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Air quality indicator for Sustainable Development 2007 final results

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The air quality indicator is one of the 68 indicators of the Government's Sustainable Development Strategy. It measures annual levels of pollution from particulates (PM10) and ozone (O3), the two pollutants thought to have the greatest health impacts, as well as the number of days on which levels of any one of a basket of five pollutants were 'moderate or higher'.

The main results are:

* Urban background particulate levels averaged 22 microgrammes per cubic metre (ug m-3) in 2007 compared to 24ug m-3 in 2006. These levels have fluctuated in the last 5 years, although there has been an overall decreasing trend since 1993, the first year for which data were available.

- Roadside particulate levels averaged 29 ug m-3 in 2007 compared to 32 ug m-3 in 2006. There has been a general downward trend since monitoring began in 1997, although this decline has slowed since 2001.
- Rural ozone levels* averaged 67 ug m-3 in 2007 compared to 74 ug m-3 in 2006 and 68 ug m-3 in 1993. There is no clear long term trend.
- Urban background ozone levels averaged 57 ug m-3 in 2007 compared to 61 ug m-3 in 2006 and 44 ug m-3 in 1992. These levels have shown an overall increasing long term trend since 1992, the first year for which data were available.
- In urban areas, air pollution in 2007 was recorded as moderate or higher on 24 days on average per site, compared with 41 days in 2006, and 59 days in 1993. This series has reflected a high degree of year-on-year variability over time, and this has again been apparent for 2007.
- In rural areas, air pollution in 2007 was moderate or higher for 24 days on average per site, compared with 56 days in 2006. This figure has also varied significantly over time.
- These figures are an update of the provisional figures published on 24th January 2008. The slight differences between figures published today and those published in January are due to the full quality control (ratification) process.

Background

An air quality "headline" indicator was introduced in 1999 in support of the UK Sustainable Development Strategy. When this strategy was updated in 2005, a new air quality indicator was included, better reflecting the effects on health of long term exposure to lower levels of pollution. The indicator is split into two parts covering; (a) annual exposure to pollutants and (b) the number of days when levels of pollutants are moderate or higher.

Particulates and ozone

Part (a) of the indicator measures annual exposure to particulates and ozone (see Figure (a) below). It was introduced in the light of increasing evidence suggesting that long-term exposure to even low levels of particulates (PM10) may have a significant effect on public health. The annual mean values for particulates are a useful measure of overall exposure to particulates at all concentrations. The annual average measures of PM10 have been included to reflect this.

The impact of long term exposure to low levels of ozone is currently less clear, but if there is no lower limit on the levels which have a health impact then the parameter used in the indicator gives the best representation of the overall annual impact of the short term effects of ozone pollution. The production of ozone is strongly influenced by the weather, more being created on hot, still, sunny days. There is an upward trend in urban background ozone levels in the UK, in common with rising hemispheric ozone levels, but this is not particularly evident in the rural ozone index. There is a more marked increase in urban areas, due to the reduction in urban emissions of nitrogen oxides, which tend to destroy ozone close to their emission source.

Days with moderate or higher air pollution

Part (b) of the indicator measures days of moderate or higher pollution according to the Air Pollution Information Service bandings used in air pollution forecasting (see Figure (b) below). At the moderate level, the effects of pollution may start to be noticeable to sensitive people. There is no clear trend in the number of either urban or rural pollution days, due to the effects of variability in weather patterns from year to year.

The bandings are based on 5 pollutants consisting of carbon monoxide, nitrogen dioxide, ozone, particulates and sulphur dioxide. These are recognised as the most important for causing short term health effects. The main causes of days of moderate or higher air pollution at urban sites are ozone and particulates (PM10). Sulphur dioxide also used to make a significant contribution but has now fallen to relatively very low levels. Carbon monoxide and nitrogen dioxide have very rarely reached moderate or higher levels since the urban index began in 1992.

Tables A and B below show the data underlying Parts (a) and (b) of the indicator respectively.

Table A: Annual average levels of Ozone and PM10 (ug m-3)

Year	PM10			OZONE		
	Urban	Background	Roadside	Urban	Background	Rural
1987	..		..	..		60
1988	..		..	..		67
1989	..		..	..		70
1990	..		..	..		72
1991	..		..	..		68
1992	..		..	44		71
1993	36		..	42		68
1994	32		..	48		72
1995	31		..	52		72
1996	31		..	48		68
1997	30		37	47		68
1998	26		33	50		69
1999	24		32	57		73
2000	23		31	53		68
2001	24		31	52		67
2002	23		29	54		68
2003	25		31	60		74
2004	22		27	57		73
2005	22		29	57		70
2006	24		32	61		74
2007	22		29	57		67

Notes to Table A:

PM10: annual mean: average across all monitoring sites. Ozone: annual mean of the daily maximum 8 hour running mean: average across all monitoring sites

.. not available because of insufficient data

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. For both ozone and PM10, from 1987-97 data capture should be more than or equal to 50% of the year and from 1998 onwards it should be more than or equal to 75% of the year. For ozone this applies to both the full year and the summer period only. .

Table B: Average number of days of moderate or higher air pollution per site

Year	Urban sites	Rural sites
1987	..	21
1988	..	31
1989	..	47
1990	..	50
1991	..	48
1992	..	44
1993	59	33
1994	47	44
1995	50	44
1996	48	41
1997	40	42
1998	24	29
1999	33	48
2000	21	27
2001	25	34
2002	20	32
2003	50	64
2004	23	44
2005	22	40
2006	41	56
2007	24	24

Notes to Table B:

.. not available because of insufficient data

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. For both ozone and PM10, from 1987-97 data capture should be more than or equal to 50% of the year, and from 1998 onwards it should be more than or equal to 75% of the year. For ozone this applies to both the full year and the summer period only.

Data capture was slightly below the recommended 75% minimum for sulphur dioxide for Manchester Piccadilly in 1998 and for Port Talbot in 1999; and for ozone for Narberth in 2000. However, Defra believe that greater consistency in trends is achieved by including the data for the above sites than by excluding them. Manchester Piccadilly was excluded in 2001, and Cardiff Centre in 1994, because stone cutting adjacent to the sites caused unrepresentative results. Narberth rural site was excluded for giving incorrect measurements during 2004 2 urban sites were added to the indicator in 2006 - Birmingham Tyburn and Wigan Centre (replacing Birmingham East and Wigan Leigh respectively).

Causes of air pollution in urban sites

Two of the five pollutants, ozone and particulates, caused over 99 per cent of the pollution days, either separately or in combination with each other (see Figure (c) below). Between 1993 and 2007, the average number of days of pollution at urban sites caused by particulates, solely or in combination with other pollutants, fell from an average per site of about 43 days to 12 days per

year. Particulates come from numerous man-made and natural sources, and can be generated in the UK or transported from abroad. UK emissions of particulates have been reduced substantially in recent years, but the number of pollution days can still fluctuate from year to year due to variations in weather conditions, as demonstrated by the unusually high figure of 17 days in 2003.

The average number of pollution days at urban sites caused by sulphur dioxide, solely or in combination with other pollutants, was 20 days per site in 1993. In 2007 sulphur dioxide did not cause any pollution days, either solely or in combinations with other pollutants.

Ozone causes the great majority of pollution days in rural areas. Since 1999 it has also caused more days of poor air quality in urban areas than particulates have, as pollution by particulates has declined. The number of days caused by ozone pollution has fluctuated in both rural and urban areas, with no clear overall trend. The hot summers in 1999, 2003 and 2006 led to the greatest number of days of moderate or higher ozone pollution since this series began in 1987. A proportion of the ozone experienced in the UK originates from releases of pollution that are blown over from mainland Europe.

The series can be volatile from one year to the next, reflecting the variability in levels of ozone, more of which is produced in hot, sunny weather, as was the case during 2003 and 2006.

These results are shown in Figure (c) and Table C below.

Table C: Average number of days of moderate or higher air pollution per site caused by the each of the basket of 5 pollutants

Year	Ozone	Nitrogen dioxide	Carbon monoxide	Sulphur dioxide	Particulates
1993	5	0	0	20	43
1994	13	0	0	13	27
1995	24	1	0	12	28
1996	17	0	0	6	30
1997	16	1	0	4	23
1998	10	0	0	3	13
1999	25	0	0	1	9
2000	13	0	0	1	7
2001	17	0	0	0	8
2002	14	0	0	0	6
2003	36	0	0	0	17
2004	18	0	0	0	4
2005	16	1	0	0	6
2006	33	0	0	0	10
2007	12	1	0	0	12

Notes to Table C:

Not every site in the automatic monitoring network is included. Sites must also meet certain data capture targets to be used in the index. For both ozone and PM10, from 1993-97 data capture should be more than or equal to 50% of the year, and from 1998 onwards it should be more than

or equal to 75% of the year. For ozone this applies to both the full year and the summer period only. Data capture was slightly below the recommended 75% minimum for sulphur dioxide for Manchester Piccadilly in 1998 and for Port Talbot in 1999; and for ozone for Narberth in 2000. However, Defra believe that greater consistency in trends is achieved by including the data for the above sites than by excluding them.

Changes to the UK automatic monitoring network and the indicator calculation

The proposed EU Directive on Ambient Air Quality and Cleaner Air for Europe is expected to come into force in May/June 2008, and provides a new regulatory framework for very small particles (PM_{2.5}). This Directive requires measurements of the concentrations of these particles as well as measurements of larger particles (PM₁₀), and also requires that measurements are comparable in all EU member states. In order to fulfil these requirements some changes are needed to the UK automatic monitoring network. These changes include the number of sites monitored, the pollutants and locations to be monitored, and the monitoring techniques to be used.

The changes will be phased in over a period which began on 2nd October 2007 and will be completed by the end of 2008. New equipment is being introduced at some monitoring sites to enable reference method equivalent measurements of PM₁₀ and PM_{2.5} to be made. The composition of sites in the monitoring network has also been reviewed with more emphasis being placed on roadside locations. This will change the ratio from the current 1 roadside site for every 4 or 5 urban background sites to 1 roadside site for every 2 urban background sites. The number of sites monitoring carbon monoxide (CO) and sulphur dioxide (SO₂) has been greatly reduced. The number of sites measuring nitrogen dioxide (NO₂) and ozone (O₃) has been increased, and around 75 new sites will be introduced to measure PM_{2.5}. Since the first of these changes was introduced in October 2007, only 3 months of 2007 results have been affected but it is anticipated that the 2008 results will be affected to a greater degree.

Due to these changes to the composition of the automatic monitoring network, changes will also have to be made to the composition of the sites included in the calculation for Part (b) of the indicator. Currently, not all sites in the automatic monitoring network are included in the calculation for Part (b) of the indicator. This is because the composition of sites used for this calculation is based on a sub-set of 67 sites that was identified in 2001, to improve year-to-year consistency in the indicator calculation. Therefore, since 2001, only data from these sites have been considered for inclusion. However, following the changes to the automatic monitoring network, many of the original 67 sites will no longer measure CO or SO₂, and many of the new sites introduced to monitor PM_{2.5}, NO₂ and O₃ will not be within this original sub-set of 67 sites. It is therefore no longer appropriate to continue to monitor only the 67 sites identified in 2001, and a new method of determining the composition of sites for the indicator calculation will therefore be used from 2008 onwards. Various options for this are now being considered. One approach might be to base the indicator on all sites (with data capture over 75%) in the automatic monitoring network, rather than basing it on a sub-set of sites. This will ensure that the current, and future, changes to the automatic monitoring network are fully represented in the indicator calculation and will also align the indicator more closely with EU reporting.

Notes to Editors

1. The air quality indicator is one of the 68 indicators of the Government's Sustainable Development Strategy published in March 2005, and includes the former air quality headline indicator of sustainable development. The banding system used in Part (b) of the indicator is that of the Air Pollution Information Service.
2. More detailed data and information are published on the UK Air Quality Archive.
3. Information about the health effects of air pollution can be found in the leaflet 'Air Pollution - what it means for your health'. This leaflet is available on the Defra website or can be ordered by calling the Defra free publications service on 08459 556000.
4. Further details and data relating to UK air quality is available on Defra's e-Digest of Environmental Statistics: <http://www.defra.gov.uk/environment/statistics/airqual/index.htm>

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* Measured as the daily maximum 8-hour running mean

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