

## Annex 5B

### An evaluation of the effects causing the reduction in sulphur dioxide emissions

5B.1 Sulphur dioxide (SO<sub>2</sub>) is an acid gas, which can affect our health and vegetation, and contributes to acid rain and local pollution. Those who suffer from asthma and chronic lung disease are particularly likely to suffer from its impact: sulphur dioxide causes constriction of the airways by stimulating nerves in the lining of the nose, throat and airways of the lung.

5B.2 Sulphur dioxide emissions have fallen rapidly over the last decade as shown in Table 5B.1. The burning of fossil fuels or the smelting of sulphide ores produces sulphur dioxide. Almost all emissions in 2004 emanated from energy sources. Table 5B.1 shows the emissions of sulphur dioxide by source in 1990 and 2004, and the percentage change between these two dates. It shows that sulphur dioxide emissions have fallen from all sources, and in most cases have at least halved.

**Table 5B.1 Estimated emissions of sulphur dioxide by source category in 1990 and 2004**

Source category	SO <sub>2</sub> emissions (thousand tonnes of SO <sub>2</sub> )		
	1990	2004	Percentage change between 1990 and 2004
<b>Total energy sources</b>	<b>3,645</b>	<b>818</b>	<b>-78</b>
Power stations	2,729	496	-82
Refineries	153	65	-58
Manufacturing industries & construction	422	158	-63
Transport	95	39	-59
Other sectors including domestic & services	212	46	-78
Other energy sources	6	4	-33
Fugitive emissions from fuels	28	10	-64
<b>Total non-energy sources</b>	<b>53</b>	<b>15</b>	<b>-72</b>
Production processes	46	14	-70
Others	7	1	-86
<b>All sources</b>	<b>3,699</b>	<b>833</b>	<b>-77</b>

Source: NETCEN, National Air Emissions Inventory

5B.3 In the UK in 2004, around three fifths of sulphur dioxide was produced by the combustion of coal, primarily in the generation of electricity at power stations. Emissions from power stations fell by 82 per cent between 1990 and 2004. The main cause was a fall in the amount of coal used in electricity generation, from 49.84 million tonnes of oil equivalent (Mtoe) in 1990 to 31.30 Mtoe in 2004.

5B.4 The introduction of flue gas desulphurisation at two major power stations has also contributed to the fall. Since 1993, flue-gas desulphurisation has come

progressively into operation at the Drax and Ratcliffe-on-Soar power stations. These represent the coal-fired power stations with the largest and fourth largest capacities, accounting for almost 6 GWe of power. This desulphurisation process, which usually involves using crushed limestone to react with sulphur dioxide in the hot flue gases, can reduce sulphur dioxide emissions by 90 per cent. The process is expensive to install, with the Drax and Ratcliffe installations costing in excess of £900 million. The ductwork is tall enough to accommodate a double-decker bus. The calcium sulphate formed by the process can be used in the manufacture of plaster wallboards. A side effect of the process is a reduction in the efficiency of the transformation of coal into electricity, increasing coal use by about 2 per cent for the same electrical output, and thereby increasing carbon dioxide and other emissions by 2 per cent.

5B.5 Two other large coal-fired power stations, West Burton and Eggborough have now installed flue gas desulphurisation systems, whilst the second largest coal-fired generator, Longannet in Scotland has developed ‘gas reburn’, a new technology for reducing its emissions since 2001. This technology is primarily designed to reduce emissions of nitrogen oxides by 80 per cent by injecting natural gas into the combustion zone. Emissions of sulphur dioxide are also reduced by 20 per cent because the ‘gas reburn’ process reduces the amount of coal needed in power generation. These measures are likely to ensure that sulphur dioxide emissions from this sector will continue to fall. Consent has been granted for flue gas desulphurisation systems to be installed at four other stations (Cottam, Rugeley, Aberthaw and Fiddlers Ferry).

5B.6 The EC Large Combustion Plants Directive (88/609/EEC) required a reduction in total sulphur dioxide emissions from existing and new combustion installations with an annual capacity of 50MW of 20 per cent by 1993, 40 per cent by 1998, and 60 per cent by 2003 taking 1980 as the baseline. This includes both power stations and industrial installations. These targets were met, with emissions from large combustion installations in 2003 being 79 per cent lower than in 1980. The Directive has been revised (2001/80/EC) and has been extended to older (pre 1987) plant.

5B.7 Table 5B.2 below shows the emissions of sulphur dioxide by fuel. Aside from the emissions from coal combustion, the biggest source of sulphur dioxide emissions is the combustion of petroleum, which contributed about 19 per cent of all emissions in 2004. Such emissions have fallen by over 77 per cent since 1990, primarily due to large reductions in fuel oil use in favour of gas in electricity generation and a general move away from oil to gas as the fuel of choice for use in industry.

5B.8 Sulphur dioxide emissions from petroleum are continuing to fall because of the EC Sulphur Content of Liquid Fuels Directive, which was implemented in the UK in June 2000. This limits the sulphur content of gas oil to 0.2 per cent from 1 July 2000 and to 0.1 per cent from 1 January 2008. Heavy fuel oil sulphur content was limited to 1 per cent from 1 January 2003 as compared to a pre-directive specification of 3.5 per cent. The already small amount of sulphur dioxide emitted from motor spirit and diesel fuel has fallen and should fall further due to the introduction of ultra low sulphur petrol and diesel.

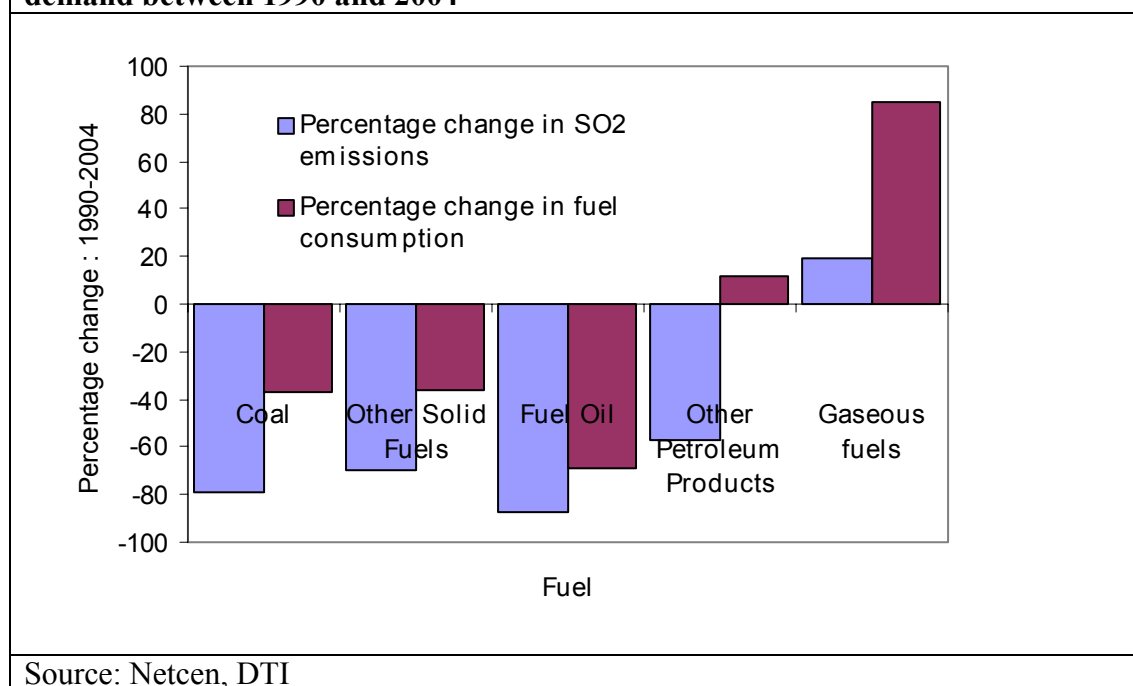
**Table 5B.2 Estimated emissions of sulphur dioxide by fuel in 1990 and 2004**

Fuel Type	SO <sub>2</sub> emissions (thousand tonnes of SO <sub>2</sub> )			
	1990	2004	Percentage change between 1990 and 2004	
Coal	2,707	578	-79	
Other solid fuels	66	20	-70	
Petroleum	Fuel oil	605	78	-87
	Other petroleum products	193	83	-57
Gaseous fuels	9	11	19	
Other emissions	118	64	-46	
<b>Total</b>	<b>3,699</b>	<b>833</b>	<b>-77</b>	

Source: DEFRA

5B.9 In addition to the overall fall in sulphur dioxide emissions levels, a further useful measure of the success of reducing sulphur dioxide levels is a consideration of ambient air concentrations of SO<sub>2</sub> measured at the national monitoring network sites. This monitoring network of some 75 sites covers urban, suburban and rural areas to ensure the UK complies with mandatory limit values set by the European Union Air Quality Directive and the UK's own national air quality standards and objectives.

**Chart 5B.1 Percentage change in sulphur dioxide emissions and energy demand between 1990 and 2004**



Source: Netcen, DTI

5B.10 There are three health objectives of the Air Quality Strategy that relate to sulphur dioxide levels. The first two of these are also EC directives, in particular that the one hour mean sulphur dioxide level should not exceed 350 µg/m<sup>3</sup> more than 24 times a year and that the 24 hour mean should not exceed 125 µg/m<sup>3</sup> more than three times a year by 31 December 2004. In 2004 all sites met the health objectives that the

1 hour mean should not exceed  $350 \mu\text{g}/\text{m}^3$  more than 24 times a year. In fact only two sites (Grangemouth and Salford) recorded any exceedences at all. The objective that the 24 hour mean should not exceed  $125 \mu\text{g}/\text{m}^3$  more than 3 times a year by the end of 2004 was met. The objective that the 15 minute mean should not exceed  $266 \mu\text{g}/\text{m}^3$  more than 35 times a year by the end of 2005 was met at all sites except Grangemouth, which had 60 exceedences. The 24 hour objective was exceeded only once, at Grangemouth; 11 sites recorded some exceedences of the 15 minute objective.

### **Further reading**

Defra e-digest of environmental statistics: sulphur dioxide

<http://www.defra.gov.uk/environment/statistics/airqual/aqsulphurd.htm>