What is particulate matter, and why are emissions of it estimated?

https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-particulate-matter-pm10-and-pm25

Particulate Matter (PM) is everything in the air that is not a gas and as such it is made up from a huge variety of chemical compounds and materials, some of which are toxic. Due to the small size of many of the particles that form PM, some of these toxic compounds may enter the bloodstream and be transported around the body, entering the heart, brain and other organs. Therefore, exposure to PM can result in serious health effects and is associated with respiratory conditions (such as asthma), cardiovascular disease (CVD), and lung cancer, and there is emerging evidence for associations with dementia, low birth weight and Type 2 diabetes. People such as the young, elderly and those with respiratory problems are most vulnerable to these effects.

When reporting UK emissions, PM is classified according to particle size: PM10 refers to particles smaller than 10 micrometres in diameter, while PM2.5 refers to finer particles smaller than 2.5 micrometres. By definition, PM10 emission measurements or estimates include PM2.5, meaning that the total mass of PM10 emissions is always greater than that of PM2.5. To isolate the coarse fraction of particulate matter (PM coarse), the mass of PM2.5 is subtracted from PM10 (PM coarse = PM10 - PM2.5). This classification approach is based on scientific consensus and longstanding evidence regarding how particles of different sizes penetrate the respiratory system and are absorbed by the lungs.

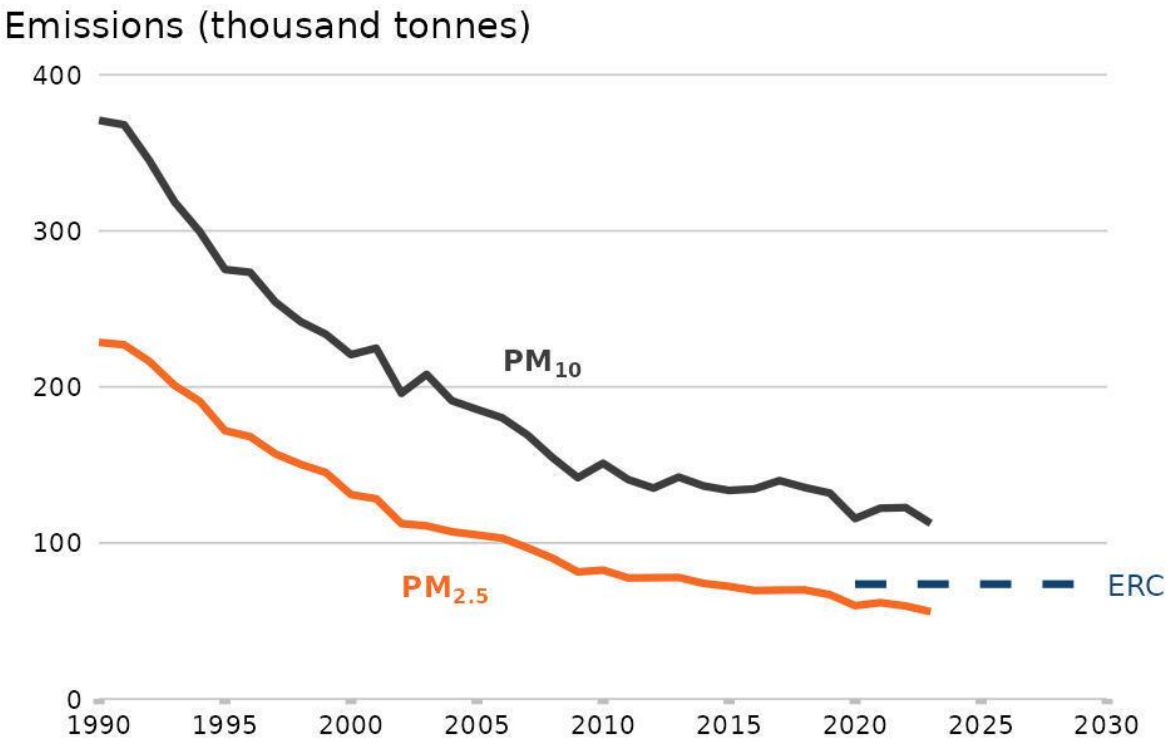
Different emission sources produce different proportions of coarse and fine particulate matter. For example, construction and demolition emit a higher proportion of coarse particles (PM10 - PM2.5), while in industrial and domestic combustion the majority of PM emissions are fine particles (PM2.5).

"Primary" PM is emitted directly as particles (for example, soot or dust) and "secondary" PM is formed in the atmosphere through changes in pollutants and reactions between them. For example, ammonia reacts with nitrogen oxides (NOx) resulting in ammonium nitrate particulates. Both PM and the precursor pollutants that form it can travel large distances through the air. **Around half of the concentrations of PM that people in the UK are exposed to come from either naturally occurring sources, such as pollen and sea spray, or are transported to the UK from international shipping and other countries. The remaining PM in UK air results from human activities in the UK, such as wood burning, various industrial processes and emissions from vehicles (mainly from tyre and brake wear).**

As human activity in the UK contributes such a high proportion of the concentrations, it is in the interest of the UK to identify and reduce all these emissions where possible.

Emissions of particulate matter generally decreased between 1990 and the early 2000's. There are many reasons for this long-term decrease, which covers most emissions sources, but the reduction in the burning of coal and improved emission standards for transport and industrial processes are major drivers. Since the late 2000s annual emissions of PM have generally continued to fall, but the rate of change has reduced. Compared to earlier decades, emission levels have been relatively steady with small annual fluctuations. In these more recent years, considerable decreases in emissions from some sources (e.g. from road transport and energy industries) have been partly offset by increases in emissions from other activities, such as wood burning in domestic settings and the burning of biomass-based fuels in industry. In 2020 PM emissions fell at a greater rate than in recent years due to reduced activity across a number of emissions sources . Whilst there was a small increase in 2021, the overall downward trend has continued. In 2023 PM2.5 and PM10 emissions were at the lowest level since emission estimates have been calculated. Emissions of particulate matter fell from 2022 to 2023, in part

due to a fall in emissions from construction and quarrying activity, as well as reduced emissions from product use.



Sources of PM2.5 [Wikipedia]

Anthropogenic Sources

- **Vehicle Emissions**: Cars, trucks, and buses release PM2.5 from fuel combustion.
- **Industrial Processes**: Factories and power plants emit fine particles during production and energy generation.
- **Residential Heating**: Burning wood, coal, or other fuels in stoves and fireplaces produces PM2.5.
- **Agricultural Activities**: Practices like burning crop residues and tilling can generate fine particulate matter.
- **Construction and Demolition**: Dust from construction sites and road work contributes to PM2.5 levels.

Chemical Reactions

- **Secondary Formation**: PM2.5 can also form in the atmosphere through chemical reactions involving gases like sulfur dioxide and nitrogen oxides, which are emitted from various sources, including power plants and vehicles.