National Atmospheric Emissions Inventory

Air Quality Pollutant Inventories for England, Scotland, Wales, and Northern Ireland: 1990-2015

Prepared by Ricardo Energy & Environment for Department for Business, Energy and Industrial Strategy; Department for Environment, Food and Rural Affairs; The Scottish Government; Welsh Government; Department of Agriculture, Environment and Rural Affairs for Northern Ireland

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ED62689 | Issue 1.0 | Date 31st August 2017

Customer:

Department for Business, Energy and Industrial Strategy; Department for Environment, Food and Rural Affairs; The Scottish Government; Welsh Government; Department of Agriculture, Environment and Rural Affairs for Northern Ireland.

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22nd September 2017

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Glossary

AQ	Air quality
AQPI	Air quality pollutant inventory
AQS for ESWNI	Air Quality Strategy for England, Scotland, Wales and Northern Ireland
NH_3	Ammonia
BAT	Best Available Techniques
BEIS	Department for Business, Energy & Industrial Strategy
BOFA	Boosted Over Fire Air
CO	Carbon monoxide
CCGT	Combined Cycle Gas Turbine
Defra	Department for Environment, Food & Rural Affairs
DECC	Department of Energy and Climate Change
DA	Devolved Administration
DERV	Diesel engine road vehicle
DUKES	Digest of UK Energy Statistics
DVLA	Driver and Vehicle Licensing Agency
EEA	European Environment Agency
EEMS	Environmental and Emissions Monitoring System
EMEP	European Monitoring and Evaluation Programme
EPR	Environmental Permitting Regulations
EU ETS	EU Emissions Trading System
EC	European Commission
EEA	European Environment Agency
EU	European Union
EPAQS	Expert Panel on Air Quality Standards
FGD	Flue-gas desulphurization
GHG	Greenhouse Gas
GDP	Gross Domestic Product
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
IED	Industrial Emissions Directive
IIR	Informative Inventory Report
IPPC	Integrated Pollution Prevention and Control
LCPD	Large Combustion Plant Directive
LDV	Light duty vehicles
Pb	Lead
LPG	Liquefied Petroleum Gas
LA	Local Authority
MSW	Municipal solid waste
NAQS	National Air Quality Strategy
NAEI	National Atmospheric Emissions Inventory

NECD	National Emissions Ceiling Direction
NO_X	Nitrogen oxides
NFR	Nomenclature for Reporting
NMVOC	Non-methane volatile organic compounds
PM_{10}	Particulate matter less than 10 micrometres
PCP	Pentachlorophenol
PI	Pollution Inventory
SED	Solvent Emissions Directive
SI	Statutory instrument
SO_2	Sulphur dioxide
UK	United Kingdom
UKPIA	United Kingdom Petroleum Industry Association
UNECE	United Nations Economic Commission for Europe
WID	Waste Incineration Directive
WHO	World Health Organization

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1 Introduction

This is the Air Quality Pollutant Inventory Report for England, Scotland, Wales and Northern Ireland. The report presents emission inventories for the Devolved Administrations of the UK for the period 1990 to 2015, for the following priority Air Quality (AQ) 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})
- 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 for Northern Ireland, by the UK emission inventory teams at Ricardo Energy & Environment, Aether and Rothamsted Research.

1.1 Background to Inventory Development

The development of Air Quality pollutant inventories (AQPI) for each of the Devolved Administrations (DAs) has been commissioned by Defra in order 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 (AQS for ESWNI). These objectives also contribute to the UK's targets in terms of meeting both national and international targets on both local and transboundary air pollution.

The provision of DA-level datasets and subsequent identification of key sources at more regional and local levels is a key step to enable prioritisation of local action and to highlight the potential impacts of specific policies and measures. The time series of AQ pollutant emissions provides an insight into the effects of environmental policies, and may help to 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 Quality Pollutants

This report includes information on the seven pollutants in the Devolved Administrations' air quality pollutant inventory. Below is a brief description of the main aspects of each pollutant. Further information can be found on the NAEI website: http://naei.defra.gov.uk/overview/ap-overview, which includes an overview of the health impacts of these pollutants.

Ammonia (NH_3) emissions play an important role in several different environmental issues including acidification, eutrophication and changes in biodiversity. The atmospheric chemistry of NH_3 and ammonium ions (NH_4^+) is such that transport of the pollutants can vary greatly, and that as a result, NH_3 emissions can exert impacts on a highly localised level, as well as contributing to the effects of long-range pollutant transport. Agriculture is an important source of NH_3 within the UK, with the vast majority of emissions arising from this sector. Non-agricultural sources of NH_3 comprise a number of diverse sources. Emission estimates for these sources are often highly uncertain due to a lack of activity and emission factor data.

Carbon monoxide (CO) arises primarily from incomplete fuel-combustion and industrial processes, and 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 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) arise primarily from combustion sources. The estimation of these emissions is complex since the nitrogen can be derived from either the fuel or atmospheric nitrogen. The emission is dependent on the conditions of combustion, in particular temperature and excess in air-fuel ratio (this is the extent by which oxygen in the air is in excess of the minimum amount required for complete combustion of the fuel), which can vary considerably. Thus combustion conditions, load and even state of maintenance are important. In regards to human health, studies suggest NO_X has an exacerbating effect on 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, 2015).

Non-Methane Volatile Organic Compounds (NMVOCs) are emitted from a large, diverse range of sources from across many industrial sectors, transport, agriculture and the domestic sector. They are emitted primarily as combustion by-products, as vapour arising from the transfer, storage and handling or use of petroleum distillates, or from the use of solvents or chemicals. The *Solvent and Other Product Use* sector comprises industrial and domestic solvent applications (such as cleaning, degreasing), as well as the manufacturing and processing of chemical products.

Particulate matter as PM_{10} is a measure of the size distribution of the particles emitted to air and represents the material with an aerodynamic diameter less than 10 micrometres. PM_{10} in the atmosphere arises from primary and secondary sources. Primary sources are direct emissions of particulate matter into the atmosphere and arise from a wide range of sources such as fuel combustion, surface erosion and wind-blown dusts 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's Report on particulate matter in the United Kingdom (AQEG, 2005) and on fine particulate matter ($PM_{2.5}$) in the United Kingdom (AQEG, 2012).

Sulphur dioxide (SO_2) emissions commonly arise from combustion, and can be calculated from the sulphur content of the fuel and from information on the amount of sulphur retained in the ash. Inventory estimates are produced using UK energy statistics, together with information on the sulphur content of liquid fuels (UKPIA, 2015) and data on sulphur content of coal from coal suppliers.

Lead (Pb) 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 as a result of the increased use of cars fitted with three-way catalysts. Leaded petrol was then phased out from general sale at the end of 1999. These changes have caused a significant decline in total Pb emissions across the UK between 1990 and 2000. The UK-wide emissions of Pb are now dominated by combustion sources (mainly of solid fuels, biomass and lubricants in industrial and domestic sectors), and from metal production processes at foundries and iron and steel works.

1.3 Data Sources and Inventory Methodology

The Devolved Administrations' inventories are compiled by disaggregating the UK emission totals presented within "UK Informative Inventory Report (1990 to 2015)" (Wakeling, et al., 2017) derived from the National Atmospheric Emissions Inventory (NAEI) database. The emission estimates for each pollutant are presented 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 (EEA, 2016).

The method for disaggregating UK emission totals across the Devolved Administrations (DAs) draws on a combination of point source data (e.g. Pollution Inventory[1] data for industrial emissions) and sub-national and local datasets such as:

- BEIS 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;
- Major road traffic count data;
- Domestic and international flight data for all major UK airports;
- Regional housing, employment, population and consumption 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 are excluded from the reported totals and accompanying dataset. In 2015, this 'unallocated' proportion of the UK inventory total was ~5% of the UK total for NOx and NMVOCs and zero or negligible for the other five pollutants. Further information on the data sources and inventory methodology can be found in Appendix B.

1.4 Uncertainties

The air quality pollutant inventories for England, Scotland, Wales and Northern Ireland are derived using a "top-down" approach whereby the UK inventory totals are disaggregated across the four countries. For most sources, there is insufficient regional data to enable a comprehensive "bottom-up" calculation to be made, and hence available proxy data are used to estimate the country-specific share of UK activity for each emission source.

The UK AQ inventory is subject to uncertainty assessments using both the Tier 1 uncertainty aggregation method and a Tier 2 method using a statistical Monte-Carlo technique. 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 both the Tier 1 methodology and the Monte-Carlo analysis are presented in Chapter 1.7 of the "UK Informative Inventory Report (1990 to 2015)" (Wakeling, et al., 2017). Table 1 below provides an indication of the relative magnitude in uncertainty estimates made for each pollutant at UK level. A 'low' rating implies a lower level of uncertainty in the emission estimates for the pollutant relative to the uncertainty in the estimates for a pollutant with a 'high' rating. Further information on the uncertainties for each pollutant can be found in Appendix D.

Uncertainties in the UK inventory are associated with the availability and quality of the activity data, emission factors and methodologies used in emissions calculations throughout the time series. As well as the uncertainties in the UK inventory, there is an additional uncertainty inherent in the methodologies of disaggregating the UK emissions across the four countries. The air quality pollutant inventories for England, Scotland, Wales and Northern Ireland are therefore subject to greater uncertainty than the equivalent UK estimates. The uncertainties in emission estimates may differ for each DA according to the relative mix of emissions from different sources with different levels of uncertainties. These have not been quantified, but the overall uncertainty ranking of each pollutant at DA level is not likely to be notably different to the ranking at UK level given in Table 1.

In general, the UK AQ inventory is regarded as an international leader in terms of quality and accuracy, e.g. through the application of higher Tier (more comprehensive) methodologies, particularly for key sources, and a continuous improvement process.

[1] 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 EPR/IED-regulated processes under their authority.

Table 1 – Indicative uncertainty rating for each pollutant present in the UK AQPI

(low refers to the uncertainty of a particular pollutant being relatively low when comparing to the other pollutants and vice versa)

Pollutant	Indicative Uncertainty Rating
Ammonia	Moderate
Carbon monoxide	Moderate
Nitrogen oxides	Low
Non-methane volatile organic compounds	Low
Particulate matter (<10um)	High
Sulphur dioxide	Low
Lead	High

2 Devolved Administrations' Air Quality Pollutant Estimates

The following sections outline the findings of the inventory for each Devolved Administration, providing information on the trends and emission estimates for each of the seven air quality pollutants.

These sections include the following:

Figures graphically presenting the inventory data, showing the annual trend from 1990 to 2015 for each pollutant. These graphs are also disaggregated by sector, and further information on these sectors can be found in Appendix F.

Summary information on trends is provided for each pollutant, highlighting the key reasons for the observed trend since 1990 and other notable aspects of the trend. This information is not guided by detailed statistical analysis, but through association of underlying trends in activity data with the visible emissions trends.

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 1990 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 patterns associated with that pollutant. For example, NO_X emissions are concentrated around the road networks of the countries.

Sector 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.

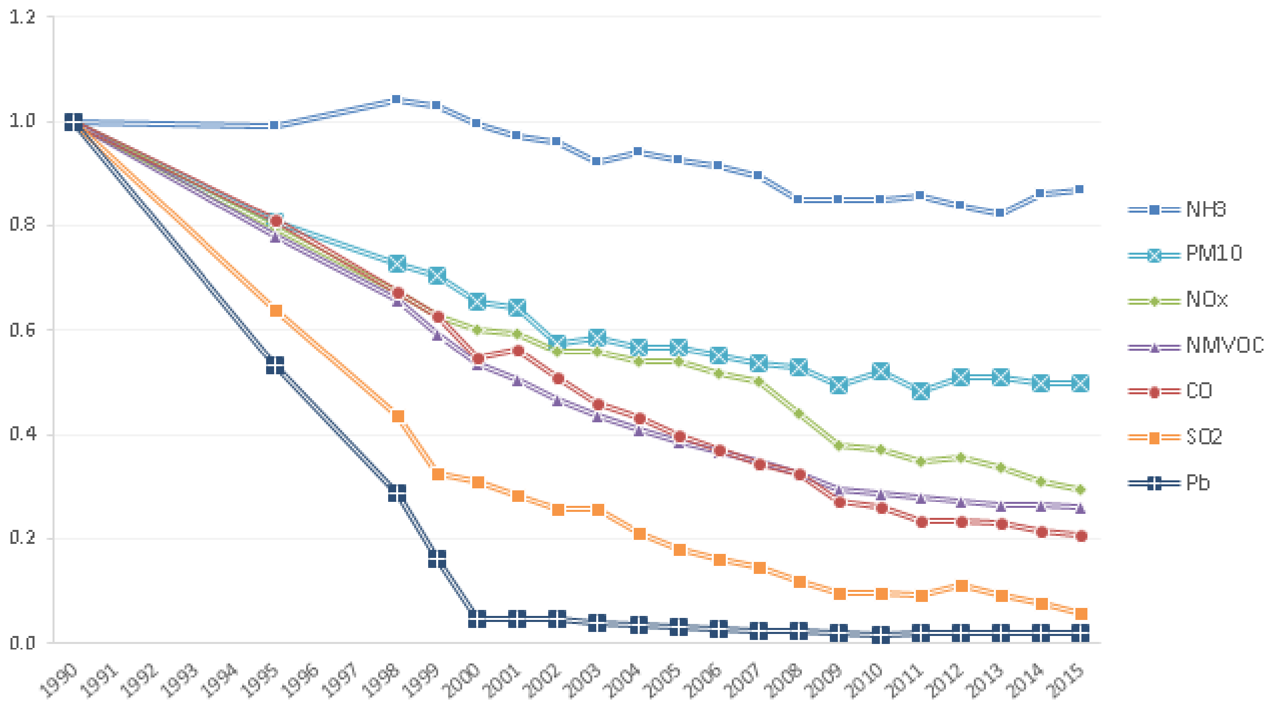
2.1 England

The following section provides a summary of emissions in England for the seven air quality pollutants: ammonia (NH_3), carbon monoxide (CO), nitrogen oxides (NO_X as NO_2), non-methane volatile organic compounds (NMVOCs), particulate matter smaller than 10 micrometres (PM_{10}), sulphur dioxide (SO_2) and lead (Pb).

Figure 1 shows emissions of all seven air quality pollutants normalised to provide the relative rate of decline since 1990. This graph shows that all pollutant emission levels are lower in 2015 than they were in 1990. The rate at which they have declined is similar for PM_{10}, NO_X, NMVOC and CO. However, Pb shows a much higher rate of reduction from 1990 to 2000 which is coincident with the phase-out of leaded petrol.

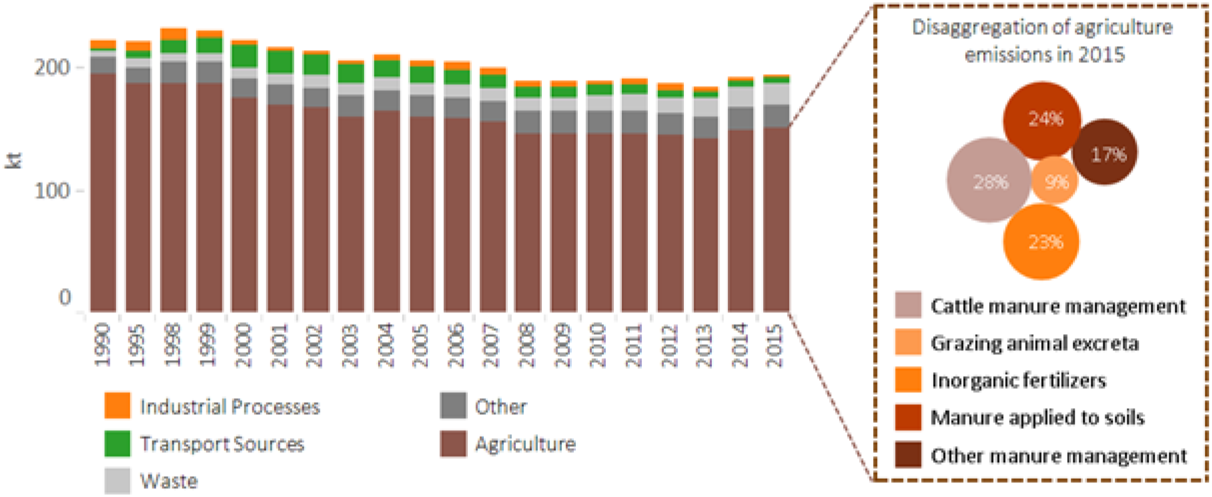
By contrast, NH_3 emissions have declined at a slower rate than other pollutants, and have even slightly risen in recent years due to increases in emissions from fertiliser application, livestock manure management and application to soils, and composting. SO_2 emissions declined rapidly between 1990 and 1999 due to reductions in the sulphur content of fuels and a shift in electricity production to use more natural gas and less coal and fuel oil. Emissions of NO_X have declined notably since 2007 primarily due to reductions in road transport emissions and the power generation sector.

Figure 1 – England normalised trends for all pollutants



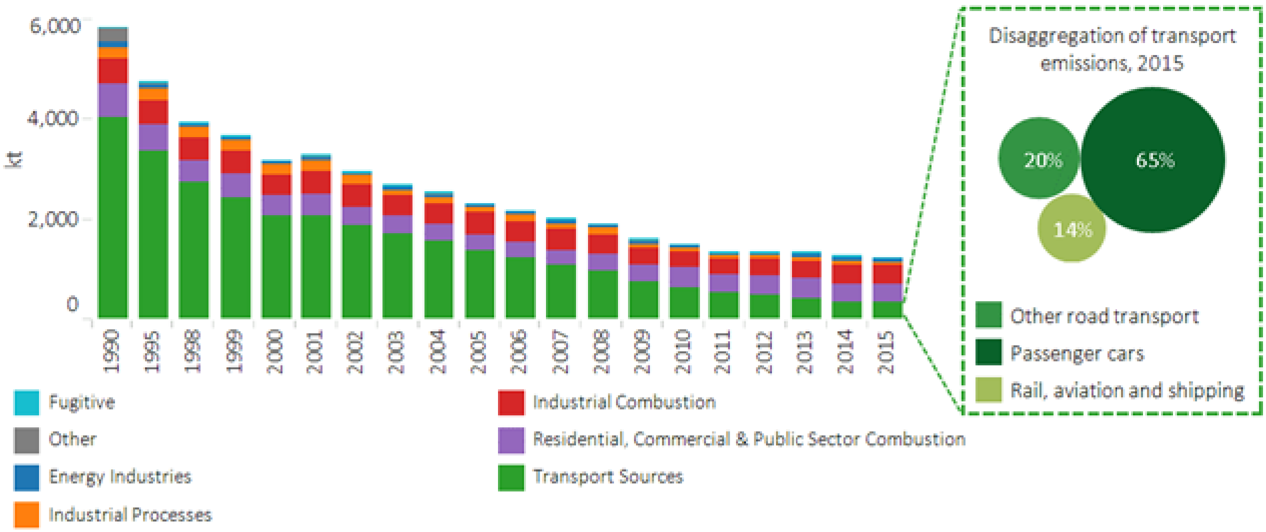
The following sections provide an overview of emissions from each of the seven pollutants giving explanations for the trends and characteristics of the graphs. Data summary tables for these emission estimates can be found in Appendix E. Mapping of the categories used in the graphs can be found in Appendix F.

Figure 2 – Ammonia Emissions in England



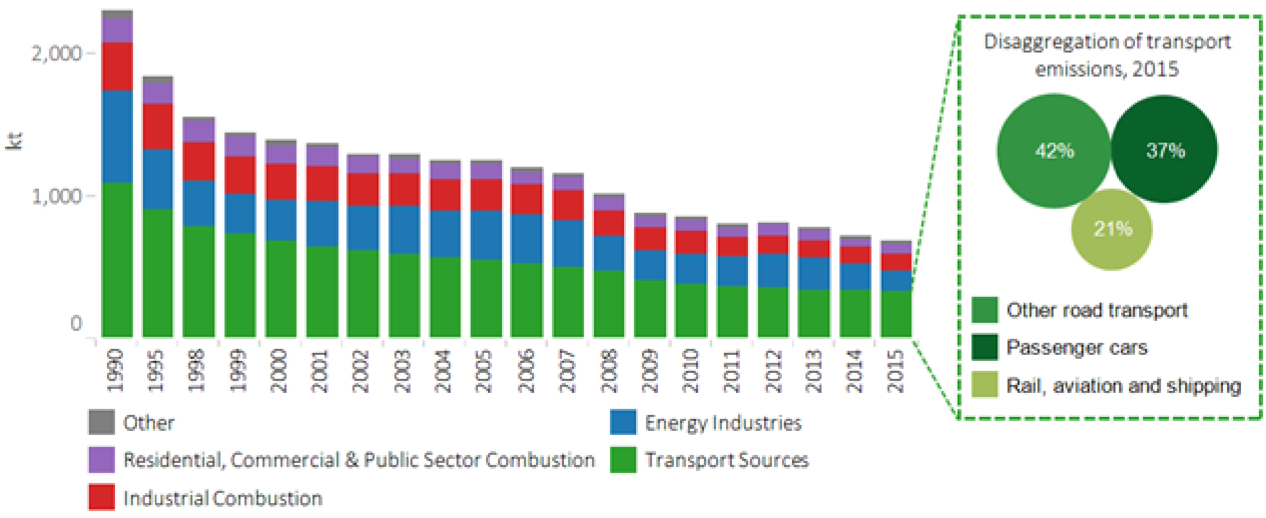
Emissions of **ammonia** were estimated to be 195kt in 2015 and have declined by 13% since 1990. Emissions in England account for 67% of the UK total in 2015. Agricultural sources make up by far the largest component in the inventory throughout the time series, with cattle manure management accounting for 28% of the emissions from this sector. The trend in NH_3 emissions has been largely driven by decreasing cattle numbers and a decline in fertiliser use, which have tended to decrease emissions across the time series. However, an increased usage of urea-based fertilisers, which are associated with higher NH_3 emission factors, has had the opposite effect in recent years. The result is a plateauing of emissions since 2008, with an observed increase between 2013 and 2015.

Figure 3 – Carbon Monoxide Emissions in England



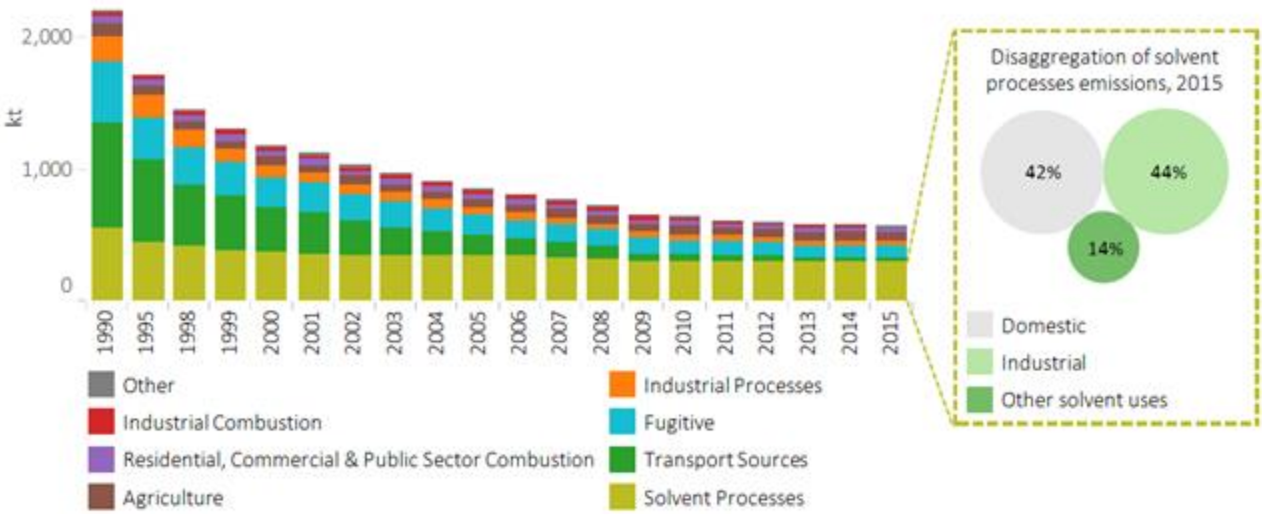
Emissions of **carbon monoxide** were estimated to be 1,222kt in 2015 and have declined by 79% since 1990. Emissions in England account for 74% of the UK total in 2015. This decline in emissions stems from changes in the transport sector, particularly in road transport. The decline is driven by the introduction of Euro standards after 1992 which requires fitting of emission control (e.g. three-ways catalyst) in new petrol vehicles and in more recent years the switch from petrol cars to diesel cars. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. In recent years, emissions from the residential and other combustion sector have increased, which corresponds with an increasing use of wood fuel, predominantly in the domestic sector (Waters, 2015).

Figure 4 – Nitrogen Oxides Emissions in England



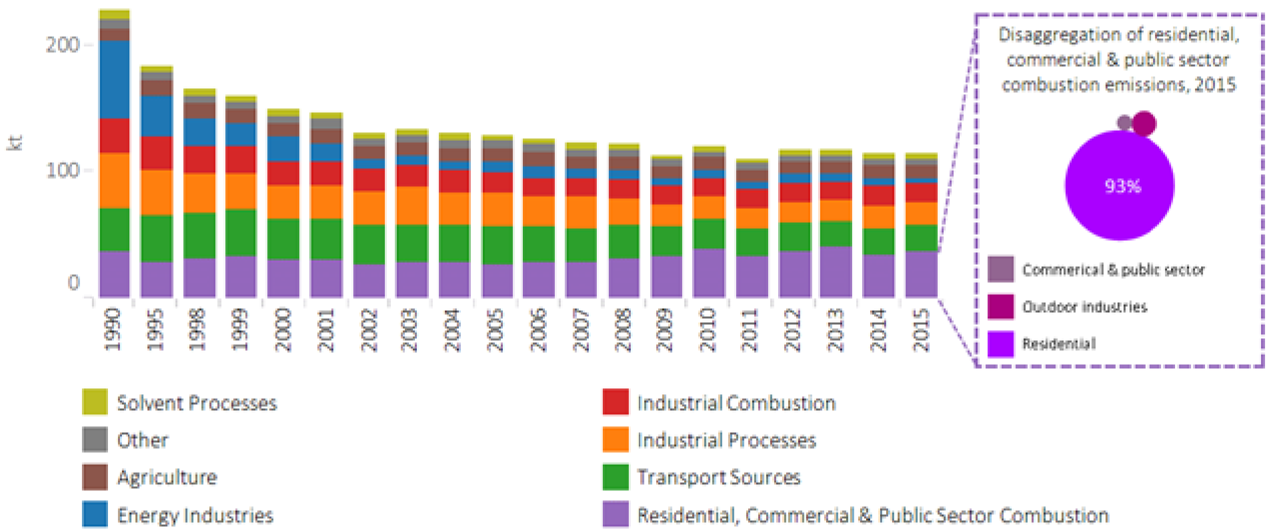
Emissions of **nitrogen oxides** were estimated to be 676kt in 2015, representing 74% of the UK total in 2015. Emissions have declined by 71% since 1990, mainly due to changes in the transport sector, particularly in road transport. This decline is driven by the successive introduction of tighter emission standards for petrol cars and all types of new diesel vehicles over the last decade. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates after the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. However, the increasing number of diesel cars partly offset these emissions reductions, because diesel cars emit higher NO_x relative to their petrol counterparts (84% of 2015 passenger car emissions is due to diesel cars). Emission reductions across the time series from the Energy sector are primarily due to shifts in the electricity generation fuel mix in the early 1990s from coal to natural gas (DECC, 2015) along with the installation of NO_X abatement at coal-fired power stations. Since 2008, the installation of Boosted Over Fire Air (BOFA) systems across coal power stations to reduce NO_X formation has led to a further decline in emissions.

Figure 5 – NMVOC Emissions in England



Emissions of **non-methane volatile organic compounds** were estimated to be 574kt in 2015, representing 69% of the UK total. Emissions have declined by 74% since 1990. Emissions from the chemical industry reduced during the 1990s, but across the time series the trend is dominated by reductions in emissions from road transport sources, including evaporative losses of fuel vapour from petrol vehicles. The decline is driven by emission control technologies introduced in new petrol vehicles since the early 1990s and in more recent years the switch from petrol cars to diesel cars. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. With this large reduction in transport emissions, solvent processes are now the most important source of NMVOC emissions, with emissions in 2015 arising from both domestic and industrial solvent applications.

Figure 6 – PM_{10} Emissions in England[2]

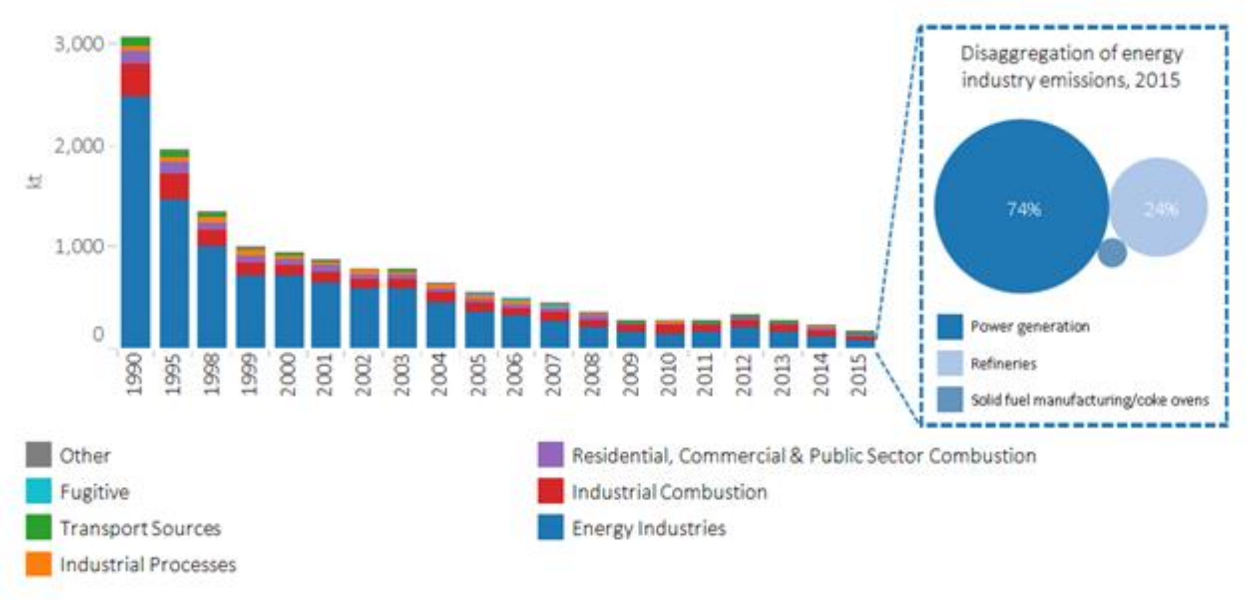


Emissions of **PM_{10}** were estimated to be 113kt in 2015 and have declined by 50% since 1990. They account for 78% of the UK total in 2015. Unlike most other pollutants, PM_{10} emissions have a large number of significant sources. Transport, residential combustion, industrial combustion and industrial processes each accounted for over 10% of total emissions in 2015. Emissions from energy industries

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

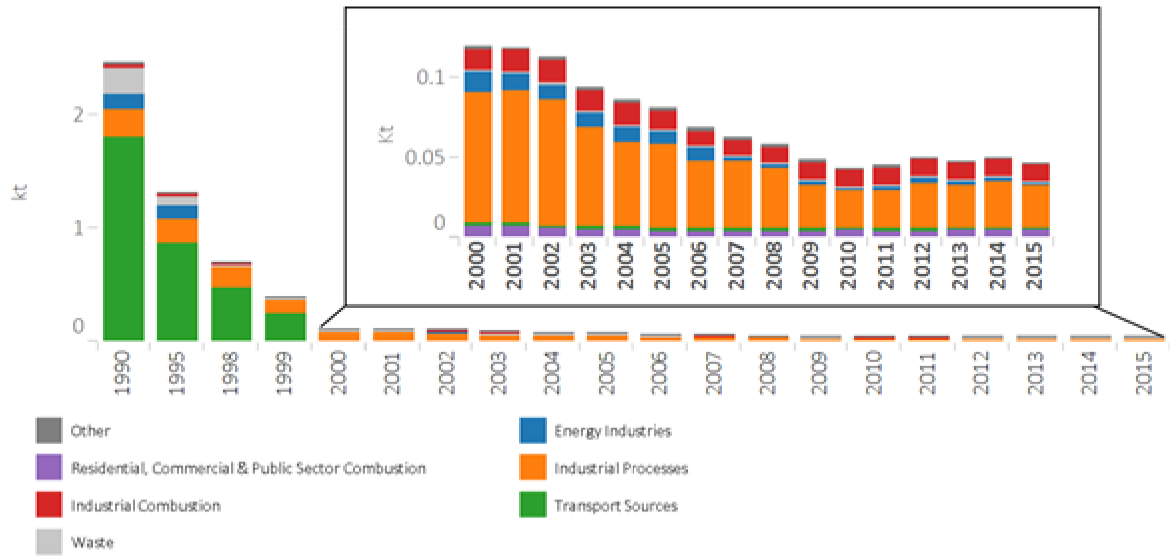
have had the most notable impact on the trend. The reduction in these emissions is primarily due to the reduction in coal-fired energy generation in place of natural gas, which has negligible PM_{10} emissions (DECC, 2015). PM_{10} exhaust emissions from diesel fuelled vehicles have been decreasing due to the successive introduction of tighter emission standards over time. Since 2007, emissions from the residential and other combustion sector have increased, which is coincident with an increasing use of wood fuel, predominantly in the domestic sector (Waters, 2015).

Figure 7 – Sulphur Dioxide Emissions in England



Emissions of **sulphur dioxide** were estimated to be 174kt in 2015, representing 74% of the UK total for that year. Emissions have declined by 94% since 1990, which has been dominated by the reduction in energy industries emissions, coincident with large changes in the power generation sector. These include the reduction in coal fired power generation since 1990; improved emission controls on large coal fired plant; co-firing of biomass in coal fired power stations; the introduction of CCGT (Combined Cycle Gas Turbine) plant, which are more efficient than conventional coal and oil stations and have negligible SO_2 emissions; and, since 2007, the rapid expansion of wind power which has no direct emissions (DECC, 2015). The increase in emissions in 2012 was due to an increase in the use of coal in power generation relative to previous years (DECC, 2015). Transport emissions have declined, coincident with the reduced sulphur content of road fuels, both petrol and diesel. Emissions from the industrial combustion sector, declined substantially during the 1990s, mainly due to a reduction in coal and fuel oil use in the chemicals sector and unclassified industry.

Figure 8 – Lead Emissions in England



Emissions of **lead** were estimated to be 47 tonnes in 2015, representing 72% of the UK total in 2015. Emissions have declined by 98% since 1990 almost entirely due to changes in the transport sector. Petrol with lead additives was phased out from general sale by the end of 1999, which is the reason underlying a 99.9% decrease in transport emissions between 1990 and 2000. Also during the 1990s, emissions from the waste sector declined as older waste incinerators were phased out. Since 2000, the predominant sources of emissions are linked to industry (industrial processes and industrial combustion) with the dominant subsector being the production of iron and steel.

Table 2 below provides a summary of the percentage contribution of each sector for each pollutant in 2015. The table is shaded according to the overall contribution of that sector to the pollutant total. The table below indicates that the Residential, Commercial & Public Sector Combustion category is the most important when considering emissions for CO and PM_{10}, accounting for over 30% 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 2015

Sector	NH_3	CO	NO_X	NMVOC	PM_{10}	SO_2	Pb
Agriculture	77.6%	0.0%	0.0%	10.7%	8.8%	0.0%	0.0%
Energy Industries	0.0%	4.5%	22.4%	0.0%	4.1%	52.2%	5.7%
Fugitive	0.0%	0.3%	0.0%	13.5%	0.0%	2.2%	0.0%
Industrial Combustion	0.0%	30.0%	17.4%	2.8%	13.1%	21.0%	21.8%
Industrial Processes	1.2%	5.1%	0.0%	7.1%	15.9%	3.9%	56.7%
Residential, Commercial & Public Sector Combustion	0.0%	32.0%	9.5%	6.9%	32.8%	18.2%	9.2%
Solvent Processes	0.0%	0.0%	0.0%	52.3%	3.6%	0.0%	0.0%
Transport Sources	2.2%	26.3%	48.3%	5.4%	17.5%	1.8%	3.7%
Waste	9.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Other sources	9.7%	1.8%	2.4%	1.4%	4.2%	0.9%	2.8%

* The sector: "other sources" will include all "other" categories in the inventory and also a number of categories that are insignificant for a specific pollutant. A breakdown of what is included within this category in respect to each pollutant can be found in Table 19.

Emission maps for all seven pollutants are shown below.

Figure 9 – NH_3 Emissions in England, 2015

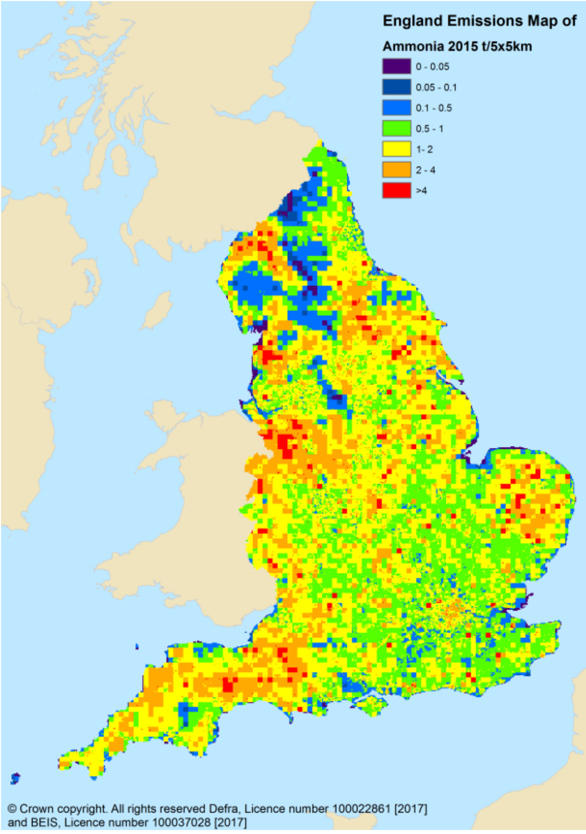


Figure 10 – CO Emissions in England, 2015

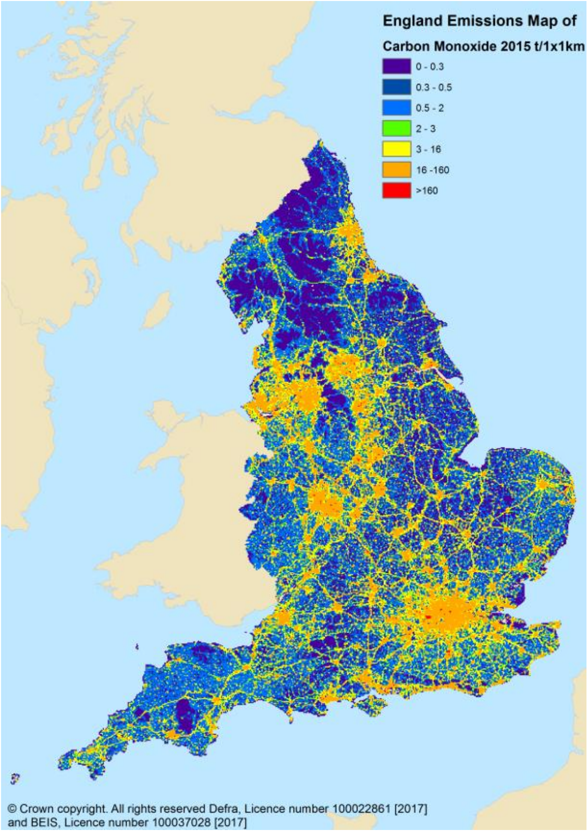


Figure 11 – NO_x Emissions in England, 2015

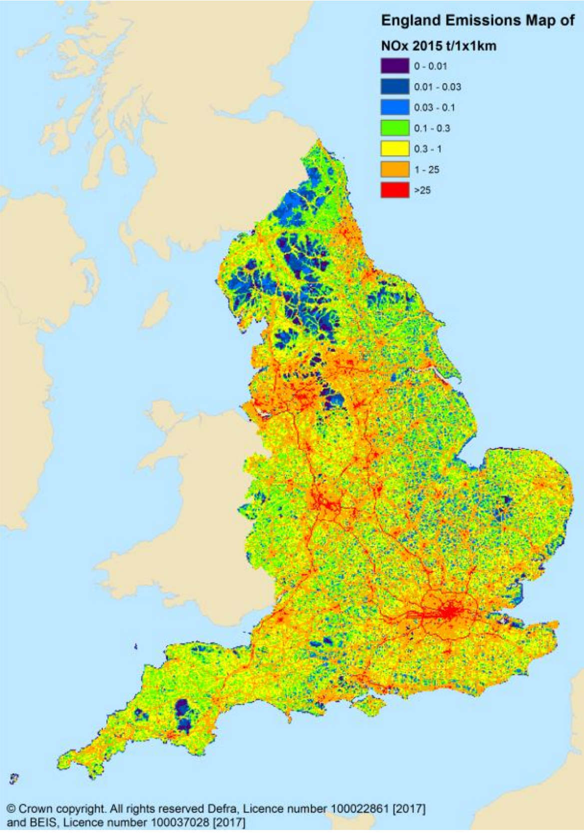


Figure 12 – NMVOC Emissions in England, 2015

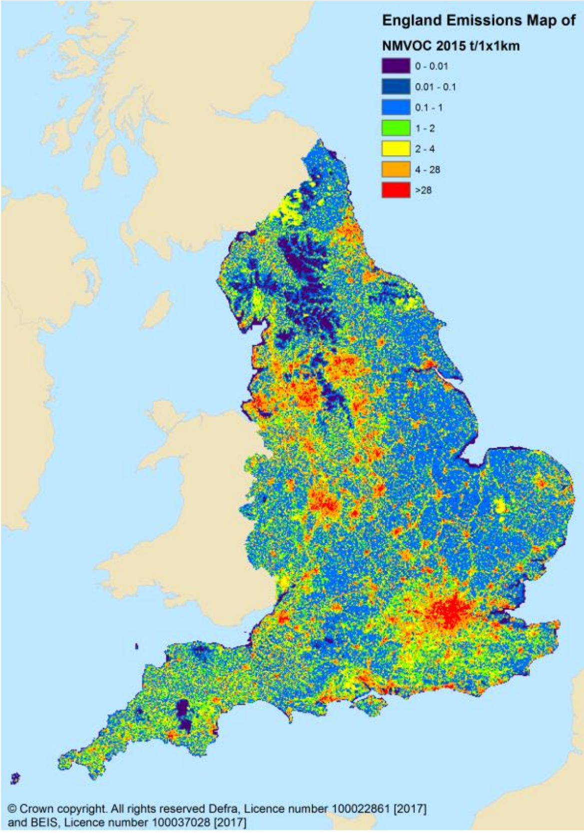


Figure 13 – PM_{10} Emissions in England, 2015

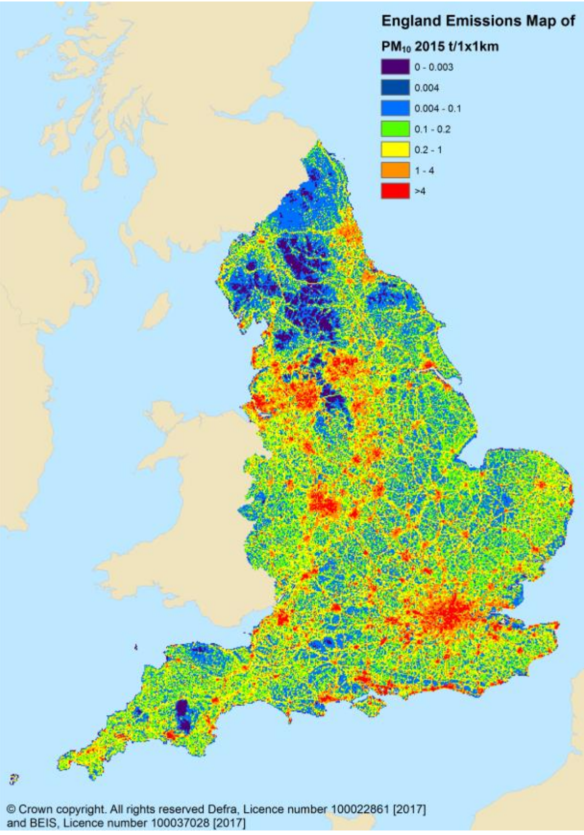


Figure 14 – Sulphur Dioxide Emissions in England, 2015

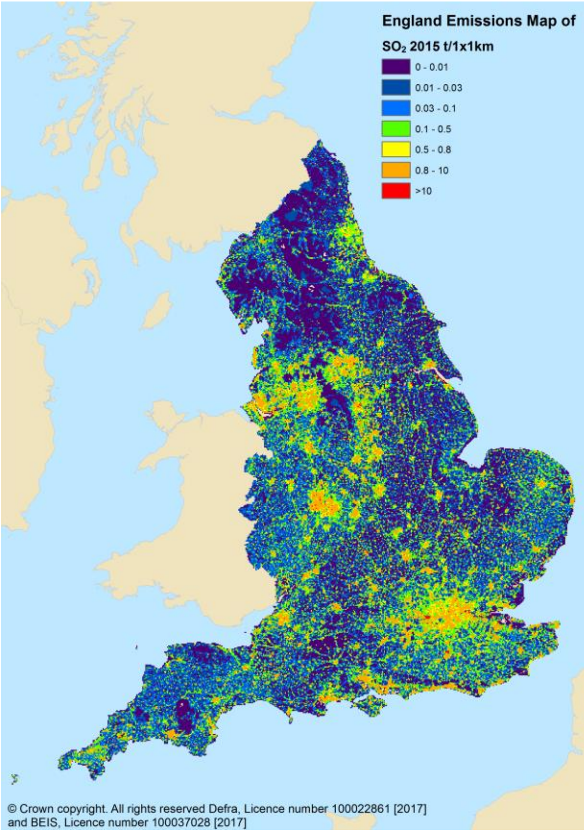
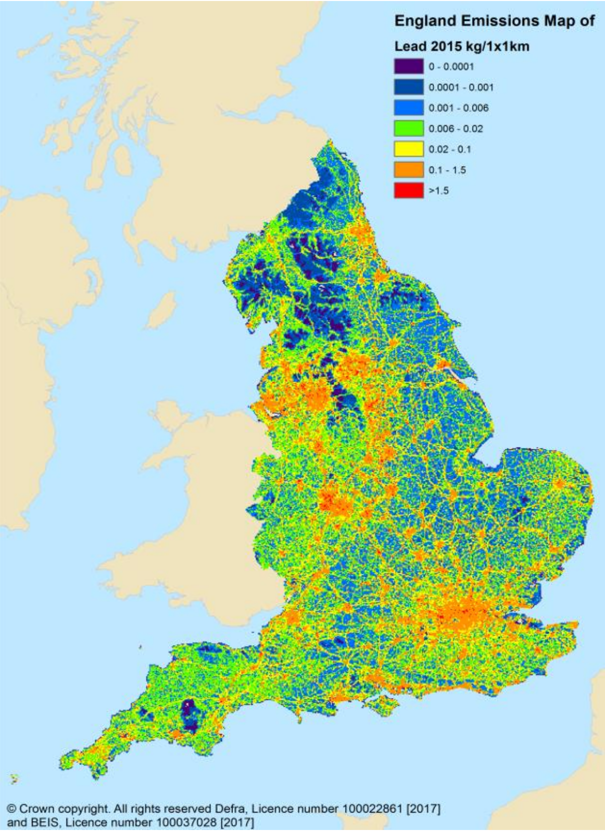


Figure 15 – Pb Emissions in England, 2015



2.2 Scotland

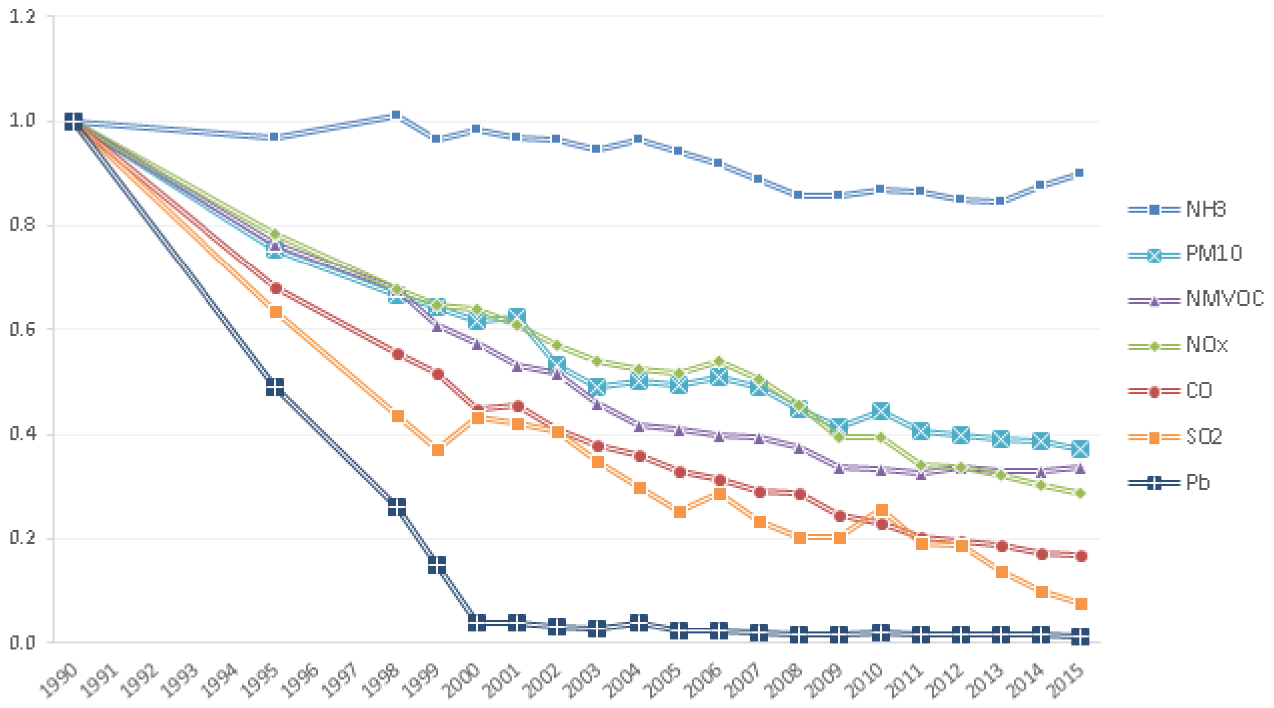
The following section provides a summary of emissions in Scotland for the seven air quality pollutants: ammonia (NH_3), carbon monoxide (CO), nitrogen oxides (NO_X as NO_2), non-methane volatile organic compounds (NMVOCs), particulate matter less than 10 micrometres (PM_{10}), sulphur dioxide (SO_2) and lead (Pb).

Figure 16 shows emissions of all seven air quality pollutants normalised to provide the relative rate of decline since 1990. This graph shows that all pollutant emission levels are lower in 2015 than they were in 1990. The decline is relatively similar for PM_{10}, NO_X, NMVOC, SO_2 and CO.

However, Pb shows a much higher rate of reduction from 1990 to 2000 which is coincident with the phase-out of leaded petrol by the end of 1999. NH_3 emissions, by contrast, have declined at a slower rate than other pollutants. The peaks in SO_2 emissions for 2006 and 2010 were due to an increase in energy emissions, linked to changes in the consumption of coal in power stations.

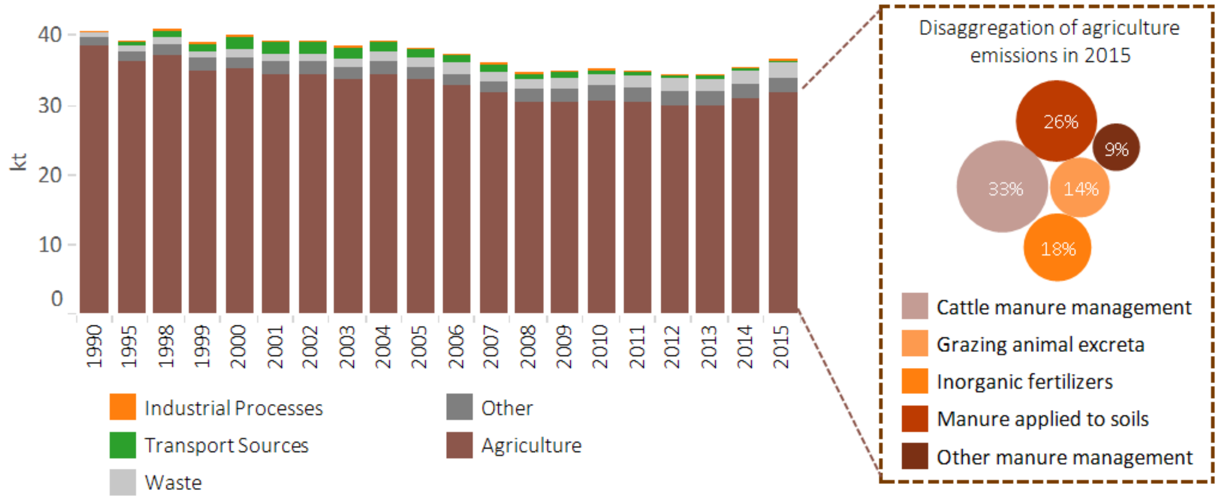
Emissions of NO_X have declined notably since 2007 primarily due to reductions in road transport emissions and the power generation sector. These are most likely linked to the installation of de-NO_X abatement systems (Boosted Over-Fire Air) on all four units at Longannet coal-fired power station (Scottish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

Figure 16 – Scotland normalised trends for all pollutants



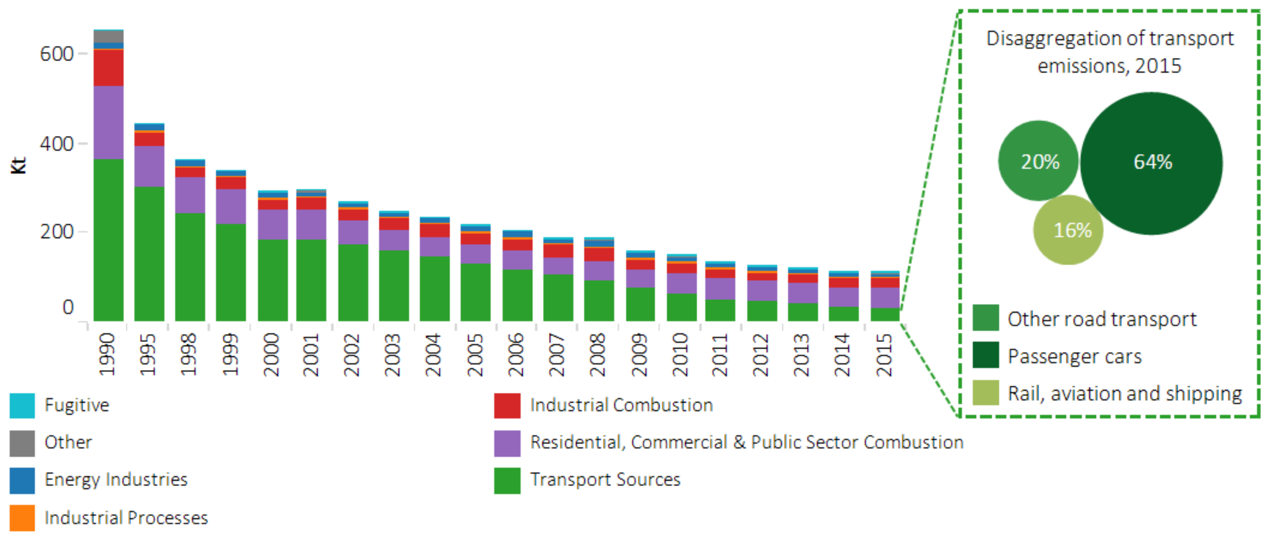
The following sections provide an overview of emissions of each of the seven pollutants giving explanations for the trends and characteristics of the graphs. Data summary tables for these emission estimates can be found in Appendix E. Mapping of the categories used in the graphs can be found in Appendix F.

Figure 17 – Ammonia Emissions in Scotland



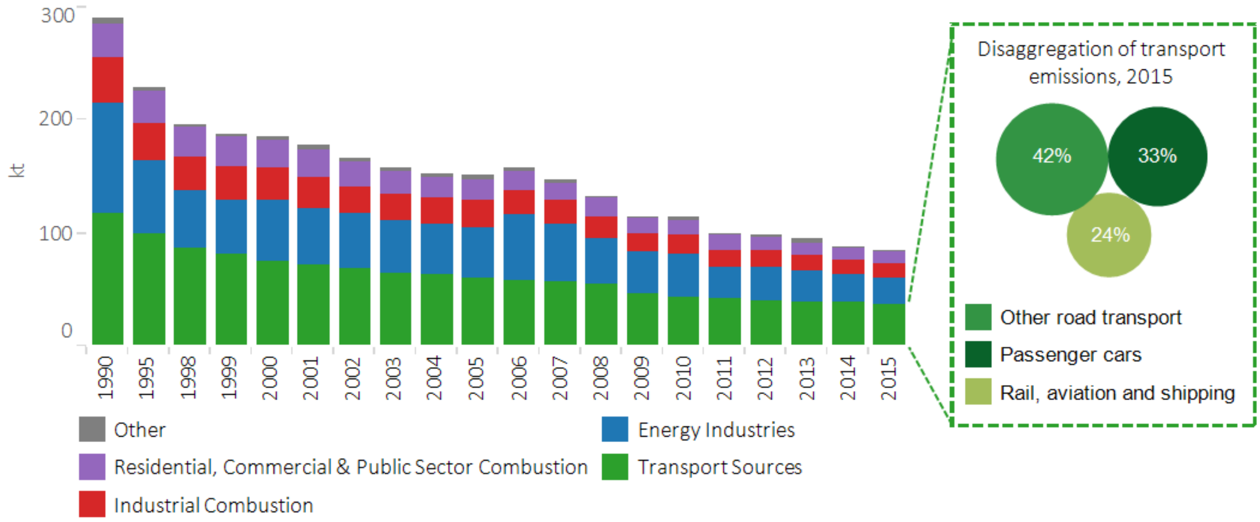
Emissions of **ammonia** were estimated to be 37kt in 2015. These emissions have declined by 10% since 1990 and accounted for 12% of the UK total in 2015. Agricultural sources have dominated the inventory throughout the time series, with cattle manure management accounting for 33% of the emissions from this sector. The trend in NH_3 emissions has been largely driven by decreasing animal numbers and a decline in fertiliser use, which have tended to decrease emissions across the time series. However, an increased usage of urea-based fertilisers, which are associated with higher NH_3 emission factors, has had the opposite effect in recent years. The result is a plateauing of emissions since 2008, with an observed increase between 2013 and 2015. Over the time-series, there has been a long-term increase in emissions from the waste sector. In the early part of the time-series this is due to an increase in the waste composted. More recently, however, this has been driven by increased anaerobic digestion activity, in particular, from the spreading of non-manure digestates on agricultural land. Transport emissions are dominated by emissions from passenger cars. Initial increases in the 1990s are linked to the introduction of three-ways catalysts, although subsequent technological advancements mean that emissions have been declining since 2000..

Figure 18 – Carbon Monoxide Emissions in Scotland



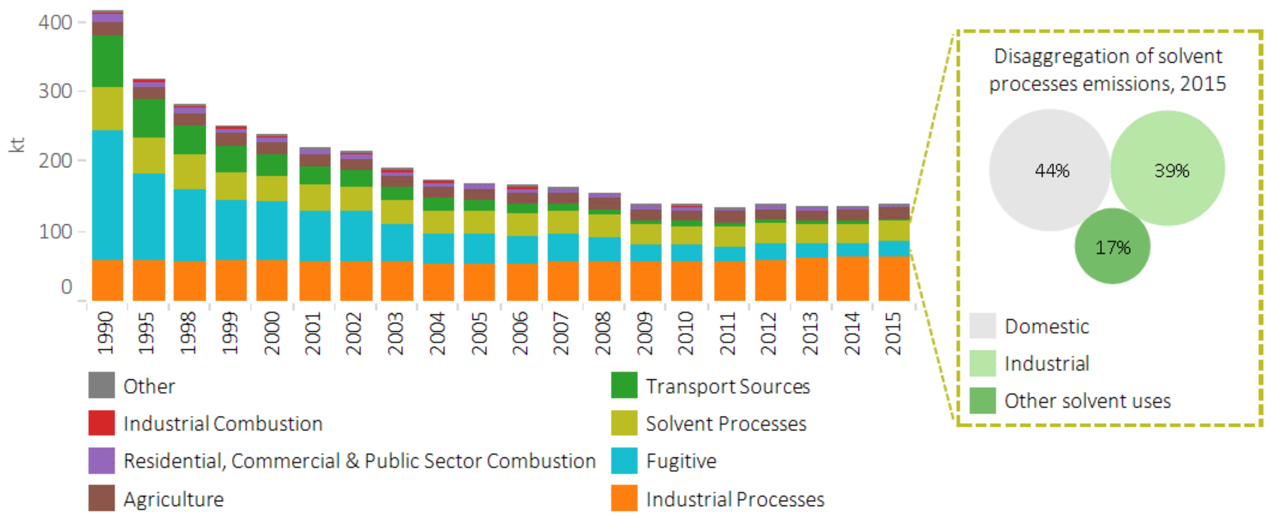
Emissions of **carbon monoxide** were estimated to be 112kt in 2015 and have declined by 83% since 1990. Emissions in Scotland accounted for 7% of the UK total in 2015. This decline in emissions stems from changes in the transport sector, particularly in road transport. The decline is driven by the introduction of Euro standards after 1992 which required fitting of emission control (e.g. three-ways catalyst) in new petrol vehicles and in more recent years the switch from petrol cars to diesel cars. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. In recent years, emissions from the residential and other combustion sector have increased, which corresponds with an increasing use of wood fuel in the domestic sector (Waters, 2015).

Figure 19 – Nitrogen Oxides Emissions in Scotland



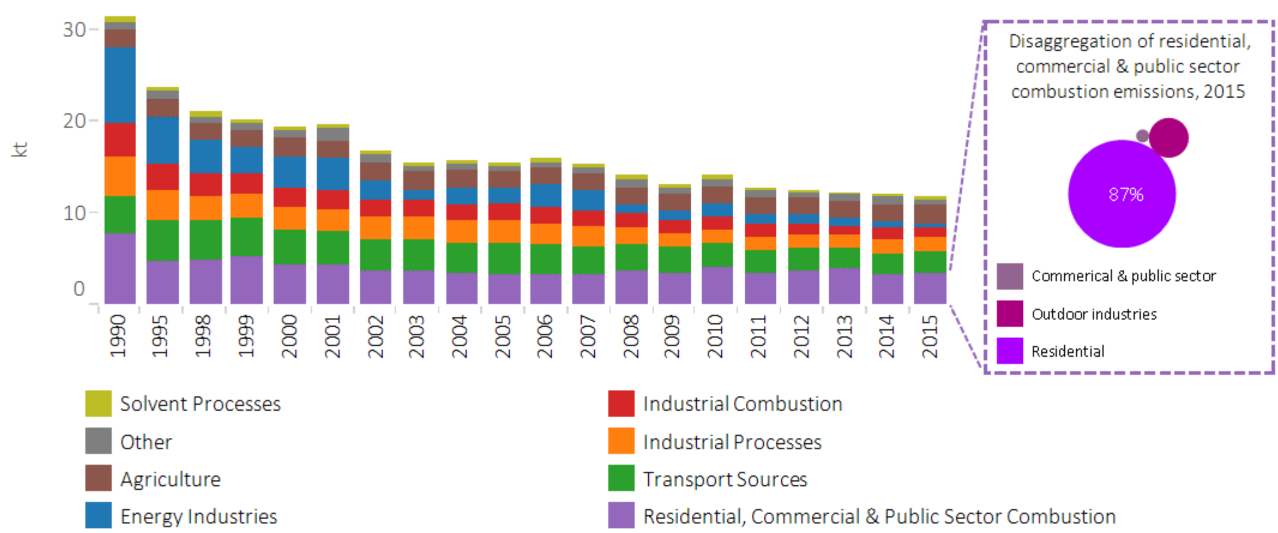
Emissions of **nitrogen oxides** were estimated to be 84kt in 2015, representing 9% of the UK total in 2015. Emissions have declined by 71% since 1990, mainly due to changes in the transport sector, particularly in road transport. This decline is driven by the successive introduction of tighter emission standards for petrol cars and all types of new diesel vehicles over the last decade. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. However, the increasing number of diesel cars partly offsets these emissions reductions, because diesel cars emit higher NO_x relative to their petrol counterparts (84% of 2015 passenger car emissions is due to diesel cars). The peak in NO_X emissions in 2006 is due to an increase in emissions linked 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 power generation fuel mix from gas to coal in that year (DECC, 2015). The decline in NO_X emissions since 2007 is also linked to the power sector, as Boosted Over-Fire Air (BOFA) abatement systems were fitted to all four of Longannet's units, to reduce NO_X emissions from coal-fired generation by up to 25% (Scottish Power, Longannet Power Station, 2012). BOFA systems were also fitted on all four units at Cockenzie power station which then closed in 2013 (Scottish Power, 2011).

Figure 20 – NMVOC Emissions in Scotland



Emissions of **non-methane volatile organic compounds** were estimated to be 140kt in 2015, representing 17% of the UK total in 2015. Emissions have declined by 66% since 1990. This reduction has been dominated by the 89% decrease in fugitive emissions since 1990. This is primarily due to the decrease in emissions from the exploration, production and transport of oil, specifically emissions from the onshore loading of oil. 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 95% of industrial processes emissions in 2015) have consistently increased since 2008 due to the increased production and storage of whisky, now contributing approximately 42% of NMVOC emissions in Scotland. Emissions from road transport sources, including evaporative losses of fuel vapour from petrol vehicles have also declined over time due to emission control technologies 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.

Figure 21 – PM_{10} Emissions in Scotland[3]

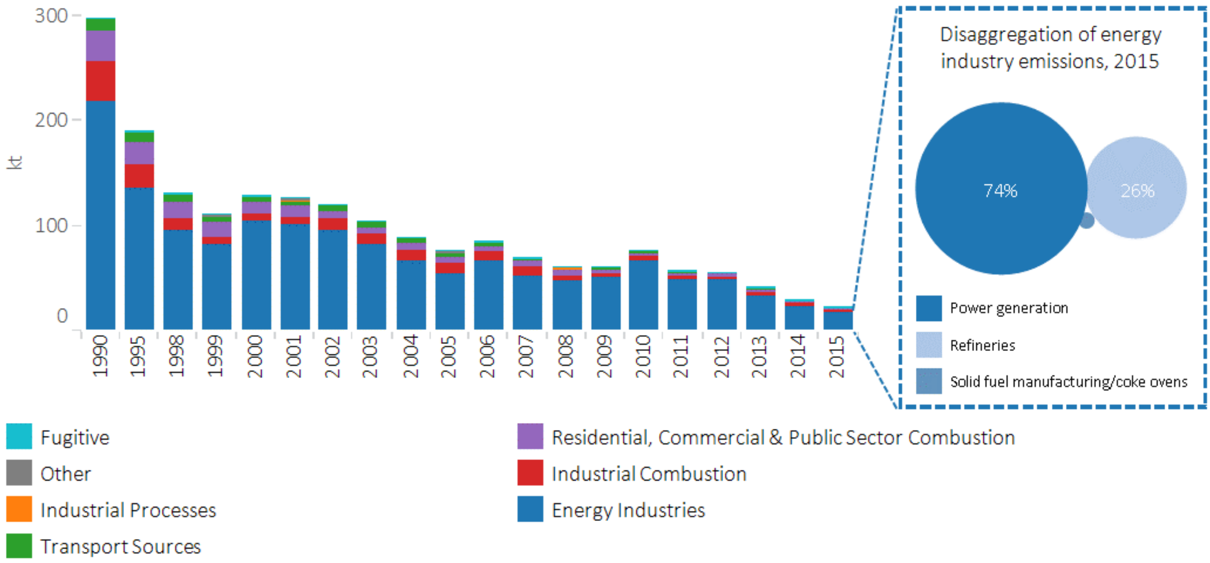


Emissions of **PM_{10}** were estimated to be 12kt in 2015, declining by 63% since 1990. These emissions account for 8% of the UK total. Unlike most other pollutants, PM_{10} emissions have a large number of important sources. Transport, residential combustion, agriculture and industrial processes each account

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

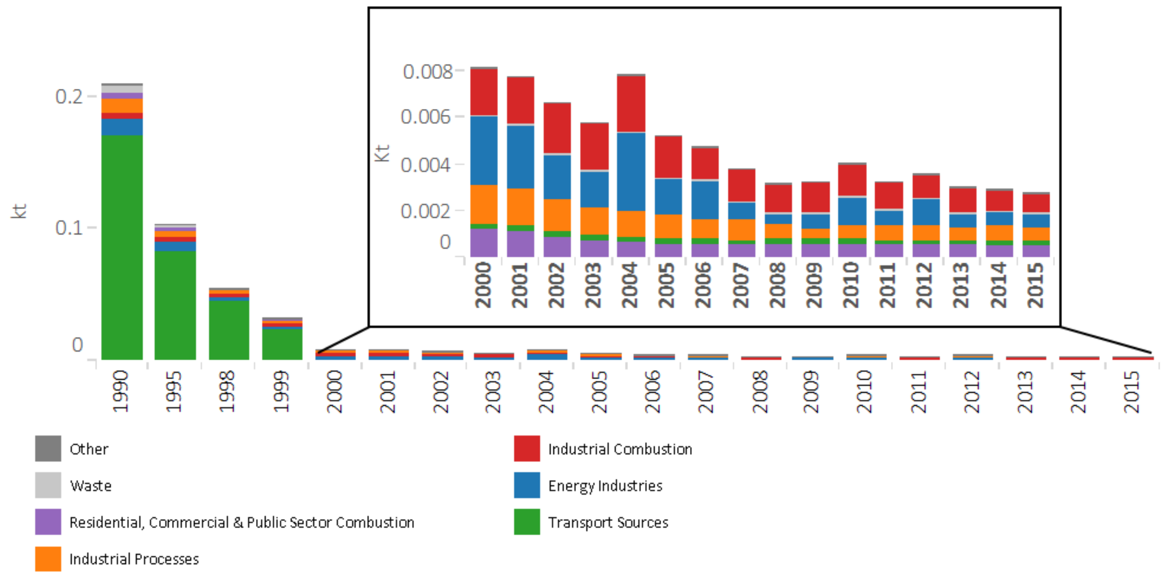
for over 10% of emissions across most of the time series. Emissions from energy industries have had the most notable impact on the trend. This reduction is primarily due to abatement at coal fired stations, the increase in nuclear and renewable energy sources and the increase in the use of gas in energy generation (which has negligible PM_{10} emissions) in place of coal (DECC, 2015). PM_{10} exhaust emissions from diesel fuelled vehicles have been decreasing due to the successive introduction of tighter emission standards over time. Increasingly non-exhaust sources of PM_{10} (for example tyre wear) have become a more important to consider as exhaust PM_{10} has been reduced. In fact, in 2015, 69% 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 domestic sector (Waters, 2015).

Figure 22 – Sulphur Dioxide Emissions in Scotland



Emissions of **sulphur dioxide** were estimated to be 23kt in 2015, representing 10% of the UK total in 2015. Emissions have declined by 92% since 1990, which has been dominated by the 92% reduction in energy industries emissions, coincident with large changes in the power generation sector. These include the reduction in coal fired power relative to other sources; improved emission controls on some large coal fired plant such as the installation of a FGD (flue-gas desulphurization) plant at Longannet power station; and also the supply of lower-sulphur coal in later years to Cockenzie (Scottish Power, 2011). Emissions from power generation fell between 2012 and 2013 due to the closure of Cockenzie power station in March 2013, and a UK-wide shift in power generation fuel mix back from coal to natural gas (DECC, 2015). Road transport emissions have declined, coincident with the reduced sulphur content of road fuels, both petrol and diesel.

Figure 23 – Lead Emissions in Scotland



Emissions of **lead** were estimated to be 2.8 tonnes in 2015, representing 4% of the UK total in 2015. Emissions have declined by 99% since 1990 almost entirely due to changes in the transport sector. Petrol with lead additives was phased out from general sale by the end of 1999, which is the reason for the 99.8% decrease in transport emissions between 1990 and 2000. The predominant sources of emissions are now combustion of coal in all sectors and the use of lubricants in transport. The peak in 2004 was due to an increase in reported emissions from coal combustion in power generation.

Table 3 below provides a summary of the percentage contribution of each sector for each pollutant in 2015. The table is shaded according to the overall contribution of that sector to the pollutant total. The table below indicates that the Residential, Commercial, & Public Sector Combustion sector is the most important sector when considering emissions of CO and PM_{10}.

The top five sectors mainly relate to fuel combustion. Industrial Processes is also notable, especially for NMVOC, 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 2015

Sector	NH_3	CO	NO_X	NMVOC	PM_{10}	SO_2	Pb
Agriculture	86.9%	0.0%	0.0%	11.1%	15.8%	0.0%	0.0%
Energy Industries	0.0%	5.8%	28.2%	0.0%	3.6%	75.0%	24.0%
Fugitive	0.0%	1.0%	0.0%	15.0%	0.0%	0.5%	0.0%
Industrial Combustion	0.0%	24.0%	14.4%	1.1%	10.0%	8.7%	30.0%
Industrial Processes	0.2%	0.0%	0.0%	46.4%	13.2%	2.8%	20.4%
Residential, Commercial & Public Sector Combustion	0.0%	39.0%	12.0%	3.1%	30.0%	10.8%	18.2%
Solvent Processes	0.0%	0.0%	0.0%	20.5%	2.8%	0.0%	0.0%
Transport Sources	1.2%	28.1%	43.4%	2.2%	18.5%	1.7%	6.9%
Waste	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
Other sources *	6.2%	2.0%	2.0%	0.7%	6.0%	0.7%	0.2%

* The sector “Other sources” includes all “other” categories in the inventory and also a number of categories that are insignificant for a specific pollutant. A breakdown of what is included within this category in respect to each pollutant can be found in Table 19

Emission maps for all seven pollutants are shown below.

Figure 24 – NH_3 Emissions in Scotland, 2015

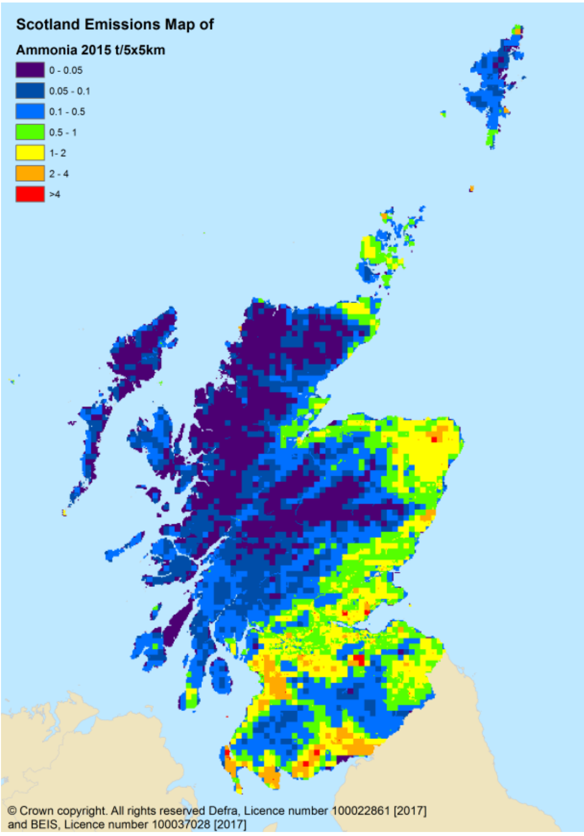


Figure 25 – CO Emissions in Scotland, 2015

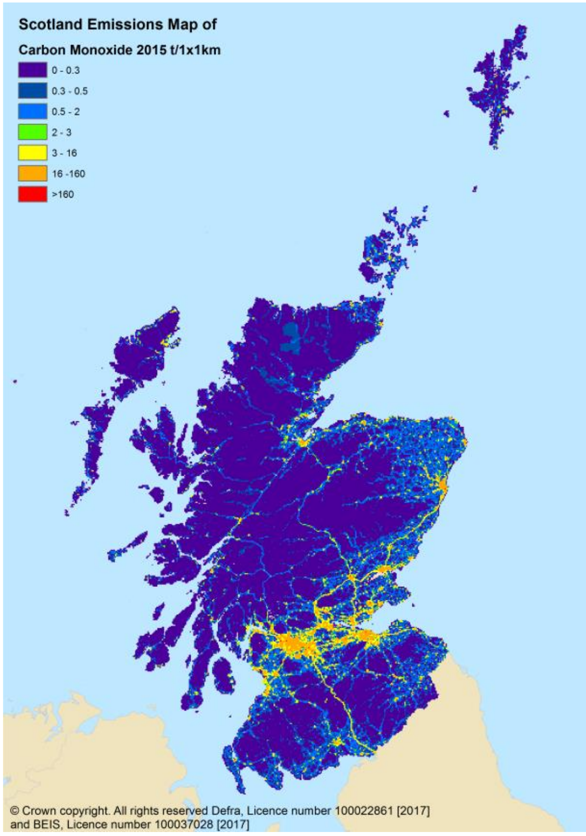


Figure 26 – NO_x Emissions in Scotland, 2015

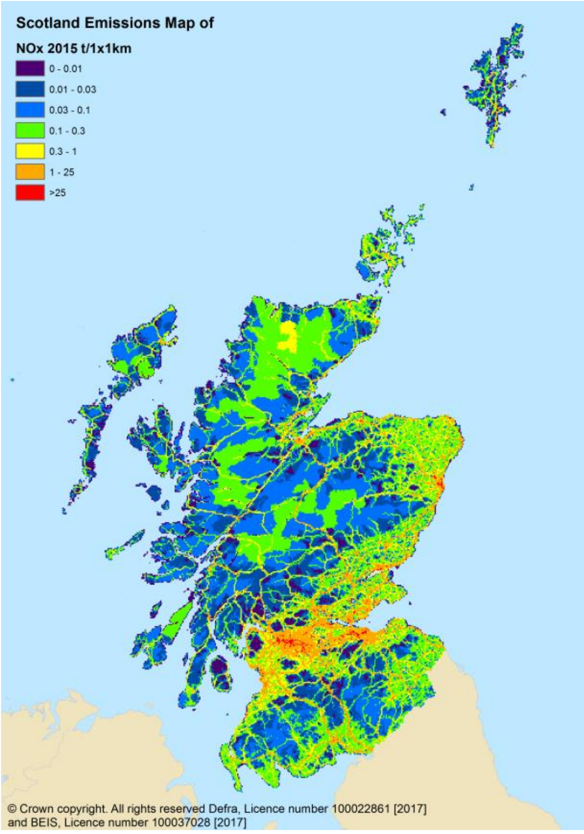


Figure 27 – NMVOC Emissions in Scotland, 2015

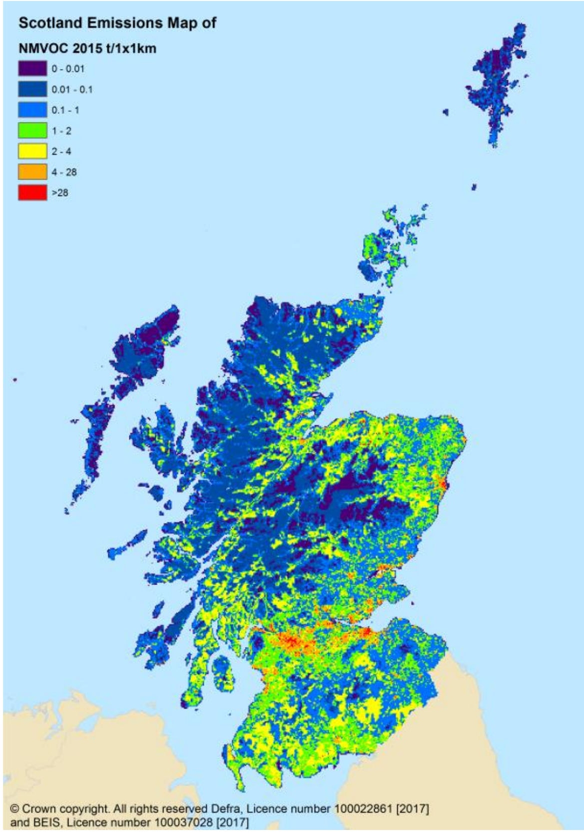


Figure 28 – PM_{10} Emissions in Scotland, 2015

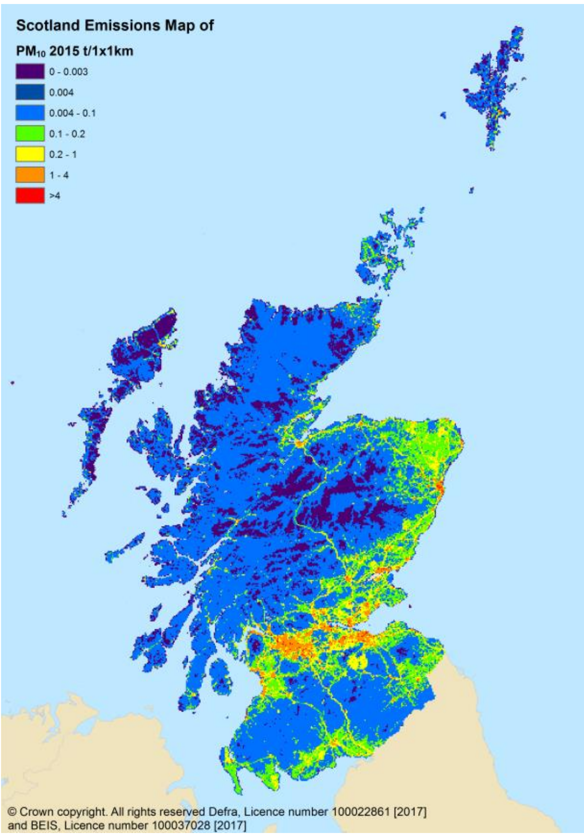


Figure 29 – SO_2 Emissions in Scotland, 2015

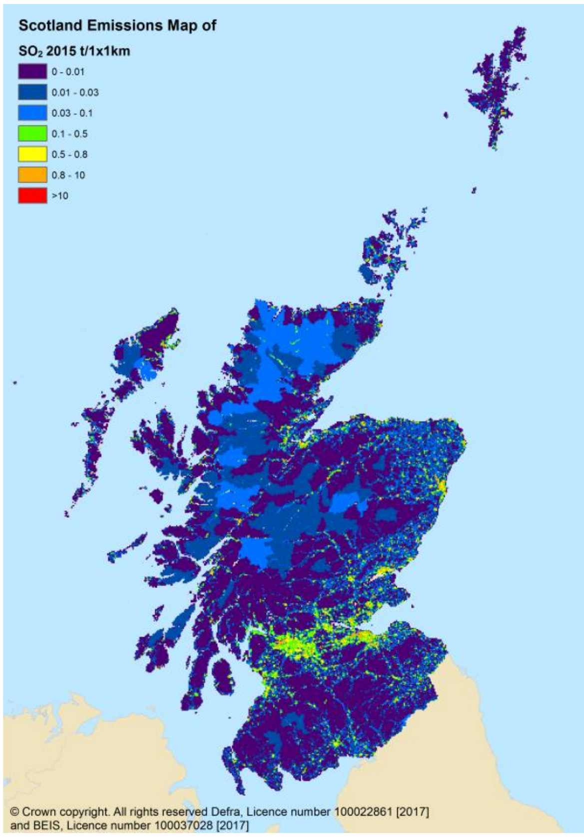
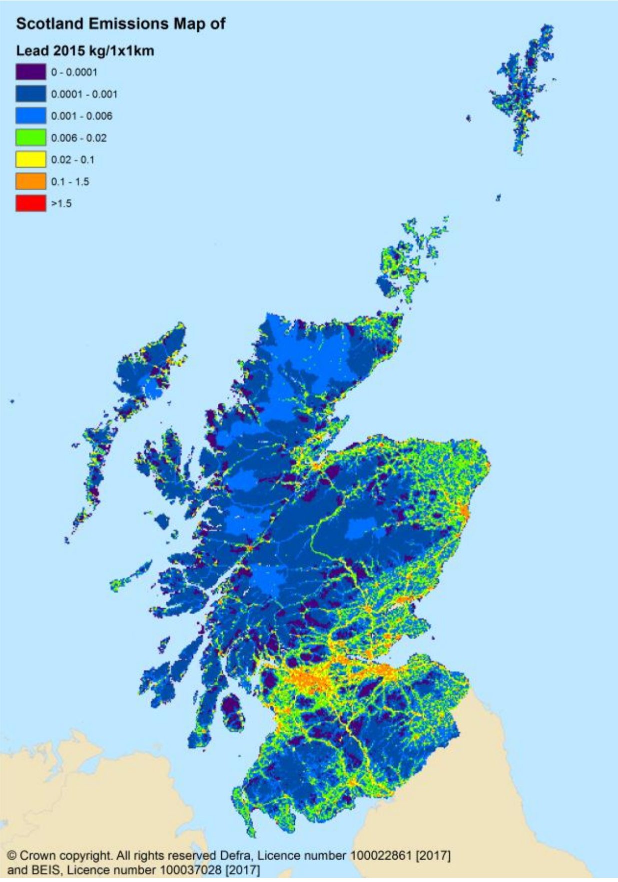


Figure 30 – Pb Emissions in Scotland, 2015



2.3 Wales

The following section provides a summary of emissions in Wales for the seven air quality 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}), sulphur dioxide (SO_2) and lead (Pb).

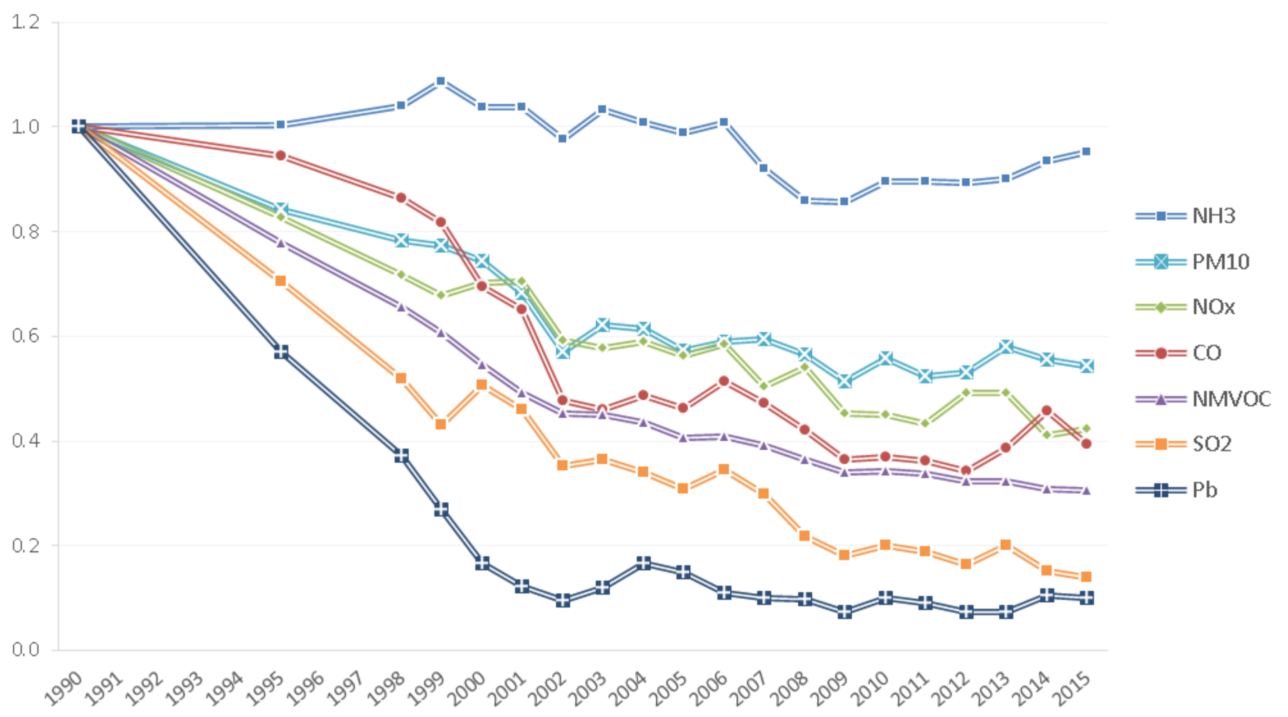
Figure 31 shows emissions of all seven air quality pollutants normalised to provide the relative rate of decline since 1990. This graph shows that all pollutant emission levels are lower in 2015 than they were in 1990. The decline is relatively similar for PM_{10}, NO_X, NMVOC and CO.

However, Pb shows a higher rate of reduction from 1990 to 2000 coincident with the phase-out of leaded petrol by the end of 1999. NH_3 emissions, by contrast, have declined at a much slower rate than other pollutants, plateauing in recent years.

Reductions in SO_2 since 2006 are due, primarily, to the retro-fitting 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.

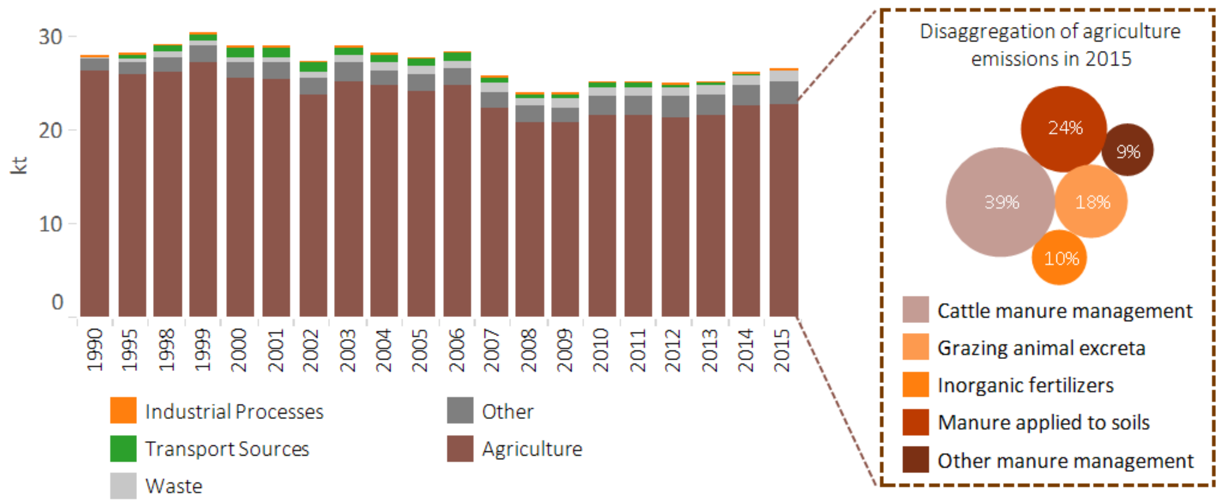
Many pollutant trends in Wales are also influenced substantially by the combustion and process emission sources linked to the iron and steel industry, and in particular changes in activity at Port Talbot steelworks. For example, between 2012 and 2013 an upturn in production at the plant led to increases in emissions from the sector across the priority air quality pollutants reported here, influencing the national trends most notably for CO, Pb and SO_2.

Figure 31 – Wales normalised trends for all pollutants



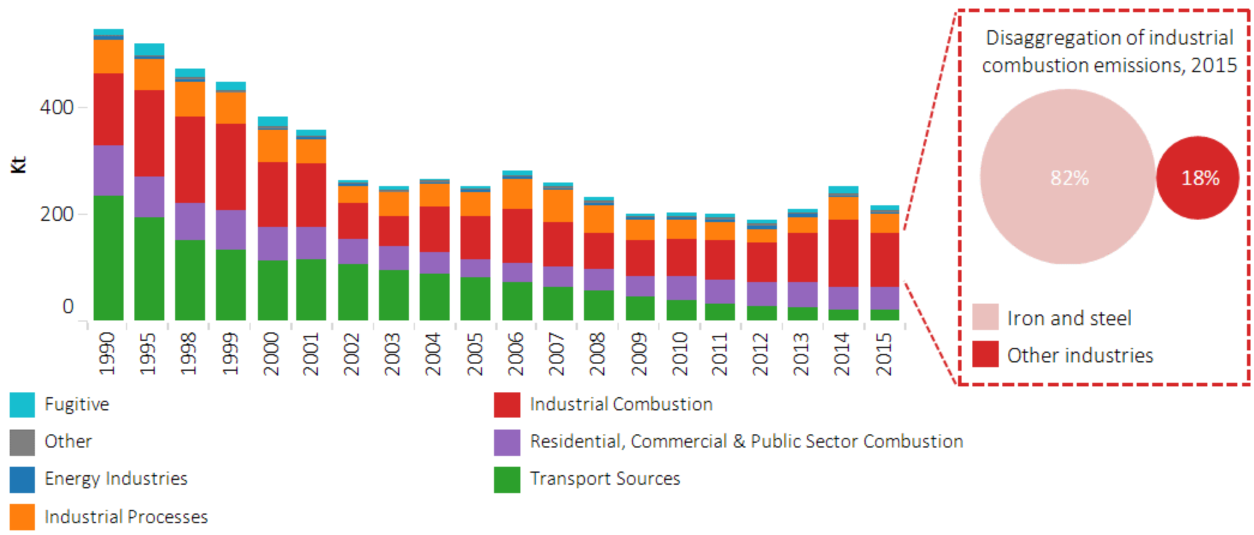
The following sections provide an overview of emissions from each of the seven pollutants giving explanations for the trends and characteristics of the graphs. Data summary tables for these emission estimates can be found in Appendix E. Mapping of the categories used in the graphs can be found in Appendix F.

Figure 32 – Ammonia Emissions in Wales



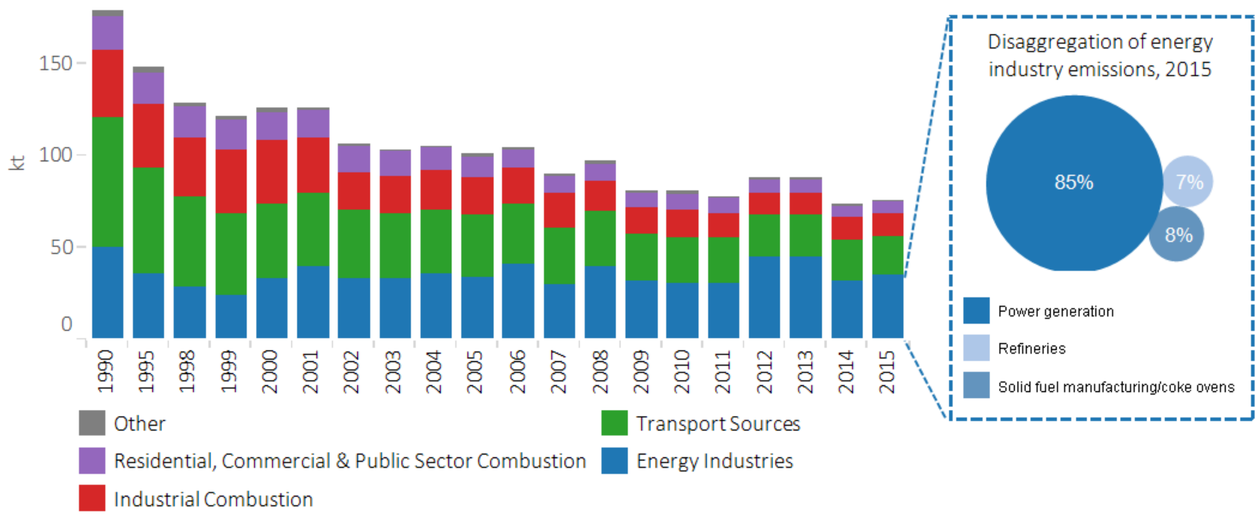
Emissions of **ammonia** were estimated to be 27kt in 2015. These emissions have declined by 5% since 1990 and account for 9% of the UK total in 2015. Agricultural sources have dominated the inventory throughout the time series, with cattle manure management accounting for 39% of the emissions from this sector in 2015. The trend in NH_3 emissions has been largely driven by decreasing animal numbers and a decline in fertiliser use, which have tended to decrease emissions across the time series. However, an increased usage of urea-based fertilisers, which are associated with higher NH_3 emission factors, has had the opposite effect in recent years. The result is a plateauing of emissions since 2008, with an observed increase between 2013 and 2015.

Figure 33 – Carbon Monoxide Emissions in Wales



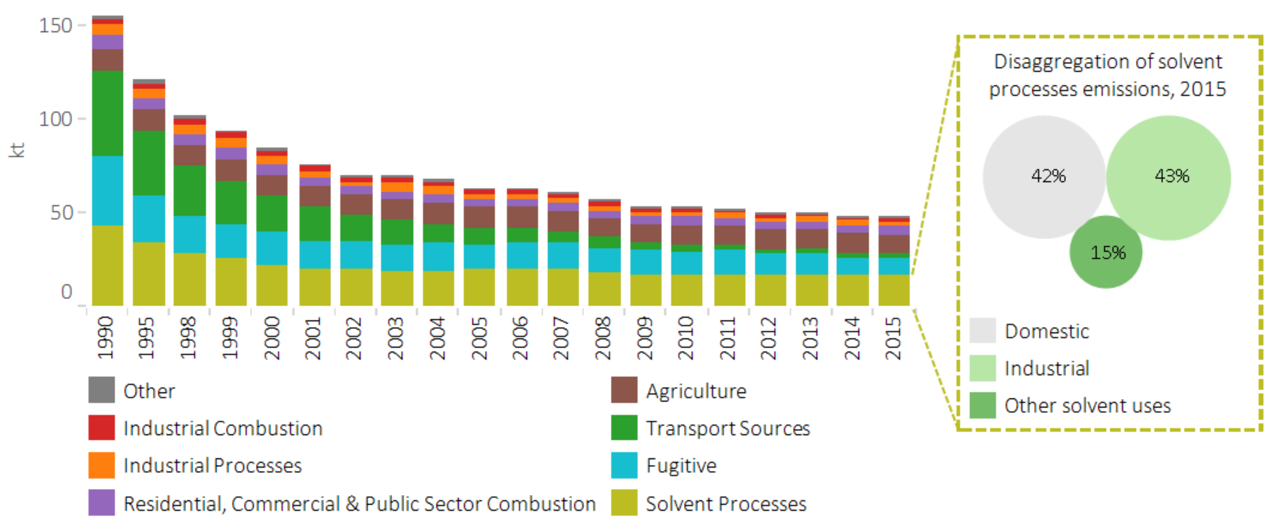
Emissions of **carbon monoxide** were estimated to be 216kt in 2015 and have declined by 61% since 1990. Emissions in Wales accounted for 13% of the UK total in 2015. This decline in emissions stems from changes in the transport sector, particularly road transport. The decline is driven by the introduction of Euro standards after 1992 which requires fitting of emission control (e.g. three-ways catalyst) in new petrol vehicles and in more recent years the switch from petrol cars to diesel cars. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. In more recent years, the most important sector has been energy industries, particularly power generation. Increases in emissions in 2012 and 2013 are linked to increased coal use at Aberthaw power station.

Figure 34 – Nitrogen Oxides Emissions in Wales



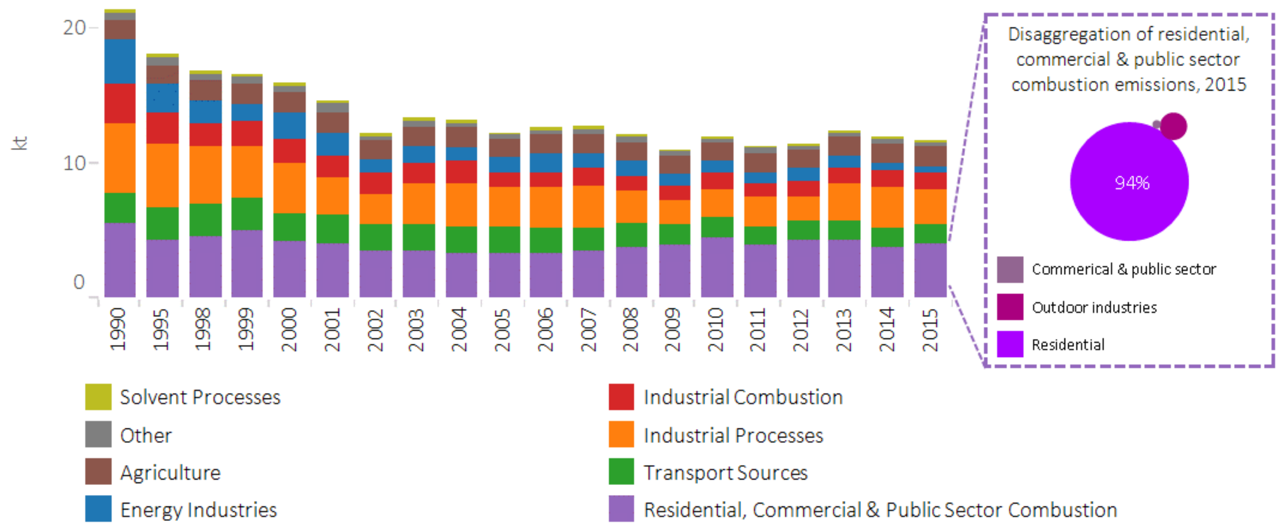
Emissions of **nitrogen oxides** were estimated to be 76kt in 2015, representing 8% of the UK total in 2015. Emissions have declined by 58% since 1990, mainly due to changes in the transport sector, particularly in road transport. This decline is driven by the successive introduction of tighter emission standards for petrol cars and all types of new diesel vehicles over the last decade. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. However, the increasing number of diesel cars partly offset these emissions reductions, because diesel cars emit higher NO_x relative to their petrol counterparts (85% of 2015 passenger car emissions is due to diesel cars). The recent fluctuations in emissions from energy industries (2012 -2015) corresponds with the changing proportion of coal-fired power generation in the energy mix, with increases in 2012 and 2013 linked to increase coal use at Aberthaw power station.

Figure 35 – NMVOC Emissions in Wales



Emissions of **non-methane volatile organic compounds** were estimated to be 48kt in 2015, representing 6% of the UK total in 2015. Emissions have declined by 69% since 1990. This reduction is mainly due to the decrease in emissions from road transport sources, including evaporative losses of fuel vapour from petrol vehicles. This decline is coincident with emission control technologies introduced in new petrol vehicles since the early 1990s and, in more recent years, the increasing proportion of diesel fuelled vehicles in the passenger fleet. 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 now the most important source of NMVOC emissions, with an equal amount of emissions arising from both industrial and domestic solvent applications.

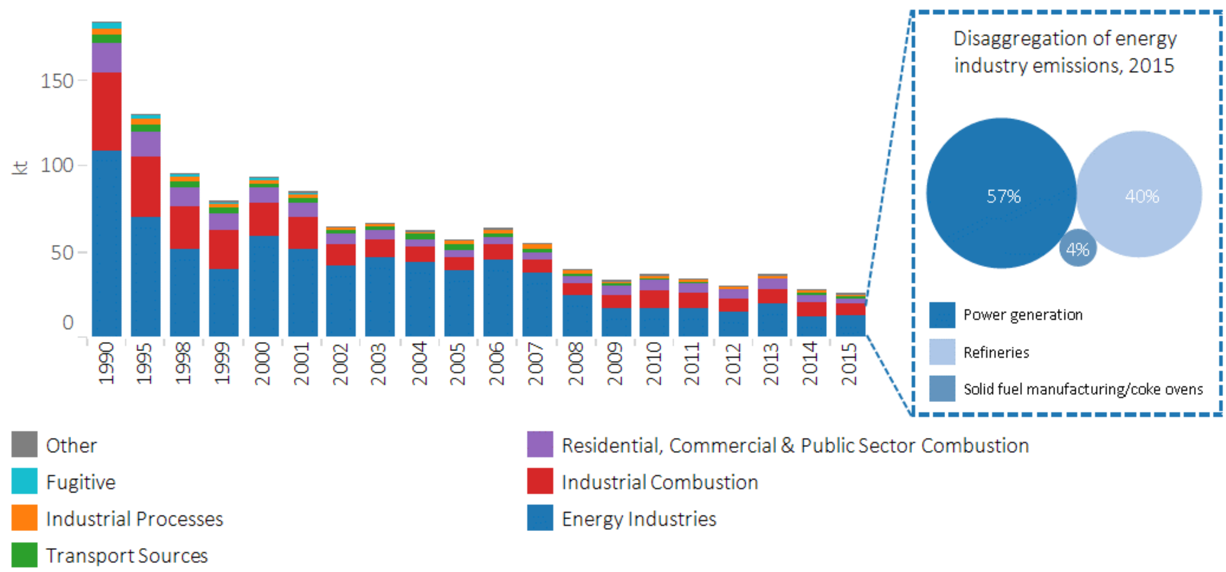
Figure 36 – PM_{10} Emissions in Wales[4]



Emissions of **PM_{10}** were estimated to be 12kt in 2015 and have declined by 46% since 1990. These emissions account for 8% of the UK total in 2015. Unlike most other pollutants, PM_{10} emissions have a large number of sources contributing significant fractions of the total. Transport, residential combustion, industrial processes and agriculture all accounted for over 10% of emissions across most of the time series. In 2015 the most important sources were residential combustion, and iron and steel process sources such as sinter plants, basic oxygen furnaces and blast furnaces. As a result, recent trends are influenced by the use of solid fuels in the domestic sector as well as iron and steel production trends, but there is no strong trend in overall emissions evident in the last 7 years. Since 2008, emissions from the residential and other combustion sector have increased, and this is primarily due to increasing wood fuel use in the domestic sector (Waters, 2015).

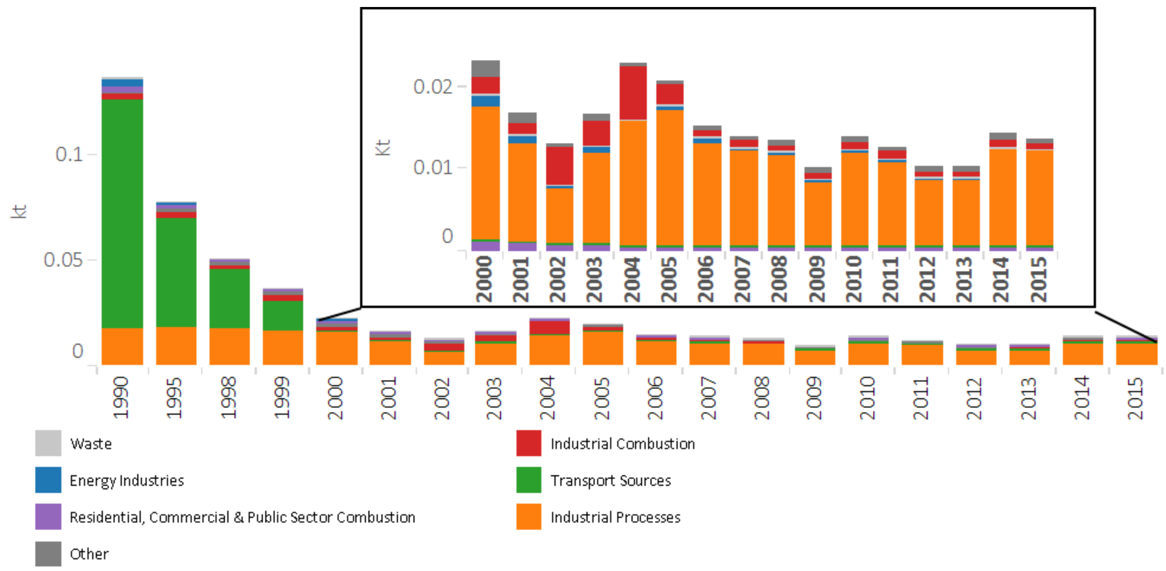
[4] 'Outdoor industries' presented in the bubble graph relate to combustion emissions from machinery in the agriculture, forestry and fishing industries.

Figure 37 – Sulphur Dioxide Emissions in Wales



Emissions of **sulphur dioxide** were estimated to be 26kt in 2015, representing 11% of the UK total in 2015. Emissions have declined by 86% since 1990, which has been dominated by the 88% reduction in energy industries emissions. This reduction is coincident with the UK-wide shift in power generation fuel mix away from coal to 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 domestic sector and production trends (and related coal use) in the iron and steel industry.

Figure 38 – Lead Emissions in Wales



Emissions of **lead** were estimated to be 14 tonnes in 2015, representing 21% of the UK total in 2015. Emissions have declined by 90% since 1990 almost entirely due to changes in the transport sector. Petrol with lead additives was phased out from general sale by the end of 1999, which is the reason for the 99.9% decrease in transport emissions between 1990 and 2000. The most substantive sources of emissions are now industrial processes in the iron and steel industry.

Table 4 below provides a summary of the percentage contribution of each sector for each pollutant in 2015. The table is shaded according to the overall contribution of that sector to the pollutant total.

The majority of the top five sectors are related to the combustion of fuel, whilst Industrial Processes is also significant, 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 2015

Sector	NH_3	CO	NO_X	NMVOC	PM_{10}	SO_2	Pb
Agriculture	85.7%	0.0%	0.0%	22.1%	12.4%	0.0%	0.0%
Energy Industries	0.0%	2.9%	45.7%	0.0%	4.4%	48.9%	1.2%
Fugitive	0.0%	4.1%	0.0%	19.0%	0.0%	4.6%	0.0%
Industrial Combustion	0.0%	46.8%	16.5%	3.3%	10.1%	27.8%	5.9%
Industrial Processes	0.2%	16.0%	0.0%	5.4%	23.2%	1.8%	82.7%
Residential, Commercial & Public Sector Combustion	0.0%	20.8%	7.8%	9.3%	34.9%	15.8%	4.1%
Solvent Processes	0.0%	0.0%	0.0%	35.3%	1.4%	0.0%	0.0%
Transport Sources	1.0%	8.9%	28.5%	3.9%	11.1%	0.8%	0.8%
Waste	4.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Other sources*	8.7%	0.5%	1.6%	1.7%	2.5%	0.3%	5.2%

* The sector "Other sources" will include all "other" categories in the inventory and also a number of categories that are insignificant for a specific pollutant. A breakdown of what is included within this category in respect to each pollutant can be found in Table 19

Emission maps for all seven pollutants are shown below.

Figure 39 – NH_3 Emissions in Wales, 2015

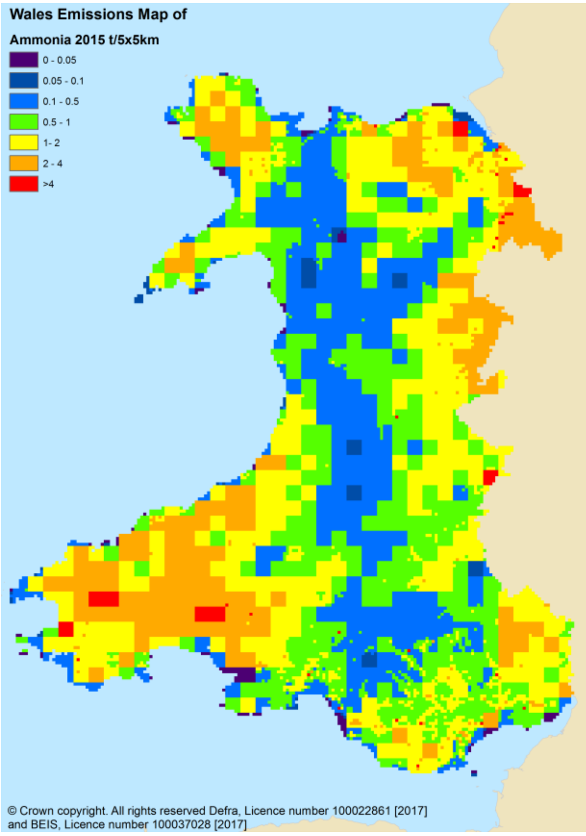


Figure 40 – CO Emissions in Wales, 2015

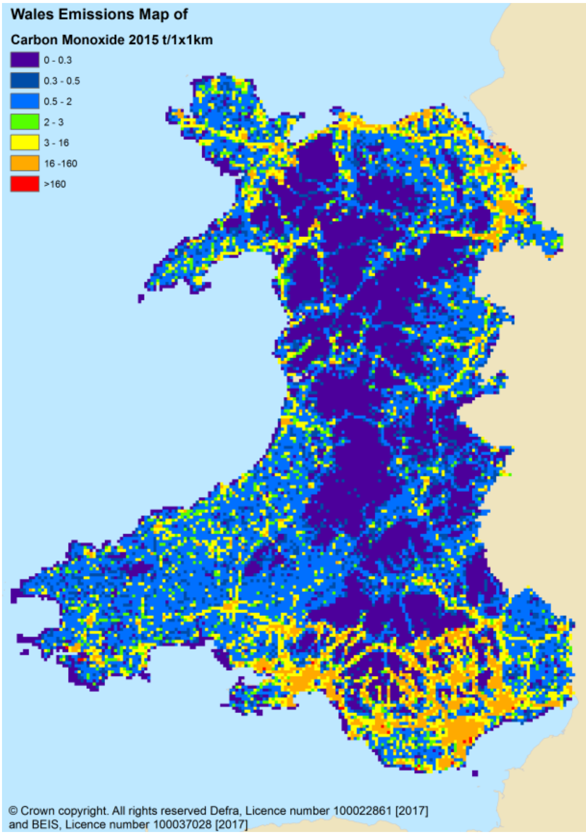


Figure 41 – NO_x Emissions in Wales, 2015

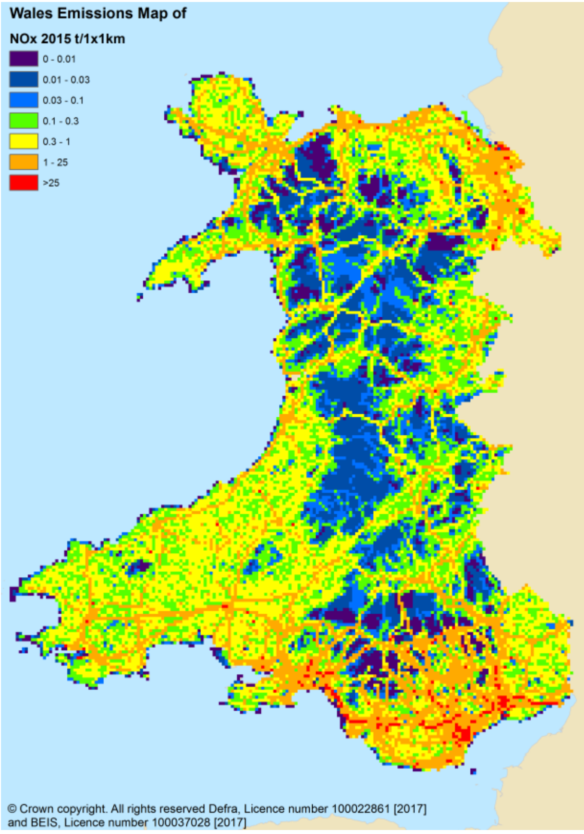


Figure 42 – NMVOC Emissions in Wales, 2015

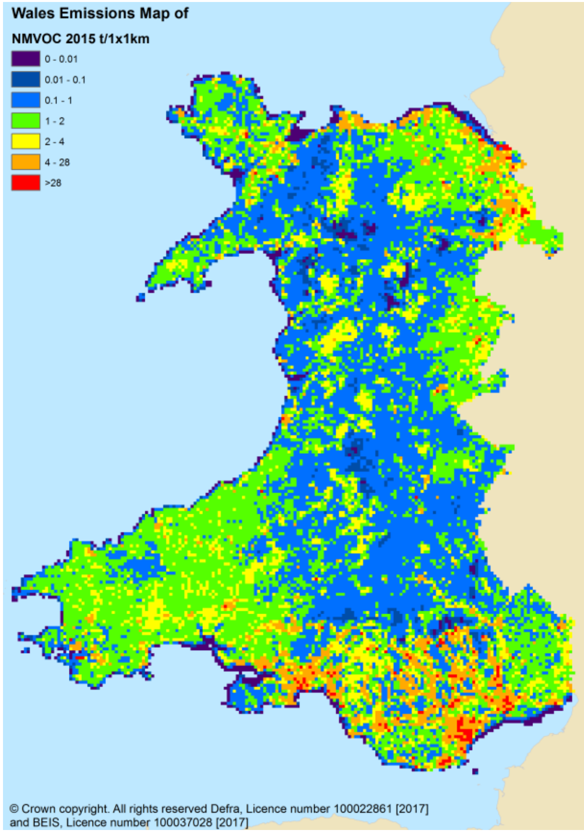


Figure 43 – PM_{10} Emissions in Wales, 2015

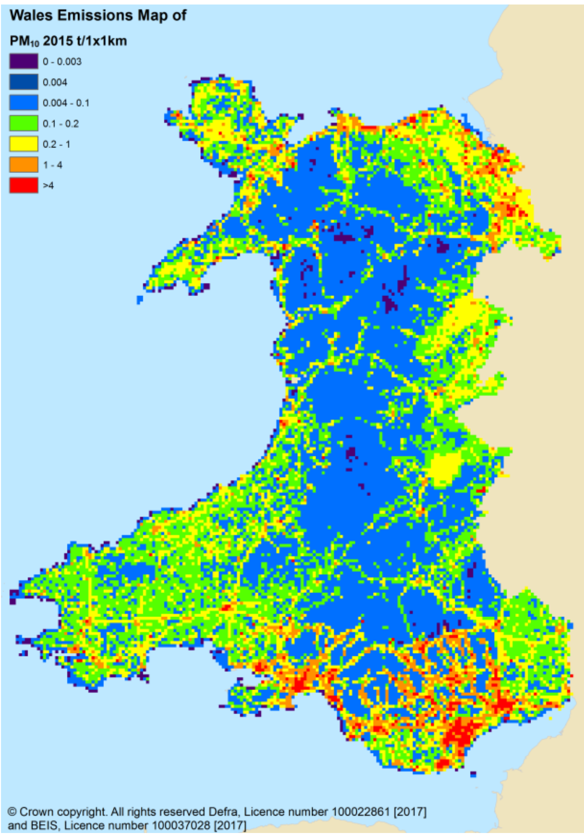


Figure 44 – Sulphur Dioxide Emissions in Wales, 2015

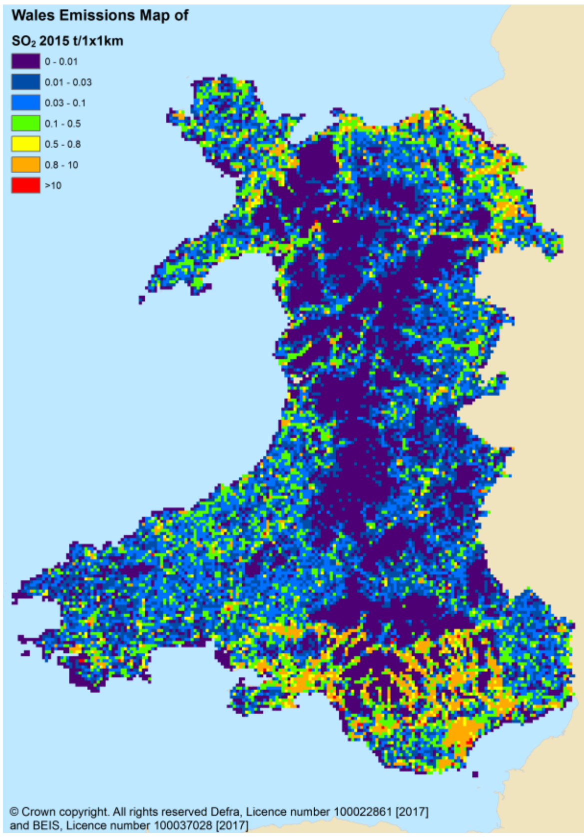
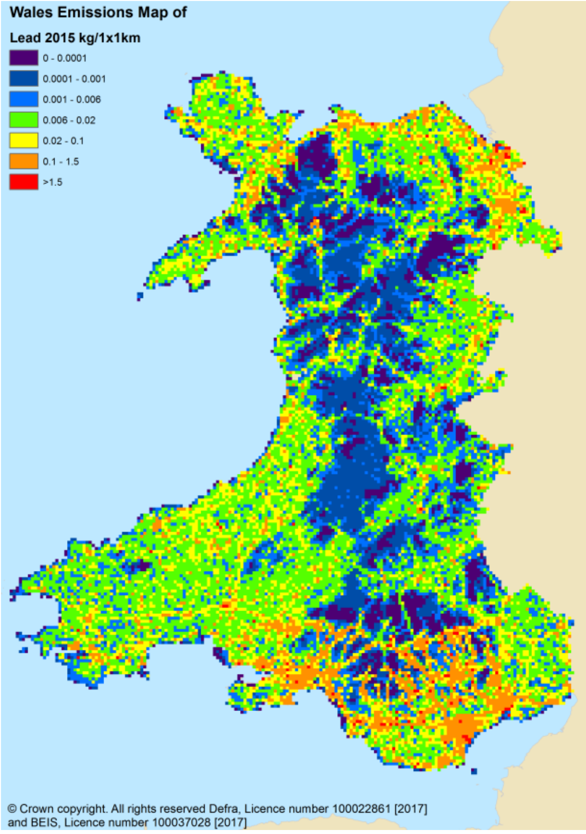


Figure 45 – Pb Emissions in Wales, 2015



2.4 Northern Ireland

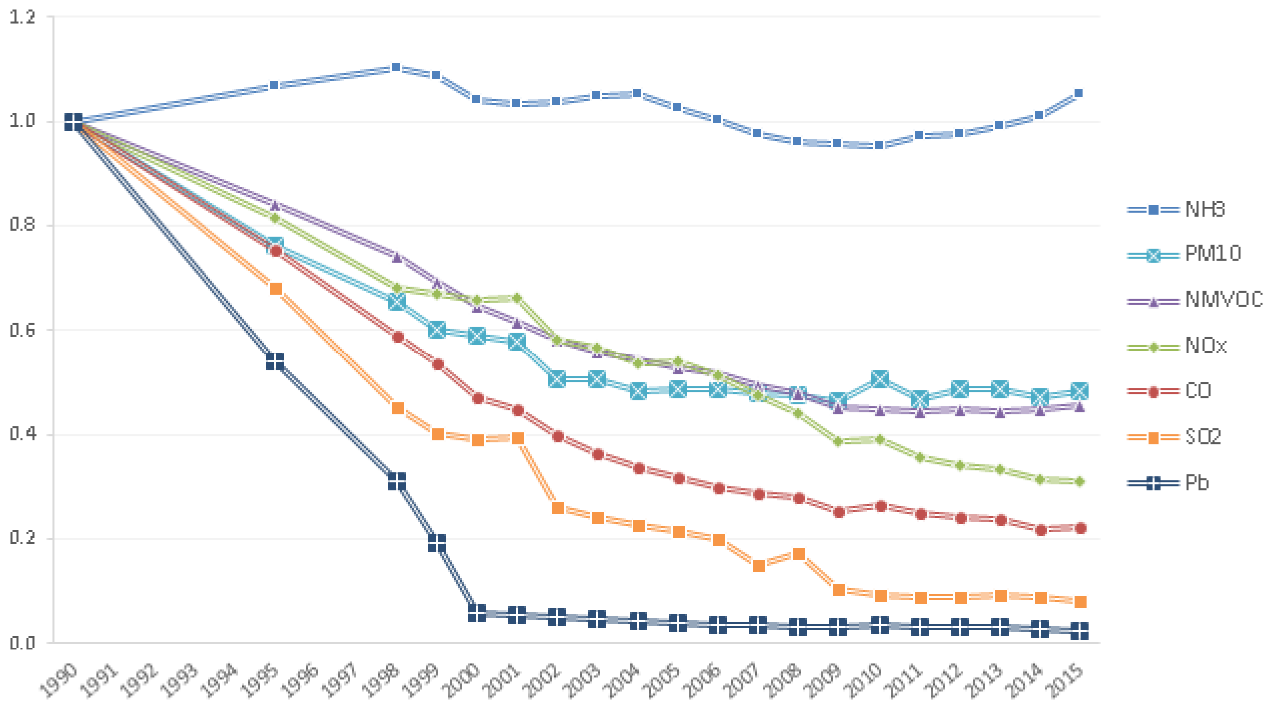
The following section provides a summary of emissions in Northern Ireland for the seven air quality pollutants: ammonia (NH_3), carbon monoxide (CO), nitrogen oxides (NO_X as NO_2), non-methane volatile organic compounds (NMVOCs), particulate matter less than 10 micrometres (PM_{10}), sulphur dioxide (SO_2) and lead (Pb).

Figure 46 shows emissions of all seven air quality pollutants normalised to provide the relative rate of decline since 1990. This graph shows that all pollutant emission levels except ammonia are lower in 2015 than they were in 1990. The decline is relatively similar for PM_{10}, NO_X and NMVOC..

However, Pb shows a much higher rate of reduction from 1990 to 2000 due to the phase-out of leaded petrol by the end of 1999. NH_3 emissions, by contrast, only reached levels that were lower than 1990 estimates from 2007 onwards but has increased again since 2010.

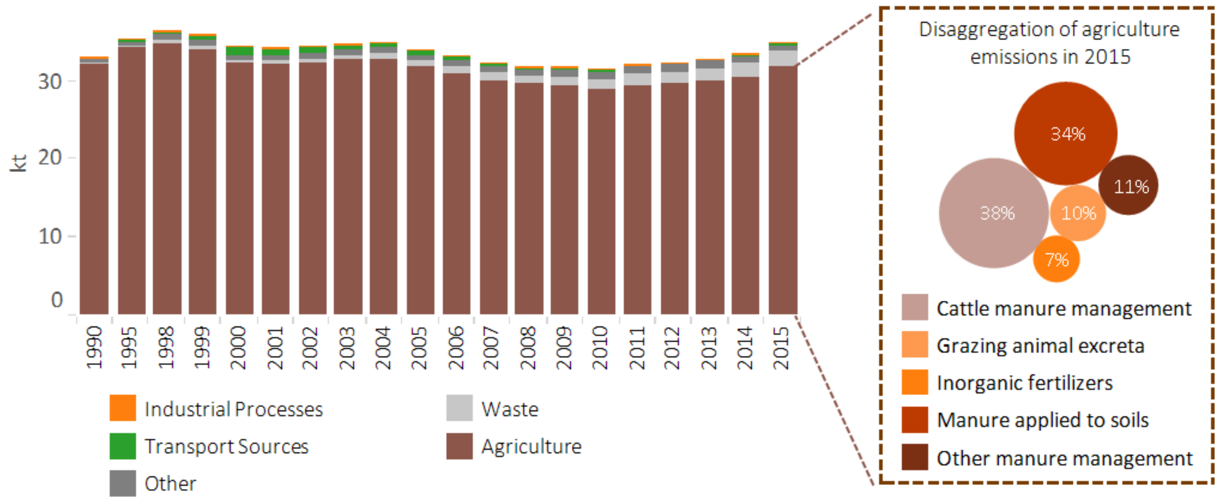
The reductions in SO_2 after 2001 are due to a reduction in use of coal in several industries but predominantly in power generation, linked to the development of the natural gas pipeline to Northern Ireland which enabled fuel-switching away from coal and oil-fired generation (DECC, 2015).

Figure 46 – Northern Ireland normalised trends for all pollutants



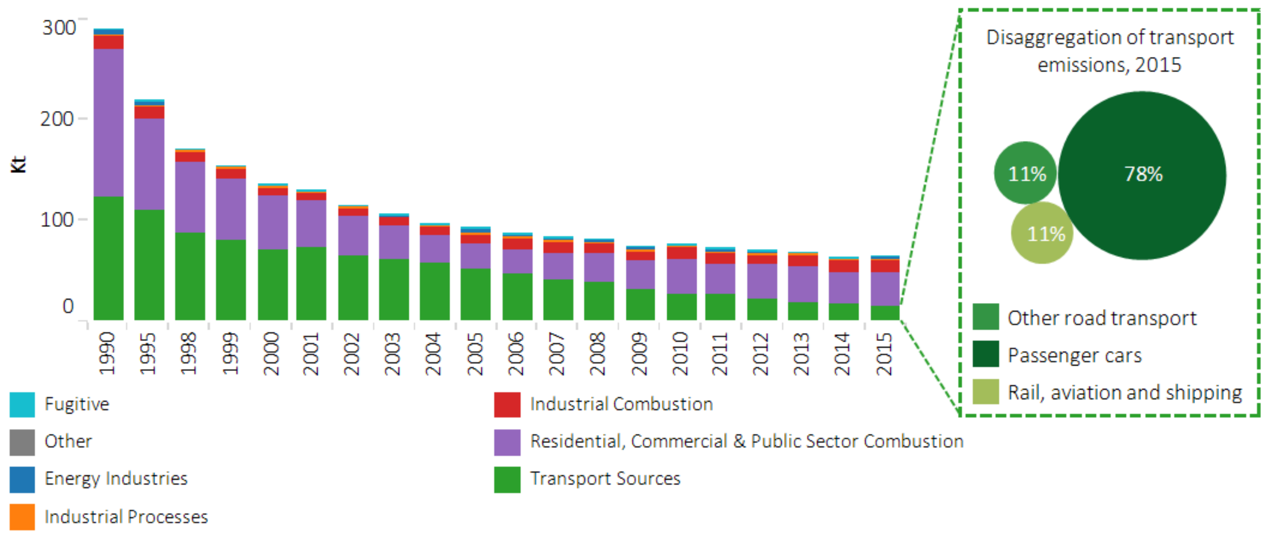
The following sections provide an overview of emissions from each of the seven pollutants giving explanations for the trends and characteristics of the graphs. Data summary tables for these emission estimates can be found in Appendix E. Mapping of the categories used in the graphs can be found in Appendix F.

Figure 47 – Ammonia Emissions in Northern Ireland



Emissions of **ammonia** were estimated to be 35kt in 2015. Emissions have increased overall by 5% since 1990 and account for 12% of the 2015 UK total. Emissions were at a minimum in 2010, but have since increased by 10%. In fact, there was a 4% increase in emissions in 2015 when compared to 2014, largely due to the increases in emissions from dairy cattle waste (related to rising livestock numbers), and from the spreading of animal manure on agricultural soils. Agricultural sources have dominated the inventory throughout the time series, with cattle manure management accounting for 38% of the emissions from this sector. Total manure management (for all agricultural livestock) accounts for 45% of emissions. NH_3 emissions have increased in recent years and this is mainly due to increased emissions from manure applied to the soil, and the manure management processes for pigs.

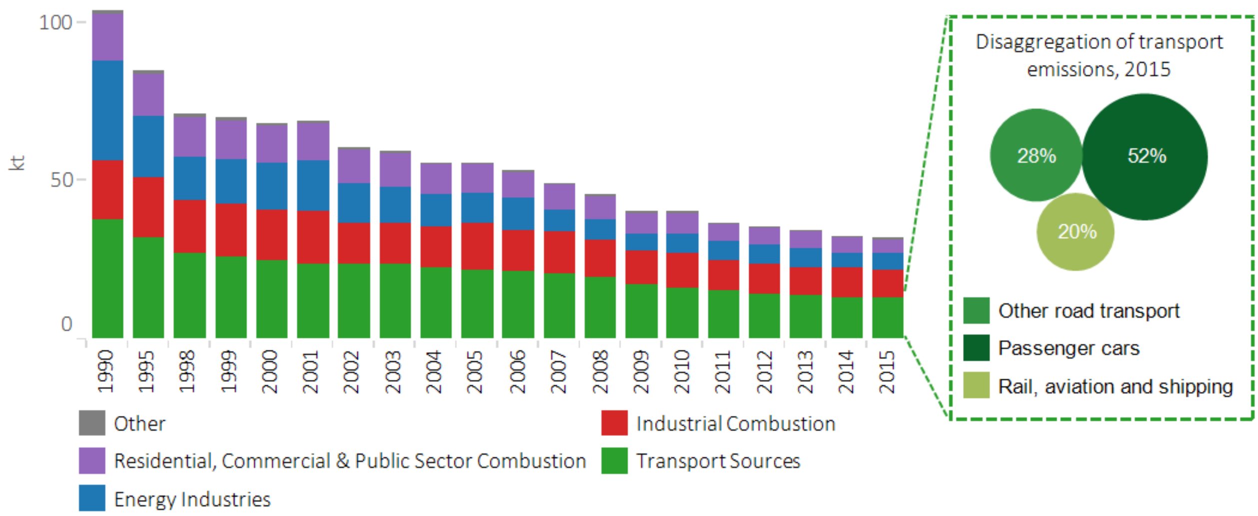
Figure 48 – Carbon Monoxide Emissions in Northern Ireland



Emissions of **carbon monoxide** were estimated to be 64kt in 2015 and have declined by 78% since 1990. Emissions in Northern Ireland accounted for 4% of the UK total in 2014. This decline in emissions stems from changes in the other combustion sector, and the transport sector, particularly in road transport. The decline is driven by the introduction of Euro standards after 1992 which requires fitting of emission control (e.g. three-ways catalyst) in new petrol vehicles and in more recent years the switch from petrol cars to diesel cars. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and

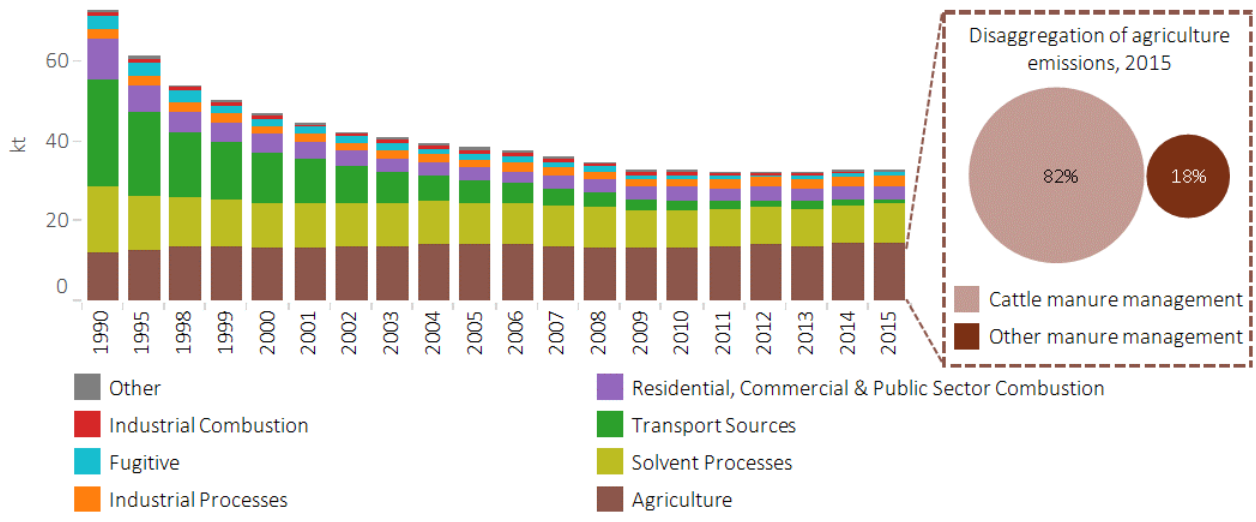
Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. The decrease in residential and other combustion in the earlier part of the time series is mainly due to the expansion of the gas network leading to reductions in the consumption of solid and liquid fuels; the increase in more recent years is due to an increasing quantity of wood burned in the domestic sector (Waters, 2015).

Figure 49 – Nitrogen Oxides Emissions in Northern Ireland



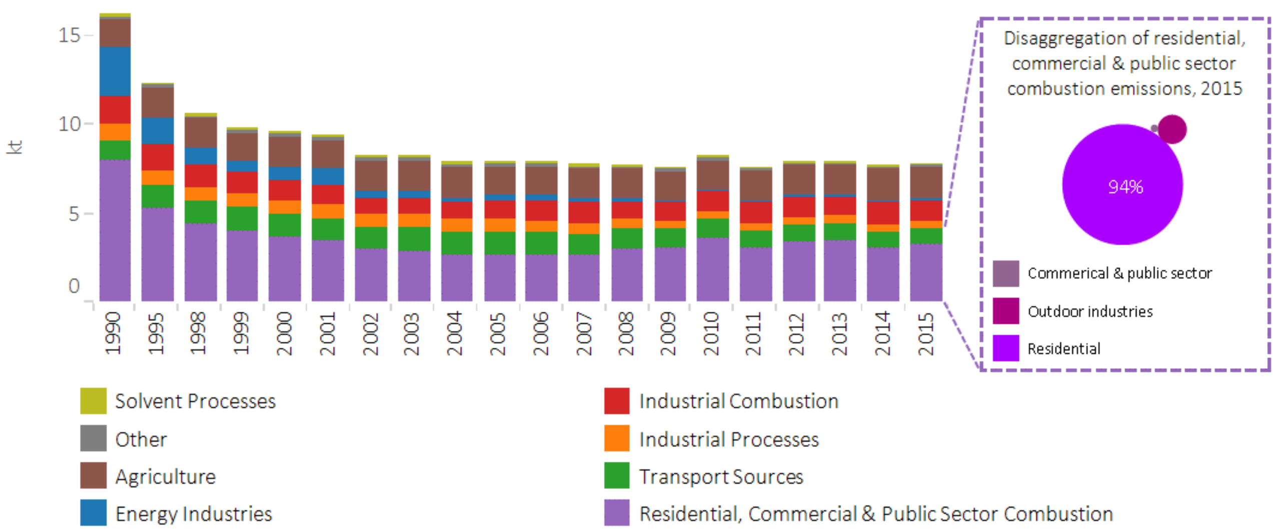
Emissions of **nitrogen oxides** were estimated to be 32kt in 2015, representing 4% of the UK total. Emissions have declined by 69% since 1990, partly due to changes in the transport sector, particularly in road transport. This decline is driven by the successive introduction of tighter emission standards for petrol cars and all types of new diesel vehicles over the last decade. Since 2008, emissions from passenger cars have further decreased, which is mainly driven by improvements in catalyst repair rates resulting from the introduction of Regulations Controlling Sale and Installation of Replacement Catalytic Converters and Particle Filters for Light Vehicles for Euro 3 (or above) light duty vehicles. However, the increasing number of diesel cars partly offset these emissions reductions, because diesel cars emit higher NO_X emissions relative to their petrol counterparts (87% of 2015 passenger car emissions is due to diesel cars). Energy industries have also had a notable impact on the trend with implementation of abatement technology and reductions in the amount of coal used.

Figure 50 – NMVOC Emissions in Northern Ireland



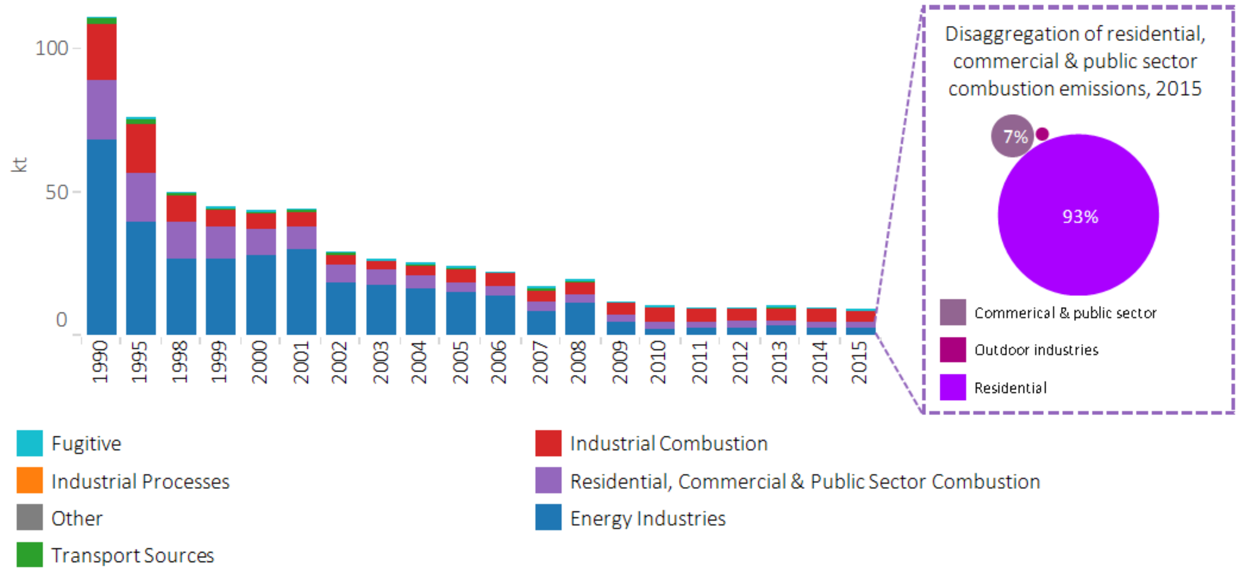
Emissions of **non-methane volatile organic compounds** were estimated to be 33kt in 2015, representing 4% of the UK total. Emissions have declined by 55% since 1990 mainly due to the decrease in road transport emission sources, including evaporative losses. This decline is coincident with emission control technologies introduced in new petrol vehicles since early 1990s and, in more recent years, the increasing proportion of diesel fuelled vehicles in the passenger fleet. The reduction in emissions also occurs to a lesser extent due to the introduction of petrol vapour recovery systems at filling stations. With this large reduction in transport emissions, agriculture is now the most important source of NMVOC emissions, more specifically emissions from cattle manure management.

Figure 51 – PM_{10} Emissions in Northern Ireland



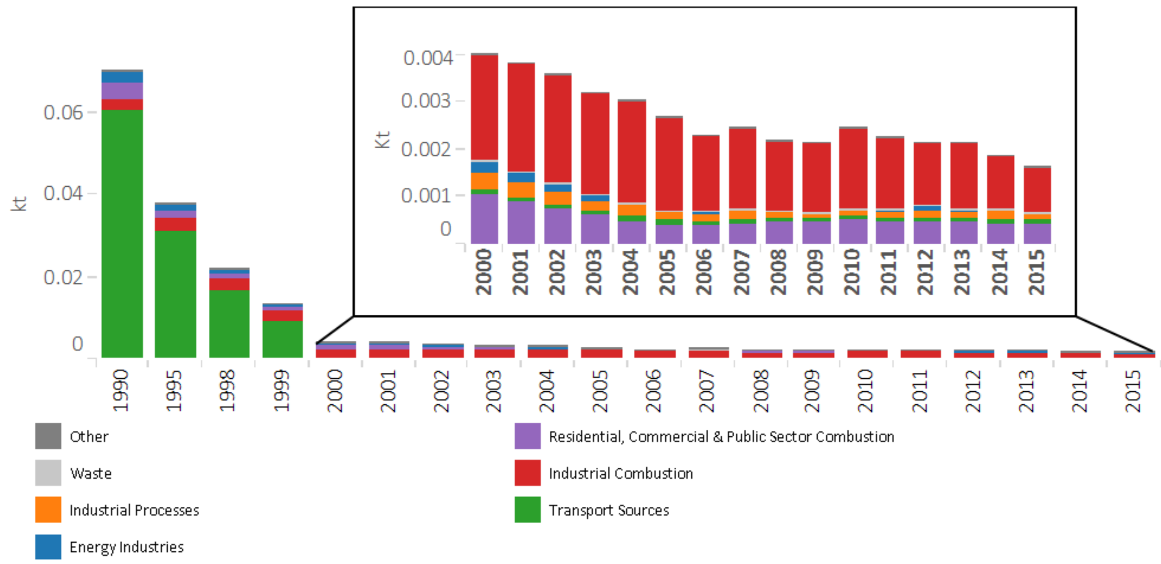
Emissions of **PM_{10}** were estimated to be 8kt in 2015 and accounted for 5% of the UK total. Emissions have declined by 52% since 1990, with the major decrease observed between 1990 and 2004. The decreasing trend was defined by emissions from residential combustion, with a reduction in the use of peat and coal and fuel-switching across many economic sectors from coal and oil to natural gas. 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 the residential and other combustion sector have primarily increased coincident with increasing wood fuel use in the domestic sector (Waters, 2015).

Figure 52 – Sulphur Dioxide Emissions in Northern Ireland



Emissions of **sulphur dioxide** were estimated to be 9kt in 2015, representing 4% of the UK total in 2015. Emissions have declined by 92% since 1990, which has been dominated by the 96% reduction in energy industries emissions due to the introduction of CCGT (Combined Cycle Gas Turbine) plant, which are more efficient than conventional coal and oil stations and have negligible SO_2 emissions. In addition, as the natural gas network has expanded to different parts of Northern Ireland, other combustion sectors (industrial combustion sector, and residential, commercial & public combustion sectors) have also shown step-changes in emissions as fuel-switching away from coal and oil has been made possible. Road transport emissions have declined, coincident with the reduced sulphur content of road fuels, both petrol and diesel.

Figure 53 – Lead Emissions in Northern Ireland



Emissions of **lead** were estimated to be 1.7 tonnes in 2015, representing 3% of the UK total in 2015. Emissions have declined by 98% since 1990 almost entirely due to changes in the transport sector. Leaded petrol was phased out from general sale by the end of 1999, which is the reason for the 99.9% decrease in transport emissions between 1990 and 2000. The most substantive source of emissions is now the use of lubricants in industry.

Table 5 below provides a summary of the percentage contribution of each sector for each pollutant in 2015. The table is shaded according to the overall contribution of that sector to the pollutant total. The table below indicates that the Residential and Other Combustion sector is the most significant sector when considering emissions for CO, Pb, PM_{10} and SO_2, accounting for at least 15% of emissions for each pollutants.

The majority of the top five sectors are related to the combustion of fuel, except for agriculture, which is an important sector in Northern Ireland when considering NH_3, PM_{10} and NMVOC. The table also highlights that whilst emissions from the solvent processes sector are not as significant when considering all pollutants, it is relatively significant when considering emissions of NMVOC.

Table 5 – Source Emission Contributions Ranked by Sector, Northern Ireland 2015

Sector	NH_3	CO	NO_X	NMVOC	PM10	SO_2	Pb
Agriculture	91.1%	0.0%	0.0%	44.6%	22.7%	0.0%	0.0%
Energy Industries	0.0%	3.5%	15.5%	0.0%	0.6%	27.2%	3.2%
Fugitive	0.0%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%
Industrial Combustion	0.0%	21.6%	28.5%	1.8%	15.5%	47.5%	58.9%
Industrial Processes	0.0%	0.0%	0.0%	7.5%	5.2%	0.0%	7.0%
Residential, Commercial & Public Sector Combustion	0.0%	51.5%	14.5%	10.4%	41.9%	23.4%	26.3%
Solvent Processes	0.0%	0.0%	0.0%	28.8%	1.4%	0.0%	0.0%
Transport Sources	0.6%	22.4%	40.3%	3.5%	10.9%	1.5%	4.3%
Waste	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Other sources*	2.8%	1.0%	1.1%	0.9%	1.7%	0.4%	0.1%

* The sector: "Other sources" will include all "other" categories in the inventory and also a number of categories that are insignificant for a specific pollutant. A breakdown of what is included within this category in respect to each pollutant can be found in Table 19

Emission maps for all seven pollutants are shown below.

Figure 54 – NH_3 Emissions in Northern Ireland, 2015

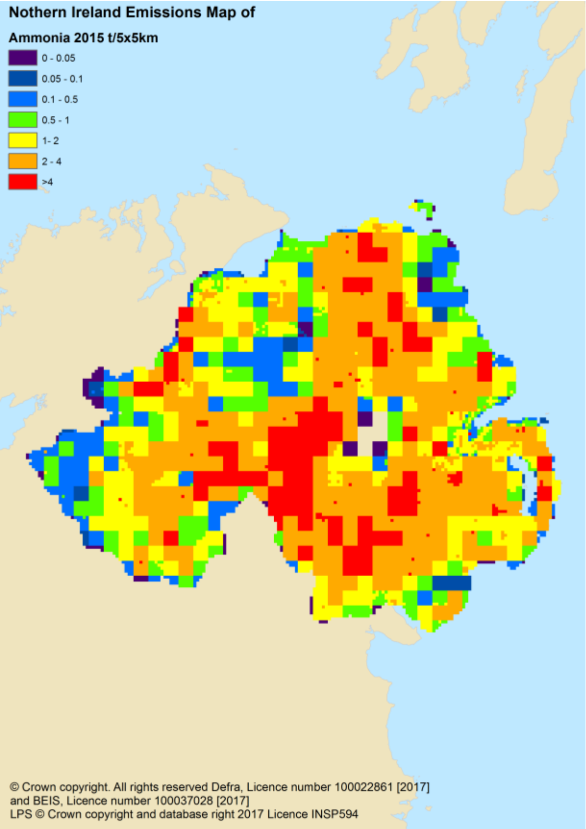


Figure 55 – CO Emissions in Northern Ireland, 2015

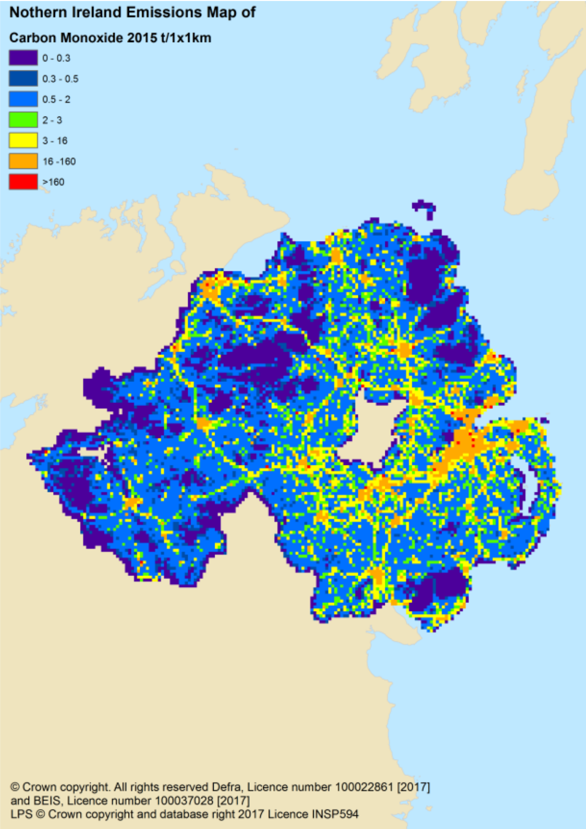


Figure 56 – NO_x Emissions in Northern Ireland, 2015

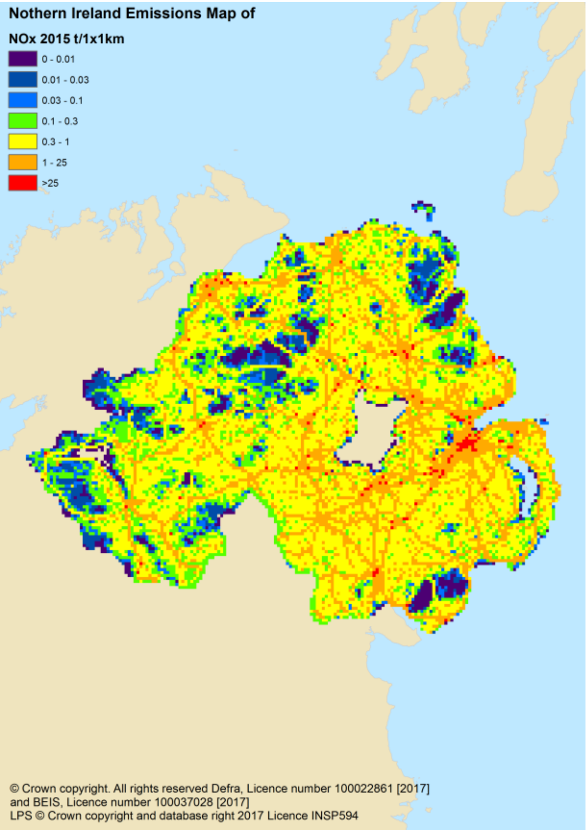


Figure 57 – NMVOC Emissions in Northern Ireland, 2015

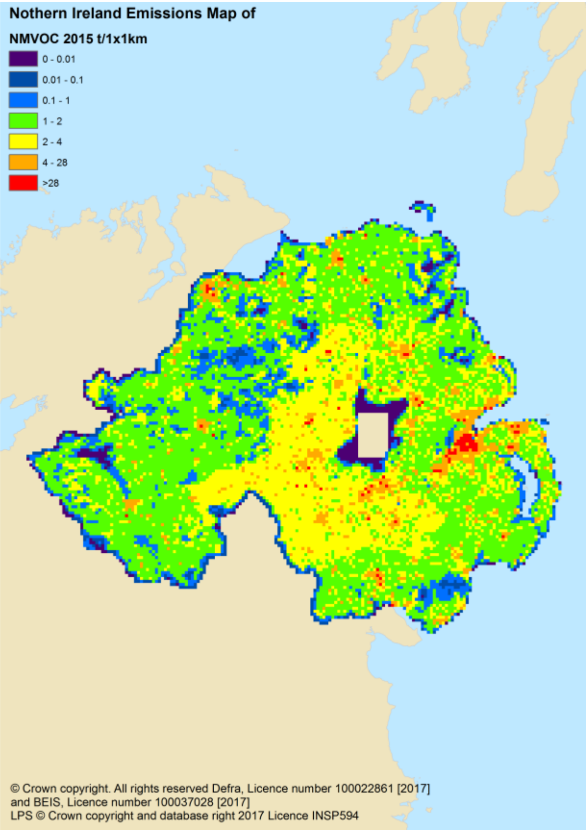


Figure 58 – PM_{10} Emissions in Northern Ireland, 2015

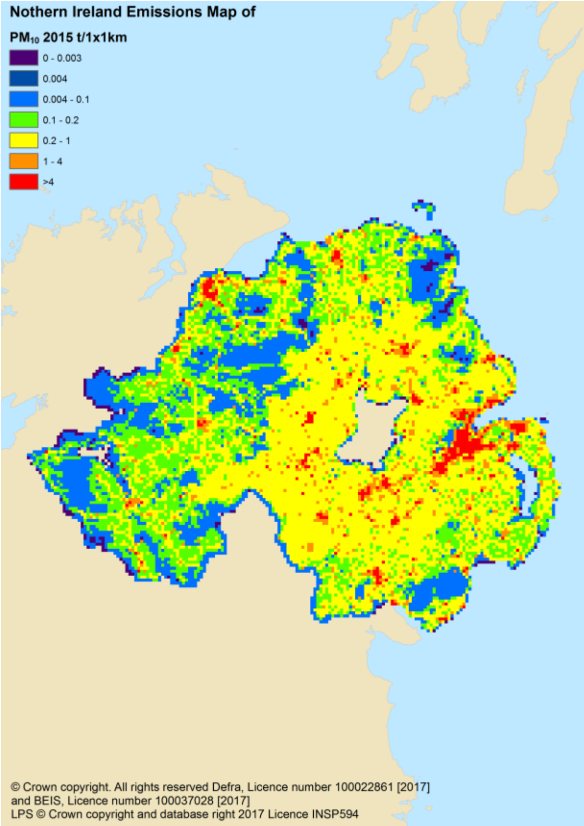


Figure 59 – SO_2 Emissions in Northern Ireland, 2015

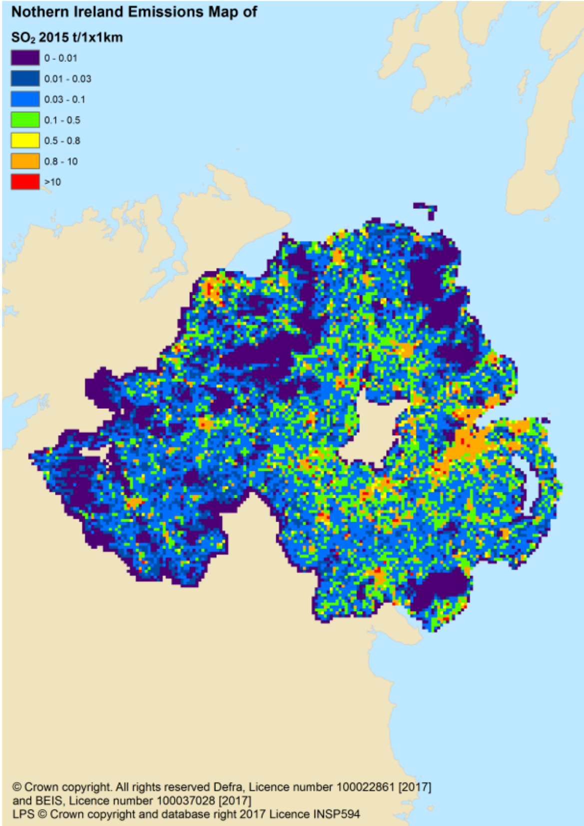
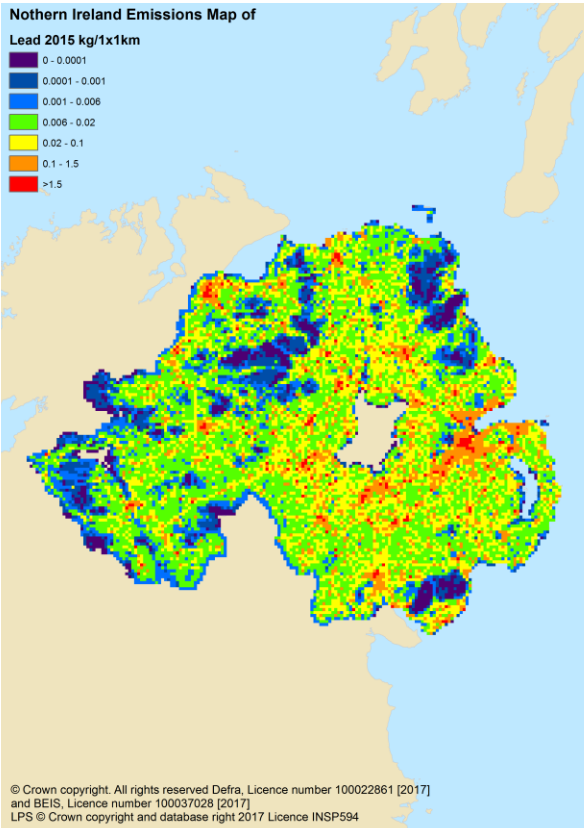


Figure 60 – Pb Emissions in Northern Ireland, 2015



Appendix A Background to Inventory Development

The following sections provide further detail on the background of the air quality pollutant inventory development for the Devolved Administrations. This is supporting information for Section 1.1 of the main report.

Overall air quality in the UK is currently estimated to be better than at any time since the industrial revolution. However, air pollution is still estimated to reduce the life expectancy of every person in the UK. The estimated burden in the UK of anthropogenic particulate matter air pollution in 2010 as a loss of life expectancy from birth is approximately six months. The burden as an effect on mortality in 2010 was equivalent to nearly 29,000 deaths in the UK at typical ages (COMEAP, 2010) and an associated loss of total population life of 300,000 life-years (PHE, 2014). The policies described below, which aim to improve air quality, are currently in place in the UK.

A.1 National Emissions Ceilings Directive

Within the EU, the National Emission Ceilings Directive (NECD) was agreed in 2001. It sets emission ceilings to be achieved from 2010 onwards for each Member State for the same four pollutants in the original Gothenburg Protocol, which cause harm to people’s health and to the natural environment: sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds and ammonia. The UK met all four of its emissions ceilings by 2010, and continues to do so.

The European Commission has since revised the NECD, repealing the original Directive and replacing it with a new legislative instrument (Directive 2016/2284/EU) which ensures the emissions ceilings originally set continue till 2020. In addition, new national emission reduction commitments will be applicable from 2020 and 2030 onwards for SO_2, NO_X, NMVOC, NH_3 and $PM_{2.5}$, so as to cut the health impact attributed to air pollution by approximately half when compared to 2005.

A.2 Gothenburg Protocol

The 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) aimed at addressing photochemical pollution, acidification and eutrophication. The Protocol to Abate Acidification, Eutrophication and Ground-level Ozone was adopted in Gothenburg in December 2000 (Gothenburg Protocol). It incorporates several measures to facilitate the reduction of emissions:

- Emission ceilings are specified for sulphur, nitrogen oxides, ammonia and NMVOCs, which were to be attained by 2010 and all subsequent years;
- 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.

The Gothenburg Protocol was amended in 2012 to include national emission reduction commitments (expressed as percentage reduction from emission levels in 2005) to be achieved in 2020 and beyond. Several of the Protocol’s technical annexes were also revised with updated sets of emission limit values for both key stationary sources and mobile sources, as well as the addition of emission reduction commitments for $PM_{2.5}$.

A.3 Industrial Emissions Directive

The Industrial Emissions Directive (2010/75/EU) entered into force in 2011 and aims to minimise pollution from applicable industrial sources throughout the EU. This Directive integrated seven existing pieces of legislation. Operators of particular industrial installations are required to obtain an integrated permit from the Environment Agency, Scottish Environment Protection Agency, Natural Resources Wales or the Northern Ireland Environment Agency.

A.4 Heavy Metals Protocol

The LRTAP Convention 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 Technology (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 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 emissions of particulate matter and of the specific heavy metals cadmium, lead and mercury applicable for certain combustion and other industrial emission sources releasing them into the atmosphere. The emission source categories for the three heavy metals were also extended to the production of silico- and ferromanganese alloys.

A.5 Persistent Organic Pollutants (POPs) Protocol

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) 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 Protocol was amended in 2009 to include seven new substances and implement revised obligations for some substances as well as emission limit values (ELVs) for waste incineration.

A.6 Sulphur Content of Liquid Fuels Directive

The EC's Directive to limit 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 main impact of these regulations has been to gradually drive down the maximum sulphur content of refinery products, with the 2007 Regulations requiring that gas oil has a maximum 0.1% content Sulphur by mass from January 2008 onwards. 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 (1A3b) and other sources where petroleum-based fuels are dominant.

A.7 Air Quality Strategy for England, Scotland, Wales and Northern Ireland

The UK Government leads on the UK's input to International and European legislation relating to Air Quality, with input from the Scottish Government, Welsh Government and Northern Ireland Government. Linked to the requirements of the EU Directives, the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets 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).

These standards relate to the quality of air, whilst the objectives are policy targets for the restriction of levels at which particular substances are present in the air. The aim of the strategy is to reduce concentrations of air pollutants to avoid unacceptably higher impacts on human health and ecosystems.

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

The Air quality plans for nitrogen dioxide form the government's plan for reducing nitrogen dioxide emissions in the UK's towns and cities as part of its commitment for cleaner air.

The air quality plans set out targeted local, regional and national measures to ensure that UK air will be cleaner than ever before. This will build on significant improvements in air quality in recent decades and fulfil the UK's environmental responsibilities, benefiting health and making cities better places to live and work.

The documents include 37 zone plans, a UK overview document, a list of national measures and a technical report. High resolution maps showing the modelled effects of the measures by 2020 and 2025 can be found on the UK Air website (UK-AIR, 2017).

A.9 EU Air Quality Directive

The Directive on Ambient Air Quality and Cleaner Air for Europe (2008/50/EC) sets concentration limit values for seven pollutants, including NO_X, SO_2, PM_{10} and CO and an exposure reduction target for $PM_{2.5}$. The Fourth Daughter Directive (2004/107/EC), under the now repealed Air Quality Framework Directive, set target values for a further five substances (heavy metals and polycyclic aromatic hydrocarbons). Member States are required to submit annual reports to the European Commission on whether the concentration limits have been achieved within their respective areas and to develop management plans where they are not. 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.

The 2008 Directive was transposed into UK law by the Air Quality Standards Regulations (2010) and their equivalents for Scotland, Wales and Northern Ireland.

Appendix B Inventory Methodology

This Appendix provides further detail on how the inventory is compiled, and the data sources that are used during compilation. This information supports Section 1.3 of the main report.

The disaggregation of air quality (AQ) pollutant emissions across the four Devolved Administrations (DAs) of the UK is part of a programme of on-going data and methodology improvement, to provide emission inventories for the Devolved Administrations. This programme spans both greenhouse gas and air quality 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 quality pollutants, the data available for 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 Business, Energy & Industrial Strategy (BEIS) within the quarterly Energy Trends publication (BEIS, 2016b) 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 domestic.

These BEIS 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 (formerly Transco). 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 zones 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 estimates available for 2005 to 2015.

The BEIS sub-national energy statistics are National Statistics and are revised and improved each year through targeted sector research aimed at reducing uncertainties in the modelling approach. 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 regions. 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 BEIS 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 Industrial Emissions Directive (IED). Major sources include power stations, cement and lime kilns, iron & steel works, aluminium and other non-ferrous metal plant, chemical industries. These data are not available across the full time series from 1990, as the regulatory reporting regimes were developed in the late 1990s (in England, Wales and Northern Ireland) and early 2000s (in Scotland).

- Emissions from **oil and gas terminals** and offshore platforms and rigs, are based on operator estimates reported to the BEIS Offshore Inspectorate team (DECC Offshore Inspectorate, 2016)) 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 (Misselbrook, Suttom, & Scholefield, 2004). Emissions are affected by a large number of factors, including animal species, age, weight, diet, housing and manure management systems, and environmental conditions. As such, the interpretation and extrapolation of experimental data is problematic, making emission estimates uncertain.
- Emissions from **waste disposal activities** are estimated based on modelled emissions from the UK air quality inventory (Defra, 2012) 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.

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., 2016).

In many source sectors, there are insufficient local activity data available back to 1990 or earlier, and assumptions and extrapolations of available datasets have frequently been used to present a time series of air quality pollution emissions.

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. There are step-changes in data availability during the time series, such as installation-specific fuel use data from major industrial plant under EU ETS (from 2005 onwards) and sites regulated under Environmental Permitting Regulations / Industrial Emissions Directive (EPR/IED) (1998 onwards for England and Wales, 1999 onwards for Northern Ireland, and in 2002 and from 2004 onwards for Scotland).

These data sources are used, where possible, to inform the back-casting of emission estimates, but there remains a greater level of uncertainty in emission estimates from the earlier part of the time series compared to more recent years. Furthermore, the data quality from these environmental regulatory systems has evolved over the years as monitoring, reporting and quality checking methods and protocols have developed. This also impacts upon the accuracy of the reported emissions of air quality pollutants which are used within inventory compilation, such that more recent data are likely to be more accurate. The uncertainties in the Devolved Administrations' air quality inventories are discussed in more detail in Appendix D.

There are a number of resources that have been used to analyse 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;
- Generic parameters and proxy data such as population or economic indicators such as GVA data.

These main resources used within the DA air quality 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 EU Emissions Trading System (EU 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).

Through analysis of the time series of data and review of the latest emission estimates, the point source data is amended as appropriate to fill in gaps and rectify any errors. 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 and so on. 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 largely based on energy use and emissions data derived from regulatory agency sources that are subject to quality checking and (in the case of EU 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 Quality Pollutant Inventory. The maps are compiled at a 1km resolution and are produced annually for the most recent NAEI database. The mapped emissions data are available on the NAEI web site at: http://naei.defra.gov.uk/data/mapping. For a more detailed description of the integration of point source data analysis and the development of UK emission maps, see (Tsagatakis, et al., 2016).

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, domestic, 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 upon the reliability of emission inventory estimates. In this study, the project team has focussed resources 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.

The table below provides a summary of the mapping grid data availability for each sector 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 Quality 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 EU ETS. Environment Agency (2016a,b), SEPA (2016a,b), Natural Resources Wales (2016a,b) NIEA (2016a,b). Exceptions are minor fuels: sewage gas use is estimated based on UK-wide estimates disaggregated using DA share of UK population (ONS, 2016); landfill gas use is based on the elution of methane from landfills from the MELMod model (Ricardo, 2015).
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 UKPIA (2016).
1A1c	Coke & SSF production (all fuels)	Point source data provided by plant operators (see 1A1a). Regional iron & steel production and fuel use data (ISSB, 2016). UK fuel use data from BEIS (2016a).
	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 (2016).
	Gas production, downstream network (all fuels)	EU ETS installation data for natural gas use from 2005-2015. All other years estimated based on the DA share from the 2005 EU ETS data. Environment Agency (2016b), SEPA (2016b), Natural Resources Wales (2016b), NIEA (2016b) Colliery methane use based on deep mined coal production, data from the Coal Authority (2016).
	Upstream oil & gas, including gas separation plant (all fuels)	BEIS Offshore Inspectorate (2016) EEMS inventory. Point source data for NO_X, SO_2, NMVOC. (CO and PM_{10} assumed same as SO_2.)
1A2a	Blast furnaces & sinter plant	Point source data provided by plant operators (see 1A1a), supplemented by site-specific breakdown of emissions by source from Tata Steel (2014).

NFR Sector	Source	Disaggregation Method
	Iron & steel combustion plant (all fuels)	Regional iron & steel production and fuel use data (ISSB, 2016) used to inform estimates to 2004. Data to disaggregate emissions from 2005 onwards is proved by the operators of integrated steelworks themselves.
1A2b	Combustion in non-ferrous metals manufacturing industry	Pollution Inventory (EA 2016a, SEPA 2016a, NRW 2016a, NIEA 2016a), EU ETS (EA 2016b, SEPA 2016b, NRW 2016b, NIEA 2016b) IDBR and employment data (ONS, 2016). 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. Detailed analysis conducted for 2008-2015; 1A2b,c,d,e 1990-2008 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 (BEIS, 2016) 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.
1A2g	Refractory & ceramic production	Regional GDP data (ONS, 2016).
	Other industrial combustion (oils)	Sub-national energy statistics, BEIS (2016b), and analysis of point source data derived from EU ETS and IED data. Environment Agency (2016a,b), SEPA (2016a,b), NRW (2016a, b) NIEA (2016a,b). 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 (2016), Northern Gas Networks (2016), Scotia Gas Networks (2016), Wales & West Utilities (2016), Airtricity (2016), Firmus Energy (2016), Vayu (2016). Sub-national energy statistics, BEIS (2016b), and analysis of point source data derived from EU ETS and IED data. Environment Agency (2016a,b), SEPA (2016a,b), NRW (2016a,b), NIEA (2016a,b).
	Industrial off-road machinery (all fuels)	Disaggregated by mapping grids from 2007-2010
1A3ai (i)	Aircraft – international take-off and landing (all fuels)	CAA (2016), UK airport statistics. All take-off and landing cycle emissions for each flight assigned to DA of origin airport.
1A3aii (i)	Aircraft – domestic take-off and landing (all fuels)	
1A3bi to 1a3bvii	Road Transport	Vehicle km, DfT, NI Department for Regional Development (DRD) Emission factors: Boulter et al. (2009) COPERT 4 (EEA, 2013b) Fuel efficiency: Road Freight Statistics, DfT (2016) Composition of fleet: Vehicle Licensing Statistics Report, DfT (GB) Dept. of Regional Development (NI). Traffic data: National Traffic Census, DfT (England, Scotland, Wales: 1990-2015) Dept. of Regional Development (NI: 1990-1999), Traffic Census Report (NI: 2000), Vehicle Kilometres of Travel Survey of Northern Ireland Annual Report (NI: 2001), Traffic and Travel Information, DRDNI (NI: 2002- 2015) Fuel consumption: Digest of UK Energy Statistics (1990-2015),
1A3c	Railways: intercity, regional and	UK specific emission factors in g/vehicle (train) km are taken from the Department

NFR Sector	Source	Disaggregation Method
	freight	for Transport's Rail Emissions Model (REM) for different rail engine classes based on factors provided by WS Atkins Rail. Data from UKPIA on sulphur content of gas oil. Gas oil consumption data from Office of Rail Regulation for passenger and freight trains for 2005-2009 combined with trends in train km to estimate consumption for other years. Train km data from REM are used to provide the breakdown between train classes. Fuel consumption: Digest of UK Energy Statistics (1990-2015)
1A3dii	Coastal shipping (all fuels)	Port movement data, DfT (2016b) Maritime Statistics. Estimates for all inland waterways are based on population (ONS, 2016).
1A3eii	Aircraft support vehicles (gas oil)	Regional aircraft movements, DfT (2016d)
1A4a	Railways – stationary combustion	Sub-national energy statistics, BEIS (2016b). Natural gas use all in England.
	Industrial & commercial combustion	Sub-national energy statistics, BEIS (2016b), 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 coal, anthracite, petroleum fuels, natural gas, analysis is from sub-national energy statistics, BEIS (2016b) and Housing Condition Survey data. Domestic peat combustion data from CEH (Personal communication, 2016). Northern Ireland gas use in the residential sector is based on estimates from all energy suppliers in Northern Ireland (Airtricity, Firmus Energy, Vayu; all 2016). Domestic wood combustion mapping grids based on a BEIS domestic wood survey (BEIS, 2016c)
1A4bii	Household and gardening mobile machinery (all fuels)	Population data (ONS, 2016)
1A4ci	Agriculture – Stationary combustion	Agricultural employment data, Defra (2015a) used for allocation of solid and gaseous fuels. Regional energy statistics, BEIS (2016b) 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 (2007).
1A4cii	Agriculture – mobile machinery	Agricultural off-road mapping grid, with overall petroleum fuel allocations constrained to the BEIS sub-national energy data (BEIS, 2016b)
1A4ciii	Fishing vessels	Port movement data, DfT (2016b) Maritime Statistics
1A5b	Military aircraft and naval shipping	Regional GDP data (ONS, 2016).
1B1a	Deep-mined coal	Regional deep mine production, Coal Authority (2016). Emissions from closed coal mines derived from WSP report (Fernando, 2011)
1B1b	Charcoal, Coke & SSF production	Charcoal production estimates based on regional GDP data (ONS, 2015). Coal feed to coke ovens, ISSB, WS, BEIS and (1999-2004) PI. 2005 onwards: EU ETS (EA 2016b, SEPA 2016b, NRW 2016b, NIEA 2016b)
	Iron & steel flaring	Coal feed to coke ovens, ISSB, WS, BEIS and (1999-2004) PI. 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 unallocated.
	Upstream oil & gas: process emissions, onshore oil loading, oil terminal storage	Emissions derived from the BEIS Offshore Inspectorate (2016) EEMS point source dataset, with extrapolations back to cover 1990, 1995 where data gaps are evident.

NFR Sector	Source	Disaggregation Method
1B2aiv	Refinery process emissions (drainage, tankage, general)	Point source data provided by plant operators (see 1A1a), UKPIA (2016) 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 UKPIA (2016).
	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, 2016)
	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 (BEIS Offshore Inspectorate, 2016) and PI/SPRI (Environment Agency 2016a; SEPA 2016a; NRW 2016a)
	Gas leakage from supply infrastructure	Leakage data provided by gas network operators: National Grid (2016), Northern Gas Networks (2016), Scotia Gas Networks (2016), Wales & West Utilities (2016), Airtricity (2016).
1B2c	Upstream oil & gas: flaring & venting	Emissions derived from the EEMS dataset (BEIS Offshore Inspectorate, 2016), with extrapolations back to cover 1990, 1995 where data gaps are evident.
	Refinery flaring	Point source data provided by plant operators (see 1A1a) supplemented by data from the trade association (UKPIA, 2016)
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 are assumed equal across all known operating plants in England and Scotland (it is believed that there is no production in Wales and Northern Ireland).
2A5	Construction, asphalt manufacture	Regional GDP data (ONS, 2016).
	Quarrying (aggregates)	Quarries mapping grid.
	Lead mining	All emissions in England.
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 and ceramics manufacture based on regional GDP statistics (ONS, 2016).
2B2	Nitric acid production	Point source data provided by plant operators (see 1A1a). Now all England.
2B6	Chemical industry – titanium dioxide	All emissions in England
2B7	Chemical industry – soda ash manufacture	All emissions in England
2B10	Ship purging	All emissions unallocated (i.e. offshore)
	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

NFR Sector	Source	Disaggregation Method
		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, 2016)
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, 2016).
	Alumina production	All emissions in Scotland.
	Process emissions from: blast furnaces, EAFs, BOFs, 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 (2014), SSI (2014) and the ISSB (2016)
	Flaring & stockpile emissions at iron & steelworks	Regional iron & steel production and fuel use data (ISSB, 2016).
	Non-ferrous metal processes	All emissions in England
	Foundries	Foundries mapping grid
2D3a	Aerosol and non-aerosol products (cosmetics & toiletries, household products, paint thinners),	Population data, ONS (2016).
	Agrochemical use	Arable mapping distribution grid
2D3b	Road dressings and bitumen use	Road dressing mapping grid.
	Asphalt manufacture	Regional GDP data (ONS, 2016).
2D3d	Trade & retail decorative paints,	Population data, ONS (2016).
	Industrial coatings: Aircraft, agricultural and construction vehicles, coil coating, leather coating	Regional GDP data (ONS, 2016).
	Industrial coatings: wood, metal, plastic, marine, vehicle refinishing.	Various coatings mapping distribution grids are used based on surveys of locations of such processes.
	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 (2016).
	Industrial surface cleaning	Industrial employment mapping distribution grid.
	Leather coating and degreasing	Regional GDP data (ONS, 2016).
2D3f	Dry cleaning (solvent use)	Dry cleaning mapping grid
2D3g	Rubber & plastic products	Population data, ONS (2016).
	Industrial coating manufacture: adhesives, inks, solvents and	Various industry-specific coatings mapping distribution grids

NFR Sector	Source	Disaggregation Method
	pigments, tyre manufacture	
2D3h	Printing – flexible packaging, publication gravure	Point source data provided by plant operators (see 1A1a).
	Other printing sources	Population data, ONS (2016).
2D3i	Seed oil extraction	All emissions in England
	Wood impregnation – creosote, LOSP	Wood impregnation mapping grid
	Solvent Use	Population data, ONS (2016).
2G	Cigarette smoking and fireworks	Population data, ONS (2016).
2H1	Paper production	GDP data, ONS (2016)
2H2	Cider & wine manufacture, sugar beet processing and sugar manufacture	All emissions are in England.
	Spirit manufacture	Point source data provided by plant operators (see 1A1a).
	Brewery emissions	Brewing mapping grid
	Food & drink process industries: meat & fish, margarine, cakes & biscuits, animal feed, coffee roasting	Population used to disaggregate emissions.
	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, 2016).
2I	Wood product process emissions	Wood coating mapping grid.
3A	Manure management	Ammonia DA splits for manure management, based on regional emissions data for 1990, 1995, 2000-2015 provided by Rothamsted Research (2016), 2013 Mapping data from CEH (Dragosits U. et al., 2014) and population data, ONS (2016).
3B	Inorganic N fertilizers	Ammonia DA splits for fertiliser use, based on regional emissions data for 1990, 1995, 2000-2015 provided by Rothamsted Research, population data, ONS (2016).
3D1	Agricultural soil emissions	Ammonia DA splits for agricultural soils, based on regional emissions data for 1990, 1995, 2000-2015 provided by Rothamsted Research (2016)
	Field burning of agricultural wastes	Field burning estimates from Rothamsted Research (2016)
3F	Landfills	Regional landfill MSW disposal data (www.wastedataflow.org), combined with DA-specific landfill model developed by the Defra Waste team (Defra, 2012b), and Scotland-specific landfill data.
5A	Composting	Population data, ONS (2016).
5B	Incineration: MSW, crematoria, chemical waste	Point source data provided by plant operators (see 1A1a).

NFR Sector	Source	Disaggregation Method
5C1	Incineration: Clinical waste, sewage sludge	Population data, ONS (2016).
	Incineration: animal carcases	Agriculture mapping grid.
	Foot & mouth pyres	Data on livestock disposal, NAO (2002).
	Open-burning of waste	Population data, ONS (2016).
5C2	Small scale waste burning	Population data, ONS (2016)
5D1	Sewage sludge decomposition	Population data, ONS (2016).
6A	Other sources: accidental fires, bonfires, cigarettes, fireworks, infant emissions from nappies, domestic pets	Population data, ONS (2016).
	Non-agricultural horses, professional horses	Driver for non-agricultural horses based on activity data time series from Rothamsted Research and CEH (2016)
	Parks, gardens and golf courses	Data on non-fuel fertiliser use, Rothamsted (2016)

B.2.3 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 (back to 1990) 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 UK Transco (Transco, 2016), other gas network operators, the Coal Authority (Coal Authority, 2016) and the Department for Business, Energy & Industrial Strategy (BEIS, 2016b). The UK energy mapping team has been involved in the on-going development of the BEIS sub-national energy statistics which provide limited data from 2004 to 2015. These data are used to underpin many of the AQ pollutant emission estimates from small-scale (non-regulated) combustion sources such as domestic, commercial, public administration and small-scale industrial sectors. Back-casting the fuel use trends to 1990 has drawn upon available UK-level data and trends supplemented by analysis of additional data, such as Housing Condition Survey data, to ensure that significant changes are represented in the inventories (e.g. to reflect the development of the gas supply infrastructure in Northern Ireland since 1999).
- 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, 2016) database of flight movements, fuel use data (BEIS), aircraft fleet information (CAA, 2016) 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, 2016).

- **Regional iron and steel production data**, and regional fuel use data in the iron and steel industry (Tata Steel, 2014), (ISSB, 2016).
- Site-specific emissions data split by combustion and process sources for all **UK refineries**, and refinery production capacities (UKPIA, 2016).
- Site-specific cement production capacities and UK-wide **cement industry** fuel use data (Mineral Products Association, 2016).
- 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** (Office of National Statistics) (ONS, 2016).

Appendix C 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 Informative Inventory Report (IIR) (Wakeling, et al., 2017). The most significant changes for each pollutant in the most recent inventory for 2014 are given in the tables below (note the shading within columns indicates magnitude of absolute emission recalculations).

Table 7 - Recalculations to 2014 estimates for ammonia between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**8.97**	**5%**	**0.12**	**0%**	**-0.03**	**0%**	**0.61**	**2%**
Agriculture	Minor revisions to sheep waste management time-series.	-0.06	0%	-0.03	0%	-0.04	0%	0.01	0%
Energy Industries	-	0.00	2%	0.00	2%	0.00	2%	0.00	2%
Fugitive	-	0.00	0%	0.00	0%	0.00	-1%	0.00	0%
Industrial Combustion	Update of emission factor used for wood combustion in unallocated industrial processes, reverting to default EMEP/EEA factors over UK-specific.	0.53	61%	0.03	50%	0.05	61%	0.07	171%
Industrial Processes	Very minor revisions to ammonia use in the chemical industry time-series.	0.18	6%	0.01	23%	0.02	26%	0.01	202%
Other	Reallocation of professional horse wastes causes the majority of these changes.	2.25	18%	0.21	13%	0.14	8%	0.08	14%
Solvent Processes	-	0.00	0%	0.00	0%	0.00	0%	0.00	0%
Transport Sources	Minor revisions to the road transport time-series for car use on motorways and rural roads.	0.06	1%	0.00	1%	0.00	1%	0.00	0%
Waste	Emissions revised upwards due to the introduction of anaerobic digestion from non-manure digestates into the national totals rather than as memo items. Emissions revised upwards across the time-series, now using best estimates for MSW and sewage sludge landfilled. Integration of Scotland-specific MELMod landfill model has reduced emissions from Scotland overall.	6.63	69%	0.36	24%	0.17	19%	0.48	38%

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions.	-0.45	-23%	-0.46	-80%	-0.36	-70%	-0.04	-21%

Table 8 - Recalculations to 2014 estimates for carbon monoxide between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**-253.98**	**-17%**	**-57.31**	**-34%**	**-38.29**	**-13%**	**-13.29**	**-17%**
Agriculture	-	0.00		0.00		0.00		0.00	
Energy Industries	Time-series revisions due to the revisions of calorific values of wood in the time-series	1.04	2%	-0.61	-8%	-0.44	-7%	0.01	1%
Fugitive	-	-0.02	0%	0.00	0%	0.04	0%	0.00	-4%
Industrial Combustion	Changes primarily due to revisions in emissions from wood combustion in unallocated industrial processes. Revisions to emission factors were applied to the combustion of wood and other biomass, with default factors now taken in preference to UK-specific. Revisions to the wood activity time-series due to revisions to calorific values in DUKES	-195.41	-34%	-13.85	-35%	-12.74	-9%	-15.77	-53%
Industrial Processes	Minor revisions to the secondary lead production time-series	0.05	0%	0.00	7%	0.08	0%	0.00	258%
Other	Whole time-series corrections to the residential wood combustion time-series causes changes to the bonfire night time-series.	0.55	5%	0.05	5%	0.03	5%	0.02	4%
Transport Sources	Emissions from cars and light duty vehicles due to changes in methodology to account for emission degradation (switching from TRL method to COPERT method)	-54.53	-13%	-6.31	-15%	-3.28	-13%	-1.04	-6%

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Waste	Revision of small-scale waste burning time-series to incorporate a more realistic time-series for waste burnt on domestic grates based on numbers of households using solid fuels as a main fuel.	-1.97	-16%	-0.19	-14%	-0.11	-18%	-0.07	-18%
Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions.	-3.71	-1%	-36.40	-46%	-21.86	-34%	3.56	13%

Table 9 - Recalculations to 2014 estimates for nitrogen oxides between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**10.12**	**1%**	**-2.75**	**-3%**	**0.44**	**1%**	**-0.39**	**-1%**
Agriculture	-	0.00		0.00		0.00		0.00	
Energy Industries	Changes to the coal emission factor due to a trivial change in the pollution inventory from minor corrections and default emission factors. Scotland emissions reduced due to the integration of Scotland-specific landfill data and therefore revisions to landfill gas emissions in this sector.	3.18	2%	-3.19	-11%	-0.07	0%	0.08	2%
Fugitive	Minor changes to time-series.	-0.03	-15%	0.00	0%	0.01	7%	0.00	-4%
Industrial Combustion	Gas oil use in industrial off-road machinery has been revised in 2014 primarily due to revisions in DUKES, but also due to updates to input drivers and adjustments made to fully reconcile against DUKES. DUKES revisions also cause large recalculations to emissions from combustion at chemical plants for all DAs.	-9.01	-7%	-0.55	-4%	-0.20	-2%	-0.12	-1%
Industrial Processes	Minor changes to time-series.	-0.06	-6%	0.00	51%	0.05	8%	0.00	50%
Other	Minor changes to time-series	0.02	0%	0.00	0%	-0.01	-1%	-0.01	-3%
Transport Sources	Revisions of the later time-series for light goods vehicles to use latest COPERT emission factors.	17.77	6%	1.91	5%	1.20	6%	-0.09	-1%

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Waste	Minor changes to time-series.	-0.05	-4%	0.00	-2%	0.01	30%	0.00	-3%
Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions. Revisions to DUKES data used for off-road mobile machinery used in agricultural processes.	-1.71	-3%	-0.92	-8%	-0.56	-9%	-0.25	-5%

Table 10 - Recalculations to 2014 estimates for NMVOCs between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**32.57**	**6%**	**-8.77**	**-6%**	**-2.52**	**-5%**	**0.61**	**2%**
Agriculture	Minor recalculations to manure management time-series.	1.03	2%	0.25	2%	-0.11	-1%	0.00	0%
Energy Industries	Minor revisions.	-0.06	-2%	-0.03	-8%	0.09	19%	0.00	1%
Fugitive	Inclusion of NMVOC emissions from deep-mined coal in the national total causes the majority of this change. Minor revisions to the gas leakage time-series.	11.09	15%	0.59	3%	0.75	9%	0.00	0%
Industrial Combustion	2014 revisions to DUKES gas oil use in industrial off-road machinery causes revisions to the industrial combustion sector.	-1.32	-8%	-0.12	-7%	0.05	3%	-0.04	-7%
Industrial Processes	Updates to the mapping grid used to disaggregate emissions from maltings.	3.71	10%	-3.59	-5%	0.19	8%	-0.12	-5%
Other	Minor revisions.	0.04	3%	0.00	2%	0.00	2%	0.00	2%
Solvent Processes	Update of mapping grids used in industrial coatings cause recalculations to several industrial processes time-series.	11.59	4%	-2.34	-7%	-1.24	-7%	0.18	2%
Transport Sources	Revisions to 2014 vkm data causes recalculations to road transport sector	0.64	2%	0.06	2%	0.04	2%	-0.01	0%

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Waste	Incorporation of Scotland-specific landfill MELMod data (recalculations offset by increasing England emissions) cause changes to landfill NMVOC emissions. Across all DAs, revision of small-scale waste burning time-series to incorporate a more realistic time-series for waste burnt on domestic grates based on numbers of households using solid fuels as a main fuel.	-1.01	-20%	-0.23	-32%	-0.07	-28%	-0.04	-25%
Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions.	6.86	22%	-3.36	-44%	-2.21	-34%	0.64	24%

Table 11 - Recalculations to 2014 estimates for PM_{10} between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**5.31**	**5%**	**-5.67**	**-32%**	**-3.08**	**-20%**	**0.69**	**10%**
Agriculture	Revision to the number of laying hens. 2016 EMEP/EEA Guidebook emission factors forces reversion to a Tier 1 methodology, and causes recalculations to cattle and pig wastes time-series.	-1.18	-11%	-0.26	-12%	-0.06	-4%	-0.12	-6%
Energy Industries	Minor revisions.	0.06	1%	-0.08	-12%	-0.01	-1%	0.00	1%
Fugitive	Minor revisions.	0.00	0%	-0.03	-5%	0.00	0%	0.00	-3%

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Industrial Combustion	Changes primarily due to revisions in emissions from wood combustion in unallocated industrial processes. Revisions to emission factors were applied to the combustion of wood and other biomass, with default factors now taken in preference to UK-specific. Revisions to the wood activity time-series due to revisions to calorific values in DUKES. DUKES revisions to gas oil in off-road mobile machinery and coal use in the chemical industry also contribute to recalculations.	3.73	32%	0.20	22%	0.23	23%	0.26	25%
Industrial Processes	Updated to mapping grid and corrections to activity data for wood products manufacture time-series for the UK causes most of the observed recalculation in this sector.	0.59	3%	-0.35	-19%	-0.22	-7%	-0.00	0%
Other	Minor revisions.	0.51	25%	0.05	26%	0.03	27%	0.02	26%
Solvent Processes	Update to mapping grids for wood and industrial metal & plastic coatings.	0.38	10%	-0.10	-24%	-0.06	-28%	0.01	8%
Transport Sources	Minor revisions.	0.11	1%	0.01	0%	0.01	1%	-0.02	-2%
Waste	Revision of small-scale waste burning time-series to incorporate a more realistic time-series for waste burnt on domestic grates based on numbers of households using solid fuels as a main fuel.	-0.36	-18%	-0.04	-17%	-0.02	-19%	-0.01	-20%
Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions.	1.48	4%	-5.06	-60%	-2.97	-44%	0.55	22%

Table 12 - Recalculations to 2014 estimates for sulphur dioxide between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Overall change		**-2.50**	**-1%**	**-0.74**	**-2%**	**0.90**	**3%**	**0.06**	**1%**

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)	Change in 2014 (kt)	Change in 2014 (%)
Energy Industries	Incorporation of Scotland-specific landfill data has caused recalculations to the emissions from landfill gas used in power stations. Reductions in SO2 emissions as a result are offset by the England inventory.	0.49	0%	-0.47	-2%	-0.01	0%	0.01	0%
Fugitive	Minor revisions.	-0.07	-1%	-0.06	-16%	0.07	5%	0.00	
Industrial Combustion	DUKES revisions to coal combustion at chemical plants in 2014 causes recalculations.	-2.84	-5%	-0.10	-4%	1.30	17%	-0.04	-1%
Industrial Processes	Minor revisions.	-0.07	-1%	0.00	0%	0.00	1%	0.00	
Other	Minor revisions.	0.02	0%	0.00	0%	0.00	-1%	0.00	-2%
Transport Sources	Minor revisions.	-0.01	0%	0.00	0%	0.00	0%	0.00	0%
Waste	Minor revisions.	-0.04	-6%	0.00	-6%	0.00	-1%	0.00	-7%
Residential, Commercial & Public Sector Combustion	Revision to DUKES for fuel oil use in miscellaneous industrial/commercial combustion and improvements to the extrapolation of petroleum coke use in solid smokeless fuel production data cause recalculations in 2014.	0.03	0%	-0.10	-4%	-0.46	-9%	0.10	5%

Table 13 - Recalculations to 2014 estimates for lead between previous and current inventory submissions

Category	Reason for the change in emissions	England		Scotland		Wales		Northern Ireland	
		Change in 2014 (t)	Change in 2014 (%)	Change in 2014 (t)	Change in 2014 (%)	Change in 2014 (t)	Change in 2014 (%)	Change in 2014 (t)	Change in 2014 (%)
Overall change		**3.77**	**8%**	**-0.94**	**-24%**	**0.15**	**1%**	**0.06**	**3%**
Energy Industries	Retrospective addition of a biomass burning plant in England causes an increase in straw emissions.	0.11	4%	0.00	0%	0.00	0%	0.00	0%
Fugitive	-	0.00	0%	0.00		0.00	0%	0.00	
Industrial Combustion	Change of methodology to calculation emission factor calculations to assume metal emissions from lime kilns are zero.	-0.42	-4%	0.08	9%	0.06	7%	-0.12	-9%
Industrial Processes	Updated to mapping grid and corrections to activity data for wood products manufacture time-series for the UK causes most of the observed recalculation in this sector.	3.66	14%	-0.83	-55%	0.22	2%	0.13	172%
Other	Minor revisions.	0.00	0%	0.00	0%	0.00	-1%	0.00	-3%
Transport Sources	Minor revisions.	0.00	0%	0.00	0%	0.00	0%	0.00	-3%
Waste	Minor revisions.	0.00	-4%	0.00	-3%	0.00	8%	0.00	-3%

Residential, Commercial & Public Sector Combustion	Domestic combustion time-series has been updated with a whole suite of new mapping grids. The most important change is to the domestic wood combustion time-series, where a new, more comprehensive survey undertaken by BEIS was incorporated into the inventory, causing whole time-series revisions.	0.42	11%	-0.19	-28%	-0.13	-20%	0.05	14%

Appendix D Uncertainties

The following sections provide information on the key characteristics of each pollutant based on the uncertainty assessments carried out for the UK AQ inventory, which uses both the Tier 1 uncertainty aggregation method and a Tier 2 statistical (Monte-Carlo) analysis. This information supports Section 1.4 of the main report. Further details are described in Chapter 1.7 of the "UK Informative Inventory Report 1990 to 2015" (Wakeling, et al., 2017).

An indicative "Uncertainty Rating" is provided for each pollutant that reflects the relative magnitude in uncertainty estimates made for each pollutant at UK level. A 'low' rating implies a lower level of uncertainty in the emission estimates for the pollutant relative to the uncertainty in the estimates for a pollutant with a 'high' rating. A quantitative estimate of uncertainties in the inventories for each pollutant at UK level is given in the "UK Informative Inventory Report 1990 to 2015" (Wakeling, et al., 2017). Quantitative estimates of uncertainties for each Devolved Administration have not been made, but would be higher than the uncertainties at UK level and reflect uncertainties in the spatial distribution of emissions. These are higher for more diffuse sources than point sources. More details on the qualitative uncertainty estimates of the spatially resolved UK inventory are given in Section 5.1 of the 2014 NAEI mapping report (Tsagatakis et al.,2016). The uncertainties in emission estimates may differ for each DA according to the relative mix of emissions from point sources and more diffuse sources in the DA and how this differs from the UK mix for a given pollutant. However, the overall uncertainty ranking of each pollutant at DA level is not likely to be significantly different to the ranking at UK level given below for each pollutant and in Table 1 of the main body of the report.

The following sections refer to causes of uncertainties in emission estimates at UK level.

D.1 Ammonia

Ammonia emission estimates are more uncertain than those for SO_2, NO_X as NO_2 and NMVOC largely due to the nature of the major agricultural sources. Emissions depend on animal type, age, weight, diet, housing systems, waste management and storage techniques. This large number of impacting factors makes interpretation of experimental data difficult and emission estimates uncertain (DOE, 1994). Emission estimates for non-agricultural sources such as wild animals are also highly uncertain. Unlike the case of NO_x as NO_2 and NMVOC, a few uncertain sources dominate the inventory for NH_3 and there is limited potential for error compensation[5].

Uncertainty Rating: **MODERATE**

D.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 boiler. Because of the high uncertainty in emission data for major sources, emission estimates for CO are much more uncertain than other pollutants such as NO_x (as NO_2) and SO_2 which are also emitted mainly from major combustion processes. Unlike the case of NO_x (as NO_2) and NMVOC, a few sources dominate the inventory and there is limited potential for error compensation.

[5] Error compensation refers to the theory that as more contributing sources are identified, there will logically be an increasing chance for lower or upper errors to be cancelled out, reducing the uncertainty in the aggregate total.

<u>Uncertainty Rating</u>: **MODERATE**

D.3 Nitrogen Oxides

NO_x (as NO_2) emission estimates are less accurate than SO_2 because, although they are calculated using measured emission factors, these emission factors can vary much more with combustion conditions; emission factors given in the literature for combustion sources show large variations. 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, significant variations in measured emission factors have been found between vehicles of the same type even when keeping these parameters constant.

From the above, one might expect the NO_x inventory to be very uncertain, however the overall uncertainty is in fact lower than for any pollutant other than SO_2 for a number of reasons:

- While NO_x emission factors are somewhat uncertain, activity data used in the NO_x inventory is very 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. The other extreme is shown by the inventories for PCP, HCH and HCB where one or two sources dominate and the inventories are highly uncertain.
- 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.

<u>Uncertainty Rating</u>: **LOW**

D.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 good emission factors or emission estimates for some sectors (e.g. fugitive sources of NMVOC emissions from industrial processes, and natural sources) and partly due to the absence of good activity data for some sources. Given the broad range of independent sources of NMVOCs, as with NO_x, there is a high potential for error compensation, and this is responsible for the relatively low level of uncertainty compared with most other pollutants in the NAEI.

<u>Uncertainty Rating</u>: **LOW**

D.5 Particulate Matter

The emission inventory for PM_{10} is 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} 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 fugitive sources are particularly uncertain.

Emission estimates for combustion of fuels are generally considered more reliable than those for 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.

***Uncertainty Rating*:** **HIGH**

D.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 domestic sectors, contains accurate emission estimates for the most important sources.

***Uncertainty Rating*:** **LOW**

D.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 very much lower, and derived from a smaller number of sources. The metal processing industries are mainly regulated under the Industrial Emissions Directive (IED) 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 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/IED industries and are unavoidable; the emissions data from IED-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.

***Uncertainty Rating*:** **HIGH**

Appendix E Summary Tables

E.1 Summary Air Quality Pollutant Emission Estimates for England

Table 14 - Summary of air quality pollutant emission estimates for England (1990-2015) *

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ammonia (kt)	Agriculture	197	188	189	188	176	170	168	161	165	161	159	156	147	148	148	148	145	142	150	151
	Transport Sources	0.7	5.8	11.5	13.3	19.2	17.9	16.7	15.3	14.2	13.1	12.2	11.2	10.0	9.5	8.4	7.3	6.2	5.3	4.7	4.3
	Industrial Processes	7.3	7.4	9.1	5.0	3.8	3.8	3.7	3.4	3.4	5.5	5.2	5.0	4.4	4.2	4.5	5.1	4.8	3.5	3.0	2.3
	Waste	6.5	7.7	7.8	8.0	8.2	9.6	9.9	10.4	11.0	11.2	11.2	11.3	10.8	11.3	12.1	13.4	13.3	14.5	16.2	18.1
	Other	12.8	13.2	16.1	16.2	16.1	16.2	16.1	16.5	16.8	16.8	16.8	16.8	17.6	17.5	18.0	18.2	18.6	19.0	18.7	18.9
	Total	**224**	**222**	**233**	**231**	**223**	**218**	**215**	**207**	**211**	**207**	**205**	**200**	**190**	**190**	**191**	**192**	**188**	**185**	**193**	**195**
Carbon monoxide (kt)	Energy Industries	100	91.5	55.4	50.0	59.7	58.6	58.1	64.2	62.3	67.7	67.3	68.5	62.1	55.4	58.5	60.7	71.3	69.3	61.7	54.9
	Industrial Combustion	488	490	441	441	388	429	420	411	426	432	409	409	393	338	315	316	331	348	372	367
	Transport Sources	4,053	3,382	2,717	2,427	2,050	2,073	1,880	1,706	1,558	1,395	1,247	1,076	970	756	644	534	476	411	354	321
	Fugitive	22.5	13.1	13.2	10.7	10.7	6.5	5.0	7.2	4.8	4.7	5.1	4.9	4.7	4.0	4.5	3.6	4.2	4.4	4.1	3.3
	Industrial Processes	225	224	202	224	225	232	194	113	105	96	124	121	114	78.1	74.7	74.0	75.0	77.9	71.8	62.7
	Other	293	30.8	29.1	29.0	28.0	44.5	29.2	28.7	27.4	26.6	28.0	28.3	26.6	25.5	24.9	24.4	23.6	22.8	22.0	22.0
	Residential, Commercial & Public Sector Combustion	669	509	480	497	439	442	384	361	347	307	301	308	341	338	393	353	383	413	375	391
	Total	**5,852**	**4,740**	**3,938**	**3,679**	**3,201**	**3,285**	**2,970**	**2,691**	**2,530**	**2,329**	**2,182**	**2,015**	**1,911**	**1,595**	**1,514**	**1,365**	**1,365**	**1,347**	**1,261**	**1,222**
Nitrogen oxides (kt)	Energy Industries	651	416	313	277	292	314	310	344	327	346	337	328	245	221	211	203	236	222	186	152
	Industrial Combustion	339	313	278	265	256	251	226	221	225	230	213	207	178	149	154	134	135	119	116	117
	Transport Sources	1,088	906	784	736	678	648	617	585	565	546	527	505	476	402	383	369	354	343	337	327
	Other	59.1	46.7	28.3	29.7	27.9	26.1	23.2	24.7	25.5	23.0	23.6	27.0	25.4	23.9	24.3	22.4	20.4	18.8	16.5	16.5
	Residential, Commercial & Public Sector Combustion	163	151	143	139	131	128	115	109	103	98.5	90.3	83.3	89.4	79.3	84.0	71.8	74.5	73.1	63.0	64.0
	Total	**2,300**	**1,833**	**1,547**	**1,447**	**1,386**	**1,368**	**1,290**	**1,283**	**1,245**	**1,243**	**1,190**	**1,151**	**1,014**	**876**	**856**	**800**	**820**	**776**	**718**	**676**
NMVOC (kt)	Agriculture	89.2	65.5	66.1	67.2	64.2	62.0	59.5	60.3	63.1	60.2	59.6	59.8	58.8	58.3	59.6	59.0	58.3	58.8	61.7	61.4
	Industrial Combustion	25.5	26.2	26.4	25.9	25.5	25.6	24.9	24.8	26.3	25.8	25.0	25.0	22.9	18.7	19.0	16.7	17.1	14.6	15.4	15.9
	Transport Sources	799	619	474	417	350	314	266	223	188	159	136	114	99.9	69.6	58.8	49.3	42.7	37.0	33.4	31.2
	Fugitive	474	330	287	251	227	226	202	188	171	158	145	135	125	118	108	106	97.2	84.2	83.2	77.3
	Industrial Processes	189	171	125	92.9	89.6	78.3	76.6	72.0	63.7	62.0	56.3	54.8	48.6	43.2	45.9	42.1	42.2	42.5	42.1	40.7

Air Quality Pollutant Inventories for England, Scotland, Wales, and Northern Ireland: 1990-2015

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Solvent Processes	553	447	408	385	364	352	343	339	340	335	335	330	312	293	293	297	296	295	301	301
	Other	21.7	21.2	18.0	17.3	18.1	17.3	18.9	16.9	15.9	15.0	15.3	14.0	13.0	11.8	10.8	10.2	9.7	8.8	8.1	7.8
	Residential, Commercial & Public Sector Combustion	59.5	46.5	49.0	51.4	45.6	44.7	41.1	41.3	40.2	38.1	37.1	36.6	39.0	37.4	42.8	36.7	40.1	42.0	37.6	39.5
	Total	**2,210**	**1,726**	**1,453**	**1,308**	**1,184**	**1,119**	**1,032**	**965**	**908**	**852**	**810**	**768**	**719**	**650**	**637**	**617**	**603**	**583**	**582**	**574**
PM_{10} (kt)	Agriculture	11.1	11.3	12.1	11.6	11.4	11.1	10.9	10.6	10.8	10.4	10.5	9.9	10.3	9.9	10.0	9.9	9.8	9.8	10.0	9.9
	Energy Industries	59.8	33.8	22.2	17.9	18.8	13.2	7.2	7.3	7.7	8.5	8.9	7.4	7.6	5.9	5.4	5.8	7.9	6.9	6.1	4.7
	Industrial Combustion	28.9	26.6	22.5	22.2	19.4	18.9	17.9	17.8	18.0	16.7	15.8	14.5	14.2	13.6	15.0	14.1	14.5	13.7	15.4	14.8
	Transport Sources	32.9	37.1	36.3	35.9	32.6	32.0	31.0	30.4	29.9	29.3	28.5	27.1	25.9	24.7	24.1	22.8	21.8	20.8	20.2	19.8
	Industrial Processes	43.1	34.5	30.1	28.1	26.5	27.4	25.9	28.8	25.0	26.2	23.6	24.7	21.4	17.6	17.4	15.9	16.2	16.9	18.0	17.9
	Solvent Processes	7.2	5.5	5.7	5.6	5.3	5.0	5.1	5.0	4.9	4.8	5.1	5.0	4.3	3.6	3.7	3.8	3.8	3.8	4.0	4.1
	Other	7.6	6.7	5.9	6.0	5.8	8.8	6.1	6.0	5.7	5.8	5.8	5.9	5.6	5.3	5.1	5.0	5.0	4.9	4.8	4.7
	Residential, Commercial & Public Sector Combustion	37.4	28.1	30.8	32.8	29.4	30.0	26.6	27.6	27.4	27.1	27.3	27.6	31.3	32.1	38.4	32.5	37.2	39.6	34.7	37.1
	Total	**228**	**184**	**166**	**160**	**149**	**146**	**131**	**133**	**129**	**129**	**126**	**122**	**121**	**113**	**119**	**110**	**116**	**116**	**113**	**113**
Sulphur dioxide (kt)	Energy Industries	2,481	1,470	1,011	723	713	638	593	596	456	356	315	272	209	154	149	163	214	166	119	91
	Industrial Combustion	315	254	150	121	106	116	97.5	89.2	95.9	99.2	87.2	82.0	78.0	71.6	78.4	65.1	70.3	65.0	59.5	36.6
	Transport Sources	70.6	58.9	36.0	28.2	20.7	18.4	18.8	19.2	19.1	19.6	19.2	14.6	11.0	9.9	8.1	7.2	6.7	6.3	6.6	3.1
	Fugitive	16.1	16.1	9.7	6.8	6.1	5.5	5.2	5.7	7.1	6.2	6.5	8.6	8.2	6.5	7.1	5.6	5.6	5.8	5.8	3.8
	Industrial Processes	51.1	54.2	55.7	45.7	38.2	30.6	28.5	31.2	29.2	28.9	28.4	26.1	17.8	11.4	10.6	10.6	5.7	6.8	7.0	6.8
	Other	12.1	7.6	4.0	4.2	3.7	4.5	3.4	3.7	3.9	3.6	3.8	7.7	7.4	7.3	6.5	5.1	4.8	4.4	4.0	1.6
	Residential, Commercial & Public Sector Combustion	135.0	105.0	82.3	77.0	63.4	63.5	49.8	44.1	41.9	37.3	34.6	33.2	35.2	31.1	36.1	32.3	32.2	33.9	32.3	31.7
	Total	**3,080**	**1,966**	**1,349**	**1,006**	**951**	**877**	**797**	**789**	**653**	**551**	**495**	**444**	**366**	**291**	**296**	**289**	**339**	**288**	**235**	**174**
Lead **(tonnes)**	Energy Industries	138	117	17.8	14.0	13.9	11.3	10.2	10.1	10.2	9.2	9.1	2.7	2.8	2.7	2.6	3.1	4.3	3.3	2.6	2.7
	Industrial Combustion	30.5	25.1	20.0	16.4	13.0	13.3	13.8	13.6	13.7	11.3	9.4	10.0	9.7	11.3	10.1	10.3	10.4	10.1	10.3	10.2
	Transport Sources	1,804	879	481	253	2.2	2.1	2.0	2.0	2.1	2.1	2.1	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
	Industrial Processes	247	210	176	105	80.6	83.0	78.0	61.2	53.1	52.0	41.9	42.1	37.1	27.0	22.9	23.8	28.2	26.5	29.3	26.5
	Waste	229	68.1	0.4	0.6	0.6	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other	3.0	2.1	2.0	1.9	1.8	1.9	2.2	1.9	2.1	2.1	2.1	2.1	2.0	1.7	1.8	1.8	1.6	1.7	1.6	1.3
	Residential, Commercial & Public Sector Combustion	23.4	13.7	10.7	10.0	7.1	7.0	5.5	4.8	4.4	3.7	3.5	3.6	4.0	3.9	4.2	4.1	4.1	4.4	4.2	4.3
	Total	**2,474**	**1,315**	**708**	**401**	**119**	**119**	**112**	**94**	**86**	**81**	**68**	**63**	**58**	**48**	**43**	**45**	**50**	**48**	**50**	**47**

* 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.

E.2 Summary Air Quality Pollutant Emission Estimates for Scotland

Table 15 - Summary of air quality pollutant emission estimates for Scotland (1990-2015) *

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ammonia (kt)	Agriculture	38.4	36.3	37.1	34.9	35.2	34.5	34.6	33.8	34.6	33.7	32.9	31.7	30.5	30.4	30.6	30.3	30.0	29.8	30.9	31.8
	Transport Sources	0.1	0.6	1.2	1.3	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.0	1.0	0.9	0.7	0.6	0.6	0.5	0.4
	Industrial Processes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Waste	0.7	0.8	0.9	0.9	1.0	1.2	1.2	1.2	1.3	1.4	1.4	1.4	1.4	1.5	1.6	1.8	1.7	1.7	1.9	2.0
	Other	1.4	1.5	1.8	1.9	1.7	1.7	1.7	1.8	1.7	1.8	1.7	1.7	1.8	1.8	2.1	2.1	2.2	2.3	2.2	2.3
	Total	**41**	**39**	**41**	**39**	**40**	**39**	**39**	**38**	**39**	**38**	**37**	**36**	**35**	**35**	**35**	**35**	**35**	**34**	**36**	**37**
Carbon monoxide (kt)	Energy Industries	14.9	14.8	10.2	9.6	11.4	11.2	10.7	9.9	10.2	10.0	11.9	11.1	13.9	13.3	11.1	9.3	9.8	8.6	7.1	6.5
	Industrial Combustion	79.7	30.6	25.6	26.2	25.4	25.3	26.9	27.0	28.6	29.8	29.6	29.4	29.7	24.4	25.8	26.2	23.7	23.6	25.7	26.8
	Transport Sources	367	304	244	218	184	187	172	159	146	131	120	103	93.7	73.6	62.5	51.6	46.4	40.3	34.7	31.5
	Fugitive	5.2	1.1	1.0	1.2	1.1	1.7	1.2	0.9	0.9	1.0	0.8	1.0	0.9	0.9	0.9	1.0	0.7	0.9	1.0	1.2
	Industrial Processes	3.5	2.9	3.4	3.2	3.2	3.1	3.1	3.1	3.1	3.1	3.8	3.9	3.8	3.2	0.1	0.1	0.1	0.1	0.1	0.1
	Other	23.6	3.3	3.1	3.0	2.9	7.1	3.0	3.0	2.8	2.8	2.9	2.9	2.8	2.7	2.6	2.5	2.4	2.4	2.3	2.3
	Residential, Commercial & Public Sector Combustion	163	90.5	77.9	79.3	66.4	65.2	52.8	47.4	44.1	39.5	38.3	39.4	42.9	42.3	47.0	43.4	45.0	46.8	42.3	43.6
	Total	**657**	**447**	**365**	**340**	**295**	**300**	**270**	**250**	**236**	**218**	**207**	**191**	**188**	**160**	**150**	**134**	**128**	**123**	**113**	**112**
Nitrogen oxides (kt)	Energy Industries	96.6	64.9	51.0	48.5	54.9	50.4	49.2	46.3	44.8	44.5	56.9	50.2	40.1	35.8	36.9	28.8	30.1	27.9	26.0	23.6
	Industrial Combustion	39.7	32.5	30.0	28.8	28.4	28.4	23.2	22.4	22.9	23.6	21.8	22.0	19.8	16.4	16.5	14.2	13.6	13.1	12.7	12.1
	Transport Sources	118	98.8	85.6	81.1	74.3	70.6	68.2	64.7	62.2	60.3	58.5	56.7	53.8	46.2	43.8	41.5	39.9	38.5	37.4	36.4
	Other	5.4	3.2	2.4	2.9	2.8	3.0	2.6	2.7	2.7	2.6	2.6	2.5	2.4	2.2	2.3	2.4	2.1	2.2	1.6	1.7
	Residential, Commercial & Public Sector Combustion	29.8	28.2	26.8	26.1	24.7	24.3	21.9	20.8	19.5	18.7	16.9	15.4	16.0	14.2	14.4	12.4	12.4	11.8	10.2	10.1
	Total	**290**	**228**	**196**	**187**	**185**	**177**	**165**	**157**	**152**	**150**	**157**	**147**	**132**	**115**	**114**	**99**	**98**	**94**	**88**	**84**
NMVOC (kt)	Agriculture	19.2	16.9	17.2	16.7	16.9	16.3	16.5	16.4	16.8	16.8	16.6	16.4	15.7	15.4	15.7	15.7	15.6	15.4	15.8	15.5
	Industrial Combustion	2.6	2.3	2.4	2.3	2.3	2.3	2.3	2.2	2.3	2.2	2.2	2.2	2.2	1.8	1.8	1.7	1.7	1.3	1.4	1.5
	Transport Sources	72.6	55.9	42.7	37.4	31.5	28.3	24.5	20.7	17.6	14.9	13.0	11.0	9.7	6.8	5.8	4.9	4.3	3.7	3.4	3.1
	Fugitive	185	123	105	86.6	82.5	72.3	72.7	54.4	41.3	42.4	39.9	39.7	36.3	24.2	22.0	20.6	24.7	20.8	19.0	21.1
	Industrial Processes	58.0	58.1	57.3	59.0	58.7	57.4	56.5	55.4	54.2	53.7	53.9	55.5	55.2	56.1	57.5	57.4	58.8	61.0	63.0	65.1
	Solvent Processes	63.4	51.2	46.8	40.0	37.3	35.5	34.1	33.7	33.5	32.8	32.8	32.5	31.0	29.3	28.5	29.0	28.6	28.3	28.9	28.7
	Other	2.6	2.6	2.3	2.0	2.3	2.1	2.2	1.9	1.9	1.7	1.8	1.5	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Residential, Commercial & Public Sector Combustion	12.4	7.7	7.8	8.1	6.8	6.4	5.7	5.5	5.2	5.1	4.9	4.9	5.1	4.8	5.2	4.6	4.7	4.7	4.2	4.3
	Total	**415**	**318**	**281**	**252**	**238**	**221**	**214**	**190**	**173**	**170**	**165**	**164**	**157**	**140**	**138**	**135**	**140**	**136**	**137**	**140**
PM_{10} (kt)	Agriculture	2.0	2.0	1.9	1.8	2.0	1.9	2.0	1.9	2.0	1.9	1.9	1.9	1.9	1.8	1.9	1.9	1.9	1.9	1.9	1.9
	Energy Industries	8.2	5.1	3.7	3.0	3.6	3.4	2.1	1.1	1.8	1.7	2.5	2.3	1.0	1.0	1.4	1.0	1.0	0.7	0.6	0.4
	Industrial Combustion	3.6	3.0	2.3	2.3	2.1	2.0	1.8	1.8	1.8	1.8	1.8	1.7	1.6	1.4	1.4	1.3	1.2	1.1	1.1	1.2
	Transport Sources	4.0	4.3	4.2	4.2	3.7	3.6	3.6	3.4	3.4	3.3	3.2	3.0	2.9	2.8	2.7	2.5	2.4	2.3	2.2	2.2
	Industrial Processes	4.4	3.2	2.8	2.6	2.4	2.5	2.4	2.6	2.4	2.5	2.3	2.2	1.9	1.5	1.6	1.5	1.4	1.4	1.6	1.6
	Solvent Processes	0.7	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Other	0.7	0.7	0.6	0.7	0.7	1.5	0.8	0.6	0.7	0.6	0.6	0.6	1.0	0.6	0.8	0.8	0.6	0.8	1.0	0.7
	Residential, Commercial & Public Sector Combustion	7.8	4.8	4.9	5.2	4.4	4.3	3.6	3.6	3.4	3.3	3.3	3.3	3.6	3.5	4.0	3.4	3.7	3.8	3.3	3.5
	Total	**31**	**24**	**21**	**20**	**19**	**20**	**17**	**15**	**16**	**16**	**16**	**15**	**14**	**13**	**14**	**13**	**13**	**12**	**12**	**12**
Sulphur dioxide (kt)	Energy Industries	217	135	96.4	81.3	104	101	96.2	82.2	66.9	53.7	66.1	52.9	46.8	49.8	66.3	48.0	48.4	33.6	23.0	17.5
	Industrial Combustion	39.5	22.7	10.5	7.7	7.0	7.6	10.0	9.7	10.3	11.3	9.2	8.0	5.6	4.3	4.3	3.7	2.5	2.8	2.5	2.0
	Transport Sources	11.5	9.9	7.1	6.5	5.4	4.9	5.1	4.6	4.5	4.5	4.1	3.0	2.2	2.1	1.6	1.3	1.2	1.1	1.1	0.4
	Fugitive	0.6	0.1	0.2	0.5	0.4	1.3	0.9	0.5	0.5	0.4	0.2	0.2	0.3	0.0	0.2	0.2	0.1	0.2	0.3	0.1
	Industrial Processes	0.8	0.7	0.8	0.8	0.7	0.7	0.6	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.6	0.7	0.8	0.6	0.6	0.7
	Other	0.8	0.6	0.4	0.3	0.3	0.6	0.3	0.3	0.4	0.3	0.4	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.4	0.2
	Residential, Commercial & Public Sector Combustion	28.4	21.1	15.4	13.8	10.8	10.4	7.6	6.3	5.7	5.0	4.8	4.6	4.7	3.3	3.2	3.0	3.1	3.0	2.5	2.5
	Total	**298**	**190**	**131**	**111**	**129**	**126**	**121**	**104**	**89**	**76**	**85**	**70**	**61**	**61**	**77**	**57**	**57**	**42**	**30**	**23**
Lead **(tonnes)**	Energy Industries	11.8	7.6	2.7	2.2	3.0	2.8	1.9	1.5	3.4	1.6	1.7	0.8	0.5	0.7	1.3	0.6	1.1	0.6	0.6	0.7
	Industrial Combustion	3.8	3.2	2.5	2.3	2.0	2.0	2.2	2.1	2.4	1.8	1.4	1.4	1.3	1.4	1.4	1.3	1.0	1.1	1.0	0.8
	Transport Sources	171	82.1	44.7	23.5	0.3	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Industrial Processes	11.3	4.9	2.7	1.9	1.7	1.6	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.4	0.5	0.7	0.7	0.6	0.7	0.6
	Waste	7.2	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Residential, Commercial & Public Sector Combustion	4.5	2.3	1.7	1.6	1.2	1.1	0.9	0.7	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
	Total	**210**	**102**	**54**	**32**	**8**	**8**	**7**	**6**	**8**	**5**	**5**	**4**	**3**	**3**	**4**	**3**	**4**	**3**	**3**	**3**

* 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.

E.3 Summary Air Quality Pollutant Emission Estimates for Wales

Table 16 - Summary of air quality pollutant emission estimates for Wales (1990-2015) *

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ammonia (kt)	Agriculture	26.5	26.0	26.1	27.2	25.5	25.4	23.7	25.2	24.8	24.3	24.8	22.5	20.9	20.7	21.5	21.5	21.5	21.5	22.6	22.9
	Transport Sources	0.1	0.4	0.7	0.8	1.2	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3
	Industrial Processes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Waste	0.4	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1
	Other	1.0	1.2	1.7	1.8	1.7	1.8	1.9	1.9	1.7	1.7	1.7	1.6	1.6	1.7	2.1	2.0	2.2	2.3	2.2	2.3
	Total	**28**	**28**	**29**	**30**	**29**	**29**	**27**	**29**	**28**	**28**	**28**	**26**	**24**	**24**	**25**	**25**	**25**	**25**	**26**	**27**
Carbon monoxide (kt)	Energy Industries	6.2	5.9	4.2	3.6	5.0	5.7	4.8	5.1	6.7	6.0	6.6	5.1	6.0	5.5	6.4	6.9	8.5	9.1	5.8	6.3
	Industrial Combustion	131	160	162	159	126	119	65.7	57.7	82.3	77.6	103	84.2	67.1	65.9	69.1	76.2	73.0	90.2	123	101
	Transport Sources	233	193	151	134	113	115	105	95.9	88.4	79.5	71.9	62.6	56.5	44.1	37.4	32.1	28.5	24.6	21.1	19.3
	Fugitive	12.4	19.2	19.2	15.0	15.3	8.7	3.6	5.0	3.5	3.1	6.6	7.1	5.2	4.8	6.4	6.0	6.0	7.8	11.3	8.8
	Industrial Processes	63.1	61.3	65.4	60.2	58.9	43.8	32.0	42.5	41.8	47.9	55.4	58.9	51.9	36.7	34.7	32.4	24.3	30.6	44.5	34.4
	Other	4.0	1.6	1.5	1.5	1.4	2.6	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1
	Residential, Commercial & Public Sector Combustion	96.6	75.9	69.3	72.9	60.1	61.1	48.4	43.7	41.6	37.2	35.7	38.0	41.4	41.3	46.9	43.2	46.0	48.2	43.1	44.9
	Total	**546**	**516**	**472**	**446**	**380**	**356**	**261**	**251**	**266**	**253**	**281**	**257**	**229**	**199**	**202**	**198**	**187**	**212**	**250**	**216**
Nitrogen oxides (kt)	Energy Industries	49.9	35.2	28.5	23.2	32.3	39.8	32.9	32.5	35.5	33.6	41.0	29.1	39.2	31.5	30.2	30.7	44.3	44.8	31.8	34.5
	Industrial Combustion	37.1	35.0	32.1	34.2	34.1	29.9	20.3	20.8	21.0	20.2	19.2	18.9	16.7	13.8	15.6	14.0	12.8	12.9	12.6	12.5
	Transport Sources	69.7	57.1	48.5	45.2	41.3	39.1	37.5	35.6	34.9	33.6	32.3	31.1	29.7	25.6	24.6	23.9	22.4	22.1	21.7	21.5
	Other	3.2	2.7	2.2	2.2	2.2	2.0	1.3	1.4	1.5	1.5	1.5	1.6	1.6	1.4	1.4	1.5	1.1	1.3	1.4	1.2
	Residential, Commercial & Public Sector Combustion	18.3	17.4	16.5	16.1	15.3	14.9	13.5	12.8	12.1	11.3	10.3	9.2	9.3	8.3	8.5	7.3	7.2	6.8	5.9	5.9
	Total	**178**	**147**	**128**	**121**	**125**	**126**	**106**	**103**	**105**	**100**	**104**	**90**	**97**	**81**	**80**	**77**	**88**	**88**	**73**	**76**
NMVOC (kt)	Agriculture	11.3	10.9	11.2	11.5	11.0	11.1	10.2	11.2	11.2	10.8	11.3	10.5	10.0	9.9	10.0	10.2	10.1	10.0	10.4	10.5
	Industrial Combustion	2.5	2.8	2.9	3.0	3.1	2.7	2.3	2.5	2.5	2.2	2.3	2.3	2.2	1.7	1.9	1.7	1.6	1.6	1.6	1.6
	Transport Sources	45.9	35.2	26.3	22.9	19.2	17.2	14.8	12.5	10.6	9.0	7.8	6.5	5.8	4.0	3.4	2.9	2.5	2.2	2.0	1.9
	Fugitive	37.2	25.0	20.7	17.5	18.1	15.0	15.1	13.9	14.3	13.7	14.3	14.2	12.5	12.8	12.7	12.8	11.2	11.8	9.5	9.1
	Industrial Processes	5.6	5.3	5.0	4.7	4.1	3.4	2.3	4.8	4.2	2.4	2.5	2.4	2.3	2.1	2.4	2.4	2.2	2.6	2.7	2.6
	Solvent Processes	42.9	33.8	27.9	26.4	22.0	20.4	19.6	19.4	19.5	19.9	20.0	19.7	18.5	17.1	16.8	17.0	16.8	16.8	16.9	16.8
	Other	2.1	2.2	1.8	1.6	1.8	1.5	1.6	1.4	1.2	1.1	1.1	1.0	1.0	0.9	1.0	0.9	0.9	0.9	0.9	0.8

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Residential, Commercial & Public Sector Combustion	8.0	6.0	6.4	6.9	5.6	5.3	4.6	4.5	4.3	4.2	4.2	4.3	4.6	4.4	5.0	4.4	4.7	4.7	4.2	4.4
	Total	**156**	**121**	**102**	**95**	**85**	**77**	**71**	**70**	**68**	**63**	**64**	**61**	**57**	**53**	**53**	**52**	**50**	**50**	**48**	**48**
PM_{10} (kt)	Agriculture	1.5	1.5	1.5	1.5	1.6	1.5	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5
	Energy Industries	3.3	2.1	1.6	1.2	1.9	1.7	1.0	1.2	1.0	1.0	1.3	1.2	1.1	0.9	0.8	0.8	0.9	1.1	0.6	0.5
	Industrial Combustion	3.0	2.3	1.6	1.8	1.7	1.6	1.6	1.6	1.7	1.2	1.2	1.2	1.1	1.0	1.2	1.1	1.1	1.1	1.2	1.2
	Transport Sources	2.2	2.4	2.4	2.4	2.1	2.1	2.0	2.0	2.0	1.9	1.9	1.7	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.3
	Industrial Processes	5.1	4.7	4.3	4.0	3.8	2.9	2.2	3.0	3.1	2.9	3.0	3.2	2.5	1.8	2.1	2.1	1.9	2.7	3.1	2.7
	Solvent Processes	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2
	Other	0.5	0.5	0.5	0.5	0.5	0.7	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Residential, Commercial & Public Sector Combustion	5.6	4.3	4.6	5.0	4.1	4.1	3.5	3.5	3.4	3.4	3.4	3.5	3.8	3.8	4.5	3.8	4.3	4.4	3.8	4.1
	Total	**22**	**18**	**17**	**17**	**16**	**15**	**12**	**13**	**13**	**12**	**13**	**13**	**12**	**11**	**12**	**11**	**11**	**13**	**12**	**12**
Sulphur dioxide (kt)	Energy Industries	109	69.6	51.7	40.1	58.8	51.7	42.2	46.2	44.1	39.1	45.8	37.2	24.3	17.8	16.9	17.3	15.3	19.4	11.8	12.7
	Industrial Combustion	45.2	35.9	24.9	22.0	20.2	18.6	11.6	10.8	8.4	7.1	8.0	8.5	7.1	7.0	9.9	8.6	7.5	8.8	8.8	7.2
	Transport Sources	5.9	5.0	3.5	3.0	2.5	2.2	2.2	2.2	2.4	2.4	2.2	1.6	1.2	1.2	1.1	1.0	0.8	0.8	0.7	0.2
	Fugitive	4.1	3.1	2.6	2.0	1.4	1.6	0.6	0.7	0.8	1.0	1.1	0.9	1.0	0.8	1.6	1.1	0.9	1.2	1.4	1.2
	Industrial Processes	2.9	2.7	2.7	2.2	2.2	2.6	2.2	1.8	2.1	2.3	2.1	2.3	2.0	0.4	0.4	0.4	0.5	0.6	0.4	0.5
	Other	0.6	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1
	Residential, Commercial & Public Sector Combustion	17.3	13.6	10.5	10.0	8.2	8.2	6.1	5.2	5.1	4.8	4.4	4.4	4.3	5.7	7.0	5.9	5.1	6.0	4.8	4.1
	Total	**185**	**130**	**96**	**80**	**93**	**85**	**65**	**67**	**63**	**57**	**64**	**55**	**40**	**33**	**37**	**35**	**30**	**37**	**28**	**26**
Lead **(tonnes)**	Energy Industries	3.7	1.8	0.8	0.6	1.5	1.0	0.5	0.8	0.4	0.7	0.8	0.4	0.5	0.5	0.5	0.4	0.4	0.3	0.2	0.2
	Industrial Combustion	2.6	2.0	1.5	2.1	2.0	1.4	4.3	2.9	6.4	2.4	0.7	0.8	0.7	0.7	0.9	0.8	0.7	0.8	1.0	0.8
	Transport Sources	109	52.5	27.9	14.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Industrial Processes	17.2	18.2	17.7	16.5	16.3	11.9	6.7	11.1	14.8	16.4	12.4	11.5	10.9	7.5	11.1	10.1	7.8	7.9	11.6	11.4
	Waste	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	1.5	1.8	1.8	1.8	2.0	1.4	0.5	0.8	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.8	0.7
	Residential, Commercial & Public Sector Combustion	2.7	1.8	1.5	1.5	1.1	1.1	0.8	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Total	**137**	**79**	**51**	**37**	**23**	**17**	**13**	**17**	**23**	**21**	**15**	**14**	**13**	**10**	**14**	**13**	**10**	**10**	**14**	**14**

* 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.

E.4 Summary Air Quality Pollutant Emission Estimates for Northern Ireland

Table 17 - Summary of air quality pollutant emission estimates for Northern Ireland (1990-2015) *

	Category	1990	1995	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ammonia (kt)	Agriculture	32.2	34.1	34.8	34.1	32.3	32.1	32.3	32.7	32.8	31.8	31.0	30.0	29.6	29.3	29.0	29.4	29.7	30.0	30.5	31.7
	Transport Sources	0.0	0.3	0.5	0.6	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.3	0.2	0.2
	Industrial Processes	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Waste	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.9	0.9	1.0	1.0	1.2	1.3	1.5	1.5	1.6	1.8	1.9
	Other	0.5	0.6	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0
	Total	**33**	**35**	**37**	**36**	**34**	**34**	**34**	**35**	**35**	**34**	**33**	**32**	**32**	**32**	**32**	**32**	**32**	**33**	**33**	**35**
Carbon monoxide (kt)	Energy Industries	4.1	3.7	2.1	1.3	1.3	1.4	1.2	1.1	2.0	3.3	2.8	2.6	2.4	2.2	2.8	2.0	1.4	1.2	1.2	2.2
	Industrial Combustion	14.3	12.8	10.7	11.1	10.0	9.5	9.2	9.2	9.7	11.3	12.2	12.9	11.6	10.8	12.9	12.9	12.4	12.5	14.1	13.9
	Transport Sources	122	109	87.5	80.0	69.8	72.8	65.0	60.9	57.3	52.2	46.8	41.7	38.3	31.0	26.8	25.7	22.6	19.3	15.9	14.4
	Fugitive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial Processes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	2.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7
	Residential, Commercial & Public Sector Combustion	148	92.0	70.1	61.9	54.4	46.0	39.1	33.5	27.5	24.5	24.4	25.7	28.4	28.9	33.8	30.6	32.8	35.2	31.7	33.1
	Total	**290**	**219**	**171**	**155**	**136**	**131**	**115**	**106**	**97**	**92**	**87**	**84**	**81**	**74**	**77**	**72**	**70**	**69**	**64**	**64**
Nitrogen oxides (kt)	Energy Industries	31.1	19.3	13.9	14.2	14.8	16.0	12.4	11.5	9.8	9.6	9.6	7.0	6.4	5.3	5.7	5.7	5.8	6.2	5.3	5.0
	Industrial Combustion	18.7	18.8	16.6	16.3	16.4	16.6	13.1	12.8	13.0	14.5	13.3	13.4	11.9	10.3	11.2	9.7	9.1	8.6	9.0	9.2
	Transport Sources	37.6	32.1	26.9	25.9	24.5	23.8	23.6	23.8	22.6	22.1	21.2	20.5	19.5	17.2	16.1	15.1	14.4	13.8	13.2	12.9
	Other	1.6	1.0	0.8	0.9	0.8	0.7	0.5	0.6	0.6	0.5	0.6	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4
	Residential, Commercial & Public Sector Combustion	14.6	13.1	12.4	12.1	11.6	11.3	10.6	10.2	9.4	9.0	8.3	7.5	7.1	6.8	6.8	5.8	5.6	5.4	4.8	4.7
	Total	**104**	**84**	**71**	**70**	**68**	**68**	**60**	**59**	**55**	**56**	**53**	**49**	**46**	**40**	**40**	**37**	**36**	**34**	**33**	**32**
NMVOC (kt)	Agriculture	12.0	12.9	13.8	13.6	13.2	13.3	13.7	13.8	14.0	13.9	13.9	13.5	13.3	13.1	13.2	13.8	14.0	13.8	14.4	14.8
	Industrial Combustion	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	0.8	0.7	0.7	0.7	0.6	0.5	0.6	0.6
	Transport Sources	26.4	21.4	16.1	14.5	12.5	11.2	9.3	7.9	6.8	5.8	5.0	4.3	3.8	2.7	2.3	1.9	1.6	1.5	1.3	1.2
	Fugitive	3.3	3.2	2.9	2.2	2.1	2.0	1.8	1.8	1.7	1.6	1.5	1.4	1.2	1.1	0.9	0.9	0.8	0.8	0.9	0.8
	Industrial Processes	2.3	2.3	2.1	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3	2.4	2.5
	Solvent Processes	16.8	13.3	12.2	11.7	11.4	11.1	10.8	10.7	10.7	10.5	10.6	10.6	10.1	9.4	9.3	9.5	9.4	9.4	9.6	9.5
	Other	0.8	0.8	0.6	0.6	0.6	0.4	0.4	0.4	0.6	0.7	0.6	0.4	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3

	Residential, Commercial & Public Sector Combustion	10.3	6.5	5.5	5.0	4.6	4.2	3.7	3.5	3.2	3.1	3.1	3.1	3.3	3.3	3.7	3.3	3.5	3.6	3.3	3.4
	Total	**73**	**61**	**54**	**51**	**47**	**45**	**42**	**41**	**40**	**38**	**38**	**36**	**35**	**33**	**33**	**33**	**33**	**32**	**33**	**33**
PM_{10} (kt)	Agriculture	1.5	1.8	1.7	1.6	1.7	1.6	1.7	1.7	1.7	1.6	1.7	1.6	1.7	1.6	1.6	1.7	1.7	1.7	1.8	1.8
	Energy Industries	2.7	1.5	1.0	0.6	0.8	1.0	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.1
	Industrial Combustion	1.6	1.5	1.2	1.2	1.2	1.1	0.9	0.9	0.9	1.1	1.2	1.1	1.0	1.0	1.3	1.2	1.2	1.1	1.3	1.2
	Transport Sources	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.0	0.9	0.9	0.9	0.9
	Industrial Processes	1.0	0.8	0.7	0.7	0.7	0.8	0.7	0.8	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Solvent Processes	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
	Residential, Commercial & Public Sector Combustion	8.0	5.3	4.4	4.1	3.7	3.5	3.0	2.9	2.7	2.7	2.7	2.7	3.0	3.0	3.6	3.0	3.4	3.5	3.1	3.3
	Total	**16**	**12**	**11**	**10**	**10**	**9**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
Sulphur dioxide (kt)	Energy Industries	68.2	39.7	26.8	26.8	28.3	29.9	18.3	17.4	16.4	14.9	13.5	8.3	11.0	4.6	2.0	2.3	2.9	3.0	2.7	2.5
	Industrial Combustion	19.6	16.8	9.1	6.0	5.0	5.4	3.3	3.0	3.5	4.5	4.2	3.9	3.9	3.9	5.1	4.5	4.0	4.2	4.7	4.3
	Transport Sources	2.6	2.3	1.5	1.3	1.0	0.9	1.0	1.0	1.0	1.1	1.0	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.1
	Fugitive	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industrial Processes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0
	Residential, Commercial & Public Sector Combustion	21.1	17.1	12.7	10.7	9.1	8.0	6.5	5.3	4.3	3.6	3.5	3.5	3.6	2.5	2.5	2.4	2.6	2.4	2.1	2.1
	Total	**112**	**76**	**50**	**45**	**43**	**44**	**29**	**27**	**25**	**24**	**22**	**17**	**19**	**12**	**10**	**10**	**10**	**10**	**10**	**9**
Lead (tonnes)	Energy Industries	2.8	1.3	0.7	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1
	Industrial Combustion	3.0	3.1	2.7	2.5	2.3	2.3	2.3	2.2	2.2	2.0	1.6	1.7	1.5	1.5	1.7	1.5	1.3	1.4	1.1	1.0
	Transport Sources	60.2	31.0	16.8	9.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Industrial Processes	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1
	Waste	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Residential, Commercial & Public Sector Combustion	3.7	2.0	1.5	1.3	1.1	0.9	0.7	0.6	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4
	Total	**70**	**38**	**22**	**13**	**4**	**4**	**4**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

* 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.

Appendix F Definition of NFR Codes and Sector categories

Table 18 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 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 19 below for further information.

Table 18 - Definition of NFR Codes and Sector Categories

NFRCode	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	Other industries
1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	Industrial Combustion	Other industries
1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	Industrial Combustion	Other industries
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

NFRCode	NFR Source Description	Sector Category	Sub-sector Category
			transport
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	Commerical & public sector
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	Industrial	Other industries

NFRCode	NFR Source Description	Sector Category	Sub-sector Category
	coal	Processes	
2A5b	Construction and demolition	Industrial Processes	Other industries
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
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
2C5	Lead production	Industrial Processes	Other industries
2C6	Zinc production	Industrial Processes	Other industries
2C7a	Copper 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)[6]	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
3B1a	Manure management - Dairy cattle	Agriculture	Cattle manure management

[6] 2G includes emissions from fireworks and cigarette smoking

NFRCode	NFR Source Description	Sector Category	Sub-sector Category
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 mangement - Laying hens	Agriculture	Other manure management
3B4gii	Manure mangement - Broilers	Agriculture	Other manure management
3B4giii	Manure mangement - 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
3Da3	Urine and dung deposited by grazing animals	Agriculture	Grazing animal excreta
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	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
5C2	Open burning of waste	Waste	Waste
5D1	Domestic wastewater handling	Waste	Waste
5E	Anaerobic Digestion - emissions from landspreading of non-manure digestates	Waste	Other waste practices
6A	Other (included in national total for entire territory) (please specify in IIR)[7]	Other	Other

[7] 6A includes emissions from accidental fires at dwellings, other buildings, and vehicles, bonfire night, domestic pets, house and garden machinery, infant emissions from nappies, non-agricultural horses and professional horses, parks, gardens and golf courses

Table 19 - Summary of the sector categories included in "Other" for each pollutant

Sector Category	CO	NH_3	NO_x	Pb	PM_{10}	SO_2	NMVOC
Agriculture	✓	☐	✓	☐	☐	☐	☐
Energy Industries	☐	✓	☐	☐	☐	☐	✓
Fugitive	☐	✓	✓	✓	✓	☐	☐
Industrial Combustion	☐	✓	☐	☐	☐	☐	☐
Industrial Processes	☐	☐	✓	☐	☐	☐	☐
Other	✓	✓	✓	✓	✓	✓	✓
Solvent Processes	☐	✓	☐	☐	☐	☐	☐
Transport	☐	☐	☐	☐	☐	☐	☐
Waste	✓	☐	✓	☐	✓	✓	✓
Residential, Commercial & Public Sector Combustion	☐	✓	☐	☐	☐	☐	☐

Appendix G Additional data tables

Appendix G contains an array of additional data tables regarding road transport, specifying the split in emissions of all pollutants according to both vehicle class and fuel type. Different sources of non-road exhaust emissions (emissions not relating to the combustion of fuel in the vehicle's engine) are also displayed according to vehicles class.

Table 20- Emissions for England, road transport, split by vehicle class and fuel type.

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Carbon monoxide (t)	Light duty vehicles	DERV	15,799	25,186	25,016	25,797	23,765	21,461	18,697	16,036	14,126	12,313
	Light duty vehicles	Petrol	571,334	406,479	190,544	55,257	21,976	18,112	16,117	14,249	12,363	11,202
	Passenger cars	DERV	8,042	17,432	17,406	12,657	10,635	9,854	9,525	9,101	8,757	9,132
	Passenger cars	Petrol	3,260,711	2,765,909	1,623,028	1,115,592	477,244	377,760	329,042	273,587	224,166	199,911
Ammonia (t)	Light duty vehicles	DERV	11	22	35	48	53	57	62	69	80	92
	Light duty vehicles	Petrol	45	69	242	196	131	114	96	82	70	59
	Passenger cars	DERV	12	35	54	90	129	154	177	201	226	325
	Passenger cars	Petrol	551	5,590	18,769	12,680	7,931	6,793	5,722	4,795	4,114	3,557
Nitrogen oxides (t)	Light duty vehicles	DERV	18,902	32,963	46,449	54,393	50,124	52,603	56,760	63,058	69,720	76,587
	Light duty vehicles	Petrol	71,939	51,071	24,572	6,397	2,150	1,824	1,574	1,401	1,274	1,148
	Passenger cars	DERV	8,198	24,591	39,813	70,092	83,759	87,849	92,317	96,147	99,359	101,399
	Passenger cars	Petrol	700,179	519,270	292,202	153,023	50,875	42,056	33,617	26,610	22,359	19,183
Lead (t)	Light duty vehicles	DERV	0	0	0	0	0	0	0	0	0	0
	Light duty vehicles	Petrol	176	66	0	0	0	0	0	0	0	0
	Passenger cars	DERV	0	0	0	0	0	0	0	0	0	0
	Passenger cars	Petrol					0	0	0	0	0	0

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
			1,608	805	1	1						
Particulate matter (t)	Light duty vehicles	DERV	4,755	7,235	5,940	4,845	3,341	2,909	2,576	2,188	1,882	1,657
	Light duty vehicles	Petrol	93	60	23	9	4	4	3	3	3	3
	Passenger cars	DERV	3,167	5,862	5,076	4,575	4,097	3,466	3,295	2,970	2,585	2,433
	Passenger cars	Petrol	1,587	1,131	643	420	245	230	211	197	196	196
Sulphur dioxide (t)	Light duty vehicles	DERV	4,330	5,399	239	236	59	62	60	58	60	66
	Light duty vehicles	Petrol	1,834	1,002	182	26	3	2	2	2	2	2
	Passenger cars	DERV	3,080	5,805	261	323	100	111	111	110	112	123
	Passenger cars	Petrol	16,755	12,168	3,676	952	138	105	118	90	89	95
NMVOC (t)	Light duty vehicles	DERV	1,712	3,183	4,737	5,075	3,397	3,001	2,818	2,619	2,483	2,454
	Light duty vehicles	Petrol	41,097	28,111	12,675	3,163	1,018	824	721	642	576	527
	Passenger cars	DERV	1,654	2,972	3,065	2,935	2,341	2,162	2,179	2,123	2,002	2,017
	Passenger cars	Petrol	428,832	339,871	183,457	96,369	30,201	23,137	18,458	14,215	11,224	9,549

Table 21 - Emissions for Scotland, road transport, split by vehicle class and fuel type.

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Carbon monoxide (t)	Light duty vehicles	DERV	1,557	2,479	2,502	2,585	2,520	2,228	1,957	1,686	1,485	1,300
	Light duty vehicles	Petrol	52,171	37,045	17,719	5,142	2,133	1,751	1,575	1,395	1,215	1,110
	Passenger cars	DERV	872	1,864	1,726	1,185	1,019	934	903	869	823	865
	Passenger cars	Petrol	294,406	246,604	144,748	104,343	45,862	36,038	31,572	26,370	21,625	19,324

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Ammonia (t)	Light duty vehicles	DERV	1	2	4	5	6	6	7	8	9	10
	Light duty vehicles	Petrol	5	8	27	22	15	13	11	9	8	7
	Passenger cars	DERV	1	4	6	10	14	17	19	22	24	34
	Passenger cars	Petrol	55	590	1,916	1,306	808	686	585	488	423	361
Nitrogen oxides (t)	Light duty vehicles	DERV	1,734	3,071	4,572	5,472	5,331	5,557	6,029	6,707	7,436	8,211
	Light duty vehicles	Petrol	7,373	5,227	2,564	667	236	199	172	153	140	126
	Passenger cars	DERV	871	2,661	4,112	7,081	8,673	8,995	9,525	9,964	10,086	10,260
	Passenger cars	Petrol	69,647	50,714	28,120	15,080	5,009	4,129	3,314	2,610	2,215	1,887
Lead (t)	Light duty vehicles	DERV	0	0	0	0	0	0	0	0	0	0
	Light duty vehicles	Petrol	17	6	0	0	0	0	0	0	0	0
	Passenger cars	DERV	0	0	0	0	0	0	0	0	0	0
	Passenger cars	Petrol	153	75	0	0	0	0	0	0	0	0
Particulate matter (t)	Light duty vehicles	DERV	479	728	605	492	360	311	279	238	205	181
	Light duty vehicles	Petrol	9	6	2	1	0	0	0	0	0	0
	Passenger cars	DERV	344	645	528	460	427	356	341	309	264	248
	Passenger cars	Petrol	146	102	58	39	23	22	20	19	19	19
Sulphur dioxide (t)	Light duty vehicles	DERV	424	529	24	24	6	7	6	6	6	7
	Light duty vehicles	Petrol	175	96	18	3	0	0	0	0	0	0
	Passenger cars	DERV	335	645	27	33	10	11	12	11	11	13
	Passenger cars	Petrol	1,591	1,137	340	91	13	10	11	9	9	9

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
NMVOC (t)	Light duty vehicles	DERV	165	308	472	512	360	316	298	278	264	263
	Light duty vehicles	Petrol	3,543	2,423	1,128	288	96	78	68	61	54	50
	Passenger cars	DERV	177	315	304	279	232	212	215	211	196	198
	Passenger cars	Petrol	38,985	30,426	16,322	8,872	2,835	2,174	1,746	1,344	1,077	913

Table 22- Emissions for Wales, road transport, split by vehicle class and fuel type.

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Carbon monoxide (t)	Light duty vehicles	DERV	1,008	1,612	1,599	1,657	1,569	1,405	1,225	1,058	931	819
	Light duty vehicles	Petrol	33,106	23,602	11,143	3,216	1,298	1,068	950	841	729	670
	Passenger cars	DERV	535	1,170	1,266	850	684	629	605	579	549	579
	Passenger cars	Petrol	188,524	157,724	89,269	64,045	27,976	23,222	20,171	16,832	13,844	12,427
Ammonia (t)	Light duty vehicles	DERV	1	1	2	3	4	4	4	5	6	6
	Light duty vehicles	Petrol	3	5	18	14	10	8	7	6	5	4
	Passenger cars	DERV	1	3	4	7	10	11	13	15	16	23
	Passenger cars	Petrol	35	381	1,201	811	497	419	350	293	258	221
Nitrogen oxides (t)	Light duty vehicles	DERV	1,103	1,970	2,907	3,509	3,342	3,481	3,732	4,146	4,580	5,075
	Light duty vehicles	Petrol	4,818	3,428	1,651	433	149	125	108	96	87	79
	Passenger cars	DERV	530	1,658	2,993	5,062	5,820	6,043	6,294	6,566	6,700	6,849
	Passenger cars	Petrol	44,365	32,286	17,337	9,302	3,082	2,534	2,012	1,594	1,372	1,177

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Lead (t)	Light duty vehicles	DERV	0	0	0	0	0	0	0	0	0	0
	Light duty vehicles	Petrol	11	4	0	0	0	0	0	0	0	0
	Passenger cars	DERV	0	0	0	0	0	0	0	0	0	0
	Passenger cars	Petrol	98	48	0	0	0	0	0	0	0	0
Particulate matter (t)	Light duty vehicles	DERV	312	476	388	317	225	194	173	148	127	113
	Light duty vehicles	Petrol	6	4	1	1	0	0	0	0	0	0
	Passenger cars	DERV	209	400	384	328	287	240	227	205	177	167
	Passenger cars	Petrol	93	65	36	24	14	13	12	11	12	12
Sulphur dioxide (t)	Light duty vehicles	DERV	274	343	15	15	4	4	4	4	4	4
	Light duty vehicles	Petrol	113	62	11	2	0	0	0	0	0	0
	Passenger cars	DERV	204	402	20	23	7	8	8	8	8	8
	Passenger cars	Petrol	1,016	726	210	56	8	6	7	5	5	6
NMVOC (t)	Light duty vehicles	DERV	107	200	300	328	227	199	187	175	166	165
	Light duty vehicles	Petrol	2,220	1,527	696	178	59	48	42	37	33	30
	Passenger cars	DERV	109	198	223	200	156	143	144	140	131	133
	Passenger cars	Petrol	24,980	19,486	10,091	5,460	1,733	1,328	1,058	819	664	568

Table 23 -Emissions for Northern Ireland, road transport, split by vehicle class and fuel type.

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Carbon monoxide (t)	Light duty vehicles	DERV	641	601	432	454	461	547	488	429	360	319
	Light duty vehicles	Petrol		510	492	281	162	130	120	119	76	67

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
			456									
	Passenger cars	DERV	309	967	1,240	843	654	581	544	509	490	512
	Passenger cars	Petrol	116,602	103,016	62,887	45,203	21,790	20,988	18,052	15,133	12,038	10,758
Ammonia (t)	Light duty vehicles	DERV	0	1	1	1	1	1	1	1	2	2
	Light duty vehicles	Petrol	0	0	1	1	1	1	1	1	0	0
	Passenger cars	DERV	1	2	5	7	9	11	12	13	14	20
	Passenger cars	Petrol	23	262	875	576	376	319	270	242	199	173
Nitrogen oxides (t)	Light duty vehicles	DERV	696	736	791	970	982	959	1,052	1,208	1,272	1,401
	Light duty vehicles	Petrol	63	69	67	36	18	15	14	13	9	8
	Passenger cars	DERV	304	1,376	2,940	5,036	5,524	5,495	5,565	5,655	5,794	5,883
	Passenger cars	Petrol	28,400	21,707	12,331	6,476	2,286	1,886	1,512	1,272	1,013	867
Lead (t)	Light duty vehicles	DERV	0	0	0	0	0	0	0	0	0	0
	Light duty vehicles	Petrol	0	0	0	0	0	0	0	0	0	0
	Passenger cars	DERV	0	0	0	0	0	0	0	0	0	0
	Passenger cars	Petrol	60	31	0	0	0	0	0	0	0	0
Particulate matter (t)	Light duty vehicles	DERV	200	178	105	87	66	54	50	44	36	32
	Light duty vehicles	Petrol	0	0	0	0	0	0	0	0	0	0
	Passenger cars	DERV	122	341	388	336	285	227	209	185	160	151
	Passenger cars	Petrol	56	41	24	15	10	9	9	9	8	8
Sulphur dioxide (t)	Light duty vehicles	DERV	170	125	4	4	1	1	1	1	1	1

Pollutant	Vehicle Classification	Fuel type	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	Light duty vehicles	Petrol	1	1	0	0	0	0	0	0	0	0
	Passenger cars	DERV	115	330	20	23	7	7	7	7	7	7
	Passenger cars	Petrol	624	465	142	37	6	4	5	4	4	4
NMVOC (t)	Light duty vehicles	DERV	70	77	86	96	70	58	56	55	49	49
	Light duty vehicles	Petrol	32	35	33	16	8	6	5	5	4	3
	Passenger cars	DERV	63	164	223	204	154	136	133	126	119	120
	Passenger cars	Petrol	15,332	12,573	6,979	3,722	1,291	992	802	661	495	422

Table 24 - Non-exhaust road transport PM_{10} emissions for England

Emission Source	Vehicle classification	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Brake Wear	Cars	2,197.4	2,289.9	2,402.2	2,445.5	2,362.4	2,367.0	2,362.4	2,347.7	2,392.7	2,408.6
	LGVs	403.2	435.1	497.1	583.7	614.8	618.7	613.1	626.7	663.6	686.1
	HGV	556.7	530.1	568.1	575.2	500.8	488.8	474.7	475.2	486.4	499.0
	Buses and coaches	147.9	168.0	175.2	178.4	174.1	160.9	151.6	155.2	155.2	148.0
	Motorcycles/moped	22.9	14.2	17.0	20.6	17.4	17.4	17.0	15.8	16.3	16.5
Road abrasion	Cars	2,169.8	2,268.9	2,432.9	2,530.4	2,480.4	2,491.3	2,485.4	2,480.7	2,531.6	2,560.3
	LGVs	256.4	286.3	335.0	396.2	420.6	424.5	423.5	436.8	461.8	480.9
	HGV	815.1	834.6	931.2	950.9	860.4	838.1	815.8	823.1	848.1	882.7
	Buses and coaches	145.1	154.6	162.1	160.5	156.4	144.4	135.3	138.8	138.8	132.4
	Motorcycles/moped	15.2	10.1	12.3	14.4	12.3	12.4	12.1	11.5	11.8	11.8
Tyre wear	Cars	2,170.5	2,268.6	2,418.1	2,499.5	2,439.7	2,448.9	2,443.5	2,435.8	2,484.7	2,509.5
	LGVs	404.3	447.1	519.6	613.2	649.4	655.0	652.4	671.1	709.8	737.7
	HGV	525.2	553.0	626.6	649.3	590.7	579.7	569.8	577.6	595.0	618.6
	Buses and coaches	72.6	79.1	82.6	82.3	80.2	74.1	69.5	71.3	71.3	68.0

	Motorcycles/moped	17.3	11.2	13.6	16.0	13.7	13.7	13.4	12.6	13.0	13.1

Table 25 - Non-exhaust road transport PM_{10} emissions for Scotland

Emission Source	Vehicle classification	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Brake Wear	Cars	205.3	214.5	224.1	235.3	233.5	233.3	232.9	232.2	236.2	237.5
	LGVs	38.0	41.3	48.8	58.0	63.5	63.6	62.9	64.3	67.9	70.7
	HGV	61.9	59.4	62.0	66.9	63.1	61.1	59.1	59.2	59.1	59.7
	Buses and coaches	20.5	22.3	23.5	23.5	25.1	23.1	21.9	22.8	22.9	22.2
	Motorcycles/moped	1.1	0.7	0.9	1.1	1.0	1.0	1.0	1.0	1.0	1.0
Road abrasion	Cars	213.0	222.6	236.2	251.8	252.4	252.3	253.8	254.0	258.6	260.5
	LGVs	25.7	28.7	34.4	41.0	45.8	45.9	45.9	47.4	50.1	52.3
	HGV	85.0	85.5	92.6	100.3	96.9	94.3	93.7	94.5	94.0	95.1
	Buses and coaches	21.0	21.5	22.8	22.3	24.7	23.1	22.2	23.1	23.2	22.3
	Motorcycles/moped	0.8	0.6	0.7	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Tyre w ear	Cars	209.3	218.8	231.3	245.6	245.4	245.3	246.3	246.3	250.7	252.4
	LGVs	39.7	44.0	52.5	62.5	69.5	69.6	69.4	71.5	75.5	78.8
	HGV	55.9	57.5	62.1	66.3	64.6	62.8	62.5	63.1	63.0	64.0
	Buses and coaches	10.3	10.8	11.4	11.2	12.3	11.4	10.9	11.3	11.4	11.0
	Motorcycles/moped	0.9	0.6	0.8	1.0	0.9	0.9	0.9	0.9	0.9	0.9

Table 26 - Non-exhaust road transport PM_{10} emissions for Wales

Emission Source	Vehicle classification	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Brake Wear	Cars	132.5	138.3	144.9	152.7	149.8	150.0	149.6	149.5	153.1	155.1
	LGVs	24.4	26.8	30.7	36.9	40.1	40.5	40.0	41.1	43.2	44.8
	HGV	34.5	32.7	33.6	33.3	29.4	28.2	27.2	27.2	27.5	27.4
	Buses and coaches	9.2	9.8	10.3	10.2	10.4	9.4	8.9	9.2	9.2	8.6
	Motorcycles/moped	0.9	0.6	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8
Road abrasion	Cars	136.0	141.9	151.1	162.6	161.3	161.4	160.7	161.5	166.4	168.7
	LGVs	16.7	18.8	22.1	26.5	29.0	29.1	28.8	29.8	31.4	32.9

Emission Source	Vehicle classification	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	HGV	47.1	46.7	48.6	48.7	43.5	41.6	40.7	40.9	41.2	41.6
	Buses and coaches	10.1	10.0	10.6	10.3	10.6	9.6	9.0	9.4	9.4	8.8
	Motorcycles/moped	0.7	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.7	0.7
Tyre wear	Cars	134.0	139.9	148.3	158.7	156.9	157.0	156.4	157.0	161.4	163.7
	LGVs	25.7	28.7	33.4	40.2	43.9	44.1	43.7	45.1	47.5	49.6
	HGV	28.8	29.2	31.0	31.5	28.3	27.3	26.8	27.0	27.5	27.9
	Buses and coaches	4.9	4.9	5.2	5.0	5.2	4.7	4.4	4.6	4.6	4.3
	Motorcycles/moped	0.8	0.5	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7

Table 27 - Non-exhaust road transport PM_{10} emissions for Northern Ireland.

Emission Source	Vehicle classification	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Brake Wear	Cars	78.1	88.5	105.1	114.9	120.0	119.4	118.7	121.4	120.8	122.0
	LGVs	5.6	6.3	7.5	10.4	11.9	11.3	11.5	12.6	12.6	13.1
	HGV	17.3	19.3	23.4	32.4	29.4	27.6	26.5	25.4	25.4	26.0
	Buses and coaches	2.7	3.2	3.9	3.2	3.4	3.7	4.2	3.8	3.7	3.6
	Motorcycles/moped	0.3	0.2	0.3	0.5	0.5	0.4	0.4	0.3	0.4	0.3
Road abrasion	Cars	84.6	95.9	113.9	126.3	132.3	130.8	129.8	133.4	133.0	134.7
	LGVs	3.6	4.1	4.9	6.9	8.3	7.9	8.0	8.7	8.7	9.1
	HGV	21.0	23.4	28.5	39.3	37.6	35.1	34.0	33.0	32.8	33.8
	Buses and coaches	2.6	3.0	3.7	3.4	3.8	4.0	4.5	4.2	4.2	4.0
	Motorcycles/moped	0.2	0.2	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.2
Tyre wear	Cars	81.9	92.9	110.3	121.9	127.6	126.4	125.5	128.8	128.3	129.8
	LGVs	5.7	6.4	7.6	10.7	12.7	12.0	12.3	13.3	13.3	13.9
	HGV	13.9	15.6	19.3	27.7	25.4	23.7	22.8	22.0	21.9	22.6
	Buses and coaches	1.3	1.5	1.9	1.6	1.8	1.9	2.2	2.0	2.0	1.9
	Motorcycles/moped	0.2	0.2	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3