



National Audit Office

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## **Report**

by the Comptroller  
and Auditor General

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**Environmental Audit Committee,  
Environment, Food and Rural Affairs Committee,  
Health Committee and Transport Committee**

# Air quality

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Environment, Food and Rural Affairs Committee,  
Health Committee and Transport Committee

# Air quality

Report by the Comptroller and Auditor General

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Commons in accordance with Section 9 of the Act

Sir Amyas Morse KCB  
Comptroller and Auditor General  
National Audit Office

13 November 2017

This briefing gives an overview of government's approach to improving air quality in the UK.

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The National Audit Office study team consisted of: Caroline Brewer, Tom Glithero, Jenna Gregg, Stanley Kwong, Katy Losse, Shoko Okamura and Fedra Vanhuysse, under the direction of Keith Davis.

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For further information about the National Audit Office please contact:

National Audit Office  
Press Office  
157–197 Buckingham Palace Road  
Victoria  
London  
SW1W 9SP

Tel: 020 7798 7400

Enquiries: [www.nao.org.uk/contact-us](http://www.nao.org.uk/contact-us)

Website: [www.nao.org.uk](http://www.nao.org.uk)

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## Key facts

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**Over 85%**

proportion of air quality zones in the UK (37 of 43) that did not meet EU nitrogen dioxide limits in 2016

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**2026**

government's estimate of when all 43 zones in the UK will be compliant with EU nitrogen dioxide limits

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**2010**

original deadline for compliance with EU nitrogen dioxide limits

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<b>2021</b>	Year by which government expects to achieve compliance with EU limits on NO <sub>2</sub> in 37 of the UK's 43 air quality zones
<b>31 Dec 2019</b>	Date by which government expects five cities to have introduced new measures so that local air quality meets nitrogen dioxide limits in 2020
<b>31 Dec 2018</b>	Date by which government expects a further 23 local authorities to have completed plans for new measures to secure compliance with air quality limits as quickly as possible
<b>Under review</b>	Estimated mortality impact of nitrogen dioxide pollution
<b>29,000</b>	Estimated equivalent number of deaths caused by fine particulate matter in the UK in 2008
<b>£20 billion</b>	Royal College of Physician's estimate of cost of the health impacts of air pollution to the UK in 2016
<b>80%</b>	Estimated proportion of nitrogen oxides concentrations at the roadside due to road transport (national average)
<b>13%</b>	Proportion of all fine particulate matter emissions in the UK due to road transport
<b>£2.5 billion</b>	Potential spend between 2015 and 2020 on schemes with intended air quality benefits of which government's Joint Air Quality Unit directly oversees £0.3 billion
<b>2018</b>	Year in which government plans to publish a wider air quality strategy

# Summary

## Aim and scope

**1** This briefing gives an overview of government's approach to improving air quality in the UK. It has been prepared in support of a joint inquiry by the Environmental Audit Committee, the Environment, Food and Rural Affairs Committee, the Health Committee and the Transport Committee of the House of Commons.

**2** Air pollution is the presence or introduction of any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere, such as nitrogen dioxide and particulate matter. Improving air quality is a cross-government responsibility. It is a devolved matter, and the respective administrations are responsible for developing air quality policy in Northern Ireland, Wales and Scotland. For England, responsibilities include:

- the Department for Environment Food & Rural Affairs (Defra), for air quality policy and strategy;
- the Department for Transport (DfT), for policy measures to reduce air pollution from transport, such as schemes to promote cycling and walking, and to mitigate the effect of new road-building;
- the Department for Communities and Local Government (DCLG), for alignment with its approach to local growth, with its stewardship of the local government financial system, and with the national planning system;
- the Department for Business, Energy & Industrial Strategy (BEIS) for regulation of industrial pollution, alignment with government's industrial strategy and for alignment with its plans to tackle climate change;
- the Department of Health and Public Health England, for advice on the health impacts of air pollution;
- local authorities, which have had statutory air quality duties since 1995 including requirements to designate air quality problem areas as 'Air Quality Management Areas' and to develop action plans to resolve the problem; and
- the Mayor of London, who sets policies and leads on the implementation of air quality measures in the capital.

**3** In this briefing we set out:

- **why air quality matters** (Part One), covering the causes and consequences of air pollution, EU air quality limits, and how the UK is performing compared with other EU member states;
- **the UK's plan for improving air quality** (Part Two), covering government's latest (July 2017) plan for tackling roadside concentrations of nitrogen dioxide, and the analysis and modelling that informed the 2017 Plan; and
- **risks and success factors for delivery of government's air quality plans** (Part Three).

**4** This briefing is based on publicly available information, supplemented by interviews with Defra, DfT, DCLG and stakeholders, as well as a review of selected internal government documents (see Appendix Two).

## **Key points**

Why air quality matters

**5 Concentrations of pollutants in the air pose a risk to health and the environment.** An expert Committee to the Department of Health has estimated that fine particulate matter (PM<sub>2.5</sub>) increased mortality by the equivalent of 29,000 deaths in the UK in 2008. It considers that on the balance of evidence nitrogen dioxide presents an additional health risk, though it cautions that it is not yet possible to make a reliable quantitative estimate of the size of this effect. Public Health England reports that long-term exposure to poor air quality is a contributory factor to around as many deaths in England as alcohol. The Royal College of Physicians has estimated that the health impacts of air pollution cost the UK £20 billion in 2016 (paragraphs 1.2 to 1.5 and Figure 1).

**6 This is despite emissions of pollutants from transport, industry and other sources having fallen in recent decades.** UK emissions of nitrogen oxides (NO<sub>x</sub>)<sup>1</sup> and fine particulate matter fell by 69% and 76% respectively from 1970 to 2015, with similar reductions in other pollutants. These reductions have been achieved through legislative restrictions on industry, European vehicle emission standards, and a shift in the UK fuel mix away from coal, among other measures (paragraph 1.7).

<sup>1</sup> The term nitrogen oxides covers nitrogen *di*-oxide (NO<sub>2</sub>) and nitric oxide (NO). The latter can react in the atmosphere to produce secondary NO<sub>2</sub>.

**7 The UK has not yet met EU concentration limits for one pollutant (NO<sub>2</sub>) that had a compliance deadline of 2010.** For reporting purposes the UK is divided into 43 air quality zones. A zone is deemed to be non-compliant if the UK's official monitoring and modelling shows that concentrations of pollutants in the air at one or more locations within the zone exceed certain limits. In 2016, 37 of the UK's 43 air quality zones did not comply with annual limits for nitrogen dioxide concentrations. Meeting these limits has been a problem across Europe, and the European Commission has launched infringement cases against a number of Member States, including the UK, Germany, France and Spain. In February 2017, the European Commission took forward the second phase of its infringement case against the UK by issuing a 'Reasoned Opinion'. This required the UK to show how it will comply with legal limits as quickly as possible. If the Commission is not satisfied with the UK's response it could refer the matter to the Court of Justice of the European Union. Government considers that a key cause of non-compliance is the failure of European vehicle regulations (Euro standards) to deliver expected emissions reductions in real-world driving conditions (see paragraphs 1.10 and 1.11).

**8 Road transport is the main contributor to non-compliance with nitrogen dioxide concentration limits, though wider air pollution problems arise from a range of sources.** The concentration of air pollutants at any particular location is determined by a combination of regional and local factors. Road transport is the largest single source of nitrogen oxide (NO<sub>x</sub>) emissions and is responsible for 80% of the NO<sub>x</sub> concentrations at locations where the UK exceeds legal limits, on average. But it is not the most significant source of emissions of all air pollutants: wood and coal burning by households represents 42% of fine particulate matter emissions, while agriculture contributes 81% of ammonia emissions (paragraph 1.6).

**9 The government has said that it remains committed to maintaining environmental protections after the UK exits the European Union.** Under the current provisions of the European Union (Withdrawal) Bill, law derived from the EU would continue in domestic law after Exit Day. This includes air quality limits and ceilings. Current arrangements for enforcement of these legal duties will no longer apply if the UK is no longer in the jurisdiction of the Court of Justice of the European Union. UK courts will continue to have a role through the judicial review process, but it is not clear whether or how government will provide for equivalent arrangements for independent, regular review of progress and financial penalties for non-compliance. The Secretary of State for Defra has said that he recognises stakeholders' concerns about a 'governance gap' after EU exit, and that proposals to address this will be considered in the course of the progress of the Withdrawal Bill. On 12 November he announced plans to consult on a new, independent body to hold the government to account for upholding environmental standards in England after the UK leaves the European Union (see paragraphs 1.14 and 1.17).

The UK's plan for improving air quality

**10 Government published its latest air quality plan in July 2017 following a series of legal challenges to previous plans.** In November 2016, the High Court concluded that the government's 2015 air quality plan was not compliant with the relevant regulations. It found that the Secretary of State fell into error in fixing on a projected compliance date of 2020 (and 2025 for London) and adopted too optimistic a model for future emissions. It concluded that the Secretary of State should aim to achieve compliance by the soonest date possible, choosing a route which reduces exposure as quickly as possible. Government published a final revised air quality plan focused on roadside nitrogen dioxide concentrations at the end of July 2017 (the 2017 Plan) (paragraphs 1.15 and 2.2).

**11 A key component of the 2017 Plan is an expectation that 28 local authorities will implement new air quality measures to achieve compliance 'in the shortest possible time'.** As part of the 2017 Plan, government wants to accelerate local authority action on air quality. It has issued a direction to 23 English local authorities to develop new local air quality plans, and is offering associated support, guidance and funding. These local authorities must complete feasibility studies for new air quality measures as soon as possible, with initial plans at the latest by 31 March 2018 and with final plans by 31 December 2018 at the latest. Central government will test whether these plans secure compliance in the shortest possible time, including by comparing the plans against its estimate that the introduction of 'charging clean air zones' could secure compliance by 2021. A charging clean air zone involves charging certain types of vehicles to enter certain areas in order to discourage use of the most polluting vehicles. The 2017 Plan also expects that a further five cities will continue with their plans to introduce new measures to secure compliance in 2020. Government expects that measures in the 2017 plan will secure full compliance in 2026, with 37 of the UK's 43 air quality zones compliant by 2021 (paragraphs 2.2 to 2.5).

**12 Government selected these local authorities based on the central scenario of a complex modelling process that is subject to substantial uncertainty.** The number of local authorities directed to take additional action under the 2017 Plan is based on a central forecast of the areas that would not comply with NO<sub>2</sub> limits in 2021 without additional local action. This is estimated by a complex modelling process that draws on several subsidiary models and numerous datasets. There will be inherent uncertainty in any model of a complex issue like air quality and so it is important for policy makers to consider the range of likely scenarios as well as a central forecast. The complexity of the air quality modelling makes it difficult to quantify the uncertainty involved, but government recognises that it is substantial. In consultation with an expert panel, government analysts concluded that the uncertainty could be +/- 29%. This would mean that while the most likely scenario is that 25 zones would be non-compliant in 2021 without additional local action, the range of possible scenarios without additional local action is between 1 and 37 non-compliant zones. Government considers that this represents the extremes of what is possible and is developing analysis to better understand the likelihood within this range (paragraphs 2.8 to 2.12).

**13 Government has committed to publish a wider air quality strategy in 2018, covering a broader range of pollutants and sources.** The 2017 Plan focuses on transport because vehicles are responsible for most of the NO<sub>2</sub> concentrations at the roadside, where the UK exceeds legal limits. There are, however, other significant contributors to air pollution such as domestic wood-burning, agriculture, industry and fossil fuel power plants. Government will set out its approach to these wider sources of air pollution in 2018 (paragraphs 1.6 and 1.9).

#### Risks and success factors

**14 The new expectations on local authorities come at a time when they are facing funding pressures.** Since 2010 government has reduced funding for local authorities as part of its plan to address the fiscal deficit. Our 2014 report on *Financial sustainability of local authorities* highlighted that local authorities have worked hard to manage the reductions in government funding through a mixture of efficiency measures and service transformation.<sup>2</sup> Government needs to assure itself that local authorities have sufficient capacity and resource to manage the actions needed. To support local authorities, government has announced a £255 million implementation fund to 2020-21 for the 28 local authorities that it expects to accelerate action on air quality, and is offering associated support and guidance. It has also committed to establish an additional Clean Air Fund to which local authorities will be able to apply, the details of which have not yet been announced (paragraphs 3.14 to 3.17).

**15 Local authorities will need support from a wide range of other organisations to resolve local air quality problems.** Local air quality is a function of national as well as local factors, such as the tax incentives on drivers to purchase types of vehicles, the impact of decisions made by Highways England relating to the Strategic Road Network, and progress in establishing the infrastructure for electric vehicles. Local authority work on air quality is also complicated by the separation between tiers of local government: while district or city councils have responsibility for managing local air quality, transport is managed by county councils (see paragraphs 3.4 and 3.13).

<sup>2</sup> Comptroller and Auditor General, *Financial sustainability of local authorities*, Session 2014-15, HC 783, National Audit Office, November 2014, available at: [www.nao.org.uk/report/financial-sustainability-of-local-authorities-2014/](http://www.nao.org.uk/report/financial-sustainability-of-local-authorities-2014/)

## **16 Strong leadership and co-ordination within government is important for achieving substantial and sustained improvements in air quality across all pollutants.**

In February 2016 Defra and DfT took the important step of establishing a joint air quality unit to oversee delivery of government's plan for tackling NO<sub>2</sub> compliance. This unit has an oversight Board with representation from across central government, and therefore provides a valuable forum to improve collaboration and co-ordination. However we consider that key improvements may be needed. The unit's Board does not include local authorities or the Local Government Association, despite the key role that local government is expected to play in improving air quality. Nor does the unit systematically oversee spend and progress on schemes run by other parts of government that include intended air quality benefits. These schemes represent over £2.2 billion of potential spend between 2015 and 2020 across more than 8 sets of initiatives to promote changes such as greater take-up of electric vehicles, and support for cycling and walking. This means that there is no clear single responsibility within government for knowing whether the initiatives form a coherent portfolio that delivers good value for money as a whole in relation to air quality. Defra and DfT told us that they agree that this is an important objective, but believe that the arrangements which they currently have in place should secure this (paragraphs 3.5 and 3.9 to 3.11).

## **Issues the Committees may wish to put to government**

### Why air quality matters

- How will EU exit affect government's approach to air quality: are ceilings, limits and priorities likely to change, how will limits be enforced?
- What will need to be in place before EU exit to secure a smooth transition for air quality legislation and standards?
- When will we have updated estimates of the adverse impacts of UK air quality?

### The UK's plan for improving air quality

- How does the plan draw on lessons learnt from government's performance on tackling air pollution to date?
- What provisions have you made to reflect the significant uncertainty associated with air quality modelling?
- What are the main issues that you plan to address in the 2018 air quality strategy?

### Risks and success factors

- How are you dealing with the risk that local authorities do not have sufficient resources and expertise to be able to meet air quality requirements effectively? What factors will determine the size and eligibility criteria for the new Clean Air Fund?
- How will you make sure that local authorities receive the right support and engagement from other parts of government?
- How can you strengthen arrangements for leadership, oversight and communication across government on air quality: what additional skills and capacity will the Joint Air Quality Unit need; should local authorities be better represented at a national strategic level; and how will you track overall progress on national as well as local air quality measures?

# Part One

## Why air quality matters

1.1 This part covers:

- the causes and consequences of poor air quality;
- the progress the UK has made in complying with European Union (EU) regulations on air quality; and
- the impact of leaving the EU.

### Consequences and causes of air pollution

1.2 Air pollution is the presence or introduction of any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Emissions of air pollutants can occur naturally but also arise from human activity, in particular from the combustion of fossil fuels in generating electricity, heating and transport (see paragraph 1.6 and Figure 2).

1.3 Air pollution has substantial health, economic and environmental impacts in the UK (**Figure 1** on page 13). The Department for Environment, Food & Rural Affairs (Defra) describes poor air quality as “the largest environmental risk to public health in the UK”. The effects of exposure to air pollutants include:

- Particulate matter (PM) can cause respiratory effects such as wheezing and coughing and can worsen asthma and chronic bronchitis. Fine particulate matter,  $PM_{2.5}$ , is of particular health concern due to penetrating deep into lungs and other tissues, including the brain, with a range of negative health effects from both long- and short-term exposure, such as increased levels of fatal cardiovascular and respiratory diseases.<sup>3</sup>
- Nitrogen oxides ( $NO_x$ ) cause inflammation of the airways and are associated with reductions in lung function.  $NO_x$  emissions include both primary  $NO_2$  and nitric oxide (NO) with the latter reacting in the atmosphere to produce secondary  $NO_2$ .
- Carbon monoxide (CO) reduces the blood’s capacity to carry oxygen through the body and blocks biochemical reactions in cells.
- Sulphur dioxide ( $SO_2$ ) and Ozone ( $O_3$ ) are both respiratory irritants and exacerbate asthma.

3 Data on PM are often categorised by particle size.  $PM_{10}$  particles are less than 10 microns in diameter – about one seventh of the thickness of a human hair.  $PM_{2.5}$  particles are less than 2.5 microns in diameter, and are also referred to as fine particulate matter.

**1.4** There are a range of estimates of the scale of these health effects (Figure 1). An expert Committee of the Department of Health, the Committee on the Medical Effects of Air Pollutants (COMEAP) has estimated that fine particulate matter (PM<sub>2.5</sub>) contributed to a mortality effect equivalent to 29,000 deaths in 2008, reducing life expectancy by an average of six months.<sup>4</sup> It expresses the mortality impact in terms of equivalent deaths, as air pollution is a contributory factor to a range of health conditions. Public Health England reports that long-term exposure to particulate matter contributes to around as many deaths in England as alcohol.

**1.5** COMEAP recently examined evidence on the health impacts of NO<sub>2</sub>. Its interim advice to government was that while it is difficult to disaggregate the effects of NO<sub>2</sub> from the effects of other air pollutants, on the balance of probability, NO<sub>2</sub> itself is a health risk. It cautioned that any calculation of attributable deaths from NO<sub>2</sub> is likely to include some overlap with the 29,000 deaths previously calculated for PM<sub>2.5</sub>, and that it is not possible to make a reliable assessment of the size of the mortality burden associated solely with NO<sub>2</sub>. Instead, COMEAP is considering the effect on mortality from the air pollution mixture as a whole.

<sup>4</sup> COMEAP is an expert committee of the Department of Health. It was established to advise government on the effects of air pollution by interpreting the wide range of evidence available. The Committee is chaired by Professor Frank Kelly, Chair in Environmental Health, King's College London. It includes both academics and air quality practitioners, as well as a lay member to ensure that the general public can access and understand the Committee's work.

## Figure 1

### Effects of poor air quality

Area of risk	Effects
Health	<p>Fine particulate matter (PM<sub>2.5</sub>) is estimated by the Committee on the Medical Effects of Air Pollutants (COMEAP) to have contributed to an equivalent of 29,000 deaths in 2008, reducing average life expectancy by six months.</p> <p>The Royal College of Physicians estimates that the total burden of outdoor air pollution is the equivalent of 40,000 deaths annually.</p> <p>There is not a consensus among experts on a quantified estimate of the mortality impact of nitrogen dioxide (NO<sub>2</sub>) alone. COMEAP advises that the available evidence and methods do not allow them to make a reliable assessment of the size of the effect which is attributable to NO<sub>2</sub> itself.</p>
Environment	<p>Air pollutants alter the chemical composition of the air, which affects plant respiration and the composition of rainwater. Impacts of this include:</p> <ul style="list-style-type: none"> <li>● 44% of UK sensitive habitats affected by acid rain in 2013;</li> <li>● 66% of UK sensitive habitats affected by eutrophication (excessive richness of nutrients) in 2013; and</li> <li>● increases in ground-level ozone, resulting in reductions of yields from sensitive crops such as wheat.</li> </ul>
Economic	<p>Several estimates of different aspects of the economic costs of air pollution have been produced. These include:</p> <ul style="list-style-type: none"> <li>● more than £16 billion a year cost to public health of exposure to particulate matter (estimated by Defra);</li> <li>● £2.7 billion cost of productivity impacts from pollution levels in 2012, (estimated by Ricardo-AEA on behalf of Defra); and</li> <li>● more than £20 billion a year costs to society, business and health services from the health problems resulting from air pollution (estimated by the Royal College of Physicians).</li> </ul>

Source: National Audit Office analysis

**1.6** The concentration of air pollutants at any particular location is determined by a combination of regional and local factors. Local road transport is responsible for 60% of the nitrogen oxide concentrations at roadside locations where the UK exceeds legal limits, on average, with regional road transport emissions (emissions from other roads in the wider area) responsible for a further 20% of nitrogen dioxide concentrations in these locations. But it is not the most significant source of emissions of all air pollutants: wood and coal burning by households represents 42% of fine particulate matter emissions, while agriculture contributes 81% of ammonia emissions (**Figure 2** overleaf).

**Figure 2**

## Significant sources of UK pollutants in 2015

	Ammonia (NH <sub>3</sub> ) (%)	Non-methane volatile organic compounds (NMVOCs) (%)	Nitrogen Oxides (NO <sub>x</sub> ) (%)	Sulphur Dioxide (SO <sub>2</sub> ) (%)	Fine particulate matter (PM <sub>2.5</sub> ) (%)
Agriculture	81	12			
Energy industries			29	54	4
Fugitive emissions		17			
Industrial processes	1	56			
Manufacturing industries and construction			16	21	17
Non-road transport			9		
Residential combustion					42
Road Transport	2	3	34	1	13
Small stationary combustion		6		17	
Waste	8				
Other sources not separately identified	8	6	12	7	24

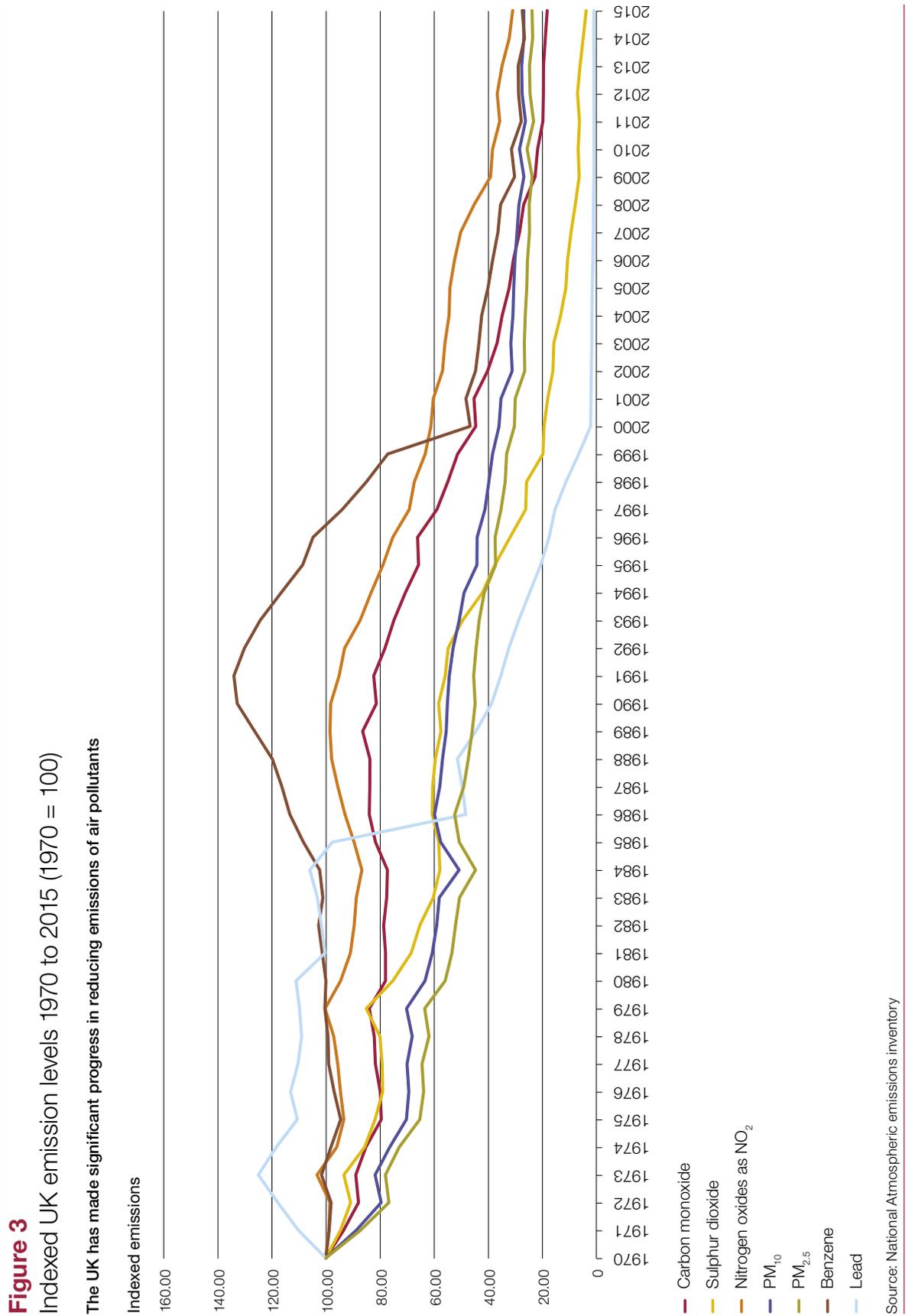
**Note**

1 Emissions are shown for the most significant sources only. Where a source is not listed against a pollutant it does not indicate that the source does not contribute towards that pollutant. Any contribution not separately listed is contained within the 'Other sources not separately identified' contribution to that pollutant.

Source: National atmospheric emissions inventory

**Progress against EU regulations on air quality**

**1.7** The UK has made significant progress in reducing emissions of air pollutants over the past few decades (**Figure 3**). For example, emissions of NO<sub>x</sub> and PM<sub>2.5</sub> fell by 69% and 76% respectively from 1970 to 2015. This has been achieved through legislation on industrial emissions, European vehicle emission standards, and a shift in the UK fuel mix away from coal, among other measures.



**1.8** The EU 2001 National Emission Ceilings Directive sets national ‘ceilings’ for air pollutants and was transposed into UK legislation by the National Emission Ceilings Regulations 2002. The ceilings cover four pollutants (nitrogen oxides, sulphur dioxide, non-methane volatile organic chemicals and ammonia) to be met from 2010. The EU 2008 Ambient Air Quality Directive sets limits for *concentrations* of pollutants in the air and was transposed into UK legislation through the Air Quality Standards Regulations 2010. It sets limits for ambient concentrations of seven pollutants (nitrogen dioxide, particulate matter, fine particulate matter, sulphur dioxide, lead, carbon monoxide and benzene). The Ambient Air Quality Directive also had an original compliance deadline of 2010.<sup>5</sup>

**1.9** The UK has met emission ceilings continuously since 2010 (**Figure 4**). In 2016 a revised Directive set new ceilings for 2020 and 2030 for these pollutants, and for PM<sub>2.5</sub>, with the aim of cutting the health impacts of air pollution by half compared with 2005. Member states must transpose the new Directive into national legislation by 1 July 2018. For all pollutants except for SO<sub>2</sub>, the UK will need to make further emissions reductions to meet the 2020 ceilings. Defra has said it will publish a wider air quality strategy (a ‘Clean Air Strategy’) in 2018 which will cover its approach to these pollutants.

### Figure 4

#### Absolute emission ceilings and emission levels in the UK

	2015 actual emissions (ktonnes)	2010 ceiling (ktonnes)	2020 ceiling (ktonnes) <sup>3</sup>	2030 ceiling (ktonnes) <sup>3</sup>
Nitrogen oxides (NO <sub>x</sub> )	918	1,167	724	434
Sulphur dioxide (SO <sub>2</sub> )	236	585	292	85
Ammonia (NH <sub>3</sub> )	293	297	283	258
Non-methane volatile organic compounds (NMVOC) 2010 <sup>1</sup>	835	1,200	N/A	N/A
NMVOC 2020/2030 <sup>2</sup>	733	N/A	729	654
Fine particulate matter (PM <sub>2.5</sub> )	105	N/A	79	61

#### Notes

- 1 The 2010 NECD ceilings for NMVOCs included emissions from all sources.
- 2 The 2020 and 2030 ceilings for NMVOCs have been revised, and now exclude emissions from manure management and agricultural soils that were included in the 2010 figure.
- 3 2020 and 2030 ceilings are based on a percentage reduction from the actual emission levels in 2005. These absolute emission ceilings have been calculated using the 2005 data in the 1970–2015 emissions inventory.

Sources: National Audit Office analysis

5 The government received an extension for 13 of the 43 air quality zones for NO<sub>2</sub> emissions. One extension ended on 1 January 2013, three on 1 January 2014, and nine on 1 January 2015.

**1.10** The UK is divided into 43 zones for reporting on ambient concentrations (Figure 5 overleaf). These are deemed non-compliant if central government's official monitoring and (for the annual limit) modelling (see paragraphs 2.8 and 2.9) indicates that ambient air quality at any location within that zone breaches the limits. The UK complies with the limits for all pollutants except nitrogen dioxide (Figure 6 on page 19), on which most of the zones have not complied since the regulations came into effect in 2010. In 2016:

- 37 of the 43 air quality zones exceeded the annual NO<sub>2</sub> limit (with one or more locations where average concentrations of NO<sub>2</sub> over the year exceeded 40 µg/m<sup>3</sup>).
- 2 zones (South Wales and London) also exceeded the hourly NO<sub>2</sub> objective (with one or more locations where hourly concentrations of NO<sub>2</sub> exceeded 200 µg/m<sup>3</sup> on more than 18 occasions in the year). In 2017, central government's official monitoring indicated that South Wales exceeded this objective in January, with London exceeding the objective in June. Kings College London has, however, reported that a local air quality monitoring site in London (Brixton Road) showed exceedance of the objective by 5 January. Defra told us that this does not count towards official compliance as the site is not operated for the purpose of compliance assessment, and is run to London Air Quality Network standards, rather than the standards necessary to meet EU directive requirements.

While most of the UK's zones are non-compliant with NO<sub>2</sub> limits, most locations across the UK do comply: government modelling predicts that in 2017 90% of modelled roads will be compliant with NO<sub>2</sub> limits.

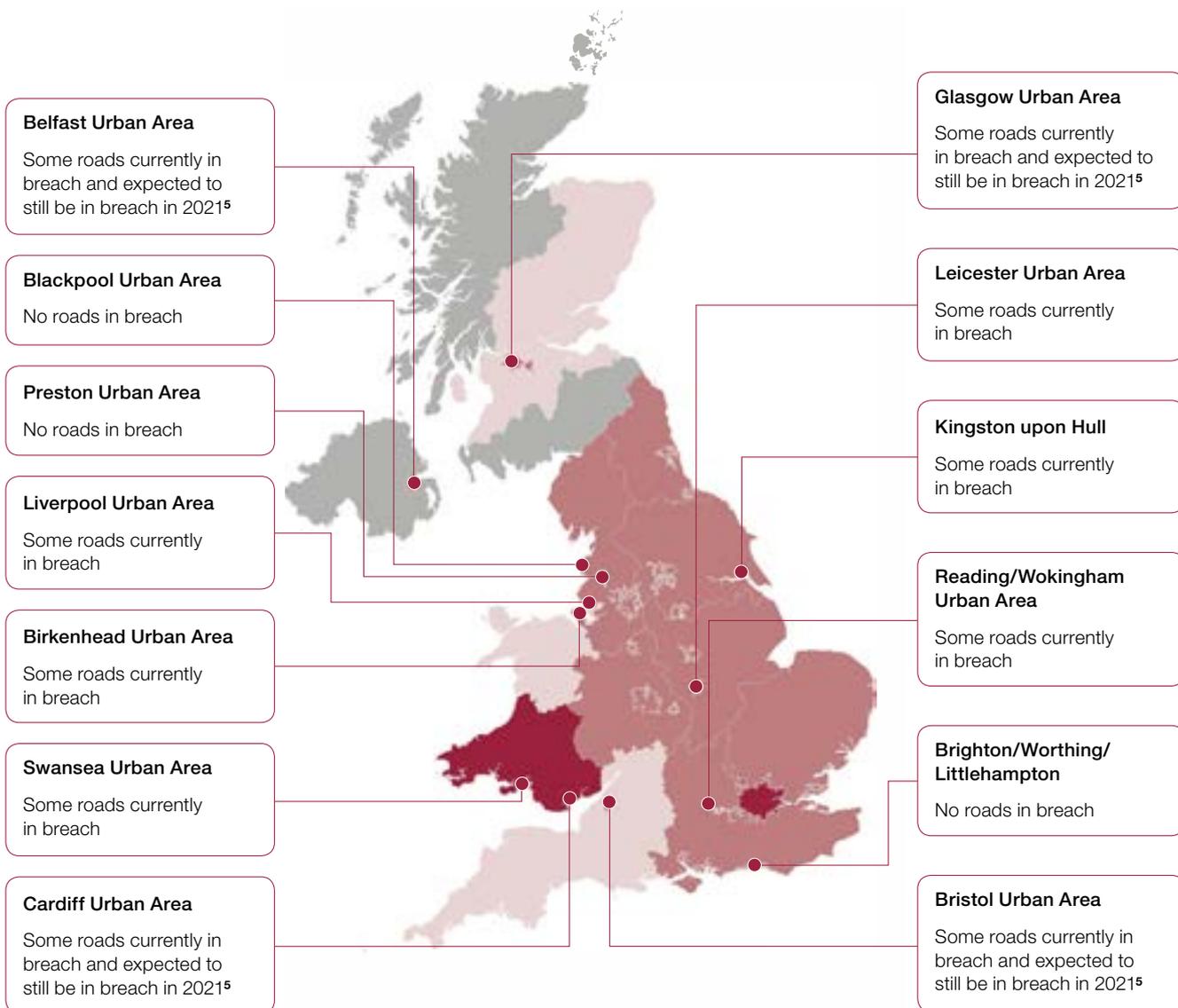
**1.11** Government considers that a key cause of non-compliance with air quality standards is the failure of European vehicle regulations (Euro standards) to deliver expected emissions reductions in real-world driving conditions. The EU has introduced successively more stringent Euro Standards since 1993 in order to reduce the emissions of new vehicles. The current standard is Euro 6, introduced in 2014, which applies to all newly manufactured vehicles. In September 2015 it was reported that Volkswagen had been using defeat devices in order to comply with emissions standards in the US. Subsequent testing by DfT found no evidence that defeat devices were widespread, however it found that there were higher levels of NO<sub>x</sub> emissions under real world conditions than had been recorded in the laboratory testing used to enforce Euro standards; average emissions in real-world driving were over 6 times higher than the legislated laboratory limit.

**1.12** The World Health Organisation (WHO) also has guideline limits for air pollutants which are in some cases more stringent than the EU limit values. Although the UK met the EU limit values for both PM<sub>2.5</sub> and PM<sub>10</sub> in 2016, only 10 zones had maximum recorded concentrations within the WHO guideline annual mean for PM<sub>10</sub> and five for PM<sub>2.5</sub>. The WHO caution that even at low concentrations particulate pollution has health impacts, and state that 'no threshold has been identified below which no damage to health is observed'.

### Figure 5

#### The UK's 43 air quality reporting zones

37 of the UK's 43 air quality zones include locations that exceed NO<sub>2</sub> limits



- Not compliant: one or more roads currently in breach and expected to still be in breach in 2025 without additional action
- Not compliant: one or more roads currently in breach and expected to still be in breach in 2021 without additional action
- Not compliant: one or more roads currently in breach but forecast to comply in 2021 without additional action
- Compliant

#### Notes

- 1 Labels shown for zones that are different to surrounding zones and would not otherwise be distinguishable at this scale.
- 2 An air quality zone is non-compliant if modelling indicates that ambient air quality at any location within that zone breaches the limits. While most of the UK's zones are non-compliant with NO<sub>2</sub> limits, most locations across the UK do comply: government modelling predicts that by 2017, 90% of modelled roads will be compliant with NO<sub>2</sub> limits.
- 3 Map is divided into agglomeration zones (major urban areas) and non-agglomeration zones.
- 4 All expected dates of compliance are as modelled by government in the 2017 Plan, without additional local action.
- 5 Without additional local action.

**Figure 6**  
UK performance against EU limit values

Pollutant	EU limit value	Measurement period	Actual performance against EU limits <sup>7</sup>	World Health Organization recommended limits
Nitrogen dioxide (NO <sub>2</sub> ) <sup>4</sup>	200 µg/m <sup>3</sup> , not to be exceeded more than 18 times a calendar year <sup>1</sup>	1 hour mean	2 zones exceeded the hourly limit on more than 18 occasions: London: 106 exceedances South Wales: 126 exceedances	200 µg/m <sup>3</sup> hourly mean
	40 µg/m <sup>3</sup> <sup>1</sup>	Calendar year mean	Average: 54 µg/m <sup>3</sup> Range: 31–102 µg/m <sup>3</sup> Limit exceeded in 37/43 zones.	40 µg/m <sup>3</sup> annual mean
Particulate matter (PM <sub>10</sub> )	50 µg/m <sup>3</sup> not to be exceeded more than 35 times a calendar year (by 2005) <sup>2</sup>	24 hour mean	No zones more than 35 exceedances	50 µg/m <sup>3</sup> 24 hour mean
	40 µg/m <sup>3</sup> <sup>2</sup>	Calendar year mean	Average: 21 µg/m <sup>3</sup> Range 11–29 µg/m <sup>3</sup>	20 µg/m <sup>3</sup> annual mean
Fine particulate matter (PM <sub>2.5</sub> )	25 µg/m <sup>3</sup> <sup>3</sup>	Calendar year mean	Average: 14 µg/m <sup>3</sup> Range: 7–18 µg/m <sup>3</sup>	25 µg/m <sup>3</sup> 24 hour mean 10 µg/m <sup>3</sup> annual mean
Sulphur dioxide (SO <sub>2</sub> )	350 µg/m <sup>3</sup> , not to be exceeded more than 24 times a calendar year <sup>2</sup>	1 hour mean	No zones more than 24 exceedances	500 µg/m <sup>3</sup> 10 minute mean
	125 µg/m <sup>3</sup> , not to be exceeded more than three times a calendar year <sup>2</sup>	24 hour mean	No zones more than three exceedances	20 µg/m <sup>3</sup> 24 hour mean
Lead <sup>5</sup>	0.5 µg/m <sup>3</sup> <sup>2</sup>	Calendar year mean	Average: 0.014 µg/m <sup>3</sup> Range: 0.004 – 0.032 µg/m <sup>3</sup>	0.5 µg/m <sup>3</sup> annual mean
Carbon monoxide (CO)	10 mg/m <sup>3</sup> <sup>2</sup>	Maximum 8-hour daily mean	Average: 1.85 µg/m <sup>3</sup> Range: 0.9 – 4.1µg/m <sup>3</sup> <sup>8</sup>	100 mg/m <sup>3</sup> for 15 minutes 60 mg/m <sup>3</sup> for 30 minutes 30 mg/m <sup>3</sup> for 1 hour 10 mg/m <sup>3</sup> for 8 hours
Benzene <sup>6</sup>	5 µg/m <sup>3</sup> <sup>1</sup>	Calendar year mean	Average 1.38 µg/m <sup>3</sup> Range: 0.29 – 3.9 µg/m <sup>3</sup>	No specific guideline value

**Notes**

- |  |  |
|--|--|
| <p>1 To be achieved and maintained by 1 January 2010.</p> <p>2 To be achieved and maintained by 1 January 2005.</p> <p>3 To be achieved and maintained by 1 January 2020.</p> <p>4 Government received an extension for 13 of the 43 air quality zones for NO<sub>2</sub> emissions.</p> <p>5 Lead is an example of a heavy metal.</p> | <p>6 Benzene is an example of a non-methane volatile organic compound (NMVOC).</p> <p>7 The average is the mean concentration across the 43 monitoring zones. The range represents the lowest and highest actual concentration figures across the 43 zones.</p> <p>8 CO concentrations are measured in 6/43 zones. Defra are confident that all zones comply because current concentrations in these zones are significantly below limits, and are not increasing.</p> |
|--|--|

**1.13** In February 2014 the European Commission started an infringement case against the UK under the Ambient Air Quality Directive. In February 2017, the UK received a 'Reasoned Opinion', which is a final written warning before a case is referred to the Court of Justice of the European Union (CJEU). If the UK cannot show how it would comply with legal limits within the timeline imposed by the Commission for responding to the Reasoned Opinion, the Commission could further escalate proceedings. The UK submitted a response to the Court of Justice of the European Union in April 2017. It is currently under review. There are infringement procedures against a number of other European countries under the Ambient Air Quality Directive: including four other countries (France, Germany, Italy and Spain) which also received Reasoned Opinions relating to NO<sub>2</sub> limits in February 2017 (**Figure 7**).

**1.14** Defra recognises potential fines relating to air quality as unquantified remote contingent liabilities within its annual accounts.<sup>6</sup> This reflects the fact that the payment of any fines is dependent on a decision by the EU to impose them, which is only expected to occur if the CJEU issues a judgment and the UK fails to act on its findings. Government does not have an estimate of what the level of penalties would be should the UK be fined by the CJEU, as it is unknown how many air quality zone breaches the court would choose to pursue, nor is it clear whether penalties may be imposed before EU-exit.

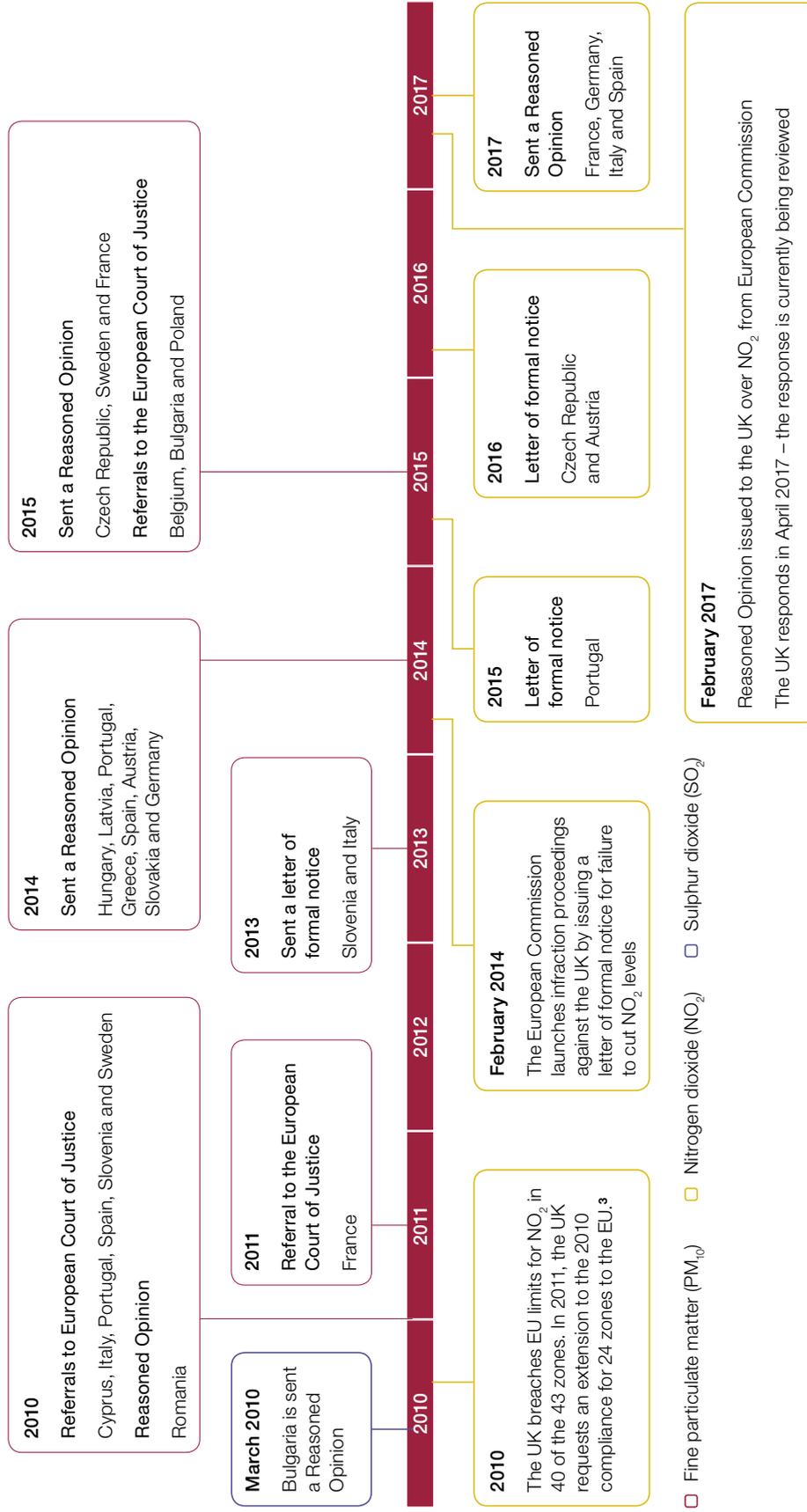
**1.15** Government's air quality plans have been subject to legal challenge:

- In November 2016, the High Court made a declaration that the government's 2015 Air Quality Plan was not compliant with the Air Quality Standards Regulations 2010. It found that the Secretary of State fell into error in fixing on a projected compliance date of 2020 (and 2025 for London) and adopted too optimistic a model for future emissions (see paragraph 2.10). It concluded that the 2015 Plan was non-compliant but should remain in force until the revised plan was published, and also that the Secretary of State should aim to achieve compliance by the soonest date possible, choosing a route which reduces exposure as quickly as possible.
- Following publication of the government's draft revised Air Quality Plan in May 2017, an environmental law organisation, ClientEarth, launched a legal challenge, stating that it should be more ambitious in tackling the UK's air pollution. The High Court ruled that ministers should be allowed to finalise the plan.
- In October 2017 Client Earth commenced legal proceedings against the government over the final air quality plan published in July 2017. The case is in its early stages and no conclusion has been reached.

<sup>6</sup> A contingent liability is a possible financial obligation whose existence will be confirmed by uncertain future events that are not wholly within the control of the entity. Classification of a contingent liability as remote is an accounting judgement that payment is not probable. This classification is reviewed annually.

**Figure 7**  
Overview of EU infringement cases since 2010

There have been several EU infringement cases on the Air Quality Directive



**Notes**

- 1 A Reasoned Opinion is a final written warning. This will typically give the member state two months to take action to rectify the breach.
- 2 The Figure does not show all infringement procedures relating to the Air Quality Directive. Four other countries (Poland, Denmark, Belgium and Hungary), for example, have been sent Pilot Letters related to NO<sub>2</sub> limits (a Pilot Letter is a stage that precedes a Letter of Formal Notice).
- 3 The UK received an extension for 13 of the 43 air quality zones.

## The impact of EU exit

**1.16** The Secretary of State for Environment, Food & Rural Affairs, the Rt Hon Michael Gove MP, has said that the government has “no intention of weakening the environmental protections that we have put in place while in the European Union”. Under the current provisions of the European Union (Withdrawal) Bill, law derived from the EU would continue in domestic law after Exit Day. This includes the ceilings and limit values currently in place.

**1.17** Current arrangements for enforcement of these legal duties will no longer apply if the UK is no longer in the jurisdiction of the CJEU. UK courts will continue to have a role through judicial review. The EFRA Select Committee questioned whether enforcement would include financial penalties, as these would no longer be paid to Europe, and while the Secretary of State recognised these as part of the potential ‘legal armoury’ he also pointed to the power of the courts to mandate action without fines. The requirement to regularly report publicly on air quality is already a part of UK law; however, it is not clear whether there will be a mechanism to continue the function of an independent regular review of progress currently provided by the EU. The government will also need to ensure that the new system meets the requirements of the Aarhus Convention, including regarding access to environmental justice.<sup>7</sup> The Secretary of State has said that he recognises stakeholders’ concerns about a ‘governance gap’ after EU exit, and that proposals to address this will be considered in the course of the progress of the Withdrawal Bill. On 12 November he announced plans to consult on a new, independent body to hold Government to account for upholding environmental standards in England after the UK leaves the European Union.

<sup>7</sup> The UK is bound by the 1998 Aarhus Convention, which enshrines the citizens’ right of access to environmental justice, allows them to participate in environmental decision-making by government, and gives them right of access to environmental information.

# Part Two

## The UK's plan to improve air quality

**2.1** This part covers:

- the 2017 Air Quality Plan (the 2017 Plan) for reducing roadside nitrogen dioxide (NO<sub>2</sub>) concentrations; and
- the air quality models that underpin the Plan.

### **The 2017 Plan for tackling roadside nitrogen dioxide concentrations**

**2.2** In response to a legal challenge to its December 2015 air quality plan, (see paragraph 1.15 in Part One), government published a revised plan for tackling roadside NO<sub>2</sub> concentrations in July 2017 (the 2017 Plan). The stated objective of this Plan is to bring NO<sub>2</sub> pollution within statutory limits in the “shortest possible time”.

**2.3** In preparing the 2017 Plan, the government updated its forecasts of air quality performance (see paragraph 2.10). It concluded that the scale of the challenge was greater than it had previously anticipated. A key step in its analysis for both the 2015 and 2017 Plans was to develop a ‘baseline scenario’ of the improvements in air quality that would result from existing measures (see paragraph 2.8). When it developed the 2015 Plan this projected that the UK would not comply in 8 of the 43 air quality zones by 2020 without additional measures. However by the time of the July 2017 Plan the equivalent baseline scenario forecast that the UK would not comply in 29 of the 43 air quality zones by 2020 without additional measures.<sup>8</sup>

<sup>8</sup> Central scenario.

**2.4** In response, a ministerial direction published with the 2017 Plan requires 23 of the 353 local authorities in England to draw up plans for delivering compliance in their local area in the shortest possible time (**Figure 8**).<sup>9</sup> Government chose these local authorities based on a central forecast of the areas that would not comply with NO<sub>2</sub> limits in 2021 without additional local action (see paragraph 2.12). The 23 local authorities must:

- undertake a feasibility study to identify the option which will deliver compliance with legal limits for NO<sub>2</sub> in the area in the shortest possible time; and
- consider whether to introduce a ‘charging Clean Air Zone’ to discourage the most polluting vehicles from problem areas. The government has stated that if a local authority can identify measures other than charging zones that are at least as effective at reducing NO<sub>2</sub>, those measures should be preferred as long as the local authority can demonstrate that this will deliver compliance as quickly.

The 23 local authorities must complete an initial plan for new measures as soon as possible and by 31 March 2018 at the latest, with final plans by 31 December 2018 at the latest (**Figure 9** on pages 26 and 27).

**2.5** The 2017 Plan also expects that:

- five cities named in the 2015 Plan continue to develop local plans to achieve compliance in the shortest possible time.<sup>10</sup> They are expected to deliver new ‘Clean Air Zones’ (which may or may not be charging) by the end of 2019, to achieve compliance with the annual mean NO<sub>2</sub> concentration limits in 2020; and that
- the Mayor of London will continue with plans for air quality, including to introduce a new ‘Ultra Low Emission Zone’, so as to achieve compliance in 2026.<sup>11</sup>

**2.6** In total, the 2017 Plan identifies £3 billion of potential spend on schemes that include air quality benefits between 2010-11 and 2020-21. This includes a £255 million Implementation Fund to support 28 local authorities to prepare and deliver their plans once approved, £1.2 billion associated with government’s 2017 cycling and walking strategy, and £1 billion of funding for ultra low emissions vehicles (**Figure 10** on page 28).

**2.7** Government’s central estimate is that the measures in the 2017 Plan will achieve compliance with NO<sub>2</sub> limits in 37 zones by 2021, and in all 43 zones by 2026.<sup>12</sup>

The following section explains the complex analysis and modelling that informed this forecast and the associated uncertainty.

9 Basildon, Bath and North East Somerset, Bolton, Bristol, Bury, Coventry, Fareham, Gateshead, Guildford, Manchester, Middlesbrough, New Forest, Newcastle, North Tyneside, Rochford, Rotherham, Rushmoor, Salford, Sheffield, Stockport, Surrey Heath, Tameside and Trafford.

10 Birmingham, Leeds, Nottingham, Derby and Southampton.

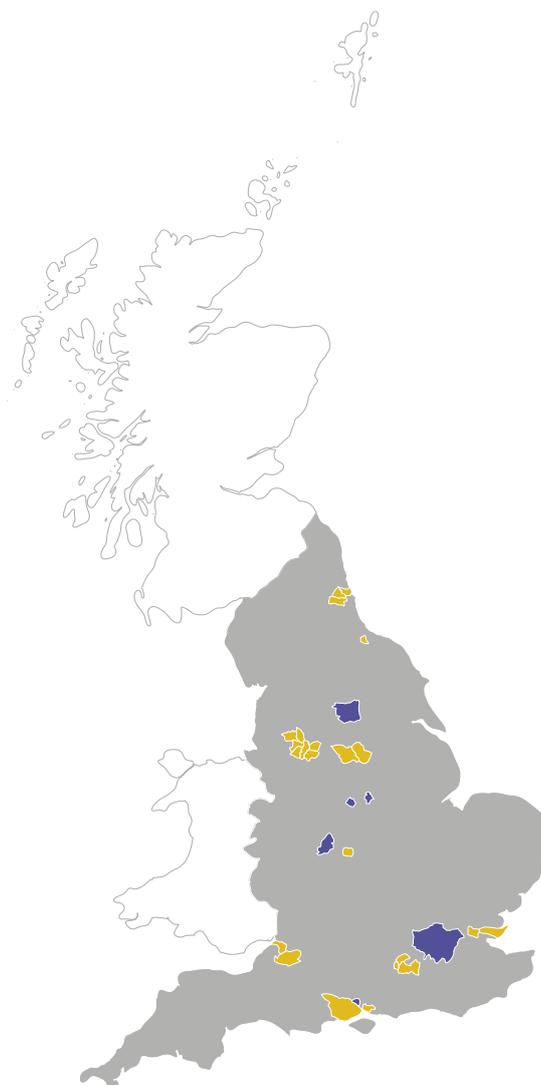
11 The Department for Environment, Food & Rural Affairs (Defra’s) central scenario.

12 This scenario includes the implementation of Clean Air Zones, but does not include the implementation of additional actions.

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**Figure 8**

Local authorities in England expected to introduce new air quality measures



■ 2015 Plan: cities expected to introduce Clean Air Zones, plus London

■ 2017 Plan: additional local authorities required to develop plans to tackle air quality

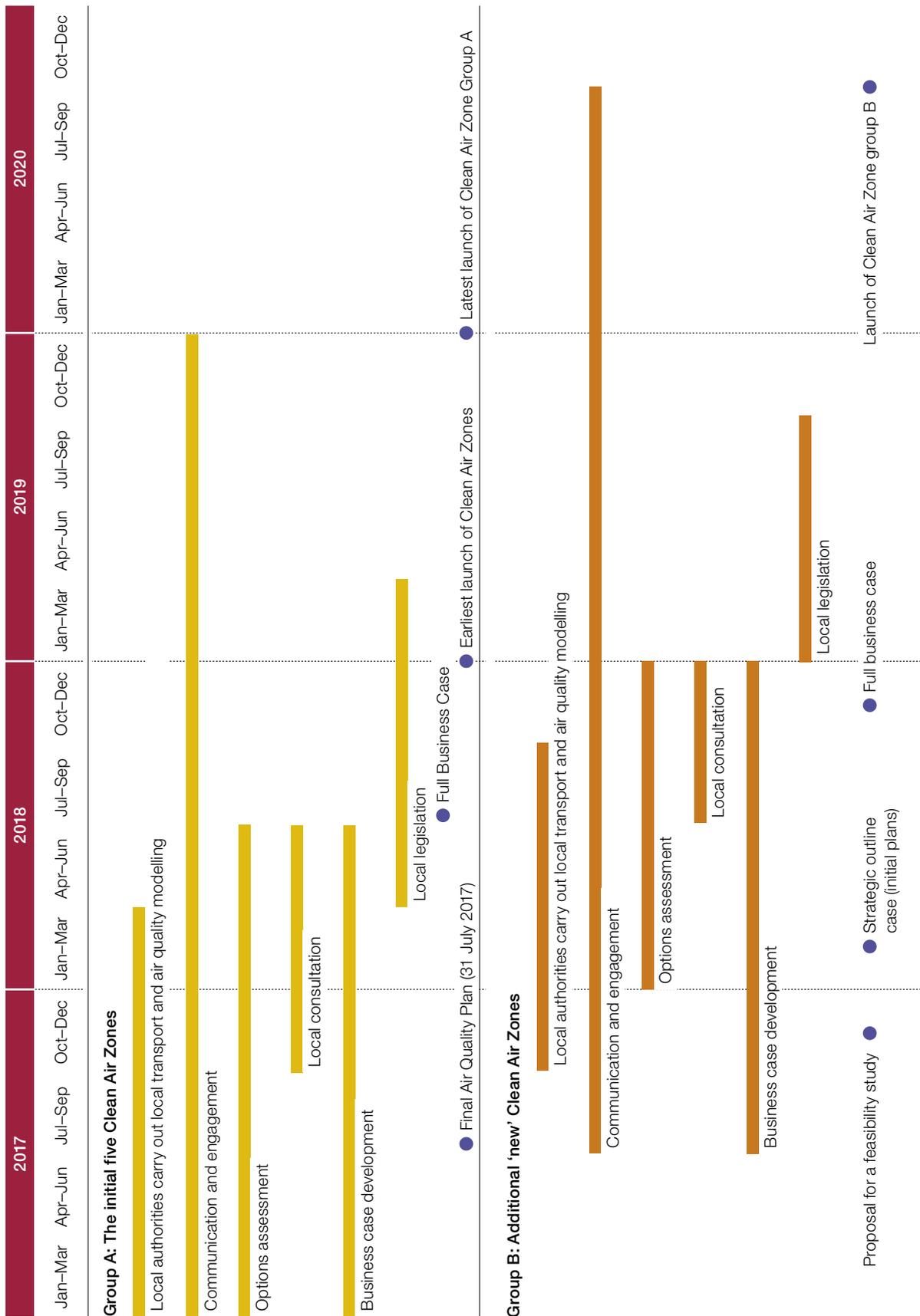
**Notes**

- 1 The 2015 air quality plan required five cities to introduce new Clean Air Zones: Birmingham, Leeds, Nottingham, Derby and Southampton. It noted that London already had plans to introduce an Ultra Low Emission Zone.
- 2 The 2017 air quality plan places additional expectations on the following local authorities: Basildon, Bath and North East Somerset, Bolton, Bristol, Bury, Coventry, Fareham, Gateshead, Guildford, Manchester, Middlesbrough, New Forest, Newcastle, North Tyneside, Rochford, Rotherham, Rushmoor, Salford, Sheffield, Stockport, Surrey Heath, Tameside and Trafford.

Source: JAQU Air Quality Plans

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**Figure 9**  
Indicative timeline of Clean Air Zones in England



**Figure 9** *continued*

## Indicative timeline of Clean Air Zones in England

**Notes**

- 1 Group A excludes London as the Mayor of London is responsible for air quality in the capital.
- 2 'Local legislation' refers to the local legislative measures, such as Traffic Regulation Orders, local authorities may need to put in place to implement their local plans.

Source: National Audit Office analysis of Department for Environment, Food & Rural Affairs internal documents

### The analysis and modelling that informed the 2017 Plan

**2.8** In developing its 2017 Plan, Defra carried out a range of analysis which informed the nature and scale of measures in the final Plan. In broad terms, this analysis comprised four steps, to assess:

- current compliance with NO<sub>2</sub> limits;
- forecast compliance given existing or ongoing action (hereafter referred to as the 'baseline' scenario);
- policy options; and
- forecast compliance given the measures in the 2017 Plan (hereafter referred to as the 'with measures' scenarios).

**2.9** The analysis drew on a complex modelling and analytical process involving:

- Pollution Climate Mapping (PCM) Model: a series of models run by consultants on Defra's behalf which estimates current and forecast concentrations of air pollutants on a 1 kilometre by 1 kilometre grid and for individual roads across the UK. This mapping draws on numerous subsidiary datasets from different organisations (**Figure 11** on pages 30 and 31) and takes around three months to complete;
- Streamlined Pollution Climate Mapping Model: a tool that approximates the results of the PCM, used to assess policy scenarios more quickly; and
- multi-criteria and cost-benefit techniques, to assess the merits of different policy options, drawing on the results of PCM and SL-PCM modelling as well as qualitative judgements.

**Figure 12** on page 32 gives an overview of the analysis and its conclusions. More detail on the cost-benefit analysis of different policy options is in Appendix One.

**Figure 10**

## Budget commitments on air quality and cleaner transport

Scheme	Responsible Department	Total committed funding 2010–2020 (£m)	Budget commitment 2010–2015 (£m)	Budget commitment 2015–2020 (£m)
<b>Implementation Fund.</b> To support 28 local authorities to design and implement new air quality measures.	Defra and DfT (JAQU)	255	n/a	255
<b>Ultra Low Emissions Vehicles (ULEVs).</b> Including investment in charging infrastructure and grant schemes for electric vehicles.	BEIS and DfT (OLEV)	1,000	400	600
<b>National Productivity Investment Fund (NPIF).</b> £290 million of the NPIF committed for reducing transport emissions: £100 million for new buses and retrofit (of which £40 million directly overseen by JAQU), £50 million to support electric taxis, and £80 million for charging infrastructure for electric vehicles.	DfT (and partly JAQU)	290	n/a	290
<b>Air Quality Grant.</b> To help local authorities improve air quality.	Defra and DfT (JAQU)	11	7	4
<b>Green Bus Fund.</b> To support bus companies and local authorities to put new low-carbon buses on the roads.	DfT	89	89	n/a
<b>Clean Bus Technology Fund and Clean Vehicle Technology Fund.</b> Including for retrofit of old buses.	DfT (JAQU)	27	20	7
<b>Cycling and walking.</b> Government's April 2017 Cycling and Walking Investment Strategy identifies £1.2 billion which may be invested in cycling and walking from 2016 to 2021.	DfT	1,200	n/a	1,200
<b>Road Investment Strategy.</b> Includes a ring-fenced fund to help Highways England improve air quality on its network.	Highways England	100	n/a	100
<b>Indicative total</b>		<b>2,970</b>	<b>516</b>	<b>2,454</b>

**Notes**

- 1 JAQU: Joint Air Quality Unit; OLEV: Office for Low Emission Vehicles; Defra: Department for Environment, Food & Rural Affairs; DfT: Department for Transport; BEIS: Department for Business, Energy & Industrial Strategy.
- 2 A portion of the 2017 Air Quality Grant was from the Implementation Fund and this is taken into account in the indicative total.
- 3 The wider air quality and cleaner transport schemes identified are not an exhaustive list across government.
- 4 This figures only includes schemes identified within the 2017 Air Quality Plan. It relates to budget commitments from different government schemes rather than a spend profile. It was not possible to confirm expenditure by year.

Source: National Audit Office analysis

**2.10** It is important that government departments have strong governance and quality assurance arrangements over such complex modelling, to review logical integrity, the validity of input data, the reasonableness of assumptions and to verify outputs. We have not carried out a comprehensive review of governance and quality assurance arrangements, but note that:

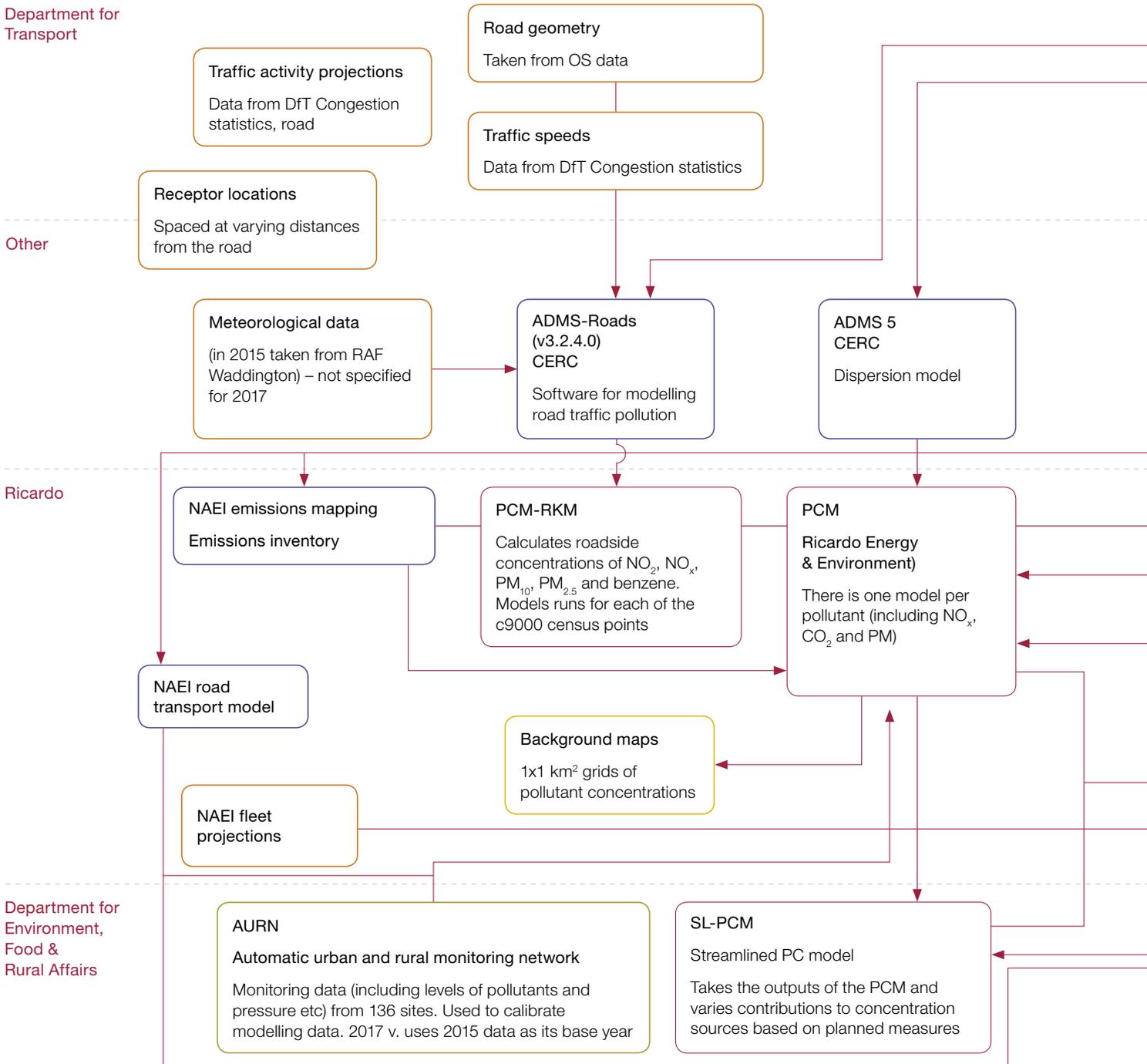
- in November 2016, the High Court found that in preparing its 2015 air quality plan government had adopted “too optimistic a model for future emissions”. The judgment noted that government had acknowledged “significant deficiencies” with the estimates of vehicle NO<sub>x</sub> emissions used in the model (COPERT 4v11). The 2017 Plan incorporated updated vehicle emission factors (COPERT 5, published in September 2016), which take into account better test data under real-world driving conditions; and
- Defra has commissioned independent reviews of its modelling approach. Between October 2014 and February 2015 a consultancy (Hartley McMaster) carried out an in-depth review and assessment of the quality assurance policies and practices for PCM modelling. This found that quality assurance policies and practices were evolving, and by the end of the review compared relatively well against three independent sets of best practice guidelines from the Intergovernmental Panel on Climate Change, the Department of Energy and Climate Change and HM Treasury.<sup>13</sup> Hartley McMaster made 10 recommendations for improvement, of which Defra told us five have been implemented, for example to improve systems to document changes and quality checks. The remaining recommendations require more substantial investment that Defra is considering.

**2.11** All complex models involve uncertainty, and decision-makers should consider the range of potential outcomes as well as central scenarios. The complexity of air quality modelling makes it difficult to quantify the uncertainty involved but government considers that it is ‘substantial’. Government convened two expert panels to consider the uncertainty associated with the modelling and cost–benefit analysis that informed the 2017 Plan. The panel on air quality modelling expressed low or very low confidence in two of the modelling assumptions: vehicle emissions factors (low confidence) and ‘dispersion modelling’ (very low confidence, including because of the inability to reflect the ‘canyon effect’ whereby streets flanked by buildings serve to decrease dispersion and hence increase the concentration of pollutants) (Figure 12).

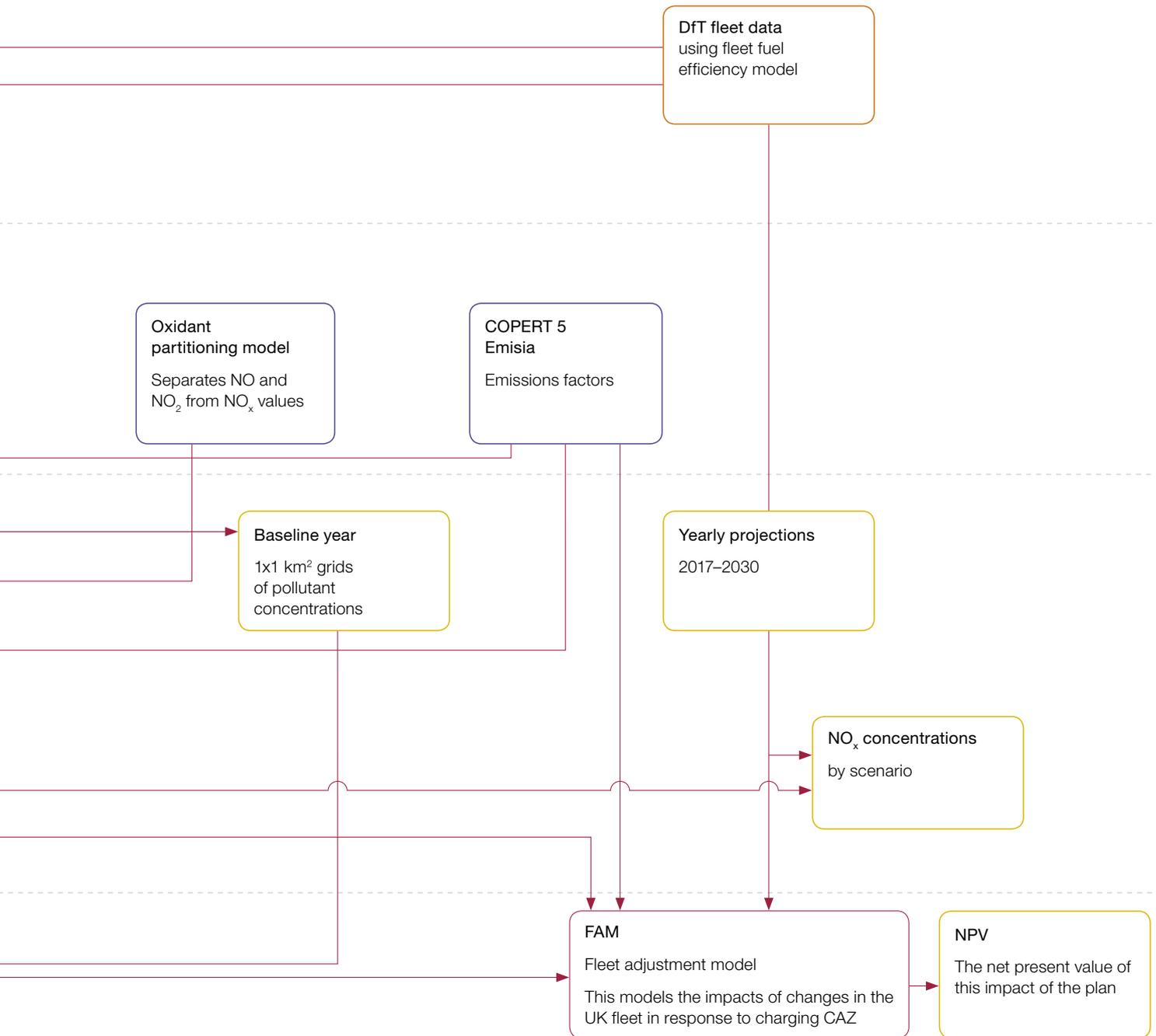
<sup>13</sup> On 14 July 2016, the government announced that the Department of Energy & Climate Change (DECC) would close and its responsibilities for energy markets and climate change would transfer to a new department, the Department for Business, Energy & Industrial Strategy (BEIS).

**Figure 11**  
An overview of the modelling that informed the 2017 Plan

There are several models and data sources that feed into the Pollution Climate Mapping, to model current and forecast air pollution concentrations



□ Model   □ Supporting model   □ Input datasets   □ Output results   □ Calibration data



**Notes**

- 1 CAZ: Clean Air Zone. CERC: Cambridge Environmental Research Ltd. NAEI: National Atmospheric Emissions Inventory.
- 2 ADMS 5, ADMS-Roads, COPERT 5, PCM and PCM-RKN are air pollution modelling products.
- 3 Chemical acronyms in the above are: Nitrogen oxides (NO<sub>x</sub>), Nitrogen oxide (NO), Nitrogen dioxide (NO<sub>2</sub>), Particulate matter (PM), Fine particulate matter (PM<sub>2.5</sub>), Carbon dioxide (CO<sub>2</sub>).

**Figure 12**

Overview of the main steps in the analysis and modelling that informed the 2017 Plan, and its conclusions

Step	Approach	Conclusion	Uncertainty
Assess current compliance	<p>'Pollution Climate Mapping' which in broad terms involves:</p> <ul style="list-style-type: none"> <li>estimating current NO<sub>x</sub> emissions<sup>2</sup>;</li> <li>combining this with data on road geometry, weather conditions and other factors to estimate current NO<sub>2</sub> concentrations by 1km squares across the UK; and</li> <li>testing and refining modelled results against <i>actual</i> NO<sub>2</sub> concentrations recorded at 147 official monitoring sites.<sup>3</sup></li> </ul>	37 of the UK's 43 air quality zones not compliant with EU nitrogen dioxide limits in 2016.	Estimated uncertainty of +/-29%. <sup>1</sup> (95% confidence that actual NO <sub>2</sub> concentrations are within +/-29% of modelled outputs).
Baseline scenario	Also uses the 'Pollution Climate Mapping' incorporating projected data, including on future traffic activity, and of future vehicle emissions (Computer Programme to calculate Emissions from Road Transport (COPERT) factors).	<p>Without additional measures:</p> <ul style="list-style-type: none"> <li>25 out of 43 zones not compliant in 2021</li> <li>All zones compliant in 2028</li> </ul>	<p>Estimated uncertainty of +/-29%. This would mean that the range of potential 'baseline' scenarios is:</p> <ul style="list-style-type: none"> <li>between 1 and 37 zone non-compliant in 2021; and</li> <li>compliance across all zones between 2022 and after 2030<sup>4</sup></li> </ul>
Policy options	<p>Analysis involved:</p> <ul style="list-style-type: none"> <li>workshop to develop a longlist of 60 potential policy options to reduce NO<sub>2</sub> concentrations;</li> <li>shortlisting of the most feasible options based on assessment of air quality impact, timing to impact and deliverability; and</li> <li>multi-criteria and cost-benefit analysis of eight shortlisted options (Appendix One).</li> </ul>	Of the eight shortlisted options, new charging Clean Air Zones would be the quickest, most cost-effective measure to tackle NO <sub>2</sub> exceedances on the majority of urban roads.	The net present value of Clean Air Zones could be between a net cost of £1.8 billion, and a net benefit of £1 billion, with a central estimate of a net cost of £1.1 billion. <sup>5</sup>
With measures scenarios	To assess the potential impact of the 2017 Plan on compliance, Defra developed illustrative scenarios of the actions that local authorities may take. These scenarios assumed that 29 local authorities implement new measures to improve local air quality, with most introducing charging Clean Air Zones by 2021.	<p>With all measures in the plan:</p> <ul style="list-style-type: none"> <li>Six zones non-compliant in 2021.</li> <li>All zones compliant by 2026.</li> </ul>	Estimated uncertainty of +/-29%.

**Notes**

- Government considers that this represents the extremes of what is possible and is developing analysis to better understand the range of what is likely.
- Total emissions are taken from the National Atmospheric Emissions Inventory and the PCM maps the emissions to estimate them for specific points such as road links.
- The Automatic Urban and Rural Monitoring Network: 147 monitoring sites as at May 2017.
- The modelling only goes as far as 2030.
- An expert panel convened by Defra reviewed the uncertainty of the cost-benefit analysis of charging Clean Air Zones. This concluded that the relationship between NO<sub>2</sub> and mortality may be the most significant source of uncertainty. Other significant sources of uncertainty include behavioural responses to the zones.

Source: National Audit Office analysis of the Technical report of the 2017 UK Plan for tackling roadside nitrogen dioxide concentrations

**2.12** The number of local authorities directed to take additional action (paragraphs 2.4 and 2.5) is based on a central forecast of the areas that would not otherwise comply with NO<sub>2</sub> limits in 2021. In consultation with an expert panel government analysts concluded that the uncertainty associated with this forecast could be +/-29%. This would mean that while the most likely scenario is that 25 zones would be non-compliant in 2021 without additional local action, the range of possible scenarios without additional local action is between 1 and 37 non-compliant zones in 2021. Government considers that this represents the extremes of what is possible and is developing analysis to better understand the likelihood within this range. The 2017 Plan notes that government will “consider further steps to ensure that air quality improved in areas that were modelled to be below but close to the legal limit and to ensure that forecast levels remain compliant”.

# Part Three

## Risks and success factors for delivering government's air quality plans

**3.1** This part covers:

- recurring themes that have proved important in implementing cross-governmental policies effectively; and
- our analysis of associated key risks and success factors for government as it continues to implement its plans to improve air quality.

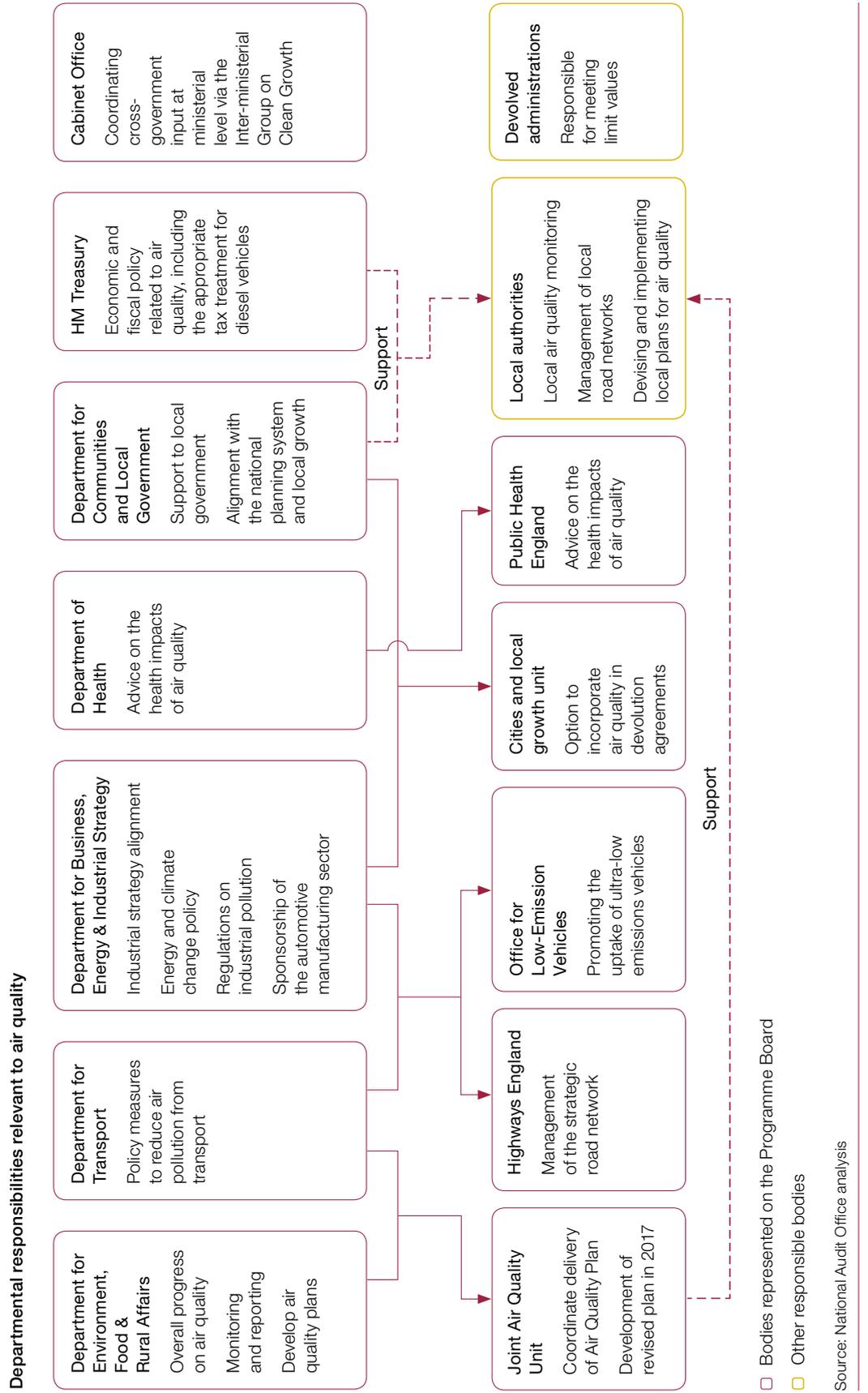
### **Roles and responsibilities for air quality**

**3.2** Improving air quality is a cross-government responsibility. It is a devolved matter, and the respective administrations are responsible for developing air quality policy in Northern Ireland, Wales and Scotland. For England, a number of central government departments play critical roles (**Figure 13**), including:

- the Department for Environment Food & Rural Affairs (Defra) is the cabinet lead for air quality and has overall responsibility for achieving UK limits and targets;
- the Department for Transport (DfT) is responsible for policy measures to reduce air pollution from transport, such as engines emission standards, schemes to promote cycling and walking, and to mitigate the effect of new road-building (via Highways England); and
- the Department for Communities and Local Government (DCLG) has a role in aligning the government's approach to air quality plans with its approach to local growth, with its stewardship of the local government financial system, and with the national planning system.

**3.3** Local authorities also have an important role. The Environment Act 1995 introduced a statutory requirement for all local authorities in the UK to assess air quality in their area, model future emissions and develop an action plan to bring concentrations down to within legal limits where necessary. Where a local authority identifies areas that exceed statutory limits and there is relevant public exposure, it must declare the geographic extent of the area as an Air Quality Management Area (AQMA). As of July 2017 the UK has 627 Air Quality Management Areas for nitrogen dioxide (NO<sub>2</sub>), 101 for particulate matter (PM), and seven for sulphur dioxide (SO<sub>2</sub>). AQMAs are found in 278 (71%) of the local authorities in the UK.

**Figure 13**  
Responsibilities for air quality



**3.4** Local authorities gained powers to tackle local air pollution via the Clean Air Act 1993 and the Road Traffic (Vehicle Emissions) (Fixed Penalty) (England) Regulations 2002. Relevant responsibilities are divided between the tiers of local government: county councils are responsible for transport, but district, borough and city councils manage more localised issues such as planning permission, which can affect air quality. In some metropolitan areas, these roles are combined through a joint authority. The Mayor of London has specific responsibilities for air quality in the capital under reserve powers of the Environment Act 1995 Part IV. Under this act, the Mayor may direct the boroughs in the Greater London area concerning how they should assess and prioritise action in their areas.

### **Good practice in implementing cross-government policies**

**3.5** Previous National Audit Office (NAO) reports have examined areas where cross-government collaboration is important to success. We have found that the following themes are important for effective integration (**Figure 14**), and so will be critical for the success of government's plans to improve air quality:

- an understanding of the potential for value from integration;
- commitment from all organisations to work in an integrated way;
- sufficient implementation capability to make integration work; and
- sustained effort to continuously improve.

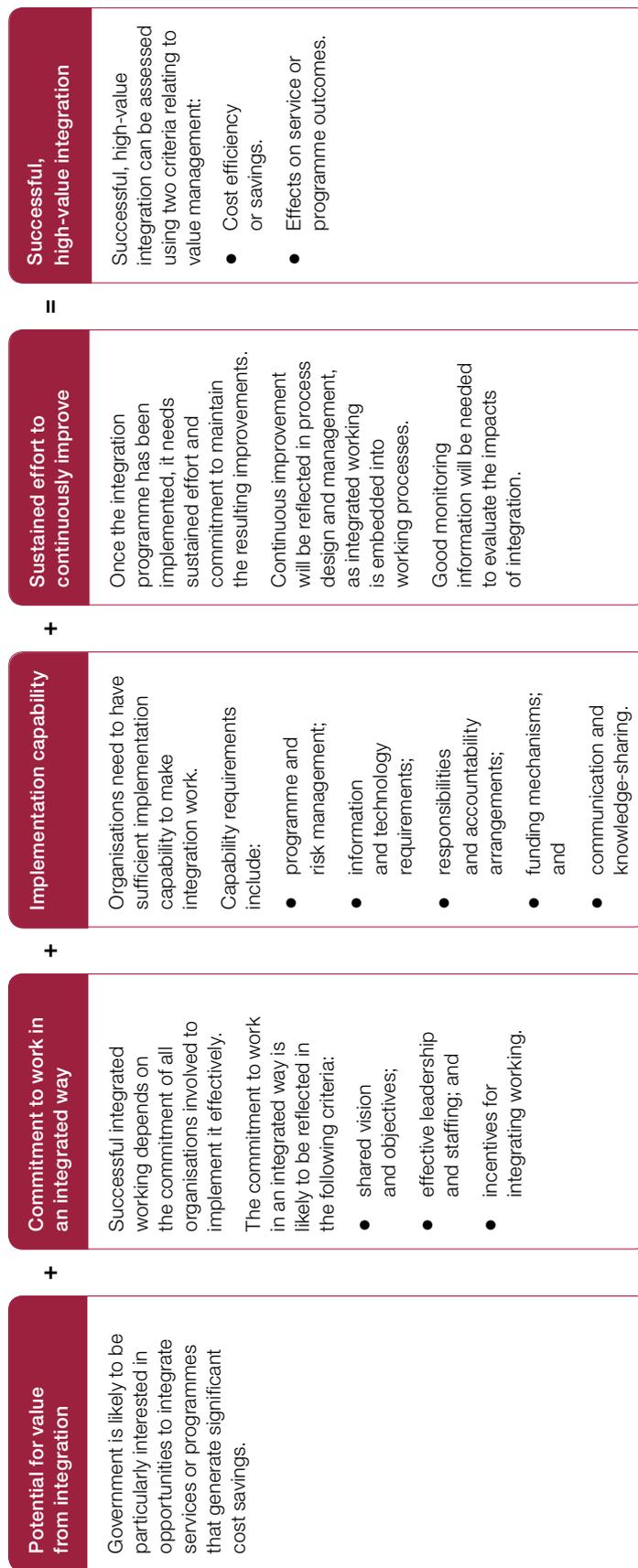
**3.6** Other NAO reports have reinforced the importance of these themes in the delivery of successful cross-government initiatives and programmes. For example:

- *Health and social care integration* (2017)<sup>14</sup> identified the need to bring greater structure and discipline to the Departments' (Department of Health and Department for Communities and Local Government) and local government's coordination of work. Factors which inhibited collaboration included misaligned financial incentives, workforce challenges and reticence over information-sharing.
- *Central government's communication and engagement with local government* (2012)<sup>15</sup> commented on communication between departments and local government. The organisational differences between central and local government make communication very challenging. Where departments are designing services for local delivery, the operational experience of local authorities is important to the effective design and implementation of programmes.

<sup>14</sup> Comptroller and Auditor General, Department of Health, Department for Communities and Local Government and NHS England, *Health and social care integration*, Session 2016-17, HC 1011, National Audit Office, February 2017.

<sup>15</sup> Comptroller and Auditor General, Department for Communities and Local Government, *Central government's communication and engagement with local government*, Session 2012-13, HC 187, National Audit Office, June 2012.

**Figure 14**  
Requirements for successful integration



Source: Comptroller and Auditor General, HM Treasury and Cabinet Office, *Integration across government*, Session 2012-13, HC 1041, National Audit Office, March 2013

**3.7** In the following sections we explore how these themes relate to government's implementation of the government's 2017 Air Quality Plan (the 2017 Plan) for tackling nitrogen dioxide concentrations. We consider two sets of risks and success factors. First, the role of the 'Joint Air Quality Unit': a government organisation established by the Department for Environment, Food & Rural Affairs (Defra) and the Department for Transport (DfT) in February 2016 to coordinate delivery of the government's plan for NO<sub>2</sub> compliance. Second, the capability of local authorities to meet their air quality obligations.

## **Risks and success factors**

### The Joint Air Quality Unit

**3.8** Following publication of the government's 2015 air quality plan (the 2015 Plan), Defra and DfT set up a Joint Air Quality Unit (the Unit) in order to coordinate delivery. In particular, they tasked the Unit with working closely with five local authorities expected to introduce New Clean Air zones (see paragraph 2.5). This included providing financial support, guidance and coordination. Following a High Court ruling against the 2015 Plan in November 2016, and the emergence of new evidence on emissions factors, the Unit also took responsibility for developing a revised plan for tackling roadside NO<sub>2</sub> concentrations which it published in July 2017.

**3.9** The Unit directly oversees £330 million of government's expected spend on air quality and cleaner transport measures.<sup>16</sup> This includes a £255 million Implementation Fund primarily to support 28 local authorities to develop and implement new local air quality measures. A central component of the 2017 Plan is that these local authorities will develop innovative plans that will secure compliance with statutory limits as quickly as possible. The Unit has a system of account managers to support coordination and communication with the relevant local authorities, and to keep track of progress. Defra told us that this includes weekly or fortnightly conversations where issues can be raised and monitored, workshops to outline the feasibility process, and provision of technical guidance.

**3.10** The Unit's programme board was established to be the main decision-making and oversight body at official level for all aspects of delivery of the 2017 Plan. For cross-government senior-level policy discussions, an Inter-Ministerial Group (IMG) on clean growth considers issues for both air quality and decarbonisation. The board has representation from across central government, but it does not include any local authorities or the Local Government Association. The unit also does not have a system for overseeing spend and progress on schemes that include intended air quality benefits run by other parts of government. These measures represent over £2.2 billion of potential spend between 2015 and 2020 across 8 sets of initiatives, including to promote the up-take of electric vehicles and to support cycling and walking. (Figure 10).

<sup>16</sup> The £330 million of funds includes the Implementation Fund; Air Quality Grant; Clean Bus Technology Fund and Clean Vehicle Technology Fund; and £40 million retrofit funding as part of the National Productivity Investment Fund (NPIF).

This means that there is no clear single responsibility within government for knowing whether the initiatives form a coherent portfolio that delivers good value for money as a whole in relation to air quality. Defra and DfT told us that they agree that this is an important objective, but believe that the arrangements which they currently have in place should secure this.

**3.11** Appropriate staffing of the Unit will be important for its success. Initially, the Unit was to have 10 full-time equivalent staff, with three originating from DfT and seven from Defra supported by legal, analytical and procurement experts from across DfT and Defra. Following the High Court ruling in November 2016, the team increased its resources to 40 staff to undertake options analysis and develop policy. The 2017 Plan has meant the Unit's workload has increased significantly as the number of local authorities it needs to work with rose from five to 28. The Unit told us that recruitment of additional staff is underway.

### **Local authority capability on air quality**

**3.12** Government will need to assure itself that local authorities have sufficient capability to meet their air quality obligations effectively, including appropriate powers, funding and accountability. This is particularly important because:

- local authorities are operating under fiscal constraints;
- some measures to improve air quality, such as diverting traffic, closing off roads or refusing planning permission, may be unpopular; and
- the 2017 Plan targets specific local authorities and locations through modelling based on a network of 147 official monitoring sites (as at May 2017), but more detailed local authority modelling may identify different hotspots of pollution.

### **Powers**

**3.13** Local authorities have a range of options available for tackling local air quality (**Figure 15** overleaf). However, local air quality is a function of national as well as local factors, such as the tax incentives on drivers to purchase types of vehicles, the impact of decisions made by Highways England relating to the Strategic Road Network, and progress in establishing the infrastructure for electric vehicles. The Local Government Association told us that it is concerned about whether local authorities have the right traffic management powers to tackle air quality effectively – for example, it considers that the deregulation of local transport services limits local authorities' ability to require significant polluters like buses and taxis to reduce emissions, as well as restricting effective promotion of public transport as an alternative mode of travel. The Local Government Association is also concerned about funding for local authorities on air quality measures, which it sees as fragmented and uncertain.

**Figure 15**

## Local authority options for improving air quality

Example approaches	Reduce	Shift	Improve
	Reduce the amount of journeys that need to be made:	Shift journeys onto less polluting modes of transport:	Improve the emissions of journeys that do need to be made by road:
	<ul style="list-style-type: none"> <li>● Parking management.</li> <li>● Car club schemes.</li> <li>● Encouragement of flexible working.</li> </ul>	<ul style="list-style-type: none"> <li>● Park and ride schemes.</li> <li>● Cycling infrastructure.</li> <li>● Bus route improvements.</li> </ul>	<ul style="list-style-type: none"> <li>● Electric vehicle infrastructure.</li> <li>● Traffic management schemes.</li> <li>● Retro-fitting.</li> </ul>

Source: Urban Transport Group, *Air Quality in the City Regions: A Transport Toolkit*, 2014

## Funding

**3.14** Government needs to assure itself that the additional funding provided to local authorities will be sufficient to fund the additional requirements being placed on them, and that they will have sufficient capacity to carry out the actions needed. Since 2010 the government has reduced funding for local government as part of its plan to address the fiscal deficit. Our 2014 report on *Financial sustainability of local authorities* highlighted that local authorities have worked hard to manage the reductions in government funding through a mixture of efficiency measures and service transformation, but that there is some evidence that service levels have been reduced.<sup>17</sup> We found that local authorities are protecting adult and children's services, often at the expense of other service areas. Pressure on local authorities has continued since 2014. Their spending power fell by 23.5% between 2010-11 and 2015-16.

**3.15** DCLG does not report figures for local authority expenditure on tackling air quality specifically. Budgets for 2017-18 published in June 2017 (and therefore before publication of the government's 2017 Plan) include information on environmental services, transport and highways, planning and development services – categories which could include expenditure related to air quality. This shows that local authorities in England expect to incur net expenditure of £5.9 billion on environmental services, £9.9 billion on highways and transport services, and £4.0 billion on planning and development services in 2017-18.<sup>18</sup>

<sup>17</sup> Comptroller and Auditor General, *Financial sustainability of local authorities*, Session 2014-15, HC 783, National Audit Office, November 2014, available at: [www.nao.org.uk/report/financial-sustainability-of-local-authorities-2014/](http://www.nao.org.uk/report/financial-sustainability-of-local-authorities-2014/)

<sup>18</sup> Figures cover capital and revenue spend.

**3.16** The 2017 Plan announced new sources of funding for local authorities: a £255 million Implementation Fund for the 28 local authorities that are central to delivery of the Plan, and an additional Clean Air Fund to help minimise the impact of local authorities' compliance plans on motorists, residents and businesses, the details of which have not yet been announced. The 2017 Plan also highlighted £100 million for low emission buses to 2020-21 announced in the 2016 Autumn Statement.

**3.17** The Joint Air Quality unit expects the £255 million implementation fund to cover support for:

- local authority feasibility studies between 2016-17 and 2018-19;
- implementation of Clean Air Zones or other measures selected by the local authority, from 2016-17 to 2019-20;
- operation and management of measures from 2018-19 to 2020-21;
- improvements in modelling and monitoring of air quality from 2017-18 to 2020-21; and
- provision of the £8 million Air Quality Grant to local authorities from 2016-17 to 2020-21.

In allocating the Implementation Fund, HM Treasury required Defra and DfT to ring-fence the support for improving air quality and manage it between them as a single pot. If extra funding is required to comply with legal requirements, HM Treasury expects Defra and DfT to find this through reprioritising existing budgets in the first instance, before approaching HM Treasury jointly.

### Accountability

**3.18** The 2017 Plan states that government will “place legal duties on relevant local authorities requiring them to develop and implement a plan designed to deliver compliance in the shortest possible time”. The Plan was accompanied by a ministerial direction under the Environment Act 1995 requiring that the 23 local authorities named in the Plan complete their initial feasibility study by 31 March 2018 at the latest. The direction also requires selection of a preferred option and setting out of implementation arrangements as soon as possible, and at the latest by 31 December 2018. Further enforcement mechanisms are available to central government through the Localism Act 2011, which gives powers to require local authorities to pay some or all of the European fines faced by the UK. However, no fines have yet been imposed that could be passed on (see paragraph 1.14 in Part One).

# Appendix One

## Overview of cost and benefits of the various policy options

### Figure 16

Analysis of shortlisted options used in the cost–benefit analysis

	Air quality impact		Timing to impact
	Total 10 year NO <sub>x</sub> reduction <sup>1</sup>	First year of impact	
<b>Clean Air Zone<sup>2</sup></b> Expansion from 5 plus London to a further 21	24 kt	8.6µg/m <sup>3</sup> in 2020	1–3years
<b>Retro-fit</b> Retro-fitting of buses, HGVs and black taxis between now and 2020	10 kt	0.09µg/m <sup>3</sup> in 2019	1–3years
<b>Scrappage</b> National scheme promoting a transfer from older conventional cars and vans to electric	0.4 kt	0.008µg/m <sup>3</sup> in 2020	1–3years
<b>Ultra-Low Emission Vehicles</b> Providing additional support to purchasers of electric vehicles	2 kt	0.008µg/m <sup>3</sup> in 2017	<1 year
<b>Speed Limits</b> Reduce motorway speed limits to 60mph where there is poor air quality	Up to 0.05 kt	Up to 2.5µg/m <sup>3</sup> in 2021	>3 years
<b>Government Buying Standards</b> 30% of all new central government diesel cars are petrol from 2018	0.083 kt	0.0005µg/m <sup>3</sup> in 2018	<1 year
<b>Vehicle labelling</b> Air Quality emissions information on new car labels	0.73 kt	0.004 µg/m <sup>3</sup> in 2018	<1 year
<b>Influencing driving style</b> Training and telematics for 100,000 car and van drivers by 2020	0.34 kt	0.012 µg/m <sup>3</sup> in 2019	1–3 years

#### Notes

- 1 The total 10-year NO<sub>x</sub> reduction is the total reduction in NO<sub>x</sub> emissions resulting from this policy option.
- 2 Clean Air Zones are expected to be implemented in non-compliant areas in 2020. This represents the average reduction in the maximum concentration for these areas in 2020.
- 3 All monetised values are 10-year net present values.

Health, reflecting the reduced cost of health problems linked to NO <sub>2</sub> <sup>4</sup>	Category of impact (£m) <sup>3</sup>			Greenhouse gases, valued using the social cost of carbon
	Government costs including implementation and set-up costs	Public, reflecting the costs of the given action to society and benefits from traffic flow improvements, monetised using the value of time-saving		
(£m)	(£m)	(£m)	(£m)	(£m)
620	-600	-1,900		19
60	-170	Negligible		Negligible
1.4	-110	70		10
7.8	-290	170		50
Less than 0.5	-25	Up to -8		Up to 0.5
Less than 0.5	-1.7	Negligible		-0.23
2.8	Negligible	Not quantified		-5.3
1.4	-14	Not quantified		17

4 This table shows the revised advice on health impacts as published in the July 2017 technical report. The May 2017 draft technical report contains higher health impacts. The health impacts shown represent a valuation of the costs to individuals of reduced life expectancy due to NO<sub>2</sub> pollution. The health impacts shown do not reflect the costs of ill health for individuals or society. The health impacts shown also only cover the estimated effects of NO<sub>2</sub> pollution and not the effects of any associated reductions in other air pollutants.

# Appendix Two

## Our approach

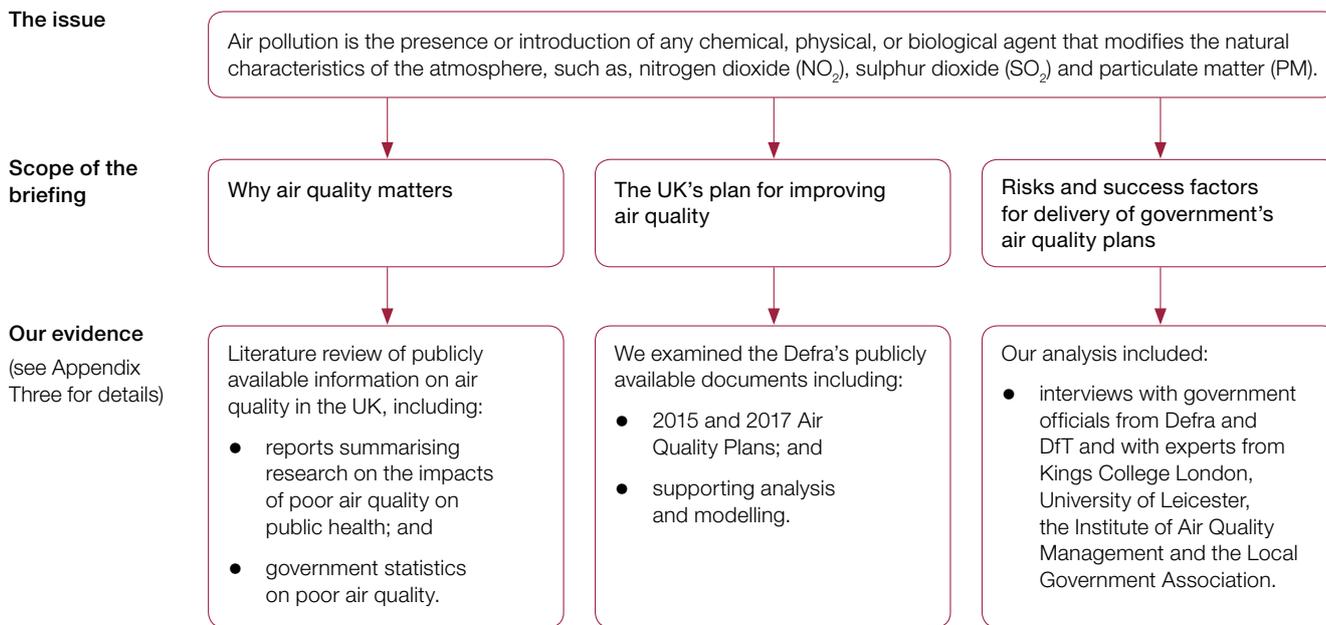
**1** This report supports a joint inquiry by the Environmental Audit Committee (EAC), the Environment, Food and Rural Affairs (EFRA) Committee, the Health Committee and the Transport Committee. It gives an overview of:

- why air quality matters;
- the UK's plan for improving air quality; and
- risks and success factors for delivery of government's air quality plans.

**2** We have drawn on evaluative criteria for effective integration across government and for modelling. We have sought to identify issues that merit further scrutiny; we have not carried out a full value-for-money assessment of government's approach to air quality.

**3** Our approach is summarised in **Figure 17**. Our evidence base is described in Appendix Three.

**Figure 17**  
Our approach



# Appendix Three

## Our evidence base

**1** Our independent findings on government's approach to air quality were reached following our analysis of evidence collected between July and November 2017. Our approach is outlined in Appendix Two. The briefing is primarily based on publicly available information, supplemented by interviews and evidence requests from government officials.

### **Literature review of publicly available information on air quality in the UK**

**2** We carried out a literature review of published material that was likely to be relevant to air quality. We used this review to develop our understanding of the wider context and to collate information available in the public domain. Sources included:

- the UK-AIR website (<https://uk-air.defra.gov.uk/>);
- the 2015 and 2017 air quality plans and their supporting documents;
- minutes and reports produced by the Committee on the Medical Effects of Air Pollutants (COMEAP);
- submissions and evidence sessions of previous select committee inquiries on air quality; and
- European Environment Agency reports on air quality.

### **Interviews with government officials**

**3** We conducted semi-structured interviews with officials at Defra and DfT, focusing on understanding:

- the air quality model used as the basis of the air quality plans; how it functions and the assurance that government has over its accuracy;
- the consultation process which led to the 2017 Plan and how this built on the 2015 Plan;

- the engagement between central government and local authorities, and how this would be developed going forward;
- the development of the Joint Air Quality Unit and how this has changed since the 2015 Plan; and
- the work that officials are undertaking to prepare for leaving the EU, and the extent to which this presents a risk for air quality.

### **Review of government documents**

4 We examined internal documents held by the Departments, including:

- the models used to inform the 2017 Plan;
- minutes of meetings of the Joint Air Quality Unit delivery board; and
- risk registers relating to air quality.

### **Interviews with stakeholders and experts**

5 We held semi-structured interviews with a range of air quality stakeholders and experts external to central government, including representatives of the Local Government Association, the Institute of Air Quality Management and academics from Leicester University and King's College London.



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