UKpia
www.ukpia.com

Briefing: Airborne Particulate Matter

- **The UK Government's and the EU's air quality objectives for fine particles (PM_{10}) to protect human health are currently met in most places in the UK.**
- **There have been significant reductions in recent decades of emissions of air pollutants from power stations, transport, household heating, agriculture and industrial processes.**
- **On average a third of fine particles in the air are primary particles, a third are secondary particles and the rest consists of dust, pollen, etc from various sources.**
- **Pollution episodes can be due to high levels of some or all the above particle types, produced locally or remotely. Hence, just reducing local emissions of primary particles will not prevent all exceedences of the fine particles air quality standard.**
- **Vehicle exhaust control technologies and tighter standards for vehicular emissions and the move to 'sulphur free' fuels' have halved emissions of PM_{10} since 1990.**
- **Emissions of ammonia, sulphur dioxide and oxides of nitrogen are also being cut, reducing the contribution of secondary particles.**

Background

Research in the US and elsewhere highlighted the dangers to human health of fine airborne particles. This led to the UK and the EU adopting air quality objectives for airborne particulate matter with an aerodynamic diameter of up to 10 micro metres (μm) known as PM_{10}.

Action to manage and improve air quality is largely driven by EU legislation. The 2008 ambient air quality directive (2008/50/EC) sets legally binding limits for concentrations in outdoor air of major air pollutants that impact public health such as particulate matter (PM10 and PM2.5), sulphur dioxide (SO2) and nitrogen dioxide (NO2). The 2008 directive replaced nearly all the previous EU air quality legislation and was made law in England through the Air Quality Standards Regulations 2010.

Sources

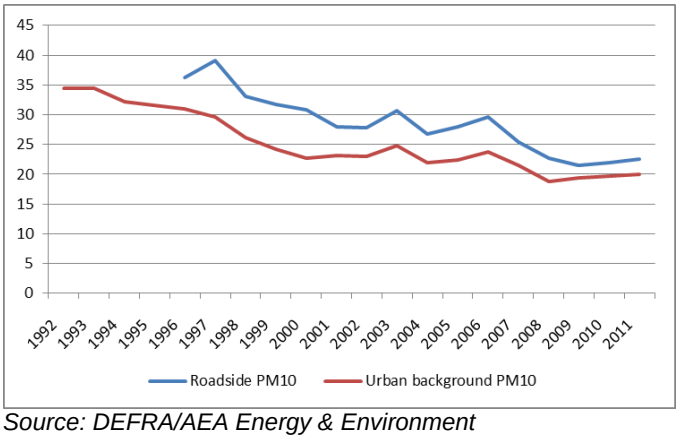
Airborne particulate matter contains a mix of:
i) **primary** particles emitted (locally & remotely) from combustion of fossil fuels. These mainly carbonaceous particles can coagulate in the air
ii) **secondary** particles are formed slowly in the atmosphere from gaseous sulphur dioxide (SO_2), nitrogen oxides (NOx) and ammonia and in some places VOCs emitted by vegetation, eg pinene from pine trees
iii) **coarse** particles from a variety of sources including pollen, sea salt, construction, farming and dust re-suspended by road traffic.

Airborne particulate matter is also a long-range pollutant, with significant concentrations of both primary and secondary particles in the UK attributable to European sources when the wind is blowing from the east or southeast. Indeed, the relationship between emissions and air quality is complex and is strongly affected by weather. Day-to-day changes in weather have a great influence on air quality. Levels of pollutants that are relatively high on a still day when dispersion is limited can be much

lower the next day or even the next hour if a wind starts to blow.

The three types of particulate matter each make up roughly one-third of total long-term average PM_{10} concentrations at urban background locations, although compositions vary from day-to-day and site-to-site.

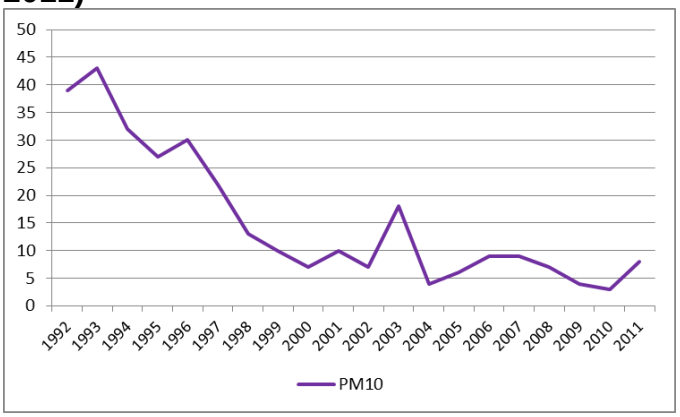
Fig. 1 Annual Levels of PM10 (µg/m^3) in the UK



Source: DEFRA/AEA Energy & Environment

Urban background particulate pollution has shown long-term improvement: concentrations declined from a peak of 35 micrograms per cubic metre (µg m^3) in 1992 to 20 µg m^3 in 2011.

Fig. 2 Average number of days of moderate or higher air pollution at urban sites (1992-2011)



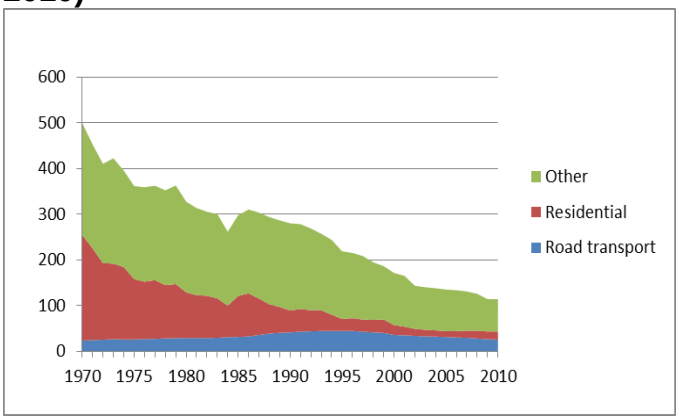
Source: DEFRA

Between 1992 and 2011, the average number of days of pollution at urban sites caused by particulates, solely or in combination with other pollutants, fell from and average per site of 39 days to 8 days per year.

Emissions

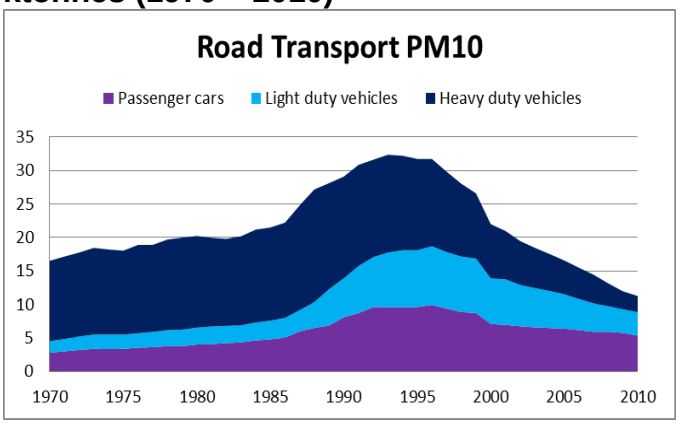
Between 1990 and 2010 total UK emissions of primary PM_{10}, including industrial and commerical, declined from 313 to 114 kilotonnes. In 2010 road transport contributed about 25.3 kilotonnes of PM_{10}, mostly produced by diesel-powered vehicles, which emit more PM_{10} per mile than comparable petrol vehicles. Residential combustion of fossil fuels (coal and gas) is another contributor.

Fig. 3 PM_{10} Emissions - ktonnes (1970 - 2010)



Source: DEFRA/AEA Energy & Environment

Fig. 4 Road Transport PM_{10} Emissions – ktonnes (1970 – 2010)



Source: DEFRA/AEA Energy & Environment

The steady decline of PM_{10} in road transport since its peak in 1995 is attributable to the introduction of emission standards for road vehicles, enabled by the introduction of sulphur free fuels.

Conclusions

On average around 22% of ambient PM_{10} are produced by road transport. Significant reductions in PM_{10} emissions from traffic have been achieved. Secondary particulate matter can account for up to 70% of the total ambient PM_{10} during pollution episodes. Hence, further reductions in road traffic emissions will not, on their own, ensure compliance with the air quality objectives for PM_{10}.