

Deadly Diesel 1: Are things worse than they seem?

Welcome to our “Deadly Diesel” series of papers. In these, we will endeavour to dig into the state of the UK’s air quality and what, if anything, is being done about it.

The rise of the diesel vehicle

Over the last decade, the number of diesel vehicles on the road has increased dramatically – due to tax breaks and the belief by consumers that they are more environmentally friendly. In 2012 their market share for new sales hit 50% (the Independent).

Is diesel clean?

Whilst the headline figures suggest that diesel vehicles are lower Carbon Dioxide emitters than petrol vehicles (in spite of test rigging by a certain manufacturer) the fact is that in terms of particulates and Nitrogen Oxides, they are worse. In 2015 the Supreme Court ordered the UK government to take urgent steps to tackle air pollution and submit a new plan for reducing NOx by the end of 2015. Further, the UK is facing substantial fines from the EU for failing to reduce the levels of Oxides of Nitrogen (NOx) in the air (The Daily Telegraph).

Why is NOx bad?

In the USA, studies on the effects of Nitrogen Dioxide on health have been going on for some time. COMEAP (Committee On the Medical Effects of Air Pollutants) stated in a 2015 paper that “*Studies have shown associations of nitrogen dioxide (NO₂) in outdoor air with adverse effects on health, including reduced life expectancy... evidence associating NO₂ with health effects has*

strengthened substantially in recent years and we now think that, on the balance of probability, NO₂ itself is responsible for some of the health impact found to be associated with it in epidemiological studies.”

So, what do Nitrogen Oxides actually do that is bad? They can create a number of adverse environmental conditions including ground-level Ozone (smog) acid rain (bad for plants) and acidic particulates that can be ingested, they degrade the quality of waterways, contribute to global warming, reduce visibility by blocking light and they react with other chemicals in the air to create toxic chemicals such as Nitrate radicals, Nitrosamines and Nitroarenes (Various sources).

Are there any limits on NOx emissions?

Yes, EU air quality standards specify a maximum limit for Nitrogen Dioxide exposure of 200ug per cubic metre of air over a 1 hour period; this limit must not be breached more than 18 times in a year. Additionally, exposure must not exceed an average of 40ug per cubic metre over the course of a year (this must not be exceeded).

The issues of NOx pollution in London are well documented and topical (the Mayor, the Guardian, TfL etc) but are the government taking action?

In response to the Supreme Court’s demands, Defra published a paper in December 2015 titled “Improving air quality in the UK; tackling *nitrogen dioxide in our towns and cities. List of UK and national measures.*” Laudable as this is, there are very few quantitative targets and lots of statements like “*Not quantified but improvements in air quality expected.*”

Perhaps more hope than action. So, what has happened in terms of NOx pollution and, specifically outside of London?

We thought that we would look at a typical regional town where significant numbers of people commuted to and from work – we chose Reading in Berkshire. Conveniently, it also happens to be a town that conducts daily measurements of roadside NO₂ and NOx levels.

Our findings

On the face of it, the measurements made and published via Defra don't look too bad as a monthly average (Table 1).

Table 1: Average monthly NO₂ (ugm⁻³) 2016

Row Label	Average of Nitrogen dioxide London Road	Average of Nitrogen dioxide New town
+ Jan		31.19
+ Feb		37.72
+ Mar	32.34	51.13
+ Apr	31.30	22.76
+ May	25.83	19.76
+ Jun	22.89	12.61
+ Jul	19.00	19.95
+ Aug	24.02	14.77
+ Sep	26.16	20.23
+ Oct	42.46	33.88
+ Nov	49.78	41.48
Grand Total	28.68	26.69

Measurements taken at London Road and at New Town are within the EU limit of 200ugm⁻³ (note: the lack of measurement in January and February was due to missing data. In fact a substantial amount of data overall was missing).

However, once a closer look at the data is taken, it reveals a worrying situation: Looking at NOx overall, measured as NO₂, during the course of 2016, the EU hourly limit of 200ugm⁻³ was breached either at London Road or New Town no less than 453 times! (see Table 2).

Table 2: Number of violations in 2016 by measurement point.

Violations of EU NOx limit of 200ugm-3 1hour		
Month (2016)	New Town	London Road
Jan	57	
Feb	41	
Mar	38	41
Apr	4	30
May	0	7
Jun	0	5
Jul	0	6
Aug	0	2
Sep	1	15
Oct	28	133
Nov	9	36
Total:	178	275

As expected, the levels of Nitrogen Oxides being emitted varies in accordance with the time of day (see Figure 1) with most occurring in the rush hour.

Conclusions

This result for Reading is clearly disappointing, especially at a time when government is meant to be acting swiftly and decisively to improve air quality. However, these measurements are only from one town. There is more work to be done by all parties, including us, to get to the true picture across the UK ... and hot off the press: *"The leaders of four major global cities say they will stop the use of all diesel-powered cars and trucks by the middle of the next decade. The mayors of Paris, Mexico City, Madrid and Athens say they are implementing the ban to improve air quality. They say they will give incentives for alternative vehicle use and promote walking and cycling. The commitments were made in Mexico at a biennial meeting of city leaders."* (BBC)

Figure 1: NO₂ in $\mu\text{g m}^{-3}$ by hour of the day

