Office for National Statistics

Environmental accounts on air emissions QMI

Quality and Methodology Information for air emissions in the UK Environmental Accounts, detailing the strengths and limitations of the data, methods used, and data uses and users.

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1 . Output information

National Statistic	
Frequency	Annual
How compiled	Various sources
Geographic coverage	UK
Last revised	4 September 2019

2 . About this Quality and Methodology Information report

This quality and methodology report contains information on the quality characteristics of the data (including the European Statistical System five dimensions of quality (PDF, 3MB)) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- help you to decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

This report aims to provide users of the air emissions statistics with information on the usability and fitness for purpose of these estimates.

The air emissions statistics form part of the Office for National Statistics (ONS) UK Environmental Accounts. This is part of a set of reports covering the UK Environmental Accounts estimates.

There is quality and methodology information available for other UK Environmental Accounts estimates, including:

- Energy use
- Material flows
- Environmental protection expenditure
- Environmental goods and services
- Environmental taxes

4 . Quality summary

Overview

A range of statistics is published in the UK Environmental Accounts on air emissions. They show the level of pollutants emitted by different areas of the economy – for example, how much sulphur dioxide was emitted in a particular year by the transport industry or the level of road transport-related emissions of carbon dioxide. The main tables cover:

- greenhouse gas emissions by industry (including households) and pollutant
- greenhouse gas emission intensity (per unit of economic output)
- acid rain precursors by industry (including households) and pollutant
- heavy metals by industry (including households) and pollutant
- other air pollutants by industry (including households) and pollutant

These are all made available for download as Microsoft Excel files from the Environmental Accounts page.

Annex 2 gives an overview of greenhouse gas emissions, acid rain precursors, heavy metals and other air pollutants while Annex 3 describes each type of pollutant.

The main source of information for this reporting is the National Atmospheric Emissions Inventory (NAEI). The NAEI is maintained by Ricardo Energy and Environment on behalf of the Department for Business, Energy and Industrial Strategy (BEIS).

The UK is required to report its air emissions to fulfil a range of international agreements:

- greenhouse gas (GHG) emissions are required to fulfil reporting obligations under the UN Framework Convention on Climate Change (UNFCCC) and for the Kyoto Protocol
- the NAEI reports emissions of air pollutants, which are required to fulfil reporting obligations to the UN Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (UNECE CLRTAP) and EU National Emission Ceiling Directive (NECD)
- the UN System of Environmental Economic Accounts (SEEA), together with the UN System of National Accounts (and the European System of Accounts), provides a framework for producing internationally comparable statistics on the environment and its relationship with the economy

The ONS is responsible for reporting the information, on an annual basis, for the third of these agreements.

While this variety of estimates is potentially confusing for users, the figures are released alongside bridging tables , which clearly explain the differences between the reporting used for the ONS air accounts and for the UNECE and UNFCCC. More information is available in Annex 4.

Uses and users

(Who is using the data and for what purposes.)

In addition to the mandatory requirement to supply data to Eurostat, the potential uses for data come from a variety of international organisations, UK and other governments, and the research community.

Because estimates are produced on a comparable basis with the System of National Accounts, it is possible to derive figures for the intensity of greenhouse gas or carbon dioxide emissions using the series on emissions and economic output. A relatively small emission intensity indicates low emissions of greenhouse gases relative to economic output and could imply relatively high energy efficiency, the use of biofuels to supply energy, or perhaps effective abatement. A relatively large emission intensity indicates high emissions of greenhouse gases relative to economic output and could imply relatively poor energy efficiency or perhaps little or ineffective abatement.

Analysis by industry can show whether a fall in emissions is wholly down to a contraction of the economy or if industries are employing more efficient and sustainable processes and technologies (for example, cleaner fuels). It is possible to examine whether economic growth is decoupling from emissions of pollutants.

One caveat when interpreting intensity must be that emissions embedded in trade are not considered. Therefore, if the UK is importing large quantities of goods from overseas, the producer countries will account for these emissions, not the UK. Indicators outside of the UK Environmental Accounts can help with this, for example, the carbon footprint estimates produced by the Department for Environment, Food and Rural Affairs.

5 . Quality characteristics of the air emissions data

Geography

Estimates are available at UK level and not further disaggregated by geography. “UK level”, in this context, is on a “residence” basis – that is, the estimates exclude emissions released in the UK by tourists and foreign transport operations and include the emissions of UK residents abroad. Likewise, emissions from businesses based in the UK but registered abroad are excluded, those from businesses registered in the UK but based abroad are included.

Coherence and comparability

The “residence” basis, required under UN SEEA, is one of the main reasons why these estimates differ from other air emissions statistics. The NAEI estimates are on a “territory basis” (thus including emissions released in the UK by tourists and foreign transport operations and excluding the emissions of UK residents abroad). The NAEI estimates provide the starting point to which Ricardo Energy and Environment apply the residence adjustments.

In addition to the residence versus territory issue, the various reporting requirements also differ for other reasons. These differences are explained in the bridging tables (see also Annex 4).

The air emissions figures are annual estimates starting from 1990. Ricardo Energy and Environment continuously take on methodological improvements, changes to reporting requirements, data revisions from suppliers and so on[1]. This means that while the whole time series is always subject to being revised, the data are comparable over time.

Timeliness and punctuality

Data are supplied to Eurostat each year as per the regulatory requirements (currently by the end of September). Eurostat then release the estimates in their air emissions database alongside data for other countries.

Ricardo Energy and Environment deliver two sets of air emissions statistics to the Office for National Statistics (ONS) for a particular time series (for example, 1990 to 2017), the first on a provisional basis at industry section level (21 categories), the second containing updated figures at the industry group level (around 130 categories). The industry splits are based on the Standard Industrial Classification (SIC 2007).

The ONS publish these estimates on our website as soon as possible following receipt from Ricardo Energy and Environment. For example, in 2019, provisional section level data for 1990 to 2017 were released in February 2019; revised data including estimates at industry group level (for the same period) were published in June 2019.

Both releases, and any articles associated with the estimates, are pre-announced on the ONS website. Previously released datasets are also accessible.

Concepts and definitions

The UN System of Environmental Economic Accounts (UN SEEA – see also Annex 1), together with the UN System of National Accounts and the European System of Accounts, provides a framework for producing internationally comparable statistics on the environment and its relationship with the economy. The ONS is responsible for reporting the information to Eurostat on an annual basis. To meet this requirement, Ricardo Energy and Environment are contracted to deliver estimates that are consistent with the SEEA framework.

Notes for: Quality characteristics of the air emissions data

1. Detailed summaries of all recalculations can be found in the Informative Inventory Report and the National Inventory Report.

6 . Methods used to produce the air emissons data

Ricardo Energy and Environment maintains the National Atmospheric Emissions Inventory (NAEI) on behalf of the Department for Business, Energy and Industrial Strategy (BEIS). These data sources provide air emissions data, calculated from activity data and emission factors, for all relevant sources in the UK as a starting point for generating the air emissions accounts.

The residence principle is then applied to these datasets thereby apportioning the emissions to an industrial classification based on Standard Industrial Classification SIC 2007.

Emissions estimates for pollutant releases from sources in the UK are estimated by combining an activity statistic (for example, distance in kilometres driven by cars) with an emission factor (for example, the emission factor for diesel). The NAEI compiles estimates of emissions from a wide range of sources in this way. The same activity data are commonly used to calculate emissions of many pollutants for a specific source. This is done by applying different emission factors to the activity statistic, and this approach can be used to estimate emissions for relevant air quality pollutants and greenhouse gases using the same activity metric.

A source is defined as a process, equipment or substance that leads to air emissions. These NAEI sources are chiefly defined according to framework set out by the Intergovernmental Panel on Climate Change (IPCC) and UN Economic Commission for Europe (UNECE), as well as by:

- other requirements for output data and inventory guidance such as that produced by European air quality inventory guidelines
- the structure of national energy statistics (largely BEIS's annual publication of the Digest of UK Energy Statistics, DUKES)
- the classifications of industrial activities used for regulatory regimes such as Integrated Pollution Prevention and Control (IPPC) and Local Authority Pollution Control (LAPC)
- the structure of industrial sectors as perceived by industry representatives (for example, through the provision of data by industry for defined subsectors, which must then be replicated in the NAEI
- the structure of other datasets, such as UK production statistics and so on

The sources can also be representative of the limits of the raw data upon which the inventory compilation are based.

These NAEI source categories are not based on a coding structure such as Standard Industrial Classification (SIC 2007) and a mapping procedure is required to make a link between source category and SIC for the environmental accounts.

The definitions are such that many of the NAEI sources can be mapped directly to a SIC 2007 code through a one-to-one relationship, where a single NAEI source is judged as being equivalent to a single SIC 2007 code.

In some other cases NAEI sources can be linked to several SIC 2007 codes through one-to-many relationships, and here the "activity" and consequent emissions from that source have to be split to each of the relevant SIC 2007 codes either directly according to their proportionate level of activity, or indirectly. A significant part of the air emissions and energy accounts work carried out by Ricardo Energy and Environment is in determining in what proportions the emissions and fuel use by these sources should be split out across the SIC divisions that span the economy. The methodology to do this is necessarily complex.

One source and activity combination that is required to be mapped to SIC is petrol consumption that relates to motorway driving by cars. Motorway driving is a common activity throughout the economy and the emissions calculated for this source and activity are thus split over all the SIC 2007 sectors that represent industry, commerce and public administration, as well as to households. The actual levels of activity and therefore emissions apportioned in this way do, however, vary significantly between these SIC 2007 sectors, and the method for doing this uses data from both the National Travel Survey and Purchases data, which provides information on fuel purchases on a monetary basis by different industries.

The source activity combination that relates to gas oil for freight trains would, conversely, be a one-to-one match with the SIC 2007 code that corresponds to the rail transport industry.

In principle, estimates for emissions made by each industry are made on the basis of which industry is the primary emitter and which industry owns the unit creating the emissions. For example, if a retailer owns a fleet of trucks that deliver stock to its stores, the emissions from those trucks would go to the retail industry. However, if the retailer hires a separate freight company to deliver its goods, the emissions would go to the road freight industry.

Annex 5 includes detail on methods for emissions from specific sources.

7 . Acknowledgement

We would like to thank Ricardo Energy and Environment for their significant contribution towards this work.

8 . Other information

More information on air emissions and other topics related to UK Environmental Accounts is available:

- UK Environmental Accounts
- Adjustments to the UK's atmospheric emissions and energy accounts to bring them on to a national accounts "residents" basis – Methodology and analysis report (PDF, 227KB)
- Business, Energy and Industrial Strategy (BEIS) UK Emissions Statistics
- The Reporting of Greenhouse Gas Emissions in the UK: The Difference between the Environmental Accounts and the United Nations Framework Convention on Climate Change (UNFCCC) Reporting (PDF, 253KB)
- UK-AIR website
- Air Quality Indicators
- UN System of Environmental and Economic Accounting (SEEA)
- European Regulation on Environmental Economic Accounts
- Eurostat Manual for Air Emissions Accounts
- National Atmospheric Emissions Inventory
- UK Greenhouse Gas Inventory – Methods and Compilation
- Digest of UK Energy Statistics

9 . Annex 1: UN SEEA

The UN System of Environmental Economic Accounts (SEEA) was adopted by the UN Statistical Commission as the first international standard for environmental-economic accounting in 2012, following a comprehensive global consultation process. The SEEA sits alongside the UN System of National Accounts (SNA) to provide a framework for producing internationally comparable statistics on the environment and its relationship with the economy.

The SEEA framework follows a similar accounting structure to the SNA and uses consistent concepts, definitions and classifications in order to facilitate the integration of environmental and economic statistics.

The SEEA says that:

“The intent in physical flow accounting is to record the physical flows underpinning the transactions recorded in the monetary supply and use tables, primarily with respect to goods, and to then extend the monetary supply and use table to record physical flows from the environment to the economy (such as flows of natural resources) and physical flows from the economy to the environment (such as emissions to air and water).”

The air emissions accounts are concerned with the physical flows of emissions from the economy to air. These flows from the economy to the environment are termed residuals.

Air emissions are defined in the SEEA as “gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes”. The aim of the account is to record “the generation of air emissions by resident economic units, by type of substance” in line with “the scope and boundaries used in the compilation of the economic accounts”.

The SEEA outlines the following breakdown of emissions within an air emissions account:

- a breakdown of emissions by type of pollutant
- a breakdown by industries (equivalent to two-digit Standard Industrial Classification: SIC 2007)
- household emissions (equivalent to Classification of individual consumption by purpose, COICOP classifications)
- separate identification of emissions from landfill sites
- a distinction between those emissions released direct to the environment and those captured and transferred to other economic units or stored

The UK currently delivers the first three of these requirements.

10 . Annex 2: Overview of pollutants

In the UK, a wide range of pollutants are emitted to atmosphere from a wide range of sources. In the Environmental Accounts of the UK, these pollutants are categorised into four groups:

- greenhouse gas emissions that contribute to global warming
- acid rain precursors
- heavy metals
- other pollutants

Greenhouse gas emissions

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect.

Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4) and ozone (O3) are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine-containing substances, dealt with under the Montreal Protocol. Besides carbon dioxide, nitrous oxide and methane, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride, nitrogen trifluoride, hydrofluorocarbons and perfluorocarbons.

Greenhouse gases are effectively transparent to natural light from the sun and relatively opaque to infra-red radiation from the Earth's surface and atmosphere. Therefore, they trap heat within the surface-tropospheric system. The Earth effectively emits infra-red radiation to space at an altitude where the atmosphere is minus 19 degrees Celsius on average, but as a result of the greenhouse effect the Earth's surface temperature is kept at an average of plus 14 degrees Celsius. Without this naturally occurring greenhouse effect the Earth's temperature would be too cold for human life.

Further information on greenhouse gases can be found in the glossary of the International panel on climate change, IPCC Fourth Assessment Report.

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. There is growing consensus that this rise in greenhouse gas emissions has led to changes in the global atmosphere which have resulted in global warming.

These direct greenhouse gases have different effectiveness in radiative forcing. The Global Warming Potential (GWP) is a means of providing a simple measure of the relative radiative effects of the emissions of the various gases. The index is defined as the cumulative radiative forcing between the present and a future time horizon caused by a unit mass of gas emitted now, expressed relative to that of CO2. It is necessary to define a time horizon because the gases have different lifetimes in the atmosphere.

For the purposes of the environmental accounts, consistent with the working group contribution to the IPCC's Fourth Assessment Report, over 100 years methane has a GWP of 25 whilst nitrous oxide has a GWP of 298. Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) have a range of GWPs because these refer to a number of species, each with its own GWP. By weighting the emission of a gas with its GWP it is possible to estimate the total contribution to global warming of UK greenhouse gas emissions.

Acid rain precursors

During the late 1960s and 1970s there was increasing evidence that increases in lake and river acidity, particularly in some upland areas of the country, were linked to an observed decline in fish population and other fauna and flora. At the time, the transport of acidifying emissions from high chimneys, such as power stations, was identified as a major problem. Rainwater can absorb the acidifying gases sulphur dioxide, nitrogen oxides and ammonia and particulates during its transport through the atmosphere. The pollutants will eventually return to the earth's surface and may result in harmful impacts – particularly in some sensitive ecosystems and building materials.

In addition, the deposition of nitrogen containing compounds may also contribute to the eutrophication – "excess nutrient enrichment" of terrestrial and marine ecosystems. This may lead to displacement of existing vegetation by more nitrogen tolerant species – for example, heather in heathlands being displaced by grass. For further information, see the Department for Environment, Food and Rural Affairs (Defra) Air Pollution in the UK report.

The emissions are weighted together using their relative acidifying effects. The weights, given relative to sulphur dioxide, are approximately 0.7 for nitrogen oxides and 1.9 for ammonia. This is a simplification of the chemistry involved and there are a number of factors that can affect the eventual deposition and effect of acid rain. The weighting factors may underestimate the damage to ecosystems caused by these acid rain precursors.

Heavy metals and other pollutants

The groupings of heavy metals and other pollutants include examples of pollutants that harm human health or the environment, but do not contribute to acid rain or global warming. Examples of heavy metals include arsenic and mercury. Examples of other pollutants are benzene and carbon monoxide.

Unlike acid rain precursors and greenhouse gas precursors these pollutants are not weighted to a single type of gas according to their environmental effect but are simply reported in tonnes. These gases are not equally harmful to the environment, so a tonne emitted of one gas may be much more harmful than a tonne emitted of another gas.

11 . Annex 3: Details of pollutants

Greenhouse gases

Carbon dioxide (CO_2) emissions come from a wide variety of natural and anthropogenic sources, however, the global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change. It is also produced in some industrial processes such as the manufacture of cement. Carbon dioxide is a long-lived gas remaining in the atmosphere for between 50 and 200 years. It is the most important anthropogenic greenhouse gas.

Methane (CH_4) is mainly produced when organic matter is broken down in the absence of oxygen. Large quantities are produced by enteric fermentation in cattle and sheep, by the spreading of animal manure and from organic waste deposited in landfill sites. Methane is also emitted in coal mining, oil and gas extraction and gas distribution activities. Methane is a significant greenhouse gas.

Nitrous oxide (N_2O) is released in a few industrial processes and from the soil when nitrogenous fertilisers are applied in agriculture and horticulture. These are the main anthropogenic sources. It is a long-lived pollutant, lasting about 120 years in the atmosphere and is a potent greenhouse gas.

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are artificial fluids that contain chlorine and/or fluorine. Because of their low reactivity and non-toxicity, they were widely used as refrigerants, foam-blowing agents, aerosol propellants and solvents.

Nitrogen trifluoride (NF_3) is the most recent addition to GHGs that are reported under the Kyoto protocol. It is most readily released through the production of liquid crystal displays (LCDs) and solar cells.

Acid rain precursors

Ammonia (NH_3) is predominantly emitted from spreading animal manure and some fertilisers.

Nitrogen oxides (NO_x) arise when fossil fuels are burnt under certain conditions. High concentrations are harmful to health and reduce plant growth. Like sulphur dioxide, nitrogen oxides contribute to acid rain; nitrogen dioxide (NO_2) also plays a part in the formation of ground ozone layer.

Sulphur dioxide (SO2) is produced when coal and some petroleum products containing sulphur impurities are burnt. Sulphur dioxide is an acid gas that can cause respiratory irritation. It can damage ecosystems and buildings directly and is a major contributor to acid rain.

Other air pollutants

The environmental accounts also reports emissions of CO, PM10 and NMVOCs, which are required by EU regulation and included in the UNECE reporting guidelines, as well as two specific NMVOCs, benzene and 1,3-butadiene. A number of other pollutants not covered by the accounts have effects that can variously affect health and the environment, including poly-organic pollutants (POPs), which are included in UNECE reporting.

Benzene is released predominantly from the distribution and combustion of petroleum products. It is a carcinogen that has also been found to cause bone-marrow depression and consequent leukopenia (depressed white blood cell count) on prolonged exposure.

1,3-Butadiene is a colourless, gaseous hydrocarbon. It is produced by dehydrogenation of butene, or of mixtures of butene and butane; it may also be made from ethanol. 1,3-butadiene is believed to be a carcinogen, for which the safe level is not known. Emissions of 1,3-butadiene arise from combustion of petroleum products and in its manufacture of synthetic rubber, nylon and latex paints in the chemical industry. 1,3-butadiene is not present in petrol but is formed as a by-product of combustion. The increasing use of catalytic converters through the 1990s has caused a significant reduction in emissions from the road transport sector.

Carbon monoxide (CO) is produced when fossil fuel is burnt with insufficient oxygen for complete combustion. It is a reagent in ground-level ozone formation and is toxic in, and at, high concentrations of carbon.

Non-methane volatile organic compounds (NMVOCs) cover a variety of chemicals, many of which are known carcinogens. Emissions of NMVOCs arise from the deliberate and incidental evaporation of solvents (for example, in paints and cleaning products), from accidental spillage and from non-combustion of petroleum products. The environmental accounts include natural emissions of NMVOCs from managed forests. NMVOCs play a role in the formation of ground level ozone, which can have an adverse effect on health. The NMVOC emissions include benzene and 1,3-butadiene.

PM10 and PM2.5 roughly equate to the mass of particles less than 10 and 2.5 micrometres in diameter respectively that are likely to be inhaled into the thoracic region of the respiratory tract.

Heavy metals

Arsenic (As) is a naturally occurring element in the Earth’s crust. It is combined with oxygen, chlorine, and sulphur to form inorganic arsenic compounds and combines with carbon and hydrogen to form organic arsenic compounds. Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

Breathing high levels of inorganic arsenic can lead to sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of “pins and needles” in hands and feet. Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic.

Cadmium (Cd) is a normal constituent of soil and water at low concentrations. Industrially, cadmium is used as an anti-friction agent, in alloys, semi-conductors, control rods for nuclear reactors and PVC and battery manufacture. The main sources of cadmium emissions are from waste incineration, and iron and steel manufacture. Emissions of cadmium have declined over recent years; this is mainly attributable to the decline in coal combustion.

Environmentally, cadmium is dangerous because many plants and some animals absorb it easily and concentrate it in tissues. Cadmium competes with calcium in the body and if levels are sufficient, it will displace calcium, causing embrittlement of bones and painful deformations of the skeleton. Cadmium also competes with zinc in the body and if levels of cadmium are high enough, cadmium will also displace zinc from enzymes in the body.

Chromium (Cr) is a naturally occurring element, which can be found in rocks, animals, plants, soil and in volcanic dust and gases. Chromium is presented in several different forms. The most common forms are chromium (0), chromium (III), and chromium (VI). No taste or odour is associated with chromium compounds. Chromium (III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium (VI) can cause irritation to the nose, such as runny nose, nosebleeds and ulcers, and holes in the nasal septum. Ingesting large amounts of chromium (VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death. Skin contact with certain chromium (VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium (VI) or chromium (III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

Copper (Cu) is a reddish metal that occurs naturally in rocks, soil, water, and air. Copper also occurs naturally in plants and animals. Metallic copper can be easily moulded or shaped. Metallic copper can be found in mixtures (called alloys) with other metals such as brass and bronze. Copper is also found as part of other compounds forming salts. Copper salts occur naturally but are also manufactured. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

Mercury (Hg) emissions mainly come from waste incineration, the manufacture of chlorine in mercury cells, non-ferrous metal production and coal combustion. Emissions of mercury have declined over recent years due to improved controls on mercury cells and their replacement by diaphragm cells and the decline of coal use. Due to the volatility of mercury, if levels are sufficiently high, compounds containing mercury attack and destroy various parts of the body, particularly teeth, lung tissues and intestines.

Nickel (Ni) can be combined with other metals, such as iron, copper, chromium, and zinc, to form alloys. Most nickel is used to make stainless steel. Nickel can be found in all soil and is emitted from volcanoes. It can also be found in meteorites and on the ocean floor. Nickel and its compounds have no characteristic odour or taste.

The most common harmful health effect of nickel in humans is an allergic reaction. People can become sensitive to nickel when jewellery or other things containing it are in direct contact with the skin. People who drank water containing high amounts of nickel had stomach aches and suffered adverse effects to their blood and kidneys.

Lead (Pb) is a very toxic element and can cause a variety of symptoms at low dose levels. Lead dust or fumes can irritate the eyes on contact, as well as causing irritation to the nose and throat on inhalation. Acute exposure can lead to loss of appetite, weight loss, stomach upsets, nausea and muscle cramps. High levels of acute exposure may also cause brain and kidney damage. Chronic exposure can lead to effects on the blood, kidneys, central nervous system and vitamin D metabolism.

Currently major sources of lead are metal production and combustion of lubricants in industry. There has been a significant reduction in emissions from metal production due to declining production, and public electricity and heat production due to improved abatement measures. Emissions have also declined as a result of the decreasing use of coal.

Selenium (Se) is a naturally occurring mineral element that is distributed widely in nature in most rocks and soils. Most processed selenium is used in the electronics industry, but it is also used as a nutritional supplement in the glass industry. Also, as a component of pigments in plastics, paints, enamels, inks and rubber. Radioactive selenium is used in diagnostic medicine.

Selenium has both beneficial and harmful effects to humans. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting and diarrhoea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis.

Brief exposures to high levels of elemental selenium or selenium dioxide in air can result in respiratory tract irritation, bronchitis, difficulty breathing and stomach pains. Longer-term exposure to either of these air-borne forms can cause respiratory irritation, bronchial spasms, and coughing.

Vanadium (V) is a compound that occurs in nature and is often found as crystals. Pure vanadium has no smell. Vanadium and vanadium compounds can be found in the Earth's crust and in rocks, some iron ores and crude petroleum deposits. Vanadium in the form of vanadium oxide is a component in special kinds of steel that is used for automobile parts. Vanadium is also mixed with iron to make important parts for aircraft engines. Small amounts of vanadium are used in making rubber, plastics, ceramics and other chemicals. Breathing high levels of vanadium can cause lung irritation, coughing, wheezing, chest pain, runny nose and a sore throat.

Zinc (Zn) can be found in air, soil and water and is present in all foods. Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulphate and zinc sulphide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives and ointments. Large doses taken by mouth even for a short time can cause stomach cramps, nausea and vomiting. It can cause anaemia and decrease the levels of your good cholesterol when it has been taken for a long time. Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever.

12 . Annex 4: Bridging tables

UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC) bridging table lists the total amount of greenhouse gas emissions and shows the adjustments that are made between the UK Environmental Accounts measure and the UNFCCC measure of greenhouse gas emissions.

The table first bridges to the headline data published by the Department for Business, Energy and Industrial Strategy (BEIS), which is on a UNFCCC basis but excludes overseas territories. The greenhouse gas (GHG) emissions reported on an UNFCCC basis are on a territory rather than residence basis and do not include:

- international aviation or shipping emissions or
- emissions from biomass

In addition to this, the GHG emissions reported to the UNFCCC include emissions from Crown dependencies and overseas territories, and net emissions from land-use, land-use change and forestry. Emissions and removals accounted for using the appropriate modalities of the Kyoto Protocol are shown as a memorandum item.

UNECE

The United Nations Economic Commission for Europe (UNECE) bridging table is presented in four parts, which correspond to the four different types of pollutants. In addition to the discrepancies arising from whether the estimates are on a residence or territory basis:

- Gibraltar is not included in the environmental accounts but is in the UNECE, so this is also displayed in the bridging table
- the environmental accounts also include bunker emissions for ships and the UNECE does not

There are also a number of sources of air emissions that are not included in the UNECE but are included in the environmental accounts. They are:

- aircraft between the UK and Crown dependencies
- aircraft between the UK and overseas territories excluding Gibraltar
- accidental forest, vegetation and straw fires
- natural sources
- natural fires
- wild animal wastes
- adult breath and sweat
- deforestation
- international shipping

In addition to this, the UNECE measures of emissions include the category of liming grassland and cropland, whereas the environmental accounts do not.

13 . Annex 5: Specific methodology

Aviation emissions

The internationally adopted approach (United Nations Framework Convention on Climate Change (UNFCCC)) for reporting emissions from aviation requires that emissions from international aviation are reported only as a memorandum item and are not included in national totals.

For the UK Environmental Accounts, all take-off and landing emissions, and emissions of greenhouse gases from aircraft in the cruise, are included on a residence basis. To make this adjustment to a residence basis there is an addition of aviation emissions from UK flight operators running international flights to and from the UK less foreign operators running international flights to and from the UK.

Flight kilometre data are sourced from the Civil Aviation Authority. Information is available on the total amount of fuel that is used for domestic aviation, international aviation and for the military. Average fuel use per kilometre is calculated and then applied to calculate estimated fuel use by UK operators on international flights from abroad less fuel use by overseas operators on flights from the UK.

Shipping emissions

The internationally adopted approach (UNFCCC) for reporting emissions from shipping requires that emissions from international shipping are reported only as a memorandum item and are not included in national totals. Adjustments for shipping emissions follow a similar methodology to aviation emissions. An adjustment is made based on the amount of fuel purchased overseas by UK operators less the amount of fuel purchased in the UK by foreign operators.

The volume of fuel purchased in the UK by overseas operators is calculated by subtracting UK purchases in the UK (estimated based on total UK operators' expenditure in the UK from balance of payments divided by the unit price per tonne from the Quarterly Energy Prices) from the total purchases in the UK (supplied by Ricardo Energy and Environment based on the national inventory).

The volumes purchased overseas by UK resident operators are estimated based on the total expenditure overseas on bunker fuel (poured into a ship's bunkers to power its engines) by UK operators taken from the Balance of Payments divided by the average annual bunker price sourced from Bunker World.

Fishing emissions

EU regulations mean that fishing fleets from each member state can fish in the waters of other member states. Vessels can also fish in international waters. This means that fuel bought by fishing fleets within the UK can be bought by foreign vessels and UK vessels may purchase fuel in other countries.

The proxy that is used to estimate fuel usage and hence emissions is the fish catches. It is assumed that vessels landing catches in a country other than their own buy an amount of fuel at the place they make their catch, which is proportional to the size of the catch.

The UK Sea Fisheries Report provides statistics on what proportion of the UK catch was caught by foreign vessels. This proportion is then subtracted from the total amount of fuel bought by fishing vessels in the UK. A similar method is used to estimate the fuel usage by UK fishing vessels overseas on the catch of UK vessels overseas. The percentage by which the amount caught by the UK fishing fleet overseas would increase the catch in UK waters is added to the fuel purchased by fishing vessels in the UK.

This method assumes that boats from other countries do not have different emissions profiles from fishing vessels that are in the UK. It also does not take account of the fact that fishing vessels fishing further away from their home port will use more fuel as it will be a greater distance to get to their catching ground. As there are more UK fishing vessels fishing overseas than overseas vessels fishing in UK waters, it is possible that this methodology underestimates the emissions caused by the UK fleet. However, it should be noted that fishing emissions make up a very small percentage of total emissions.

Private motor vehicle emissions

Private motor vehicles cover all vehicles not used for goods transport. Purchases overseas by UK residents are calculated on the basis of total kilometres driven multiplied by average fuel use per kilometre. The distance driven is estimated based on the number of overseas visits by residents in cars divided by the average vehicle occupancy (from the International Passenger Survey) multiplied by average distance travelled (set at 620 kilometres since 2001). Purchases in the UK by overseas residents are calculated similarly.

An adjustment is then made for “tank tourism”, where drivers cross international borders to take advantage of lower fuel prices. Fuel prices reported by the AA are used to monitor price differentials between the UK and France.

Goods vehicle emissions

The Department for Transport calculates most of the statistics relating to goods vehicles and coaches. To calculate the necessary statistics for goods vehicles and coaches, statistics are provided from the Department for Transport, which are sourced from the Roll-on Roll-off Survey, the International Road Haulage Survey and the Foreign Vehicles Survey.

As different heavy goods vehicles have varying sizes and capacities, and hence different fuel consumption, splits are made by heavy goods vehicles (HGVs) and large goods vehicles (LGVs). In addition to this, HGVs are split between vehicles with rigid and articulated axles. Fuel consumption for each type of vehicle is combined with the distance driven by each type to provide an estimate of emissions from foreign vehicles inside the UK and UK vehicles overseas.

Coach emissions

The net adjustment is for total diesel purchased by UK coaches overseas less total diesel purchased in the UK by overseas coaches. As with cars the International Passenger Survey provides estimates of number of residents and visitors travelling by coach and numbers of coaches are calculated based on average vehicle occupancy. As a best proxy, the average distance travelled by coaches is based on the average travelled by HGVs.

Overseas territory emissions

Following national accounts conventions, overseas territories and Crown dependencies are not included in the emissions accounts. They are also treated as overseas territories for the purposes of estimating emissions from international aviation and shipping. This means that compiling the emissions accounts for the UK involves removing all emissions from Guernsey, Jersey, Isle of Man, Gibraltar, Bermuda, Cayman Islands, Falkland Islands and Montserrat.