



Rail emissions

Quality and methodology report

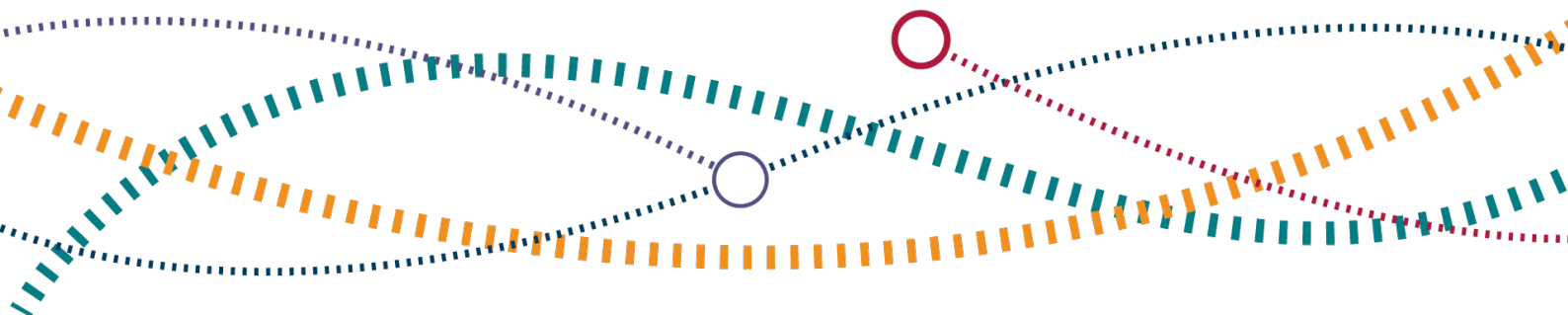
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Introduction

This is a report on the quality and methodology of the annual Rail emissions statistical release and associated data tables. It helps users to understand the quality of our statistics, and also ensures we are compliant with the three quality principles in [the Code of Practice for Official Statistics](#) - Q1: Suitable data sources, Q2: Sound methods, and Q3: Assured quality. This report also provides information on the methodology and data sources used to produce the statistics.

This report covers the following areas:

- Data sources, methodology and definitions – detail on the various data sources, methodology used to compile the statistics and key definitions;
- Historic background – a background to rail emissions statistics and details of any changes throughout the time series;
- Relevance to users – the users of the statistics, and our engagement;
- Accuracy and reliability – the accuracy, data coverage and quality assurance of the statistics;
- Timeliness and punctuality – our timescales for the production and publication of the statistics;
- Accessibility and clarity – the format of our statistics and where they can be found;
- Coherence and comparability – similar statistics published elsewhere and the degree in which the statistics can be compared over time.

Data sources, methodology and definitions

Data sources

Between April 2005 and March 2010, energy consumption data was provided for passenger operators by the Association of Train Operating Companies (ATOC), and for freight operators by Network Rail.

Since April 2010, energy consumption data (electricity and diesel consumption) has been collected from passenger and freight operators:

- Franchised passenger operators
- Non-franchised (open access) passenger operators
- Freight operators
- Eurostar services (UK side).

Passenger kilometre data is sourced from LENNON (Latest Earnings Networked Nationally Over Night) ticketing and revenue system and supplemented with data from train operators who have passenger journeys and kilometres recorded outside of LENNON.

Net tonne kilometres data for the normalisation of freight emissions are sourced from Network Rail.

Vehicle kilometre data are sourced from the Track Access Billing System (TABS), which is used to bill train operators. As well as Network Rail infrastructure, it includes vehicle kilometres travelled on HS1, Core Valley Lines, London Underground, and the East London Line.

Methodology

Passenger and freight operators provide ORR with their total traction electricity (kilowatt hours) and diesel (litres) consumption. The electricity energy usage is generally provided by Network Rail and is based on modelled consumption rates or actual metered usage.

Carbon dioxide equivalent (CO₂e) emissions are estimated from energy consumption data. The consumption data is converted into CO₂e using [standard conversion factors](#) from the Department for Energy Security and Net Zero (formerly Department for Business, Energy

& Industrial Strategy). The emission conversion factors allow activity data (for example, litres of fuel used or kilowatt hours consumed) to be converted into grams of CO₂e. This is a universal unit of measurement that allows the global warming of different greenhouse gases (GHGs) to be compared.

The UK national grid electricity factor changes from year to year as the fuel mix consumed in UK power stations changes, and as the proportion of net imported electricity also changes. These annual changes can be large as the factor depends very heavily on the relative prices of coal and natural gas as well as fluctuations in peak demand and renewables. The conversion factor for electricity decreased by 9% between April 2022 and April 2023, and the conversion factor for diesel was unchanged.

For more information on the latest conversion factors please see the [collection produced by the Department for Energy Security and Net Zero](#).

Prior to conversion into CO₂e, electricity consumption is uprated to assume 1.5% of electricity generated is lost during transmission.

In some instances, consumption data is not provided by operators. In these cases, an estimate of CO₂e is produced based on the number of vehicle kilometres run for passenger operators and the amount of freight moved (measured by net tonne kilometres) for freight operators. This is done by calculating the average level of CO₂e emissions per vehicle and net tonne kilometre respectively for the operators who have provided data and applying this factor to the vehicle kilometres for operators that require estimation. From these an estimate of actual emissions can be calculated.

To calculate the normalised emissions, total CO₂e emissions for passenger and freight operators were derived by dividing by either passenger kilometres or net tonne kilometres, as well as vehicle kilometres. We have vehicle kilometres data by traction type, meaning we are able to present the emissions per electric and diesel vehicle kilometres respectively.

Definitions

- **Traction energy** refers to rolling stock (railway vehicles, including both powered and unpowered vehicles, such as locomotives, carriages and freight wagons) on the rail network, and the energy used to power passenger and freight train movements. Non-traction emissions are excluded, such as heating and lighting in buildings, depots and stations.
- **Diesel** refers to gas, oil, diesel or biofuel volume (in litres) consumed in train movements.
- **Electricity** measures the amount of electricity consumed (in kWh) in train movements. **Kilowatt hour (kWh)** is a unit of energy by calculating electricity usage - one kWh is the electric energy converted by a one kW appliance used for one hour.
- **Passenger kilometres** are calculated by multiplying the number of passenger journeys on a particular flow by the number of corresponding train kilometres between stations.
- **Net tonne kilometres** measures the amount of freight moved on the railway network, taking into account the weight of the load and distance carried.
- **Vehicle kilometres** measures the distance travelled by an individual vehicle (locomotives, carriages, wagons, etc.) on the rail network. It includes vehicle kilometres travelled on Network Rail infrastructure and other railways such as HS1. For example a ten vehicle train travelling one kilometre is measured as one train kilometre, but ten vehicle kilometres.
- **Greenhouse gases** are gases in the Earth's atmosphere which trap heat. They allow sunlight to pass through the atmosphere, but prevent heat from sunlight leaving the atmosphere. This creates a 'greenhouse effect', where the Sun's energy is trapped, which causes the Earth and in particular the oceans, to warm, the higher the amounts of greenhouse gases in the atmosphere, the warmer the Earth becomes. There are seven greenhouse gases covered under the Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃).

Historical background

This was first published in the [National Rail Trends yearbook for the year 1 April 2007 to 31 March 2008](#).

Between 1 April 2005 and 31 March 2010, energy consumption data was provided for passenger operators by the Association of Train Operating Companies (ATOC), now known as the Rail Delivery Group (RDG), and for freight operators by Network Rail.

No data was collected between 1 April 2010 to 31 March 2011. Since 1 April 2011, energy consumption data have been collected directly from the operators meaning there is a break in the time series between 31 March 2010 and 1 April 2011.

Historically, rail emissions statistics were included in the [Rail infrastructure, assets and environmental statistical release](#). From 1 April 2018, a Rail emissions statistical release has been published separately.

Relevance to users

The degree to which the statistical product meets the user needs in both coverage and content.

As with all industries, there is continued and growing interest and emphasis on the environmental sustainability of the rail industry. Normalised emissions data provides a measure of the success of policy on reducing the environmental impact of the rail industry, as well as providing a measure against which other modes of transport can be compared.

The data published in this release is used for many purposes, including [UK greenhouse gas emissions](#) published by Department for Energy Security and Net Zero (formerly Department for Business, Energy & Industrial Strategy). It is also used for the [National Atmospheric Emissions Inventory \(NAEI\)](#) – data is split by intercity rail, regional, freight and coal (in use in heritage rail). The NAEI also publishes rail emissions estimates for England, Wales, Scotland and Northern Ireland. However, these estimates for rail do not include emissions from electricity produced for traction usage.

Defra also use ORR data for their publication of [UK emissions of air pollutants](#) (sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and particulate matter).

ORR's last [user survey](#) took place from mid-January to mid-April 2020. The aim of the survey was to gather feedback on ORR's new data portal; this includes statistical releases, data tables and other supplementary material. There were 42 responses to the survey. ORR created an [implementation plan](#) following the 2020 user survey.

More detailed information on users of ORR statistics and meeting the needs of users is available on our [user engagement webpage](#).

Accuracy and reliability

The proximity between an estimate and the unknown true value.

Data coverage

The data in this release covers all passenger and freight mainline operators in Great Britain. This includes Eurostar, who submit energy consumption data for usage on the UK-side only. The data do not include London Underground, light rail, heritage and charter services.

The energy consumption only contains traction energy consumption (i.e. energy used to power train movements). Non-traction energy consumption, for example from heating and lighting in buildings, depots and stations, are excluded.

Estimates of electricity consumption

Network Rail recover the cost of electric current for traction (EC4T) through traction electricity charges, which are charged to all electric train operators. From April 2010 some operators moved to metered electricity billing, also known as on-train metering (OTM). This means their charges are not based on modelled consumption rates, but are based on the actual metered consumption and usage. This means that operators may sometimes supply estimates rather than actuals for electricity consumption, depending on the metering for their fleet.

Estimates of emissions

Passenger and freight operators provided ORR with either actual electricity and diesel traction consumption data, or their own estimates. Energy consumption data is converted into estimated carbon dioxide equivalent emissions [standard conversion factors](#) from the Department for Energy Security and Net Zero (formerly Department for Business, Energy & Industrial Strategy). The emission conversion factors allow activity data (for example, litres of fuel used or kilowatt hours consumed) to be converted into kilograms of CO₂e.

There are uncertainties associated with all estimates of greenhouse gas emissions. The uncertainty of emissions varies considerably by gas and sector. The conversion factor for electricity varies each year, which affects the emissions calculation. This is due to increased decarbonisation of the UK National Grid.

Estimates for missing data

For the year April 2022 to March 2023, the following were estimated by ORR due to operators not providing data:

- Energy consumption for one freight operator (DB Cargo).
- Energy consumption for one passenger operator (London Overground).

In addition, we produce an estimate for the smaller freight operating companies that we do not request data from. These include operators for the purpose of infrastructure maintenance and other rail-related activities (e.g. transport of rolling stock). These operators represent less than 1% of total freight moved (measured by net tonne kilometres).

Eurostar data is provided for the calendar year. We use this to approximate energy consumption and emissions data for the financial year.

Quality assurance

All data supplied is subject to an extensive quality assurance process, including validation checks to ensure the data meets the required specification and is in line with previous trends. Any arising issues are highlighted with the operator who must confirm the anomalies or correct the data and re-submit if necessary.

The energy consumption data is converted to CO₂e emissions estimates, using the process described in the Methodology section. These calculations are quality assured and tested to ensure they are accurate.

These data are then prepared for publication. The process includes quality assuring the tables and charts produced and providing supporting commentary regarding the key trends, methodology and quality measures. These reports are subject to peer review.

The final stage of the quality assurance process is a sign off by the statistics Head of Profession confirming the data meets the quality standards and are fit for publication.

Revisions policy

Our statement on [orderly release and revisions policy](#) outlines ORR's revision policy. Details of any revisions are available in the [revisions log](#). Further information on revisions and data series breaks can also be found in the data tables.

Timeliness and punctuality

Timeliness refers to the time gap between publication and the reference period.
Punctuality refers to the gap between planned and actual publication dates.

ORR aims to publish these statistics as soon as possible after the end of the financial year. Historically rail emissions statistics have been available on the data portal approximately seven or eight months after the end of the year. However, for the year ending 31 March 2022 statistics were published within five months and we will aim to continue to do so in future.

The [publication schedule](#) available on the data portal outlines the publication dates for National Statistics quarterly and annual statistical releases and other official statistics up to 12 months in advance.

We are committed to releasing our statistics in an open and transparent manner that promotes confidence.

Accessibility and clarity

Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the metadata, illustrations and accompanying advice.

Statistics need to be presented in a clear and understandable form. All our rail statistics data tables can be accessed free of charge on the ORR [data portal](#). Commentary about the statistics and trends are provided in the statistical releases. Interactive dashboards (PowerBI) are also available.

Our data portal and its content meet the accessibility standards of the [Public Sector Bodies Website Accessibility Regulations](#). We support our users by providing the information they need in a way that is clear and accessible. Our statistical releases use plain language, and any technical terms, acronyms and definitions are clearly defined and explained when this is appropriate, to ensure that the statistics can be used effectively. Our data tables are available at the highest level of detail that is practical and in accessible formats. All data tables are available in OpenDocument Spreadsheet (.ods) format. We can also provide data in csv format on request.

Please see the ORR [accessibility statement](#) for further details, including any non-accessible content.

Data tables

All tables associated with this release can be found under the Data tables heading at the bottom of the [Rail emissions page](#).

- Estimates of normalised passenger carbon dioxide equivalent emissions – Table 6100
- Estimates of normalised passenger carbon dioxide equivalent emissions by operator – Table 6103 **(New)**
- Estimates of passenger energy consumption and carbon dioxide equivalent emissions – Table 6105
- Estimates of passenger energy consumption and carbon dioxide equivalent emissions by operator – Table 6108 **(New)**

- Estimates of normalised freight carbon dioxide equivalent emissions – Table 6110
- Estimates of normalised freight carbon dioxide equivalent emissions by operator – Table 6113 **(New)**
- Estimates of freight energy consumption and carbon dioxide equivalent emissions – Table 6115
- Estimates of freight energy consumption and carbon dioxide equivalent emissions by operator – Table 6118 **(New)**

Coherence and comparability

Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain.

Other related ORR data

Passenger usage data is published on the [Passenger rail usage](#) page on the data portal. This includes passenger kilometres by operator and passenger vehicle kilometres by operator.

Freight usage data is published on the [Freight rail usage and performance](#) page on the data portal. This includes the freight vehicle kilometres by operator.

The [Rail infrastructure and assets](#) page on the data portal. This includes information on track and route length, including the proportion of the rail network which is electrified.

Other related environmental data

The Department for Energy Security and Net Zero (formerly Department for Business, Energy & Industrial Strategy) publish [estimates of UK territorial greenhouse gas emissions](#).

The Department for Environmental, Food & Rural Affairs (Defra) publish [data on emissions of air pollutants](#) in the UK. This includes data for transport and railways.

The National Atmospheric Emissions Inventory (NAEI) publish the [Greenhouse Gas Inventory](#). It covers the UK's greenhouse gas emission estimates since 1990, broken down by industry. Rail data is included in the inventory, split into emissions from coal, freight diesel, intercity diesel and regional diesel (gas oil). There is also an interactive map which shows CO₂e emissions by local authority with an option to filter for emissions from diesel railways.

The Office for National Statistics publish [UK greenhouse gases and total emissions](#) by industry. This covers the period 1990 to 2020. This data is used in [UK Environmental Accounts](#), which measures the impact of economic activity on the environment.

There is a list of resources relating to historical [UK greenhouse gas emissions](#).

Links to other data sources are available in our new [Rail emissions data catalogue](#).

European data

The United Nations Framework Convention on Climate Change (UNFCCC) publishes [national inventory submissions](#) for greenhouse gas emissions.

The European Environment Agency (EEA) publishes [data on greenhouse gas emissions](#) for transport from the EU. Railway emissions (which only include emissions from diesel trains) have halved since 1990, but they constitute a small proportion of overall transport emissions.

Length of comparable time series

Measures	Start of time series	Any break in time series
Normalised passenger carbon dioxide equivalent emissions (Table 6100)	1 April 2005	No data for 1 April 2010 to 31 March 2011. Change in collection from 1 April 2011, i.e., energy consumption data is collected directly from the operators.
Normalised passenger carbon dioxide equivalent emissions by operator (Table 6103)	1 April 2021	None
Passenger energy consumption and carbon dioxide equivalent emissions (Table 6105)	1 April 2005	No data for 1 April 2010 to 31 March 2011. Change in collection from 1 April 2011, i.e., energy consumption data is collected directly from the operators.
Passenger energy consumption and carbon dioxide equivalent emissions by operator (Table 6108)	1 April 2021	None
Normalised freight carbon dioxide equivalent emissions (Table 6110)	1 April 2005	No data for 1 April 2010 to 31 March 2011. Change in collection from 1 April 2011,

Measures	Start of time series	Any break in time series
		i.e., energy consumption data is collected directly from the operators.
Normalised freight carbon dioxide equivalent emissions by operator (Table 6113)	1 April 2021	None
Estimates of freight energy consumption and carbon dioxide equivalent emissions (Table 6115)	1 April 2005	No data for 1 April 2010 to 31 March 2011. Change in collection from 1 April 2011, i.e., energy consumption data is collected directly from the operators.
Estimates of freight energy consumption and carbon dioxide equivalent emissions by operator (Table 6118)	1 April 2021	None



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