# Appendix A

*Excel Spreadsheet*

## A.1 FAME result

Secondary Data calculation & modelling The modelling spreadsheet of companies from the FAME database was created in an Excel spreadsheet with 6 pages. The contents of the file are organised as follows:

- **Micro** - Calculation of GVA & Employment ratios for Micro company by SIC category
- **Small** - Calculation of GVA & Employment ratios for Small company by SIC category
- **Medium** - Calculation of GVA & Employment ratios for Medium company by SIC category
- **Large** - Calculation of GVA & Employment ratios for Large company by SIC category
- **Analysis** – This sheet encompasses the aggregate data of GVA, employment, turnover, and GHG emissions and is categorsied by SIC code and business size, offering an overview dashboard of analysis and results.
- **Results** - The FAME list of companies, this sheet includes all company details, SIC category and code trade description, operating revenue, number of employees, address and the application of each equation to produce the R4NZ estimates used in the dashboard.

This file can be accessed through the link below, under the file name **'FAME_FINAL_RESULTS_0502 3.xlsx'**

https://github.com/nasatawat/R4NZ

## A.2 GHG calculation

The GHG emissions calculation and preliminary data visualisation were created in an Excel spreadsheet with 11 pages. The contents of the file are organised as follows:

- **GHG Calculation** - Describes the stages involved in data preparation and calculation technique, including how the data was processed before being used in the computation and the calculation's guiding principles.
- **Company list** - For visualisation purposes, this list indicates the way industry sectors are categorised and the companies classified into each sector. A list of 191 SMEs was identified for questionnaire distribution, along with a dummy company that was used as an example for data calculation.
- **Scope 1-cal, Scope 2-cal, and Scope 3-cal** - Outlines the techniques of calculation used to calculate greenhouse gas emissions; some of the categories given were not part of the actual calculations.

- **Scope 1, Scope 2, and Scope 3** - Displays the calculated data that was put into tables to calculate GHG emissions.
- **Summary, Sector, Company** - Shows sample visualisations of the calculation outcomes. The output view changes according to the selected data for Sector and Company.

This file can be accessed through the link below, under the file name **'GP GHG Calculation.xlsx'**

https://github.com/nasatawat/R4NZ

# Appendix: B

## Questionnaire creation

### B.1 Survey Questionnaire

The following questionnaire was used to collect primary data by emailing 191 companies. The Qualtrics XM platform was used to create the questionnaire, which combined custom JavaScript with the platform's standard functions to allow for more complicated question designs, especially for gathering quantitative data.

## Introduction

### Thank you for your interest in our survey

This survey is part of a Cranfield University MSc group project called "Ready4NetZero" in which we are calculating the carbon footprint data for businesses across the county of Bedfordshire, in order to improve sector/industry level analysis for regional net zero emissions planning and strategy.

Your participation in this survey will play a crucial role in supporting the development of this research and project outcomes.

This survey will consist of three main sections:
(1) Consent – Agreement to participate and share information.
(2) General company information & contact details – Basic details about the organization.

(3) Operational data – Information on various activities related to carbon emission sources.

We kindly request you to complete this survey by [April 25th, 2025] so that we can ensure your valuable input can be incorporated into our analysis.

This information will only be used for the purpose of this academic research and will be treated with confidentiality. If you are able to provide the requested information, at the end of this project we will be able to provide you with your organisations estimated carbon footprint.

If you have any questions, please feel free to contact us at [ned.chappell@cranfield.ac.uk].

## Survey explanation

### Structure of the Survey

The survey is divided into 3 main sections. These sections of the survey consist of:

### Consent agreement

This section provides an overview of the consent process for companies participating in the survey. It outlines how the collected data will be used and ensures that participants understand their rights and the purpose of data collection.

## General information

This section requests basic information about the company, as well as details of the respondent. Additionally, if further information is needed, the project team may follow up with the respondent.

## Questions

In this section, we request information about various activities within your company that contribute to carbon emissions. These activities are included in carbon footprint accounting and help assess the environmental impact of business operations. Please provide relevant data for the following categories:

- **Fuels** (Gaseous fuels, Liquid fuels, Solid fuels)
- **Bioenergy** (Biofuel, Biomass, Biogas)
- **Refrigerant & others** (Kyoto portocol, Blends, Montreal protocol, Fluorinated ethers, Others)
- **Passenger vehicles** (Small, Medium, Large, Average)
- **Delivery vehicles** (Vans, HGVs, HGVs refrigerated)
- **Electricity** (Electricity consumption, Renewable energy usage)
- **Heat & Steam** (Onsite, District)
- **Water** (water use, water treatment)
- **Business travel** (Air, Sea, Land)
- **Employee commuting** (How your employees commute to work)
- **Freighting goods** (Vans, HGVs, HGV Refrigerated, Flights, Rail, Sea tanker, Cargo ship)
- **Use of sold products** (Energy consumption and lifespan of the products)
- **Materials use** (Construction, Organic, Electrical items, Metal, Plastic, Paper, Others)
- **Waste disposal** (Construction, Refuse, Electrical items, Metal, Plastic, Paper, Others)

- **Industry-specific** (Ask for different information for each sector)

- **Additional information**

- **Suggestion**

**Please read the questions carefully, as most of the data collection questions require annual data. If certain information is unavailable, you may skip that question (you are able to move back and forth to read all questions). Additionally, you can save your progress and return to complete the survey later if you are unable to finish it in one session. In the final section, if you are unable to complete all the questions before the specified deadline, please proceed to the last part of the survey and indicate the reason as requested in the provided question.**

## Consent

## Consent for Data Usage

We appreciate your participation in this survey. The information collected will be used solely for research purposes and will be handled with strict confidentiality. By proceeding with this survey, you acknowledge and agree to the following:

1. The data provided will be used for academic research and analysis.
2. Your personal and company information will be kept confidential and will not be shared with any third party without consent.

3. Participation in this survey is voluntary, and you may withdraw at any time without consequences.
4. If further clarification or additional information is required, the research team may contact you.
The information provided in this survey will be used to calculate carbon emissions under **Scope 1, 2, and 3**.

**Scope 1** covers direct emissions from sources owned or controlled by the company.
**Scope 2** includes indirect emissions from the generation of purchased energy.
**Scope 3** encompasses all other indirect emissions occurring throughout the company's value chain.

This analysis aims to assess the company's emissions across different activities to support environmental impact evaluation for the purpose of our group project.
By continuing with the survey, you confirm that you have read and understood the terms above and consent to the use of your data as described.
If you have any questions or concerns, please contact Ned Chappell (Group leader) at [ned.chappell@cranfield.ac.uk].

Do you agree with the consent terms? and available to fill the survey?

○ Yes

○ No

Do you allow us to contact you for any clarification regarding the data provided?

○ Yes

○ No

What is the reason that you can't complete the survey?

○ not enough time

○ not interest

○ don't have any information

○ [          ] others

**General Information**

Company name

[                    ]

What is the primary business operations of your organisation?

Primary contact person (name, title, email)

Has your company conducted a carbon footprint assessment before?

○ Yes

○ No

Please state the reporting year for the data entered in this survey. You must ensure that all the information provided in the survey is from the same year.

**Fuels**

## Fuels

Sources of fuel consumed through combustion in owned or controlled boilers, furnaces or other machineries.

Do you use any fuel for operation for your organisation?

◯ Yes

◯ No

Which fuel did the organisation use for operational activities? What is the annual consumption of these fuels?

1. Gaseous Fuels

| Butane ⌄ | Enter Amount |
|---|---|
| tonnes ⌄ | Remove |

Add Another Fuel

2. Liquid Fuels

| Aviation spirit ⌄ | Enter Amount |
|---|---|

| tonnes | ⌄ | Remove |

Add Another Fuel

## 3. Solid Fuels

| Coal (industrial) | | ⌄ |
| Enter Amount | tonnes ⌄ | Remove |

Add Another Fuel

## Bioenergy

### Bioenergy

the combustion of fuels produced from recently living sources (such as trees) at a site or in an asset under the direct control of the reporting organisation.

Do you use any bioenergy for operation for your organisation?

○ Yes

○ No

Which bioenergy did the organisation use for operational activities? What is the annual consumption?

1. Biofuel

| Bioethanol ⌄ | Enter Amount | litres ⌄ |
| --- | --- | --- |

Remove

Add Another Fuel

2. Biomass

| Wood logs ⌄ | Enter Amount | tonnes ⌄ | Remove |
| --- | --- | --- | --- |

Add Another Fuel

3. Biogas

| Biogas ⌄ | Enter Amount | tonnes ⌄ | Remove |
| --- | --- | --- | --- |

Add Another Fuel

## Refrigerant & others

### **Refrigerant & others**

Office & industrial HVAC & air-conditioning equipment uses refrigerant and different equipment systems can contain different refrigerant types with varying emissions potential. (This information will be available in your service report or maintenance provider)

Does the company use refrigeration or air conditioning in offices or warehouses?

○ Yes
○ No

What is the amount of refrigerant gas used to top-up unit on the site annually?
1. Kyoto protocol products

| Carbon dioxide ⌄ | Enter Amount | kg ⌄ | Remove |

Add Another Type

## 2. Blends

| R401A ∨ | Enter Amount | kg ∨ | Remove |

Add Another Type

## 3. Montreal protocol products

| CFC-11/R11 = trichlorofluoromethane ∨ | Enter Amount | kg ∨ |
Remove

Add Another Type

## 4. Fluorinated ethers

| HFE-125 ∨ | Enter Amount | kg ∨ |
Remove

Add Another Type

## 5. Other products

| Trifluoromethyl sulphur pentafluoride ⌄ | Enter Amount | kg ⌄ |

Remove

Add Another Type

## Passenger vehicles

### Passenger vehicles
report travel in cars and on motorcycles that are owned or controlled by the reporting organisation. This does not include employee-owned vehicles that are used for business purposes.

Does your organisation have a fleet of vehicles?

○ Yes

○ No

What types of vehicles are in your fleet and what was their usage annually?
1. Small car (Petrol/LPG/CNG - up to a 1.4-litre engine

Diesel - up to a 1.7-litre engine Others - vehicles models of a similar size (i.e. market segment A or B)

| Diesel | Enter Amount | km | Remove |

Add Another Type

## 2. Medium car (Petrol/LPG/CNG - from 1.4-litre to 2.0-litre engine Diesel - from 1.7-litre to 2.0-litre engine Others - vehicles models of a similar size (i.e. generally market segment C)

| Diesel | Enter Amount | km | Remove |

Add Another Type

## 3. Large car (Petrol/LPG/CNG - 2.0-litre engine + Diesel - 2.0-litre engine + Others - vehicles models of a similar size (i.e. generally market segment D and above)

| Diesel | Enter Amount | km | Remove |

Add Another Type

## 4. Average car (unknown engine size)

| Diesel | Enter Amount | km | Remove |

Add Another Type

## Delivery

### Delivery vehicles

delivery travel in vans/light goods vehicles (LGVs) and heavy goods vehicles (HGVs) owned or controlled by the reporting organisation. This does not include hired vans or courier services provided by other organisations.

Did you use your own vehicles to distribute the products or services?

○ Yes
○ No

What types of owned vehicles are in your use for distribution and what is their usage annually?

## 1. Vans

Diesel/Class I (up to 1.305 tonnes) ⌄

| Enter Amount | km ⌄ | Remove |

Add Another Type

## 2. HGVs (all diesel)

| 0% Laden/Rigid (>3.5 - 7.5 tonnes) ⌄ | Enter Amount |

| km ⌄ | Remove |

Add Another Type

## 3. HGVs refrigerated (all diesel)

| 0% Laden/Rigid (>3.5 - 7.5 tonnes) ⌄ | Enter Amount |

| km ⌄ | Remove |

Add Another Type

## Electricity

## Electricity

In this section, you will be asked to provide details about your electricity usage, categorized into two parts: Traditional Electricity and Renewable Electricity.

## Traditional energy usage

What is your annual energy usage? (kWh) (excluding green energy)

<br>

## Renewable energy usage

Does your organisation utilise renewable energy?

○ Yes
○ No

What is your renewable energy resources? How much has your organisation used annually?
1. Purchased renewable energy

\*REGOs is a certificate "UK Renewable Energy Guarantees of Origin"/ GoOs is a certificate "European Guarantees of Origin"

| REGOs/Solar ⌄ | Enter Amount | kWh ⌄ | Remove |

Add Another Type

If your purchased renewable electricity type is not on the list. Please fill the information in the textbox below in the form of '(type of certificate/type of renewable energy), (amount), (unit)'

## 2. Own renewable energy on-site

| Solar ⌄ | Enter Amount | kWh ⌄ | Remove |

Add Another Type

If your own renewable electricity type is not on the list. Please fill the information in the textbox below in the form

of '(type of renewable energy), (amount), (unit)'

[ ]

## 3. Power Purchase Agreements (PPAs) with renewable generators
*PPAs is a long-term renewable energy contract with suppliers

| Solar ⌄ | Enter Amount | kWh ⌄ | Remove |

Add Another Type

If your renewable electricity type from PPAs is not on the list. Please fill the information in the textbox below in the form of '(type of renewable energy), (amount), (unit)'

[ ]

## Heat & Steam

## Heat & Steam

Heat & steam purchased through a utility provider

Does the company purchase steam or heat from external suppliers?

○ Yes

○ No

What is your onsite and district heat and steam usage per year?

| Onsite heat and steam ∨ | Enter Amount | kWh ∨ | Remove |

Add Another Type

## Water

## Water

Water & wastewater purchased through your utility

provider (Water usage and carbon emissions are closely linked)

How much water did your organisation use per year?

| Water supply ˅ | Enter Amount | cubic metres ˅ |

Does your organisation use water treatment systems?

○ Yes
○ No

How much water did your organisation treat per year?

| Water treatment ˅ | Enter Amount | cubic metres ˅ |

**Business travel**

**Business travel**
Relevant if your business offer employees the opportunity to travel by flight, ferry, car, bus, taxi or rail for business purpose? (approximate distances)

Have you collected business travel data of your organisation? or able to approximate the amount?

○ Yes

○ No

How do your employees travel for work? What is the annual distance for travels for each type?

1. Flight

| Domestic, to/from UK/Average passenger ⌄ |
|---|
| Enter Amount | passenger.km ⌄ | Remove |

Add Another Fuel

2. Ferry

| Foot passenger ⌄ | Enter Amount | passenger.km ⌄ |
|---|---|---|
| Remove | | |

Add Another Type

## 3. Land

### 3.1 Car

| Small car/Diesel ⌄ | Enter Amount |
|---|---|
| km ⌄   Remove | |

Add Another Type

### 3.2 Motorbike

| Small ⌄ | Enter Amount | km ⌄ | Remove |
|---|---|---|---|

Add Another Type

### 3.3 Taxis

| Regular taxis ⌄ | Enter Amount | passenger.km ⌄ | Remove |
|---|---|---|---|

Add Another Type

## 3.4 Bus

| Local bus (not London) ∨ | Enter Amount | passenger.km ∨ |
| --- | --- | --- |
| Remove | | |

Add Another Type

## 3.4 Rail

| National rail ∨ | Enter Amount | passenger.km ∨ | Remove |
| --- | --- | --- | --- |

Add Another Type

## Employee commuting

## Employee commuting

What is the average number of days per week that employees work on-site?

## What percentage of employees use the following commuting methods? (Total should equal 100%)

|  | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Personal car (single occupant) | ○ | | | | | | | | | | | ☐ |
| Car sharing/carpooling | ○ | | | | | | | | | | | ☐ |
| Public transportation | ○ | | | | | | | | | | | ☐ |
| Walking/cycling | ○ | | | | | | | | | | | ☐ |
| Work from home | ○ | | | | | | | | | | | ☐ |
| Other | ○ | | | | | | | | | | | ☐ |
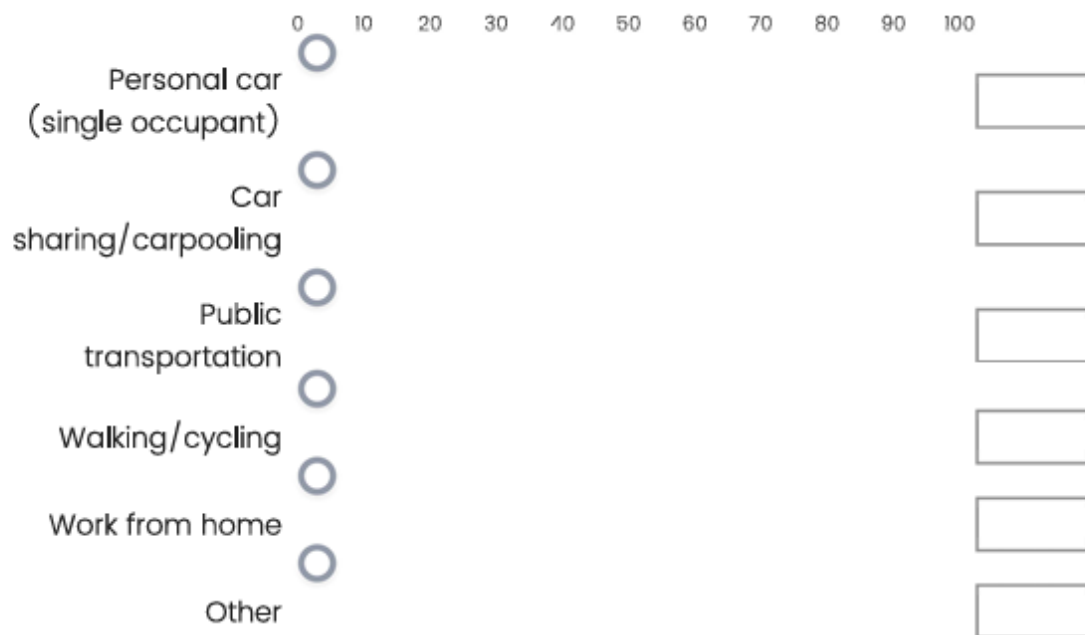
## 3. What is the average one-way commuting distance for your employees? (km). If you don't know, just leave it blank

**Freighting goods**

downstream and upstream transportation of goods over land, by sea or by air through a third-party company.

Do you use third-party logistics providers for goods?

○ Yes
○ No

Do you have information about spending on third-party logistics? What is your annual spend on third-party logistics?

○ [            ]Yes (unit: pounds)

○ No

What types of third-party vehicles are in your use for distribution and what is their usage annually?
1. Vans

Diesel/Class I (up to 1.305 tonnes) ⌄

Enter Amount | km ⌄ | Remove

Add Another Type

## 2. HGVs (all diesel)

0% Laden/Rigid (>3.5 - 7.5 tonnes) ⌄ | Enter Amount

km ⌄ | Remove

Add Another Type

## 3. HGVs refrigerated (all diesel)

0% Laden/Rigid (>3.5 - 7.5 tonnes) ⌄ | Enter Amount

km ⌄ | Remove

Add Another Type

## 4. Freight flights

Domestic, to/from UK ⌄ | Enter Amount | tonnes.km ⌄

Remove

Add Another Type

## 5. Rail

Freigt train ⌄ | Enter Amount | tonnes.km ⌄ | Remove

Add Another Type

## 6. Sea tanker

Crude tanker ⌄ | Enter Amount | tonnes.km ⌄ | Remove

Add Another Type

## 7. Cargo ship

Bulk carrier ⌄ | Enter Amount | tonnes.km ⌄ | Remove

Add Another Type

**Use of sold products**

## Use of sold products

Complete this section only if your company manufactures or sells physical products.

Do your products consume energy during use?

○ Yes

○ No

○ Not applicable

What is the approximate lifetime energy consumption of your products? (kWh). If you don't know, just leave it blank

What is the average lifespan of your main products? (years). If you don't know, just leave it blank

## For manufacturers: What percentage of your products are?

|  | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Energy-using products (requiring electricity, fuel, etc.) ○ ▢

Non-energy using products ○ ▢

## For agricultural producers: What percentage of your products require?

|  | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Refrigeration during storage ○ ▢

Processing before consumption ○ ▢

Cooking before consumption ○ ▢

## 5. For construction & real estate: What is the estimated annual energy consumption of buildings you've

constructed or sold? (kWh/m^2 per year). Fill "don't know" If you don't know, "Not applicable" if it is not applicable.

<br>

## Material use

### Material use

Production-related products (e.g., materials, components, and parts) and non-production-related products (e.g., office furniture, office supplies, and IT support).

Have you purchased materials or goods as part of your operations?

○ Yes
○ No

What was your spend on these key categories of materials and goods? report as per annum

## 1. Construction

| Aggregates/Primary material production ⌄ | Enter Amount |
|---|---|
| tonnes ⌄ | Remove |

Add Another Type

## 2. Organic

| Compost derived from garden waste/Primary material production ⌄ |
|---|
| Enter Amount | tonnes ⌄ | Remove |

Add Another Type

## 3. Electrical items

| Electrical items – fridges and freezers/Primary material production ⌄ |
|---|
| Enter Amount | tonnes ⌄ | Remove |

Add Another Type

## 4. Metal

Metal: aluminium cans and foil (excl. forming)/Primary material production ⌄

Enter Amount    tonnes ⌄    Remove

Add Another Type

## 5. Plastic

Plastics: average plastics ⌄    Enter Amount    tonnes ⌄

Remove

Add Another Type

## 6. Paper

Paper and board: board ⌄    Enter Amount    tonnes ⌄    Remove

Add Another Type

## 7. Others

Book/Primary material production ⌄    Enter Amount

tonnes ⌄    Remove

## 8. Agriculture and forestry related materials please state or estimate your annual spend on these materials (unit: pounds)

Seeds, seedling, plants

Fertilisers and pesticides

Animal feed

Agriculture equipment

Water for irrigation

## Waste disposal

## **Waste disposal**

Disposal and treatment of waste generated in the reporting company's operations

Do your organisation use third parties for waste disposal at this site?

○ Yes
○ No (use your own waste disposal system)

What are types of waste? What is the treatment type? How much has you treated annually?
*Reuse - Materials that are re-used instead of disposed of by recycling or landfill. // Open-loop - Open-loop recycling is the process of recycling material into other products. // Close-loop - Closed-loop recycling is the process of recycling material back into the same product.
1. Construction

| Aggregates/Re-use | ˅ | Enter Amount |
| tonnes ˅   Remove | | |

Add Another Type

2. Refuse
*Household residual waste - Domestic waste //

Commercial and industrial waste - Waste generated by business or industrial operations

Household residual waste/Re-use ⌄

Enter Amount | tonnes ⌄ | Remove

Add Another Type

## 3. Electrical items
*WEEE - Waste Electrical and Electronic Equipment // WEEE-large - Stationary machines for routine housekeeping tasks e.g. cookers / fridges // WEEE-small - Small power equipments // Batteries - Excludes car batteries

WEEE - fridges and freezers/Re-use ⌄ | Enter Amount

tonnes ⌄ | Remove

Add Another Type

## 4. Metal

Metal: aluminium cans and foil (excl. forming)/Re-use ⌄

Enter Amount | tonnes ⌄ | Remove

Add Another Type

## 5. Plastic

| Plastics: average plastics/Re-use | ⌄ |
| Enter Amount | tonnes ⌄ | Remove |

Add Another Type

## 6. Paper
*board - Average: 78% corrugate and 22% carton board // mixed - Assumes 25% paper, 75% board

| Paper and board: board/Re-use | ⌄ | Enter Amount |
| tonnes ⌄ | Remove |

Add Another Type

## 7. Others

| Books/Re-use | ⌄ | Enter Amount | tonnes ⌄ |
| Remove |

# Industry-specific

**Industry-specific questions**

## Which sector is your organisation in?

○ Professional services
○ Manufacturing
○ Retail & Wholesale
○ Construction & Real estate
○ Agriculture & Forestry

## What percentage of your client meetings are conducted:

| | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In person at client sites | ○ | | | | | | | | | | | [ ] |
| In person at your offices | ○ | | | | | | | | | | | [ ] |
| Virtually (video/phone) | ○ | | | | | | | | | | | [ ] |
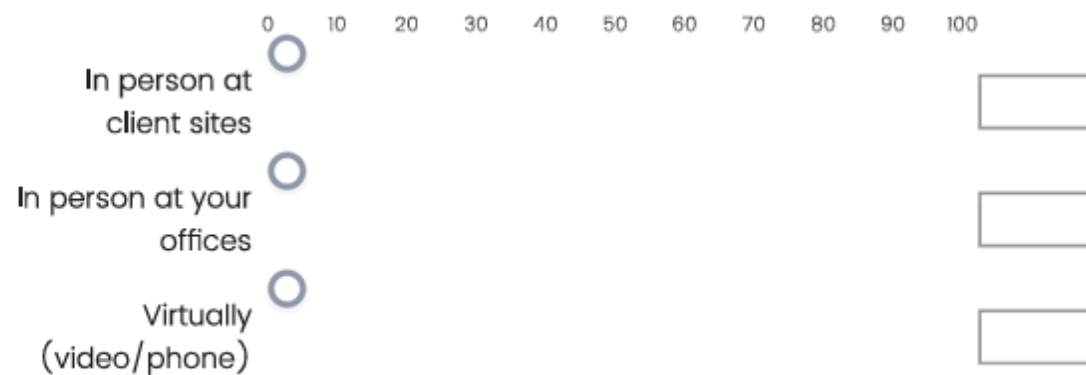
## What percentage of your manufacturing processes are:

|  | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Fully in-house ○

Partially outsourced ○

Fully outsourced ○

## What percentage of your sales are:

|  | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|

In-store/physical location ○

Online with delivery ○

Online with customer pickup ○

## What types of buildings do you typically construct/manage? (Check all that apply)

- [ ] Residential
- [ ] Commercial
- [ ] Industrial
- [ ] Infrastructure

## What is your approximate land area under management? (unit: hectares)

[                                              ]

## Additional information

## Additional information

## Has your organisation taken any measures to reduce Scope 3 emissions?

- ( ) Yes
- ( ) No

## Please briefly describe these measures

```
┌─────────────────────────────────────────────┐
│                                             │
│                                             │
│                                             │
│                                             │
└─────────────────────────────────────────────┘
```

## What challenges do you face in measuring your Scope 3 emissions? (check all that apply)

○ Limited resources/expertise

○ Difficulty obtaining data from suppliers

○ Uncertainty about calculation methods

○ Lack of industry benchmarks

○ Cost constraints

○ [_____] Others

## Suggestion for improvement

## Suggestion for our work (This is the last part of the survey)

What is your suggestion for us to improve this survey in the future about asking for your activities that contribute to carbon equivalent emissions

Have you completed the survey in full before the specified deadline?

○ complete

○ incomplete

## B.2 Coding for Questionnaire

Because a questionnaire was required to gather information on the company's use of resources, the data had to be divided into three categories: type, amount, and unit. Qualtrics XM's current features were insufficient to accommodate this requirement. As a result, JavaScript was incorporated into the system, and ChatGPT helped write the required code. As shown in Figure X, this is an example of the JavaScript code used to create the questionnaire items. In the previously indicated three-part structure, this approach is used for almost all questions that ask for quantitative data collection.

```
Qualtrics.SurveyEngine.addOnload(function() {
    var container = this.getQuestionContainer();
    var collectedData = [];

    function createEntryRow() {
        var newDropdown = document.createElement("select");
        var options = ["Foot passenger","Car passenger","Average (all passenger)"];
        for (var i = 0; i < options.length; i++) {
            var option = document.createElement("option");
            option.value = options[i];
            option.text = options[i];
            newDropdown.appendChild(option);
        }

        var newTextbox = document.createElement("input");
        newTextbox.type = "text";
        newTextbox.placeholder = "Enter Amount";

        var unitDropdown = document.createElement("select");
        var units = ["passenger.km"];
        for (var i = 0; i < units.length; i++) {
            var unitOption = document.createElement("option");
            unitOption.value = units[i];
            unitOption.text = units[i];
            unitDropdown.appendChild(unitOption);
        }

        var removeButton = document.createElement("button");
        removeButton.innerHTML = "Remove";
        removeButton.style.backgroundColor = "#c00808";
        removeButton.style.color = "white";
        removeButton.style.border = "none";
        removeButton.style.padding = "5px 10px";
        removeButton.style.marginLeft = "10px";
        removeButton.style.cursor = "pointer";

        removeButton.onclick = function() {
            container.removeChild(newContainer);
            updateEmbeddedData();
        };

        var newContainer = document.createElement("div");
        newContainer.style.border = "2px solid #ccc";
        newContainer.style.padding = "10px";
        newContainer.style.marginBottom = "10px";
        newContainer.style.borderRadius = "5px";
        newContainer.style.backgroundColor = "#f9f9f9";

        newContainer.appendChild(newDropdown);
        newContainer.appendChild(newTextbox);
        newContainer.appendChild(unitDropdown);
        newContainer.appendChild(removeButton);

        function updateEmbeddedData() {
            collectedData = [];
            var rows = container.querySelectorAll("div");
            rows.forEach(function(row) {
                var dropdown = row.querySelector("select:first-of-type");
                var textbox = row.querySelector("input");
                var unitDropdown = row.querySelector("select:last-of-type");

                if (dropdown && textbox && unitDropdown && textbox.value.trim() !== "") {
                    collectedData.push({
                        type: dropdown.value,
                        amount: textbox.value,
                        unit: unitDropdown.value
                    });
                }
            });
            Qualtrics.SurveyEngine.setEmbeddedData("Ferrydata", JSON.stringify(collectedData));
        }

        newDropdown.onchange = updateEmbeddedData;
        newTextbox.oninput = updateEmbeddedData;
        unitDropdown.onchange = updateEmbeddedData;

        return newContainer;
    }

    var addButton = document.createElement("button");
    addButton.innerHTML = "Add Another Type";
    addButton.style.backgroundColor = "green";
    addButton.style.color = "white";
    addButton.style.border = "none";
    addButton.style.padding = "5px 10px";
    addButton.style.marginTop = "10px";
    addButton.style.cursor = "pointer";

    addButton.onclick = function() {
        var newEntry = createEntryRow();
        container.insertBefore(newEntry, addButton);
        updateEmbeddedData();
    };

    var firstEntry = createEntryRow();
    container.appendChild(firstEntry);
    container.appendChild(addButton);
});
```

Annotations:
- Insert types for choosing
- Insert units for choosing
- Type the name of data of the question

*Figure 1: JavaScript Code Integrated into Qualtrics XM for Three-Part Data Collection (Type, Amount, Unit) with Key Components Annotated*

# Appendix C

*GHG calculation*

## C.1 Greenhouse Gas Conversion Factors

**Table 1.** GHG Conversion Factors for Scope 1, 2, and 3 Activities: (a) Fuels (b) Bioenergy (c) Refrigerants and Others (d) Passenger Vehicles (e) Delivery Vehicles (f) Electricity (g) Heat and Steam (h) Water (i) Business Travel (j) Freighting Goods (k) Material Use (l) Waste Disposal (Adapted from DESNZ & DEFRA, 2024)

### Scope 1 emissions

(a) **Fuels** (Total kgCO2e was used in the calculation)

| Activity | Fuel | Unit | kg $CO_2e$ | kg $CO_2e$ of $CO_2$ per unit | kg $CO_2e$ of $CH_4$ per unit | kg $CO_2e$ of $N_2O$ per unit |
|---|---|---|---|---|---|---|
| Gaseous fuels | Butane | tonnes | 3033.38067 | 3029.26000 | 2.52000 | 1.60067 |
| | | litres | 1.74532 | 1.74296 | 0.00144 | 0.00092 |
| | | kWh (Net CV) | 0.24106 | 0.24074 | 0.00020 | 0.00012 |
| | | kWh (Gross CV) | 0.22241 | 0.22210 | 0.00019 | 0.00012 |
| | CNG | tonnes | 2568.16441 | 2563.12000 | 3.85280 | 1.19161 |
| | | litres | 0.44942 | 0.44855 | 0.00067 | 0.00020 |
| | | kWh (Net CV) | 0.20264 | 0.20223 | 0.00031 | 0.00010 |
| | | kWh (Gross CV) | 0.18290 | 0.18253 | 0.00028 | 0.00009 |
| | LNG | tonnes | 2590.46441 | 2585.42000 | 3.85280 | 1.19161 |
| | | litres | 1.17216 | 1.16987 | 0.00175 | 0.00054 |
| | | kWh (Net CV) | 0.20440 | 0.20399 | 0.00031 | 0.00010 |
| | | kWh (Gross CV) | 0.18449 | 0.18412 | 0.00028 | 0.00009 |
| | LPG | tonnes | 2939.36095 | 2935.18000 | 2.55360 | 1.62735 |
| | | litres | 1.55713 | 1.55491 | 0.00136 | 0.00086 |
| | | kWh (Net CV) | 0.23031 | 0.22999 | 0.00020 | 0.00012 |
| | | kWh (Gross CV) | 0.21450 | 0.21419 | 0.00019 | 0.00012 |
| | Natural gas | tonnes | 2568.16441 | 2563.12000 | 3.85280 | 1.19161 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | cubic metres | 2.04542 | 2.04140 | 0.00307 | 0.00095 |
| | | kWh (Net CV) | 0.20264 | 0.20223 | 0.00031 | 0.00010 |
| | | kWh (Gross CV) | 0.18290 | 0.18253 | 0.00028 | 0.00009 |
| | Natural gas (100% mineral blend) | tonnes | 2590.46441 | 2585.42000 | 3.85280 | 1.19161 |
| | | cubic metres | 2.06318 | 2.05916 | 0.00307 | 0.00095 |
| | | kWh (Net CV) | 0.20440 | 0.20399 | 0.00031 | 0.00010 |
| | | kWh (Gross CV) | 0.18449 | 0.18412 | 0.00028 | 0.00009 |
| | Other petroleum gas | tonnes | 2578.24647 | 2575.70000 | 1.31040 | 1.23607 |
| | | litres | 0.94441 | 0.94348 | 0.00048 | 0.00045 |
| | | kWh (Net CV) | 0.19917 | 0.19897 | 0.00010 | 0.00010 |
| | | kWh (Gross CV) | 0.18323 | 0.18305 | 0.00009 | 0.00009 |
| | Propane | tonnes | 2997.63233 | 2993.40000 | 2.58720 | 1.64513 |
| | | litres | 1.54357 | 1.54140 | 0.00133 | 0.00084 |
| | | kWh (Net CV) | 0.23257 | 0.23225 | 0.00020 | 0.00012 |
| | | kWh (Gross CV) | 0.21411 | 0.21381 | 0.00018 | 0.00012 |
| Liquid fuels | Aviation spirit | tonnes | 3193.69480 | 3127.67000 | 39.52480 | 26.50000 |
| | | litres | 2.33116 | 2.28297 | 0.02885 | 0.01934 |
| | | kWh (Net CV) | 0.25666 | 0.25135 | 0.00318 | 0.00213 |
| | | kWh (Gross CV) | 0.24382 | 0.23878 | 0.00301 | 0.00203 |
| | Aviation turbine fuel | tonnes | 3178.36520 | 3149.67000 | 2.19520 | 26.50000 |
| | | litres | 2.54269 | 2.51973 | 0.00176 | 0.02120 |
| | | kWh (Net CV) | 0.26061 | 0.25826 | 0.00018 | 0.00217 |
| | | kWh (Gross CV) | 0.24758 | 0.24535 | 0.00017 | 0.00206 |
| | Burning oil | tonnes | 3165.04181 | 3149.67000 | 8.40000 | 6.97181 |
| | | litres | 2.54015 | 2.52782 | 0.00674 | 0.00559 |
| | | kWh (Net CV) | 0.25975 | 0.25849 | 0.00069 | 0.00057 |

| | | | | | |
|---|---|---|---|---|---|
| | kWh (Gross CV) | 0.24677 | 0.24557 | 0.00066 | 0.00054 |
| Diesel (average biofuel blend) | tonnes | 3014.09462 | 2974.86000 | 0.34720 | 38.88742 |
| | litres | 2.51279 | 2.47960 | 0.00029 | 0.03290 |
| | kWh (Net CV) | 0.25403 | 0.25070 | 0.00003 | 0.00330 |
| | kWh (Gross CV) | 0.23902 | 0.23590 | 0.00002 | 0.00310 |
| Diesel (100% mineral diesel) | tonnes | 3203.91143 | 3164.33000 | 0.34720 | 39.23423 |
| | litres | 2.66155 | 2.62818 | 0.00029 | 0.03308 |
| | kWh (Net CV) | 0.26808 | 0.26475 | 0.00003 | 0.00330 |
| | kWh (Gross CV) | 0.25197 | 0.24886 | 0.00002 | 0.00309 |
| Fuel oil | tonnes | 3228.89019 | 3216.38000 | 5.38720 | 7.12299 |
| | litres | 3.17493 | 3.16262 | 0.00530 | 0.00701 |
| | kWh (Net CV) | 0.28523 | 0.28413 | 0.00047 | 0.00063 |
| | kWh (Gross CV) | 0.26814 | 0.26709 | 0.00045 | 0.00060 |
| Gas oil | tonnes | 3226.57859 | 3190.00000 | 3.68480 | 32.89379 |
| | litres | 2.75541 | 2.72417 | 0.00315 | 0.02809 |
| | kWh (Net CV) | 0.27287 | 0.26978 | 0.00031 | 0.00278 |
| | kWh (Gross CV) | 0.25649 | 0.25359 | 0.00029 | 0.00261 |
| Lubricants | tonnes | 3180.99992 | 3171.09000 | 3.42720 | 6.48272 |
| | litres | 2.74934 | 2.74078 | 0.00296 | 0.00560 |
| | kWh (Net CV) | 0.28100 | 0.28013 | 0.00030 | 0.00057 |
| | kWh (Gross CV) | 0.26414 | 0.26332 | 0.00028 | 0.00054 |
| Naphtha | tonnes | 3142.37890 | 3131.33000 | 3.81920 | 7.22970 |
| | litres | 2.11894 | 2.11149 | 0.00258 | 0.00487 |
| | kWh (Net CV) | 0.24891 | 0.24804 | 0.00030 | 0.00057 |
| | kWh (Gross CV) | 0.23647 | 0.23564 | 0.00029 | 0.00054 |
| Petrol (average | tonnes | 2778.52935 | 2759.80000 | 10.84160 | 7.88775 |

| | | | | | |
|---|---|---|---|---|---|
| biofuel blend) | litres | 2.08440 | 2.07047 | 0.00806 | 0.00587 |
| | kWh (Net CV) | 0.23240 | 0.23085 | 0.00090 | 0.00065 |
| | kWh (Gross CV) | 0.22013 | 0.21868 | 0.00084 | 0.00061 |
| Petrol (100% mineral petrol) | tonnes | 3154.08213 | 3135.00000 | 11.04320 | 8.03893 |
| | litres | 2.35372 | 2.33955 | 0.00820 | 0.00597 |
| | kWh (Net CV) | 0.25460 | 0.25305 | 0.00090 | 0.00065 |
| | kWh (Gross CV) | 0.24186 | 0.24040 | 0.00085 | 0.00061 |
| Processed fuel oils - residual oil | tonnes | 3228.89019 | 3216.38000 | 5.38720 | 7.12299 |
| | litres | 3.17493 | 3.16262 | 0.00530 | 0.00701 |
| | kWh (Net CV) | 0.28523 | 0.28413 | 0.00047 | 0.00063 |
| | kWh (Gross CV) | 0.26814 | 0.26709 | 0.00045 | 0.00060 |
| Processed fuel oils - distillate oil | tonnes | 3226.57859 | 3190.00000 | 3.68480 | 32.89379 |
| | litres | 2.75541 | 2.72417 | 0.00315 | 0.02809 |
| | kWh (Net CV) | 0.27287 | 0.26978 | 0.00031 | 0.00278 |
| | kWh (Gross CV) | 0.25649 | 0.25359 | 0.00029 | 0.00261 |
| Refinery miscellaneous | tonnes | 2944.32093 | 2933.33000 | 3.79680 | 7.19413 |
| | litres | | | | |
| | kWh (Net CV) | 0.25961 | 0.25864 | 0.00034 | 0.00063 |
| | kWh (Gross CV) | 0.24662 | 0.24571 | 0.00031 | 0.00060 |
| Waste oils | tonnes | 3219.37916 | 3171.09000 | 3.55040 | 44.73876 |
| | litres | 2.74923 | 2.70801 | 0.00302 | 0.03820 |
| | kWh (Net CV) | 0.27458 | 0.27047 | 0.00030 | 0.00381 |
| | kWh (Gross CV) | 0.25641 | 0.25256 | 0.00028 | 0.00357 |
| Marine gas oil | tonnes | 3245.30441 | 3205.99000 | 0.90720 | 38.40721 |
| | litres | 2.77139 | 2.73782 | 0.00077 | 0.03280 |
| | kWh (Net CV) | 0.27446 | 0.27113 | 0.00008 | 0.00325 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | kWh (Gross CV) | 0.25798 | 0.25486 | 0.00007 | 0.00305 |
| | Marine fuel oil | tonnes | 3154.75334 | 3113.99000 | 1.42240 | 39.34094 |
| | | litres | 3.10202 | 3.06194 | 0.00140 | 0.03868 |
| | | kWh (Net CV) | 0.27869 | 0.27509 | 0.00012 | 0.00348 |
| | | kWh (Gross CV) | 0.26196 | 0.25858 | 0.00012 | 0.00326 |
| Solid fuels | Coal (industrial) | tonnes | 2399.43994 | 2374.87000 | 7.63840 | 16.93154 |
| | | kWh (Net CV) | 0.34002 | 0.33653 | 0.00109 | 0.00240 |
| | | kWh (Gross CV) | 0.32302 | 0.31971 | 0.00103 | 0.00228 |
| | Coal (electricity generation) | tonnes | 2262.11448 | 2250.22000 | 0.67200 | 11.22248 |
| | | kWh (Net CV) | 0.33368 | 0.33190 | 0.00010 | 0.00168 |
| | | kWh (Gross CV) | 0.31699 | 0.31530 | 0.00010 | 0.00159 |
| | Coal (domestic) | tonnes | 2904.95234 | 2632.00000 | 240.35200 | 32.60034 |
| | | kWh (Net CV) | 0.36549 | 0.33115 | 0.03024 | 0.00410 |
| | | kWh (Gross CV) | 0.34721 | 0.31459 | 0.02873 | 0.00389 |
| | Coking coal | tonnes | 3164.65002 | 3144.16000 | 8.46720 | 12.02282 |
| | | kWh (Net CV) | 0.37675 | 0.37431 | 0.00101 | 0.00143 |
| | | kWh (Gross CV) | 0.35790 | 0.35559 | 0.00095 | 0.00136 |
| | Petroleum coke | tonnes | 3386.57168 | 3377.05000 | 3.83040 | 5.69128 |
| | | kWh (Net CV) | 0.35886 | 0.35786 | 0.00040 | 0.00060 |
| | | kWh (Gross CV) | 0.34092 | 0.33997 | 0.00038 | 0.00057 |
| | Coal (electricity generation - home produced coal only) | tonnes | 2258.58670 | 2246.71000 | 0.67200 | 11.20470 |
| | | kWh (Net CV) | 0.33368 | 0.33190 | 0.00010 | 0.00168 |
| | | kWh (Gross CV) | 0.31699 | 0.31530 | 0.00010 | 0.00159 |

**(b) Bioenergy**

| Activity | Fuel | Unit | kg CO$_2$e |
|---|---|---|---|
| Biofuel | Bioethanol | litres | 0.00901 |
| | | GJ | 0.42339 |
| | | kg | 0.01135 |
| | Biodiesel ME | litres | 0.16751 |
| | | GJ | 5.05961 |
| | | kg | 0.18822 |
| | Biomethane (compressed) | litres | |
| | | GJ | 0.10625 |
| | | kg | 0.00521 |
| | Biodiesel ME (from used cooking oil) | litres | 0.16751 |
| | | GJ | 5.05961 |
| | | kg | 0.18822 |
| | Biodiesel ME (from tallow) | litres | 0.16751 |
| | | GJ | 5.05961 |
| | | kg | 0.18822 |
| | Biodiesel HVO | litres | 0.03558 |
| | | GJ | 1.03677 |
| | | kg | 0.04562 |
| | Biopropane | litres | 0.00214 |
| | | GJ | 0.08952 |
| | | kg | 0.00415 |
| | Development diesel | litres | 0.03705 |
| | | GJ | 1.03677 |
| | | kg | 0.04461 |
| | Development petrol | litres | 0.01409 |
| | | GJ | 0.42339 |
| | | kg | 0.01888 |
| | Off road biodiesel | litres | 0.16751 |
| | | GJ | 5.05961 |
| | | kg | 0.18822 |
| | Biomethane (liquified) | litres | |
| | | GJ | 0.10625 |
| | | kg | 0.00521 |
| | Methanol (bio) | litres | 0.00669 |
| | | GJ | 0.42339 |

| | | | |
|---|---|---|---|
| | | kg | 0.00844 |
| | Avtur (renewable) | litres | 0.02518 |
| | | GJ | 0.72340 |
| | | kg | 0.03185 |
| Biomass | Wood logs | tonnes | 46.25524 |
| | | kWh | 0.01132 |
| | Wood chips | tonnes | 42.76487 |
| | | kWh | 0.01132 |
| | Wood pellets | tonnes | 54.33654 |
| | | kWh | 0.01132 |
| | Grass/straw | tonnes | 54.08777 |
| | | kWh | 0.01454 |
| Biogas | Biogas | tonnes | 1.26431 |
| | | kWh | 0.00023 |
| | Landfill gas | tonnes | 0.69619 |
| | | kWh | 0.00020 |

(c) **Refrigerant & others** (Total emissions was used for calculations)

| Activity | Emission | Unit | Emissions including only Kyoto products<br>kg $CO_2e$ | Emissions including only non-Kyoto products<br>kg $CO_2e$ | Total emissions including non-Kyoto products<br>kg $CO_2e$ |
|---|---|---|---|---|---|
| Kyoto protocol products | Carbon dioxide | kg | 1.00000 | | 1.00000 |
| | Methane | kg | 28.00000 | | 28.00000 |
| | Nitrous oxide | kg | 265.00000 | | 265.00000 |
| | HFC-23 | kg | 12400.00000 | | 12400.00000 |
| | HFC-32 | kg | 677.00000 | | 677.00000 |
| | HFC-41 | kg | 116.00000 | | 116.00000 |
| | HFC-125 | kg | 3170.00000 | | 3170.00000 |
| | HFC-134 | kg | 1120.00000 | | 1120.00000 |
| | HFC-134a | kg | 1300.00000 | | 1300.00000 |
| | HFC-143 | kg | 328.00000 | | 328.00000 |
| | HFC-143a | kg | 4800.00000 | | 4800.00000 |
| | HFC-152a | kg | 138.00000 | | 138.00000 |
| | HFC-227ea | kg | 3350.00000 | | 3350.00000 |
| | HFC-236fa | kg | 8060.00000 | | 8060.00000 |
| | HFC-245fa | kg | 858.00000 | | 858.00000 |
| | HFC-43-I0mee | kg | 1650.00000 | | 1650.00000 |
| | Perfluoromethane (PFC-14) | kg | 6630.00000 | | 6630.00000 |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
|  | Perfluoroethane (PFC-116) | kg | 11100.00000 |  | 11100.00000 |
|  | Perfluoropropane (PFC-218) | kg | 8900.00000 |  | 8900.00000 |
|  | Perfluorocyclobutane (PFC-318) | kg | 9540.00000 |  | 9540.00000 |
|  | Perfluorobutane (PFC-3-1-10) | kg | 9200.00000 |  | 9200.00000 |
|  | Perfluoropentane (PFC-4-1-12) | kg | 8550.00000 |  | 8550.00000 |
|  | Perfluorohexane (PFC-5-1-14) | kg | 7910.00000 |  | 7910.00000 |
|  | PFC-9-1-18 | kg | 7190.00000 |  | 7190.00000 |
|  | Perfluorocyclopropane | kg | 9200.00000 |  | 9200.00000 |
|  | Sulphur hexafluoride (SF6) | kg | 23500.00000 |  | 23500.00000 |
|  | HFC-152 | kg | 16.00000 |  | 16.00000 |
|  | HFC-161 | kg | 4.00000 |  | 4.00000 |
|  | HFC-236cb | kg | 1210.00000 |  | 1210.00000 |
|  | HFC-236ea | kg | 1330.00000 |  | 1330.00000 |
|  | HFC-245ca | kg | 716.00000 |  | 716.00000 |
|  | HFC-365mfc | kg | 804.00000 |  | 804.00000 |
|  | Nitrogen trifluoride | kg | 16100.00000 |  | 16100.00000 |
| Blends | R401A | kg | 18.00000 | 1112.00000 | 1130.00000 |
|  | R401B | kg | 15.00000 | 1221.00000 | 1236.00000 |
|  | R401C | kg | 21.00000 | 855.00000 | 876.00000 |
|  | R402A | kg | 1902.00000 | 669.00000 | 2571.00000 |
|  | R402B | kg | 1205.00000 | 1056.00000 | 2261.00000 |
|  | R403A | kg | 1780.00000 | 1320.00000 | 3100.00000 |
|  | R403B | kg | 3471.00000 | 986.00000 | 4457.00000 |
|  | R404A | kg | 3943.00000 |  | 3943.00000 |
|  | R405A | kg | 3920.00000 | 901.00000 | 4821.00000 |
|  | R406A | kg |  | 1780.00000 | 1780.00000 |
|  | R407A | kg | 1923.00000 |  | 1923.00000 |
|  | R407B | kg | 2547.00000 |  | 2547.00000 |
|  | R407C | kg | 1624.00000 |  | 1624.00000 |
|  | R407D | kg | 1487.00000 |  | 1487.00000 |
|  | R407E | kg | 1425.00000 |  | 1425.00000 |
|  | R407F | kg | 1674.00000 |  | 1674.00000 |
|  | R408A | kg | 2430.00000 | 827.00000 | 3257.00000 |
|  | R409A | kg |  | 1485.00000 | 1485.00000 |
|  | R409B | kg |  | 1474.00000 | 1474.00000 |
|  | R410A | kg | 1924.00000 |  | 1924.00000 |
|  | R410B | kg | 2048.00000 |  | 2048.00000 |

| | | | | |
|---|---|---|---|---|
| R411A | kg | 15.00000 | 1540.00000 | 1555.00000 |
| R411B | kg | 4.00000 | 1654.00000 | 1659.00000 |
| R412A | kg | 445.00000 | 1727.00000 | 2172.00000 |
| R413A | kg | 1945.00000 | | 1945.00000 |
| R414A | kg | | 1375.00000 | 1375.00000 |
| R414B | kg | | 1274.00000 | 1274.00000 |
| R415A | kg | 25.00000 | 1443.00000 | 1468.00000 |
| R415B | kg | 104.00000 | 440.00000 | 544.00000 |
| R416A | kg | 767.00000 | 208.00000 | 975.00000 |
| R417A | kg | 2127.00000 | | 2127.00000 |
| R417B | kg | 2742.00000 | | 2742.00000 |
| R417C | kg | 1643.00000 | | 1643.00000 |
| R418A | kg | 3.00000 | 1690.00000 | 1693.00000 |
| R419A | kg | 2688.00000 | | 2688.00000 |
| R419B | kg | 2161.00000 | | 2161.00000 |
| R420A | kg | 1144.00000 | 238.00000 | 1382.00000 |
| R421A | kg | 2385.00000 | | 2385.00000 |
| R421B | kg | 2890.00000 | | 2890.00000 |
| R422A | kg | 2847.00000 | | 2847.00000 |
| R422B | kg | 2290.00000 | | 2290.00000 |
| R422C | kg | 2794.00000 | | 2794.00000 |
| R422D | kg | 2473.00000 | | 2473.00000 |
| R422E | kg | 2350.00000 | | 2350.00000 |
| R423A | kg | 2274.00000 | | 2274.00000 |
| R424A | kg | 2212.00000 | | 2212.00000 |
| R425A | kg | 1431.00000 | | 1431.00000 |
| R426A | kg | 1371.00000 | | 1371.00000 |
| R427A | kg | 2024.00000 | | 2024.00000 |
| R428A | kg | 3417.00000 | | 3417.00000 |
| R429A | kg | 13.80000 | 1.50000 | 15.30000 |
| R430A | kg | 105.00000 | 1.00000 | 106.00000 |
| R431A | kg | 40.00000 | | 40.00000 |
| R432A | kg | | 1.80000 | 1.80000 |
| R433A | kg | | 0.64000 | 0.64000 |
| R433B | kg | | 0.16000 | 0.16000 |
| R433C | kg | | 0.55000 | 0.55000 |
| R434A | kg | 3075.00000 | | 3076.00000 |
| R435A | kg | 27.60000 | 0.80000 | 28.40000 |
| R436A | kg | | 1.35000 | 1.35000 |
| R436B | kg | | 1.47000 | 1.47000 |
| R437A | kg | 1639.00000 | | 1639.00000 |
| R438A | kg | 2059.00000 | | 2059.00000 |
| R439A | kg | 1828.00000 | | 1828.00000 |

| | | | | | |
|---|---|---|---|---|---|
| | R440A | kg | 156.00000 | | 156.00000 |
| | R441A | kg | | 0.23000 | 0.23000 |
| | R442A | kg | 1754.00000 | | 1754.00000 |
| | R443A | kg | | 1.00000 | 1.00000 |
| | R444A | kg | 88.00000 | 1.00000 | 89.00000 |
| | R445A | kg | 117.00000 | 1.00000 | 118.00000 |
| | R500 | kg | 36.00000 | 7528.00000 | 7564.00000 |
| | R501 | kg | | 3870.00000 | 3870.00000 |
| | R502 | kg | | 4786.00000 | 4786.00000 |
| | R503 | kg | 4972.00000 | 8326.00000 | 13299.00000 |
| | R504 | kg | 326.00000 | 3973.00000 | 4299.00000 |
| | R505 | kg | | 7956.00000 | 7956.00000 |
| | R506 | kg | | 3857.00000 | 3857.00000 |
| | R507A | kg | 3985.00000 | | 3985.00000 |
| | R508A | kg | 11607.00000 | | 11607.00000 |
| | R508B | kg | 11698.00000 | | 11698.00000 |
| | R509A | kg | 4984.00000 | 774.00000 | 5758.00000 |
| | R510A | kg | | 1.24000 | 1.24000 |
| | R511A | kg | 6.90000 | 0.10000 | 7.00000 |
| | R512A | kg | 196.00000 | | 196.00000 |
| Montreal protocol products | CFC-11/R11 = trichlorofluoromethane | kg | | 4660.00000 | 4660.00000 |
| | CFC-12/R12 = dichlorodifluoromethane | kg | | 10200.00000 | 10200.00000 |
| | CFC-13 | kg | | 13900.00000 | 13900.00000 |
| | CFC-113 | kg | | 5820.00000 | 5820.00000 |
| | CFC-114 | kg | | 8590.00000 | 8590.00000 |
| | CFC-115 | kg | | 7670.00000 | 7670.00000 |
| | Halon-1211 | kg | | 1750.00000 | 1750.00000 |
| | Halon-1301 | kg | | 6290.00000 | 6290.00000 |
| | Halon-2402 | kg | | 1470.00000 | 1470.00000 |
| | Carbon tetrachloride | kg | | 1730.00000 | 1730.00000 |
| | Methyl bromide | kg | | 2.00000 | 2.00000 |
| | Methyl chloroform | kg | | 160.00000 | 160.00000 |
| | HCFC-22/R22 = chlorodifluoromethane | kg | | 1760.00000 | 1760.00000 |
| | HCFC-123 | kg | | 79.00000 | 79.00000 |
| | HCFC-124 | kg | | 527.00000 | 527.00000 |
| | HCFC-141b | kg | | 782.00000 | 782.00000 |
| | HCFC-142b | kg | | 1980.00000 | 1980.00000 |
| | HCFC-225ca | kg | | 127.00000 | 127.00000 |
| | HCFC-225cb | kg | | 525.00000 | 525.00000 |
| | HCFC-21 | kg | | 148.00000 | 148.00000 |

| | | | | |
|---|---|---|---|---|
| Fluorinated ethers | HFE-125 | kg | 12400.00000 | 12400.00000 |
| | HFE-134 | kg | 5560.00000 | 5560.00000 |
| | HFE-143a | kg | 523.00000 | 523.00000 |
| | HCFE-235da2 | kg | 491.00000 | 491.00000 |
| | HFE-245cb2 | kg | 654.00000 | 654.00000 |
| | HFE-245fa2 | kg | 812.00000 | 812.00000 |
| | HFE-254cb2 | kg | 301.00000 | 301.00000 |
| | HFE-347mcc3 | kg | 530.00000 | 530.00000 |
| | HFE-347pcf2 | kg | 889.00000 | 889.00000 |
| | HFE-356pcc3 | kg | 413.00000 | 413.00000 |
| | HFE-449sl (HFE-7100) | kg | 421.00000 | 421.00000 |
| | HFE-569sf2 (HFE-7200) | kg | 57.00000 | 57.00000 |
| | HFE-43-10pccc124 (H-Galden1040x) | kg | 2820.00000 | 2820.00000 |
| | HFE-236ca12 (HG-10) | kg | 5350.00000 | 5350.00000 |
| | HFE-338pcc13 (HG-01) | kg | 2910.00000 | 2910.00000 |
| Other products | Trifluoromethyl sulphur pentafluoride | kg | 17400.00000 | 17400.00000 |
| | PFPMIE | kg | 9710.00000 | 9710.00000 |
| | Dimethylether | kg | 1.00000 | 1.00000 |
| | Methylene chloride | kg | 9.00000 | 9.00000 |
| | Methyl chloride | kg | 12.00000 | 12.00000 |
| | R290 = propane | kg | 0.06000 | 0.06000 |
| | R600A = isobutane | kg | 3.00000 | 3.00000 |
| | R600 = butane | kg | 0.00600 | 0.00600 |
| | R601 = pentane | kg | 5.00000 | 5.00000 |
| | R601A = isopentane | kg | 5.00000 | 5.00000 |
| | R170 = ethane | kg | 0.43700 | 0.43700 |
| | R1270 = propene | kg | 2.00000 | 2.00000 |
| | R1234yf* | kg | 1.00000 | 1.00000 |
| | R1234ze* | kg | 1.00000 | 1.00000 |

**(d) Passenger vehicles**

| Diesel | Petrol | Hybrid | CNG | LPG | Unknown | Plug-in Hybrid Electric Vehicle | Battery Electric Vehicle |
|---|---|---|---|---|---|---|---|

| Activity | Type | Unit | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e |
|---|---|---|---|---|---|---|---|---|---|---|
| Cars (by size) | Small car | km | 0.13994 | 0.1437 | 0.11274 | | | 0.14262 | 0.03012 | 0 |
| | | miles | 0.22522 | 0.23126 | 0.18143 | | | 0.22953 | 0.04848 | 0 |
| | Medium car | km | 0.16807 | 0.17726 | 0.1149 | 0.15682 | 0.17634 | 0.17256 | 0.0812 | 0 |
| | | miles | 0.2705 | 0.28526 | 0.18492 | 0.25238 | 0.28378 | 0.27771 | 0.13066 | 0 |
| | Large car | km | 0.20729 | 0.26885 | 0.15486 | 0.23705 | 0.26759 | 0.22472 | 0.10306 | 0 |
| | | miles | 0.33362 | 0.43267 | 0.24921 | 0.38151 | 0.43064 | 0.36164 | 0.16587 | 0 |
| | Average car | km | 0.16984 | 0.1645 | 0.12607 | 0.17514 | 0.19718 | 0.16691 | 0.0936 | 0 |
| | | miles | 0.27334 | 0.26473 | 0.20288 | 0.28187 | 0.31732 | 0.2686 | 0.15062 | 0 |

**(e) Delivery vehicles**

| Activity | Type | Unit | Diesel kg CO2e | Petrol kg CO2e | CNG kg CO2e | LPG kg CO2e | Unknown kg CO2e | Plug-in Hybrid Electric Vehicle kg CO2e | Battery Electric Vehicle kg CO2e |
|---|---|---|---|---|---|---|---|---|---|
| Vans | Class I (up to 1.305 tonnes) | km | 0.15356 | 0.20071 | | | | | 0 |
| | | miles | 0.24716 | 0.32299 | | | | | 0 |
| | Class II (1.305 to 1.74 tonnes) | km | 0.18832 | 0.21709 | | | | | 0 |
| | | miles | 0.30309 | 0.34936 | | | | | 0 |

| | Unit | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Class III (1.74 to 3.5 tonnes) | km | 0.27365 | 0.34923 | | | | 0.13292 | 0 |
| | miles | 0.44042 | 0.56201 | | | | 0.21391 | 0 |
| Average (up to 3.5 tonnes) | km | 0.25023 | 0.22095 | 0.2512 | 0.27617 | 0.24934 | 0.13292 | 0 |
| | miles | 0.40273 | 0.35558 | 0.40426 | 0.44446 | 0.40127 | 0.21391 | 0 |

| Activity | Type | Unit | 0% Laden kg CO2e | 50% Laden kg CO2e | 100% Laden kg CO2e | Average laden kg CO2e |
|---|---|---|---|---|---|---|
| HGV (all diesel) | Rigid (>3.5 - 7.5 tonnes) | km | 0.4538 | 0.49279 | 0.53178 | 0.48733 |
| | | miles | 0.73031 | 0.79306 | 0.8558 | 0.78427 |
| | Rigid (>7.5 tonnes-17 tonnes) | km | 0.54426 | 0.62106 | 0.69787 | 0.59495 |
| | | miles | 0.87591 | 0.99952 | 1.12313 | 0.95749 |
| | Rigid (>17 tonnes) | km | 0.74987 | 0.9121 | 1.07433 | 0.97698 |
| | | miles | 1.20681 | 1.46798 | 1.72898 | 1.57231 |
| | All rigids | km | 0.66163 | 0.78719 | 0.91274 | 0.82657 |
| | | miles | 1.06479 | 1.26685 | 1.46891 | 1.33023 |
| | Articulated (>3.5 - 33t) | km | 0.61558 | 0.76642 | 0.91726 | 0.76642 |
| | | miles | 0.99065 | 1.23341 | 1.47616 | 1.23341 |
| | Articulated (>33t) | km | 0.63238 | 0.83833 | 1.04428 | 0.91247 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | mile s | 1.01779 | 1.34914 | 1.68059 | 1.46846 |
| All artics | km | 0.63162 | 0.83506 | 1.03849 | 0.90581 |
| | mile s | 1.01648 | 1.34388 | 1.67128 | 1.45775 |
| All HGVs | km | 0.64392 | 0.81517 | 0.98641 | 0.87296 |
| | mile s | 1.03629 | 1.31188 | 1.58748 | 1.40489 |

| Activity | Type | Unit | 0% Laden kg CO2e | 50% Laden kg CO2e | 100% Laden kg CO2e | Average laden kg CO2e |
|---|---|---|---|---|---|---|
| HGVs refrigerated (all diesel) | Rigid (>3.5 - 7.5 tonnes) | km | 0.54033 | 0.58684 | 0.63336 | 0.58033 |
| | | mile s | 0.86957 | 0.94442 | 1.01928 | 0.93394 |
| | Rigid (>7.5 tonnes-17 tonnes) | km | 0.64802 | 0.73965 | 0.83128 | 0.7085 |
| | | mile s | 1.0429 | 1.19036 | 1.33783 | 1.14022 |
| | Rigid (>17 tonnes) | km | 0.8925 | 1.08604 | 1.27958 | 1.16344 |
| | | mile s | 1.43635 | 1.74783 | 2.0593 | 1.87239 |
| | All rigids | km | 0.78757 | 0.93736 | 1.08715 | 0.98435 |
| | | mile s | 1.26746 | 1.50852 | 1.74959 | 1.58414 |
| | Articulated (>3.5 - 33t) | km | 0.71193 | 0.88686 | 1.06179 | 0.88686 |
| | | mile s | 1.14572 | 1.42725 | 1.70877 | |
| | Articulated (>33t) | km | 0.73105 | 0.96989 | 1.20873 | 1.05587 |

| | | | | | |
|---|---|---|---|---|---|
| | miles | 1.17649 | 1.56087 | 1.94524 | 1.69924 |
| All artics | km | 0.73018 | 0.96611 | 1.20203 | 1.04817 |
| | miles | 1.17511 | 1.55479 | 1.93447 | 1.68685 |
| All HGVs | km | 0.75351 | 0.95446 | 1.15542 | 1.02228 |
| | miles | 1.21266 | 1.53606 | 1.85946 | 1.64526 |

## Scope 2 emissions

### (f) Electricity

| Activity | Unit | kg CO2e |
|---|---|---|
| Electricity generated | kWh | 0.20705 |

### (g) Heat & steam

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Heat and steam | Onsite heat and steam | kWh | 0.17965 |
| | District heat and steam | kWh | 0.17965 |

## Scope 3 emissions

### (h) Water

| Activity | Unit | kg CO2e |
|---|---|---|
| Water supply | cubic metres | 0.15311 |
| | million litres | 153.1087 |
| Water treatment | cubic metres | 0.18574 |
| | million litres | 185.7412 |

### (i) Business travel (Flights use With RF emissions factor)

| Activity | Haul | Class | Unit | kg CO2e |
|---|---|---|---|---|
| Flights | Domestic, to/from UK | Average passenger | passenger.km | 0.27257 |
| | Short-haul, to/from UK | Average passenger | passenger.km | 0.18592 |
| | | Economy class | passenger.km | 0.18287 |
| | | Business class | passenger.km | 0.2743 |
| | Long-haul, to/from UK | Average passenger | passenger.km | 0.26128 |
| | | Economy class | passenger.km | 0.20011 |
| | | Premium economy class | passenger.km | 0.32015 |
| | | Business class | passenger.km | 0.58028 |
| | | First class | passenger.km | 0.8004 |
| | International, to/from non-UK | Average passenger | passenger.km | 0.1758 |
| | | Economy class | passenger.km | 0.13465 |
| | | Premium economy class | passenger.km | 0.21542 |
| | | Business class | passenger.km | 0.39044 |
| | | First class | passenger.km | 0.53854 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Ferry | Foot passenger | passenger.km | 0.01871 |
| | Car passenger | passenger.km | 0.12933 |
| | Average (all passenger) | passenger.km | 0.1127 |

| | | | Diesel | Petrol | Hybrid | CNG | LPG | Unknown | Plug-in Hybrid Electric Vehicle | Battery Electric Vehicle |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity | Type | Unit | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e | kg CO2e |
| Cars (by size) | Small car | km | 0.13994 | 0.1437 | 0.11274 | | | 0.14262 | 0.06078 | 0.04284 |
| | | miles | 0.22522 | 0.23126 | 0.18143 | | | 0.22953 | 0.09782 | 0.06895 |
| | Medium car | km | 0.16807 | 0.17726 | 0.1149 | 0.15682 | 0.17634 | 0.17256 | 0.09312 | 0.04625 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | miles | 0.27052 | 0.28526 | 0.18492 | 0.25238 | 0.28378 | 0.27771 | 0.14985 | 0.07443 |
| Large car | km | 0.20729 | 0.26885 | 0.15486 | 0.23705 | 0.26759 | 0.22472 | 0.11923 | 0.04925 |
| | miles | 0.33362 | 0.43267 | 0.24921 | 0.38151 | 0.43064 | 0.36164 | 0.1919 | 0.07925 |
| Average car | km | 0.16984 | 0.1645 | 0.12607 | 0.17514 | 0.19718 | 0.16691 | 0.10853 | 0.04745 |
| | miles | 0.27334 | 0.26473 | 0.20288 | 0.28187 | 0.31732 | 0.2686 | 0.17465 | 0.07636 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Motorbike | Small | km | 0.08319 |
| | | miles | 0.13389 |
| | Medium | km | 0.10107 |
| | | miles | 0.16265 |
| | Large | km | 0.13252 |
| | | miles | 0.21326 |
| | Average | km | 0.11367 |
| | | miles | 0.18293 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Taxis | Regular taxi | passenger.km | 0.14861 |
| | | km | 0.20805 |
| | Black cab | passenger.km | 0.20402 |
| | | km | 0.30603 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Bus | Local bus (not London) | passenger.km | 0.12999 |
| | Local London bus | passenger.km | 0.07447 |
| | Average local bus | passenger.km | 0.10846 |
| | Coach | passenger.km | 0.02717 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Rail | National rail | passenger.km | 0.03546 |
| | International rail | passenger.km | 0.00446 |
| | Light rail and tram | passenger.km | 0.0286 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| London Underground | | passenger.km | 0.0278 | | | | | |

**(j) Freighting goods** (Freight flights use With RF emissions factor)

| Activity | Type | Unit | Diesel kg CO2e | Petrol kg CO2e | CNG kg CO2e | LPG kg CO2e | Unknown kg CO2e | Plug-in Hybrid Electric Vehicle kg CO2e | Battery Electric Vehicle kg CO2e |
|---|---|---|---|---|---|---|---|---|---|
| Vans | Class I (up to 1.305 tonnes) | tonne.km | 0.85353 | 1.17394 | | | | | 0.15753 |
| | | km | 0.15356 | 0.20071 | | | | | 0.04254 |
| | | miles | 0.24716 | 0.32299 | | | | | 0.06847 |
| | Class II (1.305 to 1.74 tonnes) | tonne.km | 0.61153 | 0.82739 | | | | | 0.27927 |
| | | km | 0.18832 | 0.21709 | | | | | 0.06556 |
| | | miles | 0.30309 | 0.34936 | | | | | 0.10553 |
| | Class III (1.74 to 3.5 tonnes) | tonne.km | 0.61363 | 0.86252 | | | | 0.37952 | 0.23666 |
| | | km | 0.27365 | 0.34923 | | | | 0.15079 | 0.08929 |
| | | miles | 0.44042 | 0.56201 | | | | 0.24267 | 0.14369 |
| | Average (up to 3.5 tonnes) | tonne.km | 0.61643 | 0.81972 | 0.62197 | 0.68376 | 0.62264 | 0.37952 | 0.25438 |
| | | km | 0.25023 | 0.22095 | 0.2512 | 0.27617 | 0.24934 | 0.15079 | 0.07922 |
| | | miles | 0.40273 | 0.35558 | 0.40426 | 0.44446 | 0.40127 | 0.24267 | 0.12752 |

| Activity | Type | Unit | 0% Laden kg CO2e | 50% Laden kg CO2e | 100% Laden kg CO2e | Average laden kg CO2e |
|---|---|---|---|---|---|---|
| HGV (all diesel) | Rigid (>3.5 - 7.5 tonnes) | tonne.km | | 0.4399 | 0.23736 | 0.50546 |
| | | km | 0.4538 | 0.49279 | 0.53178 | 0.48733 |
| | | miles | 0.73031 | 0.79306 | 0.8558 | 0.78427 |
| | Rigid (>7.5 tonnes-17 tonnes) | tonne.km | | 0.26206 | 0.14724 | 0.38023 |
| | | km | 0.54426 | 0.62106 | 0.69787 | 0.59495 |
| | | miles | 0.87591 | 0.99952 | 1.12313 | 0.95749 |
| | Rigid (>17 tonnes) | tonne.km | | 0.20077 | 0.11824 | 0.15398 |

| Activity | Type | Unit | 0% Laden kg CO2e | 50% Laden kg CO2e | 100% Laden kg CO2e | Average laden kg CO2e |
|---|---|---|---|---|---|---|
| | | km | 0.74987 | 0.9121 | 1.07433 | 0.97698 |
| | | miles | 1.20681 | 1.4679 | 1.72898 | 1.57231 |
| | All rigids | tonne.km | | 0.21412 | 0.12482 | 0.17853 |
| | | km | 0.66163 | 0.78719 | 0.91274 | 0.82657 |
| | | miles | 1.06479 | 1.26685 | 1.46891 | 1.33023 |
| | Articulated (>3.5 - 33t) | tonne.km | | 0.11303 | 0.06763 | 0.11311 |
| | | km | 0.61558 | 0.76642 | 0.91726 | 0.76642 |
| | | miles | 0.99065 | 1.23341 | 1.47616 | 1.23341 |
| | Articulated (>33t) | tonne.km | | 0.09294 | 0.05789 | 0.07447 |
| | | km | 0.63238 | 0.83833 | 1.04428 | 0.91247 |
| | | miles | 1.0177 | 1.34914 | 1.68059 | 1.46846 |
| | All artics | tonne.km | | 0.09346 | 0.05814 | 0.07547 |
| | | km | 0.63162 | 0.83506 | 1.03849 | 0.90581 |
| | | miles | 1.01648 | 1.34388 | 1.67128 | 1.45775 |
| | All HGVs | tonne.km | | 0.11926 | 0.0724 | 0.09752 |
| | | km | 0.64392 | 0.81517 | 0.98641 | 0.87296 |
| | | miles | 1.03629 | 1.31188 | 1.58748 | 1.40489 |

| Activity | Type | Unit | 0% Laden kg CO2e | 50% Laden kg CO2e | 100% Laden kg CO2e | Average laden kg CO2e |
|---|---|---|---|---|---|---|
| HGV refrigerated (all diesel) | Rigid (>3.5 - 7.5 tonnes) | tonne.km | | 0.52382 | 0.28268 | 0.60195 |
| | | km | 0.54033 | 0.58684 | 0.63336 | 0.58033 |
| | | miles | 0.86957 | 0.94442 | 1.01928 | 0.93394 |
| | Rigid (>7.5 tonnes-17 tonnes) | tonne.km | | 0.31213 | 0.17541 | 0.45287 |
| | | km | 0.64802 | 0.73965 | 0.83128 | 0.7085 |
| | | miles | 1.0429 | 1.19036 | 1.33783 | 1.14022 |
| | Rigid (>17 tonnes) | tonne.km | | 0.23906 | 0.14083 | 0.1833 |
| | | km | 0.8925 | 1.08604 | 1.27958 | 1.16344 |
| | | miles | 1.43635 | 1.74783 | 2.0593 | 1.87239 |
| | All rigids | tonne.km | | 0.25495 | 0.14867 | 0.21254 |
| | | km | 0.78757 | 0.93736 | 1.08715 | 0.98435 |
| | | miles | 1.26746 | 1.50852 | 1.74959 | 1.58414 |
| | Articulated (>3.5 - 33t) | tonne.km | | 0.13078 | 0.07827 | 0.13086 |
| | | km | 0.71193 | 0.88686 | 1.06179 | 0.88686 |
| | | miles | 1.14572 | 1.42725 | 1.70877 | 1.42725 |
| | Articulated (>33t) | tonne.km | | 0.10753 | 0.06701 | 0.08617 |
| | | km | 0.73105 | 0.96989 | 1.20873 | 1.05587 |
| | | miles | 1.17649 | 1.56087 | 1.94524 | 1.69924 |

| | Unit | | | | |
|---|---|---|---|---|---|
| All artics | tonne.km | | 0.10813 | 0.0673 | 0.08732 |
| | km | 0.73018 | 0.96611 | 1.20203 | 1.04817 |
| | miles | 1.17511 | 1.55479 | 1.93447 | 1.68685 |
| All HGVs | tonne.km | | 0.13964 | 0.08481 | 0.11417 |
| | km | 0.75351 | 0.95446 | 1.15542 | 1.02228 |
| | miles | 1.21266 | 1.53606 | 1.85946 | 1.6452 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Freight flights | Domestic, to/from UK | tonne.km | 4.6734 |
| | Short-haul, to/from UK | tonne.km | 1.66816 |
| | Long-haul, to/from UK | tonne.km | 1.09904 |
| | International, to/from non-UK | tonne.km | 1.09904 |

| Activity | Type | Unit | kg CO2e |
|---|---|---|---|
| Rail | Freight train | tonne.km | 0.02779 |

| Activity | Type | Size | Unit | kg CO2e |
|---|---|---|---|---|
| Sea tanker | Crude tanker | 200,000+ dwt | tonne.km | 0.00293 |
| | | 120,000–199,999 dwt | tonne.km | 0.00445 |
| | | 80,000–119,999 dwt | tonne.km | 0.00597 |
| | | 60,000–79,999 dwt | tonne.km | 0.00759 |
| | | 10,000–59,999 dwt | tonne.km | 0.00921 |
| | | 0–9999 dwt | tonne.km | 0.03371 |
| | | Average | tonne.km | 0.00456 |
| | Products tanker | 60,000+ dwt | tonne.km | 0.00577 |
| | | 20,000–59,999 dwt | tonne.km | 0.01042 |
| | | 10,000–19,999 dwt | tonne.km | 0.01894 |
| | | 5000–9999 dwt | tonne.km | 0.02956 |
| | | 0–4999 dwt | tonne.km | 0.04556 |
| | | Average | tonne.km | 0.00902 |
| | Chemical tanker | 20,000+ dwt | tonne.km | 0.0085 |
| | | 10,000–19,999 dwt | tonne.km | 0.01093 |
| | | 5000–9999 dwt | tonne.km | 0.01529 |
| | | 0–4999 dwt | tonne.km | 0.02248 |
| | | Average | tonne.km | 0.0103 |

| | | | | |
|---|---|---|---|---|
| LNG tanker | 200,000+ m3 | tonne.km | 0.00941 |
| | 0–199,999 m3 | tonne.km | 0.01468 |
| | Average | tonne.km | 0.01153 |
| LPG Tanker | 50,000+ m3 | tonne.km | 0.00911 |
| | 0–49,999 m3 | tonne.km | 0.04404 |
| | Average | tonne.km | 0.01036 |

| Activity | Type | Size | Unit | kg CO2e |
|---|---|---|---|---|
| Cargo ship | Bulk carrier | 200,000+ dwt | tonne.km | 0.00253 |
| | | 100,000–199,999 dwt | tonne.km | 0.00304 |
| | | 60,000–99,999 dwt | tonne.km | 0.00415 |
| | | 35,000–59,999 dwt | tonne.km | 0.00577 |
| | | 10,000–34,999 dwt | tonne.km | 0.008 |
| | | 0–9999 dwt | tonne.km | 0.02956 |
| | | Average | tonne.km | 0.00353 |
| | General cargo | 10,000+ dwt | tonne.km | 0.01204 |
| | | 5000–9999 dwt | tonne.km | 0.016 |
| | | 0–4999 dwt | tonne.km | 0.01407 |
| | | 10,000+ dwt 100+ TEU | tonne.km | 0.01113 |
| | | 5000–9999 dwt 100+ TEU | tonne.km | 0.01772 |
| | | 0–4999 dwt 100+ TEU | tonne.km | 0.02005 |
| | | Average | tonne.km | 0.01321 |
| | Container ship | 8000+ TEU | tonne.km | 0.01265 |
| | | 5000–7999 TEU | tonne.km | 0.01681 |
| | | 3000–4999 TEU | tonne.km | 0.01681 |
| | | 2000–2999 TEU | tonne.km | 0.02025 |
| | | 1000–1999 TEU | tonne.km | 0.0325 |
| | | 0–999 TEU | tonne.km | 0.03675 |
| | | Average | tonne.km | 0.01612 |
| | Vehicle transport | 4000+ CEU | tonne.km | 0.0324 |
| | | 0–3999 CEU | tonne.km | 0.05832 |
| | | Average | tonne.km | 0.03852 |
| | RoRo-Ferry | 2000+ LM | tonne.km | 0.05012 |
| | | 0–1999 LM | tonne.km | 0.06105 |
| | | Average | tonne.km | 0.05159 |
| | Large RoPax ferry | Average | tonne.km | 0.37612 |
| | Refrigerated cargo | All dwt | tonne.km | 0.01306 |

**(k) Material use**

| Activity | Material | Unit | Primary material production kg CO2e | Re-used kg CO2e | Open-loop source kg CO2e | Closed-loop source kg CO2e |
|---|---|---|---|---|---|---|
| Construction | Aggregates | tonnes | 7.75127 | 2.21 | | 3.19485 |
| | Average construction | tonnes | 74.88652 | | | |
| | Asbestos | tonnes | 27 | | | |
| | Asphalt | tonnes | 39.21249 | 1.73826 | | 28.65485 |
| | Bricks | tonnes | 241.7513 | | | |
| | Concrete | tonnes | 118.7513 | | | 3.19485 |
| | Insulation | tonnes | 1861.751 | | | 1852.081 |
| | Metals | tonnes | 3815.785 | | | 1630.787 |
| | Soils | tonnes | | | | 0.98485 |
| | Mineral oil | tonnes | 1401 | | | 676 |
| | Plasterboard | tonnes | 120.05 | | | 32.17 |
| | Tyres | tonnes | 3335.572 | 731.2179 | | |
| | Wood | tonnes | 269.5042 | 38.54288 | | |
| Other | Books | tonnes | | | | |
| | Glass | tonnes | 1402.767 | | | 823.1895 |
| | Clothing | tonnes | 22310 | 152.25 | | |
| | Food and drink | tonnes | 3701.404 | | | |
| Organic | Compost derived from garden waste | tonnes | 112.0168 | | | |
| | Compost derived from food and garden waste | tonnes | 114.8335 | | | |
| Electrical items | Electrical items - fridges and freezers | tonnes | 4363.333 | | | |
| | Electrical items - large | tonnes | 3267 | | | |
| | Electrical items - IT | tonnes | 24865.48 | | | |
| | Electrical items - small | tonnes | 5647.946 | | | |
| | Batteries - Alkaline | tonnes | 4633.478 | | | |
| | Batteries - Li ion | tonnes | 6308 | | | |
| | Batteries - NiMh | tonnes | 28380 | | | |
| Metal | Metal: aluminium cans and foil (excl. forming) | tonnes | 9106.919 | | | 990.4781 |

| | Metal: mixed cans | tonnes | 5105.639 | | 1461.678 |
| | Metal: scrap metal | tonnes | 3464.564 | | 1620.276 |
| | Metal: steel cans | tonnes | 2854.919 | | 1726.727 |
| Plastic | Plastics: average plastics | tonnes | 3164.78 | | 1566.386 |
| | Plastics: average plastic film | tonnes | 2910.465 | | 1094.583 |
| | Plastics: average plastic rigid | tonnes | 3345.308 | | 1906.704 |
| | Plastics: HDPE (incl. forming) | tonnes | 3086.39 | | 1761.808 |
| | Plastics: LDPE and LLDPE (incl. forming) | tonnes | 2959.318 | | 1088.919 |
| | Plastics: PET (incl. forming) | tonnes | 3854.919 | | 2204.919 |
| | Plastics: PP (incl. forming) | tonnes | 2568.589 | | 1303.589 |
| | Plastics: PS (incl. forming) | tonnes | 4367.44 | | 2660.399 |
| | Plastics: PVC (incl. forming) | tonnes | 2935.773 | | 1838.84 |
| Paper | Paper and board: board | tonnes | 1193.966 | | 1092.355 |
| | Paper and board: mixed | tonnes | 1282.744 | | 1063.015 |
| | Paper and board: paper | tonnes | 1339.318 | | 1044.318 |

**(l) Waste disposal**

| Activity | Waste type | Unit | Open-loop kg CO2e | Closed-loop kg CO2e | Combustion kg CO2e | Composting kg CO2e | Landfill kg CO2e | Anaerobic digestion kg CO2e |
|---|---|---|---|---|---|---|---|---|
| Construction | Aggregates | tonnes | 0.98485 | 0.98485 | | | 1.23393 | |
| | Average construction | tonnes | 0.98485 | 0.98485 | 6.41061 | | | |
| | Asbestos | tonnes | | | | | 5.91325 | |

| Category | Item | Unit | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Asphalt | tonnes | 0.98485 | 0.98485 | | | 1.23393 | |
| | Bricks | tonnes | 0.98485 | | | | 1.23393 | |
| | Concrete | tonnes | 0.98485 | 0.98485 | | | 1.23393 | |
| | Insulation | tonnes | | 0.98485 | | | 1.23393 | |
| | Metals | tonnes | | 0.98485 | | | 1.26435 | |
| | Soils | tonnes | | 0.98485 | | | 19.51726 | |
| | Mineral oil | tonnes | | 6.41061 | 6.41061 | | | |
| | Plasterboard | tonnes | | 6.41061 | | | 71.95 | |
| | Tyres | tonnes | | 6.41061 | | | | |
| | Wood | tonnes | | 6.41061 | 6.41061 | 8.88386 | 925.2442 | |
| Other | Books | tonnes | | 6.41061 | 6.41061 | 8.88386 | 1164.39 | |
| | Glass | tonnes | 6.41061 | 6.41061 | 6.41061 | | 8.88386 | |
| | Clothing | tonnes | | 6.41061 | 6.41061 | | 496.683 | |
| Refuse | Household residual waste | tonnes | | | 6.41061 | | 497.0442 | |
| | Organic: food and drink waste | tonnes | | | 6.41061 | 8.88386 | 700.2096 | 8.88386 |
| | Organic: garden waste | tonnes | | | 6.41061 | 8.88386 | 646.6063 | 8.88386 |
| | Organic: mixed food and garden waste | tonnes | | | 6.41061 | 8.88386 | 655.9869 | 8.88386 |
| | Commercial and industrial waste | tonnes | | | 6.41061 | | 520.3342 | |

| Category | Item | unit | | | | |
|---|---|---|---|---|---|---|
| Electrical items | WEEE - fridges and freezers | tonnes | 6.41061 | | | 8.88386 |
| | WEEE - large | tonnes | 6.41061 | | 6.41061 | 8.88386 |
| | WEEE - mixed | tonnes | 6.41061 | | 6.41061 | 8.88386 |
| | WEEE - small | tonnes | 6.41061 | | 6.41061 | 8.88386 |
| | Batteries | tonnes | 6.41061 | | | 8.88386 |
| Metal | Metal: aluminium cans and foil (excl. forming) | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Metal: mixed cans | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Metal: scrap metal | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Metal: steel cans | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| Plastic | Plastics: average plastics | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Plastics: average plastic film | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Plastics: average plastic rigid | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Plastics: HDPE (incl. forming) | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |
| | Plastics: LDPE and LLDPE | tonnes | 6.41061 | 6.41061 | 6.41061 | 8.88386 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | (incl. forming) | | | | | | |
| | Plastics: PET (incl. forming) | tonnes | | 6.410 61 | 6.410 61 | 6.41061 | | 8.8838 6 |
| | Plastics: PP (incl. forming) | tonnes | | 6.410 61 | 6.410 61 | 6.41061 | | 8.8838 6 |
| | Plastics: PS (incl. forming) | tonnes | | 6.410 61 | 6.410 61 | 6.41061 | | 8.8838 6 |
| | Plastics: PVC (incl. forming) | tonnes | | 6.410 61 | 6.410 61 | 6.41061 | | 8.8838 6 |
| Paper | Paper and board: board | tonnes | | | 6.410 61 | 6.41061 | 8.88386 | 1164.3 9 |
| | Paper and board: mixed | tonnes | | | 6.410 61 | 6.41061 | 8.88386 | 1164.3 9 |
| | Paper and board: paper | tonnes | | | 6.410 61 | 6.41061 | 8.88386 | 1164.3 9 |

## C.2 Calculation method

The process of preparing the data and performing calculations after receiving the questionnaire responses involves several complex steps, as outlined below:

As shown in Figure 2, the exported data was in a format that was not readily usable after the primary data from the questionnaire replies was obtained. Consequently, the data needed to be converted into a format that could be used for calculations. Python code created and executed in Google Colab was utilised to achieve this (Figure 3). The final output is a set of tables categorised by activity type, which can then be used for further calculations (Figure 4).

[{"fuel":"Butane","amount":"100","unit":"tonnes"},{"fuel":"CNG","amount":"200","unit":"tonnes"}]

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [{"fuel":"B utane","a mount":" 100","unit ":"tonnes "},{"fuel":" CNG","a mount":" 200","unit ":"tonnes "}] | [{"fuel":"A viation spirit","a mount":" 100","unit ":"tonnes "},{"fuel":" Refinery miscella neous"," amount": "50","unit ":"tonnes "}] | [{"fuel":"C oal (domesti c)","amo unt":"80", "unit":"to nnes"}] | | | | | | | | | | | | | |
| [{"fuel":"B utane","a mount":" 100","unit ":"tonnes "},{"fuel":" LPG","am ount":"20 0","unit":" tonnes"}] | [{"fuel":"A viation spirit","a mount":"" ,"unit":"to nnes"}] | [{"fuel":"C oking coal","a mount":" 20","unit ":"tonnes "}] | [{"fuel":" Wood logs","a mount":" 50","unit ":"tonnes "}] | [{"fuel":"B iogas","a mount":"" ,"unit":"to nnes"}] | [{"type":" HFC-134","am ount":"20 0","unit":" kg"}] | [{"type":" R505","a mount":" 200","unit ":"kg"},{"t ype":"R40 9A","amo unt":"60", "unit":"kg "}] | [{"type":" CFC-11/R11 = trichlorof luoromet hane","a mount":"" ,"unit":"k g"}] | [{"type":" HFE-125","am ount":""," unit":"kg" }] | [{"type":"T rifluorom ethyl sulphur pentafluo ride","am ount":""," unit":"kg" }] | [{"type":" Diesel"," amount": "500","un it":"km"}] | [{"type":" Hybrid"," amount": "700","un it":"km"},{ "type":"Di esel","am ount":"20 0","unit":" km"}] | [{"type":" Diesel"," amount": "","unit":" km"}] | [{"type":" Diesel"," amount": "","unit":" km"}] | [{"fuel":"C lass I (up to 1.305 tonnes)", "amount" :"","unit": "km"}] | [{"fuel":"R igid (>3.5 7.5 tonnes)", "amount" :"","unit": "km"}] | [{"fuel": igid (>1 tonnes "amou :"2000, nit":"kn ] |

*Figure 2: Raw Exported Questionnaire Data Prior to Processing for Calculation*

```
import json
import pandas as pd
Path   = "/content/Ready4NetZero Survey_7 April 2025_11.41.xlsx"
Wanted_cols = ["Gaseousfuelsdata","Liquidfuelsdata","Solidfuelsdata","Biofueldat
df = pd.read_excel(Path)
df = df.drop(0)
for col in Wanted_cols:
    new_list = []
    for index, row in df.iterrows():
        try:
            data = json.loads(row[col])
            for d in data:
                d["Q9"] = row.Q9
                new_list.append(
                d
                )
        except:
            new_list.append(
                {
                        'Q9': row.Q9,
                }
            )
    new_df = pd.DataFrame(new_list)

    new_df.to_csv(f"{col}.csv", index = False)
```

Put your raw exported data file's path in

Put all names of data (that put in JavaScript in Qualtrics XM)

*Figure 3: Sample of Python Code Used to Transform Raw Tabular Data into a Calculation-Ready Format.*

*Figure 4: Processed Data Output Categorized by Activity Type, Generated Using Python.*

Once the data was transformed into a calculation-ready format, it was further organised into separate files and structured according to the categories outlined in Table 2. These structured files could then be imported into Excel for subsequent calculations.

**Table 2.** Method for Expanding Rows to Enable Compatibility with the Calculation Sheet in Excel.

Add "Category" as one of a column at the far right of the table.

| Company's name | Type | Amount | Unit | Category |
|---|---|---|---|---|
| | | | | |

For Category:

| Type | Category |
|---|---|
| Fuels | Fuels |

| | |
|---|---|
| Bioenergy | Bioenergy |
| Refrigerant | Refrigerant |
| Passenger vehicles | ="Passenger"&(Size)&(Unit)' |
| Delivery vehicles (Vans) | ="Deliveryvans"&(Type)&(Unit)' |
| Delivery vehicles (HGVs) | ="DeliveryHGV"&(Type)&(Unit)' |
| Delivery vehicles (HGVs refrigerated) | ="DeliveryHGVsref"&(Type)&(Unit)' |
| Electricity | Electricity |
| Onsite heat and steam | Onsite heat and steam |
| District heat and steam | District heat and steam |
| Water supply | Water supply |
| Water treatment | Water treatment |
| Business travel (Flight) | Businessflight |
| Business travel (Ferry) | Businessferry |
| Business travel (Car) | Businesscar |
| Business travel (Motorbike) | Businessmotorbike |
| Business travel (Taxis) | Businesstaxis |
| Business travel (Bus) | Businessbus |
| Business travel (Rail) | Businessrail |
| Freighting goods (Vans) | Freightvans |
| Freighting goods (HGV) | FreightHGV |
| Freighting goods (HGV refrigerated) | FreightHGVref |
| Freighting goods (Freight flights) | Freightflights |
| Freighting goods (Rail) | Freightrail |
| Freighting goods (Sea tanker) | Freightseatanker |
| Freighting goods (Cargo ship) | Freightcargoship |
| Material use (Construction) | Matconstruction |
| Material use (Other) | Matother |
| Material use (Organic) | Matorganic |
| Material use (Electrical items) | Matelectrical |
| Material use (Metal) | Matmetal |
| Material use (Plastic) | Matplastic |
| Material use (Paper) | Matpaper |
| Waste disposal (Construction) | Wasteconstruction |
| Waste disposal (Other) | Wasteother |
| Waste disposal (Refuse) | Wasterefuse |
| Waste disposal (Electrical items) | Wasteelectrical |
| Waste disposal (Metal) | Wastemetal |
| Waste disposal (Plastic) | Wasteplastic |
| Waste disposal (Paper) | Wastepaper |

# Appendix D

*Carbon Emissions and Sequestration in Bedfordshire Land Cover Types*

### Woodlands Deciduous Woodland:

The development and management of deciduous woodlands in Bedfordshire represent a significant carbon sequestration opportunity. In general, these woodlands sequester between $-4.0$ and $-5.5$ tonnes of Carbon dioxide equivalent per hectare per year($tCO_2e$/ha/year) (Forest Research, 2022). This carbon sink effect is most pronounced in young to middle-aged trees (10-45 years after planting), when growth rates are at their highest (Farm Carbon Toolkit, 2024). Species selection and management for sustainable utilisation are essential for optimising the sequestration potential.

### Coniferous forest:

Coniferous forest has an even higher rate of sequestration, capturing between $-6.0$ to $-8.5$ $tCO_2e$/ha/year (Forest Research, 2022). Fast growing species (e.g., Pines, spruces) have very high first years of carbon uptake and so pine/spruce planting is efficient use of land for early climate benefit. But with biodiversity in mind, it's important to be strategic about where trees are placed to balance carbon storage with ecosystem health.

### Improved grassland:

Intensive managed improved grassland associated with livestock grazing and fertiliser use is a net source of emissions between $+0.4$ to $+1.2$ $tCO_2e$/ha/year (IPCC, 2006; BEIS, 2023). Soil management practices are the primary contributors to soil N20 emissions. These systems could move towards neutral or even carbon sink systems under restoration or sustainable management changes.

### Natural and Semi-natural Grassland:

The semi-natural and unimproved grasslands of Bedfordshire can be significant carbon stores, capturing between $-0.3$ to $-0.9$ $tCO_2e$/ha/year (Alonso et al., 2012). These sites are characterised by undisturbed soil with relatively low nitrogen input, which leads to a slow but steady accumulation of carbon, primarily as soil organic matter.

### Arable and Horticultural Land:

Arable and horticultural activities are responsible for large emissions, which vary between $+1.0$ and $+4.5$ $tCO_2e$/ha/year (Smith et al., 2020; BEIS Inventory, 2023). Conventional farming practices such as continuous tillage and application of fertiliser, lead to the losses of soil carbon and the emissions of greenhouse gases. Putting into effect practices such as reduced tillage, agroforestry, and cover cropping can greatly minimise these effects in the long term.

### Freshwater (Rivers and Lakes):

Carbon dioxide equivalent (CO2e) emissions ranges between $+2.0$ and $+4.0$ $tCO_2e$/ha/year for inland waters such as rivers, lakes and reservoirs (Raymond et al., 2013; Holgerson & Raymond, 2016). The reason for this is mainly the production of carbon dioxide and methane as the result

of microbial activity and degradation of organic matter. While their land area may be relatively modest, their emissions are large enough to be considered in regional climate plans.

Urban and Suburban areas:

The largest emitting per hectare category are urban emissions of between +100 to +120 tCO2/ ha/ year compared to other landcovers (Friedlingstein et al., 2020; Woodland Trust, 2022; UKCCC, 2019; Department for Energy Security and Net Zero, 2023). These values reflect the intensified emissions profile of developed landscapes and are therefore considered realistic proxies for regional emissions benchmarking in planning scenarios. The primary drivers are energy use in buildings, emissions from transportation and the percentage of impervious surface. Mitigation requires urban greening and low-carbon infrastructure. Additionally, suburban and town, including most Bedfordshire towns and larger villages, still release less but fairly high amounts of CO2e from +60 to +80 tCO$_2$e/ha/year.

# Appendix E

## Satellite data (MODIS)

In Google Earth Engine (GEE), the MODIS GPP (Gross Primary Productivity) data can be accessed and analysed using various MODIS products, particularly the MOD17A2H collection, cumulative 8-day product, which provides GPP values (NASA, 2021). The cumulative 8-day product in the MODIS GPP dataset refers to the sum of GPP values over an 8-day period rather than an average or daily value. The MOD17A2H product, which is derived from the MODIS Terra and Aqua satellites, uses several key variables and empirical models to calculate GPP (Zhao et al., 2005).

## Accessing MODIS GPP in GEE

MODIS GPP data is available in GEE through the MOD17A2H product. This product contains a daily global GPP estimate at a 500-meter spatial resolution (NASA, 2021). There is a band in the MODIS that contains the actual GPP values in grams of carbon per square meter per day (gC/m²/day). To access it, you can query the GEE dataset using the MODIS collection.

## GPP Calculation in MODIS (Overview)

MODIS calculates GPP using the Light Use Efficiency (LUE) model. In GEE, the MOD17A2H dataset provides GPP (gC/m²/day) estimates that are pre-calculated using the following approach (NASA, 2021):

- Vegetation Index (VI) Input: MODIS uses vegetation indices such as NDVI and EVI (Enhanced Vegetation Index) to assess plant activity, which is strongly linked to GPP. The VI data can be used to model how much sunlight plants absorb for photosynthesis.
- Photosynthetically Active Radiation (PAR): The amount of light available for photosynthesis is estimated using MODIS data and is used as a primary input in the GPP calculation.
- Temperature and Water Stress Factors: These factors are derived from MODIS LST (Land Surface Temperature) and other environmental data. They adjust the Light Use Efficiency based on temperature and water availability, which affect photosynthesis.
- Light Use Efficiency (LUE) Model: The MODIS GPP model applies the LUE concept, where GPP is calculated as:

$$GPP = LUE \times PAR \times f(T, D)$$

Here, f (T, D) is a function that adjusts LUE based on temperature (T) and drought (D) conditions, which are derived from environmental data.

# Appendix F

## Dashboard user guide

Contents
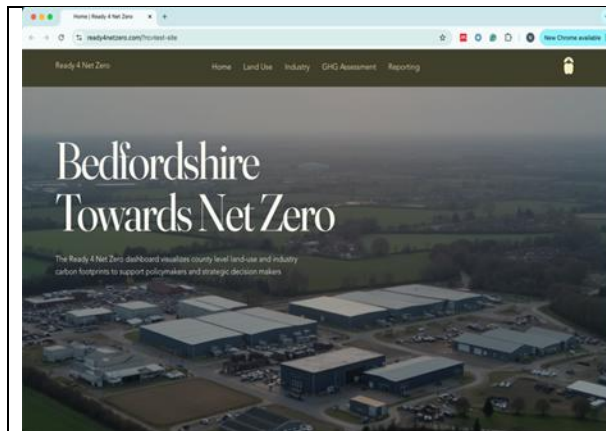
**Home page**

| | |
|---|---|
|  | 1.1 Within your preferred web browser, enter www.ready4netzero.com<br><br>This will open the dashboard and lead to the Home page.<br><br>Use the cursor to navigate up/down or to click the options on the top menu. |
|  | 1.2 Scrolling down the will lead to the initial list of services available, including online tutorials in how to use the Land Cover and Industry dashboards, and a link to the GHG Assessment page. |

| | |
|---|---|
|  | 1.3 The bottom of the page provides links to the recorded emissions and industry intensity data that has been used to create the model supporting the dashboard.<br><br>These data sources will be updated and republished annually. |
| **Land Use:**<br><br> | 2.1 The Land Use page shows two maps and instruction on how to interact with them:<br>L/H side: Land cover map<br>R/H side: CO$_2$e level map<br><br>A drop down in the top right-hand corner of each map provides a legend and base maps for each map selected. |
|  | 2.2 The dividing slider in the middle of the map can be dragged to move between the two maps.<br><br>Use the mouse cursor to zoom in and out of the map. |

| | |
|---|---|
|  | 2.3 The legend in the top right-hand corner of the land cover map shows the types of land use across the county. |
|  | 2.4 The dropdown also provides a variety of base maps available to underlay additional information, such as imagery, streets, topography, navigation and more. |
|  | 2.5 The CO₂e level map has the same legend & basemap features in the dropdown menu.<br><br>The legend in this map shows the estimated CO₂e emissions or sequestration.<br>Negative values show sequestrations<br>Positive values show emissions |
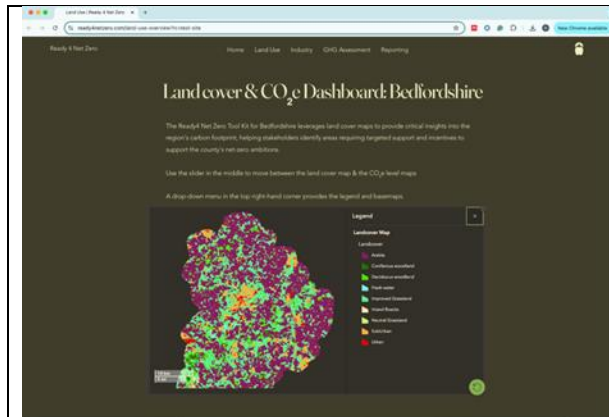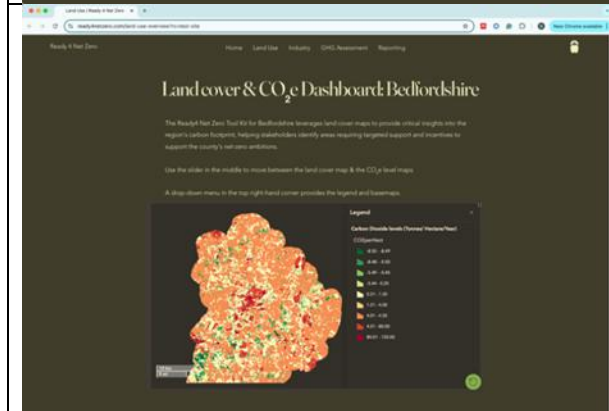
**Industry:**
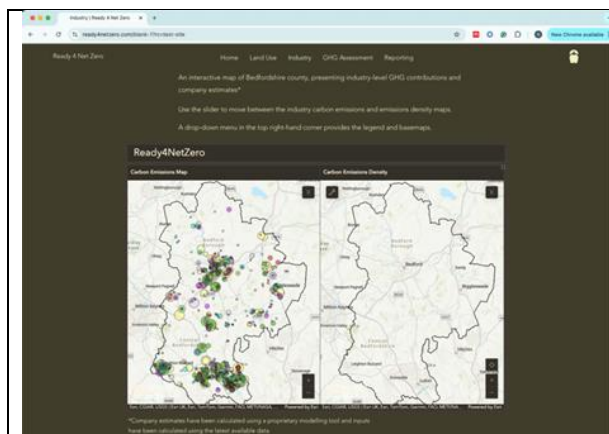
| | |
|---|---|
|  | 3.1 The Industry Analysis page also shows two maps and provides instruction on how to interact with them:<br>L/H side: Industry Carbon emissions map<br>R/H side: Carbon emissions density heat map |
|  | 3.2 The legend in the industry map shows the colour associated with each industry and the parameter of estimated $CO_2e$ emissions by plot points. |
|  | 3.3 The layers tool in the dropdown menu allows the user to select specific industries to analyse.<br><br>The highlighted selection is showing the manufacturing companies within the county. |
|  | 3.4 Clicking on a plot point will open a side menu showing further information such as company name, estimated GHG footprint, operating revenue, number of employees, and more. |

|  | 3.5 The dividing slider enables transition between the two maps.<br><br>The carbon density heat map shows concentrated areas of GHG emissions. |
| --- | --- |
|  | 3.6 User the mouse cursor to zoom in and navigate the map for enhanced detail and identification of hot spots of activity that may require investigation or decarbonisation support. |
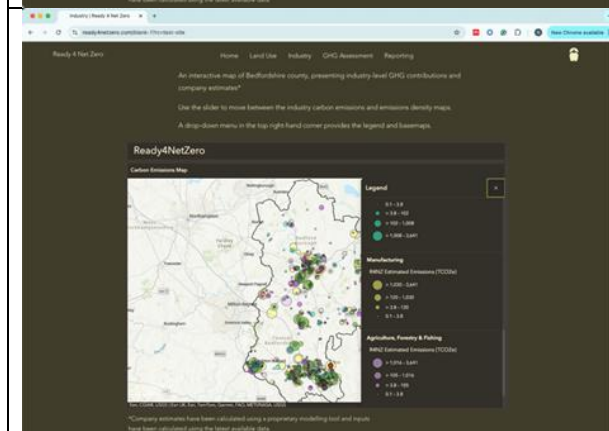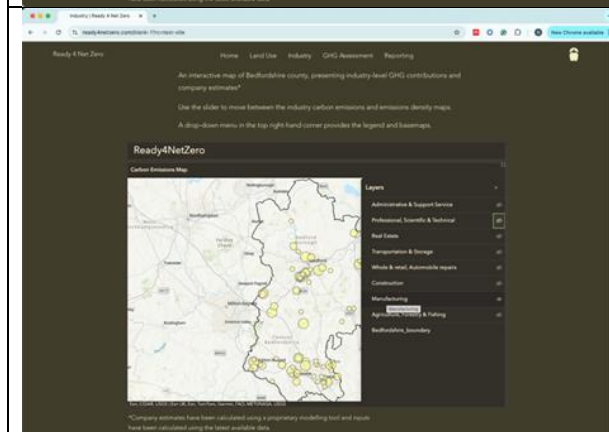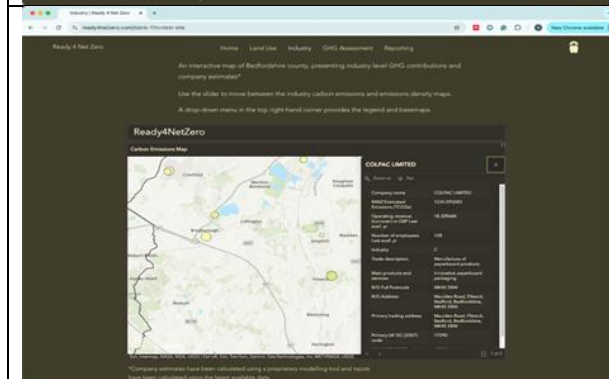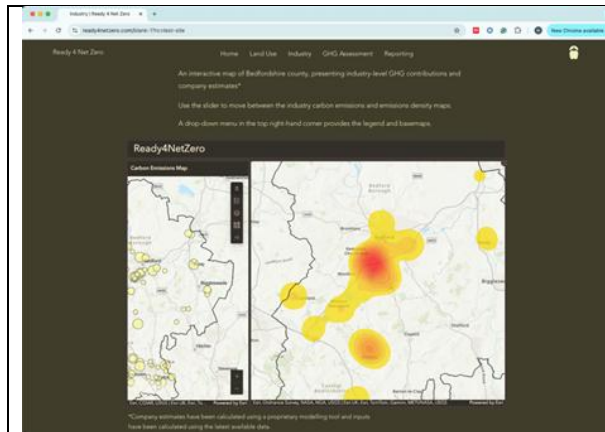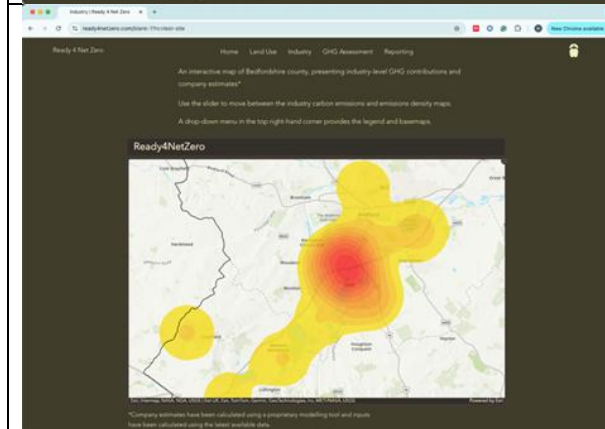
**GHG Assessment**
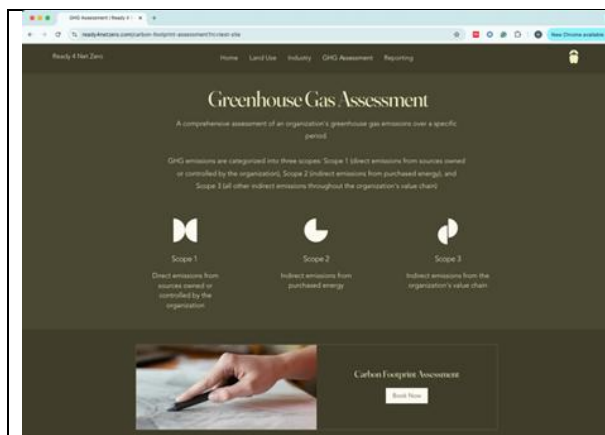
|  | 4.1 The GHG assessment page gives an overview of the GHG accounting method and description of Scope 1, 2, & 3 emissions. |
| --- | --- |

| | |
|---|---|
|  | 4.2 The booking page allows you to choose a preferred date & time with slots that will be based on availability of the R4NZ team. |
|  | 4.3 Once the booking has been scheduled and the pre-assessment information has been provided, the online assessment will begin.<br><br>The first set of questions will request company details, business activity, and contact information. |
|  | 4.4 Upon completion, the dashboard will produce a total GHG calculation as well as the breakdown of scope 1, 2 & 3 emissions data that has been input for each company. |
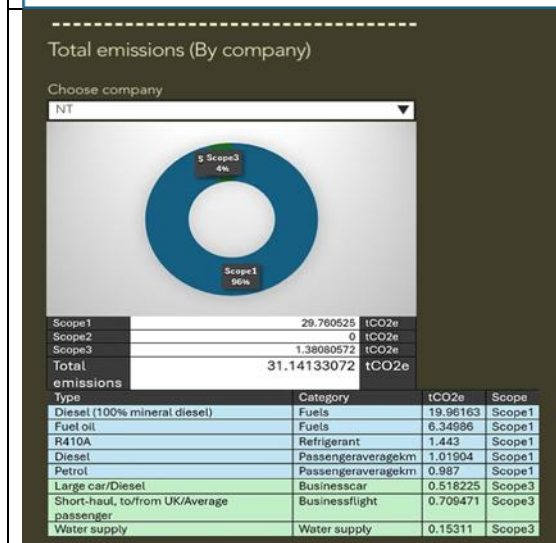
**Reporting:**
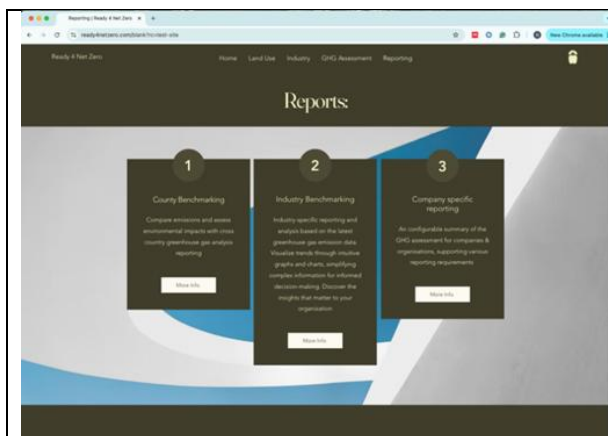
5.1 Three types of reporting modules will be available for users.

The first is county benchmarking, which will offer the ability to compare total county level and sectoral emissions.

As this requires R4NZ modelling and dashboard across other regions, this feature is not yet available to view.



5.2 Option 2: Industry Benchmarking will provide access to the database of companies and industries that have been incorporated into the model.



5.3 The interactive spreadsheet will allow users to filter searches by company name, industry category, operating revenue band, number of employees, and so on.

This screenshot shows a search by industry C – Manufacturing.

| | 5.4 Option 3 produces a summarised version of the GHG assessment for dashboard users, organisational decision maker and stakeholders. |
|---|---|
|  | The report provides the GHG emissions inventory for a company in the year of GHG emissions reporting. |
| | This sample can be accessed through the link below, under the file name 'Dashboard Sample Report 1.pdf' |
| | https://github.com/nasatawat/R4NZ |

| | 5.5 The report provides the overall results, a breakdown of scope 1, 2 & 3 emissions and recommendations for reduction. |
|---|---|
|  | An example of a full report is included in the Appendices for further review. |