



# Rail infrastructure, assets and environmental: Quality and Methodology Report

Release Date: 24 October 2017



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# Introduction

This is a report on the quality of the Rail infrastructure, assets and environmental statistical release and accompanying data portal tables. This helps users to understand the quality of our statistics, and also ensures ORR is compliant with principle 4 of the Code of Practice for Official Statistics<sup>1</sup>.

The quality report covers the following areas:

- **Methodology** – detail on the various data sources and methodology used to compile the statistics
- **Historic background** – a background to each statistic and detail of changes throughout the time series
- **Relevance of the data** - the users of the statistics, and user-engagement we have done
- **Accuracy and reliability** – the accuracy of each statistic
- **Timeliness and punctuality** – our timelines for the production, quality assurance and publication of each statistic
- **Accessibility and clarity** – the format of our statistics and where they can be found
- **Coherence and comparability** – comparisons to similar statistics published elsewhere

The following data is in scope of this report:

- **Infrastructure on the railway** – The number of kilometres of route open and for passenger and freight traffic and the length of route which is electrified. The number of track kilometres is also shown. Source: Network Rail
- **Mainline stations in Great Britain** - Source: Network Rail from 1985-86 to 1996-97 and ORR's Estimates of Station Usage from 1997-98 to 2015-16;
- **Average age of rolling stock** – including rail vehicles leased to franchised train operating companies by rolling stock leasing companies (ROSCOs), but

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<sup>1</sup> Principle 4: Sound methods and assured quality. Statistical methods should be consistent with scientific principles and internationally recognised best practices, and be fully documented. Quality should be monitored and assured taking account of internationally agreed practices. The Code of Practice can be accessed here <http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html>

excludes locomotives and Driving Van Trailers. Source: Department for Transport (DfT);

- **Environmental** – Carbon dioxide equivalent (CO<sub>2</sub>e) emissions for passenger and freight operators. Passenger data is normalised to show the average CO<sub>2</sub>e emission per passenger kilometre. Freight data is normalised to show the average CO<sub>2</sub>e emission per net tonne kilometre of freight. Source: passenger operators, Eurostar, freight operating companies, the industry ticketing database (LENNON), Association of Train Operating Companies (ATOC) and Network Rail.

# Methodology

## Infrastructure on the railways

### Route open for traffic

Since 2004-05 route open for traffic and the length of electrified route is derived from around a quarter of a million GEOGIS records. GEOGIS is the Network Rail infrastructure asset register database which contains information on the physical location and type of track using four digit track ID's to identify each individual location by track direction, track use, and track number. Whilst the GEOGIS system provides a very accurate measure of the true length of routes there may be small discrepancies from true length due to rounding. There is a drop in the measure from 2004-05 to 2005-06 caused by data cleansing of GEOGIS during 2012-13.

Prior to 2004-05 route length data and electrification data was collected using various systems and collected on a semi-annual basis. These systems, whilst often the most accurate measures available at the time would not have provided as accurate a measure as the GEOGIS system and there is therefore a break in the time series between 2003-04 and 2004-05.

There is a break in the time series between 2006-07 and 2007-08 due to a new methodology where the route classification reference data was revamped.

### Track kilometres on the rail network

Track kilometres are the total length of the track on the mainline network. This takes into account multiple track routes (e.g. for each route kilometre where there is double track, there are two track kilometres). The time series goes back to 1999-00, which is as far back as the data is available. Track kilometres are often used by Network Rail within their [annual return](#) to describe year-on-year changes in track.

### The number of stations on GB mainline rail network

From 2015-16 ORR changed the data source for the number of mainline stations which are open in Great Britain. This is now sourced from [Estimates of station usage](#), which is also published by ORR. Previously the number of stations was sourced from Network Rail via the Operational Property Asset System (OPAS). OPAS was not designed for this type of statistical reporting and the estimates of station usage data is of higher quality for the following reasons:

**Station usage data includes mainline stations only.** This includes stations managed by Network Rail, Transport for London (TfL), and other organisations on the mainline railway. Only stations opened throughout the year are included, and closed stations are excluded.

**Station usage data excludes those on the tram network.** Both the Greater Manchester tram network and Tyne and Wear metro are excluded from station usage as they are not on the mainline rail network. However, they were included in the data provided by Network Rail.

**No double counted stations within station usage data.** Each station is counted once in the station usage dataset; whereas the Network Rail source had some double counting due to a station being counted twice as higher and lower levels.

**Station usage data has clear methodology documentation for every year.** Whereas the Network Rail data has a lack of documentation and some data quality issues throughout the time series.

**Not all new stations are recorded in the Network Rail source.** Network Rail source the data from Operational Property Asset System (OPAS). Stations are included if they were deemed to be “live” and those with an operation status of “operational”, “null” and “combined”.

### Comparison of the time series between the two data sources

	Source: Network Rail	Source: ORR's Estimates of Station Usage
1985-86	2,385	
1986-87	2,405	
1987-88	2,426	
1988-89	2,470	
1989-90	2,471	
1990-91	2,488	
1991-92	2,468	
1992-93	2,468	
1993-94	2,493	
1994-95	2,489	
1995-96	2,497	
1996-97	2,498	
1997-98	2,495	2,518
1998-99	2,499	2,515
1999-00	2,503	2,491
2000-01	2,508	2,498
2001-02	2,508	2,496
2002-03	2,508	2,497
2003-04	2,507	2,498
2004-05	2,508	2,504
2005-06	2,510	2,508
2006-07	2,520	2,522
2007-08	2,516	2,522
2008-09	2,516	2,522
2009-10	2,516	2,529
2010-11	2,532	2,535
2011-12	2,535	2,537
2012-13	2,532	2,539
2013-14	2,550	2,541
2014-15	2,552	2,543
2015-16	2,556	2,557

## Average age of rolling stock

The average age of rolling stock is sourced from DfT and is calculated by adding up the individual ages of all rail vehicles in service and dividing by the total number of rail vehicles. The age of each rail vehicle is the time between the date of entering into service and the end of each quarter, e.g. a vehicle which entered service in January 2000 would be, at the end of 2001-02 Q1 (30 June 2001), 1.5 years old. The date of entry into service is deemed to be the first day of the quarter in which the rail vehicle came into service; e.g. all vehicles which entered service between 1 April 2001 and 30 June 2001 are given a service entry date of 1 April 2001.

For rolling stock for which the date of entry into service is not available (mostly rail vehicles introduced prior to privatisation) the date used is either:

- 1 January in the year of manufacture of the relevant class of rail vehicle; or
- The midpoint of the period over which the relevant class of rail vehicle was manufactured, e.g. if a class of rail vehicle was manufactured over the time frame March 1972 to March 1976 then the midpoint would be March 1974.

A vehicle drops out of the calculation when its lease either expires or is terminated.

## Environmental

For the time period between 2005-06 and 2009-10, energy consumption data was provided for passenger and freight operators by the Association of Train Operating Companies (ATOC) and Network Rail respectively.

Since 2011-12, energy consumption data have been collected directly from the operators themselves:

- Franchised passenger operators;
- Open access passenger operations;
- Freight operations; and
- Eurostar services (UK side).

These operators provide us with their total traction electricity (kWh) and diesel usage (litres) consumption. Traction energy refers to rolling stock on the Great Britain rail network and the energy used to power passenger and freight train movements.

We convert the actual energy consumption data into CO<sub>2</sub>e using standard conversion factors from the Department for Environment, Food and Rural Affairs (DEFRA) Greenhouse gas conversion factors<sup>2</sup>. The conversion factors allow activity data (e.g. litres of fuel used, kWh consumed) to be converted into kilograms of carbon dioxide equivalent (CO<sub>2</sub>e) which is a universal unit of measurement that allows the global warming potential of different greenhouse gases (GHGs) to be compared.

Prior to conversion into CO<sub>2</sub>e electricity consumption is uprated assuming 1.5% of electricity generated is lost during transmission. In some instances actual consumption data is not provided by operators. In these cases an estimate of CO<sub>2</sub>e is made based on the number of train kilometres each operator runs. This is done by working out an average level of CO<sub>2</sub>e emissions per train kilometre for the operators who have provided data and applying this factor to the train kilometres for operators that require estimation. From these an estimate of actual emissions can be calculated.

To calculate the final normalised output, the total CO<sub>2</sub>e emissions for passenger and freight operators were normalised by passenger kilometres and net tonne kilometres respectively. Passenger kilometre data is taken from passenger kilometre data published in the Passenger Rail Usage statistical release, and Eurostar and Heathrow Express data submissions. Net tonne kilometres data for the normalisation of freight emissions is source from the dataset published in the Freight Rail Usage statistical release.

For the purposes of the calculation of normalised CO<sub>2</sub>e emissions the following definitions are employed.

- Diesel – gas, oil, diesel or biofuel volume (litres) consumed in train movements (separate volumes for each fuel type used);
- Electricity – electricity consumed (kWh) in train movements;
- Passenger kilometre – moving one passenger, one kilometre; and
- Net tonne kilometre – moving one tonne of freight, one kilometre.

For the 2016-17 release a consistency review has been undertaken to ensure that methodologies have been applied consistently across the time series. As a result of this minor revisions have been incorporated into the data for 2011-12 onwards. For further information please see the [revisions log](#).

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<sup>2</sup> <http://www.ukconversionfactorscarbonsmart.co.uk/>



# Historical background –

## Infrastructure on the railways

### Route open for traffic and track kilometres

Route kilometres are the total extent of routes available for trains to operate. This is different to track kilometres which takes into account multiple track routes (e.g. for each route km where there is double track, there are two track km).

Great Britain has the 5<sup>th</sup> longest rail network in Europe, with the total length of railway lines only shorter than Germany, France, Poland and Italy.<sup>3</sup> Since the first locomotive-hauled public railway opened in 1825 the network has been continually developing with the total length of the network reaching a peak of 37,720 km in the 1910s.

Historically one of the most significant impacts on the length of route was the effect of British Railways Board reports *The Reshaping of British Railways* (1963) and *The Development of the Major Railway Trunk Routes* (1965) which were written by Dr Richard Beeching and led to cuts to the network more commonly known as the “Beeching cuts”. The first of these reports recommended that 9,700 km, mostly rural and industrial lines, should be closed whilst the second concluded that only 4,800 km of the trunk railway network, now mainline network, (out of a total of 12,100km) should be invested in. Although not all the recommended closures were implemented, the railway network length decreased dramatically. A number of the closed lines have been reopened over the past 20 years; however the length of the network remains much lower than at its peak.

The entire rail network is not open to both passenger and freight traffic as some routes are open to freight traffic only and as such the length of route open for each type of traffic is reported. Some of the network is only open for freight train movements as it is deemed that there is not adequate passenger demand for passenger services to be operated on these routes.

The entire network is not electrified, with non-electrified route requiring trains to be powered by diesel or other non-electrical methods. The electrification of routes has the benefit, over diesel routes, of lower fuel and maintenance operating costs, higher performance leading to journey time reductions, higher reliability and availability and lower leasing costs. Electric trains also tend to be quieter and have a significant role in reducing carbon emissions, both of which are beneficial to users, and non-users of the rail network.

Electrified route can be either supplied by alternating current (AC) or direct current (DC). Alternating current is supplied from overhead power lines, usually at 25,000 volts. AC

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<sup>3</sup> Eurostat – [Total length of railway lines](#)

electrification through overhead lines can be seen on the East Coast Main Line between London and Edinburgh and West Coast Main Line.

Direct current electricity is supplied from additional rails at track level (often called “3<sup>rd</sup> rail” though some systems also feature a 4<sup>th</sup> rail) which are in contact with electricity collection equipment on the train, not its wheels, with current usually supplied at 650 volts. DC electrification can be seen on the routes in Sussex and Wessex. There is also 39 km of electrified route which is supplied through overhead DC at 1,500 volts which powers the Tyne and Wear Metro.

In addition to the measures of route open to passenger and freight traffic and the length of route, electrified network capability is also measured by linespeed capability, gauge capability, route availability and electrified track capability.

- Linespeed capability - a measure of the length of running track based on speed bands;
- Gauge capability – a measurement of the length of route capable of accepting different freight vehicle types and loads by reference to size;
- Route availability – a measurement of the length of track capable of accepting different loaded vehicle types; and
- Electrified track capability – a measure of the length of running track.

These measures of network capability are not presented in the associated statistical release but can be found in the [Network Rail Annual Return](#).

## Passenger Stations

The number of passenger stations serving the rail network grew initially as the network grew in the latter half of the 19<sup>th</sup> Century and early part of the 20<sup>th</sup> Century, but as was experienced with the reduction in route length the number of stations decreased dramatically following the Beeching cuts. The cuts recommended closing over 2,300 stations on lines which were to close and also some on lines which were to remain open. As with the recent reopening of some routes, a number of these stations have also been reopened over the past 25 years. The overall number of stations provides an indication of catchment of rail services with an increased number of stations indicating a growth in the catchment area of the rail network and associated opportunity for increased rail usage.

Stations, particularly National Hubs and National Interchanges are playing an increasing important role; not just acting as a point of access to the rail network, but a growing number are also becoming transport hubs integrating with other modes of transport. The growth of retail and eating outlets at stations also indicates the increasing role stations are playing both for passengers, and non-passengers in serving needs other than just travelling, as well as acting as a vital income source for Network Rail.

The rail network has over 2,500 open stations which are owned and operated by either Network Rail or a train operating company. Network Rail own and manage 18 stations; eight “National stations” which serve large cities outside of London and 10 “London Stations” which are the main terminus of routes into London.<sup>4</sup> Whilst Network Rail remain the landlord for almost all other stations they are managed by train operating companies, tending to be those which operate the most services using the station. A list of the station facility owners (SFOs), i.e. who manages the station, can be found in the [Estimates of station usage](#) statistics produced by ORR, which also provides estimates of the number of entries, exits and interchanges at each station.

To assess the average condition of stations the station stewardship measure (SSM) is used, which is calculated by assessing the remaining life of key elements of the station by visual inspection and combining into an overall score. The SSM is a regulated output which means the ORR assesses Network Rail’s success on whether it has achieved the outputs specified in the final determination.<sup>5</sup> We publically report on Network Rail’s progress in the Network Rail Monitor<sup>6</sup>.

## Average age of rolling stock

Since the privatisation of British Rail in 1994 the rolling stock is mostly owned by three private rolling stock leasing companies (ROSCOs)<sup>7</sup>. These companies lease the rolling stock to the train operating companies (TOCs) who then deploy it on their services. For the most part, the train companies procure the rolling stock directly from the rolling stock companies. In recent years the Government has also procured large rolling stock orders directly from manufacturers for schemes such as the InterCity Express Programme, Thameslink and Crossrail. ROSCOs have a responsibility to help develop services by phasing out old and aged rolling stock to make way for modern, more convenient and safer trains.

## Environmental

First published in the 2007-08 National Rail Trends yearbook, normalised passenger and freight carbon dioxide equivalent (CO<sub>2e</sub>) emissions provide a measure of energy consumption. 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.

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<sup>4</sup> Stations owned and run by Network Rail – [Our Stations](#)

<sup>5</sup> ORR – [Periodic Review and final determination](#)

<sup>6</sup> ORR – [Network Rail Monitor](#)

<sup>7</sup> The three ROSCO’s are [Angel Trains Ltd](#), [Eversholt Rail Group](#) and [Porterbrook Leasing Company Ltd](#)

There was no data for 2010-11 due to a change in the data collection process, consequently comparisons to emissions in earlier years should be made with caution.

# Relevance

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

This statistical release and the accompanying data published on our data portal are used by a range of individuals for planning, analysis, decision making and data validation.

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.*

### Infrastructure on the railways

Please see the [methodology](#) section for detail on changes in methodology throughout the time series which affects the accuracy and reliability.

### Average age of rolling stock

Please see the [methodology](#) section for detail on the average age of rolling stock.

### Environmental

Normalised passenger and freight CO<sub>2</sub>e traction emissions are calculated from actual and estimated data for energy consumption from passenger and freight operators. Where actual energy consumption data has not been provided by a passenger or freight train operating company an estimate has been used based using the train kilometre data for each train and freight company, and using this as a proxy to estimate CO<sub>2</sub>e emissions. The estimate of CO<sub>2</sub>e which is applied to the number of train kilometres is calculated using a conversion factor derived by taking the aggregate sum of CO<sub>2</sub>e emissions calculated from operators' actual consumption data and dividing by the aggregate sum of their actual train kilometres.

Application of these estimates will result in discrepancies between the actual CO<sub>2</sub>e emissions and the published emissions data. The table below shows the number of train or freight companies we provided estimates for due to no data received from those companies.

Year	Number of estimations
2011-12	3 passenger companies (Grand Central, Heathrow Express and National Express East Anglia).  5 freight companies (BBRM, Devon and Cornwall Railways, Europorte, Harsco and Network Rail Recoveries).
2012-13	3 passenger companies (First Hull trains, Grand Central and Heathrow Express).  5 freight companies (BBRM, Devon and Cornwall Railways, Europorte, Harsco and Network Rail Recoveries).
2013-14	2 passenger companies (Grand Central and Heathrow Express).  7 freight companies (BBRM, Colas Freight, Devon Cornwall Railways, Europorte Channel, Harsco, Network Rail Recoveries, West Coast Rail Freight).

2014-15	2 passenger companies (Grand Central and Heathrow Express).  5 freight companies (BBRM, Colas Freight, Devon Cornwall Railways, Europorte Channel, West Coast Rail Freight).
2015-16	3 passenger companies (Arriva Train Wales, Grand Central and Heathrow Express).  5 freight companies (BBRM, Colas Freight, Devon Cornwall Railways, Network Rail Recoveries and West Coast Rail Freight).
2016-17	3 passenger companies (Arriva Train Wales, Caledonian Sleeper and Heathrow Express).  5 freight companies (BBRM, Colas Freight, Devon Cornwall Railways, Network Rail Recoveries, Rail Operations Group and West Coast Rail Freight).

The calculation of CO<sub>2</sub>e emissions uses conversion factors which allow activity data (e.g. litres of fuel used, kWh consumed) to be converted into kilograms of carbon dioxide equivalent (CO<sub>2</sub>e). These conversion factors are averages for activity type which will vary from the actual emissions of the rail industry, which will be dependent on the consumption efficiency of each reporting element. For more detail on the conversion factors please see the guideline to DEFRA/DECC's GHG Conversion Factors for Company Reporting<sup>8</sup>.

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<sup>8</sup> <http://www.ukconversionfactorscarbonsmart.co.uk/>

## 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.*

The data contained within this statistical release is published at the same time on the ORR data portal approximately seven months after the end of the financial year.

The [publication schedule](#) outlines the publication dates for all ORR's National and Official Statistics (quarterly and annual) up to 12 months in advance.

These publication dates are determined by availability of the data and are the earliest possible dates which we can publish the information. Sufficient time is required to collect, process, quality assure and sign off the data and to prepare the data report itself. In the event of a change to a pre-announced release date, attention would be drawn to this on the data portal together with a full explanation of the reason for the change.



## 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.***

All rail finance statistics can be accessed on the [ORR Data Portal](#) free of charge.

***The procedures and policy used to ensure sound confidentiality, security and transparent practices.***

ORR is fully compliant with the Statistics and Registration Service Act 2008 and principle 4 of the Code of Practice for Official Statistics. More information is available on our [user engagement](#) webpage.

# 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.*

## Rail infrastructure

Rail infrastructure data is obtained from a single data source, Network Rail GEOGIS database of railway infrastructure assets. The average age of rolling stock is also obtained from a single source, the DfT, for each TOC and by sector.

Network Rail also publish a range of infrastructure statistics available in the [Network Rail Annual Return](#).

Passenger station data are now sources from Estimates of station usage rather than Network Rail as the data is of better quality. See the [methodology](#) section for more information.

## Environmental

Environmental data is sourced from a numerous data sources. Absolute emissions data is sourced directly, where supplied, from the franchised train operating companies, open access operators, Eurostar, and operational freight operating companies. Other data sources are LENNON, for passenger mileage data, Network Rail, for net tonne kilometre data, and DEFRA for standard rates for converting energy consumption into CO<sub>2</sub>e.

## Comparability to European data

The objective nature of transport infrastructure and assets data means that comparable data can be obtained across the majority of European countries. Eurostat are the statistical office of the European Union and comparable data on railway transport infrastructure and measures of railway transport equipment and available from the Eurostat database.

## Length of Comparable Time Series

Measure	Time Series	Data Portal Table
Estimates of normalised passenger and freight CO <sub>2</sub> e emissions – annual data	2005-06 to 2016-17 No data available for 2010-11. There is a time series break from 2011-12	<a href="#">Table 2.100</a>
Estimates of passenger and freight energy consumption and CO <sub>2</sub> e emissions – annual data	2005-06 to 2016-17 No data available for 2010-11. There is a time series break from 2011-12	<a href="#">Table 2.101</a>
Average age of rolling stock by sector – quarterly data	2000-01 Q2 to 2016-17 Q4	<a href="#">Table 2.30</a>
Average age of rolling stock by franchised train operating company – quarterly data	2007-08 Q4 to 2016-17 Q4	<a href="#">Table 2.31</a>
Infrastructure on the railways – annual data	1985 to 2016-17 for route open data. There is a time series break between 2003-04 and 2004-05, and 2006-07 and 2007-08.	<a href="#">Table 2.52</a>
Mainline stations in Great Britain – annual data	1985-86 to 2016-17  From 2015-16 the source of the data has changed. From 1997-98 onwards ORR's Estimates of Station Usage is used. Prior to this Network Rail data is used the source. Please see the methodology section for more information.	<a href="#">Table 2.53</a>



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