UK notification to the European Commission to extend the compliance deadline for meeting PM_{10} limit values in ambient air to 2011

Racial Equality Impact Assessment (England)

August 2009

1. The EU Ambient Air Quality Directive (2008/50/EC), adopted in 2008 introduced a provision for Member States to apply for a time extension to 2011 for compliance with the existing limit values for PM_{10}. Such an extension will only be agreed by the European Commission where non-compliance has resulted from unexpected dispersion patterns, climatic conditions or transboundary impacts, and is accompanied by an air quality plan which sets out, amongst other things, how compliance will be achieved by the extended deadline (2011 at the latest).

2. In relation to PM_{10}, the limit value is already achieved across 99% of the UK, including in many urban areas. The remaining areas of non-compliance are extremely small and comprise small urban 'hotspots', including parts of central London, or areas where industrial emissions make a significant contribution. In all these areas, the limit values are expected to be achieved by 2011. The UK submitted its notification to the Commission in April 2009, following a public consultation. An Impact Assessment was produced and published as part of the consultation package. http://www.defra.gov.uk/corporate/consult/air-quality/annexc-consultation-impactassessment.pdf . A summary of consultation responses has also been published http://www.defra.gov.uk/corporate/consult/air-quality/summary-responses.pdf .

3. One respondent to the consultation suggested that delaying compliance could impose a disproportionate cost to ethnic minorities. The Impact Assessment published by Defra as part of the consultation concluded that the racial equality filter did not identify the need for a full racial equality assessment. This was because of 3 main factors:

   - Existing evidence did not provide any robust evidence that the impacts of air quality have a significantly different impact on people from different ethnic groups;

   - People from different ethnic groups would not be treated differently as a result of the proposal to submit a time extension notification; and

   - The proposal to use the additional time available under the Directive was not expected to favour particular ethnic groups but is rather seen to maximise social welfare across all ethnic groups.

4. Nevertheless, it was decided following this query to undertake such a more detailed analysis to estimate the scale of the likely impact across different ethnic groups of using the additional time available. A mapping approach was used, comparing 2001 census data with 2005 ambient air quality concentrations. Whilst this is methodology

presents opportunities for quantitative analysis of the potential impacts, there are a number of caveats associated with the results.

- **The 2005 PM_{10} concentration data used to support the 2007 National Air Quality strategy includes natural sources and would, if it were produced now, be subject to corrections for that (in accordance with the 2008 Directive) and other data issues. Therefore, using the processes we currently follow, the absolute PM_{10} concentrations would in all likelihood be significantly lower than those shown, and the areas in non-compliance with the Limit Values would be reduced. However, the distribution of concentrations would remain roughly the same**
- **The data used is highly aggregated which may disguise local impacts. Latest projections show the remaining areas of exceedences are extremely small and localised eg national modelling showed 6.5 km of roads in central London exceeding the limit value in 2011 – well within the uncertainties of the model.**
- **Data for PM_{10} concentrations used is from motorways and A-roads in 2005, and not for minor roads. Therefore the estimates do not reflect any changes in the urban background concentration.**
- **Population data for minority ethnic groups is only available from the 2001 census. This means that in 2009 the data is eight years old. However, census data is comprehensive and consistent and is the only source of data on minority ethnic groups at the spatial scale demanded by this analysis.**
- **This analysis has involved using a Geographical Information System (GIS) to overlay PM_{10} emissions data with census 2001 data. Overlaying census data with PM_{10} emission data results in problems of scale. The PM_{10} emissions data is available per length of road and is measured by $\mu g/m^3$. The smallest spatial scale at which census data is available is for census output areas (COAs) which are small census geographies consisting of around 125 households or 300 people. As COAs are defined by population, they vary in actual size, with densely populated COAs being smaller than more sparsely populated COAs. The analysis has therefore used data for everyone living in the census output areas which overlap the concentration data.**
- **The analysis calculates the average exposure to PM_{10} emissions experienced by each ethnic group based on the population in each census output areas in England overlapping the road network. The coverage of the analysis is therefore the total population of those COAs which overlay these roads. This amounts to 11.7 million people.**
- **The analysis does <u>not</u> cover those people living in COAs which do not overlay the motorway/A-road network. Given that data is only available for England, this amounts to approximately 37.5 million people. This assumption was made on the basis that the vast majority of any changes in concentration from transport measures occur in the immediate area around roads.**

5. The full analysis is provided in Annex A. It suggests that there is a difference in the costs of delaying achievement of the limit values by ethnic group. Both at national level and when split by urban and rural areas, individuals who identify themselves as White-British appear to be consistently exposed to lower concentrations of PM_{10}. Therefore the expected health costs of not achieving the limit values would be expected to be lower for this group than other ethnic groups. However, it must also be noted that the benefits of using the additional time available may also likely to be distributed in a similar manner with a disproportionate benefit accruing to ethnic minorities.[1] As indicated above, health experts advise there are no well established links between susceptibility to air pollution and ethnic group.

6. Given these findings, in line with the guidance from the Commission for Racial Equality there are four potential options:

   - **Option 1,** make changes to the proposed policy to address any concerns;
   - **Option 2,** introduce ways to remove or reduce potential for affecting some racial groups;
   - **Option 3,** find an alternative means to achieve policy aims; or
   - **Option 4,** justify the proposal because of the importance on grounds that have nothing to do with race.

7. Having considered each of these options it is felt that, by using the provisions in the new Directive to extend the compliance deadline in those small parts of the country where there have been some exceedences since the limit value came into force in 2005, some differential impacts across ethnic groups is unavoidable. While all reasonable measures are being undertaken to minimise differential impact across ethnic groups it is unlikely to completely remove the identified differential.

8. Defra has previously commissioned research specifically on social inequalities in relation to air quality. A report was published in 2006 that found in a number of urban areas of the UK the least affluent members of society tend to be exposed to the highest levels of air pollution. The report concluded that measures to improve air quality can therefore have a more pronounced effect in deprived areas and could help to reduce this social inequality. The research looked only at a few cities in the UK, but other independent research tends to support the general findings. In England, Northern Ireland, and Scotland, the most deprived communities tend to experience the highest air pollution levels (Pye *et al*, 2006[2]). In Wales, by contrast, it is the least

[1] As any practical measures to achieve compliance will necessarily primarily focus on the areas of exceedences it is likely that the additional abatement costs such as retrofitting vehicles would be greater on vehicles within the affected area.

[2] Pye, S., King, K., and Sturman, J. (2006) Air quality and social deprivation in the UK: an environmental inequalities analysis. AEA Technology, Netcen AEAT/ENV/R/2170 www.airquality.co.uk/archive/reports/cat09/0701110944_AQinequalitiesFNL_AEAT_0506.pdf

deprived communities that experience the highest pollution levels. The reason for these observations is that, for most of the UK, the highest levels of deprivation tend to be found in urban areas. Urban areas tend to have dense road networks, high vehicle usage and the highest concentrations of most air pollutants. The majority of this pollution arises from road transport emissions, although, in Northern Ireland, there is an additional contribution from solid fuel burning. In Wales, the situation is reversed: the highest proportion of deprived communities tend to be found in the less densely-settled locations, such as in the South Wales valleys, with relatively fewer deprived communities situated in the urban centres of South Wales.

9. In this instance the remaining differential impacts across ethnic groups is considered to be justified, though continued efforts will be needed, particularly at local and regional level to mitigate impacts on the disadvantaged groups. Summarised below are the considerations that have lead to this conclusion.

10. The decision on whether to apply for a time extension or not only provides scope for two potential options. Therefore under **option 1** the only potential would be to change the preferred option to not apply for the time extension. Rather than our preferred approach of allowing current/planned measures to take effect to achieve compliance by 2011, such a decision would require the UK immediately undertake major action to achieve compliance with the limit values.

11. As set out in the associated consultation Impact Assessment, looking to immediately achieve limit values would impose substantial net social cost estimated at over £3 billion. Given the areas in the UK where the limit values are not yet met are now extremely small, and the fact that projections show compliance being achieved by 2011, such costs are considered to be disproportionate. The short time-frames now involved would also mean this is not a viable option. Not applying for the time extension would furthermore also impose a major risk of infraction from the European Commission, potentially resulting in fines. Finally this option could be considered to be gold plating the Air Quality Directive. This is because the Directive specifically provides for member states to submit time extension notifications under circumstances such as those faced in the UK. To date 18 member states, including the UK have submitted notifications covering 304 zones across the EU.

12. The notification to the Commission contains details of all the local, regional and national measures being taken to improve air quality and achieve compliance. All of these actions will go some way to reducing the uneven distribution of the impacts of air pollution but is unlikely to completely remove it, given the contribution of specific sources such as traffic, to PM_{10} concentrations. The Mayor London's Air Quality Strategy, due to be published later this year, will also have an important role to play in relation to further improvements in PM_{10} and also NO_2 concentrations.

13. In this instance, the policy approach of seeking the additional time available to meet the limit values is justified for reasons that have nothing to do with race (**Option 4).**

14. **Option 2** involves undertaking an approach to mitigate the additional impact on the disadvantaged groups. As set out above, measures to improve air quality are being taken in relevant areas and the Mayor of London's Air Quality Strategy is also expected to contribute to this. **Option 3** is not relevant in this case as there are no alternative options to achieve the policy goals other than those set out in Option 1.

Annex A: Quantitative Analysis

Summary

15. Overall the analysis undertaken suggests that there is a notable difference in the impact of delaying achievement of the limit values by ethnic group. Based on analysis of people living in areas geographically overlapping the motorway and A road network, both at the national level and when split by urban and rural areas, individuals who identify themselves as White – British are consistently exposed to lower concentrations of PM_{10}. Therefore the expected health costs of not achieving limit values would be expected to be lower for this group than other ethnic groups.

16. However, it must be noted that this analysis could not equally be applied to the benefits of the preferred option. While a quantitative analysis was not possible it is likely that the benefits would also likely to be distributed in a similar manner with a disproportionate benefit accruing to racial minorities. This is felt to be the case as any measures aimed to achieve compliance would try to focus on areas of exceedence and so adjustment costs, in the form of abatement equipment or transport restrictions, would be greater on populations in these areas.

Background and scope

17. The EU Ambient Air Quality Directive (2008/50/EC) (2008 Directive) introduced a provision for Member States to apply for additional time to comply with limit values. Such an extension would only be granted where non-compliance has resulted from unexpected dispersion patterns, climatic conditions or transboundary impacts and is accompanied by an air quality setting out how compliance will be achieved by the extended deadline.

18. On 27 January 2009 Defra went to out to consult on the option of applying for such a time extension in relation to particulate matter of diameter less than 10 micrometers (PM_{10}). Specifically it related to the EU limit value on annual average concentrations of 40μg /m^3 (and for London, also the daily limit value (50μg /m^3 not to be exceeded more than 35 times a year). These limit values came into force in January 2005. Since that date the UK has reported exceedences in some areas. Though the areas of exceedences are extremely small they are in densely populated areas such as central London. Nevertheless, over 99% of the UK (land area) is already in compliance.

19. Based on the measures currently being implemented or planned all areas are expected to comply with the limits by 2011 (the extended deadline, if granted). In addition to the practical and logistical challenge in bringing forward compliance, the necessary actions would also impose a disproportionate cost on UK society. The Impact Assessment produced for the consultation suggested the minimum cost of achieving earlier compliance would be around £6 billion while the associated benefits were around £2.5 billion. Therefore attempting to immediately achieve compliance would impose a net cost of around £3.5

billion. Therefore the preferred option was to use the provision in the Directive to secure the additional time available.

20. As a result of public consultation, a number of amendments were made to the notification to the Commission to secure additional time. However, nothing emerged in the consultation responses that justified not submitting a notification to the Commission and instead seeking to take immediate action. The UK notification was submitted in April 2009. A summary of consultation responses was published on Defra's website.

21. One respondent argued that delaying compliance would impose a disproportionate cost to ethnic minorities. While the racial equality filter did not identify the need for a full racial equality assessment it was decided following this query to undertake such an analysis.

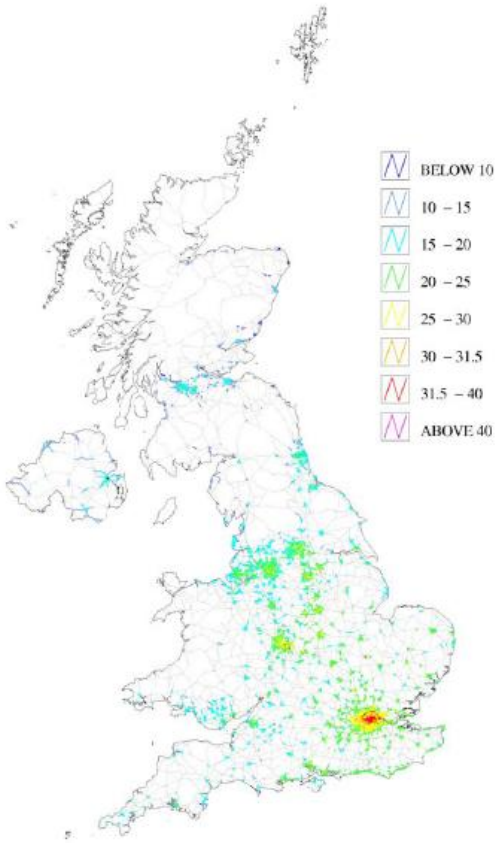
22. This note sets out the work that has been undertaken to assess the ethnic impacts of such a time extension.

Initial Racial Equality Impact Assessment

23. As an initial consideration of the potential for differential impacts across ethnic groups the emissions of road transport PM_{10} was compared against the distribution of ethnic diversity. This comparison was deemed to be appropriate as the identified mechanism to improve air quality was a mass retro fitment scheme and so would reduce roadside emissions by what may be approximated by a given proportion across the network. In the initial assessment the ethnic diversity has been defined as the proportion of the residential population not classified as White-British.

24. Figure 1 provides a diagrammatical comparison of the roadside concentrations across the UK. The emission levels provided are taken from modelling by the Pollution Climate Mapping Model (PCM model) used to assess compliance with EU limit values. To ensure a proportionate approach the map used was taken from previous modelling undertaken for the Air Quality Strategy 2007.

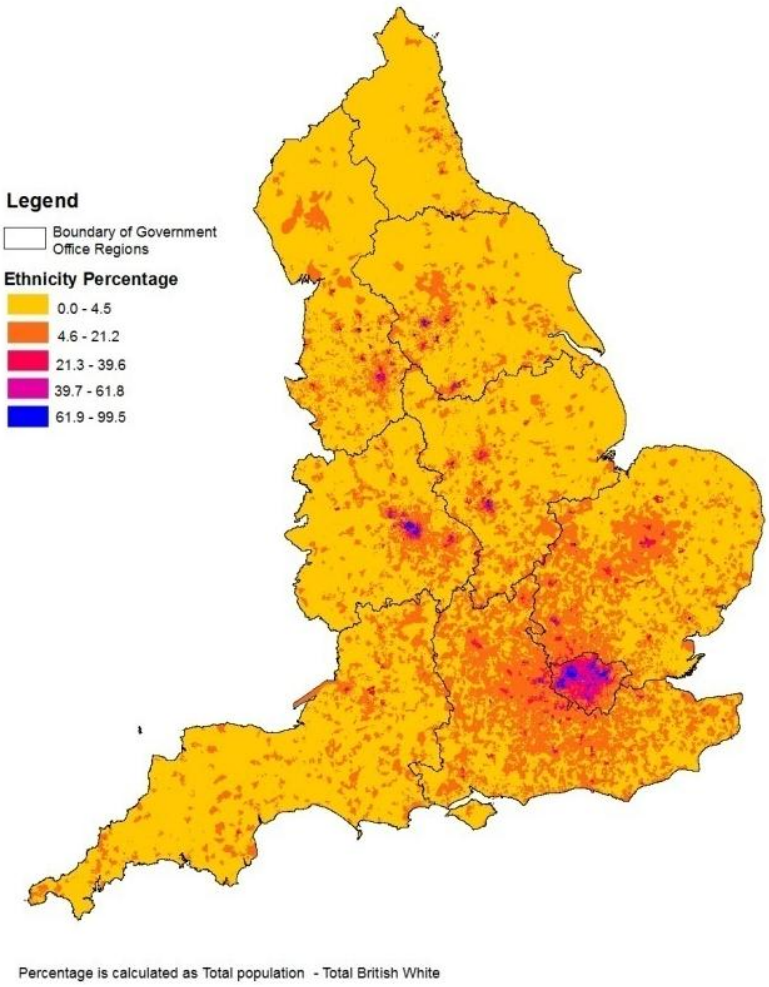
Figure 1: Ambient PM_{10} concentrations across the UK (μg/m^3 2005)



25. Figure 2 provides an indication of ethnic diversity across England. As there is no generally agreed definition of ethnic diversity therefore in this diagram ethnic diversity has been defined as the proportion of the residential population not classified as White – British in the 2001 census.[3]

[3] Despite its age the 2001 Census is seen as the best available evidence on the distribution of different racial groupings as it provides a consistent, comprehensive and clear indication.

Figure 2: Ethnicity diversity by census output area (2001)



Conclusions of Initial Racial Impact Assessment

26. Based on this initial assessment it was agreed that there was reasonable basis for a more detailed racial equality assessment. A visual comparison of the high levels of concentration and ethnic diversity shows a clear overlap between poor air quality and an ethnically diverse residential population. As the proposed measure to retrofit the is expected to proportionally reduce concentrations equally across the UK it would be expected to have a disproportionate benefit to minority ethnic groups. Thereby the delay in compliance would be expected not to deliver the small amount improvements in ethnic equality associated with achievement.

Quantitative analysis

27. A visual comparison of the location of ethnic grouping with the potential improvements suggested that being granted a time extension could fail to realise improvements in ethnic equality and therefore it was decided to undertake a more detailed quantitative assessment of the potential impacts.

28. To provide such analysis GIS mapping technologies were employed to quantitatively compare the PM_{10} emissions from road sources against ethnic groups. The key aim of this analysis was to estimate the average exposure by ethnic group that would provide a strong indication of the potential ethnic distribution of the impact of receiving a time extension.

29. Unfortunately emission mapping and ethnic information are collected on different systems and so were not directly comparable. The PCM model estimates ambient concentrations based on a geographical basis at a 1km by 1km resolution across the UK. The best available data on ethnic make-up is taken from the 2001 census. Despite its age the Census is seen as the best available source as it provides a consistent, comprehensive and definitive data set. However, it is only available by census output area. Census output areas are defined by a given total population and so the geographical scope may vary between areas, for example highly populated areas will have a smaller geographical area than more sparsely populated areas.

30. To bring together the two data sets it was necessary to adjust the basis of one of the measures. In this case the adjustment was made to the ambient concentration data to estimate an average across the different census output areas. Using GIS software to overlay the roads onto the census output areas, it was then possible using GIS tools to calculate the average emissions level for each census output area.

31. This level was then multiplied by the number of people in each ethnic group within that census output area to give the emissions level for each group in the area.

32. Having estimated the average concentration across all census output areas it was possible to estimate an average exposure level by ethnic group for the whole country. To do so it was assumed that the average ambient concentration within a census output area was experienced by all ethnic groups.

33. To intuitively explain this approach, assume that there are two areas and two ethnic groups. Area 1 has 60 per cent group A and 40 per cent group B, Area 2 then has 40 per cent group A and 60 per cent group B. Area 1 also has a higher concentration of PM_{10} than area 2 with an average of 100$\mu g/m^3$ in area 1 and 50$\mu g/m^3$ in area 2. This being the case the average exposure of group A is 80$\mu g/m^3$ while the average exposure of group B is 70$\mu g/m^3$.

34. The average exposure has then been multiplied by the proportional reduction in concentrations expected from the modelled mass retrofitting scheme to estimate the potential change in exposure by ethnic group. For example in relation to White British the total average exposure is 21.14μg/m^3 but following a mass retrofitting scheme it is modelled to fall by 0.96μg/m^3 to 20.18μg/m^3.

35. The full results of this analysis are provided in table 1 below.

Table 1: Average PM_{10} Concentration Exposure from road sources by ethnic group (μg/m^3)

	Exposure	Change	Total population	% Total population
White - British	21.14	0.96	**9,657,149**	82.7%
All non-White British	24.84	1.13	**2,015,050**	17.3%
White - Irish	23.90	1.08	180,461	1.5%
White - other	24.95	1.13	413,684	3.5%
Mixed - White and Black Caribbean	24.05	1.09	62,424	0.5%
Mixed - White and Black African	24.73	1.12	22,779	0.2%
Mixed - White and Asian	23.68	1.07	52,628	0.5%
Mixed - other	24.44	1.11	44,953	0.4%
Asian or Asian-British - Indian	24.40	1.11	334,221	2.9%
Asian or Asian-British - Pakistani	23.15	1.05	227,048	1.9%
Asian or Asian-British – Bangladeshi	26.42	1.20	91,376	0.8%
Asian or Asian-British - other	25.11	1.14	76,754	0.7%
Black or Black-British Caribbean	26.22	1.19	172,316	1.5%
Black or Black-British African	27.22	1.23	159,518	1.4%
Black or Black-British other	26.34	1.19	29,186	0.3%
Chinese	23.99	1.09	75,326	0.6%
Other Ethnic	25.26	1.15	72,376	0.6%
All People	**21.78**	**0.99**	11,672,199	100.0%

36. The results presented in table 1 show that exposure to PM_{10} from road sources varies significantly by ethnic group. On average White British are exposed to an ambient concentration from road sources of 21.1 μg/m^3 which are 14.9 per cent lower than the average ethnic exposure. However this covers a wide disparity between ethnic groups which range from 23.7μg/m^3 to 27.2μg/m^3 for Mixed White and Asian and Black or Black-British African respectively.

37. It is also important to reflect that the aggregation across these groups will hide a significant amount of information. This is a particular issue as the groups become wider and therefore specifically for the 83 % of the population who consider themselves White British. It is possibly that within this group there will be substantial variation and therefore likely that a proportion of this group will be exposed to equivalent or higher levels of exposure than all other ethnic groups while another group will be exposed to very low levels.

38. These results then mean that the distribution of the health cost of applying for and utilising a time extension would be greater for the average member of society from an ethnic minority than a person who classed themselves as White British. The difference depends upon the ethnic group with individuals who class themselves as Mixed White and Asian facing 12 per cent greater cost and individuals who class themselves Black or Black-British African facing 29 per cent higher cost.

39. It must however be noted that owing to the relative size of the populations of each ethnic group the aggregate impact on White – British will be significantly greater than any other group. To illustrated this Table 1 presents the relative size of each ethnic group. Showing that 82.5% of the population covered by this analysis class themselves as White – British and therefore, for this analysis ethnic minorities (Non – White British) comprise 17.3% of the population.

40. A large contributory factor to the observed difference in exposure was known to be the fact that urban areas tend to have a wider diversity of ethnic groups. Therefore to test the above results it was decided to recalculate the average exposures by ethnic groups split between the urban and rural populations. There is a greater tendency for ethnic groups to live in more urban areas, which is where the higher emissions are. Using the rural urban definition, which defines each output area in the country as urban or rural, the average emissions per ethnic group were recalculated for urban census output areas and then for rural census output areas. Table 2 below provides the results of this analysis.

41. Specifically, table 2 highlights that for the urban rural split the exposure to PM of each ethnic group as compared to the average White – British exposure. As can be seen from table 1, in both urban and rural areas White – British are consistently exposed to lower concentrations of PM_{10} as compared with all other ethnic groups. However, the differential between White – British and Non White – British is more pronounced in urban areas as opposed to rural areas.

Table 2: PM_{10} concentration by ethnic group and rural and urban areas ($\mu g/m^3$)

	Urban		Rural	
	$\mu g/m^3$	% WB	$\mu g/m^3$	% WB
White - British	21.28	n/a	18.37	n/a
All non-White British	24.91	+17.05%	19.09	+3.94%
White - Irish	24.00	+12.77%	19.11	+4.03%
White - other	25.09	+17.91%	18.94	+3.10%
Mixed - White and Black Caribbean	24.12	+13.33%	18.55	+0.98%
Mixed - White and Black African	24.80	+16.52%	18.84	+2.56%
Mixed - White and Asian	23.77	+11.72%	19.07	+3.81%
Mixed - other	24.53	+15.28%	18.93	+3.05%
Asian or Asian-British - Indian	24.42	+14.77%	19.92	+8.45%
Asian or Asian-British - Pakistani	23.16	+8.84%	18.80	+2.34%
Asian or Asian-British – Bangladeshi	26.43	+24.21%	18.58	+1.14%
Asian or Asian-British - other	25.15	+18.18%	19.57	+6.53%
Black or Black-British Caribbean	26.24	+23.31%	19.72	+7.35%
Black or Black British African	27.25	+28.04%	19.97	+8.71%
Black or Black-British other	26.37	+23.91%	19.74	+7.46%
Chinese	24.09	+13.21%	18.59	+1.19%
Other Ethnic	25.37	+19.21%	19.18	+4.42%
All People	**21.93**	**+3.04%**	**18.41**	**+0.21%**

42. Table 2 above shows that while the rural urban split accounts for the majority of the differential exposure by ethnic group in both locations on average White - British are exposed to lower concentrations of PM_{10} than other ethnic groups. Therefore the health cost of delaying compliance would be higher for individuals who were not identified as White British.

43. In urban locations on average individuals of White British descent are seen to be exposed to 17.1 per cent less PM_{10} than other ethnic groups. For rural locations this gap is reduced to 3.9 per cent. Exposure also varies substantially across ethnic groups. However in both urban and rural areas Black or Black-British African are exposed to the highest exposure. However

the gap is significantly lower in rural areas falling from 28.0 per cent to 8.7 per cent higher exposure than individuals identified as White British.

44. The ethnic group with the least additional exposure varies between urban and rural areas. For urban areas Asian or Asian-British – Pakistani are exposed to the closest levels to White – British being exposed to 8.8% higher concentrations. In rural areas however it is Mixed - White and Black Caribbean that face the closest exposure only being exposed to 1.0 per cent higher concentrations. This level of difference is so small that the two groups might be described as having broadly equivalent exposure.

45. In addition to the level of exposure by ethnic group it is also important to consider if different ethnic groups might have differing reactions to exposure.

46. The Health Protection Agency (HPA) believe that there is no consensus to suggest a well established link between susceptibility to air pollution and ethnic group. Whilst there is a potential for differential impacts by ethnic group it is not possible to identify any such effects with any reasonable level of certainty.

47. The HPA are aware of a small number of papers, which suggest that the effect of PM_{10} on hospital admissions and mortality does not vary by race (Zanobetti et al 2000 Env. Health Perspect. 108:841-5; Zeka et al 2006 Am J Epidemiol 163: 849-59). There are also studies that show that air pollution does have an effect in different ethnic groups although these did not necessarily compare the effect with other ethnic groups e.g. Ostro et al (2001) Epidemiology 12:200-208 showed that there is indeed an effect of air pollution on asthma symptoms in black Americans.

48. However, it is well known that there are higher rates of cardiovascular disease and diabetes in certain Asian groups. Air pollution is known to affect cardiovascular disease and there are a few studies now on effects of air pollution in diabetics. It is less known whether there are such marked differences amongst ethnic groups for respiratory diseases although there may be issues relating to poorer compliance with treatment or access to services if there is a language barrier.

49. There is a big issue in the States with regard to asthmatic responses to cockroach allergen which predominantly affects inner cities where a higher proportion of people from ethnic minorities live.

50. There are some studies on ozone and genetic polymorphisms showing that people with different versions of particular genes are more susceptible. Genetic polymorphisms may be distributed unevenly according to race (this could, of course, have a beneficial or adverse effect in different groups). For example, a paper by Islam et al 2008 Am J Respir Crit Care Med 177(4):388-95, found an increased risk of asthma in Hispanic whites with a particular genetic polymorphism when they were exposed to ozone but further studies are needed to confirm this effect.

51. Therefore, on the basis of this evidence there is a potential that there may be differential impacts by ethnic group. However, given the strength of evidence it is not possible to identify any such effects with a reasonable level of certainty.

Conclusions

52. Overall the analysis undertaken suggests that there is a notable difference in the impact of delaying achievement of the limit values by ethnic group. Both at the national level and when split by urban and rural areas, individuals who identify themselves as White – British are consistently exposed to lower concentrations of PM_{10}. Therefore the expected health costs of not achieving limit values would be expected to be lower for this group than other ethnic groups.

53. The level of the differential varies both by area and by ethnic group however some key findings are that:

    - Nationally, for those who live in areas overlapping the motorway and A road network in England, on average ethnic groups not classified as White – British are exposed to 17.5 per cent higher concentrations of PM_{10};
    - In urban areas the average gap is 17.1 per cent which is reduced in rural areas to 3.9 per cent.
    - Across the different areas individuals identified as Black or Black-British African are exposed to the highest levels of PM_{10} of up to almost 30 per cent higher than White British.
    - Mixed - White and Black Caribbean in rural areas is the only group that may be seen to have a broadly equivalent exposure having just a 1 per cent higher exposure than White British.
    - Policies therefore need to evaluate if there are any measures that could justifiably be introduced to ensure that the preferred option does not have a disproportionate impact on minority ethnic groups.

54. However a major caveat to these conclusions is that the analysis has only considered the distribution of the costs of this policy. It does not provide a similar consideration of the associated benefits. While it is not possible to readily undertake a similar analysis it is likely that the benefits would also occur disproportionately on to ethnic minorities. This is likely for the same geographical reasons that the costs are unevenly distributed. As more ethnically diverse areas tend to have worse air pollution we would expect the mitigation costs to also be focused on these areas for example through transport or domestic measures.[4]

[4] This might however be offset to some extent by any public provision.