From: [redacted]
To: A12chelmsfordA120
Subject: Re: A12 Widening Scheme - Preliminary Design Consultation
Date: 14 December 2022 11:54:13

FAO Mr Adrian Hunter, Lead Member of Examining Authority,

Sir,

I appreciate that in normal circumstances new evidence should not be considered without the other parties consent, but I think the latest comments from COMEAP issued 27/7/2022 are important for you and your colleagues to consider given National Highways apparent position that there is no increased risk to human health through the project in respect of air quality in Hatfield Peverel. The link is below:

https://www.gov.uk/government/publications/comeap-statement-response-to-who-air-quality-guidelines-2021

Yours sincerely
Mark East

-----Original Message-----
From: Mark East [redacted]>
To: A12chelmsfordA120@planninginspectorate.gov.uk
<A12chelmsfordA120@planninginspectorate.gov.uk>
Sent: Wed, 14 Dec 2022 8:54
Subject: Fwd: A12 Widening Scheme - Preliminary Design Consultation

FOA Mr Adrian Hunter, Lead Member of the Examining Authority

Sir,

I have received an invitation to participate in the preliminary meeting and have noted that air quality and impact on human health is covered for which I am grateful, although I have no doubt it would have been addressed. Whilst it is my intention to attend the preliminary meeting, I do not feel that my involvement would at this point in time add anything beyond what has already been covered in my submission (attached).

COMEAP reports are in the public domain but I have noted that they don't appear to have any involvement in this Inquiry, which is disappointing as they are the leading experts on air quality/human health risks. I feel their expertise would have been essential in reaching an informed decision, particularly their views on pollutant levels acceptable to avoid human health risks.

If I can clarify any point in my submission I am most happy to do so.

Yours sincerely
Mark East

-----Original Message-----
From: Mark East [redacted]>
To: NIEnquiries@planninginspectorate.gov.uk <NIEnquiries@planninginspectorate.gov.uk>
Sent: Fri, 12 Aug 2022 8:11
Subject: A12 Widening Scheme - Preliminary Design Consultation

Dear Sir/Madam,

I understand that the scheme will be independently assessed by an Inspector from PINS. I have concerns that the scheme as proposed is illegal as there is a lack of substantive evidence that the widening through Hatfield Peverel will not have a negative impact on human health and would not breach human rights. This is not to suggest the entire scheme is unacceptable, but I believe alternatives for the stretch through Hatfield Peverel is necessary.

I attach a submission with attachments setting out my case and reasoning. [redacted]

Thank you in advance for your anticipated kind help on what I deem to be a crucial element of consideration to this scheme. Could you please just send back a short acknowledgement of safe receipt and confirmation that it will be passed to the Inspector appointed.

Yours sincerely
Mark East

A12 Chelmsford to A120 Widening Preliminary Design Consultation

Submission Statement by

Mark East

[redacted]

Monday 9th August 2022

Dear Sir/Madam,

In my career - from which I am now retired - I held the position of 'Group Quality Control Director' [redacted]. I was responsible for international technical audits to ensure mitigation against 'Errors & Omissions'. I served as both a Chartered Insurance Practitioner and Qualified Lead Assessor BS/EN/ISO 9001.

My audit experience spanned more than 20 years. In that time, I identified significant technical errors in need of correction. These errors needed to be fixed - to avoid potential legal claims against the company. Furthermore, I successfully led several corporations in the research, development and implementation of systems and controls necessary to meet the requirements of BS/EN/ISO: 9001.

I am relatively at ease with the A12 Chelmsford to A120 widening scheme when taken in the round. I have grave concerns however, about the proposed widening of the A12 through the village of Hatfield Peverel. Geographically, Hatfield Peverel straddles this major trunk road.

Widening of the A12 will have a negative impact on human health. I believe that the proposal may constitute a breach of Human Rights. The starting point is that we are all entitled to breathe clean air. In a report to the Human Rights Council of United Nations General Assembly, Special Rapporteur Dr David R Boyd succinctly states:

'Surely if there is a human right to clean water, there must be a human right to clean air. Both are essential to life, health, dignity and well-being'.[1]

The World Health Organisation further crystallises the point and states: 'Clean air is a basic human right'.[2] Alarmingly, existing air quality levels within Hatfield Peverel are already above the WHO Global Air Quality guidelines first published in 2005 and subsequently revised in 2017 and 2021.

Over the course of the various consultation stages, I have engaged extensively with National Highways. I have laid bare my concerns about the poor air quality in Hatfield Peverel.

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[1] Report of the Special Rapporteur, Dr David R Boyd, 'Issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment', Human Rights Council, United Nations General Assembly, fortieth session, 25th February - 22nd March 2019, agenda item 3, (UN, A/HRC/40/55, 8th January 2019), p 9.

[2] 'What are the WHO air quality guidelines? Improving health by reducing air pollution', article, World Health organisation (Online, [redacted]).

Representatives of National Highways have been helpful, polite and - to a degree - understanding. Drawing on my experience, reading and consultation I draw the conclusion the A12 widening through Hatfield Peverel will have a negative impact on the health, welfare and prosperity of parishioners.

I was informed by National Highways that alternative routes - by-passing Hatfield Peverel - were considered at the initial scoping stage. These by-pass options were dismissed due to financial cost and environmental harm. I am unable to identify any report that supports an assessment on human health impact. I suggest this is a flaw, key work that has not been undertaken.

The *A12 Chelmsford to A120 Widening, Options Assessment Report* (March 2016) is out-of-date. Since the report's publication (six years ago), there has been several new housing developments in the area. The rolling out of residential building schemes are a material consideration. They merit being factored into the equation when deciding on local air quality impact. Paragraph 3.5.1 of the *Options Assessment Report* states of air quality:

'There are no air quality management areas (AQMA) declared along this section of the A12; the nearest AQMA is in Chelmsford, declared for annual NO2 (DEFRA, 2015). Potential sensitive receptors to air quality are residential properties in Boreham, Hatfield Peverel, Witham, and Rivenhall End. Chipping Hill Primary School is located approximately 200m from the A12 north-east of junction 21'.[3] This needs to be considered in a health impact assessment.

The *A12 Chelmsford to A120 Widening Scheme Assessment Report* (2017) identifies two areas along the A12 where legal limits have been breached in past years. Paragraph 8.2.1 of the *Assessment Report* states of air quality and greenhouse gases:

'Braintree District Council currently monitors nitrogen dioxide (NO2) at various locations across the district, using passive diffusion tubes. There are two monitoring sites located along the A12. A monitoring site at A12 Hatfield Peverel is located 90m to the north of the A12 carriageway. The 2014 NO2 annual mean concentration at this location was 47.7µg/m³, exceeding the relevant air quality objective (AQO) of 40µg/m³. A monitoring site at A12 Rivenhall is located at the eastbound of the A12 carriageway (London Road). The 2014 NO2 annual mean concentration at this location was 52.1µg/m³, also exceeding the relevant AQO'.[4]

The *A12 Chelmsford to A120 Widening Scheme Assessment Report* (2017) confirms that NO2 levels recorded by the diffusion tube at Hatfield Peverel were above the legal limit. The other tube in excess of the legal limit was at Rivenhall (again on the A12). Interestingly, a decision has been made to divert the route round Rivenhall to improve the air quality for residents. This begs the questions: 'Why adopt this approach for Rivenhall and not Hatfield

[3] Highways England, *A12 Chelmsford to A120 Widening Scheme Assessment Report, Options Assessment Report* (HE, March 2016) p 31.
[4] Highways England, *A12 Chelmsford to A120 Widening Scheme Assessment Report* (HE, 2017) p 35.

Peverel?' 'Do residents of Hatfield Peverel possess a lesser claim on the right to breathe clean air?'

There is today greater public awareness on the health risks associated with poor air quality through NO2 and Particulate Matter (PM). Government recognises the significant risk to public health through PM exposure. This is addressed in the Clean Air Strategy (2019).[5] DEFRA's policy aims to reduce the number of residents exposed to PM above the WHO guidelines. The A12 widening scheme - if approved - would fall foul of the government's own Clean Air Strategy.

Recent planning applications have included air quality assessments which tested air quality at receptor locations throughout the village. These assessments identified existing annual mean air pollution levels of between 13-34 for N02, 18-20 for PM10 and 12-14 for PM 2.5 (all figures shown are based on micrograms per cubic metre). These calculations did not factor in predicted increases of lorry and car movement through the A12 (once widened) or traffic from the new garden communities in neighbouring Maldon district. What is certain is that all of these assessments would fail the WHO guidelines (2021).[6] Relevant planning applications are 16/01813/OUT and 16/02096/OUT (Braintree District Council).[7]

Comparisons between developer assessments and National Highways come with a muted *caveat*. On balance, methodologies employed might not be directly comparable. However, this polite *caveat* does not extend to the actual results. These throw up staggering variations. Results of PM 2.5 and PM 10 by National Highways emerge vastly better than assessments done on behalf of developers.

Receptor point R 35 is a case in point. National Highways calculations for PM 2.5 is 10.5 micrograms per cubic metre. Developer calculations is 14.5 micrograms per cubic metre. PM 10 at R35 is also instructive. National Highway's calculations come out at 17 micrograms per cubic metre. Developer calculations come out at 21 micrograms per cubic metre.

Again, these anomalies are startling. Developer reports (16/01813/OUT and 16/02096/OUT, BDC) indicate a worsening of air quality on the back of their respective development schemes. It is unclear what modelling inputs were applied by National Highways. And it begs the question: 'Do National Highway's results reflect best outcomes only?' What is certain is that these inconsistencies merit robust scrutiny within the context of the proposed A12 widening programme before any conclusions on the scheme can be made.

In all but 2 locations out of 23 receptor points, National Highway's calculations show a degree of deterioration over time in respect of PM 2.5 and PM 10 respectively, through increased traffic. And just one improvement for NO2. National Highways suggest that traffic from Maldon going west to Chelmsford/London will indiscriminately head Witham-bound.

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[5] Department for Environment, Food & Rural Affairs, *Clean Air Strategy 2019*, (DEFRA, 2019).

[6] 'What are the WHO air quality guidelines? Improving health by reducing air pollution', article, World Health organisation (Online, [redacted]).

[7] 16/01813/OUT, Land south of Stonepath Drive, Hatfield Peverel, Essex; & 16/02096/OUT, Land at Station Road, Hatfield Peverel, Essex (Braintree District Council).

This is an over-optimistic paradigm, in my opinion. It fails to factor in a longer journey time with increased fuel costs. Instead I suggest it is obvious London-bound traffic will head west through intermediate residential villages and proposed traffic calming measures in Hatfield Peverel will not deter drivers from taking this route.

National Highway's reports suggest that Receptor points P10 and R42 will show improved air quality. This is a mystery as both receptors are at the junction end of Maldon Road / The Street. It seems irrational to hypothesise that more traffic will result in better air quality at this busy junction. This theory might not stand up to scrutiny when stress tested. It relies upon limited road layout enhancements - made in the hope that they will reduce stacking.

To understand the risks associated with exposure to poor air quality, I attach copies of three reports published by the Committee on the Medical Effects of Air Pollutants (COMEAP). The reports demonstrate - via tangible evidence - the true cost of this matter. Findings in the reports by COMEAP show that people exposed to pollution levels above WHO guidelines are likely to experience serious health issues - oftentimes life limiting and debilitating. Families are in many instances left to come to terms with the premature death of a loved one. And of course, an inordinate financial burden is thereby placed on an already over-stretched National Health Service (NHS).[8]

[redacted] Having lived in Hatfield Peverel near the A12 since 1982, there is little doubt in my mind as to the source of pollution.

New information has come to light since the A12 Chelmsford to A120 widening scheme was first proposed. Evidence-based *communiqué* are material considerations. These sources help us better understand the impact of poor air quality on public health since the scheme was first considered. Facts have been disclosed on a global platform (eg UN), in the media (eg responsible journalism) and at governmental advisory level (eg COMEAP). His Royal Highness, Prince William, The Duke of Cambridge remarks:

'The World Health Organisation calls air pollution the silent killer … Air pollution is proven to shorten our lifetimes and it hits the vulnerable, children and elderly hardest of all'.[9]

House of Lords proposed legislation is being drafted in the way of the Clean Air (Human Rights) Bill.[10] At the time of this submission (August 2022) the bill has passed its second

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[8]Committee on the Medical Effects of Air Pollutants, 'Statement on quantifying mortality associated with long-term exposure to PM 2.5', report, (COMEAP, January 2022); Committee on Medical Effects of Air Pollutants, 'Statement on update of recommendations for quantifying hospital admissions associated with short-term exposure to air pollutants', report (COMEAP, January 2022); & Committee on the Medical Effects of Air Pollutants, 'Advice on health evidence relevant to setting PM 2.5 targets – update', report, (COMEAP, January 2022).

[9] The Earthshot Prize: Repairing Our Planet, documentary, 'Clean our air', series 1:3, BBC, 3rd October 2021.

reading. It is now entering committee stage in the chamber of the House of Lords. The bill recognises WHO air quality guidelines and calls for a tough legal requirement for these targets to be met within 5 years. In the event of the Clean Air (Human Rights) Bill achieving royal assent and being enshrined in legislation - the A12 widening scheme would not be approved.

Decision makers will be aware of the Inquest into the tragic death of Ella Adoo-Kissi-Debrah. This case is a key determinant when considering the outcome of this A12 widening application. The coroner's report into the death of Ella - a little girl, 9 years of age - makes for sombre reading. It is best summarised by Blackstone Chambers as follows:

'Report to Prevent Future Deaths

21 Apr 2021

Following a landmark ruling in December 2020, H.M. Assistant Coroner for Inner South London, Philip Barlow, today issued a Report to Prevent Future Deaths (PFD), following the inquest into the death of Ella Adoo-Kissi-Debrah. In a legal first, the Coroner had concluded that "air pollution exposure" was a cause of Ella's death.

The PFD Report constitutes a further notable development of the law with the Coroner concluding that "there is a risk that future deaths could occur unless action is taken". The Coroner has urged 14 individual institutions, including central government departments, to implement changes to prevent further lives being endangered.

The Coroner's "Matters of Concern" were as follows:

1. The national limits for Particulate Matter are set at a level far higher than the WHO guidelines. The Coroner recommended that legally binding targets based on WHO guidelines would reduce the number of deaths from air pollution in the UK.

2. There is a low public awareness of the sources of information about national and local pollution levels. The Coroner has called on national as well as local government to better publicise this information and ensure it is "sufficiently detailed". He also concluded that "this is likely to require enlargement of the capacity to monitor air quality, for example by increasing the number of air quality sensors".

3. The adverse effects of air pollution on health are not being sufficiently communicated to patients and their carers by medical and nursing professionals. The Coroner concluded that

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[10] Clean Air (Human Rights) Bill (HL), A bill to establish the right to breathe clean air; to require the Secretary of State to achieve and maintain clean air in England and Wales; to involve the Health Security Agency in setting and reviewing pollutants and their limits; to enhance the powers, duties and functions of various agencies and authorities in relation to air pollution; to establish the Citizens' Commission for Clean Air with powers to institute or intervene in legal proceedings; to require the Secretary of State and the relevant national authorities to apply environmental principles in carrying out their duties under the Act and the clean air enactments; and for connected purposes', Private Members Bill starting in the House of Lords, (last updated, 10th July 2022).

this needed to be addressed through changes to undergraduate and postgraduate training, as well as professional guidance'.[11]

Environment Act (2021) has now received royal assent - thereby enacted and enshrined in law.[12] A key target is to meet PM 2.5 limits of 10 micrograms per cubic metre by no later than 2040. Many experts suggest the legal limit goal should be as early as 2030.

As intimated above a disparity between reports by National Highways and that of developers emerged. Another inconsistency that merits scrutiny against perimeters set by the Environment Act (2021). Developer reports show an upward trajectory of PM 2.5 yet National Highways suggest it will reduce. It seems absurd that a reduction in PM 2.5 will run parallel with increased traffic volume. To a layman, the calculated increase in traffic movement by National Highways, not least lorries, will result in more PM2.5 and PM 10 in the atmosphere. It impedes any meeting of the legal target of 2040 (let alone 2030) as set by the Environment Act (2021).

The point of the A12 Chelmsford to A120 widening scheme is to improve movement of freight between ports - eg Dover to/from Harwich/Felixstowe - by way of lorry transport. This will increase the vehicular capacity of this major trunk road. Pure logic shows that the scheme will lead to a deterioration of air quality in Hatfield Peverel - a settlement that straddles the A12.

It is not necessary to establish the degree of harm that will arise through more lorry and car use through / adjacent to Hatfield Peverel. Pollution levels are already above acceptable levels as set out above and validated by two independent developer reports (16/01813/OUT and 16/02096/OUT, BDC).

National Highways fails to offer a defence that - even after mitigation - there will be no deterioration of air quality at Hatfield Peverel. The statutory consultee is pressing ahead on the basis that this scheme represents the most cost-effective outcome and generates significant economic benefits. If these perceived benefits are so great, it again begs the question: 'Why was an alternative route by-passing Hatfield Peverel taken off the table?'

National Highways are not offering any assurance that there will be no expected increase in health risks and deaths to residents in Hatfield Peverel. National Highways attest that as the scheme is within the old/existing legal limits it is legally compliant. Therefore, the statutory consultee does not acknowledge a compelling duty to study the obvious health risks to residents. The new Clean Air (Human Rights) Bill we add certainty on the legal position, although many advocates would argue that the human rights position is already clear.

The decision-maker might well be advised to reflect on the definition of 'corporate manslaughter' as offered by Ashmans Solicitors:

[11] Ravi Mehta, article, Blackstone Chambers 'Inquest into the death of Ella Adoo-Kissi-Debrah, report to prevent future deaths', (Blackstone Chambers, 21st April 2021).
[12] Environment Act (2021), 2021 chapter 30, 9th November 2021.

‘Corporate manslaughter is when a business or organisation is responsible for another person’s death’.[13]

In my opinion, there appears sufficient evidence pointing to the scheme being driven by economic benefit - without sufficient assessment of public health risk to residents in Hatfield Peverel. Is National Highways showing sufficient duty of care where Hatfield Peverel is concerned? Reports from COMEAP confirm that there is a significant health risk based on the modelled pollutant levels.

In conclusion, the ‘A12 Chelmsford to A120 Widening’ proposal falls foul of DEFRA’s Clean Air Strategy (2019); the Environment Act (2021); and emerging legislation of the Clean Air (Human Rights) Bill in the House of Lords. Demonstrable evidence shows that the scheme poses a risk to the health, welfare and prosperity of residents living in Hatfield Peverel. The proposed widening could become acceptable by revisiting alternative routes that by-pass Hatfield Peverel.

As Dr David R Boyd, Special Rapporteur succinctly states in a report to the Human Rights Council of United Nations General Assembly:

‘Fulfilling the right to breathe clean air will require action at the household, local, national, regional and international levels’.[14]

Attachments:

Committee on the Medical Effects of Air Pollutants, ‘Statement on quantifying mortality associated with long-term exposure to PM 2.5’, report, (COMEAP, January 2022).

Committee on Medical Effects of Air Pollutants, ‘Statement on update of recommendations for quantifying hospital admissions associated with short-term exposure to air pollutants’, report (COMEAP, January 2022).

Committee on the Medical Effects of Air Pollutants, ‘Advice on health evidence relevant to setting PM 2.5 targets – update’, report, (COMEAP, January 2022).

Clean Air (Human Rights) Bill (HL), A bill to establish the right to breathe clean air; to require the Secretary of State to achieve and maintain clean air in England and Wales; to involve the Health Secretary Agency in Setting and reviewing pollutants and their limits; to enhance the powers, duties and functions of various agencies and authorities in relation to air pollution; to establish the Citizens Commission for Clean Air with powers to institute or intervene in legal proceedings; to require the Secretary of State and the relevant national authorities to

[13] Ashmans Solicitors, article, ‘What is corporate manslaughter?’ (Online, Ashmans Solicitors).
[14] Report of the Special Rapporteur, Dr David R Boyd, ‘Issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment’, Human Rights Council, United Nations General Assembly, fortieth session, 25th February – 22nd March 2019, agenda item 3, (UN, A/HRC/40/55, 8th January 2019), p 7.

apply environmental principles in carrying out their duties under this Act and the clean air enactments; and for connected purposes, Private Members Bill starting in the House of Lords, (last updated, 10th July 2022).

DOCUMENT ENDS

Committee on the Medical Effects of Air Pollutants

Statement on quantifying mortality associated with long-term exposure to PM

COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

Committee on the Medical Effects of Air Pollutants

Statement on quantifying mortality associated with long-term exposure to $PM_{2.5}$

Summary

1. Quantification of the health impacts of reductions in air pollution provides an important input to policy development. Recommendations for quantification typically consist of a concentration-response function (CRF) representing the relationship between a pollutant and an adverse effect on health, along with advice on how this should be applied. This statement updates COMEAP's recommendations for quantifying mortality associated with long-term exposure to fine particle air pollution ($PM_{2.5}$) in outdoor air.

2. The CRF recommended for use is 1.08 (95% CI: 1.06, 1.09) per 10 μg/m^3 annual average $PM_{2.5}$. This is a summary effects estimate from a meta-analysis of the available global literature by Chen and Hoek (2020). The use of a cut-off value for quantification is not recommended; it is recommended to assume continuing linearity[1] when quantification is performed down to very low or even zero $PM_{2.5}$ concentrations, for example when quantifying the mortality burden attributable to particulate air pollution. As some of the health effects of previous exposure could persist for some time, the full mortality benefits of reductions in concentrations of $PM_{2.5}$ are unlikely to be realised immediately. This delay in the reduction of mortality risk is known as the cessation lag. We recommend use of a cessation lag that assumes that 30% of the risk reduction occurs in the first year after pollution has reduced, 50% occurs across years 2 to 5 and the remaining 20% of the risk reduction is distributed across years 6 to 20 with smoothed annual values. This is the same lag structure that we have previously recommended (COMEAP, 2010).

3. We recommend that quantification using these methods should be accompanied by a discussion of the uncertainties. For example, it should be noted that the recommended CRF is not adjusted for effects of other pollutants[2], which means that:

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[1] Linearity on the log scale: log-linearity. Cohort studies of mortality typically relate the natural log of the hazard function to the concentration. In practice, for a small hazard ratio (as found in most air pollution studies) and over a small concentration range (as is usually the case in a health impact assessment) there is little difference between a linear and log-linear relationship. This might not be the case when larger concentration differences are being considered.

[2] There are a number of challenges in interpreting the results of 2-pollutant models. COMEAP (2018a; section 3.2.3) summarises the statistical issues as including: the lack of an interaction term; multi-collinearity (high correlations between pollutant concentrations); transfer of effect arising from exposure misclassification; and overlapping confidence intervals between coefficients reported from

a. mortality estimates will likely include effects caused by other correlated pollutants (such as NO_2) to some extent and
b. if mortality effects estimated using this coefficient are added to estimates of mortality effects associated with other pollutants, this will likely give an overestimate of the effects of the pollution mixture and of the benefits of reducing concentrations.

4. Appendix B presents COMEAP's views on studies in populations with low-level exposures and the shape of the concentration-response curve.

Introduction – background

5. Quantification of the health impacts of reductions in air pollution provides an important input to policy development. It is, for example, carried out as part of cost-benefit analysis (CBA), which values the costs and benefits associated with a given policy option (Defra, 2020). Recommendations for quantification typically consist of a concentration-response function (CRF) representing the relationship between a pollutant and an adverse effect on health, along with advice on how this should be applied. The CBA guidance, published by Defra with the endorsement of the Interdepartmental Group on Costs and Benefits (IGCB) Air, draws on COMEAP recommendations for quantifying health impacts of air pollutants, as well as recommendations made by other organisations. The public health burden associated with existing levels of air pollution can also be estimated (COMEAP, 2010; 2018a).

6. The Committee previously recommended an approach for quantifying mortality associated with long-term exposure to particulate air pollution in its reports on 'Long-term Exposure to Air Pollution: Effect on Mortality' (COMEAP, 2009) and 'Mortality effects of long-term exposure to air pollution in the UK' (COMEAP, 2010). More recently, the Committee revised its recommendation for the CRF to be used in its 'Statement on quantifying mortality associated with long-term average concentrations of fine particulate matter ($PM_{2.5}$)' (COMEAP, 2018b). The CRF recommended in the 2018 statement – 1.06 (95% confidence interval, CI: 1.04, 1.08) per 10 $\mu g/m^3$ $PM_{2.5}$ – was based on a meta-analysis of cohort studies of $PM_{2.5}$ and all-cause mortality by Hoek et al (2013).

7. More recently, the World Health Organization (WHO) has commissioned a number of systematic reviews and meta-analyses to inform the review of its Air Quality Guidelines. At its meeting in April 2020, the COMEAP Strategy Group agreed that these reviews might provide a useful basis for COMEAP to consider whether updates were required to some of the Committee's recommendations for quantification of health effects. The reviews undertaken for WHO have been published in a Special Issue of 'Environment International'.[3] At a similar time, Pope et al (2020) reviewed and compiled the findings of cohort studies on fine particulate air pollution and mortality.

single- and 2-pollutant models. In addition a coefficient for $PM_{2.5}$, even when adjusted for another pollutant (such as NO_2), likely reflects the effects of other pollutants which are more closely correlated with $PM_{2.5}$ than the other pollutant (NO_2 in this example) to some extent (COMEAP, 2018a table 7.1)

[3] Update of the WHO Global Air Quality Guidelines: Systematic Reviews

8. At the COMEAP meeting held on 11th November 2020, the Committee discussed whether these recently published reviews would provide a suitable basis for updating its recommendations for quantifying mortality associated with long-term exposure to fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2) and ozone (O_3).

9. After considering the systematic literature review commissioned by WHO to support the update of its global air quality guidelines (Huangfu and Atkinson, 2020), it was agreed that COMEAP would retain its current recommendations for quantifying mortality associated with long-term exposure to NO_2 and O_3 (CRFs and other aspects, such as cut-offs, cessation lags), as reported in the COMEAP reports on 'Associations of long-term average concentrations of nitrogen dioxide with mortality' (COMEAP, 2018a) and 'Quantification of mortality and hospital admissions associated with ground-level ozone' (COMEAP, 2015a). The Committee has recommended the use of a coefficient within the range of 1.006 to 1.013 per 10 µg/m^3 annual average NO_2 for the quantification of the mortality benefits of interventions that primarily target emissions of oxides of nitrogen (NO_x) and an unadjusted coefficient of 1.023 (95% CI: 1.008, 1.037) per 10 µg/m^3 annual average NO_2 for the assessment of the mortality benefits of interventions that reduce a mixture of traffic-related pollutants. Quantification is not recommended for mortality associated with long-term exposure to O_3.

10. The Committee agreed to set up a working group that would give further consideration to updating COMEAP's recommendations for quantifying mortality associated with long-term exposure to $PM_{2.5}$. The working group met in December 2020 and January 2021 and discussed how best to use the findings of the new reviews to update the quantification recommendations. The working group's recommendations were discussed by COMEAP's sub-group on the quantification of air pollution risks in the UK (QUARK) at its meeting on 5th February 2021 and the full Committee at the COMEAP meetings held on 8th March and 11th May 2021.

11. Specific questions that the working group were asked to consider are:

i). Do you consider that these reviews and meta-analyses provide a suitable basis for updating the Committee's recommendations for quantification of all-cause mortality associated with long-term average concentrations of $PM_{2.5}$?

If so:

ii). What (if any) single-pollutant CRF (and expression of uncertainty) would you recommend for quantification? Should a European or global CRF be chosen?

iii). What cut-off for quantification should be recommended, if calculations are to avoid extrapolation beyond the studied range of concentrations?

iv). What locations / scale of modelling might be most appropriate as the basis for application of these CRFs for quantification?

v). Consideration of an appropriate cessation lag to be used in quantification.

Current practice and recommendations

COMEAP's 2010 quantification of mortality associated with particulate air pollution

12. As well as specifying the CRF, COMEAP's recommendations for quantifying mortality associated with long-term average $PM_{2.5}$ concentrations address other methodological aspects. These are outlined in the report published by COMEAP in 2010 (COMEAP, 2010). We use the term 'cut-off' to refer to a concentration below which there is an absence of evidence for an effect either due to a complete absence of data, or because data are extremely sparse; this does not mean that there is no effect (if there is no threshold, then there will be some effects), just that there is uncertainty about its magnitude.

13. COMEAP recommended that calculations could be undertaken either by extrapolating to zero anthropogenic pollution or, to avoid extrapolation beyond the studied range of concentrations, by applying a cut-off for quantification of 7 $\mu g/m^3$, which represented the lower end of the range of concentrations studied (at that time) in epidemiological studies. COMEAP reported estimates using both of these approaches.

14. The term 'cessation lag' is used to denote the likely time lag between reductions in long-term average $PM_{2.5}$ concentrations and a consequent reduction in mortality risk. The cessation lag distribution used by the US Environmental Protection Agency (2004, 2011) was adopted by COMEAP's (2010) assessments of the mortality impact of reductions of $PM_{2.5}$ concentrations and recommended for subsequent use. This approach suggests that much of the reduction in risk occurs in the first 5 years after pollution concentrations are reduced.

15. Annual mean $PM_{2.5}$ concentrations at "background" sites[4] simulated by the Pollution Climate Mapping (PCM) model[5] at a spatial resolution of 1 km x 1 km across the UK were used by COMEAP (2010) in its calculations. This approach was considered to be a reasonable approximation to the exposure metric used in the epidemiological study from which the CRF was adopted.

16. This statement includes an updated consideration of these methodological aspects, as well as revised recommendations for the CRF itself.

Subsequent COMEAP consideration of particle metrics

17. The Committee has acknowledged that there are variations in toxicity between the various components of $PM_{2.5}$, but has concluded that the evidence available does not give a consistent view of relative toxicity (COMEAP, 2015b)[6].

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[4] Background sites as defined by the EU Ambient Air Quality Directive

[5] The Pollution Climate Mapping (PCM) model is an air pollution model that is calibrated using data from monitoring data at background sites in Defra's Automatic Urban and Rural Network (AURN). The PCM model simulated the annual average $PM_{2.5}$ concentrations used by COMEAP (2010, 2018) as the basis of its burden estimates

[6] COMEAP is currently reviewing the evidence for differential toxicity of PM according to source or components, with the intention of updating the Committee's views; finalisation of a revised statement on this topic is expected in 2022.

Also, more recently, COMEAP concluded that there was insufficient evidence to provide a quantitative comment on the risk arising from non-exhaust traffic particle emissions compared with ambient particles (COMEAP, 2020).

18. Despite changes in pollution composition over the last few years, the available epidemiological evidence base does not seem to suggest major changes in CRFs. Similarly, the summary CRF has remained similar despite the increasing number of different methods used to assign exposure in epidemiological studies – from a single monitor in a city to street-scale dispersion models. This suggests that $PM_{2.5}$ mass, even at relatively coarse spatial resolution, remains an effective metric for assessing population-scale health effects of particulate air pollution. Thus, $PM_{2.5}$ mass has remained the preferred metric for quantitative assessments of the health effects of exposure to particulate air pollution.

Multi-pollutant considerations

19. Because concentrations of different air pollutants are often strongly correlated, it is difficult to ascribe causality of associated health outcomes to individual pollutants within the air pollution mixture. When considering the many studies reporting associations of mortality with long-term average concentrations of NO_2, COMEAP (2018a) noted that associations of NO_2 with mortality likely represent a causal effect of NO_2 and also effects of closely correlated pollutants, including $PM_{2.5}$. Similarly, mortality effects associated with $PM_{2.5}$ are likely, in part, to represent the effects of other correlated pollutants (COMEAP, 2009), possibly including NO_2, as well as effects caused by particles. COMEAP (2018a) noted that, given the good evidence and plausibility of causality for $PM_{2.5}$, it was reasonable to regard the majority of the mortality effect associated with $PM_{2.5}$ as likely to be causally related to $PM_{2.5}$. Nonetheless, correlation between pollutants has implications for the interpretation and application of CRFs from epidemiological studies, which are discussed in COMEAP (2018a). A number of scientific and methodological challenges in understanding the extent of the independence of the associations of mortality with concentrations of NO_2 and $PM_{2.5}$ were also identified (COMEAP, 2018a). QUARK is currently undertaking work to consider the appropriate use of results of multi-pollutant models to inform approaches to quantification of effects associated with air pollutants. Therefore, we do not address this issue further in this statement, which focuses on recommendations for quantification using a CRF from single-pollutant models.

Recent systematic reviews, meta-analyses and studies

20. Chen and Hoek (2020) systematically searched MEDLINE and EMBASE from database inception (1966 for MEDLINE and 1974 for EMBASE) to 9 October 2018 for cohort and case-control studies on associations of $PM_{2.5}$ and PM_{10} with all-cause and cause-specific mortality. A random-effects meta-analysis was performed when at least 3 studies were available for a specific exposure-outcome pair. The authors also performed additional analyses to assess consistency across geographic region, explain heterogeneity and explore the shape of the CRF.

21. Pope et al (2020) reviewed previous cohort studies of mortality and fine particulate matter air pollution conducted in the US and other countries around the world from the last 25 years. The findings of these cohort studies were compiled and summarised using meta-analysis.

22. Vodonos et al (2018) undertook a systematic review and meta-analysis of cohort studies (indexed before April 21, 2017) which reported associations between long-term exposure to $PM_{2.5}$ and mortality. Multi-variate approaches to meta-analysis and meta-regression techniques were used to examine whether study characteristics modified the association between $PM_{2.5}$ and mortality, and to estimate the shape of the concentration-response curve.

23. As well as these reviews, studies in cohorts exposed to low levels of $PM_{2.5}$ are emerging. These have arisen from a Request for Applications (RFA) issued by the Health Effects Institute (HEI) on 'Assessing Health Effects of Long-term Exposure to Low Levels of Ambient Air Pollution'[7]. Three studies have been funded under this RFA and are currently underway:

- MAPLE: Mortality-Air Pollution Associations in Low Exposure Environments, Principal Investigator (PI) Michael Brauer, University of British Columbia, Canada. Identifying the shape of the association between long-term exposure to low levels of ambient air pollution and the risk of mortality: An extension of the Canadian Census Health and Environment Cohort using innovative data linkage and exposure methodology
- ELAPSE: an analysis of European cohorts Effects of Low-Level Air Pollution: A Study in Europe, PI Bert Brunekreef, University of Utrecht. Mortality and morbidity effects of long-term exposure to low-level $PM_{2.5}$, Black Carbon, NO_2 and O_3
- Assessing adverse health effects of long-term exposure to low levels of ambient pollution, PIs Francesca Dominici and Antonella Zanobetti, Harvard T.H. Chan School of Public Health

24. It should be noted that these HEI-funded studies, while clearly important, are still in-progress. The working group considered early findings from some of the studies, but its main focus was on available syntheses of the full published literature, rather than on individual studies.

Discussion

Comparison of reviews and selected coefficient

25. The Vodonos et al (2018) meta-regression analysis suggested that the effect estimate varied depending on the $PM_{2.5}$ concentration. COMEAP discussed this meta-regression, and other studies, when considering the shape of the exposure-response curve at low-level exposures. It did not consider the evidence sufficient, at this time, to recommend any change from the current assumption of a linear[1] CRF for use in quantification (see paragraph 37 and Appendix B), and therefore the Vodonos et al analysis was not considered further by the working group.

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[7] Assessing Health Effects of Long-term Exposure to Low Levels of Ambient Air Pollution

26. The 2 other reviews – Chen and Hoek (2020) and Pope et al (2020) – included 25 and 33 studies respectively in the main meta-analyses for the association between $PM_{2.5}$ and all-cause mortality, with 17 studies used in common in both analyses (Table A1, Appendix A). Although Pope et al included some additional studies in the meta-analysis, not all of these were based on exposure to $PM_{2.5}$; some examined associations with other particle metrics such as PM_{10} or total suspended particles.

27. Chen and Hoek (2020) undertook a domain-based risk of bias (RoB) assessment to evaluate all the studies included in their meta-analyses. This RoB assessment included evaluation of the exposure assessment. Chen and Hoek considered exposure assessment methods to be appropriate when studies had documented validity such as good agreement between model predictions and measurements.

28. A summary effects estimate of 1.08 (95% CI: 1.06, 1.09) per 10 $\mu g/m^3$ long-term average concentration of $PM_{2.5}$ was reported by Chen and Hoek (2020). Pope et al (2020) reported a similar summary effects estimate of 1.08 (95% CI: 1.06, 1.11) per 10 $\mu g/m^3$ long-term average concentration of $PM_{2.5}$ when including only "selected" studies [8] in the meta-analysis. A slightly higher summary effects estimate of 1.09 (95% CI: 1.07, 1.11) per 10 $\mu g/m^3$ $PM_{2.5}$ was obtained by Pope et al from a meta-analysis of all studies. We consider this latter meta-analysis to be less suitable as a potential basis for adoption as a CRF for quantification purposes than meta-analyses using studies selected for relevance to the general population and to avoid cohort overlap.

29. The review by Chen and Hoek was systematic, and followed a protocol developed by WHO. The paper provides more detailed information on the selection of studies for inclusion in meta-analyses than that by Pope et al. Furthermore, Chen and Hoek analysed a number of factors affecting the CRF, such as heterogeneity between studies, possible publication bias, the shape of the CRF and adjustment for other pollutants. Therefore, we regard the review by Chen and Hoek as a more suitable basis for updating COMEAP's recommendations.

European or global literature?

30. As well as meta-analyses of the global literature, both Chen and Hoek (2020) and Pope et al (2020) undertook meta-analyses restricted to studies in specific geographical regions. We discussed whether it might be appropriate to adopt a Europe-specific summary effects estimate for quantification of effects in the UK, rather than an estimate based on the global literature. Pope et al (2020) reported a summary effects estimate of 1.12 (95% CI: 1.06, 1.19) per 10 $\mu g/m^3$ $PM_{2.5}$ from a meta-analysis of 10 European studies. This included several studies which reported associations with particle metrics other than $PM_{2.5}$. Chen and Hoek (2020) combined the 5 European studies identified by their search and sifting, to produce an effects estimate of 1.07 (95% CI: 1.03, 1.11). As this estimate lies within the 95%

[8] Studies were selected to avoid using multiple studies of the same or similar cohorts (usually only the study with the largest and longest follow-up was used) and to exclude studies of cohorts which are not representative of the general population (for example studies undertaken in specific patient groups).

confidence intervals of the global summary estimate, it is not clear that the European effects estimate is significantly different from the global analysis. The authors noted that combined effects were similar across all 3 WHO regions where studies had been conducted, reducing concerns about the applicability of results from (in the past) primarily North-American studies to assess health risks in Europe and other regions.

31. Taking all these factors into account, we recommend adoption of the summary effects estimate of 1.08 (95% CI: 1.06, 1.09) per 10 μg/m^3 annual average $PM_{2.5}$ drawn from Chen and Hoek's (2020) global evidence base, for use in quantification.

Multi-pollutant analyses

32. COMEAP has previously highlighted the challenge of recommending concentration-response functions for the effects of individual pollutants in the face of the uncertainty in the interpretation of concentration-response functions from multi-pollutant models (COMEAP, 2018a). Chen and Hoek (2020) found that the summary effect estimates for the 5 studies reporting 2-pollutant results were reduced from 1.07 (95% CI: 1.05, 1.08) per 10 μg/m^3 for single-pollutant CRFs to 1.02 (95% CI: 1.00, 1.04) for CRFs adjusted for NO_2. We note that the sources and relative concentrations of pollutants differ considerably in Europe compared to US and other areas in the world, which might be important for the transferability of CRFs for $PM_{2.5}$ from elsewhere to the UK situation. While having made some progress on the topic of interpretation and use of CRFs from 2-pollutant models, QUARK considers that there is further work to be done before the challenges can be addressed quantitatively. Therefore, we have not considered pollutant adjustments when updating the recommended quantification method.

Cut-off values and shape of CRF

33. When quantifying health effects associated with air pollutants, COMEAP has previously chosen to undertake calculations using both a cut-off for quantification representing the lower end of the studied range and also by extrapolating to zero anthropogenic pollution (COMEAP, 2010; 2018a). COMEAP has regarded the portion of a burden estimate above the cut-off as that in which there is greatest confidence, while further extrapolation to zero estimates the additional effect that is likely under an assumption of the same concentration-response relationship down to zero anthropogenic pollution.

34. The use of the anthropogenic fraction of particulate pollution, rather than total particulate pollution, was because anthropogenic particulate matter can be considered as the theoretical maximum that could potentially be influenced by policy interventions.[9] However, the concentration of $PM_{2.5}$ corresponding to zero anthropogenic pollution is not straightforwardly defined in practice. The concentrations of $PM_{2.5}$ derived from sources that might initially be considered 'natural' are also affected by anthropogenic activities: for example, both wind-blown

[9] The air pollution indicator currently included in the Public Health Outcomes Framework (PHOF) – the fraction of mortality attributable to particulate air pollution – is based on the levels of anthropogenic particulate air pollution.

dust and emissions of biogenic volatile organic compounds from vegetation (precursors of secondary organic aerosol) are influenced by the cultivation of crops. Primary biological material (for instance, pollen), natural dust from arid areas and sea salt might be considered non-anthropogenically derived particles but may also act as carriers of toxic anthropogenic emissions. However, many of these latter particles may be too coarse to appear in the $PM_{2.5}$ size fraction, meaning that the non-anthropogenic proportion of $PM_{2.5}$ may be very small. In addition, it may be difficult to accurately and unambiguously quantify concentrations of non-anthropogenic $PM_{2.5}$ to enable its subtraction from total $PM_{2.5}$ mass concentration, in order to estimate the anthropogenic fraction. This relies on accurate 'mass closure' of $PM_{2.5}$ in the available measurements or models. In practice, sea salt is the only one of these components that can be easily identified for exclusion. Recent assessments from the PCM model[5] are that the contribution of sea salt to UK population-weighted annual mean $PM_{2.5}$ in 2018 and 2019 is of the order of 0.5 μg/m^3 (Brookes et al, 2020; 2021). The outputs from the PCM model are calibrated against the AURN[10] data using a 'residual'. This residual represents the contribution from sources that are not explicitly included in the model, and is also assigned as non-anthropogenic (along with the sea salt). However, in recent years, a residual has not been needed to calibrate the model (the residual has been zero) as a result of improved emission inventories and modelling methods.[11]

35. If a cut-off for quantification were to be selected, the range of concentrations which has been studied needs to be considered. Previously, the cut-offs for quantification used for estimating the annual UK mortality burden attributable to the current air pollution mixture were 7 μg/m^3 for $PM_{2.5}$ and 5 μg/m^3 for NO_2 (COMEAP, 2018a). Recent studies have included cohorts exposed to $PM_{2.5}$ concentrations lower than 7 μg/m^3 meaning that this cut-off no longer seems appropriate. In addition, policies implemented in recent years have led to improvements in air quality meaning that this cut-off would be relevant to estimates of the impacts of further interventions, as well as to burden estimates (Dajnak et al, 2020). The concentrations experienced by cohorts in the available epidemiological studies vary considerably. Table A2 (Appendix A) provides information on the range of concentrations in the studies included in the meta-analysis of $PM_{2.5}$ and all-cause mortality by Chen and Hoek (2020). Some studies do not report the distribution of exposure values but only mean (or median) values. The lowest value reported as a 5th percentile of population exposure from the studies included in the Chen and Hoek meta-analysis was 3 μg/m^3 from Pinault et al (2016) (the study contributed 3.40% of the weight to the meta-analysis). Hence, the current evidence demonstrates associations between mortality and $PM_{2.5}$ concentrations considerably lower than previously.

36. We acknowledge the considerable uncertainties involved in extrapolating above the range of studied concentrations. However, there is less uncertainty when extrapolating below studied concentrations: this can be regarded as interpolation between the studied effects and there being zero effects at zero exposure.

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[10] The Automatic Urban and Rural Network (AURN) is the UK's largest automatic monitoring network and is the main network used for compliance reporting against the Ambient Air Quality Directives.
[11] If a small residual is required, in the future, to calibrate the PCM model, regarding this as non-anthropogenic would be consistent with current practice.

37. QUARK has discussed studies in populations with low-level exposures. A summary of QUARK's views on these studies, and the shape of the CRF, is attached (Appendix B). Some primary studies, as well as reviews/meta-regressions, have suggested that the exposure-response function might be supra-linear (that is, with a bigger effect, per unit change in concentration, at lower exposures than higher exposures). However, it is not clear to what extent these results may be due to differences in populations and/or the statistical methods used. Therefore we do not consider the evidence sufficient, at this time, to recommend any change from the current assumption of a linear[1] CRF relationship when quantifying the effects associated with long-term exposure to $PM_{2.5}$, particularly as a supra-linear CRF could have important implications for quantification (see Appendix B). QUARK recognises the importance of these issues and intends to keep the literature on this topic under review, and will continue to explore relevant methodological issues, as part of its future work programme.

38. Therefore, we consider that the most appropriate approach to quantification of the mortality effects associated with long-term average concentrations of $PM_{2.5}$, based on the current evidence and methodological understanding, is to extrapolate to low or zero $PM_{2.5}$ using an assumption of continuing linearity.[1] This recommendation takes into account the uncertainties in attributing $PM_{2.5}$ to anthropogenic or non-anthropogenic sources, the low concentrations which have now been studied and the fact that extrapolation below these low concentrations is unlikely to introduce more error than would result from restricting quantification to the studied ranges. This is particularly the case for CBA where quantification of the population exposed above and below a (necessarily arbitrary) cut-off could be a major sensitivity for the analysis, given uncertainty in exposure assessment. For the reasons discussed above we think that it would be appropriate, when conducting health impact assessments or CBA, to assume continuing linearity[1] even at very low exposures. If a sensitivity analysis of estimates obtained without extrapolation is required, the information on the lower ends (such as 5th percentiles) of exposure ranges in Table A2 might provide an appropriate basis for selecting a cut-off for quantification. We note that the recently updated WHO air quality guideline (5 $\mu g/m^3$) for long-term exposure to $PM_{2.5}$ was derived from the average of the 5th percentiles of exposures in studies which reported associations with mortality in populations exposed to low levels of pollution.

39. Similarly, we also think it would be appropriate to extrapolate using an assumption of continuing linearity[1] to zero $PM_{2.5}$ when estimating mortality burdens associated with long-term average $PM_{2.5}$ concentrations. We note that this is a change from previous and current practice (for example COMEAP, 2010; 2018a,b and PHOF air pollution indicator[9]). The use of other counterfactuals might be appropriate in some situations, depending on the aims of the burden estimate. For example, there might be interest in estimating the burden attributable to PM arising from specific activities or sectors, or by concentrations exceeding guidelines or regulatory limit values. A sensitivity analysis of an estimate without extrapolation beyond the studied range could also be made, if desired. Again, the information on the lower ends of exposure ranges in Table A2 might provide an appropriate basis for selecting a cut-off for quantification in this case.

Cessation lag

40. There is likely to be a lag between exposure to pollution and consequent adverse health effects such as mortality (inception lag). Similarly, cessation lag is a term used to denote the time pattern of reductions in mortality risk following a reduction in pollution. We recommend continuing to use the cessation lag recommended by the US Environmental Protection Agency (US EPA), as described in US EPA (2004; 2011) and COMEAP (2010). According to this, 30% of the risk reduction occurs in the first year after pollution reduction, 50% occurs across years 2 to 5 (12.5% per year) and the remaining 20% of the risk reduction is distributed across years 6 – 20 with smoothed annual values. These 3 components of the lag distribution were suggested to reflect short-term, cardiovascular, and lung cancer effects, respectively.

41. Some UK studies have suggested that a small element of the estimate for black smoke has similar (Elliott et al, 2007 (12 to 16 years)) or longer (Hansell et al, 2016 (>30 years)) lags than previously considered. Pollution levels were reducing considerably over the time of these studies, so this may reflect a mixture of inception and cessation lags. We have decided to retain the recommendation to use the US EPA lag at the current time, but plan to keep information relating to lags (including mechanistic information) under review.

42. In COMEAP (2010), the evidence on cessation lag was reviewed thoroughly (summarised in Table 16 of the COMEAP (2010) working paper 'COMEAP: development of proposals for cessation lags for use in total impact calculations'). Various alternative lag structures were explored based on evidence in the literature and it was concluded that a categorical evidence-based choice between them was not possible. Sensitivity analyses were undertaken to understand the possible influence of alternative lag structures on the results of health impact assessments, using a range from no lag to a 30-year phased-in lag. In assessments of the mortality impact over the 106 years[12] following reductions in $PM_{2.5}$ concentrations, the cessation lag was found to have much less influence on estimated benefits (an 11% reduction using the 30 year phased-in lag compared with benefits estimated using the US EPA cessation lag structure) than assumptions about economic discounting (which ranged from a 55% reduction for a discount rate of 1.5% to a 91% reduction for a discount rate of 6%, compared with no discounting).[13]

43. Therefore, when assessing mortality benefits, the relative influence of the cessation lag chosen will be affected by the length of time period considered and the discount rate used. Where assessments are concerned with the mortality benefits that accrue over a short (20 to 30 year) time period after pollution concentrations are reduced, the choice of cessation lag will have more influence – and discount rate less influence – than for assessments of benefits over 106 years.

[12] It is common practice to use a follow-up period of 106 years which is a period long enough to allow the current population to die out. This ensures that the full extent of mortality benefits to those alive at the time of the intervention is reflected in the assessment.
[13] Weighting factors are commonly used in cost-benefit analyses to discount future mortality impacts in economic terms. For health effects, this discounting largely reflects Social Time Preference Rates, STPR (see for example The Green Book: appraisal and evaluation in central government).

44. The influence of the cessation lag was also found to be small compared with the uncertainty around the CRF that was used in COMEAP's (2010) estimates. The uncertainty around the summary effects estimate from the meta-analysis by Chen and Hoek (2020), which is the basis of our current revised recommendation, is much less. This means that the possible influence of the cessation lag is, therefore, relatively larger in comparison with the uncertainty around our new recommended CRF, but is still small compared with the likely influence of discounting in economic analysis.

Exposure assessment – spatial scale

45. The scale, and locations, of the pollutant modelling used as the basis for predicting health impacts of interventions, or estimating burdens, might have an important influence on the results[14] (COMEAP, 2018a; Maiheu et al, 2017). Therefore, specification of the exposure assessment characteristics (such as spatial scale of modelling, location of measurement points) for application of the CRFs for quantification might be required. In principle, it would seem desirable to use exposures that reflect the exposure assessments used in the studies from which the CRF is derived. However, the different epidemiological studies use a variety of exposure assessment methods: methods include exposure assigned to the nearest monitoring station, land use regression and dispersion models; spatial scales vary from residential address to US county.

46. The studies contributing to the Chen and Hoek summary estimate were not dominated by studies using exposure metrics of one particular spatial scale. This means that it is not possible to recommend a particular spatial scale for use in health impact assessment or burden estimates. The authors did not stratify studies of the exposure metric to assess whether the coefficient varied by spatial scale. Although there was heterogeneity across the reviewed studies, this could be due to a number of factors in addition to exposure assessment, such as differences in methods, the concentration and composition of PM, population, geographic location and time period. The factors which drive heterogeneity in reported associations of health effects with air pollutants is an issue currently being considered by QUARK. However, this work is on-going.

47. We note that spatial scale of exposure assessment is likely to have a less important influence on quantification of effects associated with $PM_{2.5}$ than for NO_2, as it is less spatially variable. Nonetheless, very broad spatial scales (for example, 10 km by 10 km and above), are unlikely to pick up variations in $PM_{2.5}$ from locally emitted sources, which would likely have been reflected in the exposure metrics for many of the studies included in Chen and Hoek's meta-analysis.

Estimation of mortality burdens and interpretation of "attributable deaths"

48. We anticipate that the main use of our recommendations will be in assessing the impacts of the mortality benefits of reducing concentrations of $PM_{2.5}$, for example in cost-benefit analyses of policies and interventions. However, CRFs can also be

[14] Finer scale modelling is likely to lead to greater exposure contrasts and reduced misclassification of exposures. It may also indirectly represent other pollutants to a greater degree than broader scale modelling.

used to estimate the mortality burden associated with long-term exposure to current levels of air pollutants. COMEAP has discussed appropriate methods for this in its previous reports (COMEAP, 2010; 2018a).

49. The interpretation of mortality burden estimates is also discussed at some length in both of these reports. COMEAP (2018a) explains why we consider it more appropriate to estimate the mortality burden of an air pollution mixture, rather than attempting to attribute the burden to specific pollutants. COMEAP (2010) discusses how to interpret estimates of the annual number of “attributable deaths” associated with long-term average concentrations of pollutants. This is not an estimate of the number of people whose untimely death is caused entirely by air pollution. Instead, it is a way of representing the effect of air pollution across the whole population: air pollution is considered to act as a contributory factor to many more individual deaths. This is why we recommend expression of the results of burden estimates as “an effect equivalent to a specific number of deaths at typical ages”.

Main conclusions and recommendations

50. The main points covered in the statement are summarised below:

i. Our recommendations for quantification of mortality associated with long-term average concentrations of exposure to NO_2 and O_3 remain as before

ii. An updated CRF (and expression of uncertainty) from single-pollutant models is recommended for quantification of mortality associated with long-term average concentrations of $PM_{2.5}$: 1.08 (95% CI: 1.06, 1.09) per 10 µg/m^3 annual average $PM_{2.5}$. This is the summary effects estimate from a meta-analysis of the global literature by Chen and Hoek (2020)

iii. We do not recommend the use of a cut-off value for quantification. We suggest quantification to zero $PM_{2.5}$, using an assumption of continuing linearity[1]. The lowest value reported as a 5th percentile of population exposure in a study included in the meta-analysis from which the CRF is adopted is 3 µg/m^3 total (rather than anthropogenic only) $PM_{2.5}$. This, and other information on the range of exposures studied, might inform the choice of cut-off value for use in sensitivity analysis, if desired

iv. We recommend that the cessation lag developed by the US EPA, and used in our previous work (COMEAP, 2010), be used in assessments of the impact of reductions in $PM_{2.5}$. This assumes that 30% of the risk reduction occurs in the first year after pollution reduction, 50% occurs across years 2 to 5 (i.e. 12.5% per year) and the remaining 20% of the risk reduction is distributed across years 6 – 20 with smoothed annual values

v. Due to the different exposure methods used in the available epidemiological studies, we are not able to specify what spatial scale is most appropriate when applying this CRF for use in quantification. Nonetheless, we recommend that very broad spatial scales (for example 10 km x 10 km or higher) that are unlikely to reflect variations in $PM_{2.5}$ from local emission sources should be avoided if effects of local sources are the primary concern

vi. Quantifications made using these methods should be accompanied by a discussion of uncertainties. One of these uncertainties arises from the heterogeneity in associations reported in the available epidemiological studies. This heterogeneity is likely due to various factors, such as differences in methodology and exposure assessments, concentration and composition of PM, population, geographic location and time period. Another uncertainty relates to attribution of causality to exposure to particulate matter and other components of the air pollution mixture, given the correlation between $PM_{2.5}$ concentrations and those of other pollutants in the populations studied. It should be noted that the suggested coefficient is not adjusted for effects of other pollutants, which means that:
   a. mortality estimates will likely include effects caused by other correlated pollutants (such as NO_2) to some extent and
   b. if mortality effects estimated using this coefficient are added to estimates of mortality effects associated with other pollutants, this will likely give an overestimate of the effects of the pollution mixture and of the benefits of reducing concentrations.

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Committee on the Medical Effects of Air Pollutants

Statement on quantifying mortality associated with long-term exposure to $PM_{2.5}$

Appendix A

This appendix includes:

a. Table A1: Comparison of studies included in the meta-analyses by Chen and Hoek (2020) and Pope et al (2020) and
b. Table A2: Details of the studies included in the meta-analysis of $PM_{2.5}$ exposure and all-cause mortality by Chen and Hoek (2020).

Table A1. All-cause mortality and $PM_{2.5}$ – comparison of studies included in meta-analyses by Pope et al (2020) and Chen and Hoek (2020)

<u>Country</u>	<u>Cohort</u>	<u>Pope et al "selected"</u>	<u>Chen and Hoek meta-analysis</u>
<u>Americas</u>			
USA	Harvard Six Cities	Lepeule et al 2012	Lepeule et al 2012
	CA-CPS I	**Not included (no CA CPS I studies selected)**	**Enstrom et al, 2005**
	ACS CPS-II	**Pope et al 2015**	**Turner et al, 2016**
	AHSMOG	McDonnell et al 2000	McDonnell et al 2000
	US Medicare	Di et al, 2017	Di et al, 2017
	US Nurses (NHS)	Hart et al, 2015	Hart et al, 2015
	US California Teachers	Ostro et al, 2015	Ostro et al, 2015
	US Male Health Professionals	Puett et al, 2011	Puett et al, 2011
	US Truckers	Hart et al, 2011	Hart et al, 2011
	US Agricultural Health (AHS)	Weichenthal et al, 2014	Weichenthal et al, 2014
	US NIS-AARP	Thurston et al 2016	Thurston et al 2016
	US CA Elderly	**Garcia et al, 2016**	**Not included (not mentioned in the review)**
	US NJ Department of Health	**Wang et al, 2016**	**Not included (not mentioned in the review)**
	US National Health (NHIS)	**Pope et al, 2019**	**Parker et al, 2018**
	US Veterans	**Not included (not mentioned in review)**	**Bowe, 2018**
Canada	CanCHEC	**Crouse et al, 2015**	**CanCHEC 1991: Cakmak et al, 2018**
			CanCHEC 2001: Pinault et al, 2017
	Canada Breast Screening (CNBSS)	Villeneuve et al, 2015	Villeneuve et al, 2015
	Canada Com Health (CCHS)	Pinault et al, 2016	Pinault et al, 2016
<u>Europe</u>			
France	PAARC	**Filleul et al, 2005**	**Not included (not mentioned in review)**
	Electric and Gas (Gazel)	Bentayeb et al 2,015	Bentayeb et al, 2015
Germany	Urban Women	**Gehring et al, 2006**	**Not included (mentioned in review but not included in list of studies reporting association between $PM_{2.5}$ and all-cause mortality. PM_{10} was studied)**
Netherlands	NLCS-Air	Beelen et al, 2008	Beelen et al, 2008

Country	Cohort	Pope et al "selected"	Chen and Hoek meta-analysis
	DUELS	**Fischer et al, 2015**	**Not included (mentioned in review but not included in list of studies reporting association between $PM_{2.5}$ and all-cause mortality. PM_{10} was studied)**
England	Clinical Practice	Carey et al, 2013	Carey et al, 2013
Italy	Rome register/Rome longitudinal	**Cesaroni et al, 2013**	**Badaloni et al, 2017**
Spain	Small area	**Keijzer et al, 2017**	**Not included (Not mentioned in review).**
Denmark	DCH	**Hvidtfeldt et al, 2019**	**Not included (Mentioned as being published after the cut-off date for the review)**
Europe	ESCAPE	Beelen et al, 2014	Beelen et al, 2014
Asia			
China	Hypertension	**Cao et al, 2011**	**Not included (Not mentioned in the review. TSP studied)**
	Chinese Men	Yin et al, 2017	Yin et al, 2017
	CLHLS	**Li et al, 2018**	**Not included (Mentioned as being published after the cut-off date for the review)**
Hong Kong	Hong Kong Elderly	**Wong et al, 2015**	**Yang, 2018**
Taiwan	Taipei (Civil Servants)	Tseng et al, 2015	Tseng et al, 2015
Japan	Nippon	**Ueda et al, 2012**	**Not included (Mentioned in review but not included in list of studies reporting association between $PM_{2.5}$ and all-cause mortality. PM_7 was studied)**
Iran	Tehran	**Yarahmadi et al, 2018**	**Not included. (Not mentioned in the review). This appears to be a burden estimate using AirQ+ software)**
Number of papers included		**33**	**25**

Table A2. Details of studies on all-cause mortality and $PM_{2.5}$ included in the meta-analysis by Chen and Hoek (2020)

First author	Year of publication	Study name	Study period	Study location	Year of exposure	5-95th percentiles of population exposure	Mean concentration	Standard deviation	Median concentration
Badaloni	2017	Rome longitudinal study	2001-2010	Rome, Italy	2010	17.6-24.2	19.6	1.9	19.1
Beelen	2008	NLCS-AIR	1987-1996	the Netherlands	1987-1996		28.3	2.1	
Beelen	2014	ESCAPE	1990s-2008	Europe	2008-2011				
Bentayeb	2015	Gazel	1989-2013	France	1989		17	4.3	16.8
Bowe	2018	U.S. veterans	2003-2012	U.S.	2004	25-75th: 10.1-13.6			11.8
Cakmak	2018	1991 CanCHEC	1991-2011	Canada	satellite estimates for 1998-2011 assigned to each year for 1984-2011				
Carey	2013	English national cohort	2002-2007	England	2002		12.9	1.4	
Di	2017	Medicare	2000-2012	continental USA	2000-2012	6.21-15.64	11		
Enstrom	2005	CA CPS I	1973-2002	11 counties in California	1979-1983		23.4		
Hart	2011	trucking companies	1985-2000	continental USA	2000		14.1	4	
Hart	2015	NHS	2000-2006	U.S.	2000-2006		12	2.8	
Lepeule	2012	Harvard Six Cities	1974-2009	6 cities in U.S.	1979-2009		15.9		
Mcdonnell	2000	AHSMOG	1977-1992	California, USA	1973-1977		31.9	10.7	

First author	Year of publication	Study name	Study period	Study location	Year of exposure	5-95th percentiles of population exposure	Mean concentration	Standard deviation	Median concentration
Ostro	2015	California Teachers Study	2001-2007	California, USA	2000-2007	13.1-22.8 (25-75th)	17.9		18.2
Parker	2018	NHIS	1997-2011	US	2004	10-90%: 8.7-14.7			11.8
Pinault	2016	CCHS-Mortality Cohort	2000-2011	Canada	1998-2012 (3-yr avg. prior to follow-up year)	3.0-11.3	6.32	2.54	5.9
Pinault	2017	2001 CanCHEC	2001-2011	Canada	2004-2012 estimates extended to 1998-2010, 3-yr average prior to follow-up	3.51-11.97	7.37	2.6	7.12
Puett	2011	Health Professionals FollowUp Study	1986-2003	U.S.	12-month ave, before each outcome (1988-2002)		17.8	3.4	
Thurston	2016a	NIH-AARP	2000-2009	6 US states and Atlanta and Detroit	2000-2008	10.7-15.9 (20-80th)	12.2	3.4	
Tseng	2015	civil servants cohort	1989-2008	29 districts within the Greater Taipei, Taiwan	2000-2008	27.3-30.9 (20-80th)			
Turner	2016	ACS-CPS II	1982-2004	USA, esp. Iowa and North Carolina	1999-2004	8.2-17.1	12.6	2.9	12.5
Villeneuve	2015	CNBSS	1980-2005	Canada	1998-2006	6.4-12.4 (25-75th)		3.4	9.1

First author	Year of publication	Study name	Study period	Study location	Year of exposure	5-95th percentiles of population exposure	Mean concentration	Standard deviation	Median concentration
Weichenthal	2014	AHS	1993-2009	Iowa and North Carolina, USA	2001-2006 average		9.52	1.66	
Wong	2015	Hong Kong elderly	1998-2011	Hong Kong	2000-2011				35.3
Yang	2018	Hong Kong elderly	1998-2011	Hong Kong	moving ave. of con, one year before and one year after the recruitment date (baseline 1998-2001)				42.2
Yin	2017	Chinese men	1990-2006	45 districts in China	ave, between 2000 and 2005		43.7		

Committee on Medical Effects of Air Pollutants

Statement on update of recommendations for quantifying hospital admissions associated with short-term exposures to air pollutants

Committee on Medical Effects of Air Pollutants

Statement on update of recommendations for quantifying hospital admissions associated with short-term exposures to air pollutants

Summary

1. We are updating our recommendations for quantification of hospital admissions associated with short-term exposures to air pollutants, specifically particulate matter (PM), nitrogen dioxide (NO_2) and ozone (O_3). These recommendations are intended to inform cost-benefit analyses that will be undertaken to support the development of air quality targets under the Environment Act 2021 (formerly the Environment Bill 2020). We have therefore adopted an approach to evaluating the evidence which has allowed us to make revised recommendations in a timely manner.

2. We have examined recent meta-analyses of studies evaluating the associations between (total, all-cause) respiratory and cardiovascular hospital admissions and short-term exposures to PM, NO_2 and O_3. We consider summary effects estimates (coefficients) from single pollutant models derived in meta-analyses of the global literature, undertaken by St George's, University of London with funding from the Department of Health, as the most suitable for use as concentration-response functions to quantify hospital admissions associated with short-term exposures to air pollutants. These are summarised in the table below.

3. We recommend that the 24-hour effect estimates for NO_2 are used in health impact assessments of interventions to improve air quality. However, concentration-response functions for 1-hour average concentrations of NO_2 might be appropriate for some uses and therefore have also been included in the table.

4. Concentrations of $PM_{2.5}$ and NO_2 are often highly correlated, meaning that associations reported from epidemiological studies likely reflect the effect of both pollutants to some extent. Therefore, using coefficients for both $PM_{2.5}$ and NO_2 (for the same health end-point) within the same assessment would result in an over-estimation of the effect of the air pollution mixture, or of the benefits of interventions to reduce emissions. However, on balance, we consider that the coefficients for all-year O_3 are likely to be independent of those for either $PM_{2.5}$ or NO_2, meaning that that there is less concern about possible over-estimation when using them in a combined assessment. In addition, policy-makers should be aware that localised interventions designed to reduce NO_2 may have the unintended consequence of increasing localised concentrations of O_3.

5. In this statement, we also draw attention to the uncertainties regarding causality for some pollutant-outcome pairs, notably cardiovascular hospital admissions associated with NO_2; these uncertainties will need to be considered when deciding which pollutant-outcome pairs to include in core assessments or in sensitivity analyses.

Random summary effects estimates (95% confidence intervals) for the percentage increase per 10 μg/m^3 reported from meta-analyses of time-series studies

	Overall	**Reference**
$PM_{2.5}$		
Respiratory hospital admissions, all ages	24-hour: 0.96 (-0.63, 2.58)	Atkinson et al (2014) Table 3
CV hospital admissions, all ages	24-hour: 0.90 (0.26, 1.53)	Atkinson et al (2014) Table 3
NO_2		
Respiratory hospital admissions, all ages	24-hour: 0.57 (0.33, 0.82) 1 hour: 0.34 (-0.02, 0.7)	Mills et al (2015) Table S2
CV hospital admissions, all ages	24-hour: 0.66 (0.32, 1.01) 1 hour: 0.36 (-0.16, 0.89)	Mills et al (2015) Table S3
O_3		
Respiratory hospital admissions, all ages	Daily maximum 8 hour running mean 0.75% (0.30, 1.2)	Walton et al (2014)
CV hospital admissions, all ages	Daily maximum 8 hour running mean 0.11% (−0.06, 0.27)	Walton et al (2014)

Introduction

6. COMEAP last made recommendations for quantifying respiratory hospital admissions associated with short term exposure to particulate matter (PM) and nitrogen dioxide (NO_2) in 1998, and its recommendations for quantifying cardiovascular hospital admissions associated with short-term exposure to PM in 2001. In 2015, COMEAP updated its 1998 recommendations for quantifying respiratory hospital admissions associated with short-term exposure to ozone (O_3), and also made recommendations for quantifying cardiovascular hospital admissions.

7. Since COMEAP's 1998, and 2001 recommendations, in particular, a significant number of primary time series studies of hospital admissions associated with PM, NO_2 and O_3, have been published, as well as a number of meta-analyses. It is now considered timely for COMEAP to update its recommendations for quantification of hospital admissions, particularly to inform the cost-benefit analyses of interventions under consideration to support the development of air quality targets under the Environment Act 2021 (formerly the Environment Bill 2020).

Approach taken – review of the evidence

DH-funded systematic reviews by SGUL

8. The Department of Health previously supported the Committee's work programme on the health effects of short-term exposure to air pollution by funding St George's, University of London (SGUL) to undertake systematic reviews and meta-analyses of time-series studies on mortality and hospital admissions. The reviews cover studies published/indexed to May 2011 and focus on all-year, single pollutant model estimates from time-series studies on $PM_{2.5}$ (Atkinson et al, 2014); components of particles (nitrate (NO_3^-); sulphate (SO_4^{2-}); elemental carbon (EC) and organic carbon (OC); particle number concentrations (PNC), metals) (Atkinson et al, 2015); NO_2 (Mills et al, 2015); and O_3 (Walton et al, 2014)[1].

9. The reviews by SGUL provide an overview of the evidence for hazard and summary estimates calculated by meta-analysis for a range of cardiovascular and respiratory diagnoses in different age groups. An overview of evidence from different geographical regions is also provided. The reviews of associations with $PM_{2.5}$, fine particle components and NO_2 are published in the peer-reviewed literature. A systematic review and meta-analysis of the two-pollutant model evidence relating to short-term exposure to NO_2 adjusted for particles has also been published (Mills et al, 2016) but making recommendations which take into account multi-pollutant approaches and the extent of potential confounding is beyond the scope of our current considerations. The SGUL review on PM (Atkinson et al, 2014) covers associations with fine particles ($PM_{2.5}$) only. The SGUL reviews present summary effects estimates for mortality and hospital admissions for a range of specific respiratory and cardiovascular endpoints, as well as for hospital admissions for all cardiovascular and all respiratory conditions.

Other systematic reviews available and commentary

10. The quantification sub-group (QUARK), on behalf of COMEAP, undertook a systematic literature review to establish whether there were meta-analyses for all cause respiratory and all cause cardiovascular hospital admissions associated with short-term exposure to PM, NO_2 and O_3, that were more recent than the SGUL meta-analyses. In order to support QUARK's discussion of the available evidence, the Public Health England (PHE) library was asked to undertake a literature search to identify systematic reviews of epidemiological studies linking short-term exposure to air pollutants with hospital admissions. The Secretariat then conducted preliminary screening. The literature search terms used are presented in Annex A. The results of the search and screening are also illustrated within Annex A, as Figure 1.

11. The search and screening process identified a large number of systematic reviews of epidemiological studies of air pollution and hospital admissions. Some reviews focused either on individual components of PM, rather than $PM_{2.5}$, or on specific events such as wildfires or desert dust events. Many reviews were of studies of hospital admissions for specific health endpoints (such as asthma), rather than for the broader categories of cardiovascular or respiratory admissions which correspond

[1] This formed the basis of COMEAP's (2015) recommendations for O_3

to COMEAP's current recommendations. Others were exclusively of studies in specific geographical regions other than Europe. While these contribute valuable information – for example regarding causality – they were not considered to provide a suitable basis for updating COMEAP's current recommendations for quantification. Therefore, QUARK Members focused on the available systematic reviews of studies of PM_{10}, $PM_{2.5}$, NO_2 and O_3 and the overall categories of cardiovascular and respiratory hospital admissions, which drew on either the global literature or focused on studies in Europe.

12. Of the remaining seven reviews, three were SGUL DH-funded systematic reviews (Atkinson 2014, Mills 2015, Mills 2016)[2]. The other four systematic reviews, and QUARK's views on their suitability as a basis for updating our recommendations, are summarised below.

13. Ji et al (2011) studied the association between short term ambient O_3 exposure and respiratory hospital admissions. This review was limited to studies in English from 1990 to 2008, converted studies to a 24-hour metric or an 8-hour metric, separated general and emergency admissions and did not combine single-city and multi-city study results. The Ji et al (2011) results for all respiratory admissions all ages per 10 ppb ozone (roughly twice a 10 $\mu g/m^3$ increment) was a 1.45% increase (95% CI: −0.04%, 2.95%) (general admissions) or a 1.24% increase (95% CI: 0.48%, 1.99%) (emergency admissions) for studies converted to an 8-hour average metric and a 2.03% increase (95% CI: −0.21%, 4.31%) (general admissions) or a 1.9% increase (95% CI 0.74%, 3.07%) (emergency admissions) for the same studies converted to a 24-hour average metric. This compares with the SGUL results of 0.75% (95% CI: 0.30%, 1.20%) and 0.69% (95% CI: 0.17%, 1.21%) per 10 $\mu g/m^3$ ozone for 8-hour average and 24-hour average ozone respectively. The estimates are similar to those found by SGUL, taking into account the different scales, but the SGUL results had 95% confidence intervals above zero. This was probably due to the additional statistical power provided by the inclusion of multi-city study results. It was decided that, although the Ji et al (2011) review provides corroborative evidence, it does not supersede the SGUL systematic review and meta-analysis which included studies in all languages, all dates up to indexing in May 2011, used the original study averaging times, and combined single and multi-city study results and general and emergency admissions.

14. Requia et al (2018) conducted a systematic review and meta-analysis of studies on air pollutants, including NO_2, O_3 and PM, and cardiorespiratory diseases (hospital admissions and mortality) of studies published between 2006 and 11 May 2016. The QUARK members who reviewed the paper considered that it did not provide a suitable basis for updating COMEAP's recommendations: it used novel meta-regression methods, and it appeared that the effects of short-term exposure (time-series and case-crossover studies) had been combined with the effects of

[2] Walton et al 2014 was not identified by the search because, while peer-reviewed, it is not published in a format that allows it to be indexed by databases such as PubMed. Mills et al (2016) includes only studies which report results from both single-pollutant and two-pollutant models (adjusting for PM). It therefore does not include all the single-pollutant estimates reviewed in Mills et al (2015).

long-term exposure (from cohort studies) within the pooled estimates presented within the paper.

15. Bell et al (2014) conducted a systematic review of the epidemiological evidence (1988 to 2013) regarding the factors that might make individuals more susceptible to mortality or hospital admissions following short-term O_3 exposure, and performed a meta-analysis. QUARK considered that this study was good quality in terms of approach, and noted that it includes primary studies up to June 2013 (slightly beyond the DH-funded systematic reviews). However, it was not considered a suitable basis for updating our recommendations for quantification because it was designed for a different purpose (examining evidence for effect modification). This meant that the authors only included papers that examined potential effect modifiers and not more general papers that studied associations between ozone and mortality or hospital admissions/emergency room visits. Hence, it is not a systematic identification of all papers relevant to a coefficient for hospital admissions. In addition, the meta-analyses combine studies of hospital admissions and emergency room visits. This means that, while the results can be used to draw qualitative conclusions about the importance of individual variables, they cannot be used quantitatively in impact assessments, as it is not clear what baseline rate would be appropriate to use.

16. Ab-Manan et al (2018) reviewed primary studies conducted between 2010 and 2016 looking at the relationship between hospital admission and air pollutants, including $PM_{2.5}$, PM_{10}, NO_2 and O_3. QUARK did not consider this study a suitable basis for updating COMEAP's recommendations because the search strategy and combination of terms used was not sufficiently comprehensive and because the study did not derive pooled estimates.

17. As a result of this review, we accepted QUARK's recommendation that the coefficients derived within the SGUL meta-analyses from single pollutant models were the most appropriate to recommend for quantification of hospital admissions associated with short-term exposure to NO_2 (Mills et al, 2015) and PM (Atkinson et al, 2014), and that the current recommendations for CRFs for O_3, which are already derived from the SGUL study (Walton et al, 2014), should remain the same. It is noted that the Atkinson et al 2014 review presents coefficients for $PM_{2.5}$, whereas our previously recommended coefficients for PM were for PM_{10}.[3]

Discussion

Global or regional effects estimates

18. The SGUL reviews present summary estimates of all studies (regardless of where they have been conducted) and also summary estimates by WHO region. For some pollutant-outcome pairs the reviews found considerable heterogeneity between regions (for example, respiratory hospital admissions associated with $PM_{2.5}$ concentrations, I^2=80%).

[3] COMEAP (2020) has noted that recommendations for quantification of effects using associations reported with a metric of particulate matter ($PM_{2.5}$ or PM_{10}) are usually regarded as indicating effects of particulate matter pollution more generally. Therefore, coefficients for the same health effect associated with $PM_{2.5}$ and PM_{10} should not be used together in the same assessment.

19. Nonetheless, we recommend that the coefficients drawn from the full global evidence base, rather than solely from European studies, should be used for quantification of hospital admissions associated with short-term exposure to PM and NO_2. This is consistent with the approach taken to the selection of the O_3 coefficients recommended by COMEAP in its 2015 report, taken from the review by Walton et al (2014). Global estimates draw on a larger evidence base than Europe-only estimates. In addition, the observed heterogeneity between regions may reflect methodological, and other, differences between studies, rather than necessarily differences between locations/regions.

Uncertainty regarding causality

20. In making its 1998 and 2001 recommendations, COMEAP acknowledged the likelihood that PM is causally related to the respiratory and cardiovascular effects associated with it in epidemiological studies. It has therefore been considered appropriate to include respiratory and cardiovascular hospital admissions associated with short-term exposure to PM in core analyses (such as burden estimates or health impact analyses)[4]. Nonetheless, the comparison of effects estimates from single- and two-pollutant models demonstrated considerable attenuation on adjustment for effects associated with NO_2 (Mills et al, 2016).

21. Due to the doubts about the causal role of NO_2, COMEAP's 1998 recommendation for a coefficient linking NO_2 with respiratory hospital admissions was intended for use in sensitivity analyses. We considered the increase in the strength of the evidence for causality since the previous COMEAP recommendations, including the REVIHAAP review (WHO, 2013a), the HRAPIE project (WHO, 2013b), the SGUL review itself (Mills et al, 2015), the SGUL adjustment for PM mass in two-pollutant models (Mills et al, 2016), and current USEPA Integrated Science Assessments (ISAs: USEPA 2016; 2019). We noted that the evidence suggesting a causal role for NO_2 in both respiratory and cardiovascular effects has strengthened in recent years. It is, however, stronger for respiratory effects than for cardiovascular effects, for which there remains a higher level of uncertainty. In addition, the evidence available for plausible biological mechanisms for cardiovascular effects is greater for PM than for NO_2 (COMEAP 2018).

Independence of epidemiological associations

22. Concentrations of pollutants are often correlated spatially and temporally, and this is particularly true of PM and NO_2. This results in uncertainty in attribution of causality of effects estimates, reported in epidemiological studies, to individual pollutants within the air pollution mixture. We have been asked to update COMEAP's previous recommendations for coefficients from single-pollutant models, in which there has been no adjustment for effects associated with correlated pollutants. This means that recommended coefficients will, to some extent, likely include effects caused by other correlated pollutants. Therefore, if effects on hospital admissions estimated using the recommendations for coefficients from single pollutant models

[4] Quantification of mortality associated with short-term exposure to PM is only included if the assessment does not also include quantification of mortality associated with long-term exposure to PM.

for PM and NO_2 are added to each other, this would give an over-estimate of the effects of the pollution mixture (or of the reduction in the pollution mixture) as a whole.

23. Concentrations of O_3 reflect a complex atmospheric chemistry. O_3 is formed by photochemical reactions between chemical precursors in the atmosphere. The concentration of O_3 is determined by the balance between these formation reactions and other physical and chemical processes that disperse O_3 or remove it from the atmosphere. As noted in COMEAP (2015), correlations between O_3 and other pollutants can vary in both size and direction according to the concentration of O_3, which varies spatially and temporally. Correlations may vary with season and/or temperature; these effects may be independent of each other and depend upon the climate of the location.

24. Correlations between concentrations of O_3 and NO_2 are also complex, as oxides of nitrogen (NO_x) are involved in both the formation and destruction of O_3; which of these processes dominates depends upon the concentration of NO_x. In the UK, O_3 is often negatively correlated with $PM_{2.5}$ at lower O_3 concentrations but positively correlated with $PM_{2.5}$ at higher O_3 concentrations; this pattern is more marked for $PM_{2.5}$ than for PM_{10} because of the secondary inorganic aerosol (SIA) component of $PM_{2.5}$.

25. The varying correlations of O_3 with other pollutants make it difficult to interpret associations of health effects with O_3 reported from single-pollutant models: there may be under-estimation or over-estimation depending on the specific study and its location. The global summary effects estimates for O_3 from the SGUL meta-analyses include studies conducted throughout the whole year and in a variety of climates. Therefore, they are likely to include periods of both positive and negative correlations between ozone and co-pollutants, and hence it does not seem likely that they are greatly affected by confounding due to correlated PM or NO_2 concentrations. Therefore, despite the uncertainty, we consider that the commonly used approach – of regarding associations of health effects with short-term variations in O_3 as independent of those with other pollutants – is likely to be appropriate. This means that quantification using the O_3 coefficient along with those for other pollutants, in assessments of effects over the long-term (for instance, at least a year), is unlikely to result in an important over-estimation of effects due to double-counting. Nonetheless, those undertaking assessments should be aware of the uncertainty around this. We also note that mitigation measures designed to reduce NO_x emissions (and NO_2 concentrations) may result in a local increase in O_3 close to source, which might be important for population exposure to O_3.

Limitations of the recommended approach

26. We are aware that a more in-depth examination of the available reviews, and of the wider epidemiological and mechanistic evidence base, might have allowed us to make more robust, up-to-date and detailed recommendations for quantification of hospital admissions associated with short-term exposures to air pollutants. However, this is beyond our current resources, particularly as updated recommendations were required in a timescale that would allow them to inform planned policy development by Defra (derivation of Environment Act $PM_{2.5}$ targets). We consider that adopting

coefficients from existing systematic reviews, and recommending that they be used in assessments in place of COMEAP's previously recommended coefficients (COMEAP, 1998; 2001), is an appropriate, pragmatic approach to updating COMEAP's previous recommendations.

27. Making recommendations which take into account multi-pollutant approaches and the extent of potential confounding is beyond the scope of our current considerations. Instead, we have updated our recommendations for single-pollutant coefficients. We anticipate that the revised recommendations will be used by Defra in its cost-benefit assessments to derive Environment Act $PM_{2.5}$ targets. We have not undertaken any new quantification estimates (burden or impact).

Research Recommendations

28. We recommend that further research into the implications of correlations between O_3 and both NO_2 and $PM_{2.5}$, and how these may affect use of the O_3 coefficients within a combined health impact assessment, should take place. This should include evaluating the possible role of these correlations in the apparent effect modification by temperature of O_3 coefficients that has been sometimes been reported.

29. We note that primary reviews only up until 2011 are included in the meta-analyses by SGUL on which our recommended coefficients are based. We would therefore recommend that the meta-analyses should be updated. In our view, this should be commissioned and undertaken by others for COMEAP/QUARK to review, rather than undertaken by us directly. Undertaking such a review is unlikely to be a priority for ourselves (COMEAP/QUARK) because of the small contribution of hospitalisations to cost-benefit assessments.

Overall conclusions and recommendations

30. Our view is that meta-analyses of associations from single pollutant models undertaken by SGUL provide the most appropriate source of coefficients for quantification of all cause cardiovascular and all cause respiratory hospital admissions associated with short-term exposures to air pollutants.

31. We recommend that the global effects estimates from these meta-analyses are used to quantify respiratory and cardiovascular hospital admissions associated with short-term exposure to PM, NO_2 and O_3. For NO_2, we recommend use of the coefficients based on 24-hour average concentrations for use in cost-benefit assessment of proposed interventions (we note that there may be some assessments in which the use of the 1-hour coefficient is appropriate). The concentration-response functions recommended are summarised in the table below.

32. Users should consider the uncertainties regarding causality, notably for cardiovascular hospital admissions associated with NO_2, when deciding which pollutant-outcome pairs to include in assessments or sensitivity analyses. They should also give appropriate consideration to the likelihood of overlap between the effects estimates reported for PM and NO_2, which means that combining them within an assessment would result in an over-estimation of effects/benefits. We consider

that associations reported with all-year O_3 are likely to be independent of those reported with other pollutants. Therefore, there is less concern regarding possible double-counting of effects (or benefits) if O_3 is included with other pollutants in a long-term assessment.

Random summary effects estimates (95% confidence intervals) for the percentage increase per 10 μg/m^3 reported from meta-analyses of time-series studies

	Overall	**Reference**
$PM_{2.5}$		
Respiratory hospital admissions, all ages	24-hour: 0.96 (-0.63, 2.58)	Atkinson et al (2014) Table 3
CV hospital admissions, all ages	24-hour: 0.90 (0.26, 1.53)	Atkinson et al (2014) Table 3
NO_2		
Respiratory hospital admissions, all ages	24-hour: 0.57 (0.33, 0.82) 1 hour: 0.34 (-0.02, 0.7)	Mills et al (2015) Table S2
CV hospital admissions, all ages	24-hour: 0.66 (0.32, 1.01) 1 hour: 0.36 (-0.16, 0.89)	Mills et al (2015) Table S3
O_3		
Respiratory hospital admissions, all ages	Daily maximum 8 hour running mean 0.75% (0.30, 1.2)	Walton et al (2014)
CV hospital admissions, all ages	Daily maximum 8 hour running mean 0.11% (−0.06, 0.27)	Walton et al (2014)

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Acknowledgements: We wish to thank Ms Ruth Chambers (COMEAP Lay Member) for her valuable contribution to the statement.

COMEAP statement on update of recommendations for quantifying hospital admissions associated with short-term exposures to air pollutants

Annex A

The literature search information is summarised in this annex.

Search question:

Systematic reviews and meta-analyses of epidemiological studies on hospital admissions associated with air pollution.

Terms used:

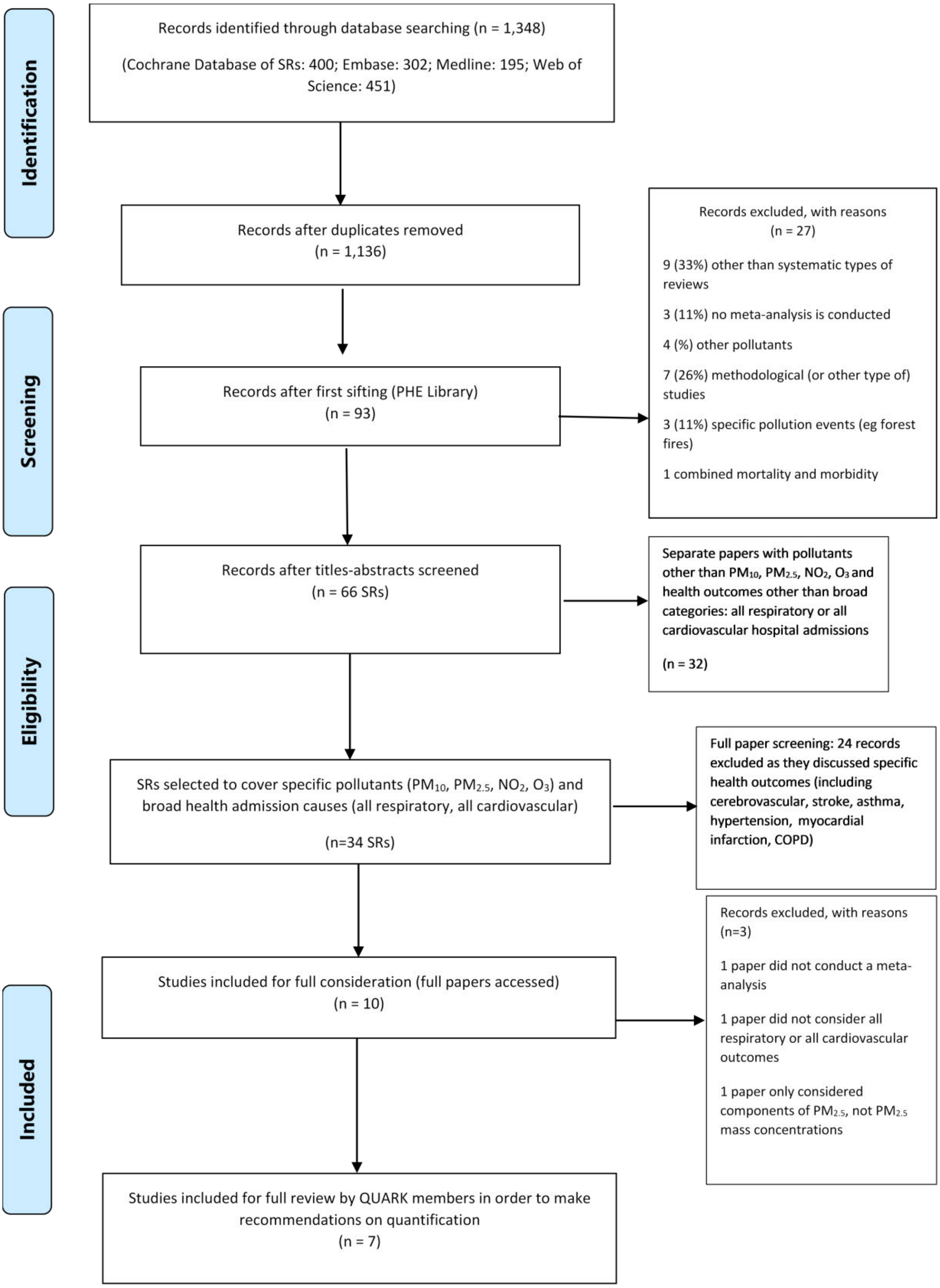
(Air pollut* or PM10 or "PM2.5" or Nitrogen dioxide* or NO2 or Ozone or O3 or Ultrafine particulate* or Black Carbon or ultrafine particle* or ultra-fine particulate* or ultra-fine particle* or particulate pollut* or PM pollut* or ambient pollut*) OR (air adj2 (quality or ambient)) OR (atmospher* adj2 pollut*) OR (vehicle adj emission*) OR ((coarse or fine) adj particle*) OR particulate matter OR (PM0* or PM1* or PM2* or PM10*) OR (nitrogen adj dioxid*) OR (NO2 or NOx or "NO(x)") OR (particulate adj2 pollut*) OR ((sulphur or sulfur) adj dioxide*) OR SO2 OR (carbon adj monoxide*) OR (air adj stagn*) OR (oxidant adj air adj pollut*) OR (airborne adj acidity)
AND
(hospital adj3 (visit or visits or attendance* or admit*)) OR (hospitalization or hospitalisation) OR (hospital adj3 admission*) OR ("accident and emergency" or emergency department* or "a&e" or "a and e") OR (physician* or consultation*) OR general practi*

Limits applied:

Age group	Language	Publication type	Time limit
	English	Systematic Reviews	2010-Dec 2020

Figure 1 presents the PRISMA diagram which illustrates the screening and review process carried out during the literature search.

Figure 1: PRISMA flowchart illustrating the numbers of papers on hospital admissions associated with air pollution



Committee on the Medical Effects of Air Pollutants

Advice on health evidence relevant to setting PM2.5 targets – update

COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

Committee on the Medical Effects of Air Pollutants

Advice on health evidence relevant to setting $PM_{2.5}$ targets – update

Background

1. In July 2021, we published advice[1] provided to Defra on the health evidence relevant to setting $PM_{2.5}$ targets. This was intended to inform Defra's development of air quality targets under the Environment Bill 2020 (now the Environment Act 2021). The advice included that:

- a focus on reducing long-term average concentrations of $PM_{2.5}$ is appropriate
- newer evidence indicates that $PM_{2.5}$ pollution can have harmful effects on people's health at lower concentrations than had been studied previously
- the available studies have not indicated a threshold of effect below which there is no harm
- reducing concentrations below the World Health Organization's (WHO) Air Quality Guideline (10 μg/m^3) would benefit public health

2. We noted that one large recent study had found an association between particulate air pollution and mortality in a population exposed to a mean $PM_{2.5}$ concentration of 6.3 μg/m^3 and a 5th percentile of 3.0 μg/m^3.

3. In September 2021, WHO published updated Air Quality Guidelines.[2] The new guideline for annual average concentrations of $PM_{2.5}$ is 5 μg/m^3.

Updated WHO Air Quality Guidelines

4. The WHO Air Quality Guidelines are based on the evidence linking concentrations of pollutants in ambient air with adverse effects on health. They are set without reference to achievability.

5. The new WHO guidelines for long-term exposure to pollutants reflect the lowest levels at which the guideline developers could be confident of an adverse effect. This was based on epidemiological studies which had found associations with adverse effects on health in populations in which some individuals were exposed to

[1] Fine particulate air pollution (PM2.5): setting targets – GOV.UK (www.gov.uk)
[2] WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide

low concentrations. In practice, the guidelines were based on the average of the 5th percentiles of exposure distributions from studies with the lowest levels of exposure. The 5th percentiles of the exposure distributions were used, rather than the lower end of the exposure range because there is less confidence in concentration-response functions at concentrations below the 5th percentile of an exposure distribution, due to the sparse data.

6. For $PM_{2.5}$, a systematic review and meta-analysis by Chen and Hoek (2020)[3] informed the development of the guideline value. The five lowest 5th percentiles of exposures in the available studies of associations with (non-accidental) all-cause mortality were used as the starting point. Depending on the five studies selected[4], the average of the five lowest 5th percentiles was 4.2 to 4.9 µg/m^3. WHO therefore considered that the available data on the association between long-term average $PM_{2.5}$ and non-accidental mortality supported a long-term guideline value of no more than 5 µg/m^3. They considered that the available studies on cause-specific mortality also supported a guideline value of no more than 5 µg/m^3.

7. We examined this 2020 review by Chen and Hoek when developing our previous advice to Defra; the study we noted with a 5th percentile of exposure of 3.0 µg/m^3 is one of those used in deriving the revised WHO guideline.

Additional comments

8. WHO's revised Air Quality Guideline for $PM_{2.5}$ confirms our previously expressed view that $PM_{2.5}$ pollution can have harmful effects on people's health at lower concentrations than had been studied previously. It also indicates that reducing concentrations to 5 µg/m^3 would have public health benefits. There is less confidence in the continued health benefits of reductions below 5 µg/m^3 because studies of populations in which a large proportion is exposed to very low concentrations are not currently available. Nonetheless, a large study with a 5th percentile of exposure as low as 3.0 µg/m^3 reported an association which continued at these low concentrations, and the available studies have not indicated a threshold for effect at the population level.

9. Therefore, on health grounds, we would strongly support a reduction of $PM_{2.5}$ concentrations, ideally to (or below) the WHO guideline value of 5 µg/m^3. However, we note that WHO recognises that the new guidelines may be challenging to meet immediately and provides interim targets to track progress towards the guideline

[3] Chen J and Hoek G (2020) Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis Environment International Article No:105974. Environment International | Update of the WHO Global Air Quality Guidelines: Systematic Reviews | ScienceDirect.com by Elsevier

[4] The average of the five lowest 5th percentiles was 4.2 µg/m^3. WHO also performed a sensitivity analysis using selected studies. In five studies that reported associations at low concentrations (excluding a study which had found no association and another which had found no evidence of an effect below 8 µg/m^3) the mean 5th percentile was 4.9 µg/m^3

values; the previous WHO guideline of 10 µg/m^3 is now recommended by WHO as the interim target 4.[5] We have previously acknowledged that the Government needs to balance the health benefits of policies and interventions against their costs, and recognised that cost-benefit assessments may play a role in defining targets.

10. WHO noted that the burden of air pollution-related disease is unevenly distributed and that vulnerable and susceptible populations are often disproportionately affected. It concluded that the available evidence on the effect, on inequalities, of interventions that have been used to reduce air pollution is mixed. More vulnerable groups, such as older people and deprived households, were found to benefit more, equally or less than other groups depending on the intervention and health outcome and the design of the study. We note that Defra plans to implement a Population Exposure Reduction Target (PERT) for $PM_{2.5}$ in addition to a concentration-based “Limit Value” type target. We previously advised that reducing exposure of the whole population would be expected to achieve the greatest overall public health benefit. However, achieving compliance with a Limit Value, target, guideline or PERT does not, of itself, reduce health inequalities. Our previous advice therefore recommended that Defra should investigate whether proposed or implemented interventions reduced inequalities in exposure or had undesirable consequences for inequalities (for example, by increasing concentrations of pollutants in areas of socioeconomic deprivation). This advice is unchanged by publication of the revised WHO Air Quality Guidelines.

11. WHO has also provided updated air quality guideline values and interim targets for long-term exposure to PM_{10}, nitrogen dioxide (NO_2) and ozone (O_3). We note that the guideline values are based on associations between air pollutant concentrations and health effects reported from single-pollutant models, which only consider the health effects associated with one pollutant at a time, without statistical adjustment for exposures to co-emitted and correlated pollutants. This means that the associations likely reflect the effect of other pollutants to some extent. COMEAP’s previous consideration of this issue[6] suggests that there would be greater benefits from reducing exposure to multiple pollutants than a single pollutant, as the available evidence reflects the effects of a pollutant mixture.

COMEAP
JANUARY 2022

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[5] WHO has recommended four interim targets for annual average concentrations of $PM_{2.5}$, with interim target 4 (10 µg/m^3) being the lowest. Interim target 2 (25 µg/m^3) is the same as the current limit value in England

[6] Nitrogen dioxide: effects on mortality

Clean Air (Human Rights) Bill [HL]

CONTENTS

Clean Air (Human Rights) Bill

A

BILL

TO

Establish the right to breathe clean air; to require the Secretary of State to achieve and maintain clean air in England and Wales; to involve the UK Health Security Agency in setting and reviewing pollutants and their limits; to enhance the powers, duties and functions of various agencies and authorities in relation to air pollution; to establish the Citizens' Commission for Clean Air with powers to institute or intervene in legal proceedings; to require the Secretary of State and the relevant national authorities to apply environmental principles in carrying out their duties under this Act and the clean air enactments; and for connected purposes.

BE IT ENACTED by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1 Overview

(1) Everyone has the right to breathe clean air and the Human Rights Act 1998 is to be read as though this were a Convention right.

(2) The Secretary of State must achieve clean air throughout England and Wales within five years of the passing of this Act and maintain clean air throughout England and Wales thereafter.

(3) The Secretary of State must provide the necessary funding to the relevant national authorities and to the Citizens' Commission for Clean Air to fulfil their duties under this Act.

(4) For the purposes of this Act—

"clean air" means air that does not contain banned pollutants or pollutants, concentrations or emissions above the limits or levels of exposure (which may be zero) which are set out in—

(a) Schedule 1 (pollutants relating to local and atmospheric pollution);

(b) Schedule 2 (indoor air pollutants);

(c) Schedule 3 (pollutants causing primarily environmental harm); and

(d) Schedule 4 (pollutants causing climate change)

to this Act;

"the limits for pollutants" in Schedules 1 to 4 are set for short, medium or long-term time frames and the units referred to in those Schedules are—

Unit	*Definition*
mg/m^3	Milligrams per cubic metre
$\mu g/m^3$	Micrograms per cubic metre
ng/m^3	Nanograms per cubic metre

"pollutants" means those particles, gases or other substances that are emitted directly into the air or formed from secondary chemical reactions in the air, including smoke, grit, dust, fumes, aerosols, volatile organic compounds, carbon dioxide and other greenhouse gases;

"the relevant national authorities" are—

(a) the Environment Agency (EA);

(b) the Committee on Climate Change (CCC);

(c) local authorities in England and Wales;

(d) the Civil Aviation Authority (CAA);

(e) Highways England;

(f) Historic England; and

(g) Natural England.

2 Reviewing and revising the pollutants and limits in Schedules 1 to 4

(1) The Environment Agency (EA) must on an annual basis review the pollutants and the limits set out in Schedules 1 to 3.

(2) The EA, in carrying out a review under subsection (1), must—

(a) take into account the best available scientific knowledge, guidance and good practice statements on ambient air pollutants from the World Health Organization (WHO);

(b) take advice from the UK Health Security Agency and epidemiologists about the effects of pollution on public health;

(c) take into account the best available scientific knowledge, guidance and good practice statements on indoor air pollutants from the WHO and the International Organization for Standardization (ISO);

(d) take into account the best available scientific knowledge and guidance on atmospheric pollutants from the United Nations Economic Commission for Europe (UNECE);

(e) consult and seek advice from scientists on the effects of air pollution on the environment;

(f) apply the precautionary principle; and

(g) include a public consultation in accordance with the Aarhus Convention.

(3) Following a review under subsection (1), the EA must advise the Secretary of State as to whether additional pollutants should be added to Schedules 1, 2 and 3 or whether the pollutant limits in those Schedules should be lowered in order to protect life, health or the environment.

(4) In advising the Secretary of State under subsection (3), the EA must have regard to—

(a) pollutant emissions and concentrations;

(b) human exposures and health impacts and outcomes;

(c) the need to address pollution across England and Wales in all settings where people spend time including the worst locations;

(d) the needs of sensitive population groups including children, the elderly and other individuals who are particularly susceptible to air pollution;

(e) exposure to pollutant concentrations when travelling by public transport in ambient air or underground;

(f) biogeographical region-specific ozone flux models and critical levels for individual plant species or groups.

(5) The Secretary of State must, in accordance with the advice received under subsection (3) and the precautionary principle, amend Schedules 1 to 3 by regulations made by statutory instrument to include additional pollutants (and their limit values which may be zero) and to lower any limits.

(6) The Secretary of State must also amend the pollutants and the limits set out in Schedules 1 to 3 to reflect revised guidance and good practice statements from the WHO, ISO and UNECE.

(7) In case of conflict between the advice of the EA under subsection (3) and guidance and good practice statements under subsection (6), any additional pollutants must be listed and the lower limit values must be adopted.

(8) The Committee on Climate Change (CCC) must on an annual basis review the pollutants and the limits listed in Schedule 4.

(9) The CCC, in carrying out a review under subsection (8), must—

(a) take into account the best available scientific knowledge and advice from the Intergovernmental Panel on Climate Change (IPCC);

(b) consult and seek advice from scientists about the effects of air pollution on the climate;

(c) apply the precautionary principle; and

(d) include a public consultation in accordance with the Aarhus Convention.

(10) Following a review under subsection (8), the CCC must advise the Secretary of State as to whether new pollutants should be added to Schedule 4 or whether the limits in Schedule 4 should be lowered in order to protect the environment and safeguard future generations, including emission limits on international aviation landing in or taking off from the United Kingdom.

(11) The Secretary of State must, in accordance with the advice received under subsection (10) and the precautionary principle, amend the limits in Schedule 4 by regulations made by statutory instrument.

(12) In advising the Secretary of State under subsections (3) and (10), the EA and the CCC may advise setting the limits for pollutants and emissions under Schedules 1 to 4 for a short, medium or long-term time frame (see section 18).

(13) Where Schedules 1 to 4 are amended and a new pollutant limit is added or a limit is reduced in accordance with, but after the commencement of all sections of, this Act the new or amended limit will take effect after a period of 12 months, beginning with the date on which the relevant amending regulations come into force.

(14) A statutory instrument containing regulations under this section is subject to annulment in pursuance of a resolution of either House of Parliament.

3 Secretary of State's duty: assessing air pollutants

(1) The Secretary of State must ensure—
  (a) the accurate and regular assessment of air pollution in England and Wales; and
  (b) the provision of detailed information about air pollution in England and Wales to the public;

and may make regulations by statutory instrument to comply with this duty.

(2) Regulations about assessing air pollution in England and Wales under subsection (1) must ensure—
  (a) the consistent use of established air pollution zones and agglomerations;
  (b) the sampling, measurement and modelling of ambient air pollutants, including the deposition of pollutants, listed in Schedule 1;
  (c) the sampling, measurement and reporting of indoor air pollutants listed in Schedule 2;
  (d) the sampling, measurement and modelling of ambient pollutants causing primarily environmental harm listed in Schedule 3; and
  (e) the sampling, measurement, modelling and reporting of other air pollutants causing climate change listed in Schedule 4.

(3) The regulations must—
  (a) require assessment of ambient air pollution in England and Wales in accordance with the Air Quality Standards Regulations 2010 (as amended) (S.I. 2010/1001);
  (b) require owners of buildings which—
    (i) are used as places of work and to which health and safety provisions apply; or
    (ii) are regularly accessed by members of the public, including children,

  to assess and report concentrations of indoor air pollutants measured in accordance with the most up to date ISO standards;
  (c) require developers to assess and report concentrations of indoor air pollutants in accordance with the most up to date ISO standards in newly refurbished or constructed residential developments during the first 12 months of occupation;
  (d) require the assessment of the deposition of air pollutants in accordance with the criteria in the Gothenburg Protocol;
  (e) require UK based organisations of all sizes to report their greenhouse gas pollutants;
  (f) require the assessment of greenhouse gas pollutants in accordance with the requirements of the Climate Change Act 2008; and
  (g) amend assessment methods in accordance with subsection (10) below.

(4) The regulations must ensure that daily information regarding ambient concentrations of the pollutants listed in Schedule 1 is provided to members of the public through a range of formats.

(5) The information under subsection (4) must include—
- (a) information on observed exceedances of the limits listed in Schedule 1 presented as averages according to the relevant averaging period set out in Schedule 1;
- (b) forecasts of ambient concentrations of the pollutants listed in Schedule 1 for that day and each of the following four days;
- (c) information about the location and types of populations affected by exceedances under paragraph (a) including possible health effects and recommended behaviours;
- (d) information on possible sources of pollutants and recommendations for preventative actions that could be taken by those in charge of the sources to reduce pollution or exposure to it.

(6) The regulations must ensure that, where any information threshold or alert threshold specified under Schedule 1 is forecast to be exceeded or actually exceeded, necessary steps must be taken to inform members of the public by means of radio, television, newspapers and the internet.

(7) The Secretary of State must publish a report within six months of this section coming into force, and within the period of six months beginning with the end of each subsequent calendar year, summarising the effects of each of the pollutants exceeding the limits over the relevant time frame, according to the appropriate averaging period, listed in Schedules 1 to 4.

(8) The Citizens' Commission for Clean Air (the "CCCA") must review annually the Secretary of State's compliance with—
- (a) the limits in Schedules 1 to 4, and
- (b) subsections (1) to (7),

during the previous calendar year.

(9) Following the review under subsection (8), the CCCA must advise the Secretary of State as to whether any methods of assessment, publication or reporting should be discontinued, amended or improved or whether methods of assessment, publication or reporting should be added with effect from the start of the subsequent calendar year.

(10) The Secretary of State must, in accordance with advice received under subsection (9) and the precautionary principle, amend assessment, publication or reporting methods through regulations made by statutory instrument.

(11) In making regulations under subsection (10), the Secretary of State must have regard to the desirability of ensuring continuity and comparability of reporting.

(12) A statutory instrument containing regulations under this section is subject to annulment in pursuance of a resolution of either House of Parliament.

4 Secretary of State's duty: additional provisions

(1) In exercising their duty under section 1 of this Act, the Secretary of State must comply with the United Nations Convention on Long-Range Transboundary Air Pollution and its protocols as listed in Schedule 5.

(2) In carrying out their duty under section 1, the Secretary of State must work with the relevant national authorities and exercise his or her powers under the clean air enactments listed in Schedule 6 and other Acts in accordance with this duty.

(3) Notwithstanding any other provision of this Act, the Secretary of State may, upon receipt of evidence that a pollution source or combination of sources (including moving sources) presents an imminent and substantial threat to current or future public health or the environment, take proportionate and necessary action to restrain any person or persons responsible for causing or contributing to the alleged pollution, to stop the emission of air pollutants, and to preserve the right to breathe clean air.

(4) Within the period of 14 days beginning with the day on which they exercised the power under subsection (3), the Secretary of State must lay a statement before both Houses of Parliament setting out—

(a) what action they took; and

(b) why, in the Secretary of State's opinion, such action was necessary and proportionate.

(5) Regulations must enable the sale and use of appliances generating wholly renewable energy.

(6) Regulations must enable energy efficiency improvements to domestic and non-domestic premises that reduce energy use and emissions of carbon dioxide.

(7) Regulations must restrict the sale and use of combustion appliances that emit pollutants to the air.

5 Environment Agency

(1) The Environment Act 1995 is amended as follows.

(2) In section 4(1) (principal aim and objectives of the Agency)—

(a) after "other enactment" insert "such as the clean air enactments set out in Schedule 6 to the Clean Air (Human Rights) Act 2022 or any other enactment governing the EA's functions in relation to the regulation of ambient air quality or controlling pollution and emissions at source"; and

(b) after "whole", insert "including to achieve and maintain clean air throughout England and Wales".

6 Committee on Climate Change

(1) The Climate Change Act 2008 is amended as follows.

(2) After section 32 (functions of the Committee) insert—

"32A Duty to advise on emission limits

It is the duty of the Committee to advise the Secretary of State on emission limits under section 2 (reviewing and revising pollutants and limits in Schedules 1 to 4) of, and Schedule 4 to, the Clean Air (Human Rights) Act 2022."

(3) In section 38 (duty to provide advice or other assistance on request) after

subsection (1)(d), insert—

“(e) the authority’s duty under the Clean Air (Human Rights) Act 2022.”

7 Local authorities

(1) Local authorities in England and Wales have a duty to achieve clean air throughout their area within five years of the coming into force of this Act and maintain clean air throughout their area thereafter.

(2) Local authorities in England and Wales must exercise their powers and functions, including under section 2 of the Local Government Act 2000 (promotion of wellbeing) and the clean air enactments, to improve the environmental wellbeing of their local area and reduce exposure for members of the public to the pollutants listed in Schedule 1 in accordance with the duty set out in subsection (1).

(3) The Secretary of State must provide money to local authorities from central funds sufficient for them to carry out their duties under this Act.

(4) In this section, the “clean air enactments” are those enactments listed in Schedule 6 and any other enactment governing a local authority’s functions in relation to—

(a) regulating ambient air quality or controlling pollution and emissions at source;

(b) land use planning;

(c) traffic planning, including actions as a Highways Authority;

(d) building regulation; and

(e) statutory nuisance.

(5) In this section “local authority” means, in relation to England and Wales—

(a) a county council;

(b) a district council;

(c) a London borough council;

(d) the Mayor of London;

(e) the Common Council of the City of London in its capacity as a local authority;

(f) the Council of the Isles of Scilly;

(g) a combined authority; and

(h) port authorities.

(6) In this section “port authority” means, in relation to England and Wales, a statutory harbour body established for the purpose of administering, preserving and improving a port, including an airport, that may include docks, landing places or other works or land.

8 The Office of Environmental Protection

The Office of Environmental Protection must exercise its functions so as to ensure the achievement of clean air.

9 Civil Aviation Authority

(1) The CAA must in exercising its functions—

(a) contribute to the maintenance of clean air in England and Wales; and

(b) apply the provisions of the UN Convention on Transboundary Pollution and its protocols as listed in Schedule 5.

(2) The Civil Aviation Act 1982 is amended as follows.

(3) In section 4 (general objectives), after subsection (1)(b) insert—

"(c) to contribute to the maintenance of clean air in England and Wales and respect for the right to breathe clean air under section 1 of the Clean Air (Human Rights) Act 2022."

10 Highways England

(1) The Infrastructure Act 2015 is amended as follows.

(2) In section 5 (general duties), after subsection (2)(a) insert—

"(aa) to contribute to the maintenance of clean air under the Clean Air (Human Rights) Act 2022;

(ab) to follow instructions given to it by the Secretary of State to contribute to the achievement of clean air."

11 Historic England

(1) The National Heritage Act 1983 is amended as follows.

(2) In section 33 (the Commission's general functions), after subsection (2)(f) insert—

"(g) shall contribute towards achieving and maintaining clean air, as prescribed by the Clean Air (Human Rights) Act 2022 and the clean air enactments as listed in Schedule 6 to that Act."

12 Natural England

(1) The Natural Environment and Rural Communities Act 2006 is amended as follows.

(2) In section 2 (general purpose), after subsection (2)(e) insert—

"(f) contribute towards achieving and maintaining clean air, as prescribed by the Clean Air (Human Rights) Act 2022 and the clean air enactments as listed in Schedule 6 to that Act."

13 The establishment of the Citizens' Commission for Clean Air

(1) There will be a body corporate known as the Citizens' Commission for Clean Air (the "CCCA" or the "Clean Air Commission").

(2) The CCCA must, by exercising the powers conferred by this Act, monitor and enforce the right to breathe clean air and the duties to achieve and maintain clean air in England and Wales.

(3) The constitution of the CCCA is set out in Schedule 7.

14 Judicial review and other legal proceedings

(1) The CCCA may institute or intervene in legal proceedings, whether for judicial review or otherwise, if it appears to the CCCA that the proceedings are

relevant to the duty to achieve and maintain clean air and compliance with relevant duties, powers and functions under the clean air enactments.

(2) The CCCA may assist an individual who is or may become party to legal proceedings if—

(a) the proceedings relate to, or may relate to, the right to breathe clean air or the duty to achieve and maintain clean air;

(b) the individual is a member of the public who has the right of access to justice under the Aarhus Convention; or

(c) they have reason to believe that an individual was a victim of a breach of the right to breathe clean air.

(3) The CCCA may assist individuals with actions for private nuisance.

15 Duty to maintain clear air: assessment

(1) The CCCA may assess the extent to which the Secretary of State, the relevant national authorities and others have complied with their duties under this Act and the clean air enactments.

(2) Where the CCCA has reason to believe that any persons or relevant national authorities have failed to comply with their duty, the CCCA may issue a notice requiring them—

(a) to comply with their duty;

(b) to take specific steps in order to achieve compliance; and

(c) to provide to the CCCA written information of the steps taken, or proposed to be taken, for the purpose of complying with their duty.

(3) A notice issued by the CCCA under subsection (2) must specify—

(a) the period of time which the information must cover; and

(b) the manner in which the information is to be provided.

(4) A person or public authority which receives a notice under this section must comply with it within the period of 28 days beginning with the day on which they received the notice.

(5) If the CCCA has reason to believe that a person or public authority which has received a notice under this section has failed to comply with a requirement of the notice, the CCCA may apply to the Court for an order requiring the person to comply.

16 Duty to maintain clean air: reporting

(1) The CCCA must—

(a) report annually to the Secretary of State on the Secretary of State's compliance with the provisions of this Act;

(b) lay this report before both Houses of Parliament; and

(c) send a copy of this report to the European Environment Agency.

(2) The report must be published by the CCCA.

17 Environmental principles

In exercising their functions and carrying out their duties under this Act and the clean air enactments, the Secretary of State and the relevant national authorities must, in addition to safeguarding public health and the right to breathe clean air, apply the following environmental principles—

(a) prevention, which means that environmental regulation must anticipate, prevent and attack the causes of environmental harm;

(b) precaution, which means that where there are threats of serious or irreversible damage to the environment, including human health, lack of full scientific certainty must not be used as a reason for postponing cost-effective measures to prevent harm;

(c) polluter pays, which means that the costs of pollution or of clean-up should be borne by the person responsible for causing the pollution;

(d) use of the best available scientific knowledge;

(e) rectification at source, which means that environmental damage should, as a priority, be remedied at its source;

(f) integration, which means that environmental protection requirements should be integrated into the definition and implementation of all policies and activities, in particular with a view to promoting sustainable development;

(g) conservation of the ecosystem structure and functioning, in order to maintain ecosystem services;

(h) anticipation, prevention or minimisation of the causes of climate change and mitigation of its adverse effects; and

(i) sustainability, which means to take into account the health of present generations and the needs of future generations.

18 Interpretation

In this Act—

“the Aarhus Convention” means the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, adopted on 25 June 1998;

in Schedule 3, “AOT40” is the accumulated amount of ozone over the threshold value of 40 parts per billion;

“the clean air enactments” are those enactments listed in Schedule 6 as amended from time to time;

“combustion appliance” includes—

(a) boilers fired by gaseous fuels which have a rated heat power output of less than 1MW,

(b) solid fuel boilers with a rated heat output of less than 1MW,

(c) combined cooling, heat and power plant,

(d) combined heat and power plant,

(e) domestic and commercial cooking equipment,

(f) fireplaces and wood burning stoves,

(g) non-road mobile machinery,

(h) stationary generators with a rated thermal output of less than 1MW.

“indoor air” refers to the quality of air in buildings;

“limits” means the concentrations, emissions or exposures set out in Schedules 1 to 4;

“long-term” means a period of time of a calendar year or more;

“medium-term” means a period of time of more than 24 hours and less than a calendar year;

"national authorities" has the meaning given in section 1;

"pollutants causing primarily environmental harm" includes those causing acidification, eutrophication, haze or smog as listed in Schedule 3;

"renewable energy" means energy generated from any naturally occurring, theoretically inexhaustible, source such as solar, wind, tidal, geothermal or hydroelectric power, excluding non-renewable sources such as fossil fuels, biomass, wood and nuclear fuels.

"short-term" means a period of time less than or equal to 24 hours; and

"units" are the maximum permitted mathematical mean for the averaging period defined.

19 Extent, commencement and short title

(1) This Act extends to England and Wales only.

(2) Except as provided for by subsection (3), this Act comes into force on the day on which it is passed.

(3) Section 3 comes into force on such day as the Secretary of State may by regulations made by statutory instrument appoint, provided this is within 12 months of the passing of this Act.

(4) This Act may be cited as the Clean Air (Human Rights) Act 2022.

SCHEDULES

SCHEDULE 1

Section 1

POLLUTANTS RELATING TO LOCAL AND ATMOSPHERIC POLLUTION

1 Pollutant concentrations

Pollutant	*Unit*	*Averaging period*
Black carbon	6 µg/m^3	24 hours (35 permitted exceedances per year)
	3 µg/m^3	1 year
Benzene (C_6H_6)	3.5 µg/m^3	1 year
1, 3 Butadiene	2.25 µg/m^3	1 year
Formaldehyde (HCHO)	8.6 µg/m^3	1 year
Ground-level ozone (O_3)	240 µg/m^3 (alert threshold)	1 hour
	180 µg/m^3 (information threshold)	1 hour
	100 µg/m^3	Running 8 hours (3 permitted exceedance days per year)
	60 µg/m^3	Peak season*
Lead	0.25 µg/m^3	1 year
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour (18 permitted exceedances each year)
	25 µg/m^3	24 hours
	10 µg/m^3	1 year
Particulate matter (PM_1, $PM_{2.5}$ and PM_{10})	$PM_{0.1}$: 1,000 particles/cm^3	1 hour
	$PM_{0.1}$: 500 particles/cm^3	24 hours

Pollutant	*Unit*	*Averaging period*
Particulate matter (PM_1, $PM_{2.5}$ and PM_{10})	PM_1: 10 µg/m^3	24 hours (4 permitted exceedance days per year)
	PM_1: 3.5 µg/m^3	1 year
	$PM_{2.5}$: 80 µg/m^3 (alert level)	Running 8 hours
	$PM_{2.5}$: 15 µg/m^3	24 hours (4 permitted exceedance days per year)
	$PM_{2.5}$: 5 µg/m^3	1 year
	PM_{10}: 45 µg/m^3	24 hours (4 permitted exceedance days per year)
	PM_{10}: 15 µg/m^3	1 year
Polycyclic aromatic hydrocarbons (PAHs) expressed as concentration of benzo(a)pyrene	0.25 ng/m^3	1 year
Sulphur dioxide (SO_2)	500 µg/m^3	10 minutes (24 permitted exceedances per year)
	40 µg/m^3	24 hours (4 permitted exceedance days per year)

* Average of daily maximum 8-hour mean O3 concentration in the six consecutive months with the highest six-month running-average O3 concentration.

2 Pollutant exposures

Pollutant	*Unit*	*Averaging period*
Particulate matter ($PM_{2.5}$)	$PM_{2.5}$: 4 µg/m^3 (population weighted exposure within each zone and agglomeration)	5% per calendar year until the limit is reached

SCHEDULE 2

Section 1

INDOOR AIR POLLUTANTS

1 Biological indoor air pollutants (dampness and mould)

Pollutant	*Concentration*	*Averaging period*
Dampness	Zero	n/a
Mould	Zero	n/a

2 Pollutant-specific guidelines (chemical pollution)

Pollutant	*Unit*	*Averaging period*
Benzene (C_6H_6)	3.5 µg/m^3	1 year
1, 3 Butadiene	2.25 µg/m^3	1 year
Carbon monoxide (CO)	4 mg/m^3	24 hours
	10 mg/m^3	8 hours
	35 mg/m^3	1 hour
	100 mg/m^3	15 minutes
Formaldehyde (HCHO)	8.6 µg/m^3	1 year
Hydrogen sulphide (H_2S)	7 µg/m^3	30 minutes
	0.15 µg/m^3	24 hours
Nitrogen dioxide (NO_2)	200 µg/m^3	1 hour (no exceedances)
	10 µg/m^3	1 year
Naphthalene	0.01 mg/m^3	1 year
Polycyclic aromatic hydrocarbons (PAHs) expressed as concentration of benzo(a)pyrene	Zero	n/a
Radon	100 becquerels/m^3	3 months
Tetrachloroethylene	0.25 mg/m^3	1 year
Trichloroethylene	Zero	n/a

3 Pollutants from indoor combustion of fuels

Pollutant	*Unit*	*Averaging period*
Particulate matter (PM_1, $PM_{2.5}$ and PM_{10})	PM_1: 10 µg/m^3	24 hours (4 permitted exceedance days per year)
	PM_1: 3.5 µg/m^3	1 year
	$PM_{2.5}$: 15 µg/m^3	24 hours (4 permitted exceedance days per year)
	$PM_{2.5}$: 5 µg/m^3	1 year
	PM_{10}: 45 µg/m^3	24 hours (4 permitted exceedance days per year)
	PM_{10}: 15 µg/m^3	1 year

SCHEDULE 3

Section 1

POLLUTANTS CAUSING PRIMARILY ENVIRONMENTAL HARM

1 Pollutant concentrations

Pollutant	*Unit*	*Calendar year*
Ammonia (NH_3)	3 µg/m^3	1 year
Ground-level ozone (O_3)	AOT40 (calculated from 1 hour values) 6,000 µg/m^3 hours	Summer (1 April to 30 September)
Nitrogen oxides (NOx) (expressed as NO_2)	75 µg/m^3	24 hours
	30 µg/m^3	Calendar year
Sulphur dioxide (SO_2)	20 µg/m^3	Calendar year and winter (1 October to 31 March)

2 Pollutant emissions

Pollutant	*Unit*	*Calendar year*
Ammonia (NH_3)	283 kilotonnes	2020
	271 kilotonnes	2025
	258 kilotonnes	2030
Non-methane volatile organic compounds (NMVOCs)	689 kilotonnes	2020
	671 kilotonnes	2025
	654 kilotonnes	2030
Oxides of nitrogen (NOx)	724 kilotonnes	2020
	579 kilotonnes	2025
	434 kilotonnes	2030
Particulate matter ($PM_{2.5}$)	79 kilotonnes	2020
	70 kilotonnes	2025
	61 kilotonnes	2030
Sulphur dioxide (SO_2)	292 kilotonnes	2020
	188 kilotonnes	2025
	85 kilotonnes	2030

SCHEDULE 4

Section 1

POLLUTANTS CAUSING CLIMATE CHANGE

1 Non-fluorinated gases

Pollutant or measure	*MtCO2e*	*Period or calendar year*
"Net UK carbon account" as defined in section 27 of the Climate Change Act 2008	2,544	2018 to 2022 (3rd budget)
	1,950	2023 to 2027 (4th budget)
	1,725	2028 to 2032 (5th budget)
	965	2033 to 2037 (6th budget)
	Zero	2050
Methane (CH_4)	Reduce emissions by around 19% below 2015 levels	2030
Nitrous oxide (N_2O)	Reduce emissions by around 19% below 2015 levels	2030

2 Fluorinated gases

Pollutant	*MtCO2e*	*Calendar year*
Hydrofluorocarbons	Reduce emissions by at least 79% below 2015 levels	2030
	Reduce emissions by at least 86% below 2015 levels	2036
Nitrogen trifluoride	Reduce emissions by at least 68% below 2016 levels	2030
Perfluorocarbons	Reduce emissions by at least 68% below 2016 levels	2030
Sulphur hexafluoride	Reduce emissions by at least 68% below 2016 levels	2030

SCHEDULE 5

Section 4

THE PROTOCOLS TO THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE'S CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

1 The 1984 Geneva Protocol on Long-Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP).

2 The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent.

3 The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes.

4 The 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes.

5 The 1994 Oslo Protocol on Further Reduction of Sulphur Emissions.

6 The 1998 Aarhus Protocol on Heavy Metals, as amended on 13 December 2012.

7 The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs), as amended on 18 December 2009.

8 The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone, as amended on 4 May 2012.

SCHEDULE 6

Section 4

THE CLEAN AIR ENACTMENTS

Health

1 The clean air enactments related to health are—
(a) the Public Health Act 1925;
(b) the Public Health Act 1936;
(c) the Public Health Act 1961;
(d) the Noise and Statutory Nuisance Act 1993;
(e) the Health and Social Care Act 2012;
(f) the Well-being of Future Generations (Wales) Act 2015.

Pollution and air quality

2 The clean air enactments related to clean air and pollution are—
(a) the Clean Air Act 1956;
(b) the Clean Air Act 1968;
(c) the Clean Air (Emission of Grit and Dust from Furnaces) Regulations 1971 (S.I 1971/162);
(d) the Control of Pollution Act 1974;
(e) the Clean Air Act 1993;
(f) the Motor Fuel (Composition and Content) Regulations 1999 (S.I. 1999/3107);

(g) the Pollution Prevention and Control Act 1999;
(h) the Air Quality (England) Regulations 2000 (S.I. 2000/928);
(i) the Air Quality (Wales) Regulations 2000 (S.I. 2000/1940 (W.138));
(j) the Pollution Prevention and Control (England and Wales) Regulations 2000 (S.I. 2000/1973);
(k) the Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007 (S.I. 2007/79);
(l) the Air Quality Standards Regulations 2010 (S.I. 2010/1001);
(m) the Air Quality Standards (Wales) Regulations 2010 (S.I. 2010/1433 (W.126));
(n) the Air Quality Standards (Amendment) Regulations 2016 (S.I. 2016/1184);
(o) the Motor Fuel (Composition and Content) and Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 (S.I. 2010/3035);
(p) the Ecodesign for Energy-Related Products Regulations 2010 (S.I. 2010/2617);
(q) the Clean Air (Miscellaneous Provisions) (England) Regulations 2014 (S.I. 2014/3318);
(r) the Sulphur Content of Liquid Fuels (England and Wales) (Amendment) Regulations 2014 (S.I. 2014/1975);
(s) the Pollution Prevention and Control (England and Wales) Regulations 2000 (S.I. 2000/1973);
(t) the Large Combustion Plants (England and Wales) Regulations 2002 (S.I. 2002/2688);
(u) the Environmental Permitting (England and Wales) (Amendment) Regulations 2018 (S.I. 2018/110).

Aviation

3 The clean air enactment related to aviation is the Civil Aviation Act 1982.

Environment

4 The clean air enactments related to the environment are—
(a) the Environmental Protection Act 1990;
(b) the Environmental Protection (Prescribed Processes and Substances) Regulations 1991 (S.I. 1991/472);
(c) the Environment Act 1995;
(d) the Local Government Act 2000;
(e) the Environmental Assessment of Plans and Programmes Regulations 2004 (S.I. 2004/1633);
(f) the Clean Neighbourhoods and Environment Act 2005;
(g) the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (S.I. 2013/390);
(h) the Environmental Permitting (England and Wales) (Amendment) (No. 2) Regulations 2013 (S.I. 2013/766)
(i) the Environmental Permitting (England and Wales) (Amendment) (No. 2) Regulations 2016 (S.I. 2016/475);
(j) the Environmental Permitting (England and Wales) Regulations 2016 (S.I. 2016/1154);

(k) the Environmental Act 2021.

Vehicles

5 The clean air enactments related to vehicles are—

(a) the Road Vehicles (Construction and Use) Regulations 1986 (S.I. 1986/1078);
(b) the Road Traffic Offenders Act 1988;
(c) the Road Traffic Reduction Act 1997;
(d) the Road Traffic (Vehicle Emissions) (Fixed Penalty) (England) Regulations 2002 (S.I. 2002/1808);
(e) the Road Vehicles (Construction and Use) (Amendment) Regulations 2004 (S.I. 2004/1706);
(f) the Non-Road Mobile Machinery (Emission of Gaseous and Particulate Pollutants) (Amendment) Regulations 2014 (S.I. 2014/1309);
(g) the Road Vehicles (Construction and Use) (Amendment etc.) (No. 2) Regulations 2017 (S.I. 2017/1251).

Planning

6 The clean air enactments related to planning are—

(a) the Town and Country Planning Act 1990;
(b) the Planning Act 2008;
(c) the Localism Act 2011;
(d) the Neighbourhood Planning Act 2017.

Climate change

7 The clean air enactments related to climate change are—

(a) the Greater London Authority Act 1999;
(b) the Motor Fuel (Composition and Content) Regulations 1999 (S.I. 1999/3107);
(c) the Climate Change and Sustainable Energy Act 2006;
(d) the Persistent Organic Pollutants Regulations 2007 (S.I. 2007/3106);
(e) the Sulphur Content of Liquid Fuels (England and Wales) Regulations 2007 (S.I. 2007/79);
(f) the Climate Change Act 2008;
(g) the Promotion of the Use of Energy from Renewable Sources Regulations 2011 (S.I. 2011/243);
(h) the Renewable Transport Fuel Obligations (Amendment) Order 2011 (S.I. 2011/2937);
(i) the Greenhouse Gas Emissions Trading Scheme Regulations 2012 (S.I. 2012/3038);
(j) the Motor Fuel (Road Vehicle and Mobile Machinery) Greenhouse Gas Emissions Reporting Regulations 2012 (S.I. 2012/3030);
(k) the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 (S.I. 2013/971);
(l) the Renewable Transport Fuel Obligations (Amendment) Order 2013 (S.I. 2013/816);
(m) the Fluorinated Greenhouse Gases Regulations 2015 (S.I. 2015/310);

(n) the Ozone-Depleting Substances Regulations 2015 (S.I. 2015/168);
(o) the Alternative Fuels Infrastructure Regulations 2017 (S.I. 2017/897).

Shipping

8 The clean air enactments related to shipping are—
(a) the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (S.I. 2008/2924);
(b) the Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2010 (S.I. 2010/895);
(c) the Merchant Shipping (Prevention of Air Pollution from Ships) and Motor Fuel (Composition and Content) (Amendment) Regulations 2014 (S.I. 2014/3076);
(d) the Merchant Shipping (Monitoring, Reporting and Verification of Carbon Dioxide Emissions) and the Port State Control (Amendment) Regulations 2017 (S.I. 2017/825).

Habitats

9 The clean air enactments related to habitats are—
(a) the European Union's General Union Environment Action Programme to 2020: Living well, within the limits of our planet (the 7th Environment Action Programme);
(b) the Conservation of Habitats and Species Regulations 2017 (S.I. 2017/1012);
(c) the Conservation of Offshore Marine Habitats and Species Regulations 2017 (S.I. 2017/1013).

SCHEDULE 7

Section 13

CONSTITUTION OF THE CITIZENS' COMMISSION FOR CLEAN AIR

Mission

1 The Citizen's Commission for Clean Air (CCCA) must exercise the powers conferred by this Act, and in order to monitor and enforce the right to breathe clean air and the duties to achieve and maintain clean air in England and Wales, its guiding principles must include—
(a) the environmental principles set out in section 17;
(b) demonstrating in its actions independence from the Government and upholding domestic laws to protect and improve the environment;
(c) ensuring that standards are set to protect public health and the environment;
(d) assessing and improving compliance with relevant environmental law by the Government and the relevant national authorities including the achievement of the limits in Schedules 1 to 4;
(e) undertaking inquiries and formal investigations to identify systemic risks;
(f) making recommendations and issuing compliance notices;
(g) involving and representing members of the public; and

(h) properly requesting resources and powers to fulfil its duties.

2 The CCCA must work collaboratively with all other similar bodies and the relevant national authorities across all parts of the United Kingdom.

Membership

3 The Secretary of State must appoint between 10 and 15 individuals as members of the CCCA (to be known as "Commissioners").

4 The chief executive of the CCCA (appointed under paragraph 22) must be a Commissioner ex officio.

5 In appointing Commissioners, the Secretary of State must—

(a) appoint an individual only if the Secretary of State considers that the individual—

(i) has experience or knowledge relating to a relevant matter; or

(ii) is suitable for appointment for some other reason; and

(b) have regard to the desirability of the Commissioners collectively having sufficient experience and knowledge relating to the relevant matters.

6 For the purposes of paragraph 5, the relevant matters are those matters in respect of which the CCCA has functions including and in particular—

(a) health;

(b) human rights;

(c) environmental protection;

(d) climate change;

(e) enforcement powers;

(f) law;

(g) planning;

(h) science; and

(i) public involvement in decision making.

7 A Commissioner must hold and vacate office in accordance with the terms of their appointment (subject to this Schedule).

8 The appointment of a Commissioner must be expressed to be for a specified period of not less than two years and not more than five years.

9 A Commissioner whose period of membership has expired may be reappointed.

10 A Commissioner may resign by giving notice in writing to the Secretary of State.

11 The Secretary of State may dismiss a Commissioner who is, in the opinion of the Secretary of State, unable, unfit or unwilling to perform their functions.

12 Paragraphs 3 and 5 to 11 do not apply to the chief executive of the CCCA.

Chairperson

13 The Secretary of State must appoint—

(a) a Commissioner as Chairperson; and

(b) one or more Commissioners as deputy Chairperson or Chairpersons.

14 The Chairperson must—
(a) preside over meetings of the CCCA;
(b) perform such functions as may be specified in the terms of their appointment; and
(c) perform such other functions as may be assigned to them by the CCCA.

15 A deputy Chairperson—
(a) may act for the Chairperson when they are unavailable, and
(b) must perform—
(i) such functions as may be specified in the terms of their appointment; and
(ii) such other functions as the Chairperson may delegate or assign to them.

16 The Chairperson or a deputy Chairperson—
(a) must vacate office if they cease to be a Commissioner;
(b) may resign by giving notice in writing to the Secretary of State; and
(c) otherwise must hold and vacate office in accordance with the terms of their appointment (and may be reappointed at a later date).

17 If the Chairperson resigns they cease to be a Commissioner (but they may be reappointed as a Commissioner at a later date).

18 The chief executive may not be appointed Chairperson or deputy Chairperson.

19 The CCCA may regulate its own proceedings (subject to this Schedule).

20 The CCCA must determine a quorum for its meetings.

21 At least five Commissioners must participate in the process by which a determination under paragraph 20 is made.

Staff

22 The CCCA—
(a) must appoint a chief executive; and
(b) may appoint other staff.

Committees

23 The CCCA may establish one or more committees, to be known as advisory committees, to advise the CCCA.

24 An advisory committee may include any of the following—
(a) Commissioners;
(b) staff;
(c) other non-Commissioners.

25 The CCCA may establish one or more committees to whom the CCCA may delegate functions, to be known as decision-making committees.

26 A decision-making committee may include any of the following—
(a) Commissioners;
(b) staff;

(c) other non-Commissioners.

27 The CCCA must ensure that the Chairperson of each decision-making committee is a Commissioner.

28 In allocating its resources the CCCA must consider the duty of each decision-making committee to exercise their functions.

29 A member of a committee must hold and vacate office in accordance with the terms of their appointment by the CCCA, which may include provision for dismissal.

30 The CCCA—

(a) may, to any extent, regulate the proceedings of a committee and may, in particular, determine a quorum for meetings;

(b) may, to any extent, permit a committee to regulate its own proceedings and may, in particular, enable a committee to determine a quorum for meetings; and

(c) may dissolve a committee.

Annual Report

31 The CCCA must for each financial year prepare a report on the performance of its functions in that year, to be known as its annual report.

32 An annual report must, in particular, evaluate the CCCA's performance of its functions.

33 The CCCA must send each annual report to the Secretary of State within the period of six months beginning with the end of the financial year to which the report relates.

34 A copy of each annual report received under paragraph 33 must be laid before both Houses of Parliament by the Secretary of State.

Money

35 The Secretary of State may pay to the Chairperson, any deputy Chairperson and each Commissioner—

(a) such remuneration as the Secretary of State may determine; and

(b) such travelling and other allowances as the Secretary of State may determine.

36 The CCCA may pay to, or in respect of, the Chairperson, any deputy Chairperson and each other Commissioner, such sums as the Secretary of State may determine by way of, or in respect of, pensions, allowances or gratuities.

37 The Secretary of State may make grants to the CCCA of such amount and subject to such conditions as the Secretary of State thinks fit.

Status

38 The CCCA must not—

(a) be regarded as the servant or agent of the Crown; or

(b) enjoy any status, immunity or privilege of the Crown.

39 Service as Commissioner or employee of the CCCA is not employment in the civil service of the State.

Freedom of information

40 In Part VI of Schedule 1 to the Freedom of Information Act 2000 (public bodies) after "The Children's Commissioner for Wales" insert "The Citizens' Commission for Clean Air".

Clean Air (Human Rights) Bill [HL]

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B I L L

To establish the right to breathe clean air; to require the Secretary of State to achieve and maintain clean air in England and Wales; to involve the UK Health Security Agency in setting and reviewing pollutants and their limits; to enhance the powers, duties and functions of various agencies and authorities in relation to air pollution; to establish the Citizens' Commission for Clean Air with powers to institute or intervene in legal proceedings; to require the Secretary of State and the relevant national authorities to apply environmental principles in carrying out their duties under this Act and the clean air enactments; and for connected purposes.

Baroness Jones of Moulsecoomb

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