

### KEY UPDATES TO THE CHAPTER

This chapter has been updated to reflect changes to the measures assessed in this report and the revised results of the assessments presented in Chapters 3-5. A full description of the new measures considered, and the updates made to existing measures, can be found at the start of Chapter 3.

Further consideration has also been given to areas recommended for further research. This section has been updated to reflect recent additional areas work and methodological development carried out since the Third report and also takes the opportunity to set out additional areas for further work highlighted as part of the AQS consultation. This is discussed in more detail in section 6.3 of this chapter.

## 6.1 Introduction

1. This chapter presents the combined assessment using both monetary analysis and non-monetary (i.e. exceedences, ecosystems and other qualitative) assessments.

## 6.2 Combined assessments of all the measures in the AQS review

2. The options considered have been assessed using a common assessment framework, in order that they can be more easily compared, and assessed against the baseline.
3. Each option has been assessed against the following criteria:
  - Monetary cost benefit analysis; and
  - Impact on exceedences, ecosystems and qualitatively described effects such as distribution, noise and competitiveness.
4. Each of the assessments undertaken has uncertainties associated with it which should be borne in mind. It is also important that the results from each assessment are considered as a whole. Chapters 3 and 4 discuss each assessment in more detail and Chapter 5 discusses the uncertainties associated with the analysis.
5. This section presents the combined assessment of all the measures considered in this report, as part of the AQS review process, and is divided into the following subsections:
  - **Section 6.2.1** deals with the monetary assessment of the measures and also presents the key messages from the cost-benefit sensitivity analysis and the new Monte Carlo analysis.
  - **Section 6.2.2** presents a short summary of the exceedence, ecosystems and other non-monetary assessments of measures.
  - **Section 6.2.3** combines the above and presents a full assessment of all the measures.

6. It must be noted that this chapter does not provide any details on the methodology used for the assessment of the measures or a detailed measure by measure discussion of the results. Instead the focus is on presenting a broad analysis of the results and presenting some overall conclusions.

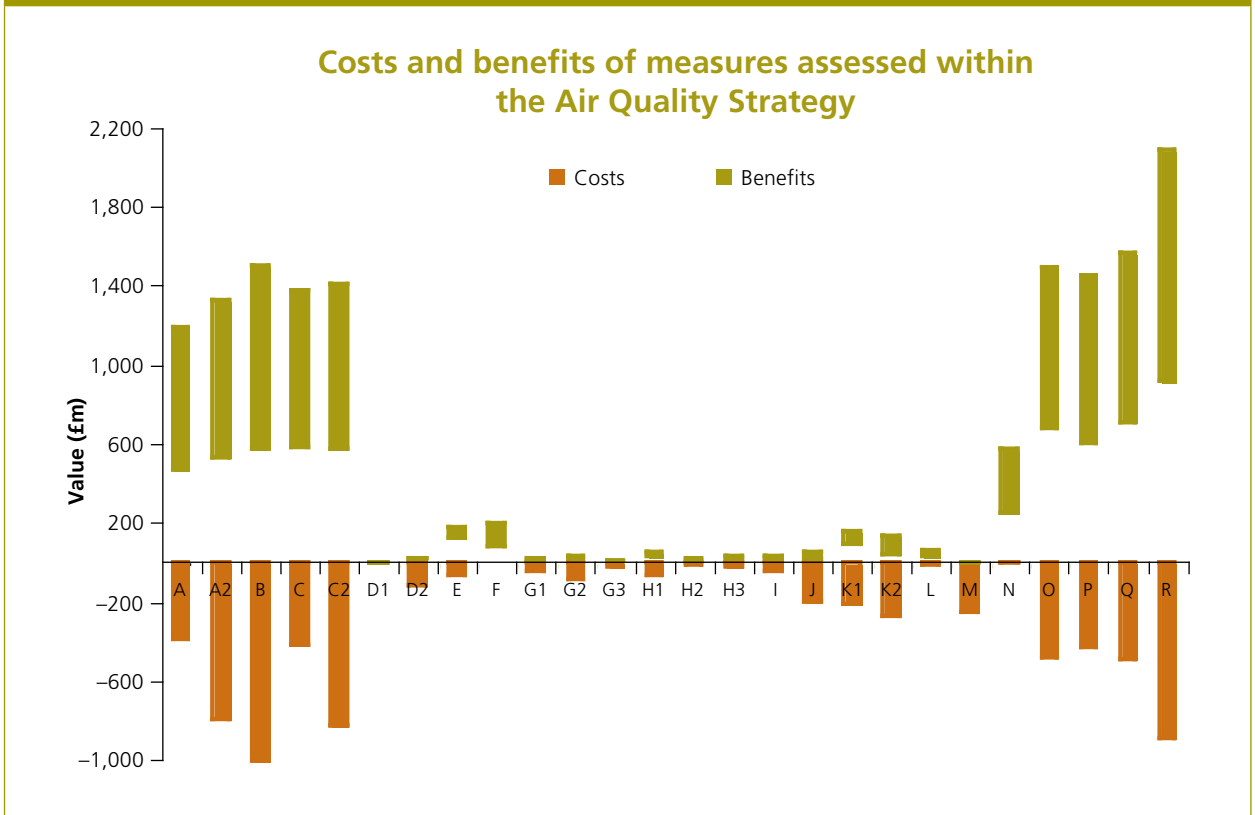
### 6.2.1 Combined monetary assessment of measures

7. As described in Chapters 2 and 3, the benefits of all the additional measures are driven primarily by the health benefits accruing from the improvement of air quality compared to the baseline. The methodology for estimating the health benefits and the baseline is explained in Chapter 2 of this document. The costs of each measure depend on the resource costs of technologies used, operational costs, welfare costs, and the resource costs of fuel. The costs and benefits have been discounted using the standard Green Book discount rate and annualised to present the equivalent annual estimates.
8. The assessment methodology used to present the monetary assessment of the additional measures considers the difference between the annualised present value of benefits and the annualised present value of costs to estimate the net present value for each measure. The benefits of each measure are presented based on a 6% per  $10\mu\text{g}\cdot\text{m}^{-3}$   $\text{PM}_{2.5}$  hazard rate reduction as recommended by COMEAP in their 2006 interim statement.<sup>1</sup> This is discussed further in section 2.5.3 of Chapter 2.
9. Figure 6.1 below presents the costs and range of benefits of the additional policy measures. The lower bound of the ranges in the graph below represents the PV of benefits with the 40 year lag and the upper bound represents the PV of benefits with no lag. It should also be noted that the costs are presented as bars between the cost estimate, which are generally point estimates, and a value of zero. Costs are presented in this way to ensure visibility as point estimates or limited ranges are not clear on the diagrams scale. Therefore it should not be read that all costs have at the bottom of their range a zero cost.

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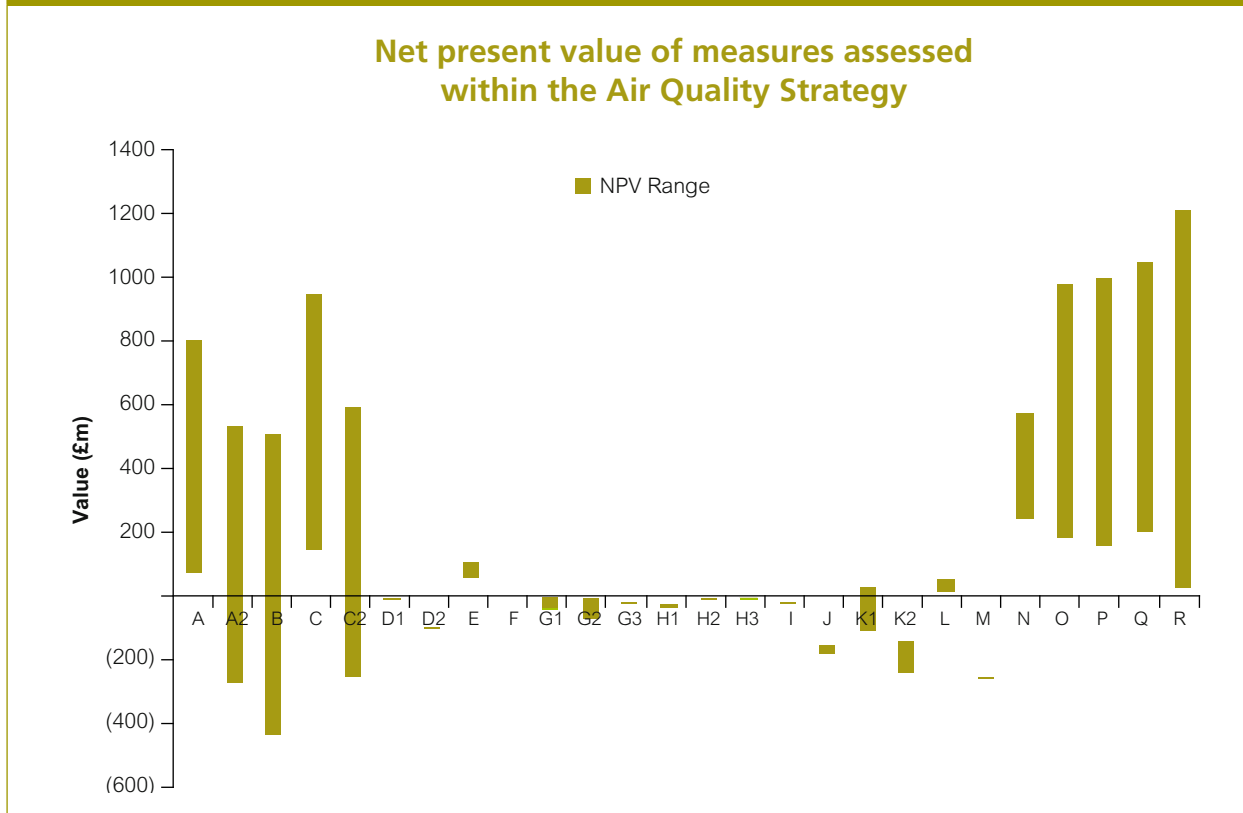
<sup>1</sup> 'Interim Statement on the Quantification of the Effects of Air Pollutants on Health in the UK', Committee on the Medical Effects of Air Pollutants, Department of Health (2006b). Available at [www.advisorybodies.doh.gov.uk/comeap/pdfs/interimlongtermeffects2006.pdf](http://www.advisorybodies.doh.gov.uk/comeap/pdfs/interimlongtermeffects2006.pdf)

Figure 6.1



10. Figure 6.2 below presents the range of the NPVs for the additional measures. As with Figure 6.1 above, the lower bound of the ranges in the graph below represents the NPV with the 40 year lag and the upper bound represents the NPV at the with no lag. Therefore there is a possibility for some measures that the NPV assessment could be partially negative and partially positive.

Figure 6.2



11. The following conclusions can be drawn from considering the graphical analysis of the NPVs of the additional measures. It must be noted that the conclusions presented below are only based on monetary cost benefits analysis, and do not consider the uncertainties affecting the monetary cost benefit analysis, or any non-monetary assessments. Full NPV results can be found in Table 6.3 later in the chapter.

- Measures A (Euro low), C (Early Euro low), E (LEV), L (SCP), N (Shipping), O, P, Q and R (combined measures) show positive NPVs, implying that the benefits of these measures are greater than the costs. However, comparing within these measures, Measures E and L have lower net present values relative to the remaining measures.
- Measures A2 (Euro revised), B (Euro high), C2 (Early Euro revised), H2 and H3 (Retrofit), K1 (LCP short term) present the possibility of having both a positive and negative NPV. This is primarily due to the lag times associated with PM<sub>10</sub> health impacts, with a positive NPV likely when no lag is considered, and a negative NPV likely when the 40 year lag is taken into account. In its 2006 interim statement, COMEAP stated that its judgement tended towards a greater proportion of the effect occurring in the years soon after pollution reduction rather than later and this should be borne in mind when interpreting these results. Comparing within these measures, Measures A2, B and C2 have a higher NPV relative to Measure H.

## Chapter 6: Conclusions and further research

- Measures D1, D2 (Phase out), G1, G2, G3 (LEZ), H1, (Retrofit), I (Domcom coal), J (Domcom NO<sub>x</sub>), K2 (LCP long term) and M (VOC) show negative net present values implying that the costs of these measures outweigh the benefits.
12. It is necessary to take into account the key conclusions from the sensitivity analysis which may alter the results of the monetary assessment discussed above.
  13. The uncertainties considered in Chapter 5 deal with both individual measure specific uncertainties (such as the impact on technological advances on specific technologies used in the measures) as well as general uncertainties (such as using alternative assumptions on the estimation of benefits of measures).
  14. This section only considers the uncertainties which have a potential to alter the results of the monetary assessment and for which results have been estimated for each individual measure; it does not present the detailed list of uncertainties which is considered in Chapter 5 of this report. Note that these uncertainties do not necessarily have a high probability of applying.
  15. Table 6.1 below discusses these measures and considers the effects these uncertainties will have on the NPV of these measures.

**Table 6.1: Measures with significant uncertainties which impact costs and benefits**

Measure	Benefit Uncertainty	Cost Uncertainty
<b>Measure A (Euro low)</b> <b>Measure C (Early Euro low)</b>	<p><b>No chronic mortality effects of particles:</b> The carbon and ozone disbenefits outweigh the other health benefits, including the acute mortality effects from reductions in particles and the measures have negative overall benefits.</p> <p><b>Assuming 0.1% reduction in hazard rate per <math>\mu\text{g.m}^{-3}</math> PM<sub>2.5</sub> (1% per <math>10\mu\text{g.m}^{-3}</math>):</b> The NPV using the 6% hazard rate is positive but switches to negative using the 1% hazard rate.</p>	<p><b>Technology costs fall due to innovation:</b> The impact of innovation on technology reduces the costs associated with these measures but this is not valued.</p>

Measure	Benefit Uncertainty	Cost Uncertainty
<p><b>Measure A2 (Euro revised)</b>  <b>Measure B (Euro high)</b>  <b>Measure C2 (Early Euro revised)</b></p>	<p><b>No chronic mortality effects of particles:</b> The carbon and ozone disbenefits outweigh the other health benefits, including the acute mortality effects from reductions in particles and the measures have negative overall benefits.</p> <p><b>Assuming 0.1% or 1.2% reduction in hazard rate per <math>\mu\text{g.m}^{-3}</math> <math>\text{PM}_{2.5}</math> (1 or 12% per <math>10\mu\text{g.m}^{-3}</math>):</b> The lower bound of the NPV using the 6% hazard rate is negative but switches to positive using the 12% hazard rate. The upper bound of the NPV using the 6% hazard rate is positive but switches to negative using the 1% hazard rate.</p> <p><b>Assuming different lagtime for long term effects of PM:</b> using a 6% hazard rate, this measure has a positive net present value assuming a zero lag effect (compared with a small negative net present value with a 40 year lag effect).</p>	<p><b>Technology costs fall due to innovation:</b> The impact of innovation on technology reduces the costs associated with these measures but this is not valued.</p>
<p><b>Measure E (LEV)</b></p>	<p><b>No chronic mortality effects of particles:</b> The benefits fall but are not negative. <b>Uncertainty regarding the social cost of carbon (SCC)<sup>2</sup>:</b> As this measure also reduces carbon emissions, using a higher value for SCC increases the benefits and using the lower bound of the SCC reduces the benefits. However using the lower value for SCC does not impact on the overall cost benefit conclusion for this measure.</p>	<p>Using different assumptions for valuing welfare costs arising from this measure. If more stringent assumptions are used for valuing welfare costs, the total costs of the measure would rise significantly.</p>

<sup>2</sup> It is worth noting that the Stern review suggested that the cost of carbon used in government evaluations was significantly undervalued. The report suggested increasing the value to \$85 per tonne of CO<sub>2</sub> (approx £160 per tonne of carbon). However as this figure has not been agreed across government the existing agreed value has been used.

Measure	Benefit Uncertainty	Cost Uncertainty
<b>Measure K (LCP)</b>	<p><b>No chronic mortality effects of particles:</b> The net benefits of the measure (K1 short term and K2 long term) are negative as the carbon and ozone disbenefits outweigh the other health benefits, including the acute mortality effects from reductions in particles.</p> <p><b>Assuming 0.1% or 1.2% reduction in hazard rate per <math>\mu\text{g}\cdot\text{m}^{-3}</math> <math>\text{PM}_{2.5}</math> (1 or 12% per <math>10\mu\text{g}\cdot\text{m}^{-3}</math>):</b> The upper bound of the NPV for K1 is positive but switches to negative using the 1% hazard rate.</p> <p><b>Assuming different lagtime for long term effects of PM:</b> using a 6% hazard rate, this measure (K1 short term) has a positive net present value assuming a zero lag effect (compared with a negative net present value with a 40 year lag effect)</p>	<p>Uncertainty associated with which coal power stations will opt for the limited life derogation under the LCPD and what baseline <math>\text{NO}_x</math> abatement measures will be adopted by opted in plants</p>
<b>Measure L (SCP)</b>	<p><b>No chronic mortality effects of particles:</b></p> <p>The net benefits of the long term measure (Measure L) are negative as the carbon and ozone disbenefits outweigh the other health benefits, included the acute mortality effects from reductions in particles.</p> <p><b>Uncertainty regarding the social cost of carbon (SCC)<sup>3</sup>:</b> As this measure also reduces carbon emissions, using a higher value for SCC increases the benefits and using the lower bound of the SCC reduces the benefits. Using the lower value does not impact on the overall cost benefit conclusion for this measure.</p>	<p>This measure has been defined at a very high level. There is uncertainty as to the implementation route and take-up rate which could impact costs.</p>

16. Monte Carlo analysis has also been carried out to assess the effect of key uncertainties on the results of the monetary assessment. The results of this analysis is presented in section 5.6 of Chapter 5 with the full analysis available in Annex 7.

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### 6.2.2 Combined non-monetary assessment of measures

17. This section presents a combined analysis of all the non-monetary assessments of the measures in the Air Quality Strategy review. A detailed discussion of the assessments of each measure and the methodology used to derive them is presented in Chapter 4. This section attempts to draw out the major messages from Chapter 4 and provides a summary of the non-monetary assessments undertaken.

#### 6.2.2.1 Exceedences

18. The impact of the measures on exceedences was discussed in detail in section 4.2 of Chapter 4 of this report. Figures 6.3 and 6.4 below summarise the impact of the measures on the extent of exceedences of objectives. They show the reduction in extent of exceedence of objectives at background or at urban roadside in 2020. The higher the bar, the more effective the measure is likely to be for reducing exceedences.

Figure 6.3

Reduction in exceedences at urban roadside, in comparison to the baseline in 2020

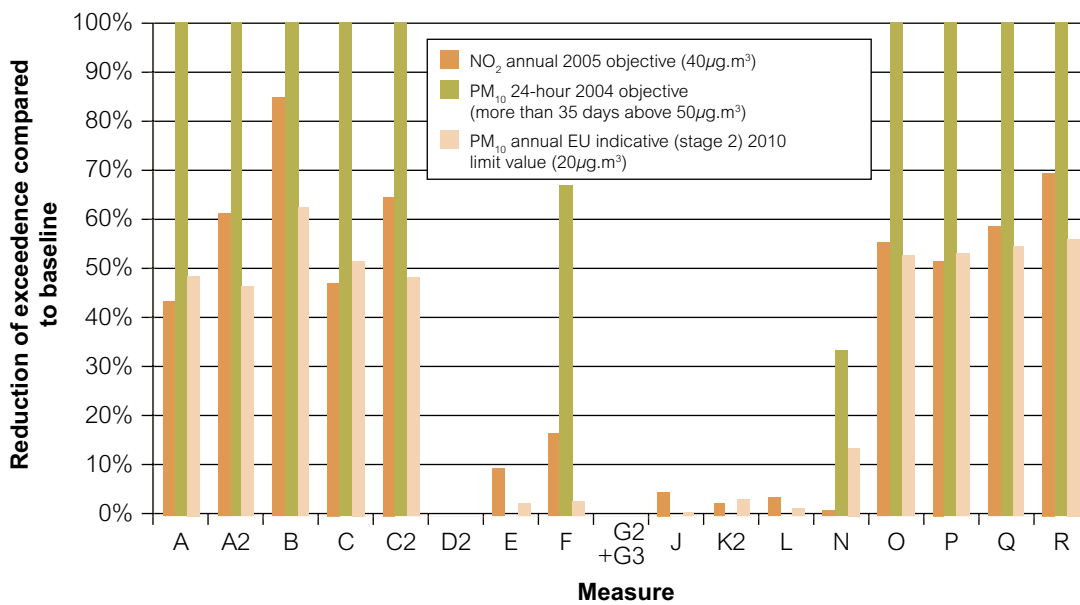
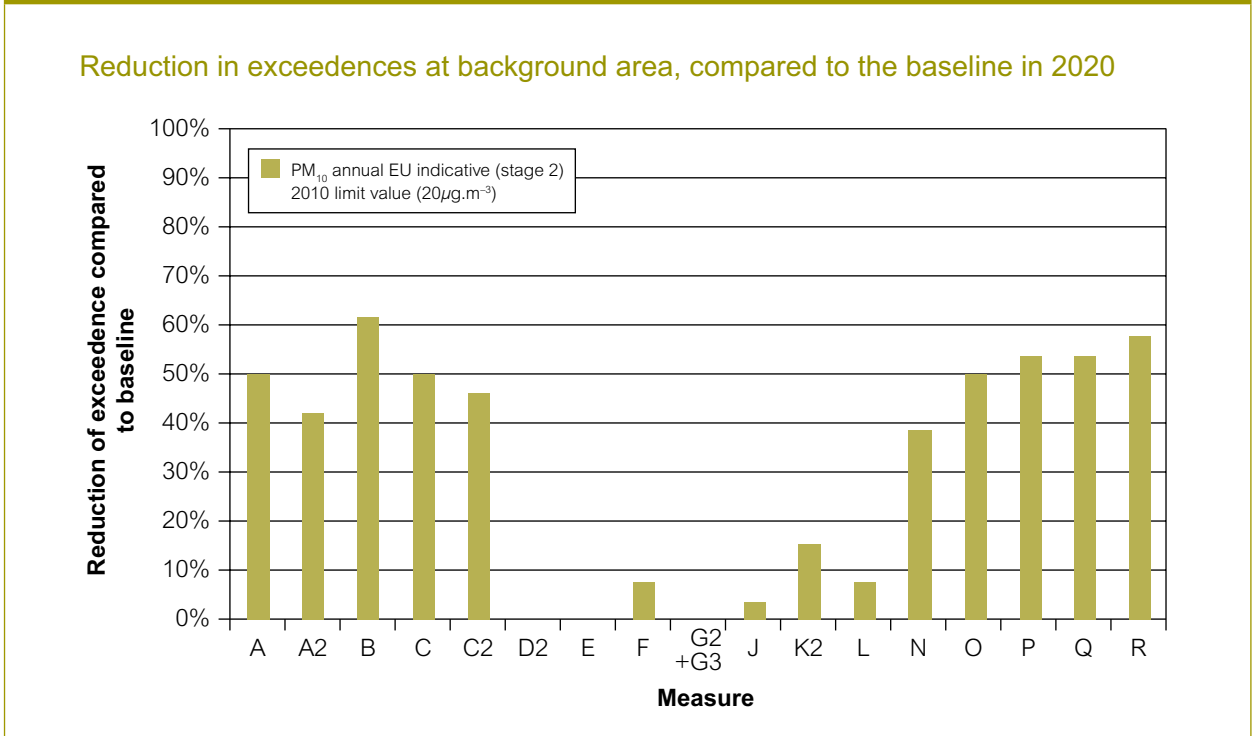


Figure 6.4



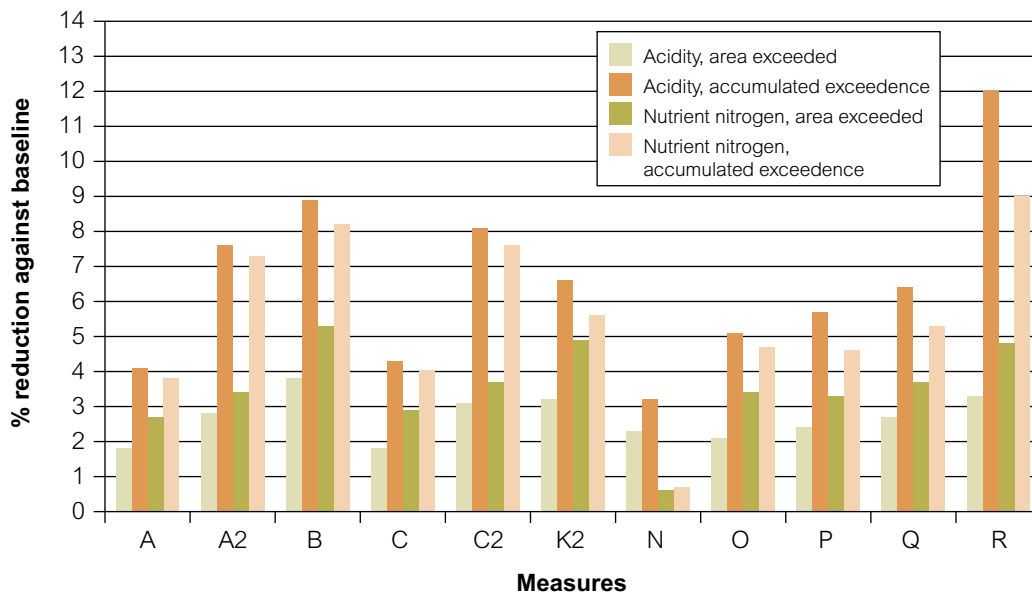
19. The figures above show that Measures A (Euro low), A2 (Euro revised), B (Euro high), C (Early Euro low), C2 (Early Euro revised), F (Road pricing), N (Shipping) and the combined Measures (O, P, Q and R) are expected to have significant impact on exceedences overall (incorporating both roadside and background exceedences).

### 6.2.2.2 Ecosystems

20. For the ecosystem assessment, the measures which were anticipated to have the most significant impact on critical loads (i.e. those measures that would affect SO<sub>2</sub>, NO<sub>x</sub> or NH<sub>x</sub> emissions) were quantified.
21. Figure 6.5 below shows the quantified impacts on ecosystems of those measures expected to generate a significant impact on critical loads.

Figure 6.5

Reduction in areas exceeded and accumulated exceedence against baseline, for acidity and nutrient nitrogen critical load exceedence



22. The chart shows that Measures B (Euro high) C2 (Early Euro revised), A2 (Euro revised) and K2 (LCP) are most favourable regarding the percentage reductions in both acidity and nutrient nitrogen critical loads. Of the remaining measures shown, Measures A (Euro low), C (Early Euro low) and N (Shipping) are expected to generate the smaller improvement, with the combined measures (O, P and Q) generating higher reductions than Measure C due to the small incremental benefits from Measures E (LEV) and L (SCP). Combined measure R however produces the highest impact as this package includes both Measures C2 and N.

### 6.2.2.3 Qualitative assessments

23. For some impacts, it has been concluded that valuation is not possible at this time and neither is it possible to describe the results in terms of quantified impacts. Therefore these impacts are described solely in qualitative terms. It is however possible to provide a guide to the scale and direction of the impact. It is important that the non-valued impacts are taken into account when assessing the different policy options, rather than conclusions being drawn solely from quantified and valued impacts.

24. The impacts which have been presented in a qualitative manner are described below:

- **Social impacts:** The existing evidence linking air quality and distributional (i.e. social and socio-economic) effects has been assessed and used as the basis of a qualitative assessment of the measures (see Chapter 4, section 4.8);

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- **Noise:** Chapter 4 also qualitatively considers the impacts on noise of the additional measures. It is expected that noise benefits will be extremely small in relation to other benefits;
  - **Competition and impact on small businesses:** Although it has not been practicable to undertake a full, detailed competition assessment as well as an assessment of impacts on small businesses, Chapter 4 presents a qualitative discussion of these impacts; and
  - **Additional health impacts:** This section also presents a summary of the major health impacts of pollutants which have been considered qualitatively such as the impacts of the additional measures on benzene and polycyclic aromatic hydrocarbons. These additional health impacts are only expected to be small given that the measures assessed for the review do not aim to tackle the health effects of these additional pollutants.
25. Table 6.2 below presents a brief discussion of these qualitative effects. Only those measures are presented which have significant impacts on two or more of the following impacts: additional health benefits, noise, distribution, competition and small businesses. For example Measure A, which has a moderate impact on distribution, is not presented here as it has a negligible impact on all the other categories. The results for Measure E would also apply to the combined measures O, Q and R; the results for Measure L would also apply to the combined measures P and Q. The qualitative impacts of all the measures are presented in a summarised tabular format in section 6.2.3. A more detailed description of the qualitative impacts can be obtained from Chapter 4 of this report.
26. The assessments of the qualitative impacts are divided into positive and negative although it has not been possible to estimate the impact on the NPV of the measures.

**Table 6.2: Qualitative effects of Measures with significant impacts**

Measure	Social impact (SI)	Noise (N)	Competition (C)	Small business (SB)	Health impacts (H)
Measure D (Phase out)	Score: +	Score: +	Score: <b>N/A</b>	Score: <b>N/A</b>	Score: +
	Comments: Wider distributional benefits than other policies, as lower income groups tend to drive older cars	Comments: Reductions in noise, as older cars tend to be more noisy	Comments: Negligible	Comments: Negligible	Comment: Reduction of benzene, 1,3-butadiene leads to a small reduced risk of leukaemia and leukaemia/lymphoma respectively

Measure	Social impact (SI)	Noise (N)	Competition (C)	Small business (SB)	Health impacts (H)
Measure E (LEVs)	Score: <b>+</b>	Score: <b>+</b>	Score: <b>N/A</b>	Score: <b>N/A</b>	Score: <b>N/A</b>
	Comments: Possible distribution benefits from improvements in AQ in deprived areas	Comments: Noise benefits may result from this measure	Comments: Negligible	Comments: Negligible	Comments: Negligible or no known effects on benefits for the relevant pollutants
Measure F (Road Pricing)	Score: <b>+</b>	Score: <b>+</b>	Score: <b>N/A</b>	Score: <b>N/A</b>	Score: <b>N/A</b>
	Comments: Possible distribution benefits from improvements in AQ in deprived areas	Comments: Reductions in noise due to less traffic	Comments: Negligible	Comments: Negligible	Comments: Negligible or no known effects on benefits for the relevant pollutants
Measure G (LEZs)	Score: <b>+</b>	Score: <b>+</b>	Score: <b>-</b>	Score: <b>-</b>	Score: <b>N/A</b>
	Comments: Possible higher air quality benefits as targeted at urban centres	Comments: Reductions in noise though less than Measure D	Comments: This measure potentially has a negative impact on competition	Comments: This measure potentially has a negative impact on small businesses	Comments: Negligible or no known effects on benefits for the relevant pollutants
Measure I (DomCom Coal)	Score: <b>+</b>	Score: <b>N/A</b>	Score: <b>-</b>	Score: <b>-</b>	Score: <b>+</b>
	Comments: Strong distributional benefits especially in Northern Ireland	Comments: Negligible	Comments: This measure has a possible negative impact on competitiveness	Comments: This measure has a possible negative impact on small businesses	Comments: Possibility of small reduced risk for lung cancer due to reduction in PAHs
L (SCP)	Score: <b>+</b>	Score: <b>N/A</b>	Score: <b>N/A</b>	Score: <b>-</b>	Score: <b>N/A</b>
	Comments: Possible higher air quality benefits as targeted at urban areas	Comments: Negligible	Comments: Negligible	Comments: This measure has a possible negative impact on small businesses	Comments: Negligible or no known effects on benefits for the relevant pollutants

### 6.2.3 Combined assessment

27. This section presents the combined assessments of all the measures taking into account the quantified assessment as well as the qualitative assessment.
28. The results of the monetary, exceedence, ecosystem and qualitative assessments are presented in Table 6.3 below. There is no attempt to explicitly rank the measures and this table concentrates on presenting the evidence used to assess the measures.
29. However some key conclusions may be drawn from the analysis. For the purpose of brevity and clarity of assessment, only those measures which do not present a negative NPV across the full range of hazard rates are discussed here.
  - Measures A (Euro low), C (Early Euro low) generated large net benefits based on the 6% coefficient, for both the no lag and 40 year lag scenarios. These measures also present high positive impacts on exceedences, ecosystems and some possible benefits in terms of distributional effects.
  - Measures A2 (Euro revised), B (Euro high), and C2 (Early Euro revised) have the potential to deliver large monetised benefits, assuming a 6% coefficient and no lag for the chronic mortality effect of particles. Assuming a 40 year lag, however, these measures have a (small) negative net present value. These measures presents significant benefits on the ecosystems and exceedence assessment.
  - Measure E (LEV) presents positive net benefits as well as having moderately positive impacts on exceedence, noise and distribution.
  - Measure K1 (LCP short term) shows positive net benefits, assuming the 6% coefficient and no lag assumptions. Measure K2 also has some benefits in terms of exceedences of current objectives and ecosystem benefits. There are, however, possible negative impacts on competition and security of supply.
  - Measures L (SCP) and N (Shipping) present an overall positive benefit cost assessment. The scale of the net benefits from the shipping measure is potentially considerable. Measure N may also deliver ecosystems and exceedence benefits. However, Measure L may have negative impacts in terms of a small business assessment.
  - The combined Measures O, P, Q and R deliver significant ecosystem, exceedence and other qualitative benefits. These measures also have the potential to deliver very high net monetary benefits at the top end of the range of possible benefits.

**Table 6.3: Summary of the assessments for AQS review additional measures**

Measure	NPV £million	Exceedence assessment	Ecosystem assessment	Major qualitative impacts affecting NPV
<b>Measure A</b> (Euro low)	80 – 801	Between 44% and 100% reduction for individual objectives	Significant positive impact	SI+
<b>Measure A2</b> (Euro revised)	(264) – 539	Between 46% and 100% reduction for individual objectives	Significant positive impact	SI+
<b>Measure B</b> (Euro high)	(432) – 514	Between 62% and 100% reduction for individual objectives	Significant positive impact	SI+
<b>Measure C</b> (Early Euro low)	148 – 947	Between 47% and 100% reduction for individual objectives	Significant positive impact	SI+
<b>Measure C2</b> (Early Euro revised)	(246) – 595	Between 48% and 100% reduction for individual objectives	Significant positive impact	SI+
<b>Measure D1</b> (Phase out)	(4) – (3)	Not modelled	No/insignificant effects	SI+, N+, H+
<b>Measure D2</b> (Phase out)	(97) – (93)	Between 0.4% and 5% reduction for individual objectives	No/insignificant effects	SI+, N+, H+
<b>Measure E</b> (LEV)	63 – 112	Between 3% and 9% reduction for individual objectives	No/insignificant effects	SI+, N+
<b>Measure F</b> (Road Pricing)	–	Between 3% and 67% reduction for individual objectives	No/insignificant effects	SI+, N+
<b>Measure G1</b> (LEZs, London Phase I)	(33) – (1)	Not modelled	No/insignificant effects	SI+, N+, C-, SB-

Measure	NPV £million	Exceedence assessment	Ecosystem assessment	Major qualitative impacts affecting NPV
<b>Measure G2</b> (LEZs, London Phase II)	(67) – (2)	Between 0% and 33% reduction for individual objectives	No/insignificant effects	SI+, N+, C-, SB-
<b>Measure G3</b> (LEZs, 7 other urban areas)	(14) – (12)	Not modelled	No/insignificant effects	SI+, N+, C-, SB-
<b>Measure H1</b> (Retrofit – 65%)	(33) – (17)	Not modelled	No/insignificant effects	SI+
<b>Measure H2</b> (Retrofit – 20%)	(5) – 0	Not modelled	No/insignificant effects	SI+
<b>Measure H3</b> (Retrofit – 35%)	(7) – 2	Not modelled	No/insignificant effects	SI+
<b>Measure I</b> (Domcom Coal)	(23) – (15)	Not modelled	No/insignificant effects	SI+, C-, SB-, H+
<b>Measure J</b> (Domcom NO <sub>x</sub> )	(179) – (148)	Between 0% and 5% reduction for individual objectives	No/insignificant effects	SI+
<b>Measure K1</b> (LCP)	(107) – 34	Not modelled	No/insignificant effects	C-
<b>Measure K2</b> (LCP)	(232) – (139)	Between 0% and 15% reduction for individual objectives	Significant positive impact	C-
<b>Measure L</b> (SCP)	18 - 57	Between 0% and 8% reduction for individual objectives	No/insignificant effects	SI+, SB-
<b>Measure M</b> (VOCs)	(249) – (248)	Not modelled	No/insignificant effects	
<b>Measure N</b> (Shipping)	245 – 576	Between 1% and 38% reduction for individual objectives	Significant positive impact	

Measure	NPV £million	Exceedence assessment	Ecosystem assessment	Major qualitative impacts affecting NPV
<b>Measure O</b> (Early Euro low + LEV)	186 – 978	Between 50% and 100% reduction for individual objectives	Significant positive impact	SI+, N+
<b>Measure P</b> (Early Euro low + SCP)	163 – 1,000	Between 52% and 100% reduction for individual objectives	Significant positive impact	SI+, SB-
<b>Measure Q</b> (Early Euro low + LEV + SCP)	203 – 1,053	Between 52% and 100% reduction for individual objectives	Significant positive impact	SI+, N+, SB-
<b>Measure R</b> (Early Euro revised + LEV + Shipping)	33 – 1,211	Between 56% and 100% reduction for individual objectives	Significant positive impact	SI+, N+

Notes:

a This summary shows the lowest and highest expected impact by 2020 (2010 for Measures D and G) on baseline exceedences across all objectives and does not represent a range for individual objectives.

**SI** represent social impacts which includes impacts on distribution, SI+ implies that the measure has a positive impact on distribution, SI- implies a negative impact.

**N** represents the impacts on noise, N+ implies a positive impact on noise, N- implies that the measure has a negative noise impact, i.e. due to the measure noise increases

**C** represents impacts on competitiveness, C+ implies a positive impact and C- represents a possible negative impact

**SB** represents impacts on small businesses, SB+ implies a positive impact and SB- represents a possible negative impact

**H** represents qualitative description of the other health impacts these measures may generate, H+ implies a positive health impact. H- implies a possible negative health impact.

### 6.3 Work going forward

30. The primary focus of the Interdepartmental Group on Costs and Benefits (IGCB) is to undertake the formal economic analysis of the possible impacts of potential future measures that could be implemented to achieve the objectives set out in the Air Quality Strategy. Therefore the further research outlined in this section will focus on improving our understanding on the methodology and assessment techniques of the costs and benefits of air pollution and measures to alleviate them. Further detailed work on improving our understanding on the measuring and quantifying impacts of air pollution can be obtained from Chapter 5 of the Air Quality Strategy review consultation document.
31. Since the publication of the third report we have carried out additional areas of work which were recommended in Chapter 6 of the third report for further consideration:
  - A Monte Carlo analysis has been carried out to consider the impact of key assumptions of the overall results of the monetary assessment. The results of this work have been presented in section 5.6 of Chapter 5. This has helped improve our understanding around the impact of the size of hazard rate coefficient for chronic mortality effects, the potential lag time for this effect, uncertainties around cost outturns and the effect of the choice of uplift factor.
  - Further work on the possible effects of innovation on technology costs
  - Additional work has been carried out to consider the costs of specific measures – namely Measure B – that have the potential for large benefits but currently have high costs. The conclusions from this work, carried out as part of the Monte Carlo analysis, can be found in section 5.6 of Chapter 5.
32. For future research priorities, we recommend in particular, further work on the following, as set out in the Third Report:
  - Improving understanding of the appropriate size of the coefficient for the long term effects of particles;
  - Improving (if possible) understanding of the types of particles that are driving the long term effects of particles;
  - Improving understanding of windows of exposure and lag time to effect for the long term effects of particles;
  - Further development of the lifetable methodology e.g. to incorporate the above improvements in understanding;
  - Possible long term effects of other pollutants e.g. ozone;
  - Development of ways to incorporate effects on respiratory symptoms (including increasing the robustness of the underlying evidence);
  - Disentangling (if possible) the separate health effects of nitrogen dioxide and particles;
  - Mechanisms of effects of long term exposure including effects of long term exposure on chronic morbidity;

- Damage cost analysis e.g. the incorporation of transboundary effects, the effect of different baseline years on damage cost estimates, disaggregation of ozone damage costs for VOCs and NO<sub>x</sub> to differentiate between sector and area;
  - Undertake further refinement to the quantification and valuation of the total impact of air quality in the UK;
  - Further work on the possible effects of innovation on technology costs, that could substantially reduce the resource costs of the specific technologies used in future measures; and
  - Additional work on the costs of specific measures that have the potential for large benefits but currently have high costs (e.g. Measure B) to explore opportunities to reduce these costs.
33. In addition, in light of discussions carried out during the AQS review consultation and the identification of new areas of potential research, we also recommend the further work on the following areas:
  34. Further development of the underlying evidence on the impacts of SO<sub>2</sub> on asthmatics through bronchoconstriction and consequently the methodology used to quantifying and value such impacts.
  35. Additional work on the impacts of acid and nutrient deposition in habitat areas.
  36. Development of ways to incorporate 'collateral benefits' or air quality improvements, such as increased fitness and quality of life, into the formal assessment methodology.
  37. Further work on quantifying the impacts on ecosystems from air quality.
  38. Extending the impact pathway methodology and damage costs to all the pollutants covered by the Air Quality Strategy.