

Update: 8 August 2022

Pathway to achieve the new WHO air quality guideline for fine particles (PM_{2.5})

The purpose of this article is to demonstrate that the UK should comply easily with limit values aligned to the World Health Organisation's ("WHO's") old air quality guideline for fine particulate matter ("PM_{2.5}") (2005) by 2030 and how it could comply with limit values aligned to the new air quality guideline (2021) by 2030 or earlier as proposed by Baroness Jones' Clean Air (Human Rights) Bill ("CAHR Bill")¹.

Air pollution in 2020

Anthropogenic (human-made) and non-anthropogenic components of population-weighted annual mean concentrations for PM_{2.5} in England in 2020 were 6.9307 micrograms per cubic metre (ug/m³) and 0.606 ug/m³ respectively² (totalling 7.5367 ug/m³). While these numbers were population-weighted and not average concentrations *per se* or directly comparable with 'limit values' or WHO air quality guidelines, they show that the vast majority of local air pollution is caused and therefore controllable by humans i.e. 92% in this case.

The Chair of Defra's Air Quality Expert Group explained helpfully on 18 November 2021³:

Whilst 2020 was clearly a very unusual year for air pollution emissions due to the COVID-19 pandemic, an annual average PM_{2.5} limit value of 10 ug m-3 or higher would have been achieved across the UK, including central London. This would be valuable contextual information for decision-makers when set alongside the assessments based on different future emission scenarios.

While 2020 was a highly unusual year, Professor Lewis is correct that it provides valuable contextual information when looking at future emission scenarios e.g. to 2030 (or earlier).

Understanding air pollution

The atmosphere ("One air") comprises air pollutants and greenhouse gases with the former including particles (which are regulated as a 'lump' based on their maximum diameter e.g. PM_{2.5} or PM₁₀) and gases which are regulated individually e.g. nitrogen dioxide (NO₂). These pollutants can impact on health, the natural environment and climate change.

It is important to understand the difference between emissions and concentrations and budgets, ceilings, WHO air quality guidelines, limit values, objectives, targets and population-weighted estimates for air pollutants including greenhouse gases. In essence, emissions (e.g. from tailpipes or chimneys) become concentrations (which are measured in the air) which result in human exposures, health effects and death outcomes (as recorded on death certificates). There is also an important distinction between primary PM_{2.5} (i.e. directly emitted particulate matter) and secondary PM_{2.5} that forms from chemical reactions between pollutants in the atmosphere. Less than 20% of PM_{2.5} concentrations measured in a city like London may be from primary and secondary PM_{2.5} generated within the city (with regional, national and transboundary PM_{2.5} making up the balance).

¹ <https://cleanair.london/ellaslaw/>

² <https://uk-air.defra.gov.uk/data/pcm-data>

³ https://cleanair.london/app/uploads/CAL-458-AQEG-Chairs-summary_PM2.5.pdf

In relation to ambient (outdoor) air quality, the CAHR Bill is aligned closely to limit values (Clause 3(3)) because they have been found to be more effective in facilitating downward trends of PM_{2.5} than other types of air quality standards, such as target values (page 86 of the Fitness Check)⁴. Limit values do not apply everywhere⁵ unlike WHO air quality guidelines which cover all settings where people spend time (page 6 of Executive Summary for new WHO air quality guidelines)⁶. Limit values are used to control concentrations of air pollution. Relevant legislation and regulations include:

- the Air Quality Standards Regulations 2010 (“2010 AQSR”); and
- the Directive on ambient air quality and cleaner air for Europe (Directive 2008/50/EC).

The Environment Act 2005 and subsequent legislation set requirements for ‘objectives’.

It is also important to understand the difference between background, local, regional and transboundary sources of air pollution. The reason that countries work together to reduce transboundary air pollution is because some of the anthropogenic PM_{2.5} (for example) that is not-controllable in one country **is** controllable in others (**and vice versa**).

These multiple geographical sources of air pollution are controlled principally by a suite of national, regional and international laws and regulations. These include:

- the National Emission Ceiling Regulations 2018⁷ (“2018 NECR”);
- the National Emissions Ceilings Directive 2016⁸ (Directive (EU) 2016/2284) (“2016 NECD”) which entered into force in 2018 and sets national emission reduction requirements in two steps to 2020 and 2030 (and thereafter). It also sets targets to be achieved by 2025; and
- the UNECE’s Convention on Long-range Transboundary Air Pollution⁹ which is extended by a number of protocols including the Gothenburg Protocol to abate acidification, eutrophication and ground-level ozone¹⁰. The amended Gothenburg Protocol¹¹ (“2012 GP”) entered into force in 2019 and set national emission reduction requirements to be achieved by 2020 (i.e. it has no second step to 2030).

These regulations and legislation set “emission reduction commitments” (“ERC”) for five pollutants as a fixed percentage reduction from a given base year (i.e. 2005) rather than in terms of absolute maximum amounts of kilotons of annual emissions. This means that there is more “room for flexibility” because the base year emissions could be changed (up or down) as a result of improved emission inventories or because some were previously ignored. These changes are allowed through a process called ‘adjustments’ (which Defra is using to achieve compliance with the 2020 requirement for ammonia (“NH₃”)¹²).

⁴ https://cleanair.london/app/uploads/CAL-466-SWD_2019_427_F1_AAQ-Fitness-Check-eg-limit-values.pdf

⁵ https://cleanair.london/app/uploads/CAL-269-Letter-of-clarification-from-the-Commission-190214_Redacted-1.pdf

⁶ <https://cleanair.london/app/uploads/CAL-423-New-WHO-AQGs-Executive-Summary-220921.pdf>

⁷ <https://www.legislation.gov.uk/ukxi/2018/129/made>

⁸ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016L2284&qid=1659797190491>

⁹ <https://unece.org/convention-and-its-achievements>

¹⁰ <https://unece.org/gothenburg-protocol>

¹¹ <https://unece.org/environment-policy/air/protocol-abate-acidification-eutrophication-and-ground-level-ozone>

¹² <https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-ammonia-nh3>

The ERCs for 2020 in the 2012 GP were set prior to the 2016 NECD which led (unfortunately) to the 2016 NECD largely ending up at the same low ambition level as the 2012 GP. The ERCs for 2030 in the NECD are stricter although not enough, especially for NH₃.

The review of the 2012 GP is expected to be completed by the end of 2022¹³ and followed by negotiations on a revision to the Protocol over the next two to three years. As the UK is no longer part of the EU, it should push for much stricter future emission reduction targets by 2030, 2035 and 2040. These should be stricter for 2030 than set by the 2016 NECD.

The Pathway

Defra should publish a pathway to achieve an annual average PM_{2.5} limit value of 5 ug/m³ as soon as possible and by 2030 at the latest (the “Pathway”) i.e. aligned to the new WHO air quality guideline for PM_{2.5}. The Pathway should include:

1. calendar 2020 (actual) and calendar 2030 (estimated). Note: CAL has chosen round numbers for simplicity;
2. England as a whole and each of nine regions: North East; North West; Yorkshire and the Humber; East Midlands; West Midlands; East of England; London; South East and South West (i.e. as used in Defra’s modelling¹⁴);
3. each of the following:
 - 3.1. average ambient PM_{2.5} concentrations (ug/m³) i.e. total including primary, secondary and non-anthropogenic i.e. across the whole region and England as a whole;
 - 3.2. population-weighted PM_{2.5} concentrations (ug/m³) i.e. total including primary, secondary and non-anthropogenic; and
 - 3.3. qualitative commentary and quantitative assessment of the impact on PM_{2.5} concentrations where limit values apply including using the modelling and assessment approaches referred to or indicated by Professor Lewis above.
4. the following future emission scenarios:
 - 4.1. the UK complying fully with the 2016 NECD for NH₃, non-methane volatile organic compounds, oxides of nitrogen (NO_x), PM_{2.5} and sulphur dioxide (SO₂) in 2030;
 - 4.2. the UK reducing NH₃ emissions from all sources, including both agricultural and non-agricultural, by 50% as suggested in the scientific paper titled ‘Abating ammonia is more cost-effective than nitrogen oxides for mitigating PM_{2.5} air pollution’ (by Mark A Sutton, Mike Holland and others, 5 November 2021). 4.2 may include paragraph 4.1;
 - 4.3. the phasing out of all domestic wood burning in urban areas by 2030¹⁵;
<https://www.gov.uk/government/statistics/emissions-of-air-pollutants>
 - 4.4. the phasing out of all other domestic solid fuel burning in urban areas by 2030;
 - 4.5. the phasing out of all biomass burning, including wood, from industrial combustion by 2030;

¹³ <https://unece.org/media/environment/Air-Pollution-Convention/news/366883>

¹⁴ <https://uk-air.defra.gov.uk/data/pcm-data>

¹⁵ https://cleanair.london/app/uploads/CAL-429-CCC-covering-letter-reply-211221_EIR-UK-Health-Expert-Advisory-Group-Report.pdf

- 4.6. the introduction of the measures to reduce emissions from domestic shipping by 2030 that match or exceed the EU27's ambition level i.e. through legislation, regulation and economic instruments;
- 4.7. the introduction of Emission Control Areas ("ECAs") for oxides of nitrogen (NOx) ("NECA") and sulphur dioxide (SO₂) ("SECA"), that match or exceed the EU27's standards, in the whole sea area from South Portugal, Spain, France, South and West UK, around Ireland, North West of Scotland and along the mid- and northern Norway coast by 2030. NOx and SO₂ emissions are important and significant precursors of secondary PM_{2.5}. These zones could be negotiated with France, Ireland, Norway and Portugal and through the International Maritime Organisation;
- 4.8. other measures (excluding those above) required by UK legislation, regulation or guidance that would reduce PM_{2.5} emissions by 2030 (please identify each of these) e.g. vehicle emissions and non-road mobile machinery standards;
- 4.9. the possible impact of new powers requested by the Mayor of London and London Councils to control emissions from plant and equipment in areas of poor air quality e.g. boilers, combined heat and power plant, cooking appliances used in restaurants, solid fuel burning in fireplaces and stoves, non-road mobile machinery and static generators. Please note commercial cooking as identified in the London Atmospheric Emissions Inventory 2019¹⁶;
- 4.10. the contribution from other UK sources of primary and secondary PM_{2.5} not included above (please identify each of these);
- 4.11. all EU 27 countries complying fully with their obligations under the 2016 NECD by 2030 (which would reduce secondary PM_{2.5} in the UK);
- 4.12. the EU27 implementing fully its zero pollution vision for 2050¹⁷ and achieving a straight line reduction in air emissions between 2021 and 2050;
- 4.13. the UK matching the EU27's ambition level as described in paragraph 4.12; and
- 4.14. the UK being fully on-track in 2030 (in straight-line terms) to comply with the 5th and 6th carbon budgets set by the Climate Change Committee.

Emission scenarios above may exclude or be on top of reductions in emissions and concentrations of PM_{2.5} arising from innovation, technology, measures needed to limit global heating to 1.5 degrees, lifestyle policies (which may range from bans, charges, campaigns to build public understanding, incentives and adoption e.g. seat belts) and other policies e.g. to protect public health or the environment or promote active travel.

Next steps

The CAHR Bill would enshrine the human right to clean air precisely and explicitly in UK law. It does so by adopting a 'One Air' approach to clean air and sets ambitious targets to comply with the WHO's new air quality guidelines within five years. This obligation is backed by a comprehensive framework of measurement, reporting and annual improvement which could be enforced on an annual basis thereafter at the discretion of the Citizens' Commission for Clean Air.

There is an overwhelming public interest in Defra disclosing modelling, assessments and possible pathways to achieve an annual average PM_{2.5} limit value of 5 ug/m³ across the UK as soon as possible and by 2030 at the latest to provide contextual information for the general public, legislators, policy makers and others.

¹⁶ <https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019>

¹⁷ https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en