Department for Environment, Food and Rural Affairs

STATISTICAL RELEASE: 15 DECEMBER 2011

EMISSIONS OF AIR POLLUTANTS IN THE UK, 1970 TO 2010

- The UK has met current international targets to reduce total emissions by 2010 of four air pollutants that cause harm to people's health and to the natural environment.
- Emissions of sulphur dioxide have fallen by 89 per cent between 1990 and 2010, but increased by 2 per cent between 2009 and 2010. Emissions in 2010 were 31 per cent below the lowest international target for the UK.
- Emissions of nitrogen oxides have fallen by 62 per cent between 1990 and 2010, and fell by 3 per cent between 2009 and 2010. Emissions in 2010 were 5 per cent below the lowest international target for the UK.
- Emissions of non-methane volatile organic compounds have fallen by 71 per cent between 1990 and 2010, and fell by 4 per cent between 2009 and 2010. Emissions in 2010 were 34 per cent below the international target for the UK.
- Emissions of ammonia have fallen by 21 per cent between 1990 and 2010, but increased by 0.5 per cent between 2009 and 2010. Emissions in 2010 were 4 per cent below the international target for the UK.

Why quantify UK emissions of air pollutants?

There are many sources of air pollution, including power stations, traffic, household heating, agriculture and industrial processes. The National Atmospheric Emissions Inventory (NAEI)[1] provides estimates of the amount and the type of pollutants that are emitted to the air each year from all UK sources. These are estimated to help to find ways of reducing the impact of human activities and the resulting air pollutants on the environment and our health.

Some air pollutants directly affect us or our environment because they are harmful chemicals (such as nitrogen dioxide from nitrogen oxides and some

[1] //naei.defra.gov.uk/index.php

Non Methane Volatile Organic Compounds (NMVOCs)) and others because they can react in the environment to produce harmful chemicals. Other pollutants or pollutant combinations upset the natural balance of acidity and nitrogen in the environment (such as sulphur dioxide, nitrogen oxides and ammonia) and can for example damage sensitive environments and buildings through acid rain.

This Defra National Statistics Release covers UK emissions of:

- sulphur dioxide (SO_2);
- nitrogen oxides (NO_x);
- non-methane volatile organic compounds (NMVOCs); and
- ammonia (NH_3).

These four pollutants are primarily responsible for:

- **acidification** (SO_2, NO_x and NH_3) - where chemical reactions involving air pollutants create acidic compounds which can cause harm to vegetation and buildings (including as acid-rain);
- **eutrophication** (NO_x and NH_3) - where the nitrogen can be deposited in soils or in rivers and lakes through rain and affects the nutrient levels and diversity of species in sensitive environments, for example encouraging algae growth in lakes and water courses.
- **ground-level ozone** (NO_x and NMVOCs) – where chemical reactions involving air pollutants create the toxic gas ozone (O_3) which can affect people's health and can damage wild plants, crops, forests and some materials.

All four pollutants can also react in the atmosphere to form secondary particulate matter (PM). PM emissions can adversely impact human health, with chronic exposure to PM contributing to the risk of developing cardiovascular and respiratory diseases.

There are two main international agreements on air pollution emissions, both of which have 2010 as the target year:

- the **National Emission Ceilings Directive (NECD)** - sets ceilings for each EU Member State for emissions of sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds (NMVOCs), and ammonia.
- the **Gothenburg Protocol under the Convention on Long Range Transboundary Air Pollution (CLRTAP)** - sets similar or identical UK emissions ceilings for the same pollutants.

Reductions in air pollutant emissions[2] are achieved by for example changes in fuel use (such as switching from coal to gas power stations), through reducing fuel use, through changes to industrial processes, through pollutant capture or conversion (for example catalytic convertors on vehicles), and through legal restrictions. Changes in behaviour such as making more sustainable transport choices also contribute to emissions reductions. Behaviour and hence the level of emissions can be also influenced by changes in fuel price and the wider economic situation.

The NAEI is used to monitor emissions against the international targets, and the UK figures are reported annually to the European Commission via the European Environment Agency[3]. The statistics presented below compare the UK emissions against the international targets.

Some pollutants, referred to as greenhouse gases (such as carbon dioxide) may have little direct effect on health, but can contribute to changing global conditions and potentially give rise to dramatic changes in climate and sea level. Trends for greenhouse gases are produced by the NAEI, and are published separately by the Department for Energy and Climate Change[4].

Understanding air pollutant emissions figures

It should be noted that the mass of the emissions for the different pollutants should not be compared as their effects on health and the environment are very different.

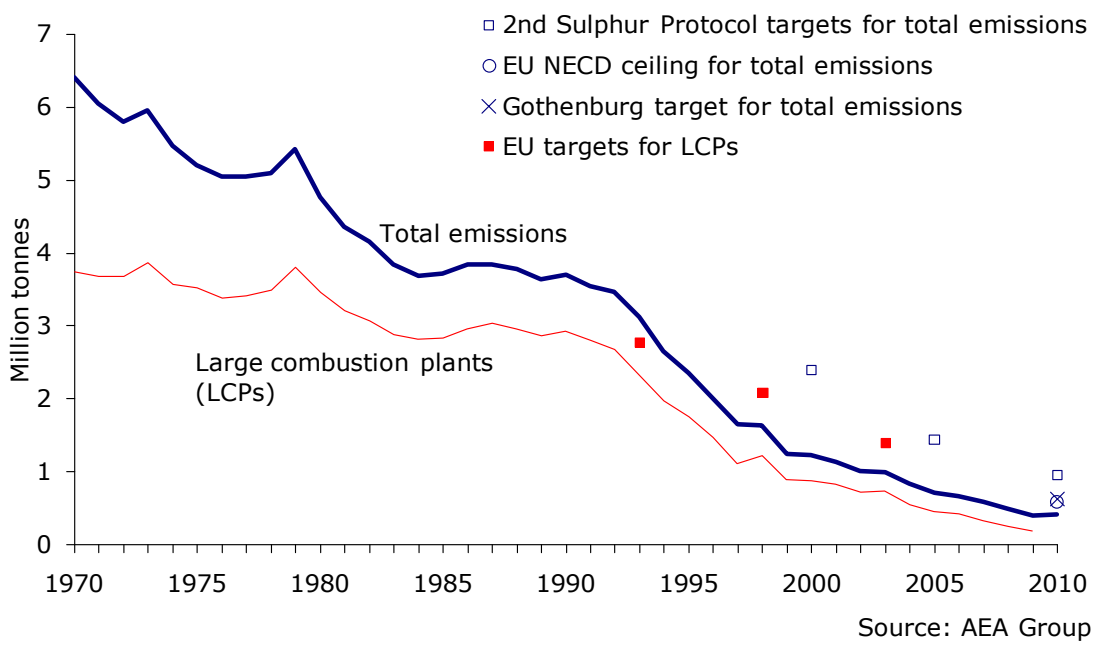
Whilst overall reductions in air emissions may signify reductions in potential harm to human health or to the natural environment, the way the pollutant is emitted is also important. Emissions from high chimneys (for example power stations) will not affect air quality[5] (concentrations of pollutants) as much as the same quantity of emissions released at ground level such as from cars and buses. This is because pollutants emitted close to the ground do not generally get dispersed as well as pollutants emitted further from the ground.

It is not possible, except for a limited number of large industrial processes, to measure emissions directly, so the NAEI is based on highly detailed assumptions on the amount of each air pollutant generated from different fuel use and activities in the UK. Refer to the NAEI[6] for more details.

[2] For Defra policy on air emissions see www.defra.gov.uk/environment/quality/air/air-quality/
[3] www.eea.europa.eu/
[4] www.decc.gov.uk/en/content/cms/statistics/climate_stats/climate_stats.aspx
[5] A separate Defra National Statistics Release is published annually on air quality (next release in February 2012) see www.defra.gov.uk/statistics/environment/air-quality/
[6] //naei.defra.gov.uk/index.php

Sulphur dioxide

Figure 1: UK Sulphur dioxide emissions and targets: 1970 – 2010



- The UK has met current international targets to reduce emissions of sulphur dioxide.

- Emissions of sulphur dioxide fell by 89 per cent between 1990 and 2010, from 3.7 to 0.41 million tonnes.

- There was a small increase in sulphur dioxide emissions of 2.3 per cent between 2009 and 2010 – such fluctuations are due to harsher winters and resulting increases in fuel consumption for heating and electricity generation.

The main source of sulphur dioxide (SO_2) emissions is from combustion in energy production and transformation (58 per cent in 2010), followed by combustion in manufacturing industries (18 per cent in 2010). It is these sources that have been the strongest drivers for the long term trend of falling emissions, by switching from coal to gas and improved efficiency.

International targets

- **EU NECD target met**: *to reduce SO_2 emissions to 0.585 million tonnes by 2010* (2010 emissions were 0.41 million tonnes or 31 per cent below the target)

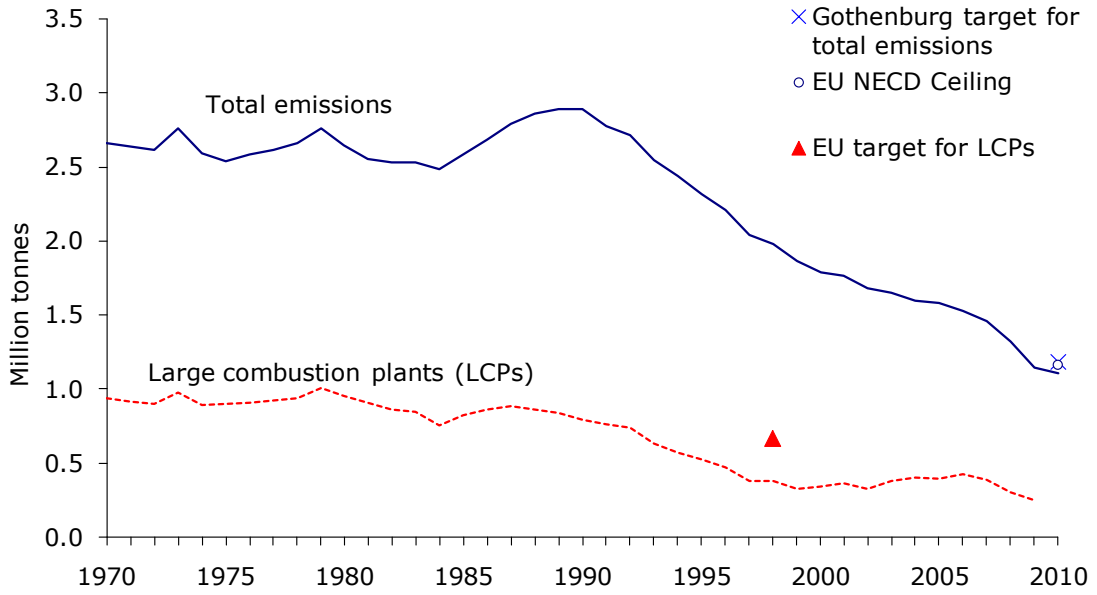
- **UNECE Gothenburg Protocol target met**: *to reduce SO_2 emissions to 0.625 million tonnes by 2010* (2010 emissions were 0.41 million tonnes)

- **UNECE Second Sulphur Protocol target met**: *to reduce SO_2 emissions to 80 per cent below 1980 levels by 2010, with intermediate targets for 2000 and 2005* (2010 emissions were 91 per cent below 1980 levels).

- **EC Large Combustion Plant (LCP) Directive target met**: *to reduce SO_2 emissions from Large Combustion Plants (those with a thermal input greater than 50 megawatts) to 60 per cent below 1980 levels by 2003, with intermediate targets for 1993 and 1998* (2003 emissions from LCPs were 79 per cent below 1980 levels and in 2009[7] 95 per cent below).

Nitrogen oxides

Figure 2: UK Nitrogen oxides emissions and targets: 1970 - 2010



Source: AEA Group

- The UK has met current international targets to reduce emissions of nitrogen oxides.

- Emissions of nitrogen oxides have fallen by 62 per cent between 1990 and 2010, to 1.11 million tonnes in 2010.

[7] The EC Large Combustion Plant Directive has not required LCP emissions to be reported for 2010 and so an estimate for 2010 is not available.

- There was a three per cent decrease in emissions of nitrogen oxides between 2009 and 2010.

Increases in road traffic account for the steep climb in nitrogen oxide (NO_x) emissions between 1984 and 1989, and road transport still accounts for around one third of total NO_x emissions. Catalytic converters and stricter regulations have resulted in a strong downward trend since 1990, particularly from road transport but emissions from power stations have been also reduced.

International targets

- **EU NECD target met** - *to reduce NO_x emissions to 1.167 million tonnes by 2010* (2010 emissions were 1.11 million tonnes or 5 per cent below the target)

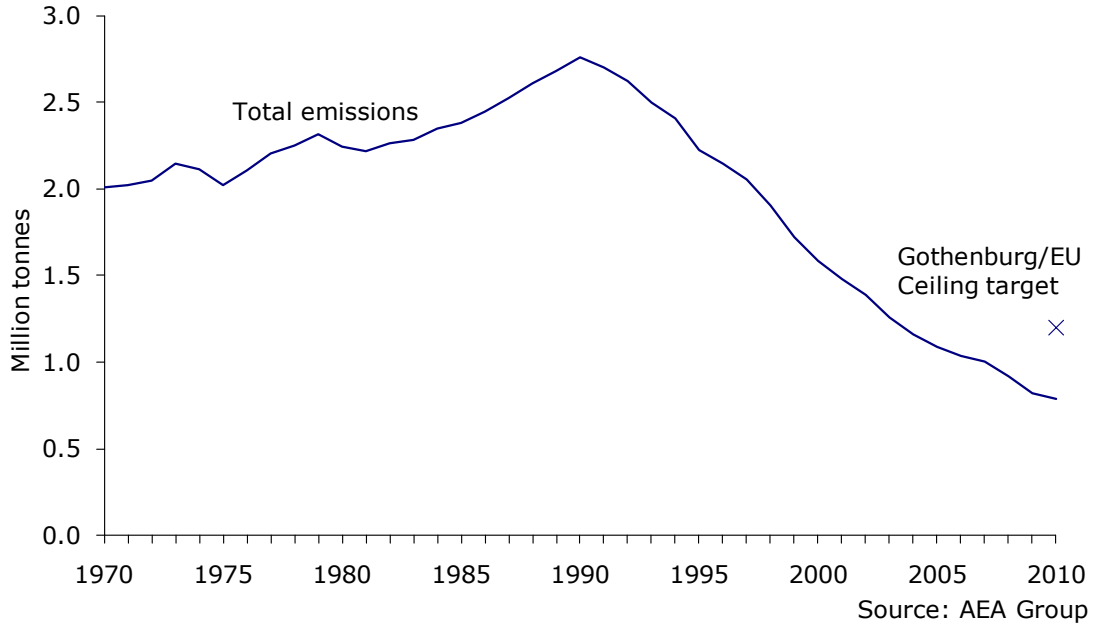
- **UNECE Gothenburg Protocol target met** – *to reduce NO_x emissions to 1.181 million tonnes by 2010* (2010 emissions were 1.11 million tonnes)

- **EC Large Combustion Plants (LCP) Directive target met** - *to reduce NO_x emissions from Large Combustion Plants (those with a thermal input greater than 50 megawatts) to 30 per cent below 1980 levels by 1998* (1998 emissions were 60 per cent below 1980 levels and in 2009[8] 75 per cent below).

[8] The EC Large Combustion Plant Directive has not required LCP emissions to be reported for 2010 and so an estimate for 2010 is not available

Non-methane volatile organic compounds

Figure 3: UK Non-methane volatile organic compounds emissions and targets: 1970-2010



- The UK has met current international targets to reduce emissions of non-methane volatile organic compounds.

- Emissions of non-methane volatile organic compounds have fallen by 71 per cent between 1990 and 2010, to 0.79 million tonnes in 2010.

- There was a four per cent decrease in emissions of non-methane volatile organic compounds between 2009 and 2010.

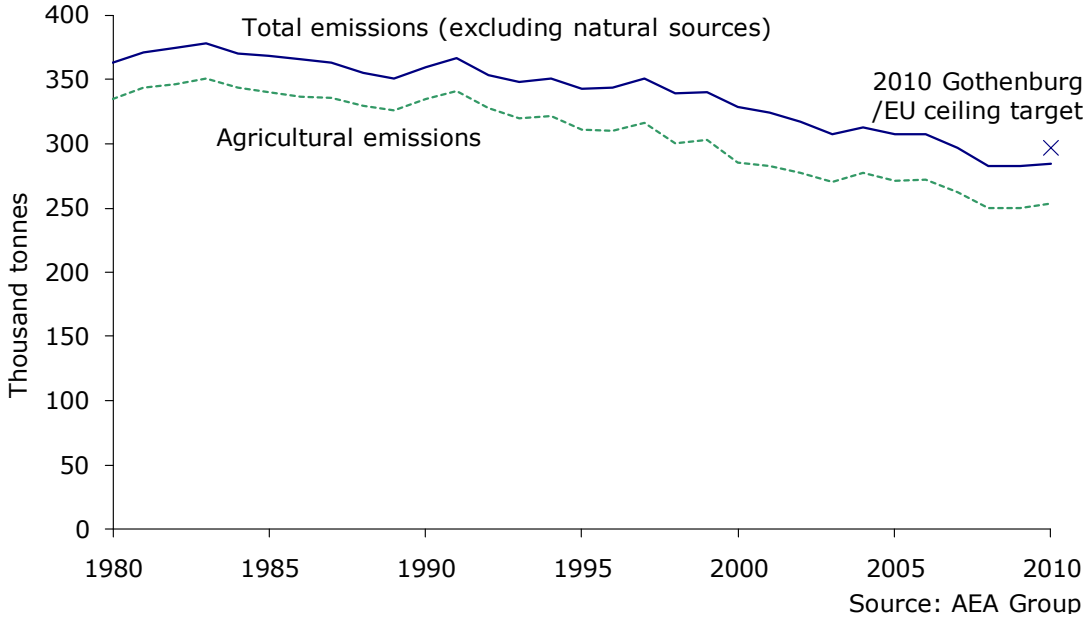
Solvents, production processes, and the extraction and distribution of fossil fuels are the primary sources of non-methane volatile organic compounds NMVOC emissions. The marked decrease in emissions since the early 1990s reflects stricter limits on emissions from various sectors.

International targets

- **EU NECD / UNECE Gothenburg Protocols targets met** – to reduce NMVOC emissions to below 1.2 million tonnes by 2010 (2010 emissions were 0.79 million tonnes or 34 per cent below the target).

Ammonia

Figure 4: UK Ammonia emissions and targets: 1980-2010



- The UK has met current international targets to reduce emissions of ammonia.

- Emissions of ammonia have fallen by 21 per cent between 1990 and 2010, to 284 thousand tonnes in 2010.

- There was a slight increase of 0.5 per cent in emissions of ammonia between 2009 and 2010.

Emissions from agriculture accounted for 89 per cent of total ammonia emissions in 2010. Agriculture's contribution to the total has decreased slightly since 1990, largely due to reductions in cattle numbers and more efficient fertiliser use. However, more recently there has been increased use of urea as a nitrogen-containing fertiliser and a resulting slight increase in emissions from agriculture.

International targets

- **EU NECD / UNECE Gothenburg Protocols targets met** – to reduce ammonia emissions to below 297 thousand tonnes by 2010 (2010 emissions were 284 thousand tonnes or 4 per cent below the target).

A Defra National Statistics publication

National Statistics are produced to high professional standards set out in the National Statistics Code of Practice. They undergo regular quality assurance reviews to ensure they meet customer needs.

Responsible Defra statistician: Stephen Hall

Main notes

1. Table 1 below shows the emissions figures for the four pollutants, from 1970 to 2010. Table 2 below shows the emissions by source for 2009 and 2010.

2. The figures in this Defra National Statistics Release are from the National Atmospheric Emissions Inventory for 1970 to 2010, produced for Defra and the Devolved Administrations by AEA Group. For further information on the Inventory see the NAEI website.

3. There are uncertainties associated with all estimates of pollutant emissions. However, although for any given year considerable uncertainties may surround the emission estimates, it should be noted that trends over time are likely to be more reliable. In particular more recent levels of emissions are likely to be influenced by the economic crisis.

4. Results for other pollutants, including those covered by the UK Air Quality Strategy, will be released in February 2012.

5. The methodology and assumptions in the NAEI are continually refined as for example better scientific information becomes available on emissions associated with different fuel use and activities. Data for earlier years is therefore revised based on these new assumptions. A pre-release announcement was published to highlight the main changes. Annex A repeats the description of the change in methodology but also provides details of the main impact of the changes.

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Table 1: Emissions of air pollutants in the UK, 1970 to 2010

Year	Sulphur dioxide (Million tonnes)	Nitrogen oxides (Million tonnes)	Non-methane volatile organic compounds (Million tonnes)	Ammonia (excluding natural sources) (Thousand tonnes)
1970	6.420	2.658	2.010	no data
1971	6.057	2.637	2.024	no data
1972	5.808	2.615	2.049	no data
1973	5.967	2.757	2.146	no data
1974	5.473	2.593	2.115	no data
1975	5.220	2.535	2.022	no data
1976	5.049	2.583	2.110	no data
1977	5.054	2.611	2.206	no data
1978	5.101	2.660	2.250	no data
1979	5.426	2.760	2.314	no data
1980	4.780	2.643	2.247	363.343
1981	4.358	2.553	2.219	371.191
1982	4.157	2.531	2.266	374.516
1983	3.842	2.530	2.284	378.154
1984	3.688	2.487	2.347	369.947
1985	3.715	2.581	2.383	368.399
1986	3.854	2.685	2.448	365.579
1987	3.842	2.788	2.529	363.404
1988	3.778	2.857	2.612	355.363
1989	3.648	2.889	2.681	351.136
1990	3.707	2.885	2.762	359.941
1991	3.546	2.776	2.702	366.635
1992	3.465	2.711	2.625	353.358
1993	3.124	2.543	2.501	347.958
1994	2.663	2.434	2.412	350.609
1995	2.356	2.317	2.227	342.609
1996	2.010	2.211	2.146	344.052
1997	1.652	2.039	2.056	350.958
1998	1.632	1.977	1.908	339.024
1999	1.246	1.861	1.725	340.129
2000	1.228	1.791	1.586	328.289
2001	1.133	1.761	1.481	324.392
2002	1.014	1.678	1.389	317.156
2003	0.992	1.646	1.260	307.231
2004	0.832	1.594	1.163	312.417
2005	0.706	1.580	1.088	307.453
2006	0.665	1.525	1.039	307.055
2007	0.586	1.461	1.002	296.386
2008	0.491	1.317	0.922	282.549
2009	0.397	1.143	0.822	282.980
2010	0.406	1.106	0.789	284.391

Source: National Air Emissions Inventory, AEA Group

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Table 2: Emissions of air pollutants by source in the UK, 2009 and 2010 (Thousand tonnes)

	Source	2009 SO_2	2009 NO_x	2009 NMVOC	2009 NH_3	2010 SO_2	2010 NO_x	2010 NMVOC	2010 NH_3
1	Energy industries (Combustion in power plants & Energy Production)	226.21	350.30	4.78	0.80	237.56	336.08	4.85	0.83
2	Manufacturing Industries and Construction	75.26	176.70	21.82	0.33	71.40	178.18	22.68	0.36
3	Road Transport	0.92	395.77	84.00	11.55	0.98	370.77	70.13	10.32
4	Non-road transport	14.78	86.47	11.86	NA	13.93	84.61	11.59	NA
5	Other sectors (Commercial, residential , agriculture and fishing stationary and mobile combustion)	41.10	93.80	36.16	1.85	42.24	96.84	37.08	1.93
6	Other, Mobile (Including military)	7.93	28.53	2.19	0.00	6.38	28.15	2.13	0.00
7	Fugitive emissions	9.08	2.34	169.92	0.14	12.80	2.60	151.25	0.15
8	Industrial Processes	21.30	8.02	102.82	4.10	20.41	7.18	103.15	4.02
9	Solvent and other product use;	NA	NA	352.75	1.21	NA	NA	350.95	1.21
10	Agriculture	NA	NA	NA	249.99	NA	NA	NA	252.96
11	Waste	0.73	1.08	34.71	12.73	0.75	1.13	33.54	12.35
12	Other* (included in national total for entire territory)	NA	0.27	1.41	0.28	NA	0.27	1.41	0.28
	NATIONAL TOTAL	397.32	1143.29	822.42	282.98	406.43	1105.81	788.77	284.39
	Memo items**	185.77	437.32	108.08	8.15	185.77	437.32	108.08	8.15

* Emissions from Gibraltar are included in national total

** Memo Items are reported but EXCLUDED from national totals. Memo items include: International & National Aircraft (cruise), International Shipping, VOC emissions from forest fires and NH3 emissions from wild animals and humans, Natural Emissions (Volcanoes)

Source: National Air Emissions Inventory, AEA Group

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Annex A

Changes in methodology in the NAEI for 2010

Some methodological changes in the NAEI affect the calculation of emissions of nitrogen oxides (NO_X) from road transport. Small changes occur every year to reflect improved knowledge and data sources; however this amendment reflects a significant change in methodology.

Summary of changes

The changes to the NO_X emissions from road transport result from:

(a) changes in exhaust emission factors, and
(b) changes in fleet composition defined by analysis of the Department for Transport's (DfT) Automatic Number Plate Recognition (ANPR) data for different road types and Driver and Vehicle Licensing Agency licensing data for the UK's Devolved Administrations.

NO_X Emission Factors

The previous version of the inventory used emission factors published by DfT in 2009. NO_X emission factors for road transport have been revised, and now use the COPERT4 v8.1 emission factors published in May 2011. COPERT is a software tool developed by the European Environment Agency (EEA) and used widely to calculate emissions from road transport. The methodology is part of the EMEP/EEA air pollutant emission inventory guidebook, and is consistent with the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines. The latest version of the COPERT model is available for download from //www.emisia.com/copert/. The COPERT4 v8.1 factors are based on new sources of information on vehicle emissions emerged since the DfT emission factors were developed.

Fleet Composition

The previous version of the inventory used vehicle fleet composition data developed through analysis of national licensing data and travel surveys. The DfT are now able to provide anonymised ANPR data for 256 sites in the UK for 2007-2010. These were analysed to define the composition of the fleet in terms of vehicle age (and hence Euro emission standard) and fuel type actually observed on different types of roads: urban, rural and motorways. These data were used in conjunction with vehicle licensing data for each Devolved Administration (DA) country to adjust current assumptions made when calculating the UK vehicle fleet, with the aim of providing a more realistic 'on-road' vehicle fleet by DA region.
The new factors increase total road transport emissions by 34.6 ktonnes or 9.6 per cent in 2009 compared with the 2009 NAEI figures. The changes are mainly due to increases in petrol and diesel car emission estimates partially offset by a reduction in the estimate for artic HGV emissions. The new

emission factors are responsible for most of the overall changes in the road transport emissions inventory for NO_X. There are also relatively small changes in estimates of emissions for other pollutants as a consequence of using the ANPR data.

Total UK NO_X emissions by vehicle type using new emission factors and vehicle data for the 2010 NAEI (Thousand tonnes)

ktonnes	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	% difference from 2009 NAEI
Petrol car	347.9	316.5	280.1	241.4	211.3	184.7	165.5	140.1	126.1	75.7	61.9	**38.4%**
Diesel car	48.2	53.8	61.6	69.2	78.1	86.1	90.8	94.2	101.0	102.7	101.2	**45.1%**
Petrol LGV	29.1	23.7	18.3	13.9	10.6	7.7	6.7	5.3	4.1	3.3	1.8	**26.8%**
Diesel LGV	54.4	57.1	57.8	60.0	61.8	62.5	61.8	62.3	59.6	57.7	58.1	**23.7%**
Rigid HGV	85.2	83.9	82.6	82.1	80.1	78.7	76.5	74.7	68.7	56.7	54.2	**-4.3%**
Artic HGV	103.2	100.6	98.1	94.6	95.2	91.2	89.1	89.7	79.1	62.1	57.2	**-31.4%**
Bus	49.8	48.0	46.7	47.4	44.9	43.5	43.6	42.9	38.1	36.4	35.3	**2.6%**
Motor cycle	1.5	1.5	1.6	1.8	1.6	1.6	1.5	1.4	1.3	1.2	1.1	**0.0%**
TOTAL	**719.3**	**685.1**	**646.8**	**610.3**	**583.6**	**556.0**	**535.4**	**510.7**	**478.0**	**395.7**	**370.7**	
% difference from 2009 NAEI	**-3.7%**	**-2.5%**	**-2.6%**	**-2.7%**	**-2.7%**	**-1.5%**	**1.4%**	**4.1%**	**7.8%**	**9.6%**		

Rationale for the change in methodology

Trends in ambient roadside concentrations of NO_X and nitrogen dioxide (NO_2) in the UK have generally shown a decrease in concentration from ~1996 to 2002–4, followed by a period of more stable concentrations from 2002/2004–9. However, trends in the ambient concentrations of NO_X and NO_2 have not decreased by as much as suggested by previous UK road transport emission inventories. The report 'Trends in NO_X and NO_2 emissions and ambient measurements in the UK'[9] published by Defra in 2011, outlines the analysis that was undertaken to assess the differences in measured concentrations and forecast trends of NO_X and NO_2 in the UK, and informs the changes which will be implemented in the 2010 NAEI.

[9] //uk-air.defra.gov.uk/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf