estimating NHS costs is complex, and the PHE study does not include the secondary impact of health care costs that arise from people living longer due to better air quality.
8. Defra (2017) UK plan for tackling roadside nitrogen dioxide concentrations.
9. DfT and Defra (2017) UK Plan for tackling roadside nitrogen dioxide concentrations: Technical report.
10. Statutory limit values are legally binding and must not be exceeded. In the case of NO_2 this is 40 $\mu g/m^3$ for the annual mean and 200 $\mu g/m^3$ for the 1-hour mean. In order for the UK to comply with the limit value, all local areas across the UK must be in compliance.
11. UK best practice guidance, Local Air Quality Management Technical Guidance 2016 LAQM. TG(16) (Defra, 2018) states that the error of concentrations produced from air quality models should be within 10 % of the limit value. Therefore for NO_2 the error in modelled concentrations should be 4 $\mu g/m^3$, which means setting the limit value to 36 $\mu g/m^3$ takes into account error in the model.
12. https://cleanairgm.com/clean-air-zone-map/
13. The annual mean NO_2 concentrations are calculated by taking the average of the annual mean using monitoring data and the PCM roads model for roadside locations. While the hourly concentrations are measured by analysing the relationship between the annual mean and 1-hour maximum based on a regression equation.
14. The annual mean NO2 concentrations are calculated by taking the average of the annual mean using monitoring data and the PCM roads model for roadside locations. While the hourly concentrations are measured by analysing the relationship between the annual mean and 1-hour maximum based on a regression equation.
15. The annual mean measures the average of the annual mean using all the roadside data, while the maximum figures is the maximum annual mean concentration.Greater Manchester Combined Authority (2021) Cllr Andrew Western, Portfolio Lead for Green City-Region Portfolio Lead and Leader of Trafford Council
16. Greater Manchester Combined Authority (2019) Greater Manchester's Clean Air Plan – Tackling Nitrogen Dioxide Exceedances at the Roadside - Outline Business Case
17. Ibid.

18. This is based on CAZ feasibility studies for Bath, Birmingham, Caerphilly, Cardiff, Derby, Liverpool, Manchester and Newcastle.
19. This is based on an average of the estimated reduction in NO_2 following the introduction of a CAZ-D across eight cities (Bath, Birmingham, Caerphilly, Cardiff, Derby, Liverpool, Manchester and Newcastle), sourced from each city's CAZ feasibility studies.
20. Ricardo analysis
21. More detail on this can be found in the accompanying methodology document.
22. ONS (2021), Population Estimates, 2019
23. ONS (2021), Annual Population Survey – Employment rate, 2019
24. ONS (2021), Mortality Statistics by Underlying Cause and Age, 2019
25. ONS (2020) Mortality Statistics; ONS (2021), Annual Population Survey – Employment rate, 2019
26. ONS (2020) Mortality Statistics
27. Ibid.
28. The estimate for deaths is based on long-term exposure to NO_2 while the hospital admissions figures are due to short-term NO_2 exposure. A full explanation of the methodology can be found in the accompanying methodology document.
29. This is based on the upper end estimate of 21 deaths prevented, calculated using deaths data from the ONS.
30. Limited academic evidence on the quantification of a reduction in NO_2 on the health of a population meant that several channels of impact were not quantified. A full explanation of this can be found in the accompanying methodology document.
31. Analysis provided by Ricardo shows that the impact of a CAZ D will vary by city. One cause of this variation is that the area in scope of a CAZ is different, for instance the CAZ in Greater Manchester covers the entire city region, while in Birmingham only the city centre is impacted. The larger the area of the CAZ, and therefore the greater number of vehicles in scope, the greater the estimated NO_2 reduction. Other factors also include how far a city is away from the statutory limit values, in which case the level of change could be greater.
32. Estimates based on the 2011 Census of Population (origin-destination statistics) and ONS Population Estimates for 2019. The estimates are based on the difference between the number of all usual residents and Greater Manchester residents who work in Greater Manchester in 2011. This difference is subsequently projected forward to 2019 based on total population growth for Greater Manchester between 2011 and 2019 (from the ONS Population Estimates).
33. Visit Britain (2020), Overnight and day visitors (from elsewhere in the UK and international) - 2019
34. The analysis is based on deaths and hospital admissions by local authority and therefore only captures those individuals recorded as living in Greater Manchester or visiting Greater Manchester's hospitals and not those from other local authorities.
35. Bengtson, M (2020) The effect of nitrogen dioxide on low birth weight in women with inflammatory bowel disease: a Norwegian pregnancy cohort study
36. Li, Y (2019) Association between air pollution and type 2 diabetes: an updated review of the literature
37. Ibid.
38. Schultze et al (2020), "Risk of COVID-19-related death among patients with chronic obstructive pulmonary disease or asthma prescribed inhaled corticosteroids: an observational cohort study using the OpenSAFELY platform", Lancet Respiratory Medicine Journal, Vol. 8, Issue 11 (funded by UK Medical Research Council)
39. Air Quality Expert Group (2004) Nitrogen Dioxide in the United Kingdom Summary
40. DEFRA (2020) Air quality appraisal: impact pathways approach
41. Modelling the impact of CAZs on other pollutants such as $PM_{2.5}$ would have required a significant undertaking and a number of assumptions and therefore the decision was taken to omit this from the quantification.

42. Bengtson, M (2020) The effect of nitrogen dioxide on low birth weight in women with inflammatory bowel disease: a Norwegian pregnancy cohort study.
43. The number of working years gained are converted into number of working days on the basis of the number of hours worked in a given week by all Greater Manchester residents in employment (based on the ONS Annual Survey of Hours and Earnings 2019 data on average number of hours worked per week), and an assumed 48 weeks per year worked (4 weeks entitled to paid holiday).
44. GMCA (2020) 'Shovel ready' Greater Manchester building projects boosted by £54m of Government funding https://www.greatermanchester-ca.gov.uk/news/shovel-ready-greater-manchester-building-projects-boosted-by-54m-of-government-funding/
45. The concentration response function (CRF) used in this analysis estimates the impact of a unit change in concentration to the number of hospital admissions due to respiratory disease. It does not capture the full extent of working days lost due to respiratory illness. To do this we would need figures on sickness absence in the workforce due to respiratory illness, to capture days lost sick at home and in hospital.
46. ONS (2016) Household Satellite Account.
47. GMCVO (2017) Greater Manchester State of the Voluntary, Community and Social Enterprise Sector 2017.
48. Defra (2012), Valuing the Impacts of Air Quality on Productivity.

CBI Economics

This report was produced by CBI Economics and commissioned by the Clean Air Fund using modelling by CBI Economics based on input data from a variety of sources.

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