Department for Environment, Food and Rural Affairs

Call for Evidence on Domestic Burning of House Coal, Smokeless Coal, Manufactured Solid Fuel and Wet Wood

Evidence background documentation

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Introduction

This document supports the Call for Evidence on Domestic Burning of Wet Wood and Coal which seeks information on a number of factors associated with domestic burning practices, for example: what fuel is used, how frequently people burn and what appliance, if any, is used. This background information sets out the government evidence in this area so far and highlights the areas where we would welcome further evidence.

What is Particulate Matter?

Particulate Matter (PM) is made up of airborne solid and/or liquid particles, which have an impact on health and the environment. These are commonly classified according to size, either as PM_{10} (particles of ≤10μm diameter) or $PM_{2.5}$ (particles of ≤2.5μm diameter - 200 times smaller than a grain of sand).

PM can be further classified into primary particles, which are emitted directly from sources, and secondary particles formed in the atmosphere by chemical reactions. Some PM is a mixture of both, for example, soot, which is made up from primary emissions from fires, which are then covered by a secondary coating made up of emissions from other sources.

Some particulate matter is from natural sources, like sea spray, but much of the particulate matter in our air is formed by human activity, like solid fuel burning, industrial processes, farming or transport.

Particulate matter (in particular, $PM_{2.5}$) is the air pollutant that causes the greatest harm to human health in Europe. The World Health Organisation (WHO) advises that there is no safe level and therefore all actions to reduce $PM_{2.5}$ levels will have a positive impact on health.

Particulate pollution from domestic burning – the bigger picture

Particulate pollution in the UK has dropped significantly since measurement began in 1970. One of the sectors which has been responsible for the drop is domestic combustion (pale green below). Much of this is the result of the Clean Air Act, which allowed Local Authorities to declare a smoke control area, in which it is an offence to burn coal, or supply it for use, along with more efficient stoves and an increasing proportion of homes connected to the gas grid.

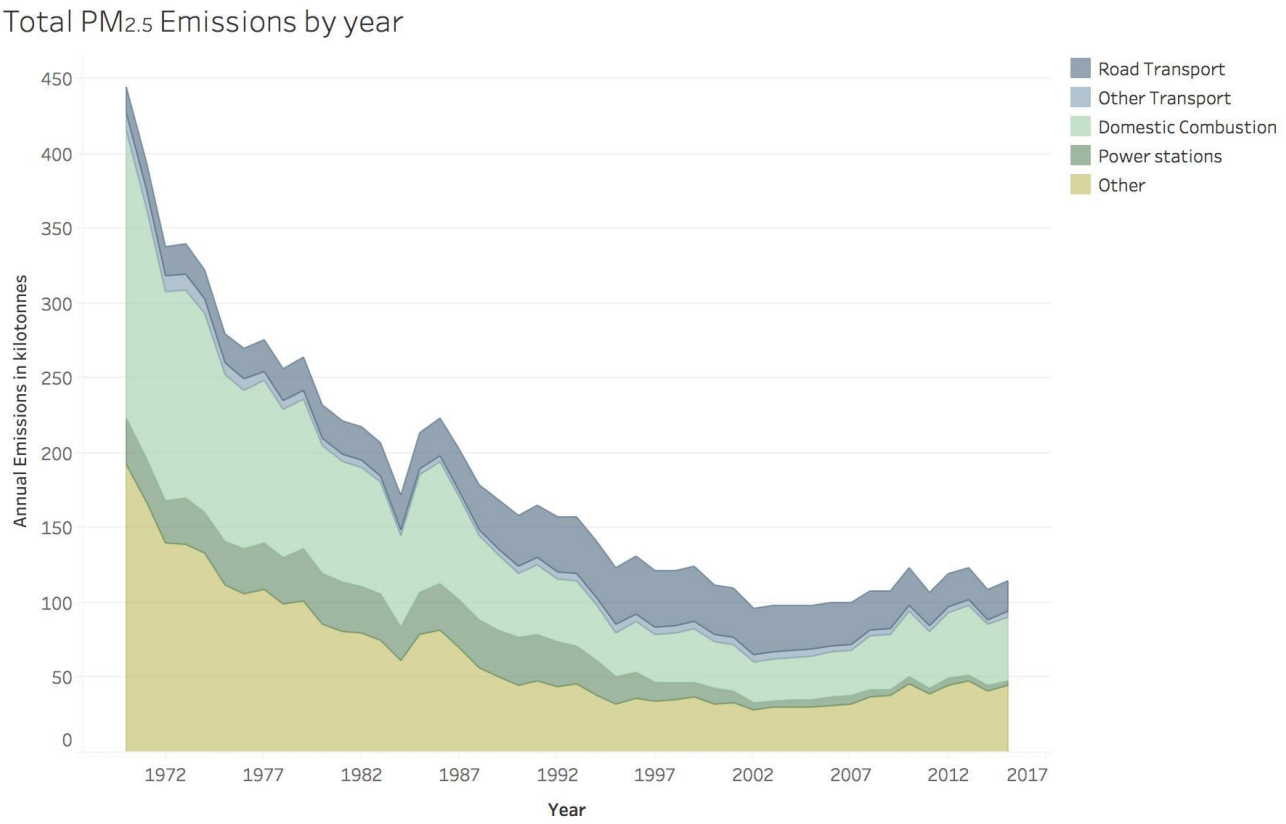


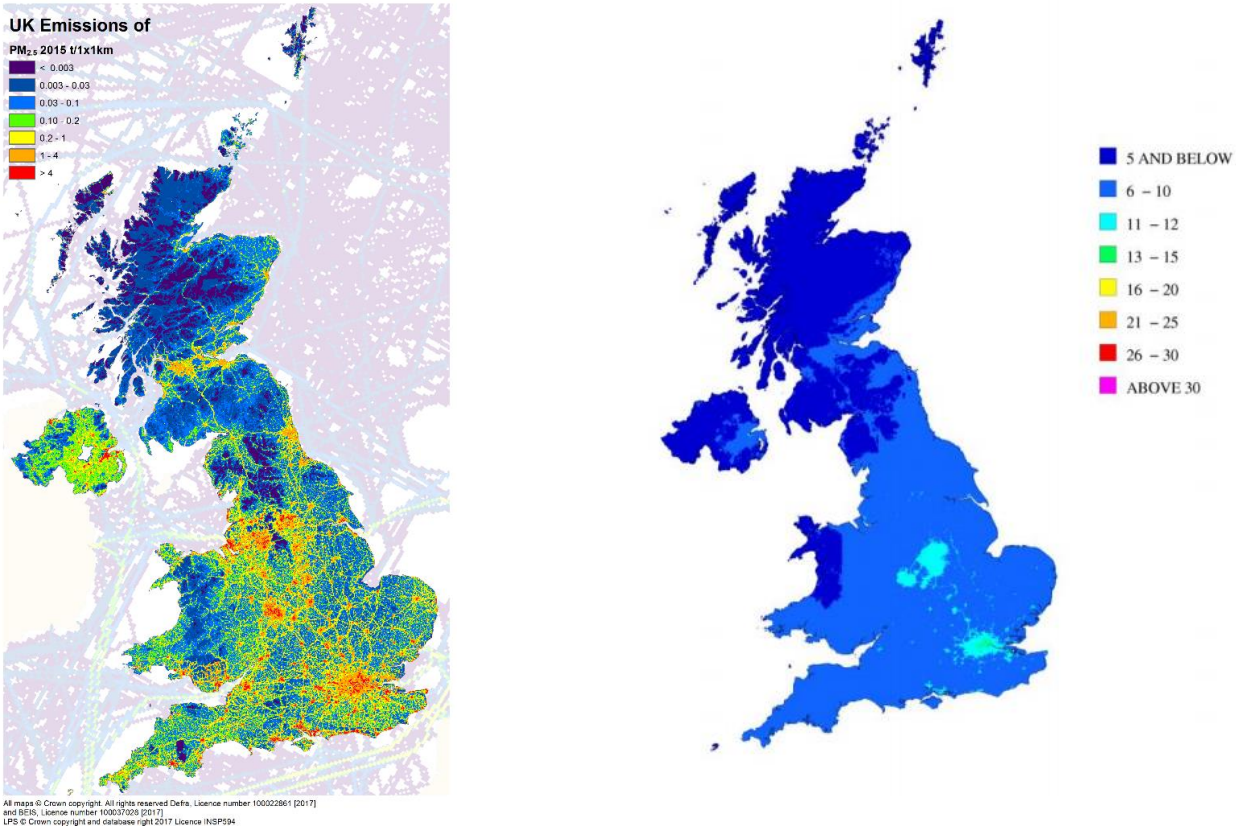
Figure 1 – Total $PM_{2.5}$ emissions from all UK sectors by year. The Domestic Combustion category is made up of emissions from all solid fuels burned in the domestic sector, not just wet wood and coal. Source: NAEI 2015

Despite this long term downward trend, since 2005 we have begun to see an increase in emissions from the domestic sector, as shown in Figure 1. We believe this is largely down to an increase in the popularity of open fires and wood-burning stoves. A proportion of the fuel used is wet wood, which can have at least double the emissions of particulate matter compared to dry wood.

UK emissions from human activity contribute around 50-55% of total annual average $PM_{2.5}$ in the UK's air, while emissions from other countries contribute around 21-30%, with the remainder from natural sources or international shipping.[1] This means that international cooperation is essential to deliver widespread reductions. The largest contributions to the UK's particulate concentrations from overseas arise from European countries. Conversely, particulates emitted in the UK are blown to other countries in Europe and around the northern hemisphere more generally. The balance between "imported" and "exported" pollution can vary from year to year depending on meteorology. The UK is a signatory to the United Nations' Convention on Long-range Transboundary Air Pollution, which requires all signatories to reduce their emissions of harmful pollutants.

[1] *Mitigation of United Kingdom $PM_{2.5}$ Concentrations*, Air Quality Expert Group, 2015 https://uk-air.defra.gov.uk/assets/documents/reports/cat11/1508060903_DEF-PB14161_Mitigation_of_UK_PM25.pdf

Particulate matter is emitted across the UK, as shown in Figure 2a. This includes significant emission in urban areas, where large numbers of people live, which significantly increases human exposure to those emissions. As a result of UK emissions and contributions from outside of the UK, concentrations of $PM_{2.5}$ vary as shown in Figure 2b. General features show higher concentrations in UK cities as well as higher concentrations to the South East of the UK reflecting the contributions from other European countries.



a b

Figure 2.
a) Map of $PM_{2.5}$ emissions across the UK in 2015. Source: NAEI 2015,
b) Annual mean concentrations of $PM_{2.5}$ in the UK 2016 (µg/m^3). Source: Air Pollution in the UK 2016.[2]

PM emissions from wood

Our evidence shows there is a very wide variation in emissions from experiments examining wood burning, with a wide range of factors influencing the amount of pollution which is produced.[3,4] The two most significant factors that increase emissions of particulates are the moisture content of the wood and the appliance which is used (open

[2] Air Pollution in the UK 2016. https://uk-air.defra.gov.uk/library/annualreport/index
[3] Smoke Emission Measurements on Unseasoned Wood, Kiwa, 2015
[4] EMEP/EEA emission inventory guidebook, 2013

fire, stove etc). Some stoves are approved by Defra for use in a smoke control area and are proven to emit lower levels of particulate matter. The stove industry has also launched the Ecodesign-ready brand, which is applied to stoves with emissions low enough to meet the Ecodesign provisions from 2022.

Modern stoves circulate air within them in a way which significantly increases the efficiency of the combustion process, resulting in a cleaner burn than open fires, which reduces $PM_{2.5}$ emissions by up to nine times compared to an open fire[5]. In open fires, the air flow is largely uncontrolled and this increases the extent of incomplete combustion – increasing the PM emissions and reducing the heating efficiency, because so much heat is lost directly up the chimney – as much as 85% in some cases.

When trees are felled, they contain as much as 70% water, depending on the species. When wood is burned with a high moisture content, the particulate emissions are far higher than when it is burned dry. The heat output is also significantly reduced and the partially combusted wood smoke builds up on the inside of the stove and chimney, which increases the risk of chimney fires.

Wood volumes

It is challenging to accurately assess the amount of wood which is burned in domestic settings in the UK. This is largely because of the highly diverse supply chain with wood easily accessible to many households without needing to go to a retailer, for example, from gardens or common land. Attempts have been made to quantify the amount of wood burned in the UK; in 2015 the Department for Energy and Climate Change (DECC), now part of the Department of Business, Energy and Industrial Strategy (BEIS), carried out a survey to quantify wood use in the UK[6]. The results of the survey suggest that up to 6 million tonnes of wood (depending on the method of calculation) are burned every year.

Evidence from the Forestry Commission and anecdotal evidence from the wood industry put this figure more in the region of 3 million tonnes, once offcuts from the manufacture of furniture and other timber products are taken into account. More evidence is required in this area.

In addition to the uncertainty around the total volume of wood, there is also very limited data on the moisture content of wood when it is burned. Estimates from the wood industry suggest that around 80% is burned wet; but other sources such as the domestic wood use survey run by BEIS suggest a much lower proportion – possibly as low as 20%.

[5] EMEP/EEA emission inventory guidebook, 2013
[6] https://www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey

Sulphur content of solid fuels

At present, there is a 2% limit on the sulphur content of a fuel for it to be authorised for use within a smoke control area. Solid fuel destined for burning outside these areas has no limit. Anecdotal evidence suggests that the drop in the price of crude oil has made it economically viable to import high-sulphur petroleum coke for the manufacture of solid fuels. These fuels may have up to 6% sulphur content.

When sulphur is burned, it forms sulphur dioxide (SO_2), another regulated pollutant which the Government is legally bound to keep below emission limits as well as meeting ambient limit values. It is harmful to human health and the environment, particularly in the formation of so-called acid rain, but also by contributing to secondary particulate formation.

Combustion of solid fuels can also be responsible for the release of other pollutants such as polycyclic aromatic hydrocarbons (PAHs) and heavy metals that are damaging to health and the environment.

Currently, anthracite; a form of naturally mined, high-purity coal, is authorised for use in smoke control areas. This is because it produces lower levels of particulate matter when burned than bituminous, or “house” coal. The emissions of carbon dioxide from anthracite, however, are higher than from house coal, or other solid fuels approved for use in smoke control areas. We are not currently seeking more evidence on anthracite.

Recent additions to our evidence base

We have been working to develop our understanding of both the emissions from domestic wood burning as well quantifying the impacts in UK towns and cities. The UK’s Air Quality Expert Group (AQEG) reviewed the potential impacts of biomass on UK’s air quality and the report is available here: https://uk-air.defra.gov.uk/library/reports?report_id=935.

AQEG made the following overarching recommendations:

Assessing the impacts of biomass burning on UK air quality requires action to:

- *Improve long term ambient measurements of biomass combustion tracers;*
- *Reduce uncertainties in inventory estimates particularly around small-scale burning, including the assessment of real world emissions.*

We are today publishing two further reports that advance our understanding in both of these areas: the measurement of emissions from wood burning stoves and a measurement study reporting the impact of domestic wood burning on UK air quality.[7] By continuing to develop our evidence base we have been able to improve our mapping of $PM_{2.5}$ emissions in the UK and new maps have been published and can be explored as interactive maps.[8] These updated maps have been used as part of our annual assessment

[7] https://uk-air.defra.gov.uk/library
[8] http://naei.beis.gov.uk/data/gis-mapping

of air quality in the UK the results of which are reported in the Air Pollution in the UK report.[2]

Areas where we would welcome further evidence

- Evidence that we have seen to date suggests that emissions from wet wood are at least double the emissions from dry wood. Further evidence and accompanying data would be welcome.
- It has been suggested that there is a large degree of variation in emissions based on how a fire is lit, for example the way the logs are placed on to the fire. This lack of reproducibility makes it difficult to derive a robust emission factor.
- Data on how many people use wet vs. dry wood are not readily available. This is partly because of the ease with which the public can collect their own wood for burning, and partly because wood can be bought wet and then stored until it is dry.
- Estimates of the total amount of wood which is burned in the UK vary considerably.
- Limited data on the prevalence of domestic bonfires are available, with the last assessment of activity carried out in 2010. Additionally, evidence on what is burned is limited. Increased air pollution is sometimes measured following events like bonfire night, but this is highly variable and dependent on a number of factors, including wind speed and wind direction.