Creating a world fit for the future

Company reporting of air-pollutant emissions: A scoping project

Final report

Report for IoUH and CAF

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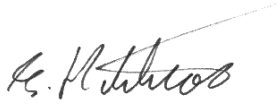

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Executive Summary

The reporting of greenhouse gas (GHG) emissions is a well-established practice for businesses. They measure and report on their emissions for a range of reasons, including legal requirements, to secure certification to schemes relevant to their industry, or due to the demands of clients and staff who care about the environment. This helps companies to understand how they can reduce their carbon footprint and regulators to assesses improvements being made by businesses.

However, the same is not true in relation to wider emissions associated with air pollution. As such businesses do not have the same understanding of their impact on air pollution or how they may reduce this impact. This scoping project has set out to address this issue, by exploring how increased levels of measuring and reporting of emissions relevant to **a**ir quality **p**ollutants (AP) can be achieved, concentrating on $PM_{2.5}$, PM_{10} and NO_x, alongside or as part of existing GHG reporting.

The project has two main objectives:

1. **To develop an approach to estimating air pollutant emissions** – considering the scope of the approach, priority business sectors in terms of the level if impact on emissions and an practical estimation approach which was tested with 4 businesses.
2. **To explore an overall reporting process** – considering existing mechanisms for GHG and AP reporting, barriers and challenges for business in reporting and incentives and support to allow companies to progress AP reporting.

These two streams of work then feed into a set of recommendations for establishing an AP reporting system for businesses. The recommendations and scoping work have focused on the UK context, but with the intention of expanding any future scheme out to w wider international audience.

The outcomes of the scoping study and recommendation for a reporting scheme are set out below:

Scope and focus of a scheme

The geographical location of GHG emissions is not necessarily important, rather it is the total mass of emissions that is key. However, with AP emissions the location is important in terms of concentration, exposure and resultant health impact. As such direct emissions from a businesses activities, particularly in urban areas, should be considered the priority for AP reporting. Indirect emissions from mainly electricity, will contribute to wider air pollution issues, so are considered a secondary priority. Therefore, aligning this with the 'scopes' of GHG reporting the recommendation, at least for an initial scheme, is to target:

- **Scope 1 emissions** – from sources owned and operated by the business;
- **Scope 2 emissions** – in terms of purchased electricity or heat.

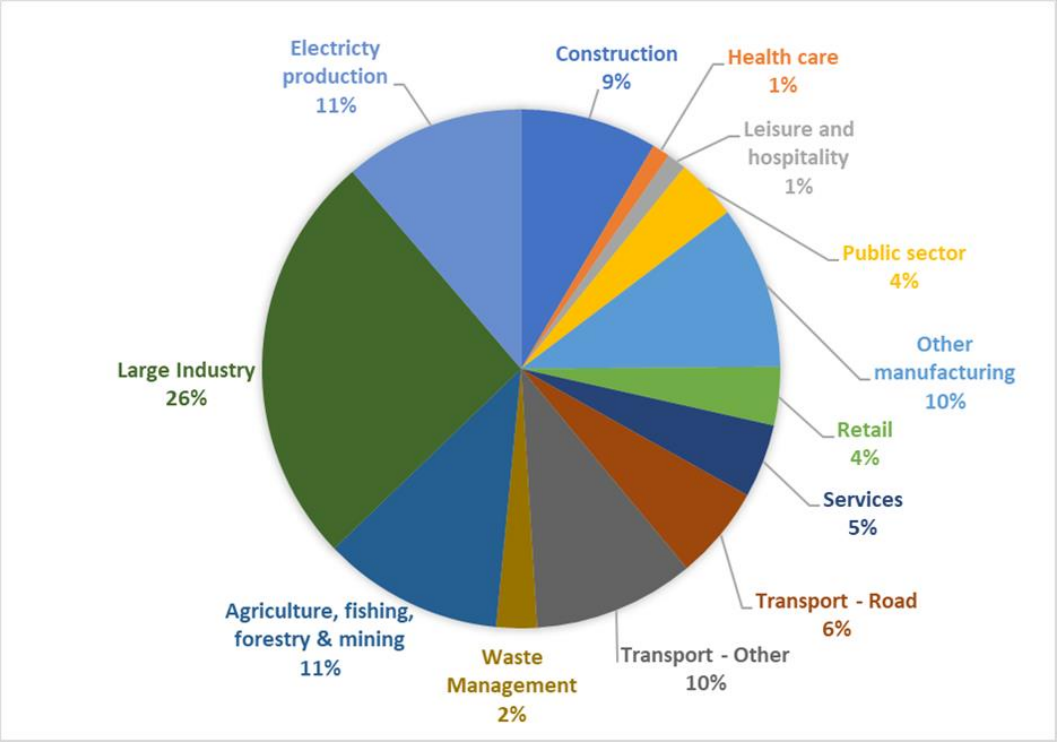
In terms of considering which business sectors should be a priority for an initial reporting scheme analysis was carried out of the ONS Environmental Accounts for the UK to explore which business sectors produced the most emissions and a consideration of whether these were likely to be in areas where people would be exposed (i.e. largely urban areas). As an example the breakdown of NOx emission by key industry sectors is shown below in Figure ES1.

Large industry, electricity production and agriculture are large emitting sectors, but are not expected to be in urban areas so were not seen as a priority. The remaining sectors that were key sources of emissions and likely to be urban areas , indicated that the priority sectors for a scheme should be:

- **The transport sector** – especially urban logistics businesses;
- **The construction sector** – with many construction sites in urban areas;
- **The services and retail sector** – covering offices, retail businesses, leisure and hospitality and public services all of which are likely to be in urban areas.

Manufacturing businesses could also be considered as a priority, though less may be in urban areas.

Figure ES1 – National NOx emission by main industry sector



For each of these industry sector an analysis was also carried out of what activities generated most of the emissions (also described as key emission sources). This analysis indicated that the key sources that any estimation methods should focus on were:

- **Transport activity** – related to directly owned, leased or hired vehicles, and also a consideration of rail travel;
- **Use of heat and power** – covering combustion emissions from heating plant and scope 2 emissions from use of electricity;
- **Off road machinery** (often termed Non-Road Mobile Machinery) – a key source in construction, but also present in the service and retail sector in relation to materials handling.

Fugitive dust, for example from construction activity, was also identified as a major source of PM emissions. However, our pilot work identified that methods available for calculating these emissions were not very accurate nor were businesses likely to have the right kind of data to support these calculations. On this basis dust was ruled out for any initial scheme.

Structure of a reporting scheme

The core of any reporting scheme will be the methods that can be used for the estimation of emissions and how these relate the GHG emissions estimation and most importantly the data that businesses are likely to have available to carry out the emissions calculations. The key source of internationally recognised estimation methods is the 'EMEP/EEA air pollutant emission inventory guidebook' produced by the European Environment Agency. This is used for both GHG and AP emissions estimation and is therefore recommended as the basis for the calculation methods and was used for the pilot with the 4 organisations in this scoping study.

The basic approach to calculating GHG and AP emissions is the same – an amount of activity multiplied by an emission factor. However, the nature of the activity data and emissions factors for AP calculations is more complex and potentially requires more lays of data to be collected by an organisation. To manage this and help align reporting with existing GHG reporting processing a tier approach, similar to that already in the 'guidebook' is recommended to allow companies a flexible approach to AP reporting. The recommended tiered approach is as follows:

- **Tier 1 – a simple approach based on fuel use** and fuel-based emission factors, that should allow the air pollutant estimations to be done within the existing GHG data collection approaches.
- **Tier 2 – increased complexity introducing some elements of technology** into the emission factors where this data is available. In some case this kind of data is already collected for GHG calculations, especially for better estimation of non-CO_2 gases.
- **Tier 3 – with the most detail included around technology and operating conditions** being used. In this case the data required will be beyond what is normally used for GHG estimation.

Companies could start with the simpler Tier 1 approach and then develop data needed for more complex teir 2 and 3 approach. With increasing levels of complexity, the estimation estimates are likely to be more accurate and will also allow improvement actions to be reflected in more detail in the reporting results. This is illustrated in Figure ES2 below.

Figure ES2 Emission sources by tier and uncertainty

Source	Tier 1	Tier 2	Tier 3
Transport	✓	✓	✓
NRMM	✓	✓	✓
Combustion plant	✓	✓	Bespoke method
Electricity	✓	✓	

In terms of the broader nature of scheme it is clear that organisations report GHG emissions through a wide range of schemes both under a regulatory regime or as part of a voluntary industry or environmental transparency scheme. In terms of AP reporting this is only done in a limited way for example under environmental permitting for key sites or processes and not for an business as a whole.

To understanding more fully what would incentivise and support business to report their AP emissions more fully and what a scheme may look like for this a business survey was carried out with responses from 189 organisation. A key message from this survey as that some form of regulation, like that requiring GHG reporting, would be the key driver for companies to report. This could be developed through clear guidance or inclusion of air pollution in scheme such as ESG or environmental management, but this needs to be explored further. However, there was also a strong willingness from business to understanding their impacts on air pollution more fully and take action.

In relation to a reporting scheme the key elements that businesses felt were most important was:

- **Clear guidance on how to calculate emissions** – such as the approach being piloted in this scoping study;
- **Supporting data sheets and assumptions** – so that the information needed for calculations is easily available;
- **Templates for data collection and reporting** – to make the process common and replaceable across businesses;
- **A formal scheme** – under which they can report and disclose their emission results like the Carbon Disclosure Project in relation to GHG rpeorting.

Next steps for a reporting scheme

The scoping study has identified and trailed a basic approach to a reporting method and established that there is interest from business in doing more in this area. It is therefore recommended that the work is progressed in the form of an initial ‘beta’ reporting scheme and this is run for a period of 2

years to full test how it works and the reactions from businesses. These next two phases would in simple terms comprise the following:

- **'Beta scheme' development** – comprising:
  - Develop scheme guidance and supporting tools
  - Set up initial scheme website
  - Develop initial scheme members working with business organisations such as the CBI and logistics UK
- **2 year implementatin phase** – comprising:
  - Promote scheme membership
  - Management membership, and scheme site
  - Provide technical support for members

In terms of establishing the success of the scheme over these next two phases the following success criteria are suggested:

- **Success of the beta scheme development**
  - At least one partner membership organisation such as Logistics UK or the CBI is backing and promoting the scheme to its members;
  - Six business who have trailed all the materials and website, and agreed it meets business needs;
  - Twenty business signed up to start reporting from year 2
- **Success of implementation phase**
  - 50 organisations signed up to the scheme
  - A reduction in reported emissions from years 2 -3, which can be justified by improvement actions
  - Positive feedback on the scheme and its benefits for business from a survey of the scheme members

Table of Contents

1 Introduction

Measuring and reporting greenhouse gas emissions is a well-established practice for businesses. Businesses measure and report on their emissions for a range of reasons, including legal requirements set out in the Companies Act, to secure certification to schemes relevant to their industry, or due to the demands of clients and staff who care about the environment. This helps companies to understand how they can reduce their carbon footprint and regulators to assesses improvements being made by businesses.

This scoping project explores how increased levels of measuring and reporting of emissions relevant to **a**ir quality **p**ollutants (AP) can be achieved, concentrating on $PM_{2.5}$, PM_{10} and NO_x, alongside or as part of existing carbon audits. This report presents the work done during this study.

There were five tasks in the work programme:

- **Task 1** analyses mechanisms of GHG and air quality reporting in the context of current legal legislation, guidance, and voluntary reporting by businesses. This task also examines the required level and scale of reporting with regards to emission sources and industry types and discusses potential uncertainties associated with estimating emissions.
- **Task 2** creates a map of organisations that already estimating, measuring and reporting emissions for both GHG and Air Pollutions. This task also identifies the industries and types that are associated with significant emission of air pollutions and selects key industries and businesses considered for the pilot study.
- **Task 3** assesses the potential to adopt current GHG measurement framework (both UK and global) and the existing data capture by companies for air pollution. Sets out the advantages and limitations of relying on existing frameworks and data, as well as makes a recommendation regarding the best unit(s) for measurements.
- **Task 4** pilots the AP emission methods with commercial organisations representing a range of sectors and presents four case studies documenting process of AP reporting undertaken by these organisations.
- **Task 5** explores barriers that organisations might experience during the implementation of the AP reporting process and examines incentive mechanisms and regulations for reporting that would encourage companies to report AP. These aspects are explored through engagement survey that presents a wider industry's perspective.

Finally, this project provides recommendations of the next steps that will develop this project further.

2 Overview of existing GHG reporting mechanisms and scope

In this section we provide an overview of the main GHG reporting mechanisms in use by UK organisations. This is largely focussed on regulatory schemes, but also covers some of the more prominent voluntary mechanisms. We have also examined the key uncertainties which affect GHG reporting, and the processes that organisations may deploy to reduce these.

2.1 Overarching standards for GHG reporting

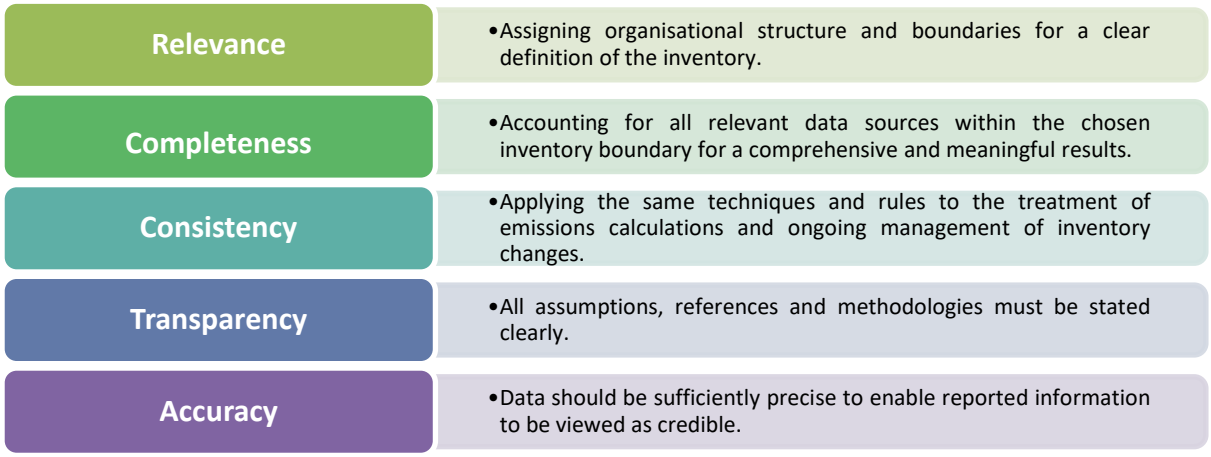
Greenhouse Gas (GHG) Protocol

The GHG Protocol Standard for Corporate Accounting and Reporting[1] is the most widely used international accounting tool for understanding, quantifying, and managing GHG emissions. It is used by governments and businesses and is the foundation for nearly every GHG standard and programme

[1] https://ghgprotocol.org/corporate-standard

in the world. The GHG Protocol is produced by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI).

Figure 1 Five principles of WRI and WBCSD



The GHG Protocol provides requirements and guidance for organisations calculating their emissions and ensures that organisations meet the five principles shown in *Figure 1*. It has been specifically designed to:

- Help organisations prepare a GHG inventory that represents a true and fair account of their emissions using standardised approaches and principles.
- Simplify and reduce the costs of compiling an emissions inventory.
- Provide organisations with information that can be used to build an effective strategy to manage and reduce emissions.
- Increase consistency and transparency in GHG accounting and reporting among various organisations and GHG programmes.

Box 1 explains the three scopes of emissions defined in the WRI GHG Protocol Standard.

Box 1. Definitions of scopes of emissions.

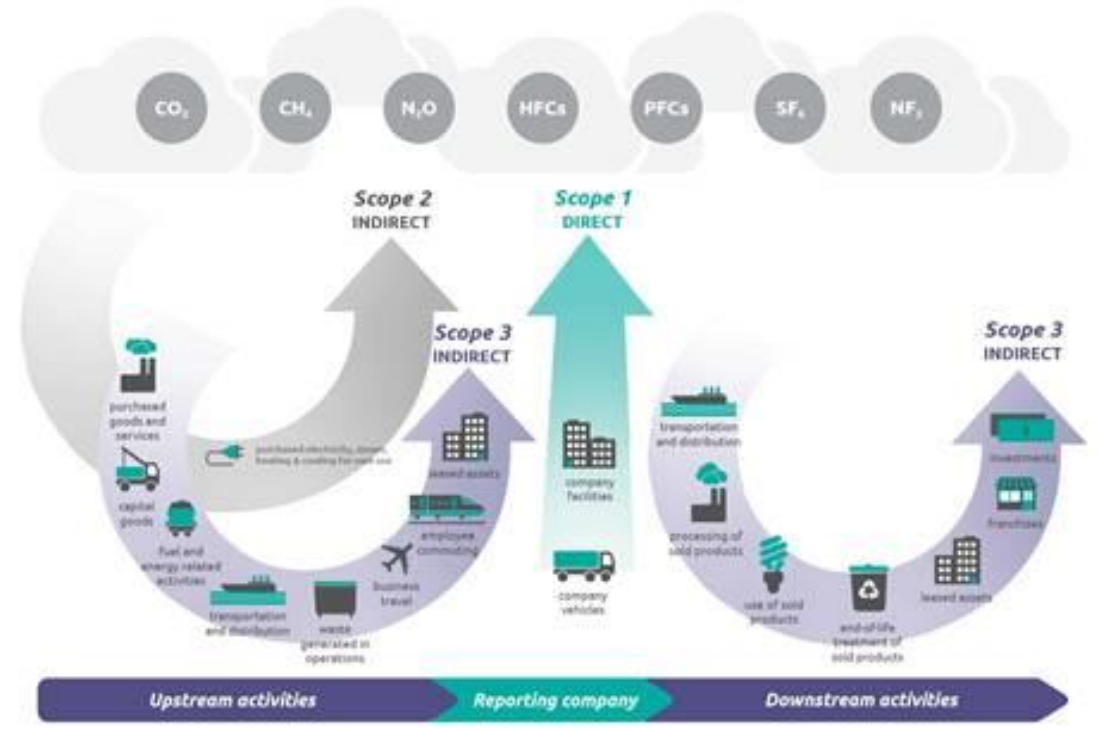
Scope of emissions. The figure below shows the definitions of the scope of emissions from the GHG Protocol Standard. By analogy air pollutant emissions reporting could follow these definitions. There are three scopes of emissions.

Scope 1: Direct GHG emissions - direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.

Scope 2: Electricity indirect GHG emissions - Scope 2 accounts for GHG emissions from the generation of purchased electricity2 consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect GHG emissions - Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

Figure 2-2. Scope of emissions from the GHG Protocol Standard



The GHG protocol covers the accounting and reporting of six greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

The GHG Protocol states that it should not be used to quantify the reductions associated with GHG mitigation projects for use as offsets or credits. The GHG Protocol provides further requirements and guidance for this purpose.

Organisations can choose to use the GHG Protocol – it is not mandatory.

2.2 Mandatory GHG reporting

Regulations are a key driver for organisations to report their GHG emissions. This section outlines the main legislation impacting the UK and the organisations it applies to.

2.2.1 Mandatory GHG reporting in the EU

European Union Emissions Trading Scheme (EU ETS)

The European Union Emissions Trading Scheme (EU ETS) is the world's largest multi-country, multi-sector GHG emissions trading system. It covers almost 50% of EU emissions, including more than 11,000 power stations and industrial plants across the EU with around 10% of these in the UK. These include oil refineries, offshore platforms and industries that produce iron and steel, cement and lime, paper, glass, ceramics and chemicals. Aviation operators flying into or from a European airport are also covered by the EU ETS, where approximately 150 UK administered aircraft operators take part in the EU ETS.

The EU ETS works on a 'cap and trade' basis, where a 'cap' or allowance is put on the CO_2 emitted by businesses, which then creates a market of tradable emission allowances. Businesses covered by the

EU ETS[2] must then monitor and report their emissions annually (and have this checked by an accredited verifier) and surrender enough emission allowances to cover their annual emissions by 30th April the following year. These allowances are then cancelled so they cannot be used again.

Note that if a business is likely to emit more than its allocation, it has the option to take measures to reduce emissions or alternatively to buy additional allowances.

2.2.2 Mandatory GHG reporting in the UK for business

United Kingdom Emissions Trading Scheme (UK ETS)

The United Kingdom Emissions Trading Scheme (UK ETS) replaced the UK's participation in the EU ETS on 1 January 2021. The UK government has established the scheme to increase the climate ambition of the UK's carbon pricing policy, while protecting the competitiveness of UK businesses[3].

It has similar aims to the EU ETS, however it sets a 5% lower emissions cap to facilitate the UK's commitment to reaching net-zero emissions by 2050. Approximately 40% of the UK's GHG emissions are covered by this scheme.

Streamlined Energy and Carbon Reporting (SECR)

Streamlined Energy and Carbon Reporting (SECR) is a government policy requiring large organisations to disclose their energy use, GHG emissions, and related information annually. The aim is to incentivise energy efficiency and the reduction of CO_2 emissions. The scheme was introduced in April 2019 and coincides with the end of the CRC Energy Efficiency Scheme[4].

The scheme applies to organisations who meet two or more of the following criteria within a financial year:

- More than 250 employees.
- Annual turnover greater than £36m.
- Annual balance sheet total greater than £18m.

At the time of launch of SECR, it was estimated that approximately 12,000 companies would be required to participate in SECR. Note that public sector organisations and those consuming less than 40,000 kWh are exempt. There is no exemption from involvement for energy used in other schemes – e.g. Climate Change Agreements (CCAs – see Section 2.3) or the ETS.

Affected organisations are required to:

- Make a public disclosure within their annual directors' report of energy use and CO_2e emissions.
- Report using a relative intensity metric e.g. tonnes CO_2/number of employees.
- Provide a narrative on energy efficiency actions taken during the reporting period.
- Align with their financial reporting year.

Net zero transition plans

The UK government will be requiring certain large businesses to produce net zero transition plans from next year. They will need to calculate an emissions baseline to have a plan and are also likely to need to demonstrate how they will monitor, evaluate and report progress against the plan. The science based targets initiative has similar requirements but with less detail on how targets will be met.

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[2] Businesses that are covered by the EU ETS include those that produce emissions from: Power and heat generation; Energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals; and Civil aviation.

[3] https://researchbriefings.files.parliament.uk/documents/CBP-9212/CBP-9212.pdf

[4] The Carbon Reduction Commitment, which closed in 2018, was a mandatory scheme which aimed to incentivise energy efficiency and cut emissions in large energy users in the UK's public and private sectors annually.

2.2.3 Mandatory GHG reporting for UK Government and Local Authorities

Greening Government Commitments

Government departments, non-ministerial departments, agencies, and Non-Departmental Public Bodies must report, as a minimum, certain GHG emissions in their Annual Reports as part of their statements on sustainability performance and be subject to the Greening Government Commitments[5].

The Greening Government Commitments present high-level targets set out for central government and its agencies to encourage reductions in domestic flights, waste, paper consumption, and water use, compared to a 2009/10 baseline. It also creates standards for transparent and public reporting in sustainable procurement and key sustainability areas, such as climate change adaptation, biodiversity, sustainable food and catering and sustainable construction.

Local Authorities

Local authorities in the UK have been requested by National Government to measure and report their GHG emissions from their own estate and operations. In 2011, DECC signed a Memorandum of Understanding (MoU)[6] with the Local Government Association to recognise the pivotal role that Local Authorities have in reducing emissions at the local level. The MoU highlighted an approach for sharing information on GHG emissions from councils' own estates and operations, so that councils were able to measure and report them each year. Other considerations in the MoU include:

- Ensuring the collection and publication of emissions data is in line with international reporting standards.
- Reducing the burden of data collection on local authorities partly through aligning the data with the CRC Energy Efficiency Scheme (which closed in 2018). This means reporting local authority CO_2e emissions, derived from their annual energy consumption at their sites/premises. Local authorities are encouraged to report emissions associated with transport (categorised as Scope 3).
- Aiming to embed accountability for local authorities' own CO_2 emissions at local authority level.

2.3 Voluntary GHG reporting

It is becoming increasingly important for organisations to report their GHG emissions, for both reputational and environmental reasons. The UK Government has now declared a climate emergency and has amended the Climate Change Act, such that the UK now has a target to become net zero by 2050. In response, many organisations are now voluntarily reporting their GHG emissions even when not mandated to do so, as it helps demonstrate their commitment to reducing emissions to their stakeholders. For many organisations this has become an important aspect of remaining competitive in the marketplace.

Climate Change Agreements (CCA)

Climate Change Agreements (CCA) are voluntary agreements entered into by UK industry and the Environment Agency, to reduce energy consumption and CO_2 emissions. The agreements provide organisations with a financial incentive for meeting targets, where operators receive a discount on the Climate Change Levy (CCL), the tax added to electricity and fuel bills.

The current Climate Change Agreement (CCA) scheme started in 2013. Its energy and carbon reduction targets run to the end of 2022, and provide eligible participants with access to reduced rates of Climate Change Levy until March 2025.

CCAs are available for a wide range of industry sectors; from major energy-intensive processes such as chemicals and paper, to supermarkets and agricultural businesses. If a company has more than one

5 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850130/Env-reporting-guidance_inc_SECR_31March.pdf

6 https://www.gov.uk/guidance/sharing-information-on-greenhouse-gas-emissions-from-local-authority-own-estate-and-operations-previously-ni-185

eligible facility in the same sector, it can hold an individual CCA for each facility or choose to group them together under one CCA.

To receive discounts, organisations must measure and report their energy consumption and CO_2 emissions against agreed targets over 2-year periods.

Science Based Targets initiative (SBTi)

The Science Based Targets initiative (SBTi) is a joint initiative by Climate Disclosure Project (CDP), the UN Global Compact, the World Resources Institute and World-Wide Fund for Nature. It aims to increase the level of ambition on climate action, by encouraging companies to set GHG emission reduction targets. These targets must be consistent with the scientific recommendation to limit emissions, to prevent temperatures from rising 1.5°C - 2°C above pre-industrial levels.

Once companies have set a target in line with STBI's criteria, the target must be validated, communicated to stakeholders, and reported and tracked against company-wide emissions each year. Companies that have adopted STBI's are referenced on the Science Based Targets website[7], which includes the sign-up date, and sector that the company sits within.

The Carbon Disclosure Project (CDP)

The CDP runs a global environmental disclosure system that allows companies and cities to disclosure their carbon emissions in a public way. The initiative provides guidance on how to report emissions and an online reporting system where members report emissions on an annual basis. There are currently over 13,000 business reporting their emissions through the CDP along with over 1000 cities and regions.

The data can then be accessed to explore trends in emissions and also includes a rating scheme to allow business and cities to benchmark themselves against similar organisations.

2.4 Sector specific voluntary GHG reporting

Companies may report their GHG emissions using the definitions of Scopes 1, 2, and 3 in the GHG Protocol Standard, given in Box 1, above.

The activities which the companies e.g. freight transport companies report under these 3 scopes are then given in the bullet points under each of the headings for the scopes. Different companies report different activities under each of the 3 scopes, but, the activities align to the definitions of the scopes.

Freight Transport Operations

Reporting emissions associated with freight transport in the UK is currently not mandatory, but is regarded as best practice by the UK Government. The UK Government (with the input of the freight and logistics industry) has developed guidance[8] that provides clear instructions on calculating GHG emissions from freight transport operations. Freight transport operators are encouraged to voluntarily calculate emissions to adhere to industry best practice; provide a basis for managing emissions; and provide information that may be requested by customers. The methodology follows the principles of the GHG protocol, but with a focus on the following key emissions sources:

Scope 1 – Activities owned or controlled which release emissions straight into the atmosphere:

- Owned transport fuel use.
- Fuels combustion for heating/cooling of premises – e.g. warehouses and offices.
- Fugitive emissions from refrigeration in warehouses/transport.
- Fugitive emissions from air-conditioning in offices (companies should aim to have zero fugitive emissions from air conditioning as the gases used in these systems have relatively large GWPs).

[7] https://sciencebasedtargets.org/companies-taking-action#table

[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/218574/ghg-freight-guide.pdf

Scope 2 – Emissions released from heat, steam, and cooling – often just generated from purchased electricity:

- Purchased electricity for warehouses/offices.
- Any other purchased heat, steam or cooling.

Scope 3 – Emissions from the extraction and processing of the fuel prior to combustion in the engines of owned vehicles:

Reporting for the freight industry has been further encouraged through the Logistics Emissions Reduction Scheme (LERS)[9] a free-to join-industry initiative to record, report and reduce carbon emissions managed by Logistics UK.

Construction Companies

For large, listed construction companies, GHG emissions reporting is becoming an important aspect of the overall decision-making process. Construction companies can reduce costs by participating in schemes that support the reduction of energy consumption and thus energy costs. For example:

- Many construction companies are participating in voluntary schemes, such as the Carbon Disclosure Project (CDP), which collects carbon reporting data from large companies on behalf of investors who are starting to target the construction and property sector.
- Other voluntary sustainability standards, such as the Global Reporting Initiative (GRI), are beginning to form a staple part of construction standards. Companies not seen to be following guidelines that support the reduction of GHG emissions might lose potential investment opportunities as a result.

The key emission sources in construction which are likely to fall into each of the GHG protocol reporting scopes are:[10].

Scope 1

- Fuel relating to projects which include construction sites or managed assets.
- Fuel relating to premises which include offices, warehouses, plant depots, etc. occupied by the company.
- On site process and fugitive emissions
- Own vehicle fuel (on and off road)

Scope 2

- Electricity relating to projects which include construction sites or managed assets.
- Electricity relating to premises which include offices, warehouses, plant depots, etc. occupied by the company.
- Imported heat

Scope 3

- Third party vehicle fuel
- Public Transport
- Sub-Contractors
- Waste
- Materials
- Product

Retail Industry

[9] http://lers.org.uk/
[10] https://ghgprotocol.org/sites/default/files/ENCORD-Construction-CO2-Measurement-Protocol-Lo-Res_FINAL_0.pdf

The retail industry in the UK consists of over 300,000 separate businesses, and employs over 3 million people, representing over 8% of all UK jobs. The British Retail Consortium (BRC), which comprises over 170 major retailers, recognises that it has a key role to play in tackling climate change. To support the UK Government in achieving its target of net zero emissions by 2050, over 60 leading retailers that form part of BRC have committed resources to delivering a Climate Action Roadmap. The Roadmap sets out five areas of action:

- Putting decarbonisation at the core of all business decision making.
- Reducing carbon emissions from shops and distribution centres.
- Moving to net zero logistics operations.
- Increasing sustainably sourced products.
- Helping customers and employees to live low carbon lifestyles.

This means that companies contributing to this action plan will be required to report their emissions annually to feed into the Roadmap. Sources will fall into the following categories, in line with GHG Protocol[11]:

Scope 1

- Direct emissions from operations, including from fleet vehicles, heating fuels and refrigeration.

Scope 2

- Emissions from purchased electricity or heat.

Scope 3

- Emissions embodied in product value chains, both upstream (from suppliers) and downstream (from customers).

A significant number of companies within the industry are also taking voluntary steps in adopting standards and protocols for the measurement of GHG emissions, such as the GHG Protocol. This includes the adoption of SBTi's, which defines a common basis for corporations to set emissions reductions targets. Other initiatives notably include the Carbon Disclosure Project (CDP), the Global Reporting Initiative (GRI), the Sustainability Accounting Standards Boards (SASB) and Carbon Trust Carbon Neutral Certification scheme.

Health Service

The National Health Service (NHS) has committed to achieve net zero by following two clear targets[12]:

- Emissions that the NHS control directly (the NHS Carbon Footprint) will achieve net zero by 2040, with an ambition to reach an 80% reduction by 2028 to 2032.
- Emissions that the NHS can influence (the NHS Carbon Footprint Plus) will achieve net zero by 2045, with an ambition to reach an 80% reduction by 2036 to 2039.

As part of this, annual sustainability reporting is now mandated for clinical commissioning groups (CCG's) and trusts by the NHS Standard Contract. GHG emissions must be included in a boards annual report.

Emission sources in the health industry are likely to include:

Scope 1

- Stationary gas/fuel combustion (boilers, generators)
- Other fossil fuels consumed on-site e.g. LPG, propane, etc.
- Refrigerant gas
- Site vehicles

[11] https://brc.org.uk/media/677373/climate-action-roadmap-executive-summary-apr21.pdf

[12] https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf

- Business Travel (owned vehicles)
- Process emissions (on site waste and wastewater management)
- Anaesthetic Gasses

Scope 2

- Emissions from the purchase of electricity
- Emissions from the purchase of steam, heat and cooling

Scope 3

- Tenant energy use:
  - electricity
  - natural gas / heating fuels
  - steam, heat and cooling
- Electricity transmission & distribution (T&D)
- Business Travel
- Water Consumption and Wastewater Treatment
- Waste

3 Current air pollutant reporting requirements and scope

Unlike GHG emissions which have global impacts on the earth's climate, most of the focus around air pollutants (AP) and air quality is on human exposure to these pollutants, and their associated health effects.

This difference between the global effects of GHGs and local human exposure impacts of air quality pollutants means there is a different approach to the regulation, management and reporting of air pollutants. For air pollutants, most of the reporting is done at a national and local authority level rather than an organisation level. At the organisation level, most reporting is related to environmental permitting and discharge consents.

3.1 European and national level requirements

It is worth setting out the basic regulatory framework around air pollution as the context for emission calculations and within which business also operate.

3.1.1 Ambient Air Quality Directive

The primary aim of air quality policy is to reduce the burden of ambient air pollution on human health, natural and managed ecosystems and the built environment. The Air Quality Directive (AQD, 2008/50/EC) and 4th Daughter Directive (4DD 2004/107/EC) set limit, target and other threshold concentrations for ambient air quality and prescribe the methods that can be used to assess and report compliance with these environmental objectives.

The Directive covers a wide range of air pollutants, with the limit values for the key pollutants of concern shown in Table 1. These values are expressed in terms of a limit which should not be exceeded over a given averaging period. Alongside the EU limit values, the World Health Organisation (WHO) guidelines for each pollutant are shown in the table. The WHO guidelines, which were updated in 2021, are designed to support the formulation of air quality policies to reduce the health impact of air pollution. The WHO guidelines are lower than the current EU or UK limit values for many pollutants.

Table 1 Pollutant limit values from the EU Air Quality Directive (2008/50/EC) and WHO guidelines

Pollutant	Averaging period	Concentration	
		EU limit	WHO Guidelines*
PM_{10}	24 hour mean	50 µg/m^3	45 µg/m^3
	Annual mean	40 µg/m^3	15 µg/m^3
$PM_{2.5}$	Annual mean	25 µg/m^3 **	5 µg/m^3
Ozone	Daily 8 hour mean	120 µg/m^3	100 µg/m^3
Nitrogen dioxide (NO_2)	Hourly mean	200 µg/m^3	25 µg/m^3
	Annual mean	40 µg/m^3	10 µg/m^3

Notes:

* WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide. Global update 2021

** $PM_{2.5}$ value is introduced in the new directive and is based on the average exposure index (AEI)

The requirement for air quality management in the UK slightly predates the EU directives and is set in the Environment Act 1995. The EU limit values were consequently integrated into UK legislation through the Air Quality Regulations. The EU directive sets an obligation of the UK Government to achieve these limit values across the country, the Environment Act also sets out the Local Air Quality Management (LAQM) regime for managing air quality at the local authority level. The current Environment Bill will provide the underpinning for overseeing these environmental regulations following our departure from the EU.

Essentially, LAQM requires all local authorities to regularly review and assess air quality in their areas. Where areas are found to be in likely breach of the national air quality standards and there is population exposure, then an Air Quality Management Area (AQMA) should be formally declared. When an AQMA is declared an Air Quality Action Plan (AQAP) to address the problem must be developed and implemented. Progress of implementation has to be reported by each Local Authority to Defra each year.

These ambient air quality regulations are complemented by source based legislation including the National Emissions Ceilings Directive (2001/80/EC) and Industrial Emissions Directive (2010/75/EU) as described below.

3.1.2 National Emission Ceilings Directive

The revised National Emission Ceilings Directive (NECD, 2016/2284/EU), which entered into force on 31 December 2016, set new emission reduction commitments for each Member State for the total emissions of NOx, SOx, NMVOC, NH3 and PM2.5 in 2020 and 2030. The new Directive repealed and replaced Directive 2001/81/EC to ensure that the emission ceilings for 2010 set in that Directive continued to apply until 2020. Member States have to report their emission inventories annually to the European Environment Agency (EEA) and the European Commission in order to monitor progress and verify compliance. The reporting requirement is closely aligned with those for the Convention on Long-range Transboundary Air Pollution (CLRTAP), which include a common scope of reporting of pollutant inventories and similar reporting timeframe. Under the revised NECD, each Member State was required to publish by April 2019 a National Air Pollution Control Programme (NAPCP), setting out the measures it will put in place to reduce emissions to meet the 2020 and 2030 emission reduction commitments. The UK NAPCP is available at https://www.gov.uk/government/publications/air-quality-uk-national-air-pollution-control-programme .

UK compliance against the NECD is measured using the National Atmospheric Emissions Inventory (NAEI). The UK has met all of its targets for the 2010-2019 period.

The NAEI is developed and maintained by Ricardo Energy & Environment, in collaboration with Aether, CEH, Forest Research, Hartley McMaster and Gluckman Consulting. It is funded by the Department for Business, Energy & Industrial Strategy (BEIS), Department for Environment, Food and Rural Affairs (Defra), the Scottish Government, the Welsh Government and the Northern Ireland Department of Agriculture, Environment and Rural Affairs.

The NAEI estimates annual pollutant emissions from 1970 to the most current publication year for the majority of pollutants; currently this is 2019. Emissions of pollutants are estimated from 1970, 1990 or 2000 to the most current publication year. To deliver the estimates, the NAEI team collect and analyse information from a wide range of sources – from national energy statistics through to data collected from individual industrial plants. A primary source of emission estimation methods is the 2019 edition of the EMEP/EEA Emission Inventory Guidebook which is available online at https://www.eea.europa.eu/publications/emep-eea-guidebook-2019 . This publication includes separate chapters on each category of source and many of the methods are used in the NAEI and also therefore likely to be of relevance for this project.

The NAEI data are also used in the preparation of the air emissions data for the Office for National Statistics (ONS) Environmental Accounts. These data have been used in the analysis presented in Section 4. Note that there are some differences in the scope of the UK estimates as given in the NAEI and those in the Environmental Accounts. In other words, although these use a common set of basic emissions data, the scope of what is included is slightly different.

3.1.3 Industrial Emissions Directive

Industrial processes are regulated by the Industrial Emissions Directive (IED, 2010/75/EU). The IED defines the types of industrial activities that are required to have a permit to operate, and to use 'best available techniques' (BAT) to prevent or minimise emissions. Activities included within the scope of IED include large combustion plant (LCPs), as well as industrial processes such as petroleum refining and the manufacture of cement clinker, steel and chemicals. The IED is implemented through the Environmental Permitting (EP) regime in England and Wales, the Pollution Prevention and Control (PPC) regime in Scotland and in Northern Ireland through the Pollution Prevention and Control Regulations (Northern Ireland) 2013. BAT reference documents are produced by the European Commission and are available to download from https://eippcb.jrc.ec.europa.eu/reference/ . These documents are produced on a sectoral basis and of particular importance are 1) the BAT reference documents (BREF) which provide a detailed review of technologies and techniques by sector and 2) the BAT Conclusions (BATC) which specify the standards and emission limit values (ELVs) that permitted processes must not be exceeded unless agreed with the regulator.

The permitting of industry is discussed in more detail in Section 3.2.

3.1.4 Medium Combustion Plant Directive

The Medium Combustion Plant Directive (MCPD) entered into force on 18th December 2015 and regulates combustion plant that have a rated thermal input of between 1 and 50 MWth. Note that MCPs will occur not just in industry, but also in the public, commercial and agricultural sector. The MCPD requires all plant within its scope to be permitted, and, sets limits on the levels of pollutants that can be emitted. Permitting dates depend on whether a plant is 'new' or 'existing' and also on the thermal input of the plant, and only new plant are currently permitted. Further details of MCPD permitting are given in the next section.

3.2 Environmental permitting and regulation of businesses

Reporting of air pollutant (AP) emissions is linked to the regulation of facilities, and while the arrangements are slightly different in the various regions of the UK, the basics are broadly similar. Operators of certain types of process are required to apply for an environmental permit in order to operate that process.

3.2.1 Scope of AP reporting

The types of processes that require a permit are set out in regulations for each part of the UK. There are some minor differences in the way these different regulations categorise processes but all of them identify certain types of processes as “Part A”. In England, Scotland & Wales there are also Part B processes and in Northern Ireland there are also Part B and Part C processes. Part A processes are regulated by the national regulator i.e. the Environment Agency (England), Natural Resources Wales; Scottish Environment Protection Agency; Northern Ireland Environment Agency. Part B processes may be regulated by the same national regulator or by local authorities, and Part C processes in Northern Ireland are regulated by local authorities. For the sake of simplicity, the following lists describe the situation in England and Wales.

Part A processes, regulated by the national regulator, include:

- power stations and other large combustion plant (LCPs, net rated thermal input of >50 MW);
- crude oil refineries;
- coke ovens;
- steelmaking and large-scale production/processing of non-ferrous metals;
- cement kilns;
- lime kilns;
- glass fibre production;
- brick production;
- chemicals manufacture;
- waste incineration;
- landfill and other waste disposal;
- paper mills;
- Intensive agriculture.

Part B processes in England and Wales, regulated by local authorities, include:

- larger medium-sized combustion plant (MCPs, net rated thermal input of 20-50 MW);
- smaller-scale metal industry processes such as foundries;
- glass kilns producing flat, container, lead or special glass;
- crushing & grinding of minerals;
- roadstone coating;
- crematoria;
- small waste incinerators;
- printing & coating processes, including spray coating processes;
- timber processes including manufacture of chipboard and similar products.

The summary above is not a complete list and is somewhat simplified, since the regulations include thresholds for some types of process so that, for example, a brickworks can be Part A or Part B depending on the size and nature of the individual facility.

Regulation of these Part A/B/C processes throughout the UK is almost entirely concerned with stationary plant/processes. There are limited exceptions such as mobile crushing plant and mobile waste incinerators. Permits don’t cover operation of road vehicles or off-road vehicles or most mobile machinery.

These regulations have been in place for decades. More recently, regulation has been extended to all medium combustion plant (so, net rated thermal input of 1-50 MW). These types of plant will now require permits as well, with new MCPs (plant put into operation on or after 20 December 2018) already required to have a permit, and existing MCPs requiring permits by 1 January 2024 or 1 January 2029 depending upon the size of the plant. There is also additional regulation of ‘specified generators’ in England, Wales and Northern Ireland (but not currently in Scotland), which address combustion plant of upto 50 MW thermal input that generate electricity. National regulators will be responsible for the permitting of both MCPs and specified generators.

All the regulatory regimes mentioned above will cover emissions of NO_X and dust (generally speaking, regulation is concerned with particulate matter as a whole, rather than limited to PM_{10} or $PM_{2.5}$). Operators will have to comply with various conditions but note that the normal mechanisms for controlling emissions are i) to apply emission limit values (ELVs), so that is upper limits on the concentration of pollutants in vented gases; ii) ensuring adequate dispersion of pollutants, for example by releasing gases to the atmosphere at a suitable height. Annual emissions are not necessarily of importance, other than where a permitted process is required to submit data to the regulator, for example, for inclusion in the PI or other regulators' inventories.

3.2.2 How the reporting is done

For all regulated processes, the regulator may require the operator to provide information, for example on emissions. Each regulator will maintain a 'public register' containing a wide range of information relating to the permit, including information sought from the operator (such as emissions). These public registers must be made available for public inspection at all reasonable times, free of charge. In theory, therefore, emissions data for any regulated process may be in the public domain, albeit perhaps held in paper form at the regulator's premises. It should be noted as well that permits relate to "installations" i.e. to specific activities carried out on a specific site. Permits don't cover all of the activity carried out by an operator throughout the UK. So, depending upon the nature of a business, permitted activity might only contribute a small part of the emissions from a business.

In addition to the public register, the national regulators all maintain emission inventories: Pollution Inventory (PI, covering England), Scottish Pollutant Release Inventory (SPRI), Welsh Emissions Inventory (WEI), and the Northern Ireland Pollution Inventory (NIPI). These 'regulator inventories' (RIs) will mainly cover Part A processes. Currently, none of the RIs is directly accessible/searchable over the internet: the SPRI was, until being disrupted by a significant cyber attack in December 2020, and the PI was once available in a searchable form on the "What's In Your Backyard" part of the Environment Agency website but that has now been closed. The entire Pollution Inventory dataset is now available to download under an Environment Agency conditional licence (from https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory). The WEI and NIPI do not seem to be available online. All four datasets are provided to REE for use in the National Atmospheric Emissions Inventory (NAEI) and so may be freely available to the public on request.

Data from the RIs also appears in the European Pollutant Release and Transfer Register (E-PRTR), which is searchable online at https://industry.eea.europa.eu/ . Both the RIs and E-PRTR have thresholds for each air pollutant, and emissions from a facility only have to be reported if they exceed the threshold. Otherwise, the operator can simply report that emissions are less than the threshold, without having to provide an exact figure. The thresholds are generally higher in E-PRTR than in the RIs, so the data reported in E-PRTR is a subset of that contained in the RIs. The E-PRTR thresholds for NO_X and PM_{10} are 100 tonnes and 50 tonnes respectively ($PM_{2.5}$ is not required for E-PRTR). In comparison, the PM_{10} (and $PM_{2.5}$) threshold in the PI is just 1 tonne, though the NO_X threshold is 100 tonnes, so the same as E-PRTR. These reporting thresholds are designed to allow the inventories to capture the greater part of emissions within their scope, while reducing the reporting burden for smaller emitters. But the thresholds do mean that relatively few facilities actually have to report emissions in E-PRTR or the RIs. For example, there will be many tens of thousands of non-residential facilities operating combustion plant across the UK but there are typically just a few hundred that report NO_X in the RIs, and perhaps a quarter as many reporting $PM_{2.5}$.

3.3 Summary of current AP rpeorting

The UK uses well established methods to estimate air pollutant emissions so it can fulfil its international reporting requirements. The key sources for these methods are the National Atmospheric Emission Inventory (NAEI), which is run by Ricardo on behalf of the UK Government, and the 'EMEP/EEA air pollutant emission inventory guidebook' produced by the European Environment Agency and designed to support reporting for the NECD. The NAEI uses methods in the guidebook. Where possible and appropriate, the NAEI team uses highly developed "higher Tier" country and process specific methods to improve the accuracy of the air pollutant emission estimates.

There is some reporting of air pollutants at a company or business level driven by environmental permitting regulations but there are significant limitations around these in respect of company wide reporting. These limitations include:

- The regulations are linked to specific installations, and not all activities of a particular business or institution.
- The regulations are mainly limited to stationary plant, and so do not cover emissions from transport for example.
- The regulation comes in various forms with only the largest/most polluting installations being "Part A", almost all of which would be considered 'industry' (a few LCPs are non-industrial).
- Lots of other installations are permitted as Part B or either already are or will be permitted as MCPs. Regulation of MCPs is not limited to industry: an MCP operated by a commercial organisation or by a public body is still an MCP and still subject to regulation.
- Regulators collect lots of data and that can appear in the 'public register' but that might just be papers in a filing cabinet in an office. It is not necessarily information that is easily available and so lacks the transparency of corporate GHG reporting.
- There are some very large sites that report emissions in the regulator inventories / E-PRTR but they are exceptional, and not the norm. So, for example most factories won't be reporting NOx & PM2.5 in the E-PRTR.
- The emphasis for regulators is generally compliance with Emission Limit Values, set as part of permits, and minimising poor air quality by ensuring good dispersion. Annual emissions are not so important - the main concern with air quality is concentration and exposure. This is because concentration and exposure and linked to human health impacts.

So, although some individual processes or installations may report emissions there is nothing comprehensive covering all emissions sources for an organisation. However, awareness of air pollutants from this existing reporting may support interest in a wider company or organisation level AP reporting framework.

4 Scale of business air pollutant emissions by sector and source

In this section we explore which economic sectors and sources produce the greatest amount of air pollutant emissions, and where these are likely to be released in relation to human expsuore. This then allows us to consider target industries and sources, which are likely to have the greatest impact on air quality, that should be the focus on any initial reporting scheme.

The NAEI provides a detailed set of data for both AP and GHG emissions from across the UK on a source basis, i.e. where the emissions are generated. The NAEI has about 650 different source categories used either for reporting NO_X or $PM_{2.5}$. These source categories primarily distinguish between different types of emission source (so, fuel combustion, different types of industrial manufacturing processes, waste disposal processes etc.). Division by economic sector is of secondary importance in the NAEI and is often only done at an aggregated level. However, NAEI data are used in the derivation of air emissions data for the ONS Environmental Accounts and these data separate emissions into about 130 separate economic sectors. This dataset therefore complements the NAEI and the two datasets together allow us to analyse which sectors and which types of sources generate the largest proportion of AP and GHG emissions.

The ONS Environmental Accounts information is explored below to help identify key sectors to target, and what the sources of emissions are and how these are related to GHG reporting scope.

4.1 Emissions according to key economic sectors – data from the ONS Environmental Accounts

The ONS Environmental Accounts air emissions data provides disaggregation of each NAEI source category to some 134 discrete economic sectors, which we have amalgamated into 13 sectors for

simplicity. The relative contribution of each of these sectors to NOx and PM2.5 emissions is shown below in Figure 2 and Figure 3 . Most of these categories should be self-explanatory but one requires explanation: large industry refers to the types of processes regulated as Part A (see Section 3.2).

Figure *2* shows total NOx emissions from economic sectors. For NOx emissions, large industry is by far the biggest source, followed by agriculture, fishing, forestry and mining; and electricity production. However, the locations of sites from these sectors would be expected to be distant from urban environments and hence provide less of an exposure risk and so be less important from an air quality perspective. The next biggest sectors are other manufacturing, transport, and construction all of which would be present in the urban context. This is followed by the services, retail and public sector again important in an urban context. The smallest sectors are health care, leisure and waste management.

Figure 2 Total NOx emissions by sector

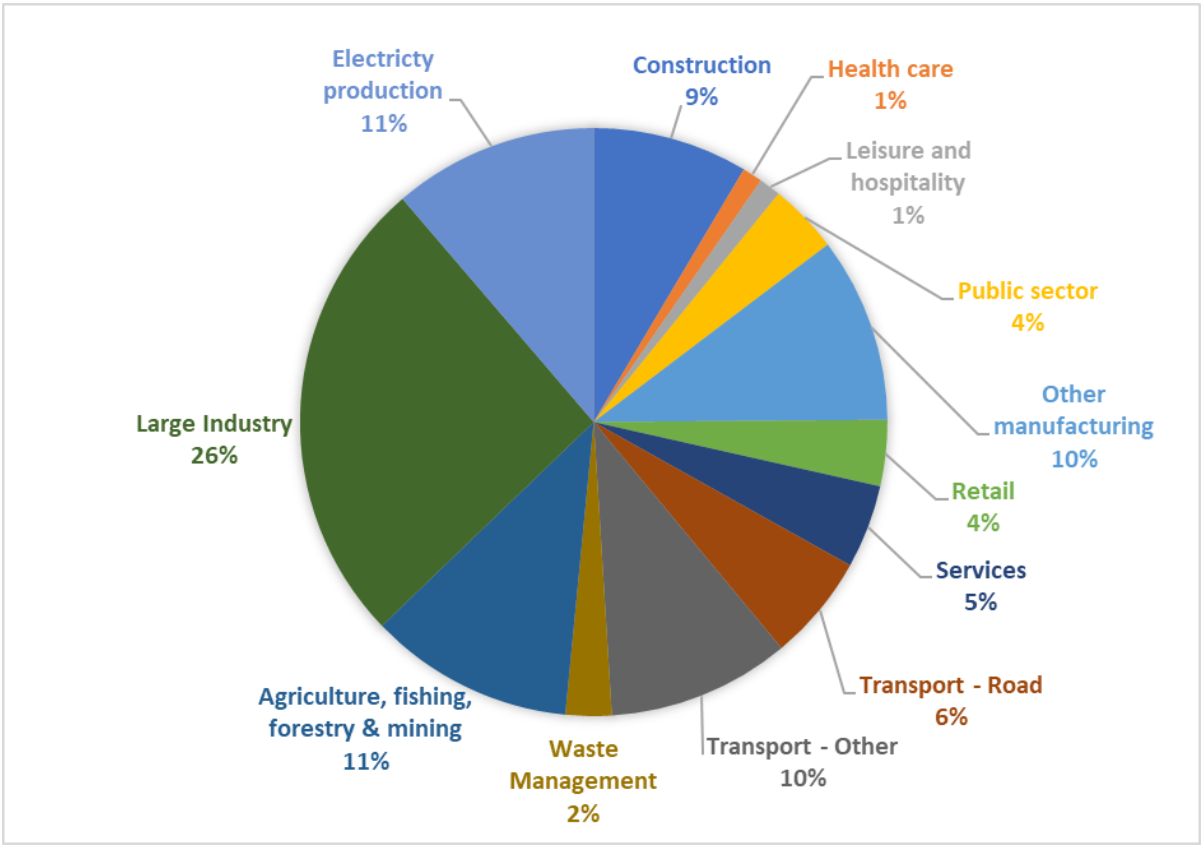
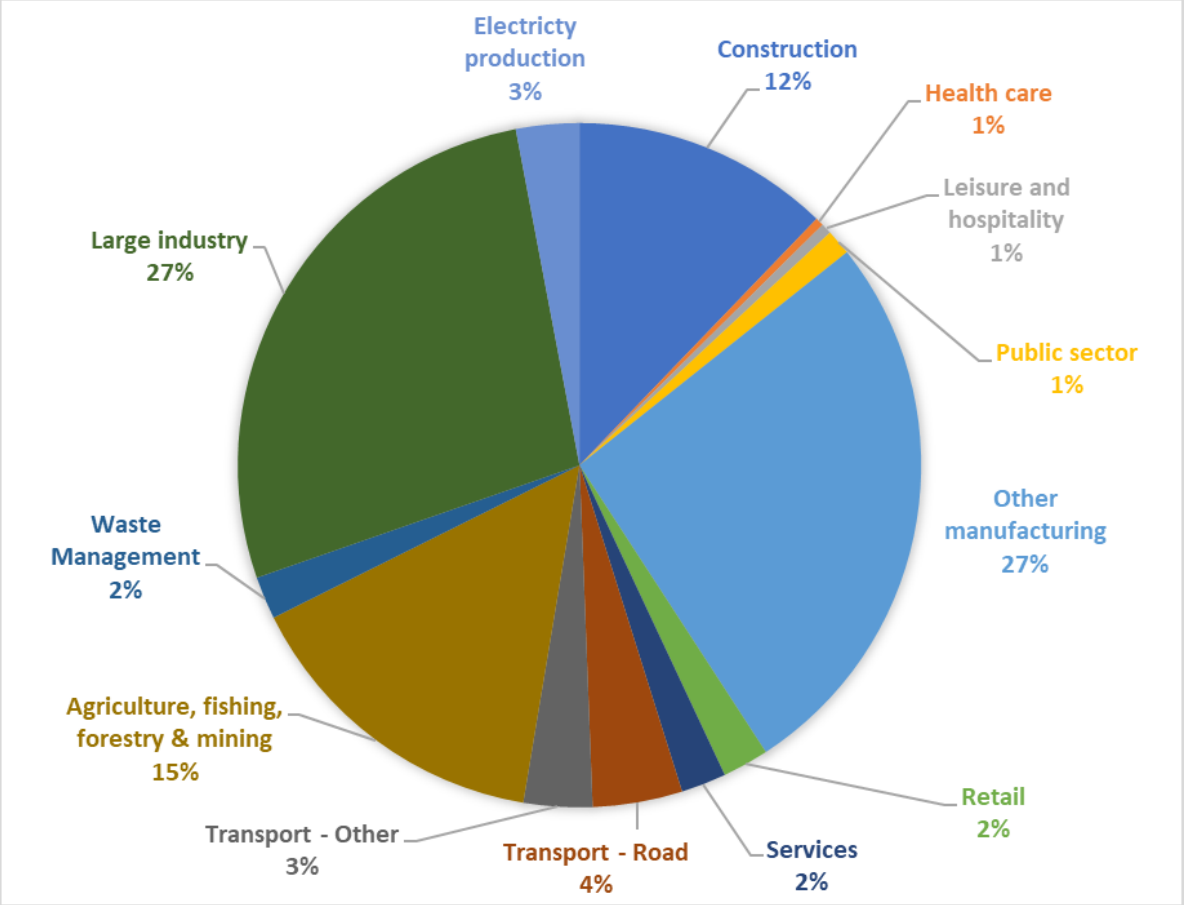


Figure 3 shows total PM2.5 emissions by sector. The results of the sectoral analysis for PM2.5 are a somewhat different in comparison to NOx:

- Larger industry and other manufacturing are by far the two biggest sectors;
- Agriculture, fishing and forestry is still a significant sector;
- Construction also increases its importance;
- Electricity production is a much smaller source for PM;
- Transports contribution is also reduced but still important;
- Services, retail and public sector are the smallest sector.

Figure 3 Total PM2.5 emissions by sector



In terms of identifying priority or target sectors, the picture is slightly complex. Large industry, agriculture, fishing, forestry and mining, and electricity production are all likely to be outside urban environments so of less importance here. Manufacturing is a large sector, especially for PM emission, and could be in both urban industrial estates and non-urban areas so is one for consideration. Construction could again be in rural or urban locations, but urban areas are likely to have the highest proportion of construction activities and so would seem a key sector in relation to AP emissions. Road transport is similar and we know from an exposure point of view most air quality management areas in the UK relate to transport emissions so again will be important. The service sector, retail and the public sector when combined are larger than the road transport sector and are likely to be urban focused, and so make an important 4th target sector.

Lastly it should be noted that at source level electricity production is shown as a separate sector, but from an end user perspective this is driven by the electricity use within the other sectors but with emission physically separate from the location of this sector.

4.2 Emissions according to source - data from the NAEI

The analysis from the ONS air accounts, presented above, helps us identify which economic sectors release relatively large emissions of NOx and PM. Data reported by the underlying NAEI also allows us to explore the specific sources of emissions within the different economic sectors – but note the NAEI is not primarily designed to report emissions from an economic sector point of view.

Again, for simplicity the 650 or so sources in the NAEI have been aggregated into 10 key categories: larger combustion plant, smaller combustion plan, industrial processes, construction dust, Non-Road Mobile Machinery (NRMM), road transport, other transport, agriculture and animals, land use and other. Note that the NAEI does not reports data according to the size of combustion plant and so we have had

to approximate this by categorising economic sectors into those where combustion plant are typically larger MCPs or LCPs, and those where plant are typically smaller MCPs or small combustion plant.

Figure 4 and Figure 5 provide this breakdown for the key sectors identified above in 4.1section of construction, other manufacturing, retail and services. For the road transport sector clearly the key source of emissions is road transport.

Figure 4 NOx emissions by source

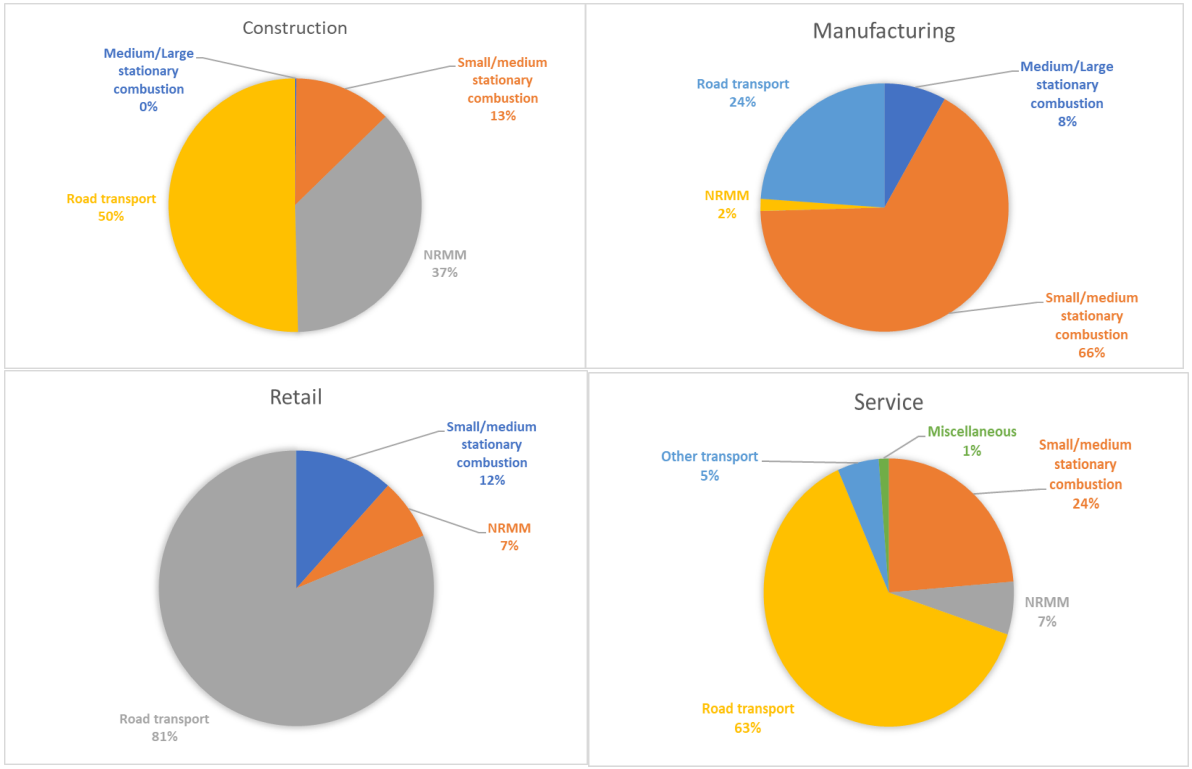
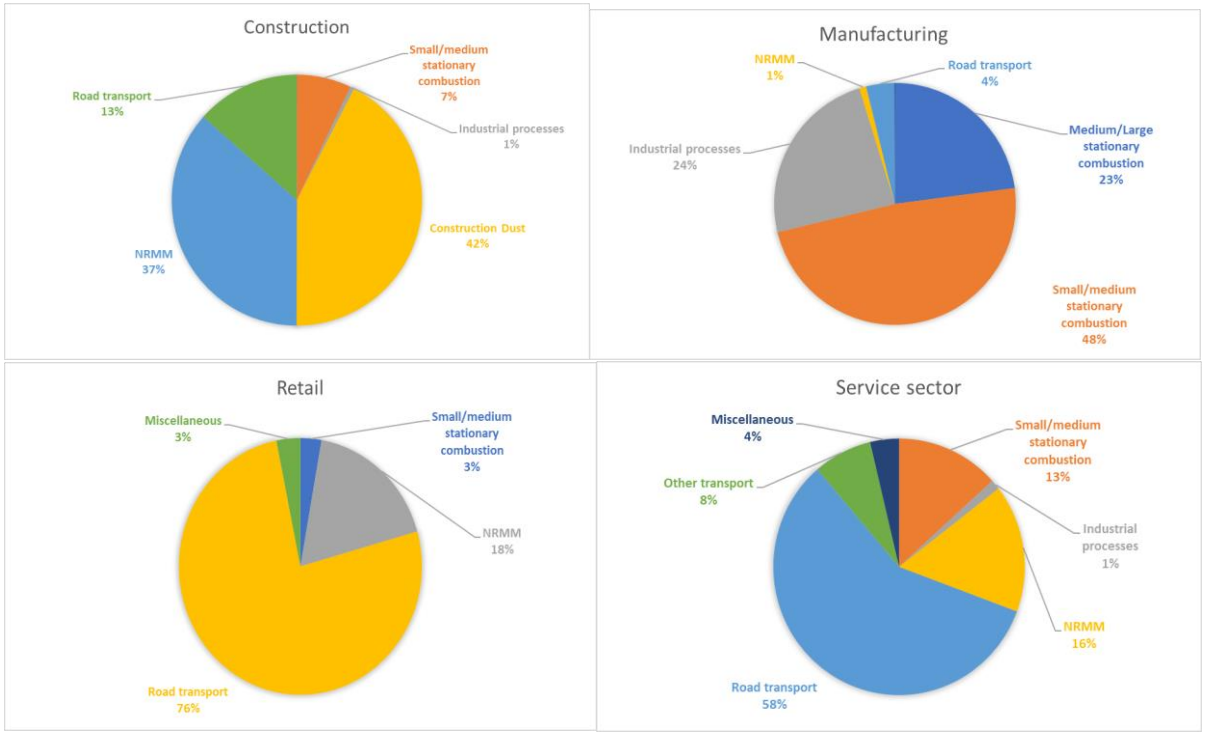


Figure 5 PM2.5 emissions by source



For NOx emissions, road transport is a key component of the emissions from construction, retail and the service sector. The next most important source is small and medium combustion plant, this being the biggest source in manufacturing, and important for the other sectors. The third most important source is then non-road mobile machinery (NRMM), or off-road machinery, and is very important for the construction sector but also relevant for the other sectors.

For PM2.5 emissions, the sources vary from sector to sector. For construction the dominant source is construction dust followed by off road machinery and then road transport. For the manufacturing sector, the main sources of PM2.5 are from combustion plant and industrial processes. The $PM_{2.5}$ profiles for retail and services are very similar to those sectors' profiles for NO_X, and are dominated by road transport, with the remainder largely from NRMM and small combustion plant.

4.3 Mapping AP sources to GHG reporting categories

We have compared the sources of AP emissions with the sources of GHG emissions that are covered under the scope of GHG reporting.

Our comparison reveals:

- For air pollution emissions, since impacts are considered in relation to concentrations and exposure, it is important where emissions are released and not just how much is released. As such the primary consideration for AP reporting should be emissions generated directly by the organisation into the surrounding area. So, in relation to GHG reporting this would map to scope 1 emissions being the primary focus air pollution reporting.
- However, as noted above in Section 4.1 above, AP emissions from electricity production are driven by electricity demand in each of the end user sectors. The end-users of the electricity are very widespread, but there are no AP emissions at the point of electricity consumption. All the emissions occur from the generation of electricity where the power stations are located.
- Although emissions from power stations located far away from urban locations make a very small contribution to air pollution in urban areas, power station emissions make an important contribution to total national emissions. These totals are used to judge compliance with NECD targets. In terms of GHG reporting emissions from power stations would map to scope 2 emission, but are probably of secondary importance for the initial phases of AP reporting.
- The key sources of direct AP emissions identified were from transport, combustion plant and NRMM. Emissions from these sources would fall under scope 1 in terms of GHG reporting, and this implies that to comply with their GHG reporting obligations, organisations will be collecting activity data and fuel use for these sources. These activity data and fuel use data can be used directly for GHG emission estimation.
- The key source that does not "map" across to a GHG reporting category is PM 2.5 related construction dust for which there would be no equivalent in GHG reporting. It should also be noted that the PM2.5 related to road transport will also include non-combustion emissions from resuspended road dust, and tyre and brake wear; again not something that has an equivalent GHG reporting category.
- Lastly although most sources, except for dust related sources, "map" over to what would be covered by scope 1 GHG reporting, additional information will be needed. GHG reporting is based largely on fuel use for a given source, such as diesel use in transport or gas use in a boiler, however estimation of AP emissions also requires information on the type of technology the fuel is burnt in as for example emissions from a Euro III truck will be different to a Euro VI even for the same amount of fuel use.

5 Estimating emissions at the company level

In Section 4 we identified key sources that could be included in a future company level "AP scope 1" equivalent to the GHG reporting currently done under the WRI's scope 1. These key sources emissions were: transport, combustion, non-road mobile machinery and fugitive dust. In addition, scope 2 electricity related emissions were also suggested for company air pollutant reporting as this aligns well with current company level GHG reporting.

In this section, first we set out the potential methods that could be used for estimating these emissions, based on the well established methods used for national level emissions estimation. These methods were then trialled with 4 organisations, which acted as case studies to test not only the approach but also the practicalities of collecting the data. Finally, we consider the uncertainties associated with the methods we suggest to estimate emissions.

5.1 Emission estimation methods

In its simplest form the estimation, for both GHG (primarily CO_2) and air pollutant emissions, are derived by combining activity data with an emission factor:

$$Emission = ActivityData\ (AD) \times Emission\ Factor\ (EF)$$

For GHG emission estimates the activity data is typically in the form of fuel use (diesel, natural gas, etc) and the emission factor is a simple function of fuel type. In this case fuels must be purchased and can be a major operating cost and so businesses and institutions can be expected to have good records of the quantities of fuels bought.

For AP emissions the activity data could be in the form of fuel use but is also often in other units such as vehicle kilometres (vkm). Emission factors are also more problematic. All fuel combustion leads to emissions of NO_X and particulate matter, although levels of particulate matter are generally very small when gases are combusted. Emission factors define the quantity of pollutant expected to be emitted for each unit of fuel combusted, and this quantity will be different for different types of fuel, but also will depend on the combustion conditions i.e. how the fuel is burnt and in what technology. In this respect, NO_X and particulate matter are very different from CO_2. The emission of CO_2 from burning a tonne of natural gas will be pretty much the same regardless of whether that gas is burnt in a domestic central heating boiler or in the largest power station. When estimating CO_2, it is often only necessary to know how much fuel is burnt, with no need to understand exactly how it is burnt. Whereas, in order to estimate emissions of NO_X and particulate matter, it is essential to understand what type of device is being used. The emissions of the non-CO_2 gases (CH_4 and N_2O) do depend on combustion conditions and technology.

So the simple activity combined with an emissions factor becomes more complex for estimating air pollutant emissions as illustrated below:

$$Emission\ (CO2) = AD\ (fuel) \times EF(fuel)$$

Where as

$$Emission\ (NOx, PM) = AD\ (fuel\ or\ other) \times EF(fuel, technology, conditions)$$

The estimation for AP emissions at the national is well established and the key source of emission factor data used across Europe is the EMEP/EEA Emission Inventory Guidebook (2019 edition, available at https://www.eea.europa.eu/publications/emep-eea-guidebook-2019) and complementary COPERT data for road transport. The Guidebook is divided into chapters covering different types of sources. Guidebook chapters usually present a small number of alternative methods, which range from the simplest "Tier 1" approach, through to an intermediate complexity "Tier 2" method and, for some sources only, a "Tier 3" method. Tier 1 methods normally rely on the simple emission factor equation as described at the start of this section. As well as being the simplest method, the Tier 1 approach results in the most uncertain emission estimates, because it ignores details such as technology types and the presence of abatement systems. Tier 2 is also an emission factor method, but it allows modelling of

technology type as well in line with the more complex AP equation shown above, so the resulting emission estimates should be more accurate. Tier 3 methods generally rely on detailed bespoke emissions data at the level of individual equipment types or brands.

5.1.1 Road transport emissions

This section covers emissions from road vehicles, and so covers company's owned vehicles along with rented vehicles such as hire cars and leased vehicles. For road vehicles activity data are usually mileage, but emission factors can also be derived that apply to fuel total usages as the activity data. Companies may have records of vehicle mileage, for example from staff mileage claims or from vehicle service records, or even from tachograph data, but this will not always be the case. Companies are more likely to have fuel purchase records, which may be at an aggregate level or by individual vehicle if the operate fuel management systems.

For air quality pollutants, road vehicle emission factors vary with vehicle type, engine technology emissions certification (Euro) standard, and driving conditions - average speed in particular. This contrasts with the typical approach used to estimating emissions of CO_2 from fuel combustion where emission factors are constant for a given fuel type, and depend primarily on the carbon contents of the fuels. However, estimating the non-CO_2 GHGs emitted depends on similar factors controlling the emissions of air quality pollutants, for example, engine technology.

Emissions from road vehicles were calculated using COPERT v5.3 emission factors, as recommended by the EMEP/EEA Emission Inventory Guidebook. COPERT provides speed-related emission functions for cars, LGVs, HGVs, buses and motorcycles. The emission functions apply to average speeds rather than instantaneous speeds. A speed of 50 kph, for example, could be used to represent urban driving conditions. In reality, instantaneous tail pipe emissions will depend on a number of other factors such as acceleration the detail of which are not captured by the COPERT emission functions.

For this study the pollutants considered were NOx and PM. However, COPERT provides emission functions for several other pollutants and fuel consumption. The fuel consumption functions were used to derive emission factors (g/kg fuel) that could be applied to fuel totals in the absence of mileage data. These COPERT functions provide the emission factors (g/km) that are applied to distances travelled (km). The functions apply to hot-running, i.e. when the vehicle has reached its normal operating temperature. The EMEP/EEA Emission Inventory Guidebook provides recommendations to account for additional emissions resulting from cold-starts, i.e. emissions beyond those estimated from hot-running due to the vehicle operating below its normal operating temperature. However, cold-start emissions have not been considered in this study due to data required to estimate them for individual vehicles not being readily available. These could be considered in further work and based on a additional increment related to UK totals of cold start emissions.

For each pollutant, and fuel consumption, different emission functions are provided by vehicle category. In addition to the basic vehicle types such as cars, LGVs and HGVs, the vehicles are categorised by size, fuel type (petrol, diesel, electric or alternative[13]) and emission standard. Vehicle sizes for cars and motorcycles[14] are based on engines size. For other vehicles they are based on weight and, for HGVs and Coaches, if the vehicle is articulated or rigid. These size categories are provided for information in Appendix 1.

As well as fuel combustion (or exhaust emissions) an estimate of fugitive PM emissions from tyre and brake wear and road surface wear was made using emission factors from the EMEP/EEA Guidebook.

In order to estimate emissions from our case study organisations basic data were requested on vehicle activity, either mileage or fuel, and vehicle categorisation covering basic vehicle type, vehicle size, fuel type and emission standard. In addition to this basic the following general data were requested:

- Registration Number
- Vehicle Make

[13] Biodiesel, Bioethanol, LPG, CNG, LNG, Biomethane, Petrol Full Hybrid, Petrol Plug-in Hybrid, Diesel Full Hybrid
[14] For motorcycles 2-stroke and 4-stroke engines are distinguished.

- Vehicle Model
- Predominant road type where the vehicle is operated.

The road type was requested so that an approximate average speed could be estimated to input into the speed related emission functions. It is recognised that actual vehicle speed data are unlikely to be available unless a tachograph is fitted to the vehicle. It was therefore deemed appropriate to apply an average speed based to the predominant road type (urban, rural or motorway). Emission factors are sensitive to vehicle speed so the selection of a specific speed that is representative of urban, rural or motorway driving is a limitation of the methodology.

The registration number and vehicle make and model were requested so that cross checks could be made against DVLA record on the accuracy of the vehicle type, size, fuel and emissions standard data provided.

5.1.2 Emissions from heat and power

This section covers emissions from stationary plant used to provide heat and power to sites, so appliances such as boilers, gas turbines, and engines. The estimation approach used are published in the EMEP/EEA Emission Inventory Guidebook. The Guidebook is divided into chapters covering different types of sources and the types of combustion device relevant for this project are dealt with in the chapter on '1A4 Small Combustion'[15].

As noted in the introduction to this section it is essential to understand what type of device is being used. In the real world, there will be a huge range of industrial-scale equipment sizes and designs, and the age and therefore condition of equipment may also have a significant impact on emissions, as would the presence of any abatement systems used to minimise emissions. Established emission inventory methods for industrial-scale combustion, such as the Guidebook, are unfortunately very basic and only go some way towards reflecting the real-world variation in emission rates between different equipment. In one sense, this is a major problem – those current methods cannot reflect the fine detail, such as, for example, showing what impact there might be from replacing an old appliance with a new one of the same kind. But the methods do allow us to estimate the differing impacts of burning different fuels – how much more, or how much less NO_X might be emitted by generating heat and power from coal, say, rather than natural gas. And the methods do allow a very small amount of modelling of different appliance types, for example with separate emission factors for gaseous fuels burnt in boilers, engines and gas turbines.

To reflect this the Guidebook chapters usually present a small number of alternative methods, which range from the simplest "Tier 1" approach, through to an intermediate complexity "Tier 2" method and, for some sources only, a "Tier 3" method. Tier 1 methods normally rely on the simple emission factor equation as described at the start of this section. As well as being the simplest method, the Tier 1 approach results in the most uncertain emission estimates, because it ignores details such as technology types and the presence of abatement systems. Tier 2 is also an emission factor method, but it allows limited modelling of technology type as well, so the resulting emission estimates should be more accurate. However, as mentioned previously, the level of modelling is still relatively basic and we would suggest that the Guidebook Tier 2 factors are really only marginal improvements over the Tier 1 factors. Tier 3 methods generally rely on detailed emissions data and/or application of emission factors at the level of individual facilities and would generally require too much information to be a practical proposition for this project.

A selection of Guidebook factors is presented in Table 2. All of the case study organisations burned natural gas only, which is as expected given the nature and location of those organisations. However, across the UK it would be expected that some organisations would burn oils or LPG, particularly in rural areas with limited access to natural gas, and a very small number of mostly large industrial sites will burn coal or other solid mineral fuels. An increasing number of sites may burn biomass or other biofuels.

[15] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-4-small-combustion/view

The Guidebook has a small set of emission factors that cover all these various fuels but only those for gas are shown in Table 2.

Table 2 Emission factors for small industrial-scale combustion of gaseous fuels

Technology	Guidebook Table	Factor g/GJ (net)	
		NO_X	$PM_{2.5}$
Standard boilers, > 50 kW_{th} < 1 MW_{th}	3.26	73	0.45
Standard boilers, 1 MW_{th} – 50 MW_{th}	3.27	40	0.45
Gas turbines	3.28	48	0.2
Stationary reciprocating engines	3.30	135	2
Tier 1 (non-technology specific)	3.8	74	0.78

There are just four factors available to cover the diverse range of real-world technologies, sizes and conditions of plant. There is a similar level of choice for other fuels with factors for just boilers for solid fuels and fuel oils since other technologies are not applicable for those fuels. There are single factors each for gas burnt in gas turbines and engines, and a choice of two factors for boilers, with each factor covering a distinct range of thermal capacity. This low level of detail is far from ideal, since the factors presented make no distinction between old technology and new state-of-the-art, and there is no distinction between different sizes of gas turbine and engine. The basic Guidebook factors also exclude any consideration of abatement although the impact of abatement can be added if sufficient information is available on the efficiency of that abatement. The Guidebook factors are not ideal but are the best available. They are used in national inventories including the UK inventory, and at that level they produce emission estimates that are assumed to be moderately uncertain. Uncertainty is likely to be higher still at the level of individual facilities. The Guidebook Tier 1 factor (also shown in the Table 2) could be used in instances where no information is available on the technology type. However, the range of values in the table show that the choice of factor is important and that understanding the technology used is therefore important, and the use of the Tier 1 factor should only be considered if it proves difficult to obtain information on the type of combustion devices in use. The Tier 1 factor is actually the mean of the four other (Tier 2) factors presented, and so presumes an equal quantity of fuel burnt in boilers of each size, and engines and turbines. The Tier 1 factor might also be appropriate if facilities have very large numbers of appliances of different types but do not have a breakdown of fuel usage for each one.

Having said that the available factors are limited and not ideal, we do however need to consider how easy it would be to collect detailed data from operators. The Guidebook might only provide separate factors for three broad categories of technology, but we believe that level of differentiation is likely to match the level of information that can in any case be provided by many operators. Even the split of boilers into two size classes is likely to cause problems for many operators. We considered it unlikely that the personnel who were being asked to supply data for the project would have any figures for the thermal capacity of plant, and that, had we insisted on this information being provided, it might either have discouraged the supply of data or possibly resulted in poor quality data. Therefore, for this study we decided to only ask operators for relatively simple data - the fuels burnt, the quantities burnt and the types of any combustion plant. All of the businesses contacted had relatively trivial consumption of natural gas and it was entirely safe to assume that all plant were in the 50 kW_{th} to 1 MW_{th} range. In future it would be possible to generate a threshold value for fuel usage at which one could switch to assuming that fuel was burnt in larger-sized plant, however this would be complicated if a site only had an overall figure for fuel consumption and multiple appliances.

The next section details the case studies that were carried out, and the returned data templates did suggest that we were already close to the practical limit of what detail could be requested.

Future improvement of the EMEP/EEA Guidebook might lead to a larger selection of factors but that is unlikely in the short-term. But long-term, it might be possible to refine methods to be more responsive to technology choices and abatement, for example. But our assessment is that operators will struggle if asked to provide highly detailed and highly technical data and this is supported by the experience of the case studies. So the current Guidebook method seems to us to be a sensible compromise, and that might still be the case even if more factors were to become available. The current Tier 2 Guidebook method will not generate extremely accurate emission estimates but it will allow estimates to be made relatively simply and will at least differentiate between different fuels and broad categories of technology.

Emissions associated with electricity were also calculated. For this, our methodology was to use the UK inventory figures for air pollutant emissions from electricity generation, and UK energy statistics for electricity supply, and to calculate an average emission per unit of electricity supplied. One of the case study organisations bought electricity on a REGO (Renewable Energy Guarantees of Origin) tariff, so in this case we calculated the average emission per unit of renewable electricity instead. Renewable electricity means no emissions of CO_2 but at least some renewable sources like biomass are significant sources of NO_X and $PM_{2.5}$ and as a result, the factors estimated for REGO tariff electricity were actually higher than those for standard tariff electricity.

5.1.3 Emissions from Non-Road Mobile Machinery (NRMM)

This section covers emissions from combustion engine non-road mobile machinery, so covers equipment such as construction plant, mobile industrial equipment, agricultural tractors, forestry equipment and military equipment. There will also be electrically power vehicles for example some types of forklifts, but the emissions associated with those will be captured from scope 2 electricity emission calculations discussed in the section above.

For off road machinery activity data are usually expressed in terms of energy output (kWh), but emission factors can also be derived that apply to fuel totals as the activity data. Companies are more likely to hold records of fuel purchases, than energy output. However, energy data may be estimated from odometer readings or deployment schedules and load factor estimates.

For off-road machinery emissions were calculated using EMEP/EEA Guidebook Tier 3 Emission Factors. The EMEP/EEA Guidebook provides energy-based emission factors and fuel consumption (g/kWhr) for non-road mobile machinery.

For each pollutant (and energy consumption), different emission factors are provided by engine power rating and emission standard, as shown in the table below:

Table 1 Off road machinery power rating bands and emission categories

Power rating bands	Emission categories
0-8 kW	None (electric vehicles only)
8-19 kW	Uncontrolled (<1981, 1981-1990, 1991- Stage I)
19-37 kW	Stage I
37-56 kW	Stage II
56-75 kW	Stage IIIA
75-130 kW	Stage IIIB
130-560 kW	Stage IV
>560 kW	Stage V

For the estimation of off-road machinery emissions the following data were requested from our case study company:

- ID or Registration number
- Make
- Model
- Description
- Hire Company (if leased)
- Date or Year of Manufacture
- Vehicle Age
- Euro Standard
- Fuel Type
- Engine Type[16]
- Net Power Rating (kW) or Net Power Range (kW)
- Annual Fuel Use or
- Annual Use (hours) and Average Load Factor (%) or
- Annual Energy Use (kWhr)

This selection of data was requested both the allow cross checking of information and to provide alternative sources of data to derive the input data needed for the calculations. For example, the emission factors depend on the Euro emission standard that the vehicle complies with. However, if the Euro standard for a particular vehicle is unknown then it can be inferred from the date of manufacture by assuming that it complies only with the standard that was in place at the time of manufacture.

Similarly, the emission factors are applied to estimates of energy use. However, if energy use is unknown then it can be derived from the hourly usage and an average load factor. In the event that none of these are known then energy use can be back calculated from fuel use data.

The EMEP/EEA Guidebook also provides engine deterioration factor adjustments. However, these are not currently applied as the data required (engine age and average lifetime) are not readily available.

The following were not used directly in the calculations. However, they were requested to better understand the activity data and in the case of hire company the scope of the emissions.

- ID or Registration number
- Make
- Model
- Description
- Hire Company (if leased)

5.1.4 Fugitive and construction dust

Estimating dust emissions from fugitive sources is always difficult. By their very nature, fugitive emissions are difficult or impossible to measure accurately, are very variable in magnitude in time and space, and so any estimation methods are based on few data and therefore very uncertain. Construction sites will encompass a wide range of activities or sources that give rise to dust, for example:

- site clearance and earth-moving operations;
- stocks of dusty or potentially dusty materials such as cement, plaster, bricks and concrete blocks, sand and aggregates etc;
- handling and use of those dusty materials, such as mixing of cement and plaster;
- drilling, cutting, grinding, sand-blasting and other similar activities;

[16] Relevant to uncontrolled diesels only

- resuspension of dust from unpaved roads and other areas of a construction site.

Activities will vary from site to site and the magnitude of many of the fugitive sources will also depend on weather – strong winds will increase suspension of dusty material and prolonged periods of dry weather will make dusty materials more susceptible to suspension. Most dust from construction is thought to originate from soils rather than from building materials, but in reality there is likely to be a different profile of dust emissions from each site, depending on the nature of the construction work, the activities carried out, the local soil characteristics, the weather during construction, and any dust reduction measures carried out.

Estimating dust from construction sites would require a wealth of information to be done accurately, and would need methods that are still to be developed. For now, the EMEP/EEA Emission Inventory Guidebook provides inventory compilers with a relatively simple but crude Tier 1 method to estimate dust emissions at the national level. This method relies on the following equation, which is taken from US guidance:

$$EM_{PM} = EF_{PM} \times d \times (1 - CE) \times 24PE \times (\frac{s}{0.09})$$

Where:

EM_{PM}	=	Emissions in kg
EF_{PM}	=	the emission factor for the type of construction (kg/(m^2.year))
$A_{Affected}$	=	area affected by construction activity (m^2)
d	=	duration of construction (years)
CE	=	efficiency of emission control measures
PE	=	Thornthwaite precipitation-evaporation index (unitless)
s	=	soil silt content (%)

The following values for EF_{PM} are then provided for $PM_{2.5}$

Table 2. Emission factors for $PM_{2.5}$ resuspended from construction

Type of construction	Default $EF_{PM2.5}$, kg/(m^2.year)
Construction of houses	0.0086
Construction of apartments	0.030
Non-residential construction	0.1
Construction of roads	0.23

The Guidebook also provides default values for many of the other parameters, although UK-specific values for the Thornthwaite precipitation-evaporation index have been calculated for use in the UK inventory. In theory, it would be better to use local values for parameters such as the soil silt content and the Thornthwaite index but those are unlikely to be easy to establish, so a mix of UK values and Guidebook defaults would be practical. The method is highly uncertain, with the Guidebook suggesting that the 95% confidence interval for the $EF_{PM2.5}$ values extends from an order of magnitude lower than the best values listed in the table above, to a value that is roughly 3 times the best value. Those confidence intervals are for the factors when used in the context of a national inventory, and the uncertainty will certainly be higher if the factors are applied to individual sites. But in theory the method could be used for company reporting. One positive is that it would require businesses to only provide one parameter – the area of construction – for each of the four types of construction activities listed above. So, if a business was constructing a housing estate, then the method would require just the

area to be covered by the houses themselves, and the area covered by the roads within the housing estate. The Guidebook also provides default values for the area per house/apartment so, for these two types of construction, a business could even just supply the number of dwellings of each type being built.

The sub-division of construction activities into the four categories is obviously somewhat simplistic and although the 'non-residential construction' category is intended to be a catch-all category and to cover anything that isn't in the other categories, it seems to us that the method will be much more uncertain for this category than the other three, because of the variety of 'construction' that could be covered by it – presumably anything from the making of parks and other relatively open spaces, to the building of high-rise commercial buildings and public buildings and utilities such as an airport or a sewage system. It is also important to note that the Guidebook method only relates to construction: it does not cover any emissions from demolition. This is particularly important for the UK where a lot of construction occurs on brownfield land and where demolition of previous structures may be an important element of construction activities. So in summary, a method is available for construction but is very uncertain and yields incomplete emission estimates but would require only very simple data to be provided by businesses.

5.2 Case studies to trial approach

In order to test out the estimation methods, and particularly the availability of data that can be used, four case study organisations were recruited to work through the process. We have not provided the name of the organisation, and just refer to them as organisation A, B, C and D. The organisations were selected from different sectors and focusing on different sources as set out below:

- Organisation A – a large construction where we primarily focused on of road machinery emissions, but also explored the possibility of estimating construction dust
- Organisation B – a health trust where we focused on their vehicle fleet
- Organisation C – a service company considering emissions from heat and power and vehicle for business use
- Organisation D – a second service company again focusing on heat and power and vehicle for business use

A data request template was created for use with the organisations to test whether and what information we could gather could be used to estimate selected air quality pollutants using the methods described above. These templates had several built in quality control and data validation checks and so the users would see errors if they entered data which was "not expected". However, we also gave the users considerable flexibility to enter the data they had "to hand" and this flexibility was deliberate to ensure the users were able to enter their data without large amounts of extra formatting. We also explored how much of the information that already existed to support company level GHG reporting and other purposes could be used for AQP reporting

5.2.1 Organisation A – Construction company

This was a large construction company working on 6 sites in London and the assessment was carried out at the level of the site rather than the company. This was done as there were various organisations working on the sites but co-ordinated through the main construction company, and it also aligned with the way in which they were collecting information to report GHG emissions at the site level for other requirements.

In discussion with the company, it was clear that the key source of emissions was from the operation of construction equipment. The majority of the equipment was powered renewable diesel (HVO) but there was also some specialist equipment powered by electricity. All other power provided to the site was also electricity and so the two main sources of emissions considered were the off-road machinery and electricity use. There was also a discussion around construction dust but the data available did not allow us to calculate emissions for this. A summary of the emissions, by site, is provided below and followed by further discussion on each source.

Table 5 Case study A - Annual emissions of NOx and PM by site

	Emissions from NRMM		Emissions from electricity use	
Site Code	NOx (kg)	PM (kg)	NOx (kg)	PM (kg)
1	122	4.2	265.4	10.1
2	269	8.8	329.5	12.51
3	1198	48.2	157.7	6.0
4	96	2.2	101.9	3.84
5	86	11.4	87.38	3.32
6	7	1.1	N/A	N/A

Off road machinery

The company provided plant lists for their sites along with total fuel consumption data for each site. The plant list generally provided sufficient information to establish the machinery type, year of manufacture, fuel type and power rating. However, there were no fuel, usage or energy data specific to individual piece of equipment or plant.

In addition, small amounts of telematics data were available that provided some fuelling information for a few excavators and telehandlers.

In order to estimate emissions, the total fuel consumed at each site had to be distributed amongst the plant that operated there. With the exception of excavators and telehandlers, no data were available to apportion the fuel. For excavators and telehandlers an estimate of fuel use was made based on the limited telematics data. These estimates were extrapolated to sites without telematics data. Other plant were assumed to receive a fraction of the remaining fuel weighted by the their power rating. The assumption being that the hourly usages for the other plant are same as each other.

Emissions were then calculated for each site by applying emission factors to estimates of energy use that were back calculated from the assumed fuel use estimates. Standard diesel emission factors were used as there are no specific NOx and PM emissions factors for HVO. There is a limited amount of research data on the effect of HVO on air pollutant emission, which suggests there may be a benefit for PM but little for NOx, but it is not conclusive.

Electricity use

Electricity data were available for each of the sites, with one exception. The electricity used at all sites was supplied on a REGO (renewable) tariff. The emissions was then simply calculated by applying the UK average emissions for renewable electricity, as described in section 5.1.2, to the electricity usage data provided.

Construction dust

With this case-study it was initially assumed that it would provide a good example for estimating emissions of construction dust. However, ultimately, we did not generate any emission estimates for this construction because:

a) the business was unable to supply the area covered by its various construction sites
b) the activity was very specialised and not typical of general construction work, the project team therefore felt that any estimates based on the Guidebook method would be so uncertain as to possibly be worthless.

Summary conclusions

In terms of the total emissions calculated those generated from off road machinery and electricity use were of a similar scale. This would be in stark contrast to the GHG emission calculation where the

renewable energy would be assumed to be zero emission, but in terms of AP pollutant emissions this is not the case due to biomass fuels used. Combustion of these fuels will release NOX and PM.

Estimating GHG emissions for NRMM would normally mean applying a constant fuel-dependant emission factor to fuel consumption data. Following this approach, the calculations do not require any information about the vehicles that consume the fuel, so all the vehicle related data collected for air quality purposes becomes redundant. However, if fuel consumption data are not available then GHG emissions can be estimated from the EMEP/EEA fuel consumption (g/kWhr) factors in a way that is analogous to the air quality pollutants.

For air quality reporting, considerably more data are required to calculate NRMM emissions than in the case for GHG reporting. In addition to the quantities of fuel required for GHG emission calculations, air quality calculations require specific information on the equipment consuming the fuel and information on its utilisation (either fuel consumed by individual plant or kWhr usage).

Often the data required for the estimation of NRMM emissions are not currently collected in sufficient detail to make accurate estimates of air quality emissions. Companies would need to establish procedures for data collection specifically to feed the air quality calculation. These could include fuelling records for individual vehicles and/or odometer readings pre and post deployment.

In contrast to NRMM emissions, the estimation of AP emissions from electricity use used the same data as that needed for GHG calculations. These data were readily available and the calculations could be made easily.

For construction dust, as noted above, it seems unlikely that organisations will have the necessary data to allow estimates of dust emissions to be calculated. In addition, the calculation methods are fairly crude and so any results would be very uncertain.

5.2.2 Organisation B – Health trust

The health trust was a large and complex organisation with many sources of emissions. However, in discussion with them it was agreed to focus on their vehicle fleet for this exercise as they had recently had a detailed assessment of GHG emissions from their fleet and wanted to complement this with an understanding of air pollutant emissions from the vehicles. Interested was also expressed in understanding the likely total emissions from the CHP plant as this was a major source of energy to the organisation's buildings. A summary of the emissions from the fleet, CHP plant and imported electricity are summarised below. For the fleet the PM2.5 emissions are split between exhaust related and non-exhaust related such as brake and tyre wear.

Table 6 Case study B - Annual emissions by source in kg

Emissions	Fleet	CHP plant	Imported electricity
NOx (kg)	737	52,488	10,684
PM2.5 (kg)	-	776	277
Exhaust	1.8	-	-
Non-exhaust	21.6	-	-

Fleet emissions

The trust provided near complete records of their road vehicle data for 2019/20 financial year. There were some issues with the data they entered into our data collected template that resulted in the following error message being reported: "Mismatch between Vehicle Type and Euro Standard". The error message appeared for several reasons outlined below:

- Lack of detail in relation to the Euro 6 vehicle standard which has sub-classes as shown below which would not be readily available to the company and so would have to be assumed based on age:

    - Euro 6: September 2015
    - Euro 6d-TEMP: September 2019
    - Euro 6d: January 2021
- Being able to distinguish between a full hybrid or a plugin hybrid. However, this information would normally be available but the need for this distinction needs to be made clear.

For most vehicles both mileage and fuel use were provided. This presented several options for the calculation of emissions:

- Mileage based
- Fuel based
- Use both mileage and fuel to derive average energy consumption and back fit an average speed to use in the speed-related emission functions.

The first of these options was preferred as the mileage data were deemed to be more accurate than the fuel data. The third option was rejected as it often yielded speeds that were unrealistic.

CHP and electricity emissions

The CHP consisted of two large (7.5 MW thermal) gas power plants providing the bulk of the heat and electricity at the trust. An estimate of the gas use for each plant was provided along with an estimate of any electricity exported to the grid. The organisation was also able to provide a value of imported grid electricity used to supplement the power generated from the CHP at times of high electricity demand. This provided sufficient information to calculate emissions for the CHP plant based on the Guidebook tier 2 method. However, when doing this a correction was not made to account for any exported electricity but this refinement could be considered for the future. The calculation of emissions from imported electricity were based on grid average emissions factors.

Summary conclusions

The results for the organisation indicate that the CHP plant is a major source of emissions at the organisation and are an order of magnitude greater than emissions from transport. Also, the emissions related with imported electricity were also significant. It is also worth noting that with a modern vehicle fleet, as is the case with the organisation, most PM emissions are released from non-exhaust sources. It will be difficult to control these PM emissions further as even zero emission tail pipe vehicles (such as electric) will still have these non-exhaust emissions.

In terms of transport emission, the key focus of this case study, GHG emission can be simply calculated from fuel use. However, if fuel consumption data are not available then GHG emissions can be estimated from the COPERT energy consumption functions in a way that is analogous to the air quality pollutants. In this case a constant fuel-dependant emission factor would be applied to the estimated energy consumption. So generally, for air quality reporting, considerably more data are required to calculate emissions than in the case for GHG reporting. In addition to the quantities of fuel required for GHG emission calculations, air quality calculations require specific information on the equipment (in the case vehicles) consuming the fuel and information on how the equipment is operated (e.g. they type of driving normally done - urban, rural or motorway).

In the case of the trust the data needed was largely available with a few minor issues. However, it should be noted that this was in a situation where they had just had a detailed review and data collection exercise for the purpose of estimating GHG emission for the fleet. They noted that this level of data was not normally available and they will need to set up the systems to collect this detail going forward. So it is likely that for many companies the data required are not currently collected in sufficient detail to make accurate estimates of air quality emissions. Companies would need to establish procedures for data collection specifically to feed the air quality calculations.

Particular attention should be given to collecting accurate data. As seen above there is often confusion surrounding the data requirements for the air quality calculations. In particular, the specific sub-class of Euro 6 cars was not known, and the definition of hybrid vehicles need to be clarified as Full hybrid and Plug-in hybrid vehicles are substantially different.

Further improvement to the air quality calculations, for example the inclusion of cold-starts, require data that would be difficult for companies to collect. However, it's possible that they may become available in the future, for example if telematics or tachograph equipment become routinely used. In the meantime, it may be possible to make broad brush assumption based on UK average data that could be used to plug some of the gaps in the methodology. A watching brief should be kept on developments of data collection techniques and emission calculation methodologies.

The trust was able to provide sufficient data for the calculation of emissions from the CHP plant and electricity used based on what they would normally collect for GHG emission calculation. For the CHP plant the calculations used the generic emission factors from the guidebook, which we have noted have significant uncertainty around them. Further improvements could be made to the estimation of this significant source of specific data on the emissions characteristics of the plant in use. This may be collected from the supplier of manufacture of the plant or even direct flue measurements.

5.2.3 Case studies C and D – Service companies

The two service companies have been considered together as they both cover similar sources with a focus on heat and power emissions from their buildings and emissions from vehicles used for business travel. The data collected from both these organisations essentially matched what they had collected for the purposes of GHG reporting. A summary of the emission results is provided in Table below.

Table 7 Case studies C and D – emissions by source

Emissions	Company 1			Company 2		
	Fleet	Gas	Electricity	Fleet	Gas	Electricity
NOx (kg)	48.0	24.2	178.3	5.5	15.8	157.6
PM2.5 (kg)		0.1	3.8		0.1	6.0
Exhaust	0.6	-	-	0.1	-	-
Non-exhaust	5.5	-	-	0.4	-	-

Fleet

Company 1 provided annual mileage data broken down by diesel, electric[17] and petrol vehicles covering mainly hired vehicles used for business travel. No further details or breakdown were given, so we assumed that all the fuel was consumed by passenger cars in urban driving conditions and that the vehicles comply with Euro 6d-TEMP: September 2019.

The passenger car assumption was made on the basis that most of the fuel would be used in hire cars. However, this assumption reflects a limitation as there will also be fuel used in LGVs that is not separately accounted for. Similarly, the euro standard assumption was based on the typical age of hire cars and similar limitations apply. The choice urban driving conditions was considered most appropriate, but again this reflects a significant limitation.

Company 2 provided mileage data from expense claims for car use along with estimated mileage from taxi usage. No information was provided on the fuel type or other details of the vehicles. It was therefore assumed that car use was split between diesel, petrol and electric vehicles in the same proportion as they are in the Central London fleet. On the grounds that company cars tend to be newer vehicles, the petrol and diesel cars were assumed to meet a minimum Euro 6 standard with the relative proportions of vehicles meeting the Euro 6d standards being the same as in the Central

[17] Have assumed 100% EV from the REE category of EV/hybrid

London fleet. Taxis were assumed to be black cabs with the proportion of vehicles meeting the various emissions standards being the same as in the ULEZ fleet.

Typical for their GHG reporting both companies would also look at rail and air travel, but these have not been included in the current for reasons of simplicity. However, such modes would need to be covered in a full reporting scheme.

Heat and power

Both the case study organisations used electricity and a relatively small quantities of natural gas. None of the organisations used oils or solid fuels in stationary plant. Therefore, for each case study we only needed to estimate emissions associated with the generation of the electricity, plus any emissions associated with natural gas use.

Summary conclusions

The main source of emissions for the service organisations relates to electricity use in their buildings which is likely to be used for a range of purposes including heating and cooling. Emissions from vehicle use is the next biggest source, with smallest source being from gas use which is often fairly limited in office buildings.

Transport emissions from these types of service companies will largely relate to vehicles used from business travel either hire, company or personal vehicles. The data provided will be fairly generic for example in terms of milage with little detail on the vehicles themselves. In this case assumptions will need to be made on the likely vehicle types in use. In the future, consideration should also be given to including rail and air travel in the approach of for calculating air pollutant emissions to align more fully with the reporting being done for GHG emissions.

The data requirements for stationary heat and power sources are relatively straightforward and all case study organisations were able to supply enough information to enable emission estimates to be made. The information provided was generally incomplete in at least some details or provided in an alternative format to the template provided, which strengthens our view that it is pragmatic to keep methodologies and data requests relatively simple. Some of the information requested in the template could actually be removed since it was not provided by the majority of responders and therefore wasn't used. Essential information is limited to consumption figures for each fuel and for electricity and the broad category of appliance used, although even this can be dispensed with without making it impossible to estimate emissions. The case studies suggest that businesses can provide this information and converting the information into emission estimates is straightforward.

5.3 Uncertainty

As discussed above the calculation of both GHG and air pollutant emissions in its simple form combines activity data with the appropriate emissions factor. Therefore, there are three main sources of uncertainty associated with estimating emissions:

1. Uncertainties in the activity data.
2. Uncertainties in the emission factors.
3. Uncertainties associated with the overall calculation methodology.

The relative balance between the impact of these uncertainties on the overall uncertainty varies according to the source of emissions.

5.3.1 Activity data

The use of activity data to estimate emissions introduces uncertainty. This is largely driven by the availability and accuracy of the data, which can vary considerably between data sources and organisations. The quality of data input is directly related to the quality of data output. As described in the methodology sections above the estimation of air pollutants is likely to require more activity input data than with estimating GHG emission. Therefore, issues around availability and accuracy of input data are likely to be increased when trying to estimate air pollutant emissions.

Although the issues surrounding data impact all sectors, they typically become more significant as the complexity of processes and of site arrangements increases. For example, a corporate operation with a small number of owned sites will generally have easy access to its energy use data. Complexities in accessing good quality data may be introduced in circumstances where the organisation occupies part of a building and pays its bills via a service charge to the landlord. Similarly, organisations with complex estate portfolios, e.g. the healthcare sector, will often have one or more third parties involved in their facilities management. This can lead to reduced visibility of data, or inconsistencies in available data.

Where an organisation leases sites to a third party it may experience difficulties obtaining data, meaning that there is an increased use of estimates. This is seen in scenarios such as airport terminals and shopping centres. A similar scenario is often seen when organisations seek business travel data. This may be split into several sources, often including the company's own travel and finance teams, as well as third parties involved in aspects such as flight booking.

Sectors such as construction that have a continually shifting portfolio of sites may experience challenges obtaining data. This can be minimised by ensuring that all new sites are always given a clear objective on data collection and reporting requirements.

The timeseries consistency and historical availability of activity data are other factors. This becomes important if changes in emissions over time need to be estimated. It is generally true that data availability before – let's say – the mid-2000s is often quite poor. It is also typically true that once an organisation starts to report GHG emissions, it quickly improves the quality and availability of data needed to support this reporting. A consequence of this data improvement action is that the first set of reported estimates are typically less accurate than subsequent sets of reported data, and in future years, it might be necessary to update the estimates that have already been reported. Gap filling techniques using proxy data may be needed also, and this will increase uncertainty.

Reducing uncertainty – use of the data hierarchy

When selecting data, always aim to use the most accurate available source. This can be facilitated by following a data hierarchy as shown below.

Priority 1: Primary data – Activity data that is measured directly and accurately (e.g. metered use of electricity).

Priority 2: Secondary data – Activity data that is estimated or published (e.g. estimated bills, manufacturer efficiency figures for vehicles).

Priority 3: Extrapolated data – Activity data calculated by projecting a trend using existing data (e.g. to fill a data gap such as a period of missing meter readings).

Priority 4: Proxy data – Using existing similar data in place of missing data (e.g. using February data to fill a gap for March).

5.3.2 Emission factors

Emission factors are used to estimate both GHG emissions and air pollutant emissions by applying relevant conversions to activity data. As an example, the carbon contents of fossil fuels would be used as an emission factor in the calculation of CO_2 from fuel consumption.

When considering GHG emissions very accurate estimates of emissions of CO_2 are possible if accurate fuel consumption data, and fuel specific carbon emission factors are available. These estimates are typically associated with low uncertainty. Looking at examples at the other end of the uncertainty spectrum, estimates of emissions of the non-CO_2 GHGs from fuel combustion are often associated with relatively much higher uncertainties. This is often driven by the EFs of CH_4 and N_2O having high uncertainties. These high uncertainties arise because emissions of these GHGs are not directly dependent on their masses in the fuels, but are controlled by combustion conditions which generate the GHGs. There are a wide range of combustion conditions even within a given technology type. This range creates a wide variation in the possible values of an EF and hence increases the uncertainty on the EF. An implication of this means it is important as far as possible to accurately match the EF to the technology in use. Applying one EF to a wide range of technologies will increase the uncertainty on the estimates of emissions.

The situation with non-GHG emission factors mirrors that with air pollutant emissions as discussed previously in the methodology section. In this case a very complex set of emission factors may be available to account for the range of different technologies and operating conditions. This is typically the case for transport emissions but not for combustion plant as we have mentioned before. The challenge then is that to get more robust emissions results we need to more detailed emission factors that required more detailed input data which may not be available and so in itself can then re-introduce uncertainty.

Reducing uncertainty – credibility of emission factors

In order, to balance the robustness of emission factors with the availability of data the EMEP/EEA Emission Inventory Guidebook introduces the concept of tiered levels of calculation complexity:

- Tier 1 – where very simple generic emission factors are used with limited activity data needed, potentially just fuel use and type, where all the other technology and operating condition factors assumed and based for example on national averages.
- Tier 2 – with increases complexity by introducing some elements of technology into the emission factors where this data is available.
- Tier 3 – with the most detail included around technology and operating conditions are used.

As you progress up the tiers the accuracy of the approach to calculating emissions increases but the data requirements also increase, which can as noted before re-introduce some uncertainty. Therefore to get good emissions estimate you need to strive for the most accurate and detailed activity data you can achieve and match this against the most detailed emission factors. As with GHG reporting it is likely that companies will improve the data collection methods as they start to engage with the process of air pollutant reporting and so be able to move up the tiers and complexity of estimation.

5.3.3 Calculation methodology

Where data is readily available and a standardised approach[18] can be used, calculation methodologies introduce relatively low uncertainty. Where there is missing data and/or no standard approach to calculating emissions, it is necessary to make a series of assumptions and/or estimations. These introduce more uncertainty. For example if an average mix of vehicle technologies needs to be assumed the outcome will be more uncertain.

Some sectors may have complicated processes for which a bespoke emissions calculation process is required. This increases relative uncertainty, and detailed understanding of the process is essential to ensure that robust assumptions and methodology are developed. This is most likely to sectors such as waste treatment of industrial emission which we are suggesting would not be a focus for a first prototype of an air pollution reporting scheme.

Reducing uncertainty – making credible assumptions

The more credible and accurate the assumptions used, the less uncertain the result. The most appropriate assumptions are made in consultation with staff directly involving in influencing or monitoring a particular activity. Credible assumptions may also be sourced from industry e.g. trade bodies.

Reducing uncertainty – verification

Verification involves having a third party undertake an independent assessment of the accuracy and completeness of data and calculations. Verification tests the accuracy of the data and methodology used as well as the credibility of the overall approach and assumptions. Carrying out a verification can help to reduce uncertainty[19].

[18] For example, internationally recognised standards such as the Greenhouse Gas Protocol (See Chapter 7: Managing Inventory Quality) provide approaches designed to reduce uncertainty.
[19] ISO14064:3 Specification with guidance for the validation and verification of greenhouse gas assertions requires verifiers to agree a materiality threshold which defines the degree of uncertainty that is acceptable to the organisation in its emissions reporting.

In order to provide stakeholders with confidence in emissions data, regulations such as Streamlined Energy and Carbon Reporting require organisations to provide a calculation methodology in their reporting. Providing this increases transparency and facilitates comparability. Companies include this data in their annual report, and it is typically verified by an independent body as part of the financial audit process.

The CDP voluntary reporting scheme incentivises verification by giving an improved score to those that have implemented the process.

Companies reporting GHG emissions may also choose to supply a statement from a third party to demonstrate that verification has taken place.

6 Barriers and incentives to air pollution reporting

An online survey was developed to measure a current level of corporation awareness of air quality and to better understand potential drivers and barriers that businesses may face during reporting process.

The survey included 15 questions and firstly examined current GHG reporting status and commitments to a wider environmental management processes or sustainability frameworks organisations might have in place. The survey also analysed what factors might play a role in incorporating air pollution into existing GHG corporate reporting processes and how this can be developed. A copy of the survey questions is included in appendix 2 for information.

Over a 4-week period, the survey was distributed across a wide range of businesses representing different sectors such as:

- Construction
- Health Care
- Leisure and Hospitality
- Services
    - Public Sector
    - Academia
    - Consultancy
    - Office Provider
    - Service Provider
    - Other
- Other Manufacturing
- Retail
- Transportation – Road (Fleet provider)
- Transportation – Road (Fleet owner)
- Transportation – Other
- Waste Management
- Large industry
- Other

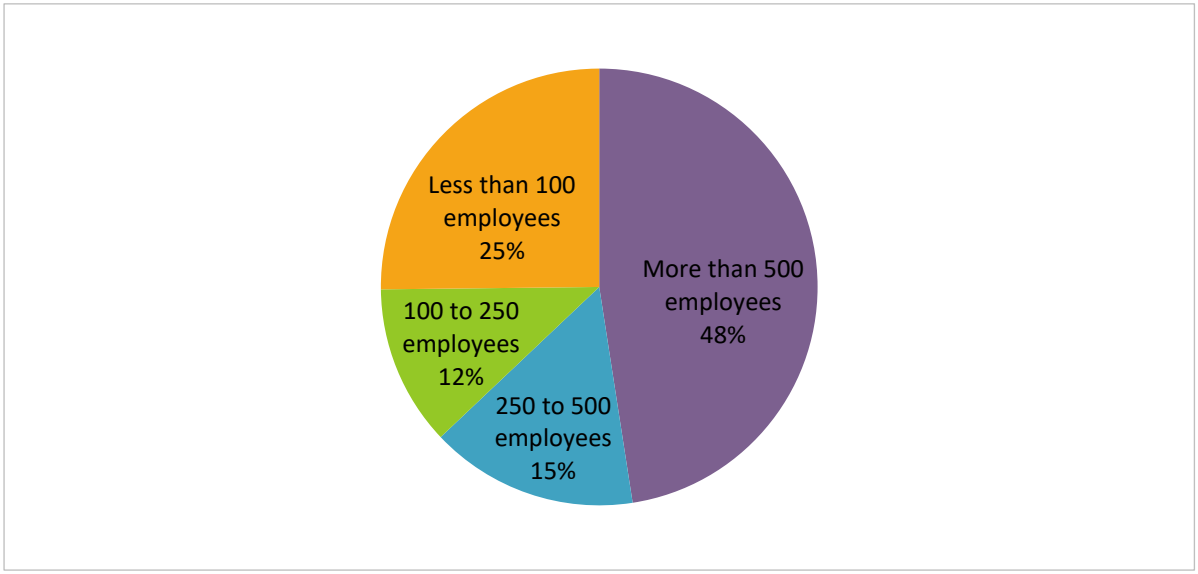
In total, 189 organisations responded to the survey. The survey was completed in full by around 50 organisations, therefore not all questions have the same number of responses. The largest number of responses came from organisations defined under ‘other’ (28) followed by consultancy (26), manufacturing (20) and large industry (15) (Table 8). A wide range of sectors are represented including airports, architecture, automotive, cement, chemical industries, energy industries, food and drink, local authorities and government agencies, leasing, media, NGOs, packaging, paint, paper, printing, shipping, steel, education and universities, utilities and water companies.

Table 8 Sectors/organisations represented in the survey

Value	Percent	Count
Other	19.7%	28
Services - Consultancy	18.3%	26
Manufacturing	14.1%	20
Large industry	10.6%	15
Services - Academia	8.5%	12
Waste Management	7.0%	10
Construction	6.3%	9
Services - Service Provider	6.3%	9
Transportation – Other	4.9%	7
Services - Other	4.2%	6
Health Care	2.8%	4
Transportation – Road (Fleet owner)	2.8%	4
Retail	1.4%	2
Services - Office Provider	1.4%	2
Transportation – Road (Fleet provider)	0.7%	1

Almost half of the responses came from organisations with more than 500 employees (Figure 6). A quarter came from those with less than 100 employees and the remainder from those with between 100 and 500 employees.

Figure 6 Size of organisation



6.1 Understanding current company level action on GHG and air pollution emission reporting

To gauge the current extent of action on GHG and air pollution reporting, the survey investigated the level of reporting on GHG emissions, wider company environmental management systems and air quality policies and reporting frameworks.

6.1.1 GHG Emission Reporting Framework

The results shows that majority of respondents, 69%, report GHG emissions under a number of different reporting frameworks. (Figure 7). This is notable as over half of the responses came from organisations with more than 500 employees, where reporting is compulsory in the UK. The majority of those organisations which do report GHG emissions do so under the following frameworks:

- Greenhouse Gas (GHG) Protocol (18%)
- Carbon Disclosure Project (CDP) (9.4%)
- Streamlined Energy and Carbon Reporting (SECR) framework (7.5%)
- Greening Government Commitments (UK Government and Local Authorities) (3.8%)
- European Union Emissions Trading Scheme (EU ETS) (2.8%)
- United Kingdom Emissions Trading Scheme (UK ETS) (2.8%)
- Climate Change Agreements (CCA) (2.8%)
- Global Reporting Initiative (GRI) (2.8%)
- Carbon Trust Carbon Neutral Certification scheme (2.8%)
- Other (16%)
- .

16% of respondents selected option ‘Other’, with a number of reporting systems described. These included:

- Airport Carbon Accreditation scheme
- Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Order 2015
- Shipping emissions reported under the International Maritime Organization (IMO) Fuel Oil Data Collection System (DCS) for international shipping (required for ships of 5,000 gross tonnage or above) and the UK’s monitoring, reporting and verification (MRV) scheme.
- Sustainable Energy Authority of Ireland (SEAi) Monitoring and Reporting (M&R)
- Sustainable Finance Disclosure Regulation (SFDR)
- Water Industry's own reporting regime
- Waste and Resource Action Programme (WRA) tool Carbon Waste and Resources Metric (WARM)
- Zero Waste Scotland (ZWS) carbon metric

Of the surveyed organisations 22% stated that they do not report current their GHG emissions. This group might be represented by smaller and mid-size organisations that are not required to report on GHG emissions.

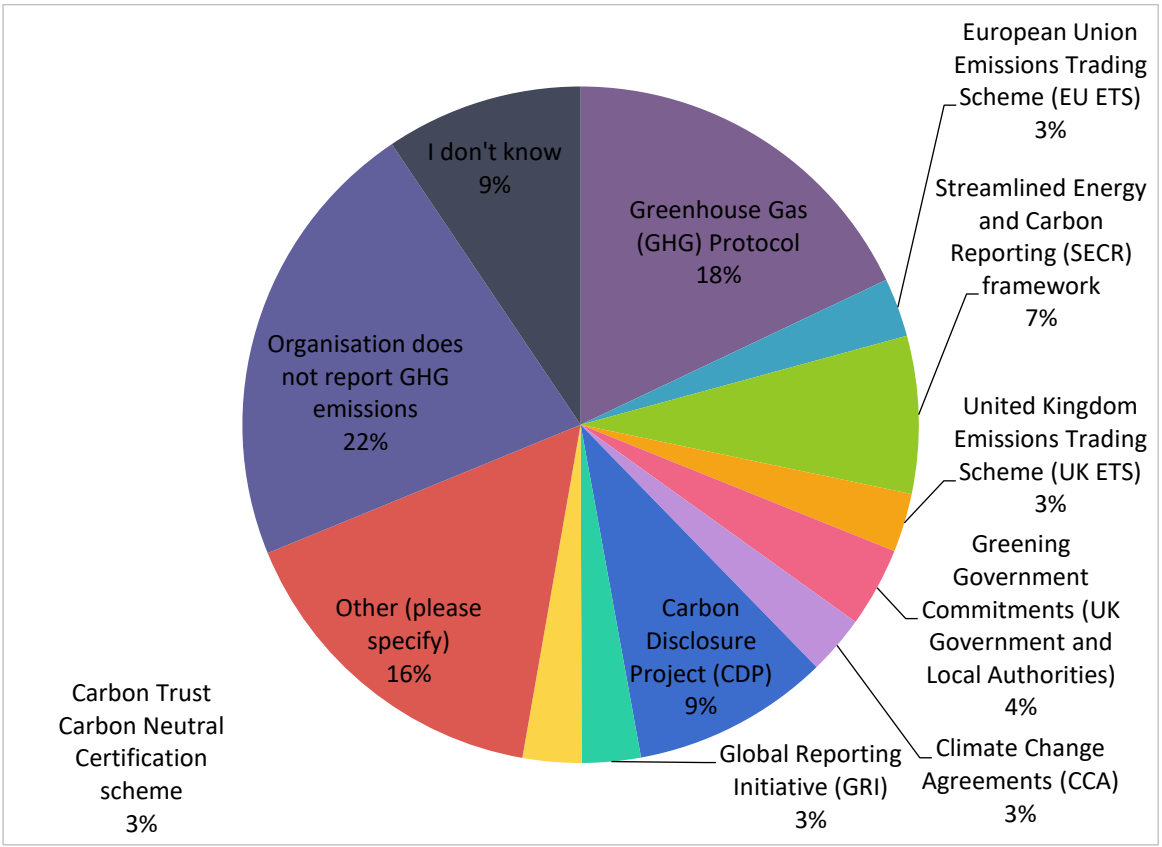
Whereas 9% of the responses selected “I don’t know”, what this might suggest is that the survey was completed by a person that is not responsible or familiar with GHG reporting progress.

The ‘Other’ option was also used by some respondents to note that the survey only allowed selection of one option and that GHG emissions were submitted under several the options given. One respondent commented that their organisation will soon be using the Corporate Sustainability Reporting Directive (CSRD) and Task Force on Climate-Related Financial Disclosures (TCFD).

A further 9% of respondents were unaware of whether their organisation reported GHG emissions. Amongst the other options provided in the survey, 9% of organisations use the Carbon Disclosure Project (CDP) and 7% use the Streamlined Energy and Carbon Reporting (SECR) framework. Less selected options were the Greening Government Commitments (UK Government and Local Authorities) (4%), and the European Emissions Trading Scheme (EU ETS), United Kingdom ETS (UK ETS), Climate Change Agreements (CCA), Global Reporting Initiative (GRI) and Carbon Trust Carbon Neutral

Certification Scheme (all 3%). These responses tell us there are a wide range of schemes where some kind of carbon or GHG reporting is done.

Figure 7 Does your organisation currently report GHG emissions under the following reporting frameworks?



6.1.2 Environmental Reporting and Management Systems

In terms of wider environmental reporting or management systems (EMS) in place, respondents were given a multiplied choice to selected relevant reporting frameworks. In total 129 responses (69%) stated that reporting is undertaken under one or more listed reporting frameworks. Within these responses, ISO14001 was the most popular choice of those surveyed, with 46 respondents (58%) confirming that this framework is in use in their organisation (Table 9). Whereas SBTi , TCFD and CDP were selected respectively by 19, 17 and 16 of respondents.

'Other' was the second most selected option (24), Excluding ISO14001, of the yes, no or don't know responses, many more respondents stated that the other frameworks listed are **not** in use than those who confirmed that their organisation use the listed systems (40-58% of responses given). A further 15 or 19% stated that they did not know whether other frameworks were used by their organisation.

Table 9 Does your organisation have any wider environmental reporting or management systems in place, under the following frameworks?

Framework	Yes		No		I don't know		Responses
	Count	Row %	Count	Row %	Count	Row %	Count
ISO14001	46	58%	24	30%	9	11%	79
Other	24	36%	27	40%	16	24%	67
The Science	19	28%	32	48%	16	24%	67

Framework	Yes		No		I don't know		Responses
	Count	Row %	Count	Row %	Count	Row %	Count
Based Targets initiative (SBTi)							
Task Force on Climate-Related Financial Disclosures (TCFD)	17	24%	34	49%	19	27%	70
Carbon Disclosure Project (CDP)	16	24%	37	54%	15	22%	68
EMAS	7	11%	36	58%	19	31%	62

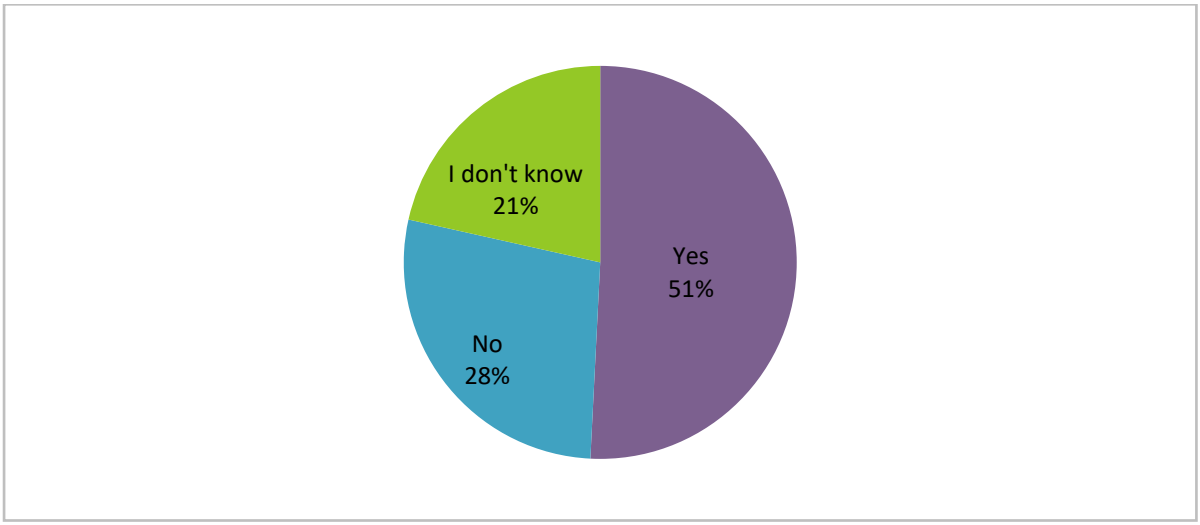
6.1.3 Air Quality Policy and Air Pollution Reporting Frameworks

Figure 8 provides the summary of responses to the question “Does your organisation currently have policies in place to reduce its impact on air quality?” Over a quarter of organisations do not have any air quality specific policies and 21% are unsure if they do. Of those organisations with air quality related policies in place, a wide range of policies or drivers to reduce air quality impact were cited in the responses, including the following:

- Sustainability reporting
- Health and safety assessments (for example on manufacturing and construction tasks)
- Regulatory disclosure
- Sustainable transport strategies and initiatives such as
    - Encourage public transport
    - Travel only when necessary
    - Cycle-to-work scheme
    - Bike rack installation
    - Low carbon/electric fleet/vehicle scheme
    - One company has plans to produce Hydrogen to be used to replace diesel vehicles
- Sustainability measures such as using a renewable energy provider
- Environmental, Social, and Governance (ESG) strategies
- Policies specific to office air quality:
    - Regular monitoring
    - Use of waterless printing which uses no high VOC chemicals in the printing
- Investment in best available techniques (BAT)
- Following minimum standards for non-road mobile machinery (NRMM) with EU emission levels
- Policies to reduce fossil fuel consumption - heat recovery, heat pumps, renewable fuels
- Policies specific to the shipping sector:
    - SEEMP implementation
    - ISO 50001
    - Reduced speed sailing with bulk carriers
- Policies specific to the waste sector:
    - Waste/contaminated soil is treated aerobically

One respondent working in architecture also gave their specific experience of their organisation's AP policies. "*[They exist] to a limited degree - as architects and designers we have processes to consider how our designs impact upon air quality (indoor and outdoor). We also have policies to use electric taxis and couriers as a priority and to ensure our energy on a green tariff. We don't have a particularly comprehensive focus upon this.*"

Figure 8 Does your organisation currently have policies in place to reduce its impact on air quality?



6.1.4 Summary

- Just over two-thirds of those taking part indicated that their organisation reports GHG emissions under a variety of frameworks, the majority using the GHG protocol.
- Over half of the organisation surveyed indicated using a wider environmental reporting framework. Out of 79 responses over half of the organisations surveyed use ISO14001 for wider environmental reporting and management.
- Around half of the organisations surveyed currently have policies in place to reduce their impact on air quality.

6.2 Barriers to reporting AP emissions

The survey also analysed what factors might play a role in incorporating air pollution into the existing GHG corporate reporting process. Firstly, the perceived importance of air quality and the estimated contribution of the respondent's sector was considered. As shown in Figure 7, GHGs are relatively well known and reported, however this cannot be assumed for AP and it is important to gauge the level of awareness of AP. The view of the organisation on their contribution to AP is also important to consider as the perception that individual organisations are not adding much to the problem could prevent action. If an organisation does not feel responsible this could be a barrier to any voluntary reporting.

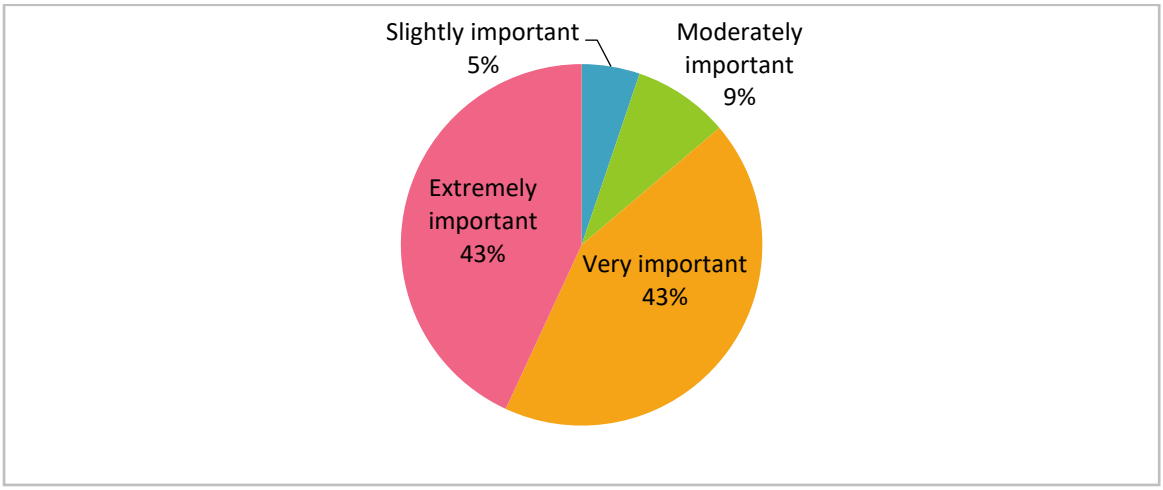
Secondly, the survey investigated the inclusion of air quality in environmental management systems and the current level of reporting of air pollution under various regulations. Awareness of air pollutants from this existing reporting may support interest in a wider company or organisation level AP reporting framework.

Finally, the respondents were asked to rank what they perceived to be the main barriers preventing their organisation from reporting its air pollution emissions. Suggested barriers included lack of incentives, data resources, knowledge and guidance.

6.2.1 Awareness and perception of air quality

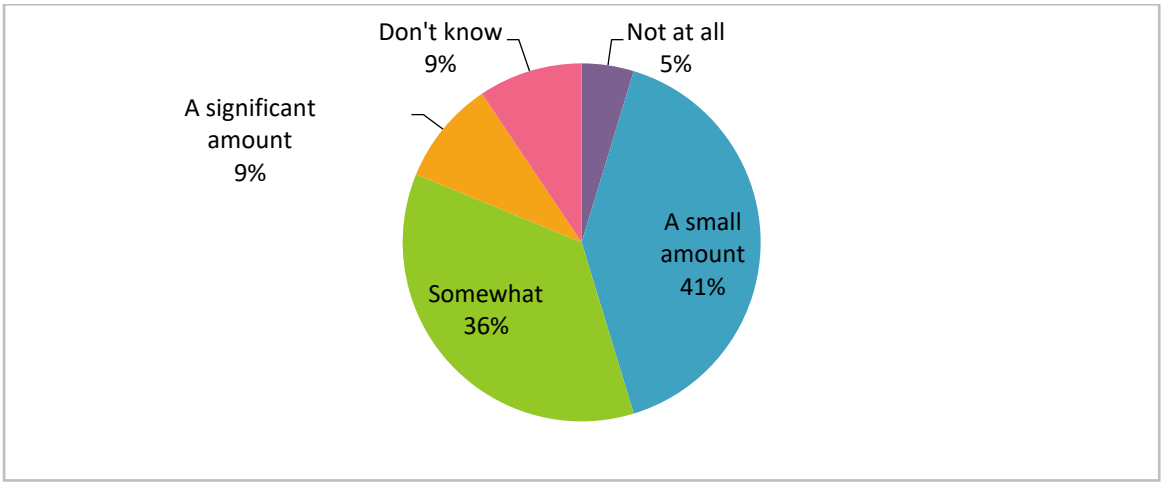
Of those surveyed, the vast majority stated that air quality is either 'extremely important' (43%) or 'very important' (43%) as an environmental health concern (Figure 9). Only 9% think that it is 'moderately important' and 5% that it is 'slightly important'. The responses indicate that overall those surveyed had a high awareness of the existing air quality concerns.

Figure 9 How important do you think air quality is as an environmental health concern?



The majority of respondents (41%) think that their company contributes only a 'small amount' to air pollution compared to other organisations from the same sector (Figure 1010). Slightly fewer think that their company contributes 'somewhat'. An equal proportion of those surveyed either don't know how much their company contributes or think that they contributed a 'significant amount' (9%). Only 5% think that their company does not contribute to air pollution at all.

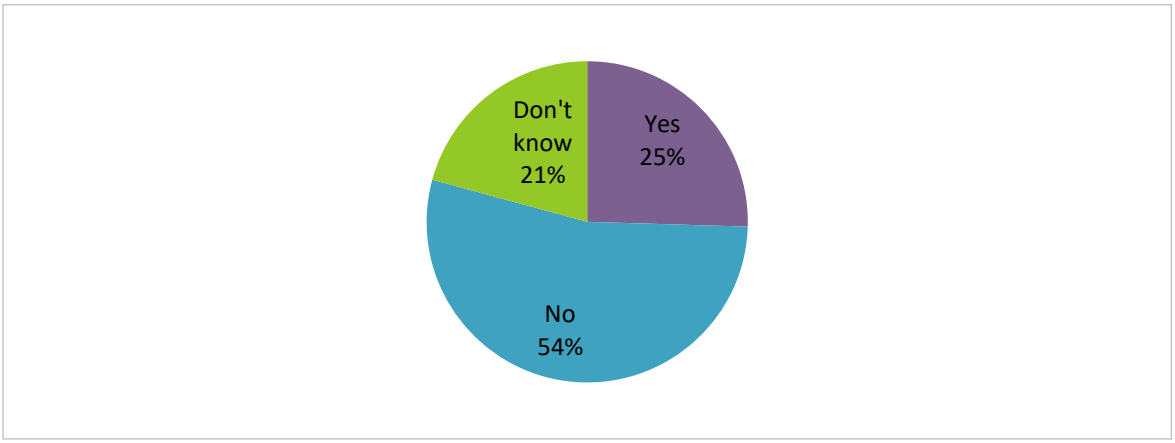
Figure 10 How much do you think your company contributes to air pollution compared to other organisations from the same sector?



6.2.2 The current level of reporting of air pollution

It was established that over half of the wider environmental reporting frameworks and management systems used by respondent's organisations (as listed in Table 9) do not currently consider or address air pollution (Figure 11). A quarter of those surveyed stated that their EMS does consider air pollution and further 21% were unsure.

Figure 11 Does the environmental management system consider air pollution?



Of those EMS that do consider air quality, various air pollutants are covered, including:

- Ammonia (NH_3)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Carbon monoxide (CO)
- Dust
- Hydrofluorocarbons (HFCs)
- Hydrogen chloride (HCl)
- Metals
- Non-methane volatile organic compounds (NMVOC)
- Nitrogen oxides (NOx)
- Particulate matter (PM_{10} and $PM_{2.5}$)
- Sulphur oxides (SOx)

Transport was given as a specific source of air pollution considered by one organisation's EMS. Other more general statements were made by respondents in reference to air quality within EMS, including:

"*Air quality is considered as part of our wider sustainability strategy including links with health and wellbeing"*

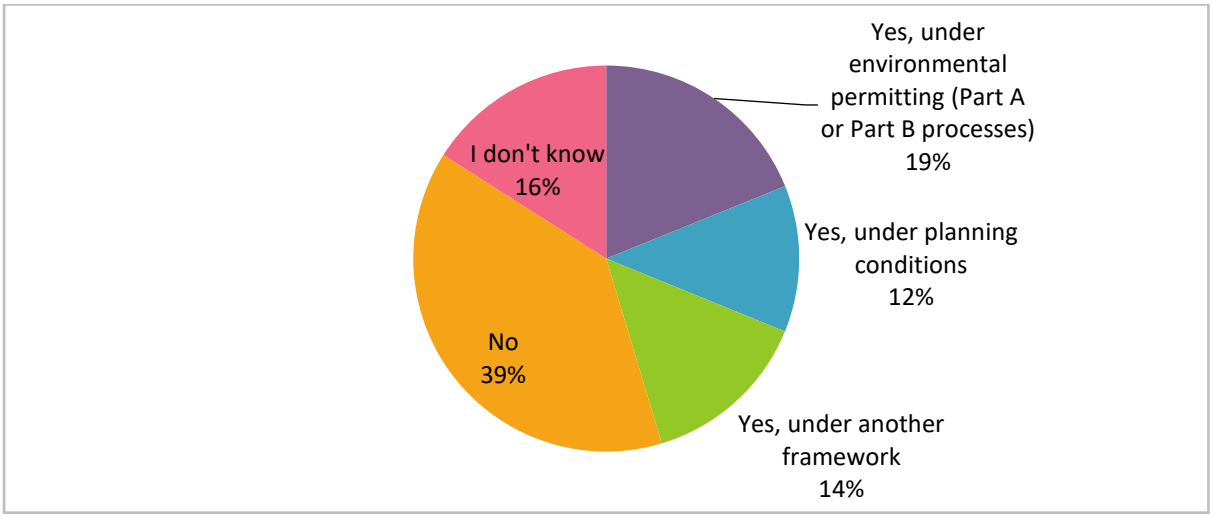
"Air quality is monitored every 3 years"

"Air quality KPIs and yearly/monthly targets [are set]"

Further, it was found that some EMS also included emissions in line with permitting requirements such as "*particulate emissions in line with [Pollution Prevention and Control] PPC Permit requirements and SOx & NOx from [Medium Combustion Plant Directive] MCPD".*

The survey then established that around half of those surveyed either did not currently monitor or report air pollution emissions under any other regulations or did not know if this was the case (Figure 12). Of those that do report under other regulations, 19% report via environmental permitting, 14% report under 'other' regulations and 12% report under planning conditions.

Figure 12 Does your organisation currently monitor or report air pollution emissions under any other regulations?



Of those reporting under 'other' regulations, these included:

- LAQM regulations
- Shipping regulations
  - The International Maritime Organization (IMO) Data Collection System (DCS)
  - EU Monitoring, Reporting and Verification (MRV)
  - UK MRV
  - Energy Efficiency Operational Indicator (EEOI)
- Small to Medium Combustion Plant Directive (MCPD)
- Unified reporting framework CDP/ Global Covenant of Mayors for Climate and Energy (GCOM)
- Vehicle emissions remote sensing procedures
- Voluntary reporting

6.2.3 Barriers identified by organisations

Finally, the respondents were asked to rank what they perceived to be the main barriers preventing their organisation from reporting its air pollution emissions (Table 10). The primary barrier was found to be a 'Lack of a key incentive/driver to report'. The 'availability of data' and 'clear guidance for reporting' were ranked second and third respectively.

Crucially, the lowest ranked barrier was 'Lack of skills/knowledge to be able to do reporting'. Costs and resources to do the reporting was the second lowest ranked barrier. These results indicate that the respondents believe that if reporting air pollution was incentivised then availability of resources and necessary skills would not present a major issue.

Table 10 What barriers do you think might prevent your organisation from reporting its air pollution emissions? (Ranked in order of importance, where 1 the most important and 5 least important)

Item	Overall Rank	Score	Total Respondents
Lack of a key incentive/driver to report	1	182	48
Lack of availability of data within your organisation	2	180	53

Item	Overall Rank	Score	Total Respondents
Lack of clear guidance and methods for reporting	3	168	50
Cost/resource to do the reporting	4	151	50
Lack of skills/knowledge to be able to do reporting	5	120	52

6.2.4 Summary

- The majority of respondents stated that air quality is either ‘extremely important’ (43%) or ‘very important’ (43%) as an environmental health concern.
- The majority of respondents think that their company contributes only a ‘small amount’ or ‘somewhat’ to air pollution compared to other organisations from the same sector.
- A quarter of those surveyed stated that their EMS does consider air pollution.
- Around half (55%) of those surveyed either did not currently monitor or report air pollution emissions under any other regulations or did not know if this was the case.
- The primary barrier was found to be a ‘Lack of a key incentive/driver. to report’, followed by ‘availability of data’ and ‘clear guidance for reporting’
- Lowest ranked barrier was ‘Lack of skills/knowledge to be able to do reporting’, followed by ‘Costs and resources to do the reporting’.
- Most respondents (30%) state that they have the skills and resources to report their organisation’s air pollution footprint.

6.3 Incentives and support for AP emission reporting

Organisations were asked what they considered would be the primary drivers within their organisation, or the sector, that would encourage your organisation to report air pollutant emissions (Table 11). The responses are ranked in order of importance using rating scale of 1 to 10, where 1 is least important and 10 is the most important.

6.3.1 Primary drivers identified by organisations

The most important drivers are regulatory requirements, both environmental and health and safety regulatory requirements. These were ranked very highly with 63% and 57% of respondents marking these a ten for environmental and health and safety regulations respectively. Government policy and guidance was the next highly ranked category, ranked a 10 by 40% of respondents. This is followed by ‘Reducing health effects of poor air quality’, ‘Impacts on local residents/ community’, ‘Improving worker health’ and ‘Social responsibility’.

Interestingly, the option with the lowest ranking was ‘Helping to add shareholder value (by increasing the share price)’, with 22% of respondents giving this the lowest ranking and only 7% giving it the highest ranking. Other options ranked somewhere in the middle include ‘Customer choice and preference’, ‘Gaining green credentials’ and ‘Clients and supplier chain choice and procurement’.

Table 11 Primary drivers which encourage the organisation/sector to report air pollution

Topic / Rank	1	2	3	4	5	6	7	8	9	10
Regulatory requirements (Environmental)	3.5%		1.8%				5.3%	10.5%	15.8%	63.2%
Regulatory requirements (Health & Safety)		1.7%	5.2%			3.4%	6.9%	13.8%	12.1%	56.9%
Government Policy and Guidance		5.2%			1.7%	6.9%	12.1%	20.7%	13.8%	39.7%
Reducing health effects of poor air quality			1.8%	3.6%	3.6%	7.1%	16.1%	14.3%	17.9%	35.7%
Impacts on local residents / community			7.0%	1.8%	1.8%	7.0%	12.3%	26.3%	10.5%	33.3%
Improving worker health	1.7%	3.4%		1.7%	13.8%	5.2%	5.2%	20.7%	15.5%	32.8%
Social responsibility			3.5%	7.0%	7.0%	5.3%	17.5%	15.8%	17.5%	26.3%
Clients and supplier chain choice and procurement	3.6%	3.6%	5.5%	5.5%	14.5%	9.1%	10.9%	16.4%	14.5%	16.4%
Gaining green credentials		5.4%	1.8%	14.3%	17.9%	8.9%	10.7%	17.9%	10.7%	12.5%
Customer choice and preference	1.8%	5.5%	9.1%		12.7%	9.1%	14.5%	18.2%	18.2%	10.9%
Helping to add shareholder value (by increasing the share price)	21.8%	7.3%	5.5%	1.8%	10.9%	9.1%	10.9%	12.7%	12.7%	7.3%

6.3.2 Provision of support and resources

The survey then asked respondents to rank by importance which resources and support would encourage their organisation to report its emissions (Table 12). The mostly highly ranked resource is the availability of guidance, data and emission factors online. This is closely followed by online tools and templates. Certification schemes and virtual training also rank highly. It is notable that virtual training is ranked relatively highly as responses to a previous question suggested that knowledge or reporting is not a barrier (Table 10).

A reporting portal is ranked midway down the options, followed by an online helpdesk. The lowest ranked options are an awards scheme or event to promote achievement in reducing emissions and a membership to support reporting and allow peer-to-peer exchange.

Table 12 What resources and support do you think would encourage your organisation to report its emissions? Please rank in order of importance

Item	Overall Rank	Score	Total Respondents
"How to" guidance and related data and emission factors available on-line	1	357	51
On-line tools and templates	2	298	49
A clearly branded reporting/certification scheme that you can sign up to	3	251	49
Virtual training webinars or videos	4	248	49
A transparent reporting portal where you can share/promote your results	5	204	44
An online help desk for queries	6	157	46
A membership scheme to support your reporting and allow peer-to-peer exchange	7	141	44
An awards scheme/event to promote achievement in reducing emissions	8	141	47

6.3.3 Current air quality status

Lastly, participants in the survey were asked to give their view on a number of statements as to whether they agreed or disagreed that they best represent their organisation's position on AP emissions (Table 13). The responses were very mixed, reflective of the wide range of organisations represented in the survey.

In response to the statement that 'Air pollutant emissions are a significant environmental impact of our business', respondents were divided. Around 36% agreed or strongly agreed, but around 30% of respondents disagreed, and 12% strongly disagreed. However, the statement with the strongest response was that 46% of respondents 'agree' that 'We would like to understand and take more action on reducing our emissions'.

Most respondents (30%) also agree that they have the skills and resources to report their organisation's air pollution footprint. This finding is in agreement with the previous question where skills and resourcing were the lowest ranked barrier to reporting air pollution.

There was generally more support for action on AP emissions than taking no action, with 15-20% of respondents strongly agreeing with the statements provided in the survey and only 2-12% strongly disagreeing. However, the strongest response for 5 out of the 8 statements was that the respondents neither agreed nor disagreed (23 – 43%).

Table 13 Please indicate which of the following statements best represents your organisation's position

Statement	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Air pollutant emissions are a significant environmental impact of our business	16.4%	19.7%	23.0%	29.5%	11.5%
We would be interested in reporting our air pollutant emissions along with our carbon emissions	16.9%	35.6%	39.0%	6.8%	1.7%
We have skills and internal resources to report the air pollution footprint	15.0%	30.0%	26.7%	23.3%	5.0%
We would like to understand and take more action on reducing our emissions	19.3%	45.6%	28.1%	3.5%	3.5%
We would like to join a scheme/initiative to support us in reporting and reducing air pollutant emissions	13.6%	25.4%	39.0%	15.3%	6.8%
Our customers and clients would like to see us report and take action to reduce our air pollutant emissions	13.6%	28.8%	39.0%	15.3%	3.4%
The local community would like to see us report and take action to reduce our air pollutant emissions	16.4%	24.6%	39.3%	14.8%	4.9%
Our investors would like to see us report and take action to reduce our air	16.7%	14.8%	42.6%	20.4%	5.6%

6.3.4 Summary

- The most important drivers are environmental and health and safety regulatory requirements.
- Government policy and guidance was the next highly ranked category.
- The mostly highly ranked resource is the availability of guidance, data and emission factors online, followed by online tools and templates.
- ‘In answer to the question, ‘Air pollutant emissions are a significant environmental impact of our business’ - around 36% agreed or strongly agreed, but around 30% of respondents disagreed, and 12% strongly disagreed.
- The statement with the strongest response was that 46% of respondents ‘agree’ that ‘We would like to understand and take more action on reducing our emissions’.
- There was generally more support for action on AP emissions than taking no action, with 15-20% of respondents strongly agreeing with the statements provided in the survey and only 2-12% strongly disagreeing.

7 Conclusions and recommendations

7.1 Current reporting of GHG and AP emissions

Sections 2 and 3 of this report set out the current context around GHG and AP reporting that needs to underpin and approach to AP reporting by companies in the future. It was also explored further through a business engagement survey.

The conclusions from our analysis are that:

GHG estimation and reporting

- The WRI's GHG Protocol is the primary approach that underpins most company GHG reporting across the world, as well as in the UK, and so provides an internationally accepted methodology for estimating GHG emissions.
- The key GHG reporting requirement in the UK is the UK government's Streamlined Energy and Carbon Reporting (SECR) requirement for larger business. This requires full reporting and disclosure of GHG emissions. Many smaller businesses do not report GHG emissions because they are not legally required to do so.
- However, there are a wide number of other schemes under which companies report their GHG emissions. Some of these are mandatory, such as the EU-ETS, and others which are not such as the CDP. In many cases an organisation may report emissions under more than one scheme.
- It should also be noted that the UK government will be requiring certain large businesses to produce net zero transition plans from next year. They will need to calculate an emissions baseline to have a plan and are also likely to need to demonstrate how they will monitor, evaluate and report progress against the plan.
- Our survey results suggested that 70% of business do report GHG emissions and this goes beyond mandatory reporting and covers quite a wide range of schemes.

Air pollution estimation and reporting

- AP emission reporting is done at the UK national level under the EU National Emission Ceilings Directive (NECD), and there are agreed methods for estimating emissions.
- At the organisational level, the main driver for of AP reporting is compliance reporting that is required for specific sites or processes under the terms of environmental permits issued by regulators.
- There can also be reporting of emission or monitoring of air pollutant concentrations in relation of planning conditions.
- However, there are significant limitations around these in respect of company-wide reporting and so very few organisations will provide a full estimate of their AP emissions.
- Of the organisations we surveyed only 25% reported AP emissions in any way and most under the environmental permits or planning conditions.

Internationally accepted methodologies to estimate GHGs from business activities' are publicly available and are widely adopted. Also due to national level reporting requirements, there are well established methods and emissions data for estimating air pollutant emissions. The key source for these methods is the 'EMEP/EEA air pollutant emission inventory guidebook' produced by the European Environment Agency which underpins inventories such as the UK National Atmospheric Emission Inventory (NAEI), which is run by Ricardo on behalf of the UK Government.

So, there is a clear gap in relation to any comprehensive AP reporting by business, but there are some existing principles at the national and international level that can be used as the basis for such a reporting system.

7.2 Scope and priority sectors for AP reporting

Box 1 in section 2.1 explains the three scopes of emissions defined in the WRI GHG Protocol Standard; Scope 1, Scope 2 and Scope 3.

If we consider the current frameworks for GHG reporting, the existing methods for AP emissions estimation and the likely key sources of AP emissions explored in Chapter 4, we are able to suggest some basic boundaries for AP reporting.

These boundaries are:

- GHG reporting is done on an end user basis and defined in three categories:
  - Scope 1 – direct emission from sources owned or operated by the company;
  - Scope 2 – indirect emissions from electricity or imported heat where the actual emissions would be off site;
  - Scope 3 – other indirect emissions such as those associated with supplied goods and services
- The geographical location of GHG emissions in the context of this work is not important. GHG emissions have global impacts on the earth's climate, though these might well be experienced local such as high temperature episodes or flooding events.
- In contrast most of the focus around air pollutants and air quality is on human exposure to a small set of air pollutants, and their associated health effects. In this case location is important in terms of concentrations and exposure; therefore reporting of direct emissions from plant and equipment owned and operated by the company should be the primary focus. This would align with a focus on GHG reporting Scope 1.
- The AP emissions from electricity generated from power stations, and then purchased by businesses, would normally occur at power stations which are often large distances away from the businesses using the electricity generated. The emissions from this electricity generation will be too distant from the business to make a contribution to local-scale impacts in the area surrounding the business. However, power station emissions will still contribute to regional-scale pollution. The implication of this is that Scope 2 emissions are worth considering and so should be included in the scheme, but we think they should be a secondary consideration as the impact, in terms of local air quality and human exposure from emissions from the electricity generated, will be lower.
- The GHG Protocol only includes methodologies to estimates emissions from sources of GHG emissions and only estimates emissions of a subset of all GHGs. This statement might seem self-evident, but, there are important AP emissions which have no equivalent source of GHGs; for example, fugitive emissions of particulate matter such as dust emissions from construction, and resuspension of road dust.
- Key sources of APs identified in our analysis in chapter 4, and so which we have explored in this study, are:
  - Road transport
  - Combustion plant
  - Non-road Mobile Machinery
  - Fugitive dust from construction activities.

In terms of trialling an initial approach to AP reporting, and as a focus for an initial scheme, the intention was to target some priority sectors based on their likely contribution to AP emissions at local scales that could affect human health. Based on the analysis in Section 4 the sectors likely to produce most AP emission in urban areas, and where they are likely to increase human exposure, we would suggest focusing on:

- Construction companies
- Transport – primarily urban freight and logistics
- Manufacturing, especially where key sites are in urban areas
- Services, retail and public sector

7.3 A methodological approach to estimating AP emissions

The key source for these methods used for estimating air pollutant emissions is the 'EMEP/EEA air pollutant emission inventory guidebook' produced by the European Environment Agency and this has been used as a basis for a trial method in this project. The details of the approach used were set out in section 5.1 above and were tested with 4 organisations.

In general terms the calculation of air pollutant emission is more complex than for GHG emissions, or at least a major part of them in the terms of CO_2 emissions. This in turn leads to a requirement for the collection of more detailed or additional layers of data than is needed for GHG emission reporting. In order to manage this and allow companies to work with the data they have available and align as much as possible with data already existing with GHG reporting we would propose an approach analogous to the tiers approach used by the EMEP/EEA Emission Inventory Guidebook:

- Tier 1 – a simple approach based on fuel use and fuel-based emission factors where all the other technology and operating condition elements are assumed and based for example on national averages. This should allow the air pollutant estimations to be done within the existing GHG data collection approaches.
- Tier 2 – with increased complexity by introducing some elements of technology into the emission factors where this data is available. In some case this kind of data is already collected for GHG calculations, especially for better estimation of non-CO_2 gases. Therefore, will be aligned with organisation that have a more detailed and robust approach to data collection for GHG purposes.
- Tier 3 – with the most detail included around technology and operating conditions being used. In this case the data required will be beyond what is normally used for GHG estimation. It may be available in some organisation but additional systems will be needed to compile it to allow this most robust approach to emission calculation.

In addition, the accuracy of the existing calculation approach and available emission factors varies between sources, and so estimates from some sources will be more uncertain. This is illustrated in Table 3 below indicating which tier of calculation approach is current available for each source and the likely robustness of the approach using a red, amber, yellow green rating with increasing confidence.

Table 3 Emission sources by tier and uncertainty

Source	Tier 1	Tier 2	Tier 3
Transport	✓	✓	✓
NRMM	✓	✓	✓
Combustion plant	✓	✓	Bespoke method
Electricity	✓1	✓2	
Fugitive dust	✓		

Notes 1) assumed as UK average, 2) assumed based on actual known generating mix.

Using this approach it should be possible to estimate emissions for each of the main sources for the business sectors we are considering with the exception of fugitive dust. The current methods for this are highly uncertain and the data available to allow its calculating does not seem readily available. Therefore. we would not recommend including fugitive dust in an air pollutant reporting scheme.

7.4 Barriers and incentives to reporting AP emissions

In order to explore the potential for implementing an AP reporting scheme with businesses, a business survey was carried out to understanding existing practices around GHG and environmental reporting, barriers to extending this to cover AP reporting and potential incentives to encourage organisations to report AP emissions.

Of the companies surveyed 70% report GHG emissions in some form and have an environmental management system in place. As expected fewer organisations, only 25%, currently report air pollutant emissions in any way. Of these most report under environmental permitting or planning

conditions, with a few under other schemes or voluntary. This confirms our view that there will be very few if any organisation that report air pollutant emissions in a comprehensive manor as they do for GHG emissions.

However, on a positive note about 50% suggested they did have some policies to help reduce emissions of air pollutants mostly related to:

- Regulatory compliance, so environmental permitting or planning as noted above;
- Health and safety policies which would be interesting to explore further as may well relate to indoor air quality as well as ambient air quality;
- Transport and fleet policies – such as fleet management or commuter plans, as part of wider sustainability policies;
- As a consequence of carbon reduction activities.

The key barriers to reporting air pollutant emissions were the lack of a regulatory driver, available data to allow them to do it and clear guidance and methods. Mirroring this key driver that would encourage them to report air pollutant emissions would be an environmental or health and safety regulation with 60% stating this position. About 30% stated that wider health, social and policy drivers would be an incentive, but interesting to note that less that 20% saw there being any business driver for this such as stakeholder value or client demand.

They key support that companies would be looking for if there were to report air pollutant emissions would be clear guidance and methods, tools and a reporting scheme, which filly aligns with the objectives of this project. Also 65% of organisation said they would like to understand them emission more and the actions they can take to reduce them, with 55% being in potentially rpeorting air pollutant emissions alongside their GHG emissions.

So, in summary the key implications for this project are:

- Realistically some form of regulatory drive may be needed to encourage business to report air pollutant emissions;
- However, there is significant interest from organisation in understanding their emissions and reporting them alongside their current GHG reporting;
- To support any such reporting the key needs were a clear method and guidance for estimating emissions and a scheme to report these under in line with what this project is scoping.

7.5 Recommendations for an initial AP reporting scheme

Our business survey indicated that there was a clear willingness from businesses to understand their air pollutant emissions better, what actions they could take to reduce them and report AP emissions alongside GHG emissions. However, it was also clear that a regulatory incentive would be a key driver to get major traction for company reporting of AP emission. But key building blocks for any reporting would be clear guidance and methods, tools and reporting a framework. Therefore, we would recommended progessing with a ‘beta scheme, that developed these building blocks and trialled them with business, alongside working with regulatory bodies to provide a stronger regulatory driver for such reporting. An outline of such a ‘beta scheme’ is set out below as phases 2 and 3 of this project building on the phase 1 scoping work reported here.

7.5.1 Overall approach

The aim of a second and third phase of the company reporting of air-pollutant emissions project would be to produce a ‘beta’ version of a reporting and improvement scheme building on the learnings from the scoping phase (phase 2) and then role this out over a 2 year implementation period (phase 3). If this initial running of a reporting scheme is successful then further developments could be carried out in a phase 4.

The key elements of phases 2 and 3 will comprise

- Focusing an initial scheme on reporting a reduced number of emissions sources and sectors

- Providing a guidance document setting out how to estimate and report emissions, along with some supporting tools and an improvement action plan template;
- Develop a scheme website to host the material, report results and provide support
- Work with partner organisations to promote the scheme and generate members, potential partners being the CBI and Logistics UK
- Run and manage the scheme for a 2 year period following set up in year 1.

7.5.2 Scope of sectors and sources to be covered in the 'beta' scheme

The target sectors proposed would be:

- Commercial/service/retail sector – potentially engaging through the CBI
- Transport companies – engaging through Logistics UK

The key sources (scope of reporting) would be:

- Road vehicles owned and operated by the organisation (including lease and hire vehicles, and mileage claims)
- Heat and power covering:
  - Stationary combustion plant such as boilers
  - Electricity use
  - Purchased heat
- Off road vehicles/machinery

Excluded would be industrial processes and fugitive dust.

7.5.3 Developing the 'beta' scheme in year 1

Refine method, data and produce guidance

Building on the scoping phase the beta scheme would refine the methods and generate the data/factors to be used. As described in the method section the aim would be for 3 tiers of calculation with increasing complexity to allow companies to start simple and develop over time. The tiers would cover:

- Tier 1 – generic/aggregated factors which can be used with total fuel use and fully aligned with GHG reporting
- Tier 2 – more detailed factors for disaggregated fuel use by vehicle/device, with some assumptions which would require some additional data collection beyond standard GHG reporting practice
- Tier 3 – the most defined factors considering both technology and operating conditions, and in some cases specific detail of the emissions of individual plant or vehicles

The approach and methods will be compiled into a guidebook for reporting. This is likely to be structured along the following lines:

- Part 1 - Introduction
  - Understanding air pollution
  - Aim and scope of reporting
  - Overall approach
- Part 2 – Estimation methods covering each main source
  - Road transport
  - Heat and power
  - Off-road machinery
- Part 3 – How to get your data ready and report results
  - Building on GHG data collection
  - Practical examples of how to collect and organise your data for each source
  - Typical problems and solutions
  - Reporting the results

Supporting the main guidance document would be complementary tools and data for example:

- Spreadsheet of factors

- Data collection templates
- Results reporting templates
- Improvement action plan template

Beta reporting scheme

Alongside the methods and guidance, the basics of a 'beta' reporting scheme would be set up which would cover:

- Developing scheme initial partnerships
  - Develop partnership with Logistics UK and CBI for co-branding
  - Develop scheme identity and branding
  - Engage and sign up first 20 businesses
- Set up an initial scheme website
  - Info about approach and summary material
  - Download info guides, tools, etc
  - Reporting/members area

7.5.4 Running the 'beta' Scheme for a 2 year trial period

Following the setup of the scheme it would be run, managed and promoted for 2 years. The key components of this work would be:

- Develop promotional material
  - Summary of AQ reporting scheme – a clear, simple, graphical summary document 3-4 pages, professionally designed
  - A short video on the concept, with business endorsements
- Market more widely to develop up to 50 members using the promotional material and working closely with logistics UK and the CBI, and other partners such as Global Action Plan
- Membership management and support
  - Manage membership database
  - Provide an annual member's event (live or virtual)
  - Help desk and technical support

7.5.5 Evaluation and success factors

This project sits within IoUH's strategic priority of *'Working with businesses to find equitable solutions to reducing emissions'*. The key outcomes of this theme and how they are addressed by this project are:

- Businesses are more accountable for their emissions – by reporting their air pollutant emissions businesses will have a clearer understanding of their impact and will be more accountable for it
- Reduction in emissions from key sources – by understanding their emissions by source businesses will be able to take action to reduce emissions and these can be set out in an improvement action plan.

Ideally these outcomes would be measured by the number of businesses engaged in the reporting scheme and the reduction in emissions generated from successive years of reporting.

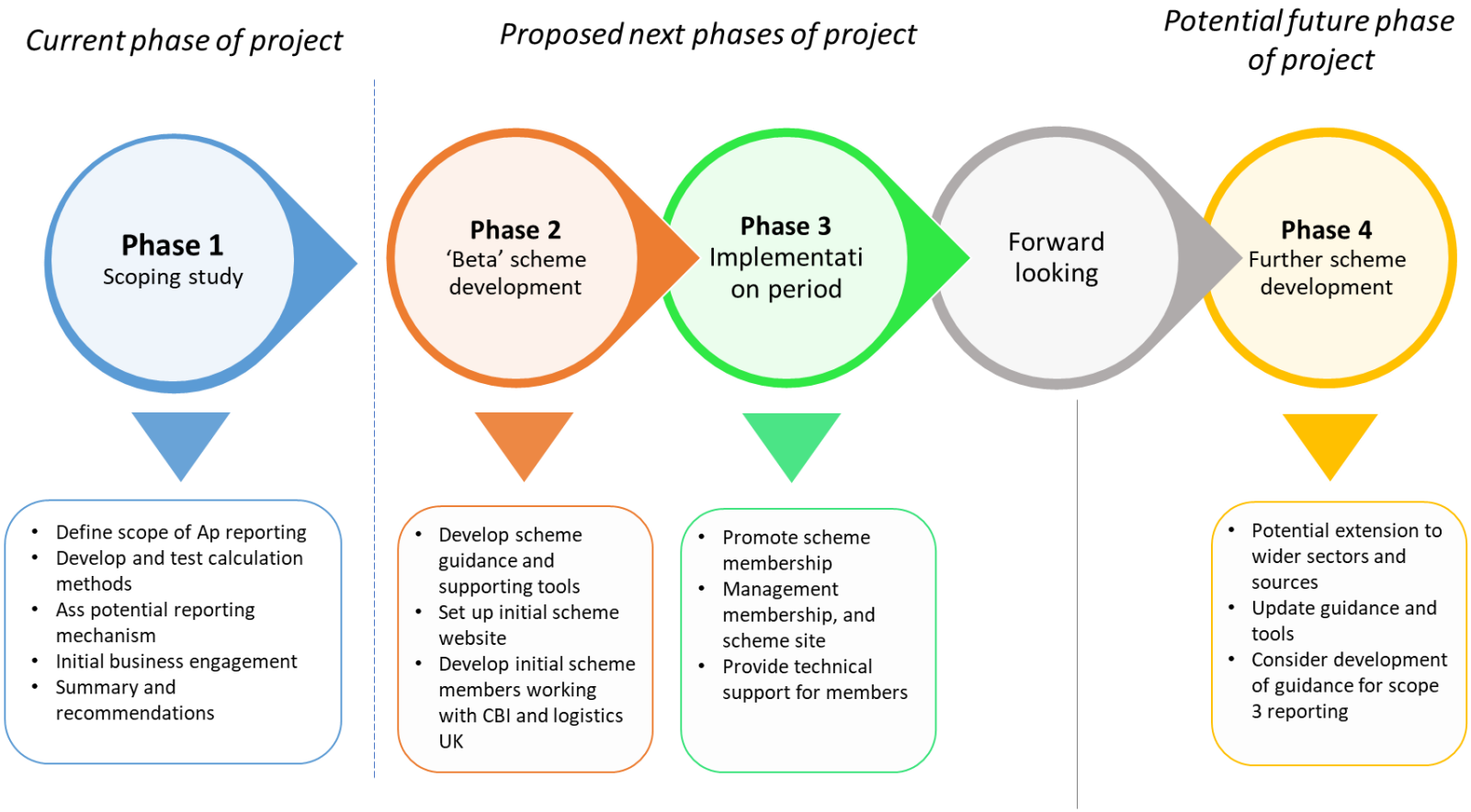
So, in terms of evaluating success these would be broken down between the year 1 set up phase and then the years 2-3 operational phase as follows:

- Success in year 1
  - At least one partner membership organisation such as Logistics UK or the CBI is backing and promoting the scheme to its members;
  - Six business who have trailed all the materials and website, and agreed it meets business needs;
  - Twenty business signed up to start reporting from year 2
- Break point to review success

- Success in years 2 -3
    - 50 organisations signed up to the scheme
    - A reduction in reported emissions from years 2 -3, which can be justified by improvement actions
    - Positive feedback on the scheme and its benefits for business from a survey of the scheme members

Most of the data needed for the evaluation of the success of the scheme is built into the management of the scheme itself in terms of the number of members and reported emissions. The key exception is the survey for business feedback at the end of year which will be an additional task in year 3.

Company reporting of air-polluting emissions. A roadmap



Appendix 1 – Additional technical information on methods

Table A1-4 Vehicle size categories

Basic vehicle types	Vehicle size categories
Cars	<1.4 l
	1.4 l to 2.0 l
	> 2.0 l
LGVs	N1(I)
	N1(II)
	N1(III)
HGVs	Rigid <=7.5 t
	Rigid 7,5 - 12 t
	Rigid 12 - 14 t
	Rigid 14 - 20 t
	Rigid 20 - 26 t
	Rigid 26 - 28 t
	Rigid 28 - 32 t
	Rigid >32 t
	Articulated 14 - 20 t
	Articulated 20 - 28 t
	Articulated 28 - 34 t
	Articulated 34 - 40 t
	Articulated 40 - 50 t
	Articulated 50 - 60 t
Buses/Coaches	Urban Buses Midi <=15 t
	Urban Buses Standard 15 - 18 t
	Urban Buses Articulated >18 t
	Coaches Standard <=18 t
	Coaches Articulated >18 t
Moped	< 50 cc
M/cycle, 2-stroke	<=150 cc
M/cycle, 4-stroke	<=150 cc
	150-250 cc
	250-750 cc
	>750 cc

Table A1-5 Vehicle emission standard categories

Basic vehicle types	Euro Stand
Cars, Motorcycles[20] and LGVs	None (electric vehicles only)
	Pre-Euro
	Euro 1
	Euro 2
	Euro 3
	Euro 4
	Euro 5
	Euro 6: September 2015
	Euro 6d-TEMP: September 2019
	Euro 6d: January 2021
HGVs and Buses/Coaches	None (electric vehicles only)
	Conventional
	Euro I
	Euro II
	Euro II plus SCR
	Euro III
	Euro III plus SCR
	Euro IV
	Euro V - EGR
	Euro V - SCR
	Euro VI

[20] Motorcycles only go up to Euro 5.

Appendix 2 – Survey Questionnaire

Q1: Which best represents your sector or organisation?

- Construction
- Health Care
- Leisure and Hospitality
- Services (Please specify)
    - Public Sector
    - Academia
    - Consultancy
    - Office Provider
    - Service Provider
    - Other (Please specify)
- Other Manufacturing
- Retail
- Transportation – Road (Fleet provider)
- Transportation – Road (Fleet owner)
- Transportation – Other
- Waste Management
- Large industry
- Other (Please specify)

Q2: What is the size of your organisation?

- More than 500 employees
- 250 to 500 employees
- 100 to 250 employees
- Less than 100 employees

Q3: Does your organisation currently report GHG emissions under the following reporting frameworks?

    - Greenhouse Gas (GHG) Protocol
    - European Union Emissions Trading Scheme (EU ETS)
    - Streamlined Energy and Carbon Reporting (SECR) framework
    - United Kingdom Emissions Trading Scheme (UK ETS)
    - Greening Government Commitments (UK Government and Local Authorities)
    - Climate Change Agreements (CCA)
    - Carbon Disclosure Project (CDP)
    - Global Reporting Initiative (GRI),
    - Carbon Trust Carbon Neutral Certification scheme
    - Other (Please specify)
    - Organisation does not report GHG emissions
- Don't know

Q4 Does your organisation have any wider environmental reporting or management systems in place, under the following frameworks ? (yes, No, I don't know)

    - TCFD
    - ISO14001
    - EMAS
    - The Science Based Targets initiative (SBTi)
    - Carbon Disclosure Project (CDP)

Q5 Does the wider environmental reporting framework or management system used by your organisation (as listed in Question 4) consider or address air pollution?

Q6 Does your organisation currently monitor or report air pollution emissions under any other regulations?

- Yes, under environmental permitting (Part A or Part B processes)
- Yes, under planning conditions
- Yes, under another framework (please specify)
- No
- I don't know

Q7 Does your organisation currently have policies in place to reduce its impact on air quality?

- Yes
- No
- I don't know

Q8 How much do you think your company contributes to air pollution compared to other organisations from the same sector?

- No at all
- A small amount
- Somewhat
- A significant amount
- Don't know

Q9 How important do you think air quality is as an environmental health concern?

- Not at all important
- Slightly important
- Moderately important
- Very important
- Extremely important

Q10 What do you consider would be the primary drivers within your own organisation, or the sector, that would encourage your organisation to report air pollutant emissions? Please rank in order of importance using rating scale of 1 to 10, where 1 is least important and 10 is the most important.

- Regulatory requirements (Environmental)
- Regulatory requirements (Health & Safety)
- Government Policy and Guidance
- Improving worker health
- Impacts on local residents/community
- Gaining green credentials
- Clients and supplier chain choice and procurement
- Social responsibility
- Customer choice and preference
- Helping to add shareholder value (by increasing the share price)

Q11 What barriers do you think might prevent your organisation from reporting its air pollution emissions? Please rank in order of importance

- Lack of a key incentive/driver to report
- Lack of availability of data within your organisation
- Lack of clear guidance and methods for reporting

- Cost/resource to do the reporting
- Lack of skills/knowledge to be able to do reporting

Q12 What resources and support do you think would encourage your organisation to report its emissions? Please rank in order of importance

- "How to" guidance and related data and emission factors available on-line
- On-line tools and templates
- Virtual training webinars or videos
- An online help desk for queries
- A transparent reporting portal where you can share/promote your results
- A clearly branded reporting/certification scheme that you can sign up to
- A memberships scheme to support your reporting and allow peer-to-peer exchange
- An awards scheme/event to promote achievement in reducing emissions
- Other (Please specify)

Q13 Please indicate which of the following statements best represents your organisation's position

Statement	**Strongly agree**	**Agree**	**Neither agree nor disagree**	**Disagree**	**Strongly disagree**
Air pollutant emissions are a significant environmental impact of our business					
We would be interested in reporting our air pollutant emissions along with our carbon emissions					
We have skills and internal resources to report the air pollution footprint					
We would like to understand and take more action on reducing our emissions					
We would like to join a scheme/initiative to support us in reporting and reducing air pollutant emissions					
Our customers and clients would like to see us report and take action to reduce our air pollutant emissions					
The local community would like to see us report and take action to reduce our air pollutant emissions					

Q14 If you would like to stay informed with the outcomes of this project and take part in future stakeholder events, please complete the form

First Name

Last Name

Email address

Company