ROLLS-ROYCE GREENHOUSE GAS EMISSIONS BASIS OF REPORTING

The purpose of this document is to outline the process for data collection and verification for the greenhouse gas emissions data, as published in our 2022 Annual Report, within our Climate Report 2022 and online at www.rolls-royce.com/sustainability. We calculate our scope 1, 2 and 3 emissions in accordance with the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard and Corporate Value Chain (Scope 3) Accounting and Reporting Standard (GHG Protocol). In so far as possible, any known deviations from the GHG Protocol are documented.

Organisational boundary

Sustainability performance data is collected from across our global operations on an operational control basis. We aim to account for 100% of the data from wholly owned operations and subsidiaries; majority owned jointly controlled entities and associates, where we have an equity stake of ≥51%; and minority owned jointly controlled entities and associates, where we have an equity stake of ≤50% and retain management control.

Acquisitions and divestments

We aim to fully integrate any acquired entities from our data collection, consolidation and reporting processes within the first calendar year following acquisition. For divested entities that are financially classified as "discontinued operations" (divested or held for sale), all current year and historical performance data, including normalised data from the discontinued operation, will be excluded from the consolidation process for the reporting year in which the divestment took place, with the exception of disclosure within our Streamlined Energy and Carbon Reporting (SECR) statement. For any divested entities that are not financially classified as discontinued operations, performance data will be included in current year up to the time of sale completion. In subsequent reporting years all data including historical and normalised data from the divested entity will be excluded from the consolidation process. Where an acquisition or divestment is material, with the inclusion or removal of the entity's data results in a variation that exceeds ± 5% of the original, historical data will be restated where attainable. We aim to restate data for a minimum of two years prior to acquisition or divestment, which may include restating target baselines where appropriate.

Reporting period

The reporting period for our sustainability performance metrics is aligned to our financial reporting period, from 1 January through to 31 December. Where it is not possible to provide complete data within this timeframe, for example due to a lag in energy invoicing for scope 1 + 2 emissions calculations, then actual data is collected for the period from January to October inclusive. This is then adjusted to the full reporting period through the application of an appropriate adjustment factor.

Data quality

The aim of our reporting processes is to provide data that is complete, accurate and relevant to our operations. For any data that is subsequently found to be materially in error following reporting or where conversion factors may have materially changed, then this will be clearly indicated and the data restated for purposes of baselines and trend analysis. For the purposes of materiality, we aim for each reported performance metric to be within ± 5% of the true figure. All reported figures are subsequently reviewed during the next reporting cycle and where this results in a variation that exceeds ± 5% of the original will be restated.

The Audit Committee, as a subcommittee of the Board, reviews and approves the data collection and calculation process and the consolidated metrics prior to external disclosure.

Scope 1 + Scope 2 emissions

Definitions

"Scope 1 emissions" accounts for direct greenhouse gas emissions from sources that are owned or controlled by the company.
"Scope 2 emissions" accounts for indirect emissions associated with the generation of imported/ purchased electricity, heat or steam.

Scope and boundary

Reported emissions include greenhouse gas emissions from our global operations; including our facilities and manufacturing activities.

Units

For the purposes of statutory reporting, greenhouse gas emissions are expressed both as an absolute amount in kilotonnes of carbon dioxide equivalent ($ktCO_2e$) and as an intensity in kilotonnes of carbon dioxide equivalent per million pounds sterling of group revenues ($ktCO_2e$/£m).

Greenhouse gas emissions are expressed as a consolidated figure, adjusted to reflect the full reporting period through the application of an adjustment factor. This is the average of the emissions ratio for each year from 2009 through to 2013 inclusive.

$$\text{Emissions ratio} = \frac{\text{Greenhouse gas emissions for the whole year}}{\text{Greenhouse gas emissions for January through to October inclusive}}$$

The reported figure is subsequently reviewed during the next reporting cycle and, where this results in a material change, the figure is restated to reflect the actual figure for the whole reporting period. Data is reported to whole numbers or at least 2 significant figures.

Collection process

A web-based HS&E Performance Reporting System is used to collect Greenhouse Gas data from each individual site on a monthly basis.

This data is collected on a site by site basis for the period from January through to December inclusive. Where it is not possible to provide complete data with the usual financial reporting period from 1 January to 31 December then actual data is collected for the period from January to October inclusive. This data is then adjusted to the full reporting period through the application of an appropriate adjustment factor.

The first stage in the process is to collect the amount of energy consumed in kilowatt-hours (kWh) for our facilities and in support of our manufacturing activities. This includes grid electricity; electricity supplied by combined heat and power plant (CHP), on-site generated electricity, natural gas, landfill gas, fuel oils, solid fuel, liquefied natural gas (LNG) and liquefied petroleum gas (LPG).

The amount of energy consumed for product development and testing is also captured and includes the above energy types, along with aviation fuel and diesel. For power generation we capture the amount of grid electricity and natural gas used during the operation of our commercial gas-fired power stations.

We also capture emissions of greenhouse gases from our processes, for example, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). These are collected as actual emissions and are measured in kilogrammes. Scope 1 + Scope 2 greenhouse gas emissions data is subject to external verification via a Limited Assurance Engagement.

Scope 3 emissions, category 11 – use of sold products

Definitions

"Scope 3 emissions" accounts for indirect greenhouse gas emissions from sources that occur within the organisation's value chain. "Category 11, use of sold products emissions" accounts for indirect emissions associated with the lifetime emissions occurring in the use of products sold within a given year.

Scope and boundary

Reported emissions cover estimated lifetime CO_2e emissions from units sold within the reporting year. Units are counted as single instances of finished product deliveries of original equipment, predominately gas turbine and reciprocating engines, and excludes components, services or other activities. In some instances parts of the Rolls-Royce Group supply components into third party products; these have not been captured.

Unless otherwise stated, spare engines are excluded on the basis that they are likely to enter operational service only in the event that another engine is removed from service, on either a temporary or permanent basis, and therefore act as a like-for-like replacement. Emissions are calculated net of returns, for the purposes of maintaining consistency with financial disclosures.

As set out in our introduction, our calculation is based on operational control. Finished product deliveries from joint ventures where we have operational control are included unless otherwise stated. For a small number of joint ventures within our Defence Aero business, where we do not have operational control but act as partners in an assembly programme, we have made a judgement to include emissions associated with the engines assembled and delivered by Rolls-Royce. This could be considered a minor overstatement.

Unless a specific entry into service date is known, the point of entry into service is taken as the year of delivery.

Non-product-delivering business units (i.e. New Markets, comprising Rolls-Royce Electrical and Rolls-Royce SMR), along with central functions, are excluded on the basis that they do not deliver finished products or engines to external customers at this point in time.

Units

Emissions are expressed both as an absolute amount in megatonnes of carbon dioxide equivalent ($MtCO_2e$) and as an intensity in megatonnes of carbon dioxide equivalent per million pounds sterling of Group revenues from the sale of original equipment ($MtCO_2e$/£m OE revenue).

Collection and calculation process

CO_2 emissions data from the use of sold products is calculated per individual product type on an annual basis against products sold within the reporting year. Where it is not possible to do so on a per individual product type basis, a judgement is taken to select the most representative values for a product category.

This exercise is performed within the three product-delivering Rolls-Royce business units (Civil Aerospace, Defence and Power Systems). Each business units' detailed calculation methodology, including any known deviations from the GHG Protocol or judgements applied and key data inputs, is detailed in the subsequent tables. Some of the information used to perform these calculations is considered propriety and is therefore outlined but not described in detail. Where appropriate we have indicated external data sources that could be used to corroborate our calculations, although it is likely that any results using these data sources may differ from our reported metrics due to variances in the levels of accuracy and completeness compared to using Rolls-Royce proprietary information.

The calculation tool varies by business according to their internal management arrangements and may be spreadsheet based or utilise bespoke digital tools developed internally.

Each business units' calculation and metrics are consolidated at a Group-level for the purposes of internal quality reviews and approval, and ultimately for external disclosure. Consolidated metrics, and the calculation methodology applied, are tested internally, and are reviewed by the climate steering committee, as a subcommittee of the Executive Team, and by the Safety, Ethics and Sustainability Committee and the Audit Committee, as subcommittees of the Board, prior to external disclosure.

The collection process and the methodology applied for each product type can be summarised as:

Number of units sold within the reporting year
X
Number of hours of operation for each unit over its in-service lifetime
X
Typical fuel usage per hour of operation
X
Lifecycle CO_2e emissions per kg of fuel used
X
Weight-based allocation factor (where applicable)

This calculation methodology relies on a combination of actuals and assumptions, some of which may be subject to change over time as we continue to further refine and mature our emissions calculations.

Detail on each calculation stage, including the assumptions made at the time of our 2022 annual disclosures, is outlined below:

Number of units sold within a given year

The first stage in the process is to collect the total number of product units of each type delivered within the reporting period. This data is collected on a business-by-business basis for each product type for units sold within the period from 1 January through to 31 December inclusive. This is typically counted at point of delivery; when the product is transported from a Rolls-Royce facility, which may be for integration with a larger platform or for storage and therefore may not necessarily be the calendar year the product enters operational service. Where there are deviations this is outlined in the business units detailed calculation methodology tables.

In the rare event where it is not possible to provide complete data with the usual financial reporting period from 1 January to 31 December then actual data is collected for the period from January to October inclusive. This data is then adjusted to the full reporting period through the application of an appropriate adjustment factor based on anticipated deliveries.

Unless stated, spare engines are excluded on the basis that these units only enter operational service when another engine is taken out of service. Units are taken at an engine level, rather than at a component level, on the same basis.

In-year deliveries are taken net of returns. This is to ensure consistency with financial disclosures but also to compensate for any potential lag in returns impact and therefore avoid repeated restatements. In the event that a significant one-off return were to occur, exceeding ± 5% of the original, a judgement will be taken on the inclusion of one-off significant returns and a subsequent restatement.

Number of hours of operation for each unit over its in-service lifetime

An estimate of the in-service life of each product unit is made. This includes an estimate of the service life length of the product unit, and the number of hours of operation in each year of its service life.

Data collected from our own fleets is used to inform our assessment of the likely in-service life of sold products of each product type. Where possible, this is represented statistically as a retirement curve which expresses the gradually reducing likelihood of an individual product remaining in service as time progresses from one year to the next. The form of the retirement curve is calculated for each product type and takes account of very different in-service lifetimes observed in our different business units.

In the event that retirement curve data is not available, an average life expectancy is taken as an alternative; for Civil Aerospace products an assumption of 25 year in-service life is taken and for Defence 35-40 years. For Power Systems this ranges per product type and application, from 5 to around 25 years. Where available, a more specific assumption will be applied per product type.

Typical fuel usage per hour of operation

Data relating to typical fuel consumption per hour of operation is taken from our proprietary engine performance data. In Power Systems, where products can be utilised in multiple applications (i.e. the *mtu* series 4000 has power generation, maritime, agriculture and mining use cases), a judgement is taken based on the average power sold for an application sub-type and the operating profile of a representative engine. This is due to the complexity of the product range and diversity of end-market applications. Representative engines are selected from the individual product type with high sales figures for the sub-application that best matches the average power sold for the entire sub-application.

Lifecycle CO_2e emissions per kg of fuel used

Multiple assumptions about anticipated choice of fuel, and the carbon intensity of that fuel, throughout in-service life, could be taken.

For the purposes of disclosure, two principal fuel pathways have been evaluated. One of these assumes a 100% fossil fuel based pathway out to 2050, the other assumes a near 100% sustainable fuel uptake by 2050. These act as bookends to a pathway that in reality, given the status of current and anticipated future policies including fuel mandates in some applications and geographies, will be somewhere in the middle.

We utilise external emissions conversion factors to convert mass of fuel usage to mass of CO_2e. This conversion factor not only accounts for CO_2 emissions released at the point of use of the fuel by our products, but also accounts for upstream emissions of CO_2 and other long-lived greenhouse gases during non-use phases of the fuel's lifecycle.

Weight-based allocation factor

Engines are classified as intermediate rather than final products, especially in aerospace. Therefore an adjustment factor is applied according to the proportion of the overall vehicle weight attributable to the Rolls-Royce product. For example in our Civil Aerospace business a single Trent XWB-84 engine contributes approximately 3.8% of the total weight of the Airbus A350-900 it powers, therefore a weight-based allocation factor of 0.038 is applied.

We have taken a judgement to account for the total weight of the individual product, i.e. the weight at a whole engine level, which does therefore include engine components that come from our supply chain and are integrated into the final product by Rolls-Royce for delivery. This could be considered a minor overstatement.

At present, weight-based adjustment factors are applied solely to our Civil Aerospace and Defence products; we do not currently have the same level of data concerning the weight of the final platform in order to perform this calculation on the rest of the product range, nor would such an approach be meaningful in some applications, for example in stationary power-generation applications in Power Systems. We estimate that around 60% of products delivered by Power Systems in 2022 were destined for mobile applications, including rail, maritime and land-based transport applications, for which a weight-based adjustment could be considered applicable.

For the purposes of disclosure we present both a weight-based adjusted metric and a total metric with no weight-based adjustment applied.

Intensity metric

Alongside absolute CO_2e emissions disclosures, we disclose a normalised metric to demonstrate the carbon intensity of our portfolio. This is calculated as an emissions ratio:

Emissions ratio:

$$\frac{\text{Total } CO_2\text{e emissions from products sold within the reporting year}}{\text{Revenues originating from the sale of original equipment within the reporting year}}$$

This is calculated and disclosed for each fuel pathway.

Original equipment revenues are taken from the financial disclosures made within our Annual Report. Original equipment revenues have been selected as a denominator as these most closely reflect the delivery of finished products within the reporting year, rather than including revenues associated with service activities relating to the installed fleet.

Detailed calculation methodology – Civil Aerospace

Calculation stage	Business unit approach	Key inputs and data sources
Number of units sold within a given year	OE engines sold within the reporting year, including units sold from joint ventures and entities over which Rolls-Royce has operational control. Within Civil Aerospace, there are no joint ventures that supply finished engine products; the majority supply components into the aerospace supply chain, operation of testing facilities, or provide maintenance, repair and overhaul services. There are a small number of entities that provide components into third party products, for example Europea Microfusioni Aerospaziali S.p.A., is a wholly owned subsidiary supplying precision advanced micro-castings into Rolls-Royce as well as to third parties for non-aerospace applications. Emissions for these components have not been included in our calculations, although we anticipate that any contribution would be immaterial, particularly after a weight-based adjustment is applied. This could be considered a minor understatement. Spare engines are excluded on the basis that these units only enter operational service when another engine is taken out of service. Leased engines are excluded on the same basis. The total volume of OE engine deliveries is published within our financial disclosures each year.	Internal data derived from sales figures
Number of hours of operation for each	An assumption is applied that the operational service life of all Civil Aerospace products begins the quarter following engine delivery. This is to account for a potential timelapse after	Internal data derived from service information

unit over its in-service lifetime	delivery from Rolls-Royce to the airframer for integration before delivery to the final customer. Through our on-wing intelligence and service arrangements, we collect data on the actual operation throughout the engine's in-service life. This includes information on the hours of operation at an individual engine level. Through this information, we build up a picture of the usage intensity of each engine type at different parts of its in-service lifetime over time. For new engine types we can draw upon experience from previous engine types, taking note of the expected route structures on which engines will be deployed. This allows us to make judgements about the future in-service operation and life expectancy of a particular engine type. Information on the expected hours of operation of an engine is amassed internally through proprietary databases but can be corroborated to a certain extent against third party information, such as the Cirium database. The anticipated in-service life of an engine can be derived in a similar manner through known historic information and market intelligence. This is represented statistically as a retirement curve which expresses the gradually reducing likelihood of an individual product remaining in service as time progresses from one year to the next. On average, an individual product type has a operational life expectancy of around 25 years. We corroborate our assumptions against judgements published by airframe manufacturers to ensure consistency.	

Typical fuel usage per hour of operation	Data relating to typical fuel consumption per hour of operation is taken from our known engine performance data, informed by aircraft performance models.	Internal data derived from engine programme information
Lifecycle CO_2e emissions per kg of fuel used	Lifecycle (well-to-wake) CO_2e emissions per unit of fuel energy are multiplied by the amount of fuel energy per kg of fuel.	For fossil fuel based pathway: Lifecycle CO_2e emissions (well-to-wake) per unit of fuel energy taken from SBTi Aviation Guidance August 2021. Typical fuel energy per kg of jet fuel taken from US Department of Energy For sustainable fuel based pathway: reduction in lifecycle (well-to-wake) CO_2e emissions expressed as a percentage of fossil fuel baseline.
Weight-based allocation factor	A weight-based allocation factor is applied according to the engine contribution to the overall platform weight. Engine and aircraft weights are taken from European Union Aviation Safety Agency (EASA) type certificate data sheets. For aircraft weights, we have taken a judgement to use maximum zero fuel weight (MZFW). The weight of fuel within an aircraft can be highly variable, depending on the length and nature of the route, the load of the aircraft, and also varies throughout the duration of a single flight as fuel is consumed. Using MZFW avoids underestimating the engine's contribution to the overall aircraft weight. We use the engine's "dry weight", which is the weight disclosed in the type certificate data sheets.	EASA aircraft certificates

	In some cases a single aircraft or engine type may have more than one sub-type, each with different weights. To avoid under-estimating the engine's share of aircraft weight, we take the heaviest engine option and the lightest aircraft option.	

Detailed calculation methodology – Defence

Our Defence business supplies finished products to customers in two primary markets, Defence aerospace and Defence naval. Where relevant we have distinguished variances in the calculation methodology between the two.

Calculation stage	Business unit approach	Key inputs and data sources
Number of units sold within a given year	The number of units has been defined at a whole product level, with the exception of the LiftSystem within Defence aerospace. LiftSystem is not an entire engine, but components within a unit, and has been included. OE engines sold within the reporting year, including units sold from joint ventures and entities over which Rolls-Royce has operational control. There are a small number of joint ventures in Defence aerospace where we do not have operational control but act as partners in an assembly programme, for which we have made a judgement to include emissions associated with the engines assembled and delivered by Rolls-Royce. This includes programmes such as the Eurofighter Typhoon for which the EJ200 engine is built under the Eurojet Turbo GmbH consortium, of which Rolls-Royce is a partner. There are no leased or returned engines for Defence aerospace or Defence naval. Spare engines are included for Defence aerospace. This is on the basis that spare engine deliveries are not captured as separate sales. This may result in a minor overstatement. For Defence aerospace, the operational service life start point is taken from the year of delivery. For Defence naval, where we only have visibility of the platform entry into service, i.e. the date of ship launch, the units are	Internal data derived from sales figures

	counted within the year of entry into operational service rather than the year of delivery. This includes engine deliveries as well as non-engine units such as gensets and propellers. Components and handling systems are excluded. We recognise this as a departure from the GHG Protocol.	
Number of hours of operation for each unit over its in-service lifetime	Operating hours are calculated based on a combination of internal service information and applied internal subject matter expert judgement. Service lifetime is calculated based on known and estimated years service data. For Defence aerospace, lifetime expectancy of each unit is taken from known customer information held internally. Where this is not available then average data is drawn from published industry data (Cirium and Janes databases). Where this is not possible or applicable to specific products, an assumption is applied of a 35 year in-service life. For Defence naval, an assumption is applied of a 40 year in-service life in the absence of any alternative information.	Internal data derived from service information. Cirium aviation database (for Defence aerospace) Janes military platform database (for Defence aerospace and Defence naval)
Typical fuel usage per hour of operation	Fuel consumption data is calculated based on a combination of internal and customer engine performance information and applied internal subject matter expert judgement. Engine performance information, including fuel consumption, is produced by Rolls-Royce in engine specification documentation by engine type and application, and is considered proprietary information.	Internal data derived from engine programme information, including validation and verification procedures. Customer data derived from average flying cycle information for the EJ200 engine programme.

	Judgement is applied by engine programme chief engineers/ performance engineers.	
Lifecycle CO_2e emissions per kg of fuel used	Lifecycle (well-to-wake) CO_2e emissions per unit of fuel energy are multiplied by the amount of fuel energy per kg of fuel.	For fossil fuel based pathway: Lifecycle CO_2e emissions (well-to-wake) per unit of fuel energy taken from SBTi Aviation Guidance August 2021. Typical fuel energy per kg of jet fuel taken from US Department of Energy For sustainable fuel based pathway: reduction in lifecycle (well-to-wake) CO_2e emissions expressed as a percentage of fossil fuel baseline.
Weight-based allocation factor	A weight-based allocation factor is applied according to the engine contribution to the overall platform weight. For Defence aerospace, this is taken from external sources, including from European Aviation Safety Agency (EASA) aircraft type certificate data sheets per engine and per aircraft type. In the event that external information is not available for a particular platform or application, an average of similar platform weights has been taken. Where possible a maximum take off weight, minus fuel, has been utilised. For Defence naval, a weight-based allocation is made according to externally published displacement information. This is sourced from Janes database and then averaged for small, medium or large ships. Where not available, a judgment of 75% displacement is assumed. Individual ships are then categorised as small, medium or large and the weight-based allocation is	Janes database EASA type certification data sheets Where external information is not available an average of similar platform weights is taken

	applied based on the estimated weight of the Rolls-Royce equipment on board.	

Detailed calculation methodology – Power Systems

Calculation stage	Business unit approach	Key inputs and data sources
Number of units sold within a given year	OE engines sold within the reporting year, including units sold from all legal entities over which Rolls-Royce has operational control (≥51% equity share and contractually secured operational control). There are instances where we have ≥51% ownership but lack the operational control required to obtain relevant emissions data. Selected spare engines are included where there is a separate purchase order in place. Spare engines that are delivered to replace engines in operational service are not included, on the basis that another engine is being removed from service, on either a temporary or permanent basis, and therefore the spare engine acts as a like-for-like replacement. There are no leased engines within the Power Systems portfolio.	Internal data derived from sales figures
Number of hours of operation for each unit over its in-service lifetime	Operating hours are calculated on a sub-application basis based on a representative engine. Representative engines are used instead of actual individual product types due to the complexity of the product range and diversity of end-market applications. For example, a single product category the *mtu* series 4000 has power generation, maritime, agriculture and mining use cases. Within the power-generation application, there are six different power ratings, including standby, prime and continuous power, covering a wide power output range and multiple sub-applications, including data centres, industrial plants,	Internal data derived from sales figures and services database

	residential buildings and decentralised power stations. The application and sub-application, determines the use profile of the product type, and in turn has a significant impact on operating hours, such as if it is used for continuous or back-up power generation only. Representative engines are selected from the individual product type with high sales figures for the sub-application that best matches the average power sold for the entire sub-application. For instance, in the marine sub-application "yacht" the engine model 12V2000M96L was chosen as it is one of the most sold engines in this sub-application between 2012 and 2019 that is also closest to the average power sold in this segment (on average power, see below). Operating hours, alongside the average power output, are set for a representative engine based on information for typical use cases in the sub-application and service data collected from the field. In-service lifetime is calculated based on the operating hours, the average power output factor to determine the useful life for the representative engine within the sub-application. This information is taken from the "time between overhaul" information provided in customer service manuals and used by Power Systems in the context of service agreements.	
Typical fuel usage per hour of operation	Fuel consumption data is derived from the performance data of the representative engine when operating at average power. Engine performance data is produced by Rolls-Royce in engine specification documentation by engine type and application, and is considered proprietary information.	Internal data derived from engineering data

	Average power is taken as the average power output of engines sold across the period 2012-2019 and as consolidated in the Power Systems sales database used for management reporting.	
Lifecycle CO2e emissions per kg of fuel used	Emissions factors are applied for the fossil fuel based pathway and sustainable fuels based pathways. The fossil fuel based pathway assumes use of 100% mineral diesel across the portfolio. In addition to the tank to wake factor of 2,65 kg CO_2/litre diesel, an upstream emission mark-up of 23% (for well-to-tank emissions) of diesel is added. Emission mark-ups are adjusted for other fuels and for hybrid propulsion.	Taken from externally published database, BEIS
Weight-based allocation factor	A weight-based allocation factor is not currently applied in Power Systems. We do not currently have the same level of data concerning the weight of the final platform in order to perform this calculation on the rest of the product range, nor would such an approach be meaningful in some applications, for example in stationary power-generation applications. A judgement has been taken that weight-based or volume-based (marine applications) allocation for mobile applications was not deemed feasible for 2022 disclosure due to the heterogenous final products in which engines are used and the unavailability of the necessary data on these final products. This is partly due to the fact that an important part of Power Systems product portfolio is sold through distributors to the final client.	Not applicable

	We estimate that around 60% of products delivered by Power Systems in 2022 were destined for mobile applications, including rail, maritime and land-based transport applications, for which a weight-based adjustment could be considered applicable.	

Other related metrics

To supplement our GHG Protocol aligned disclosures, we publish additional metrics related to greenhouse gas emissions within the Annual Report and Climate Review. A summary of the calculation methodologies used in the preparation of those disclosures is detailed.

In-year fleet based emissions (scope 3, use of sold products)

Given the high levels of uncertainty and assumptions, as detailed above, that are associated with the GHG Protocol aligned methodology of assessing a forward-looking lifetime projection of CO_2e emissions associated with the sale of finished products within the reporting year, alongside the cumulative nature of carbon in the atmosphere, we consider that it may be more appropriate to assess carbon emissions from the in-year operation of the Rolls-Royce powered fleet within the reporting year.

In addition to the emissions metrics calculated in line with the GHG Protocol, we have additionally calculated and disclosed emissions associated with the in-year fleet operation.

This calculation relies on many of the same underlying data and assumptions as the GHG Protocol aligned methodology, and can be summarised as:

Number of units anticipated to be in active service within the reporting year
X
Number of hours of operation for each unit within the reporting year
X
Typical fuel usage per hour of operation
X
Lifecycle CO_2e emissions per kg of fuel used

In some business units, the number of units anticipated to be in active service within the reporting year is estimated from historical sales combined with an estimate of in-service lifetime

These inputs are taken from internal data sources, such as historical sales data and through-life service agreements. Where actual data is not available, or may be subject to security restrictions such as in defence applications, assumptions are made based on published industry data.

In some cases (particularly Civil Aerospace), we can access data for the actual number of hours of operation delivered by each product type during the course of the year. In such cases there is no need to estimate the number of units in active service, nor to estimate the number of hours of operation for each unit within the reporting year.

We have disclosed in-year fleet based emissions against the two principal fuels pathways utilised under the GHG Protocol methodology; a fossil fuel based pathway and a sustainable fuel based pathway. As the use of sustainable fuels across the fleet increases in response to increasing policy and legislation, such as fuel mandates, a greater divergence between these two metrics should be anticipated in future years.

External data sources

Cirium aviation analytics – database accessed under licence - Cirium – Data and analytics for aviation and travel related industries

Janes defence equipment intelligence – database accessed under licence - Janes | Military platforms and defence equipment intelligence

UK Department of Business, Energy and Industrial Strategy (BEIS), Greenhouse gas reporting: conversion factors - Government conversion factors for company reporting of greenhouse gas emissions - GOV.UK (www.gov.uk)

US Department of Energy, Sustainable Aviation Fuel – Review of Technical Pathways - https://www.energy.gov/sites/prod/files/2020/09/f78/beto-sust-aviation-fuel-sep-2020.pdf