Summary: Intervention & Options

Department /Agency:	**Title:**	
Defra	**Impact Assessment of extending the compliance deadline for meeting PM_{10} limit values in ambient air from 2005 to 2011**	
Stage: Consultation	**Version:** 1	**Date:** January 2009
Related Publications:		

Available to view or download at:

http://www.defra.gov.uk/corporate/consult/air-quality/index.htm

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What is the problem under consideration? Why is government intervention necessary?

Council Directive 2008/50/EC allows an exemption from meeting limit values for PM_{10} from 2005 to 2011 where compliance cannot be achieved, subject to certain criteria and demonstrating how limit values will be achieved by 2011. The UK has reported exceedences of limit values each year since 2005, though compliance is expected to be attained by 2011 in all parts of the UK under current planned measures. Government intervention is necessary to avoid the disproportionate costs of immediate mitigating actions.

What are the policy objectives and the intended effects?

The objective is to secure for 8 UK zones/agglomerations exemption from the PM_{10} limit value until 2011, at which time full compliance is expected to be achieved through planned measures. This will avoid disproportionate costs of immediate mitigating action and prevent infraction by the Commission.

What policy options have been considered? Please justify any preferred option.

The preferred option is to submit a notification to the Commission to secure the exemption for 8 zones/agglomerations in the UK where exceedences have occurred or are expected to occur between 2005 and 2011. This option is estimated to deliver a total net benefit of over £3.3 bn over the alternate option of immediate action to secure compliance via a mass Diesel Particulate Filter retrofitting scheme. If we do not to submit a notification or take immediate action infraction proceedings will be instigated on the basis of current and future breaches up to 2011.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects?

The UK is required to monitor ambient air quality and report any breaches to the Commission each year.

Ministerial Sign-off For CONSULTATION STAGE Impact Assessments:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

....Date:

Summary: Analysis & Evidence

Policy Option: Submit notification (option)

Description: Submit a notification to the European Commission to exempt 8 UK zones from the obligation to meet the PM 10 limit value until 2011.

COSTS

ANNUAL COSTS	
One-off (Transition)	**Yrs**
£ 0	1
Average Annual Cost (excluding one-off)	
£ 171 million	

Description and scale of **key monetised costs** by 'main affected groups'

Air pollution has a range of impacts on human health and the natural and man made environment. The most significant impacts being on human health. These health impacts will be focused on the areas of exceedence.

Total Cost (PV) **£ 2.6 billion**

Other **key non-monetised costs** by 'main affected groups'

The above valuation does not include all the potential impacts of air pollution but focuses on the key areas where there is a robust evidence. Particular omissions include a range of morbidity impacts, where robust epidemiological evidence does not exist and impacts on ecosystems,

BENEFITS

ANNUAL BENEFITS	
One-off	**Yrs**
£ 4.9 billion	1
Average Annual Benefit (excluding one-off)	
£ 67 million	

Description and scale of **key monetised benefits** by 'main affected groups'

The key costs of this measure are the additional technology and the additional running costs of the road vehicles. The initial cost would likely be incurred by Government but ongoing cost would definitely fall to the consumers of road transport

Total Benefit (PV) **£ 5.9 billion**

Other **key non-monetised benefits** by 'main affected groups'

The savings included in this estimate only include technical and operational costs of the additional technology. It may be considered to be a conservative estimate as it does not include installation, administrative or enforcement costs.

Key Assumptions/Sensitivities/Risks

The results of this analysis are robust across a range of sensitivities. This analysis suggests that this option would only impose a net cost if the valuation of the health impacts were to more than double or if the technology costs were to be reduced by two thirds.

Price Base Year 2008	Time Period Years 20	**Net Benefit Range** (NPV) [1] **£ 0.7bn to 5.5bn**	**NET BENEFIT** (NPV Best estimate) **£ 3.3 billion**

What is the geographic coverage of the policy/option?			UK	
On what date will the policy be implemented?			ongoing	
Which organisation(s) will enforce the policy?			Defra and DA's	
What is the total annual cost of enforcement for these organisations?			£ 0	
Does enforcement comply with Hampton principles?			Yes	
Will implementation go beyond minimum EU requirements?			No	
What is the value of the proposed offsetting measure per year?			£ N/A	
What is the value of changes in greenhouse gas emissions?			£ 117 million (benefit)	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro	Small	Medium	Large
Are any of these organisations exempt?	No	No	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices) (Increase - Decrease)

Increase of £ 0 Decrease of £ 0 **Net Impact** £ 0

Evidence Base (for summary sheets)

[Use this space (with a recommended maximum of 30 pages) to set out the evidence, analysis and detailed narrative from which you have generated your policy options or proposal. Ensure that the information is organised in such a way as to explain clearly the summary information on the preceding pages of this form.]

Introduction

The Air Quality Framework Directive (96/62/EC) and the Daughter Directives (1999/30/EC, 2000/69/EC, 2002/3/EC) set limit values for various pollutants in ambient air including particulate matter (PM_{10}). The values for PM_{10} came into force in 2005.

The new Directive 2008/50/EC on ambient air quality and cleaner air for Europe recognises the difficulties across Europe in achieving compliance with the limit values for particulate matter (PM_{10}), and nitrogen dioxide. In 2007 breaches of PM_{10} limit values were reported by all member states except the Republic of Ireland, in one third of zones in the EU.

Pursuant to Article 22 of Directive 2008/50/EC, Member States may notify to the Commission seeking exemption from the limit values for PM_{10} until 11 June 2011 at the latest. In practice, this is a partial extension as, during the time extension period, the Member State must ensure that the limit value is not exceeded by more than the maximum margin of tolerance specified in Annexe XI. In their notification, Member States must demonstrate that:

- all appropriate measures have been taken at national, regional and local level to meet the deadline for the limit values, i.e. 1 January 2005, and that limit values could not be achieved because of the presence of one or more of the following elements: site-specific dispersion characteristics, adverse climatic conditions or transboundary contributions;
- compliance with the limit values will be achieved at the expiry of the exemption period.

In order to facilitate the notification procedure, a **Communication from the Commission** has been adopted providing guidance to Member States on the information to be provided and the scope of the conditions. When notifying, Member States are strongly recommended to use the forms set out in the **Staff Working Paper** accompanying the Communication. These forms, with an accompanying report, will set out in some considerable detail how the conditions for an application, as set out above, will be met.

If the Commission does not raise objections within nine months of receipt of an official and complete notification, the exemption from the limit value will apply for a three year period ending on **11 June 2011**.

Outside the zones or agglomerations covered by the exemption decision, limit values must be complied with in full.

In the UK, as a result of improvements in air quality over many years, the PM_{10} limit values are met across most of the country. The remaining areas where there have been exceedences at some point since 2005 are relatively small, although significant numbers of people are likely to be exposed as the exceedences tend to be in highly populated areas.

Local emissions are relatively constant from year to year, with a decreasing trend over time. The greatest inter-annual variation is meteorology, which affects local dispersion and more importantly, the source composition and value of the regional background. The evidence demonstrates that a key contributor to the breaches of limit values in the UK is transboundary contributions, one of the criteria in the Directive for securing an exemption[1]. Whilst Community measures, in particular in relation to industrial emissions control and national emissions ceilings, might be expected to address this, given that our remaining exceedences are confined to small urban 'hotspots', additional national, regional or local measures would also contribute.

Policy options

1. **Option 1: Do not submit to the Commission an Article 22 notification seeking a partial exemption from the obligation to apply the PM limit value until 2011 for those parts of the UK where exceedences have been reported since 2005.**

Despite improvements in air quality in recent years, the UK, has reported breaches of EU limit values across a number of UK zones and agglomerations in 2005, 2006 and 2007. In 2005 for example, there were exceedences of the PM_{10} limit value in 3 areas of the country along a total of 216 kilometres of major roads. We expect to meet the limit value across the UK by 2011, on the basis of current and planned measures. Given the date for compliance with the limit value was January 2005, this option would require immediate mitigating action in all zones with reported breaches to avoid infraction and/or domestic legal action and the potentially very high costs of that.

2. **Option 2: Submit an Article 22 notification to secure a partial exemption from meeting the PM_{10} limit values until 2011 for relevant zones/agglomerations**

Under this option, UK would seek from the Commission an exemption from the obligation to apply limit values until 11 June 2011 for the 8 zones/agglomerations below where, following data corrections outlined below, exceedences remained in 2005 and/or 2006 and/or 2007:

- Greater London Urban Area
- West Midlands Urban Area
- West Yorkshire Urban Area
- Glasgow Urban Area
- Brighton/Worthing/Littlehampton
- Swansea Urban Area
- Eastern (England)
- Yorkshire and Humberside

The evidence from which this list has been generated includes a revised baseline (business as usual) projection, using 2005 as a base year, and incorporating all currently agreed policy measures, including the current proposals for the "Euro VI" emission standards for heavy goods vehicles. This updates earlier projections and is set out in some detail in the consultation document accompanying this impact assessment. The baseline has been corrected to take account of sea salt contributions, as permitted by the new directive 2008/50/EC, and to account for measurement error in 2005. This latter point was addressed in a recent report by our contractor, and sent to the Commission on 6th June 2008[2].

This option would enable planned measures to come into effect and, if necessary any additional actions to be taken to ensure compliance by June 2011.

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[1] http://www.emep.int/SR_data/sr_tables.html; also Charron, A., Harrison, R.M., & Quincey, P. (2007) What are the sources and conditions responsible for exceedences of the 24 h PM_{10} limit value ($50\mu g\ m^{-3}$) at a heavily trafficked London site?, *Atmospheric Environment*, 41, p. 1960-1975; and Abdalmogith, S.S., & Harrison, R.M. (2006) An analysis of spatial and temporal properties of daily sulphate, nitrate and chloride concentrations at UK urban and rural sites, *Journal of Environmental Monitoring,* 8, p. 691–699.

[2] www.airquality.co.uk/archive/reports/reports.php?report_id=515

Costs and benefits

The full economic analysis of this policy is attached as annex A to this IA. What follows below is a brief summary of the key assumptions and results of this analysis.

To value the different options the impact-pathway approach developed by the Interdepartmental Group on Costs and Benefits Air Quality subject group (IGCB(A)) has been applied. This approach is established as the best practice approach to evaluate air quality impacts.

In order to inform the decision between the two potential options a single scenario has been modelled to consider the impacts of either applying for the time extension or not. As the two options are mutually exclusive the benefits of one option are the costs of the other and vice versa. The modelling has been undertaken on the scenario of undertaking measures to meet the limit values immediately, rather than allowing current plans to deliver compliance by 2011. However these results are presented from the perspective of the preferred option i.e. apply for the time extension in the cover sheet so the health benefits modelled are shown as costs and the technological costs are shown as benefits. **Please note as option 2 is presented in the summary sheet the costs identified below are presented as benefits (i.e. costs avoided) and the benefits are presented as costs (i.e. air quality improvements foregone).**

The revised UK Air Quality Strategy published in 2007 identified few national measures had positive net benefits, though it also recognised that local measures have an important role to play. Those national measures with positive net benefits have been pursued, and further improvements in air quality will likely cost more than the value of the health benefits.

Under this measure it is assumed that a mass retrofitting scheme of emissions control equipment for road vehicles would be introduced in the UK. Referring back to the analysis conducted for the National Air Quality Strategy in 2007 retrofitting was selected as the most effective potential option on the basis of monetary cost, technical feasibility and practicability. The costs and benefits of such a scheme have been estimated to illustrate the likely social impact of this option. While it is possible that a portfolio of local schemes might be able to achieve this objective at a lower cost a national measure is preferred both in order to ensure certainty and to ensure the speed of action. It is unlikely that local decision making and implementation processes could achieve the necessary national coverage needed to ensure guaranteed compliance with the limit values in the shortest time. Therefore some form of national direction and coordination would be required, ultimately making this option practically indistinguishable from a national measure such as that discussed under Option 1.

To achieve such significant improvements in air quality it is assumed that a large scale retrofitting of Diesel Particulate Filters (DPFs) is undertaken to reduce PM emission reductions across the existing fleet. The implementation of this scheme is assumed to occur in 2009 across all the different vehicle types. Table 1 below outlines the estimated required uptake of this scheme in order to achieve compliance.

Table 1: Fleet uptake of retrofitting

Vehicle Type	Vehicles retrofitted ,000s (% of fleet)
Diesel Car	1,260 (45%)
Diesel LGV	3,036 (100%)
Articulated HGV	135 (100%)
Rigid HGV	310 (100%)
Captive fleet[1]	112 (100%)

[1] Buses and Coaches

Benefits

The improvements in air quality have a range of benefits on human health and the natural and man-made environment. In quantifying the monetary benefits the primary focus has been on the potential health benefits. This focus is because the primary driver of the monetary valuation of air quality policy has been health benefits accounting for well in excess of 95% of the total benefits. The health impacts are primarily driven through the chronic health impacts of exposure to particulate matter (PM). All the analysis has been undertaken in accordance with the advice of the Committee on the Medical Effects of Air Pollution (COMEAP).

There is however remaining uncertainty around the health impacts as a continually growing area. In order to address this sensitivity an alternate set of assumptions on health effects have been applied in the sensitivity analysis based in the EU Clean Air for Europe (CAFE) methodology. This sensitivity shows that the key results are not sensitive to these assumptions.

This option is assumed not to have any impact after 2030 when all the retrofitted vehicles are estimated to have left the fleet. Based on this uptake rate is was estimated that emissions of PM would fall by over 10,600 tonnes in 2010 falling to under 100 tonnes by 2030. These changes in emissions were than valued using the damage cost methodology. The damage cost methodology provides unit values for changes in emissions of air pollutants linking emissions in tonnes to monetary values.[3]

Table 2: Annual present value of health impacts (£millions)

PM life years saved	**PM – RHA (2010 p.a.)** [1]	**PM – CHA (2010 p.a.)** [2]	**Total (central)**
169	0.2 - 1.1	0.2 - 1.1	171
[1] Respiratory hospital admission [2] Cardiovascular hospital admission			

[3] Damage costs are explained in more detail in Annex A.

Costs

The cost of installing diesel particulate filters (DPFs) across the road fleet has broadly been split into three parts:

- Technology costs: the unit costs of the DPF technology and the operational costs for the different vehicle types are estimated across the fleet. The resource costs of technology is presented in Table 3 below. These total costs are then annualised over the lifetime of the measure taking into account the vehicle survival rate

Table 4: Resource costs per unit of technology[4]

Vehicle Type	Unit Resource costs	Annual Cleaning costs
Diesel car	£614	£0
Diesel LGV	£1,106	£0
Articulated HGVs	£1,750	£240
Rigid HGVs	£1,350	£160
Captive Fleet	£1,350	£160

- Resource costs of fuel: DPF technology also can have a negative impact on fuel economies for some vehicle types. A negative impact on fuel economy implies that the particular vehicle will use more fuel per km than a the vehicle did before the retrofitting took place (i.e. a fuel penalty). This measure also estimates the carbon impacts due to the negative impact on fuel economies and the resulting additional carbon emissions.
- Cleaning costs of HGV diesel particulate filters: The efficient operation of DPFs on HGVs also requires that they are cleaned annually. If this cleaning cost if not incurred then a significant fuel penalty would be imposed that is likely to outweigh the cleaning cost.

Table 4 below presents these costs which have been discounted according with standard methodology and annualised over the lifetime of the measure (2009 – 2029).

Table 4: Costs of DPF retrofitting in the UK (£ millions)

Annualised Technology Costs	Annualised Resource cost of extra fuel consumed plus carbon emissions	Annualised cleaning costs of DPFs on HGVs	Annual PV of Costs
324	40	26	391

Conclusion on costs and benefits

Table 5 below presents the annual Net Present Value (NPV) of the scheme to retrofit DPFs across the UK fleet.

Table 5: Annual costs and benefits of implementing Option 1(£ millions)[a]

Annual PV of Costs	Annual PV of Benefits	Annual NPV

[4] Source Air Quality Strategy (2007) available from www.defra.gov.uk

391	171	(220)
a Numbers in brackets represent negative values.		

The results in table 5 show that that the costs of a mass retrofitting scheme substantially outweigh the benefits. The results suggest that not applying for additional time to meet the limit value would impose a net cost of £220 million each year over the lifetime of the retrofitted technology. This equates to a net cost of £3.3 billion between 2010 and 2030.[5]

It should also be noted that these impacts are not evenly distributed over time. The majority of the £5.9bn NPV of costs would be incurred in the first year as the cost of the new technology is around £4.9bn. The ongoing costs of around £1bn, of additional fuel, carbon emissions and DPF cleaning, are also skewed towards the early period with over a fifth of the costs (22%) occurring in 2010 and only a fiftieth (2%) half way through the life of the vehicles in 2020. The benefits are also skewed towards the early years after the retrofitting scheme. Of the £2.6bn in benefits over a fifth (21%) occur in the 2010 falling to under on fiftieth (2%) half way through the life of the vehicles in 2020.

Sensitivities

Sensitivity analysis is undertaken to test how sensitive the results are to the key assumptions made in the assessment. Annex A provides a range of sensitivities analysis covering the key assumptions in relation to both benefits and costs. The seven key assumptions tested were:

Benefits sensitivities

- The time lag between changes in exposure to air pollutants and the associated health impacts;
- The estimated change in hazard rate associated with exposure to particulate matter;
- The geographical scope of impacts included; and
- Valuation of health impacts.

Cost sensitivities

- Including installation costs;
- Allowing prices to reflect scarcity; and
- Reflecting experience in differences between estimated and realised costs.

A summary of the impact of these different sensitivities is presented in table 6, below.

Table 6: Impact sensitivities (£ million)

Benefit Sensitivities	Annual NPV	Ammended NPV
Time lag	(220)	(197) – (257)
Hazard Rate	(220)	(49) – (362)
Geographical scope	(220)	(186)
Valuation	(220)	244 – (117)
Cost Sensitivities		
Non technology costs	(220)	(234)

[5] It is important to note that the total net present value does not equate to the annualised cost multiplied by the duration. The difference is the impact of discounting to estimate an annual value equal to a given lump sum.

Scarcity	(220)	(337)
Innovation	(220)	24 – 76
[a] Numbers in brackets represent negative values.		

As can be seen from table 6 the cost of a mass retrofitting scheme was seen to outweigh the associated benefits across most of the range of sensitivities.. Looking across the sensitivities there is a wide potential range, between a net annual cost of £362 million to a net benefit of £244. However across the 11 different sensitivities only 3 move this scenario to being cost beneficial.

However, a closer inspection of these switching assumptions suggests that they are very unlikely:

- In relation to the valuation of health outcomes only if the value of a life year exceeds around £66,000 does the retrofitting measure become cost beneficial. This value is far out of line from other health valuations used in the UK the IGCB for air pollution, of £29,000, the value of a life year implied from the DfT VSL, of around £30,000, and the Department of Health QUALY of between £30,000 - £40,000.[6]
- Innovation is required to reduce the technology costs by two thirds in order to switch the analysis to being cost beneficial. However it must be stressed that this is particularly unlikely for this scheme as the basis for such a bias is thought to be innovation and the prescriptive nature of this option allows no such room.

Administrative Burden

The preferred option would impose no additional administrative burden as it would impose no additional policy measures. However, relative to a mass retrofitting scheme there is a substantial avoided administrative cost. This cost would be substantial as it would involve the processing and recording of retrofitting on all vehciels that are retrofitted, over over 3 million vehicles. This however has not been calculated for this policy as it was clear that this was unlikely to be a favoured option.

Implementation and evaluation

Under our existing compliance assessment arrangements, on an annual basis air quality monitoring data will be collated to assess progress towards compliance and this will be supplemented with modelling assessments. If necessary additional actions will be put in place to ensure compliance with the limit values by 2011 and beyond.

Specific impact Assessments

A summary of the consideration of the specific impact assessments is presented in annex B. Overall it found that given the preferred option required no additional government action then it was unlikely to have a notable impact on competition, small firms, legal aid, sustainable development, race equality, disability equality, gender equality, human rights or rural areas. It was seen to have notable potential impacts on carbon, the environment and human health however these areas are covered in the evidence base.

[6] It must be noted that some international valuations do exceed this value in particular the high value used for the EU Clean Air For Europe (CAFE) analysis.

Conclusions and policy recommendation

The preferred option is to use the provisions in the new air quality directive 2008/50/EC to apply to the European Commission for a partial exemption from the obligation to apply the limit value until June 2011 for 8 zones/agglomerations across the UK where exceedences have been reported since the limit value came into force in January 2005. This option, which gives some time to enable planned measures to come into effect is estimated to deliver a total net benefit of over £3.3bn over the alternate option of immediate action to secure compliance via a mass DPF retrofitting scheme.[7]

[7] It must be noted that this benefit takes the form of the reduced costs associated with not installing DPFs across the vehicle fleet less the potential air quality benefit this delivers.

Specific Impact Tests: Checklist

Use the table below to demonstrate how broadly you have considered the potential impacts of your policy options.

Ensure that the results of any tests that impact on the cost-benefit analysis are contained within the main evidence base; other results may be annexed.

Type of testing undertaken	***Results in Evidence Base?***	***Results annexed?***
Competition Assessment	No	No
Small Firms Impact Test	No	No
Legal Aid	No	No
Sustainable Development	No	No
Carbon Assessment	Yes	No
Other Environment	Yes	No
Health Impact Assessment	Yes	No
Race Equality	No	No
Disability Equality	No	No
Gender Equality	No	No
Human Rights	No	No
Rural Proofing	No	No

Annexes

Annex A: Economic Analysis of the Time Extension Notification

Executive Summary

2. This paper presents the economic analysis undertaken to estimate the monetary cost benefit analysis of not applying for a time extension for the achievement of the PM limit values. As the modelling suggests that as a result of the current policy measures the required targets will be achieved within the duration of the time extension and therefore there are no additional costs to this decision.

3. In order to address these exceedences it assumes that a mass retrofitting scheme is introduced to install diesel particulate filters (DPFs) to road vehicles to reduce road transport emissions. This option was been selected as the most effective potential option on the bases of monetary cost, technical feasibility and practicability. It is the costs and benefits of this scheme that has been quantified to provide an indication of the likely social impact

4. The results of this analysis suggest that the costs substantially outweigh the benefits of such a scheme. This analysis suggests that not applying for the time extension would impose a net cost of £220m per annum each year over the life time of the retrofitted technology. This equates to a net cost of £3.3bn between 2010 and 2030.

5. It should also be noted that these impacts are not evenly distributed over time. The majority of the £5.9bn NPV of costs would be incurred in the first year as the cost of the new technology is around £4.9bn. The ongoing costs of around £1bn, of additional fuel, carbon emissions and DPF cleaning, are also skewed towards the early period with over a fifth of the costs (22%) occurring in 2010 and only a fiftieth (2%) half way through the life of the vehicles in 2020. The benefits are also skewed towards the early years after the retrofitting scheme. Of the £2.6bn in benefits over a fifth (21%) occur in the 2010 falling to under on fiftieth (2%) half way through the life of the vehicles in 2020.

6. This result was seen to be robust across a range of sensitivities. Looking across the sensitivities there is a wide potential range, between a net annual cost of £362 million to a net benefit of £244. However across the 11 different sensitivities only 3 move this scenario to being cost beneficial.

7. However, a closer inspection of these switching assumptions suggests that they are very unlikely:

   - In relation to the valuation of health outcomes only if the value of a life year exceeds around £66,000 does the retrofitting measure become cost beneficial. This value is far out of line from other health valuations used in the UK the IGCB for air pollution, of £29,000, the value of a life year implied from the DfT VSL, of around £30,000, and the Department of Health QUALY of between £30,000 - £40,000.

- Innovation is required to reduce the technology costs by two thirds in order to switch the analysis to being cost beneficial. However it must be stressed that this is particularly unlikely for this scheme as the basis for such a bias is thought to be innovation and the prescriptive nature of this option allows no such room.

Methodology

8. To value the different options this paper has applied the impact-pathway approach developed by the Interdepartmental Group on Costs and Benefits Air Quality subject group (IGCB(A)). This approach is the interdepartmentally agreed best practice approach to evaluate air quality impacts in the UK.

9. The main steps in applying the impact pathway approach are:
   - Quantification of air pollutant emissions for both the baseline and additional measures;
   - Conversion of projected emissions into population weighted concentrations for the baseline and differing policy scenarios. This is used to quantify the exposure of people, the environment and building to changes in air quality;
   - Quantification of health and non-health impacts associated with the change in pollutants, for example, using concentration-response functions that estimate the relationship between changes in air pollutants and changes in health outcomes;
   - Valuation (monetisation) of health and non-health impacts;
   - Assessment of costs associated with the implementation of each of the policy scenarios;
   - Comparison of costs and benefits on a consistent basis; and
   - Description and analysis of uncertainties associated with the quantification and valuation of impacts.

10. More detail on the application of the impact pathway approach is available from the IGCB(A) website www.defra.gov.uk/

11. The impact pathway approach set out above while providing robust estimates of air quality impacts is relatively resource intensive and so it has not been able to complete this analysis in the deadlines required for this project. To allow a more proportionate approach the IGCB also provide damage cost. Damage costs are one way of approximating the impacts of changes in air pollution. These values measure the marginal external costs caused by each additional tonne of pollutant emitted - or conversely the benefits of reducing a pollutant emitted by one tonne

    These damage costs are based on values for the same range of health impacts, including mortality and morbidity effects, and non-health impacts, such as damage to buildings and effects on crop yields, and also take account of both primary and secondary air pollution changes. The values of these were agreed following recommendation by the IGCB in 2005 and full methodology have been published alongside its updated third report.[8]

12. The results presented in the main body of this report provide the central estimates of the air quality impacts. Given the complexity of the modelling undertaken there are a wide range of uncertainties around these values. To reflect these uncertainties a range of sensitivities around the central figures have been undertaken and are presented in the sensitivities section towards the end of this annex.

13. In line with national appraisal guidance (the Green Book[9]) the impacts presented in this analysis have been undertaken from a social perspective. Therefore the costs and benefits focus primarily on the impacts on resources excluding any transfers such as profits or taxes. It must be noted therefore that the potential fiscal and social implications of these policies may not be well reflected in this analysis.

14. In each case the measures are assessed relative to the base case projections of national air quality. The Air Quality Strategy (2007) described the approach to estimating the future emissions of air pollutants. The current emission projections are based on Department of Business Enterprise and Regulatory Reform (BERR) UEP30 energy forecasts,[10] Department for Transport's 10 year plan for transport,[11] updated in September 2004,[12] and the National Atmospheric Emissions Inventory (NAEI).[13]

Scenario

15. As set out in the IA not applying for the time extension for compliance with achievement of the PM limit value would require immediate action to achieve the limit values across the UK. This analysis therefore looks to estimate the consequences of such action.

16. In order to address these exceedences it assumes that a mass retrofitting scheme is introduced to install diesel particulate filters (DPFs) to road vehcilces to reduce road transport emissions. As discussed in the preceding IA retrofitting has been selected as the most effective potential option on the bases of monetary cost, technical feasibility and practicability. It is the costs and benefits of this scheme that has been quantified to provide an indication of the likely social impact.

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[8] For further information on the background to the damage cost approach and what damage costs include the full Air quality damage cost guidance available from www.defra.gov.uk.
[9] Available from www.hm-treasury.gov.uk
[10] Available from http://www.berr.gov.uk/whatwedo/energy/environment/projections/index.html.
[11] 'Transport Ten Year Plan 2000', Department for Transport (2000). Available at http://www.dft.gov.uk/
[12] 'The Future of Transport – White Paper', Department for Transport, (2004b). Available at http://www.dft.gov.uk/
[13] Available at http://www.naei.org.uk/reports.php.

Impacts of a national DPF retrofitting scheme

17. The implementation of this scheme is assumed to occur in 2009 across all the different vehicle types. Table A.1 below outlines the estimated minimum required uptake of retrofitting in order to achieve compliance after installation.

Table A.1: Fleet uptake of retrofitting[14]

Vehicle Type	Vehicles retrofitted ,000s (% of fleet)
Diesel Car	1,260 (45%)
Diesel LGV	3,036 (100%)
Articulated HGV	135 (100%)
Rigid HGV	310 (100%)
Captive fleet[1]	112 (100%)
[1] Buses and Coaches	

Benefits

18. The reduction in emissions for this measure were estimated by AEA Technology[15] by considering the difference in emissions when the existing fleet were retrofitted with DPFs as set out above. Introducing this scheme was assumed not to change change behavioural decisions such as distance travelled or the rate at which the vehicle fleet renews itself.

19. The emissions reductions from this technology are modelled to fall over time as the retrofitted vehicles exist the fleet. This natural fleet turnover combined with uptake rate in table A.1 estimate emission reductions given in Table A.2 below.

Table A.2: Change in emissions for option 1

Country	Pollutant	Emissions Saved (tonnes)				
		2010	2015	2020	2025	2030
UK	PM_{10}	10,627	3,062	882	254	94

[14] Source Pollution Climate Mapping Model (PCM) based on Department for Transport traffic projections.
[15] Insert ref.

20. The damage cost methodology, described in the methodology section, has been applied to estimate the provides estimates of the health impacts of these emission savings.[16] This option is assumed not to have any impact after 2030 when all the retrofitted vehicles are estimated to have left the fleet. Table A.4 provides the health impacts generated by the above changes in emissions.

Table A.4: Quantified impacts of Option 1

PM life years saved (,000s)	PM – RHA (2010 p.a)	PM – CHA (2010 p.a.)
112	181	181

21. These health benefits have then been monetised using the per tonne damage costs. The relevant annual damage cost estimate has been applied to the changes in emissions between 2010 and 2030, for each year within this change it has been assumed that the emission change applies to the mid-point of year.

Table A.5: Annual present value of impacts of Option 1 (£millions)

PM life years saved	PM – RHA	PM – CHA
169	0.2 - 1.1	0.2 - 1.1

Costs

22. The costs of this scheme can be separated into three components:

- *Technology costs:* The unit costs of the DPF technology and the operational costs for the different vehicle types are outlined in Table A.6 below. The costs presented are the costs per unit of producing the technology. The costs are annualised over the lifetime of the measure taking into account the vehicle survival rates.

[16] It should be noted that non-health impacts were not modelled for this option therefore the benefits may be marginally underestimated. However, the non-health impacts of PM typically only account for less than 0.5% of the health impacts.

Table A.6: Resource costs per unit of technology[17]

Vehicle Type	Unit Resource costs	Annual Cleaning costs
Diesel car	£614	£0
Diesel LGV	£1,106	£0
Articulated HGVs	£1,750	£240
Rigid HGVs	£1,350	£160
Captive Fleet	£1,350	£160

Resource costs of fuel: DPF technology also can have a negative impact on fuel economies for some vehicle types. A negative impact on fuel economy implies that the particular vehicle will use more fuel per km than a the vehicle did before the retrofitting took place (i.e. a fuel penalty). This measure also estimates the carbon impacts due to the negative impact on fuel economies and the resulting additional carbon emissions. Fuel economy assumptions for the different vehicle types in this measure are presented in the Table A.7

Table A.7: Fuel penalty of retrofitting DPFs by vehicle type[18]

Vehicle Type	Impact on fuel economy
Diesel Car	- 5%
Diesel LGV	- 5%
Articulated HGV	0%
Rigid HGV	0%
Captive fleet[1]	0%
[1] Buses and Coaches	

- *Cleaning costs of HGV diesel particulate filters:* The efficient operation of DPFs on HGVs also requires that they are cleaned annually. This cost therefore has been estimated using the cleaning costs set out in table A.6.

23. The costs of this measure as described above are discounted at the standard appropriate HM Treasury Green Book rate and annualised over the lifetime of this measure (2009 – 2029) and presented in Table A.8 below.

[17] Source Air Quality Strategy (2007) available from www.defra.gov.uk
[18] The impact on fuel efficiencies are taken from the Updated Third Report of the Interdepartmental Group on Costs and Benefits released alongside the Air Quality Strategy (2007). Available from www.defra.gov.uk.

Table A.8: Costs of retrofitting scheme in the UK (£ millions)

Annualised Technology Costs	Annualised Resource cost of extra fuel consumed plus carbon emissions	Annualised cleaning costs of DPFs on HGVs	Annual PV of Costs
£324	£40	£26	£391

Costs and benefits

24. Table A.9 below presents the annual Net Present Value (NPV) of the scheme to retrofit diesel particulate traps across the UK fleet i.e. the annual benefits minus the annual costs.

Table A.9: Annual costs and benefits of implementing Option 1(£millions)[a]

Annual PV of Costs	Annual PV of Benefits	Annual NPV
391	171	(220)

[a] Numbers in brackets represent negative values.

25. The results in Table A.9 above indicate that the costs substantially outweigh the benefits of this scheme. This analysis suggests that not applying for the time extension would impose a net cost of £220m per annum each year over the life time of the retrofitted technology. This equates to a net cost of £3.3bn between .2010 and 2030.

26. It should also be noted that these impacts are not evenly distributed over time. The majority of the £5.9bn NPV of costs would be incurred in the first year as the cost of the new technology is around £4.9bn. The ongoing costs of around £1bn, of additional fuel, carbon emissions and DPF cleaning, are also skewed towards the early period with over a fifth of the costs (22%) occurring in 2010 and only a fiftieth (2%) half way through the life of the vehicles in 2020.

27. The benefits are also skewed towards the early years after the retrofitting scheme. Of the £2.6bn in benefits over a fifth (21%) occur in the 2010 falling to under on fiftieth (2%) half way through the life of the vehicles in 2020.

28. As noted previously these results are dependent on a range of assumptions. To address this uncertainties further sensitivity analysis of the impacts of the NPV of this measure when costs are changed is presented in the sensitivities section below.

Sensitivities

29. This section provides details as to the major uncertainties surrounding the main analytical results presented above. To do so this section has been subdivided into two sections of:

- Benefit sensitivities; discusses uncertainties surrounding the quantification and valuation of benefits and presents results of sensitivity analyses.

- Cost sensitivities; discusses uncertainties surrounding the costs of the different options and presents results of sensitivity analyses.

Benefit sensitivities

30. A wide range of assumptions are necessarily made in order to produce the benefits analysis presented in this report. This section focuses on the key sensitivies that either are particularly uncertain or may have a major impact on the estimates. These sensitivities are:

- The time lag between changes in exposure to air pollutants and the associated change in the health impacts.

- The estimated change in the hazard rate associated with exposure to particulate matter.

- The geographical scope of the impacts included.

- The valuation of health effects

31. In addition to the four key sensitivities set out above there are a range of other sensitivities that could have a substantial impact on the benefits estimates but are not possible to explore quantitatively. The primary example relates to the range of morbidity impacts of air pollution. While the Clean Air For Europe (CAFE) analysis includes a wide range of morbidity impacts based on COMEAP advice they are not included by IGCB. Owing to uncertainties over both the prevalence and associated cost of such impacts it is not possible to asses this sensitivity quantitatively but it should be noted that this may have a substantial impact on the total benefit estimate.[19]

[19] A brief overview of the methodological differences see the updated third IGCB report available from http://www.defra.gov.uk/environment/airquality/publications/stratreview-analysis/index.htm

Lag time

32. The lag time between a reduction in pollution and a reduction in hazard rate (from chronic mortality) is unknown. For the main analysis an average lag of 11 years has been assumed in line with the Monte Carlo analysis provided in the updated third IGCB report. There are however notable uncertainties over the precise duration of this lag.

33. To reflect this uncertainty IGCB consider it best practice to present a range around this central value reflecting a lag of between 0 and 40 years. This is based on the recommendation in the COMEAP report on long term exposure to particles in 2001. Lag between exposure and change in hazard has a significant impact on the estimated health impacts owing to changes in the population during the lag. Table A.X below provides the central, no lag and 40 year lag estimates of the benefits from Options 1 and 2.

Table A.10: Annual benefits for different lag times (£ millions)

	Zero lag	Central estimate (11 year lag)	40 year lag (Low)
Retrofitting scheme	£194	£171	£134

Hazard rate

34. The second key uncertainty relates to the change in hazard rate associated with different exposures to particulate matter (PM). On the recommendation from the Committee on the Medical Effects of Air Pollution (COMEAP) a 0.6% hazard rate reduction per $\mu g.m^{-3}$ $PM_{2.5}$ has been applied in the main analysis of this annex.[20].

35. However there is remaining uncertainty over the level of the hazard rate change associate to PM. The 95 per cent confidence intervals in the Pope study estimate a hazard rate reduction of between 0.2% to 1.1% per $\mu g.m^{-3}$ $PM_{2.5}$. This however only represents the statistical (sampling) uncertainty around this estimate. Therefore to reflect the wider uncertainties COMEAP recommend the use of a typical 'low' and typical 'high' hazard rates of 0.1% and 1.2% per $\mu g.m^{-3}$ $PM_{2.5}$. As the chronic health impacts of PM account for the majority of the estimated impacts this has a major impacts on the monetised impacts of the option as shown in table A.X below.[21]

[20] This is based on Pope *et al* 2002 which is an estimate using the average of measurements in 1979-1983 and 1999-2000

[21] Linear scaling has been applied to estimate the impacts of these changes in hazard rate. While linear scaling is a reasonable approximation for the small coefficients and small concentration changes used in most of the analysis in this paper. Where changes are larger, the more precise equation is based on multiplicative scaling of the original study RR (relative risk), taken here as 1.06 for an original concentration change of 10 $\mu g/m^3$. If the new concentration change in population-weighted mean for the policy of interest is $-x$ $\mu g/m^3$ (with a negative sign as the analysis usually

Table A.11: Annual benefits for different hazard rates (£ millions)

	Typical high (1.2%)	Central estimate	Typical low (0.1%)
Retrofitting scheme	£342	£171	£29

Geographic scope

36. As a UK appraisal tool the IGCB methodology focuses on the costs and benefits to the UK. However air pollution can travel long distances and so can have significant transboundary impacts. The exclusion of these impacts however arguably means that the estimates understate the total impacts of national measures.

37. The scale of the international impacts however depend on a wide range of factors including the type of pollutant and the location and height of the emission. As a result it is very difficult to generalise on the size of this external impact. As a result IGCB are commissioning work into this area.

38. To provide an indicative estimate of the importance of this impact an externality factor of 20 per cent for transport emissions[22]. The results of this sensitivity are presented in table A.12 below.

Table A.12: Annual benefits including transboundary impacts (£ millions)

	Transboundary estimate	Central estimate (UK only)
Retrofitting scheme [a]	£205	£171

[a] As this option consists exclusively of transport measures only the transport impact has been applied.
As this option only inclu

Valuation of health end-points

39. The final key benefit sensitivity that has been undertaken relates to the **valuation of the health end points**. The central analysis has been undertaken based on the recommendations based on evidence drawn mainly from Chilton et al (2004) study and a study carried out by Pearce et al (1998). The recommendations on valuation are presented in table A.13 below.

concerns reductions), then the new RR is calculated as $1.06^{-x/10}$. The new RR derived can then, as a percentage change, be multiplied by the standard factor to give the desired result.

[22] The 20 per cent has been selected from expert judgement based on the fact that the low emission level of road transport sources and the environment into which they are emitted.

Table A.13: IGCB recommended health values

Health effect	Form of measurement to which the valuations apply	Central value (2004 prices)
Acute Mortality	Number of years of life lost due to air pollution, assuming 2-6 months loss of life expectancy for every death brought forward. Life expectancy losses assumed to be in poor health	£15,000
Chronic Mortality	Number of years of life lost due to air pollution. Life expectancy losses assumed to be in normal	£29,000
Respiratory Hospital Admissions	Case of a hospital admission, of average duration 8 days	£1,900 – £9,100
Cardiovascular Hospital Admissions	Case of a hospital admission, of average duration 9 days	£2,000 – £9,200

40. While these estimates come with associated sensitivities they have a relatively small impact on the total impacts either increasing benefits by around 24 per cent or reducing them by around 15 per cent. In order to provide a more wide ranging estimate the EU value of a life year has been applied that estimates the value of a life year at between €52,000 (median, approx £47,000) and €120,000 (mean, approx £109,000[23]). Table A.14 below provides the changes in benefits using this alternate values of life years.

Table A.14: Annual benefits alternate values of life years lost (£ millions)

	CAFE valuation		Central estimate (£29,000)
	Mean (£109,000)	Median (£47,000)	
Retrofitting scheme	£635	£274	£171

41. As can be seen by the above analysis these sensitivities can have a major impact on the benefit estimates for the different options. It is key to note that only where a life year is values at the mean CAFE level (£109,000 per life year lost) does this option become cost beneficial, showing a net benefit of £244m per annum. For all the other sensitivities the costs still significantly outweigh the benefits.

Cost sensitivities

[23] Based on an average Sterling exchange rate of €1.10

42. As with the benefit modelling a range of assumptions are necessarily made in order to produce the cost analysis presented in this report. This section focuses on the key sensitivities that either are particularly uncertain or may have a major impact on the estimates. These sensitivities are:

- Including **non technology costs**.
- Allowing the price of technology to reflect practical **scarcity**.
- Reflecting observed **differentials between estimated and realised** costs.

43. In addition to the quantifiable uncertainties surrounding cost there are a range of non-quantifiable sensitivities. These sensitivities are discussed in the main body of this IA and include political and social constraints on the options. One particularly notable economic constraint is the cost of additional taxation on economic growth and international competitiveness. Unfortunately it is not possible to reflect this constraint quantitatively but it could potentially have a major impact on the social costs of the options.

Installation costs

44. The first key sensitivity relates to including a wider range of costs outside the technology costs focused upon in the main analysis. As set out in the methodology to take a social perspective the primary focus has been on the main resource costs of technology, and fuel. However implementing this scheme is likely to impose significant non technology costs, including the cost of capital equipment being out of use and the installation costs of the technology. These costs should be included in any decision making however given the time constraint it was not possible to develop a robust estimate and so it is included as asensitivity.

45. It is not possible to generalise on the non-technological costs therefore it is necessary to consider each element seperatly. Table A.15 provides the key non-technological costs and their assumed level.

Table A.15: Non technological costs

Vehicle Type	Installation cost
DPF fitting	
Diesel car	£40.65
Diesel LGV	£40.65

Articulated HGV	£81.25
Rigid HGV	£81.25
Captive fleet[1]	£81.25
[a] Installation costs are based on an assumed annual salary of £30,000 plus the standard 30 per cent for overheads recommended in the IA guidance. [b] Time taken for diesel cars and LGVs is assumed as three hours and for HGVs and captive fleet it is assumed at six hours	

46. Given these likely non-technological costs the annualised NPV of costs is presented in table A.16 below.

Table A.16: Option cost across different geographical areas (£ millions)

	Including non technological costs	Central estimate
Retrofitting scheme	£405	£391

Scarcity

47. The main analysis assumes a fixed price of the technologies introduced through the different options. In reality a rapid substantial shift in technology may create scarcity thereby pushing up the price of the technology. This is particularly likely in the case of much air cleaning equipment which may be based on limited resources.

48. The price cost reaction to increases in demand depend on both the change in demand and the supply conditions. In relation to demand the key factors are both the level of change, with all things being equal a greater change having a larger impact and the speed, again with rapid short term changes having a greater influence on price[24]. In relation to the supply conditions the key consideration is the availability of the factors of production, with all things being equal items with easier access to the factors of production or substitutes meaning changes will have a lower impact on price.[25]

49. Given these broad relationships the retrofitting scheme is likely to give rise to a major increase in the cost of technology as it involves a major increase in demand for a single technology (DPFs) which is imposed for a very limited period of a single year. On the supply side DPFs are produced and installed from a limited capacity base and require

[24] We would expect such short scale changes to have a greater impact on price as the market has less time to adapt.
[25] If a product requires a particularly limited resource changes in demand are likely to have a large impact on price as the product will be relatively price inelastic. The alternate is however also true that if all the inputs are abundant then the change is unlikely to have a major impact on price as it is unlikely to impact on the price of the inputs.

specialist factors of production. While no elasticity of supply curve is available to robustly quantify the likely increase an indicative price increase of 30 per cent has been used.

50. Based on the above assumptions table A.17 below provides estimates of the potential costs of the different options considered in this IA.

Table A.17: Option cost across different geographical areas (£ millions)

	Including non technological costs	Central estimate
Retrofitting scheme [a]	£508	£391

Regulation as a spur to innovation

51. The final costs sensitivity that has been performed relates to the observed difference between the estimated and real technology costs. Past evidence especially from the Evaluation of the Air Quality Strategy[26] has shown that the ex-post implementation costs of many policies have been less than the predicted (ex-ante) costs.

52. The study assessed the reasons for some of the differences between ex-ante and ex-post costs. It was concluded that there are sometimes errors from the baseline predictions. There are also often omissions of measures that allow cost-effective reductions (options other than end of pipe, consideration of technological innovation, etc.). The study stressed to have found no evidence of industry providing exaggerated cost estimates, but that the costs that was put forward by industry was usually based on pessimistic/'worst case' assumptions, or with a limited field of reference (i.e. without potential advances (learning), new measures, the fall of costs with large scale production, etc.). Moreover, in many cases the ex-ante costs are based on specific technical components, that in practice, the manufacturers did not need to fit to comply with new legislation.

53. The study arrived at the key conclusion that 'legislation itself acts as a spur to research and innovation.

54. The study presented a broad overview of the differences in the ex-ante and ex-post costs of the road transport and ESI measures and this is presented in Table A.18 below. From the tables we see that the differences in the ex-ante and ex-post cost of both road transport and ESI sectors are quite significant

[26] 'An Evaluation of the Air Quality Strategy' Defra, (2005a). Available at http://www.defra.gov.uk/environment/airquality/strategy/evaluation/report-index.htm

Table A.18: Summary of ex-ante and ex-post costs (1990 – 2001)

	Ex ante costs	**Ex post cost**
Road transport measures	£16,109M – £22,807M	Estimated £2,000M – £4,000M
Electricity sector	~£6,000M to ~ £30,000M	~£2,000M

55. Using the upper and lower estimates of the differential between ex-ante and ex-post costs table A.19 provides upper and lower estimates of the costs of the options assessed in this IA. In applying these estimates the bias has only been applied to the fixed costs and not the ongoing costs that are less likely to be susceptible to the same level of bias.

Table A.19: Impact of innovation (£ millions)

	Central estimate (£million)	**High bias estimate (£ million)**	**Low bias estimate (£ million)**
Option 1	£391	£95	£147

56. It must however be noted that this type of bas is especially unlikely in this retrofitting scenario. As noted in the original study such bias are likely to occur as a result of research and innovation. This option provides no such scope for innovation as it occurs immediately, lasts a short time period and provides a prescribed technology.

57. As can be seen by the above analysis these sensitivities can have a major impact on the cost estimates for the different options. For the retrofitting scheme only where technology costs are substantially overestimated are costs reduced to the point that the benefits outweigh the costs. Where such a bias exists this option suggests a net benefit of between £24 - £76 million per annum. However it must be stressed that this is particularly unlikely for this options as the basis for such a bias is thought to be innovation and the prescriptive nature of this option allows no room for such innovation. For all the other sensitivities undertaken the costs consistently outweigh the benefits and the sensitivities significantly increase the net cost.

Conclusions on Costs and Benefits Sensitivities

58. A summary of the impact of the different sensitivities is presented in table A.20 below.

Table A.20: Summary sensitivities on retrofitting scheme[a]

	Annual Net Present Value (£ million)

	Central	Sensitivity range
Benefit Sensitivities		
Time lag	(£220)	(£197) – (£257)
Hazard Rate	(£220)	(£49) – (£362)
Geographical scope	(£220)	(£186)
Valuation	(£220)	£244 – (£117)
Cost Sensitivities		
Non technology costs	(£220)	(£234)
Scarcity	(£220)	(£337)
Innovation	(£220)	£24 – £76
[a] Numbers in brackets represent negative values.		

59. Table A.20 demonstrates that the costs of this retrofitting scheme are likely to outweigh the benefits is robust across a range of sensitivities. Taken together these sensitivities create a wide potential range of between a net annual cost of £362 million per annum to a net benefit of £244 million per annum. However across the 11 different sensitivities only 3 move this policy to being cost beneficial.

60. However, a closer inspection of these switching assumptions suggests that they are increasingly unconvincing:

- In relation to the valuation of health outcomes only if the value of a life year exceeds around £66,000 does the retrofitting measure become cost beneficial. This value is far out of line from other health valuations used in the UK the IGCB for air pollution, of £29,000, the value of a life year implied from the DfT VSL, of around £30,000, and the Department of Health QUALY of between £30,000 - £40,000.
- Innovation is required to reduce the technology costs by two thirds in order to switch the analysis to being cost beneficial. However it must be stressed that this is particularly unlikely for this scheme as the basis for such a bias is thought to be innovation and the prescriptive nature of this option allows no such room.

Annex B: Specific Impact Test analysis

This section looks to set out the approach taken for each of the specific impact tests. The specific impact tests have been undertaken for the preferred option of applying for the time extension under which no additional policy measures are necessary.

Competition Assessment

The preferred option places no additional burden on any business and so could not significantly distort competition.

Small Firms Impact Test

The preferred option places no additional burden on any business and so could not significantly disadvantage small firms.

Legal Aid

No legal challenges are expected in light of the preferred option.

Sustainable Development

As the preferred option provides no additional policies it is unlikely that this policy will significantly impact on sustainable development.

Carbon Assessment

The key climate change impact of the preferred option is to reduce carbon emissions over the lifetime of the measure by £117million or an annualised value of £7.7 million. This saving is due to the avoidance of the potential fuel penalty associated with the installation of DPFs on LGVs and cars. This impact is included in the central analysis and so has not be considered separately.

Other Environment

Achieving the limit values would have notable environmental impacts on both air quality and climate change. However, as both these impacts have been evaluated and monetised in the central analysis it has not been reanalysed here.

Health Impact Assessment

Air pollution has a notable impacts on human health through both chronic and acute impacts. Where robust evidence exists for such links they are included in the IGCB methodology and therefore are reflected in the central analysis. Uncertainties surrounding the health impacts however have also been reflected using a different set of assumptions (the Clean Air for Europe CAFE methodology). However, the results of the analysis were not seen to be sensitive to these assumptions.

Race Equality

The preferred option is not expected to have a disproportionate cost to any specific race and so should not impact on race equity.

Disability Equality

The preferred option is not expected to have a disproportionate cost to any specific race and so should not impact on race equity.

Gender Equality

The preferred option is expected to impact equally across the different genders and so should not impact on gender equity.

Human rights

As the preferred option does not impose new policy measures it is not expected to be challenged on the basis of human rights.