National Atmospheric Emissions Inventory

Air Pollutant Inventories for England, Scotland, Wales, and Northern Ireland: 2005-2022

Prepared by Aether Ltd for the Department for Environment, Food & Rural Affairs, The Scottish Government, The Welsh Government and The Northern Ireland Department for Agriculture, Environment and Rural Affairs.

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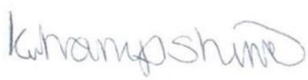


Table of contents

List of figures

List of tables

Glossary

AIS	Automatic Identification System
AQEG	Air Quality Expert Group
NH_3	Ammonia
B[a]P	Benzo[a]pyrene
BAT	Best Available Techniques
BATC	Best Available Techniques Conclusion
BEIS	Department for Business, Energy & Industrial Strategy
BOFA	Boosted Over Fire Air
BSFP	British Survey of Fertiliser Practice
CAA	Civil Aviation Authority
CO	Carbon monoxide
CCGT	Combined Cycle Gas Turbine
CLRTAP	Convention on Long-Range Transboundary Air Pollution
COMEAP	Committee on the Medical Effects of Air Pollutants
Defra	Department for Environment, Food & Rural Affairs
DA	Devolved Administration
DAERA	Department of Agriculture, Environment and Rural Affairs of Northern Ireland
DERV	Diesel engine road vehicle
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
DFPNI	Department of Finance and Personnel, Northern Ireland
DRD	Northern Ireland Department for Regional Development
DUKES	Digest of UK Energy Statistics
DVLA	Driver and Vehicle Licensing Agency
EEMS	Environmental and Emissions Monitoring System
EMEP	European Monitoring and Evaluation Programme
EPR	Environmental Permitting Regulations
E-PRTR	European Pollutant Release and Transfer Register
ETS	Emissions Trading System
EU ETS	EU Emissions Trading System
EC	European Commission
EEA	European Environment Agency
EU	European Union
FGD	Flue-gas desulphurization
GCV	Gross calorific value
GHG	Greenhouse Gas
GDP	Gross Domestic Product
HCB	Hexachlorobenzene
Hg	Mercury
HFO	Heavy Fuel Oil
I-TEQ	International Toxic Equivalents
IDBR	Inter-Departmental Business Register
IED	Industrial Emissions Directive
IIR	Informative Inventory Report
IMO	International Maritime Organisation
IPPC	Integrated Pollution Prevention and Control
ISSB	Iron and Steel Statistics Bureau
LCPD	Large Combustion Plant Directive

LDV	Light duty vehicles
LDZ	Local Distribution Zone
LOSP	Light Organic Solvent Preserved Timber
LPG	Liquefied Petroleum Gas
LA	Local Authority
MDO	Marine Diesel Oil
MMO	Marine Management Organisation
MSW	Municipal solid waste
MPA	Mineral Products Association
NAPCP	National Air Pollution Control Programme
NAQS	National Air Quality Strategy
NAEI	National Atmospheric Emissions Inventory
NCV	Net Calorific Value
NECD	National Emissions Ceiling Directive
NECR	National Emissions Ceilings Regulations
NHS	National Health Service
NIEA	Northern Ireland Environment Agency
NO_X	Nitrogen oxides
NFR	Nomenclature for Reporting
NMVOC	Non-methane volatile organic compounds
NRMM	Non-road Mobile Machinery
NRW	Natural Resources Wales
ONS	Office for National Statistics
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
PAHs	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCDD/Fs	Dioxins and furans [polychlorobenzodioxins (PCDDs) and polychlorodibenzofurans (PCDFs)]
PCP	Pentachlorophenol
PI	Pollution Inventory
$PM_{2.5}$	Particulate matter less than 2.5 micrometres
PM_{10}	Particulate matter less than 10 micrometres
POPs	Persistent Organic Pollutants
PRODCOM	UK Manufacturers' Sales by Product
PRTR	Pollutant Release and Transfer Register
PSEC	Public Sector Energy Campaign
REM	Rail Emissions Model
RIDB	Regulator Inventory Database
SED	Solvent Emissions Directive
SEPA	Scottish Environment Protection Agency
SI	Statutory instrument
SO_2	Sulphur dioxide
SSF	Smokeless Solid Fuels
UK	United Kingdom
UKCEH	United Kingdom Centre for Ecology and Hydrology
UNECE	United Nations Economic Commission for Europe
WID	Waste Incineration Directive
UNECE	United Nations Economic Commission for Europe
WHO	World Health Organization
WID	Waste Incineration Directive

WHO	World Health Organization

1 Introduction

This report presents air pollutant emissions inventories for England, Scotland, Wales, and Northern Ireland (collectively England and the Devolved Administrations), for the period 2005 to 2022 for the following priority pollutants:

- Ammonia (NH_3)
- Carbon monoxide (CO)
- Nitrogen oxides (NO_X as NO_2)
- Non-methane volatile organic compounds (NMVOCs)
- Particulate matter less than 10 micrometres (PM_{10})
- Particulate matter less than 2.5 micrometres ($PM_{2.5}$)
- Sulphur dioxide (SO_2)
- Lead (Pb)

These inventories are compiled on behalf of the UK Department for Environment, Food & Rural Affairs (Defra), the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs (DAERA) for Northern Ireland, by the UK emission inventory teams at Aether, Ricardo, ADAS, Rothamsted Research, and the UK Centre for Ecology & Hydrology (UKCEH).

In addition to the above suite of air pollutants, for which source data and inventory methods are well-established, experimental inventory statistics are presented in **Appendix C** for emissions of (i) dioxins and furans (PCDD/Fs), (ii) benzo[a]pyrene (B[a]P), and (iii) mercury (Hg). These are priority toxic pollutants, for which emission estimates are within the scope of UK inventory submissions under the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The inventories for B[a]P and PCDD/Fs were presented for the first time in the 1990-2017 inventory. The data quality at the sub-national level is such that the PCDD/F and B[a]P inventory data continue to be regarded as experimental statistics at this stage. The inventory for Hg was presented for the first time in the 1990-2019 inventory. Similarly, the data quality at the sub-national level means that these emissions estimates should be regarded as experimental statistics only. Further work is needed to improve the quality of England and the Devolved Administrations' estimates across the time series; see **Appendix C** for further details.

1.1 Background to Inventory Development

The development of air pollutant inventories (API) for England and each of the Devolved Administrations (DAs) has been commissioned by Defra to better inform policy-makers within the Devolved Administrations in their pursuit of objectives set by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland. These objectives also contribute to the UK's meeting both national and international targets on both local and transboundary air pollution. The UK Government published an Environmental Improvement Plan in January 2023, setting out actions it intended to take to move towards meeting statutory environmental targets. In July 2024, the Government announced a rapid review of this Plan, to ensure it is fit for purpose in delivering statutory environmental targets.

Provision of DA-level datasets and subsequent identification of key sources at more regional and local levels is crucial for the prioritisation of local action and to highlight the potential impacts of specific policies and measures. The time series of air pollutant emissions provides an insight into the effects of environmental policies and may help identify where policies could be pursued to achieve both Air Quality and Greenhouse Gas policy goals.

Further information on the background of the inventory development can be found in **Appendix A**.

1.2 About the Air Pollutants

Each of the priority air pollutants for which DA inventories are calculated is briefly described below. Further information can be found on the NAEI website: https://naei.energysecurity.gov.uk/air-pollutants, which includes an overview of the health impacts of these pollutants.

- **Ammonia (NH_3)** emissions play a key role in several different environmental issues, including acidification, eutrophication, and changes in biodiversity. The atmospheric chemistry of NH_3 and ammonium (NH_4^+) is such that the transport of the pollutants can vary greatly. As a result, NH_3 emissions can both exert impacts on a highly localised level and contribute to the effects of long-range pollutant transport. Agriculture is the most important source of NH_3 within the UK, contributing to the majority of emissions across the time series. Emission estimates for non-agricultural sources are often uncertain since ammonia tends to originate from diffuse sources, leading to a lack of activity and emission factor data.

- **Carbon monoxide (CO)** arises primarily from incomplete fuel combustion and industrial processes. CO is of concern mainly due to its toxicity and its role in tropospheric ozone formation. In terms of human health, CO combines with haemoglobin in the blood, decreasing the uptake of oxygen by the lungs, with symptoms varying from nausea to asphyxiation depending upon the level of exposure.
- **Nitrogen oxides (NO_X)** emissions arise primarily from combustion sources. Estimating these emissions is complex since the nitrogen can be derived either from the nitrogen contained within fuels or through the oxidation of atmospheric nitrogen at the high temperatures associated with combustion engines. The emissions rate depends on combustion conditions, particularly temperature and the relative proportions of air-fuel in a combustion chamber, which can vary considerably. Thus, combustion conditions, engine load, and state of engine maintenance are important. Studies into the effects of exposure on human health suggest NO_X exacerbates respiratory illnesses and cardiovascular disease; however, due to NO_X often being co-emitted with several other pollutants, the quantification of health impacts from NO_X alone is complex (COMEAP, 2018).
- **Non-Methane Volatile Organic Compounds (NMVOCs)** are emitted to air from various sources across many industrial sectors, transport, agriculture, and the residential sector. They are emitted primarily as combustion by-products, as vapour arising from the transfer, storage and handling or use of petroleum distillates, or solvent or chemical use. The *Solvent and Other Product Use* sector comprises industrial and domestic solvent applications (such as cleaning, degreasing) and the manufacturing and processing of chemical products. NMVOCs are involved in the photochemical production of ozone and the formation of secondary aerosols in the atmosphere over a large spatial scale. However, the exact reactivity is dependent on the particular compound in question. Some NMVOCs also directly impact human health: benzenes and 1,3-butadiene are both carcinogens, for example.
- **Particulate matter** is a general term describing the size distribution of the solid and liquid particles emitted to air. Particulate matter is categorised into different size fractions: **PM_{10}** refers to particles with an aerodynamic diameter of fewer than 10 micrometres, whilst **$PM_{2.5}$** refers to particles with an aerodynamic diameter of fewer than 2.5 micrometres. In general, particulate matter in the atmosphere arises from primary and secondary sources. Primary sources are direct emissions of particulate matter into the atmosphere. They arise from a wide range of sources such as fuel combustion and mechanical break-up in, for example, quarrying and construction sites. Particulate matter may be formed in the atmosphere through reactions of other pollutants such as SO_2, NO_X and NH_3 to form solid sulphates and nitrates, as well as organic aerosols formed from the oxidation of NMVOCs. These are known as secondary sources. These inventories only consider primary sources. For further information on secondary particulates, see the Air Quality Expert Group (AQEG) Report on particulate matter in the United Kingdom (AQEG, 2005) and fine particulate matter ($PM_{2.5}$) in the United Kingdom (AQEG, 2012).
- **Sulphur dioxide (SO_2)** emissions commonly arise from combustion. They can be calculated from the sulphur content of the fuel and information on the amount of sulphur retained in the ash. Inventory estimates are produced using UK energy statistics, information on the sulphur content of liquid fuels, and data on the sulphur content of coal from coal suppliers. SO_2 has long been recognised as a pollutant because of its role, along with particulate matter, in winter-time smog formation and the creation of acid rain. Studies indicate that SO_2 causes nerve stimulation in the lining of the nose and throat. This can cause irritation, coughing and a feeling of chest tightness, which may cause the airways to narrow. People who have asthma are considered to be particularly sensitive to SO_2 concentrations.
- **Lead (Pb)** is a very toxic element and can cause various symptoms at low concentrations. Lead dust or fumes can irritate the eyes on contact and irritate the nose and throat on inhalation. Acute exposure can lead to loss of appetite, weight loss, stomach upsets, nausea and muscle cramps. High levels of acute exposure may also cause brain and kidney damage. Chronic exposure can affect the blood,

kidneys, central nervous system and vitamin D metabolism. Emissions prior to 1999 arose primarily from the combustion of leaded petrol. The lead content of petrol was reduced from around 0.34 g/l to 0.143 g/l in 1986. From 1987, sales of unleaded petrol increased, particularly due to the increased use of cars fitted with three-way catalytic converters that are incompatible with leaded petrol due to catalyst poisoning. Leaded petrol was then phased out from general sale at the end of 1999. These changes have caused a significant decline in total lead emissions across the UK between 1990 and 2000. UK-wide Pb emissions now primarily originate from combustion sources (mainly of solid fuels, biomass, and lubricants in industrial and residential sectors, and metal production processes at foundries and iron and steelworks).

1.3 Data Sources and Inventory Methodology

The England and Devolved Administrations' inventories are compiled by disaggregating the UK emission totals presented within the Annex I template[1] that has been compiled using the methodologies set out in the IIR[2] (Elliot, et al., 2024).The emission estimates for each pollutant are presented in this report in Nomenclature for Reporting (NFR) format to be consistent with the UK inventory submissions to the United Nations Economic Commission for Europe (UNECE), which follow international inventory reporting guidelines. Emission estimates at the national level are made using direct emission measurements (e.g. for industrial point sources) or by combining activity data with a mixture of country-specific and default emission factors (EMEP/EEA Guidebook, 2019). These are known as 'bottom-up' and 'top-down' approaches, respectively.

The method for disaggregating UK emission totals across England and the Devolved Administrations (DAs) draws on a combination of point source data (e.g. . Pollution Inventory[3] data for industrial emissions) and sub-national datasets such as:

- DESNZ sub-national statistics on energy use;
- Other regional energy use data for specific industries or regional data on raw material consumption or sector-specific production;
- Data on vehicle kilometres travelled;
- Domestic and international flight data from each major UK airport;
- Regional housing, employment, population, and economic data;
- Agricultural surveys (livestock numbers, crop production, fertiliser application);
- Land use survey data.

Disaggregated emission estimates are only published when they can be directly attributed to the constituent countries. Therefore, emissions from offshore oil and gas installations and the vessels servicing them are excluded from the reported totals and accompanying dataset. In 2022, this 'unallocated' proportion of the UK inventory total was 4% of the UK total for NMVOCs, 6% for NO_X, 2% for CO, and 1% for SO_2, PM_{10} and $PM_{2.5}$. The 'unallocated' proportion of the UK inventory was zero or negligible for the remaining pollutants. For this reason, the sum of the DA total emissions for these pollutants do not match the published UK national totals. Further information on the data sources and inventory methodology can be found in **Appendix B**.

1.4 Uncertainties

Uncertainties in the UK inventory are associated with the availability and quality of activity data, emission factors, and the methodologies used in emissions calculations throughout the time series. These uncertainties are quantified using a Tier 1 uncertainty aggregation (or error propagation) method. The Tier 1 methodology investigates the impact of the assumed uncertainty of individual parameters (such as emission factors and activity statistics) upon the uncertainty in the total emission of each pollutant. The Tier 1 methodology and the

[1] https://naei.energysecurity.gov.uk/data

[2] 'UK Informative Inventory Report (1990 to 2022)' https://naei.energysecurity.gov.uk/reports/uk-informative-inventory-report-1990-2022

[3] The term "Pollution Inventory" is used here to represent the industrial emissions databases of the UK environmental regulators: The Environment Agency, the Scottish Environment Protection Agency, Natural Resources Wales and the Northern Ireland Environment Agency, which comprise annual emission estimates from all environmental permitting and regulation-regulated processes under their authority. The environmental permitting and regulation system for England and Wales is set out in the Environmental Permitting (England and Wales) Regulations 2016; the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 for Northern Ireland; and the Environmental Authorisations (Scotland) Regulation 2018 for Scotland.

Monte-Carlo analysis result for the UK air pollutant inventory are presented in Chapter 1.7 of the IIR (Elliot, et al., 2024).

The air pollutant inventories for England and the Devolved Administrations are derived by disaggregating UK emissions across the four countries and the unallocated region, and so the UK-wide uncertainty is compounded by further uncertainty introduced by the methods developed to split emissions on a source-activity scale. The uncertainties associated with the air pollutant inventories for England and each of the DAs are quantified using a Tier 1 uncertainty aggregation approach, described in **Appendix E** and summarised in **Table 1**. In general, the NAEI is regarded as an international leader in terms of quality and accuracy, e.g. through the application of higher Tier methodologies, particularly for key sources, and a continuous improvement process.

Further commentary on the levels of uncertainty in data used to estimate the emission inventories of B[a]P, PCDD/Fs, and Hg is included in **Appendix C.3.2**.

Using the top row of **Table 1** as an example, PM_{10} emissions in England were 148 kt in 2005 with a 34% uncertainty (±50 kt), resulting in a range of 97 kt to 198 kt. In 2022, emissions were 100 kt with a 46% uncertainty (±46 kt), resulting in a range of 54 kt to 146 kt. From 2005 to 2022, there was a 32% reduction in emissions with a 6% uncertainty, corresponding to a decrease between 45 kt and 51 kt.

Table 1 - Total Tier 1 uncertainty values by pollutant split by region[4]

DA/Pollutant	Emissions			Estimated uncertainty		
	2005 (kt)	2022 (kt)	Trend (%)	2005 (%)	2022 (%)	Trend (%)
England						
PM_{10}	148	100	-32%	34%	46%	6%
$PM_{2.5}$	82	50	-40%	25%	41%	9%
SO_2	585	84	-86%	7%	23%	1%
NO_X	1290	456	-65%	7%	9%	2%
NMVOCs	896	502	-44%	13%	23%	5%
NH_3	193	174	-10%	21%	18%	11%
Pb (t)	167	108	-36%	56%	73%	6%
Scotland						
PM_{10}	19	10	-48%	33%	53%	8%
$PM_{2.5}$	12	5	-58%	25%	48%	11%
SO_2	100	7	-93%	11%	18%	1%
NO_X	203	76	-63%	12%	16%	3%
NMVOCs	180	144	-20%	18%	18%	4%
NH_3	36	31	-14%	28%	25%	5%
Pb (t)	15	8	-43%	72%	97%	11%
Wales						
PM_{10}	13	9	-33%	30%	44%	9%
$PM_{2.5}$	8	5	-40%	31%	50%	13%

[4] Note that CO emission uncertainties are not quantified in the UK air pollutant inventory, and as such, no Tier 1 approach is presented in the DA air pollutant inventories.

DA/Pollutant	Emissions			Estimated uncertainty		
	2005 (kt)	2022 (kt)	Trend (%)	2005 (%)	2022 (%)	Trend (%)
SO_2	64	14	-78%	11%	25%	3%
NO_X	106	41	-61%	11%	13%	3%
NMVOCs	64	42	-35%	23%	41%	9%
NH_3	22	23	2%	36%	36%	10%
Pb (t)	26	26	-1%	69%	97%	13%
Northern Ireland						
PM_{10}	8	7	-19%	52%	69%	12%
$PM_{2.5}$	5	4	-20%	39%	64%	19%
SO_2	29	13	-55%	16%	47%	7%
NO_X	63	29	-53%	15%	18%	5%
NMVOCs	42	35	-16%	40%	56%	8%
NH_3	30	32	6%	32%	31%	9%
Pb (t)	6	5	-24%	79%	84%	32%

2 Devolved Administrations' Air Pollutant Estimates

The following sections outline the emissions inventories for England and the Devolved Administrations, providing information on the trends and emission estimates for each of the eight air pollutants.

These sections include the following:

- **Figures presenting the inventory data**, showing the annual trend from 2005 to 2022 for each pollutant. These graphs are also disaggregated by sector, and further information on the categorisation used in these summaries relative to NFR code can be found in **Appendix G**.
- **Summary information on trends** is provided for each pollutant, highlighting the key reasons for the observed trend since 2005 and other notable aspects. This information is not guided by detailed statistical analyses but through the association of underlying trends in activity data with the visible trends in emissions.
- **Normalised trends** for all pollutants are graphically presented to enable pollutant comparison. This normalised graph provides information on the relative rate at which all pollutants have declined across the time series, with 2005 emissions as the base value (equal to 1).
- **Mapped emissions** for all pollutants are also provided to show the geographical disaggregation of each pollutant. This helps the reader to identify substantive areas for emissions and the spatial patterns associated with that pollutant. For example, NO_X emissions are concentrated around the road networks of the countries.
- **Sectoral contribution matrix** provides an overview of the importance of each sector for each pollutant. For example, the transport sector accounts for a considerable proportion of CO, NO_X and PM_{10} emissions in some regions. This is another way in which the pollutants can be compared.

2.1 England

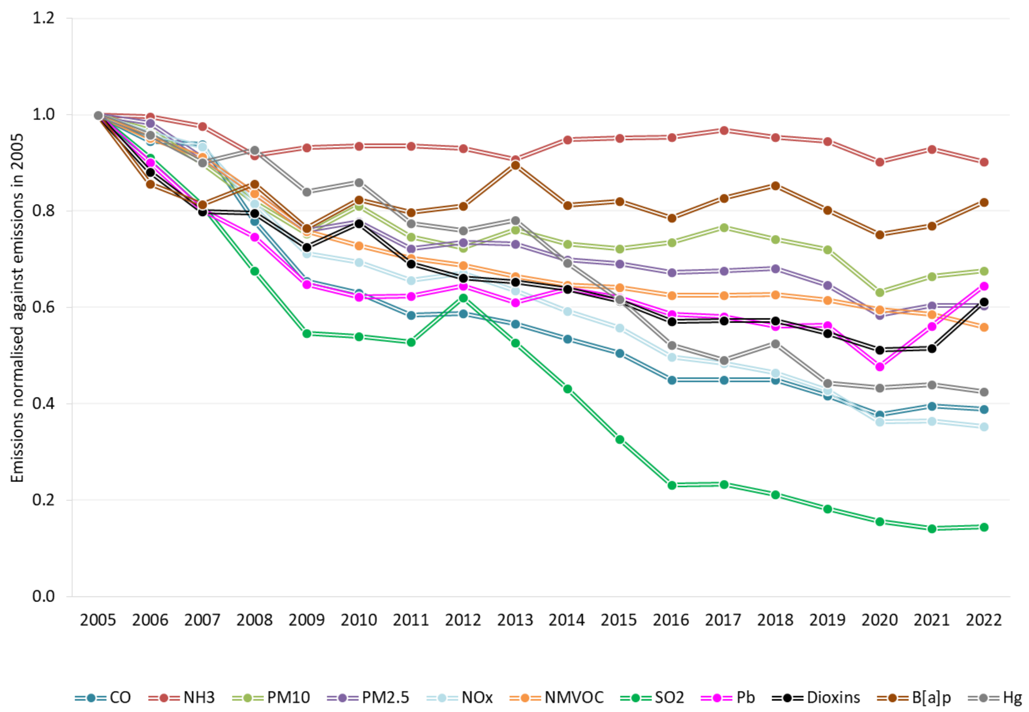
The following section summarises emissions in England for the eight priority air pollutants: NH_3, CO, NO_X, NMVOCs, PM_{10}, $PM_{2.5}$, SO_2, and Pb. Information is also presented for emissions of PCDD/Fs, B[a]P, and Hg, with more detailed information for these three pollutants presented in **Appendix C.2**. Emissions of PCDD/Fs, B[a]P, and Hg should be considered as experimental statistics only[5]. **Appendix F** presents the inventory data summary tables for England and the DAs, whilst **Appendix G** presents source category mapping used in the report**.**

Figure 1 shows emissions of all eleven air pollutants normalised against the 2005 baseline to illustrate the relative trends since then. This graph shows that all pollutant levels are lower in 2022 than they were in 2005. The greatest rate of decline is observed in the trend for SO_2 emissions principally due to the reduction in coal use within the economy, with more modest declines observable for CO, NO_X, Hg, Pb, NMVOCs, and dioxins.

By contrast, NH_3 emissions have declined at a slower rate than other pollutants and have even risen between 2010 and 2017 before slowly decreasing again in recent years. A recent peak seen in 2021 was a result of dips in both 2020 and 2022. Due to poor weather in August 2019, winter wheat was not planted and fertiliser was not used on this crop in 2020 resulting in decreased NH_3 emissions in 2020. In 2022, NH_3 emissions have decreased slightly again as a result of a reduction in nitrogen fertiliser use. Emissions from B[a]P have increased in recent years, a trend principally dictated by increases in wood combustion in residential settings.

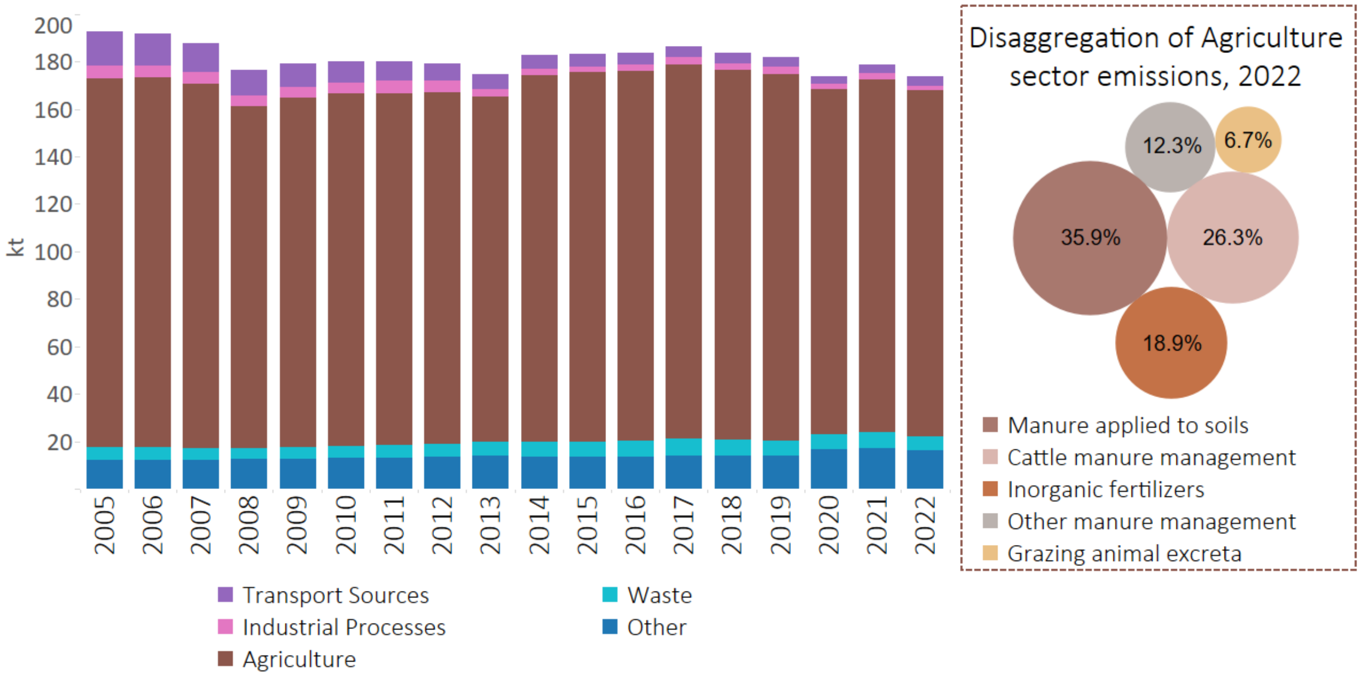
The emissions of several pollutants have increased in 2022 compared to 2021. The increase in emissions of lead seen from 2021 to 2022 is due to increases in emissions from steel production and firework use. The transport sector has also seen increases in emissions in 2022 due to increased transport usage during the recovery from COVID-19. This resulted in higher emissions in 2022 from domestic aviation, road transport and higher non-exhaust emissions from road transport (e.g. from brake wear affecting $PM_{2.5}$, PM_{10}, Pb and B[a]P). The increase in 2022 emissions of dioxins is a result of increased emissions from sinter production in the iron and steel sector.

Figure 1 – England normalised trends for all pollutants



[5] The statistics are considered experimental as they have been recently developed: the benzo[a]pyrene and dioxin inventories were first developed for the 1990-2017 inventory published in 2019, whilst the mercury inventory was first developed for the 2005-2019 inventory published in 2021. While the inventories and trends have been interrogated and to ensure the suitability of methods for the most important sources, it is recognised that data quality on a subnational level is generally poor. As a result, these statistics are currently considered experimental only, and require further work to evaluate the methods used, to identify alternative methods that are more suitable, and to reduce the uncertainty in the early part of the time series. More information on the inventory methods used for B[a]P, dioxins, and mercury is available in **Appendix C**.

Figure 2 – Ammonia Emissions in England

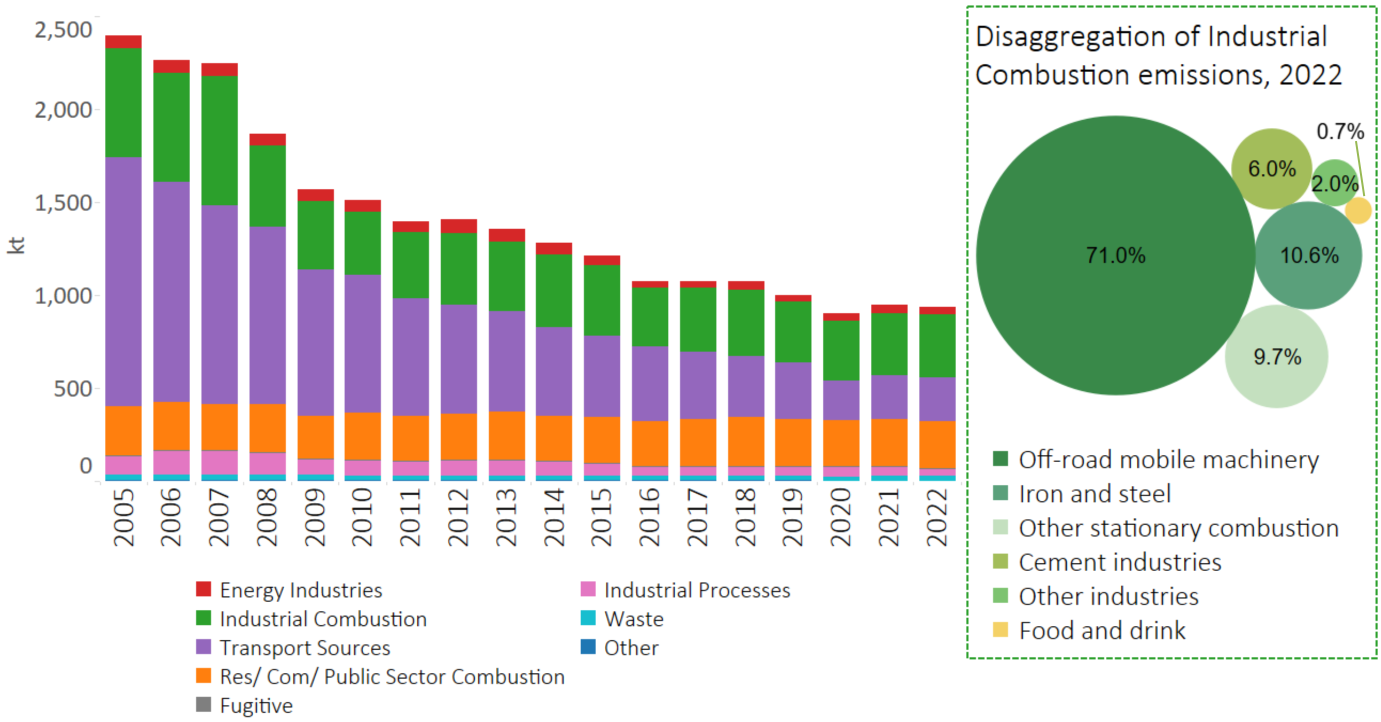


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of ammonia in England were estimated to be 174kt in 2022 and have declined by 9.7% since 2005. Emissions in England account for 67% of the UK total for ammonia in 2022. Agricultural sources make up by far the largest contribution to ammonia emissions in the inventory throughout the time series. In 2022, emissions from cattle manure management (NFR 3B1a, 3B1b) and animal manure applied to soils (NFR 3Da2a) each account for 22% and 21% of total emissions in England respectively, whilst inorganic fertilisers (NFR 3Da1) account for a further 16%. The initial trends in NH_3 emissions from 2005 were primarily driven by decreases in livestock numbers (except for poultry) and declines in the use of nitrogen-based fertilisers until 2010. After this point, the declines associated with these sources levelled out and even began to increase slightly. The increase in emissions since 2013 is primarily a result of increased application of urea-based and organic fertilisers such as digestate to agricultural soils.

In 2022, ammonia emissions decreased by 2.8% since 2021, primarily driven by the 7% decrease in inorganic fertiliser use.

Figure 3 – Carbon Monoxide Emissions in England[6]



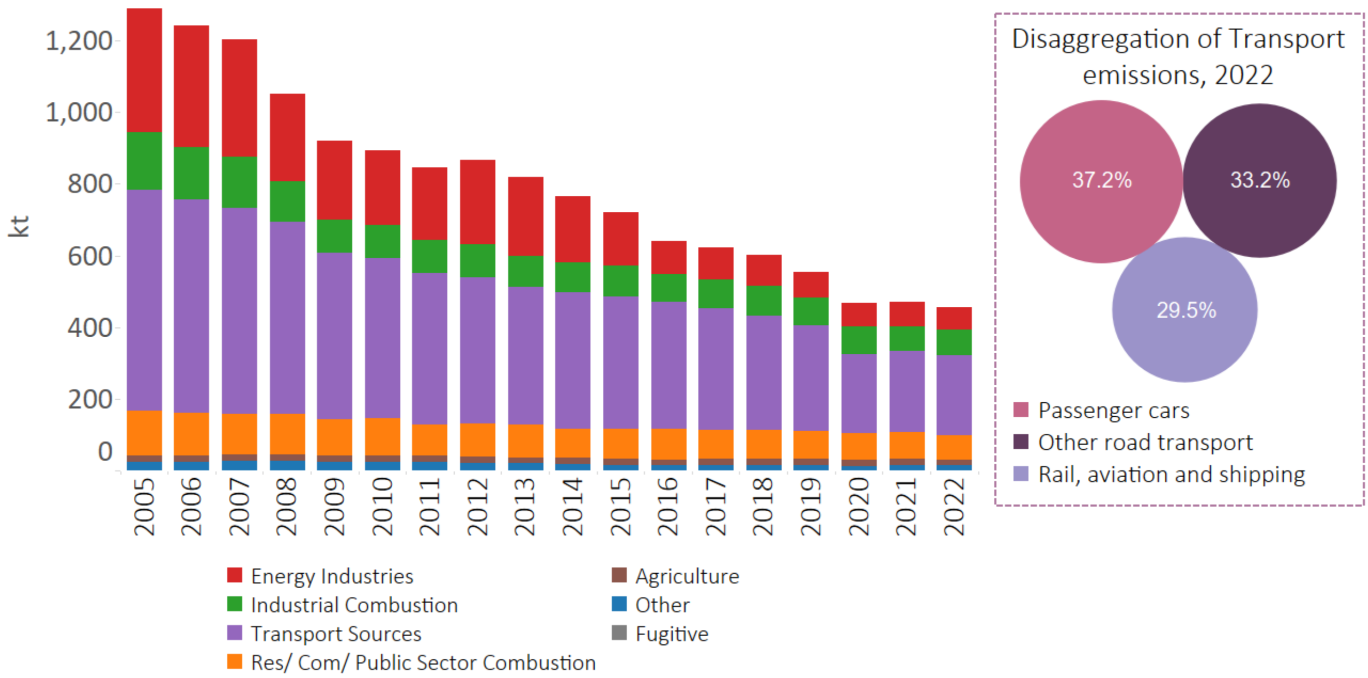
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of carbon monoxide in England were estimated to be 934kt in 2022 and have declined by 61% since 2005. Emissions in England account for 76% of the UK total for carbon monoxide in 2022. Historically, the decline in emissions is driven by trends from transport sources, particularly from the road sector, where there has been an 86% decrease in emissions since 2005 (contributing 74% of the overall CO trend for England). This decline is primarily due to the penetration of vehicles compliant with more recent Euro standards into the fleet, which required the fitting of emission controls (e.g. three-way catalytic converters) in new petrol vehicles. Improved catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles in 2008 also contribute to the trend. More recently, the switch from petrol cars to diesel cars, which have lower associated CO emissions rates, has also contributed to the observed trend.

In 2022, emissions decreased by 1.4% since 2021. The main sector driving this trend is road transport, which decreased by 4% between 2021 and 2022. In addition, public electricity and heat production (1A1a), decreased by 18.7% between 2021 and 2022, as a result of declining emissions from power stations.

[6] Other industries presented in the bubble graph relate to combustion emissions in the chemical, non-ferrous metals, pulp paper and print and other industries.

Figure 4 – Nitrogen Oxides Emissions in England

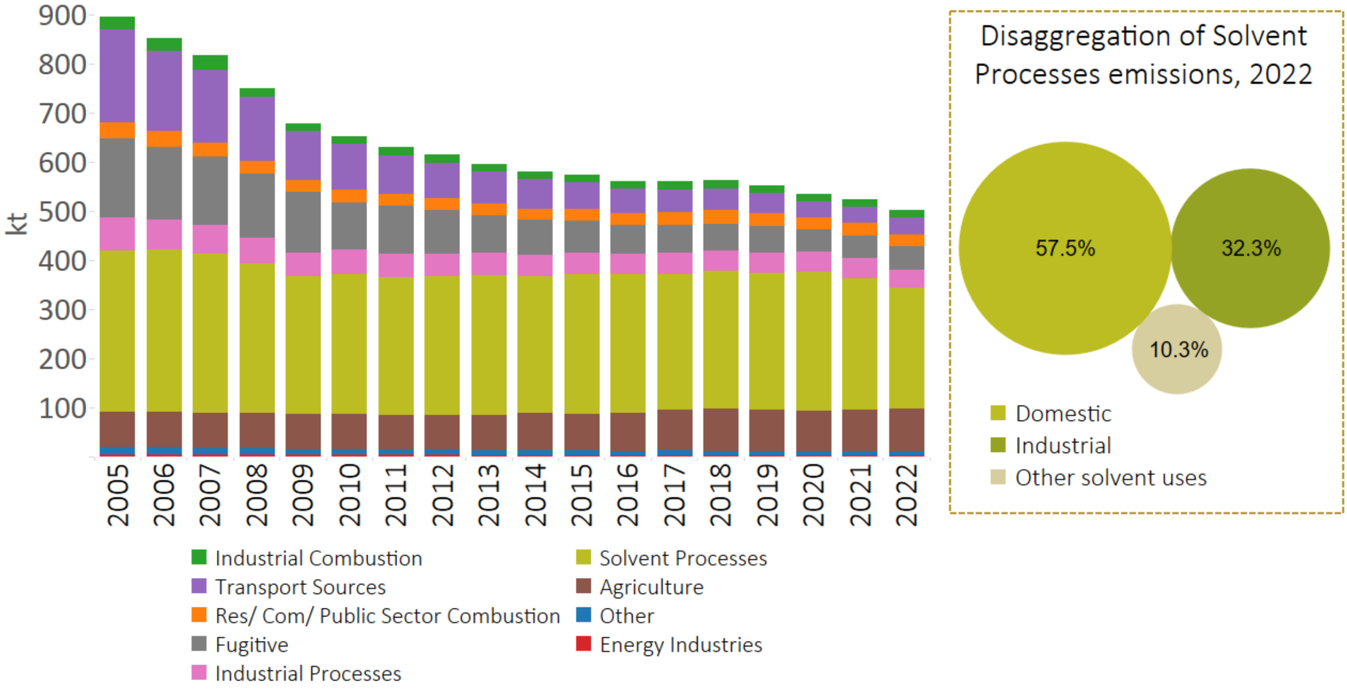


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of nitrogen oxides in England were estimated to be 456kt in 2022, representing 71% of the UK total for nitrogen oxides. Emissions have declined by 65% since 2005, mainly due to changes in transport sources, particularly in road transport (accounting for 69% of the overall trend in England's total nitrogen oxides emissions from 2005-2022). This decline is driven by the successive introduction of tighter emission standards for petrol cars and all types of new diesel vehicles over the past decade. Improved catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles in 2008 also contribute to the trend. However, more recently, the increasing number of diesel cars has offset these emissions reductions because diesel cars emit higher NO_X relative to their petrol counterparts. Emissions from energy industries (1A1a) have decreased by 83% since 2005, accounting for 31% of the overall NO_x trend. This reduction across the time series is due to shifts in the electricity generation fuel mix and uptake of efficient abatement technologies. For example, Boosted Over Fire Air (BOFA) systems have been utilised in coal-fired power stations since 2008. More recently, the accelerated phase-out of coal firing at power stations in favour of natural gas, and an increasing share of renewable energy generation (DESNZ, 2023b) has contributed to a 60% decline in overall NO_X emissions since 2015.

In 2022, nitrogen oxide emissions decreased by 2.9% since 2021. This is largely driven by a 3% decrease in emissions from road transport (1A3b).

Figure 5 – NMVOC Emissions in England

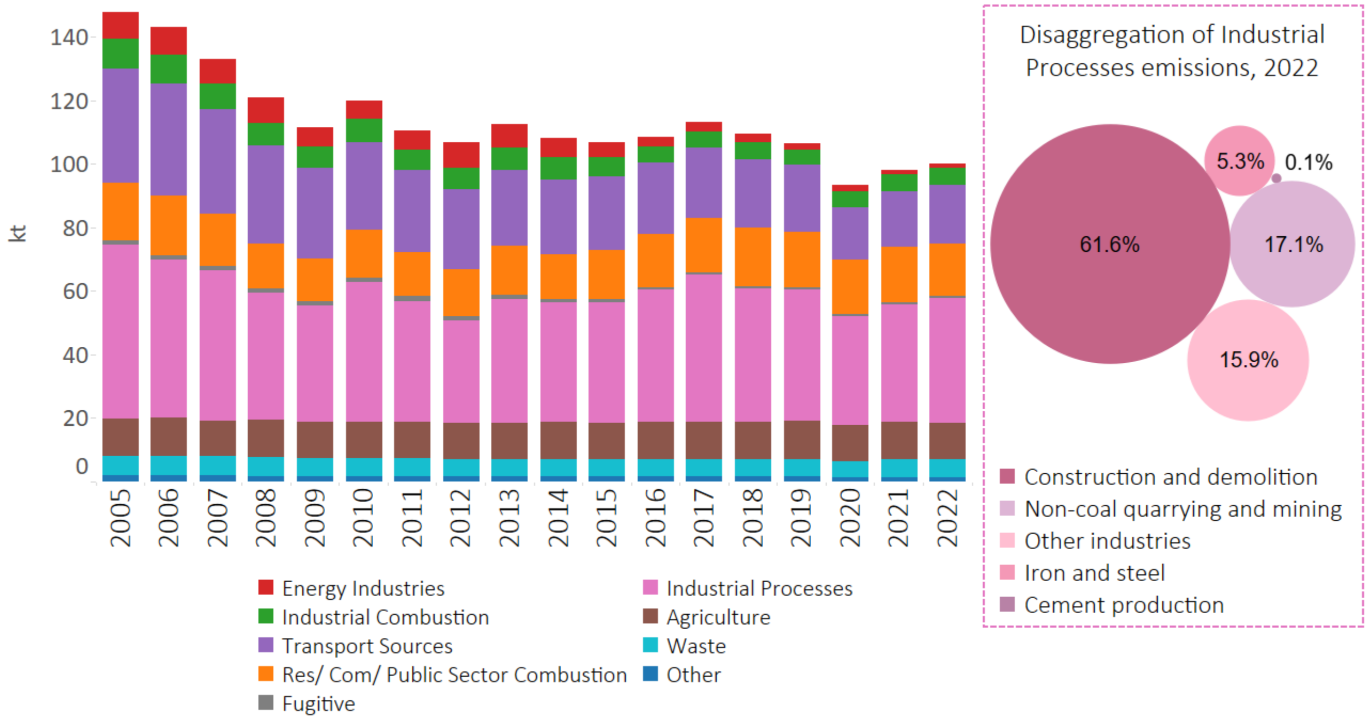


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of non-methane volatile organic compounds (NMVOCs) in England were estimated to be 502kt in 2022, representing 66% of the UK total for NMVOCs in 2022. Emissions have declined by 44% since 2005. The decline in emissions is driven by reductions in emissions from transport and fugitive sources. Emissions from road transport sources, including evaporative losses of fuel vapour from petrol vehicles, have declined over time due to emission control technologies introduced in new petrol vehicles since the early 1990s and continue to affect the observed trend since 2005. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. As such, emissions of NMVOCs from road transport sources (1A3b) have declined by 86% since 2005, contributing to 39% of the overall NMVOC trend. As a result, solvent processes are the most important source of NMVOC emissions, predominantly from solvent use in domestic and industrial settings. Emissions from this source (2D) have also been reducing, with a 25% decrease in emissions from solvent use since 2005, which contributes 21% of the overall NMVOC trend.

In 2022, NMVOC emissions fell by 4.3% since 2021. This is largely driven by a decrease of 8% in emissions from solvent use.

Figure 6 – PM_{10} Emissions in England[7]



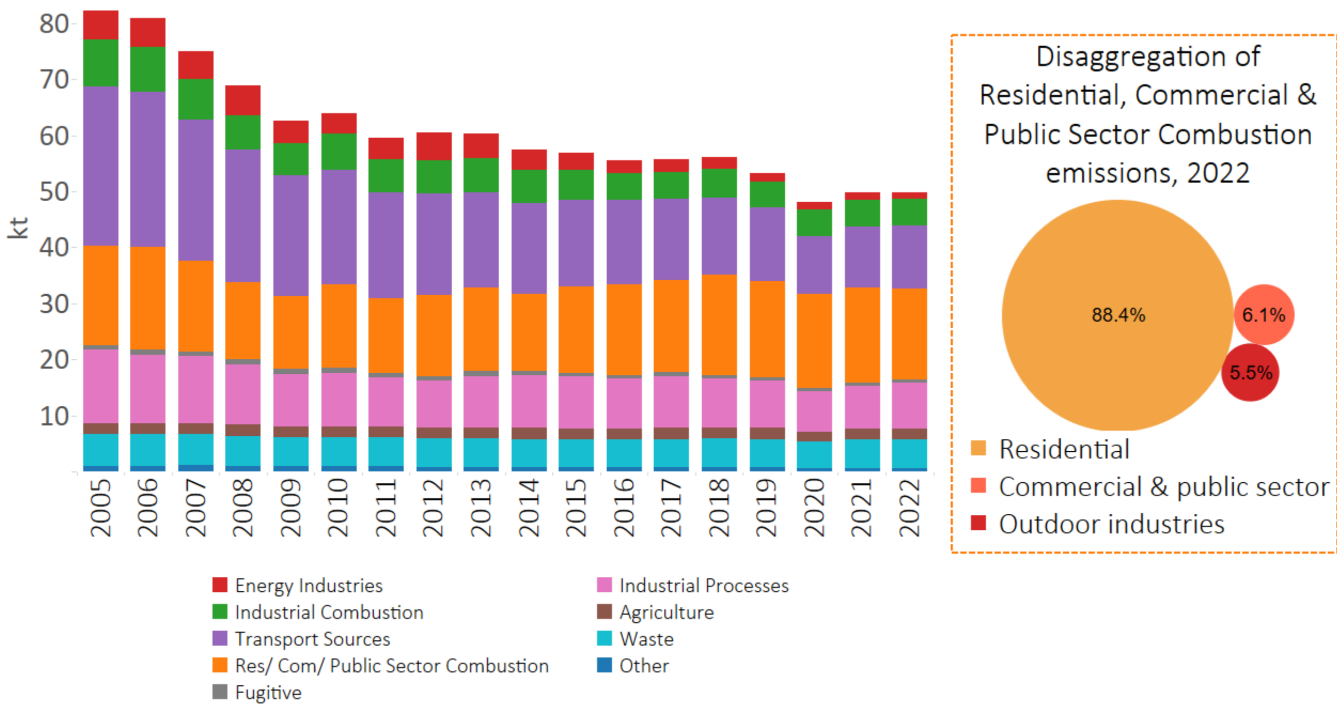
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of PM_{10} in England were estimated to be 100kt in 2022 and have declined by 32% since 2005. They accounted for 79% of the PM_{10} UK total in 2022. Unlike most other pollutants, the emissions profile of PM_{10} is diverse. In order of % contribution to emissions in 2022, these sources include: industrial processes (39%), transport sources (19%), residential combustion (15%), agriculture (11%), and industrial combustion (5%). PM_{10} exhaust emissions from diesel vehicles have been decreasing due to the successive introduction of tighter emission standards over time, causing a decline (48%) in the contribution of transport sources since 2005. However, since 2009, increased emissions from the combustion of biomass in other industries (i.e. NFR code 1A2gviii) and domestic wood combustion have offset reductions.

Emissions of PM_{10} have increased by 1.9% between 2021 and 2022, predominantly from transport and industrial processes for which emissions have increased by 5% and 6% respectively. However, emissions from residential sector (1A4b) decreased by 4% between 2021 and 2022 due to reduced coal and wood use.

[7] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Figure 7 – $PM_{2.5}$ Emissions in England[8]



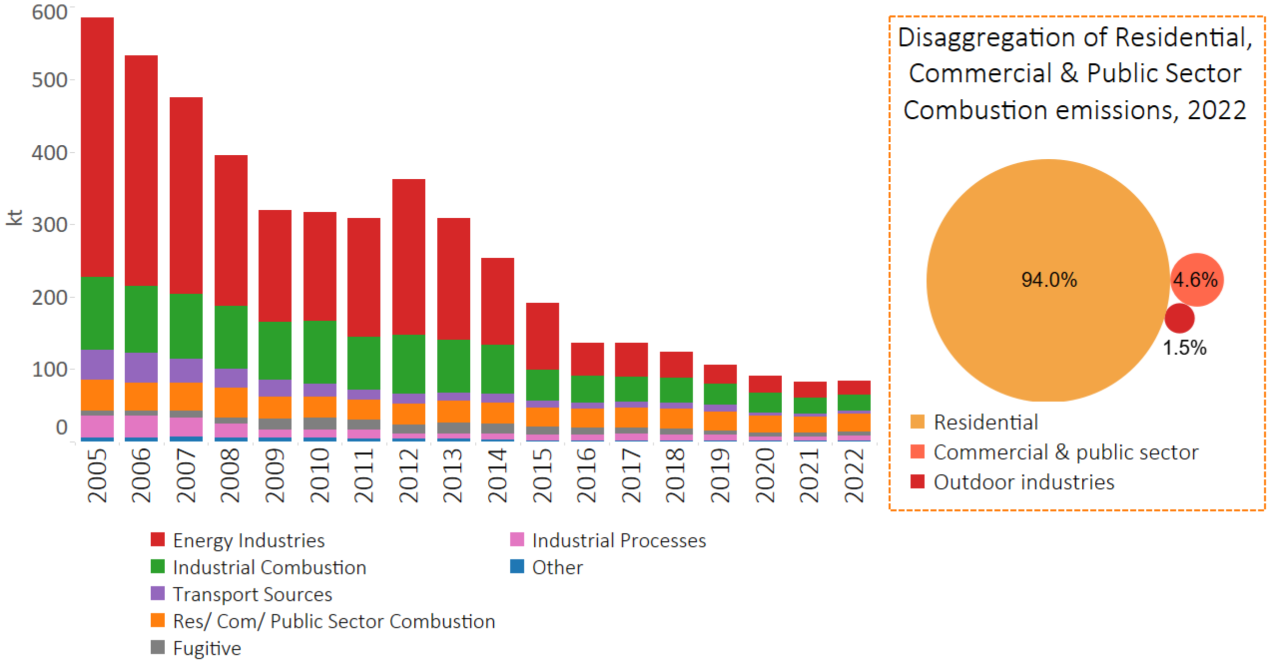
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of $PM_{2.5}$ in England were estimated to be 50kt in 2022 and have declined by 40% since 2005. Emissions in England account for 77% of the $PM_{2.5}$ UK total in 2022. As with PM_{10}, $PM_{2.5}$ emissions have a large number of significant sources. Since combustion tends to produce finer particles, emissions from these sources (e.g. energy industries, industrial combustion) are of greater importance for this size fraction compared to PM_{10}. For $PM_{2.5}$, the residential sector combustion category accounts for 29% of 2022 emissions. The primary drivers behind the UK-level decline in emissions since 2005 include the continued switch in the fuel mix used in electricity generation away from coal and towards natural gas, and reductions in emissions in the transport sector due to the introduction of progressively more stringent emissions standards through time. These reductions are partially offset by a 10% increase in emissions from residential combustion since 2005, with recent increases in wood combusted domestically principally behind this trend.

In 2022, there was no significant change in emissions from 2021. There was a 4% increase in $PM_{2.5}$ emissions from transport, although emissions have declined by 60% in this sector since 2005.

[8] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 8 – Sulphur Dioxide Emissions in England[9]



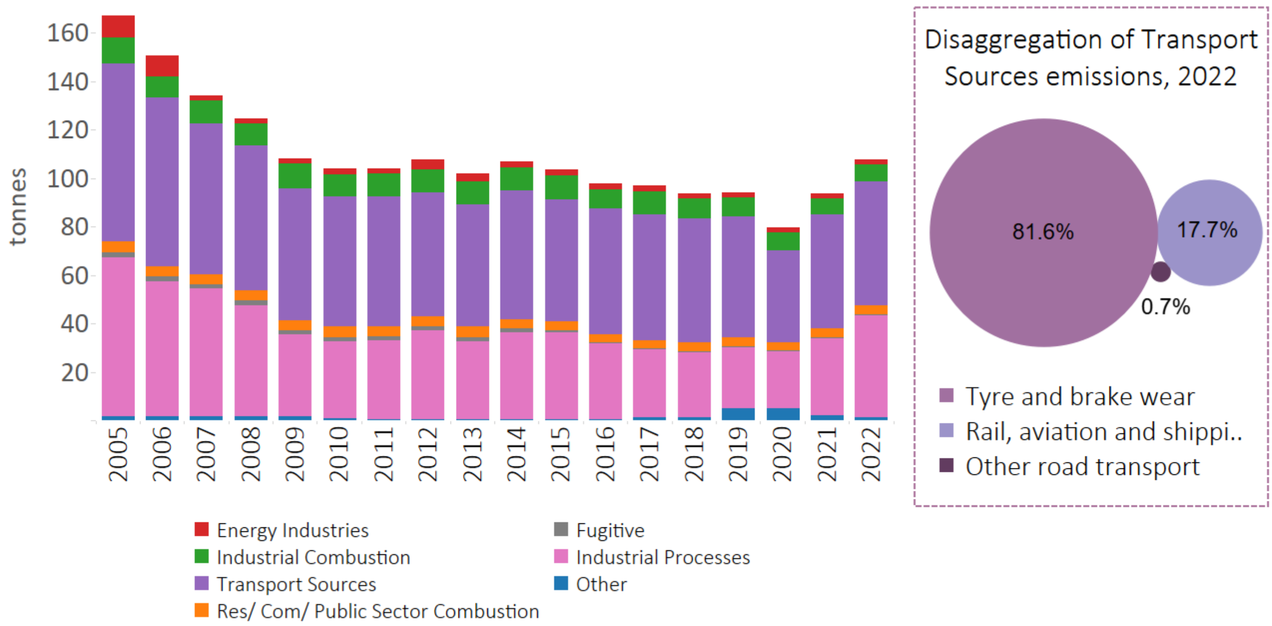
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of sulphur dioxide in England were estimated to be 84kt in 2022, representing 70% of the UK total for sulphur dioxide. Emissions have declined by 86% since 2005, which has been dominated by significant reduction in energy industries emissions, coincident with large changes in the power generation sector. These include the introduction of CCGT (Combined Cycle Gas Turbine) plants, which are more efficient than conventional coal and oil stations and have negligible SO_2 emissions; installation of flue gas desulphurisation at select power stations; and the rapid expansion of the renewable share of electricity generation (DESNZ, 2023b). The increase in emissions in 2012 was due to an increase in the use of coal in power generation relative to previous years (DESNZ, 2023b).

There was a 1.6% increase in SO_2 emissions in 2022 compared to 2021. In 2022, power stations (1A1a) contributed to 8% of the SO_2 emissions although, overall, emissions from this sector have decreased by 98% since 2005. Between 2021 and 2022, emissions from power stations decreased by 10.8%. Transport sources emissions have also declined, coincident with the reduced sulphur content of road fuels, both petrol and diesel. SO_2 emissions from residential combustion increased by 17% between 2021 and 2022, predominantly from shifts in modelled fuel use in fireplaces, stoves and boilers. Emissions from industrial combustion have declined by 78.8% since 2005, mainly due to a reduction in coal and fuel oil use in the chemicals sector and other industries.

[9] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 9 – Lead Emissions in England



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of lead in England were estimated to be 108 tonnes in 2022, representing 73% of the UK total for lead. Emissions have declined by 36% since 2005. The main contributors are road transport (39%) and iron and steel production (24%). Overall, emissions from the road transport sector (1A3b) have decreased by 2% since 2005, whereas the reduction of activities at iron and steelworks representing a 13% decrease in emissions since 2005. In 2019 and 2020, there is an increase in lead emissions from the 'Other' category. This is driven by variations in lead emissions associated with different aviation fuel types used in military aircraft at a UK level.

Between 2021 and 2022, lead emissions have increased by 14.7%. This is primarily driven by a 46% increase in emissions from steel production, which contributed to 58% to the trend between 2021 and 2022. In addition, there was a 6% increase in emissions from transport tyre and break wear (1A3bvi). This sector contributed 16% to the trend from 2021 to 2022.

Error! Reference source not found. below provides a summary of the percentage contribution of each sector for each pollutant in 2022. The table is shaded according to the overall contribution of that sector to the pollutant total, (with darker shades representing greater contribution). The table below indicates that the Residential, Commercial & Public Sector Combustion category is important for B[a]P, $PM_{2.5}$, SO_2, CO and PM_{10}, Dioxins, and NOx, accounting for at least 15% of emissions for each pollutant.

Fuel combustion is a major source of emissions, whilst Industrial Processes are also important, especially for emissions of Pb from the iron and steel industry. This table also highlights that although emissions from the agriculture sector are not significant when considering all pollutants, it is of very high significance when considering emissions of NH_3; the same is true for NMVOC emissions from Solvent Processes.

Table 2 - Source Emission Contributions Ranked by Sector, England 2022

Sector	NH3	CO	NOx	VOC	PM10	PM2.5	SO2	Pb	B[a]P	Dioxins	Hg
Agriculture	84.1%	NA	3.4%	17.1%	11.5%	3.7%	NA	NA	NA	NA	NA
Energy Industries	IE	3.7%	13.9%	0.4%	1.4%	2.4%	24.0%	2.0%	3.7%	2.7%	23.6%
Fugitive	IE	0.2%	0.0%	9.5%	0.6%	1.2%	5.8%	0.2%	0.3%	IE	IE
Industrial Combustion	IE	36.5%	15.4%	2.9%	5.1%	9.4%	25.3%	6.2%	0.6%	17.8%	23.5%
Industrial Processes	1.0%	4.5%	IE	7.6%	39.2%	16.4%	8.8%	39.5%	0.9%	18.8%	10.4%
Residential, Commercial & Public Sector Combustion	IE	27.1%	15.0%	4.7%	16.6%	32.5%	30.0%	3.4%	86.8%	15.4%	9.1%
Solvent Processes	IE	NA	NA	48.9%	IE	IE	NA	NA	IE	IE	NA
Transport Sources	2.2%	25.0%	49.3%	7.0%	18.6%	22.8%	4.9%	47.7%	2.5%	4.0%	7.3%
Waste	3.4%	2.6%	IE	IE	5.6%	10.4%	IE	IE	5.0%	41.0%	25.7%
Other	9.3%	0.3%	2.9%	1.8%	1.4%	1.2%	1.2%	1.0%	0.2%	0.3%	0.3%

* The sector: “other” will include all “other” categories in the inventory and also a number of categories that are insignificant for a specific pollutant. These have been marked in the table as “IE” (used in inventory reporting for “Included Elsewhere”). A breakdown of what is included within this category in respect to each pollutant can be found in **Table 32**.

Figure 10 – Ammonia Emissions in England, 2022

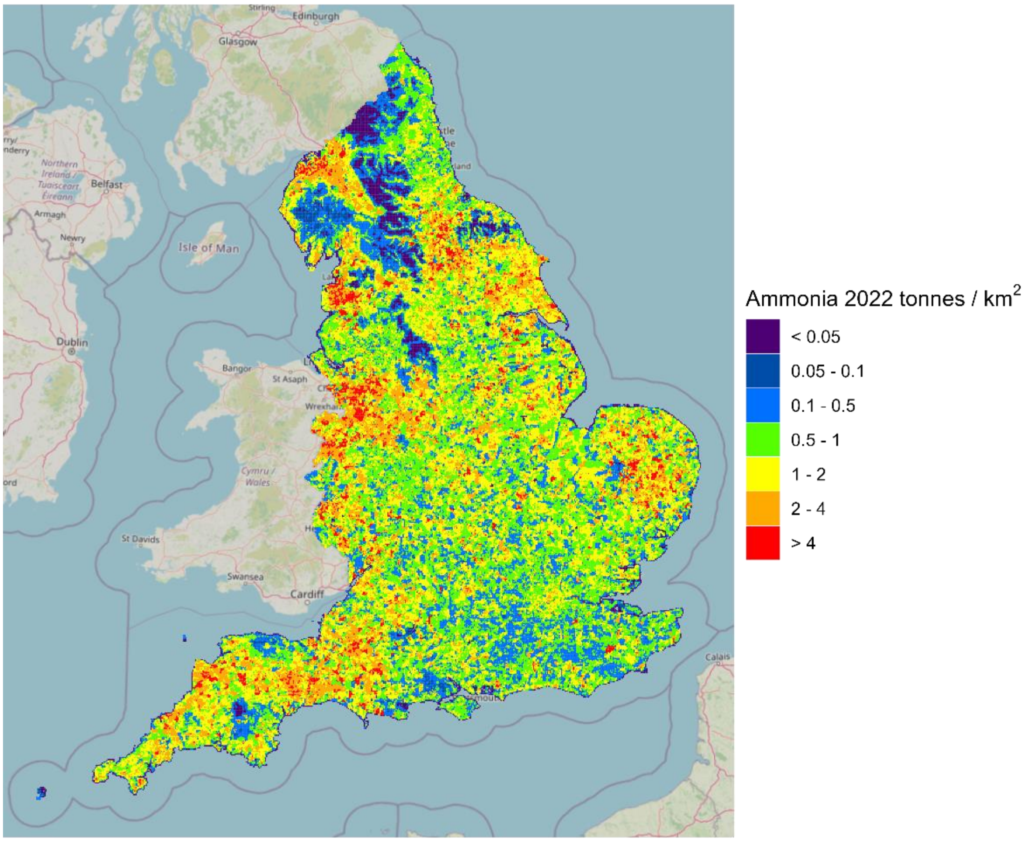


Figure 11 – Carbon Monoxide Emissions in England, 2022

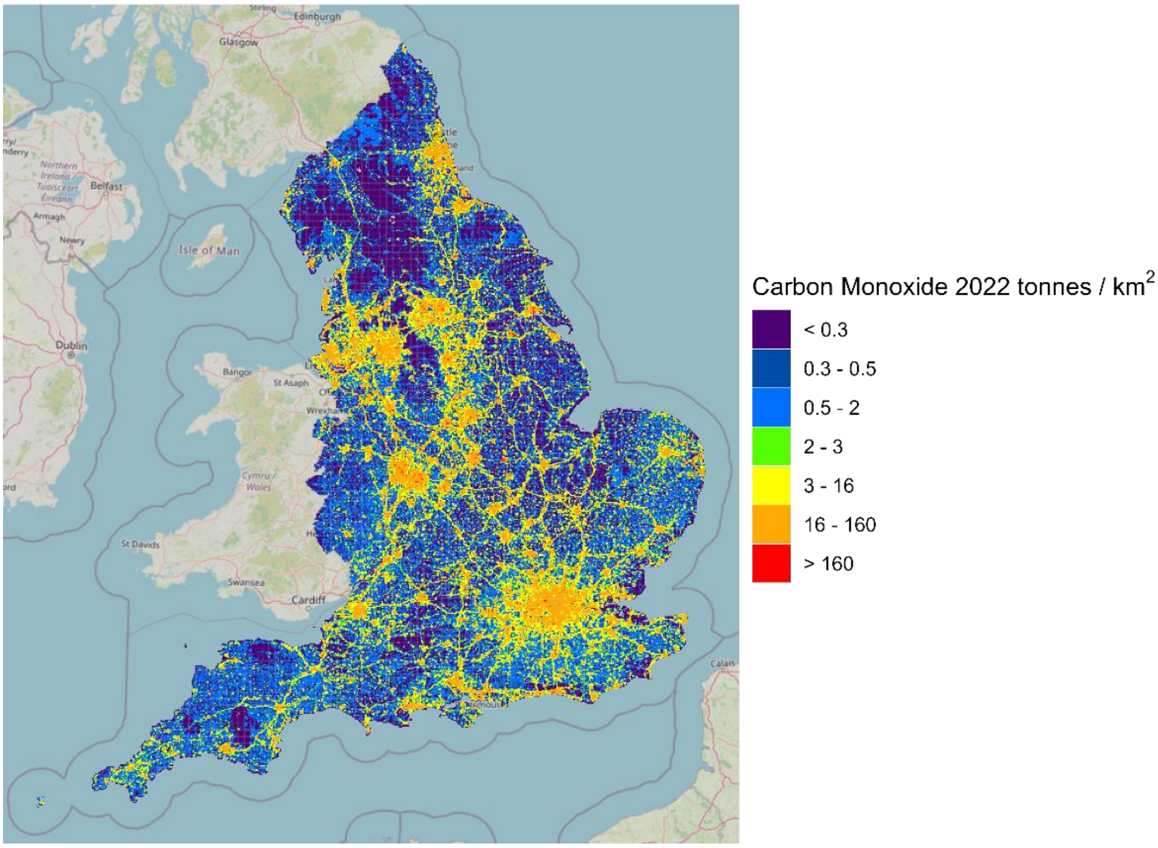


Figure 12 – Nitrogen Oxides Emissions in England, 2022

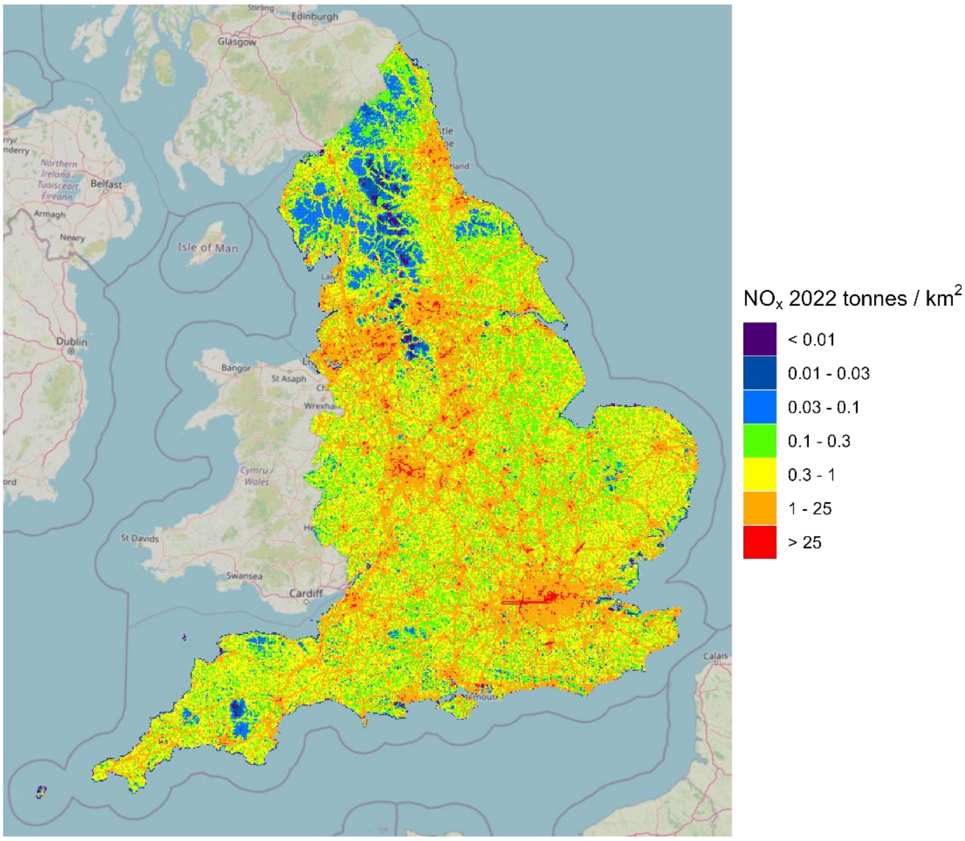


Figure 13 – NMVOC Emissions in England, 2022

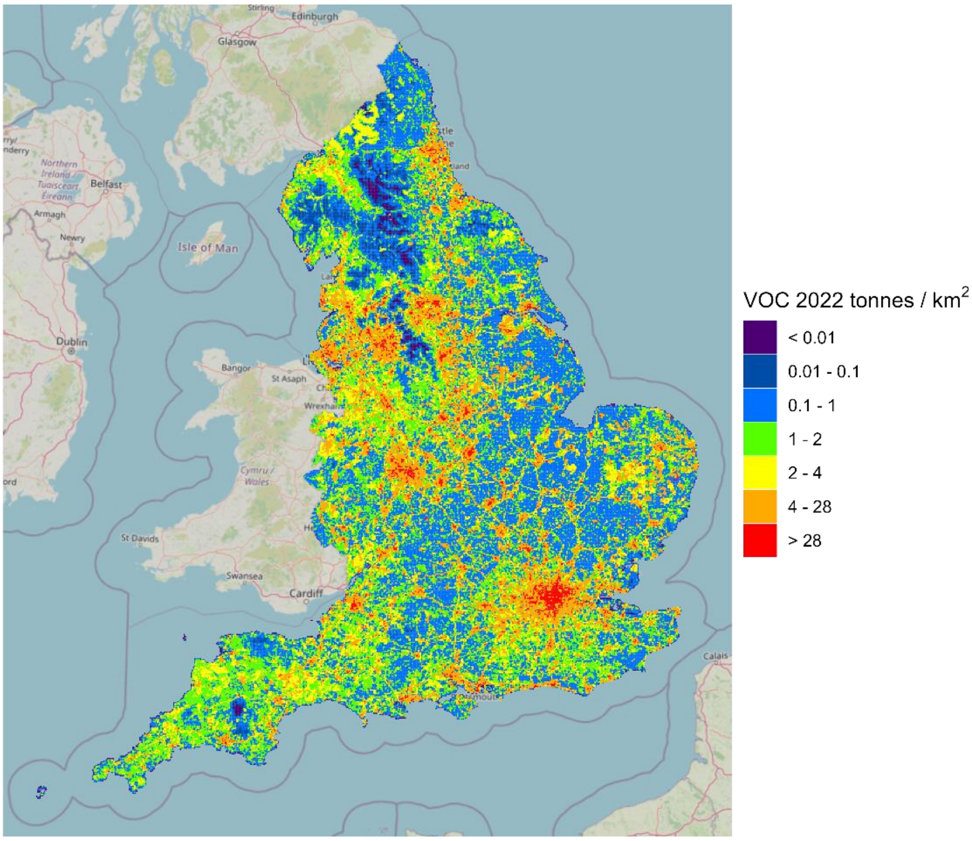


Figure 14 – PM_{10} Emissions in England, 2022

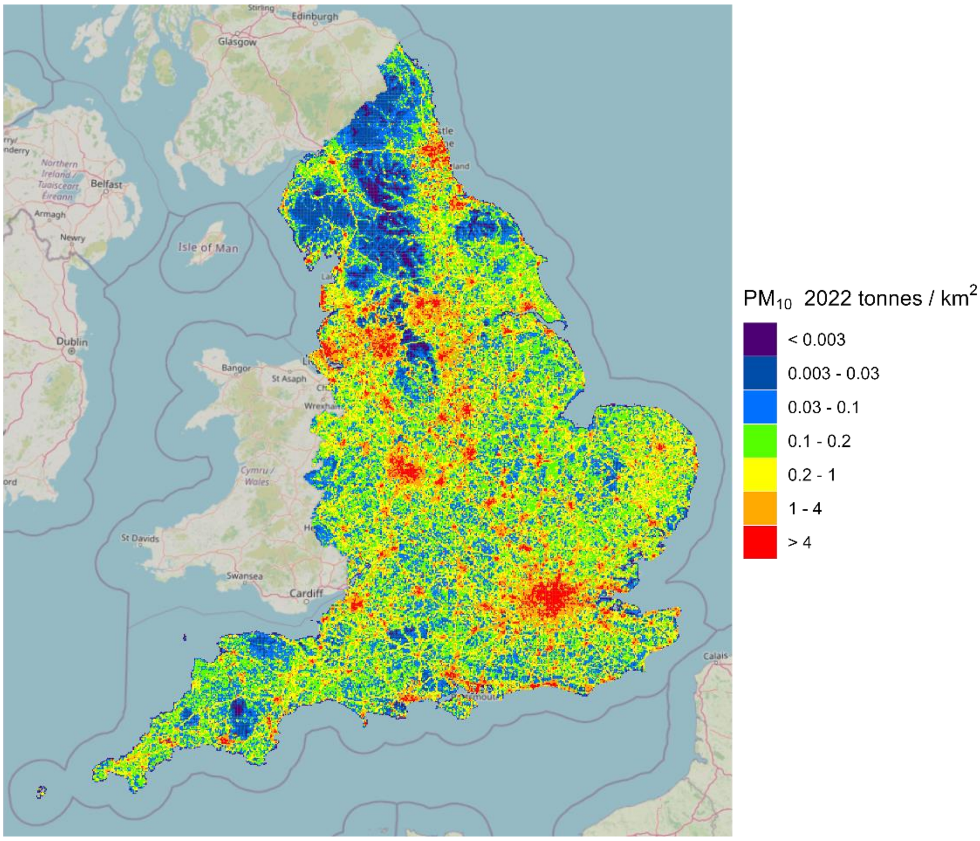


Figure 15 – $PM_{2.5}$ Emissions in England, 2022

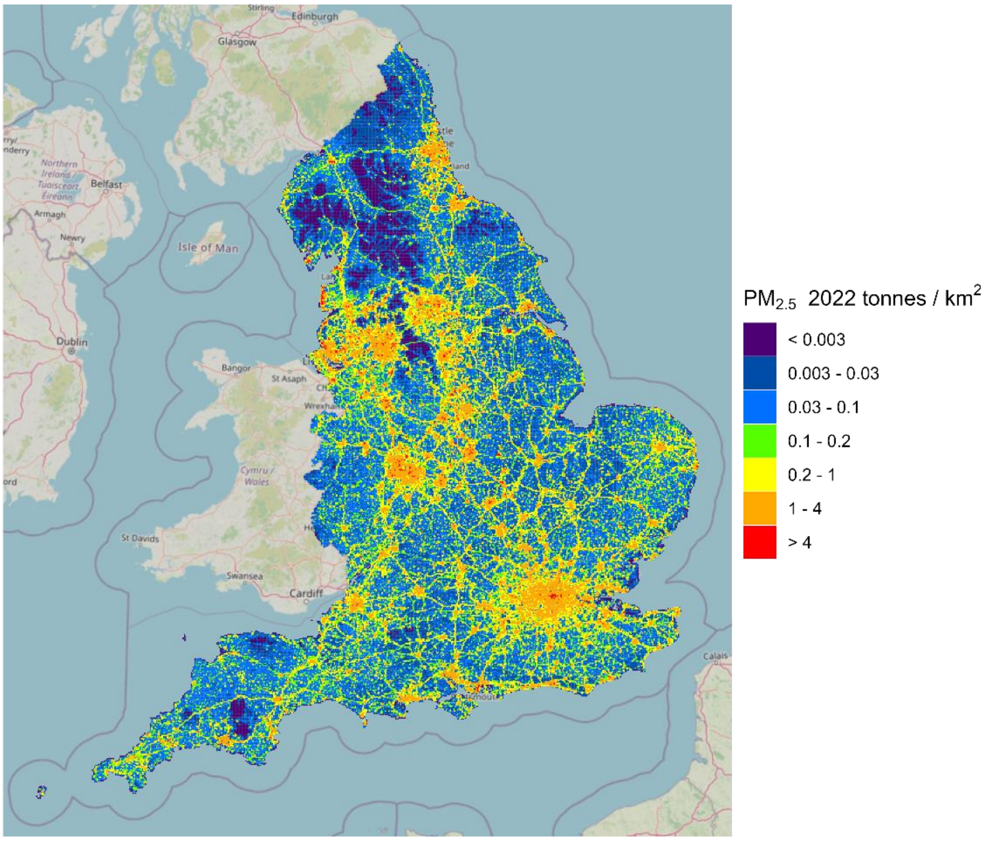


Figure 16 – Lead Emissions in England, 2022

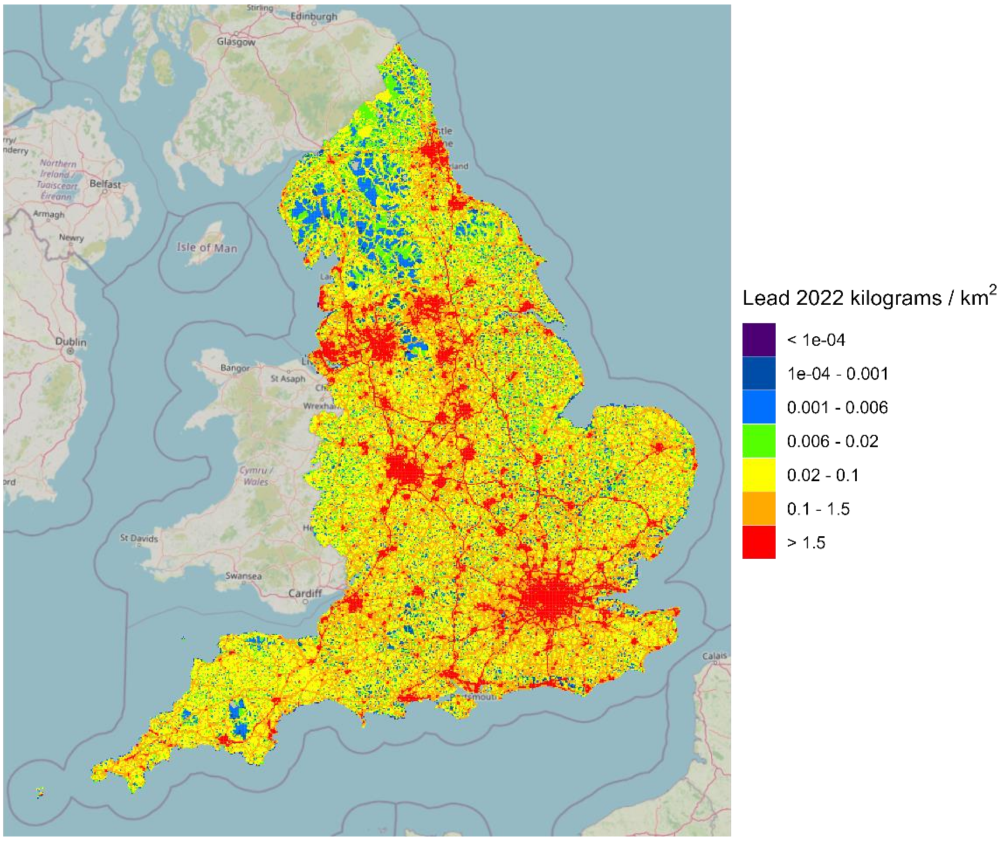
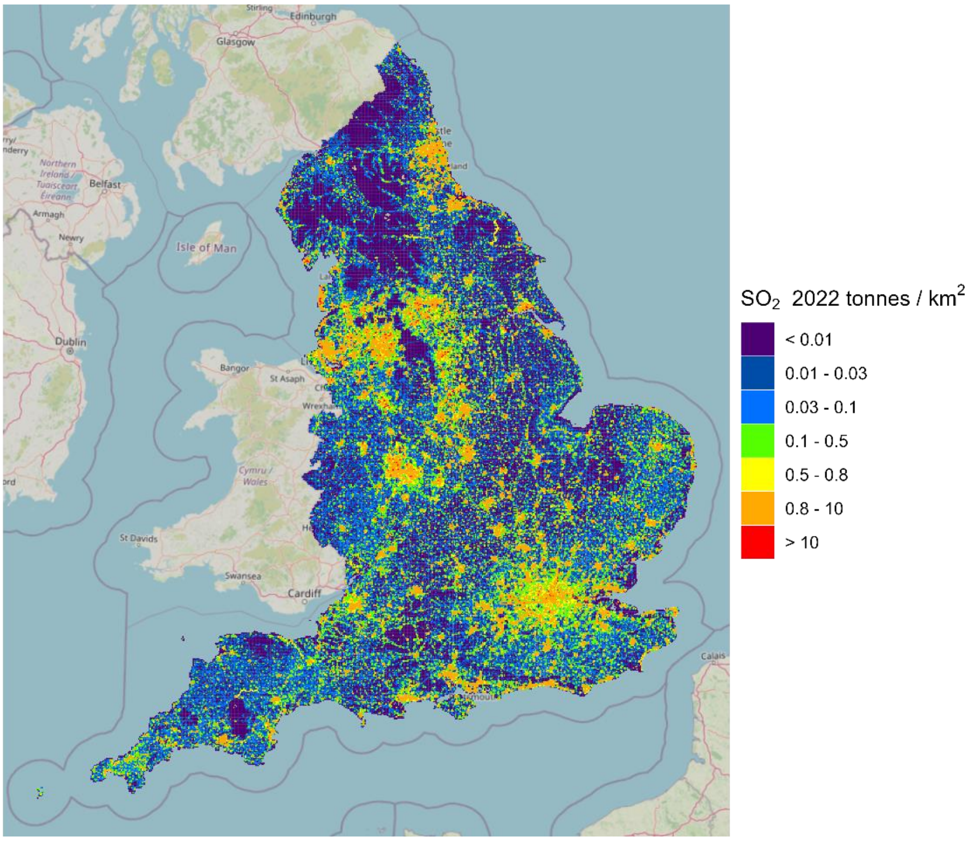


Figure 17 – Sulphur Dioxide Emissions in England, 2022



2.2 Scotland

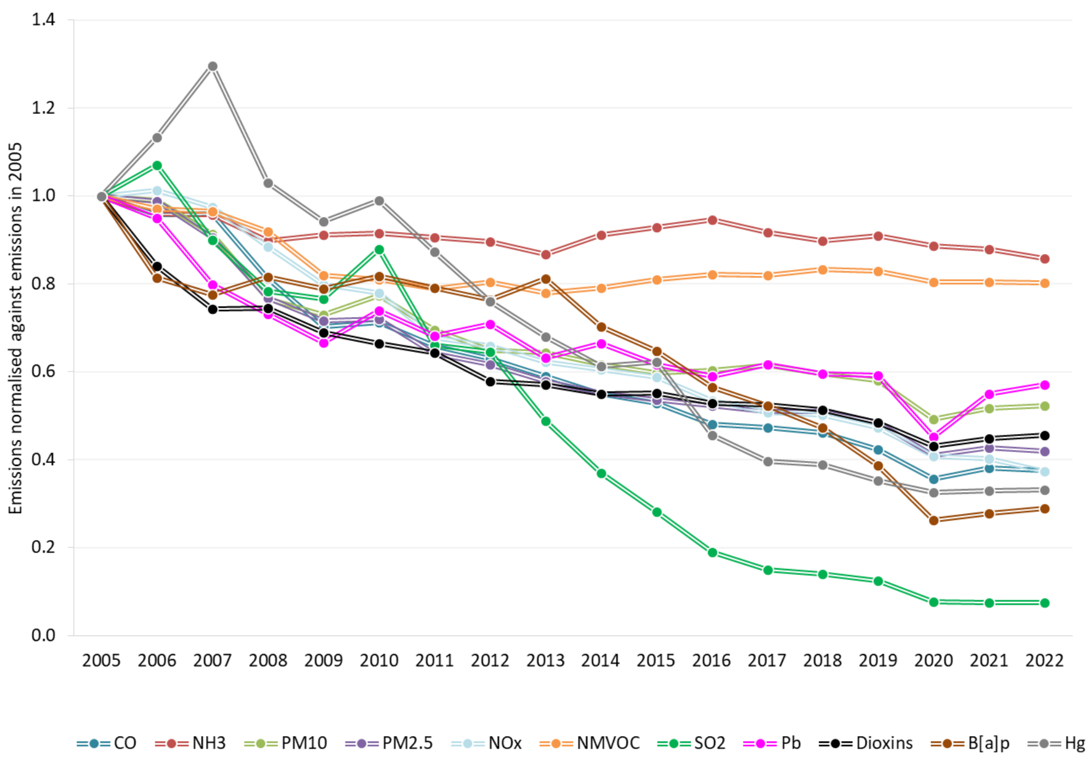
The following section provides a summary of emissions in Scotland for the eight priority air pollutants: NH_3, CO, NO_X, NMVOCs, PM_{10}, $PM_{2.5}$, SO_2, and Pb. Information is also presented for emissions of PCDD/Fs, B[a]P, and Hg, with more detailed information for these three pollutants presented in **Appendix C.2**. Emissions of PCDD/Fs, B[a]P, and Hg should be considered as experimental statistics only[10]. **Appendix F** presents the DA inventory data summary tables, whilst **Appendix G** presents source category mapping used in the report**.**

Figure 18 shows emissions of all eleven air pollutants normalised against the 2005 baseline to illustrate the relative trends since then. This graph shows that all pollutant levels are lower in 2022 than they were in 2005. The greatest rate of decline is observed in the trend for SO_2 emissions, principally due to the reduction in coal use within the economy, with more modest declines observable for CO, NO_X, Hg, Pb, NMVOCs, NH_3, $PM_{2.5}$, PM_{10} and B[a]P. Emissions from Hg initially increased between 2005 and 2007 before decreasing in line with the trend in emissions from power stations.

Emissions of Pb decrease noticeably in 2020 before recovering in subsequent years. This decrease was primarily due to a 20% reduction in emissions due to tyre and break wear in the transport sector. Due to the COVID-19 pandemic, travel restrictions resulted in a reduction in traffic volumes.

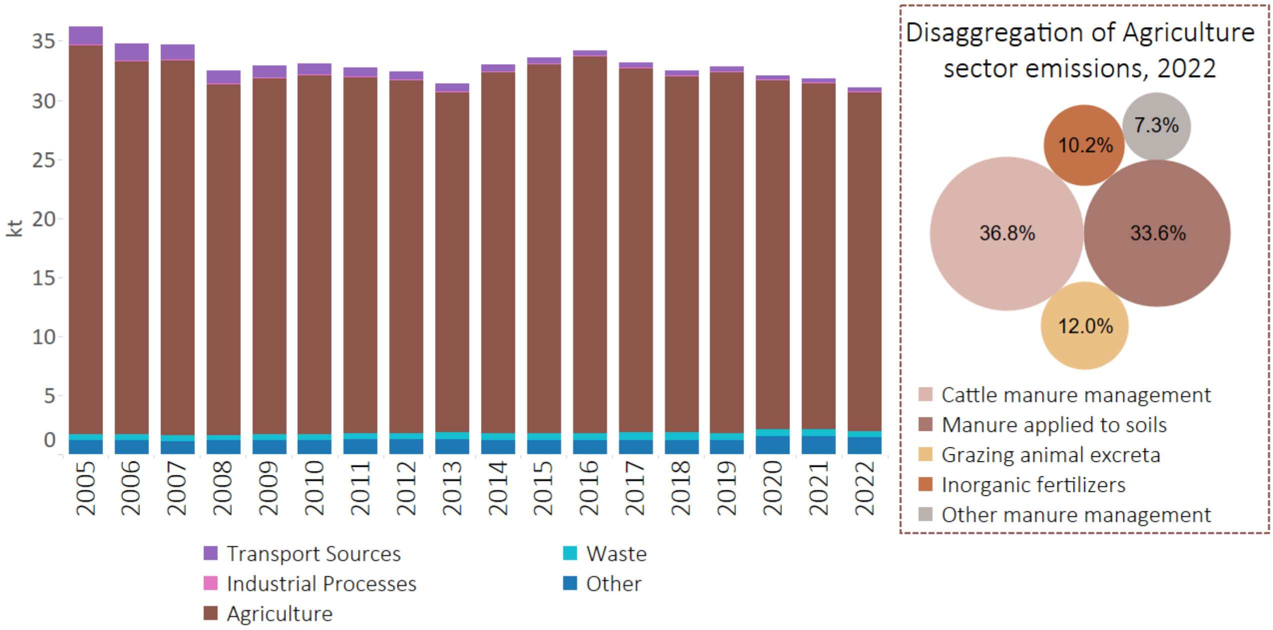
Emissions of NO_X have declined notably since 2007 primarily due to reductions in road transport emissions and the power generation sector. These are most likely linked to the installation of de-NO_X abatement systems (Boosted Over-Fire Air) on all four units at Longannet coal-fired power station and also at Cockenzie power station, which can reduce NO_X emissions formed during coal combustion by up to 25% (Scottish Power, Longannet Power Station, 2012; Scottish Power, Cockenzie Power Station: Site Information, 2011). Cockenzie power station has since ceased operation, in March 2013, and Longannet power station closed in March 2016.

Figure 18 - Scotland normalised trends for all pollutants



[10] The statistics are considered experimental as they have been recently developed: the benzo[a]pyrene and dioxin inventories were first developed for the 1990-2017 inventory published in 2019, whilst the mercury inventory was first developed for the 2005-2019 inventory published in 2021. While the inventories and trends have been interrogated and to ensure the suitability of methods for the most important sources, it is recognised that data quality on a subnational level is generally poor. As a result, these statistics are currently considered experimental only, and require further work to evaluate the methods used, to identify alternative methods that are more suitable, and to reduce the uncertainty in the early part of the time series. More information on the inventory methods used for B[a]P, dioxins, and mercury is available in **Appendix C**.

Figure 19 – Ammonia Emissions in Scotland

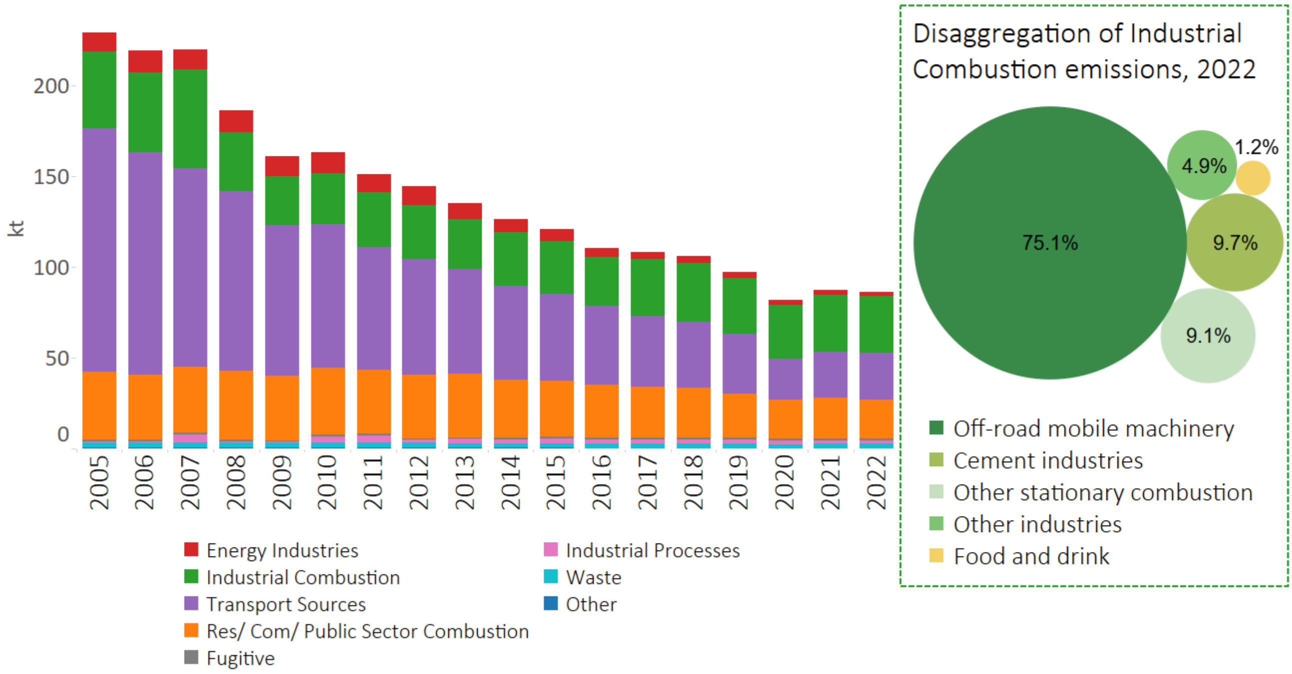


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of ammonia in Scotland were estimated to be 31kt in 2022. These emissions have declined by 14% since 2005 and accounted for 12% of the UK total for ammonia in 2022. Agriculture sources have dominated the inventory throughout the time series, with cattle manure management accounting for 34% of the emissions from this sector in 2022. The initial trends in NH_3 emissions were primarily driven by decreases in livestock numbers (except for poultry) and declines in the use of nitrogen-based fertilisers. After 2010, however, the decline began to be offset by increased application of urea-based and organic fertilisers such as digestate to agricultural soils causing fluctuating emissions totals since 2008, with no significant trends across these years.

In 2022, ammonia emissions decreased by 2.4% since 2021, largely due to a reduction in nitrogen fertiliser use.

Figure 20 – Carbon Monoxide Emissions in Scotland[11]



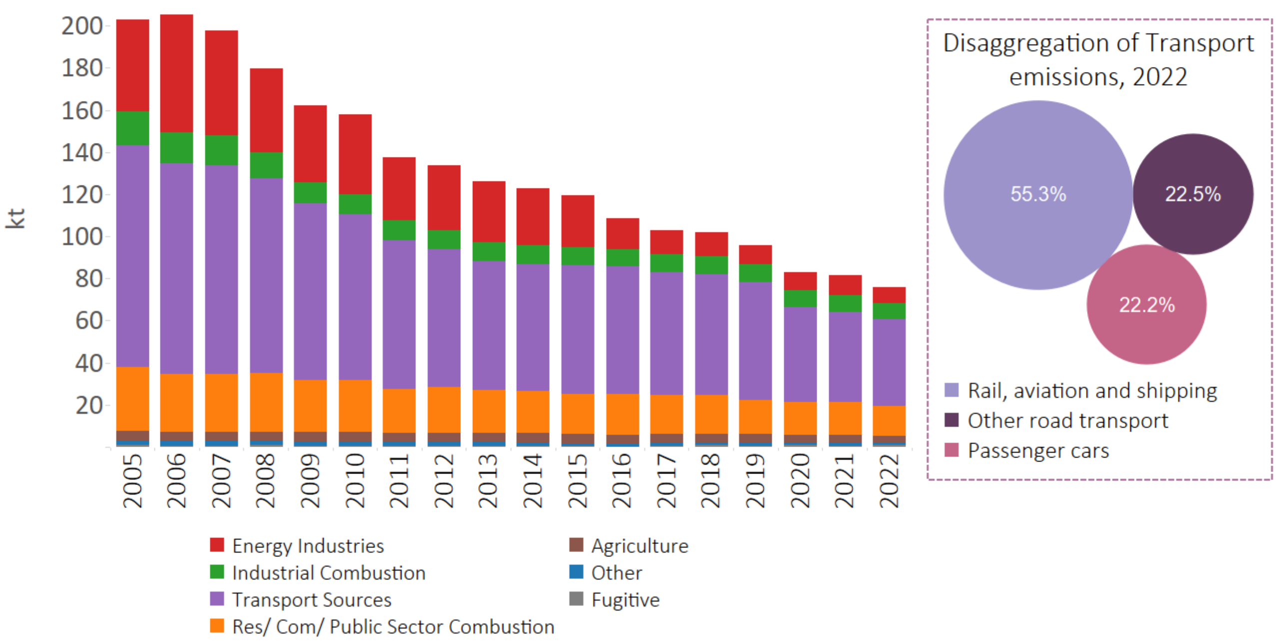
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of carbon monoxide in Scotland were estimated to be 86kt in 2022 and have declined by 62% since 2005. Emissions in Scotland accounted for 7% of the UK total for carbon monoxide in 2022. This decline in emissions stems from changes in the contribution of transport sources, particularly in the road sector where emissions have declined by 85% since 2005 (contributing to 73% of the national trend in CO emissions). This decline is primarily due to the increased proportion in the fleet of vehicles compliant with more recent Euro standards, which required the fitting of emission controls (e.g. three-way catalytic converters) in new petrol vehicles. Improved catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles in 2008 also contribute to the trend. More recently, the switch from petrol cars to diesel cars, which have lower associated CO emissions rates, has also contributed to the observed trend.

CO emissions decreased by 1% between 2021 and 2022, with road transport emissions decreasing by 1.7% in this period.

[11] Other industries presented in the bubble graph relate to combustion emissions in the chemical, non-ferrous metals, pulp paper and print and other industries.

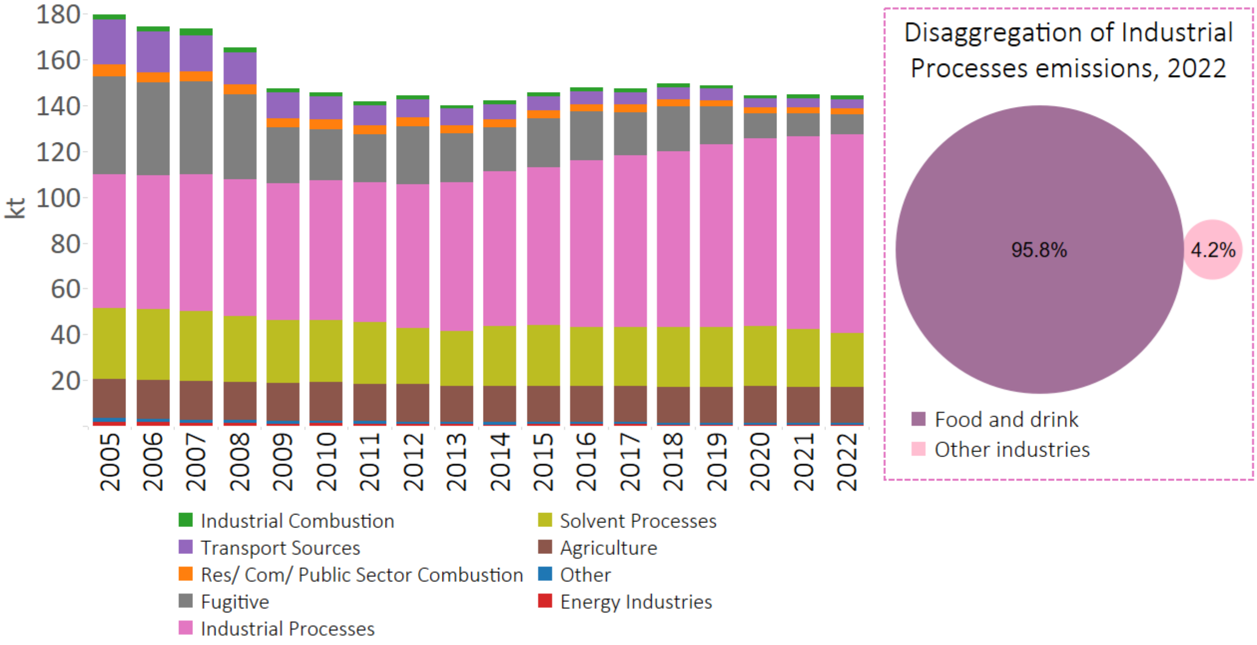
Figure 21 – Nitrogen Oxides Emissions in Scotland



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of nitrogen oxides in Scotland were estimated to be 76kt in 2022, representing 12% of the UK total for nitrogen oxides. Emissions have declined by 63% since 2005, mainly due to changes in transport sources, particularly in road transport. This decline is driven by the successive introduction of tighter Euro emission standards, and the continued penetration of vehicles which comply with these standards. In addition, improvements in catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles contributes to the decline since 2008. However, the recent preferred uptake of diesel cars over petrol cars partly offsets these emissions reductions, because diesel cars emit higher NO_X relative to their petrol counterparts. The peak in NO_X emissions in 2006 is due to the increased use of coal at power stations that year. There was also a small increase in coal-fired generation in 2012 due to a UK-wide shift in the fuel mix used for power generation from gas to coal in that year (DESNZ, 2023a). Energy industry emissions have declined across the time series, linked to Boosted Over-Fire Air (BOFA) abatement systems which were fitted to all four of Longannet's units, to reduce NO_X emissions from coal-fired generation by up to 25% (Scottish Power, 2012). BOFA systems were also fitted on all four units at Cockenzie power station which then closed in 2013 (Scottish Power, 2011). Longannet power station closed in March 2016 marking the end of coal combustion for power generation in Scotland and causing a step-change in emissions between 2015 and 2016. NO_X emissions decreased by 7% between 2021 and 2022, with a 4% decrease in emissions in this period from the transport sector. 55% of the NO_X emissions were due to the transport sector in 2022. In addition, emissions from power stations decreased by 22% between 2021 and 2022. This sector (1A1), contributed 36% of NOx emissions in Scotland in 2022.

Figure 22 – NMVOC Emissions in Scotland[12]

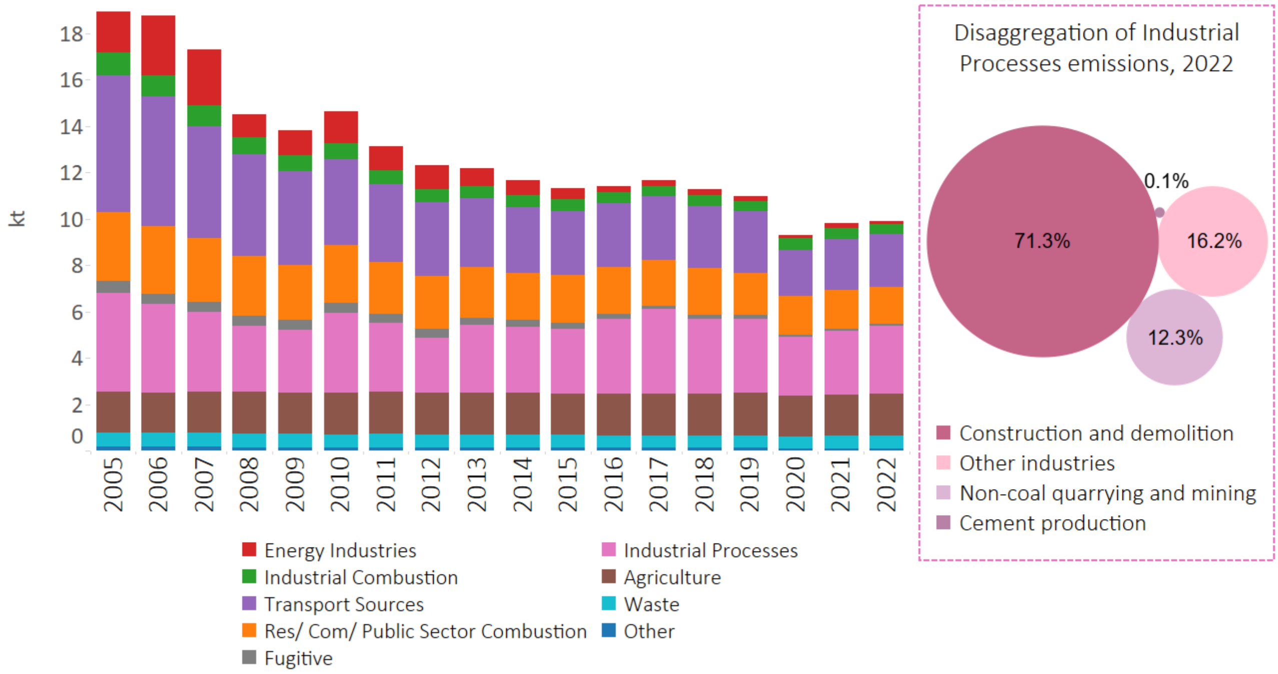


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of non-methane volatile organic compounds in Scotland were estimated to be 144kt in 2022, representing 19% of the UK total for NMVOCs. Emissions have declined by 20% since 2005. This reduction is a result of reductions in fugitive and road transport emissions which have each declined 85% since 2005. The decrease in road transport account for 41% of the overall NMVOC trend. The declining trend seen in fugitive emissions is due to the decrease in emissions from the exploration, production, and transport of oil, specifically emissions from the onshore loading of oil (note offshore emissions are not allocated to the DAs). The decrease between 2008 and 2009 was due to reductions in fugitive NMVOC emissions from oil loading at the Sullom Voe terminal in Shetland. Emissions from the food and drink industry (which accounts for around 58% of NMVOC emissions in Scotland in 2022) have increased since 2009 due to the increased production and storage of whisky. In total, spirit manufacture contributed approximately 56% of NMVOC emissions in Scotland in 2022. Emissions from road transport sources, including evaporative losses of fuel vapour from petrol vehicles have also declined over time due to emission control technologies that have progressively been introduced in new petrol vehicles since the early 1990s. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. Between 2021 and 2022, emissions of NMVOCs increased by 3.9%, which is largely driven by the 3% increase in emissions from the food and drink industry (2H2). The 3% increase in the food and drink industry (2H2) accounted for 46% of the overall trend in NMVOC emissions observed in 2021-2022.

[12] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Figure 23 – PM_{10} Emissions in Scotland[13]



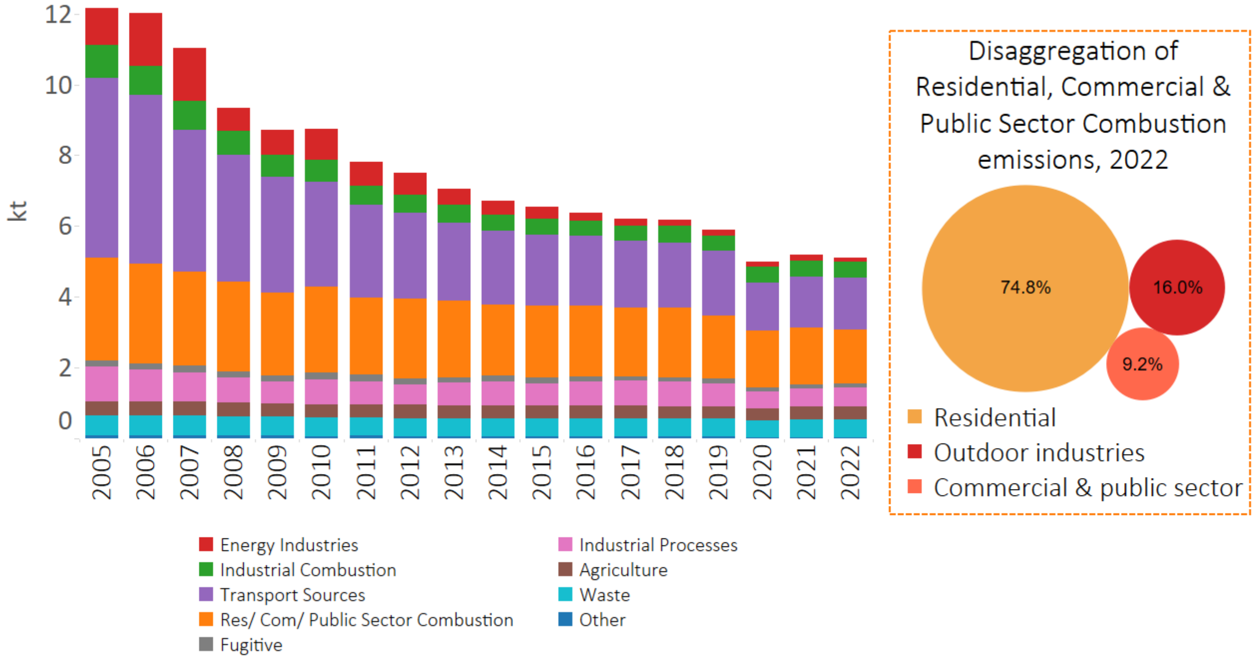
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of PM_{10} in Scotland were estimated to be 10kt in 2022, declining by 48% since 2005. These emissions account for 8% of the UK total PM_{10} emissions. Unlike most other pollutants, the emissions profile of PM_{10} is diverse. In order of % contribution to emissions in 2022, these sources include: industrial processes (30%), transport sources (23%), and residential combustion (12%). Emissions from industrial processes are dominated by other industries which aggregates a large number of industrial sectors such as other chemical industry, construction and demolition, aluminium production and wood processing. The reduction in emissions over the time series is primarily due to abatement at coal-fired stations, the increase in nuclear and renewable energy sources and the increase in the use of natural gas in energy generation (which has negligible PM_{10} emissions) in place of coal (DESNZ, 2023a), as well as the continued increasing share of renewables in the energy mix. PM_{10} exhaust emissions from diesel-fuelled vehicles have been decreasing due to the continued fleet penetration of vehicles complying with more recent and more stringent Euro emissions standards. Increasingly non-exhaust sources of PM_{10} (for example tyre wear) have become more important to consider as exhaust PM_{10} has been reduced. In fact, in 2022, 89% of emissions from the road transport sector were related to non-exhaust sources. In recent years, emissions from the residential and other combustion sector have slightly increased, and this is due to an increasing quantity of wood fuel use, primarily in the residential sector (DESNZ, 2023a).

PM_{10} emissions increased by 1.2% between 2021 and 2022, led by increases in several sectors including construction and demolition (2A5b) with a 7% increase and the transport sector (1A3b) with a 4% increase. In contrast, PM_{10} emissions from power stations (1A1) decreased by 39% between 2021 and 2022.

[13] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Figure 24 – $PM_{2.5}$ Emissions in Scotland[14]



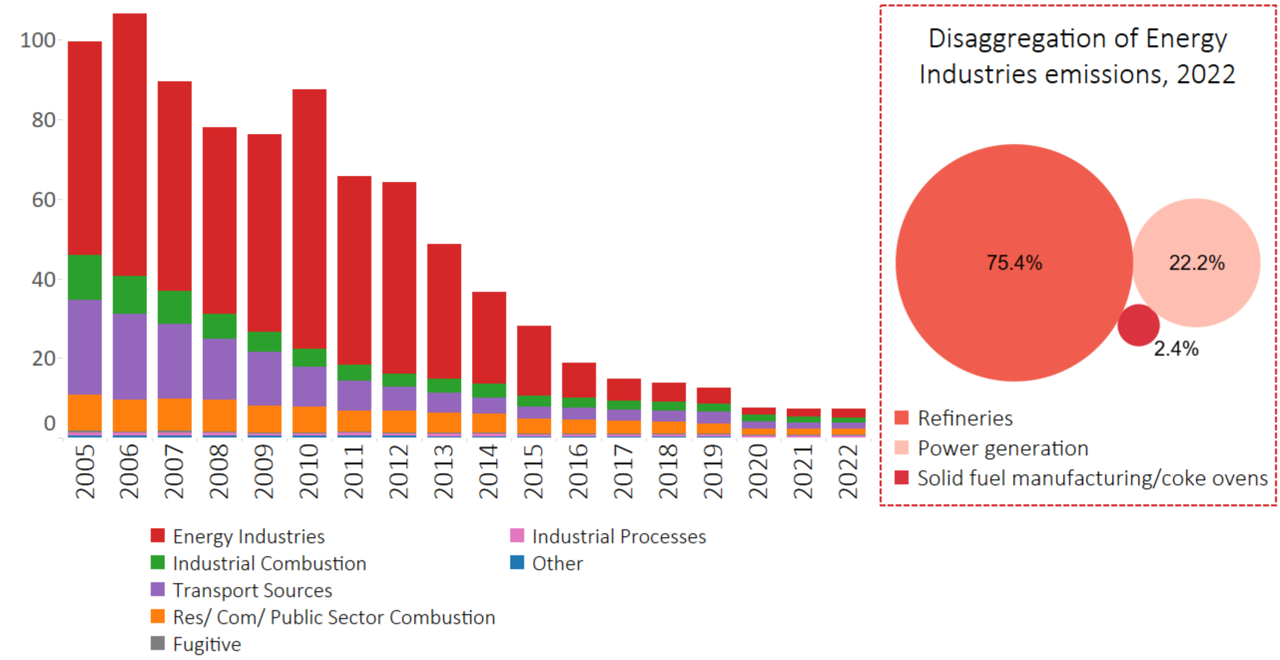
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of $PM_{2.5}$ in Scotland were estimated to be 5kt in 2022, declining by 58% since 2005. These emissions account for 8% of the UK total for $PM_{2.5}$ in 2022. As with PM_{10}, $PM_{2.5}$ emissions have a large number of significant sources. However, process emissions tend to produce coarser PM fractions and as such, combustion emissions are of greater importance for $PM_{2.5}$ compared to PM_{10}. For $PM_{2.5}$, the residential, commercial, and public sector combustion category (which includes agricultural combustion and fishing vessels – NFR code 1A4c) accounts for 30% of 2022 emissions. The primary drivers for the decline in emissions since 2005 are the continued switch from coal to natural gas in electricity generation, and reductions in emissions from the transport sector due to the introduction of progressively more stringent emissions standards through time.

$PM_{2.5}$ emissions decreased by 1.9% between 2021 and 2022, led by increases in several sectors. From 2021 to 2022, $PM_{2.5}$ emissions decreased by 39% from the energy sector (power stations), which contributes 73% of the overall $PM_{2.5}$ trend in 2021 to 2022. There was also a 3% increase in emissions from the transport sector from 2021-2022.

[14] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 25 – Sulphur Dioxide Emissions in Scotland

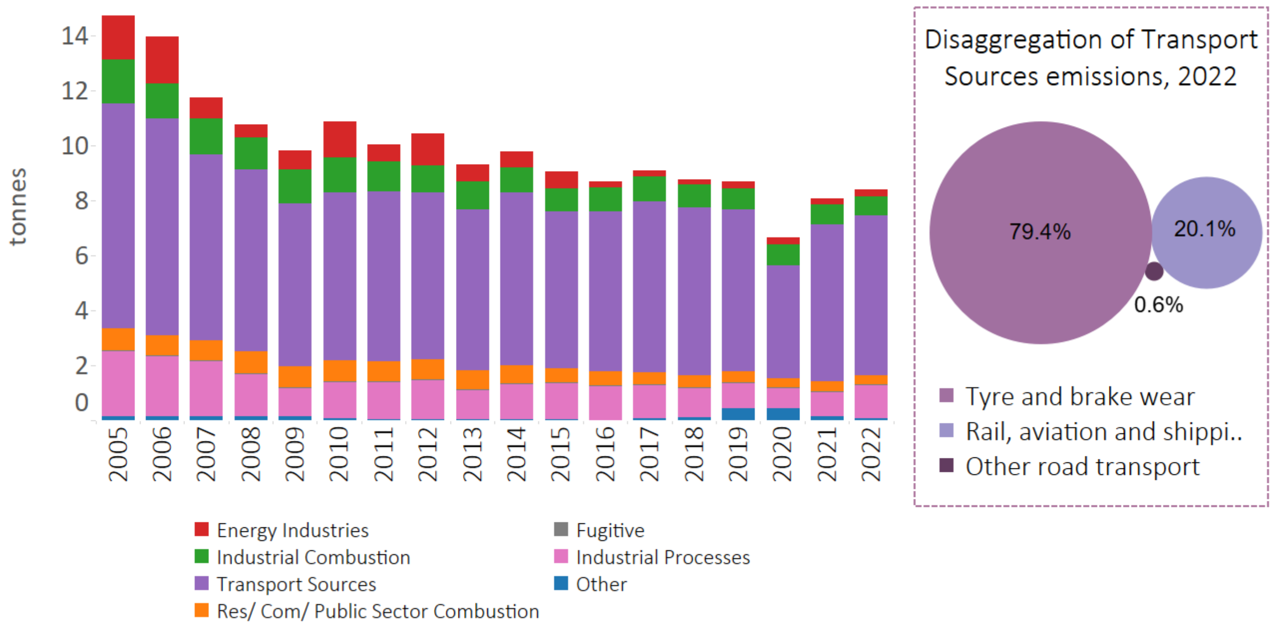


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of sulphur dioxide in Scotland were estimated to be 7kt in 2022, representing 6% of the UK total in 2022 for sulphur dioxide. Emissions have declined by 93% since 2005 because of continued changes in the power generation sector. Since 2005, SO_2 emissions from power stations have reduced by 99%. Such changes include the reduction in coal fired power relative to other sources; improved emission controls on some large coal fired plants such as the installation of an FGD (flue-gas desulphurization) plant at Longannet power station; the use of coal of lower sulphur content in later years to Cockenzie (Scottish Power, 2012) before its closure in March 2013, and finally the complete cessation of coal combustion for power generation in Scotland in 2016 after the closure of Longannet.

In 2022, SO_2 emissions decreased by 0.1% since 2021, which is driven by a 20% decrease in emissions from power stations.

Figure 26 – Lead Emissions in Scotland



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of lead in Scotland were estimated to be 8.4 tonnes in 2022, representing 6% of the UK total in 2022 for lead. Emissions have declined by 43% since 2005 due to changes in energy sources, industrial combustion, and industrial processes. Emissions from power stations have decreased by 85% since 2005, due to the phase out of coal from the energy generation mix, with the closure of Longannet in 2016 marking the end of the use of coal in energy generation in Scotland. Transport emissions account for 69% of the total in 2022. Unlike exhaust emissions which have been subject to the continued implementation of more stringent European regulation, non-exhaust emissions are not regulated and are strongly linked to the v-km driven on Scotland's roads. Non-exhaust emissions have increased by 12% since 2005. Industrial combustion accounts for 8% in 2022, and use of fireworks contributes a further 9%. Three of the seven sites in the UK which manufacture fibreboard, chipboard and oriented strand board are located in Scotland, and are key sites for lead emissions due to the burning of waste wood as fuel.

In 2019 and 2020, there is an increase in lead emissions from the 'Other' category. This is driven by variations in lead emissions associated with different aviation fuel types used in military aircraft at a UK level.
Lead emissions have increased by 4% since 2021, primarily due to a 7% increase in emissions due to tyre and break wear in the transport sector. This was likely influenced by reduced road traffic during COVID-19 restrictions in 2020 and an increase in road traffic in 2021 as restrictions eased.

Error! Reference source not found. below provides a summary of the percentage contribution of each sector for each pollutant in 2022. The table is shaded according to the overall contribution of that sector to the pollutant total, (with darker shades representing greater contribution). The table below indicates that the Residential, Commercial & Public Sector Combustion is an important sector when considering emissions of B[a]P, $PM_{2.5}$, CO, SO_2, NOx, PM_{10}, and dioxins.

The Industrial Processes sector is also notable, especially for NMVOCs, which is due to the importance of the food and drink industry in Scotland. This table also highlights that although emissions from the agriculture sector are not as significant when considering all pollutants, it is of very high importance when considering emissions of NH_3.

Table 3 - Source Emission Contributions Ranked by Sector, Scotland 2022

Sector	NH3	CO	NOx	VOC	PM10	PM2.5	SO2	Pb	B[a]P	Dioxins	Hg
Agriculture	92.2%	NA	4.6%	10.9%	18.2%	7.0%	NA	NA	NA	NA	NA
Energy Industries	IE	2.6%	9.8%	0.3%	1.3%	2.2%	32.2%	2.9%	0.1%	2.6%	8.3%
Fugitive	IE	1.4%	1.1%	6.3%	0.9%	1.8%	1.5%	IE	IE	IE	IE
Industrial Combustion	IE	36.4%	10.1%	1.0%	4.6%	8.4%	17.4%	8.1%	1.1%	20.4%	22.2%
Industrial Processes	0.2%	1.9%	IE	60.1%	29.5%	10.7%	6.3%	14.5%	2.4%	1.3%	7.3%
Residential, Commercial & Public Sector Combustion	IE	24.9%	18.5%	1.7%	15.8%	29.9%	21.0%	4.0%	81.7%	15.7%	12.3%
Solvent Processes	IE	NA	NA	16.2%	IE	IE	NA	NA	IE	IE	NA
Transport Sources	1.2%	29.7%	54.6%	2.8%	23.1%	29.3%	20.4%	69.5%	4.9%	6.5%	15.5%
Waste	1.7%	2.8%	IE	IE	5.6%	10.0%	IE	IE	9.5%	53.4%	34.2%
Other	4.6%	0.3%	1.4%	0.6%	1.0%	0.8%	1.3%	1.1%	0.3%	0.1%	0.2%

* The sector: “other” includes all “other” categories in the inventory and also a number of categories that are insignificant for a specific pollutant. These have been marked in the table as “IE” (used in inventory reporting for “Included Elsewhere”). A breakdown of what is included within this category in respect to each pollutant can be found in **Table 32**.

Figure 27 – Ammonia Emissions in Scotland, 2022

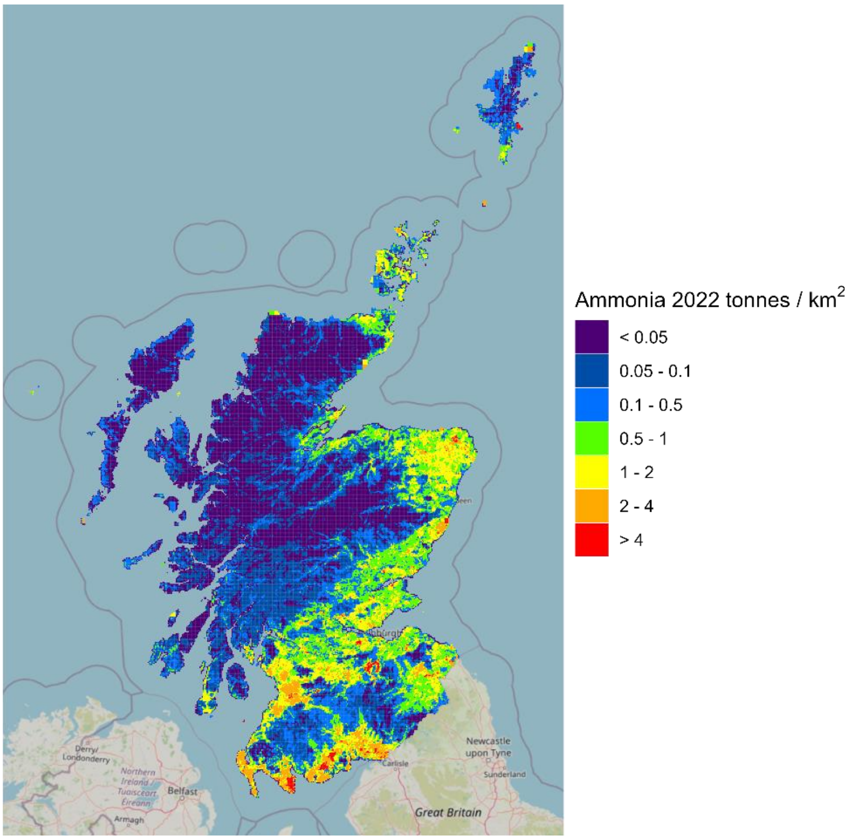


Figure 28 – Carbon Monoxide Emissions in Scotland, 2022

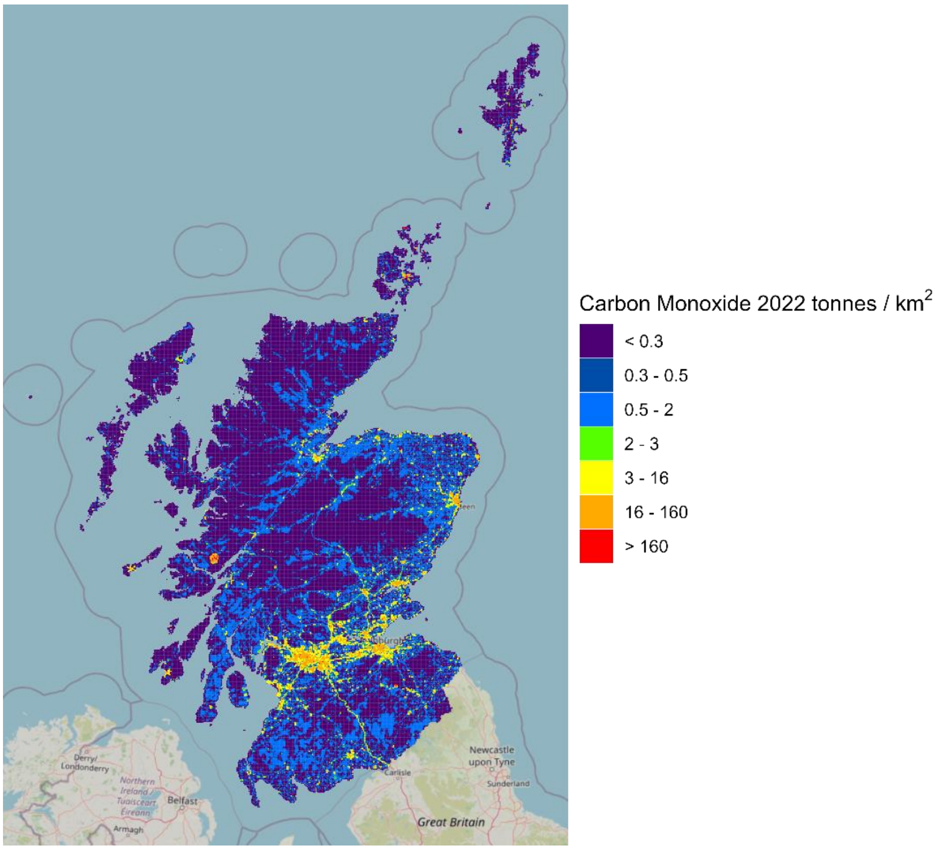


Figure 29 – Nitrogen Oxides Emissions in Scotland, 2022

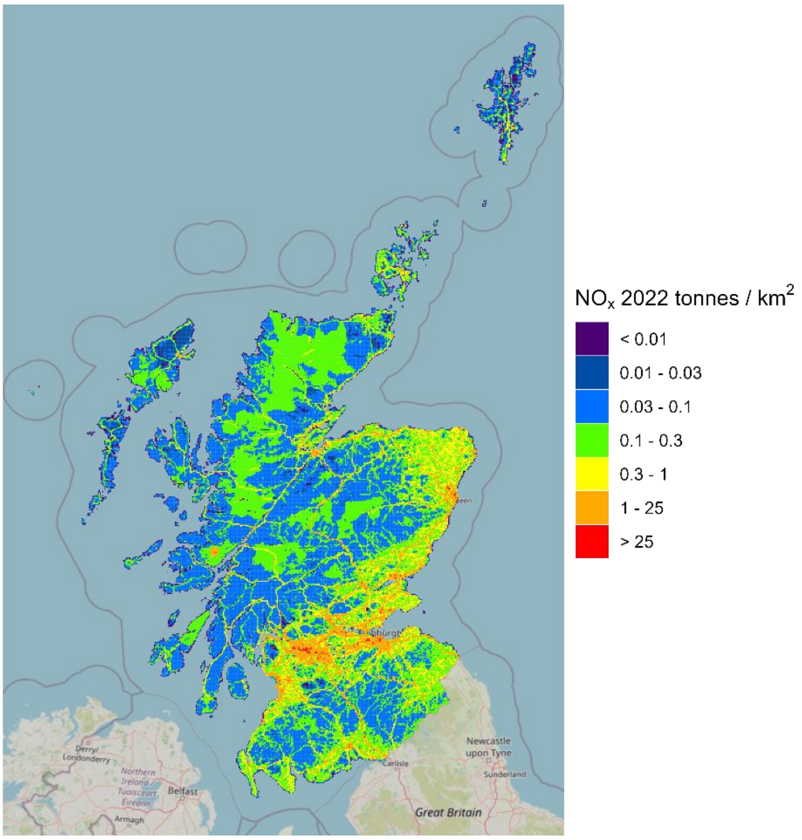


Figure 30 – NMVOC Emissions in Scotland, 2022

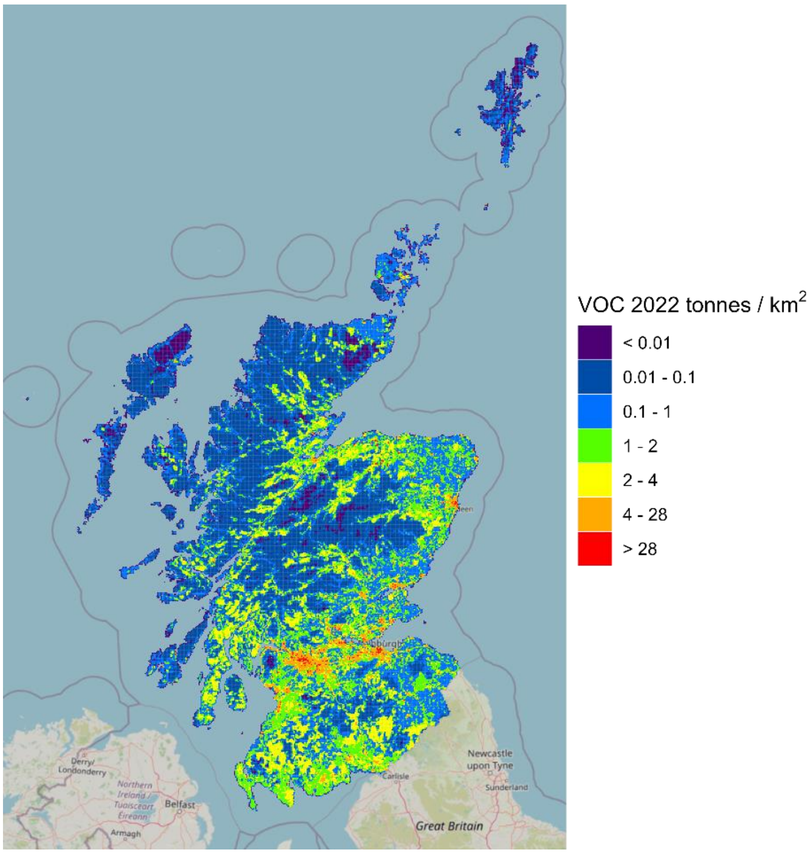


Figure 31 – PM_{10} Emissions in Scotland, 2022

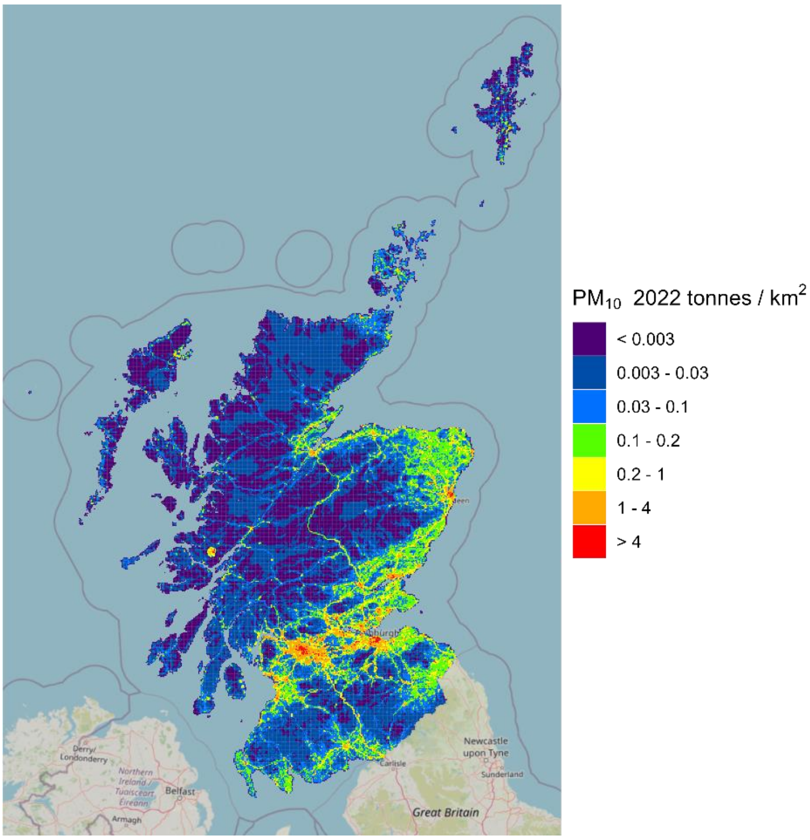


Figure 32 – $PM_{2.5}$ Emissions in Scotland, 2022

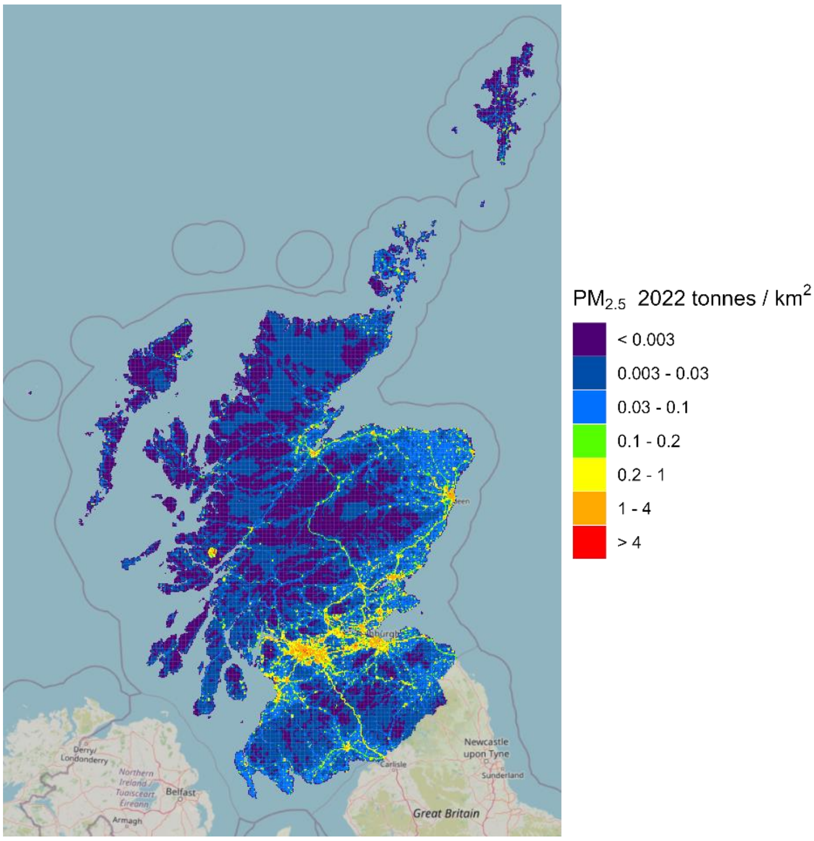


Figure 33 – Lead Emissions in Scotland, 2022

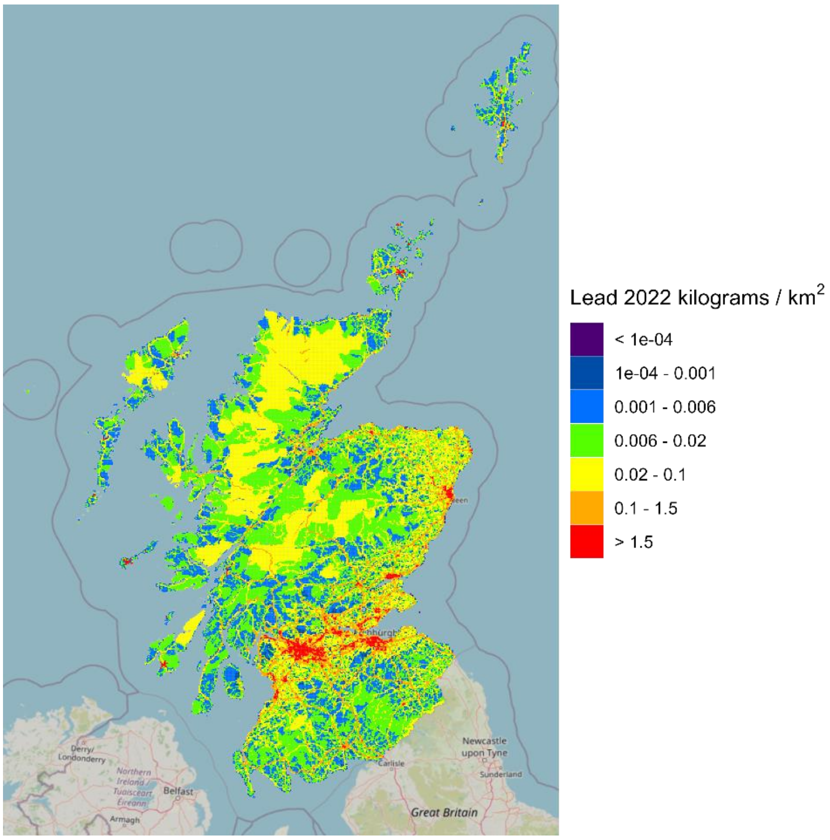
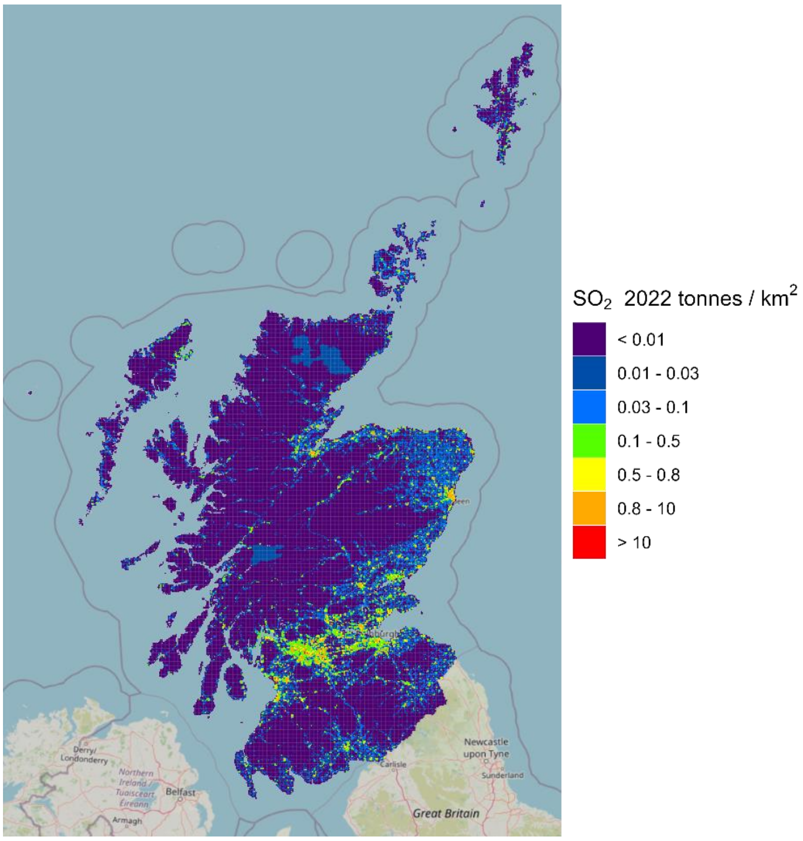


Figure 34 – Sulphur Dioxide Emissions in Scotland, 2022



2.3 Wales

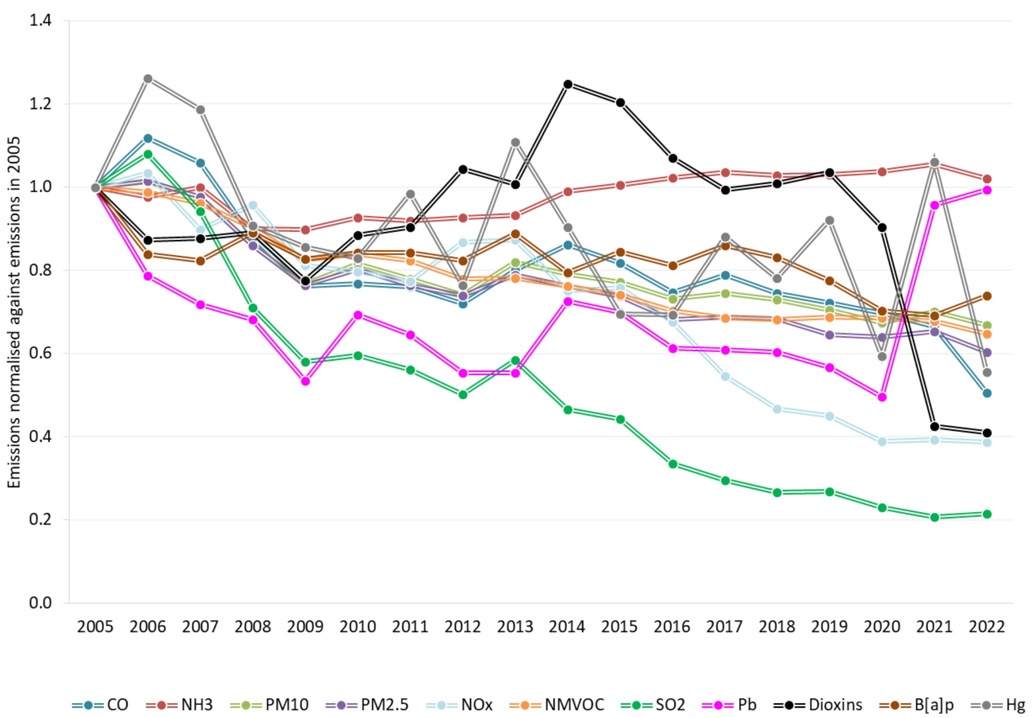
The following section provides a summary of emissions in Wales for the eight priority air pollutants: NH_3, CO, NO_X, NMVOCs, PM_{10}, $PM_{2.5}$, SO_2, and Pb. Information is also presented for emissions of PCDD/Fs, B[a]P, and Hg, with more detailed information for these three pollutants presented in **Appendix C.2**. Emissions of PCDD/Fs, B[a]P, and Hg should be considered as experimental statistics only[15]. **Appendix F** presents the DA inventory data summary tables, whilst **Appendix G** presents source category mapping used in the report**.**

Figure 35 shows emissions of all eleven air pollutants normalised against the 2005 baseline to illustrate the relative trends since then. This graph shows that most pollutant levels are lower in 2022 than they were in 2005. The greatest rate of decline is observed in the trend for SO_2 with more modest overall declines observable for NO_X, CO, Hg, NMVOCs, PM_{10}, and $PM_{2.5}$ and dioxins. Reductions in SO_2 since 2006 are due, primarily, to the retrofitting of flue gas desulphurisation and the co-firing of biomass at power stations, with the increase in 2013 due in part to increases in generation and hence the amount of fuel consumed.

Emissions of NH_3 have been rising in recent years due to increases in activity from several sources; urea-based fertiliser application; increases in housed cattle numbers and subsequent manure spreading on soils; and increases in digestate and other organic fertilisers which are applied to soils.

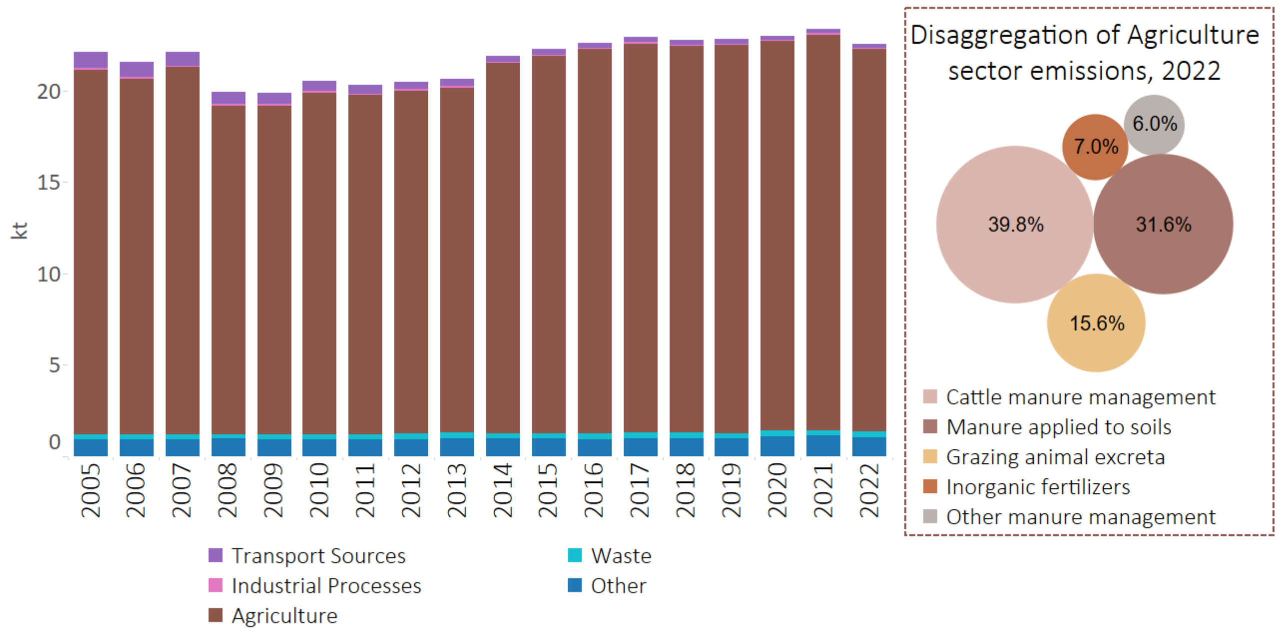
Many pollutant trends in Wales are also influenced substantially by the combustion and process emission sources linked to the iron and steel industry, and in particular changes in activity at Port Talbot steelworks. For example, between 2012 and 2013 an upturn in production at the plant led to increases in emissions from the sector across the priority air pollutants reported here, influencing the national trends most notably for SO_2, CO, and Hg (and to some extent dioxins). Again, the sharp decrease in dioxin emissions and the increase in Pb emissions in 2021 and 2022 is primarily a result of changes in sinter production activity whilst the increase in Hg emissions in 2021 is driven by increases in emissions from electric arc furnaces in the iron and steel industry.

Figure 35 – Wales normalised trends for all pollutants



[15] The statistics are considered experimental as they have been recently developed: the benzo[a]pyrene and dioxin inventories were first developed for the 1990-2017 inventory published in 2019, whilst the mercury inventory was first developed for the 2005-2019 inventory published in 2021. While the inventories and trends have been interrogated and to ensure the suitability of methods for the most important sources, it is recognised that data quality on a subnational level is generally poor. As a result, these statistics are currently considered experimental only, and require further work to evaluate the methods used, to identify alternative methods that are more suitable, and to reduce the uncertainty in the early part of the time series. More information on the inventory methods used for B[a]P, dioxins, and mercury is available in **Appendix C**.

Figure 36 – Ammonia Emissions in Wales

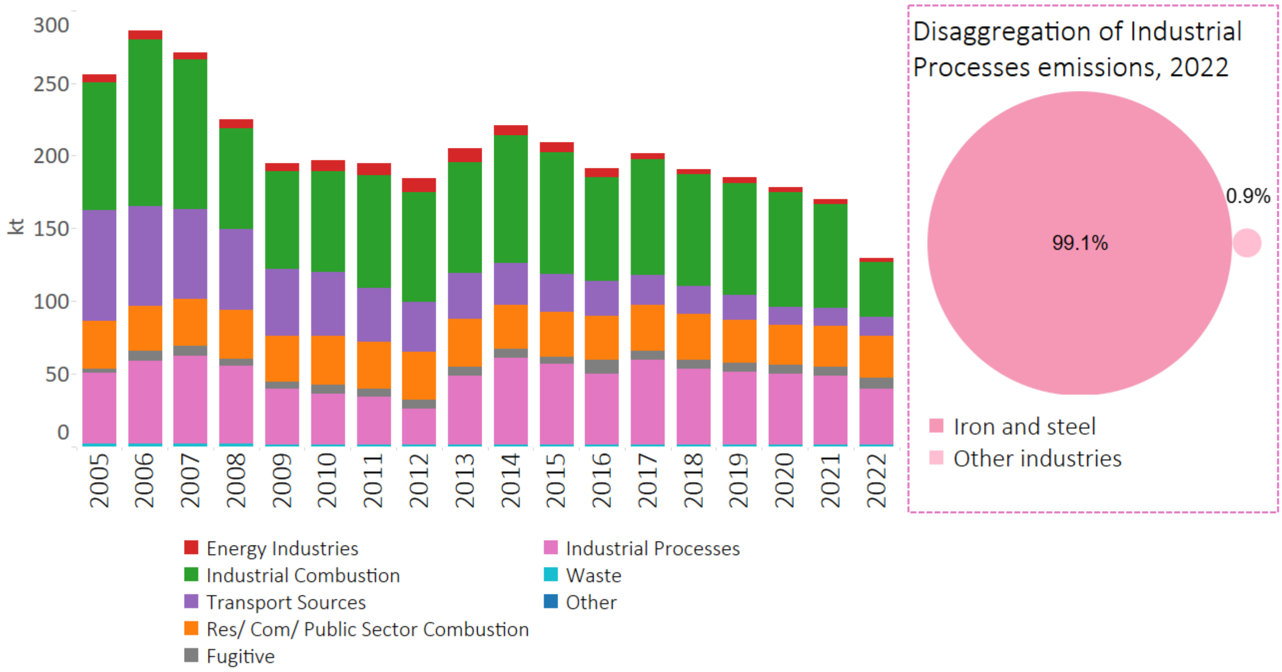


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of ammonia in Wales were estimated to be 23kt in 2022. These emissions are at a similar level in 2022 to 2005, increasing by 2%, and account for 9% of the UK total ammonia emissions. Agriculture sources have dominated the time series, with cattle manure management alone accounting for at least 32% of emissions throughout. Emissions increases since 2008 have been driven largely by emissions from manure management practices, particularly for dairy cattle, and from the application of urea-based fertilisers and digestate to soils. A decline in emissions from transport sources is observed since 2005: although initially implemented to target NO_X emissions from road transport, increased prevalence in improved catalytic systems has contributed to the decline in emissions of NH_3 from road transport.

In 2022, emissions from ammonia decreased by 3% since 2021, driven by decreases in emissions from inorganic nitrogen fertiliser applications.

Figure 37 – Carbon Monoxide Emissions in Wales[16]



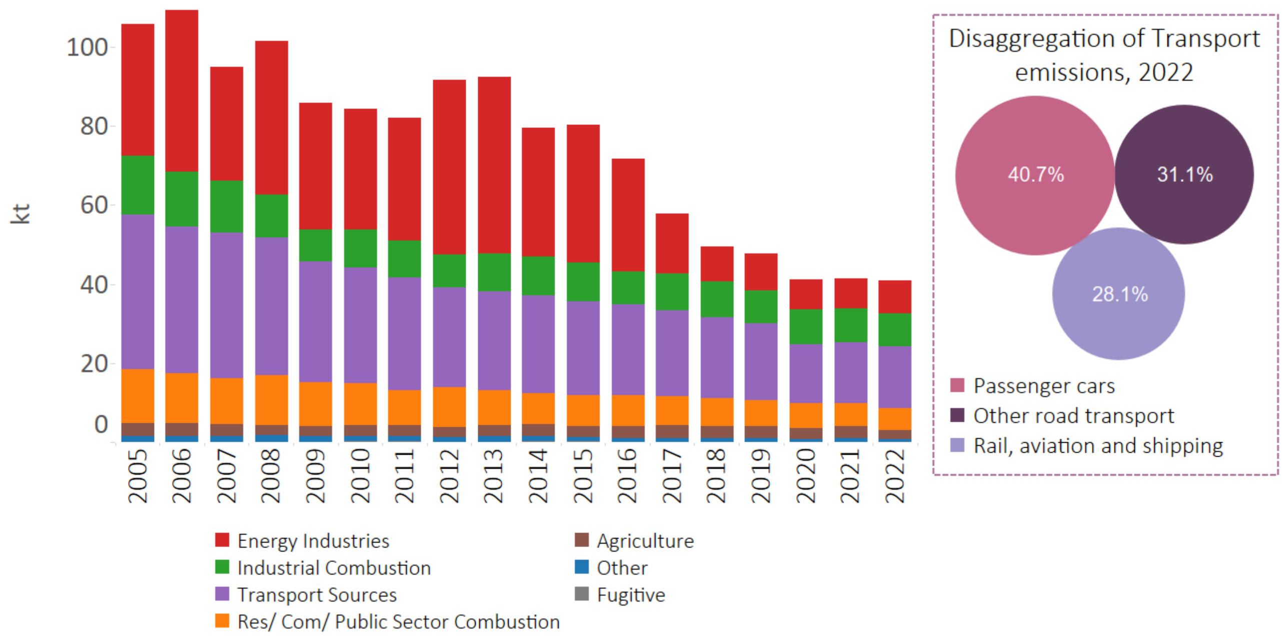
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of carbon monoxide in Wales were estimated to be 130kt in 2022 and have declined by 49% since 2005. Emissions in Wales accounted for 10% of the CO UK total in 2022. This decline in emissions stems from changes in the contribution of transport sources, particularly in the road transport sector where emissions have declined by 86% since 2005. This decline is primarily due to the penetration of vehicles compliant with more recent Euro standards, which required the fitting of emission controls (e.g. three-way catalytic converters) in new petrol vehicles. Improved catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles in 2008 also contribute to the trend. More recently, the switch from petrol cars to diesel cars, which have lower associated CO emissions rates, has also contributed to the observed trend. In more recent years, the industrial combustion sector has been growing in importance. Emissions from industrial combustion have declined by 57% since 2005, and contribute 39% to the overall CO trend. In addition, levels of activity within the iron and steel industry subsector are increasingly important. Iron and steel process sources such as sinter plants, basic oxygen furnaces and blast furnaces, and combustion sources were the largest source in 2022, representing 49% of CO emissions.

From 2021 to 2022, emissions of CO decreased by 24%. This has been driven by a 67% decrease in emissions from stationary combustion in the iron and steel sector (1A2a), which contributes to 84% of the trend. This is assumed to be driven by the decline in steel production in Port Talbot.

[16] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Figure 38 – Nitrogen Oxides Emissions in Wales

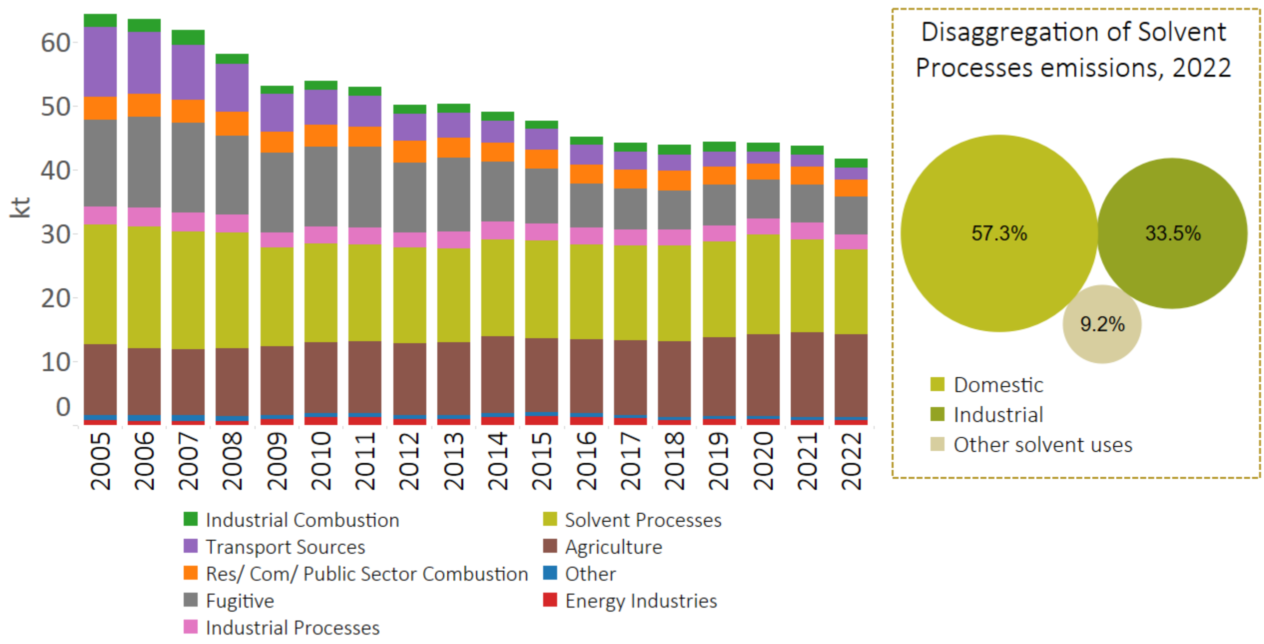


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of nitrogen oxides in Wales were estimated to be 41kt in 2022, representing 6% of the UK total for nitrogen oxides. Emissions have declined by 61% since 2005, mainly due to changes in transport sources, particularly in road transport. Emissions from road transport have declined by 61% since 2005, which contributes 27% to the overall NOx trend. This is driven by the successive introduction of tighter Euro emission standards, and the continued penetration of vehicles which comply with these standards. In addition, improvements in catalyst repair rates resulting from regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles contributes to the decline since 2008. However, the recent preferred uptake of diesel cars over petrol cars partly offsets these emissions reductions, because diesel cars emit higher NO_x relative to their petrol counterparts. The reduction in emissions from energy industries more recently corresponds to the reduction in coal use at Aberthaw power station since 2013, but in particular between 2017 and 2019. As of 2022, NO_x emissions from power stations have decreased by 87% since 2005, and are 91% lower than in 2013.

Between 2021 and 2022, emissions from NOx decreased by 2%, although emissions from transport (1A3) have increased by 3%. The overall decrease in NOx emissions is driven by a 12% decrease in iron and steel combustion emissions between 2021 and 2022.

Figure 39 – NMVOC Emissions in Wales



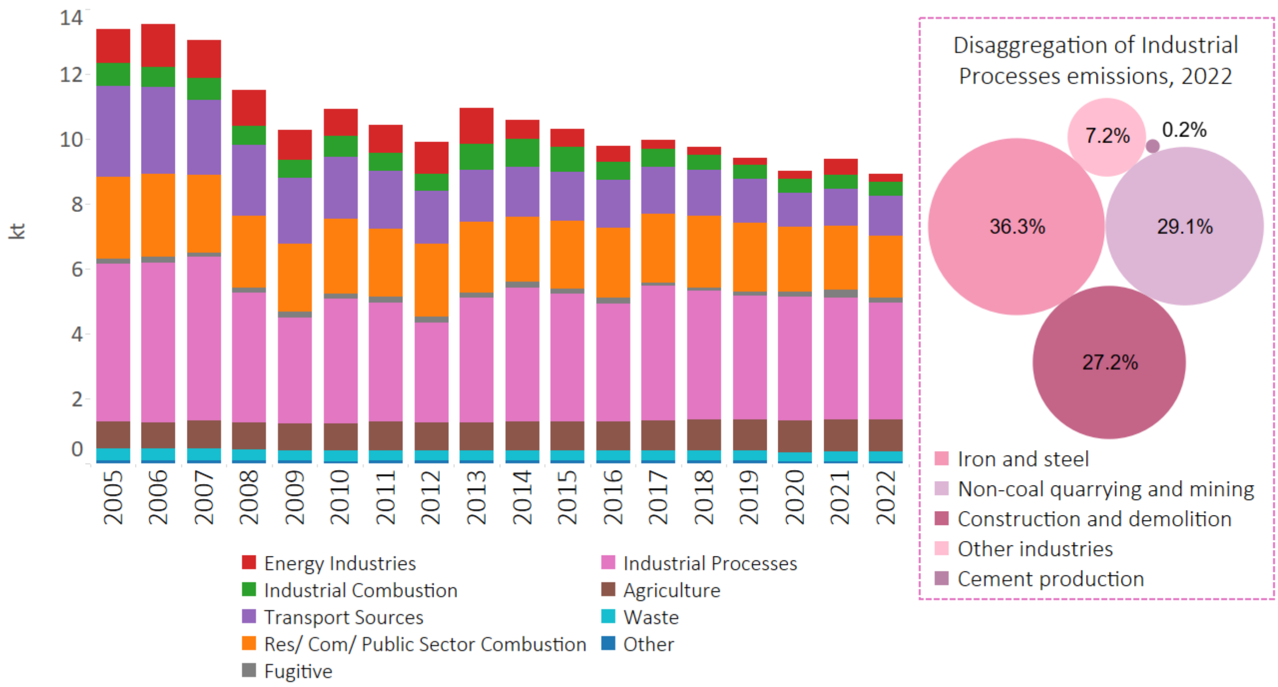
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of non-methane volatile organic compounds in Wales were estimated to be 42kt in 2022, representing 6% of the UK total for NMVOCs. Emissions have declined by 35% since 2005. This reduction is mainly due to the 86% decrease in emissions from road transport, as well as decreases to fugitive sources, including evaporative losses of fuel vapour from petrol vehicles, since 2005. The decline in road transport contributes 39% to the overall NMVOC trend, and coincides with the increasing proportion of diesel-fuelled vehicles in the passenger fleet which are associated with lower emissions rates of NMVOCs. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. Due to this large reduction in transport emissions, solvent processes are the most important source of NMVOC emissions in recent years, now accounting for 32% of NMVOC emissions, with the largest emissions arising from domestic solvent applications, and to a lesser extent industrial applications. Since 2005, NMVOC emissions from solvent use has decreased by 29%.

Agriculture accounts for 31% of NMVOC emissions in Wales in 2022. Cattle manure management and animal manure represent for 53% and 29% of all agricultural emissions respectively. In contrast to the overall decreasing trend in NMVOC emissions since 2005, emissions from agriculture have increased by 18% since 2005.

In 2022, emissions from NMVOCs decreased by 5% since 2021. This is largely driven by a 9% decrease in emissions from solvent use, which contributes 63% to overall NMVOC trend from 2021 to 2022.

Figure 40 – PM_{10} Emissions in Wales[17]



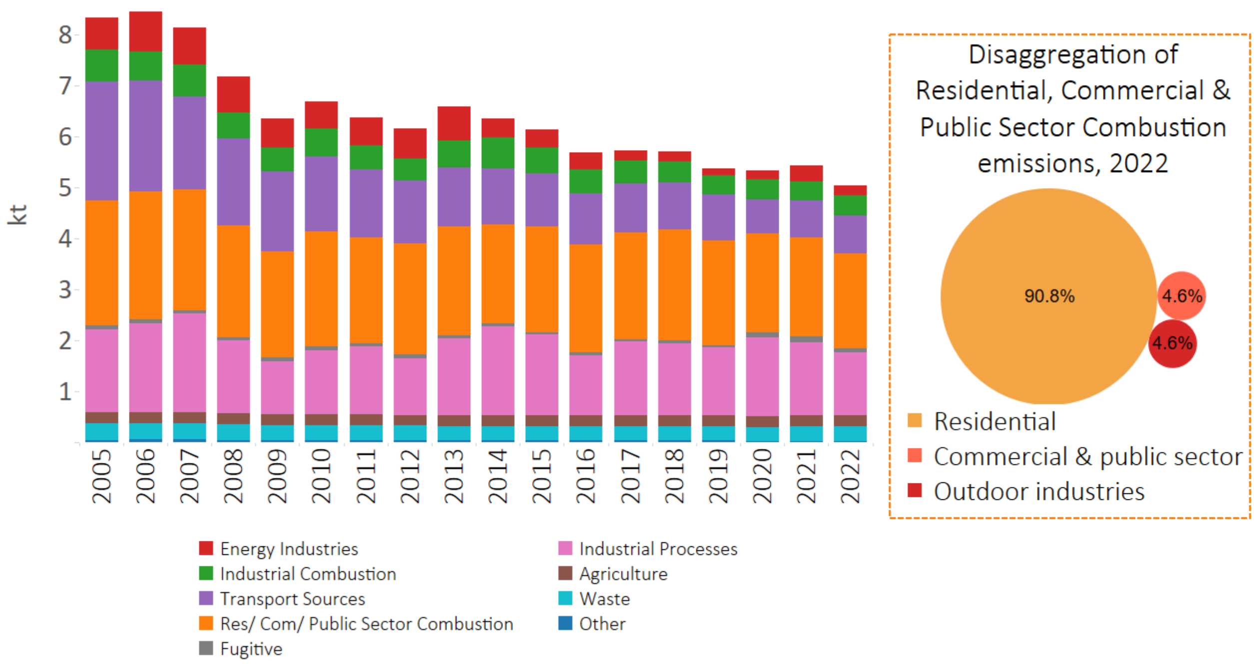
Note: The disaggregated emissions chart may not add up to 100% due to rounding

Emissions of PM_{10} in Wales were estimated to be 9kt in 2022 and have declined by 33% since 2005. These emissions account for 7% of the PM_{10} UK total in 2022. Unlike most other pollutants, the emission profile of PM10 is diverse. In order of % contribution to emissions in 2022, these sources include: industrial processes (40%), residential combustion (21%), transport sources (14%), agriculture (11%), and industrial combustion (5%). Iron and steel process sources such as sinter plants, basic oxygen furnaces and blast furnaces, and combustion sources, account for 17% of PM_{10} emissions in 2022. Recent trends have been influenced by each of these sectors, although there is no strong variation in overall emissions since 2011. In recent years, emissions from residential, commercial and public sector combustion have increased somewhat, and this is primarily due to increasing wood fuel use in the residential sector (DESNZ, 2023a).

In 2022, PM_{10} emissions have decreased by 5% since 2021. This is primarily driven by a 17% decrease in emissions from iron and steel occurred between 2021 and 2022 which has a 68% contribution to the overall PM_{10} trend. In addition, a 50% decrease in emissions from petroleum refining (1A1b) also contributes to the overall PM_{10} trend.

[17] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Figure 41 – $PM_{2.5}$ Emissions in Wales[18]



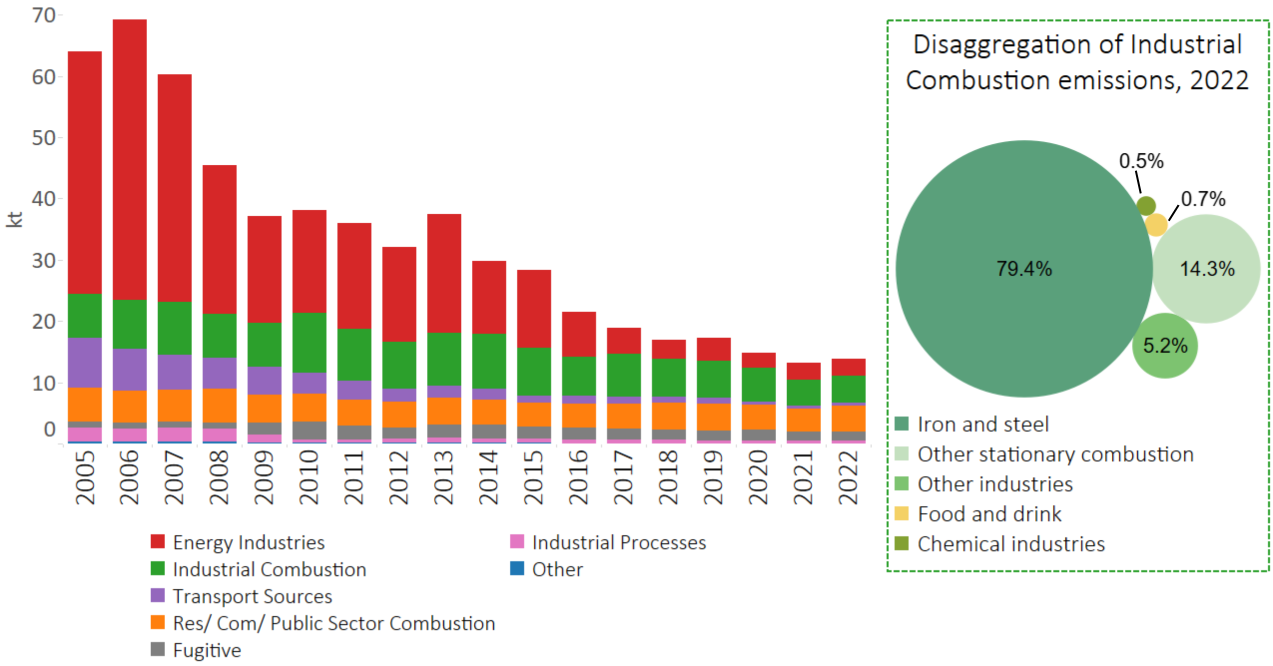
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of $PM_{2.5}$ in Wales were estimated to be 5kt in 2022 and have declined by 40% since 2005. These emissions account for 8% of the $PM_{2.5}$ UK total in 2022. As with PM_{10}, $PM_{2.5}$ emissions have a large number of significant sources. However, process emissions tend to produce coarser PM fractions and as such, combustion emissions are of greater importance for $PM_{2.5}$ compared to PM_{10}. For $PM_{2.5}$, the residential, commercial, and public sector combustion category (NFR 1A4, which also includes agricultural combustion and fishing vessels) accounts for 37% of 2022 emissions. The primary reasons for the declines in emissions since 2005 are the continued switch in the fuel mix used in electricity generation away from coal and towards natural gas, and reductions in emissions from the transport sector due to the turnover of the vehicle fleet, with the continued penetration of vehicles that comply with more stringent exhaust emissions standards over time. However, declines in emissions have been offset by increases in emissions from the residential sector, and in particular, the combustion of wood.

In 2022, $PM_{2.5}$ emissions decreased by 7% since 2021, which is largely driven by a 19% decrease in emissions from iron and steel production, contributing 59% to the overall $PM_{2.5}$ trend. There has also been a 49% decrease in emissions from petroleum refining (1A1b) between 2021 and 2022, which contributes 32% to the overall $PM_{2.5}$ trend.

[18] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 42 – Sulphur Dioxide Emissions in Wales[19]



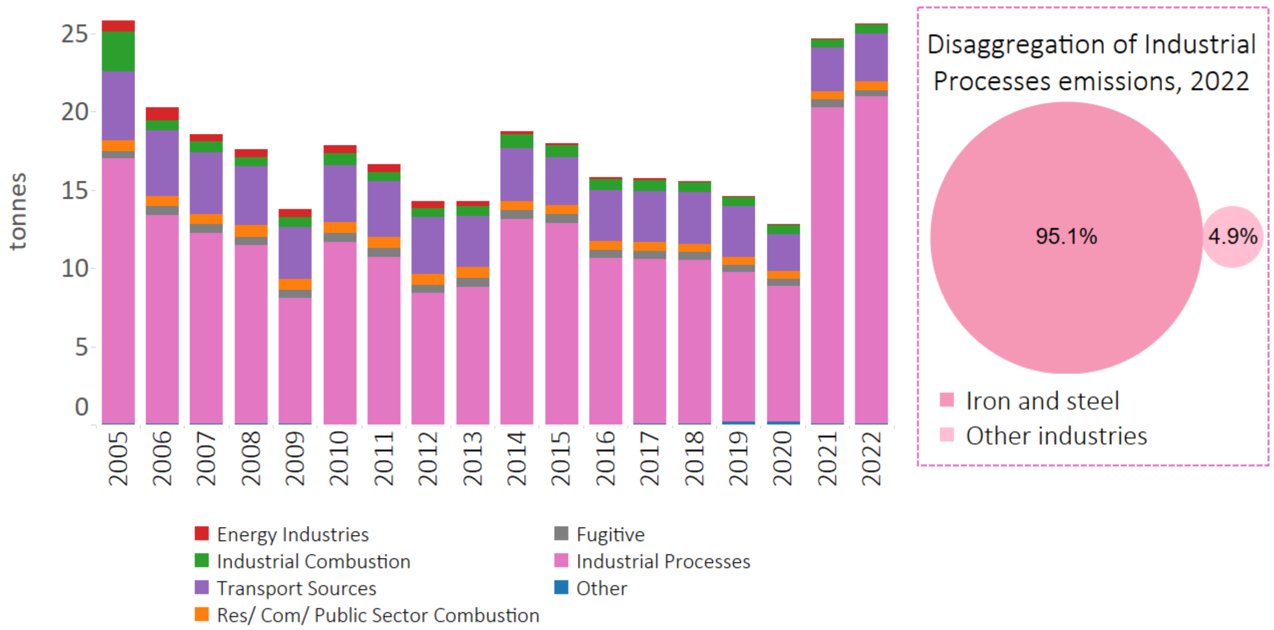
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of sulphur dioxide in Wales were estimated to be 14kt in 2022, representing 11% of the UK total for sulphur dioxide. Emissions have declined by 78% since 2005, which has been driven mainly by reductions in energy industries emissions. Power stations alone have seen a 99% drop in emissions in 2022 compared to 2005, which coincides with the continued UK-wide shift in power generation fuel mix away from coal and towards natural gas, nuclear, and renewable sources. Trends in recent years are influenced by emissions from a range of energy industries (power generation, oil refining) as well as the use of solid fuels in the residential sector and production trends (and related coal use) in the iron and steel industry.

In 2022, emissions from sulphur dioxide increased by 4%. This has in part been driven by a 17% increase in residential emissions since 2021.

[19] Other industries presented in the bubble graph relate to combustion emissions in the chemical, non-ferrous metals, pulp paper and print and other industries.

Figure 43 – Lead Emissions in Wales[20]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of lead in Wales were estimated to be 26 tonnes in 2022, representing 17% of the lead UK total. Emissions have declined by 0.7% since 2005. Industrial processes remains the largest source of lead emissions across the timeseries, with iron and steel contributing 79% of emissions in 2022.

In 2022, emissions increased by 4% since 2021, with iron and steel contributing to 67% of the increase. The importance of the sector to overall emissions means that the volatility in levels of production at Port Talbot steelworks play a primary role in dictating interannual trends, particularly in recent years where emissions have been highly variable.

[20] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Error! Reference source not found. below provides a summary of the percentage contribution of each sector for each pollutant in 2022. The table is shaded according to the overall contribution of that sector to the pollutant total, (with darker shades representing greater contribution). The majority of the most significant sectors are related to the combustion of fuel, whilst Industrial Processes is also significant for many pollutants, which is due to the iron and steel industry present in Wales. This table also highlights that although emissions from the agriculture sector are not as important when considering all pollutants, it is of very high significance when considering emissions of NH_3.

Table 4 - Source Emission Contributions Ranked by Sector, Wales 2022

Sector	NH3	CO	NOx	VOC	PM10	PM2.5	SO2	Pb	B[a]P	Dioxins	Hg
Agriculture	92.8%	NA	5.8%	31.1%	11.1%	4.4%	NA	NA	NA	NA	NA
Energy Industries	IE	2.1%	20.6%	1.8%	3.0%	3.7%	19.2%	0.3%	0.3%	1.7%	6.1%
Fugitive	IE	6.1%	0.1%	14.3%	1.6%	1.7%	9.7%	1.5%	5.8%	IE	IE
Industrial Combustion	IE	29.2%	19.9%	3.1%	4.8%	7.8%	32.2%	2.1%	0.3%	12.4%	27.2%
Industrial Processes	0.3%	29.6%	IE	5.7%	40.4%	24.4%	3.6%	81.8%	1.2%	29.0%	41.7%
Residential, Commercial & Public Sector Combustion	IE	22.1%	13.3%	6.1%	21.3%	36.8%	31.2%	2.1%	89.3%	27.7%	8.7%
Solvent Processes	IE	NA	NA	32.0%	IE	IE	NA	NA	IE	IE	NA
Transport Sources	1.0%	9.8%	38.6%	4.7%	13.7%	15.1%	3.9%	12.0%	1.0%	2.9%	4.0%
Waste	1.3%	1.0%	IE	IE	3.4%	5.5%	IE	IE	2.0%	26.1%	11.4%
Other	4.7%	0.1%	1.7%	1.2%	0.8%	0.6%	0.3%	0.2%	0.1%	0.2%	0.9%

* The sector: "other" will include all "other" categories in the inventory and also a number of categories that are insignificant for a specific pollutant. These have been marked in the table as "IE" (used in inventory reporting for "Included Elsewhere"). A breakdown of what is included within this category in respect to each pollutant can be found in **Table 32**.

Figure 44 – Ammonia Emissions in Wales, 2022

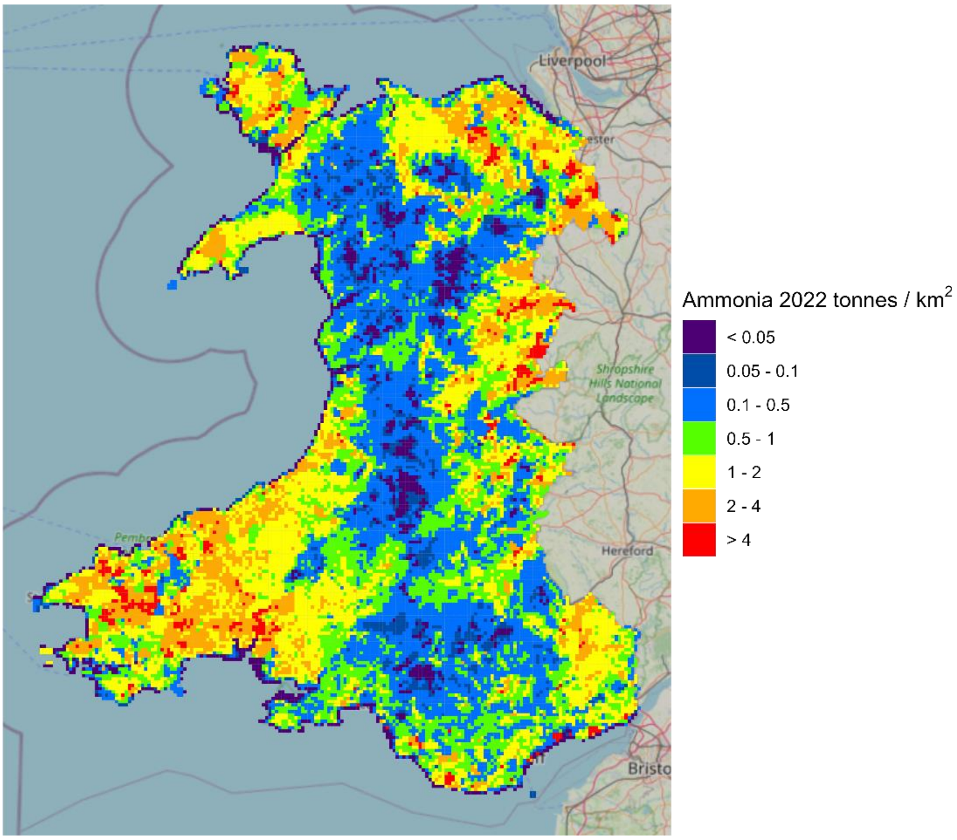


Figure 45 – Carbon Monoxide Emissions in Wales, 2022

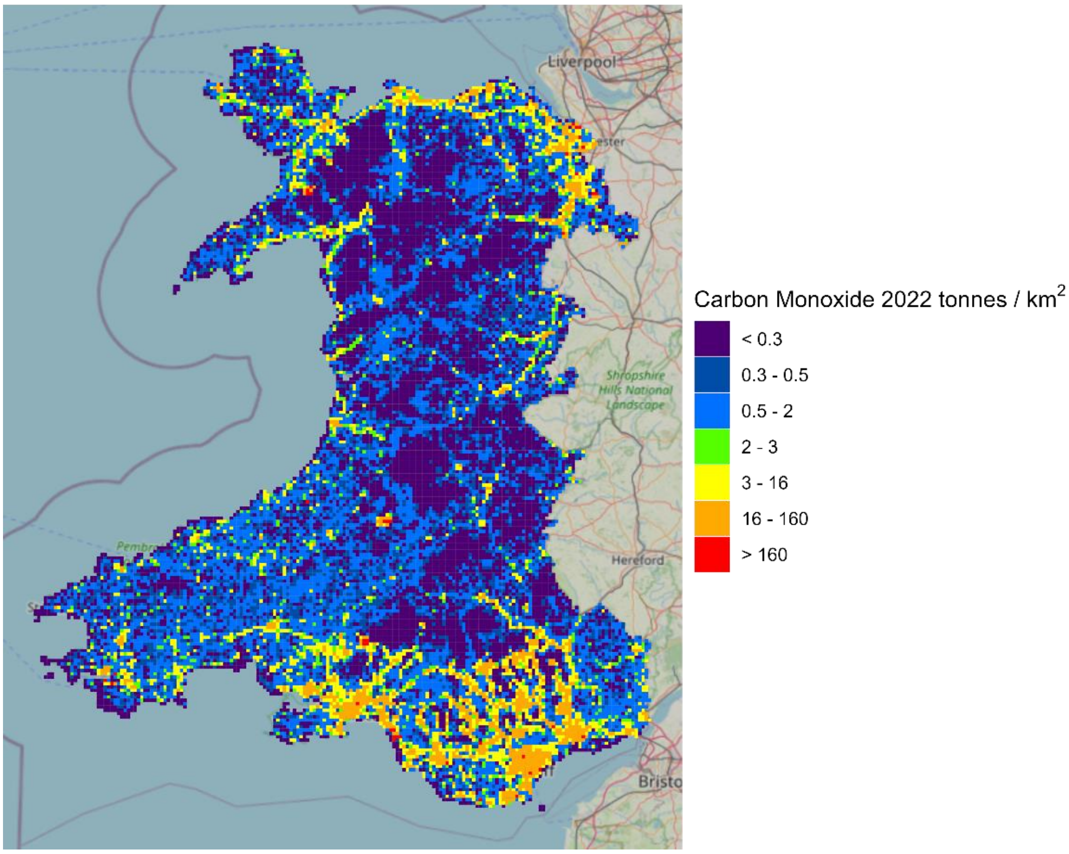


Figure 46 – Nitrogen Oxides Emissions in Wales, 2022

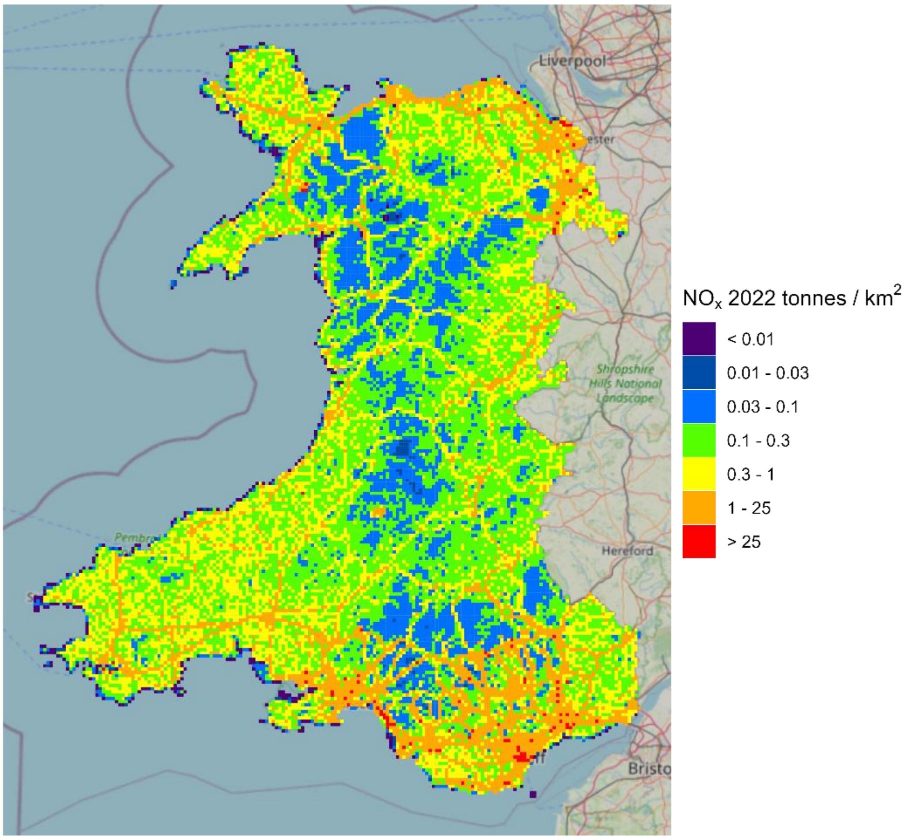


Figure 47 – NMVOC Emissions in Wales, 2022

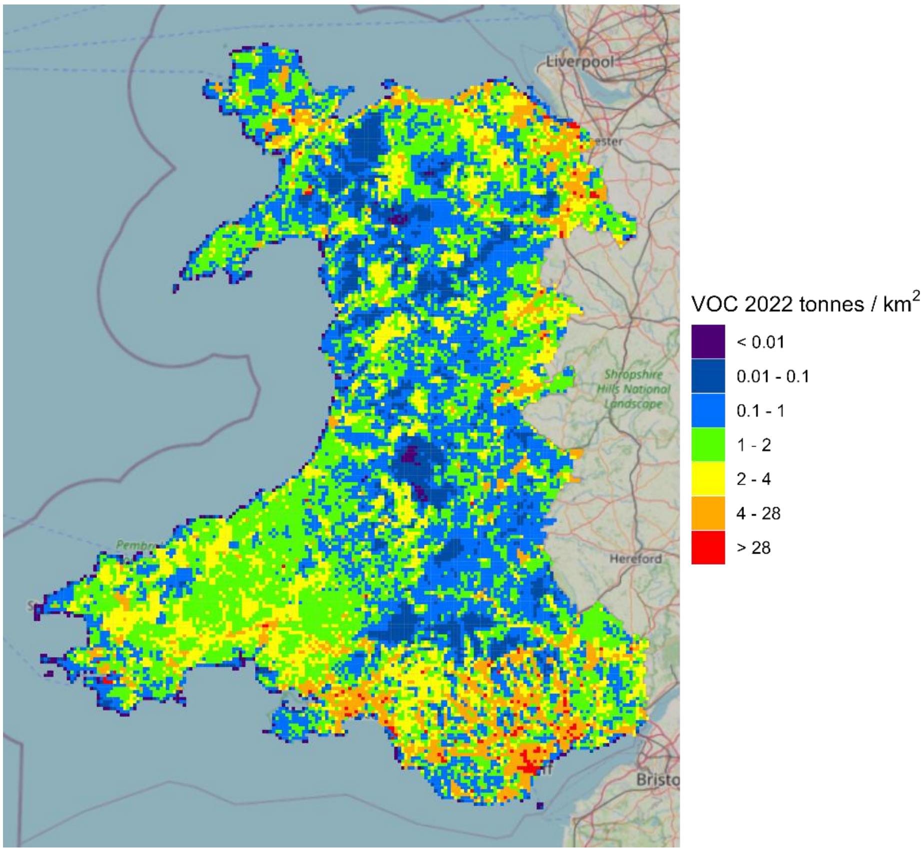


Figure 48– PM_{10} Emissions in Wales, 2022

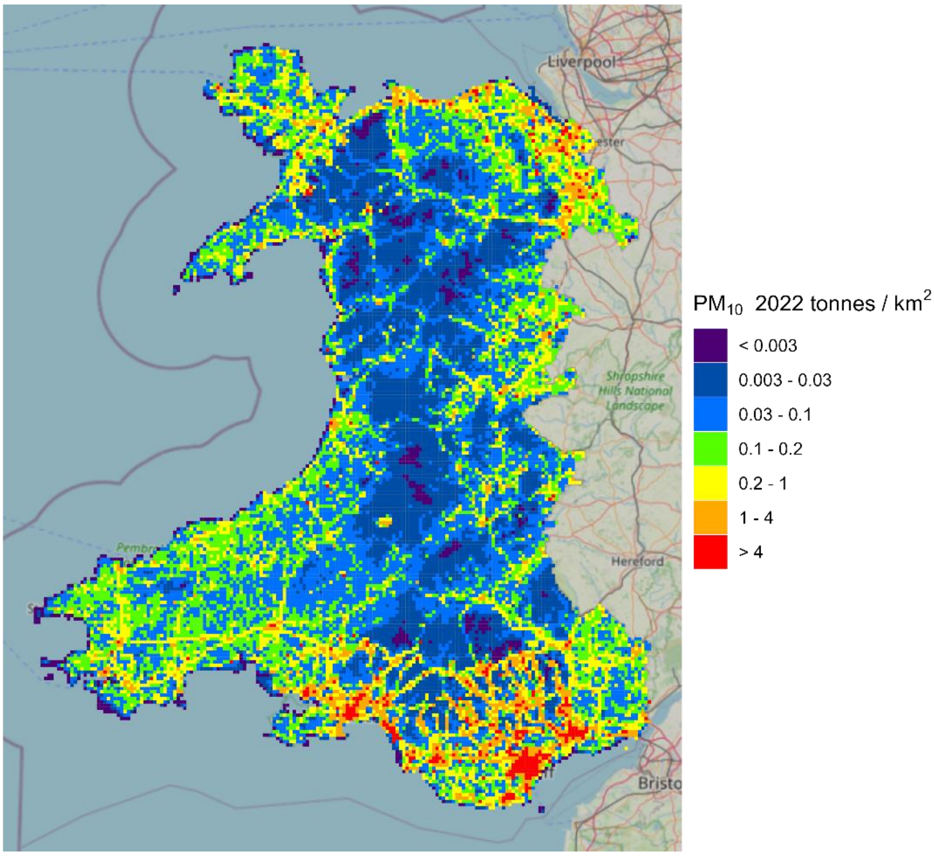


Figure 49 – $PM_{2.5}$ Emissions in Wales, 2022

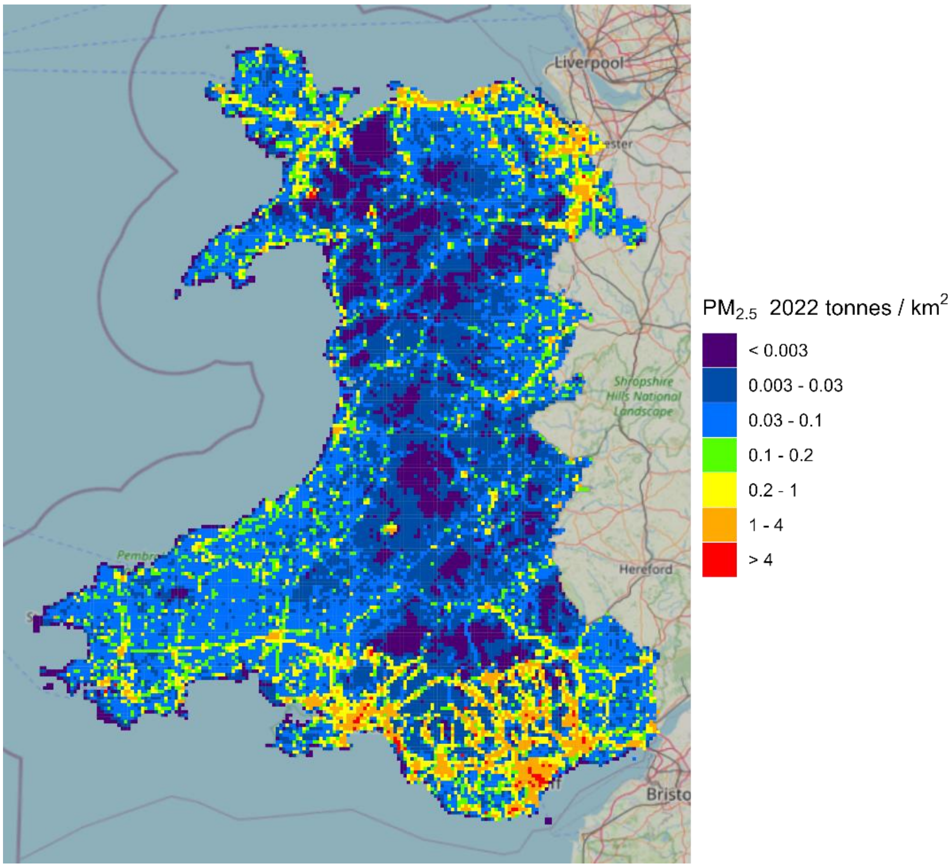


Figure 50 – Lead Emissions in Wales, 2022

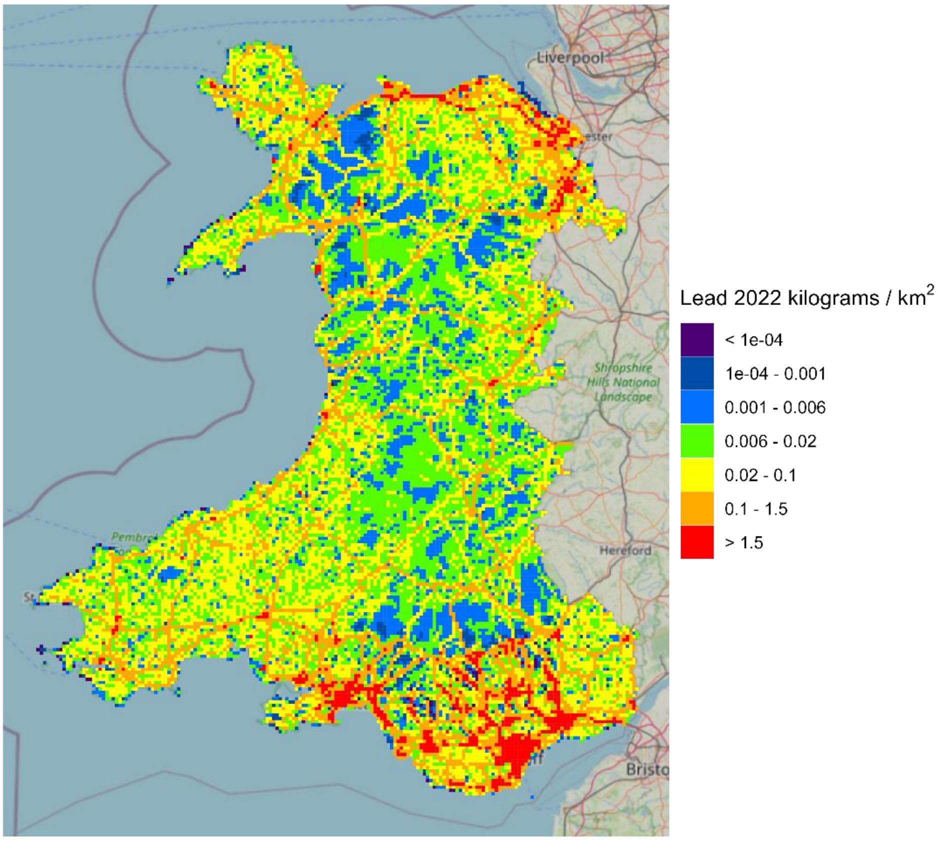
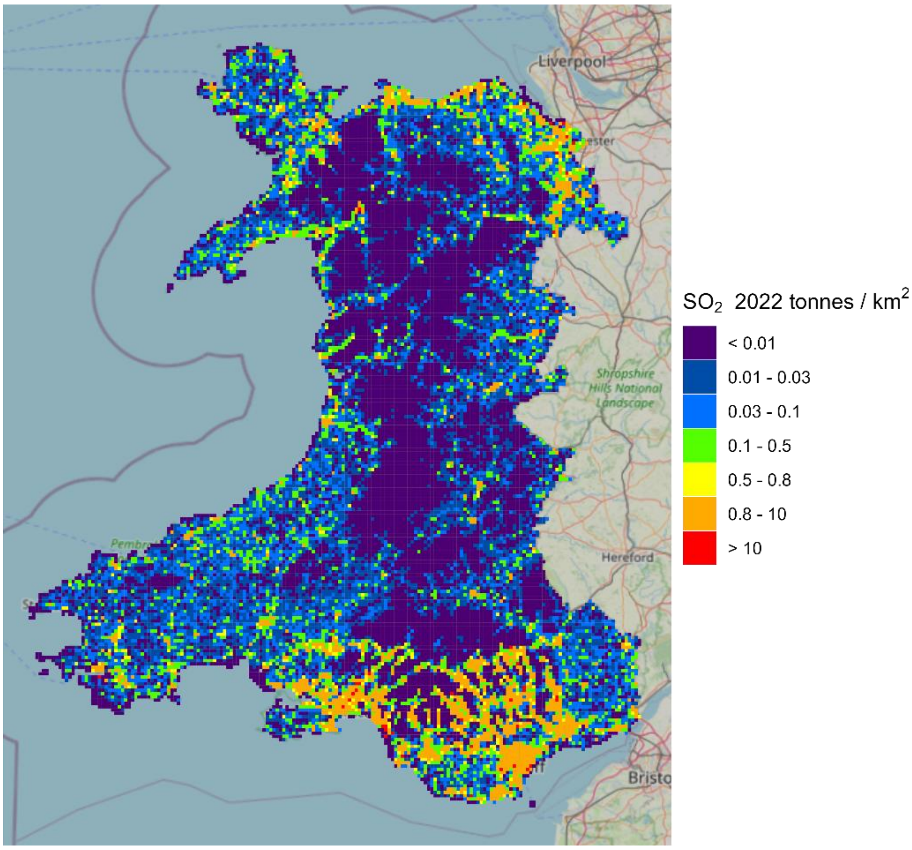


Figure 51 – Sulphur Dioxide Emissions in Wales, 2022



2.4 Northern Ireland

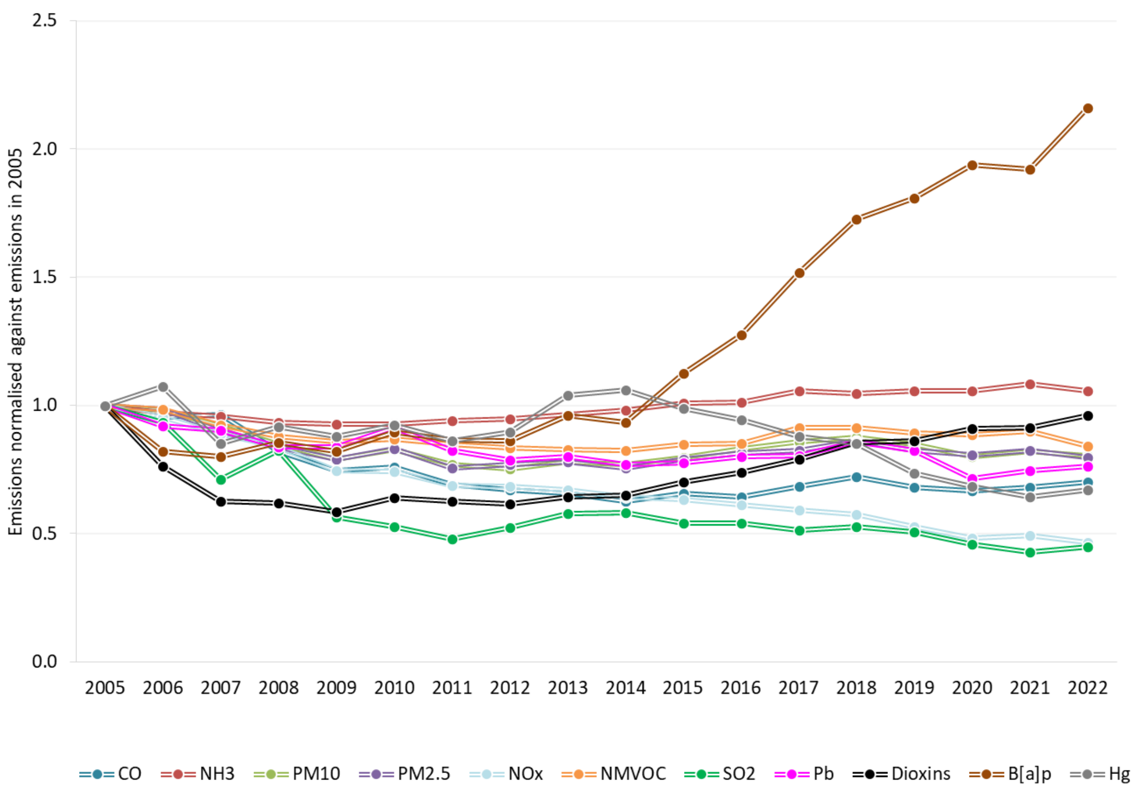
The following section provides a summary of emissions in Northern Ireland for the eight priority air pollutants: NH_3, CO, NO_X, NMVOCs, PM_{10}, $PM_{2.5}$, SO_2, and Pb. Information is also presented for emissions of PCDD/Fs, B[a]P, and Hg, with more detailed information for these three pollutants presented in **Appendix C.2**. Emissions of PCDD/Fs, B[a]P, and Hg should be considered as experimental statistics only[21]. **Appendix F** presents the data summary tables for England and each of the DAs, whilst **Appendix G** presents source category mapping used in the report**.**

Figure 52 shows emissions of all eleven air pollutants normalised to provide the relative rate of change since 2005. This graph shows that most pollutant levels are lower in 2022 than they were in 2005. The greatest rate of decline is observed in the trend for SO_2 with more modest declines observable for NO_X, CO, Hg, Pb, $PM_{2.5}$, and NMVOCs. Reductions in SO_2 since 2005 are due to a reduction in use of coal in several industries but predominantly in power generation, linked to the development of the natural gas pipeline to Northern Ireland that enabled fuel switching away from coal and oil-fired generation (DESNZ, 2022b).

NH_3 emissions, by contrast, have increased since 2010 due to rising dairy cattle numbers, and hence emissions from manure management practices for these animals, and also from the spreading of cattle manure to agricultural soils. In addition, there has been an increase in other nitrogen-based fertiliser use, primarily urea-based and digestate fertilisers.

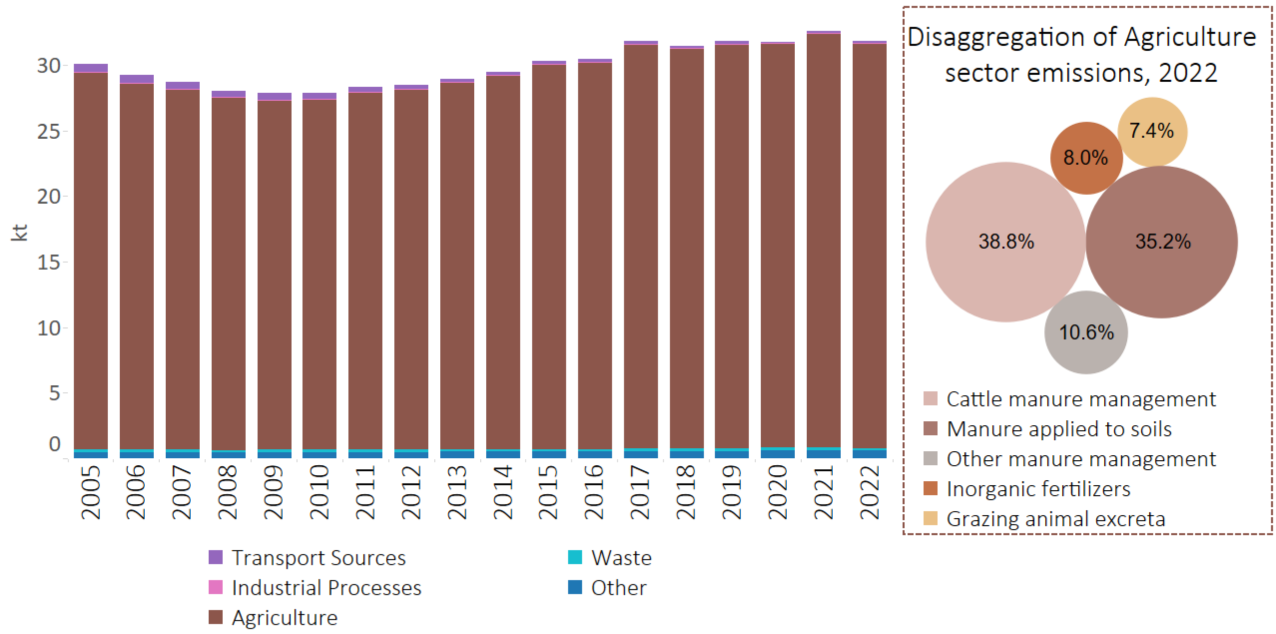
The increasing trend for B[a]P since the early 2010s is dominated by changes in emissions from domestic combustion, and in particular the growing use of wood as a fuel. The increase in dioxins emissions is also due to the growing use of wood as a fuel.

Figure 52 – Northern Ireland normalised trends for all pollutants



[21] The statistics are considered experimental as they have been recently developed: the benzo[a]pyrene and dioxin inventories were first developed for the 1990-2017 inventory published in 2019, whilst the mercury inventory was first developed for the 2005-2019 inventory published in 2021. While the inventories and trends have been interrogated and to ensure the suitability of methods for the most important sources, it is recognised that data quality on a subnational level is generally poor. As a result, these statistics are currently considered experimental only, and require further work to evaluate the methods used, to identify alternative methods that are more suitable, and to reduce the uncertainty in the early part of the time series. More information on the inventory methods used for B[a]P, dioxins, and mercury is available in **Appendix C**.

Figure 53 – Ammonia Emissions in Northern Ireland

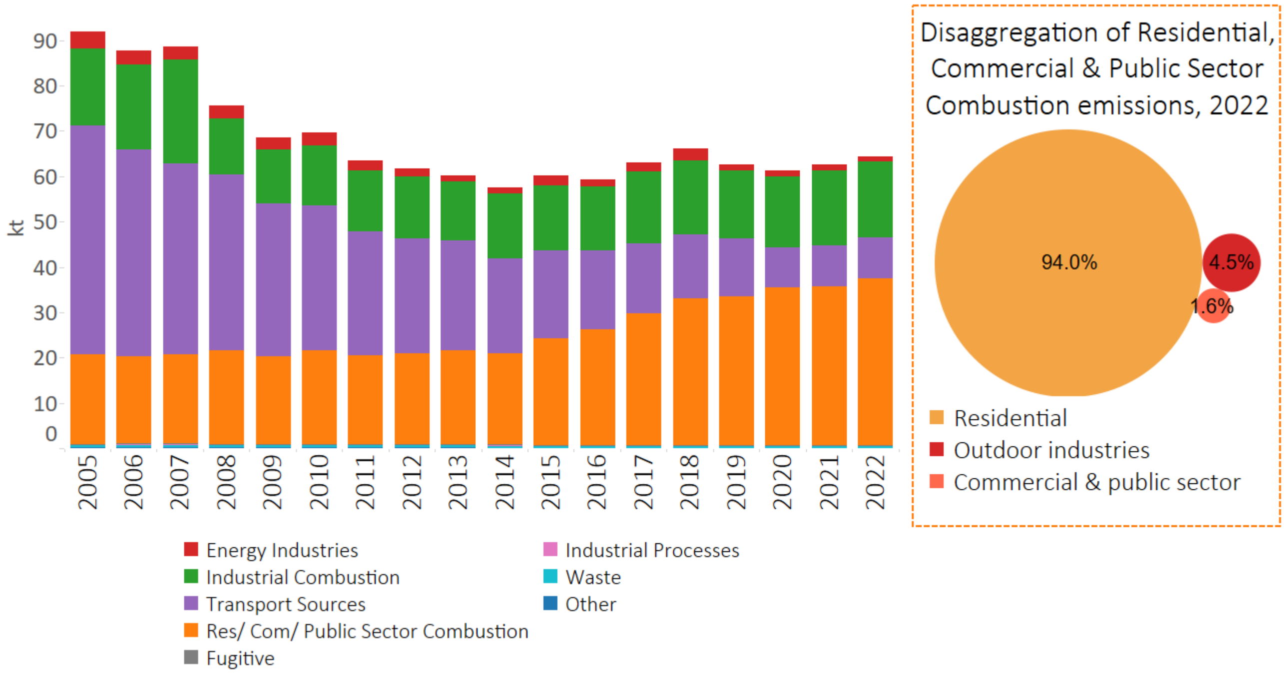


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of ammonia in Northern Ireland were estimated to be 32kt in 2022. Emissions have increased overall by 6% since 2005 and account for 12% of the ammonia UK total in 2022. Agriculture sources have dominated the inventory throughout the time series, with cattle manure management accounting to 38% of the emissions from this sector in 2022, and manure applied to soils (3Da2) contributing 34%. NH_3 emissions have increased since 2011 largely due to increasing dairy cow numbers and emissions associated with dairy manure management. Since 2017, the trend has plateaued, however, with slight declines in dairy cattle numbers and in mineral fertiliser use being offset by an increase in poultry numbers.

In 2022, emissions have decreased by 2% compared to 2021, which is largely due to a 6% decrease in emissions from manure applied to soils, accounting for 90% of the overall NH_3 trend.

Figure 54 – Carbon Monoxide Emissions in Northern Ireland[22]



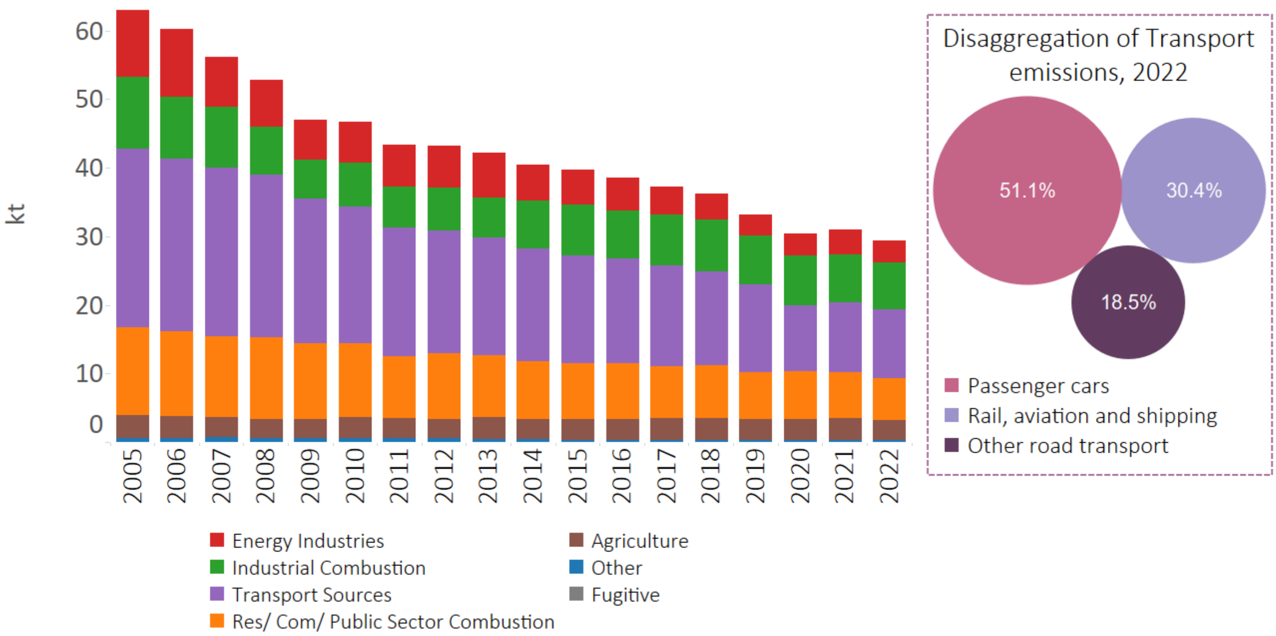
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of carbon monoxide in Northern Ireland were estimated to be 64kt in 2022 and have declined by 30% since 2005. Emissions in Northern Ireland accounted for 5% of the UK total in 2022. The decline in emissions stems largely from trends from transport sources. In particular, emissions from road transport have decreased by 85% since 2005. The decline is driven by the continuation and development of Euro standards first introduced in 1992 which requires fitting of emission controls (e.g. three-way catalytic converters) in new vehicles. Emissions from petrol vehicles, associated with higher emissions rates of CO, have been most impacted by these regulations. The more recent preference of diesel cars over petrol cars has further led to a decline in CO emissions from the transport sector. Finally, improvements in catalyst repair rates resulting from the introduction of regulations controlling the sale and installation of replacement catalytic converters and particle filters in light-duty vehicles, dictated by regulation from 2008, have contributed to a further decline. The impact of the expansion of the gas network in Northern Ireland in the early part of the time series is overshadowed by increases in the quantity of wood burned in the residential sector (DESNZ, 2023a), which is behind a 129% increase in emissions since 2005 (from NFR sector 1A4b: Residential combustion). There have been significant recalculations in this sector; please refer to **Appendix D** for further details.

In 2022, emissions increased by 3% since 2021. This is largely driven by a 6% increase in residential combustion emissions. There was a 1% increase in emissions in from transport emissions since 2021. Emissions from Stationary Combustion in Manufacturing Industries and Construction: Other (NFR code 1A2gviii) decreased by 2% between 2021 and 2022. This category contributes 9% of the total CO emissions for Northern Ireland in 2022.

[22] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 55 - Nitrogen Oxides Emissions in Northern Ireland

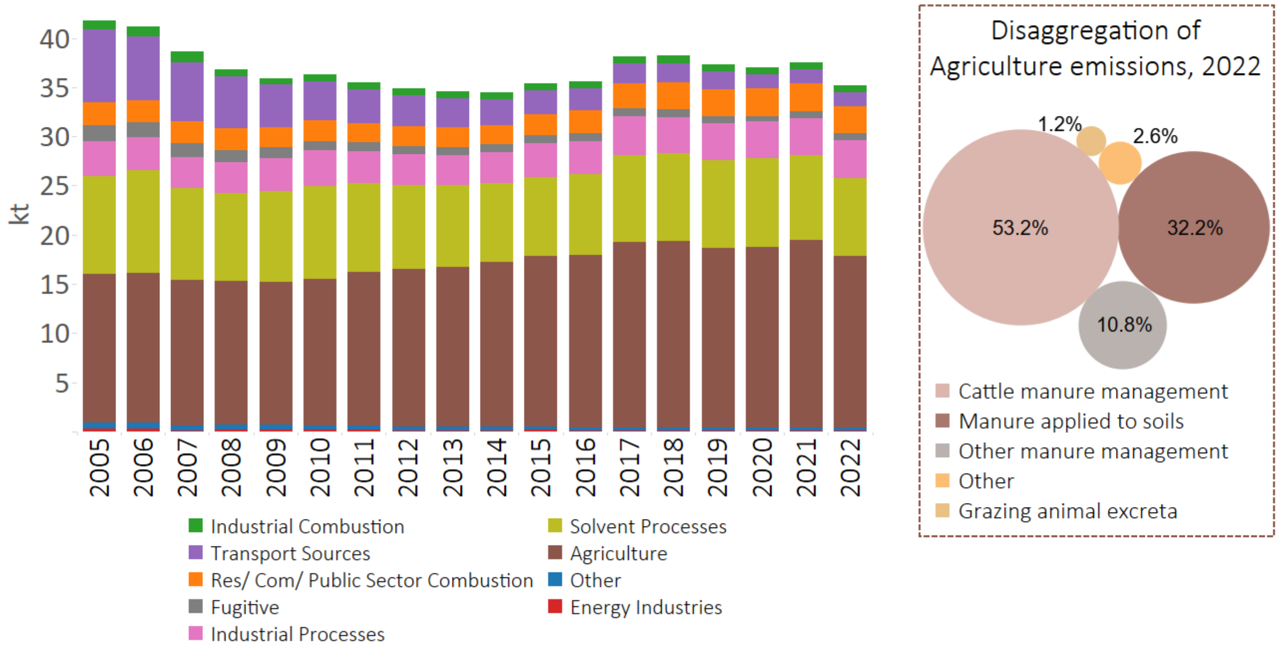


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of nitrogen oxides in Northern Ireland were estimated to be 29kt in 2022, representing 5% of the UK total for nitrogen oxides in 2022. Emissions have declined by 53% since 2005, principally due to changes in transport sources, particularly in road transport. Since 2005, NO_X emissions have reduced by 66% from the road transport sector, which contributes 41% to the overall NO_X trend. The successive introduction of tighter exhaust emission standards for vehicles over the past few decades, and the associated penetration of vehicles that comply with these standards into the fleet have led to these reductions. Further reductions are due to improvements in catalyst repair rates resulting from the introduction of regulations controlling the sale and installation of replacement catalytic converters and particle filters for light-duty vehicles. However, the recent preferential uptake of diesel cars over petrol counterparts works to offset these reductions, as diesel cars are associated with higher NO_X emissions rates. Energy industries have also had a notable impact on the trend, due to the implementation of abatement technologies, and, more recently, the reductions in the amount of coal used as operations at Kilroot power station begin to phase down.

In 2022, emissions from nitrogen oxides decreased by 5% since 2021. This is largely driven by an 11% decrease from the energy sector (1A1), which contributes 27% to the overall NO_X trend. Emissions from the transport sector decreased by 1% since 2021.

Figure 56 – NMVOC Emissions in Northern Ireland

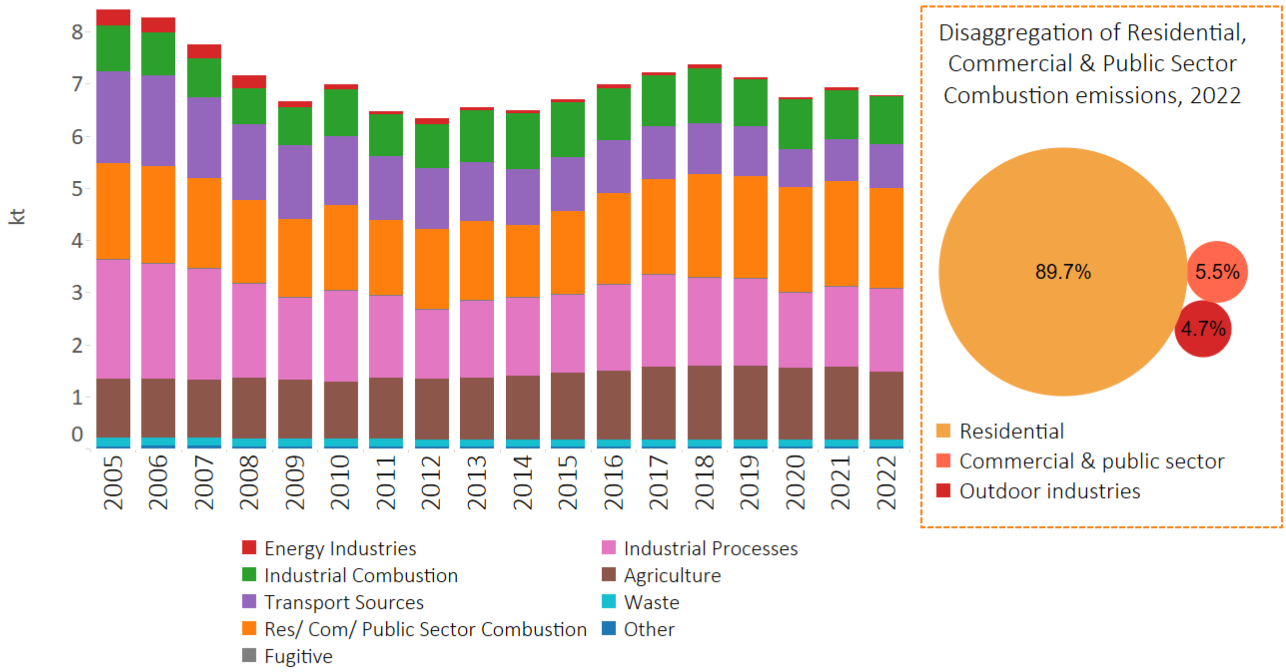


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of non-methane volatile organic compounds in Northern Ireland were estimated to be 35kt in 2022, representing 5% of the UK total for NMVOCs. Emissions have declined by 16% since 2005 driven by reductions in the transport sector in the early portion of the time series. This decline is coincident with the increasing proportion of diesel fuelled vehicles in the passenger fleet and improved fuel economy. Whilst transport emissions continually decreased across the time series, annual reductions slowed after 2012. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. Later in the timeseries, agriculture is the most important source of NMVOC emissions, contributing 50% of emissions in 2022. Within this, emissions from cattle manure management contribute 53% to total agriculture emissions in 2022.

In 2022, emissions from NMVOCs decreased by 6% since 2021. This is largely driven by a 19% decrease in emissions from manure applied to soils (3Da2a), which contributes 54% to the overall NMVOC trend from 2021 to 2022.

Figure 57 – PM_{10} Emissions in Northern Ireland[23]



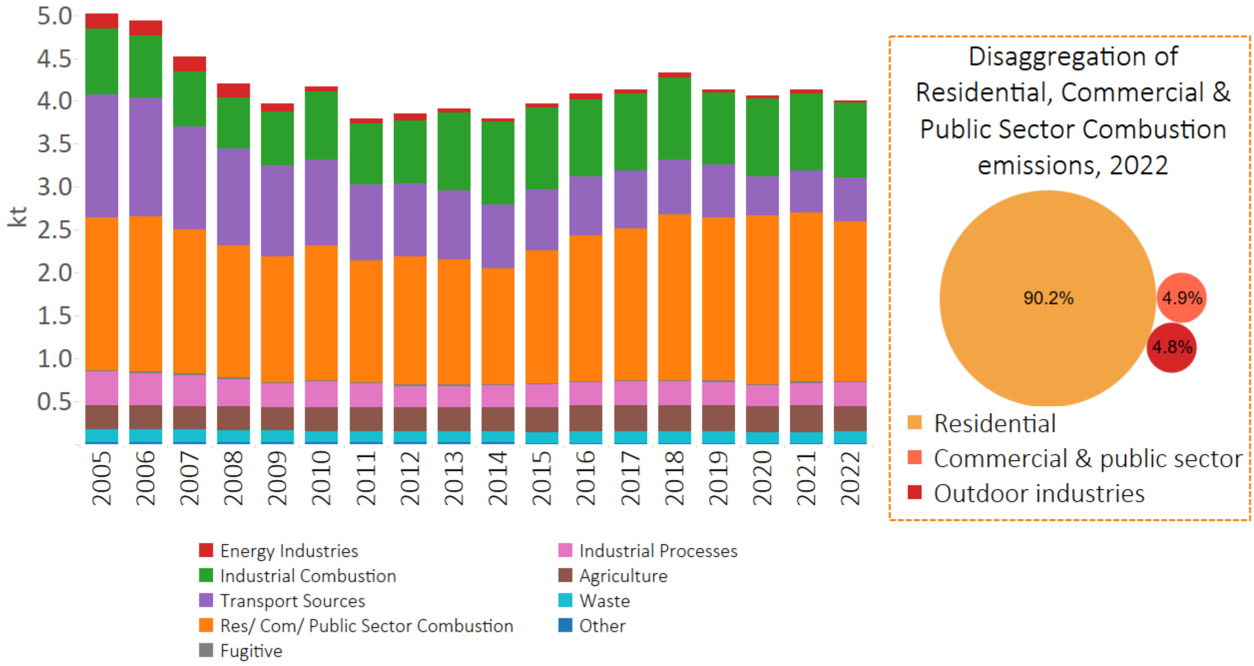
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of PM_{10} in Northern Ireland were estimated to be 7kt in 2022 and accounted for 5% of the UK total for PM_{10}. Emissions have decreased by 19% since 2005. PM_{10} exhaust emissions from vehicles have been decreasing due to the successive introduction of tighter emission standards over time, while non-exhaust PM_{10} emissions from vehicles have been increasing due to increasing traffic activity. In recent years, emissions from residential, commercial and public sector combustion have primarily increased, coinciding with increased wood fuel use in the residential sector (DESNZ, 2023a). These two trends offset one another meaning that there is no major trend in PM_{10} emissions across the time series.

In 2022, emissions decreased by 2% since 2021. This has largely been driven by a 5% decrease in emissions from residential combustion which contributes 65% to the overall PM_{10} trend.

[23] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 58 - $PM_{2.5}$ Emissions in Northern Ireland[24]



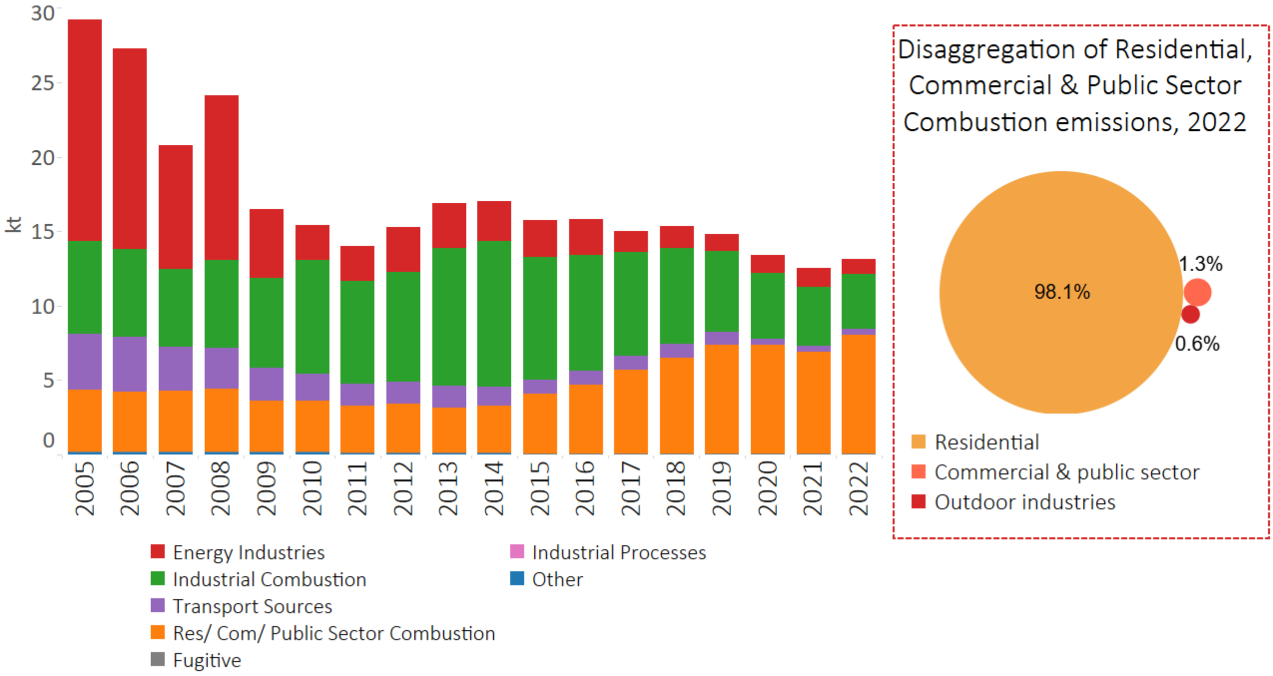
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of $PM_{2.5}$ in Northern Ireland were estimated to be 4kt in 2022 and accounted for 6% of the UK total for $PM_{2.5}$. Emissions have decreased by 20% since 2005. As with PM_{10}, $PM_{2.5}$ emissions have a large number of significant sources. However, process emissions tend to produce coarser PM fractions and as such, combustion emissions are of greater importance for $PM_{2.5}$ compared to PM_{10}. For $PM_{2.5}$, residential combustion has increased by 57% since 2005, and accounts for 42% of 2022 emissions. Emissions from transport have decreased by 64% since 2005, which contributes 90% to the overall $PM_{2.5}$ trend. This is due to progressively more stringent exhaust emissions standards over time.

In 2022, emissions of $PM_{2.5}$ decreased by 3% since 2021. This is driven by a 5% decrease in residential emissions since 2021, which contributes 73% of this trend.

[24] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 59 – Sulphur Dioxide Emissions in Northern Ireland[25]

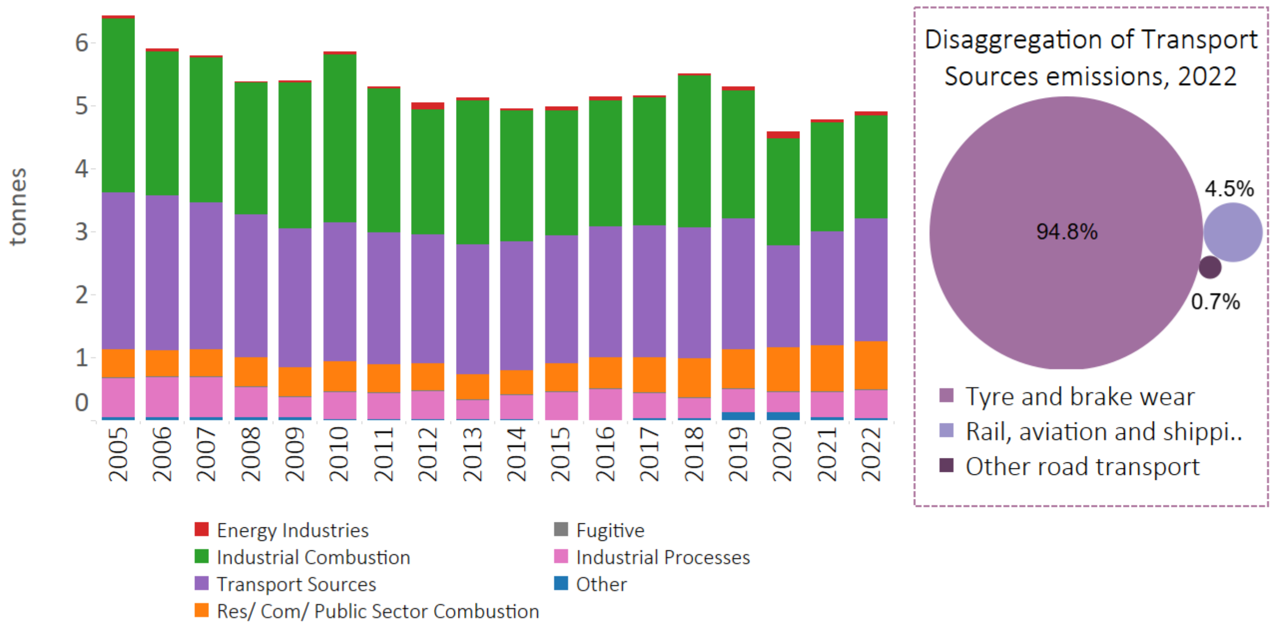


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of sulphur dioxide in Northern Ireland were estimated to be 13kt in 2022, representing 11% of the UK total for sulphur dioxide. Emissions have declined by 55% since 2005, which has been dominated by the 93% reduction in power station emissions due to the introduction of CCGT (Combined Cycle Gas Turbine) plants, which are more efficient than conventional coal and oil power stations and have negligible SO_2 emissions. In addition, as the natural gas network has expanded to different parts of Northern Ireland, other sectors have also shown step-changes in emissions as fuel switching away from coal and oil has been made possible. In 2022, power stations contributed 8% of SO_2 emissions. In 2022, 60% of the SO_2 emissions come from residential combustion, an increase of 167% since 2005. This is due to an increase in the residential combustion of petroleum coke.

[25] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 60 – Lead Emissions in Northern Ireland



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of lead in Northern Ireland were estimated to be 5 tonnes in 2022, representing 3% of the UK total for lead. Emissions have declined by 24% since 2005. The most important sources of emissions are transport sources and industrial combustion, which account for 40% and 34% of the 2022 Northern Ireland total, respectively. Lead emissions from transport have decreased by 22% since 2005. Non-exhaust emissions (such as brake wear and tyre wear) are related to the vehicle-kilometres driven, and unlike exhaust emissions, are unregulated. Therefore, the trend in road transport emissions is a reflection of the vehicle-kilometres driven on Northern Ireland’s roads. Emissions from the industrial combustion sector show a high degree of volatility across the time series, particularly from unallocated sectors (NFR sector 1A2gviii) and is driven by the interannual variation in the use of fuels associated with high levels of Pb emissions, such as wood and municipal solid waste (MSW).

In 2019 and 2020, there is an increase in lead emissions from the ‘Other’ category. This is driven by variations in lead emissions associated with different aviation fuel types used in military aircraft at a UK level.

In 2022, lead emissions increased by 3% since 2021. This is largely driven by a 7% increase in transport emissions.

Table 5 below provides a summary of the percentage contribution of each sector for each pollutant in 2022. The table is shaded according to the overall contribution of that sector to the pollutant total, (with darker shades representing greater contribution). The table indicates that the residential, commercial & public combustion sector is a substantial sector when considering emissions for B[a]P, SO_2, CO, Dioxins, $PM_{2.5}$, PM_{10}, Hg, and NOx accounting for at least 20% of emissions for each pollutant.

The majority of the most significant sectors are related to the combustion of fuel, except for agriculture, which is an important sector in Northern Ireland when considering NH_3, NMVOC, and PM_{10}.

Table 5 - Source Emission Contributions Ranked by Sector, Northern Ireland 2022

Sector	NH3	CO	NOx	VOC	PM10	PM2.5	SO2	Pb	B[a]P	Dioxins	Hg
Agriculture	97.0%	NA	9.7%	49.5%	19.1%	7.5%	NA	NA	NA	NA	NA
Energy Industries	IE	1.9%	11.0%	0.2%	0.4%	0.6%	7.6%	1.1%	0.1%	0.3%	7.0%
Fugitive	IE	0.0%	0.0%	2.0%	0.2%	0.4%	IE	IE	IE	IE	IE
Industrial Combustion	IE	25.8%	23.1%	2.0%	13.7%	21.9%	28.2%	33.6%	0.1%	26.8%	49.1%
Industrial Processes	0.0%	0.1%	IE	10.9%	23.6%	6.8%	0.2%	9.3%	0.1%	0.4%	1.9%
Residential, Commercial & Public Sector Combustion	IE	56.9%	20.9%	7.8%	28.2%	46.5%	60.8%	15.6%	98.9%	53.3%	26.3%
Solvent Processes	IE	NA	NA	22.6%	IE	IE	NA	NA	IE	IE	NA
Transport Sources	0.5%	14.3%	34.2%	4.1%	12.2%	12.8%	3.0%	39.7%	0.4%	2.0%	5.7%
Waste	0.6%	0.9%	IE	IE	2.1%	3.3%	IE	IE	0.4%	17.2%	10.0%
Other	1.9%	0.1%	1.1%	0.9%	0.5%	0.4%	0.2%	0.6%	0.0%	0.0%	0.1%

* The sector: “other” will include all “other” categories in the inventory and also a number of categories that are insignificant for a specific pollutant. These have been marked in the table as “IE” (used in inventory reporting for “Included Elsewhere”). A breakdown of what is included within this category in respect to each pollutant can be found in **Table 32**.

Figure 61 – Ammonia Emissions in Northern Ireland, 2022

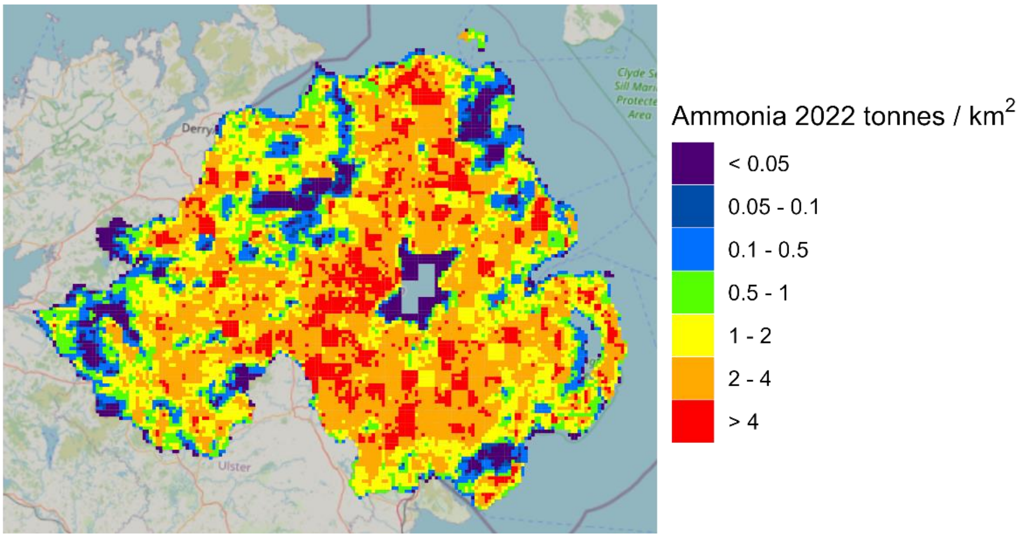


Figure 62 – Carbon Monoxide Emissions in Northern Ireland, 2022

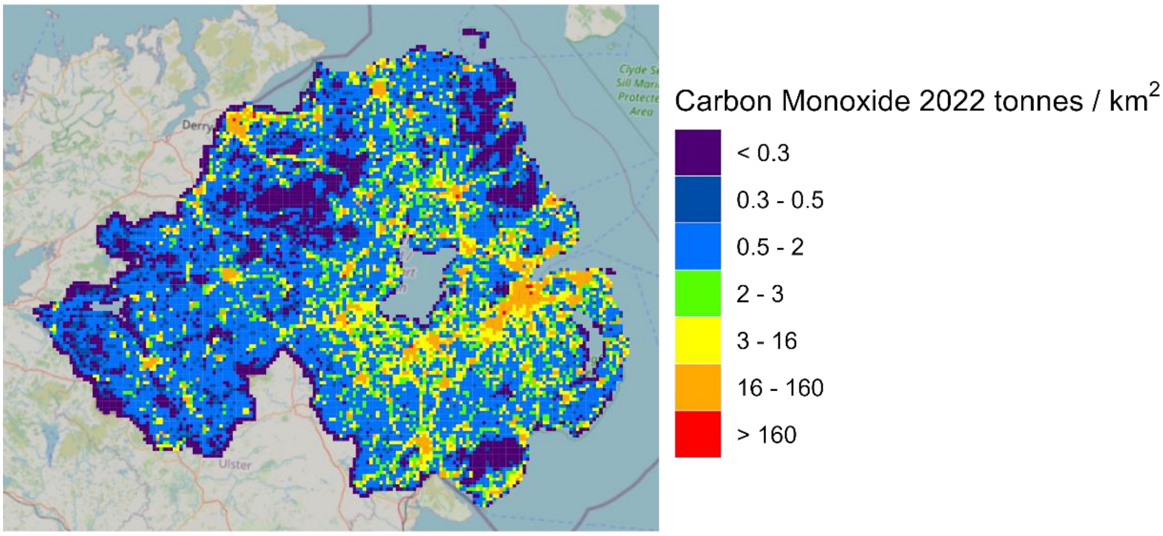


Figure 63 – Nitrogen Oxides Emissions in Northern Ireland, 2022

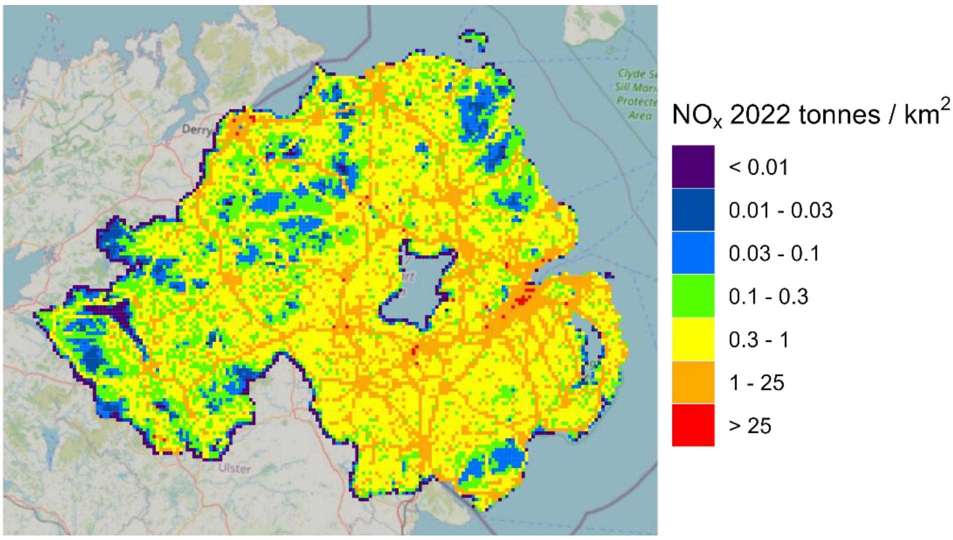


Figure 64 – NMVOC Emissions in Northern Ireland, 2022

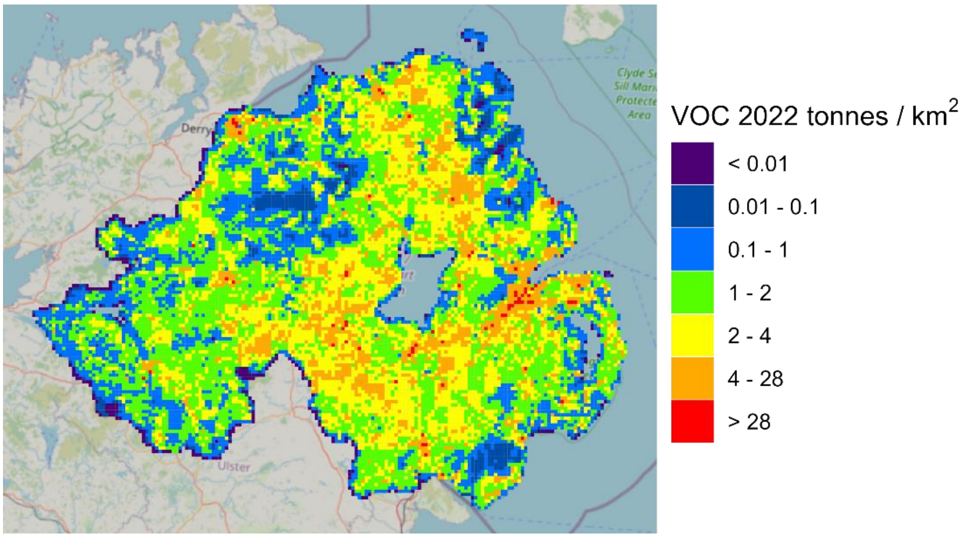


Figure 65 – PM_{10} Emissions in Northern Ireland, 2022

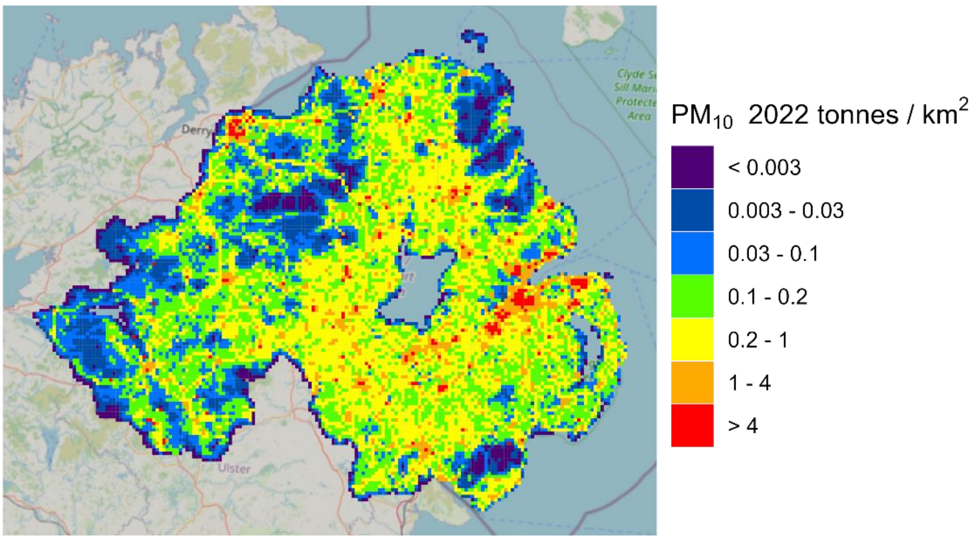


Figure 66 – $PM_{2.5}$ Emissions in Northern Ireland, 2022

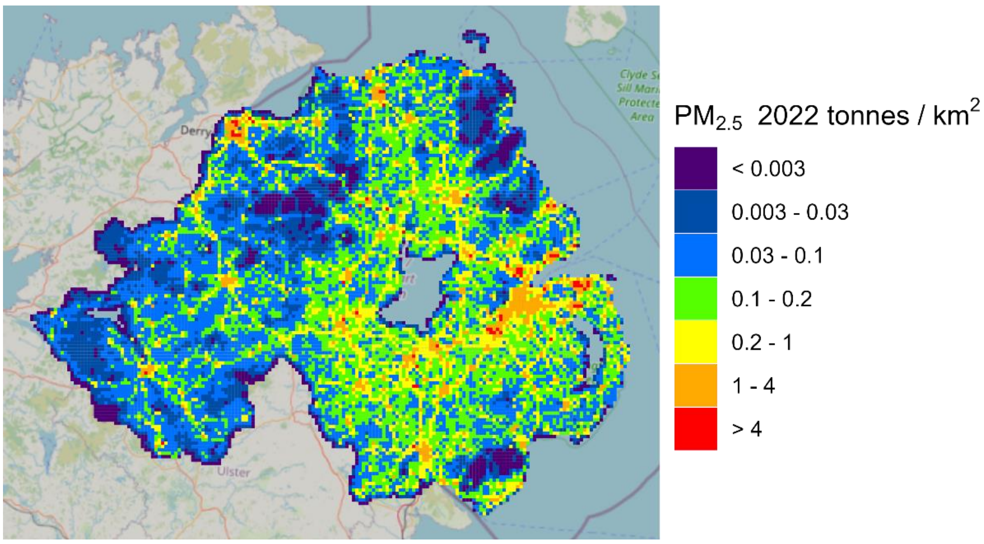


Figure 67 – Lead Emissions in Northern Ireland, 2022

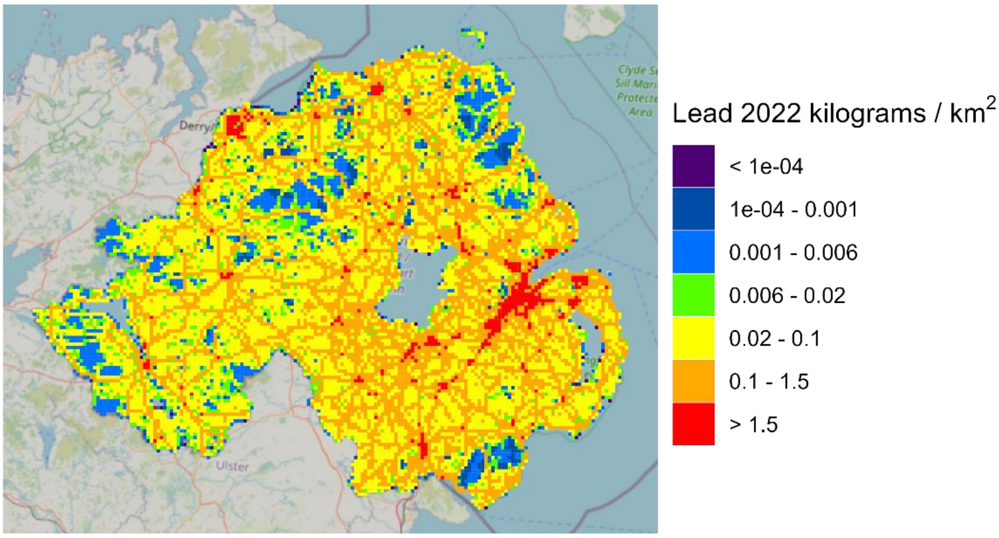
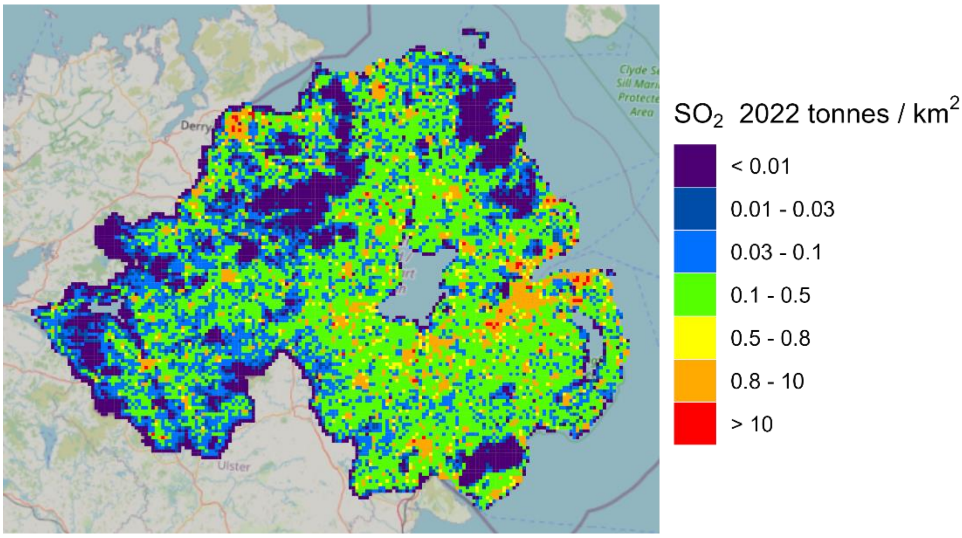


Figure 68 – Sulphur Dioxide Emissions in Northern Ireland, 2022



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Appendix A Background to Inventory Development

The following sections provide further detail on the development of the air pollutant inventories for England and the Devolved Administrations. This is supporting information for **Section 1.1** of the main report.

The latest inventory data shows that the UK continues to meet international ceilings for nitrogen oxides, ammonia, non-methane volatile organic compounds, and sulphur dioxide emissions. Further information on UK emissions trends can be found in the Defra Accredited Official Statistics Release: Emissions of air pollutants in the UK, 1970 to 2022, see: https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-background

A.1 National Emissions Ceilings Regulations

The National Emission Ceilings Regulations 2018 (NECR) [26] transposes the obligations of the National Emission Ceilings Directives (Directive 2001/81/EC and 2016/2284/EU) into UK law.

The National Emissions Ceilings Regulations set UK level emission reduction commitments (ERCs) for SO_2, NO_X, NMVOC and NH_3 between 2010 and 2019. These have now been superseded by the current, more stringent ERCs which are applicable from 2020-29 and 2030 onwards for the total emissions of SO_2, NO_x, NMVOC, NH_3, and $PM_{2.5.}$

The UK has met its ERCs for SO_2, NO_x, NMVOC, and $PM_{2.5}$ for 2020- 2022.[27]

A.2 Gothenburg Protocol

The UK, EU Member States, Central and Eastern European countries, the United States and Canada negotiated the ‘multi-pollutant’ protocol under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) to address photochemical pollution, acidification, and eutrophication. The Protocol to Abate Acidification, Eutrophication and Ground-level Ozone was adopted in Gothenburg in December 2000 (Gothenburg Protocol) and amended in 2012, to include particulate matter (PM) and black carbon, and national ERCs to be achieved by 2020 and beyond[28.]

It incorporates several measures to facilitate the reduction of emissions:

- Emission ceilings are specified for sulphur dioxide, nitrogen oxides, ammonia and NMVOCs, which were to be attained between 2010-2019;
- Variable emission reduction commitments for 2020 onwards, based on a percentage reduction from a 2005 baseline, are detailed for sulphur dioxide, nitrogen oxides, ammonia, NMVOCs, and $PM_{2.5}$;
- Emission limits are specified for sulphur, nitrogen oxides and NMVOCs from stationary sources;
- Emission limits are indicated for carbon monoxide, hydrocarbons, nitrogen oxides and particulates from new mobile sources;
- Environmental specifications for petrol and diesel fuels are given;
- Several measures to reduce ammonia emissions from the agriculture sector are required.
- A flexibility mechanism has been introduced to allow Parties, under clearly defined circumstances, to propose adjustments to their emissions inventories or ERCs[29].

[26] https://www.legislation.gov.uk/uksi/2018/129/contents/made

[27] https://naei.energysecurity.gov.uk/air-pollutants/why-do-we-estimate-aq-emissions

[28] https://unece.org/environment-policy/air/protocol-abate-acidification-eutrophication-and-ground-level-ozone

[29] https://unece.org/environment-policy/air/protocol-abate-acidification-eutrophication-and-ground-level-ozone

The Gothenburg Protocol review report, published in 2022 by the UN Economic and Social Council[30], concluded further targeted emission reduction measures for NO_x, NMVOCs and CH_4 would be necessary across sectors including agriculture, energy and transport and shipping[31].

A.3 Industrial Regulation and Pollutant Release and Transfer Register

The Industrial Emissions Directive (IED, Directive 2010/75/EU) entered into force in 2011 and aims to minimise pollution from applicable industrial sources throughout the EU, consolidating previous legislation. This directive was also transposed into UK law[32]. Operators of particular industrial installations (IED Annex I) are required to obtain an integrated permit from the Environment Agency, Scottish Environment Protection Agency, Natural Resources Wales, or the Northern Ireland Environment Agency and apply Best Available Techniques (BAT). Local Authorities are the permitting authority for integrated permits for some types of activities in England and Wales. Enactment of the IED domestically for England and Wales was carried out through The Environmental Permitting (England and Wales) Regulations 2013, amend the existing permitting regime at the time, the Environmental Permitting (England and Wales) Regulations 2010. Scotland and Northern Ireland similarly implemented the IED through analogous legislation: the Pollution Prevention and Control (Scotland) Regulations 2012 and the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013. Note that subsequent amendments and revisions to legislation across England, Scotland, Wales and Northern Ireland have maintained these controls.

The regulations require these 'Part A' permits to consider and base permit conditions upon BAT, as defined in BAT conclusions (BATC) developed from the BAT reference documents, or 'BREFs', a review process facilitated by the European IPPC Bureau, to assess environmental performance across industrial sectors (European Commission, 2020). In this manner, the IED helps aid the technological development and performance of specific sites. While BATC published prior to the EU Exit continue to apply, the UK does not need to meet the requirements of any new EU BATC, except for installations within Northern Ireland within scope of Article 4 of the Northern Ireland Protocol. The UK is therefore in the process of developing a BATC system[33].

The IED, along with the E-PRTR regulations (EC Regulation 166/2006), also transposed into UK law[34],includes a requirement to share and engage the public in determining the permit. All issued IED environmental permits are published on the UK Government website, up to 2024[35]. There is a requirement for public access to emission data, made available through a separate reporting flow, the UK Pollutant Transfer and Release Register (UK-PRTR)[36].

A.4 Heavy Metals Protocol

CLRTAP has been extended by a number of protocols, including the 1998 Protocol on Heavy Metals, to which the UK is a signatory. The Heavy Metals Protocol targets three particularly harmful substances: lead, cadmium, and mercury.

Countries are obliged to reduce their emissions of these three metals below their levels in 1990 (or an alternative year between 1985 and 1995). The protocol aims to cut emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration. The protocol specifies limit values for emissions from stationary sources and requires the use of Best Available Techniques (BAT) to minimise emissions from these sources, through the application of special filters or scrubbers for combustion sources, or mercury-free processes. The protocol also requires countries to

[30] https://unece.org/sites/default/files/2023-09/ECE_EB.AIR_150_Add.2_2305247E.pdf

[31] https://unece.org/media/press/386648

[32] https://www.legislation.gov.uk/eudr/2010/75/contents

[33] https://www.gov.uk/government/publications/establishing-the-best-available-techniques-for-the-uk-uk-bat/establishing-the-best-available-techniques-for-the-uk-uk-bat

[34] https://www.legislation.gov.uk/eur/2006/166/body/adopted

[35] https://www.gov.uk/government/collections/industrial-emissions-directive-ied-environmental-permits-issued

[36] https://www.gov.uk/guidance/uk-pollutant-release-and-transfer-register-prtr-data-sets

phase out leaded petrol. Under the protocol, measures are introduced to lower heavy metal emissions from other products (such as mercury in batteries), and examples are given of management measures for other mercury-containing products, such as electrical components (thermostats, switches), measuring devices (thermometers, manometers, barometers), fluorescent lamps, dental amalgam, pesticides and paint.

The protocol was amended in 2012 to introduce more stringent emission limit values for particulate matter and the specific heavy metals (cadmium, lead, and mercury), applicable for specific combustion and other industrial emission sources. The emission source categories for the three heavy metals were also extended to the production of silico- and ferromanganese alloys. Amendments came into effect in 2022. The Minamata Convention on Mercury in 2013, raised the profile of mercury to a global level, and a treaty was negotiated under the United Nations Environment Programme (UNEP)[37].

A.5 Persistent Organic Pollutants (POPs) Protocol and the Stockholm Convention

The UNECE adopted the Protocol on Persistent Organic Pollutants (POPs) in 1998, which focuses on a list of 16 substances that have been singled out according to agreed risk criteria. The substances comprise eleven pesticides, two industrial chemicals and three by-products/contaminants.

The objective of the Protocol is to eliminate any discharges, emissions, and losses of POPs. The Protocol bans the production and use of some products, whilst others are scheduled for elimination at a later stage. The Protocol includes provisions for dealing with the wastes of products that will be banned. It also obliges Parties to reduce their emissions of dioxins, furans, polycyclic aromatic hydrocarbons (PAHs; of which B[a]P is one) and hexachlorobenzene (HCB) below their levels in 1990 (or an alternative year between 1985 and 1995). For the incineration of municipal, hazardous, and medical waste, it lays down specific limit values. The Parties to the Protocol on POPs adopted decisions 2009/1 and 2009/2 to amend the Protocol to include seven new substances and implement revised obligations for some substances as well as emission limit values (ELVs) for waste incineration. These amendments came into force in January 2022 for 2009/1 and February 2023 for 2009/2.

In 2001, the Stockholm Convention on POPs was adopted which built on the 1998 Protocol raising the profile of POPs aimed at prohibiting, or gradually reducing, the production and use of persistent organic chemicals worldwide. There are currently 30 POPs listed in the Convention which fall into three broad categories: pesticides, industrial chemicals, and unintentional by-products of combustion and some industrial and non-industrial processes. An updated version of the UK's National Implementation Plan (NIP)[38] which sets out how the UK will implement their obligations under the Convention was published in 2022 and has been developed by Defra in agreement with the Scottish Government, Welsh Government, DAERA, and other relevant Government Departments and Agencies. The NIP also gives an overview of how internationally produced POPs are being managed in the UK and offers a UK Dioxins Action Plan for future actions[39.] Note that Annex 2 of the Northern Ireland Protocol / Windsor Framework, Northern Ireland remains aligned with EU POPs legislation.

A.6 Sulphur Content of Liquid Fuels Directive

The EC's Directive to limit the sulphur content in gas oil and fuel oil has been transposed into UK regulations which were initially established in 2000 but were updated with Statutory Instruments brought into force across the DAs via the Sulphur Content of Liquid Fuel Regulations 2007 (England and Wales: SI79/2007; Scotland: SI 27/2007; Northern Ireland: SI 272/2007). The Sulphur Content of Liquid Fuels Directive (1999/32/EC) limits the sulphur content in gas oil to 0.1% by mass and in heavy fuel oil to 1% by mass[40]. This requirement entered the 2007 regulations, effective from January 2008 onwards. The main impact of these regulations has been to gradually drive down the maximum sulphur content of refinery products. The impacts of this change are evident within the recent emission trends of the UK, and DA inventories as SO_2 emissions have declined substantially between 2007 and 2008 from road transport (NFR 1A3b) and other sources where petroleum-based fuels are

[37] https://www.unep.org/resources/report/minamata-convention-mercury

[38] https://chm.pops.int/Implementation/NIPs/NIPTransmission/tabid/253/Default.aspx

[39] https://www.fao.org/faolex/results/details/en/c/LEX-FAOC214659

[40] https://www.gov.uk/government/publications/report-on-sulphur-content-of-liquid-fuels

dominant. Amendment regulations for the Sulphur Content of Liquid Fuels (England and Wales) [41], the Sulphur Content of Liquid Fuels (Scotland)[42], and the Sulphur Content of Liquid Fuels Regulations (Northern Ireland)[43] came into effect in 2014, and there are currently no known outstanding effects of these changes.

A.7 Devolved Administration Air Quality Policy

The UK Government leads on the UK's input to International targets relating to Air Quality, with input from the Scottish Government, Welsh Government and Northern Ireland Government. Linked to the requirements of the EU Directives which have been transposed into UK law, e.g. the NECR, the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (Defra, 2007) set out a framework of standards and objectives for the air pollutants of most concern at the time (sulphur dioxide, particulate matter, nitrogen oxides, polycyclic aromatic hydrocarbons, benzene, 1,3-butadiene, carbon monoxide, lead, ammonia and ozone). The AQS has since been superseded in all of the DAs, with the exception of Northern Ireland.

Defra published the Environmental Improvement Plan in 2023, which set out action to be taken to improve air quality in England. The Government announced a rapid review of this Plan in 2024, to ensure it is fit for purpose in delivering statutory targets. Similarly, the Devolved Administrations have also developed national plans and strategies to drive effective action at the local level. Scotland's 'Cleaner air for Scotland 2: Towards a Better Place for Everyone', was published in 2021, and Wales' Clean Air Plan for Wales: Healthy Air, Healthy Wales' was published in August 2020. DAERA issued a Clean Air Strategy Public Discussion document for Northern Ireland in 2021, outlining trends, monitoring and regulatory requirements for air pollutants[44].

A.8 Air quality plan for nitrogen dioxide (NO_2) in the UK

In July 2017, the Government published the UK plan for tackling roadside nitrogen dioxide concentrations, followed by a supplement in October 2018. Together these are referred to as the 'NO_2 plan'. The NO_2 plan set out how Government will achieve compliance with legal limits for nitrogen dioxide in the shortest possible time. As part of this, the Government has been working closely with 64 English local authorities, placing legal duties on them, and providing over £550m of funding so far, to tackle their nitrogen dioxide exceedances and achieve compliance with NO_2 legal limits in the shortest possible time. Due to the highly localised nature of the problem, local knowledge is crucial in solving pollution problems in these hotspots. The Government is taking a national leadership role and is providing financial and expert support to local authorities to develop, implement and evaluate innovative plans.

A.9 Air Quality Standard Regulations

The Air Quality Standards Regulations 2010 set legally binding concentration limit values for seven key air pollutants, including NO_X, SO_2, PM_{10} and CO and an exposure reduction target for $PM_{2.5}$. There are also target values for a further five substances (heavy metals and polycyclic aromatic hydrocarbons). This legislative framework was established to manage air quality and to avoid exceeding the air pollutant concentration limits known to be harmful to human health and the environment. Evidence requirements revolve around monitoring, assessment and reporting to ensure compliance with air quality standards. Where air quality standards are at risk of being exceeded, authorities are required to develop action plans, which may include emissions reductions strategies and pollution control measures[45.]

[41] https://www.legislation.gov.uk/uksi/2014/1975

[42] https://www.legislation.gov.uk/ssi/2014/258

[43] https://www.legislation.gov.uk/nisr/2014/147/made

[44] https://www.daera-ni.gov.uk/sites/default/files/consultations/daera/20.21.066%20Draft%20Clean%20Air%20Strategy%20for%20NI%20-%20Public%20Discussion%20Doc%20Final%20V6.PDF

[45] https://www.avisoconsultancy.co.uk/legal-register/the-air-quality-standards-regulations-2010

Appendix B Inventory Methodology

This Appendix provides further detail on the methodology used to compile the emissions inventories and the data sources used during compilation. This information supports **Section 1.3** of the main report.

The disaggregation of air pollutant emissions across England and the Devolved Administrations (DAs) of the UK is part of a programme of ongoing data and methodology improvement. This programme spans both greenhouse gas and air pollutant emission inventories and is driven by the developing requirements for sub-national reporting against emission targets and Devolved Administration policy development.

B.1 Data Availability

For many emission sources of air pollutants, the data available for England and the Devolved Administration emissions are less detailed than for the UK as a whole and, for some sources, country-level data are not available at all. In particular, energy-balance data (i.e. fuel production, transformation, and sector-specific consumption data) are not available across the time series for England, Scotland, Wales, and Northern Ireland.

Sub-national energy statistics are published annually by the Department for Energy Security and Net Zero (DESNZ), formerly known as BEIS, within the quarterly Energy Trends publication (DESNZ, 2023b). These sub-national statistics are limited in their detail when compared to UK-level energy statistics, but do provide estimated fuel use data for England, Scotland, Wales and Northern Ireland for the following combustion source sectors: industry, commercial, agriculture (combustion sources) and residential.

These DESNZ sub-national energy statistics are based on local electricity and gas consumption patterns, as part of a project to develop Local Authority carbon dioxide emissions data. These statistics use local electricity and gas use data from the National Grid and the gas supply network operators. Solid and liquid fuel use is calculated using point source consumption data for major industrial sites, and a complex modelling process to distribute remaining UK fuel allocations that uses employment and population data and takes account of smoke control areas and the patterns of gas and electricity consumption. The latest available data include Local Authority fuel use estimates available for solid, liquid, gas, and electricity use are available from 2005 for Great Britain, and since 2008 for Northern Ireland[46].

The DESNZ sub-national energy statistics are Accredited Official Statistics and are revised and improved each year through targeted sector research to reduce uncertainties in the modelling approach (DESNZ, 2023b). The lack of consistent and comprehensive fuel use data from across the Devolved Administrations (especially for solid and liquid fuels) leads to significant potential errors in the distribution of UK fuel use across the DAs. Expert judgement and proxy data are used to address data gaps and inconsistencies in energy use data over the time series. The Devolved Administrations' emission estimates for earlier years in the inventory time series and the reported inventory trends are associated with higher uncertainty than the data and trends reported in the UK emissions inventory.

The DESNZ sub-national energy statistics are used to derive estimates for industry sector combustion of fuels such as fuel oil, gas oil and coal. These data are based predominantly on analysis of available point source data, supplemented by production and employment surveys, and in several sectors data on building Display Energy Certificates and Energy Performance Certificates are used to provide a better indicator of the Devolved Administrations' energy use than the production or employment indices.

For other important emission sources there are complete country-level datasets available, although some of these are less detailed than data used for the UK Inventory:

- **Industrial process** emissions are based on plant operator estimates reported to environmental agencies under regulatory systems such as the Industrial Emissions Directive (IED), and the Environmental Permitting (England and Wales) Regulations (EPR), the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, and the Environmental Authorisations (Scotland) Regulation 2018, that transposes this. Major sources include power stations, cement and lime kilns, iron & steel works, aluminium, and other non-ferrous metal plant, and chemical industries.

[46] UK local and regional greenhouse gas emissions estimates for 2005-2022: Technical Report: https://assets.publishing.service.gov.uk/media/667ad55e5b0d63b556a4b304/2005-2022-local-authority-ghg-emissions-statistical-release.pdf

- Emissions from **oil and gas terminals** and offshore platforms and rigs, are based on operator estimates reported to the DESNZ OPRED team through the Environmental Emissions Monitoring System (EEMS). Emissions from the offshore oil & gas exploration and production sector are not attributed to a specific country inventory, but are reported within an “unallocated” category, whilst emissions from onshore oil & gas terminals are assigned to the appropriate country inventories.

- **Agricultural emissions** are based on official livestock datasets, annual fertiliser use surveys, farm management practice surveys and detailed emission factors from recent literature sources. The methodology for compiling the inventory of NH_3 emissions from agriculture follows that of Carswell & Gilhespy (2024). Although a detailed, mostly Tier 3, methodology is used, it is not possible to fully represent many of the factors impacting emissions, for example animal stocking densities, soil type, daily weather etc, making emission estimates uncertain.

- Emissions from **waste disposal activities** are estimated based on modelled emissions from the UK pollutant emissions inventory (Elliot, et al., 2024) split out across the DAs based on local authority waste disposal activity reporting (www.wastedataflow.org) which provides an insight into the local shares of UK activity for recycling, landfilling, incineration and other treatment and disposal options. Waste incineration emissions are based on point source emissions data.

- Emissions from **shipping activities** are based on a bottom-up inventory introduced into the inventory estimates in 2018 for the 1990-2016 dataset. High-resolution terrestrial Automatic Identification System (AIS) vessel movement data supplied by the UK Maritime and Coastguard Agency for 2014 is used to calculate emissions specific to each vessel at each point of the vessel’s voyage around the UK’s coastline. This method captures a number of smaller vessels and voyages that were not captured by the previous approach, such as movement to and from offshore oil and gas installations. Country-specific proxies based predominantly on port movement statistics (DfT, 2023d) are used to estimate fuel use and emissions back to 2005 and forecast to 2022. Emissions from shipping were split between the DAs using the methodology described in the 1990-2016 DA Air Pollutant Inventory report, published in 2018 (Jones, et al., 2018).

For some sources where regional data are not available, current NAEI mapping grids have been used. These mapping grids are commonly based on census and other survey data that are periodically updated and used within UK emissions mapping and modelling work (Tsagatakis, et al., 2023).

B.2 Key Compilation Resources

As a result of the more limited DA-specific activity and emission factor data, the emission estimates for the England, Scotland, Wales, and Northern Ireland inventories are subject to greater uncertainty than the equivalent UK estimates. Installation-specific fuel use data for major industrial plants are available over the time series onwards under the EU / UK ETS, and from sites regulated under Environmental Permitting Regulations[47] / Industrial Emissions Directive (EPR/IED). The data quality from these environmental regulatory systems has evolved over the years as monitoring, reporting and quality checking methods and protocols have developed meaning that fuel use estimates in earlier years of the time series are subject to greater levels of uncertainty. This also impacts the accuracy of the reported emissions of air pollutants used within inventory compilation, such that more recent data are likely to be more accurate. The uncertainties in the Devolved Administrations’ inventories are discussed in more detail in **Appendix E**.

There are a number of resources that have been used to estimate the Devolved Administrations’ share of UK emissions for each emission source, including:

- NAEI point source database;
- NAEI emission mapping grid data;
- Local and regional data derived from analysis of activity data trends;

[47] Environmental Permitting (England and Wales) Regulations, the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, and the Environmental Authorisations (Scotland) Regulation 2018

- Generic parameters and proxy data such as population or economic indicators such as Gross Value-Added data.

The main resources used within the DA air pollutant inventory are outlined below.

B.2.1 NAEI Point Source Database

Operators of all EPR/IED-regulated industrial plant are required to submit annual emission estimates of a range of pollutants (including all of those pertinent to this report) to their local UK environmental regulatory agency, and these emission estimates are subject to established procedures of Quality Assurance and Quality Checking prior to publication.

These industrial point-source pollution inventories (held by the Environment Agency, the Scottish Environment Protection Agency, Natural Resources Wales and the Northern Ireland Environment Agency) are emission datasets that have been developing and improving since their inception in the mid-1990s. Robust and reliable data for installations in England and Wales have been widely available since around 1998, whilst the equivalent datasets in Scotland and Northern Ireland became available from the early 2000s.

NAEI point source data have been improved over recent years through the increasing quality and availability of these EPR/IED-regulated industrial pollution emission datasets, as well as through the availability of site-specific fuel use data for sites that operate within the Emissions Trading System (ETS), which has been running since 2005. Annual data requests are also made directly to plant operators or trade associations in key sectors such as power stations, refineries, cement & lime manufacture, iron & steel manufacture, chemical industry and waste treatment and disposal, in order to procure more detailed emissions data and other parameters (such as production data).

By analysing the time series of data and reviewing the latest emission estimates, the point source data is amended as appropriate to fill in gaps and rectify any errors. This has been formalised in a recent upgrade to the processing in the NAEI, with the development of a new integrated database that ensures consistency in approach between sectors and sites. These finalised data are then used as the basis for the NAEI industrial emissions estimates. The location of each site is known and therefore, the point source database can be queried to extract all emissions information relevant to a given geographical area, and hence the DA-level inventories can partly be populated in this way.

The NAEI point source database is most useful for industries that are dominated by large EPR/IED-authorised plant, such as power stations, refineries, iron & steel manufacturing, cement, and lime kilns. For these sectors, the point source database covers nearly 100% of emissions, and is regarded to be the best available dataset for such sources, as it is based on reported energy use and emissions data derived from regulatory agency sources that are subject to quality checking and, in the case of ETS data, independent verification.

Annual revisions to the NAEI point source database are conducted when new data become available and/or when installation-level data are revised by operators, regulators or through enquiry by the UK inventory team to resolve data discrepancies which may be evident between reporting mechanisms.

B.2.2 NAEI Emission Mapping Grids

Emission maps for the whole of the UK are routinely produced as part of the NAEI for 25 pollutants, including all of the pollutants considered in the Devolved Administrations' Air Pollutant Inventory. The maps are compiled at a 1km resolution and are produced annually. The mapped emissions data are available on the NAEI website at: https://naei.energysecurity.gov.uk/data/maps. For a more detailed description of the integration of point source data analysis and the development of UK emission maps, see the UK Spatial Emissions Methodology (Tsagatakis, et al., 2023).

The emission maps are used by the UK inventory team and other organisations for a variety of Government policy support work at the national scale. In particular, the maps are used as input into a programme of air pollution modelling studies.

The geographical distribution of emissions across the UK is built up from distributions of emissions in each source sector. These source sector distributions are developed using a set of statistics appropriate to that sector. For large industrial 'point' sources, emissions are compiled from a variety of official UK sources (Environment

Agency, Scottish Environment Protection Agency, Natural Resources Wales, Northern Ireland Environment Agency, and Local Authority data). For sources that are distributed widely across the UK (known as 'area' sources), a distribution map is generated using appropriate surrogate statistics for that sector. The method used for each source varies according to the data available but is commonly based on either local activity statistics such as raw material use, energy use, industrial production and employment data, housing and population data, road vehicle and fuel sales data, periodic census or socio-economic survey data.

Periodic surveys and censuses of industrial, commercial, residential, and other economic sectors provide indicators regarding the location and scale of a wide variety of activity data that can be used to disaggregate emissions totals, and these are commonly utilised within the NAEI mapping grids.

The key limitation to the use of mapping grids within inventory development is the difficulty in obtaining an accurate time series of emissions from a given sector, as the mapping grids are typically only updated every few years as more survey data becomes available. The data availability limitations inevitably impact the reliability of emission inventory estimates. Resources were focused on ensuring that the most significant sources are assessed most accurately across the time series, whilst less significant source sectors may be disaggregated using a mapping grid for all years in the time series.

B.2.3 Methodological choice by NFR sector

The table below provides a summary of the method and data availability for each sector in the DA inventories using the Nomenclature for Reporting (NFR) structure, which is the format currently required for the submission under the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP).

Table 6 - Disaggregation Methodologies for the Devolved Administrations' Air Pollutant Inventories

NFR Sector	Source	Disaggregation Method
1A1a	Public electricity and heat production (all fuels)	All emissions from major fuels are derived from the point source database, which is based on annual emissions estimates reported to UK environmental regulators by IPC/IED-regulated industry and (since 2005) fuel use data available from the ETS, (Environment Agency, 2023a; Environment Agency, 2023b; SEPA, 2023a; SEPA, 2023b; Natural Resources Wales, 2023a; Natural Resources Wales, 2023b; Northern Ireland Environment Agency, 2023a; Northern Ireland Environment Agency, 2023b) Exceptions are minor fuels: sewage gas use is estimated based on UK-wide estimates disaggregated using DA share of UK population (ONS, 2023); landfill gas use is based on the emission of methane from landfills from the MELMod model (Ricardo, 2024).
1A1b	Petroleum refining (all fuels)	Point source data provided by plant operators to IPC/IED pollution inventories (see 1A1a). Further detail on combustion and process emissions provided by (Fuel Industries UK, 2023).
1A1c	Coke & SSF production (all fuels)	Point source data provided by plant operators (see 1A1a). Regional iron & steel production and fuel use data (ISSB, 2023). UK fuel use data from DESNZ (DESNZ, 2023a).
	Nuclear fuel production (all fuels)	All emissions are in England.
	Colliery combustion and colliery methane production (all fuels)	Deep mined coal production, data from the Coal Authority (Coal Authority, 2022).
	Gas production, downstream network (all fuels)	ETS installation data for natural gas use from 2005-2022. (Environment Agency, 2023a; Environment Agency, 2023b; SEPA, 2023a; SEPA, 2023b; Natural Resources Wales, 2023a; Natural Resources Wales, 2023b; Northern Ireland Environment Agency, 2023a; Northern Ireland Environment Agency, 2023b). Colliery methane use based on deep-mined coal production, data from the Coal Authority (Coal Authority, 2022).
	Upstream oil & gas, including gas separation plant (all fuels)	DESNZ OPRED (DESNZ, 2023c) EEMS inventory. Point source data for NO_X, SO_2, VOC (CO and PM_{10} assumed same as SO_2.).

NFR Sector	Source	Disaggregation Method
1A2a	Blast furnaces, sinter plant, and fuel combustion at iron & steel plants	Point source data provided by plant operators (see 1A1a), supplemented by site-specific breakdown of emissions by source from Tata Steel (Tata Steel, 2023).
1A2b	Combustion in non-ferrous metals manufacturing industry	Pollution Inventory, ETS (Environment Agency, 2023a; Environment Agency, 2023b; SEPA, 2023a; SEPA, 2023b; Natural Resources Wales, 2023a; Natural Resources Wales, 2023b; Northern Ireland Environment Agency, 2023a; Northern Ireland Environment Agency, 2023b) IDBR and employment data (ONS, 2023). Overall analysis of the 1A2b,c,d,e and point source emissions and employment by sector used to constrain the DA totals to previous 1A2 DA estimates, using 1A2g Other Industry as residual allocation for emissions in the UK inventory not assigned to 1A2b,c,d, or e. Detailed analysis conducted for 2008-2018; 1A2b,c,d,e 2005-2008 DA trends matched with UK trends due to data limitations for the detailed industry sub-sector activities at DA level. Coal use in autogeneration derived from Energy Trends publications (DESNZ, 2023b). Exceptions: All NH_3 production and methanol production (both 1A2c) is located in England.
1A2c	Combustion in chemical manufacturing industry, NH_3 production	
1A2d	Combustion in paper, pulp, and print manufacturing industry	
1A2e	Combustion in food processing, beverages, and tobacco manufacturing industry	
1A2f	Combustion in minerals industries: cement and lime	Cement: Point source data from plant operators (see 1A1a). All lime production is in England, and it is also assumed that all scrap tyre combustion occurs in England.
1A2g	Refractory & ceramic production	Regional GDP data (ONS, 2023).
	Other industrial combustion (oils)	Sub-national energy statistics, DESNZ (DESNZ, 2023b), and analysis of point source data derived from ETS and IED data. Environment Agency (Environment Agency, 2023b), SEPA (SEPA, 2023a), NRW (Natural Resources Wales, 2023a) and NIEA (Northern Ireland Environment Agency, 2023a). Overall analysis of the 1A2b,c,d,e and g sectors used to constrain the DA totals to previous 1A2 DA estimates, using 1A2g Other Industry as residual.
	Other industrial combustion (SSF, coke)	
	Other industrial combustion (coal)	
	Other industrial combustion & auto-generators (gas)	Natural gas consumption data from gas network operators: National Grid (National Grid, 2023), Northern Gas Networks (Northern Gas Networks, 2023), Scotia Gas Networks (2023), Wales & West Utilities (2023), Airtricity , Firmus Energy (2023), Vayu (2023). Sub-national energy statistics, DESNZ (DESNZ, 2023b), and analysis of point source data derived from ETS and IED data. (Environment Agency, 2023b), (SEPA, 2023a), (Natural Resources Wales, 2023a), (Northern Ireland Environment Agency, 2023a).
	Other industrial combustion (wood)	Regional GDP data (ONS, 2023).
	Industrial off-road machinery (all fuels)	Mapping grids are used, interpolated between 2007 and 2010, with the 2011 grid used for later years.
1A3ai (i)	Aircraft – international take-off and landing (all fuels)	Civil Aviation Authority (CAA, 2023), UK airport statistics. All take-off and landing cycle emissions for each flight assigned to DA of origin and destination airport.
1A3aii (i)	Aircraft – domestic take-off and landing (all fuels)	
1A3bi, 1A3bii, 1A3biii, 1A3biv, 1A3bv,	Road Transport	Vehicle km, DfT (for GB), NI Department for Regional Development (DRD) up until 2015 (for later years, GB growth factors are then applied as data no longer available). Emission factors: COPERT 5.6 (EEA Guidebook – 2022 Update). Fuel efficiency: Road Freight Statistics, (DfT, 2023a).

NFR Sector	Source	Disaggregation Method
1A3bv, 1A3bvii		Composition of fleet: GB - Vehicle Licensing Statistics Report (DfT, 2023b). Traffic data: National Traffic Statistics, (DfT, 2023c) (England, Scotland, Wales: 1990-2022). Traffic and Travel Information, (DRDNI, 2013) (DRDNI, 2016) (NI: 2005-2015). Fuel consumption: Digest of UK Energy Statistics (1990-2022) (DESNZ, 2023a).
1A3c	Railways: intercity, regional and freight	Mapping grids are used for each rail type, with the 2019 grid extrapolated across the timeseries.
1A3dii	Coastal shipping (all fuels)	UK Maritime and Coastguard Agency (DfT, 2023d). MMO Fishing statistics (MMO, 2023). (Scarbrough T., 2017), (IMO, 2015). Estimates for all inland waterways are based on population (ONS, 2023).
1A3eii	Aircraft support vehicles (gas oil)	Regional aircraft movements (DfT, 2023e).
1A4a	Railways – stationary combustion	Sub-national energy statistics (DESNZ, 2023b) Natural gas use all in England.
	Industrial & commercial combustion	Sub-national energy statistics (DESNZ, 2023b) and analysis of point source data and public and commercial mapping grids from regional employment data by sector. Gas use data supplemented by data from gas network operators (same references as 1A2g). PSEC data (DFPNI, 2015) used to inform the N Ireland estimates.
	Public sector combustion	
1A4bi	Domestic combustion	For petroleum fuels and natural gas, analysis is from sub-national energy statistics, (DESNZ, 2023b) and Housing Condition Survey data. Domestic peat combustion data from CEH (Personal communication, 2018). Northern Ireland gas use in the residential sector is based on estimates from all energy suppliers in Northern Ireland(Firmus Energy, 2023; Airtricity, 2023). Domestic wood and solid fuel combustion mapping grids based on a Defra solid fuels survey (Defra, 2020).
1A4bii	Household and gardening mobile machinery (all fuels)	Population data (ONS, 2023).
1A4ci	Agriculture – Stationary combustion	Agricultural employment data (ONS, 2023) used for allocation of solid and gaseous fuels. Regional energy statistics (DESNZ, 2023b) used for petroleum-based fuels. N Ireland gas use data for agriculture sector based on 2005 estimate for the sector provided by Phoenix Natural Gas (Phoenix Natural Gas, 2007).
1A4cii	Agriculture – mobile machinery	Agricultural off-road mapping grid, with overall petroleum fuel allocations constrained to the DESNZ sub-national energy data (DESNZ, 2023b).
1A4ciii	Fishing vessels	UK Maritime and Coastguard Agency (DfT, 2023d). MMO Fishing statistics (MMO, 2023). (Scarbrough T., 2017), (IMO, 2015).
1A5b	Military aircraft and naval shipping	Regional GDP data (ONS, 2023).
1B1a	Deep-mined coal	Regional deep mine production (Coal Authority, 2022). Emissions from closed coal mines derived from WSP report (Fernando, 2011), updated to account for deviations from the projected closure dates assumed in the original study.
1B1b	Charcoal, Coke & SSF production	Charcoal production estimates based on regional GDP data (ONS, 2023). Coal feed to coke ovens, ISSB, WS, BEIS and (1999-2004) PI. 2005 onwards: ETS (Environment Agency, 2023b; SEPA, 2023b; Natural Resources Wales, 2023b; Northern Ireland Environment Agency, 2023b).

NFR Sector	Source	Disaggregation Method
	Iron & steel flaring	Data to disaggregate emissions from 2005 onwards is proved by the operators of integrated steelworks themselves.
1B2ai	Upstream oil & gas: offshore oil loading, well testing.	All emissions occur offshore (and therefore are unallocated).
	Upstream oil & gas: process emissions, onshore oil loading, oil terminal storage	Emissions derived from DESNZ OPRED (DESNZ, 2023c) EEMS point source dataset.
1B2aiv	Refinery process emissions (drainage, tankage, general)	Point source data provided by plant operators (see 1A1a), (Fuel Industries UK, 2023) and analysed using the NAEI point source database.
1B2av	Petrol terminal storage and loading, Refinery road and rail haulage emissions	Point source data provided by plant operators (see 1A1a), supplemented by refinery road/rail loading estimates from Fuel Industries UK (Fuel Industries UK, 2023).
	Petrol station emissions from delivery, vehicle refuelling, storage tanks and spillages	Regional road transport distribution based on analysis of vehicle km data for different vehicle types and the resultant fuel use distributions. Hence, references as 1A3b.
1B2b	Gasification processes	Regional GDP data (ONS, 2023).
	Upstream gas production: terminal storage, well testing, process emissions	All well testing emissions offshore (therefore all Unallocated). Process and storage emissions based on operator-reported data from EEMS (DESNZ, 2023c)and PI/SPRI (Environment Agency, 2023a; SEPA, 2023a; Natural Resources Wales, 2023a).
	Gas leakage from supply infrastructure	Leakage data provided by gas network operators: National Grid (National Grid, 2023; Northern Gas Networks, 2023; Wales & West Utilities, 2023; Scotia Gas Networks, 2023; Airtricity, 2023).
1B2c	Upstream oil & gas: flaring & venting	Emissions derived from the EEMS dataset (DESNZ, 2023c).
	Refinery flaring	Point source data provided by plant operators (see 1A1a) supplemented by data from the trade association (Fuel Industries UK, 2023).
2A1	Slag cement production	Point source data provided by plant operators (see 1A1a).
2A3	Glass industry process emissions	Point source data provided by plant operators (see 1A1a). Exceptions are emissions from production of flat glass, frits, and lead crystal, all of which only occur in England. Glass ballotini emissions are not reported by operators, and so emissions in each DA are assumed proportional to emissions from other glass production processes.
2A5	Construction, asphalt manufacture	Regional GDP data (ONS, 2023).
	Quarrying (aggregates)	Emissions based on 2014 mines mapping grid applied to all years.
2A6	Bricks and ceramics	All fletton brick production in England. Non-fletton brick estimates based on point source data provided by plant operators (see 1A1a). Process emissions from concrete batching plants, ceramics and refractory manufacture based on regional GDP statistics (ONS, 2023).
2B2	Nitric acid production	Point source data provided by plant operators (see 1A1a). Now all England.
2B3	Adipic acid production	All emissions are in England.
2B6	Chemical industry – titanium dioxide	All emissions are in England.

NFR Sector	Source	Disaggregation Method
2B7	Chemical industry – soda ash manufacture	All emissions are in England.
2B10	Ship purging	All emissions occur offshore (and therefore are unallocated).
	Chemical industry process emissions	Mapping grids for chromium, magnesia, nitric acid use, phosphate-based fertilizers, pigment manufacture, and reforming. Coal tar and bitumen processes, and ammonia use in the chemical industry based on point source data provided by plant operators (see 1A1a). Other chemical industry sources (i.e. alkyl lead, ammonia-based fertilizer, carbon black, sulphuric acid use, solvent and oil recovery, and sulphuric acid production) are based on population statistics (ONS, 2023), regional GDP data (ONS, 2023) or assumed to all be in England.
2C1	Industrial process emissions from SMEs, hot & cold steel rolling emissions, lead battery manufacture, zinc alloy and semis production, and zinc oxide production	Regional GDP data (ONS, 2023).
	Process emissions from: blast furnaces, electric arc furnaces, basic oxygen furnaces, primary aluminium production & anode baking, non-ferrous metal processes	Point source data provided by plant operators (see 1A1a), plus supplementary data provided by Tata Steel (Tata Steel, 2023) and the ISSB (ISSB, 2023).
	Flaring & stockpile emissions at iron & steelworks	Regional iron & steel production and fuel use data (ISSB, 2023).
2C3	Alumina production	All emissions are in Scotland.
	Primary and secondary aluminium production	Estimates based on point source data provided by plant operators (see 1A1a).
2C4	Magnesium alloying	Regional GDP data (ONS, 2023).
2C5	Secondary lead manufacture	Estimates based on point source data provided by plant operators (see 1A1a).
	Lead battery manufacture	Regional GDP data (ONS, 2023).
2C6	Zinc oxide, alloy, and semis production	Regional GDP data (ONS, 2023).
	Non-ferrous metal processes	All emissions are in England.
2C7	Nickel and tin production	Regional GDP data (ONS, 2023).
	Other non-ferrous metal production processes	All emissions are in England.
	Copper alloy and semis production and secondary copper production	Estimates based on point source data provided by plant operators (see 1A1a).
	Foundries	Foundries based on mapping grids, derived through methods described in Section B.2.2.

NFR Sector	Source	Disaggregation Method
2D3a	Aerosol and non-aerosol products (cosmetics & toiletries, household products, paint thinners),	Population data, (ONS, 2023).
	Agrochemical use	Based on arable land mapping grids, derived through methods described in Section B.2.2.
	Non-aerosol products - automotive products	Regional road transport distribution based on analysis of vehicle km data for different vehicle types and the resultant fuel use distributions (see 1A3b).
	Hand Sanitiser – Non-Healthcare use	Population data (ONS, 2023).
	Hand Sanitiser – Healthcare use	NHS staff numbers (National Health Service, 2023).
2D3b	Road dressings	Road dressing mapping grid, based on mapping grids, derived through methods described in Section B.2.2.
	Bitumen use	Population data (ONS, 2023).
	Asphalt manufacture	Regional GDP data (ONS, 2023).
2D3d	Trade & retail decorative paints,	Population data (ONS, 2023).
	Industrial coatings: Aircraft, agricultural and construction vehicles, coil coating, leather coating	Regional GDP data (ONS, 2023).
	Industrial coatings: wood, metal, plastic, marine, vehicle refinishing.	Various coatings mapping distribution grids are used based on surveys of locations of such processes, derived through methods described in Section B.2.2.
	Industrial coatings: film, metal packaging, automotive, drum, textile, paper	Point source data provided by plant operators (see 1A1a).
2D3e	Domestic surface cleaning.	Population data (ONS, 2023).
	Leather coating and degreasing	Regional GDP data (ONS, 2023).
2D3f	Dry cleaning (solvent use)	Dry cleaning mapping grid, derived through methods described in Section B.2.2.
2D3g	Rubber & plastic products	Population data, (ONS, 2023).
	Foam blowing	Regional GDP data (ONS, 2023).
	Industrial coating manufacture: adhesives, inks, solvents and pigments, tyre manufacture	Various industry-specific coatings mapping distribution grids, derived through methods described in Section B.2.2.
2D3h	Printing – flexible packaging, publication gravure	Point source data provided by plant operators (see 1A1a).
	Other printing sources	Population data (ONS, 2023).
2D3i	Seed oil extraction	All emissions are in England.
	Wood impregnation – creosote, LOSP	Wood impregnation mapping grid.
	Industrial adhesives and sealants	Regional GDP data (ONS, 2023).

NFR Sector	Source	Disaggregation Method
	Solvent Use	Population data (ONS, 2023).
	Aircraft and Runways	UK airport data (CAA, 2023).
2G	Cigarette smoking and fireworks	Population data (ONS, 2023).
	Lubricant use in road vehicle engines	Regional road transport distribution based on analysis of vehicle km data for different vehicle types and the resultant fuel use distributions, see 1A3b.
2H1	Paper production	GDP data (ONS, 2023).
2H2	Cider & wine manufacture, sugar beet processing and sugar manufacture	All emissions are allocated to England in the absence of relevant spatial datasets.
	Spirit manufacture	Point source data provided by plant operators (see 1A1a).
	Brewery emissions	Brewing mapping grid and point source database.
	Food & drink process industries: meat & fish, margarine, cakes & biscuits, animal feed, coffee roasting, animal rendering	Population used to disaggregate emissions (ONS, 2023).
	Other food & drink processes: bread baking, malting.	Point source data provided by plant operators (see 1A1a).
2H3	Other industry Part B process emissions	Regional GDP data (ONS, 2023),
2I	Wood impregnation - general	Population used to disaggregate emissions (ONS, 2023).
	Wood product process emissions (including creosote use)	Wood coating mapping grid, derived through methods described in Section B.2.2.
2K	Transformers, capacitors and fragmetisers	Population used to disaggregate emissions (ONS, 2023).
3A	Manure management	DA splits for manure management based on regional pollutant-specific emissions data provided by Rothamsted Research (2023). The UK IIR provides more details on this (Elliot, et al., 2024).
3B	Inorganic N fertilizers	DA splits for fertilizers based on regional pollutant-specific emissions data provided by Rothamsted Research (Carswell A., 2023). The UK IIR provides more details on this (Elliot, et al., 2024).
3D	Agricultural soil emissions	DA splits for agricultural soils based on regional pollutant-specific emissions data provided by Rothamsted Research (Carswell A., 2023). The UK IIR provides more details on this (Elliot, et al., 2024).
3F	Field burning of agricultural wastes	Field burning estimates from Rothamsted Research (Carswell A., 2023). The UK IIR provides more details on this (Elliot, et al., 2024).
5A	Landfills	DA-specific models based on country-specific waste landfilling data published by the Environment Agency, Scottish Environmental Protection Agency, Natural Resources Wales, and Northern Ireland Environment Agency (2023).
	Waste disposal – batteries, measurement and control equipment, electrical equipment, lighting fluorescent tubes	Population used to disaggregate emissions (ONS, 2023).
5B	Composting (at household)	Population data (ONS, 2023).

NFR Sector	Source	Disaggregation Method
	Composting (at permit sites)	Regional GDP data (ONS, 2023).
	Anaerobic Digestion	Population data (ONS, 2023).
5C1	Incineration: MSW, crematoria, chemical waste	Point source data provided by plant operators (see 1A1a).
	Incineration: Clinical waste, sewage sludge	Population data (ONS, 2023).
	Incineration: animal carcasses	Based on arable land mapping grids, based on mapping grids, derived through methods described in Section B.2.2.
5C2	Open-burning of waste	Population data (ONS, 2023).
	Agricultural waste burning (not animal carcasses)	Based on arable land mapping grids, based on mapping grids, derived through methods described in Section B.2.2.
5D1	Sewage sludge decomposition	Population data (ONS, 2023).
5E	Accidental fires – vehicles, dwellings, other buildings, Bonfire night	Population data (ONS, 2023). For bonfire night Northern Ireland is excluded.
	Regeneration of activated carbon	Regional GDP data (ONS, 2023).
6A	Other sources: infant emissions from nappies, domestic pets, house and garden machinery	Population data (ONS, 2023).
	Non-agricultural horses, professional horses	Driver for non-agricultural horses based on activity data time series from Rothamsted Research and CEH (Carswell A., 2023).
	Parks, gardens, and golf courses	Data on fertiliser use, Rothamsted (Carswell A., 2023). The UK IIR provides more details on this (Elliot, et al., 2024).

B.2.4 Other Regional Data

In recent years, the NAEI team has aimed to develop a consistent time series of detailed datasets to inform DA and local emission inventories and pollutant mapping campaigns. Examples of such datasets that have been used in this study include:

- **Sub-national fuel use data** for natural gas, solid fuel and petroleum-based fuels, from National Grid (National Grid, 2023), other gas network operators, the Coal Authority (Coal Authority, 2022) and the Department for Energy Security and Net Zero (DESNZ, 2023b). The UK energy mapping team has been involved in the on-going development of the DESNZ sub-national energy statistics which provide limited data from 2004 to 2022. These data are used to underpin many of the air pollutant emission estimates from small-scale (non-regulated) combustion sources such as residential, commercial, public administration and small-scale industrial sectors.
- The **Road Transport** emissions database uses emission factors (g/km) for different types of vehicles, which depend on the fuel type (petrol or diesel) and are influenced by the drive cycle or average speeds on the different types of roads; traffic activity for each DA region, including distance and average speed travelled by each type of vehicle on each type of road; DA-specific fleet data on petrol/diesel car mix, car engine size and fleet composition (i.e. age distribution) for cars, light goods vehicles (LGVs) and rigid heavy goods vehicles (HGVs) based on data from the Driver and Vehicle Licensing Agency (DVLA); the age of the fleet determines the proportion of vehicles manufactured in conformity with different exhaust emission regulations.

- **Aircraft emissions** are derived from the Civil Aviation Authority's (CAA, 2023) database of flight movements, fuel use data (DESNZ, 2023a), aircraft fleet information (CAA, 2023) and emission factors from international guidance and research (Intergovernmental Panel on Climate Change, IPCC) to derive emission estimates for aircraft cruise, take-off and landing cycles.
- **Regional quarry production data** and quarry location information, (British Geological Survey (BGS), 2023).
- **Regional iron and steel production data**, and regional fuel use data in the iron and steel industry (Tata Steel, 2023), (ISSB, 2023).
- Site-specific emissions data split by combustion and process sources for all **UK refineries**, and refinery production capacities (Fuel Industries UK, 2023).
- Site-specific cement production capacities and UK-wide **cement industry** fuel use data (Mineral Products Association, 2023).
- The **rail sector** uses information from the UK's Department for Transport Rail Emissions Model (REM).
- **Regional housing and population data** (Department for Communities and Local Government).
- **Regional economic activity and industrial production indices** (ONS, 2023).

Appendix C Experimental inventories for PCDD/Fs, benzo[a]pyrene and mercury

C.1 Background

In addition to the core suite of air pollutants that have been reported in inventories for England and the Devolved Administrations, for which source data and inventory methods are well-established, this publication includes an experimental set of inventory statistics of: (i) dioxins and furans (PCDD/Fs), (ii) benzo[a]pyrene (B[a]P), and (iii) mercury (Hg). These are toxic pollutants, emission estimates for which are included within the scope of UK inventory submissions under the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

DA-level estimates have been developed for these three pollutants, and the data quality at sub-national level is such that the data are regarded as **experimental statistics only**. These inventories have the potential to enhance the evidence-base for decision-making processes and identify priorities for action, both on a national and local scale. However, without further work to assess the completeness, interrogate outliers, and apply good practice gap-filling techniques to installation-level data, or to study regional variations of unregulated combustion (such as residential burning) to consider country-specific trends, then the inventory estimates will remain highly uncertain and should only be used for indicative purposes.

Benzo[a]pyrene, B[a]P, is a toxic polycyclic aromatic hydrocarbon (PAH), one of a group of persistent organic pollutants (POPs) that contain two or more benzene rings. The International Agency for Research on Cancer (IARC) has determined that B[a]P is a carcinogen. Its primary mechanism for formation is incomplete combustion, predominantly from vehicle exhausts, wood and coal fires, whilst trace amounts are also found in cigarette smoke.

Like other POPs, B[a]P accumulates in organisms that are exposed to it; it binds strongly to sediments, soils and other solid matter, and it is stable so remains in the environment making it a concern at a local and a global scale. Industrial emissions in the UK are controlled through the UK Pollution, Prevention and Control (PPC) Regulations and the subsequent Industrial Emissions Directive (IED).

Dioxins and furans (PCDD/Fs) are toxic chemicals which are not intentionally manufactured but are released to the atmosphere as by-products from a number of processes including waste incineration, fuel combustion (industrial, domestic and transport), and metal processing. As with B[a]P, trace amounts are found in cigarette smoke. Dioxins released to the air are deposited to ground, and watercourses, where livestock and fish may ingest them; dioxins bio-accumulate and concentrate through food chains, are stable and persistent in the environment, and hence can be transported long distances and even re-suspended to the atmosphere, again making them a local and global concern. Humans may ingest or inhale dioxins, and whilst health effects depend on the precise speciation, several dioxin substances are determined to be carcinogenic. Industrial emissions of dioxins are controlled through the Pollution, Prevention and Control (PPC) Regulations, Industrial Emissions Directive (IED) and Waste Incineration Directive (WID) and associated UK regulations.

Mercury (Hg) is a heavy metal neurotoxin, and in its organic form, methylmercury (MeHg) is associated with neurocognitive deficiencies in foetuses and can cause cardiovascular issues in adults. Acute exposure to elemental mercury can also lead to the irritation of the lung causing coughing, chest pain, and shortness of breath, with very high levels impacting the central nervous system. Atmospheric mercury chemistry is complex and, once emitted, cycles between the atmosphere, land, and surface waters through a series of physical and chemical transformations that can have far-reaching impacts on the environment and biological toxicity. Once deposited it can be transformed and bioaccumulated by aquatic organisms or resuspended for deposition elsewhere. Bioaccumulation represents the primary route to exposure for humans and wildlife, with the exact toxicity related to the speciation of mercury. Emissions of Hg in the UK are regulated by the 1998 Protocol on Heavy Metals, which obliges signatories to reduce emissions below 1990 levels, as well as specifying limit values for emissions from stationary sources and requires the use of Best Available Techniques (BAT) to minimise emissions as far as possible. The protocol was amended in 2012 to introduce more stringent emission limit values applicable to specific combustion and industrial emissions sources.

C.2 Key Sources and Emission Trends

C.2.1 Dioxins and Furans

PCDD/Fs are primarily formed during incomplete combustion. In the UK, for example, the key source categories are primarily in the small-scale combustion (NFR 1A4) and waste management (NFR 5) sectors. Since the combustion of solid and liquid fuels are more complex and often heterogeneous, the PCDD/F emissions from their combustion is greater than those from gaseous fuels. Emissions of PCDD/Fs declined significantly between 1990 and 2000 (Elliot, et al., 2024), with a steadier decline observed across the reported time series here (2005-2022). Sector-specific trends are;

- **Power station emissions:** emissions of dioxins from combustion for electricity generation at power stations have declined across the time series, reflecting the reduced amount of coal in the energy mix for this sector.
- **Road transport emissions:** emissions from road transport declined considerably between 1990 and 2005, after the phase out of leaded petrol from general sale by the end of 1999. Since then, improvements in engine efficiencies, driven by the requirements of EURO standards adoption, have continued to reduce emissions from this sector.
- **Small Stationary Combustion**: Dioxin emissions in this sector are dominated by residential burning of coal and wood. Coal use has declined significantly over the time series, whilst wood burning in the residential sector has increased substantially in the last 10-15 years across the UK and has become one of the main source categories for dioxin emissions in recent years.
- **Waste management**: Dioxin emissions from waste management sources have been substantially reduced across the time series in the UK, primarily driven by the introduction of more stringent regulatory controls for incineration of wastes through: technical guidance for waste incineration processes regulated under the integrated process control (IPC) regime (Environment Agency, 1996); the EU Waste Incineration Directive (2000/76/EC); and subsequent UK regulations such as the Environmental Permitting (England and Wales) Regulations 2010 SI 2010 No.675. There are long-term reductions across the time-series in the amount of household waste burned on domestic open fires resulting in a decrease in emissions from this source.

C.2.2 Benzo[a]pyrene

Similar to dioxins, UK emissions of benzo[a]pyrene are formed principally in non-optimal combustion conditions, in particular in the combustion of solid and liquid fuels. Whilst emissions declined significantly between 1990 and 2004, as a result of the decline of the primary aluminium production sector in the UK and the cessation of anode baking, emissions have increased across the time series presented here. This is driven almost entirely by trends in the residential combustion sector (NFR 1A4b), and in particular the use of wood and coal in fireplaces. This source dominates the UK and DA inventories for B[a]P across all years of the time series.

C.2.3 Mercury

In the UK, emissions of mercury across the time series emerge from three main sources: energy generation at power stations (NFR 1A1), activity at crematoria (NFR 5C) and through its use in industrial processes, most commonly in mercury cells within chloralkali production to produce caustic soda and chlorine. As a result, the trends exhibited are largely related to the activities within these sectors, most notably:

- **Power stations**: highest emission rates of mercury are associated with the use of coal at power stations, and so emissions have declined considerably between 2005 and 2022 as a result of the reduction in the use of coal in the electricity-generating fuel mix.
- **Chloralkali process emissions:** emissions have declined as a result of reduced use of mercury cells in the production process, and due to improved techniques being used at installations, driven in part by the EPR regulations. There are insignificant emissions from chloralkali production from 2020 due to the move away from mercury technology.
- **Crematoria emissions:** show a decline across the time series between 2005 and 2022 but are subject to volatile interannual trends and are highly sensitive to changes in activity at different crematoria sites.

C.3 Development of experimental inventories

The DA inventories for PCDD/Fs, B[a]P, and Hg have been derived using the same methodology as for the other air pollution inventories, that is to derive the best available 'driver' data to disaggregate the reported UK emissions totals from the latest IIR (Elliot, et al., 2024). To maximise the use of resources available to develop these experimental inventories, the inventory agency has sought to prioritise analysis to derive accurate DA estimates as far as practicable for Key Categories. Future work may help to further refine the data, methods and extend the analysis to further improve the evidence base for inventory stakeholders.

The methods used to derive emissions estimates for the most important sources mirrors those outlined in Table 6 above, with more simplistic methods for less important categories being used (such as the use of carbon emissions information from point sources for sectors that are small emitters of B[a]P, dioxins, or Hg).

C.3.1 Key Category Emission Sources for POPs

For **B[a]P**, the IIR describes the UK inventory Key Category Analysis for the latest year of emissions data, 2022, indicating that the only key category is residential combustion (NFR sector 1A4bi), due to the very high emissions reported for residential fuel combustion, driven in recent years by the burning of wood in residential fireplaces, stoves and boilers.

In addition to 1A4bi, and considering the impact of other source categories on the reported inventory trends, the inventory agency considers that qualitative key categories for B[a]P also include the following sources, in approximate order of significance:

- NFR 5E: Accidental fires. The most significant sources here are the emissions from fires in dwellings and other buildings.
- NFR 5C2: Waste burning. A larger source in 2005 which has since declined in significance due to recent reductions in the amount of waste burning in open residential fires.

For **PCDD/Fs**, the IIR describes five key categories in 2022 emissions:

- NFR 5C2: Waste burning. PCDD/F emissions are derived from both agricultural waste burning, which has all but disappeared as an activity in recent years, but also from small-scale waste burning. As noted above for B[a]P, the activity data and emission factors to accurately estimate these emissions are scarce, and hence these emission estimates are associated with quite high uncertainty.
- NFR 5E: Accidental fires. The most significant sources here are the emissions from fires in dwellings and other buildings, and also PCDD/F emissions on bonfire night.
- NFR 2C1: Iron and Steel Process emissions. Emissions of PCDD/Fs are primarily from sinter plant in integrated iron and steel works.
- NFR 1A4bi: Residential fuel combustion. Similar to for B[a]P, the highest emission source in 2022 is emissions from residential fuel combustion, and wood burning in particular, following a decline in coal and anthracite burning over time, replaced in recent years by a growth in wood use. Whilst the level and trend of recent wood use is somewhat uncertain, with the UK energy statistics dependent on a small number of residential fuel use surveys, work continues within Defra and DESNZ to further improve the data used to estimate emissions from domestic combustion.
- NFR 1A2gviii: Other industrial combustion of fuels. These emissions are dominated by emissions from burning of solid fuels: wood, coal, and biomass.

For **Hg**, the IIR describes nine key categories:

- NFR 1A1a: Public electricity generation. Emissions are dominated by coal use in power stations and have declined significantly since the 2005 base year as a result of the phase out of coal use in electricity generation over this period.
- NFR 5C1bv: Crematoria. Emissions have declined by roughly a third across the time series but interannual trends remain volatile.
- NFR 1A2gviii: Other industrial combustion – as with 1A1a, the emissions from this sector are related to amount of mercury content within the fuels used industrially, with coal typically having the highest mercury content and thus the greatest contribution to emissions, but also petroleum coke and biomass contributing to emissions from this sector considerably.
- NFR 5A: Biological treatment of waste – solid waste disposal on land. Emissions of Hg are primarily related to the disposal of measurement and control equipment.
- NFR 1A2f: Stationary combustion in non-metallic minerals production – as with 1A1a, the emissions from this sector, which relate to the production of cement, are related to the mercury content of the fuels used and are most sensitive to variability in coal combustion.
- NFR: 1A4bi: Residential stationary combustion. Once again, emissions here are related to the combustion of fuels which have a larger mercury content, with coal, solid smokeless fuels (SSF), wood, and petroleum coke the dominant fuels.

- NFR 2C1: Iron and steel production. As with 1A1a, emissions from the iron and steel production sector arise from dust particles in electric arc furnaces and during sinter production.
- NFR 2C7c: Other metal production. Emissions here are principally associated with processes at foundries, and are intrinsically tied to levels of steel production in the UK and as such are sensitive to changes in activity, and also to the mercury content of scrap metal melted in furnaces.
- NFR 1A3bi: Road transport emissions. Mercury emissions from road transport are associated with the combustion of fuels containing trace amounts of mercury.

C.3.2 Inventory Uncertainty

Inventories for persistent organic pollutants (POPs) are more uncertain than those for gaseous pollutants, PM_{10}, and metals. This is largely due to the paucity of emission factor measurements on which to base emission estimates and the complexity of dealing with POPs as families of congeners (PCDD/PCDFs, PAHs). The issue is further exacerbated by a lack of activity data for some important sources, for example small scale waste burning.

Where emissions in the DA and UK inventories are based on installation-level reported data by operators (which is the case for many high-emitting energy sector, industrial combustion, industrial process and waste management sources such as incineration), the emissions data reported for PCDD/Fs and B[a]P are typically less complete (than for other pollutants, e.g. NO_X, SO_2, PM_{10}) due to the reporting thresholds within the regulators' inventories: the Environment Agency's Pollution Inventory (PI); the Natural Resources Wales' Welsh Emissions Inventory (WEI), the Scottish Environment Protection Agency's Scottish Pollutant Release Inventory (SPRI), the Northern Ireland Environment Agency Pollution Inventory (NIPI). Through analysis of the reported time series by many installations, the inventory agency further notes that reporting of POPs is typically more susceptible to reporting errors by operators, often by several orders of magnitude. In the compilation of the UK inventories for these species, therefore, the inventory agency makes every effort to (i) identify outliers in the reported data by installation operators, and (ii) apply inventory good practice gap-filling techniques (such as data interpolation and extrapolation, or use of year to year trends in other reported emissions as a proxy) to derive a more consistent, complete and accurate inventory time series.

This susceptibility to operator reporting errors for high-emitting industrial sources exacerbates the limitations in activity data and research to inform accurate emission factors for many POPs emission sources, adding to the overall level of uncertainty in UK and DA reported levels and trends of POPs emissions.

Emissions from unregulated sectors, such as through the combustion of wood and coal domestically, are yet more uncertain. For the UK inventory, the Digest of UK Energy Statistics (DUKES) is used to inform the activity (or amount) of fuel that is consumed in a given year. Sub-national energy statistics and emission maps, based predominantly on periodic user surveys and available data from censuses and housing condition surveys, are used to estimate the DA shares of this UK activity. The fuel use data at DA-level is less uncertain for metered fuels (i.e. natural gas and electricity), but more uncertain for those fuels that are the main source of POPs emissions, such as wood and coal.

Mercury emissions are considered to be slightly less uncertain than the inventory for Pb, another toxic heavy metal. The difference in uncertainties between heavy metals is characterised by the relative contribution of sources for which strong regulation has required improvements in data collection and reporting, particularly of the amount of fuel combusted. Characterising the metal content of the fuel itself can be challenging, however, and is highly sensitive to the heterogeneity of the fuel used. The uncertainty is also influenced by the relative contribution of sources for which data are less widely available or more uncertain, such as the distribution of fuel used in domestic combustion or the distribution of facilities using mercury cells in chloralkali production processes.

The UK inventory quantifies Tier 1 uncertainty aggregation estimates for B[a]P. The method has been replicated here, following the same procedure as outlined in Appendix E, with the results presented in the table below. In the 2005-2021 inventory cycle, new B[a]P factors for domestic combustion were introduced that shifted the weighting of emissions away from the dominant wood emissions. This reduced uncertainty due to higher compensation as underestimates in one sector are more likely to be compensated by overestimates in another sector if the weighting of emissions is more even.

Table 7 - Tier 1 uncertainty aggregation for B[a]P for each DA

	Emissions			Estimated uncertainty		
DA	**2005 (kg)**	**2022 (kg)**	**Trend (%)**	**2005 (%)**	**2022 (%)**	**Trend (%)**
England	5948	4873	-18%	53%	88%	10%
Scotland	932	270	-71%	70%	141%	14%
Wales	1010	746	-26%	57%	66%	20%
Northern Ireland	525	1135	116%	86%	38%	83%

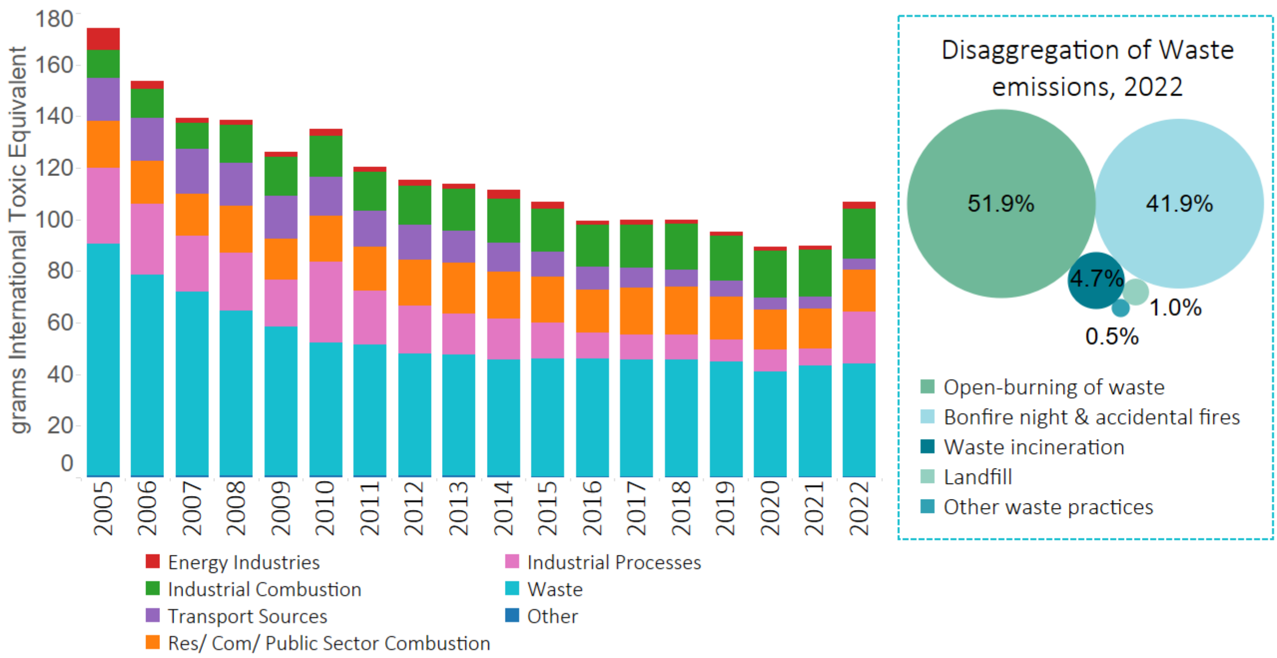
The UK inventory does not quantify the uncertainty of the PCDD/Fs or Hg inventory using an error propagation approach, and therefore no similar estimates for the DA inventories are possible. The IIR (Elliot, et al., 2024) has estimated uncertainties of these pollutants using a Tier 2 Monte Carlo approach pre-2015 (which is not included under the scope of current DA uncertainty calculations). The results of this are estimates of uncertainty of:

- PCDD/Fs: +/- > 50%
- Hg: between -30 and +50%

C.4 Benzo[a]pyrene, dioxin, and mercury inventories for England, Scotland, Wales, and Northern Ireland.

C.4.1 England

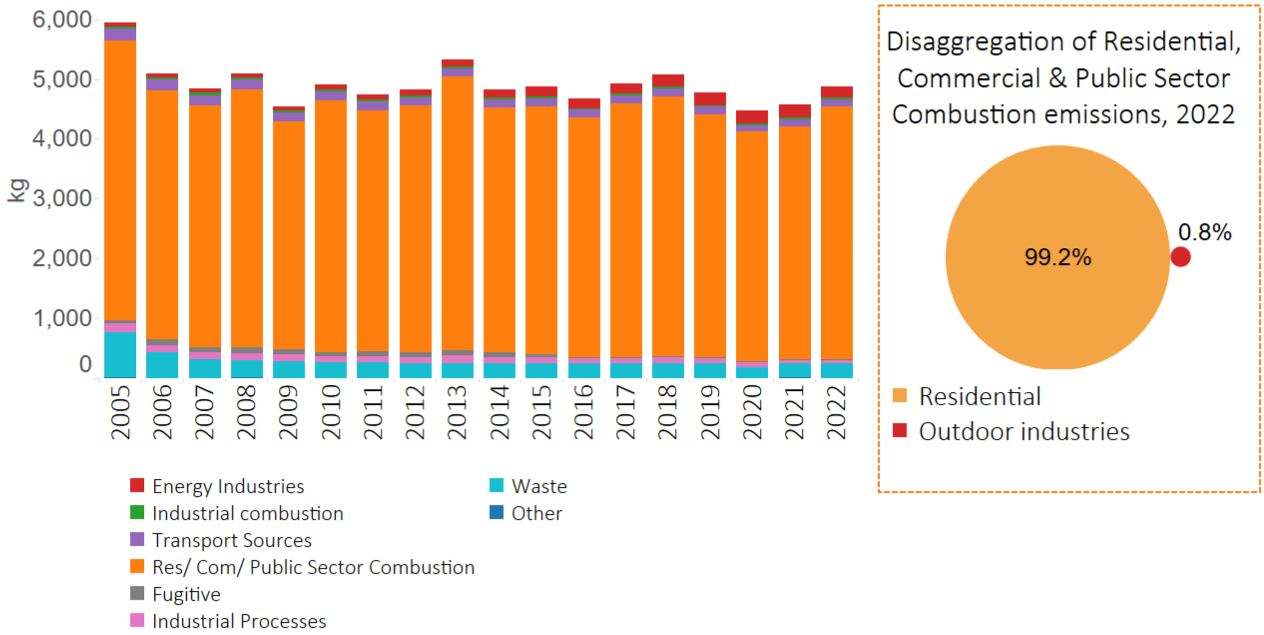
Figure 69 - Dioxins emissions in England



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of dioxins in England were estimated to be 107g international toxic equivalents (I-TEQ)[48] in England in 2022, representing 81% of the dioxins UK total. Emissions have declined by 39% since 2005. Dioxin emissions in England mainly from the residential sector, followed by the business sector. The emissions of PCCD/Fs have declined since 2005, tracking trends in reducing coal-firing at power stations and the introduction of more stringent regulatory controls and the promotion of alternative waste disposal and recycling streams to reduce small-scale open waste burning of household and garden waste. However, there is a relatively big increase from 2021 to 2022, mainly due to increased emissions from sinter production in the iron and steel sector

Figure 70 - B[a]P emissions in England[49]



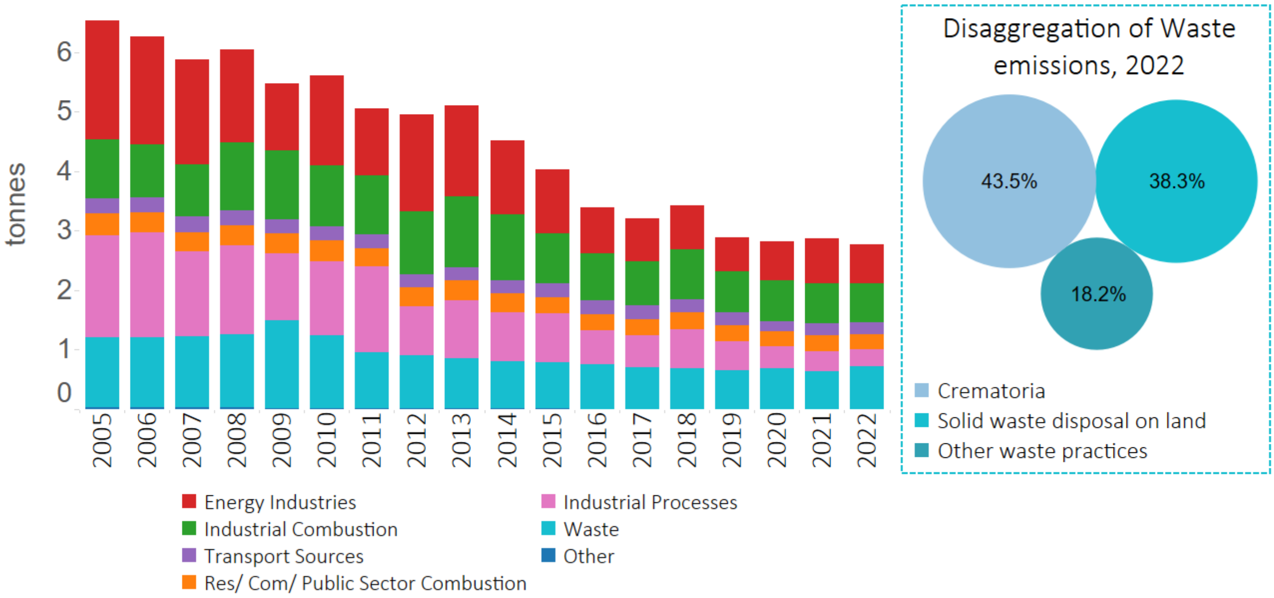
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of benzo(a)pyrene in England were estimated to be 4,873 kg in 2022, representing 69% of the UK total for benzo(a)pyrene. Emissions have decreased by 18% since 2005. Emissions decreased significantly between 2005 and 2008 due to a decrease in agricultural waste burning, however, they have been increasing again in more recent years due to an increase in emissions from domestic combustion and power stations. Emissions from residential combustion account for 86% of the B[a]P emissions from England in 2022, a significant proportion of which is from domestic wood combustion.

[48] I-TEQ are used for groups of pollutants, such as dioxins, and involve weighting the mass of individual compounds based on the toxicity relative to the most toxic compound in the group of compounds.

[49] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 71 - Hg Emissions in England



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of Hg in England were estimated to be 2.8 t in 2022 and have declined by 58% since 2005. Emissions in England account for 79% of the UK total for Hg in 2022. This decline in emissions stems from changes in combustion in power and heat generation and chloralkali process emissions, with a 35% and 26% contribution to the overall Hg trend respectively. The decline in emissions from power and heat generation is driven by the reduction in combustion of coal.

Figure 72 - Dioxin Emissions in England, 2022

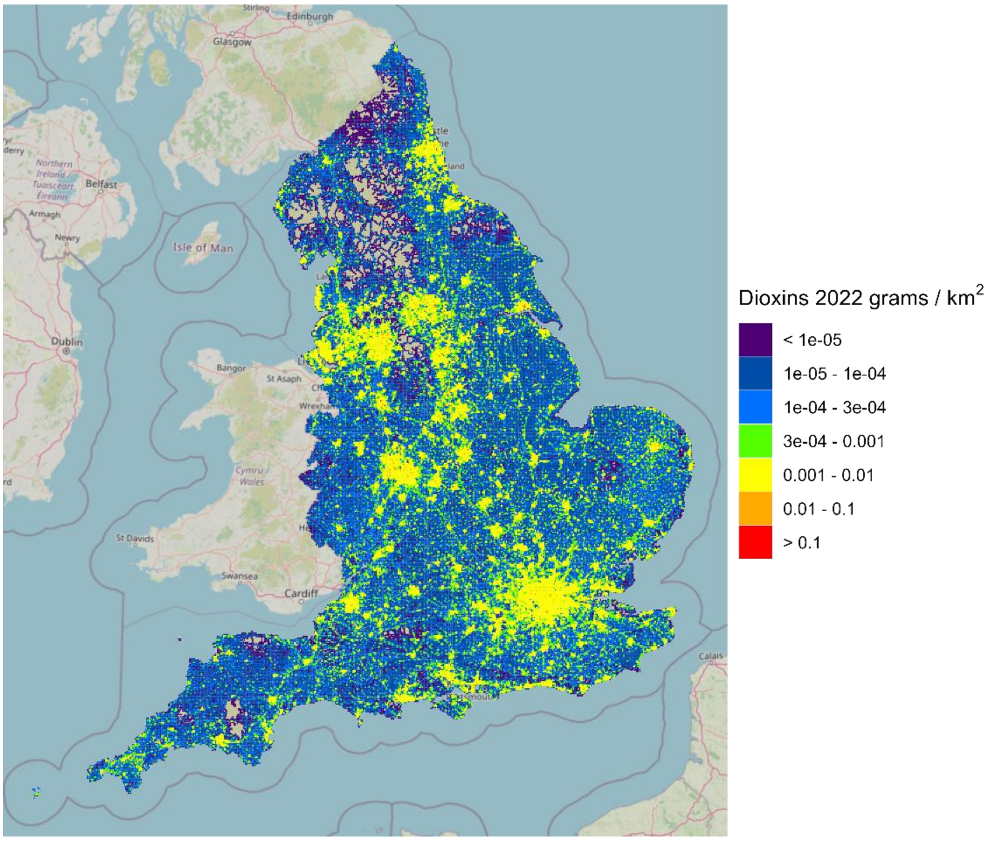


Figure 73 - B[a]P Emissions in England, 2022

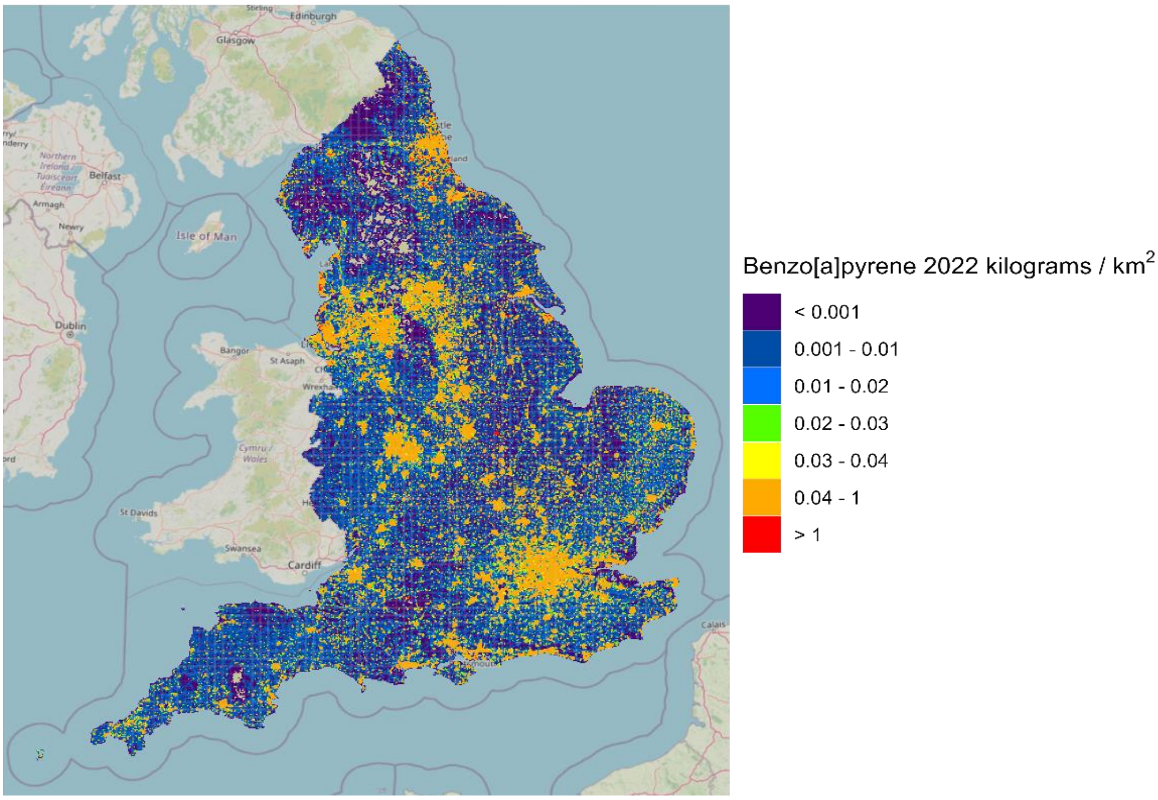
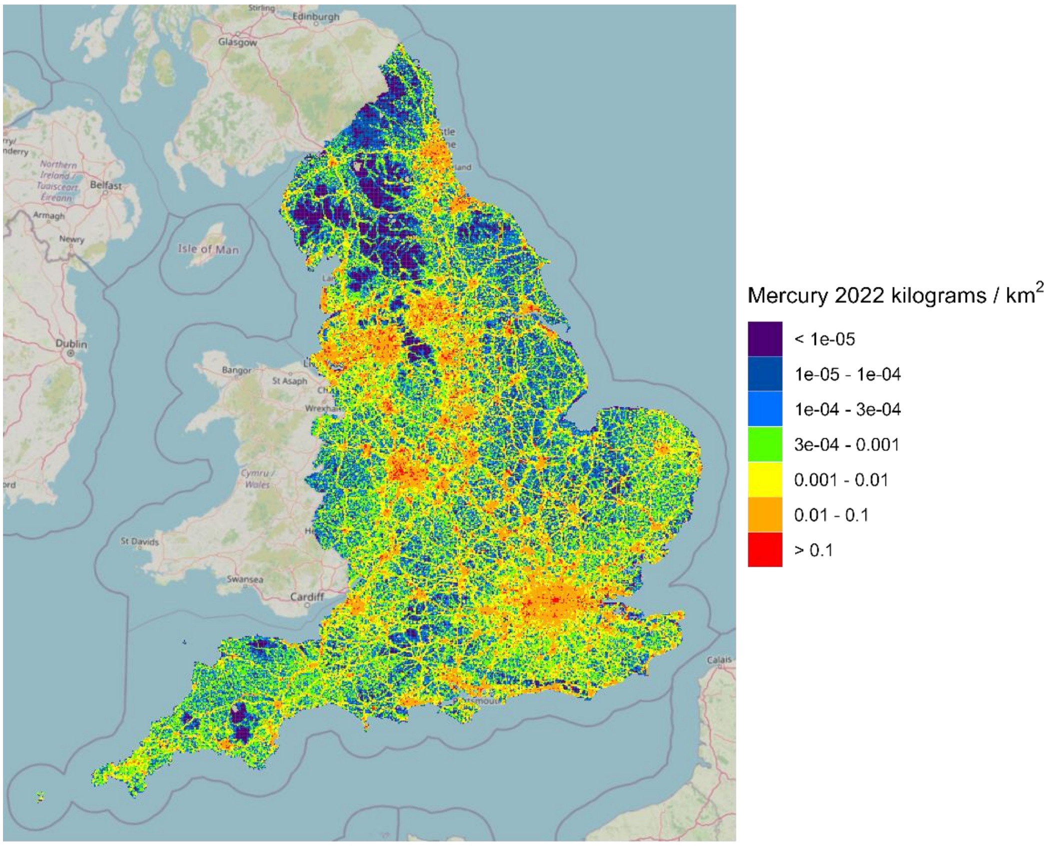
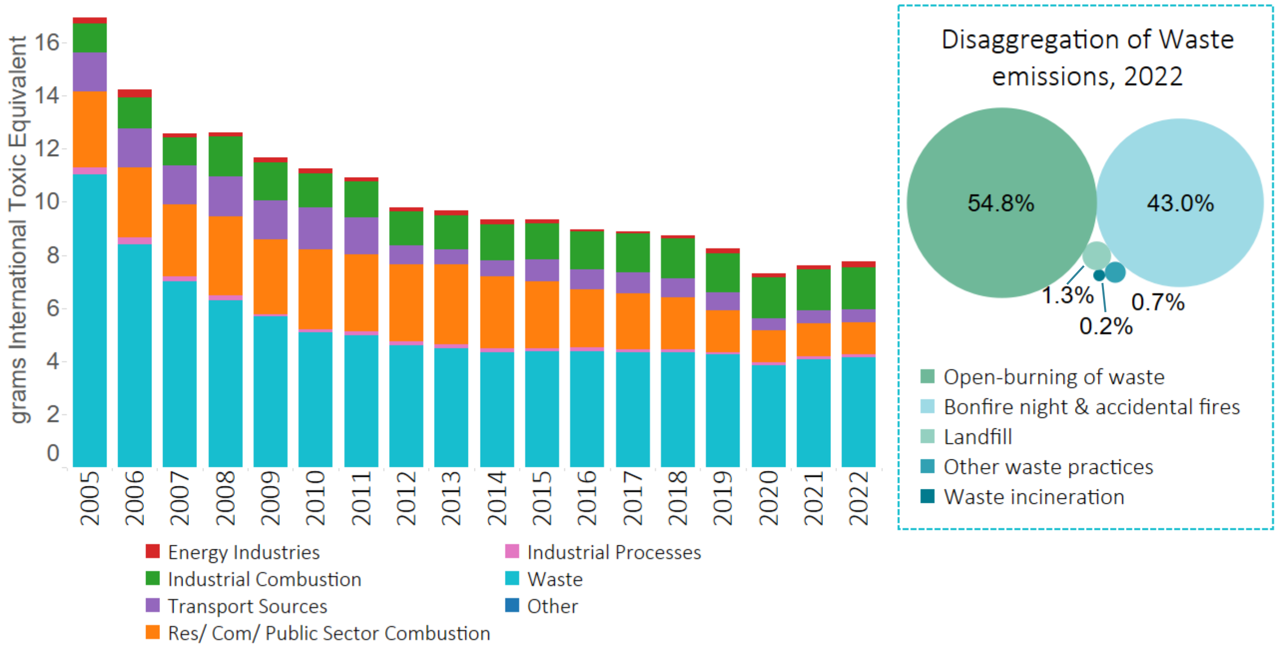


Figure 74 – Hg emissions in England, 2022



C.4.2 Scotland

Figure 75 - Dioxins Emissions in Scotland

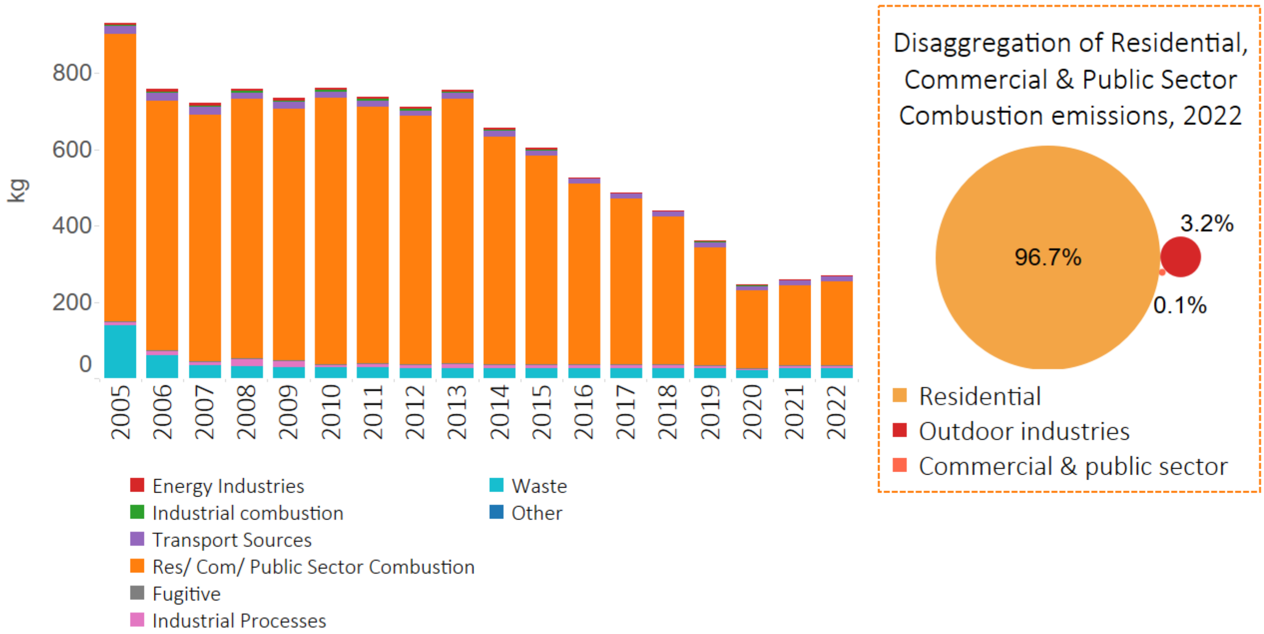


Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of dioxins in Scotland were estimated to be 7.7g international toxic equivalents (I-TEQ)[50] in Scotland in 2022, representing 6% of the UK total for dioxins. Emissions have declined by 54% since 2005, mainly driven by a reduction in emissions from the waste sector. The decline in dioxin emissions since 2005 tracks the trend of a reduction in coal use in power stations, and the introduction of more stringent regulatory controls and the promotion of alternative waste disposal and recycling streams to reduce small-scale open waste burning of household and garden waste.

[50] I-TEQ are used for groups of pollutants, such as dioxins, and involve weighting the mass of individual compounds based on the toxicity relative to the most toxic compound in the group of compounds.

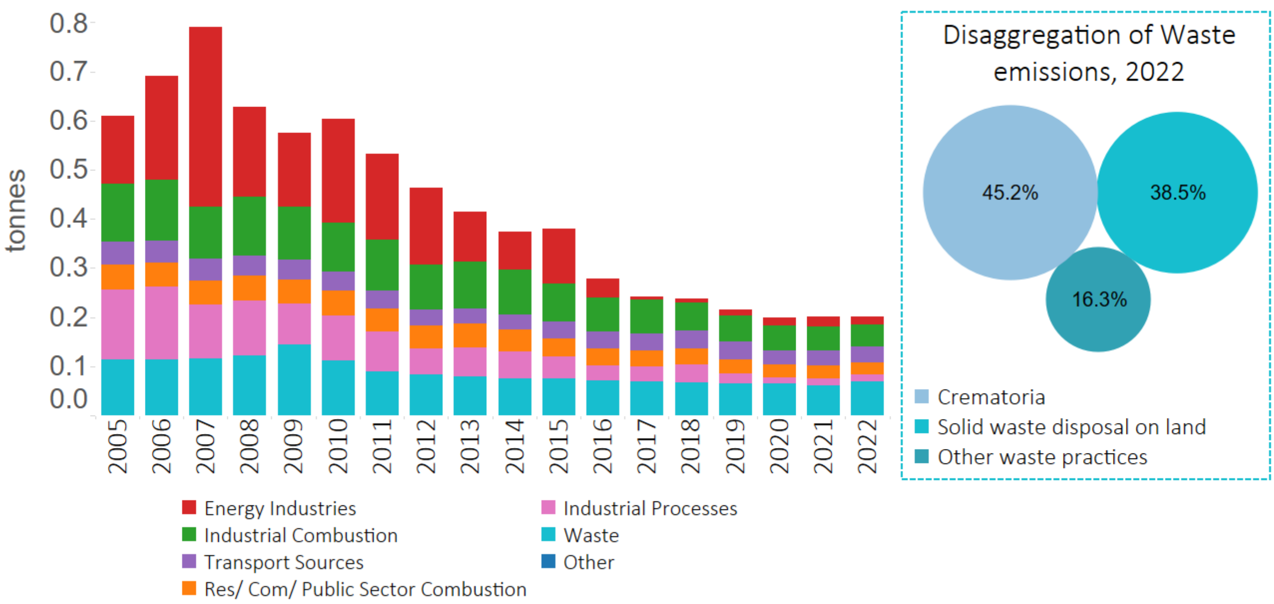
Figure 76 - B[a]P emissions in Scotland[51]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of benzo(a)pyrene in Scotland were estimated to be 270 kg in 2022, representing 4% of the UK total for benzo(a)pyrene. Emissions have decreased 71% since 2005, primarily driven by a reduction in agricultural waste burning. Emissions from residential combustion account for 79% of the B[a]P emissions from Scotland in 2022, with domestic wood and coal combustion accounting for a significant proportion of the sector.

Figure 77- Hg emissions in Scotland



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

[51] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Emissions of Hg in Scotland were estimated to be 0.20 t in 2022 and have declined by 67% since 2005. Emissions in Scotland account for 6% of the UK total in 2022 for Hg. This decline in emissions stems from changes to combustion in power and heat generation and chloralkali process emissions, with a 29% and 22% contribution to the overall Hg trend, respectively. The decline in emissions from power and heat generation is driven by the reduction in combustion of coal. As observed above, the emissions from energy industries have been negligible since 2017 since the cessation of coal used for energy generating purposes in Scotland. Since 2016, emissions from crematoria have been the largest source of emissions, representing 15% of the Scotland total Hg emissions in 2022.

Figure 78 - Dioxin Emissions in Scotland, 2022

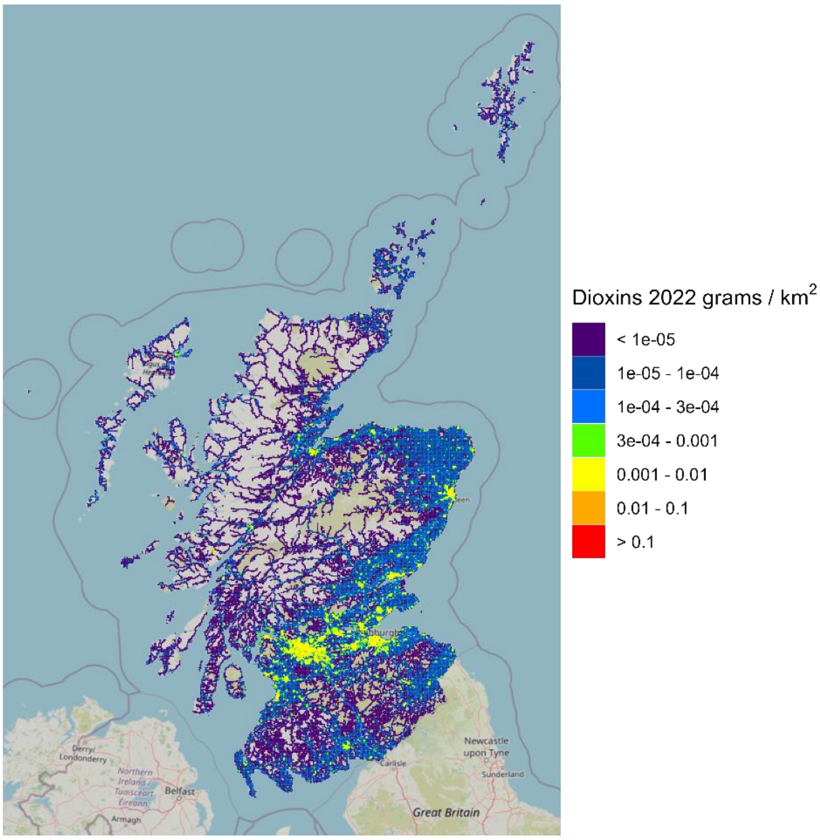


Figure 79 - B[a]P Emissions in Scotland, 2022

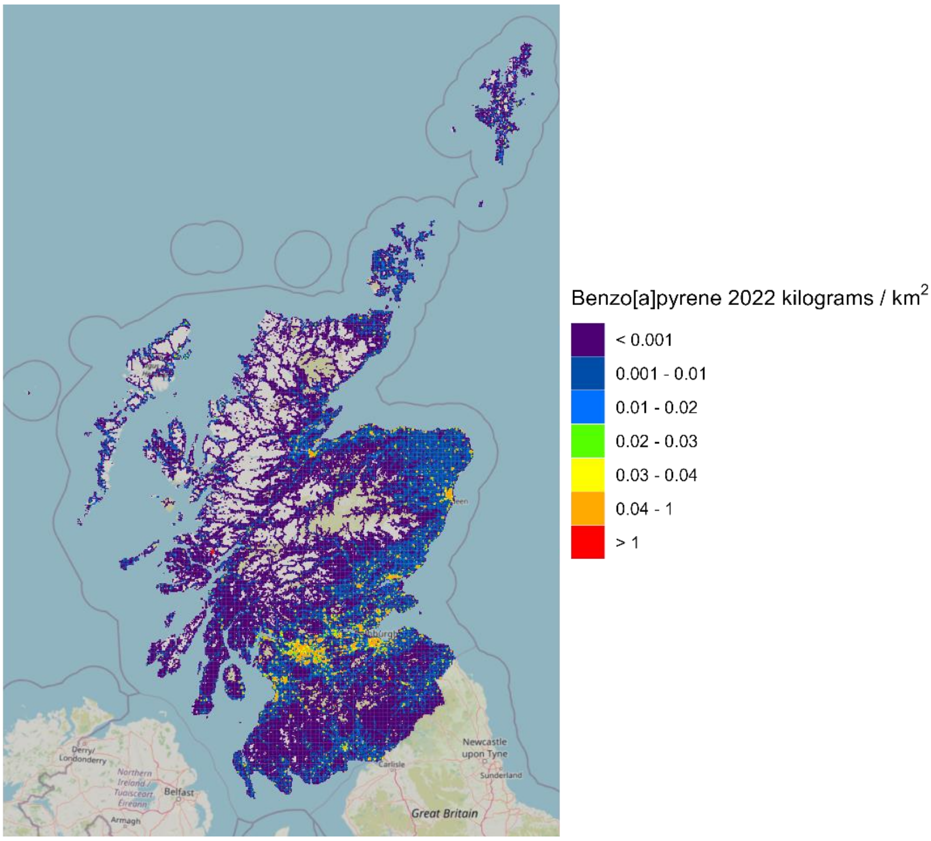
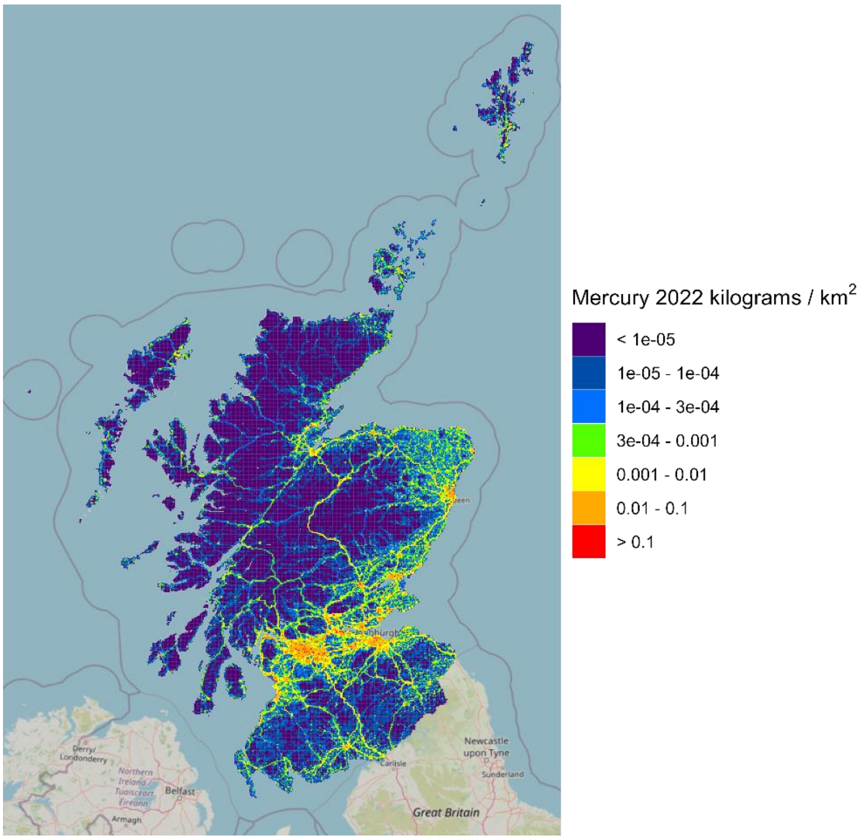
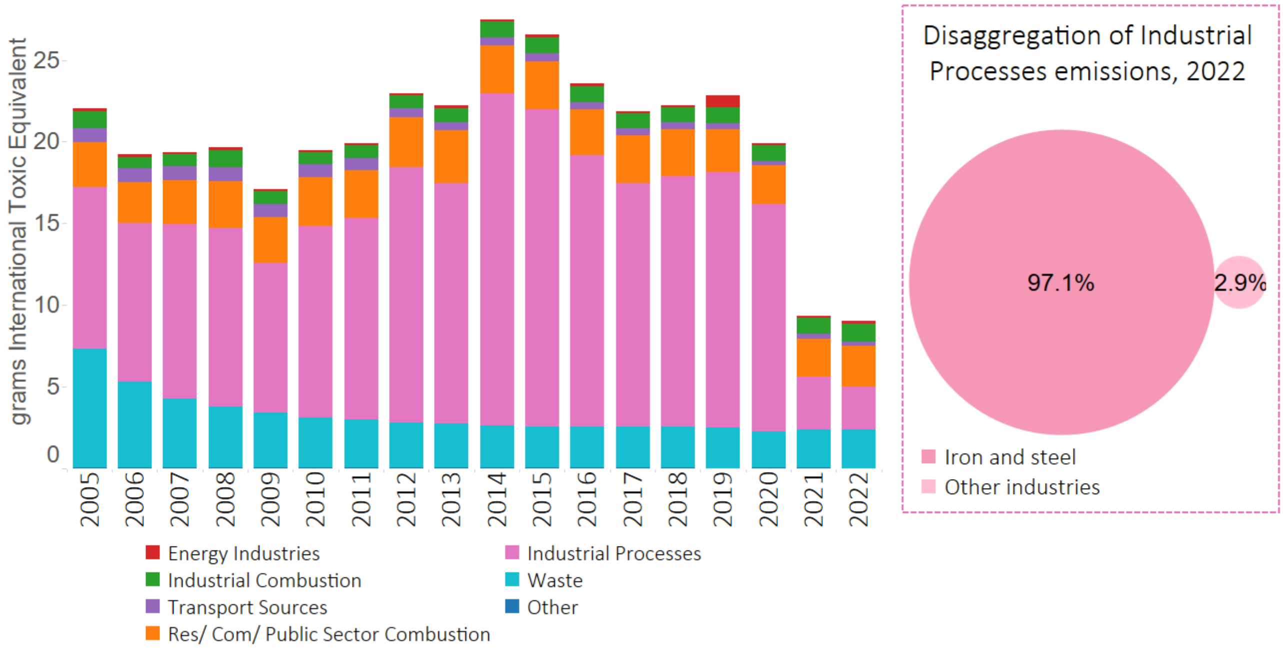


Figure 80 - Hg Emissions in Scotland, 2022



C.4.3 Wales

Figure 81 - Dioxins Emissions in Wales[52]



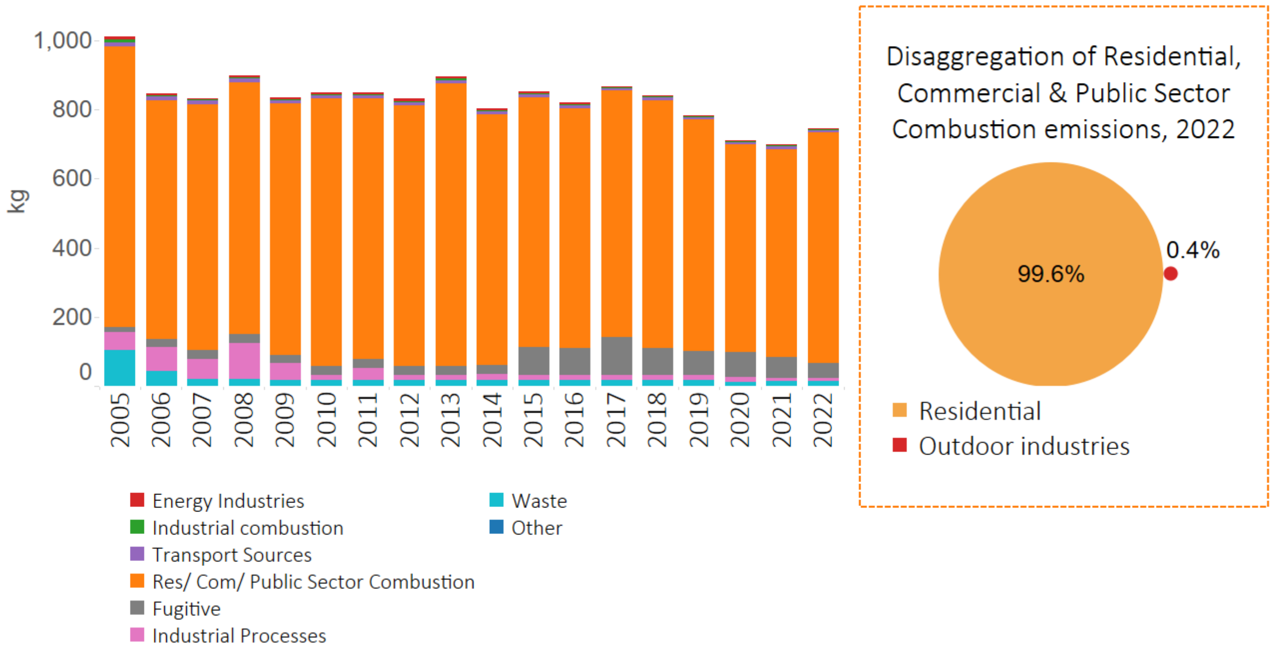
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of dioxins in Wales were estimated to be 9.0 g international toxic equivalents (I-TEQ)[53] in Wales in 2022, representing 7% of the UK total for dioxins. Emissions are 59% lower in 2022 compared to 2005. The iron and steel sector, particularly emissions from sinter production, influences the change in emissions from industrial processes. This is the main driver behind the reduction in emissions in 2022.

[52] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

[53] I-TEQ are used for groups of pollutants, such as dioxins, and involve weighting the mass of individual compounds based on the toxicity relative to the most toxic compound in the group of compounds.

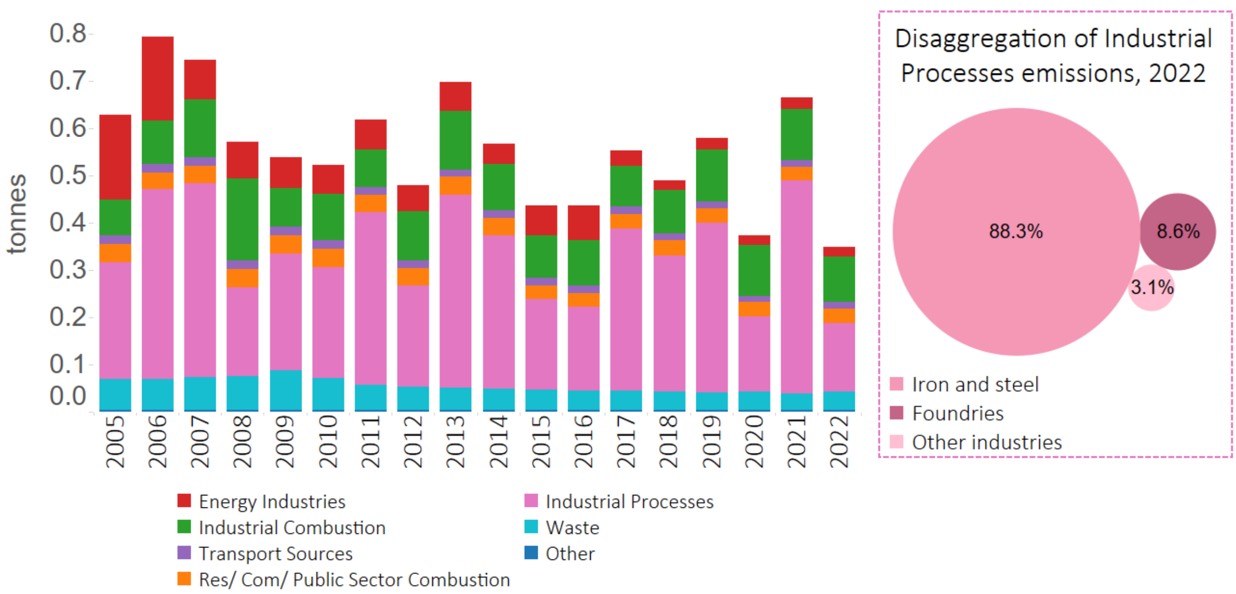
Figure 82 - B[a]P Emissions in Wales[54]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of benzo(a)pyrene in Wales were estimated to be 746 kg in 2022, representing 11% of the UK total for benzo(a)pyrene. Emissions have decreased 26% since 2005. This is due to the decreases in the industrial processes and waste sectors by 83% and 85% respectively since 2005. The reductions in emissions from these sectors are offset by increases in emissions from other sectors, most notably an 67% rise in fugitive emissions, which is all attributable to increased coal production.

Figure 83 - Hg Emissions in Wales[55]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

[54] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

[55] Other industries presented in the bubble graph relate to emissions from glass production, storage handling and transport of chemical products, nitric acid production, titanium dioxide production, soda ash production, aluminium production, lead production, zinc production, copper production, other mineral products, other chemical industry, other metal production, pulp and paper industry, wood processing, other product use, other industrial processes.

Emissions of Hg in Wales were estimated to be 0.35 t in 2022 and have decreased by 45% since 2005 (Figure 83). Emissions in Wales account for 10% of the Hg UK total in 202. Hg emissions from both from combustion in power and heat generation and chloralkali processes have decreased in this period, by 88% and 100% respectively. The decline in emissions from power and heat generation is driven by the reduction in combustion in coal and liquid biofuels. While emissions from these sectors have reduced, emissions from combustion in cement industries have significantly increased by 232% between 2005 and 2022, although emissions from industrial processes overall have decreased by 24% since 2005. The apparent volatility in the time-series in more recent years is principally driven by variations in the activity at Port Talbot steelworks: the site reports high variability in emissions on an inter-annual basis and with emissions from associated electric arc furnaces, sinter production, and blast furnaces varying accordingly.

Figure 84 - Dioxin Emissions in Wales, 2022

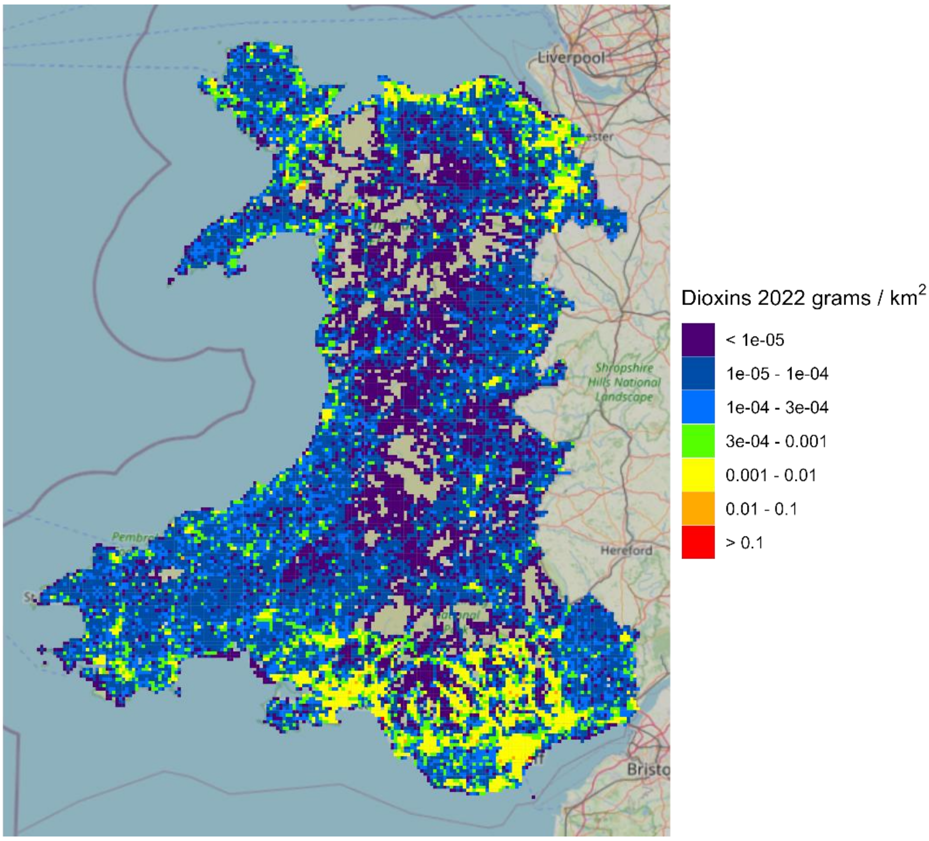


Figure 85 - B[a]P Emissions in Wales, 2022

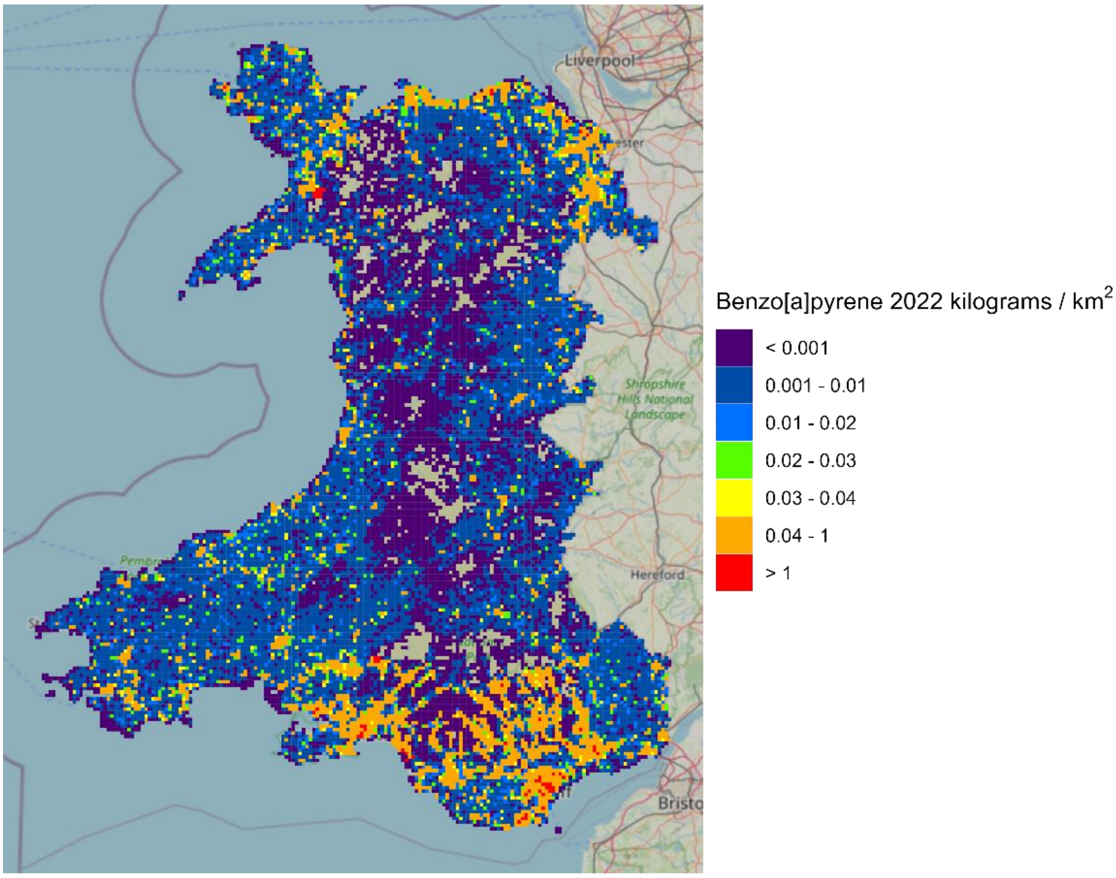
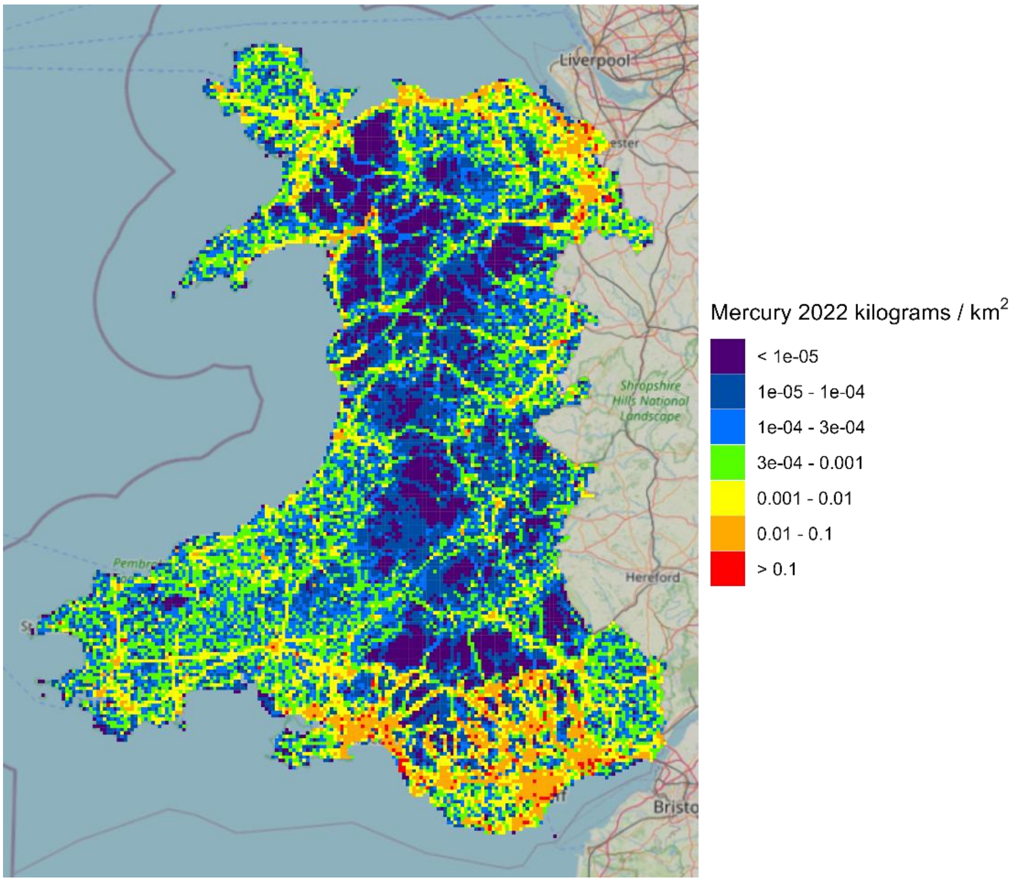
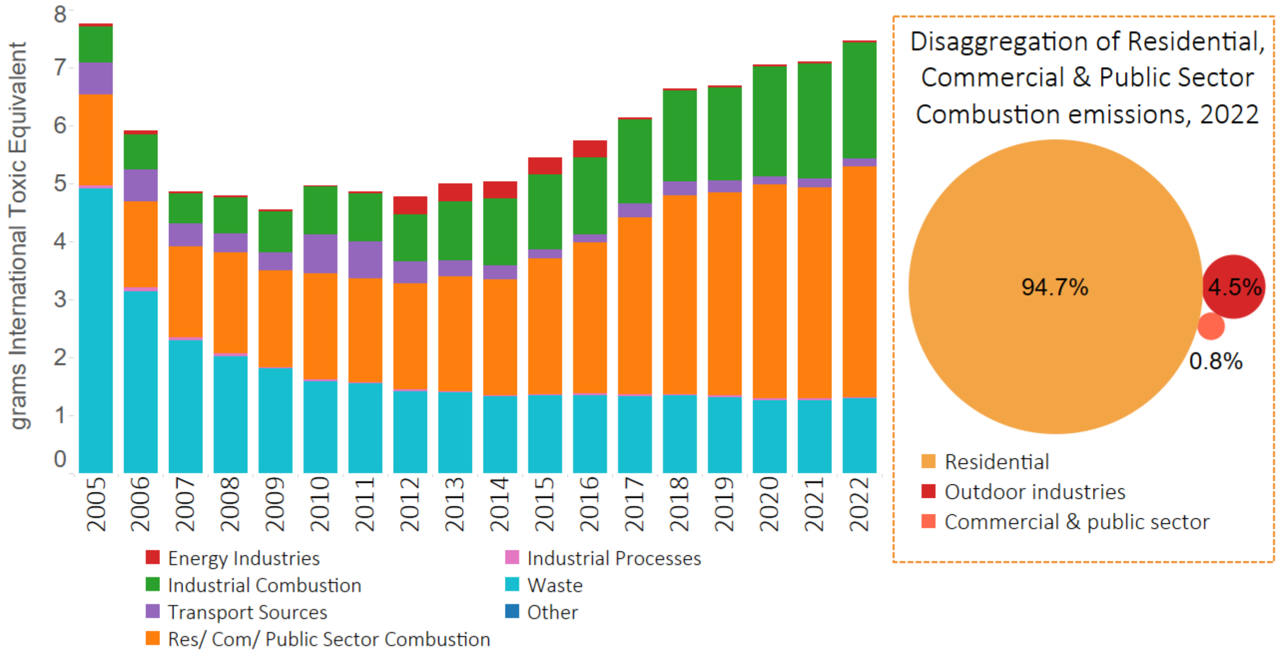


Figure 86 - Hg Emissions in Wales, 2022



C.4.4 Northern Ireland

Figure 87 - Dioxins Emissions in Northern Ireland[56]



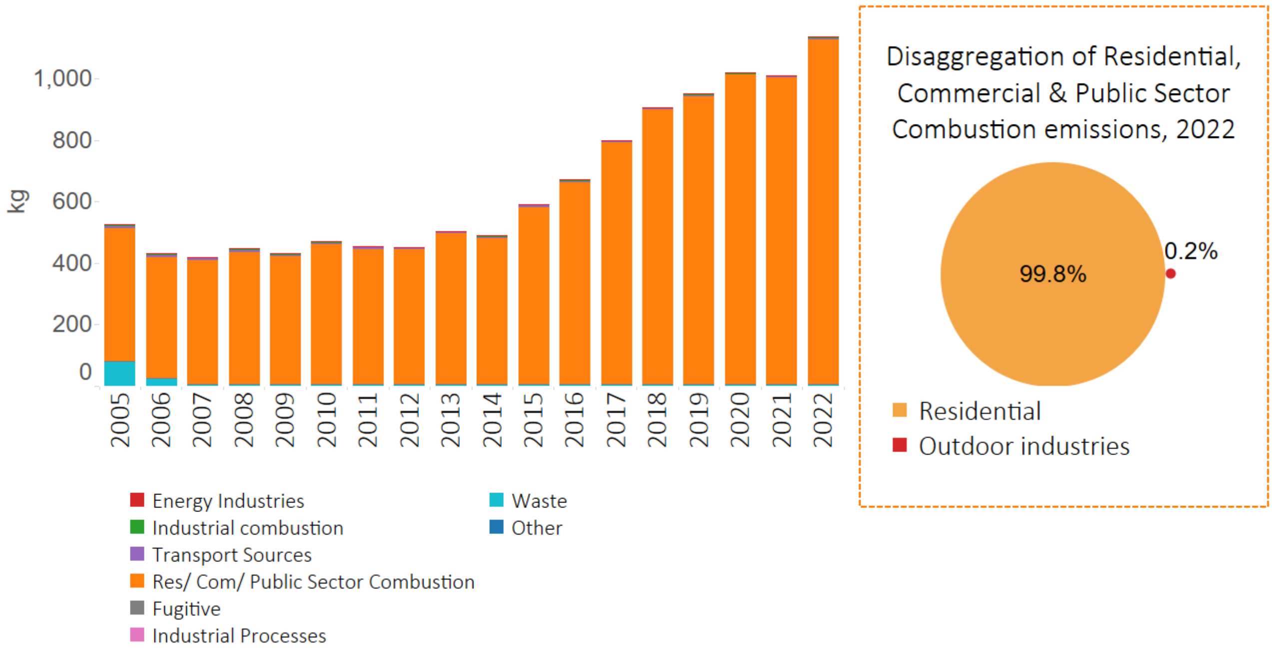
Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of dioxins in Northern Ireland were estimated to be 7.5g international toxic equivalents (I-TEQ)[57] in 2022, representing 6% of the UK total for dioxins. Emissions have fluctuated across the time series, but the overall dioxins trend is a 4% decrease since 2005. The initial reduction in emissions seen between 2005 and 2009 is driven by the increase in natural gas use, replacing oils and solid fuels, in residential combustion and reductions in agricultural waste burning. However, emissions have been increasing since 2009 due to increased wood and other biomass combustion in residential and unallocated industries (1A4bi and 1A2gviii respectively).

[56] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

[57] I-TEQ are used for groups of pollutants, such as dioxins, and involve weighting the mass of individual compounds based on the toxicity relative to the most toxic compound in the group of compounds.

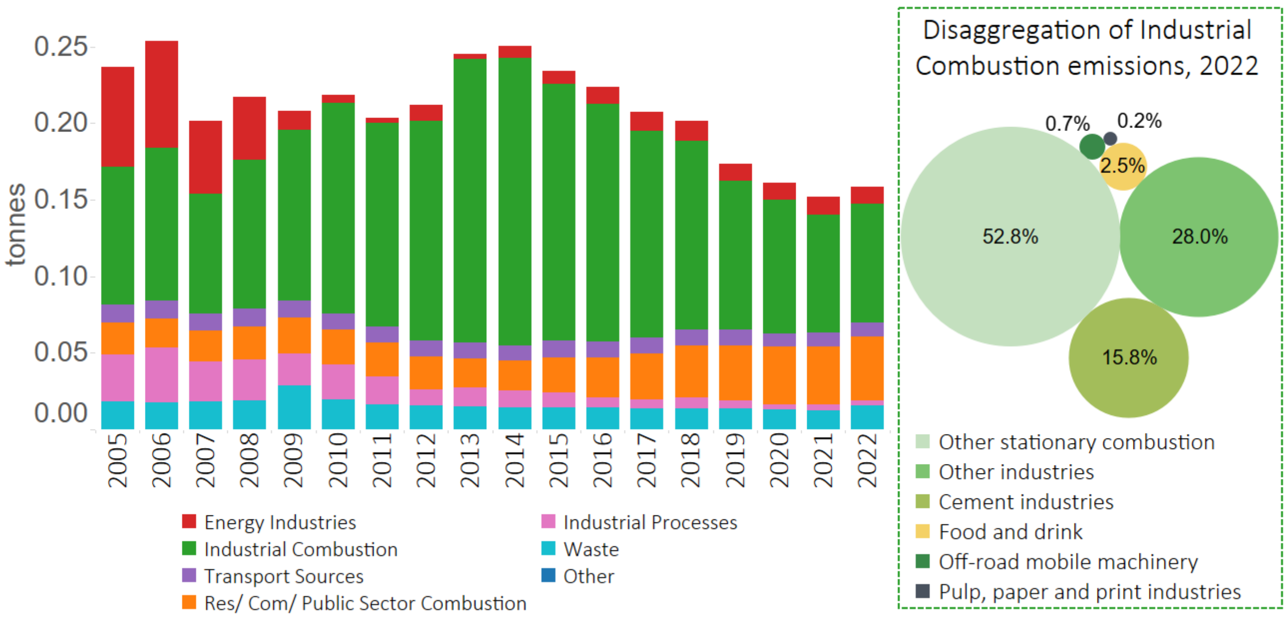
Figure 88 - B[a]P Emissions in Northern Ireland[58]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

Emissions of benzo(a)pyrene in Northern Ireland were estimated to be 1135kg in 2022, representing 16% of the UK total for benzo(a)pyrene. The majority of benzo(a)pyrene emissions in Northern Ireland come from residential combustion practices, primarily from the combustion of solid fossil fuels, particularly smokeless solid fuels.

Figure 89 - Hg Emissions in Northern Ireland[59]



Note: The disaggregated emissions chart may not add up to 100% due to rounding.

[58] Outdoor industries presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

[59] Other industries presented in the bubble graph relate to combustion emissions in the chemical, non-ferrous metals, pulp paper and print and other industries.

Emissions of Hg in Northern Ireland were estimated to be 0.16 t in 2022 and have declined by 33% since 2005. Emissions in Northern Ireland account for 5% of the UK total in 2022 for Hg. This decline in emissions stems from changes to combustion in power and heat generation and chloralkali process emissions, with a 69% and 35% contribution to the overall Hg trend respectively. The decline in emissions from power and heat generation is driven by the reduction in combustion of natural gas and power station oil.

Figure 90 - Dioxin Emissions in Northern Ireland, 2022

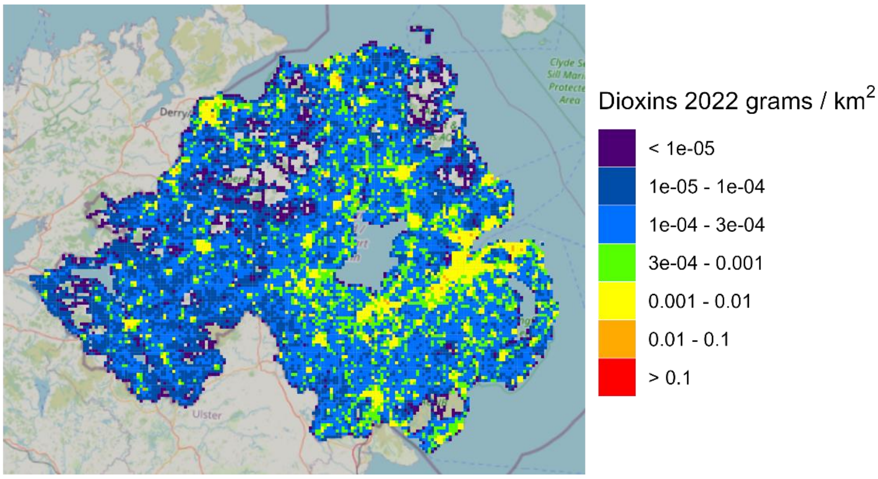


Figure 91 - B[a]P Emissions in Northern Ireland, 2022

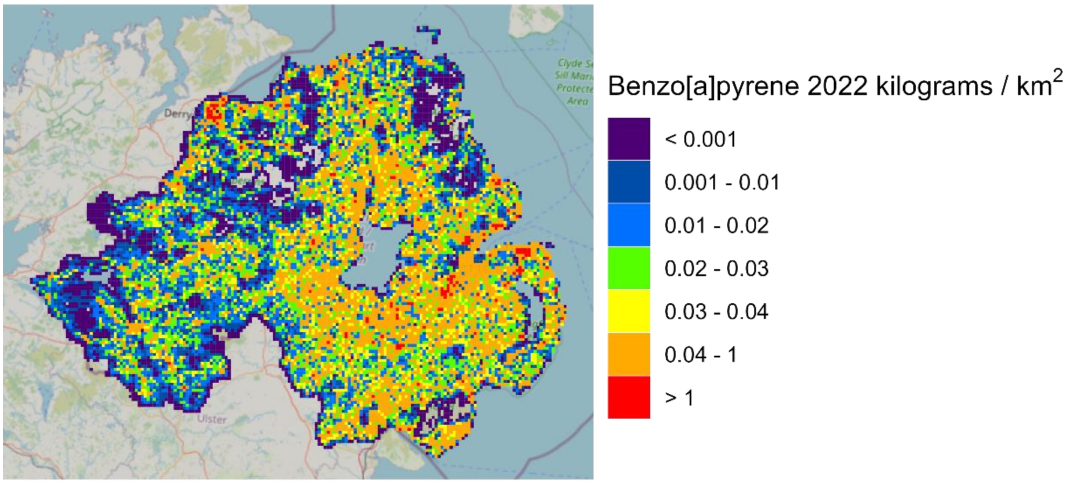
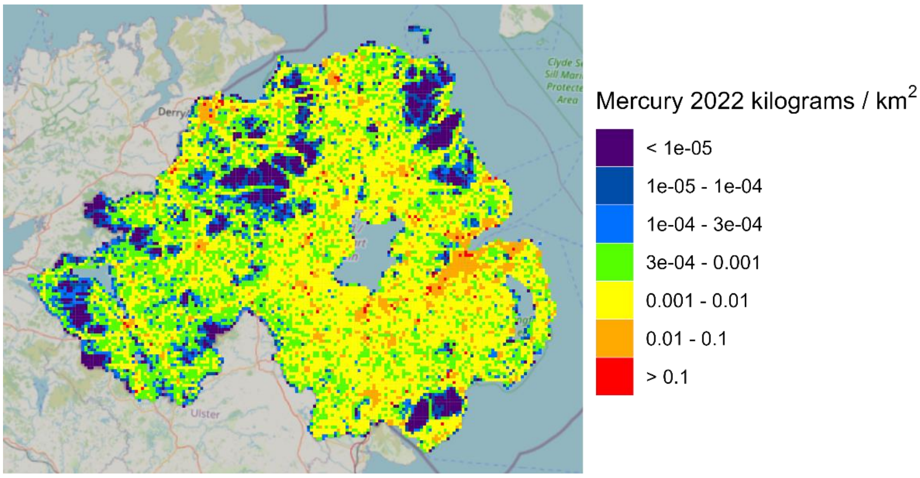


Figure 92 - Hg Emissions in Northern Ireland, 2022



Appendix D Recalculations

Throughout the UK inventory, emission estimates are updated annually across the full time series in response to new research and revisions to data sources. These changes also have an impact on the calculation of the Devolved Administrations' inventories. For further details on recalculations and method changes affecting each NFR sector, see chapter 8 'Recalculations and Methodology Changes' of the UK IIR (Elliot, et al., 2024). The most significant changes for each pollutant in the most recent inventory for 2021 are given in the tables below. Categories with a low overall contribution to a pollutant across the inventory are reported under 'Other' as shown in the following tables and summarised in **Table 32**.

In these tables, 'Change in 2005' and 'Change in 2021' refers to the change in emission estimate for 2005 and 2021 between the previous inventory and the current inventory.

Table 8 - Recalculations to 2005 and 2021 estimates for ammonia (NH_3) between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**1.0**	**0.5%**	**0.052**	**0.1%**	**0.057**	**0.3%**	**0.001**	**0.0%**
Overall change (2021)		**1.8**	**1.0%**	**0.012**	**0.0%**	**0.077**	**0.3%**	**-0.38**	**-1.2%**
Energy Industries	This category is included under "Other"								
Industrial Combustion	This category is included under "Other"								
Transport Sources	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.006	0.0%	0.001	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.005	-0.1%	-0.001	-0.4%	-0.001	-0.3%	0.000	-0.3%
Solvent Processes	This category is included under "Other"								
Residential, Commercial & Public Sector Combustion	This category is included under "Other"								
Industrial Processes	Changes at the UK inventory level, paper production has now been split into Neutral Sulphite Semi-Chemical Process (NSSC), and Mechanical Pulping. After	2005	2005	2005	2005	2005	2005	2005	2005
		0.008	0.1%	-0.006	-5.8%	0.007	10%	-0.006	-46%
		2021	2021	2021	2021	2021	2021	2021	2021

	this split paper production is no longer a source for NH3. Also there have been updates in BRT fraction (Batch, Recycled glass, Trace elements) in the production process for glass.	0.001	0.0%	0.000	0.4%	0.004	5.4%	-0.005	-43%
Agriculture	Changes in activity data across the entire time series and the implementation of new country specific emission factors. 3Da1 (Inorganic N-fertilizers (includes also urea application) emissions have been revised up due to increases in arable fertiliser from small revisions from DAERA (NI) in the surveyed quantities of nitrogen fertiliser types. 3B4gi and 3Da3 (Manure management - Laying hens and Urine and dung deposited by grazing animals respectively) have increased due to updated ratio of time spent outdoors for outdoor poultry. Updates to 3B4gi have also included changes to manure diverted to incineration and anaerobic digestion.	2005	2005	2005	2005	2005	2005	2005	2005
		0.35	0.2%	0.001	0.0%	0.011	0.1%	-0.019	-0.1%
		2021	2021	2021	2021	2021	2021	2021	2021
		1.3	0.9%	-0.041	-0.1%	0.062	0.3%	-0.40	-1.2%
Fugitive	This category is included under “Other”								
Waste	5B1 (Biological treatment of waste – Composting) emissions have been revised up due to revisions to composting activity data, this data is expected to fluctuate each year leading to recalculation in composting at household and at permit sites. Recalculations to the early part of the timeseries are driven by changes to sector 5A due to revisions to	2005	2005	2005	2005	2005	2005	2005	2005
		0.62	13%	0.061	13%	0.035	14%	0.025	15%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.32	5.1%	0.026	4.5%	0.011	3.5%	0.011	5.8%

	activity data. The regression used to estimate data pre-2007 has been updated and increases the tonnage to landfill quite significantly leading to large recalculation in 2005 landfill, non-fuel combustion.								
Other	1A1a (Public electricity and heat production) emissions have been revised up as a result of now including an NH3 emission factor for wood combustion in power stations. There are also other minor recalculations in this sector.	2005	2005	2005	2005	2005	2005	2005	2005
		0.017	0.1%	-0.004	-0.4%	0.005	0.5%	0.001	0.1%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.17	1.0%	0.028	1.9%	0.001	0.1%	0.006	0.9%

Table 9 - Recalculations to 2005 and 2021 estimates for carbon monoxide (CO) between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-214**	**-8.2%**	**0.48**	**0.2%**	**-2.1**	**-0.8%**	**2.7**	**3.0%**
Overall change (2021)		**20**	**2.1%**	**-5.2**	**-5.7%**	**-3.2**	**-1.8%**	**5.0**	**8.7%**
Energy Industries	Recalculations at the UK level to 1A1c (Manufacture of solid fuels and other energy industries) due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout. Note for England, post 2016, there were significant recalculations which are attributed to taking account of all biomass plants. This resulted in a change to the methodology, affecting the calculation of residual for consistent treatment of biogas.	2005	2005	2005	2005	2005	2005	2005	2005
		0.34	0.5%	0.41	4.1%	0.001	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.23	-0.5%	0.048	1.8%	0.055	1.7%	0.009	0.6%
Industrial Combustion	1A2gviii and 1A2d (Stationary combustion in manufacturing industries and construction: Other and Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print respectively) emissions have been revised down due to incorporating CO within the Industrial Scale Combustion model, enabling a split of large, medium and small combustion plants to be taken into account. This allows more representative guidebook emission factors to be applied throughout. Due to the disaggregation of non-road mobile machinery (NRMM),	2005	2005	2005	2005	2005	2005	2005	2005
		-27	-4.4%	-4.5	-9.6%	-2.0	-2.3%	-3.4	-17%
		2021	2021	2021	2021	2021	2021	2021	2021
		-35	-9.5%	-3.3	-9.6%	-2.7	-3.7%	-8.2	-33%

	there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.								
Transport Sources	Recalculations to transport are driven by 1A3bi (Road transport: Passenger cars) revisions. This is due to updating the methodology to use COPERT 5.6 rather than 5.4. The main contributions to the differences are revised cold start emission factors for petrol vehicles in COPERT 5.6 compared to 5.4. Additionally, COPERT 5.6 now includes degradation emission factors for the hot exhaust component of emissions.	2005	2005	2005	2005	2005	2005	2005	2005
		-182	-12%	5.3	4.1%	0.15	0.2%	5.8	13%
		2021	2021	2021	2021	2021	2021	2021	2021
		52	29%	6.0	31%	3.2	35%	3.2	54%
Solvent Processes	N/A								
Residential, Commercial & Public Sector Combustion	Revisions are due to a combination of methodological changes: Firstly, there are revisions to DUKES and the migration of the calculation of emission factors into the Industrial Scale Combustion model, has enabled a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout. Secondly, there were revisions to the DA driver methodology for residential coal and anthracite use which were updated to use the domestic solid fuel mapping grid. This resulted in decreases in 1A4bi in Scotland and Wales and increases in England and Northern Ireland between 2015-2021. Thirdly, natural gas water boiler now has a split in technologies,	2005	2005	2005	2005	2005	2005	2005	2005
		2.1	0.8%	0.035	0.1%	0.14	0.4%	0.48	2.5%
		2021	2021	2021	2021	2021	2021	2021	2021
		9.1	3.7%	-7.5	-25%	-3.5	-11%	10	41%

	meaning that the weighted average changes across the timeseries. There are also recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii.								
Industrial Processes	The largest recalculations are due to changes at the UK inventory level. Paper production has now been split into Neutral Sulphite Semi-Chemical Process (NSSC), and Mechanical Pulping. This split, combined with the use of Tier 2 emission factors, means that only NSSC is a source for CO.	2005	2005	2005	2005	2005	2005	2005	2005
		-7.3	-6.8%	-0.68	-62%	-0.33	-0.7%	-0.20	-67%
		2021	2021	2021	2021	2021	2021	2021	2021
		-5.7	-9.9%	-0.50	-21%	-0.23	-0.5%	-0.15	-73%
Agriculture	N/A								
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		-0.001	0.0%	0.000	0.0%	0.000	0.0%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.0%	-0.001	-0.1%	0.000	0.0%	0.000	1.2%
Waste	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		-0.006	0.0%	0.000	0.0%	-0.003	-0.2%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.030	0.1%	0.010	0.4%	-0.024	-1.9%	0.004	0.7%
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.001	0.3%	-0.001	-0.3%	-0.001	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.017	-0.6%	-0.004	-1.6%	-0.001	-0.8%	0.000	0.5%

Table 10 - Recalculations to 2005 and 2021 estimates for nitrogen oxides (NO_X) between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-11**	**-0.8%**	**-2.1**	**-1.0%**	**-0.14**	**-0.1%**	**-1.5**	**-2.4%**
Overall change (2021)		**-5.0**	**-1.1%**	**-1.6**	**-1.9%**	**-0.60**	**-1.4%**	**-2.9**	**-8.6%**
Energy Industries	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.030	0.0%	0.001	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.32	0.5%	0.012	0.1%	-0.028	-0.4%	0.033	0.9%
Industrial Combustion	Recalculations at a UK level include the disaggregation of burning oil use from NFR sector 1A2gviii (Stationary combustion in manufacturing industries and construction: Other) to 1A4ai and 1A4ci (Commercial/Institutional: Stationary and Agriculture/Forestry/Fishing: Stationary respectively). This results in a decrease in emissions from 1A2gviii and an increase in 1A4ai and 1A4ci. There is an overall decrease as lower, more sector appropriate emission factors could be used for 1A4ai and 1A4ci. There are also recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		-36	-18%	-4.8	-23%	-2.3	-13%	-4.7	-31%
		2021	2021	2021	2021	2021	2021	2021	2021
		-28	-29%	-3.9	-33%	-2.2	-20%	-5.7	-45%
Transport Sources	There has been an increase in 1A3b road transport emissions at a UK level due to using COPERT 5.6 rather than COPERT 5.4. This change is driven by increases in emission factors and emissions from cold start and degradation.	2005	2005	2005	2005	2005	2005	2005	2005
		13	2.2%	2.1	2.0%	1.4	3.8%	1.1	4.2%
		2021	2021	2021	2021	2021	2021	2021	2021
		14	6.5%	0.88	2.1%	0.91	6.3%	0.57	5.9%

Solvent Processes	N/A								
Residential, Commercial & Public Sector Combustion	Recalculations at a UK level include the disaggregation of burning oil use from NFR sector 1A2gviii (Stationary combustion in manufacturing industries and construction: Other) to 1A4ai and 1A4ci (Commercial/Institutional: Stationary and Agriculture/Forestry/Fishing: Stationary respectively). This reallocation of burning oil results in a decrease in emissions from 1A2gviii and an increase in 1A4ai and 1A4ci. There is an overall decrease of emission factors as lower, more sector appropriate emission factors could be used for 1A4ai and 1A4ci. There is a decrease in emissions in 1A4bi Residential: Stationary emissions due to implementing a split in technologies for natural gas fired water boilers, hence adjusting the weighted emission factor. There is a net increase for this sector.	2005	2005	2005	2005	2005	2005	2005	2005
		14	12%	0.67	2.2%	0.82	6.5%	2.2	20%
		2021	2021	2021	2021	2021	2021	2021	2021
		11	17%	1.00	7.0%	0.81	16%	2.3	52%
Industrial Processes	This category is included under "Other"								
Agriculture	Changes in activity data across the entire time series and the implementation of new country specific emission factors. Laying hens and Urine and dung deposited by grazing animals respectively) have increased due to updated ratio of time spent outdoors for outdoor poultry. Updates to 3B4gi have also included changes to manure diverted to incineration and anaerobic digestion.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.74	-4.0%	0.000	0.0%	0.000	0.0%	0.001	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.68	-3.9%	0.084	2.1%	-0.029	-1.0%	-0.054	-1.7%
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.0%	0.40	142%	0.000	0.0%	0.000	1.2%
Waste	This category is included under "Other"								

Other	At a UK level, there is a decrease in emissions from 2H1 Pulp and paper industry where estimates were upgraded from Tier 1 to Tier 2 emission factors.	2005	2005	2005	2005	2005	2005	2005	2005
		-1.3	-5.2%	-0.12	-5.7%	-0.079	-5.0%	-0.039	-6.2%
		2021	2021	2021	2021	2021	2021	2021	2021
		-1.0	-6.1%	-0.10	-7.8%	-0.064	-6.6%	-0.023	-5.9%

Table 11 - Recalculations to 2005 and 2021 estimates for NMVOCs between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-3.0**	**-0.3%**	**2.8**	**1.6%**	**0.35**	**0.5%**	**0.82**	**2.0%**
Overall change (2021)		**9.6**	**1.9%**	**0.70**	**0.5%**	**-0.27**	**-0.6%**	**0.98**	**2.7%**
Energy Industries	Recalculations at the UK level to 1A1c (Manufacture of solid fuels and other energy industries) due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout.	2005	2005	2005	2005	2005	2005	2005	2005
		1.1	29%	1.3	235%	0.004	0.5%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.37	24%	0.24	117%	0.29	67%	0.000	0.2%
Industrial Combustion	Emissions for 1A2gviii (Stationary combustion in manufacturing industries and construction: Other) have increased due to NMVOCs being included within the expanded Industrial Scale Combustion model in the UK inventory. The higher emission factor for gas combustion is partially offset by lower emission factor for biomass combustion, however there is a net increase.	2005	2005	2005	2005	2005	2005	2005	2005
		1.6	6.5%	0.33	16%	-0.078	-3.7%	0.11	12%
		2021	2021	2021	2021	2021	2021	2021	2021
		2.1	15%	0.28	21%	-0.066	-4.5%	-0.16	-18%
Transport Sources	There has been a change in 1A3b road transport emissions at a UK level due to using COPERT 5.6 rather than COPERT 5.4. This has a particular effect on cold start emissions from petrol cars.	2005	2005	2005	2005	2005	2005	2005	2005
		-9.4	-4.7%	1.2	6.6%	0.52	4.9%	0.96	15%
		2021	2021	2021	2021	2021	2021	2021	2021
		6.4	23%	0.72	22%	0.39	26%	0.36	34%
Solvent Processes	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		-0.23	-0.1%	0.021	0.1%	-0.31	-1.6%	-0.12	-1.2%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.33	0.1%	-0.26	-1.0%	-0.41	-2.7%	0.070	0.8%

Residential, Commercial & Public Sector Combustion	Due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied. There are revisions to public sector burning oil use due to an update to the public sector DA driver value included burning oil for the first time, and a revision at the UK level to improve burning oil extrapolation before 2016.	2005	2005	2005	2005	2005	2005	2005	2005
		4.6	17%	0.55	13%	0.31	9.3%	0.19	9.3%
		2021	2021	2021	2021	2021	2021	2021	2021
		3.3	15%	-0.24	-8.1%	-0.19	-6.5%	0.82	40%
Industrial Processes	The largest recalculations are due to changes at the UK inventory level. Paper production has now been split into Neutral Sulphite Semi-Chemical Process (NSSC), and Mechanical Pulping. After this split and use of Tier 2 emission factors, only NSSC is a source for NMVOCs.	2005	2005	2005	2005	2005	2005	2005	2005
		-1.2	-1.9%	-0.22	-0.4%	-0.12	-4.1%	-0.051	-1.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		-2.7	-6.2%	-0.26	-0.3%	-0.13	-4.7%	-0.12	-3.0%
Agriculture	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.067	0.1%	0.003	0.0%	-0.002	0.0%	-0.001	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.53	-0.6%	-0.075	-0.5%	-0.009	-0.1%	0.045	0.2%
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.53	0.3%	-0.39	-0.9%	0.027	0.2%	-0.26	-14%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.37	0.8%	0.30	3.1%	-0.15	-2.4%	-0.051	-7.6%
Waste	This category is included under “Other”								
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.002	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.011	-0.1%	0.001	0.1%	-0.004	-0.8%	0.006	1.9%

Table 12 - Recalculations to 2005 and 2021 estimates for PM_{10} between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-3.7**	**-2.4%**	**-1.4**	**-6.7%**	**0.48**	**3.7%**	**0.21**	**2.6%**
Overall change (2021)		**-14**	**-12%**	**-2.2**	**-18%**	**-0.68**	**-6.8%**	**-1.4**	**-16%**
Energy Industries	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		-0.001	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.007	-0.4%	0.001	0.3%	-0.001	-0.2%	0.001	2.1%
Industrial Combustion	Recalculation at UK level across the timeseries, mainly due to the recalculation in 1A2gviii (Stationary combustion in manufacturing industries and construction: Other), due to the integration into the Industrial Scale Combustion Model, allowing for the split of large, medium and small combustion plants to be taken into account. This allows more representative emission factors to be applied, particularly for biomass, coal, natural gas and other fuels.	2005	2005	2005	2005	2005	2005	2005	2005
		-6.1	-40%	-0.66	-40%	-0.34	-32%	-0.77	-46%
		2021	2021	2021	2021	2021	2021	2021	2021
		-11	-69%	-0.99	-68%	-0.78	-65%	-2.3	-71%
Transport Sources	The recalculation leads to increase in PM10 at the UK level across the timeseries. This is mainly due to using COPERT 5.6 rather than COPERT 5.4. This results in more appropriate emission factors such as conventional vehicles which have higher brake wear emission factors.	2005	2005	2005	2005	2005	2005	2005	2005
		3.1	9.5%	0.38	7.0%	0.24	9.3%	0.16	10%
		2021	2021	2021	2021	2021	2021	2021	2021
		1.8	11%	0.19	9.5%	0.12	11%	0.082	12%
Solvent Processes	This category is included under “Other”								
Residential, Commercial & Public Sector Combustion	There are recalculations at the UK level due to improvements to the Domestic Combustion model to take into account stove sales and heating degree days. Growth in wood use is now allocated more appropriately between newer, less emitting appliances and existing appliances, therefore applying the most reasonable emission factors. For 2021, there was an increase in wood use (compared to the	2005	2005	2005	2005	2005	2005	2005	2005
		0.63	3.6%	0.053	1.8%	0.026	1.1%	0.11	6.3%
		2021	2021	2021	2021	2021	2021	2021	2021

	previous year) from both heating demand and new installations but the greater part of this increase was from use allocated to new appliances. There are revisions to public sector burning oil use due to an update to the public sector DA driver value included burning oil for the first time, and a revision at the UK level to improve burning oil extrapolation before 2016.	-1.4	-7.6%	-0.50	-23%	-0.38	-16%	0.38	23%
Industrial Processes	At the DA level there are recalculations across the timeseries for quarrying due to an updated mapping grid. This results in decreases for England and Scotland, and increases for Wales and Northern Ireland. There is also a revision down at the UK level in 2021 for road construction due to revisions to the activity data.	2005	2005	2005	2005	2005	2005	2005	2005
		-1.3	-2.4%	-1.1	-21%	0.55	13%	0.71	45%
		2021	2021	2021	2021	2021	2021	2021	2021
		-3.0	-7.5%	-0.89	-24%	0.38	11%	0.45	42%
Agriculture	Very minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.1%	0.000	-0.4%	0.000	0.0%	0.000	1.2%
Waste	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.001	0.0%	0.000	0.0%	-0.001	-0.2%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.020	0.4%	0.003	0.6%	-0.006	-1.8%	0.001	1.0%
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.002	0.1%	0.000	0.2%	-0.002	-2.1%	-0.001	-1.5%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.094	7.3%	0.004	4.1%	-0.004	-5.9%	0.003	9.7%

Table 13 - Recalculations to 2005 and 2021 estimates for sulphur dioxide (SO_2) between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-2.8**	**-0.5%**	**-0.26**	**-0.3%**	**-0.12**	**-0.2%**	**-0.21**	**-0.7%**
Overall change (2021)		**-6.1**	**-6.9%**	**-1.5**	**-17%**	**-1.1**	**-7.4%**	**0.89**	**7.6%**
Energy Industries	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.012	0.0%	0.010	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.061	0.3%	0.001	0.1%	0.005	0.2%	-0.005	-0.4%
Industrial Combustion	At UK level, emissions from 1A2gviii (Stationary combustion in manufacturing industries and construction: Other) have decreased due to revised fuel use data from DUKES, and other contributing factors including disaggregating burning oil use from industrial use into commercial and public sectors, thus allowing the use of more sector appropriate emission factors. For earlier years, the recalculation is caused by an update to the burning oil conversion factor and burning oil extrapolation before 2016 to get a more consistent timeseries from the unclassified burning oil.	2005	2005	2005	2005	2005	2005	2005	2005
		-2.0	-1.9%	-0.20	-1.7%	-0.13	-1.8%	-0.20	-3.2%
		2021	2021	2021	2021	2021	2021	2021	2021
		-4.1	-15%	-0.27	-15%	-0.37	-8.0%	-1.1	-21%
Transport Sources	Major recalculations to transport sources from SO2 are due to the disaggregation and reallocation of emissions from non-road mobile machinery (NRMM) to other NFR codes. For this reason there are recalculations affecting 1A3eii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii. Cold start emissions for cars and LGVs are a new source for SO2 resulting in an increase in emissions across the timeseries from road transport.	2005	2005	2005	2005	2005	2005	2005	2005
		0.99	2.5%	0.093	0.4%	0.069	0.9%	0.037	1.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.002	-0.1%	0.001	0.1%	0.000	0.0%	0.000	0.1%
Solvent Processes	N/A								
		2005	2005	2005	2005	2005	2005	2005	2005

Residential, Commercial & Public Sector Combustion	Due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii. There are some small recalculations, mainly influenced by coal use for Domestic Fireplace - Standard and anthracite use for Domestic Boiler due to DUKES revisions in later years.	0.75	1.8%	0.084	0.9%	0.065	1.2%	0.032	0.8%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.29	1.3%	-1.1	-43%	-0.56	-13%	2.0	42%
Industrial Processes	The largest recalculations are due to changes at the UK inventory level. Paper production has now been split into Neutral Sulphite Semi-Chemical Process (NSSC), and Mechanical Pulping. After this split and use of Tier 2 emission factors only NSSC is a source for SO2.	2005	2005	2005	2005	2005	2005	2005	2005
		-2.6	-8.0%	-0.25	-23%	-0.11	-4.6%	-0.077	-74%
		2021	2021	2021	2021	2021	2021	2021	2021
		-2.1	-27%	-0.19	-26%	-0.089	-17%	-0.056	-70%
Agriculture	N/A								
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.34	-5.6%	0.000	0.0%	-0.047	-3.0%	0.000	
Waste	N/A								
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.002	0.0%	0.001	0.2%	-0.003	-1.1%	-0.001	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.002	0.2%	0.000	-0.4%	-0.003	-5.7%	0.000	0.9%

Table 14 - Recalculations to 2005 and 2021 estimates for lead (Pb) between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (t)	Change (%)	Change (t)	Change (%)	Change (t)	Change (%)	Change (t)	Change (%)
Overall change (2005)		**14**	**9.1%**	**1.6**	**13%**	**0.71**	**2.8%**	**0.42**	**7.0%**
Overall change (2021)		**14**	**18%**	**1.1**	**16%**	**0.81**	**3.4%**	**0.83**	**21%**
Energy Industries	Emissions from natural gas added to inventory for 1A1c; an emission factor was added as part of work on emission factor completeness across the inventory where the emission factor already exists in the emission factor database. There are also revisions to point sources in 2021 affecting wood combustion in power stations.	2005	2005	2005	2005	2005	2005	2005	2005
		0.054	0.6%	0.051	3.3%	0.002	0.3%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.22	12%	0.047	24%	0.018	34%	0.011	23%
Industrial Combustion	Due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		0.37	3.6%	0.030	1.9%	0.055	2.2%	-0.15	-5.1%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.16	-2.4%	-0.044	-5.9%	-0.014	-2.5%	-0.077	-4.3%
Transport Sources	Emissions have been revised up, mostly due to implementing updated emission factors from COPERT 5.6 for brake and tyre wear (1A3bvi).	2005	2005	2005	2005	2005	2005	2005	2005
		13	22%	1.2	18%	0.79	22%	0.58	30%
		2021	2021	2021	2021	2021	2021	2021	2021
		12	33%	1.3	28%	0.78	39%	0.53	42%
Solvent Processes	N/A								
Residential, Commercial & Public Sector Combustion	Due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied. Emissions from natural gas added to inventory for miscellaneous Industrial/commercial combustion and public sector combustion; an emission factor was added as part of work on emission factor completeness across the inventory where the emission factor	2005	2005	2005	2005	2005	2005	2005	2005
		0.57	14%	0.066	9.0%	0.035	4.9%	0.014	3.3%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.83	30%	-0.12	-26%	-0.042	-7.6%	0.28	63%

	already exists in the emission factor database.								
Industrial Processes	Minor changes, including PRTR 2021 data now being available for wood processing and production, which has been included, and at the DA level an update to the foundries mapping grid across the whole timeseries.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.075	-0.1%	0.27	13%	-0.17	-1.0%	-0.020	-3.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		1.3	4.3%	0.010	1.1%	0.072	0.4%	0.078	24%
Agriculture	N/A								
Fugitive	Minor recalculations.	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000		0.000	0.0%	0.000	
		2021	2021	2021	2021	2021	2021	2021	2021
		0.010	4.1%	0.000		0.001	0.3%	0.000	
Waste	This category is included under “Other”								
Other	Minor recalculations.	2005	2005	2005	2005	2005	2005	2005	2005
		0.001	0.0%	0.000	0.2%	-0.001	-1.0%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.002	0.1%	-0.001	-0.8%	-0.001	-1.2%	0.001	1.1%

Table 15 - Recalculations to 2005 and 2021 estimates for $PM_{2.5}$ between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)	Change (kt)	Change (%)
Overall change (2005)		**-4.6**	**-5.3%**	**-0.51**	**-4.0%**	**-0.19**	**-2.2%**	**-0.55**	**-9.9%**
Overall change (2021)		**-13**	**-20%**	**-1.6**	**-23%**	**-1.1**	**-17%**	**-1.8**	**-30%**
Energy Industries	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		-0.001	0.0%	-0.002	-0.2%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.005	-0.4%	0.000	0.2%	-0.001	-0.3%	0.001	2.4%
Industrial Combustion	Recalculation at UK level across the timeseries, mainly due to the recalculation in 1A2gviii (Stationary combustion in manufacturing industries and construction: Other), due to the integration into the Industrial Scale Combustion Model, allowing for the split of large, medium and small combustion plants to be taken into account. This allows more representative emission factors to be applied, particularly for biomass, coal, natural gas and other fuels.	2005	2005	2005	2005	2005	2005	2005	2005
		-6.3	-43%	-0.67	-42%	-0.38	-37%	-0.81	-51%
		2021	2021	2021	2021	2021	2021	2021	2021
		-11	-70%	-0.98	-69%	-0.78	-67%	-2.2	-71%
Transport Sources	The recalculation leads to increase in PM2.5 at the UK level across the timeseries. This is mainly due to using COPERT 5.6 rather than COPERT 5.4. This results in more appropriate emission factors such as conventional vehicles which have higher brake wear emission factors.	2005	2005	2005	2005	2005	2005	2005	2005
		1.9	7.1%	0.27	5.6%	0.16	7.5%	0.11	8.2%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.62	6.0%	0.071	5.1%	0.043	6.3%	0.030	6.5%
Solvent Processes	This category is included under “Other”								
Residential, Commercial & Public Sector Combustion	There are recalculations at the UK level due to improvements to the Domestic Combustion model to take into account stove sales and heating degree days. Growth in wood use is now allocated more appropriately between newer, less emitting appliances and existing appliances, therefore applying the most reasonable emission factors. For 2021, there was an	2005	2005	2005	2005	2005	2005	2005	2005
		0.56	3.3%	0.045	1.6%	0.023	0.9%	0.097	5.8%
		2021	2021	2021	2021	2021	2021	2021	2021

	increase in wood use (compared to the previous year) from both heating demand and new installations but the greater part of this increase was from use allocated to new appliances. There are revisions to public sector burning oil use due to an update to the public sector DA driver value included burning oil for the first time, and a revision at the UK level to improve burning oil extrapolation before 2016.	-1.5	-8.0%	-0.50	-24%	-0.38	-16%	0.36	23%
Industrial Processes	At the DA level there are recalculations across the timeseries for quarrying due to an updated mapping grid. This results in decreases for England and Scotland, and increases for Wales and Northern Ireland. There is a revision to fletton brick manufacture in England across the timeseries due to a correction in units to the emission factors used in the UK inventory.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.80	-5.8%	-0.15	-13%	0.009	0.5%	0.049	14%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.75	-8.9%	-0.14	-21%	0.022	1.6%	0.034	15%
Agriculture	Very minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.1%	0.000	-0.1%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.1%	0.000	-0.4%	0.000	0.0%	0.000	1.2%
Waste	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.001	0.0%	0.000	0.0%	-0.001	-0.2%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.019	0.4%	0.003	0.6%	-0.005	-1.9%	0.001	1.0%
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.001	0.1%	0.000	0.2%	-0.001	-1.6%	0.000	-1.1%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.028	4.8%	0.001	1.9%	-0.002	-5.8%	0.001	7.0%

Table 16 - Recalculations to 2005 and 2021 estimates for B[a]P between previous and current inventory submissions – note these are experimental statistics only.

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (kg)	Change (%)	Change (kg)	Change (%)	Change (kg)	Change (%)	Change (kg)	Change (%)
Overall change (2005)		**0.11**	**0.0%**	**0.002**	**0.0%**	**-1.2**	**-0.1%**	**-0.37**	**-0.1%**
Overall change (2021)		**270**	**6.3%**	**-282**	**-52%**	**-131**	**-16%**	**347**	**52%**
Energy Industries	At the UK level, there are recalculations in later years to straw combustion in power stations due to biomass plants being fully taken into account. There are also recalculations to 1A1c (Manufacture of solid fuels and other energy industries) due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout.	2005	2005	2005	2005	2005	2005	2005	2005
		0.037	0.1%	0.001	0.0%	0.002	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		3.2	1.5%	-0.003	-3.2%	0.033	1.4%	0.015	1.5%
Industrial Combustion	Recalculations to industrial combustion at the UK level are due to revisions to DUKES and due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout. There are also recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		-7.9	-17%	-0.81	-19%	-1.2	-14%	-0.53	-23%
		2021	2021	2021	2021	2021	2021	2021	2021
		-4.0	-11%	-0.41	-11%	-0.43	-16%	-0.28	-17%
Transport Sources	Recalculations at the UK level to B[a]P emissions from brake wear due to using COPERT 5.6 which has higher brake wear emission factors compared to COPERT 5.4. This has a smaller impact on later years when there are	2005	2005	2005	2005	2005	2005	2005	2005
		5.9	3.1%	0.54	2.7%	0.39	3.3%	0.23	3.0%

	more electric and hybrid vehicles in the fleet.	2021	2021	2021	2021	2021	2021	2021	2021
		3.1	2.8%	0.30	2.5%	0.20	2.8%	0.13	2.9%
Solvent Processes	This category is included under "Other"								
Residential, Commercial & Public Sector Combustion	At the UK level, the recalculation accounting for almost all of the increases for B[a]P, was a recalculation driven by revisions to DUKES for the solid smokeless fuel use within the residential sector (1A4bi, Residential: Stationary), as well as the improvement to apportion more reliable activity data to differing appliance types. There were revisions to the DA driver methodology for residential coal and anthracite use which were updated to use the domestic solid fuel mapping grid. This resulted in decreases in 1A4bi in Scotland and Wales and increases in England and Northern Ireland between 2015-2021.	2005	2005	2005	2005	2005	2005	2005	2005
		1.6	0.0%	0.14	0.0%	0.10	0.0%	0.061	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		271	7.5%	-285	-58%	-130	-18%	347	53%
Industrial Processes	There are DA specific recalculations to B[a]P emissions for 2I wood processing due to an updated wood treatment mapping grid for the entire timeseries. There are recalculations to England and Scotland for primary aluminium production in 2020 and 2021 due to an error correction to attribute all emissions to Scotland, not England in these years.	2005	2005	2005	2005	2005	2005	2005	2005
		0.42	0.3%	0.13	1.1%	-0.42	-0.8%	-0.13	-11%
		2021	2021	2021	2021	2021	2021	2021	2021
		-3.2	-6.5%	3.4	93%	0.052	0.7%	0.057	6.3%
Agriculture	N/A								
Fugitive	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000		0.001	0.0%	0.000	
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	0.0%	0.000		0.000	0.0%	0.000	
Waste	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.51	0.2%	0.11	0.4%	-0.23	-1.5%	0.021	0.5%
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005

		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.065	-0.7%	-0.004	-0.5%	-0.013	-2.7%	-0.001	-0.2%

Table 17 - Recalculations to 2005 and 2021 estimates for dioxins between previous and current inventory submissions – note these are experimental statistics only.

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (g-ITQ)	Change (%)	Change (g-ITQ)	Change (%)	Change (g-ITQ)	Change (%)	Change (g-ITQ)	Change (%)
Overall change (2005)		**-2.2**	**-1.3%**	**-0.49**	**-2.8%**	**-0.18**	**-0.8%**	**-0.45**	**-5.5%**
Overall change (2021)		**0.041**	**0.0%**	**-1.0**	**-12%**	**-0.59**	**-6.0%**	**0.55**	**8.3%**
Energy Industries	At the UK level, there are recalculations in later years to straw combustion in power stations due to biomass plants being fully taken into account. There are also recalculations to 1A1c (Manufacture of solid fuels and other energy industries) due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout.	2005	2005	2005	2005	2005	2005	2005	2005
		0.041	0.5%	-0.009	-3.5%	0.001	0.5%	0.000	0.3%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.056	3.3%	-0.008	-5.8%	0.001	0.9%	0.000	1.0%
Industrial Combustion	Recalculations to industrial combustion at the UK level are due to revisions to DUKES and due to the migration of the calculation of the emission factors into the Industrial Scale Combustion model, this enables a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout. There are also recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		-2.3	-18%	-0.51	-32%	-0.15	-13%	-0.49	-44%
		2021	2021	2021	2021	2021	2021	2021	2021
		-1.8	-8.9%	-0.15	-9.0%	-0.21	-17%	-0.73	-27%
Transport Sources	There are recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A3eii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii,	2005	2005	2005	2005	2005	2005	2005	2005
		0.32	2.0%	0.004	0.3%	0.040	4.8%	0.048	9.8%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.17	4.0%	0.004	0.8%	0.013	5.2%	0.021	16%

	allowing more appropriate emission factors to be applied.								
Solvent Processes	This category is included under “Other”								
Residential, Commercial & Public Sector Combustion	Recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied. There are also revisions due to the migration of the calculation of emission factors into the Industrial Scale Combustion model, which has enabled a split of large, medium and small combustion plant to be taken into account, hence applying more representative guidebook emission factors throughout.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.21	-1.2%	-0.035	-1.2%	-0.033	-1.2%	-0.010	-0.7%
		2021	2021	2021	2021	2021	2021	2021	2021
		1.5	10%	-0.90	-42%	-0.38	-14%	1.2	52%
Industrial Processes	There are minor recalculations to emissions from foundries at the DA level due to an update to the foundries mapping grid across the whole timeseries.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.019	-0.1%	0.063	29%	-0.036	-0.4%	-0.005	-9.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.009	-0.1%	-0.010	-9.1%	0.018	0.6%	0.002	7.3%
Agriculture	N/A								
Fugitive	This category is included under “Other”								
Waste	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.004	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.12	0.3%	0.023	0.6%	-0.037	-1.6%	0.012	0.9%
Other	Minor recalculations	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.3%	0.000	0.6%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.015	4.7%	0.001	15%	0.001	2.8%	0.000	17%

Table 18 - Recalculations to 2005 and 2021 estimates for Hg between previous and current inventory submissions – note these are experimental statistics only.

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change (t)	Change (%)	Change (t)	Change (%)	Change (t)	Change (%)	Change (t)	Change (%)
Overall change (2005)		**0.31**	**5.0%**	**0.058**	**10%**	**0.020**	**3.3%**	**0.001**	**0.4%**
Overall change (2021)		**0.14**	**5.1%**	**0.014**	**7.4%**	**0.014**	**2.1%**	**0.001**	**0.8%**
Energy Industries	Minor recalculations.	2005	2005	2005	2005	2005	2005	2005	2005
		0.001	0.1%	0.000	0.0%	0.001	0.4%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.008	-1.1%	0.000	0.0%	0.000	-1.1%	0.000	-1.7%
Industrial Combustion	There are recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A2gvii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		0.27	38%	0.034	40%	0.028	59%	0.002	2.5%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.12	20%	0.021	82%	0.013	14%	-0.014	-15%
Transport Sources	Emissions have been revised up, mostly due to implementing updated emission factors from COPERT 5.6 for brake and tyre wear (1A3bvi).	2005	2005	2005	2005	2005	2005	2005	2005
		0.007	2.8%	0.001	2.0%	0.001	3.7%	0.000	2.7%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.009	4.5%	0.001	3.2%	0.001	7.6%	0.000	2.7%
Solvent Processes	N/A								
Residential, Commercial & Public Sector Combustion	Recalculations due to the disaggregation of non-road mobile machinery (NRMM), there are recalculations affecting 1A4aii and 1A4cii as emissions are reallocated within 1A2gvii, 1A4aii, 1A4cii, and 1A3eii, allowing for more appropriate emission factors to be applied.	2005	2005	2005	2005	2005	2005	2005	2005
		0.035	11%	0.005	9.5%	0.002	6.1%	0.000	-0.1%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.054	26%	-0.002	-7.8%	0.001	5.1%	0.015	63%
Industrial Processes	There are minor recalculations to emissions from foundries at the DA level due to an update to the foundries mapping grid across the whole timeseries.	2005	2005	2005	2005	2005	2005	2005	2005
		-0.006	-0.3%	0.019	15%	-0.011	-4.3%	-0.002	-4.9%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.001	0.2%	-0.003	-17%	0.001	0.1%	0.001	16%

Agriculture	N/A								
Fugitive	This category is included under “Other”								
Waste	Emissions have been revised down in the cremation sector by accounting for up-to-date figures on crematoria abatement (5C1bv, Cremation).	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.0%	0.000	0.0%	0.000	0.0%
		2021	2021	2021	2021	2021	2021	2021	2021
		-0.033	-5.1%	-0.003	-5.1%	-0.002	-6.1%	0.000	-2.3%
Other	Minor recalculations.	2005	2005	2005	2005	2005	2005	2005	2005
		0.000	0.0%	0.000	0.3%	0.000	0.0%	0.000	-0.4%
		2021	2021	2021	2021	2021	2021	2021	2021
		0.000	4.3%	0.000	-1.0%	0.000	1.2%	0.000	1.2%

Appendix E Uncertainties

Uncertainties in the UK inventory are associated with the availability and quality of activity data, emission factors, and the methodologies used in emissions calculations throughout the time series. These uncertainties are quantified in assessments using a Tier 1 uncertainty aggregation method. The Tier 1 methodology investigates the impact of the assumed uncertainty of individual parameters (such as emission factors and activity statistics) upon the uncertainty in the total emission of each pollutant. Results from the Tier 1 methodology are presented in Chapter 1.7 of the IIR(Elliot, et al., 2024). For England's and the Devolved Administrations' air pollutant inventories, uncertainties are assessed for the NECR and Gothenburg Protocol base year (2005) and the most recently reported year by source sector and by pollutant using the Tier 1 approach. Full details of the approach can be found in Chapter 5 of the EMEP/EEA Guidebook (2019).

The Tier 1 method estimates uncertainties by source category using an error propagation approach, using simplistic rules for the base year and the latest year and the trend between them. This method does not account for correlations and dependencies between source categories that may occur because the same activity data or emission factors may be used for multiple emissions estimates. Potential examples of this include cases where the total consumption of a fuel is more certain than the consumption disaggregated by source category which implies that hidden dependencies exist within the statistics because of the constraints required to scale to overall consumption. Dependency is somewhat addressed here by aggregating source categories to a level across NFR sectors before uncertainties are combined, resulting in some loss of detail but minimising the influence of these potential hidden dependencies. In addition, the Tier 1 uncertainty approach does not allow for asymmetry to be incorporated into the calculations which can lead to unrepresentative uncertainty ranges. For example, ammonia emissions from 1A in 2005 have an uncertainty >100% so the calculated lower boundary is negative (see Appendix E.1).

Additional considerations are needed for the air pollutant inventories for England and the Devolved Administrations due to the uncertainties associated with the method used to derive them. The inventories are derived by disaggregating UK emissions across the four countries and the unallocated region, and so the UK-wide uncertainty is compounded by further uncertainty introduced by the methods developed to split emissions on a source-activity scale. To account for this, and to ensure treatment of the DAs in a consistent manner but assuming independency between DAs, the uncertainty associated with activity is expressed as:

$$\bar{U}_{Ai} = U_A w_i \frac{\sum_i |E_i|}{\sqrt{\sum_i w_i^2 E_i^2}}$$

Where U_A is the uncertainty in the UK activity, w_i is the weighting factor for each DA representing the relative uncertainty in the activity, and E_i is the emission for each DA. If we additionally assume that the source comprises a large number of similar sources (e.g. factories, houses and fields) distributed throughout the UK then we can apply the weighting expressed as:

$$w_i = \frac{1}{\sqrt{|E_i|}}$$

So that choosing an emissions sensitivity of a half would yield:

$$\bar{U}_{Ai} = U_A \sqrt{\frac{\sum_i |E_i|}{|E_i|}}$$

By applying this DA-specific activity uncertainty to the UK-wide activity uncertainties derived for Elliot, *et al.,* (2024), it is possible to apply the formulaic approach outlined in Chapter 5 of the EMEP/EEA Guidebook (2019). In general, the NAEI is regarded as an international leader in terms of quality and accuracy, e.g. through the application of higher Tier methodologies, particularly for key sources, the strength of data provision agreements, and a continuous improvement process that addresses sensitivities for major and emerging sources.

E.1 Ammonia

Ammonia emission estimates are generally more uncertain than those for SO_2, NO_X and NMVOCs and are dominated by uncertainties in the estimates of emissions from agricultural sources, which represent the majority of the national total ammonia emissions. Although the England and DA inventories use a detailed (largely Tier 3) approach to estimating emissions from agriculture, which accounts for different animal sub-categories and management systems, it is not possible to fully represent the many factors influencing emissions from what are often diffuse emission sources, such as animal stocking densities, daily weather, soil type and conditions, etc. These factors are therefore reflected in the uncertainties associated with individual emission factors. The uncertainty parameters for agriculture have been updated to reflect the latest understanding in the 2024 submission.

Using the top row of **Table 19** as an example, ammonia emissions from 1A in England were 14.8 kt in 2005, with a 104% uncertainty (±15.4 kt), giving a range of -0.53 kt to 30.2 kt. However, since there are no methods to sequester AQ emissions captured in the NAEI, the realistic range is 0 kt to 30.2 kt. In 2022, emissions were 5.0 kt with a 62% uncertainty (±3.1 kt), resulting in a range of 1.9 kt to 8.1 kt. From 2005 to 2022, there was a reduction of 9.81 kt with a 0.1% uncertainty, making the reduction range 9.80 kt to 9.83 kt. The uncertainty as a percentage of the DA total is the sector uncertainty as a proportion of the DA total.

Table 19 - Tier 1 uncertainties for ammonia emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	14.82	103.6%	8.0%	5.01	62.4%	1.8%	0.1%
1B	0.30	39.0%	0.1%	0.15	47.5%	0.0%	0.0%
2A	0.41	34.1%	0.1%	0.37	33.6%	0.1%	0.0%
2B	4.03	24.1%	0.5%	0.71	49.9%	0.2%	0.0%
2C	0.00	91.2%	0.0%	0.00	91.2%	0.0%	0.0%
2D	1.01	137.9%	0.7%	1.02	144.4%	0.8%	0.4%
2G	0.19	72.9%	0.1%	0.11	72.9%	0.0%	0.0%
2H	0.87	135.1%	0.6%	0.60	135.1%	0.5%	0.0%
3B	67.96	45.4%	16.0%	56.36	40.9%	13.3%	9.9%
3D	87.45	17.6%	8.0%	89.76	16.9%	8.7%	2.7%
5A	1.15	62.2%	0.4%	0.14	62.3%	0.1%	0.0%
5C	0.05	78.1%	0.0%	0.01	88.9%	0.0%	0.0%
5B	2.71	33.4%	0.5%	4.45	19.2%	0.5%	0.4%
5D	1.46	95.2%	0.7%	1.25	92.6%	0.7%	0.2%
6A	10.13	126.5%	6.7%	13.86	102.5%	8.2%	4.1%
Total	**192.54**	**20.7%**	**20.7%**	**173.82**	**18.0%**	**18.0%**	**11.1%**
Scotland							
1A	1.51	118.1%	4.9%	0.47	63.8%	1.0%	0.2%
1B	0.03	59.3%	0.0%	0.00	59.5%	0.0%	0.0%
2A	0.05	59.4%	0.1%	0.04	60.5%	0.1%	0.0%
2B	0.02	135.0%	0.1%	0.01	135.0%	0.0%	0.0%
2D	0.10	161.3%	0.5%	0.10	212.8%	0.7%	0.1%
2G	0.02	122.7%	0.1%	0.01	124.5%	0.0%	0.0%
3B	15.30	59.6%	25.2%	12.65	54.6%	22.2%	4.4%
3D	17.66	18.7%	9.1%	16.00	17.4%	9.0%	1.8%
5A	0.12	79.6%	0.3%	0.02	77.8%	0.0%	0.1%
5C	0.00	151.3%	0.0%	0.00	143.9%	0.0%	0.0%
5B	0.26	95.3%	0.7%	0.40	43.8%	0.6%	0.2%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
5D	0.15	125.3%	0.5%	0.12	105.2%	0.4%	0.0%
6A	0.99	175.3%	4.8%	1.26	152.3%	6.2%	1.7%
Total	**36.19**	**27.7%**	**27.7%**	**31.07**	**24.8%**	**24.8%**	**5.1%**
Wales							
1A	0.96	118.3%	5.2%	0.35	58.9%	0.9%	0.3%
1B	0.04	38.9%	0.1%	0.00	43.2%	0.0%	0.0%
2A	0.05	58.4%	0.1%	0.03	61.9%	0.1%	0.0%
2B	0.01	135.0%	0.1%	0.02	135.0%	0.1%	0.0%
2D	0.06	177.9%	0.5%	0.06	256.8%	0.6%	0.0%
2G	0.01	151.2%	0.1%	0.01	155.3%	0.0%	0.0%
3B	9.22	77.4%	32.2%	9.58	77.4%	32.8%	9.1%
3D	10.71	23.5%	11.4%	11.35	23.4%	11.8%	2.7%
5A	0.08	88.2%	0.3%	0.01	87.1%	0.0%	0.2%
5C	0.00	168.5%	0.0%	0.00	173.5%	0.0%	0.0%
5B	0.12	135.1%	0.8%	0.20	59.5%	0.5%	0.2%
5D	0.09	145.0%	0.6%	0.07	114.8%	0.3%	0.1%
6A	0.78	232.6%	8.2%	0.88	200.5%	7.8%	2.1%
Total	**22.12**	**35.5%**	**35.5%**	**22.56**	**35.8%**	**35.8%**	**9.7%**
Northern Ireland							
1A	0.69	127.6%	2.9%	0.24	67.9%	0.5%	0.2%
1B	0.00	120.4%	0.0%	0.00	185.8%	0.0%	0.0%
2A	0.00	388.6%	0.0%	0.01	96.6%	0.0%	0.0%
2D	0.03	203.2%	0.2%	0.03	309.9%	0.3%	0.0%
2G	0.01	190.4%	0.0%	0.00	191.4%	0.0%	0.0%
3B	13.78	63.6%	29.2%	15.24	59.5%	28.5%	8.7%
3D	14.99	22.5%	11.2%	15.62	21.8%	10.7%	3.2%
5A	0.06	94.7%	0.2%	0.01	93.9%	0.0%	0.1%
5C	0.00	226.9%	0.0%	0.00	209.6%	0.0%	0.0%
5B	0.08	169.6%	0.4%	0.13	74.1%	0.3%	0.1%
5D	0.05	173.7%	0.3%	0.04	127.4%	0.2%	0.0%
6A	0.39	267.8%	3.5%	0.49	238.2%	3.7%	1.0%
Total	**30.08**	**31.6%**	**31.6%**	**31.82**	**30.6%**	**30.6%**	**9.3%**

E.2 Carbon Monoxide

Carbon monoxide emissions occur almost exclusively from combustion of fuels, particularly by road transport. Emission estimates for road transport are moderately uncertain, as measurements are quite limited on some vehicle types and emissions highly variable between vehicles and for different traffic situations.

Emissions from stationary combustion processes are also variable and depend on the technology employed and the specific combustion conditions. Emission estimates from small and medium-sized installations are derived from emission factors based on relatively few measurements of emissions from different types of boilers. Because of the higher uncertainty in emission factors for these sources, emission estimates for CO are much more uncertain than other pollutants such as NO_X (as NO_2) and SO_2. Unlike the cases of NO_X (as NO_2) and NMVOC, a few sources dominate the inventory and there is limited potential for error compensation.

Note that no Tier 1 uncertainties are computed for the UK inventory, and as such DA estimates of uncertainty are not provided for this pollutant. The carbon monoxide emissions estimates are considered to have moderate uncertainty.

E.3 Nitrogen Oxides

NO_X (as NO_2) emission estimates have the lowest uncertainty of all the pollutants and the accuracy of their estimation is comparable to that of SO_2 emissions. This is because, while NO_X emissions are calculated with emission factors with a high variability, the activity data is more certain than for other pollutants and there are a large number of independent emission sources, including high quality measured data from large point sources.

Emission factors for NO_x are considered to have low accuracy because although they are calculated using measured emission factors, these emission factors can vary significantly with combustion conditions; emission factors given in the literature for combustion sources show substantial variation. In the case of road transport (1A3b) emissions, while the inventory methodology takes into account variations in the amount of NO_X emitted as a function of speed and vehicle type, substantial variation in measured emission factors has been found between vehicles of the same type even when keeping these parameters constant.

However, the overall uncertainty is low due to number of reasons:

- While NO_X emission factors are somewhat uncertain, activity data used in the NO_X inventory is much less uncertain. This contrasts with inventories for pollutants such as volatile organic compounds, PM_{10}, metals, and persistent organic pollutants, which contain a higher degree of uncertainty in source activity estimates.
- The NO_X inventory is made up of a large number of independent emission sources with many of similar size and with none dominating. This leads to a large potential for error compensation, where an underestimate in emissions in one sector is very likely to be compensated by an overestimate in emissions in another sector.
- Many of the larger point-source emission sources make up the bulk of the UK estimates, and these are commonly derived from continuous emission measurement data and hence are regarded to be good quality.

Table 20 - Tier 1 uncertainties for nitrogen oxide (NO_X) emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	1267.19	6.7%	6.6%	437.24	9%	8.3%	1.5%
1B	0.50	25.6%	0.0%	0.16	44%	0.0%	0.0%
2B	1.27	26.3%	0.0%	0.61	51%	0.1%	0.0%
2C	1.09	24.3%	0.0%	0.35	33%	0.0%	0.0%
2G	0.09	91.1%	0.0%	0.05	92%	0.0%	0.0%
2H	0.02	65.0%	0.0%	-	0%	0.0%	0.0%
3B	1.13	64.9%	0.1%	0.95	71%	0.1%	0.0%
3D	16.84	54.0%	0.7%	14.46	65%	2.1%	0.1%
5C	1.65	35.2%	0.0%	1.45	36%	0.1%	0.0%
5E	0.27	87.5%	0.0%	0.10	83%	0.0%	0.0%
6A	0.28	115.0%	0.0%	0.29	114%	0.1%	0.0%
Total	**1290.33**	**6.6%**	**6.6%**	**455.66**	**9%**	**8.6%**	**1.6%**
Scotland							
1A	197.29	11.9%	11.5%	71.30	17%	15.7%	2.8%
1B	0.72	120.9%	0.4%	0.83	44%	0.5%	0.0%
2B	0.01	57.2%	0.0%	0.01	57%	0.0%	0.0%
2C	0.01	59.4%	0.0%	0.00	30%	0.0%	0.0%
2G	0.01	130.8%	0.0%	0.00	133%	0.0%	0.0%
2H	0.00	67.4%	0.0%	-	0%	0.0%	0.0%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
3B	0.24	93.1%	0.1%	0.20	99%	0.3%	0.0%
3D	4.53	76.2%	1.7%	3.25	66%	2.8%	0.1%
5C	0.13	83.9%	0.1%	0.11	84%	0.1%	0.0%
5E	0.03	87.6%	0.0%	0.01	83%	0.0%	0.0%
6A	0.03	365.3%	0.0%	0.02	394%	0.1%	0.0%
Total	**203.00**	**11.7%**	**11.7%**	**75.74**	**16%**	**15.9%**	**2.8%**
Wales							
1A	101.97	11.4%	11.0%	38.24	13%	11.9%	2.8%
1B	0.10	18.3%	0.0%	0.03	21%	0.0%	0.0%
2B	0.02	57.2%	0.0%	0.03	57%	0.0%	0.0%
2C	0.52	19.3%	0.1%	0.16	19%	0.1%	0.0%
2G	0.01	155.5%	0.0%	0.00	159%	0.0%	0.0%
2H	0.00	70.3%	0.0%	-	0%	0.0%	0.0%
3B	0.20	99.4%	0.2%	0.19	105%	0.5%	0.1%
3D	3.00	99.5%	2.8%	2.19	81%	4.3%	0.1%
5C	0.08	109.4%	0.1%	0.05	120%	0.2%	0.0%
5E	0.02	87.6%	0.0%	0.01	83%	0.0%	0.0%
6A	0.03	334.4%	0.1%	0.02	361%	0.2%	0.0%
Total	**105.93**	**11.4%**	**11.4%**	**40.91**	**13%**	**12.6%**	**2.8%**
Northern Ireland							
1A	59.70	15.1%	14.2%	26.54	17%	15.3%	4.9%
1B	0.00	129.9%	0.0%	0.00	130%	0.0%	0.0%
2B	0.00	57.2%	0.0%	0.00	57%	0.0%	0.0%
2G	0.00	190.6%	0.0%	0.00	191%	0.0%	0.0%
2H	0.00	73.2%	0.0%	-	0%	0.0%	0.0%
3B	0.12	116.1%	0.2%	0.13	115%	0.5%	0.1%
3D	3.18	90.5%	4.6%	2.72	93%	8.6%	0.2%
5C	0.03	181.0%	0.1%	0.02	202%	0.1%	0.0%
5E	0.01	87.7%	0.0%	0.00	83%	0.0%	0.0%
6A	0.01	517.1%	0.1%	0.01	545%	0.2%	0.0%
Total	**63.06**	**15.0%**	**15.0%**	**29.43**	**18%**	**17.5%**	**4.9%**

E.4 Non-Methane Volatile Organic Compounds

The NMVOC inventory is more uncertain than those for SO_2 and NO_X. This is due in part to the difficulty in obtaining robust emission factors or emission estimates for some sectors (e.g. fugitive sources of NMVOC emissions from industrial processes) and partly due to the absence of accurate activity data for some sources, such as for the use of cleaning products and domestic use of fuels for each specific Devolved Administration. Given the broad range of independent sources of NMVOCs, as with NO_X there is a potential for error compensation. Error compensation is where an underestimate in emissions in one sector can be compensated by an overestimate of emissions in another sector when a large number of independent sources are utilised, with none dominating.

Table 21 - Tier 1 uncertainties for non-methane volatile organic compounds (NMVOCs) emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	254.47	17.3%	4.9%	75.89	17.1%	2.6%	0.8%
1B	161.36	27.7%	5.0%	47.68	22.3%	2.1%	0.2%
2A	1.91	37.6%	0.1%	0.72	34.6%	0.0%	0.0%
2B	30.30	56.5%	1.9%	4.89	55.5%	0.5%	0.0%
2C	1.08	83.5%	0.1%	0.35	75.6%	0.1%	0.0%
2D	327.85	12.1%	4.4%	245.45	20.4%	10.0%	5.1%
2G	0.22	195.9%	0.0%	0.12	198.5%	0.0%	0.0%
2H	31.24	153.1%	5.3%	30.95	187.0%	11.5%	0.2%
2I	1.33	121.3%	0.2%	1.19	121.3%	0.3%	0.1%
3B	45.74	146.4%	7.5%	45.94	144.1%	13.2%	1.6%
3D	26.74	118.8%	3.5%	39.94	126.3%	10.1%	0.7%
5A	5.18	34.3%	0.2%	1.40	34.3%	0.1%	0.0%
5C	5.23	190.2%	1.1%	5.08	195.2%	2.0%	0.5%
5D	0.30	502.4%	0.2%	0.43	513.2%	0.4%	0.3%
5E	1.34	88.4%	0.1%	0.47	84.2%	0.1%	0.0%
6A	1.22	99.2%	0.1%	1.28	99.6%	0.3%	0.1%
Total	**895.50**	**13.1%**	**13.1%**	**501.80**	**22.9%**	**22.9%**	**5.5%**
Scotland							
1A	28.98	18.0%	2.9%	8.45	22.4%	1.3%	1.0%
1B	43.02	57.0%	13.6%	9.06	39.4%	2.5%	0.8%
2A	0.02	70.2%	0.0%	0.01	70.9%	0.0%	0.0%
2B	7.17	57.2%	2.3%	3.42	57.2%	1.4%	0.0%
2C	0.01	80.6%	0.0%	0.01	84.6%	0.0%	0.0%
2D	31.12	22.5%	3.9%	23.43	46.0%	7.5%	2.6%
2G	0.02	219.3%	0.0%	0.01	222.7%	0.0%	0.0%
2H	50.83	21.9%	6.2%	83.22	21.4%	12.3%	2.4%
2I	0.11	218.2%	0.1%	0.08	235.6%	0.1%	0.0%
3B	11.43	137.8%	8.8%	9.96	130.0%	9.0%	0.6%
3D	5.71	103.2%	3.3%	5.73	101.1%	4.0%	0.1%
5A	0.52	60.3%	0.2%	0.16	57.8%	0.1%	0.1%
5C	0.58	273.7%	0.9%	0.55	282.8%	1.1%	0.1%
5D	0.03	1541.8%	0.3%	0.04	1607.6%	0.5%	0.2%
5E	0.14	88.5%	0.1%	0.05	84.3%	0.0%	0.0%
6A	0.11	169.4%	0.1%	0.09	179.3%	0.1%	0.0%
Total	**179.81**	**18.5%**	**18.5%**	**144.26**	**17.8%**	**17.8%**	**3.8%**
Wales							
1A	17.42	19.3%	5.2%	6.57	29.4%	4.6%	2.3%
1B	13.67	30.1%	6.4%	5.97	30.1%	4.3%	5.3%
2A	0.02	69.5%	0.0%	0.01	72.1%	0.0%	0.0%
2B	0.33	52.6%	0.3%	0.10	51.7%	0.1%	0.0%
2C	0.54	83.4%	0.7%	0.40	93.6%	0.9%	0.0%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
2D	18.88	27.1%	7.9%	13.34	57.9%	18.5%	5.3%
2G	0.01	236.4%	0.0%	0.01	241.3%	0.0%	0.0%
2H	1.74	161.6%	4.3%	1.76	181.8%	7.7%	0.2%
2I	0.07	255.0%	0.3%	0.07	249.2%	0.4%	0.1%
3B	7.79	154.6%	18.7%	8.33	163.4%	32.7%	3.7%
3D	3.19	98.2%	4.9%	4.63	102.2%	11.4%	1.3%
5A	0.34	71.3%	0.4%	0.10	69.9%	0.2%	0.1%
5C	0.26	332.2%	1.4%	0.24	347.3%	2.0%	0.4%
5D	0.02	2020.2%	0.6%	0.02	2132.9%	1.2%	0.4%
5E	0.08	88.5%	0.1%	0.03	84.4%	0.1%	0.0%
6A	0.13	158.8%	0.3%	0.10	167.9%	0.4%	0.0%
Total	**64.50**	**22.9%**	**22.9%**	**41.70**	**40.6%**	**40.6%**	**8.8%**
Northern Ireland							
1A	11.04	22.8%	6.0%	4.96	32.9%	4.7%	3.1%
1B	1.60	39.7%	1.5%	0.71	33.3%	0.7%	0.4%
2A	0.00	385.4%	0.0%	0.00	102.5%	0.0%	0.0%
2B	0.07	57.2%	0.1%	0.05	57.2%	0.1%	0.0%
2C	0.00	93.9%	0.0%	0.00	95.9%	0.0%	0.0%
2D	9.88	38.2%	9.0%	7.93	75.7%	17.1%	5.6%
2G	0.01	263.2%	0.0%	0.00	266.0%	0.0%	0.0%
2H	3.48	61.6%	5.1%	3.73	68.2%	7.2%	1.0%
2I	0.05	307.4%	0.3%	0.05	276.5%	0.4%	0.1%
3B	9.86	148.6%	35.0%	11.15	153.4%	48.6%	5.2%
3D	5.31	126.0%	16.0%	6.26	108.7%	19.4%	1.2%
5A	0.26	79.2%	0.5%	0.07	78.3%	0.2%	0.3%
5C	0.15	429.2%	1.5%	0.14	442.1%	1.8%	0.2%
5D	0.01	2646.6%	0.7%	0.01	2721.9%	1.1%	0.4%
5E	0.05	88.6%	0.1%	0.02	84.5%	0.0%	0.0%
6A	0.06	222.7%	0.3%	0.05	233.3%	0.3%	0.0%
Total	**41.82**	**40.4%**	**40.4%**	**35.16**	**55.8%**	**55.8%**	**8.4%**

E.5 Particulate Matter

The emission inventories for PM_{10} and $PM_{2.5}$ are subject to high uncertainty. This stems from uncertainties in the emission factors themselves, and the activity data with which they are combined to quantify the emissions. For many source categories, emissions data and/or emission factors are available for total particulate matter only and emissions of PM_{10} / $PM_{2.5}$ must be estimated based on assumptions about the size distribution of particle emissions from that source. This adds a further level of uncertainty for estimates of PM_{10} and, to an even greater extent, $PM_{2.5}$ and other fine particulate matter.

Many sources of particulate matter are diffuse or fugitive in nature e.g. emissions from coke ovens, metal processing, or quarries. These emissions are difficult to measure, and, in some cases, it is likely that no entirely satisfactory measurements have ever been made, so emission estimates for these sources are particularly uncertain.

Particulate matter is emitted from a range of sources including the combustion of fuels, for which estimations are generally considered more reliable, along with industrial processes, quarrying and construction. All parts of the inventory would need to be improved before the overall uncertainty in PM could be reduced to the levels seen in the inventories for SO_2, NO_X or NMVOC.

Table 22 - Tier 1 uncertainties for $PM_{2.5}$ emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	60.33	24.1%	17.7%	33.52	49.9%	33.6%	7.5%
1B	0.80	334.9%	3.3%	0.60	450.8%	5.4%	0.0%
2A	6.56	106.4%	8.5%	4.53	124.7%	11.4%	0.6%
2B	0.40	72.4%	0.3%	0.06	36.7%	0.0%	0.0%
2C	2.74	156.6%	5.2%	1.32	151.0%	4.0%	0.1%
2D	0.45	227.3%	1.2%	0.42	194.7%	1.6%	0.1%
2G	2.09	204.0%	5.2%	1.24	218.3%	5.4%	0.5%
2H	0.49	484.7%	2.9%	0.35	495.0%	3.4%	0.0%
2I	0.80	246.0%	2.4%	0.70	246.0%	3.5%	0.6%
3B	1.43	279.7%	4.8%	1.28	275.7%	7.1%	0.6%
3D	0.55	536.1%	3.6%	0.59	539.3%	6.4%	0.1%
5A	0.00	62.2%	0.0%	0.00	62.3%	0.0%	0.0%
5C	3.48	153.8%	6.5%	3.60	156.0%	11.3%	5.6%
5E	2.21	289.7%	7.8%	1.55	368.0%	11.5%	0.6%
6A	0.02	1200.7%	0.3%	0.02	1215.9%	0.6%	0.1%
Total	**82.35**	**24.6%**	**24.6%**	**49.76**	**41.3%**	**41.3%**	**9.5%**
Scotland							
1A	10.01	25.1%	20.6%	3.56	54.2%	37.9%	9.5%
1B	0.19	207.2%	3.2%	0.09	259.2%	4.6%	0.0%
2A	0.53	91.7%	4.0%	0.31	96.9%	5.9%	0.4%
2B	0.03	90.7%	0.2%	0.01	91.1%	0.3%	0.0%
2C	0.09	328.7%	2.5%	0.03	287.4%	1.5%	0.0%
2D	0.03	304.5%	0.8%	0.03	276.8%	1.4%	0.1%
2G	0.21	216.0%	3.8%	0.12	229.8%	5.4%	0.2%
2H	0.05	485.0%	1.8%	0.03	495.3%	2.9%	0.0%
2I	0.07	305.6%	1.6%	0.05	318.3%	2.9%	0.3%
3B	0.30	236.5%	5.8%	0.26	225.9%	11.5%	0.7%
3D	0.09	472.1%	3.5%	0.10	437.1%	8.3%	0.1%
5A	0.00	79.6%	0.0%	0.00	77.8%	0.0%	0.0%
5C	0.36	304.6%	8.9%	0.36	312.2%	21.9%	4.9%
5E	0.22	293.8%	5.4%	0.15	374.9%	11.0%	0.5%
6A	0.00	1322.9%	0.2%	0.00	1309.8%	0.4%	0.0%
Total	**12.17**	**25.2%**	**25.2%**	**5.09**	**48.4%**	**48.4%**	**10.7%**
Wales							
1A	6.06	36.0%	26.2%	3.19	67.5%	42.9%	12.7%
1B	0.07	184.1%	1.5%	0.08	139.1%	2.3%	0.0%
2A	0.35	80.6%	3.3%	0.22	67.5%	3.0%	0.2%
2B	0.03	90.4%	0.3%	0.02	91.0%	0.3%	0.0%
2C	1.06	85.5%	10.9%	0.87	92.3%	15.9%	0.2%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
2D	0.02	295.4%	0.8%	0.02	237.3%	0.9%	0.1%
2G	0.12	225.1%	3.3%	0.07	239.1%	3.2%	0.1%
2H	0.02	485.4%	1.2%	0.01	495.7%	1.4%	0.0%
2I	0.04	332.9%	1.8%	0.04	328.5%	2.7%	0.4%
3B	0.20	268.4%	6.4%	0.20	279.9%	11.0%	1.0%
3D	0.02	392.5%	0.9%	0.02	421.8%	2.1%	0.0%
5A	0.00	88.2%	0.0%	0.00	87.1%	0.0%	0.0%
5C	0.20	401.5%	9.5%	0.19	417.0%	16.0%	3.6%
5E	0.13	297.0%	4.6%	0.09	380.7%	6.4%	0.4%
6A	0.00	1285.9%	0.4%	0.00	1266.4%	0.5%	0.0%
Total	**8.33**	**31.5%**	**31.5%**	**5.03**	**50.5%**	**50.5%**	**13.2%**
Northern Ireland							
1A	4.18	39.9%	33.2%	3.28	72.5%	59.3%	18.4%
1B	0.01	500.4%	1.5%	0.01	500.4%	1.8%	0.0%
2A	0.27	90.1%	4.8%	0.19	115.9%	5.4%	0.4%
2B	0.00	691.1%	0.0%	0.00	700.0%	0.0%	0.0%
2C	0.01	200.5%	0.4%	0.00	460.7%	0.3%	0.0%
2D	0.01	336.3%	0.6%	0.01	267.8%	0.6%	0.1%
2G	0.07	240.0%	3.4%	0.04	252.1%	2.6%	0.4%
2H	0.01	485.7%	1.3%	0.01	496.1%	1.1%	0.0%
2I	0.03	374.5%	2.1%	0.03	349.7%	2.8%	0.5%
3B	0.27	265.7%	14.1%	0.28	263.1%	18.7%	1.4%
3D	0.02	456.3%	1.4%	0.01	430.3%	1.6%	0.0%
5A	0.00	94.7%	0.0%	0.00	93.9%	0.0%	0.0%
5C	0.11	520.6%	11.8%	0.12	528.6%	15.4%	2.8%
5E	0.04	298.1%	2.2%	0.01	303.8%	1.1%	0.0%
6A	0.00	1481.7%	0.3%	0.00	1492.3%	0.3%	0.0%
Total	**5.02**	**38.6%**	**38.6%**	**4.00**	**64.5%**	**64.5%**	**18.6%**

Table 23 - Tier 1 uncertainties for PM_{10} emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	72.44	22.5%	11.0%	41.83	42.0%	17.6%	4.3%
1B	1.30	156.6%	1.4%	0.63	113.1%	0.7%	0.0%
2A	43.88	71.4%	21.2%	33.08	77.8%	25.7%	3.0%
2B	0.55	66.2%	0.2%	0.08	42.8%	0.0%	0.0%
2C	4.85	126.2%	4.1%	2.31	120.9%	2.8%	0.1%
2D	1.28	269.7%	2.3%	1.18	228.0%	2.7%	0.2%
2G	2.88	283.8%	5.5%	1.74	298.0%	5.2%	0.4%
2H	1.61	491.9%	5.4%	1.15	495.0%	5.7%	0.1%
2I	1.00	145.5%	1.0%	0.87	145.4%	1.3%	0.5%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
3B	6.88	407.6%	19.0%	6.34	414.1%	26.3%	0.8%
3D	4.82	323.0%	10.5%	5.13	325.4%	16.7%	0.3%
5A	0.01	62.2%	0.0%	0.01	62.3%	0.0%	0.0%
5C	3.81	151.6%	3.9%	3.92	155.0%	6.1%	3.4%
5E	2.38	289.7%	4.7%	1.67	368.0%	6.1%	0.4%
6A	0.03	1200.7%	0.3%	0.04	1215.9%	0.4%	0.1%
Total	**147.74**	**34.1%**	**34.1%**	**99.97**	**45.7%**	**45.7%**	**6.4%**
Scotland							
1A	11.69	22.7%	14.0%	4.46	46.5%	20.9%	6.8%
1B	0.51	369.9%	9.9%	0.09	77.1%	0.7%	0.0%
2A	3.58	85.1%	16.1%	2.54	92.1%	23.6%	1.8%
2B	0.05	90.8%	0.2%	0.03	91.2%	0.2%	0.0%
2C	0.10	296.9%	1.6%	0.03	252.3%	0.8%	0.0%
2D	0.10	325.2%	1.7%	0.08	295.1%	2.4%	0.1%
2G	0.29	292.4%	4.5%	0.17	306.8%	5.2%	0.1%
2H	0.15	492.1%	3.9%	0.10	495.3%	5.0%	0.0%
2I	0.08	232.5%	1.0%	0.06	248.9%	1.5%	0.2%
3B	0.87	339.5%	15.6%	0.84	365.3%	31.1%	0.8%
3D	0.90	282.8%	13.4%	0.97	260.3%	25.3%	0.3%
5A	0.00	79.6%	0.0%	0.00	77.8%	0.0%	0.0%
5C	0.39	299.8%	6.2%	0.39	309.3%	12.1%	2.8%
5E	0.24	293.8%	3.7%	0.16	374.9%	6.1%	0.3%
6A	0.00	1322.9%	0.2%	0.00	1309.8%	0.3%	0.0%
Total	**18.95**	**32.7%**	**32.7%**	**9.92**	**53.4%**	**53.4%**	**7.6%**
Wales							
1A	7.07	31.4%	16.6%	3.83	57.8%	24.8%	8.2%
1B	0.16	203.6%	2.4%	0.14	105.2%	1.7%	0.0%
2A	2.98	70.0%	15.6%	2.06	72.3%	16.6%	1.3%
2B	0.05	90.5%	0.4%	0.03	91.1%	0.3%	0.0%
2C	1.54	62.7%	7.2%	1.33	69.0%	10.2%	0.2%
2D	0.07	298.6%	1.6%	0.06	242.6%	1.6%	0.1%
2G	0.17	299.1%	3.8%	0.10	314.0%	3.4%	0.1%
2H	0.07	492.5%	2.5%	0.05	495.7%	2.6%	0.0%
2I	0.05	267.3%	1.1%	0.05	261.8%	1.5%	0.2%
3B	0.50	330.7%	12.4%	0.57	366.9%	23.5%	1.1%
3D	0.34	323.6%	8.3%	0.42	345.2%	16.1%	0.4%
5A	0.00	88.2%	0.0%	0.00	87.1%	0.0%	0.0%
5C	0.22	395.5%	6.4%	0.21	413.9%	9.7%	2.0%
5E	0.14	297.0%	3.1%	0.09	380.7%	3.9%	0.2%
6A	0.00	1285.9%	0.4%	0.00	1266.4%	0.4%	0.0%
Total	**13.37**	**29.6%**	**29.6%**	**8.94**	**44.1%**	**44.1%**	**8.6%**
Northern Ireland							
1A	4.79	36.4%	20.7%	3.70	54.7%	29.8%	11.3%
1B	0.02	129.9%	0.2%	0.01	129.9%	0.3%	0.0%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
2A	2.10	72.8%	18.1%	1.47	73.5%	15.9%	2.0%
2B	0.00	696.4%	0.0%	0.00	700.0%	0.0%	0.0%
2C	0.02	139.5%	0.3%	0.00	421.8%	0.2%	0.1%
2D	0.03	356.3%	1.2%	0.03	282.0%	1.2%	0.2%
2G	0.10	310.3%	3.6%	0.06	324.2%	2.8%	0.3%
2H	0.04	492.9%	2.6%	0.03	496.1%	2.2%	0.0%
2I	0.04	317.7%	1.3%	0.04	287.9%	1.7%	0.3%
3B	0.86	409.5%	42.0%	1.04	378.9%	57.8%	2.4%
3D	0.26	369.8%	11.5%	0.26	343.3%	13.2%	0.1%
5A	0.00	94.7%	0.0%	0.00	93.9%	0.0%	0.0%
5C	0.12	513.3%	7.6%	0.13	524.9%	9.8%	1.7%
5E	0.04	298.1%	1.4%	0.02	303.8%	0.7%	0.0%
6A	0.00	1481.7%	0.3%	0.00	1492.3%	0.3%	0.0%
Total	**8.43**	**52.3%**	**52.3%**	**6.78**	**69.1%**	**69.1%**	**11.8%**

E.6 Sulphur Dioxide

SO_2 emissions can be estimated with the most confidence as they depend largely on the level of sulphur in fuels. Hence, the inventory, which is based upon comprehensive analysis on the sulphur content of coals and fuel oils consumed by power stations and the agriculture, industry, and residential sectors, contains accurate emission estimates for the most important sources.

Table 24 - Tier 1 uncertainties for sulphur dioxide (SO_2) emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	547.50	7.5%	7.0%	71.55	26.8%	22.7%	0.9%
1B	6.98	13.7%	0.2%	4.91	27.2%	1.6%	0.0%
2A	17.17	14.1%	0.4%	5.34	14.1%	0.9%	0.1%
2B	7.38	22.7%	0.3%	0.37	34.1%	0.1%	0.0%
2C	4.48	15.0%	0.1%	1.00	36.9%	0.4%	0.0%
2G	0.68	77.2%	0.1%	0.68	74.2%	0.6%	0.1%
2H	0.06	97.3%	0.0%	-	0.0%	0.0%	0.0%
5C	0.74	108.7%	0.1%	0.44	161.9%	0.8%	0.0%
Total	**584.98**	**7.0%**	**7.0%**	**84.29**	**22.8%**	**22.8%**	**0.9%**
Scotland							
1A	98.23	11.1%	11.0%	6.75	19.8%	18.2%	0.9%
1B	0.41	160.3%	0.7%	0.11	50.2%	0.7%	0.0%
2B	0.00	30.0%	0.0%	0.00	50.0%	0.0%	0.0%
2C	0.74	25.2%	0.2%	0.40	12.1%	0.7%	0.0%
2G	0.06	241.1%	0.2%	0.07	230.2%	2.1%	0.1%
2H	0.01	98.9%	0.0%	-	0.0%	0.0%	0.0%
5C	0.08	148.2%	0.1%	0.05	210.6%	1.3%	0.0%

NFR sector	2005			2022			
	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (kt)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
Total	**99.53**	**11.0%**	**11.0%**	**7.36**	**18.4%**	**18.4%**	**0.9%**
Wales							
1A	60.63	11.4%	10.7%	11.93	29.1%	25.2%	3.0%
1B	1.03	13.0%	0.2%	1.33	15.9%	1.5%	0.1%
2B	0.01	30.0%	0.0%	-	0.0%	0.0%	0.0%
2C	2.29	15.8%	0.6%	0.46	36.7%	1.2%	0.1%
2G	0.04	308.7%	0.2%	0.04	307.5%	0.8%	0.1%
2H	0.00	101.0%	0.0%	-	0.0%	0.0%	0.0%
5C	0.04	133.6%	0.1%	0.02	147.2%	0.2%	0.0%
Total	**64.04**	**10.8%**	**10.8%**	**13.78**	**25.3%**	**25.3%**	**3.0%**
Northern Ireland							
1A	29.19	15.8%	15.7%	13.08	47.5%	47.3%	7.4%
2B	0.00	30.0%	0.0%	-	0.0%	0.0%	0.0%
2G	0.03	386.8%	0.3%	0.03	369.0%	0.7%	0.2%
2H	0.00	103.0%	0.0%	-	0.0%	0.0%	0.0%
5C	0.02	169.5%	0.1%	0.01	169.2%	0.1%	0.0%
Total	**29.24**	**15.7%**	**15.7%**	**13.12**	**47.3%**	**47.3%**	**7.4%**

E.7 Lead

The Pb inventory is more uncertain than SO_2 and NO_X inventories, and the certainty of the emissions varies over the time series as different source sectors dominate at different times, due to the very significant reductions in emissions from the key sources in 1990, notably road transport. From the key sources in 1990, the Pb emission estimates were based on measured concentrations of lead in the fuels, which were tightly regulated prior to being phased out in the late 1990s. This gives a high confidence in the estimates for those sources of fuel combustion, which dominated in the early 1990s, but are now much reduced.

In more recent years, the level of emissions is estimated to be much lower and derived from a smaller number of sources. The metal processing industries are mainly regulated under the Environmental Permitting Regulations (EPR) and the estimates provided by plant operators to the regulatory agencies and used in the national inventories are based on emission measurements or emission factors that have been researched for the specific process type. There is a moderate level of uncertainty associated with these annual emission estimates due to the discrete nature of the stack emissions monitoring techniques and determination of mass emission flow rates from point sources. Furthermore, the variability of lead content of raw materials such as fuels (e.g. coal) is such that the discrete Pb emission measurements only provide a snap-shot of the process and plant performance, and there is some uncertainty about how representative that result may be for use in scaling up to provide annual emission estimates.

These uncertainties are inherent within the inventories from environmental regulators of EPR industries and are unavoidable; the emissions data from EPR-regulated installations used in the compilation of these DA inventories are subject to a managed process of quality checking by the environmental regulatory agencies and are regarded as the best data available for inventory compilation.

The observed year-to-year variations in emission estimates are based on actual trends reported by plant operators and may reflect changes in lead content of raw materials. The uncertainty in emission monitoring applies to all pollutants to some degree, but more so for pollutants such as Pb for which (i) no continuous emission monitoring systems are available, and (ii) where fuel composition is known to be highly variable depending on the fuel source. This is not the case for species such as NO_X and SO_2 where many regulated sites will use Continuous Emission Monitoring Systems and the fuel elemental composition is either not a significant factor in process emissions or does not vary as much as for heavy metals and other trace contaminants.

The emission estimates of Pb from other smaller-scale combustion and process sources from industrial and commercial activities are less well documented and the estimates are based on emission factors that are less certain than those based on regulatory emissions monitoring and reporting.

Table 25 - Tier 1 uncertainties for lead (Pb) emissions by NFR sector for each DA

NFR sector	2005			2022			
	Emissions (t)	Combined uncertainty for sector	Uncertainty as % of DA total	Emissions (t)	Combined uncertainty for sector	Uncertainty as % of DA total	Uncertainty introduced into trend in DA total
England							
1A	99.14	82.1%	48.8%	64.57	108.6%	65.2%	4.7%
1B	1.92	103.7%	1.2%	0.26	102.4%	0.2%	0.0%
2A	0.55	68.1%	0.2%	0.16	94.8%	0.1%	0.0%
2B	13.14	50.2%	3.9%	1.73	55.6%	0.9%	0.0%
2C	36.76	101.6%	22.4%	29.34	111.2%	30.3%	1.3%
2G	12.94	182.9%	14.2%	8.19	182.8%	13.9%	2.3%
2I	2.16	92.5%	1.2%	3.01	92.5%	2.6%	1.4%
5C	0.34	91.0%	0.2%	0.26	112.9%	0.3%	0.1%
Total	**166.95**	**55.7%**	**55.7%**	**107.53**	**73.3%**	**73.3%**	**5.6%**
Scotland							
1A	12.30	78.7%	65.8%	7.15	109.9%	93.8%	10.6%
2A	0.10	92.4%	0.6%	0.01	106.6%	0.2%	0.0%
2C	0.80	413.6%	22.4%	0.21	449.4%	11.1%	0.0%
2G	1.31	207.8%	18.5%	0.79	208.7%	19.8%	0.3%
2I	0.18	203.6%	2.5%	0.20	222.2%	5.3%	1.4%
5C	0.02	214.4%	0.3%	0.02	267.1%	0.5%	0.1%
Total	**14.70**	**72.0%**	**72.0%**	**8.39**	**96.6%**	**96.6%**	**10.7%**
Wales							
1A	8.42	72.4%	23.6%	4.27	114.3%	19.0%	12.6%
1B	0.40	107.1%	1.7%	0.40	133.3%	2.1%	0.0%
2A	0.01	181.8%	0.0%	0.01	107.2%	0.1%	0.0%
2B	0.71	135.0%	3.7%	0.06	240.0%	0.6%	0.0%
2C	15.38	108.5%	64.7%	20.25	119.7%	94.6%	1.7%
2G	0.76	225.7%	6.6%	0.45	228.4%	4.0%	1.7%
2I	0.12	242.6%	1.1%	0.18	236.5%	1.6%	0.5%
5C	0.02	209.9%	0.1%	0.01	323.2%	0.1%	0.1%
Total	**25.81**	**69.3%**	**69.3%**	**25.62**	**96.6%**	**96.6%**	**12.8%**
Northern Ireland							
1A	5.78	85.7%	77.0%	4.44	90.8%	82.3%	32.3%
2A	0.02	114.9%	0.4%	0.00	124.6%	0.1%	0.1%
2C	0.09	213.3%	3.1%	0.04	391.9%	3.2%	0.1%
2G	0.44	253.6%	17.4%	0.28	254.3%	14.3%	1.7%
2I	0.08	297.2%	3.5%	0.14	265.1%	7.4%	3.1%
5C	0.01	283.3%	0.4%	0.01	416.5%	0.5%	0.2%
Total	**6.42**	**79.1%**	**79.1%**	**4.90**	**83.9%**	**83.9%**	**32.5%**

Appendix F Summary Tables

In these tables, 'Other' is inclusive of categories which are considered to contribute negligible emissions for a given pollutant. For example, in the case of nitrogen oxides, the 'Other' sector includes emissions from the industrial processes, waste, and other categories. The allocations of categories to the "Other" sector is presented in **Table 32**.

A full dataset is published alongside this report, available to download from the NAEI website.

F.1 Summary Air Pollutant Emission Estimates for England

Table 26 - Summary of air pollutant emission estimates for England (2005-2022)*

	Category	2005	2010	2015	2018	2019	2020	2021	2022
Ammonia (kt)	Transport Sources	14.3	9.17	5.15	4.45	4.34	3.26	3.61	3.85
	Industrial Processes	5.50	4.45	2.21	2.58	3.05	2.46	2.52	1.79
	Agriculture	155	148	156	156	154	145	149	146
	Waste	5.37	5.31	6.42	7.01	6.31	6.46	6.62	5.86
	Other	12.0	12.9	13.6	13.8	13.9	16.7	17.1	16.2
	Total	**193**	**180**	**183**	**184**	**182**	**174**	**179**	**174**
Carbon monoxide (kt)	Energy Industries	67.8	60.1	54.1	46.3	34.7	39.5	42.6	35.0
	Fugitive	5.04	4.65	2.92	1.52	1.50	1.89	1.85	1.76
	Industrial Combustion	587	341	375	360	329	325	337	341
	Transport Sources	1341	741	439	326	301	211	232	234
	Residential, Commercial & Public Sector Combustion	263	254	248	266	253	247	255	253
	Industrial Processes	101	77.0	65.7	49.6	52.7	55.7	52.6	42.5
	Waste	28.3	26.0	24.9	24.5	24.2	21.6	23.8	24.1
	Other	5.25	5.37	3.13	2.98	3.00	2.57	2.80	2.78
	Total	**2398**	**1510**	**1213**	**1077**	**999**	**905**	**947**	**934**
Nitrogen oxides (kt)	Energy Industries	346	210	150	84.1	71.0	67.4	65.9	63.5
	Fugitive	0.50	0.54	0.19	0.24	0.31	0.23	0.11	0.16
	Industrial Combustion	160	93.6	84.9	83.8	77.6	75.8	70.9	70.0
	Transport Sources	616	446	370	318	295	222	225	225
	Residential, Commercial & Public Sector Combustion	126	103	82.1	81.3	77.2	74.7	75.1	68.4
	Agriculture	18.0	17.1	18.1	17.5	17.8	16.3	16.7	15.4
	Other	23.7	24.6	14.5	14.8	14.3	11.9	15.3	13.4
	Total	**1290**	**895**	**720**	**600**	**553**	**468**	**469**	**456**
NMVOC (kt)	Energy Industries	4.84	4.01	2.65	2.06	1.92	1.76	1.92	1.97
	Fugitive	161	96.2	66.5	54.9	53.4	46.3	46.3	47.7
	Industrial Combustion	26.0	17.1	15.0	17.5	15.6	14.5	15.7	14.7

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Transport Sources	190	91.7	54.8	43.6	41.8	31.8	34.0	34.9
	Residential, Commercial & Public Sector Combustion	32.2	26.0	23.7	26.3	25.2	24.4	25.4	23.8
	Industrial Processes	66.1	49.7	42.3	42.0	41.9	41.1	40.0	38.2
	Solvent Processes	328	285	284	281	278	282	267	245
	Agriculture	72.5	71.4	75.7	85.1	84.5	82.4	84.6	85.9
	Other	14.3	11.4	9.53	9.52	9.45	9.12	9.14	9.19
	Total	**896**	**653**	**574**	**562**	**552**	**534**	**524**	**502**
PM_{10} (kt)	Energy Industries	8.44	5.49	4.67	2.74	1.86	1.77	1.50	1.42
	Fugitive	1.30	1.40	0.98	0.69	0.68	0.65	0.63	0.63
	Industrial Combustion	9.31	7.34	6.20	5.51	4.96	5.13	5.13	5.06
	Transport Sources	36.0	27.6	22.9	21.4	20.9	16.4	17.8	18.6
	Residential, Commercial & Public Sector Combustion	18.2	15.2	15.7	18.4	17.6	17.3	17.4	16.6
	Industrial Processes	54.8	43.9	37.7	42.0	41.3	34.3	37.0	39.2
	Agriculture	11.7	11.5	11.4	11.8	11.9	11.3	11.8	11.5
	Waste	6.21	5.66	5.53	5.58	5.56	5.08	5.55	5.59
	Other	1.86	1.60	1.60	1.59	1.58	1.39	1.38	1.38
	Total	**148**	**120**	**107**	**110**	**106**	**93.2**	**98.1**	**100.0**
Sulphur dioxide (kt)	Energy Industries	358	149	91.4	35.6	26.7	24.6	22.7	20.2
	Fugitive	6.98	16.2	11.2	7.64	5.59	6.17	5.71	4.91
	Industrial Combustion	101	86.2	43.1	34.2	29.0	26.7	22.1	21.3
	Transport Sources	41.5	18.0	8.93	8.68	8.74	4.03	3.90	4.12
	Residential, Commercial & Public Sector Combustion	42.0	29.5	27.3	27.5	27.2	23.5	21.8	25.3
	Industrial Processes	29.8	11.4	7.05	8.24	7.34	5.18	5.57	7.39
	Other	6.00	5.32	1.95	1.88	1.79	1.26	1.11	1.04
	Total	**585**	**316**	**191**	**124**	**106**	**91.4**	**82.9**	**84.3**
Lead (tonnes)	Energy Industries	8.91	2.23	2.59	2.08	2.16	2.16	2.07	2.13
	Fugitive	1.92	1.67	1.03	0.30	0.29	0.30	0.26	0.26
	Industrial Combustion	10.6	9.18	9.76	8.27	7.73	7.23	6.54	6.65
	Transport Sources	73.4	53.8	50.4	51.2	50.1	38.1	47.2	51.3
	Residential, Commercial & Public Sector Combustion	4.71	4.47	3.45	3.71	3.47	3.42	3.60	3.67
	Industrial Processes	65.5	31.8	35.9	26.7	25.2	23.5	32.1	42.4
	Other	1.82	0.71	0.33	1.41	5.05	4.95	1.95	1.09
	Total	**167**	**104**	**104**	**93.7**	**94.0**	**79.6**	**93.8**	**108**
$PM_{2.5}$ (kt)	Energy Industries	5.20	3.61	2.98	2.12	1.48	1.45	1.24	1.18
	Fugitive	0.80	0.87	0.71	0.61	0.61	0.60	0.59	0.60
	Industrial Combustion	8.35	6.51	5.35	5.06	4.56	4.76	4.75	4.69

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Transport Sources	28.5	20.5	15.6	13.8	13.3	10.2	10.9	11.3
	Residential, Commercial & Public Sector Combustion	17.7	14.9	15.3	17.9	17.2	16.8	16.9	16.2
	Industrial Processes	13.1	9.66	9.22	8.85	8.41	7.25	7.71	8.19
	Agriculture	1.98	1.93	1.91	1.93	1.93	1.85	1.91	1.87
	Waste	5.69	5.19	5.08	5.13	5.12	4.68	5.11	5.15
	Other	0.99	0.87	0.70	0.70	0.69	0.58	0.61	0.60
	Total	**82.4**	**64.0**	**56.9**	**56.1**	**53.3**	**48.1**	**49.8**	**49.8**
B[a]P (kg)	Energy Industries	71.1	73.2	173	187	207	207	220	179
	Fugitive	63.6	80.5	52.5	14.6	14.5	20.7	18.3	14.7
	Industrial Combustion	39.1	31.7	29.9	36.1	30.3	30.5	33.0	31.3
	Transport Sources	196	150	134	129	129	102	113	120
	Residential, Commercial & Public Sector Combustion	4666	4206	4131	4354	4059	3847	3895	4229
	Industrial Processes	136	94.3	98.8	92.2	76.5	72.7	45.6	45.2
	Waste	766	258	249	249	247	180	244	246
	Other	9.29	6.82	7.05	7.72	7.99	7.51	8.85	7.52
	Total	**5948**	**4901**	**4875**	**5070**	**4771**	**4468**	**4577**	**4873**
Dioxins (g I-TEQ)	Energy Industries	8.69	2.61	3.00	1.64	1.84	1.66	1.76	2.88
	Industrial Combustion	10.8	16.0	16.5	17.7	17.3	18.2	18.3	19.1
	Transport Sources	16.9	15.0	9.67	6.76	6.13	4.39	4.42	4.32
	Residential, Commercial & Public Sector Combustion	17.9	17.8	17.8	18.7	16.7	15.8	15.8	16.4
	Industrial Processes	29.4	31.2	13.9	9.45	8.41	8.21	6.41	20.1
	Waste	90.0	51.7	45.6	45.4	44.7	40.8	43.1	43.8
	Other	0.75	0.73	0.55	0.41	0.34	0.35	0.34	0.32
	Total	**174**	**135**	**107**	**100.0**	**95.4**	**89.4**	**90.0**	**107**
Hg (t)	Energy Industries	1.99	1.51	1.08	0.74	0.57	0.66	0.74	0.65
	Industrial Combustion	0.99	1.03	0.84	0.84	0.69	0.68	0.68	0.65
	Transport Sources	0.26	0.24	0.23	0.23	0.23	0.18	0.20	0.20
	Residential, Commercial & Public Sector Combustion	0.36	0.35	0.27	0.28	0.26	0.25	0.26	0.25
	Industrial Processes	1.72	1.25	0.82	0.66	0.48	0.36	0.35	0.29
	Waste	1.18	1.21	0.78	0.68	0.66	0.68	0.62	0.71
	Other	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
	Total	**6.53**	**5.61**	**4.03**	**3.43**	**2.90**	**2.83**	**2.87**	**2.77**

* The uncertainties in the data are greater than the precision indicated by the table above. This higher level of resolution has been chosen to aid transparency.

F.2 Summary Air Pollutant Emission Estimates for Scotland

Table 27 - Summary of air pollutant emission estimates for Scotland (2005-2022)*

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Transport Sources	1.46	0.92	0.51	0.43	0.42	0.31	0.35	0.38
	Industrial Processes	0.09	0.07	0.05	0.07	0.06	0.05	0.06	0.05
	Agriculture	33.0	30.4	31.2	30.1	30.6	29.6	29.3	28.6
	Waste	0.52	0.52	0.61	0.64	0.58	0.59	0.60	0.54
	Other	1.17	1.18	1.18	1.21	1.21	1.49	1.52	1.44
	Total	**36.2**	**33.1**	**33.6**	**32.5**	**32.9**	**32.1**	**31.8**	**31.1**
Carbon monoxide (kt)	Energy Industries	10.3	11.6	6.66	3.77	3.37	2.46	2.74	2.26
	Fugitive	0.96	0.91	1.17	1.28	1.16	1.22	1.10	1.20
	Industrial Combustion	42.7	28.4	29.3	32.5	30.6	29.7	31.1	31.4
	Transport Sources	134	78.6	47.4	36.0	32.7	22.6	25.5	25.6
	Residential, Commercial & Public Sector Combustion	37.5	37.3	31.1	27.3	24.5	21.5	22.3	21.5
	Industrial Processes	0.42	3.41	2.42	2.24	2.00	1.83	1.92	1.62
	Waste	2.93	2.68	2.53	2.47	2.44	2.18	2.40	2.43
	Other	0.48	0.50	0.28	0.26	0.26	0.22	0.24	0.24
	Total	**229**	**163**	**121**	**106**	**97.1**	**81.7**	**87.3**	**86.2**
Nitrogen oxides (kt)	Energy Industries	43.6	38.0	24.5	11.3	9.14	8.25	9.52	7.40
	Fugitive	0.72	0.35	0.42	0.92	0.62	0.81	0.68	0.83
	Industrial Combustion	16.1	9.88	8.27	8.44	8.31	8.32	7.84	7.64
	Transport Sources	105	78.4	61.3	57.4	56.0	44.8	43.0	41.4
	Residential, Commercial & Public Sector Combustion	30.5	24.9	19.2	18.5	16.5	15.7	15.3	14.0
	Agriculture	4.77	4.45	4.36	4.18	4.17	3.95	4.02	3.46
	Other	1.97	2.14	1.18	1.20	1.15	0.93	1.21	1.06
	Total	**203**	**158**	**119**	**102**	**95.9**	**82.8**	**81.5**	**75.7**
NMVOC (kt)	Energy Industries	1.86	1.19	0.76	0.51	0.45	0.48	0.45	0.37
	Fugitive	43.0	22.3	21.4	19.4	16.6	11.1	10.2	9.06
	Industrial Combustion	2.44	1.79	1.56	1.81	1.67	1.55	1.60	1.51
	Transport Sources	19.7	10.2	6.21	5.15	4.90	3.74	3.95	4.06
	Residential, Commercial & Public Sector Combustion	4.89	4.28	3.38	3.14	2.86	2.57	2.65	2.46
	Industrial Processes	58.2	60.8	69.2	76.8	79.6	82.0	84.1	86.7
	Solvent Processes	31.1	27.1	26.5	26.4	26.2	26.3	25.3	23.4
	Agriculture	17.1	16.7	15.7	15.5	15.6	15.8	15.5	15.7
	Other	1.47	1.17	0.98	0.96	0.95	0.90	0.92	0.93

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Total	**180**	**146**	**146**	**150**	**149**	**144**	**145**	**144**
PM_{10} (kt)	Energy Industries	1.75	1.38	0.49	0.25	0.20	0.16	0.22	0.13
	Fugitive	0.51	0.43	0.24	0.16	0.17	0.11	0.10	0.09
	Industrial Combustion	1.00	0.68	0.50	0.49	0.46	0.49	0.47	0.45
	Transport Sources	5.91	3.73	2.76	2.67	2.64	2.01	2.20	2.29
	Residential, Commercial & Public Sector Combustion	2.98	2.49	2.07	2.02	1.84	1.65	1.65	1.57
	Industrial Processes	4.25	3.43	2.80	3.24	3.18	2.50	2.75	2.92
	Agriculture	1.77	1.80	1.79	1.79	1.82	1.79	1.78	1.81
	Waste	0.63	0.57	0.55	0.55	0.55	0.50	0.55	0.55
	Other	0.15	0.13	0.12	0.11	0.11	0.10	0.10	0.10
	Total	**18.9**	**14.6**	**11.3**	**11.3**	**11.0**	**9.32**	**9.80**	**9.92**
Sulphur dioxide (kt)	Energy Industries	53.7	65.1	17.6	4.85	3.95	1.87	2.18	2.37
	Fugitive	0.41	0.15	0.11	0.15	0.16	0.14	0.14	0.11
	Industrial Combustion	11.4	4.53	2.61	2.15	2.03	1.75	1.50	1.28
	Transport Sources	23.7	10.2	3.01	2.90	2.95	1.57	1.50	1.50
	Residential, Commercial & Public Sector Combustion	8.97	6.43	3.79	2.98	2.49	1.52	1.42	1.54
	Industrial Processes	0.82	0.64	0.72	0.69	0.69	0.58	0.53	0.46
	Other	0.56	0.50	0.18	0.17	0.16	0.12	0.10	0.10
	Total	**99.5**	**87.5**	**28.1**	**13.9**	**12.4**	**7.55**	**7.37**	**7.36**
Lead (tonnes)	Energy Industries	1.61	1.31	0.64	0.20	0.25	0.25	0.24	0.24
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	1.57	1.25	0.84	0.85	0.78	0.75	0.70	0.68
	Transport Sources	8.18	6.12	5.68	6.09	5.89	4.12	5.73	5.82
	Residential, Commercial & Public Sector Combustion	0.81	0.77	0.53	0.45	0.39	0.33	0.34	0.33
	Industrial Processes	2.38	1.35	1.34	1.07	0.95	0.77	0.89	1.22
	Other	0.16	0.06	0.02	0.12	0.43	0.42	0.16	0.09
	Total	**14.7**	**10.9**	**9.06**	**8.77**	**8.69**	**6.64**	**8.07**	**8.39**
$PM_{2.5}$ (kt)	Energy Industries	1.06	0.88	0.32	0.20	0.16	0.14	0.18	0.11
	Fugitive	0.19	0.18	0.18	0.13	0.15	0.10	0.10	0.09
	Industrial Combustion	0.94	0.62	0.45	0.45	0.43	0.45	0.44	0.43
	Transport Sources	5.06	2.97	2.00	1.85	1.82	1.36	1.45	1.49
	Residential, Commercial & Public Sector Combustion	2.90	2.43	2.02	1.97	1.79	1.60	1.60	1.52
	Industrial Processes	0.98	0.70	0.63	0.68	0.63	0.48	0.52	0.55
	Agriculture	0.39	0.38	0.37	0.36	0.36	0.36	0.36	0.36
	Waste	0.58	0.53	0.51	0.51	0.50	0.46	0.50	0.51
	Other	0.08	0.07	0.05	0.05	0.05	0.04	0.04	0.04
	Total	**12.2**	**8.75**	**6.53**	**6.19**	**5.89**	**4.99**	**5.19**	**5.09**

	Category	2005	2010	2015	2018	2019	2020	2021	2022
B[a]P (kg)	Energy Industries	5.48	7.55	4.07	0.23	0.24	0.16	0.10	0.17
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	3.53	3.52	2.91	3.67	2.96	3.00	3.24	3.04
	Transport Sources	20.6	16.2	14.1	13.9	14.0	10.9	12.2	13.1
	Residential, Commercial & Public Sector Combustion	752	699	547	387	309	204	211	221
	Industrial Processes	12.3	8.17	8.74	9.18	7.47	6.73	7.12	6.61
	Waste	137	27.7	26.1	26.0	25.7	19.2	25.5	25.6
	Other	0.93	0.68	0.69	0.75	0.77	0.72	0.85	0.73
	Total	**932**	**763**	**604**	**441**	**360**	**245**	**260**	**270**
Dioxins (g I-TEQ)	Energy Industries	0.25	0.19	0.15	0.10	0.17	0.16	0.12	0.20
	Industrial Combustion	1.09	1.28	1.37	1.49	1.48	1.54	1.56	1.58
	Transport Sources	1.47	1.57	0.83	0.72	0.66	0.46	0.50	0.50
	Residential, Commercial & Public Sector Combustion	2.85	3.00	2.52	1.95	1.58	1.21	1.24	1.21
	Industrial Processes	0.28	0.14	0.14	0.14	0.10	0.10	0.10	0.10
	Waste	11.0	5.06	4.34	4.31	4.24	3.84	4.06	4.13
	Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Total	**17.0**	**11.3**	**9.36**	**8.72**	**8.23**	**7.32**	**7.59**	**7.74**
Hg (t)	Energy Industries	0.14	0.21	0.11	0.01	0.01	0.02	0.02	0.02
	Industrial Combustion	0.12	0.10	0.08	0.06	0.05	0.05	0.05	0.04
	Transport Sources	0.05	0.04	0.03	0.04	0.04	0.03	0.03	0.03
	Residential, Commercial & Public Sector Combustion	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.02
	Industrial Processes	0.14	0.09	0.05	0.04	0.02	0.01	0.01	0.01
	Waste	0.11	0.11	0.07	0.07	0.06	0.07	0.06	0.07
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.61**	**0.60**	**0.38**	**0.24**	**0.21**	**0.20**	**0.20**	**0.20**

* The uncertainties in the data are greater than the precision indicated by the table above. This higher level of resolution has been chosen to aid transparency.

F.3 Summary Air Pollutant Emission Estimates for Wales

Table 28 - Summary of air pollutant emission estimates for Wales (2005-2022) *

	Category	2005	2010	2015	2018	2019	2020	2021	2022
Ammonia (kt)	Transport Sources	0.90	0.56	0.31	0.26	0.25	0.19	0.20	0.22
	Industrial Processes	0.07	0.08	0.07	0.08	0.06	0.06	0.08	0.06
	Agriculture	19.9	18.7	20.6	21.1	21.2	21.3	21.6	20.9
	Waste	0.29	0.27	0.31	0.34	0.31	0.31	0.32	0.28
	Other	0.93	0.91	0.96	0.97	0.96	1.11	1.12	1.06
	Total	**22.1**	**20.5**	**22.2**	**22.8**	**22.8**	**23.0**	**23.3**	**22.6**
Carbon monoxide (kt)	Energy Industries	6.04	7.33	7.23	3.63	3.85	3.06	3.26	2.73
	Fugitive	3.11	6.38	4.64	6.18	6.12	6.19	6.00	7.94
	Industrial Combustion	87.5	69.2	83.7	76.8	77.1	79.5	71.5	37.9
	Transport Sources	76.0	43.6	25.9	19.2	17.0	11.8	12.5	12.8
	Residential, Commercial & Public Sector Combustion	32.8	33.7	31.0	31.6	29.5	27.7	28.3	28.6
	Industrial Processes	48.9	34.7	55.6	51.9	50.1	48.8	47.3	38.3
	Waste	1.58	1.44	1.34	1.31	1.29	1.15	1.25	1.26
	Other	0.22	0.22	0.13	0.12	0.12	0.10	0.11	0.11
	Total	**256**	**197**	**210**	**191**	**185**	**178**	**170**	**130**
Nitrogen oxides (kt)	Energy Industries	33.5	30.7	34.8	8.96	9.31	7.55	7.66	8.41
	Fugitive	0.10	0.14	0.16	0.05	0.05	0.06	0.06	0.03
	Industrial Combustion	14.9	9.52	9.87	8.95	8.49	8.78	8.71	8.16
	Transport Sources	39.2	29.3	23.7	20.5	19.5	15.0	15.3	15.8
	Residential, Commercial & Public Sector Combustion	13.5	10.6	8.01	7.13	6.56	6.21	5.94	5.45
	Agriculture	3.20	2.82	2.82	3.01	3.04	2.82	2.97	2.37
	Other	1.48	1.36	0.99	0.87	0.83	0.74	0.91	0.70
	Total	106	84.5	80.3	49.5	47.8	41.2	41.5	40.9
NMVOC (kt)	Energy Industries	0.74	1.20	1.40	0.74	0.91	0.89	0.72	0.74
	Fugitive	13.7	12.5	8.47	6.11	6.29	6.05	6.06	5.97
	Industrial Combustion	2.04	1.48	1.30	1.51	1.46	1.34	1.41	1.28
	Transport Sources	11.0	5.49	3.32	2.62	2.42	1.83	1.91	1.97
	Residential, Commercial & Public Sector Combustion	3.59	3.46	3.00	3.04	2.83	2.64	2.72	2.55
	Industrial Processes	2.71	2.59	2.69	2.57	2.51	2.45	2.54	2.36
	Solvent Processes	18.9	15.5	15.3	15.0	15.1	15.7	14.7	13.3
	Agriculture	11.0	11.1	11.7	11.8	12.2	12.8	13.2	13.0
	Other	0.87	0.67	0.56	0.56	0.55	0.53	0.52	0.51

	Category	2005	2010	2015	2018	2019	2020	2021	2022
PM_{10} (kt)	**Total**	**64.5**	**54.0**	**47.7**	**44.0**	**44.4**	**44.2**	**43.8**	**41.7**
	Energy Industries	1.03	0.83	0.57	0.25	0.20	0.23	0.48	0.27
	Fugitive	0.16	0.17	0.16	0.10	0.12	0.17	0.22	0.14
	Industrial Combustion	0.71	0.65	0.75	0.47	0.43	0.45	0.42	0.43
	Transport Sources	2.80	1.91	1.51	1.40	1.38	1.04	1.14	1.22
	Residential, Commercial & Public Sector Combustion	2.51	2.29	2.10	2.23	2.10	1.99	1.99	1.90
	Industrial Processes	4.87	3.83	3.92	3.96	3.82	3.81	3.76	3.61
	Agriculture	0.84	0.85	0.91	0.96	0.98	0.97	0.99	0.99
	Waste	0.36	0.32	0.31	0.31	0.31	0.28	0.30	0.30
	Other	0.10	0.08	0.08	0.08	0.08	0.07	0.07	0.07
Sulphur dioxide (kt)	**Total**	**13.4**	**10.9**	**10.3**	**9.77**	**9.41**	**9.01**	**9.38**	**8.94**
	Energy Industries	39.6	16.9	12.6	3.24	3.64	2.31	2.84	2.64
	Fugitive	1.03	2.84	2.00	1.74	1.56	1.76	1.54	1.33
	Industrial Combustion	7.23	9.73	7.75	6.19	6.02	5.68	4.18	4.44
	Transport Sources	8.07	3.47	1.23	0.97	1.00	0.48	0.47	0.54
	Residential, Commercial & Public Sector Combustion	5.55	4.55	3.91	4.30	4.44	3.97	3.68	4.30
	Industrial Processes	2.34	0.47	0.67	0.50	0.46	0.50	0.45	0.50
	Other	0.26	0.23	0.08	0.08	0.08	0.05	0.05	0.04
Lead (tonnes)	**Total**	**64.0**	**38.2**	**28.3**	**17.0**	**17.2**	**14.8**	**13.2**	**13.8**
	Energy Industries	0.67	0.56	0.16	0.07	0.09	0.08	0.07	0.08
	Fugitive	0.40	0.55	0.53	0.50	0.47	0.48	0.48	0.40
	Industrial Combustion	2.56	0.72	0.74	0.63	0.61	0.57	0.55	0.54
	Transport Sources	4.37	3.62	3.11	3.31	3.20	2.35	2.78	3.08
	Residential, Commercial & Public Sector Combustion	0.75	0.74	0.56	0.57	0.52	0.49	0.52	0.53
	Industrial Processes	17.0	11.7	12.9	10.4	9.54	8.64	20.2	20.9
	Other	0.08	0.03	0.01	0.06	0.20	0.20	0.08	0.04
$PM_{2.5}$ (kt)	**Total**	**25.8**	**17.9**	**18.0**	**15.6**	**14.6**	**12.8**	**24.7**	**25.6**
	Energy Industries	0.62	0.53	0.36	0.19	0.15	0.17	0.32	0.19
	Fugitive	0.07	0.07	0.06	0.04	0.05	0.09	0.12	0.08
	Industrial Combustion	0.64	0.55	0.51	0.42	0.37	0.40	0.38	0.39
	Transport Sources	2.32	1.47	1.04	0.92	0.89	0.66	0.72	0.76
	Residential, Commercial & Public Sector Combustion	2.46	2.25	2.06	2.18	2.05	1.94	1.94	1.85
	Industrial Processes	1.63	1.27	1.58	1.41	1.32	1.56	1.42	1.23
	Agriculture	0.22	0.21	0.22	0.22	0.22	0.22	0.22	0.22
	Waste	0.33	0.30	0.28	0.28	0.28	0.26	0.28	0.28
	Other	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Total	**8.33**	**6.68**	**6.14**	**5.69**	**5.38**	**5.32**	**5.43**	**5.03**
B[a]P (kg)	Energy Industries	7.06	5.10	5.44	2.25	2.38	2.30	2.44	2.15
	Fugitive	14.2	25.2	79.3	76.8	70.8	70.8	59.2	43.3
	Industrial Combustion	7.77	2.18	2.08	2.75	2.05	2.11	2.29	2.09
	Transport Sources	12.4	9.51	8.54	8.47	8.33	6.49	7.19	7.80
	Residential, Commercial & Public Sector Combustion	813	775	724	717	669	602	604	666
	Industrial Processes	51.9	15.6	15.9	16.0	15.1	14.4	7.84	8.62
	Waste	103	17.0	16.0	15.6	15.5	11.8	15.0	15.1
	Other	0.54	0.39	0.40	0.43	0.44	0.42	0.48	0.41
	Total	**1010**	**850**	**852**	**840**	**783**	**710**	**698**	**746**
Dioxins (g I-TEQ)	Energy Industries	0.18	0.13	0.19	0.12	0.71	0.10	0.11	0.16
	Industrial Combustion	1.01	0.75	0.95	0.96	0.97	1.00	1.02	1.12
	Transport Sources	0.87	0.76	0.52	0.38	0.36	0.26	0.27	0.26
	Residential, Commercial & Public Sector Combustion	2.78	3.03	2.94	2.91	2.62	2.37	2.35	2.50
	Industrial Processes	9.85	11.7	19.4	15.3	15.7	13.9	3.26	2.62
	Waste	7.28	3.01	2.54	2.51	2.47	2.25	2.32	2.36
	Other	0.06	0.07	0.05	0.04	0.03	0.03	0.03	0.02
	Total	**22.0**	**19.5**	**26.5**	**22.2**	**22.8**	**19.9**	**9.35**	**9.03**
Hg (t)	Energy Industries	0.18	0.06	0.06	0.02	0.02	0.02	0.02	0.02
	Industrial Combustion	0.07	0.10	0.09	0.09	0.11	0.11	0.11	0.09
	Transport Sources	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
	Residential, Commercial & Public Sector Combustion	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
	Industrial Processes	0.25	0.23	0.19	0.29	0.36	0.16	0.45	0.15
	Waste	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.63**	**0.52**	**0.44**	**0.49**	**0.58**	**0.37**	**0.67**	**0.35**

* The uncertainties in the data are greater than the precision indicated by the table above. This higher level of resolution has been chosen to aid transparency.

F.4 Summary Air Pollutant Emission Estimates for Northern Ireland

Table 29 - Summary of air pollutant emission estimates for Northern Ireland (2005-2022) *

	Category	2005	2010	2015	2018	2019	2020	2021	2022
Ammonia (kt)	Transport Sources	0.63	0.42	0.24	0.20	0.19	0.14	0.15	0.15
	Industrial Processes	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.02
	Agriculture	28.8	26.8	29.4	30.5	30.9	30.8	31.6	30.9
	Waste	0.19	0.17	0.19	0.21	0.19	0.19	0.20	0.18
	Other	0.49	0.48	0.51	0.55	0.54	0.64	0.63	0.61
	Total	**30.1**	**27.9**	**30.3**	**31.5**	**31.8**	**31.8**	**32.6**	**31.8**
Carbon monoxide (kt)	Energy Industries	3.68	2.94	2.35	2.70	1.16	1.35	1.36	1.25
	Fugitive	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Industrial Combustion	17.2	13.1	14.3	16.4	15.1	15.7	16.5	16.6
	Transport Sources	50.4	32.0	19.4	14.0	12.7	8.79	9.12	9.23
	Residential, Commercial & Public Sector Combustion	19.7	20.8	23.4	32.3	32.9	34.8	35.0	36.7
	Industrial Processes	0.10	0.09	0.06	0.05	0.05	0.05	0.05	0.05
	Waste	0.71	0.64	0.59	0.57	0.56	0.55	0.55	0.56
	Other	0.15	0.14	0.08	0.08	0.08	0.07	0.07	0.07
	Total	91.9	69.6	60.2	66.2	62.5	61.3	62.6	64.5
Nitrogen oxides (kt)	Energy Industries	9.81	5.97	5.12	3.79	3.13	3.25	3.65	3.23
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	10.5	6.40	7.40	7.55	7.17	7.26	6.91	6.80
	Transport Sources	26.1	19.9	15.7	13.7	12.8	9.68	10.1	10.1
	Residential, Commercial & Public Sector Combustion	12.8	10.9	8.28	7.69	6.87	6.90	6.79	6.15
	Agriculture	3.31	2.97	2.94	3.21	2.95	3.11	3.11	2.85
	Other	0.59	0.61	0.33	0.35	0.34	0.28	0.36	0.32
	Total	**63.1**	**46.7**	**39.8**	**36.3**	**33.2**	**30.5**	**31.0**	**29.4**
NMVOC (kt)	Energy Industries	0.35	0.22	0.15	0.11	0.08	0.08	0.13	0.08
	Fugitive	1.60	0.91	0.81	0.79	0.77	0.59	0.63	0.71
	Industrial Combustion	0.99	0.71	0.75	0.81	0.73	0.71	0.74	0.70
	Transport Sources	7.41	3.98	2.42	1.90	1.78	1.34	1.40	1.44
	Residential, Commercial & Public Sector Combustion	2.26	2.16	2.16	2.74	2.72	2.83	2.88	2.73
	Industrial Processes	3.61	3.61	3.43	3.62	3.70	3.74	3.78	3.85
	Solvent Processes	9.88	9.50	8.05	8.96	8.92	9.02	8.62	7.93
	Agriculture	15.2	14.8	17.3	18.9	18.3	18.3	19.0	17.4
	Other	0.55	0.42	0.33	0.32	0.32	0.31	0.32	0.31
	Total	**41.8**	**36.4**	**35.4**	**38.2**	**37.3**	**37.0**	**37.5**	**35.2**

	Category	2005	2010	2015	2018	2019	2020	2021	2022
PM_{10} (kt)	Energy Industries	0.30	0.08	0.06	0.07	0.04	0.04	0.05	0.02
	Fugitive	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Industrial Combustion	0.89	0.91	1.05	1.06	0.91	0.95	0.95	0.93
	Transport Sources	1.76	1.32	1.04	0.98	0.96	0.72	0.79	0.83
	Residential, Commercial & Public Sector Combustion	1.83	1.61	1.59	1.98	1.94	2.02	2.02	1.91
	Industrial Processes	2.29	1.76	1.50	1.69	1.68	1.43	1.53	1.60
	Agriculture	1.13	1.09	1.27	1.40	1.41	1.38	1.40	1.30
	Waste	0.17	0.15	0.14	0.14	0.14	0.14	0.14	0.14
	Other	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03
	Total	**8.43**	**6.98**	**6.70**	**7.37**	**7.13**	**6.74**	**6.93**	**6.78**
Sulphur dioxide (kt)	Energy Industries	14.9	2.32	2.50	1.49	1.15	1.17	1.25	0.99
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	6.23	7.69	8.25	6.46	5.46	4.45	4.00	3.70
	Transport Sources	3.75	1.75	0.96	0.90	0.87	0.36	0.40	0.40
	Residential, Commercial & Public Sector Combustion	4.17	3.48	3.99	6.44	7.27	7.35	6.83	7.97
	Industrial Processes	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03
	Other	0.17	0.14	0.05	0.05	0.05	0.03	0.03	0.03
	Total	**29.2**	**15.4**	**15.8**	**15.4**	**14.8**	**13.4**	**12.5**	**13.1**
Lead (tonnes)	Energy Industries	0.05	0.05	0.05	0.03	0.06	0.11	0.06	0.05
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	2.76	2.67	2.00	2.41	2.04	1.71	1.72	1.65
	Transport Sources	2.48	2.20	2.02	2.08	2.07	1.61	1.81	1.95
	Residential, Commercial & Public Sector Combustion	0.44	0.47	0.44	0.62	0.63	0.70	0.73	0.77
	Industrial Processes	0.64	0.45	0.46	0.32	0.37	0.33	0.41	0.46
	Other	0.05	0.02	0.01	0.04	0.13	0.13	0.05	0.03
	Total	**6.42**	**5.85**	**4.97**	**5.51**	**5.30**	**4.59**	**4.78**	**4.90**
$PM_{2.5}$ (kt)	Energy Industries	0.18	0.06	0.05	0.06	0.03	0.03	0.04	0.02
	Fugitive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Industrial Combustion	0.77	0.79	0.95	0.96	0.85	0.90	0.90	0.88
	Transport Sources	1.43	0.99	0.71	0.64	0.62	0.45	0.49	0.51
	Residential, Commercial & Public Sector Combustion	1.78	1.58	1.55	1.93	1.90	1.97	1.97	1.86
	Industrial Processes	0.39	0.30	0.26	0.28	0.27	0.24	0.26	0.27
	Agriculture	0.28	0.27	0.29	0.31	0.31	0.30	0.31	0.30
	Waste	0.15	0.14	0.13	0.13	0.13	0.13	0.13	0.13
	Other	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
	Total	**5.02**	**4.17**	**3.97**	**4.33**	**4.14**	**4.06**	**4.13**	**4.00**
B[a]P	Energy Industries	1.98	0.97	1.00	0.87	0.97	0.97	1.03	0.84

	Category	2005	2010	2015	2018	2019	2020	2021	2022
	Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Industrial Combustion	1.81	1.24	1.23	1.57	1.24	1.30	1.41	1.31
	Transport Sources	8.11	6.47	5.48	5.34	5.34	4.14	4.58	4.90
	Residential, Commercial & Public Sector Combustion	434	456	578	893	937	1007	997	1122
	Industrial Processes	1.02	0.98	0.91	1.30	0.93	0.87	0.96	0.93
	Waste	78.4	4.56	4.08	4.16	4.09	4.10	4.13	4.20
	Other	0.31	0.23	0.24	0.26	0.27	0.25	0.30	0.25
	Total	**525**	**470**	**590**	**906**	**950**	**1018**	**1009**	**1135**
Dioxins (g I-TEQ)	Energy Industries	0.06	0.03	0.30	0.03	0.03	0.03	0.02	0.03
	Industrial Combustion	0.62	0.82	1.29	1.57	1.60	1.90	2.00	2.00
	Transport Sources	0.54	0.69	0.15	0.24	0.21	0.15	0.15	0.15
	Residential, Commercial & Public Sector Combustion	1.57	1.82	2.34	3.44	3.50	3.69	3.63	3.98
	Industrial Processes	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	Waste	4.92	1.59	1.34	1.33	1.31	1.25	1.26	1.28
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**7.77**	**4.97**	**5.46**	**6.64**	**6.69**	**7.06**	**7.10**	**7.47**
Hg (t)	Energy Industries	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Industrial Combustion	0.09	0.14	0.17	0.12	0.10	0.09	0.08	0.08
	Transport Sources	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Residential, Commercial & Public Sector Combustion	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.04
	Industrial Processes	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00
	Waste	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**0.24**	**0.22**	**0.23**	**0.20**	**0.17**	**0.16**	**0.15**	**0.16**

* The uncertainties in the data are greater than the precision indicated by the table above. This higher level of resolution has been chosen to aid transparency.

F.5 Summary Air Pollutant Emission Estimates for England and the Devolved Administrations

Table 30 - Summary of air pollutant emission estimates for England and the Devolved Administrations (2005-2022)

Pollutant	DA	Sector	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022
Ammonia (kt)	England	Transport Sources	14.29	9.17	5.15	4.87	4.61	4.45	4.34	3.26	3.61	3.85
		Agriculture	155.41	148.32	155.75	156.02	157.72	155.77	154.44	144.99	148.98	146.12
		Industrial Processes	5.50	4.45	2.21	2.57	3.02	2.58	3.05	2.46	2.52	1.79
		Waste	5.37	5.31	6.42	6.66	7.37	7.01	6.31	6.46	6.62	5.86
		Other	11.97	12.91	13.57	13.49	13.81	13.82	13.91	16.72	17.05	16.19
		Total	192.54	180.16	183.09	183.61	186.52	183.63	182.04	173.90	178.78	173.82
	Scotland	Transport Sources	1.46	0.92	0.51	0.49	0.45	0.43	0.42	0.31	0.35	0.38
		Agriculture	32.95	30.40	31.25	31.89	30.78	30.14	30.61	29.62	29.29	28.65
		Industrial Processes	0.09	0.07	0.05	0.05	0.05	0.07	0.06	0.05	0.06	0.05
		Waste	0.52	0.52	0.61	0.62	0.68	0.64	0.58	0.59	0.60	0.54
		Other	1.17	1.18	1.18	1.18	1.21	1.21	1.21	1.49	1.52	1.44
		Total	36.19	33.09	33.59	34.23	33.17	32.49	32.88	32.06	31.83	31.07
	Wales	Transport Sources	0.90	0.56	0.31	0.30	0.27	0.26	0.25	0.19	0.20	0.22
		Agriculture	19.92	18.69	20.60	20.97	21.25	21.10	21.21	21.30	21.62	20.93
		Industrial Processes	0.07	0.08	0.07	0.06	0.06	0.08	0.06	0.06	0.08	0.06
		Waste	0.29	0.27	0.31	0.32	0.35	0.34	0.31	0.31	0.32	0.28
		Other	0.93	0.91	0.96	0.95	0.96	0.97	0.96	1.11	1.12	1.06
		Total	22.12	20.51	22.25	22.61	22.90	22.75	22.79	22.97	23.34	22.56
	Northern Ireland	Transport Sources	0.63	0.42	0.24	0.22	0.21	0.20	0.19	0.14	0.15	0.15
		Agriculture	28.77	26.80	29.37	29.54	30.84	30.50	30.88	30.83	31.59	30.86
		Industrial Processes	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.02
		Waste	0.19	0.17	0.19	0.20	0.22	0.21	0.19	0.19	0.20	0.18
		Other	0.49	0.48	0.51	0.50	0.54	0.55	0.54	0.64	0.63	0.61
		Total	30.08	27.88	30.31	30.47	31.81	31.47	31.81	31.80	32.57	31.82

Carbon Monoxide (kt)	England	Energy Industries	67.77	60.13	54.08	36.76	35.87	46.32	34.69	39.51	42.58	35.02
		Industrial Combustion	586.97	341.25	375.09	315.91	348.40	360.34	329.24	324.75	336.84	341.17
		Transport Sources	1341.23	741.42	438.56	400.53	357.85	325.53	301.32	211.25	231.69	233.64
		Residential, Commercial & Public Sector Combustion	262.68	253.73	248.30	245.70	256.01	266.13	252.71	247.27	255.07	253.26
		Industrial Processes	100.64	77.03	65.75	49.14	49.98	49.63	52.67	55.66	52.55	42.49
		Fugitive	5.04	4.65	2.92	1.56	1.47	1.52	1.50	1.89	1.85	1.76
		Other	5.25	5.37	3.13	2.90	2.94	2.98	3.00	2.57	2.80	2.78
		Waste	28.27	26.03	24.93	24.75	24.63	24.47	24.15	21.64	23.83	24.08
		Total	2397.85	1509.61	1212.75	1077.24	1077.15	1076.91	999.29	904.54	947.23	934.21
	Scotland	Energy Industries	10.31	11.64	6.66	4.87	3.78	3.77	3.37	2.46	2.74	2.26
		Industrial Combustion	42.65	28.42	29.27	26.90	31.17	32.50	30.64	29.72	31.06	31.37
		Transport Sources	133.88	78.55	47.41	43.16	39.22	36.05	32.73	22.58	25.47	25.57
		Residential, Commercial & Public Sector Combustion	37.46	37.26	31.14	28.99	28.05	27.30	24.45	21.50	22.33	21.49
		Industrial Processes	0.42	3.41	2.42	2.41	2.35	2.24	2.00	1.83	1.92	1.62
		Fugitive	0.96	0.91	1.17	1.12	0.86	1.28	1.16	1.22	1.10	1.20
		Other	0.48	0.50	0.28	0.26	0.26	0.26	0.26	0.22	0.24	0.24
		Waste	2.93	2.68	2.53	2.51	2.49	2.47	2.44	2.18	2.40	2.43
		Total	229.10	163.37	120.88	110.22	108.19	105.86	97.05	81.71	87.26	86.17
	Wales	Energy Industries	6.04	7.33	7.23	6.10	4.30	3.63	3.85	3.06	3.26	2.73
		Industrial Combustion	87.54	69.25	83.75	71.79	79.76	76.78	77.08	79.53	71.53	37.94
		Transport Sources	75.95	43.57	25.88	23.76	20.71	19.15	17.01	11.77	12.54	12.76
		Residential, Commercial & Public Sector Combustion	32.82	33.70	31.03	30.24	30.94	31.60	29.49	27.70	28.28	28.65
		Industrial Processes	48.90	34.70	55.61	48.59	58.54	51.87	50.06	48.81	47.26	38.34
		Fugitive	3.11	6.38	4.64	9.54	6.22	6.18	6.12	6.19	6.00	7.94
		Other	0.22	0.22	0.13	0.12	0.12	0.12	0.12	0.10	0.11	0.11
		Waste	1.58	1.44	1.34	1.33	1.32	1.31	1.29	1.15	1.25	1.26
		Total	256.17	196.59	209.59	191.46	201.91	190.63	185.01	178.31	170.23	129.72
		Energy Industries	3.68	2.94	2.35	1.48	1.91	2.70	1.16	1.35	1.36	1.25

	Northern Ireland	Industrial Combustion	17.16	13.07	14.27	14.08	15.87	16.45	15.12	15.70	16.47	16.61
		Transport Sources	50.38	31.99	19.45	17.34	15.41	14.00	12.66	8.79	9.12	9.23
		Residential, Commercial & Public Sector Combustion	19.74	20.77	23.39	25.59	29.06	32.33	32.87	34.79	34.96	36.66
		Industrial Processes	0.10	0.09	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05
		Fugitive	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
		Other	0.15	0.14	0.08	0.07	0.08	0.08	0.08	0.07	0.07	0.07
		Waste	0.71	0.64	0.59	0.58	0.58	0.57	0.56	0.55	0.55	0.56
		Total	91.93	69.65	60.21	59.23	62.98	66.21	62.53	61.32	62.62	64.45
Nitrogen Oxides (kt)	England	Energy Industries	345.86	209.77	149.67	93.48	91.16	84.10	70.97	67.43	65.90	63.47
		Industrial Combustion	160.21	93.60	84.93	78.26	79.47	83.77	77.61	75.84	70.88	70.00
		Transport Sources	616.04	445.52	370.45	354.74	340.57	318.45	295.29	221.84	225.14	224.84
		Residential, Commercial & Public Sector Combustion	126.07	103.49	82.12	83.58	80.48	81.34	77.25	74.74	75.08	68.36
		Agriculture	17.97	17.14	18.10	17.16	17.51	17.51	17.77	16.29	16.67	15.41
		Fugitive	0.50	0.54	0.19	0.31	0.15	0.24	0.31	0.23	0.11	0.16
		Other	23.67	24.64	14.47	13.75	14.42	14.84	14.30	11.90	15.33	13.43
		Total	1290.33	894.70	719.94	641.29	623.77	600.25	553.49	468.26	469.11	455.66
	Scotland	Energy Industries	43.59	37.97	24.51	14.79	11.57	11.30	9.14	8.25	9.52	7.40
		Industrial Combustion	16.08	9.88	8.27	7.99	8.29	8.44	8.31	8.32	7.84	7.64
		Transport Sources	105.41	78.39	61.29	60.81	58.59	57.37	56.03	44.76	42.98	41.35
		Residential, Commercial & Public Sector Combustion	30.46	24.94	19.22	19.39	18.61	18.49	16.49	15.74	15.29	13.99
		Agriculture	4.77	4.45	4.36	4.23	4.26	4.18	4.17	3.95	4.02	3.46
		Fugitive	0.72	0.35	0.42	0.19	0.51	0.92	0.62	0.81	0.68	0.83
		Other	1.97	2.14	1.18	1.11	1.16	1.20	1.15	0.93	1.21	1.06
		Total	203.00	158.11	119.26	108.51	102.99	101.91	95.89	82.76	81.55	75.74
	Wales	Energy Industries	33.53	30.72	34.76	28.36	15.24	8.96	9.31	7.55	7.66	8.41
		Industrial Combustion	14.87	9.52	9.87	8.34	9.25	8.95	8.49	8.78	8.71	8.16
		Transport Sources	39.20	29.28	23.69	23.06	21.75	20.54	19.48	15.00	15.29	15.79

		Residential, Commercial & Public Sector Combustion	13.54	10.61	8.01	7.85	7.35	7.13	6.56	6.21	5.94	5.45
		Agriculture	3.20	2.82	2.82	3.09	3.21	3.01	3.04	2.82	2.97	2.37
		Fugitive	0.10	0.14	0.16	0.06	0.06	0.05	0.05	0.06	0.06	0.03
		Other	1.48	1.36	0.99	0.88	0.95	0.87	0.83	0.74	0.91	0.70
		Total	105.93	84.45	80.30	71.64	57.82	49.50	47.76	41.17	41.54	40.91
	Northern Ireland	Energy Industries	9.81	5.97	5.12	4.87	4.09	3.79	3.13	3.25	3.65	3.23
		Industrial Combustion	10.45	6.40	7.40	6.93	7.39	7.55	7.17	7.26	6.91	6.80
		Transport Sources	26.07	19.88	15.72	15.21	14.70	13.70	12.79	9.68	10.15	10.08
		Residential, Commercial & Public Sector Combustion	12.84	10.90	8.28	8.29	7.68	7.69	6.87	6.90	6.79	6.15
		Agriculture	3.31	2.97	2.94	2.96	3.10	3.21	2.95	3.11	3.11	2.85
		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Other	0.59	0.61	0.33	0.32	0.34	0.35	0.34	0.28	0.36	0.32
		Total	63.06	46.73	39.80	38.58	37.30	36.29	33.25	30.49	30.97	29.43
NMVOC (kt)	England	Energy Industries	4.84	4.01	2.65	2.43	2.55	2.06	1.92	1.76	1.92	1.97
		Industrial Combustion	26.01	17.12	15.05	14.56	16.06	17.50	15.63	14.53	15.74	14.66
		Transport Sources	190.43	91.75	54.83	50.50	46.62	43.64	41.75	31.80	33.99	34.94
		Solvent Processes	327.85	284.90	283.68	282.04	277.44	280.94	277.87	282.25	267.19	245.45
		Residential, Commercial & Public Sector Combustion	32.20	26.05	23.74	24.05	24.83	26.27	25.21	24.38	25.44	23.80
		Agriculture	72.48	71.42	75.74	77.79	82.65	85.08	84.51	82.40	84.61	85.88
		Industrial Processes	66.07	49.72	42.34	41.75	43.65	41.98	41.90	41.05	40.01	38.22
		Fugitive	161.36	96.18	66.53	57.26	56.24	54.86	53.43	46.26	46.29	47.68
		Other	14.26	11.36	9.53	9.37	9.46	9.52	9.45	9.12	9.14	9.19
		Total	895.50	652.50	574.08	559.74	559.50	561.84	551.69	533.56	524.33	501.80
	Scotland	Energy Industries	1.86	1.19	0.76	0.75	0.77	0.51	0.45	0.48	0.45	0.37
		Industrial Combustion	2.44	1.79	1.56	1.49	1.71	1.81	1.67	1.55	1.60	1.51
		Transport Sources	19.69	10.23	6.21	5.79	5.40	5.15	4.90	3.74	3.95	4.06
		Solvent Processes	31.12	27.11	26.51	25.72	26.01	26.39	26.25	26.32	25.32	23.43

		Residential, Commercial & Public Sector Combustion	4.89	4.28	3.38	3.27	3.16	3.14	2.86	2.57	2.65	2.46
		Agriculture	17.15	16.75	15.69	15.80	15.62	15.50	15.61	15.85	15.46	15.68
		Industrial Processes	58.17	60.83	69.19	72.71	74.68	76.76	79.63	81.96	84.10	86.75
		Fugitive	43.02	22.32	21.38	21.24	19.00	19.42	16.55	11.07	10.17	9.06
		Other	1.47	1.17	0.98	0.96	0.97	0.96	0.95	0.90	0.92	0.93
		Total	179.81	145.67	145.66	147.72	147.32	149.64	148.87	144.43	144.61	144.26
	Wales	Energy Industries	0.74	1.20	1.40	1.29	1.03	0.74	0.91	0.89	0.72	0.74
		Industrial Combustion	2.04	1.48	1.30	1.33	1.46	1.51	1.46	1.34	1.41	1.28
		Transport Sources	11.01	5.49	3.32	3.08	2.77	2.62	2.42	1.83	1.91	1.97
		Solvent Processes	18.88	15.54	15.33	14.77	14.79	15.03	15.14	15.68	14.66	13.34
		Residential, Commercial & Public Sector Combustion	3.59	3.46	3.00	2.98	2.98	3.04	2.83	2.64	2.72	2.55
		Agriculture	10.99	11.07	11.68	11.68	11.79	11.78	12.25	12.80	13.24	12.96
		Industrial Processes	2.71	2.59	2.69	2.69	2.56	2.57	2.51	2.45	2.54	2.36
		Fugitive	13.67	12.52	8.47	6.88	6.32	6.11	6.29	6.05	6.06	5.97
		Other	0.87	0.67	0.56	0.56	0.56	0.56	0.55	0.53	0.52	0.51
		Total	64.50	54.02	47.75	45.26	44.25	43.97	44.36	44.21	43.77	41.70
	Northern Ireland	Energy Industries	0.35	0.22	0.15	0.13	0.10	0.11	0.08	0.08	0.13	0.08
		Industrial Combustion	0.99	0.71	0.75	0.70	0.78	0.81	0.73	0.71	0.74	0.70
		Transport Sources	7.41	3.98	2.42	2.21	2.04	1.90	1.78	1.34	1.40	1.44
		Solvent Processes	9.88	9.50	8.05	8.30	8.78	8.96	8.92	9.02	8.62	7.93
		Residential, Commercial & Public Sector Combustion	2.26	2.16	2.16	2.32	2.51	2.74	2.72	2.83	2.88	2.73
		Agriculture	15.17	14.85	17.32	17.46	18.91	18.95	18.30	18.35	19.05	17.41
		Industrial Processes	3.61	3.61	3.43	3.35	3.95	3.62	3.70	3.74	3.78	3.85
		Fugitive	1.60	0.91	0.81	0.81	0.80	0.79	0.77	0.59	0.63	0.71
		Other	0.55	0.42	0.33	0.32	0.31	0.32	0.32	0.31	0.32	0.31
		Total	41.82	36.36	35.42	35.60	38.18	38.20	37.33	36.98	37.54	35.16
PM_{10} (kt)	England	Energy Industries	8.44	5.49	4.67	3.03	2.94	2.74	1.86	1.77	1.50	1.42
		Industrial Combustion	9.31	7.34	6.20	5.28	5.32	5.51	4.96	5.13	5.13	5.06

		Transport Sources	35.96	27.57	22.91	22.50	22.00	21.37	20.94	16.36	17.76	18.59
		Residential, Commercial & Public Sector Combustion	18.20	15.24	15.73	16.56	17.03	18.36	17.63	17.28	17.35	16.61
		Agriculture	11.71	11.52	11.41	11.62	11.81	11.77	11.86	11.29	11.80	11.47
		Industrial Processes	54.76	43.89	37.75	41.75	46.33	41.96	41.35	34.29	37.02	39.23
		Fugitive	1.30	1.40	0.98	0.69	0.68	0.69	0.68	0.65	0.63	0.63
		Waste	6.21	5.66	5.53	5.55	5.55	5.58	5.56	5.08	5.55	5.59
		Other	1.86	1.60	1.60	1.58	1.58	1.59	1.58	1.39	1.38	1.38
		Total	147.74	119.71	106.77	108.56	113.23	109.56	106.43	93.24	98.12	99.97
	Scotland	Energy Industries	1.75	1.38	0.49	0.30	0.23	0.25	0.20	0.16	0.22	0.13
		Industrial Combustion	1.00	0.68	0.50	0.46	0.46	0.49	0.46	0.49	0.47	0.45
		Transport Sources	5.91	3.73	2.76	2.74	2.73	2.67	2.64	2.01	2.20	2.29
		Residential, Commercial & Public Sector Combustion	2.98	2.49	2.07	2.05	1.99	2.02	1.84	1.65	1.65	1.57
		Agriculture	1.77	1.80	1.79	1.80	1.81	1.79	1.82	1.79	1.78	1.81
		Industrial Processes	4.25	3.43	2.80	3.23	3.62	3.24	3.18	2.50	2.75	2.92
		Fugitive	0.51	0.43	0.24	0.18	0.16	0.16	0.17	0.11	0.10	0.09
		Waste	0.63	0.57	0.55	0.55	0.55	0.55	0.55	0.50	0.55	0.55
		Other	0.15	0.13	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10
		Total	18.95	14.65	11.32	11.43	11.66	11.29	10.98	9.32	9.80	9.92
	Wales	Energy Industries	1.03	0.83	0.57	0.47	0.28	0.25	0.20	0.23	0.48	0.27
		Industrial Combustion	0.71	0.65	0.75	0.56	0.55	0.47	0.43	0.45	0.42	0.43
		Transport Sources	2.80	1.91	1.51	1.49	1.43	1.40	1.38	1.04	1.14	1.22
		Residential, Commercial & Public Sector Combustion	2.51	2.29	2.10	2.14	2.13	2.23	2.10	1.99	1.99	1.90
		Agriculture	0.84	0.85	0.91	0.92	0.93	0.96	0.98	0.97	0.99	0.99
		Industrial Processes	4.87	3.83	3.92	3.62	4.15	3.96	3.82	3.81	3.76	3.61
		Fugitive	0.16	0.17	0.16	0.19	0.11	0.10	0.12	0.17	0.22	0.14
		Waste	0.36	0.32	0.31	0.31	0.31	0.31	0.31	0.28	0.30	0.30
		Other	0.10	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07
		Total	13.37	10.92	10.31	9.78	9.97	9.77	9.41	9.01	9.38	8.94

	Northern Ireland	Energy Industries	0.30	0.08	0.06	0.08	0.06	0.07	0.04	0.04	0.05	0.02
		Industrial Combustion	0.89	0.91	1.05	0.99	0.98	1.06	0.91	0.95	0.95	0.93
		Transport Sources	1.76	1.32	1.04	1.02	1.01	0.98	0.96	0.72	0.79	0.83
		Residential, Commercial & Public Sector Combustion	1.83	1.61	1.59	1.73	1.81	1.98	1.94	2.02	2.02	1.91
		Agriculture	1.13	1.09	1.27	1.31	1.39	1.40	1.41	1.38	1.40	1.30
		Industrial Processes	2.29	1.76	1.50	1.66	1.77	1.69	1.68	1.43	1.53	1.60
		Fugitive	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Waste	0.17	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
		Other	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03
		Total	8.43	6.98	6.70	6.99	7.22	7.37	7.13	6.74	6.93	6.78
Sulphur Dioxide (kt)	England	Energy Industries	358.29	149.42	91.43	45.30	47.03	35.56	26.73	24.59	22.67	20.22
		Industrial Combustion	100.53	86.16	43.07	36.02	33.30	34.20	29.03	26.70	22.14	21.30
		Transport Sources	41.46	18.04	8.93	8.72	8.85	8.68	8.74	4.03	3.90	4.12
		Residential, Commercial & Public Sector Combustion	41.96	29.51	27.30	26.39	27.42	27.46	27.20	23.46	21.84	25.31
		Industrial Processes	29.76	11.43	7.05	8.28	9.38	8.24	7.34	5.18	5.57	7.39
		Fugitive	6.98	16.20	11.18	9.14	8.09	7.64	5.59	6.17	5.71	4.91
		Other	6.00	5.32	1.95	1.85	1.88	1.88	1.79	1.26	1.11	1.04
		Total	584.98	316.09	190.92	135.70	135.95	123.67	106.41	91.39	82.93	84.29
	Scotland	Energy Industries	53.65	65.06	17.62	8.91	5.48	4.85	3.95	1.87	2.18	2.37
		Industrial Combustion	11.38	4.53	2.61	2.43	2.28	2.15	2.03	1.75	1.50	1.28
		Transport Sources	23.74	10.16	3.01	3.02	2.85	2.90	2.95	1.57	1.50	1.50
		Residential, Commercial & Public Sector Combustion	8.97	6.43	3.79	3.49	3.24	2.98	2.49	1.52	1.42	1.54
		Industrial Processes	0.82	0.64	0.72	0.76	0.72	0.69	0.69	0.58	0.53	0.46
		Fugitive	0.41	0.15	0.11	0.13	0.10	0.15	0.16	0.14	0.14	0.11
		Other	0.56	0.50	0.18	0.17	0.17	0.17	0.16	0.12	0.10	0.10
		Total	99.53	87.47	28.06	18.91	14.84	13.89	12.44	7.55	7.37	7.36
	Wales	Energy Industries	39.56	16.90	12.62	7.25	4.24	3.24	3.64	2.31	2.84	2.64
		Industrial Combustion	7.23	9.73	7.75	6.47	7.05	6.19	6.02	5.68	4.18	4.44

		Transport Sources	8.07	3.47	1.23	1.21	1.06	0.97	1.00	0.48	0.47	0.54
		Residential, Commercial & Public Sector Combustion	5.55	4.55	3.91	3.91	4.14	4.30	4.44	3.97	3.68	4.30
		Industrial Processes	2.34	0.47	0.67	0.61	0.51	0.50	0.46	0.50	0.45	0.50
		Fugitive	1.03	2.84	2.00	1.94	1.85	1.74	1.56	1.76	1.54	1.33
		Other	0.26	0.23	0.08	0.08	0.08	0.08	0.08	0.05	0.05	0.04
		Total	64.04	38.19	28.27	21.47	18.94	17.02	17.20	14.75	13.21	13.78
	Northern Ireland	Energy Industries	14.89	2.32	2.50	2.44	1.39	1.49	1.15	1.17	1.25	0.99
		Industrial Combustion	6.23	7.69	8.25	7.77	6.98	6.46	5.46	4.45	4.00	3.70
		Transport Sources	3.75	1.75	0.96	0.96	1.00	0.90	0.87	0.36	0.40	0.40
		Residential, Commercial & Public Sector Combustion	4.17	3.48	3.99	4.59	5.59	6.44	7.27	7.35	6.83	7.97
		Industrial Processes	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03
		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Other	0.17	0.14	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03
		Total	29.24	15.40	15.77	15.83	15.03	15.37	14.83	13.39	12.54	13.12
Lead (t)	England	Energy Industries	8.91	2.23	2.59	2.46	2.44	2.08	2.16	2.16	2.07	2.13
		Industrial Combustion	10.65	9.18	9.76	8.01	9.25	8.27	7.73	7.23	6.54	6.65
		Transport Sources	73.40	53.78	50.43	51.85	52.00	51.24	50.10	38.05	47.25	51.30
		Residential, Commercial & Public Sector Combustion	4.71	4.47	3.45	3.50	3.59	3.71	3.47	3.42	3.60	3.67
		Industrial Processes	65.55	31.81	35.92	31.45	28.25	26.72	25.24	23.51	32.11	42.44
		Fugitive	1.92	1.67	1.03	0.32	0.29	0.30	0.29	0.30	0.26	0.26
		Other	1.82	0.71	0.33	0.30	1.03	1.41	5.05	4.95	1.95	1.09
		Total	166.95	103.86	103.51	97.89	96.86	93.73	94.04	79.63	93.78	107.53
	Scotland	Energy Industries	1.61	1.31	0.64	0.22	0.21	0.20	0.25	0.25	0.24	0.24
		Industrial Combustion	1.57	1.25	0.84	0.86	0.92	0.85	0.78	0.75	0.70	0.68
		Transport Sources	8.18	6.12	5.68	5.82	6.18	6.09	5.89	4.12	5.73	5.82
		Residential, Commercial & Public Sector Combustion	0.81	0.77	0.53	0.49	0.47	0.45	0.39	0.33	0.34	0.33
		Industrial Processes	2.38	1.35	1.34	1.27	1.21	1.07	0.95	0.77	0.89	1.22

		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Other	0.16	0.06	0.02	0.02	0.08	0.12	0.43	0.42	0.16	0.09
		Total	14.70	10.86	9.06	8.68	9.08	8.77	8.69	6.64	8.07	8.39
	Wales	Energy Industries	0.67	0.56	0.16	0.15	0.09	0.07	0.09	0.08	0.07	0.08
		Industrial Combustion	2.56	0.72	0.74	0.71	0.70	0.63	0.61	0.57	0.55	0.54
		Transport Sources	4.37	3.62	3.11	3.25	3.26	3.31	3.20	2.35	2.78	3.08
		Residential, Commercial & Public Sector Combustion	0.75	0.74	0.56	0.55	0.56	0.57	0.52	0.49	0.52	0.53
		Industrial Processes	16.97	11.66	12.89	10.64	10.55	10.44	9.54	8.64	20.22	20.95
		Fugitive	0.40	0.55	0.53	0.52	0.52	0.50	0.47	0.48	0.48	0.40
		Other	0.08	0.03	0.01	0.01	0.04	0.06	0.20	0.20	0.08	0.04
		Total	25.81	17.88	18.01	15.83	15.72	15.58	14.63	12.81	24.70	25.62
	Northern Ireland	Energy Industries	0.05	0.05	0.05	0.07	0.04	0.03	0.06	0.11	0.06	0.05
		Industrial Combustion	2.76	2.67	2.00	2.00	2.04	2.41	2.04	1.71	1.72	1.65
		Transport Sources	2.48	2.20	2.02	2.07	2.09	2.08	2.07	1.61	1.81	1.95
		Residential, Commercial & Public Sector Combustion	0.44	0.47	0.44	0.49	0.55	0.62	0.63	0.70	0.73	0.77
		Industrial Processes	0.64	0.45	0.46	0.50	0.42	0.32	0.37	0.33	0.41	0.46
		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Other	0.05	0.02	0.01	0.01	0.02	0.04	0.13	0.13	0.05	0.03
		Total	6.42	5.85	4.97	5.14	5.16	5.51	5.30	4.59	4.78	4.90
$PM_{2.5}$ (kt)	England	Energy Industries	5.20	3.61	2.98	2.29	2.21	2.12	1.48	1.45	1.24	1.18
		Industrial Combustion	8.35	6.51	5.35	4.75	4.81	5.06	4.56	4.76	4.75	4.69
		Transport Sources	28.54	20.51	15.57	15.02	14.45	13.80	13.30	10.16	10.94	11.33
		Residential, Commercial & Public Sector Combustion	17.72	14.87	15.35	16.14	16.59	17.88	17.17	16.81	16.89	16.16
		Agriculture	1.98	1.93	1.91	1.93	1.95	1.93	1.93	1.85	1.91	1.87
		Industrial Processes	13.08	9.66	9.22	8.91	9.32	8.85	8.41	7.25	7.71	8.19
		Fugitive	0.80	0.87	0.71	0.62	0.61	0.61	0.61	0.60	0.59	0.60
		Waste	5.69	5.19	5.08	5.10	5.10	5.13	5.12	4.68	5.11	5.15
		Other	0.99	0.87	0.70	0.68	0.69	0.70	0.69	0.58	0.61	0.60

		Total	82.35	64.02	56.85	55.45	55.72	56.09	53.28	48.14	49.75	49.76
	Scotland	Energy Industries	1.06	0.88	0.32	0.23	0.18	0.20	0.16	0.14	0.18	0.11
		Industrial Combustion	0.94	0.62	0.45	0.42	0.42	0.45	0.43	0.45	0.44	0.43
		Transport Sources	5.06	2.97	2.00	1.96	1.91	1.85	1.82	1.36	1.45	1.49
		Residential, Commercial & Public Sector Combustion	2.90	2.43	2.02	2.00	1.93	1.97	1.79	1.60	1.60	1.52
		Agriculture	0.39	0.38	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.36
		Industrial Processes	0.98	0.70	0.63	0.69	0.71	0.68	0.63	0.48	0.52	0.55
		Fugitive	0.19	0.18	0.18	0.15	0.12	0.13	0.15	0.10	0.10	0.09
		Waste	0.58	0.53	0.51	0.51	0.51	0.51	0.50	0.46	0.50	0.51
		Other	0.08	0.07	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
		Total	12.17	8.75	6.53	6.37	6.20	6.19	5.89	4.99	5.19	5.09
	Wales	Energy Industries	0.62	0.53	0.36	0.34	0.20	0.19	0.15	0.17	0.32	0.19
		Industrial Combustion	0.64	0.55	0.51	0.46	0.46	0.42	0.37	0.40	0.38	0.39
		Transport Sources	2.32	1.47	1.04	1.01	0.95	0.92	0.89	0.66	0.72	0.76
		Residential, Commercial & Public Sector Combustion	2.46	2.25	2.06	2.10	2.09	2.18	2.05	1.94	1.94	1.85
		Agriculture	0.22	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
		Industrial Processes	1.63	1.27	1.58	1.17	1.45	1.41	1.32	1.56	1.42	1.23
		Fugitive	0.07	0.07	0.06	0.07	0.05	0.04	0.05	0.09	0.12	0.08
		Waste	0.33	0.30	0.28	0.28	0.28	0.28	0.28	0.26	0.28	0.28
		Other	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
		Total	8.33	6.68	6.14	5.68	5.73	5.69	5.38	5.32	5.43	5.03
	Northern Ireland	Energy Industries	0.18	0.06	0.05	0.07	0.05	0.06	0.03	0.03	0.04	0.02
		Industrial Combustion	0.77	0.79	0.95	0.90	0.90	0.96	0.85	0.90	0.90	0.88
		Transport Sources	1.43	0.99	0.71	0.69	0.67	0.64	0.62	0.45	0.49	0.51
		Residential, Commercial & Public Sector Combustion	1.78	1.58	1.55	1.69	1.77	1.93	1.90	1.97	1.97	1.86
		Agriculture	0.28	0.27	0.29	0.30	0.31	0.31	0.31	0.30	0.31	0.30
		Industrial Processes	0.39	0.30	0.26	0.28	0.28	0.28	0.27	0.24	0.26	0.27
		Fugitive	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

		Waste	0.15	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
		Other	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
		Total	5.02	4.17	3.97	4.08	4.14	4.33	4.14	4.06	4.13	4.00
B[a]P (kg)	England	Energy Industries	71.11	73.20	173.39	159.50	164.65	187.30	206.97	207.38	219.79	179.21
		Industrial combustion	39.07	31.73	29.87	30.33	31.34	36.14	30.31	30.52	32.98	31.30
		Transport Sources	195.97	149.81	133.78	133.01	131.64	129.50	128.89	102.38	112.82	120.41
		Residential, Commercial & Public Sector Combustion	4666.35	4206.42	4130.74	3995.47	4239.33	4353.62	4059.19	3847.49	3895.00	4229.36
		Industrial Processes	136.44	94.32	98.84	81.19	80.58	92.23	76.48	72.71	45.61	45.17
		Fugitive	63.64	80.50	52.47	19.53	14.69	14.57	14.53	20.72	18.29	14.68
		Waste	765.77	258.43	248.51	250.03	249.67	248.90	246.64	179.70	243.50	245.65
		Other	9.29	6.82	7.05	6.41	7.85	7.72	7.99	7.51	8.85	7.52
		Total	5947.64	4901.22	4874.65	4675.46	4919.74	5069.98	4771.01	4468.41	4576.84	4873.31
	Scotland	Energy Industries	5.48	7.55	4.07	0.92	0.48	0.23	0.24	0.16	0.10	0.17
		Industrial combustion	3.53	3.52	2.91	3.00	3.07	3.67	2.96	3.00	3.24	3.04
		Transport Sources	20.55	16.19	14.08	14.05	14.10	13.92	13.98	10.95	12.21	13.09
		Residential, Commercial & Public Sector Combustion	752.47	699.00	547.02	473.89	434.57	387.20	309.17	204.06	210.81	220.62
		Industrial Processes	12.28	8.17	8.74	8.72	8.48	9.18	7.47	6.73	7.12	6.61
		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Waste	137.12	27.75	26.14	26.19	26.17	25.97	25.72	19.15	25.45	25.65
		Other	0.93	0.68	0.69	0.62	0.76	0.75	0.77	0.72	0.85	0.73
		Total	932.37	762.85	603.63	527.39	487.64	440.93	360.32	244.78	259.79	269.90
	Wales	Energy Industries	7.06	5.10	5.44	4.67	2.02	2.25	2.38	2.30	2.44	2.15
		Industrial combustion	7.77	2.18	2.08	2.12	2.11	2.75	2.05	2.11	2.29	2.09
		Transport Sources	12.36	9.51	8.54	8.55	8.41	8.47	8.33	6.49	7.19	7.80
		Residential, Commercial & Public Sector Combustion	813.38	774.88	724.47	694.23	712.78	717.45	668.71	602.13	603.60	666.26
		Industrial Processes	51.88	15.58	15.94	14.89	15.32	15.97	15.13	14.44	7.84	8.62
		Fugitive	14.16	25.24	79.28	79.27	110.54	76.78	70.82	70.84	59.16	43.30
		Waste	102.71	16.98	15.98	15.83	15.70	15.63	15.50	11.75	14.97	15.06

		Other	0.54	0.39	0.40	0.36	0.44	0.43	0.44	0.42	0.48	0.41
		Total	1009.87	849.84	852.13	819.93	867.33	839.73	783.37	710.46	697.98	745.69
	Northern Ireland	Energy Industries	1.98	0.97	1.00	1.11	0.77	0.87	0.97	0.97	1.03	0.84
		Industrial combustion	1.81	1.24	1.23	1.25	1.25	1.57	1.24	1.30	1.41	1.31
		Transport Sources	8.11	6.47	5.48	5.45	5.41	5.34	5.34	4.14	4.58	4.90
		Residential, Commercial & Public Sector Combustion	433.82	455.57	577.55	657.29	785.42	892.75	937.02	1006.74	996.95	1122.47
		Industrial Processes	1.02	0.98	0.91	1.35	1.00	1.30	0.93	0.87	0.96	0.93
		Fugitive	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Waste	78.38	4.56	4.08	4.16	4.18	4.16	4.09	4.10	4.13	4.20
		Other	0.31	0.23	0.24	0.21	0.26	0.26	0.27	0.25	0.30	0.25
		Total	525.44	470.03	590.48	670.83	798.29	906.26	949.86	1018.37	1009.35	1134.90
Dioxins (g-I-TEQ)	England	Energy Industries	8.69	2.61	3.00	1.75	1.61	1.64	1.84	1.66	1.76	2.88
		Industrial Combustion	10.75	15.98	16.52	16.25	16.98	17.67	17.30	18.22	18.25	19.07
		Transport Sources	16.95	14.99	9.67	8.73	7.63	6.76	6.13	4.39	4.42	4.32
		Residential, Commercial & Public Sector Combustion	17.89	17.85	17.85	16.96	18.21	18.66	16.69	15.77	15.77	16.41
		Industrial Processes	29.40	31.16	13.85	10.00	9.51	9.45	8.41	8.21	6.41	20.10
		Waste	90.02	51.71	45.58	45.48	45.38	45.37	44.73	40.82	43.07	43.78
		Other	0.75	0.73	0.55	0.49	0.45	0.41	0.34	0.35	0.34	0.32
		Total	174.45	135.02	107.03	99.66	99.77	99.96	95.44	89.42	90.01	106.88
	Scotland	Energy Industries	0.25	0.19	0.15	0.09	0.08	0.10	0.17	0.16	0.12	0.20
		Industrial Combustion	1.09	1.28	1.37	1.40	1.45	1.49	1.48	1.54	1.56	1.58
		Transport Sources	1.47	1.57	0.83	0.77	0.81	0.72	0.66	0.46	0.50	0.50
		Residential, Commercial & Public Sector Combustion	2.85	3.00	2.52	2.20	2.09	1.95	1.58	1.21	1.24	1.21
		Industrial Processes	0.28	0.14	0.14	0.15	0.12	0.14	0.10	0.10	0.10	0.10
		Waste	11.02	5.06	4.34	4.35	4.33	4.31	4.24	3.84	4.06	4.13
		Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Total	16.96	11.26	9.36	8.96	8.89	8.72	8.23	7.32	7.59	7.74
	Wales	Energy Industries	0.18	0.13	0.19	0.20	0.15	0.12	0.71	0.10	0.11	0.16

		Industrial Combustion	1.01	0.75	0.95	0.95	0.94	0.96	0.97	1.00	1.02	1.12
		Transport Sources	0.87	0.76	0.52	0.46	0.42	0.38	0.36	0.26	0.27	0.26
		Residential, Commercial & Public Sector Combustion	2.78	3.03	2.94	2.78	2.89	2.91	2.62	2.37	2.35	2.50
		Industrial Processes	9.85	11.74	19.37	16.60	14.93	15.32	15.65	13.88	3.26	2.62
		Waste	7.28	3.01	2.54	2.53	2.52	2.51	2.47	2.25	2.32	2.36
		Other	0.06	0.07	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.02
		Total	22.04	19.49	26.55	23.57	21.88	22.24	22.81	19.90	9.35	9.03
	Northern Ireland	Energy Industries	0.06	0.03	0.30	0.30	0.03	0.03	0.03	0.03	0.02	0.03
		Industrial Combustion	0.62	0.82	1.29	1.33	1.45	1.57	1.60	1.90	2.00	2.00
		Transport Sources	0.54	0.69	0.15	0.14	0.24	0.24	0.21	0.15	0.15	0.15
		Residential, Commercial & Public Sector Combustion	1.57	1.82	2.34	2.60	3.06	3.44	3.50	3.69	3.63	3.98
		Industrial Processes	0.05	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
		Waste	4.92	1.59	1.34	1.34	1.33	1.33	1.31	1.25	1.26	1.28
		Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total	7.77	4.97	5.46	5.75	6.13	6.64	6.69	7.06	7.10	7.47
Mercury (t)	England	Energy Industries	1.99	1.51	1.08	0.79	0.73	0.74	0.57	0.66	0.74	0.65
		Industrial Combustion	0.99	1.03	0.84	0.79	0.74	0.84	0.69	0.68	0.68	0.65
		Transport Sources	0.26	0.24	0.23	0.23	0.23	0.23	0.23	0.18	0.20	0.20
		Residential, Commercial & Public Sector Combustion	0.36	0.35	0.27	0.27	0.27	0.28	0.26	0.25	0.26	0.25
		Industrial Processes	1.72	1.25	0.82	0.57	0.54	0.66	0.48	0.36	0.35	0.29
		Waste	1.18	1.21	0.78	0.74	0.70	0.68	0.66	0.68	0.62	0.71
		Other	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Total	6.53	5.61	4.03	3.40	3.21	3.43	2.90	2.83	2.87	2.77
	Scotland	Energy Industries	0.14	0.21	0.11	0.04	0.01	0.01	0.01	0.02	0.02	0.02
		Industrial Combustion	0.12	0.10	0.08	0.07	0.07	0.06	0.05	0.05	0.05	0.04
		Transport Sources	0.05	0.04	0.03	0.04	0.03	0.04	0.04	0.03	0.03	0.03
		Residential, Commercial & Public Sector Combustion	0.05	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02

		Industrial Processes	0.14	0.09	0.05	0.03	0.03	0.04	0.02	0.01	0.01	0.01
		Waste	0.11	0.11	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07
		Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.61	0.60	0.38	0.28	0.24	0.24	0.21	0.20	0.20	0.20
	Wales	Energy Industries	0.18	0.06	0.06	0.07	0.03	0.02	0.02	0.02	0.02	0.02
		Industrial Combustion	0.07	0.10	0.09	0.09	0.09	0.09	0.11	0.11	0.11	0.09
		Transport Sources	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
		Residential, Commercial & Public Sector Combustion	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
		Industrial Processes	0.25	0.23	0.19	0.18	0.34	0.29	0.36	0.16	0.45	0.15
		Waste	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
		Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.63	0.52	0.44	0.44	0.55	0.49	0.58	0.37	0.67	0.35
	Northern Ireland	Energy Industries	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Industrial Combustion	0.09	0.14	0.17	0.16	0.13	0.12	0.10	0.09	0.08	0.08
		Transport Sources	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Residential, Commercial & Public Sector Combustion	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04
		Industrial Processes	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
		Waste	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
		Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total	0.24	0.22	0.23	0.22	0.21	0.20	0.17	0.16	0.15	0.16

Appendix G Definition of NFR Codes and Sector categories

Table 31 below provides a lookup table between the NFR codes and descriptions used to provide a high degree of detail in the inventory, and the categories used in the graphs within this report.

The Sector Category "Other" is applied to 1A5b and 6A across all pollutants, as shown in the table below. Additional Sector Categories are also included under "Other" for each pollutant. If a Sector Category is insignificant for a pollutant, then it is included within the "Other" category in the tables and graphs of the report. See **Table 32** below for further information.

Table 31 - Definition of NFR Codes and Sector Categories

NFR Code	NFR Source Description	Sector Category	Sub-sector Category
1A1a	Public electricity and heat production	Energy Industries	Power generation
1A1b	Petroleum refining	Energy Industries	Refineries
1A1c	Manufacture of solid fuels and other energy industries	Energy Industries	Solid fuel manufacturing/coke ovens
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Industrial Combustion	Iron and steel
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Industrial Combustion	Other industries
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Industrial Combustion	Other industries
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Industrial Combustion	Other industries
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Industrial Combustion	Food and drink
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Industrial Combustion	Cement industries/ Other industries for SO_2 only
1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	Industrial Combustion	Off-road mobile machinery
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	Industrial Combustion	Other stationary combustion
1A3ai(i)	International aviation LTO (civil)	Transport Sources	Rail, aviation and shipping
1A3aii(i)	Domestic aviation LTO (civil)	Transport Sources	Rail, aviation, and shipping
1A3bi	Road transport: Passenger cars	Transport Sources	Passenger cars
1A3bii	Road transport: Light duty vehicles	Transport Sources	Other road transport
1A3biii	Road transport: Heavy duty vehicles and buses	Transport Sources	Other road transport
1A3biv	Road transport: Mopeds & motorcycles	Transport Sources	Other road transport
1A3bv	Road transport: Gasoline evaporation	Transport Sources	Other road transport
1A3bvi	Road transport: Automobile tyre and brake wear	Transport Sources	Other road transport / Tyre and brake wear for Pb only
1A3bvii	Road transport: Automobile road abrasion	Transport Sources	Other road transport
1A3c	Railways	Transport Sources	Rail, aviation, and shipping

1A3dii	National navigation (shipping)	Transport Sources	Rail, aviation, and shipping
1A3eii	Other (please specify in the IIR)	Transport Sources	Rail, aviation, and shipping
1A4ai	Commercial/institutional: Stationary	Residential, Commercial & Public Sector Combustion	Commercial & public sector
1A4aii	Commercial/institutional: Mobile	Industrial Combustion	Other industries
1A4bi	Residential: Stationary	Residential, Commercial & Public Sector Combustion	Residential
1A4bii	Residential: Household and gardening (mobile)	Residential, Commercial & Public Sector Combustion	Residential
1A4ci	Agriculture/Forestry/Fishing: Stationary	Residential, Commercial & Public Sector Combustion	Outdoor industries
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Residential, Commercial & Public Sector Combustion	Outdoor industries
1A4ciii	Agriculture/Forestry/Fishing: National fishing	Residential, Commercial & Public Sector Combustion	Outdoor industries
1A5b	Other, Mobile (including military, land based and recreational boats)	Other	Other
1B1a	Fugitive emission from solid fuels: Coal mining and handling	Fugitive	Fugitive
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Fugitive	Fugitive
1B2ai	Fugitive emissions oil: Exploration, production, transport	Fugitive	Fugitive
1B2aiv	Fugitive emissions oil: Refining / storage	Fugitive	Fugitive
1B2av	Distribution of oil products	Fugitive	Fugitive
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	Fugitive	Fugitive
1B2c	Venting and flaring (oil, gas, combined oil and gas)	Fugitive	Fugitive
2A1	Cement production	Industrial Processes	Cement production
2A3	Glass production	Industrial Processes	Other industries
2A5a	Quarrying and mining of minerals other than coal	Industrial Processes	Non-coal quarrying and mining
2A5b	Construction and demolition	Industrial Processes	Construction and demolition
2A6	Other mineral products (please specify in the IIR)	Industrial Processes	Other industries
2B10a	Chemical industry: Other (please specify in the IIR)	Industrial Processes	Other industries
2B10b	Storage, handling, and transport of chemical products (please specify in the IIR)	Industrial Processes	Other industries
2B2	Nitric acid production	Industrial Processes	Other industries
2B3	Adipic acid production	Industrial Processes	Other industries
2B6	Titanium dioxide production	Industrial Processes	Other industries
2B7	Soda ash production	Industrial Processes	Other industries

2C1	Iron and steel production	Industrial Processes	Iron and steel
2C3	Aluminium production	Industrial Processes	Other industries
2C4	Magnesium production	Industrial Processes	Other industries
2C5	Lead production	Industrial Processes	Other industries
2C6	Zinc production	Industrial Processes	Other industries
2C7a	Copper production	Industrial Processes	Other industries
2C7b	Nickel production	Industrial Processes	Other industries
2C7c	Other metal production (please specify in the IIR)	Industrial Processes	Other industries
2D3a	Domestic solvent use including fungicides	Solvent Processes	Domestic
2D3b	Road paving with asphalt	Solvent Processes	Industrial
2D3d	Coating applications	Solvent Processes	Industrial
2D3e	Degreasing	Solvent Processes	Industrial
2D3f	Dry cleaning	Solvent Processes	Industrial
2D3g	Chemical products	Solvent Processes	Industrial
2D3h	Printing	Solvent Processes	Industrial
2D3i	Other solvent use (please specify in the IIR)	Solvent Processes	Other solvent uses
2G	Other product use (specified in the IIR)	Industrial Processes	Other industries
2H1	Pulp and paper industry	Industrial Processes	Other industries
2H2	Food and beverages industry	Industrial Processes	Food and drink
2H3	Other industrial processes (please specify in the IIR)	Industrial Processes	Other industries
2I	Wood processing	Industrial Processes	Other industries
2K	Consumption of POPs and heavy metals	Industrial Processes	Other industries
3B1a	Manure management - Dairy cattle	Agriculture	Cattle manure management
3B1b	Manure management - Non-dairy cattle	Agriculture	Cattle manure management
3B2	Manure management - Sheep	Agriculture	Other manure management
3B3	Manure management - Swine	Agriculture	Other manure management
3B4d	Manure management - Goats	Agriculture	Other manure management
3B4e	Manure management - Horses	Agriculture	Other manure management
3B4gi	Manure management - Laying hens	Agriculture	Other manure management
3B4gii	Manure management - Broilers	Agriculture	Other manure management
3B4giii	Manure management - Turkeys	Agriculture	Other manure management
3B4giv	Manure management - Other poultry	Agriculture	Other manure management
3B4h	Manure management - Other animals (please specify in IIR)	Agriculture	Other manure management
3Da1	Inorganic N-fertilizers (includes also urea application)	Agriculture	In-organic fertilizers
3Da2a	Animal manure applied to soils	Agriculture	Manure applied to soils
3Da2b	Sewage sludge applied to soils	Agriculture	Manure applied to soils

3Da2c	Other organic fertilizers applied to soils (including compost)	Agriculture	Manure applied to soils
3Da3	Urine and dung deposited by grazing animals	Agriculture	Grazing animal excreta
3Da4	Crop residues applied to soils	Agriculture	Other agricultural practices
3Dc	Farm-level agricultural operations including storage, handling, and transport of agricultural products	Agriculture	Other agricultural practices
3De	Cultivated crops	Agriculture	Other agricultural practices
3F	Field burning of agricultural residues	Agriculture	Other agricultural practices
5A	Biological treatment of waste - Solid waste disposal on land	Waste	Waste
5B1	Biological treatment of waste - Composting	Waste	Waste
5B2	Anaerobic Digestion	Waste	Other waste practices
5C1a	Municipal waste incineration	Waste	Waste
5C1bii	Hazardous waste incineration	Waste	Waste
5C1biii	Clinical waste incineration	Waste	Waste
5C1biv	Sewage sludge incineration	Waste	Waste
5C1bv	Cremation	Waste	Waste[60]
5C2	Open burning of waste	Waste	Waste
5D1	Domestic wastewater handling	Waste	Waste
5D2	Industrial wastewater handling	Waste	Waste
5E	Anaerobic Digestion - emissions from land spreading of non-manure digestates	Waste	Other waste practices
6A	Other (included in national total for entire territory) (please specify in IIR)	Other	Other

[60] For Hg, cremation is separated from the “Waste” category to aid visualisation of the distribution of waste emissions

Table 32 - Summary of the sector categories included in "Other" for each pollutant

Sector Category	NH_3	CO	NO_x	VOC	PM_{10}	$PM_{2.5}$	SO_2	Pb	B[a]P	Dioxins	Hg
Agriculture											
Energy Industries	✓										
Fugitive	✓									✓	✓
Industrial Combustion	✓										
Residential, Commercial & Public Sector Combustion	✓										
Industrial Processes			✓								
Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Solvent Processes	✓				✓	✓			✓	✓	
Waste		✓	✓	✓			✓	✓			