The Impact of COVID-19 on Air Quality

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Introduction

In Greater Manchester (GM) we have big ambitions to improve the environment across all ten of our districts. Not only to protect our most vulnerable communities and individuals now, but to safeguard the health of our own children and our children's children.

Our 5-Year Environment Plan has a target to be carbon neutral by 2038 whilst our Transport Strategy contains targets for 50% of all journeys to be sustainable by 2040 – that's a million more journeys on foot, bike or public transport every single day.

Together with plans to implement the largest Clean Air Zone outside of London next year, we take the monitoring of air quality very seriously.

Air quality monitoring in Greater Manchester

There are 10 districts that form GM (Bolton, Bury, Rochdale, Oldham, Stockport, Manchester, Tameside, Trafford, Salford & Wigan) that collectively manage 20 real-time air quality monitoring stations, all operated to Defra's AURN standards. The results from the stations and the c400 nitrogen dioxide (NO_2) tubes dotted around the region are available to view at www.cleanairgm.com. We are very fortunate to also have access to the resources of the University of Manchester expertise and their Air Quality Monitoring Supersite.

The biggest influential factor on both short- and longer-term concentrations of pollutants in the air is the weather and this is one of the reasons that local air quality monitoring looks at annual trends, over many years. The legal AQ limits relate to annual averages, with hourly limits to protect against short term pollution episodes. In the UK, there are widespread exceedance of the annual average limit for NO_2, whereas exceedance of the short-term standard is comparatively rare. It is therefore important to bear this in mind when assessing the impact the lockdown had over a relatively short period of time (during March-May 2020), on improving the quality of our air.

The impact of lockdown

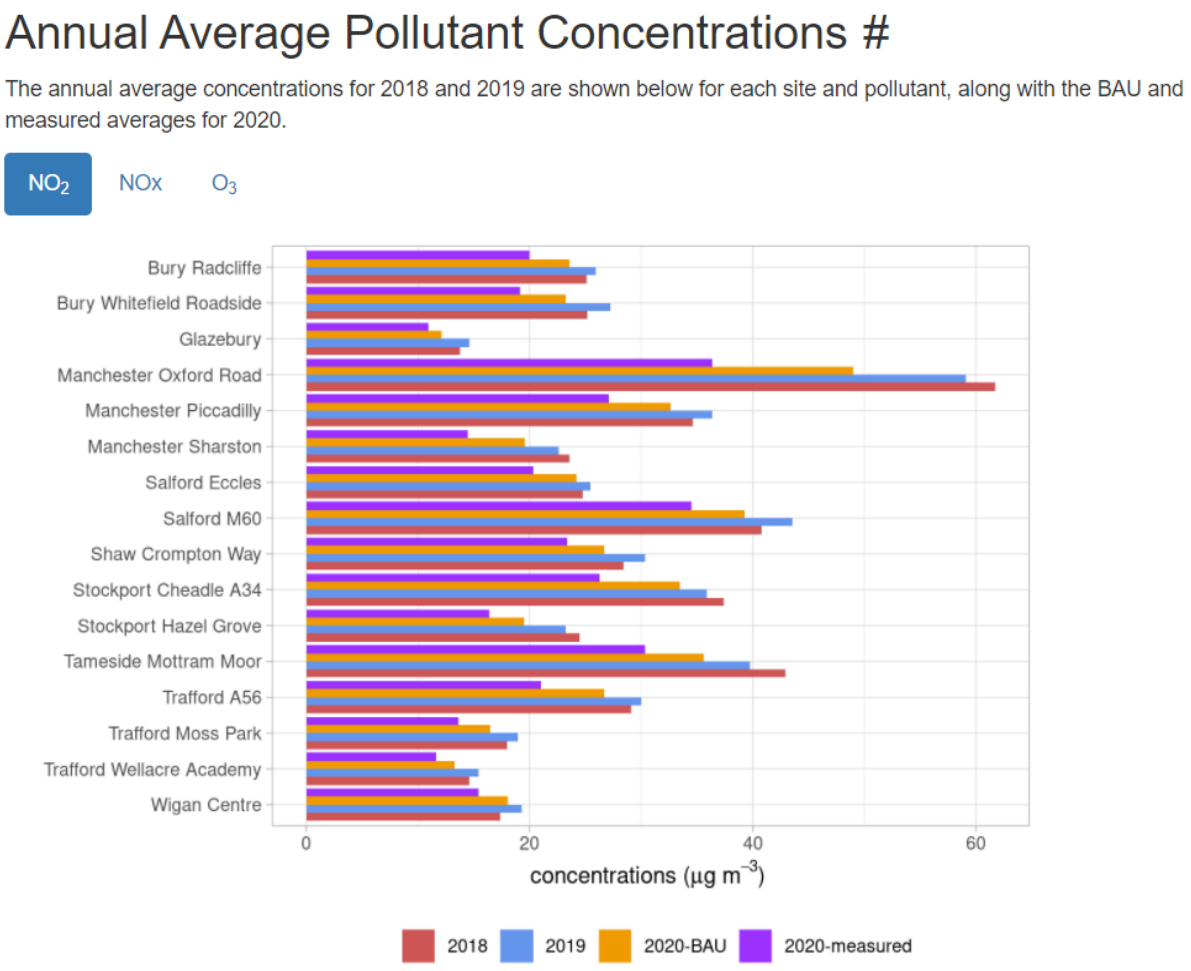
In April 2020, the AQ Expert Group, at the request of Defra, called for evidence from the research communities in relation to the impact the lockdown was having on air quality. I had the opportunity to spend time with Professor Hugh Coe who is a Professor of Atmospheric Composition and the Director of the Manchester Environmental Research Institute (MERI). He took me through the University of Manchester's submission and their assessment of not only their super site, but of the AQ monitoring stations across the UK. I summarise the findings below:

1. Metrological context: due to the unusual weather conditions experienced in the first quarter of 2020, care should be taken when comparing year to year trends in air pollutants. The weeks prior to the lockdown were some of the windiest in at least 30 years, whilst spring 2020 was the sunniest since records began.
2. NOx showed substantial reduction of between 20-80% in most Urban Roadside sites across the AURN network locations in the UK.
3. There was no systematic reduction in PM2.5 in the UK since the outbreak.

4. There was a distinct reduction in black carbon from traffic, but a detectable increase in the contribution from wood burning, resulting in no noticeable change in the absolute concentration of black carbon before and after lockdown.
5. Although NOx showed a marked decrease across the UK, this was mirrored by a corresponding increase in Ozone.

These findings were echoed by Lee et al[1] who noted that NO_2 decreased by an average of 40 – 48% at urban traffic and urban background sites. The increase in Ozone had a marked increase at urban traffic sites of 48% and 11% at urban background sites. This has been attributed to the fact that there was not as much NOx for the O3 to oxidise to form NO_2 and was exacerbated due to the hot weather and the increase in biogenic Volatile Organic Compounds (VOC) that originate from plants such as trees. They conclude with the observation that improvements in air quality and a future warmer climate may lead to the reduction in NO_2 being offset by increases in O_3 and therefore it is vital to control manmade sources of VOCs to mitigate this effect.

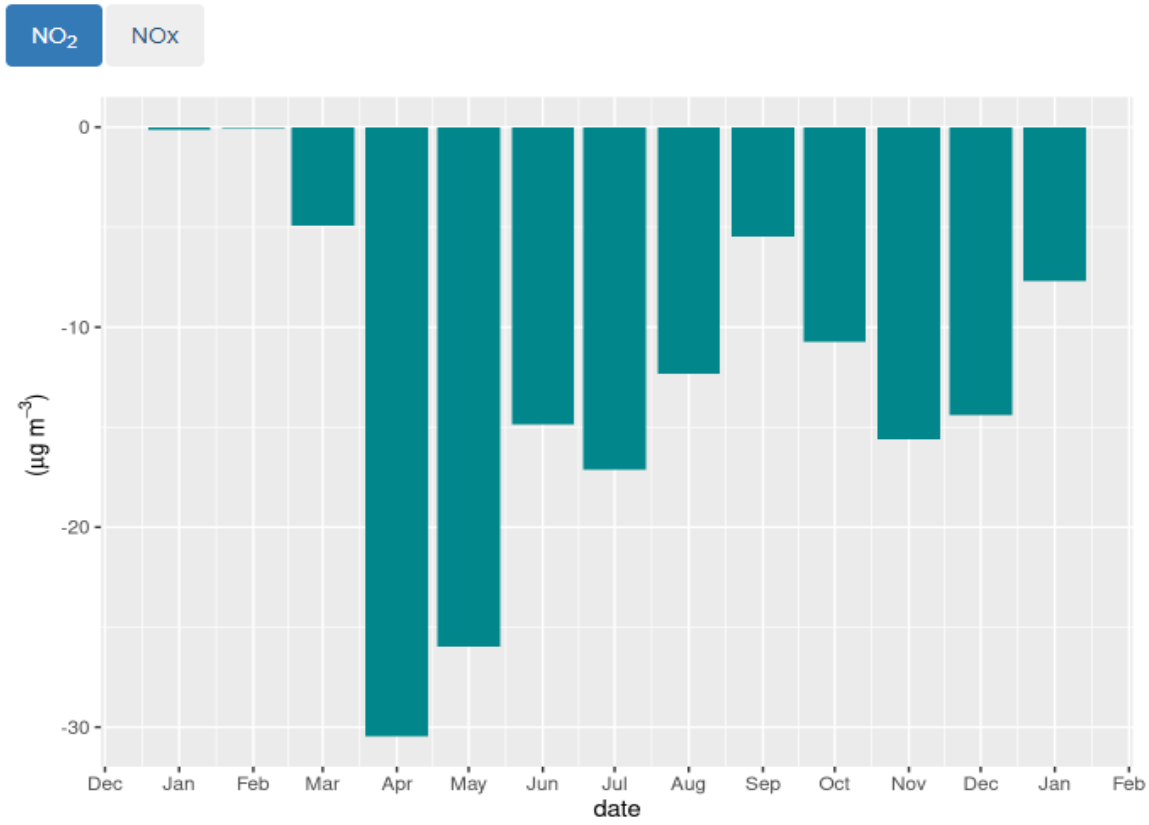
To really appreciate the impact the lockdowns have had on air quality in Greater Manchester, David Madle from Ricardo Energy and Environment[2] showed me published data from the GM AQ monitoring stations (based on provisional datasets; may be subject to change). The following graph illustrates the difference in the annual average concentrations for 2018, 2019, 2020 (Business As Usual) and 2020 Measured, depicted in the bar chart below. This clearly shows a reduction in NO_2 across all monitoring stations in 2020 Measured. The following graph illustrates the monthly difference at the Manchester Oxford Road monitoring station.

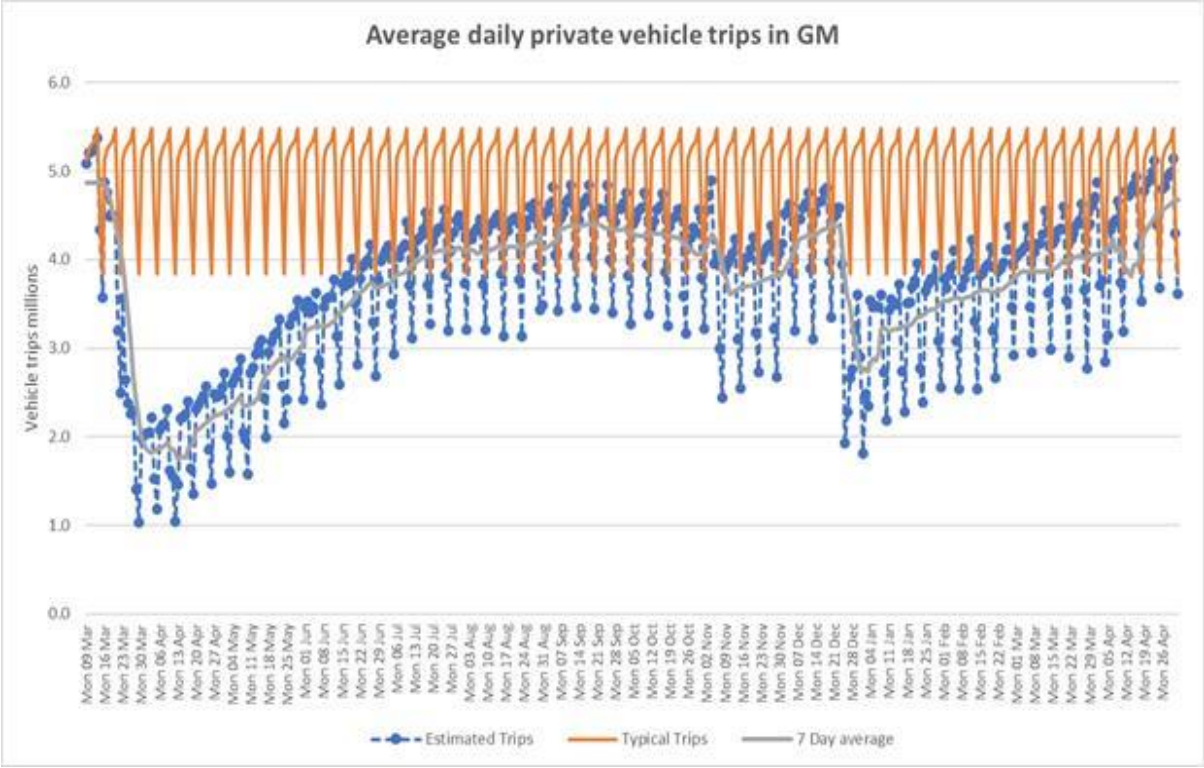


[1] J. D. Lee et al.: UK surface NO_2 levels dropped by 42% during the COVID-19 lockdown
[2] Ricardo Energy and Environment - Lockdown Effects on Air Quality (airqualityengland.co.uk)
https://www.airqualityengland.co.uk/assets/reports/300/GreaterManchester_report_covid_analysis.html

Monthly Change in Pollutant Concentrations

To put the magnitude of the decrease into perspective, the monthly mean difference in measured and modelled “business as usual” (BAU) concentrations are shown below for Manchester Oxford Road.





The reduction in NO2 in March/April is also reflected in the reduction in private vehicle trips across Greater Manchester, which reduced from c5.5million trips on the 16th of March to c1million on the 23rd. The second and third lockdown also shows a reduction in traffic, but to a much lesser extent. The above graph illustrated that private vehicle movements are almost back to pre-pandemic levels.

Proactive action within Greater Manchester to improve air quality

The 10 Greater Manchester Authorities are working together to introduce the largest Clean Air Zone outside of London, covering 500 square miles, to tackle NO2 and to bring about compliance with the legal limit in the shortest possible time. The plans have been subject to a public consultation and are in the process of being finalised and will be brought forward for decision makers no later than summer '21. This will see the most polluting commercial type vehicles charged to enter and move within the zone. For further information visit www.cleanairgm.com

Additionally, the Mayor's Challenge Fund, championed by GM's first cycling and walking commissioner, Chris Boardman, is delivering the UK's largest cycling and walking network with plans for over 1800 miles and 2400 new crossings, connecting every neighbourhood, school, high street and public transport hub in the city-region. For further information visit: https://activetravel.tfgm.com/.

The benefits of introducing cycle lanes in a busy city such as Manchester can be demonstrated by the scheme introduced on Oxford Road. In 2017, Transport for Greater Manchester (TfGM) implemented a £122m Bus priority package and cycle lane scheme.

Before:

After:

Summary of outcomes of Oxford Road cycle and bus lane scheme

Autumn 2017: Total southbound flow was 38% higher than in the same period in autumn 2016.

March 2015-March 2018 comparison:

- 0-2 miles from the city centre increase of between 85% and 176%
- 2-2.5 miles from the city centre increase of between 104% and 128%.

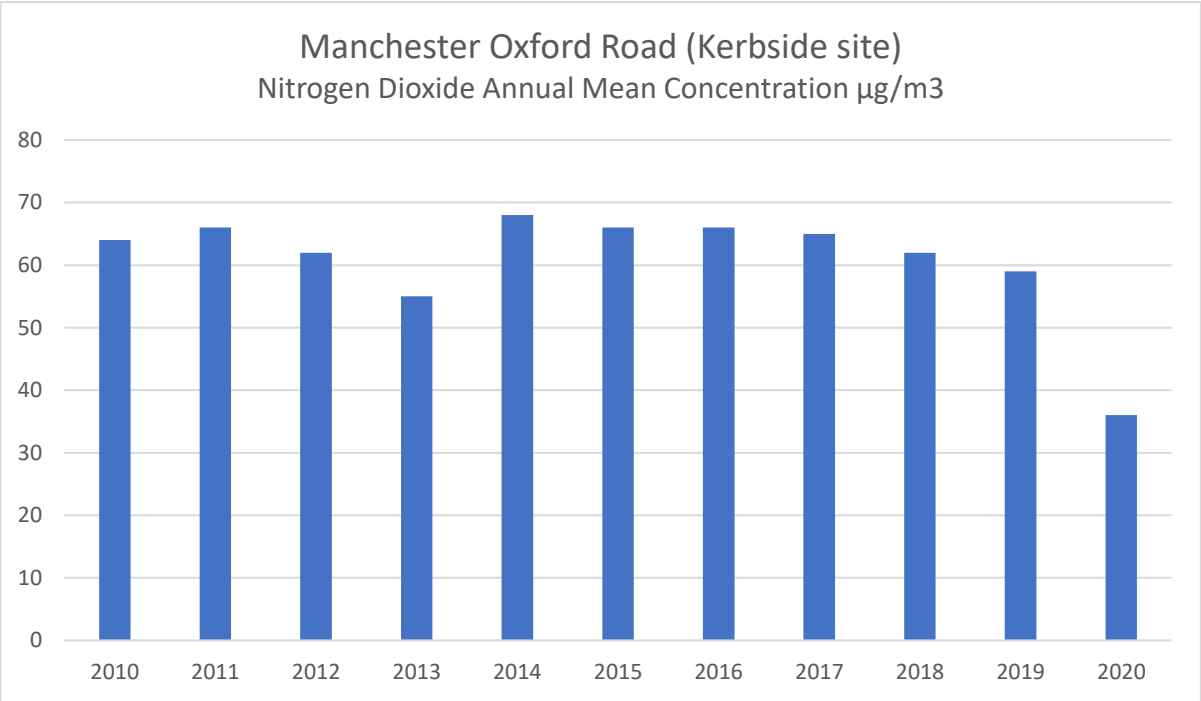
2018: More than 1 million journeys were counted on the route on Oxford Road, with up to 5,000 people passing this marker each day. This equates to 621,000 car journeys and reduces up to 1.9 tonnes of nitrogen dioxide or 873.5 tonnes of carbon dioxide.

The scheme won the Excellence in Cycling and Walking category at the 2018 National Transport Awards.

In Greater Manchester, cycle mode share has increased from 5-8% (2021-2019) with car mode share decreasing by a similar amount.

Changes in measured NO_2

The changes in the measured NO_2 since 2010 can be seen from the graph below, with results taken form the Oxford Road kerbside real-time monitor. Over that period, improvements in the age of the vehicle fleet will have had some impact on the readings; however, a positive reduction in NO_2 levels is noticeable from 2018 onwards. The impact of the lockdown can be clearly seen.



Notes:

- 2010: site set up
- 2015-2016: roadworks/Metrolink works/road closures
- 2017: bus gate & cycle lanes
- 2020: COVID-19 impacts
- 2016 to 2019 comparison: **11% reduction**
- 2019-2020 comparison: **39% reduction (COVID-19 impacts)**

Conclusion

The impacts of lockdown on air quality have proven that exposure to poor or illegal levels of pollution can be tackled by addressing emissions from road transport. However, now that the lockdown is easing and traffic levels have returned to c85% of their pre covid levels, the question arises, "what level of change to the fleet and modal shift is needed to replicate the improvements in AQ noted during the lockdown"? Air Quality Consultants were commissioned to rapidly assess a range of traffic interventions based on data from 6 European cities[3], concluding that in Paris 67% of all vehicle km would need to be travelled in zero emission vehicles (ZEV), in Madrid 10% of all goods vehicles and 94% of car km would need to be by ZEV. Another scenario was that if all cars, vans, buses, motorcycles and trucks in the selected cities were to be zero exhaust emission, then the NOx from traffic would be zero and locally generated PM2.5 would reduce by 22-66%. This is also the same extent of modal shift necessary in the next 5-10 years needed to meet many carbon neutral targets declared around the country, showing how consideration of a wider range of impacts can potentially be used to support public policy measures and build the case for action.

[3] Covid-19, Air Quality and Mobility Policies: Six European Cities available Covid-19, Air Quality and Mobility Policies: Six European Cities (www.aqconsultants.co.uk)