APPLICATION BY RIVEROAK STRATEGIC PARTNERS LTD (“THE APPLICANT”)

FOR AN ORDER GRANTING DEVELOPMENT CONSENT FOR THE UPGRADE AND REOPENING ON MANSTON AIRPORT

PINS Reference Number: TR020002

WRITTEN SUMMARY OF STONE HILL PARK LTD’S ORAL SUBMISSIONS PUT AT THE HABITATS REGULATIONS ASSESSMENT, BIODIVERSITY AND OTHER ENVIRONMENTAL ISSUES HEARING HELD ON 5 JUNE 2019

1. BACKGROUND

1.1. The Issue Specific Hearing 6 (the “Hearing”) was held at 02:00pm on 5 June 2019 at Discovery Park, Sandwich, CT13 9FF.

1.2. The Hearing took the form of running through items listed in the agenda published by the Examining Authority (the “ExA”) (the "Agenda").

1.3. The format of this summary follows that of the Agenda and only refers to parts of the Agenda where Stone Hill Park Limited (“SHP”) made substantive comments.

1.4. Present from SHP was Jamie Macnamara and Iain Mackintosh.

2. AGENDA ITEM 4 – EIA MATTERS

Air Quality

2.1. The Applicant has not assessed the likely worst case effects of its proposed development.

2.2. In SHP’s comments on the Applicant’s answer to third written question ND.3.9, it is explained that there is a fundamental error in the Azimuth Report [APP-085] that infects the environmental effects assessed in the application (see Appendix 1). In summary, the forecast contained in the Azimuth Report is wholly incompatible with the E-commerce integrator business model (i.e. to import freight to serve the south east of England) set out in the Applicant’s recent oral and written submissions. This has a material impact on both the split of import / export tonnages and the fleet mix on which the environmental assessments are based (set out in Appendix 3.3. of the ES [APP-044]).

Fleet Mix

2.3. The Applicant has assumed that 25% of all cargo ATMs (1,456 in Year 2, rising to 4,310 in Year 20), would be ATR-72 integrator feeder **turboprop** aircraft. In previous submissions, SHP’s aviation experts have clearly explained that ATR-72s would not be required for the E-commerce integrator model now proposed by the Applicant. The Applicant has not been able to explain what these ATMs would do, where they would fly and what they would carry, despite this issue being raised by SHP in the Need and Operations Hearing on 21 March 2019 and multiple subsequent submissions

2.4. This is critically important as ATR-72 aircraft are by far the smallest aircraft included in the fleet mix having a maximum landing weight on 22 tonnes, compared to an average of c.170 tonnes for the other cargo aircraft included in the fleet mix (see analysis contained in Appendix 1).

2.5. The environmental effects of replacing up to 4,310 ATR-72 ATMs with any other aircraft in the fleet mix (which are jet aircraft rather than turboprop aircraft) would be material, and have not been assessed. For additional context, Part 2 of Appendix 1 of the Noise Mitigation Plan [REP6-022] shows that the ATR-72 aircraft are the quietest of all aircraft shown – they are shown to be either exempt or have the lowest noise quota count of 0.25.

2.6. Another consequence of the E-commerce model is that the split of imports and exports contained within the application documents would be materially incorrect (i.e. the split would need to be heavily weighted towards imports rather than the roughly equal split shown in the application documents) and the ES will have assessed the wrong effects.

2.7. For example, we would refer the ExA to Section 6.4 of Volume 15 – Transport Assessment (Part 2) [APP-061], which sets out the forecast HGV movements. These are based on the import and export tonnages taken from the Azimuth report (see Table 6.3), which are a broadly evenly split. Any change to the split of exports and imports would have a material impact on the Applicant's *"efficient working"* assumption contained in paragraph 6.4.8, such that applying the same assumptions to an import weighted forecast would increase HGV movements, demonstrating that the likely worst case has not been assessed.

Biodiversity

2.8. At the point the application was accepted on 14 August 2018, there were significant gaps in survey data which undermined the validity and robustness of the ES. These gaps were identified prior to submission by both SHP and the Planning Inspectorate and RSP had chosen to submit the Application without addressing those criticisms. The Applicant has made no effort to address this through the examination.

2.9. In its Cover Letter submitted at Deadline 1 [REP1-001], the Applicant enclosed (as Enclosure 1) a *"timeline for the provision of the outstanding ecological survey data required to confirm the worst case ecological impact assessment, in response to the request on page F1 of the Rule 6 letter issued by the ExA on 11 December 2018 ('Rule 6 letter')."*

2.10. The Enclosure 1 set out a timeline for completion of the numerous outstanding surveys, and in section 2.2 Programme it stated *"[I]t is proposed that the survey information gathered, the assessment and any changes to the proposed mitigation are issued to the Examining Authority by May (Deadline 7), so that there is sufficient time for interested parties to comment upon it before the end of the examination."*

2.11. As set out in paragraph 10.5 of SHP's relevant representations [RR-1601] it would not be lawful or appropriate for survey results to be deferred until a later decision making stage;

"Case law (R v Cornwall County Council ex p Hardy[1]) has long established that decision making cannot be taken without appropriate species surveys, since surveys might reveal significant adverse effects to be likely on protected species. The case clearly establishes that it is not lawful or appropriate for survey results to be deferred until a later decision making stage (in this case on discharge of requirements) as the Secretary of State will not be in a position to know whether the ES before him represents the full environmental information required by the EIA Regulations, or whether the proposed mitigation is adequate, before determining the Application."

2.12. As explained in SHP's answer to second written question Ec.2.2 [REP6-053], the Applicant has made no effort meet its commitment to complete the outstanding ecology surveys.

Climate Change

2.13. In the course of the Hearing the Applicant asserted that a benefit of the Applicant's a business model is that transporting freight by air rather than trucking was more sustainable.

2.14. SHP submitted that the effects of transporting freight by air rather than trucking had material adverse environmental consequences, which had not been assessed in the ES. SHP undertook to provide evidence to the examination as part of its Deadline 8 submissions.

2.15. Attached at Appendix 2 is an explanatory note summarising the July 2018 Department of Business, Energy and Industrial Strategy ("BEIS") report setting out the Government's Green House Gas Conversion Factors that provides a methodology for calculating emissions from a range of different activities, including road freight and air freight. In summary, the report demonstrates transporting freight by air is materially more harmful with CO_2 emissions of Airfreight calculated to be **between 5.8 and 27.4 times** higher than trucking freight by road, depending on the length of flight. It is important to note that base data used for the air freight calculations exclude the additional impacts of Radiative Forcing, which the Department recommends are included - Radiative Forcing is the influence of other climate change effects of aviation (such as water vapour and nitrogen oxides) and the Department recommends using a multiplier of 1.9 ensures a holistic view of the additional environmental impacts of airfreight are recorded.

Therefore, in addition to being less economically efficient, the Applicant's purported business model of replacing trucking of freight with transporting freight by air would have materially adverse environmental consequences, which have not been assessed.

Noise

2.16. It is noted that the ExA is considering whether the dDCO should have an SOAEL daytime of 60 dB, with consequential amendments made to the Noise Mitigation Plan. This would be consistent with the Government's Aviation 2050 green paper.

2.17. However, paragraph 3.122 of the green paper that the Government goes further in proposing that for *"airspace changes which lead to significantly increased overflight, to set a new minimum threshold of an increase of 3dB LAeq, which leaves a household in the 54dB LAeq 16hr contour or above as a new eligibility criterion for assistance with noise insulation."* It would seem logical that this lower threshold should apply to an airport that has already been closed for over 5 years. It is noted that other airports, such as London City Airport and Bristol Airport operate schemes at 57 dB LAeq,16h.

2.18. It is also noted that Stansted Airport planning application UTT/18/0460/FUL, which Uttlesford District Council resolved to grant in November 2018, includes a requirement to extend the sound insulation grant scheme to include households in the 57 dB LAeq,16h noise contour. Appended as Appendix 3 are (i) the draft s106 agreement (see schedule 3: Part 1) that secures this, and other obligations; (ii) a graphic from London Stansted Airport setting out the proposed scheme and the relevant noise contours and (iii) the Uttlesford DC planning committee report dated 30 November 2018.

2.19. The November Uttlesford DC planning committee report notes in paragraph 9.175 that;

"For the purposes of the ES aircraft noise modelling has been produced by the CAA's Environmental Research and Consultancy Department (ERCD), using their Aircraft Noise Contour (ANCON) model (current version 2.3). The ERCD is a specialist body within the CAA with national and international expertise on the assessment of aircraft noise. They produce noise contours for the designated London airports, and they generated the noise contours used by the Airports Commission. Their work is robust, authoritative and also impartial."

It is noted that the Applicant did not use the ERCD or its noise model for the purposes of assessing noise contours, whilst the contours submitted by Five10Twelve and No Night Flights have done so.

2.20. The Noise Contours included in the Applicant's application do not reflect the likely worst case environmental effects, having failed to consider different flight route, fleet mixes and runway usages. As a result, the noise contours are unlikely to reflect a likely worst case.

Noise-Related DCO requirements

2.21. We would refer the ExA to comments in paragraphs 2.1 to 2.16 of SHP's Written Summary of Oral Submissions put at the dDCO Hearing held on 7 June 2019.

2.22. The ES has not properly assessed the likely significant environmental effects of the proposed development. As explained in paragraph 2.12 of the Written Summary of Oral Submissions put at the dDCO Hearing, the DCO would need to include a complex suite of requirements to offer protection to the local community. However, at this late stage in the examination, it is not practical to attempt to determine what these restrictions would need to be, or how they would be monitored, costed and controlled.

APPENDIX 1: FLEET MIX ASSESSED IN THE ASSESSED IN THE ENVIRONMENTAL STATEMENT

The environmental assessments are based on a fleet mix (set out in Appendix 3.3. of the ES [APP-044]), based on the forecasts contained in the Azimuth report [APP-085].

As explained in detail SHP's recent submissions, the forecast contained in the Azimuth report [APP-085] is wholly incompatible with the E-commerce business model set out in the Applicant's recent oral and written submissions. One consequence is the erroneous fleet mix, which would not be appropriate for an import led E-commerce integrator model of the nature explained.

As set out in Appendix 3.3, the environmental assessments assume >25% of forecast cargo ATMs are ATR-72 integrator feeder turboprop aircraft highlighted in the table below

As shown in the table, these aircraft are the smallest and lightest aircraft included in the cargo fleet mix having a maximum landing weight on 22 tonnes. For context, the average maximum landing weight of the other cargo aircraft included in the mix is c.170 tonnes (the largest being 306 tonnes - see analysis contained in Appendix 1 appended to this summary).

These aircraft also generate materially less noise than the other aircraft assessed.

Summary of Fleet Mix from Appendix 3.3. to the ES [APP-044]

Order in Appendix 3.3	Carrier	Aircraft Type	Quota Count - Low	Quota Count - High	Max Landing Weight (Tonnes)
1	Amazon	767-400	0.50	2.00	159
2	Amazon	777-200	0.50	4.00	224
3	Cargolux	747-800	1.00	2.00	306
7	Fedex / DHL	767-300	0.50	2.00	136
8	Fedex / DHL	757-200	0.25	1.00	90
9	Fedex / DHL	330-200	0.50	2.00	180
10	**Fedex / DHL (Feeders)**	**ATR72**	**0.00**	**0.25**	**22**
11	Fresh fish and spider crabs	777-200	0.50	4.00	224
12	Iran Air	777-200	0.50	4.00	224
13	Live animal operations	777-200	0.50	4.00	224
14	Middle Eatsern Airlines	777-200	0.50	4.00	224
15	Pakistan International Airlines	777-200	0.50	4.00	224
16	Postal Services	737-800	0.50	1.00	65
17	Qatar Airways	777-200	0.50	4.00	224
18	Russian airlines	747-400	1.00	8.00	296
19	TAAG Angola airlines	747-400	1.00	8.00	296
20	TAAG Angola airlines	747-800	1.00	2.00	306
21	Other Freight operations	737-300	0.50	1.00	53
22	Military Freighter Moverments	C-130E	0.50	2.00	203
23	Military Freighter Moverments	C17	n/a	n/a	70
24	Humanitarian and Medivac	747-400	1.00	8.00	296
25	Humanitarian and Medivac	747-800	1.00	2.00	306

Notes

1. Only aircraft with assessed flights are included
2. Quota Count numbers taken from Noise Mitigation Plan

APPENDIX 2: ANALYSIS OF EMISSIONS FROM AIR FREIGHT VS. TRUCKING OF FREIGHT

This explanatory note provides analysis from the July 2018 Department for Business, Energy and Industrial Strategy ("BEIS") report *"2018 Government GHG Conversion Factors for Company Reporting"* and associated BEIS Emissions Factors model titled *"Conversion Factors 2018 – Condensed Set"*.

Copies of both documents have been appended to this submission, however both documents are also available via the following links and are more accessible in soft copy;

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/726911/2018_methodology_paper_FINAL_v01-00.pdf

https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

These documents provides a methodology for calculating emissions from a range of different activities, including road freight and air freight.

The commentary on Freight Land Transport Emissions is given in Section 6 of the main report, whilst Section 8 covers Air Transport Emissions Factors. The relevant data is found in the "Freighting Goods" worksheet of "Conversion Factors 2018 – Condensed Set".

In summary, the analysis shows the following;

- Transporting freight by air rather than road (HGVs) CO_2 emissions be **5.8 – 27.4x** greater per freight tonne kilometre - the level is dependent on the flight stage length. For example, "Short-haul airfreight" has emissions that are **9.15x** the level of trucking freight.
- The BEIS Report further notes that there is uncertainty over the other climate change effects of aviation (such as water vapour, contrails, NOx, etc.). BEIS recommends these effects are accounted for by employing a Radiative Forcing ("RF") multiplier of 1.9 (please refer to paragraphs 8.34-8.38).
- If this multiplier was applied, emissions would be **11 – 52x greater** than for trucking of freight.
- For the purpose of this analysis, when assessing emissions from trucking we have used the "Average Emissions of all HGV's" figure of 0.11kg CO_2 per Tonne Kilometre (see Table 1 below).
- In view of the differences between, domestic, short haul and long haul emissions, we have considered the full range of airfreight distance options (see Table 2 below), which range from 0.66kg – 3.05kg CO_2 per Tonne Kilometre.

Table 1: HGV (All Diesel)

Vehicle Type (size)	Average Laden - Emissions (kg CO_2 per Tonne Km)	Cell Reference in "Freighting Goods" Data Tables
Average of All HGV's	0.11146	R-63

Table 2: Freighter Emissions

Type	Emissions (kg CO_2 per Tonne Km) – Excludes Radiative Forcing	Cell Reference in "Freighting Goods" Data Tables
Domestic, to/from UK	3.05367	J-98
Short haul, to/from UK	1.01957	J-99
Long-haul to/from UK	0.64521	J-100

- **Note on Radiative Forcing:** As set out in paragraphs 8.34-8.38 of the BEIS Report, there is uncertainty over the other climate change effects of aviation (such as water vapour, contrails, NOx, etc.) the exact amount of these additional impacts is currently being researched. BEIS believe that the additional impacts of aviation are great enough that they should be accounted for, this is accomplished in practice by employing a Radiative Forcing ("RF") multiplier that increases the emission factor of aeroplanes by 90%. (i.e. a multiplier of 1.9). The analysis in Table 2 excludes the impact of the Radiative Forcing multiplier.

APPENDIX 3: LONDON STANSTED AIRPORT PLANNING APPPLICATION UTT/18/0460/FUL

This Appendix 3 comprises the following 3 documents;

1. Draft s106 agreement dated 27 March 2019 (see Schedule 3: Part 1 in relation to Noise);
2. graphic from London Stansted Airport setting out the proposed scheme and the relevant noise contours; and
3. the Uttlesford DC planning committee report dated 30 November 2018

Department for Business, Energy & Industrial Strategy

2018 GOVERNMENT GHG CONVERSION FACTORS FOR COMPANY REPORTING

Methodology paper for emission factors: final report

July 2018

Any enquiries regarding this publication should be sent to Climatechange.Statistics@beis.gov.uk.

This document has been produced by Nikolas Hill, Eugenia Bonifazi, Rebekah Bramwell, Eirini Karagianni (Ricardo Energy & Environment) and Billy Harris (WRAP) for the Department for Business Energy & Industrial Strategy (BEIS).

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1. General Introduction

1.1. Greenhouse gases (GHG) can be measured by recording emissions at source, by continuous emissions monitoring or by estimating the amount emitted using activity data (such as the amount of fuel used) and applying relevant conversion factors (e.g. calorific values, emission factors, etc.).

1.2. These conversion factors allow organisations and individuals to calculate GHG emissions from a range of activities, including energy use, water consumption, waste disposal and recycling, and transport activities. For instance, a conversion factor can be used to calculate the amount of GHG emitted as a result of burning a particular quantity of oil in a heating boiler.

1.3. The 2018 Government Greenhouse Gas Conversion Factors for Company Reporting[1] (hereafter the 2018 GHG Conversion Factors) represent the current official set of UK government emissions factors. These factors are also used in a number of different policies. This paper outlines the methodology used to update and expand the emission factors for the 2018 GHG Conversion Factors.

1.4. Values for the non-carbon dioxide (CO_2) GHGs, methane (CH_4) and nitrous oxide (N_2O), are presented as CO_2 equivalents (CO_2e), using Global Warming Potential (GWP) factors from the Intergovernmental Panel on Climate Change (IPCC)'s fourth assessment report (GWP for CH_4 = 25, GWP for N_2O = 298), consistent with reporting under the United Nations Framework Convention on Climate Change (UNFCCC). Although the IPCC have prepared a newer version since, the methods have not yet been officially accepted for use under the UNFCCC. As this is the basis upon which all emissions are calculated in the UK GHG inventory (GHGI), the 2018 GHG Conversion Factors are therefore consistent with this.

1.5. The GHGI for 2016, on which these 2018 GHG Conversion Factors are based on, is available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/1804191054_ukghgi-90-16_Main_Issue1.1_UNFCCC.pdf.

1.6. The 2018 GHG Conversion Factors are for one year, from the end of May 2018, and will continue to be reviewed and updated on an annual basis.

1.7. The GHG Conversion Factors have been provided on the GOV.UK site: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting.

1.8. The purpose of this report is to provide the methodological approach, the key data sources and the assumptions used to define the emission factors provided in the 2018 GHG Conversion Factors. The report aims to expand and compliment the information already provided in the data tables themselves. However, it is not intended to be an exhaustively detailed explanation of every calculation performed (this is not practical/possible), nor is it intended to provide guidance on the practicalities of

[1] Previously known as the 'Guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting'.

reporting for organisations. Rather, the intention is to provide an overview with key information so that the basis of the emission factors provided can be better understood and assessed.

1.9. Further information about the 2018 GHG Conversion Factors together with previous methodology papers is available at: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting.

Overview of changes since the previous update

1.10. Major changes and updates in terms of methodological approach from the 2017 update version are summarised below. All other updates are essentially revisions of the previous year's data based on new/improved data whilst using existing calculation methodologies (i.e. using a similar methodological approach as for the 2017 update):

a) The emission factors for HGVs and Buses were revised this year as a new technology is developed to enable manufacturers to meet diesel engine emissions standards for NO_x emissions. This technology is known as selective catalytic reduction (SCR) and uses a urea solution to effectively remove NO_x and NO_2 from diesel engines' exhaust gases. Emissions from the consumption of urea in heavy duty vehicles and buses is estimated in the conversion factors for the first time and are included in the estimates for the overall CO_2 emission factors.

b) Improvements were made to the Heat & Steam model to make formulae clearer, more concise and easier to trace which assists the QA process. The previous model included hard coded values that were not clearly documented and now these have been changed so that imported data is clearly labelled. The model uses the same data sets as previous years and when combined with the emission factors from other Conversion Factor Workbooks, they are used to:

   a. Compile a list of emission factors per fuel type contained in the Digest of UK Energy Statistics (DUKES) data.

   b. Determine the amount of each fuel type used for heat to build a fuel mix emission factor which is used to derive emission factors per MWh heat. Previously, the model was calculating the emission factors per MWh power in the same sheet with the heat and power emission factors via the PowerStation displacement and boiler displacement methods. These calculations are still contained in the workbook but since they do not form part of the model's output, they have been relegated to an 'Other methods' methodology section.

   c. Report on: kg CO_2 per kWh heat & steam, kg CO_2e (from CH_4) per kWh heat & steam, kg CO_2e (from N_2O) per kWh heat & steam, kg CO_2e (Total direct) per kWh heat & steam and kg CO_2e (WTT) per kWh heat & steam.

c) There have been a number of revisions to the output factors from the Waste Disposal model as a result of an upgrade and data changes. The emissions factors for glass landfill / green and mixed organics composting had previously been taken directly from published studies using a different methodology to the other waste factors. New factors are now used and are based on a standardised approach using data on transport emissions to and on site, and MELMod (landfill emissions model) factors for the landfill emissions.

d) The Material Use model has also been through a number of revisions due to an upgrade and data changes. Key references for closed loop steel recycling have been updated and the methodology has been improved. This more recent and improved data directly provides Lifecycle Inventory emissions factors per kg of steel recycled, whereas these were previously derived based on emissions for different grades of recycled steel. In addition, the updated metals recycling factors for construction and demolition have been standardised using the updated closed loop steel recycling factor. The methodology has changed and is now based directly on emissions from metals recycling; previously this had been based on published estimated savings from recycling metals.

e) Conversion factors for Transmission and Distribution losses for Overseas Electricity use are no longer included in the GHG Conversion Factors from 2018. These emission factors are now calculated and published by the IEA (International Energy Agency) and as such are not duplicated here. The main conversion factors for overseas electricity generation were not provided in the UK's GHG Conversion Factors after 2015, due to changes in the IEA's licencing conditions. Users requiring these data can purchase them directly from the IEA[2].

1.11. Additional information is also provided in Appendix 3 of this report on major changes to the values of specific emission factors (i.e. for many factors this is plus or minus 10% compared with the 2017 GHG Conversion Factors, though a lower threshold is used in some cases where a much lower degree of annual variation is expected). Some of these changes are due to the methodological adjustments outlined above and in the later sections of this methodology paper, whist others are due to changes in the underlying source datasets.

1.12. Detailed guidance on how the emission factors provided should be used is contained in the introduction to the 2018 GHG Conversion Factors themselves. This guidance must be referred to before using the emission factors and provides important context for the description of the methodologies presented in this report and in the table footnotes.

1.13. It is important to note that this methodology paper's primary aim is to provide information on the methodology used in creating the Government GHG Conversion Factors for Company Reporting (GCF). It does not provide guidance on the approach or methodology required for GHG reporting.

[2] Available here: http://www.iea.org/bookshop/729-CO2_Emissions_from_Fuel_Combustion

Structure of this methodology paper

1.14. The following Sections 2 to 13 provide methodological summary for the data tables contained in the GCF.

Area covered	Location in this document
Fuel Emission Factors	see Section 2
UK Electricity, Heat and Steam Emission Factors	see Section 3
Refrigerant and Process Emission Factors	see Section 4
Passenger Land Transport Emission Factors	see Sections 5
Freight Land Transport Emission Factors	see Sections 6
Sea Transport Emission Factors	see Section 7
Air Transport Emission Factors	see Section 8
Bioenergy and Water	see Section 9
Overseas Electricity Emission Factors	see Section 10
Hotel Stay	see Section 11
Material Consumption/Use and Waste Disposal	see Section 12
Fuel Properties	see Section 13
Unit Conversions	N/A *

*This report does not provide any methodological description for unit conversions, since these are for standard units, provided as simple supplementary information or guidance.

Table 1: Summary Structure of this Methodology Paper

2. Fuel Emission Factors

Summary of changes since the previous update

2.1. The methodology has been improved to remove a double count of activity data in road transport for (petrol and diesel fuels) for cold starts (N_2O) that was present in the underlying NAEI source data presentation. This has resulted in an increase of around 75% for the N_2O emission factor in the 2018 update, compared to 2017. However, the impact on the overall CO_{2e} emission factor is lower than 1%.

Direct Emissions

2.2. All the fuel conversion factors for direct emissions presented in the 2018 GHG Conversion Factors are based on the emission factors used in the UK GHG Inventory (GHGI) for 2016 (managed by Ricardo Energy & Environment[3]).

2.3. The CO_2 emissions factors are based on the same ones used in the UK GHGI and are essentially independent of application (assuming full combustion). However, emissions of CH_4 and N_2O can vary to some degree for the same fuel depending on the particular use (e.g. emission factors for gas oil used in rail, shipping, non-road mobile machinery or different scales/types of stationary combustion plants can all be different). The figures for fuels in the 2018 GHG Conversion Factors are based on an activity-weighted average of all the different CH_4 and N_2O emission factors from the GHGI.

2.4. The standard emission factors from the GHGI have been converted into different energy and volume units using information on Gross and Net Calorific Values (CV) (see definition of Gross CV and Net CV in the footnote below[4]) from BEIS's Digest of UK Energy Statistics (DUKES) 2017[5].

2.5. There are three tables in the 2018 GHG Conversion Factors, the first of which provides emission factors for gaseous fuels, the second for liquid fuels and the final table provides the emission factors for solid fuels.

2.6. When making calculations based on energy use, it is important to check (e.g. with your fuel supplier) whether these values were calculated on a Gross CV or Net CV basis and use the appropriate factor. Natural gas consumption figures quoted in kWh by suppliers in the UK are generally calculated (from the volume of gas used) on a

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[3] UK Greenhouse Gas Inventory for 2016 (Ricardo Energy & Environment), available at: https://uk-air.defra.gov.uk/library/reports?report_id=954.

[4] Gross CV or higher heating value (HHV) is the CV under laboratory conditions. Net CV or lower heating value (LHV) is the useful calorific value in typical real-world conditions (e.g. boiler plant). The difference is essentially the latent heat of the water vapour produced (which can be recovered in laboratory conditions).

[5] Available at: https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Gross CV basis[6]. Therefore, the emission factor for energy consumption on a Gross CV basis should be used by default for calculation of emissions from natural gas in kWh, unless your supplier specifically states they have used Net CV basis in their calculations instead.

Indirect/WTT Emissions from Fuels

2.7. These fuel lifecycle emissions (also sometimes referred to as 'Well-To-Tank', or simply WTT, emissions usually in the context of transport fuels) are the emissions 'upstream' from the point of use of the fuel. They result from the extraction, transport, refining, purification or conversion of primary fuels to fuels for direct use by end-users and the distribution of these fuels. They are classed as Scope 3 according to the GHG Protocol.

2.8. Last year a newer report: 'Study on Actual GHG Data for Diesel, Petrol, Kerosene and Natural Gas' by Exergia, EM Lab and COWI for DG Ener (2015), was used to calculate the WTT factors for certain fuels. The same report is used within the 2018 Conversion Factors to calculate the WTT factors for the following fuels:

- Petrol
- Diesel
- Kerosene
- Natural gas
- CNG
- LNG.

2.9. The Exergia et al report does not contain data on the WTT emissions from Coal, Naphtha and LPG and therefore the JRC Well-To-Wheels (2014)[7] study is used for these fuels (being the most recent update to this source).

2.10. For fuels covered by the 2018 GHG Conversion Factors where no fuel lifecycle emission factor was available in either source, these were estimated based on similar fuels, according to the assumptions in Table 4.

2.11. WTT emissions for petrol, diesel and kerosene in the Exergia et al study, used within the 2018 GHG Conversion Factors, are based on:

- Detailed modelling of upstream emissions associated with 35 crude oils used in EU refining, which accounted for 88% of imported oil in 2012.
- Estimates of the emissions associated with transport of these crude oils to EU refineries by sea and pipeline, based on location of ports and refineries.
- Emissions from refining, modelled on a country by country basis, based on the specific refinery types in each country. An EU average is then calculated based on the proportion of each crude oil going to each refinery type.
- An estimate of emissions associated with imported finished products from Russia and the US.

[6] See information available on National Grid website: http://www2.nationalgrid.com/UK/Industry-information/Gas-transmission-operational-data/calorific-value-description/

[7] "Well-to-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context" Version 4a, May 2014. Report EUR 26236 EN– 2014. http://iet.jrc.ec.europa.eu/about-jec/

2.12. Emission factors are also calculated for diesel as supplied at public and commercial refuelling stations, by factoring in the WTT component due to biodiesel supplied in the UK as a proportion of the total supply of diesel and biodiesel (2.30% by unit volume, 2.12% by unit energy – see Table 2). These estimates have been made based on BEIS's Quarterly Energy Statistics for Renewables[8].

2.13. Emission factors are also calculated for petrol as supplied at public and commercial refuelling stations, by factoring in the bioethanol supplied in the UK as a proportion of the total supply of petrol and bioethanol (4.46% by unit volume, 2.95% by unit energy – see Table 2). These estimates have also been made based on BEIS's Quarterly Energy Statistics for Renewables.[8].

	Total Sales, millions of litres		Biofuel % Total Sales		
	Biofuel	Conventional Fuel	per unit mass	per unit volume	per unit energy
Diesel/Biodiesel	694.14	29,539	2.44%	2.30%	2.12%
Petrol/Bioethanol	749.43	16,050	4.84%	4.46%	2.95%

Source: Department for Transport, Table RTFO 01: Volumes of fuels by fuel type. Data used here comes from two different versions of the report: Year 8 report 6 (final version) and Year9 report 2, both published in February 2018.

Available at: - https://www.gov.uk/government/collections/biofuels-statistics

Table 2: Liquid biofuels for transport consumption: 4th quarter 2016 – 3rd quarter 2017

2.14. Emissions for natural gas, LNG and CNG in the Exergia et al study, used within the 2018 GHG Conversion Factors, are based on:

- Estimates of emissions associated with supply in major gas producing countries supplying the EU. These include both countries supplying piped gas and countries supplying LNG.
- The pattern of gas supply for each Member State (based on IEA data for natural gas supply in 2012)[9].
- Combining the information on emissions associated with sources of gas, with the data on the pattern of gas supply for each Member State, including the proportion of LNG that is imported.

2.15. A similar methodology was developed for use in the 2018 GHG Conversion Factors, to allow the value calculated for gas supply in the UK in the Exergia et al study to be updated annually. This allows changes in the sources of imported gas, particularly LNG, to be reflected in the emissions value.

2.16. Information on quantities and source of imported gas are available annually from DUKES[10] and can be used to calculate the proportion of gas in UK supply coming from each source. These can then be combined with the Exergia et al emissions factors for gas from each source, to calculate a weighted emissions factor for UK supply.

[9] IEA, 2014. Natural Gas Information 2014.

[10] From Table 4.1 Commodity balances for natural gas and Table 4.5 Natural gas imports and exports, DUKES 2017

2.17. The methodology for calculating the WTT emission factors for natural gas and CNG is different to the other fuels as it considers the increasing share of UK gas supplied via imports of LNG (which have a higher WTT emission factor than conventionally sourced natural gas) in recent years. Table 3 provides a summary of the information on UK imports of LNG and their significance compared to other sources of natural gas used in the UK grid, updated to include the most recent data used in the 2018 update. Small quantities of imported LNG are now re-exported, so a value for **net** imports is used in the methodology. The figures in Table 3 have been used to calculate the revised figures for Natural Gas and CNG WTT emission factors provided in Table 4 below. There was a significant decline in LNG imports in 2016.

Year	LNG % of total natural gas imports (2)	Net Imports as % total UK supply of natural gas (1)	LNG Imports as % total UK supply of natural gas
2010	35.4%	39.3%	19.1%
2011	47.2%	42.0%	29.5%
2012	27.9%	47.2%	17.5%
2013	19.5%	50.1%	12.1%
2014	26.7%	44.7%	15.9%
2015	30.7%	42.0%	18.9%
2016	22.2%	48.5%	13.3%

Source: DUKES 2017, (1) Table 4.1 - Commodity balances and (2) Table 4.5 - Natural gas imports and exports.

Table 3: Imports of LNG into the UK as a share of imports and net total natural gas supply

2.18. The final combined emission factors (in $kgCO_2e/GJ$, Net CV basis) are presented in Table 4. These include WTT emissions of CO_2, N_2O and CH_4 and were converted into other units of energy (e.g. kWh, Therms) and to units of volume and mass using the default Fuel Properties and Unit Conversion factors also provided in the 2018 GHG Conversion Factors alongside the emission factor data tables.

Fuel	Indirect/WTT EF ($kgCO_2e/GJ$, Net CV basis)	Source of Indirect/WTT Emission Factor	Assumptions
Aviation Spirit	18.20	Estimate	Similar to petrol
Aviation turbine fuel[1]	15.00	Exergia, EM Lab and COWI (2015)	Emission factor for kerosene
Burning oil[1]	15.00	Estimate	Assume same as factor for Kerosene, as above

Fuel	Indirect/WTT EF ($kgCO_2e/GJ$, Net CV basis)	Source of Indirect/WTT Emission Factor	Assumptions
CNG[2]	11.41	Exergia, EM Lab and COWI (2015)	Factors in UK % share LNG imports
Coal (domestic)	14.81	JEC WTW (2014)	Emission factor for coal
Coal (electricity generation)	14.81	JEC WTW (2014)	Emission factor for coal
Coal (industrial)	14.81	JEC WTW (2014)	Emission factor for coal
Coal (electricity generation - home produced coal only)	14.81	JEC WTW (2014)	Emission factor for coal
Coking coal	14.81	Estimate	Assume same as factor for coal
Diesel (100% mineral diesel)	17.40	Exergia, EM Lab and COWI (2015)	
Fuel oil[4]	15.00	Estimate	Assume same as factor for kerosene
Gas oil[5]	17.40	Estimate	Assume same as factor for diesel
LPG	8.04	JEC WTW (2014)	
LNG[6]	19.60	Exergia, EM Lab and COWI (2015)	
Lubricants	9.53	Estimate	Based on LPG figure, scaled relative to direct emissions ratio
Marine fuel oil	15.00	Estimate	Assume same as factor for fuel oil
Marine gas oil	17.40	Estimate	Assume same as factor for gas oil
Naphtha	14.10	JEC WTW (2014)	
Natural gas	7.89	Exergia, EM Lab and COWI (2015)	Factors in UK % share LNG imports
Other petroleum gas	6.80	Estimate	Based on LPG figure, scaled relative to direct emissions ratio

Fuel	Indirect/WTT EF ($kgCO_2e$/GJ, Net CV basis)	Source of Indirect/WTT Emission Factor	Assumptions
Petrol (100% mineral petrol)	18.20	Exergia, EM Lab and COWI (2015)	
Petroleum coke	12.21	Estimate	Based on LPG figure, scaled relative to direct emissions ratio
Processed fuel oils - distillate oil	9.18	Estimate	Based on LPG figure, scaled relative to direct emissions ratio
Processed fuel oils - residual oil	9.67	Estimate	Based on LPG figure, scaled relative to direct emissions ratio
Refinery miscellaneous	8.78	Estimate	Based on LPG figure, scaled relative to direct emissions ratio
Waste oils	9.53	Estimate	Based on LPG figure, scaled relative to direct emissions ratio

Notes:

(1) Burning oil is also known as kerosene or paraffin used for heating systems. Aviation Turbine fuel is a similar kerosene fuel specifically refined to a higher quality for aviation.
(2) CNG = Compressed Natural Gas is usually stored at 200 bar in the UK for use as an alternative transport fuel.
(3) Fuel oil is used for stationary power generation. Also use this emission factor for similar marine fuel oils.
(4) Gas oil is used for stationary power generation and 'diesel' rail in the UK. Also use this emission factor for similar marine diesel oil and marine gas oil fuels.
(5) LNG = Liquefied Natural Gas, usually shipped into the UK by tankers. LNG is usually used within the UK gas grid; however, it can also be used as an alternative transport fuel.

Table 4: Basis of the indirect/WTT emissions factors for different fuels

3. UK Electricity, Heat and Steam Emission Factors

Summary of changes since the previous update

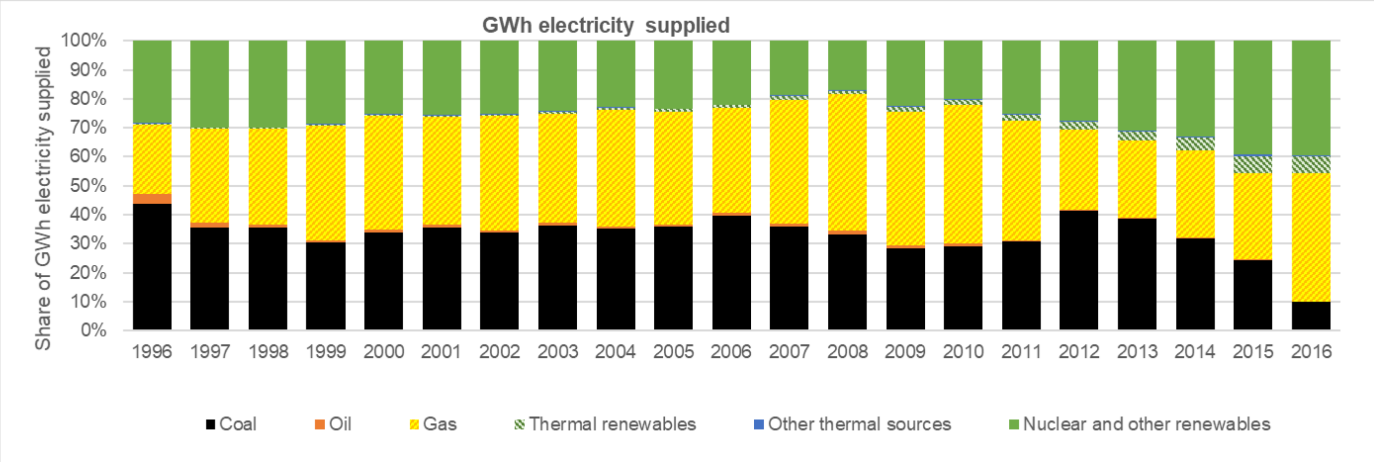
3.1. The Heat & Steam model was updated in 2018 to streamline its processes. The methodology continues to follow the DUKES CHP method for heat to calculate the 2018 GHG conversion factor for heat & steam.

3.2. Additionally, there have been changes to the data that the CHP methodologies depend upon. These comprise changes to DUKES CHP fuel mix, assumptions about the CH_4 and N_2O emissions for certain fuels and changes to the underlying data within NAEI.

Direct Emissions from UK Grid Electricity

3.3. The electricity conversion factors given represent the average CO_2 emission from the UK national grid per kWh of electricity generated, classed as Scope 2 of the GHG Protocol and separately for electricity transmission and distribution losses, classed as Scope 3. The calculations also factor in net imports of electricity via the interconnectors with Ireland, the Netherlands and France. These factors include only direct CO_2, CH_4 and N_2O emissions at UK power stations and from autogenerators (the latter added for the first time in the 2013 GHG Conversion Factors), plus those from the proportion of imported electricity. They do not include emissions resulting from production and delivery of fuel to these power stations (i.e. from gas rigs, refineries and collieries, etc.).

3.4. The UK grid electricity factor changes from year to year as the fuel mix consumed in UK power stations (and autogenerators) 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. This fluctuation in UK electricity generation mix is illustrated in Figure 1 below.



Notes: The chart presents data for actual years; the emissions factors for a given GHG Conversion Factor update year correspond to the data for the actual year 2 years previous, i.e. the 2018 emission factors are based on 2016 data.

Figure 1: Time series of the mix of UK electricity generation by type

3.5. The UK electricity emission factors provided in the 2018 GHG Conversion Factors are based on emissions from sector 1A1ai (power stations) and 1A2b (autogenerators) in the UK Greenhouse Gas Inventory (GHGI) for 2016 (Ricardo Energy & Environment) according to the amount of CO_2, CH_4 and N_2O emitted per unit of electricity consumed (from DUKES 2017)[11]. These emissions from the GHGI only include autogeneration from coal and natural gas fuels, and do not include emissions for electricity generated and supplied by autogenerators using oil or other thermal non-renewable fuels[12]. In previous updates, this was accounted for by removing this component from the DUKES GWh data. However, since the 2016 update, estimates of the emissions due to these components have been made using standard NAEI emission factors, and information from DUKES Table 5.6, and BEIS's DUKES team on the total fuel use (and shares by fuel type) for this component. An additional correction is made to account for the share of autogeneration electricity that is exported to the grid (~15.4% for the 2016 data year), which varies significantly from year-to-year.

3.6. The UK is a net importer of electricity from the interconnectors with France and Netherlands, and, to a more limited amount, with Ireland according to DUKES (2017). For the 2018 GHG Conversion Factors the total net electricity imports were calculated from DUKES (2017) Table 5.1.2 (Electricity supply, availability and consumption 1970 to 2016). The net shares of imported electricity over the interconnectors are calculated from data from DUKES (2017) Table 5A (Net Imports via interconnectors, GWh).

3.7. An average imported electricity emission factor is calculated from the individual factors for the relevant countries[13] weighted by their respective share of net imports.

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[11] DUKES (2017): https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[12] Other thermal non-renewable fuels include the following (with ~2017 update % share): blast furnace gas (~32%), chemical waste (~30%), coke oven gas (~5%) and municipal solid waste (MSW, ~35%)

[13] French electricity factor: Rte. Available at: http://www.rte-france.com/en/eco2mix/eco2mix-telechargement-en.

Dutch electricity factor: CBS. Available at: https://www.cbs.nl/nl-nl/achtergrond/2017/06/rendementen-en-co2-emissie-elektriciteitsproductie-2015

Irish electricity factor, SAEI. Available at: http://www.seai.ie/Energy-Data-Portal/Emission_Factors/

This average electricity emission factor – including losses – is used to account for the net import of electricity, as it will also have gone through the relevant countries' distribution systems. Note that this method effectively reduces the UK's electricity emission factors as the resulting average net imported electricity emission factor is lower than that for the UK. This is largely due to the fact that France's electricity generation is much less carbon-intensive than that of the UK, and accounts for the largest share of the net imports.

3.8. The source data and calculated emissions factors are summarised in the following Table 5, Table 6 and Table 7. Time series source data and emission factors are fixed/locked from the 2017 GHG Conversion Factor update onwards and have been highlighted in light grey. The tables provide the data and emission factors against the relevant data year. Table 5 also provides a comparison of how the data year reads across to the GHG conversion factors update / reporting year to which the data and emission factors are applied, which is two years ahead of the data year. For example, the most recent emission factor for the 2018 GHG Conversion Factors is based on a data year of 2016.

3.9. A full-time series of data using the most recently available GHGI and DUKES datasets for all years is also provided in Appendix 1 of this report. This is provided for purposes **other than company reporting**, where a fully consistent data time series is desirable, e.g. for policy impact analysis. This dataset also reflects the changes in the methodological approach implemented for the 2016 update, and is applied across the whole-time series.

Data Year	Applied to Reporting Year*	Electricity Generation (1) GWh	Total Grid Losses (2) %	UK electricity generation emissions (3), ktonne		
				CO_2	CH_4	N_2O
1990	1992	290,666	8.08%	204,614	2.671	5.409
1991	1993	293,743	8.27%	201,213	2.499	5.342
1992	1994	291,692	7.55%	189,327	2.426	5.024
1993	1995	294,935	7.17%	172,927	2.496	4.265
1994	1996	299,889	9.57%	168,551	2.658	4.061
1995	1997	310,333	9.07%	165,700	2.781	3.902
1996	1998	324,724	8.40%	164,875	2.812	3.612
1997	1999	324,412	7.79%	152,439	2.754	3.103
1998	2000	335,035	8.40%	157,171	2.978	3.199
1999	2001	340,218	8.25%	149,036	3.037	2.772
2000	2002	349,263	8.38%	160,927	3.254	3.108
2001	2003	358,185	8.56%	171,470	3.504	3.422
2002	2004	360,496	8.26%	166,751	3.490	3.223
2003	2005	370,639	8.47%	177,044	3.686	3.536
2004	2006	367,883	8.71%	175,963	3.654	3.414

Data Year	Applied to Reporting Year*	Electricity Generation (1) GWh	Total Grid Losses (2) %	UK electricity generation emissions (3), ktonne		
				CO_2	CH_4	N_2O
2005	2007	370,977	7.25%	175,086	3.904	3.550
2006	2008	368,314	7.21%	184,517	4.003	3.893
2007	2009	365,252	7.34%	181,256	4.150	3.614
2008	2010	356,887	7.45%	176,418	4.444	3.380
2009	2011	343,418	7.87%	155,261	4.450	2.913
2010	2012	348,812	7.32%	160,385	4.647	3.028
2011	2013	330,128	7.88%	148,153	4.611	3.039
2012	2014	320,470	8.04%	161,903	5.258	3.934
2013	2015	308,955	7.63%	146,852	4.468	3.595
2014*	2016	297,897	8.30%	126,358	4.769	2.166
2015	2017	296,959	8.55%	106,209	7.567	2.136
2016	2018	297,203	7.85%	84,007	7.856	1.532

Notes:

(1) **From 1990-2013**: Based upon calculated total for centralised electricity generation (GWh supplied) from DUKES Table 5.5 Electricity fuel use, generation and supply for year 1990 to 2014. The total is consistent with UNFCCC emissions reporting categories 1A1ai+1A2d includes (according to Table 5.5 categories) GWh supplied (gross) from all 'Major power producers'; plus, GWh supplied from thermal renewables + coal and gas thermal sources, hydro-natural flow and other non-thermal sources from 'Other generators'.

* **From 2014 onwards**: based on the **total** for **all** electricity generation (GWh supplied) from DUKES Table 5.6, with a reduction of the total for autogenerators based on unpublished data from the BEIS DUKES team on the share of this that is actually exported to the grid (~15% in 2016 data year).

(2) Based upon calculated net grid losses from data in DUKES Table 5.1.2 (long term trends, only available online).

(3) **From 1990-2013**: Emissions from UK centralised power generation (including Crown Dependencies only) listed under UNFCC reporting category 1A1a and autogeneration - exported to grid (UK Only) listed under UNFCC reporting category 1A2f from the UK Greenhouse Gas Inventory for 2012 (Ricardo-AEA, 2014) for data years 1990-2012, for the GHGI for 2013 (Ricardo-AEA, 2015) for the 2013 data year.

* **From 2014 onwards**: Excludes emissions from Crown Dependencies and also includes an accounting (estimate) for autogeneration emissions not specifically split out in the NAEI, consistent with the inclusion of the GWh supply for these elements also from 2014 onwards. Data is from the GHGI (Ricardo Energy & Environment, 2018) for the 2016 data year.

Table 5: Base electricity generation emissions data

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
1990	0.70395	0.00019	0.00577	0.70991	0.05061	0.00001	0.00042	0.05104	0.7658	0.00021	0.00628	0.77229	**3.85%**
1991	0.685	0.00018	0.00564	0.69081	0.04318	0.00001	0.00033	0.04352	0.74675	0.00019	0.00615	0.75309	**5.18%**
1992	0.64907	0.00017	0.00534	0.65458	0.05678	0.00002	0.00042	0.05722	0.70205	0.00019	0.00578	0.70801	**5.29%**
1993	0.58632	0.00018	0.00448	0.59098	0.05101	0.00002	0.00037	0.0514	0.6316	0.00019	0.00483	0.63662	**5.25%**
1994	0.56204	0.00019	0.0042	0.56643	0.04471	0.00002	0.0003	0.04502	0.62154	0.00021	0.00464	0.62639	**5.22%**
1995	0.53394	0.00019	0.0039	0.53803	0.03813	0.00001	0.00024	0.03839	0.58721	0.00021	0.00429	0.5917	**4.97%**
1996	0.50774	0.00018	0.00345	0.51137	0.04182	0.00002	0.00026	0.0421	0.55432	0.0002	0.00376	0.55828	**4.80%**
1997	0.46989	0.00018	0.00297	0.47304	0.03816	0.00002	0.00022	0.0384	0.50961	0.00019	0.00322	0.51302	**4.76%**
1998	0.46912	0.00019	0.00296	0.47226	0.04084	0.00002	0.00024	0.04111	0.51211	0.0002	0.00323	0.51555	**3.51%**
1999	0.43806	0.00019	0.00253	0.44077	0.04375	0.00002	0.00027	0.04404	0.47745	0.00020	0.00275	0.48041	**3.94%**
2000	0.46076	0.0002	0.00276	0.46372	0.04083	0.00002	0.00024	0.04109	0.50293	0.00021	0.00301	0.50616	**3.82%**
2001	0.47872	0.00021	0.00296	0.48189	0.04398	0.00002	0.00027	0.04427	0.52354	0.00022	0.00324	0.52701	**2.78%**
2002	0.46256	0.0002	0.00277	0.46554	0.04487	0.00002	0.00027	0.04516	0.50418	0.00022	0.00302	0.50742	**2.24%**
2003	0.47767	0.00021	0.00296	0.48084	0.03621	0.00002	0.00023	0.03646	0.52187	0.00023	0.00323	0.52533	**0.57%**
2004	0.47831	0.00021	0.00288	0.4814	0.03831	0.00002	0.00025	0.03857	0.52395	0.00023	0.00315	0.52733	**1.97%**
2005	0.47196	0.00022	0.00297	0.47515	0.03884	0.00002	0.00024	0.0391	0.50883	0.00024	0.0032	0.51226	**2.16%**
2006	0.50098	0.00023	0.00328	0.50448	0.03883	0.00002	0.00023	0.03908	0.53993	0.00025	0.00353	0.54371	**1.97%**
2007	0.49625	0.00024	0.00307	0.49956	0.03838	0.00002	0.00022	0.03863	0.53555	0.00026	0.00331	0.53911	**1.37%**
2008	0.49433	0.00026	0.00294	0.49752	0.03611	0.00002	0.00021	0.03634	0.53414	0.00028	0.00317	0.53759	**2.91%**
2009	0.45211	0.00027	0.00263	0.45501	0.03783	0.00002	0.00024	0.03809	0.49074	0.0003	0.00285	0.49389	**0.80%**
2010	0.4598	0.00028	0.00269	0.46277	0.05061	0.00001	0.00042	0.05104	0.49613	0.0003	0.0029	0.49933	**0.73%**
2011	0.44877	0.00029	0.00285	0.45192	0.04318	0.00001	0.00033	0.04352	0.48715	0.00032	0.0031	0.49056	**1.76%**

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
2012	0.5052	0.00034	0.00381	0.50935	0.04418	0.00003	0.00033	0.04454	0.54938	0.00037	0.00414	0.55389	**3.40%**
2013	0.4753	0.0004	0.0035	0.4791	0.0392	0.0000	0.0003	0.0396	0.5146	0.0004	0.0038	0.5187	**4.10%**
2014	0.42417	0.00040	0.00217	0.42673	0.03837	0.00004	0.00020	0.03860	0.46254	0.00044	0.00236	0.46534	**6.44%**
2015	0.35766	0.00064	0.00214	0.36044	0.03343	0.00006	0.00020	0.03369	0.39108	0.00070	0.00234	0.39412	**6.59%**
2016	0.28266	0.00066	0.00154	0.28486	0.02409	0.00006	0.00013	0.02428	0.30675	0.00072	0.00167	0.30913	5.57%

Notes: * From 1990-2013 the emission factor used was for French electricity only, and is as published in previous methodology papers. The methodology was updated from 2014 onwards with new data on the contribution of electricity from the other interconnects, hence these figures are based on a weighted average emission factor of the emission factors for France, the Netherlands and Ireland, based on the % share supplied.

Time series data in light grey is locked/fixed for the purposes of company reporting and has not been updated in the database in the 2018 GHG Conversion Factors update.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

⇒ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES),

Table 6: Base electricity generation emission factors (excluding imported electricity)

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Elec Imports
	For electricity GENERATED (supplied to the grid, plus imports)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
1990	0.6812	0.00019	0.00558	0.68697	0.05985	0.00002	0.00049	0.06036	0.74106	0.0002	0.00607	0.74733	**3.85%**
1991	0.65616	0.00017	0.0054	0.66174	0.05915	0.00002	0.00049	0.05966	0.71532	0.00019	0.00589	0.72139	**5.18%**
1992	0.62005	0.00017	0.0051	0.62532	0.05061	0.00001	0.00042	0.05104	0.67066	0.00018	0.00552	0.67636	**5.29%**
1993	0.55913	0.00017	0.00428	0.56358	0.04318	0.00001	0.00033	0.04352	0.60232	0.00018	0.00461	0.6071	**5.25%**
1994	0.53633	0.00018	0.00401	0.54051	0.05678	0.00002	0.00042	0.05722	0.59311	0.0002	0.00443	0.59773	**5.22%**
1995	0.5113	0.00018	0.00373	0.51521	0.05101	0.00002	0.00037	0.0514	0.56231	0.0002	0.0041	0.56661	**4.97%**
1996	0.48731	0.00017	0.00331	0.4908	0.04471	0.00002	0.0003	0.04502	0.53202	0.00019	0.00361	0.53582	**4.80%**
1997	0.45112	0.00017	0.00285	0.45414	0.03813	0.00001	0.00024	0.03839	0.48925	0.00019	0.00309	0.49253	**4.76%**
1998	0.45633	0.00018	0.00288	0.45939	0.04182	0.00002	0.00026	0.0421	0.49816	0.0002	0.00314	0.5015	**3.51%**
1999	0.42438	0.00018	0.00245	0.427	0.03816	0.00002	0.00022	0.0384	0.46254	0.0002	0.00267	0.46541	**3.94%**
2000	0.44628	0.00019	0.00267	0.44914	0.04084	0.00002	0.00024	0.04111	0.48712	0.00021	0.00292	0.49024	**3.82%**
2001	0.46725	0.0002	0.00289	0.47034	0.04375	0.00002	0.00027	0.04404	0.511	0.00022	0.00316	0.51438	**2.78%**
2002	0.45378	0.0002	0.00272	0.4567	0.04083	0.00002	0.00024	0.04109	0.49461	0.00022	0.00296	0.49779	**2.24%**
2003	0.47537	0.00021	0.00294	0.47853	0.04398	0.00002	0.00027	0.04427	0.51936	0.00023	0.00322	0.5228	**0.57%**
2004	0.47033	0.00021	0.00283	0.47337	0.04487	0.00002	0.00027	0.04516	0.51521	0.00022	0.0031	0.51853	**1.97%**
2005	0.46359	0.00022	0.00291	0.46673	0.03621	0.00002	0.00023	0.03646	0.49981	0.00023	0.00314	0.50318	**2.16%**
2006	0.49263	0.00022	0.00322	0.49608	0.03831	0.00002	0.00025	0.03857	0.53094	0.00024	0.00347	0.53465	**1.97%**
2007	0.49054	0.00024	0.00303	0.49381	0.03884	0.00002	0.00024	0.0391	0.52939	0.00025	0.00327	0.53291	**1.37%**
2008	0.48219	0.00026	0.00286	0.48531	0.03883	0.00002	0.00023	0.03908	0.52102	0.00028	0.00309	0.52439	**2.91%**
2009	0.44917	0.00027	0.00261	0.45205	0.03838	0.00002	0.00022	0.03863	0.48755	0.00029	0.00284	0.49068	**0.80%**
2010	0.45706	0.00028	0.00267	0.46002	0.03611	0.00002	0.00021	0.03634	0.49317	0.0003	0.00289	0.49636	**0.73%**
2011	0.44238	0.00029	0.00281	0.44548	0.03783	0.00002	0.00024	0.03809	0.4802	0.00031	0.00305	0.48357	**1.76%**

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Elec Imports
	For electricity GENERATED (supplied to the grid, plus imports)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
2012	0.49023	0.00033	0.00369	0.49426	0.04287	0.00003	0.00032	0.04322	0.5331	0.00036	0.00402	0.53748	**3.40%**
2013	0.4585	0.00035	0.00334	0.46219	0.03786	0.00003	0.00028	0.03816	0.49636	0.00038	0.00362	0.50035	**4.10%**
2014	0.40957	0.00039	0.00209	0.41205	0.03705	0.00003	0.00019	0.03727	0.44662	0.00042	0.00228	0.44932	**6.44%**
2015	0.34885	0.00062	0.00209	0.35156	0.03261	0.00006	0.00020	0.03287	0.38146	0.00068	0.00229	0.38443	**6.59%**
2016	0.28088	0.00066	0.00153	0.28307	0.02394	0.00006	0.00013	0.02413	0.30482	0.00072	0.00166	0.3072	**5.57%**

Notes: * From 1990-2013 the emission factor used was for French electricity only. The methodology was updated from 2014 onwards with new data on the contribution of electricity from the other interconnects, hence these figures are based on a weighted average emission factor of the emission factors for France, the Netherlands and Ireland, based on the % share supplied.

Time series data in light grey is locked/fixed for the purposes of company reporting and has not been updated in the database in 2018 GHG Conversion Factors update.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

⇒ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES)

Table 7: Base electricity generation emissions factors (including imported electricity)

Indirect/WTT Emissions from UK Grid Electricity

3.10. In addition to the GHG emissions resulting directly from the generation of electricity, there are also indirect/WTT emissions resulting from the production, transport and distribution of the fuels used in electricity generation (i.e. indirect/WTT/ fuel lifecycle emissions as included in the Fuels WTT tables). The average fuel lifecycle emissions per unit of electricity generated will be a result of the mix of different sources of fuel / primary energy used in electricity generation.

3.11. Average WTT emission factors for electricity have been calculated using the corresponding fuels WTT emission factors and data on the total fuel consumption by type of generation from Table 5.6, DUKES, 2017. The data used in these calculations are presented in Table 8, Table 9 and Table 10, together with the final WTT emission factors for electricity. As for the direct emission factors presented in the previous section, earlier years (those prior to the current update) are based on data reported in previous versions of DUKES and following the convention set from 2015 data year, historic time series factors/data have not been updated. The relevant time series source data and emission factors that are fixed/locked have therefore been highlighted in light grey and are unchanged since the last update (i.e. in 2017).

Data Year	Fuel Consumed in Electricity Generation, GWh					
	Coal	Fuel Oil	Natural Gas	Other thermal (excl. renewables)	Other generation	Total
1990 to 1995	N/A	N/A	N/A	N/A	N/A	N/A
1996	390,938	45,955	201,929	16,066	243,574	898,462
1997	336,614	25,253	251,787	16,066	257,272	886,992
1998	347,696	17,793	267,731	16,046	268,184	917,450
1999	296,706	17,920	315,548	16,187	256,159	902,520
2000	333,429	18,023	324,560	15,743	228,045	919,800
2001	367,569	16,545	312,518	12,053	249,422	958,107
2002	344,552	14,977	329,442	12,343	244,609	945,923
2003	378,463	13,867	323,926	17,703	241,638	975,597
2004	364,158	12,792	340,228	16,132	228,000	961,309
2005	378,846	15,171	331,658	21,877	233,705	981,257
2006	418,018	16,665	311,408	18,038	224,863	988,991
2007	382,857	13,491	355,878	14,613	189,813	956,652
2008	348,450	18,393	376,810	13,074	167,638	924,366
2009	286,820	17,597	359,303	11,551	213,450	888,721
2010	297,290	13,705	373,586	9,322	202,893	896,796
2011	302,729	10,514	307,265	8,913	232,146	861,567
2012	399,253	9,076	214,146	12,926	230,227	865,628
2013	365,697	6,849	202,325	15,198	239,526	829,594
2014	280,452	6,167	218,395	19,934	275,426	800,374
2015	212,336	7,192	212,976	23,050	323,693	779,248

Data Year	Fuel Consumed in Electricity Generation, GWh					
	Coal	Fuel Oil	Natural Gas	Other thermal (excl. renewables)	Other generation	Total
2016	87,669	6,790	298,077	25,319	325,774	743,630

Source: For the latest 2016 data year, Table 5.6, Digest of UK Energy Statistics (DUKES) 2017 (BEIS, 2017), available at: https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes#2015. Earlier years are based on data reported in previous versions of DUKES and following the new convention set from 2013 update (2011 data year), historic time series factors/data (i.e. prior to the very latest year) have not been updated.

Table 8: Fuel Consumed in electricity generation (GWh), by year

Data Year	Fuel Consumed in Electricity Generation, % Total					
	Coal	Fuel Oil	Natural Gas	Other thermal (excl. renewables)	Other generation	Total
1990	43.50%	5.10%	22.50%	1.80%	27.10%	100.00%
1991	38.00%	2.80%	28.40%	1.80%	29.00%	100.00%
1992	37.90%	1.90%	29.20%	1.70%	29.20%	100.00%
1993	32.90%	2.00%	35.00%	1.80%	28.40%	100.00%
1994	36.30%	2.00%	35.30%	1.70%	24.80%	100.00%
1995	38.40%	1.70%	32.60%	1.30%	26.00%	100.00%
1996	36.40%	1.60%	34.80%	1.30%	25.90%	100.00%
1997	38.80%	1.40%	33.20%	1.80%	24.80%	100.00%
1998	37.90%	1.30%	35.40%	1.70%	23.70%	100.00%
1999	38.60%	1.50%	33.80%	2.20%	23.80%	100.00%
2000	42.30%	1.70%	31.50%	1.80%	22.70%	100.00%
2001	40.00%	1.40%	37.20%	1.50%	19.80%	100.00%
2002	37.70%	2.00%	40.80%	1.40%	18.10%	100.00%
2003	32.30%	2.00%	40.40%	1.30%	24.00%	100.00%
2004	33.20%	1.50%	41.70%	1.00%	22.60%	100.00%
2005	35.10%	1.20%	35.70%	1.00%	26.90%	100.00%
2006	46.10%	1.00%	24.70%	1.50%	26.60%	100.00%
2007	43.50%	5.10%	22.50%	1.80%	27.10%	100.00%
2008	38.00%	2.80%	28.40%	1.80%	29.00%	100.00%
2009	37.90%	1.90%	29.20%	1.70%	29.20%	100.00%
2010	32.90%	2.00%	35.00%	1.80%	28.40%	100.00%
2011	36.30%	2.00%	35.30%	1.70%	24.80%	100.00%
2012	46.12%	1.05%	24.74%	1.49%	26.60%	100.00%
2013	44.08%	0.83%	24.39%	1.83%	28.87%	100.00%
2014	35.04%	0.77%	27.29%	2.49%	34.41%	100.00%
2015	27.25%	0.92%	27.33%	2.96%	41.54%	100.00%
2016	11.79%	0.91%	40.08%	3.40%	43.81%	100.00%

Notes: Calculated from figures in Table 8.

Table 9: Fuel consumed in electricity generation as a % of the Total, by year

Data Year	Indirect/WTT Emissions as % Direct CO_2 Emissions, by fuel							
	Coal	Fuel Oil	Natural Gas	Other thermal (excl. renewables)	Other generation	Weighted Average	Direct CO_2 ((kg CO_2/ kWh)	Calc Indirect /WTT (kg CO_2e/ kWh
1990	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.6812	0.10012
1991	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.65616	0.09644
1992	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.62005	0.09113
1993	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.55913	0.08218
1994	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.53633	0.07883
1995	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.5113	0.07515
1996	16.50%	18.90%	10.40%	12.50%	14.70%	**14.70%**	0.48731	0.07162
1997	16.50%	18.90%	10.40%	12.50%	14.10%	**14.10%**	0.45112	0.06345
1998	16.50%	18.90%	10.40%	12.50%	14.00%	**14.00%**	0.45633	0.06372
1999	16.50%	18.90%	10.40%	12.50%	13.50%	**13.50%**	0.42438	0.0573
2000	16.50%	18.90%	10.40%	12.50%	13.60%	**13.60%**	0.44628	0.06079
2001	16.50%	18.90%	10.40%	12.50%	13.80%	**13.80%**	0.46725	0.06452
2002	16.50%	18.90%	10.40%	12.50%	13.60%	**13.60%**	0.45378	0.06184
2003	16.50%	18.90%	10.40%	12.50%	13.80%	**13.80%**	0.47537	0.06545
2004	16.50%	18.90%	10.40%	12.50%	13.60%	**13.60%**	0.47033	0.06413
2005	16.50%	18.90%	10.40%	12.50%	13.70%	**13.70%**	0.46359	0.06368
2006	16.50%	18.90%	10.40%	12.50%	14.00%	**14.00%**	0.49263	0.06888
2007	16.50%	18.90%	10.40%	12.50%	13.60%	**13.60%**	0.49054	0.06694
2008	16.50%	18.90%	10.40%	12.50%	13.50%	**13.50%**	0.48219	0.06492
2009	16.50%	18.90%	12.40%	12.50%	14.30%	**14.30%**	0.44917	0.06423
2010	16.50%	18.90%	13.90%	12.50%	15.10%	**15.10%**	0.45706	0.069
2011	16.50%	18.90%	15.30%	12.50%	15.90%	**15.90%**	0.44238	0.07033
2012	16.40%	18.80%	13.45%	12.59%	15.35%	**15.35%**	0.49023	0.07527
2013	16.38%	18.92%	12.62%	12.59%	15.02%	**15.02%**	0.4585	0.0689
2014	16.38%	18.45%	13.61%	12.59%	15.11%	**15.11%**	0.40957	0.06188
2015	16.38%	19.01%	16.03%	12.59%	16.07%	**16.07%**	0.34885	0.05605
2016	16.38%	18.99%	14.63%	12.59%	14.95%	14.95%	0.28088	0.04198

Notes: Indirect/WTT emissions as % direct CO_2 emissions is based on information for specific fuels. Weighted average is calculated from the figures for fuels from both Table 9 and Table 10.

Table 10: Indirect/WTT emissions share for fuels used for electricity generation and the calculated average indirect/WTT emission factor, by year

Emission Factors for the Supply of Purchased Heat or Steam

3.12. Updated emission factors for the supply of purchased heat or steam have been provided for the 2018 GHG Conversion Factors. These conversion factors represent the average emission from the heat and steam supplied by the UK CHPQA scheme[14] operators for a given year. This factor changes from year to year, as the fuel mix consumed changes and is therefore updated annually. No statistics are available that would allow the calculation of UK national average emission factors for the supply of heat and steam from non-CHP operations.

3.13. CHP (Combined Heat and Power) simultaneously produces both heat and electricity, and there are several conventions used to allocate emissions between these products. At the extremes, emissions could be allocated wholly to heat or wholly to electricity, or in various proportions in-between. The GHG Conversion Factors uses the 1/3 : 2/3 DUKES method (Method 1) to determine emissions from heat. This method, together with the alternative boiler displacement and power displacement methods, is described below. It is important to note that since the GHG Conversion Factor for heat is based on the DUKES method. Methods 2 and 3 are provided for information only.

3.14. To determine the amount of fuel attributed to CHP heat (qualifying heat output, or ‘QHO’), it is necessary to apportion the total fuel to the CHP scheme to the separate heat and electricity outputs. This then enables the fuel, and therefore emissions, associated with the QHO to be determined. There are three possible methodologies for apportioning fuel to heat and power, which include:

a. **Method 1:** 1/3 : 2/3 Method (DUKES)

b. **Method 2:** Boiler Displacement Method

c. **Method 3:** Power Station Displacement Method

The basis of each method is described in the following sub-sections.

Method 1: 1/3 : 2/3 Method (DUKES)

3.15. Under the UK’s Climate Change Agreements (CCAs)[15], this method, which is used to apportion fuel use to heat and power, assumes that twice as many units of fuel are required to generate each unit of electricity than are required to generate each unit of heat. This follows from the observation that the efficiency of the generation of electricity (at electricity only generating plant) varies from as little as 25% to 50%, while the efficiency of the generation of heat in fired boilers ranges from 50% to about 90%.

[14] See https://www.gov.uk/guidance/combined-heat-power-quality-assurance-programme

[15] Climate Change Agreements (CCAs) are agreements between UK energy intensive industries and UK Government, whereby industry undertakes to make challenging, but achievable, improvements in energy efficiency in exchange for a reduction in the Climate Change Levy (CCL).

3.16. Mathematically, Method 1 can be represented as follows:

$$Heat\_Energy = \left(\frac{Total\,Fuel\,Input}{(2 \times Electricity\_Output) + Heat\_Output} \right) \times Heat\_Output$$

$$Electricity\_Energy = \left(\frac{2 \times Total\,Fuel\,Input}{(2 \times Electricity\_Output) + Heat\_Output} \right) \times Electricity\_Output$$

Where:

- ‘Total Fuel Input (TFI)’ is the total fuel to the prime mover.
- ‘Heat Output’ is the useful heat generated by the prime mover.
- ‘Electricity Output’ is the electricity (or the electrical equivalent of mechanical power) generated by the prime mover.
- ‘Heat Energy’ is the fuel to the prime mover apportioned to the heat generated.
- ‘Electricity Energy’ is the fuel to the prime mover apportioned to the electricity generated.

3.17. This method is used only in the UK for accounting for primary energy inputs to CHP where the CHP generated heat and electricity is used within a facility with a CCA.

Method 2: Boiler Displacement Method

3.18. Under this convention it is assumed that the heat generated by the CHP displaces heat raised by a boiler with an efficiency of 81% on a GCV basis (90% NCV basis[16]), but that the boiler uses the same fuel mix as the actual fuel mix to the CHP to determine the CO_2 emissions.

3.19. Mathematically, Method 2 can be represented as follows:

$$Heat\_Energy = \left(\frac{Heat\_Output}{0.81} \right)$$

Where: the Heat Energy and Heat Output are as defined for Method 1, above.

3.20. This method has wider understanding within the European Union and has the advantage that it would be compatible with other allocation methodologies for heat.

3.21. Carbon emission factors for Heat and Electricity are calculated according to this method as follows:

CO_2 emission from Fuel for Boiler

$$= \left(\frac{QHO}{0.81} \right) * FuelMixCO2Factor$$

CHP Heat EF = CO_2 emission from Fuel for Boiler / QHO

$$= \left(\frac{FuelMixCO2Factor}{0.81} \right)$$

[16] Annex II, EU Decision (2011/877/EU) establishing harmonised efficiency reference values for separate production of electricity and heat.

CO_2 emission from Fuel for Electricity

$$= \left\{ TFI - \left(\frac{QHO}{0.81} \right) \right\} * FuelMixCO2Factor$$

3 - CHP Electricity EF

$$= \left\{ \left\{ \mathrm{TFI} - \left(\frac{\mathrm{QHO}}{0.81} \right) \right\} * \mathrm{FuelMixCO2Factor} \right\} / \mathrm{QPO}$$

Where: the QHO is the (Qualifying) Heat Output; EF = emission factor.

Method 3: Power Station Displacement Method

3.22. Under this convention it is assumed that the electricity generated by the CHP displaces electricity generated by conventional power only plant with an agreed efficiency (using the UK's fossil fuel fired power stations annual efficiencies, taken into consideration the transmission and distribution losses). This establishes the fuel for electricity and the balance of the fuel to the prime mover is then assumed to be for the generation of heat.

3.23. Mathematically, Method 3 can be represented by:

$$Heat\ Energy = Total\ Fuel\ Input - \left(\frac{Electricity\_Output}{Power\_Stations\_Efficiency} \right)$$

Where: Heat Energy, Total Fuel Input and Electricity Output are defined for Method 1, above.

3.24. This method raises the question of which power generation efficiency to use. For comparison in this analysis we have used the power generation efficiency of gas fired power stations, which has been taken to be 49.5% on a GCV basis[17].

3.25. Carbon emission factors for Heat and Electricity are calculated according to this method as follows:

CO_2 emission from Fuel for Boiler

$$= \left\{ TFI - \left(\frac{ElectricityOutput}{0.495} \right) \right\} * FuelmixCO2Factor$$

CHP Heat emission factor = CO_2 emission from Fuel for Boiler / QHO CO_2 emission from Fuel for Electricity

$$= \left(\frac{QPO}{0.495} \right) * FuelmixCO2Factor$$

CHP Electricity Emission factor

$$= \left(\frac{FuelmixCO2Factor}{0.495} \right)$$

[17] Digest of UK Energy Statistics (DUKES) 2017, Chapter 5, Table 5.10. Plant loads, demands and efficiency in 2016.

Calculation of CO_2 Emissions Factor for CHP Fuel Input, FuelMixCO_2factor

3.26. The value FuelMixCO_2factor referred to above is the carbon emission factor per unit fuel input to a CHP scheme. This factor is determined using fuel input data provided by CHP scheme operators to the CHPQA programme, which is held in confidence.

The value for FuelMixCO_2factor is determined using the following expression:

$$\text{FuelMixCO2factor} = \frac{\sum(\text{Fuel Input} \times \text{Fuel CO2 Emissions Factor})}{\text{TFI}}$$

Where:

- FuelMixCO_2factor is the composite emissions factor (in tCO_2/MWh thermal fuel input) for a scheme
- Fuel Input is the fuel input (in MWh thermal) for a single fuel supplied to the prime mover
- Fuel CO_2 Emissions factor is the CO_2 emissions factor (in tCO_2/MWh_{th}) for the fuel considered.
- TFI is total fuel input (in MWh thermal) for all fuels supplied to the prime mover.

3.27. Fuel inputs and emissions factors are evaluated on a Gross Calorific Value (Higher Heating Value) basis. The following Table 11 provides the individual fuel types considered under the CHPQA scheme and their associated emissions factors, consistent with other reporting.

Fuel	CO_2 Emissions Factor ($kgCO_2/kWh_{th}$)
Biodiesel, bioethanol etc	0.00
Biomass (such as woodchips, chicken litter etc)	0.00
Blast furnace gas	1.01
Coal and lignite	0.32
Coke oven gas	0.14
Domestic refuse (raw)	0.12
Ethane	0.18
Fuel oil	0.27
Gas oil	0.25
Methane	0.18
Mixed refinery gases	0.25
Natural gas	0.18
Other Biogas (e.g. gasified woodchips)	0.00
Other gaseous waste	0.18
Other liquid waste (non-renewable)	0.19
Other liquid waste (renewable)	0.00
Other solid waste	0.23
Sewage gas	0.00

Fuel	CO_2 Emissions Factor ($kgCO_2/kWh_{th}$)
Waste exhaust heat from high temperature processes	0.00
Waste heat from exothermic chemical reactions	0.00
Other waste heat	0.00
Wood Fuels (woodchips, logs, wood pellets etc)	0.00
Fuel cells	0.18
Syngas / Other Biogas (e.g. gasified woodchips)	0.00
Other Industrial By-Product gases	0.18
Hospital waste	0.23

Sources: Defra/BEIS GHG Conversion Factors for Company Reporting (2017 update) and National Atmospheric Emissions Inventory (NAEI).

Note: For waste derived fuels the emission factor can vary significantly according to the waste mix. Therefore, if you have site-specific data it is recommended that you use that instead of the waste derived fuel emissions factors in this table.

Table 11: Fuel types and associated emissions factors used in determination of FuelMixCO_2factor

3.28. The 1/3 : 2/3 method (Method 1) was used to calculate the new heat/steam emission factors provided in the Heat and Steam tables of the 2018 GHG Conversion Factors. This is shown in Table 12. It is important to note that the conversion factors update year is two years ahead of the data year. For example, the most recent emission factor for the 2018 GHG Conversion Factors is based on the data year of 2016 in the table.

3.29. While not used in the 2018 GHG conversion factors, the factor for heat from CHP and power from CHP was calculated using the other two CHP methods and the DUKES power method. These are: 0.22012 CO_2/kWh heat (Boiler displacement), 0.19233 CO_2/kWh heat (Power station displacement), 0.37236 CO_2/kWh power (DUKES method), 0.30401 CO_2/kWh power (Boiler displacement), 0.35997 CO_2/kWh power (power station displacement).

Data Year	$KgCO_2$/kWh supplied heat/steam
	Method 1 (DUKES: 2/3rd - 1/3rd)
2001	0.23770
2002	0.22970
2003	0.23393
2004	0.22750
2005	0.22105
2006	0.23072
2007	0.23118
2008	0.22441

Data Year	$KgCO_2/kWh$ supplied heat/steam
	Method 1 (DUKES: 2/3rd - 1/3rd)
2009	0.22196
2010	0.21859
2011	0.21518
2012	0.20539
2013	0.20763
2014	0.20245
2015	0.19564
2016	0.18618

Table 12: Heat/Steam CO_2 emission factor for DUKES 1/3 2/3 method.

Calculation of Non-CO_2 and Indirect/WTT Emissions Factor for Heat and Steam

3.30. CH_4 and N_2O emissions have been estimated relative to the CO_2 emissions, based upon activity weighted average values for each CHP fuel used (using relevant average fuel emission factors from the NAEI). Where fuels are not included in the NAEI, the value for the closest/most similar alternative fuel was utilised instead. There have been some updates to the assumptions here in the 2018 update, although the overall impacts are not significant.

3.31. Indirect/WTT GHG emission factors have been estimated relative to the CO_2 emissions, based upon activity weighted average indirect/WTT GHG emission factor values for each CHP fuel used (see Indirect/WTT Emissions from Fuels from Fuels section for more information). Where fuels are not included in the set of indirect/WTT GHG emission factors provided in the 2018 GHG Conversion Factors, the value for the closest/most similar alternative fuel was utilised instead.

3.32. The complete final emission factors for supplied heat or steam utilised are presented in the 'Heat and Steam' tables of the 2018 GHG Conversion Factors, and are counted as Scope 2 emissions under the GHG Protocol.

3.33. For district heating systems, the location of use of the heat will often be some distance from the point of production and therefore there are distribution energy losses. These losses are typically around 5%, which need to be factored into the calculation of overall GHG emissions where relevant and are counted as Scope 3 emissions under the GHG Protocol (similar to the treatment of transmission and distribution losses for electricity).

4. Refrigerant and Process Emission Factors

Summary of changes since the previous update

4.1. There are no major changes for the refrigerant factors in the 2018 update.

Global Warming Potentials of Greenhouse Gases

4.2. Although revised GWP values have since been published by the IPCC in the Fifth Assessment Report (2014), the conversion factors in the Refrigerant tables incorporate (GWP) values relevant to reporting under UNFCCC, as published by the IPCC in its Fourth Assessment Report that is required to be used in inventory reporting.

Greenhouse Gases Listed in the Kyoto Protocol

4.3. Mixed/Blended gases: GWP values for refrigerant blends are calculated on the basis of the percentage blend composition (e.g. the GWP for R404a that comprises of 44% HFC125[18], 52% HFC143a and 4% HFC134a is [3500 x 0.44] + [4470 x 0.52] + [1430x 0.04] = 3922). A limited selection of common blends is presented in the Refrigerant tables.

Other Greenhouse Gases

4.4. CFCs and HCFCs[19]: Not all refrigerants in use are classified as GHGs for the purposes of the UNFCCC and Kyoto Protocol (e.g. CFCs, HCFCs). These gases are controlled under the Montreal Protocol and as such GWP values are also listed in the provided tables.

[18] HFC: Hydrofluorocarbon

[19] CFCs: Chlorofluorocarbons; HCFCs: Hydrochlorofluorocarbons

5. Passenger Land Transport Emission Factors

Summary of changes since the previous update

5.1. The emission factors for buses (and other heavy-duty vehicles) were revised this year to account for new technology being deployed on new vehicles to enable manufacturers to meet the most recent diesel engine emissions standards for NO_x emissions. This technology uses a urea solution (also known as 'AdBlue') to effectively reduce NO_x from diesel engines' exhaust gases. Emissions resulting from the consumption of urea in buses is estimated in the conversion factors for the first time in 2018 and are included in the estimates for the overall CO_2 emission factors.

5.2. For hybrid cars, a revision has been made to the underlying SMMT (Society of Motor Manufacturers & Traders) source dataset used in the derivation of passenger car emission factors, which has resulted in increased factors for (non-plug-in) hybrid cars in some cases.

Direct Emissions from Passenger Cars

Emission Factors for Petrol and Diesel Passenger Cars by Engine Size

5.3. SMMT (Society for Motor Manufacturers and Traders)[20] provides numbers of registrations and averages of the NEDC[21] gCO_2/km figures for new vehicles registered from 1997 to 2017[22]. The dataset represents a good indication of the relative NEDC gCO_2/km by size category. Table 13 presents the 2001-2017 average CO_2 emission factors and number of vehicle registrations.

[20] SMMT is the Society of Motor Manufacturers and Traders that represents the UK auto industry. http://www.smmt.co.uk/

[21] NEDC = New European Driving Cycle, which is used in the type approval of new passenger cars.

[22] The SMMT gCO_2/km dataset for 1997 represented around 70% of total registrations, which rose to about 99% by 2000 and essentially all vehicles thereafter.

Vehicle Type	Engine size	Size label	NEDC gCO_2 per km	Total no. of registrations	% Total
Petrol car	< 1.4 l	Small	126.9	13,055,579	55%
	1.4 - 2.0 l	Medium	165.3	8,999,251	38%
	> 2.0 l	Large	249.4	1,479,185	6%
Average petrol car		**All**	**154.4**	**23,534,015**	**100%**
Diesel car	<1.7 l	Small	110.9	5,308,184	33%
	1.7 - 2.0 l	Medium	139.0	7,346,311	46%
	> 2.0 l	Large	171.7	3,401,926	21%
Average diesel car		**All**	**140.4**	**16,056,421**	**100%**

Table 13: Average CO_2 emission factors and total registrations by engine size for 2001 to 2017 (based on data sourced from SMMT)

5.4. For the 2018 GHG Conversion Factors update, the SMMT data have been used in conjunction with DfT's ANPR (Automatic Number Plate Recognition) data to weight the emission factors to account for the age and activity distribution of the UK vehicle fleet in 2015 (the ANPR dataset is only updated in the NAEI on a bi-annual basis)).

5.5. The ANPR data have been collected annually (since 2007) over 256 sites in the UK on different road types (urban and rural major/minor roads, and motorways) and regions. Measurements are made at each site on one weekday (8am-2pm and 3pm-9pm) and one-half weekend day (either 8am-2pm or 3pm-9pm) each year in June and are currently available for 2007, 2008, 2009, 2010, 2011, 2013, 2014 and 2015. Data are not available for 2016, as this dataset is only updated on a bi-annual basis for the NAEI, therefore for the 2018 GHG Conversion Factors the 2015 data have been used. There are approximately 1.4 -1.7 million observations recorded from all the sites each year, and they cover various vehicle and road characteristics such as fuel type, age of vehicle, engine sizes, vehicle weight and road types.

5.6. Data for the UK car fleet were extracted from the 2015 ANPR dataset and categorised according to their engine size, fuel type and year of registration. The 2018 GHG Conversion Factors' emission factors for petrol and diesel passenger cars were subsequently calculated based upon the equation below:

$$2018 \text{ update } \mathrm{gCO_2/km} = \Sigma \left(\mathrm{gCO_2/km_{yr\ reg}} \times \frac{\mathrm{ANPR_{yr\ reg}}}{\mathrm{ANPR_{total\ 2015}}} \right)$$

5.7. A limitation of the NEDC (New European Driving Cycle – used in vehicle type approval) is that it takes no account of further 'real-world' effects that can have a significant impact on fuel consumption. These include use of accessories (air con, lights, heaters etc.), vehicle payload (only driver +25kg is considered in tests, no passengers or further luggage), poor maintenance (tyre under inflation, maladjusted tracking, etc.), gradients (tests effectively assume a level road), weather, more aggressive/harsher driving style, etc. It is therefore desirable to uplift NEDC based data to bring it closer to anticipated 'real-world' vehicle performance.

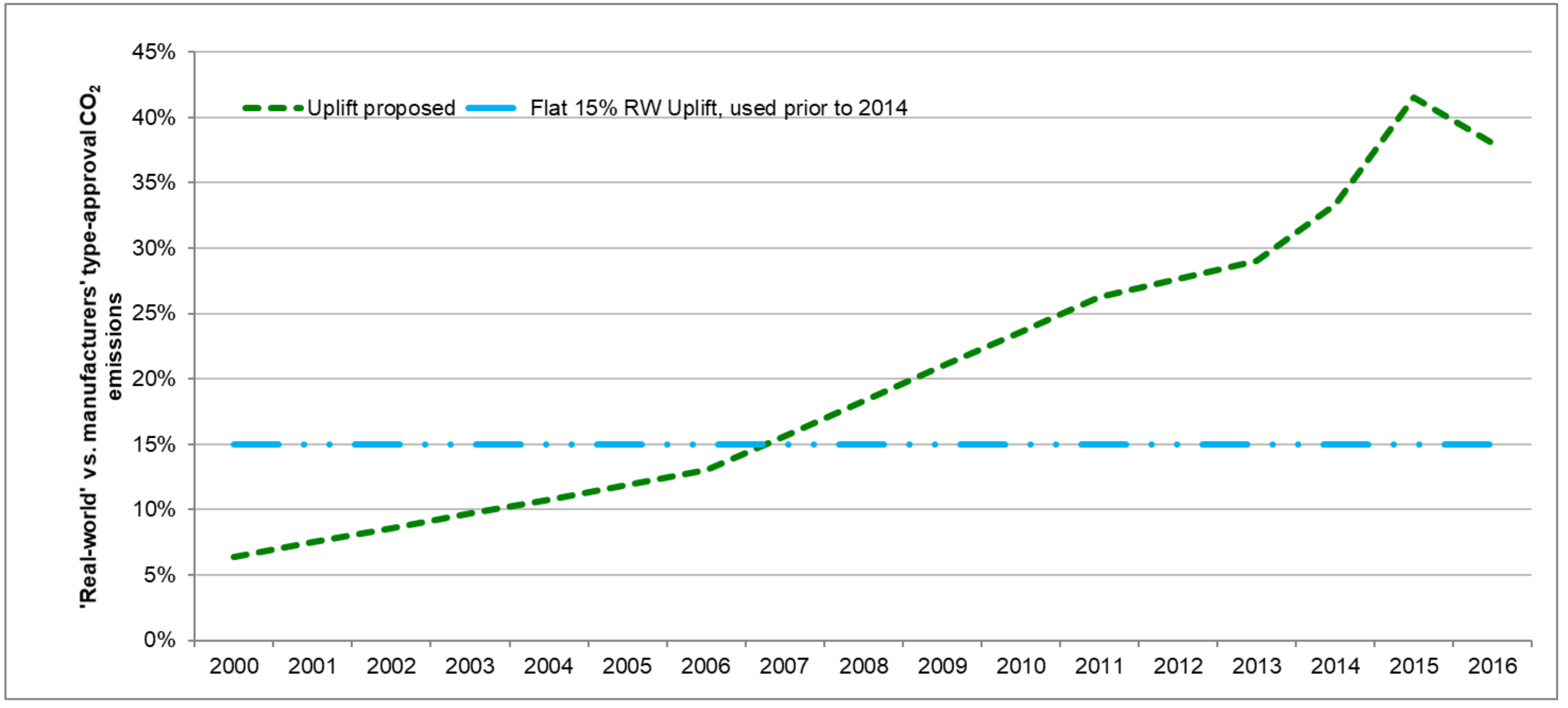
5.8. An uplift factor over NEDC based gCO_2/km factors is applied to take into account the combined 'real-world' effects on fuel consumption. The uplift applied varies over time and is based on work performed by ICCT (2017)[23]; this study used data on almost 1.1 million vehicles from fourteen data sources and eight countries, covering the fuel consumption/CO_2 from actual real-world use and the corresponding type-approval values. The values used are based on average data from the two UK-based sources analysed in the ICCT study, as summarised in Table 14 below, and illustrated in Figure 2 alongside the source data/chart reproduced from the ICCT (2017) report. This was an update of the previous report used for the 2017 update to the GHG Conversion Factors. The methodology for the revised approach was also agreed with DfT upon its introduction in 2014.

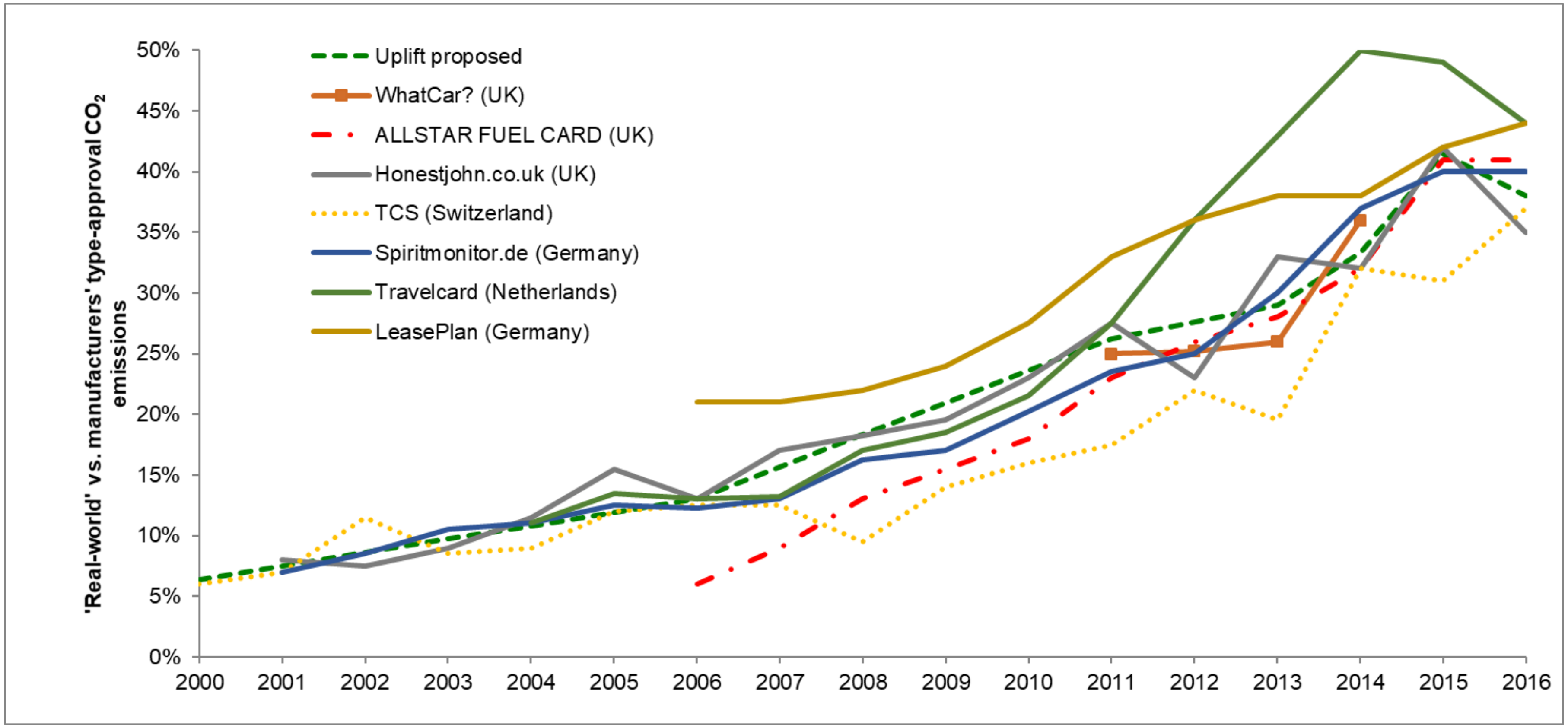
[23] Report by the ICCT, November 2017, FROM LABORATORY TO ROAD: A 2017 update of official and 'real-world' fuel consumption and CO_2 values for passenger cars in Europe, available at: https://www.theicct.org/sites/default/files/publications/Lab-to-road-2017_ICCT-white%20paper_06112017_vF.pdf.

Data year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
RW uplift %	8.60%	9.70%	10.8%	11.9%	13.0%	15.6%	18.3%	21.0%	23.6%	26.2%	27.6%	29.0%	33.3%	41.5%	38.0%

Table 14: Average GCF 'real-world' uplift for the UK, applied to the NEDC-based gCO_2/km data

5.9. The above uplifts have been applied to the ANPR weighted SMMT gCO_2/km to give the new 'Real-World' 2018 GHG Conversion Factors, to take into account the 'real-world' impacts on fuel consumption not captured by drive cycles such as the NEDC in type-approval. The final average equivalent uplift averaged across all vehicles was 20.9% on top of NEDC gCO_2/km.





Notes: In the above charts a y-axis value of 0% would mean no difference between the CO_2 emissions per km experienced in 'real-world' driving conditions and those from official type-approval testing.

Figure 2: Updated GCF 'Real world' uplift values for the UK based on ICCT (2017)

5.10. Figures for the aggregated average emission factors by engine type and fuel type (as well as the overall average) were calculated based on weighting by the relative mileage of the different categories. This calculation utilised data from the UK GHG Inventory on the relative % total mileage by petrol and diesel cars. Overall for petrol and diesel, this split in total annual mileage was 50.5% petrol and 49.5% diesel, and can be compared to the respective total registrations of the different vehicle types for 2011-2017, which were 59.4% petrol and 40.6% diesel.

5.11. Emission factors for CH_4 and N_2O have been updated for all vehicle classes and are based on the emission factors from the NAEI. The emission factors used in the NAEI are based on COPERT 4 version 11[24].

5.12. The final 2018 emission factors for petrol and diesel passenger cars by engine size are presented in the 'Passenger vehicles' and 'business travel- land' tables of the 2018 GHG Conversion Factors.

Hybrid, LPG and CNG Passenger Cars

5.13. The methodology used in the 2018 update for small, medium and large hybrid petrol/diesel electric cars is similar to that used previously, and is calculated in a similar way to conventional petrol and diesel vehicles. The emission factors are based on datasets with numbers of registrations and averages of the NEDC gCO_2/km figures from SMMT for new hybrid vehicles registered between 2011 and 2017. In previous years, the SMMT source dataset used in the derivation of passenger car emission factors included plug-in hybrid cars with in the hybrid category. A small revision to this dataset was made in 2018 to exclude these data (as these vehicles are now captured separately), which has resulted in increased factors in some cases.

5.14. Due to the significant size and weight of the LPG and CNG fuel tanks it is assumed only medium and large sized vehicles are available. In the 2018 GHG Conversion Factors, CO_2 emission factors for CNG and LPG medium and large cars are derived by multiplying the equivalent petrol EF by the ratio of CNG (and LPG) to petrol emission factors on a unit energy (Net CV) basis. For example, for a Medium car run on CNG:

$$\mathrm{gCO_2/km_{CNG\ Medium\ car}} = \mathrm{gCO_2/km_{Petrol\ Medium\ car}} \times \frac{\mathrm{gCO_2/kWh_{CNG}}}{\mathrm{gCO_2/kWh_{Petrol}}}$$

5.15. For the 2018 GHG Conversion Factors, the emission factors for CH_4 and N_2O were updated, but the methodology remains unchanged. These are based on the emission factors from the NAEI (produced by Ricardo Energy & Environment) and are presented together with an overall total emission factors in the 'Passenger vehicles' and 'business travel- land' tables of the 2018 GHG Conversion Factors.

Plug-in Hybrid Electric and Battery Electric Passenger Cars (xEVs)

5.16. Since the number of electric vehicles (xEVs[25]) in the UK fleet is rapidly increasing (and will continue to increase in the future), at least for passenger cars and vans,

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[24] COPERT 4 is a software tool used world-wide to calculate air pollutant and greenhouse gas emissions from road transport, see: http://emisia.com/products/copert-4.

[25] xEVs is a generic term used to refer collectively to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), range-extended electric vehicles (REEVs, or ER-EVs, or REX) and fuel cell electric vehicles (FCEVs).

there is a need for specific emission factors for such vehicles to complement emission factors for vehicles fuelled primarily by petrol, diesel, natural gas or LPG.

5.17. Consequently, for the first time in the 2018 GHG Conversion Factors, new emission factors were developed for these vehicle types. The methodology, data sources and key assumptions utilised in the development of these emission factors for xEVs were discussed and agreed with the DfT.

5.18. These emission factors are currently presented in a number of data tables in the GHG Conversion Factors workbook, according the type / 'Scope' of the emission component. The following tables / worksheets, shown in Table 15, are required for BEVs (battery electric vehicles) and PHEVs (plug-in hybrid electric vehicles), and related REEVs (range-extended electric vehicles). Since there are still relatively few models available on the market, all PHEVs and REEVs are grouped into a single category. There are not yet meaningful numbers of fuel cell electric vehicles (FCEVs) in use, so these are not included at this time.

5.19. Table 15 provides an overview of the GHG Conversion Factor tables that have been developed for the reporting of emissions from electric vehicles, which aligns with current reporting. Whilst most emission factors could be accommodated by simply extending existing tables for cars and vans, two new tables (marked NEW) were needed to account for emissions resulting from electricity consumption, and these were added in the 2017 GHG Conversion Factors.

Emission component	Emissions Scope and Reporting Worksheet	Plug-in hybrid electric vehicles (PHEVs)	Battery electric vehicles (BEVs)
Direct emissions from use of petrol or diesel	**Scope 1:** • Passenger vehicles • Delivery vehicles	Yes	(Zero emissions)
Emissions resulting from electricity use: (a) Electricity Generation (b) Electricity Transmission & Distribution losses	**(a) Scope 2:** • UK electricity for EVs [NEW in 2017 update] **(b) Scope 3:** • UK electricity T&D for EVs [NEW in 2017 update]	Yes	Yes
Upstream emissions from use of liquid fuels and electricity	**Scope 3:** • WTT- pass vehs & travel-land • WTT- delivery vehs & freight	Yes	Yes
Total GHG emissions for all components for not directly owned /controlled assets	**Scope 3:** • Business travel- land • Freighting goods • Managed assets- vehicles	Yes	Yes

Note:

- **Scope 1 (direct) emissions** are those from activities owned or controlled by your organisation. Examples of Scope 1 emissions include emissions from combustion in owned or controlled boilers, furnaces and vehicles; and emissions from chemical production in owned or controlled process equipment.
- **Scope 2 (energy indirect) emissions** are those released into the atmosphere that are associated with consumption of purchased electricity, heat, steam and cooling. These indirect emissions are a consequence of an organisation's energy use, but occur at sources the organisation does not own or control.
- **Scope 3 (other indirect) emissions** are a consequence of your actions that occur at sources an organisation does not own or control and are not classed as Scope 2 emissions. Examples of Scope 3 emissions are business travel by means not owned or controlled by an organisation, waste disposal, materials or fuels an organisation's purchases. Deciding if emissions from a vehicle, office or factory that you use are Scope 1 or Scope 3 may depend on how organisations define their operational boundaries. Scope 3 emissions can be from activities that are upstream or downstream of an organisation. More information on Scope 3 and other aspects of reporting can be found in the Greenhouse Gas Protocol Corporate Standard.

Table 15: Summary of emissions reporting and tables for new electric vehicle emission factors

Data inputs, sources and key assumptions

5.20. A number of data inputs and assumptions were needed in order to calculate the final GHG conversion factors for electric cars and vans. The following table, Table 16, provides a summary of the key data inputs needed, the key data sources and other assumptions used for the calculation of the final xEV emission factors.

5.21. The calculation of UK fleet average emission factors for electric vehicles is based upon data obtained from the EEA CO_2 monitoring databases for cars and vans, which are publicly available[26 27]. This database provides details by manufacturer and vehicle type (and by EU member state) on the annual number of registrations and test cycle performance for average CO_2 emissions (gCO_2/km) and electrical energy consumption (Wh/km, for plug-in vehicles). This allows for the classification of vehicles into market segments and also the calculation of registrations weighted average performance figures. The xEV models included in the current database (which covers registrations up to the end of 2016) and their allocation to different market segments, is provided in Table 16. For the purposes of calculating the corresponding emission factors for the tables split by car 'size' category, it is assumed segments A and B are 'Small' cars, segments C and D are 'Medium' cars and all other segments are 'Large' cars.

Make	Model	Segment	Segment Name	BEV	PHEV
Audi	A3	C	Lower Medium	-	Yes
Audi	Q7	H	Dual Purpose	-	Yes
BMW	I3	B	Supermini	Yes	-
BMW	I3 REEV	B	Supermini	-	Yes
BMW	I8	G	Specialist Sports	-	Yes
BMW	Series 2	C	Lower Medium	-	Yes
BMW	Series 3	D	Upper Medium	-	Yes
BMW	Series 5	E	Executive	-	-
BMW	X5	H	Dual Purpose	-	Yes
BYD	E6Y	C	Lower Medium	Yes	-
Chevrolet	Volt	C	Lower Medium	-	Yes

[26] https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-14

[27] https://www.eea.europa.eu/data-and-maps/data/vans-10

Make	Model	Segment	Segment Name	BEV	PHEV
Citroen	C-Zero	A	Mini	Yes	-
Ford	Focus	C	Lower Medium	Yes	-
Hyundai	Ioniq	C	Lower Medium	Yes	-
Kia	Optima	D	Upper Medium	-	Yes
Kia	Soul	B	Supermini	Yes	-
Mahindra	E20PLUS	C	Lower Medium	Yes	-
McLaren	P1	G	Specialist Sports	-	Yes
Mercedes-Benz	B Class	C	Lower Medium	Yes	-
Mercedes-Benz	C Class	D	Upper Medium	-	Yes
Mercedes-Benz	E Class	E	Executive	-	Yes
Mercedes-Benz	GL	H	Dual Purpose	-	Yes
Mercedes-Benz	S Class	F	Luxury Saloon	-	Yes
Mia	Mia	A	Mini	Yes	-
Mitsubishi	I-MIEV	A	Mini	Yes	-
Mitsubishi	Outlander	H	Dual Purpose	-	Yes
Nissan	e-NV200	I	Multi Purpose Vehicle	Yes	-
Nissan	Leaf	C	Lower Medium	Yes	-
Opel	Ampera	D	Upper Medium	-	Yes
Peugeot	Ion	A	Mini	Yes	-
Porsche	918	G	Specialist Sports	-	Yes
Porsche	Cayenne	H	Dual Purpose	-	Yes
Porsche	Panamera	F	Luxury Saloon	-	Yes
Renault	Fluence Z.E.	D	Upper Medium	Yes	-
Renault	Kangoo	I	Multi Purpose Vehicle	Yes	-
Renault	Zoe	C	Lower Medium	Yes	-
Smart	ForTwo	A	Mini	Yes	-
Tesla	Model S	F	Luxury Saloon	Yes	-
Tesla	Model X	H	Dual Purpose	Yes	-
Tesla	Roadster	G	Specialist Sports	Yes	-
Think	ThinkCity	A	Mini	Yes	-
Toyota	Prius	C	Lower Medium	-	Yes
Volkswagen	E-Up	A	Mini	Yes	-
Volkswagen	Golf	C	Lower Medium	Yes	Yes
Volkswagen	Passat	D	Upper Medium	-	Yes
Volvo	V60	D	Upper Medium	-	Yes
Volvo	XC90	H	Dual Purpose	-	Yes

Notes: Only includes models with registrations in the UK fleet up to the end of 2016.

Table 16: xEV car models and their allocation to different market segments

5.22. During the course of the derivation of the emission factors, a number of discrepancies were found in the EEA CO_2 monitoring database for the gCO_2/km and Wh/km data for certain models, which were then updated based on other sources of official NEDC type-approval data, for example from manufacturer's websites and the Green Car Guide[28].

5.23. Consistent with the approach used for the calculation of emission factors for conventionally fuelled passenger cars, the gCO_2/km and Wh/km figures from type approval with NEDC need adjusting to account for real-world performance (charging losses are already accounted for under the type approval methodology[29]). A number of assumptions are therefore made in order to calculate adjusted 'Real-World' energy consumption and emission factors, consistent with the approach for conventionally fuelled passenger cars. These assumptions were discussed and agreed with DfT.

5.24. A further complication for PHEVs is that the real-world electric range is lower than that calculated on the standard regulatory testing protocol, which also needs to be accounted for in the assumption of the average share of total km running on electricity. Figure 3 provides an illustration of the utility function used to calculate the share of electric km based on the electric range of a PHEV. Real-World factors for average gCO_2/km and Wh/km for PHEVs are therefore further adjusted based on the ratio of calculated electric shares of total km under Test-Cycle and Real-World conditions.

5.25. The key assumptions used in the calculation of adjusted Real-World gCO_2/km and Wh/km figures are summarised in Table 17. The calculated real-world figures for individual vehicle models are used to calculate the final registrations-weighted average factors for different vehicle segments/sizes. These are then combined with other GHG Conversion Factors to calculate the final set of emission factors for different Scopes/reporting tables (i.e. as summarised in earlier Table 15).

Data type	Raw data source / assumption	Other notes
Numbers of registrations of different vehicle types/models	Reported for GB by vehicle make/model in EEA CO_2 monitoring databases: • Data for 2010-2016 for cars • Data for 2012-2016 for vans	This data is used in conjunction with CO_2/km and Wh/km data to calculate registrations-weighted average figures by market segment or vehicle size category.
CO_2 emissions from petrol or diesel fuel use per km (test-cycle)	As for registrations	Zero for BEVs. For PHEVs the emission factors are for the average share of km driven in charge-sustaining mode / average liquid fuel consumption per km

[28] https://www.greencarguide.co.uk/

[29] www.vda.de/dam/vda/publications/2014/facts-and-arguments-about-fuel-consumption.pdf

Data type	Raw data source / assumption	Other notes
Wh electricity consumption per km (test-cycle)	As for registrations	Average electricity consumption per average km (i.e. factoring in for PHEVs that only a fraction of total km will be in electric mode).
Test-Cycle to Real-World conversion for gCO_2 / km	Assumption based on literature, consistent with source used for the car EFs for conventional powertrains.	An uplift of **35%** is applied to the test-cycle emission component.
Test-Cycle to Real-World conversion for Wh per km	Assumption based on best available information on the average difference between test-cycle and real-world performance	An uplift of **40%** is applied to the test-cycle electrical energy consumption component. This is consistent with the uplift currently being used in analysis for the EC DG CLIMA, developed/agreed with the EC's JRC.
Electric range for PHEVs under Test-Cycle conditions	Available from various public sources for specific models	Values representative of the models currently available on the market are used, i.e. generally between 30-50km. The notable exception is the BMW i3 REX, which was 200km up to 2015.
Electric range for PHEVs under Real-World conditions	Calculated based on Test-Cycle electric range and Test-Cycle to Real-World conversion for Wh per km	Calculated based on Test-Cycle electric range and Test-Cycle to Real-World conversion for Wh/km
Share of electric km on Test-Cycle	Calculated using the standard formula used in type-approval*: **Electric km %** = 1 – (25 / (25 + Electric km range))	Uses Test-Cycle electric range in km
Share of electric km in Real-World conditions	Calculated using standard formula*: **Electric km %** = 1 – (25 / (25 + Electric km range))	Uses Real-World electric range in km
Loss factor for electric charging	N/A	Charging losses are already accounted for under the type approval testing protocol in the Wh/km dataset.

Data type	Raw data source / assumption	Other notes
GHG emission factors for electricity consumption	UK electricity emission factors ($kgCO_2e$ / kWh): • Electricity generated • Electricity T&D • WTT electricity generated • WTT electricity T&D	From the UK GHG Conversion Factors model outputs for UK Electricity
CH_4, N_2O and WTT CO_2e emissions from petrol /diesel use	Calculated based on derived Real-World g/km for petrol /diesel.	Calculation uses GHG Conversion Factors for petrol/diesel: uses ratio of direct CO_2 emission component to CH_4, N_2O or WTT CO_2e component for petrol/diesel.

Notes: * the result of this formula is illustrated in Figure 3 below.

Table 17: Summary of key data elements, sources and key assumptions used in the calculation of GHG conversion factors for electric cars and vans

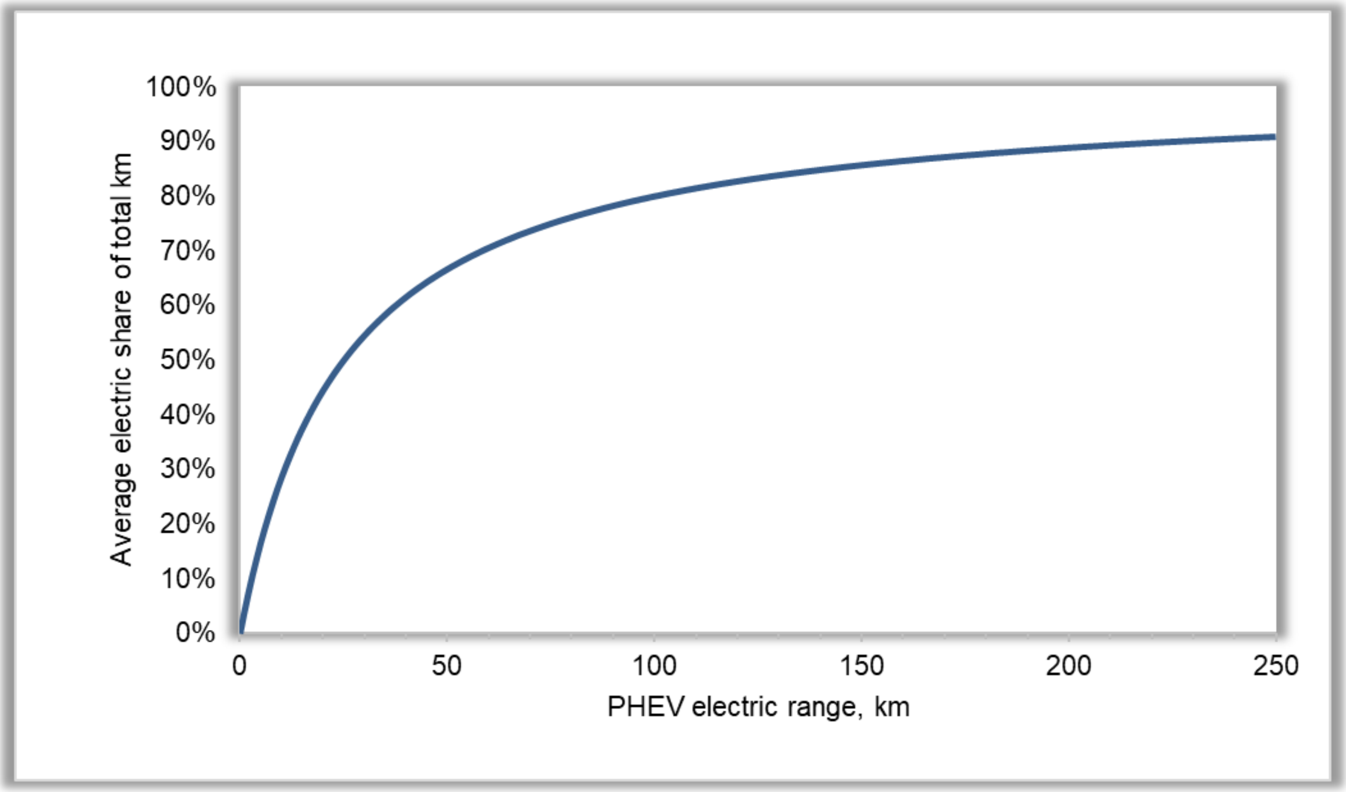

Figure 3: Illustration of the relationship of electric range to average electric share of total km for PHEVs assumed in the calculations

Emission Factors by Passenger Car Market Segments

5.26. For the 2018 GHG Conversion Factors, the market classification split (according to SMMT classifications) was derived using detailed SMMT data on new car registrations between 2011 and 2017 split by fuel[30], presented in Table 18, and again combining this with information extracted from the 2015 ANPR dataset. These data were then uplifted to take into account 'real-world' impacts, consistent with the methodology used to derive the car engine size emission factors. The supplementary market segment based emission factors for passenger cars are presented in the 'Passenger vehicles' and 'business travel- land' tables of the 2018 GHG Conversion Factors.

5.27. Emission factors for CH_4 and N_2O were also updated for all car classes. These figures are based on the emission factors from the UK GHG Inventory. The emission factors used in the NAEI are now based on COPERT 4 version 11[31]. The factors are presented together with the overall total emission factors in the tables of the 2018 GHG Conversion Factors.

5.28. As a final additional step, an accounting for biofuel use has been included in the calculation of the final passenger car emission factors.

Fuel Type	Market Segment	Example Model	2001 to 2017		
			gCO_2/km	# registrations	% Total
Diesel	A. Mini	Smart ForTwo	90.4	8,531	0.1%
	B. Super Mini	VW Polo	106.8	1,896,272	11.81%
	C. Lower Medium	Ford Focus	118.3	4,796,196	29.87%
	D. Upper Medium	Toyota Avensis	136.3	3,623,841	22.57%
	E. Executive	BMW 5-Series	143.3	1,346,631	8.39%
	F. Luxury Saloon	Bentley Continental GT	177.2	78,147	0.49%
	G. Specialist Sports	Mercedes SLK	135.3	115,036	0.72%
	H. Dual Purpose	Land Rover Discovery	164.5	2,884,603	17.97%
	I. Multi Purpose	Renault Espace	147.1	1,307,165	8.14%
	All	**Total**	**140.4**	**16,056,422**	**100%**
Petrol	A. Mini	Smart ForTwo	113.0	860,929	3.65%
	B. Super Mini	VW Polo	129.6	11,513,671	48.80%
	C. Lower Medium	Ford Focus	153.4	6,272,207	26.58%
	D. Upper Medium	Toyota Avensis	183.6	2,018,160	8.55%
	E. Executive	BMW 5-Series	210.9	529,511	2.24%

[30] This data was provided by EST and is based on detailed data sourced from SMMT on new car registrations.

[31] COPERT 4 is a software tool used world-wide to calculate air pollutant and greenhouse gas emissions from road transport, see: http://emisia.com/products/copert-4.

Fuel Type	Market Segment	Example Model	2001 to 2017		
			gCO_2/km	# registrations	% Total
	F. Luxury Saloon	Bentley Continental GT	292.2	91,849	0.39%
	G. Specialist Sports	Mercedes SLK	211.3	796,413	3.38%
	H. Dual Purpose	Land Rover Discovery	212.0	751,592	3.19%
	I. Multi Purpose	Renault Espace	168.8	759,966	3.22%
	All	**Total**	**154.4**	**23,594,298**	**100%**
Unknown Fuel (Diesel + Petrol)	A. Mini	Smart ForTwo	111.8	869,460	2.19%
	B. Super Mini	VW Polo	125.0	13,409,943	33.82%
	C. Lower Medium	Ford Focus	136.3	11,068,403	27.91%
	D. Upper Medium	Toyota Avensis	149.5	5,642,001	14.23%
	E. Executive	BMW 5-Series	157.2	1,876,142	4.73%
	F. Luxury Saloon	Bentley Continental GT	227.3	169,996	0.43%
	G. Specialist Sports	Mercedes SLK	194.0	911,449	2.30%
	H. Dual Purpose	Land Rover Discovery	171.4	3,636,195	9.17%
	I. Multi Purpose	Renault Espace	154.5	2,067,131	5.21%
	All	**Total**	**147.0**	**39,650,720**	**100%**

Table 18: Average car CO_2 emission factors and total registrations by market segment for 2001 to 2017 (based on data sourced from SMMT)

Direct Emissions from Taxis

5.29. The emission factors for black cabs are based on data provided by Transport for London (TfL)[32] on the testing of emissions from black cabs using real-world London Taxi cycles, and an average passenger occupancy of 1.5 (average 2.5 people per cab, including the driver, from LTI, 2007 – a more recent source has not yet been identified). This methodology accounts for the significantly different operational cycle of black cabs/taxis in the real world when compared to the NEDC (official vehicle type-approval) values, which significantly increases the emission factor (by ~40% vs NEDC).

5.30. The emission factors (per passenger km) for regular taxis were estimated on the basis of the average type-approval CO_2 factors for medium and large cars, uplifted by the same factor as for black cabs (i.e. 40%, based on TfL data) to reflect the difference between the type-approval figures and those operating a real-world taxi cycle (i.e. based on different driving conditions to average car use), plus an assumed average passenger occupancy of 1.4 (CfIT, 2002[33]).

5.31. Emission factors per passenger km for taxis and black cabs are presented in the 'business travel- land' tables of the 2018 GHG Conversion Factors. The base emission factors per vehicle km are also presented in the 'business travel- land' tables of the 2018 GHG Conversion Factors.

5.32. Emission factors for CH_4 and N_2O have been updated for all taxis for the 2018 update. These figures are based on the emission factors for diesel cars from the latest UK GHG Inventory and are presented together with the overall total emission factors in the tables of the 2018 GHG Conversion Factors.

5.33. It should be noted that the current emission factors for taxis still don't take into account emissions spent from "cruising" for fares. Currently robust data sources do not exist that could inform such an "empty running" factor. If suitably robust sources are identified in the future, the methodology for taxis may be revisited and revised in a future update to account for this.

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[32] The data was provided by TfL in a personal communication and is not available in a public TfL source.

[33] Obtaining the best value for public Subsidy of the bus industry, a report by L.E.K. Consulting LLP for the UK Commission for Integrated Transport, 14 March 2002. Appendix 10.5.1: Methodology for settlements with <25k population. Available at: http://webarchive.nationalarchives.gov.uk/20110304132839/http://cfit.independent.gov.uk/pubs/2002/psbi/lek/index.htm

Direct Emissions from Vans/Light Goods Vehicles (LGVs)

5.34. Average emission factors by fuel, for light good vehicles (LGVs: N1 vehicles, vans up to 3.5 tonnes gross vehicle weight) and by size class (I, II or III) are presented in Table 19 and in the “delivery vehicles” section of the 2018 GHG Conversion Factors. These have been updated for this year’s update. The data set used to allocate different vehicles to each class is based on reference weight (approximately equivalent to kerb weight plus 60kg) from an extraction from the SMMT MVRIS (Motor Vehicle Registration Information System) data set used in previous work for the DfT. The assumed split of petrol van stock between size classes uses the split of registrations from this dataset.

5.35. Emission factors for petrol and diesel LGVs are based upon emission factors and vehicle km from the NAEI for 2016. These emission factors are further uplifted by 15% to represent ‘real-world’ emissions (i.e. also factoring in typical vehicle loading versus unloaded test-cycle based results), consistent with the previous approach used for cars, and agreed with DfT in the absence of a similar time-series dataset of ‘real-world’ vs type-approval emissions from vans (see earlier section on passenger cars). In a future update, it is envisaged this uplift will be further reviewed.

5.36. In the 2018 GHG Conversion Factors, CO_2 emission factors for CNG and LPG vans are calculated from the emission factors for conventionally fuelled vans using the same methodology as for passenger cars. The average van emission factor is calculated on the basis of the relative NAEI vehicle km for petrol and diesel LGVs for 2016, as presented in Table 19.

5.37. Emission factors for CH_4 and N_2O were also updated for all van classes, based on the emission factors from the UK GHG Inventory.

5.38. As a final additional step, an accounting for biofuel use has been included in the calculation of the final LGVs emission factors.

Van fuel	Van size	Direct gCO_2e per km				vkm	Capacity
		CO_2	CH_4	N_2O	Total	% split	Tonnes
Petrol (Class I)	Up to 1.305 tonne	232.2	0.28	0.87	233.3	38.37%	0.64
Petrol (Class II)	1.305 to 1.740 tonne	258.7	0.28	0.87	259.9	48.63%	0.72
Petrol (Class III)	Over 1.740 tonne	312.7	0.28	0.87	313.8	13.00%	1.29
Petrol (average)	**Up to 3.5 tonne**	**255.6**	**0.28**	**0.87**	**256.7**	**0.00%**	**0.76**
Diesel (Class I)	Up to 1.305 tonne	150.5	0.01	1.85	152.4	6.18%	0.64
Diesel (Class II)	1.305 to 1.740 tonne	237.9	0.01	1.85	239.7	25.74%	0.98
Diesel (Class III)	Over 1.740 tonne	279.0	0.01	1.85	280.8	68.08%	1.29
Diesel (average)	**Up to 3.5 tonne**	**260.4**	**0.01**	**1.85**	**262.3**	**0.00%**	**1.17**
LPG	Up to 3.5 tonne	273.5	0.06	1.04	274.6		1.17
CNG	Up to 3.5 tonne	247.4	1.40	1.04	249.9		1.17
Average		**260.3**	**0.00**	**1.80**	**262.1**		**1.16**

Table 19: New emission factors for vans for the 2018 GHG Conversion Factors

Plug-in Hybrid Electric and Battery Electric Vans (xEVs)

5.39. As outlined earlier for cars, since the number of electric cars and vans (xEVs[34]) in the UK fleet is rapidly increasing, there is now a need to include specific emission factors for such vehicles to complement the existing emission factors for other vehicle types.

5.40. The methodology, data sources and key assumptions utilised in the development of the emission factors for xEVs are the same for vans as that outlined earlier for cars. These were discussed and agreed with DfT.

5.41. It should be noted that only models with registrations in the UK fleet up to the end of 2016 are included in the model. Notes: Only includes models with registrations in the UK fleet up to the end of 2016

5.42. Table 20 provides a summary of the vans models registered into the UK market by the end of 2016 (the most recent data year for the source EEA CO_2 monitoring database at the time of the development of the 2018 GHG Conversion Factors). At this point there are only battery electric vehicle (BEV) models available in the vans marketplace.

Make	Model	Van Segment	BEV	PHEV
Citroen	Berlingo	Class II	Yes	-
Ford	Transit connect	Class III	Yes	-
Mercedes-Benz	Vito	Class III	Yes	-
Mia	Mia	Class I	Yes	-
Nissan	E-nv200	Class II	Yes	-
Peugeot	Partner	Class II	Yes	-
Renault	Kangoo	Class II	Yes	-
Tata	Ace	Class I	Yes	-

Notes: Only includes models with registrations in the UK fleet up to the end of 2016

Table 20: xEV van models and their allocation to different size categories

5.43. All other methodological details are as already outlined for xEV passenger cars.

[34] xEVs is a generic term used to refer collectively to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), range-extended electric vehicles (REEVs, or ER-EVs, or REX) and fuel cell electric vehicles (FCEVs).

Direct Emissions from Buses

5.44. The 2015 and earlier updates used data from DfT from the Bus Service Operators Grant (BSOG) in combination with DfT bus activity statistics (vehicle km, passenger km, average passenger occupancy) to estimate emission factors for local buses. DfT holds very accurate data on the total amount of money provided to bus service operators under the scheme, which provides a fixed amount of financial support per unit of fuel consumed. Therefore, the total amount of fuel consumed (and hence CO_2 emissions) could be calculated from this, which when combined with DfT statistics on total vehicle km, bus occupancy and passenger km allows the calculation of emission factors[35].

5.45. From the 2016 update onwards, it was necessary to make some methodological changes to the calculations due to changes in the scope/coverage of the underlying DfT datasets, which include:

- BSOG datasets are now only available for commercial services, and not also for local authority supported services.
- BSOG datasets are now only available for England, outside of London: i.e. datasets are no longer available for London, due to a difference in how funding for the city is managed/provided, nor for other parts of the UK.

5.46. In the 2018 update, an additional calculation was also added to the emission factors for buses to account for additional direct CO_2 emissions resulting from the use of a technology developed to enable manufacturers to meet recent diesel engine emissions standards for NO_x, known as selective catalytic reduction (SCR). This technology uses a urea solution (also known as 'AdBlue') to effectively remove NO_x and NO_2 from diesel engines' exhaust gases; this process occurs over a specially formulated catalyst. Urea solution is injected into the vehicles' exhaust system before harmful NO_x emissions are generated from the tail pipe. When the fuel is burnt, urea solution is injected into the SCR catalyst to convert the NO_x into a less harmful mixture of nitrogen and water vapour; small amounts of carbon dioxide are also produced as a result of this reaction. Emissions from the consumption of urea in buses have been estimated in the conversion factors for the first time for the 2018 update (consistent with the methodology also applied in the UK NAEI for this component) and are included in the estimates for overall CO_2 emission factors for buses. A summary of the key assumptions used in the calculation of emissions from urea is provided in the following Table 21. These are based on assumptions in the EMEP/EEA Emissions Inventory Guidebook.

	CO_2 EF for urea consumption ($kgCO_2$/kg urea solution)[1]	**Percentage of vehicles using urea**	**Urea consumption rate as a percentage of fuel consumed by vehicles using urea**
Euro IV	0.238	75%	4%
Euro V	0.238	75%	6%

[35] The robustness of the BSOG data has reduced over the years because of the changes to the way BSOG is paid to operators and local authorities. Approximations have been made in recent update years where data was not available (based on previous year data) and a revised methodology has commenced from 2016.

	CO_2 EF for urea consumption ($kgCO_2$/kg urea solution)[1]	Percentage of vehicles using urea	Urea consumption rate as a percentage of fuel consumed by vehicles using urea
Euro VI	0.238	100%	3.5%

Notes: [1]Assumes 32.5% (by mass) aqueous solution of urea

Table 21: Key assumptions used in the calculation of CO_2 emissions from Urea (aka 'AdBlue') use

5.47. Briefly, the main calculation for local buses can be summarised as follows:

a) Total fuel consumption (Million litres) = Total BSOG (£million) / BSOG fuel rate (p/litre) x 100
b) Total bus passenger-km (Million pkm) = Total activity (Million vkm) x Average bus occupancy (#)
c) Average fuel consumption (litres/pkm) = Total fuel consumption / Total bus passenger-km
d) **Average bus emission factor** = Average fuel consumption x Fuel Emission Factor ($kgCO_2e$/litre) + Average Emission Factor from Urea Use

5.48. Whilst the overall fundamental approach used in the 2017 and 2018 updates, apart from the urea addition, is similar to that previously used (i.e. as outlined above), the scope of coverage of the underlying data is different, which has resulted in step-change in emission factors for non-London local buses. In addition, since no BSOG data is available for London any more, the emission factors for London buses are taken directly from TfL's environmental reporting. Overall average emission factors for all local buses are estimated from DfT statistics on the relative passenger-km activity for London and non-London local buses[36].

5.49. As a final additional step, an accounting for biofuel use has been included in the calculation of the final bus emission factors.

5.50. Emission factors for coach services were estimated based on figures from National Express, who provide the majority of scheduled coach services in the UK.

5.51. Emission factors for CH_4 and N_2O are based on the emission factors from the UK GHG Inventory. These factors are also presented together with an overall total factor in Table 22.

5.52. Table 22 gives a summary of the 2018 GHG Conversion Factors and average passenger occupancy. It should also be noted that fuel consumption and emission factors for individual operators and services will vary significantly depending on the local conditions, the specific vehicles used and on the typical occupancy achieved.

[36] DfT Bus statistics, Table BUS0302b "Passenger kilometres on local bus services by metropolitan area status and country: Great Britain, annual from 2004/05", available at: https://www.gov.uk/government/statistical-data-sets/bus03-passenger-distance-travelled

Bus type	Average passenger occupancy	gCO_2e per passenger km			
		CO_2	CH_4	N_2O	Total
Local bus (not London)	9.50	119.07	0.04	0.96	120.07
Local London bus	19.29	71.62	0.02	0.47	72.11
Average local bus	**11.91**	**100.17**	**0.03**	**0.77**	**100.97**
Coach	17.56*	27.58	0.02	0.41	28.01

Notes: Average load factors/passenger occupancy mainly taken from DfT Bus statistics, Table BUS0304 "Average bus occupancy on local bus services by metropolitan area status and country: Great Britain, annual from 2004/05". * Combined figure based on data from DfT for non-local buses and coaches combined calculated based on an average of the last 5 years for which this was available (up to 2007). Actual occupancy for coaches alone is likely to be significantly higher.

Table 22: Emission factors for buses for the 2018 GHG Conversion Factors

Direct Emissions from Motorcycles

5.53. Data from type approval is not currently readily available for motorbikes and CO_2 emission measurements were only mandatory in motorcycle type approval from 2005.

5.54. For the practical purposes of the GHG Conversion Factors, emission factors for motorcycles are split into 3 categories:

- Small motorbikes (mopeds/scooters up to 125cc);
- Medium motorbikes (125-500cc); and
- Large motorbikes (over 500cc).

5.55. Since the 2009 update the emission factors have been calculated based on a large dataset kindly provided by Clear (2008)[37], based on a mix of magazine road test reports and user reported data. A summary is presented in Table 23, with the corresponding complete emission factors developed for motorcycles presented in the 'Passenger vehicles' tables of the 2018 GHG Conversion Factors. The total average has been calculated weighted by the relative number of registrations of each category in 2008 according to DfT licencing statistics for 2016[38]. In the absence of newer information, the methodology and dataset are unchanged for the 2018 GHG Conversion Factors.

5.56. These emission factors are based predominantly upon data derived from real-world riding conditions (rather than test-cycle based data) and therefore likely to be more representative of typical in-use performance. The average difference between the factors based on real-world observed fuel consumption and other figures based upon test-cycle data from ACEM[39] (+9%) is smaller than the corresponding differential

[37] Dataset of motorcycle fuel consumption compiled by Clear (http://www.clear-offset.com/) for the development of its motorcycle CO_2 model used in its carbon offsetting products.

[38] DfT Vehicle Licencing Statistics, Table VEH0306 "Licensed motorcycles by engine size, Great Britain, annually: 1994 to 2016", available at: https://www.gov.uk/government/collections/vehicles-statistics

[39] The European Motorcycle Manufacturers Association

previously used to uplift cars and vans test cycle data to real-world equivalents (+15%).

5.57. Emission factors for CH_4 and N_2O were updated for the 2018 GHG Conversion Factors based on the emission factors from the 2016 UK GHG Inventory (Ricardo Energy & Environment, 2018). These factors are also presented together with overall total emission factors in the tables of the 2018 GHG Conversion Factors.

CC Range	Model Count	Number	Av. gCO_2/km	Av. MPG*
Up to 125cc	24	58	85.0	76.2
125cc to 200cc	3	13	77.8	83.2
200cc to 300cc	16	57	93.1	69.5
300cc to 400cc	8	22	112.5	57.5
400cc to 500cc	9	37	122.0	53.1
500cc to 600cc	24	105	139.2	46.5
600cc to 700cc	19	72	125.9	51.4
700cc to 800cc	21	86	133.4	48.5
800cc to 900cc	21	83	127.1	50.9
900cc to 1000cc	35	138	154.1	42.0
1000cc to 1100cc	14	57	135.6	47.7
1100cc to 1200cc	23	96	136.9	47.3
1200cc to 1300cc	9	32	136.6	47.4
1300cc to 1400cc	3	13	128.7	50.3
1400cc to 1500cc	61	256	132.2	48.9
1500cc to 1600cc	4	13	170.7	37.9
1600cc to 1700cc	5	21	145.7	44.4
1700cc to 1800cc	3	15	161.0	40.2
1800cc to 1900cc	0	0		0.0
1900cc to 2000cc	0	0		0.0
2000cc to 2100cc	1	5	140.9	46.0
<125cc	**24**	**58**	**85.0**	**76.2**
126-500cc	**36**	**129**	**103.2**	**62.7**
>500cc	**243**	**992**	**137.2**	**47.2**
Total	303	1179	116.2	55.7

Note: Summary data based on data provided by Clear (www.clear-offset.com) from a mix of magazine road test reports and user reported data. * MPG has been calculated from the supplied gCO_2/km dataset, using the fuel properties for petrol from the latest conversion factors dataset.

Table 23: Summary dataset on CO_2 emissions from motorcycles based on detailed data provided by Clear (2008)

Direct Emissions from Passenger Rail

5.58. Emission factors for passenger rail services have been updated and provided in the "Business travel – land" section of the 2018 GHG Conversion Factors. These include updates to the national rail, international rail (Eurostar), light rail schemes and the London Underground. Emission factors for CH_4 and N_2O emissions were also updated in the 2018 GHG Conversion Factors. These factors are based on the assumptions outlined in the following paragraphs.

International Rail (Eurostar)

5.59. The international rail factor is based on a passenger-km weighted average of the emission factors for the following Eurostar routes: London-Brussels, London-Paris, London-Marne Le Vallee (Disney), London-Avignon and the ski train from London-Bourg St Maurice[40]. The emission factors were provided by Eurostar for the 2018 update, together with information on the basis of the electricity figures used in their calculation.

5.60. The methodology applied in calculating the Eurostar emission factors currently uses 3 key pieces of information:

a) Total electricity use by Eurostar trains on the UK and France/Belgium track sections;

b) Total passenger numbers (and therefore calculated passenger km) on all Eurostar services;

c) Emission factors for electricity (in $kgCO_2$ per kWh) for the UK and France/Belgium journey sections. These are based on the UK grid average electricity from the GHG Conversion Factors and the France/Belgium grid averages from the last freely available version of the IEA CO_2 Emissions from Fuel Combustion highlights dataset (from 2013).

5.61. The new figure from Eurostar is 12.157 gCO_2/pkm.

5.62. CH_4 and N_2O emission factors have been estimated from the corresponding emission factors for electricity generation, proportional to the CO_2 emission factors.

National Rail

5.63. The national rail factor refers to an average emission per passenger kilometre for diesel and electric trains in 2016-17. The factor is sourced from information from the Office of the Rail Regulator's National rail trends for 2016-17 (ORR, 2017)[41]. This has been calculated based on total electricity and diesel consumed by the railways for the year (sourced from ATOC), and the total number of passenger kilometres (from National Rail Trends).

5.64. CH_4 and N_2O emission factors have been estimated from the corresponding emissions factors for electricity generation and diesel rail (from the UK GHG Inventory), proportional to the CO_2 emission factors. The emission factors were calculated based on the relative passenger km proportions of diesel and electric rail provided by DfT for 2006-7 (since no newer datasets are available from DfT).

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[40] Although there are now also direct Eurostar routes to Lyon and Marseille, information relating to these routes has not been provided in 2018.

[41] Available from the ORR's website at: http://dataportal.orr.gov.uk/browsereports/9

Light Rail

5.65. The light rail factors were based on an average of factors for a range of UK tram and light rail systems, as detailed in Table 24.

5.66. Figures for the London Overground and Croydon Tramlink for 2016/17 are based on figures kindly provided by TfL, adjusted to the new 2018 grid electricity CO_2 emission factor.

5.67. The factors for Midland Metro, Tyne and Wear Metro, Manchester Metrolink and Sheffield Supertram were calculated based on annual passenger km data from DfT's Light rail and tram statistics[42] and the new 2018 grid electricity CO_2 emission factor.

5.68. The factor for the Glasgow Underground was calculated based on the annual passenger km data from DfT's Glasgow Underground statistics, and the new 2018 grid electricity CO_2 emission factor.

5.69. The average emission factor for light rail and tram was estimated based on the relative passenger km of the eight different rail systems (see Table 24).

5.70. CH_4 and N_2O emission factors have been estimated from the corresponding emissions factors for electricity generation, proportional to the CO_2 emission factors.

	Type	Electricity use	gCO2e per passenger km				Million pkm
		kWh/pkm	CO_2	CH_4	N_2O	Total	
DLR (Docklands Light Rail)	Light Rail	0.105	31.95	0.07	0.17	32.20	656.80
Glasgow Underground	Light Rail	0.164	50.08	0.12	0.27	50.47	35.35
Midland Metro	Light Rail	0.135	41.24	0.10	0.22	41.56	65.60
Tyne and Wear Metro	Light Rail	0.351	107.00	0.25	0.58	107.83	329.70
London Overground	Light Rail	0.075	22.94	0.05	0.12	23.12	1,294.39
London Tramlink	Tram	0.212	64.66	0.15	0.35	65.17	153.56
Manchester Metrolink	Tram	0.078	23.91	0.06	0.13	24.09	395.30
Sheffield Supertram	Tram	0.350	106.69	0.25	0.58	107.52	81.80
Average* or Total		**0.129**	**39.35**	**0.09**	**0.21**	**39.65**	**3,013**

Notes: * Weighted by relative passenger km

Table 24: GHG emission factors, electricity consumption and passenger km for different tram and light rail services

[42] DfT Light rail and tram statistics, https://www.gov.uk/government/collections/light-rail-and-tram-statistics

London Underground

5.71. The London Underground rail factor was provided from DfT, which was based on the 2018 UK electricity emission factor, so was therefore adjusted to be consistent with the 2018 grid electricity CO_2 emission factor.

5.72. CH_4 and N_2O emission factors have been estimated from the corresponding emissions factors for electricity generation, proportional to the CO_2 emission factors.

Indirect/WTT Emissions from Passenger Land Transport

Cars, Vans, Motorcycles, Taxis, Buses and Ferries

5.73. Indirect/WTT emission factors for cars, vans, motorcycles, taxis, buses and ferries include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel). These indirect/WTT emission factors were derived using simple ratios of the direct CO_2 emission factors and the indirect/WTT emission factors for the relevant fuels from the "Fuels" section and the corresponding direct CO_2 emission factors for vehicle types using these fuels in the "Passenger vehicles", "Business travel – land" and "Business travel – air" sections in the 2018 GHG Conversion Factors.

Rail

5.74. Indirect/WTT emission factors for international rail (Eurostar), light rail and the London Underground were derived using a simple ratio of the direct CO_2 emission factors and the indirect/WTT emission factors for grid electricity from the "UK Electricity" section and the corresponding direct CO_2 emission factors for vehicle types in the "Passenger vehicles", "Business travel – land" and "Business travel – air" sections in the GHG Conversion Factors.

5.75. The emission factors for National rail services are based on a mixture of emissions from diesel and electric rail. Indirect/WTT emission factors were therefore calculated from corresponding estimates for diesel and electric rail combined using relative passenger km proportions of diesel and electric rail provided by DfT for 2006-7 (no newer similar dataset is available).

6. Freight Land Transport Emission Factors

Summary of changes since the previous update

6.1. The emission factors for Heavy Goods Vehicles were revised this year to account for additional CO_2 emissions resulting from the use of urea by NO_x exhaust emissions control systems in newer vehicles, in a similar way to the emission factors for Buses, as discussed in Section 5.

Direct Emissions from Heavy Goods Vehicles (HGVs)

6.2. The HGV factors are based on road freight statistics from the Department for Transport (DfT, 2018)[43] for Great Britain (GB), from a survey on different sizes of rigid and articulated HGVs in the fleet in 2016. The statistics on fuel consumption figures (in miles per gallon) have been estimated by DfT from the survey data. For the 2018 GHG Conversion Factors, these are combined with test data from the European ARTEMIS project showing how fuel efficiency, and therefore the CO_2 emissions, varies with vehicle load.

6.3. The miles per gallon (MPG) figures in Table RFS0141 of DfT (2018) are converted to gCO_2 per km factors using the standard fuel conversion factor for diesel in the 2018 GHG Conversion Factors tables. Table RFS0117 of DfT (2018) shows the percent loading factors are on average between 36-65% in the UK HGV fleet. Figures from the ARTEMIS project show that the effect of load becomes proportionately greater for heavier classes of HGVs. In other words, the relative difference in fuel consumption between running an HGV completely empty or fully laden is greater for a large >33t HGV than it is for a small <7.5t HGV. From analysis of the ARTEMIS data, it was possible to derive the figures in Table 25 showing the change in CO_2 emissions for a vehicle completely empty (0% load) or fully laden (100% load) on a weight basis compared with the emissions at half-load (50% load). The data show the effect of load is symmetrical and largely independent of the HGVs Euro emission classification and type of drive cycle. So, for example, a >17t rigid HGV emits 18% more CO_2 per kilometre when fully laden and 18% less CO_2 per kilometre when empty relative to emissions at half-load.

6.4. The refrigerated/temperature-controlled HGVs included a 19.3% and 16.1% uplift which is applied to rigid and arctic refrigerated/temperature-controlled HGVs respectively. The refrigerated/temperature-controlled average factors have a 18% uplift applied. This is based on average data for different sizes of refrigerated HGV from Tassou et al (2009)[44].This accounts for the typical additional energy needed to

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43 "Transport Statistics Bulletin: Road Freight Statistics July 2016 to June 2017, (DfT, 2018). Available at: https://www.gov.uk/government/statistics/road-freight-statistics-july-2016-to-june-2017

44 *Food transport refrigeration – Approaches to reduce energy consumption and environmental impacts of road transport*, by S.A. Tassou, G. De-Lille, and Y.T. Ge. Applied Thermal Engineering, Volume 29, Issues 8–9, June 2009, Pages 1467–1477. Available at: http://www.sciencedirect.com/science/article/pii/S135943110800286X

power refrigeration equipment in such vehicles over similar non-refrigerated alternatives[45].

	Gross Vehicle Weight (GVW)	% change in CO_2 emissions
Rigid	<7.5t	± 8%
	7.5-17t	± 12.5%
	>17 t	± 18%
Articulated	<33t	± 20%
	>33t	± 25%

Source: EU-ARTEMIS project

Table 25: Change in CO_2 emissions caused by +/- 50% change in load from average loading factor of 50%

6.5. Using these loading factors, the CO_2 factors derived from the DfT survey's MPG data, each corresponding to different average states of HGV loading, were corrected to derive the 50% laden CO_2 factor shown for each class of HGV. These are shown in the final factors presented in sections "Delivery vehicles" and "Freighting goods" of the 2018 GHG Conversion Factors.

6.6. The loading factors in Table 25 were then used to derive corresponding CO_2 factors for 0% and 100% loadings in the above sections. Because the effect of vehicle loading on CO_2 emissions is linear with load (according to the ARTEMIS data), then these factors can be linearly interpolated if a more precise figure on vehicle load is known. For example, an HGV running at 75% load would have a CO_2 factor halfway between the values for 50% and 100% laden factors.

6.7. It might be surprising to see that the CO_2 factor for a >17t rigid HGV is greater than for a >33t articulated HGV. However, these factors merely reflect the estimated MPG figures from DfT statistics that consistently show worse MPG fuel efficiency, on average, for large rigid HGVs than large articulated HGVs once the relative degree of loading is taken into account. This is likely to be a result of the usage pattern for different types of HGVs where large rigid HGVs may spend more time travelling at lower, more congested urban speeds, operating at lower fuel efficiency than articulated HGVs which spend more time travelling under higher speed, free-flowing traffic conditions on motorways where fuel efficiency is closer to optimum. Under the drive cycle conditions more typically experienced by large articulated HGVs, the CO_2 factors for large rigid HGVs may be lower than indicated in "Delivery vehicles" and "Freighting goods" of the 2018 GHG Conversion Factors. Thus, the factors in "Delivery vehicles" and "Freighting goods", linked to the DfT (2018) statistics on MPG (estimated by DfT from the survey data) reflect each HGV class's typical usage pattern on the GB road network.

6.8. UK average factors for all rigid and articulated HGVs are also provided in sections "Delivery vehicles" and "Freighting goods" of the 2018 GHG Conversion Factors if the

[45] 'Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles – Lot 1: Strategy', a report for EC DG CLIMA by AEA Technology plc and Ricardo, February 2011. Available at: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ec_hdv_ghg_strategy_en.pdf

user requires aggregate factors for these main classes of HGVs, perhaps because the weight class of the HGV is not known. Again, these factors represent averages for the GB HGV fleet in 2016. These are derived directly from the mpg values for rigid and articulated HGVs in Table RFS0141of DfT (2018).

6.9. At a more aggregated level, factors for all HGVs are still representing the average MPG for all rigid and articulated HGV classes in Table RFS0141 of DfT (2018). This factor should be used if the user has no knowledge of or requirement for different classes of HGV and may be suitable for analysis of HGV CO_2 emissions in, for example, inter-modal freight transport comparisons.

6.10. The conversion factors included in “Delivery vehicles” in the 2018 GHG Conversion Factors are provided in distance units to enable CO_2 emissions to be calculated from the distance travelled by the HGV in km multiplied by the appropriate conversion factor for the type of HGV and, if known, the extent of loading.

6.11. For comparison with other freight transport modes (e.g. road vs. rail), the user may require CO_2 factors in tonne km (tkm) units. The “Freighting goods” section of the 2018 GHG Conversion Factors also provides such factors for each weight class of rigid and articulated HGV, for all rigid and for all articulated aggregated for all HGVs. These are derived from the fleet average gCO_2 per vehicle km factors in “Delivery vehicles”. The average tonne freight lifted figures are derived from the tkm and vehicle km (vkm) figures given for each class of HGV in Tables RFS0119 and RFS0109, respectively (DfT, 2018). Dividing the tkm by the vkm figures gives the average tonnes freight lifted by each HGV class. For example, a rigid HGV >3.5 - 7.5t has an average load of 49%. The 2018 GHG Conversion Factors, include factors in tonne km (tkm) for all loads (0%, 50%, 100% and average).

6.12. A tkm is the distance travelled multiplied by the weight of freight carried by the HGV. So, for example, a HGV carrying 5 tonnes freight over 100 km has a tkm value of 500 tkm. The CO_2 emissions are calculated from these factors by multiplying the number of tkm the user has for the distance and weight of the goods being moved by the CO_2 conversion factor in “Freighting goods” of the 2018 GHG Conversion Factors for the relevant HGV class.

6.13. Emission factors for CH_4 and N_2O have been updated for all HGV classes. These are based on the emission factors from the 2015 UK GHG Inventory. CH_4 and N_2O emissions are assumed to scale relative to vehicle class/CO_2 emissions for HGVs. These factors are presented with an overall total factor in sections “Delivery vehicles” and “Freighting goods” of the 2018 GHG Conversion Factors.

6.14. In the 2018 update, an additional calculation was added to the emission factors to account for the urea (aka ‘AdBlue’) use by newer HGVs for control of NOx exhaust emissions (in SCR systems) similar to that for Buses. Therefore, emissions from the consumption of urea in HGVs are estimated in the conversion factors for the first time and are included in the estimates for overall CO_2 emission factors.

Direct Emissions from Vans/Light Goods Vehicles (LGVs)

6.15. Emission factors for light good vehicles (LGVs, vans up to 3.5 tonnes), were calculated based on the emission factors per vehicle-km in the earlier section on passenger land transport.

6.16. The typical / average capacities and average payloads agreed with DfT that are used in the calculation of van emission factors per tonne km are presented in Table 26. These are based on quantitative assessment of a van database used by Ricardo Energy & Environment previously in a variety of policy assessments for DfT.

Van fuel	Van size, Gross Vehicle Weight	Vkm % split	Av. Capacity tonnes	Av. Payload tonnes
Petrol (Class I)	Up to 1.305 tonne	38.37%	0.64	0.24
Petrol (Class II)	1.305 to 1.740 tonne	48.63%	0.72	0.26
Petrol (Class III)	Over 1.740 tonne	13.00%	1.29	0.53
Petrol (average)	**Up to 3.5 tonne**		**0.76**	**0.31**
Diesel (Class I)	Up to 1.305 tonne	6.18%	0.64	0.24
Diesel (Class II)	1.305 to 1.740 tonne	25.74%	0.98	0.36
Diesel (Class III)	Over 1.740 tonne	68.08%	1.29	0.53
Diesel (average)	**Up to 3.5 tonne**		**1.17**	**0.47**
LPG (average)	Up to 3.5 tonne		1.17	0.47
CNG (average)	Up to 3.5 tonne		1.17	0.47
Average (unknown fuel)			**1.16**	**0.47**

Table 26: Typical van freight capacities and estimated average payload

6.17. The average load factors assumed for different vehicle types used to calculate the average payloads in Table 26 are summarised in Table 27, on the basis of DfT statistics from a survey of company owned vans.

Average van loading	Utilisation of vehicle volume capacity				
	0-25%	26-50%	51-75%	76-100%	Total
Mid-point for van loading ranges	12.5%	37.5%	62.5%	87.5%	
Proportion of vehicles in the loading range					
Up to 1.8 tonnes	45%	25%	18%	12%	**100%**
1.8 – 3.5 tonnes	36%	28%	21%	15%	**100%**
All LGVs	38%	27%	21%	14%	**100%**
Estimated weighted average % loading					
Up to 1.8 tonnes					**36.8%**
1.8 – 3.5 tonnes					**41.3%**
All LGVs					**40.3%**

Notes: Based on information from Table 24, TSG/UW, 2008[46]

Table 27: Utilisation of vehicle capacity by company-owned LGVs: annual average 2003 – 2005 (proportion of total vehicle kilometres travelled)

6.18. Emission factors for CH_4 and N_2O have been updated for all van classes in the 2018 GHG Conversion Factors. These are based on the emission factors from the UK GHG Inventory. N_2O emissions are assumed to scale relative to vehicle class/CO_2 emissions for diesel vans.

6.19. Emission factors per tonne km are calculated from the average load factors for the different weight classes in combination with the average freight capacities of the different vans in Table 26 and the earlier emission factors per vehicle-km in the "Delivery vehicles" and "Freighting goods" sections of the 2018 GHG Conversion Factors.

Direct Emissions from Rail Freight

6.20. The data, used to update the rail freight emission factors for the 2018 GHG Conversion Factors, was provided by the Office of the Rail Regulator's (ORR, 2017)[47]. This factor is presented in "Freighting goods" in the 2018 GHG Conversion Factors. There have been no further updates to the methodology in the 2018 update.

6.21. The factor can be expected to vary with rail traffic route, speed and train weight. Freight trains are hauled by electric and diesel locomotives, but the vast majority of freight is carried by diesel rail and correspondingly CO_2 emissions from diesel rail freight are over 96% of the total for 2016-17 (ORR, 2017).

6.22. Traffic-, route- and freight-specific factors are not currently available, though these would present a more appropriate means of comparing modes (e.g. for bulk aggregates, intermodal, other types of freight). The rail freight CO_2 factor will be reviewed and updated if data become available relevant to rail freight movement in the UK.

6.23. CH_4 and N_2O emission factors have been estimated from the corresponding emissions for diesel rail from the UK GHG Inventory, proportional to the CO_2 emissions. The emission factors were calculated based on the relative passenger km proportions of diesel and electric rail provided by DfT for 2006-7 in the absence of more suitable tonne km data for freight.

Indirect/WTT Emissions from Freight Land Transport

Vans and HGVs

6.24. Indirect/WTT emission factors for Vans and HGVs include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel).

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[46] TSG/UW, 2008. "Using official data sources to analyse the light goods vehicle fleet and operations in Britain" a report by Transport Studies Group, University of Westminster, London, November 2008. Available at: http://www.greenlogistics.org/SiteResources/61debf21-2b93-4082-ab15-84787ab75d26_LGV%20activity%20report%20(final)%20November%202008.pdf

[47] Available from the ORR's website here: https://dataportal.orr.gov.uk/displayreport/html/html/31212a97-cf7a-42d5-9fe3-a134b5c08b6a

These indirect/WTT emission factors were derived using simple ratios of the direct CO_2 emission factors and the indirect/WTT emission factors for the relevant fuels and the corresponding direct CO_2 emission factors for vehicle types using these fuels.

Rail

6.25. The emission factors for freight rail services are based on a mixture of emissions from diesel and electric rail. Indirect/WTT emission factors were therefore calculated in a similar way to the other freight transport modes, except for combining indirect/WTT emission factors for diesel and electricity into a weighted average for freight rail using relative CO_2 emissions from traction energy for diesel and electric freight rail provided from ORR in Table 2.101 Sustainable development: Estimates of passenger and freight energy consumption and CO_2e emissions (2016).

7. Sea Transport Emission Factors

Summary of changes since the previous update

7.1. There are no major changes for the shipping factors in the 2018 update.

Direct Emissions from RoPax Ferry Passenger Transport and freight

7.2. Direct emission factors from RoPax passenger ferries and ferry freight transport is based on information from the Best Foot Forward (BFF) work for the Passenger Shipping Association (PSA) (BFF, 2007)[48]. No new methodology or updated dataset has been identified for the 2018 GHG Conversion Factors.

7.3. The BFF study analysed data for mixed passenger and vehicle ferries (RoPax ferries) on UK routes supplied by PSA members. Data provided by the PSA operators included information by operating route on: the route/total distance, total passenger numbers, total car numbers, total freight units and total fuel consumption.

7.4. From the information provided by the operators, figures for passenger km, tonne km and CO_2 emissions were calculated. CO_2 emissions from ferry fuels were allocated between passengers and freight on the basis of tonnages transported, taking into account freight, vehicles and passengers. Some of the assumptions included in the analysis are presented in the following table.

Assumption	Weight, tonnes	Source
Average passenger car weight	1.250	MCA, 2007[49]
Average weight of passenger + luggage, total	0.100	MCA, 2007[49]
Average Freight Unit*, total	22.173	BFF, 2007[50]
Average Freight Load (per freight unit)*, tonnes	13.624	RFS 2005, 2006[51]

Notes: Freight unit includes weight of the vehicle/container as well as the weight of the actual freight load

Table 28: Assumptions used in the calculation of ferry emission factors

7.5. CO_2 emissions are allocated to passengers based on the weight of passengers + luggage + cars relative to the total weight of freight including freight vehicles/containers. For the data supplied by the 11 (out of 17) PSA operators this equated to just under 12% of the total emissions of the ferry operations. The emission factor for passengers was calculated from this figure and the total number of

[48] BFF, 2007. "Carbon emissions of mixed passenger and vehicle ferries on UK and domestic routes", Prepared by Best Foot Forward for the Passenger Shipping Association (PSA), November 2007.

[49] Maritime and Coastguard Agency, Marine Guidance Note MGN 347 (M), available at: http://www.dft.gov.uk/mca/mcga07-home/shipsandcargoes/mcga-shipsregsandguidance/marinenotices/mcga-mnotice.htm?textobjid=82A572A99504695B

[50] This is based on a survey of actual freight weights at 6 ferry ports. Where operator-specific freight weights were available, these were used instead of the average figure.

[51] Average of tonnes per load to/from UK derived from Table 2.6 of Road Freight Statistics 2005, Department for Transport, 2006.

passenger km, and is presented in the "Business travel – sea" section of the 2018 GHG Conversion Factors. A further split has been provided between foot-only passengers and passengers with cars in the 2018 GHG Conversion Factors, again on a weight allocation basis.

7.6. CO_2 emissions are allocated to freight based on the weight of freight (including freight vehicles/containers) relative to the total weight of passengers + luggage + cars. For the data supplied by the 11 (out of 17) PSA operators, this equated to just over 88% of the total emissions of the ferry operations. The emission factor for freight was calculated from this figure and the total number of tonne km (excluding the weight of the freight vehicle/container), and is presented in "Freighting goods" in the 2018 GHG Conversion Factors tables.

7.7. It is important to note that this emission factor is relevant only for ferries carrying passengers and freight and that emission factors for passenger only ferries are likely to be significantly higher. No suitable dataset has yet been identified to enable the production of a ferry emission factor for passenger-only services (which were excluded from the BFF (2007) work).

7.8. CH_4 and N_2O emission factors have been estimated from the corresponding emissions for shipping from the 2016 UK GHG Inventory, proportional to the CO_2 emissions.

Direct Emissions from Other Marine Freight Transport

7.9. CO_2 emission factors for the other representative ships (apart from RoPax ferries discussed above) are now based on information from Table 9-1 of the IMO (2009)[52] report on GHG emissions from ships. The figures in "Freighting goods" of the 2018 GHG Conversion Factors represent international average data (i.e. including vessel characteristics and typical loading factors), as UK-specific datasets are not available.

7.10. CH_4 and N_2O emission factors have been estimated from the corresponding emissions for shipping from the 2016 UK GHG Inventory, proportional to the CO_2 emissions.

Indirect/WTT Emissions from Sea Transport

7.11. Indirect/WTT emissions factors for ferries and ships include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel). These indirect/WTT emission factors were derived using simple ratios of the direct CO_2 emission factors and the indirect/WTT emission factors for the relevant fuels and the corresponding direct CO_2 emission factors for ferries and ships using these fuels.

[52] "Prevention of Air Pollution from Ships, Second IMO GHG Study 2009. Update of the 2000 IMO GHG Study, Final report covering Phase 1 and Phase 2", Table 9-1 – Estimates of CO_2 efficiency for cargo ships, International Maritime Organisation, 2009. Available at: https://www.transportenvironment.org/docs/mepc59_ghg_study.pdf

8. Air Transport Emission Factors

Summary of changes since the previous update

8.1. There are no major changes for the aviation factors in the 2018 update.

Passenger Air Transport Direct CO_2 Emission Factors

8.2. Emission factors for non-UK international flights were calculated in a similar way to the main UK flight emission factors, using DfT data on flights between different regions by aircraft type, and emission factors calculated using the EUROCONTROL small emitters tool. Average passenger load factors (79.6%) were taken from IATA (2018) statistics[53].

8.3. The 2018 update of the average factors (presented at the end of this section) has been calculated using the same updated data source as in 2015, 2016 and 2017. The EUROCONTROL small emitters tool was used as the basis for calculating the CO_2 emissions factors resulting from fuel burn over average flights for different aircraft. The principal advantages of the source are:

- The tool is based on a methodology designed to estimate the fuel burn for an entire flight, it is updated on a regular basis in order to improve when possible its accuracy, and has been validated using actual fuel consumption data from airlines operating in Europe.
- The tool covers a wide range of aircraft, including many newer (and more efficient) aircraft increasingly used in flights to/from the UK, and also variants in aircraft families.
- The tool is approved for use for flights falling under the EU ETS via the Commission Regulation (EU) No. 606/2010.

8.4. A full summary of the representative aircraft selection and the main assumptions influencing the emission factor calculation is presented in Table 29. Key features of the calculation methodology, data and assumptions include:

- A wide variety of representative aircraft have been used to calculate emission factors for domestic, short- and long-haul flights;
- Average seating capacities, load factors and proportions of passenger km by the different aircraft types (subsequently aggregated to totals for domestic, short- and long-haul flights) have all been calculated from detailed UK Civil Aviation Authority (CAA, 2017) statistics for UK registered airlines for the year 2016 (the most recent complete dataset available at the time of calculation), split by aircraft and route type (Domestic, European Economic Area, other International)[54];
- Freight transported on passenger services has also been taken into account (with the approach taken summarised in the following section). Accounting for freight makes a significant difference to long-haul factors.

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[53] http://www.iata.org/pressroom/pr/Pages/2018-03-08-01.aspx

[54] This dataset was provided by DfT for the purposes of the Conversion Factors calculations, and provides a breakdown by both aircraft and route type, which is unavailable in publicly available sources, e.g. Annual Airline Statistics available from the CAA's website at: http://www.caa.co.uk/default.aspx?catid=80&pagetype=88&pageid=1&sglid=1

	Av. No. Seats	Av. Load Factor	Proportion of passenger km	Emissions Factor, $kgCO_2/vkm$	Av. flight length, km
Domestic Flights					
AIRBUS A319	149	78%	34%	16.2	367
AIRBUS A320-100/200	172	74%	21%	17.0	350
AIRBUS A321	200	70%	4%	19.0	396
ATR72 200/500/600	72	61%	1%	5.5	311
BOEING 737-700	152	67%	1%	13.9	463
BOEING 737-800	189	82%	6%	19.2	288
BOEING 767-300ER/F	259	71%	1%	29.8	349
BOMBARDIER DASH 8 Q400	77	67%	22%	7.1	380
EMB ERJ175 (170-200)	82	66%	1%	10.6	415
EMBRAER ERJ190	99	67%	3%	13.2	388
EMBRAER ERJ195	117	62%	1%	16.0	323
SAAB 2000	37	70%	2%	6.8	363
SAAB FAIRCHILD 340	28	70%	2%	3.9	296
Sikorsky Aircraft S-92	16	87%	1%	3.7	371
Weighted average	**136**	**74%**	**100%*(total)**	**11.2**	**361**
Short-haul Flights					
AIRBUS A319	149	80%	14%	10.8	1386
AIRBUS A320-100/200	175	76%	28%	10.9	1728
AIRBUS A321	210	75%	10%	12.7	1805
AIRBUS A330-300	295	70%	0%	24.3	1577
ATR72 200/500/600	69	68%	0%	4.5	969
AVROLINER RJ85	94	64%	0%	12.3	771
BOEING 737-300	147	85%	1%	11.8	1492
BOEING 737-700	139	78%	1%	10.4	1540
BOEING 737-800	188	85%	37%	11.0	2022
BOEING 737-900	184	80%	2%	11.6	1932
BOEING 757-200	199	76%	2%	15.0	1722
BOEING 757-300	280	88%	0%	16.5	2080
BOEING 767-300ER/F	289	75%	1%	20.5	1887
BOEING 787-800 DREAMLINER	315	94%	0%	19.9	2372
BOMBARDIER DASH 8 Q400	78	65%	0%	6.0	763
EMB ERJ175 (170-200)	88	67%	0%	8.1	1054
EMBRAER ERJ195	106	70%	1%	10.2	1429
Fokker F28	72	78%	0%	10.7	1198
Weighted average	**180**	**80%**	**100%*(total)**	**11.2**	**1,677**

	Av. No. Seats	Av. Load Factor	Proportion of passenger km	Emissions Factor, $kgCO_2/vkm$	Av. flight length, km
Long-haul Flights					
AIRBUS A310	247	83%	0%	18.5	5002
AIRBUS A320-100/200	180	90%	1%	10.2	3149
AIRBUS A321	174	71%	0%	11.8	3607
AIRBUS A330-200	275	77%	5%	21.0	6332
AIRBUS A330-300	281	72%	5%	21.7	6577
AIRBUS A340-300	267	66%	1%	25.2	6905
AIRBUS A340-600	308	77%	2%	31.5	6702
AIRBUS A350-900	310	84%	0%	23.7	6926
AIRBUS A380-800	495	73%	17%	47.0	6802
BOEING 737-800	167	76%	1%	10.4	3599
BOEING 747-400	354	79%	15%	38.0	7685
BOEING 757-200	170	69%	2%	14.4	5746
BOEING 767-300ER/F	224	64%	4%	19.1	5477
BOEING 767-400	245	68%	1%	20.7	5838
BOEING 777-200	258	71%	14%	25.5	6813
BOEING 777-300	342	72%	14%	28.8	6374
BOEING 777-300ER	308	73%	4%	30.8	7328
BOEING 787-800 DREAMLINER	253	77%	9%	18.4	6670
BOEING 787-900 DREAMLINER	254	78%	6%	19.9	7035
Weighted average	**324**	**74%**	**100%**	**27.2**	**6,523**

Notes: Figures on seats, load factors, % tkm and av. flight length have been calculated from 2017 CAA statistics for UK registered airlines for the different aircraft types. Figures of $kgCO_2/vkm$ were calculated using the average flight lengths in the EUROCONTROL small emitters tool. * 100% denotes the pkm share of the aircraft included in the assessment - as listed in the table. The aircraft listed in the table above account for 94% of domestic pkm, 94% of short-haul pkm and 95% of long-haul pkm.

Table 29: Assumptions used in the calculation of revised average CO_2 emission factors for passenger flights for 2018

8.5. **Allocating flights into short- and long-haul:** Domestic flights are those that start and end in the United Kingdom, which are simple to categorise. However, allocating flights into short- and long-haul is more complicated. In earlier versions of the GHG Conversion Factors it was suggested at a crude level to assign all flights <3700km to short haul and all >3700km to long-haul (on the basis of the maximum range of a Boeing 737). However, this approach was relatively simplistic, difficult to apply without detailed flight distance calculations, and was not completely consistent with CAA statistical dataset used to define the emission factors.

8.6. The current preferred definition is to assume that all fights to 'Europe' (or those of similar distance, up to a 3,700km maximum) are short-haul, and those that are to non-European destinations (or for flights over 3,700km) should be counted as long-haul. Some examples of such 'long-haul' flights have been provided in the following Table 30 (as previously provided within the 2012 Annexes in the old format). The methodology has been unchanged since 2013, and it is up to the users of the GHG Conversion Factors to use their best judgement on which category to allocate particular flights into.

Area	Destination Airport	Distance, km
Short-haul		
Europe	Amsterdam, Netherlands	400
Europe	Prague (Ruzyne), Czech Rep	1,000
Europe	Malaga, Spain	1,700
Europe	Athens, Greece	2,400
Average (CAA statistics)		**1,366**
Long-haul		
North Africa	Abu Simbel/Sharm El Sheikh, Egypt	3,300
Southern Africa	Johannesburg/Pretoria, South Africa	9,000
Middle East	Dubai, UAE	5,500
North America	New York (JFK), USA	5,600
North America	Los Angeles California, USA	8,900
South America	Sao Paulo, Brazil	9,400
Indian sub-continent	Bombay/Mumbai, India	7,200
Far East	Hong Kong	9,700
Australasia	Sydney, Australia	17,000
Average (CAA statistics)		**6,823**

Notes: Distances based on International Passenger Survey (Office for National Statistics) calculations using airport geographic information. Average distances calculated from CAA statistics for all flights to/from the UK in 2013

Table 30: Illustrative short- and long- haul flight distances from the UK

8.7. A new set of aviation factors was added for international flights between non-UK destinations in the 2015 update. This relatively high-level analysis allows users to choose a different factor for passenger air travel if flying between countries outside of the UK. All factors presented are for direct (non-stop) flights only. This analysis was only possible for passenger air travel and so international freight factors are assumed to be equal to the current UK long haul air freight factors[55].

Taking Account of Freight

8.8. Freight, including mail, are transported by two types of aircraft – dedicated cargo aircraft which carry freight only, and passenger aircraft which carry both passengers

[55] Please note - The international factors included are an average of short and long-haul flights which explains the difference between the UK factors and the international ones.

and their luggage, as well as freight. The CAA data show that almost all freight carried by passenger aircraft is done on scheduled long-haul flights. In fact, the quantity of freight carried on scheduled long-haul passenger flights is nearly 8 times higher than the quantity of freight carried on scheduled long-haul cargo services. The apparent importance of freight movements by passenger services creates a complicating factor in calculating emission factors. Given the significance of air freight transport on passenger services there were good arguments for developing a method to divide the CO_2 between passengers and freight, which was developed for the 2008 update, and has also been applied in subsequent updates.

8.9. The CAA data provides a split of tonne km for freight and passengers (plus luggage) by airline for both passenger and cargo services. This data may be used as a basis for an allocation methodology. There are essentially three options, with the resulting emission factors presented in Table 31:

a. **No Freight Weighting:** Assume all the CO_2 is allocated to passengers on these services.

b. **Freight Weighting Option 1:** Use the CAA tonne km (tkm) data directly to apportion the CO_2 **between passengers and freight**. However, in this case, the derived emission factors for freight are significantly higher than those derived for dedicated cargo services using similar aircraft.

c. **Freight Weighting Option 2:** Use the CAA tkm data modified to treat freight on a more equivalent/consistent basis to dedicated cargo services. This takes into account the additional weight of equipment specific to passenger services (e.g. seats, galleys, etc.) in the calculations.

Freight Weighting:	None		Option 1: Direct		Option 2: Equivalent	
Mode	**Passenger tkm % of total**	**gCO_2 /pkm**	**Passenger tkm % of total**	**gCO_2 /pkm**	**Passenger tkm % of total**	**gCO_2 /pkm**
Domestic flights	100%	144.9	99.77%	144.6	99.77%	144.6
Short-haul flights	100%	80.2	98.70%	78.7	98.70%	78.7
Long-haul flights	100%	122.1	65.71%	79.5	85.13%	103.1

Table 31: CO_2 emission factors for alternative freight allocation options for passenger flights based on 2018 GHG Conversion Factors

8.10. The basis of the freight weighting **Option 2** is to take account of the supplementary equipment (such as seating, galley) and other weight for passenger aircraft compared to dedicated cargo aircraft in the allocation. In comparing the freight capacities of the cargo configuration compared to passenger configurations, we may assume that the difference represents the tonne capacity for passenger transport. This will include the weight of passengers and their luggage (around 100 kg per passenger according to IATA), plus the additional weight of seating, the galley, and other airframe adjustments necessary for passenger service operations. The derived weight per passenger seat used in the calculations for the 2018 GHG Conversion Factors were calculated for the specific aircraft used and are on average over twice the weight per passenger and their luggage alone. In the **Option 2** methodology the derived ratio for different aircraft types were used to upscale the CAA passenger tonne km data, increasing this as a percentage of the total tonne km – as shown in Table 31.

8.11. It does not appear that there is a distinction made (other than in purely practical size/bulk terms) in the provision of air freight transport services in terms of whether something is transported by dedicated cargo service or on a passenger service. The related calculation of freight emission factors (discussed in a later section) leads to very similar emission factors for both passenger service freight and dedicated cargo services for domestic and short-haul flights. This is also the case for long-haul flights under freight weighting **Option 2**, whereas under **Option 1** the passenger service factors are substantially higher than those calculated for dedicated cargo services. It therefore seems preferable to treat freight on an equivalent basis by utilising freight weighting **Option 2**.

8.12. **Option 2** was selected as the preferred methodology to allocate emissions between passengers and freight for the 2008 and subsequent GHG Conversion Factors.

8.13. Validation checks using the derived emission factors calculated using the EUROCONTROL small emitters tool and CAA flights data have shown a very close comparison in derived CO_2 emissions with those from the UK GHG Inventory (which is scaled using actual fuel supplied).

8.14. The final average emission factors for aviation are presented in Table 32. The figures in Table 32 DO NOT include the 8% uplift for Great Circle distance NOR the uplift to account for additional impacts of radiative forcing which are applied to the emission factors provided in the 2018 GHG Conversion Factor data tables.

Mode	Factors for 2018	
	Load Factor%	gCO_2/pkm
Domestic flights	73.7%	144.6
Short-haul flights	79.9%	78.7
Long-haul flights	74.0%	103.1

Notes: Load factors based on data provided by DfT that contains detailed analysis of CAA statistics for the year 2016

Table 32: Final average CO_2 emission factors for passenger flights for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

Taking Account of Seating Class Factors

8.15. The efficiency of aviation per passenger km is influenced not only by the technical performance of the aircraft fleet, but also by the occupancy/load factor of the flight. Different airlines provide different seating configurations that change the total number of seats available on similar aircraft. Premium priced seating, such as in First and Business class, takes up considerably more room in the aircraft than economy seating and therefore reduces the total number of passengers that can be carried. This in turn raises the average CO_2 emissions per passenger km.

8.16. There is no agreed data/methodology for establishing suitable scaling factors representative of average flights. However, in 2008 a review was carried out of the seating configurations from a selection of 16 major airlines and average seating configuration information from Boeing and Airbus websites. This evaluation was used to form a basis for the seating class based emission factors provided in Table 33, together with additional information obtained either directly from airline websites or from other specialist websites that had already collated such information for most of the major airlines.

8.17. For long-haul flights, the relative space taken up by premium seats can vary by a significant degree between airlines and aircraft types. The variation is at its most extreme for First class seats, which can account for from 3 to over 6 times[56] the space taken up by the basic economy seating. Table 33 shows the seating class based emission factors, together with the assumptions made in their calculation. An indication is also provided of the typical proportion of the total seats that the different classes represent in short- and long-haul flights. The effect of the scaling is to lower the economy seating emission factor in relation to the average, and increase the business and first class factors.

8.18. The relative share in the number of seats by class for short-haul and long-haul flights was updated/revised in 2015 using data provided by DfT's aviation team, following checks conducted by them on the validity of the current assumptions based on more recent data.

Flight type	Cabin Seating Class	Load Factor%	gCO_2 /pkm	Number of economy seats	% of average gCO_2/pkm	% Total seats
Domestic	**Weighted average**	**73.7%**	**144.6**	**1.00**	**100.0%**	**100.0%**
Short-haul	**Weighted average**	**79.9%**	**78.7**	**1.02**	**100.0%**	**100.0%**
	Economy class	79.9%	77.4	1.00	98.4%	96.7%
	First/Business class	79.9%	116.2	1.50	147.5%	3.3%
Long-haul	**Weighted average**	**74.0%**	**103.1**	**1.31**	**100.0%**	**100.0%**
	Economy class	74.0%	78.9	1.00	76.6%	83.0%
	Economy+ class	74.0%	126.3	1.60	122.5%	3.0%
	Business class	74.0%	228.9	2.90	222.1%	11.9%
	First class	74.0%	315.7	4.00	306.3%	2.0%

Notes: Load factors based on data provided by DfT that contains detailed analysis of CAA statistics for the year 2016

Table 33: CO_2 emission factors by seating class for passenger flights for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

Freight Air Transport Direct CO_2 Emission Factors

8.19. Air Freight, including mail, are transported by two types of aircraft – dedicated cargo aircraft which carry freight only, and passenger aircraft which carry both passengers and their luggage, as well as freight.

8.20. Data on freight movements by type of service are available from the Civil Aviation Authority (CAA, 2017). These data show that almost all freight carried by passenger aircraft is done on scheduled long-haul flights and accounts approximately for 89% of all long-haul air freight transport. How this freight carried on long-haul passenger services is treated has a significant effect on the average emission factor for all freight services.

[56] For the first class sleeper seats/beds frequently used in long-haul flights.

8.21. The next section describes the calculation of emission factors for freight carried by cargo aircraft **only** and then the following sections examine the impact of freight carried by passenger services and the overall average for all air freight services.

Emission Factors for Dedicated Air Cargo Services

8.22. Following the further development of emission factors for passenger flights and discussions with DfT and the aviation industry, revised average emission factors for dedicated air cargo were developed for previous updates. These have been updated for the 2018 update for the GHG Conversion Factors – presented in Table 34. As with the passenger aircraft methodology the factors presented here do not include the distance or radiative forcing uplifts applied to the emission factors provided in the 2018 GHG Conversion Factor data tables.

Mode	Revised factors for 2018	
	Load Factor%	$kgCO_2$ /tkm
Domestic flights	46.3%	2.9
Short-haul flights	76.1%	0.9
Long-haul flights	75.0%	0.8

Notes: Load factors based on Annual UK Airlines Statistics by Aircraft Type – CAA 2012 (Equivalent datasets after this are unavailable due to changes to CAA's confidentiality rules)

Table 34: Revised average CO_2 emission factors for dedicated cargo flights for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

8.23. The updated factors have been calculated in the same basic methodology as for the passenger flights, which was updated in 2015 to use the aircraft specific fuel consumption /emission factors calculated using the EUROCONTROL small emitters tool[57]. A full summary of the representative aircraft selection and the main assumptions influencing the emission factor calculation are presented in Table 35. The key features of the calculation methodology, data and assumptions for the GHG Conversion Factors include:

a. A wide variety of representative aircraft have been used to calculate emission factors for domestic, short- and long-haul flights;

b. Average freight capacities, load factors and proportions of tonne km by the different airlines/aircraft types have been calculated from CAA (Civil Aviation Authority) statistics for UK registered airlines for the year 2016 (the latest available complete dataset).

[57] The EUROCONTROL small emitters tool is available at: https://www.eurocontrol.int/articles/small-emitters-tool

	Average Cargo Capacity, tonnes	Av. Load Factor	Proportion of tonne km	EF, $kgCO_2$ /vkm	Av. flight length, km
Domestic Flights					
BAE ATP	8.0	47%	8.5%	6.81	231
BAE 146-200/QT	10.0	34%	0.0%	0.00	173
BOEING 737-300	15.2	45%	62.8%	26.33	155
BOEING 757-200	23.2	56%	6.2%	23.41	155
BOEING 747-8 (FREIGHTER)	126.9	19%	0.0%	0.00	173
BOEING 767-300ER/F	58.0	46%	22.5%	26.16	512
Average	**24.7**	**46%**	**100% (total)**	**22.70**	**379**
Short-haul Flights					
BAE ATP	8.0	43%	0.2%	5.58	502
BOEING 757-200	22.0	77%	71.3%	16.04	748
BOEING 747-8 (FREIGHTER)	124.3	33%	0.8%	54.81	619
BOEING 767-300ER/F	30.8	76%	27.7%	20.53	1892
Average	**25.2**	**76%**	**100% (total)**	**17.05**	**1,432**
Long-haul Flights					
BAE ATP	8.0	16%	0.0%	5.87	390
BOEING 757-200	21.6	79%	17.5%	15.22	1294
BOEING 747-8 (FREIGHTER)	129.4	73%	24.8%	37.79	4653
BOEING 767-300ER/F	29.6	75%	57.7%	19.20	5098
Average	**53.0**	**75%**	**100% (total)**	**19.39**	**4,381**

Notes: Figures on cargo, load factors, % tkm and av. flight length have been calculated from CAA statistics for UK registered airlines for different aircraft in the year 2016. Figures of $kgCO_2$/vkm were calculated using the average flight lengths in the EUROCONTROL small emitters tool.

Table 35: Assumptions used in the calculation of average CO_2 emission factors for dedicated cargo flights for the 2018 GHG Conversion Factors

Emission Factors for Freight on Passenger Services

8.24. The CAA data provides a similar breakdown for freight on passenger services as it does for cargo services. As already discussed earlier, the statistics give tonne-km data for passengers and for freight. This information has been used in combination with the assumptions for the earlier calculation of passenger emission factors to calculate the respective total emission factor for freight carried on passenger services. These emission factors are presented in the following Table 36 with the two different allocation options for long-haul services. The factors presented here do not include the distance or radiative forcing uplifts applied to the emission factors provided in the 2018 GHG Conversion Factor data tables (discussed later).

Freight Weighting: Mode	% Total Freight tkm		Option 1: Direct		Option 2: Equivalent	
	Passenger Services (PS)	Cargo Services	PS Freight tkm, % total	Overall $kgCO_2$ /tkm	PS Freight tkm, % total	Overall $kgCO_2$ /tkm
Domestic flights	5.1%	94.9%	0.2%	2.8	0.2%	2.8
Short-haul flights	24.1%	75.9%	1.3%	0.9	1.3%	0.9
Long-haul flights	85.9%	14.1%	34.3%	1.3	14.9%	0.6

Table 36: Air freight CO_2 emission factors for alternative freight allocation options for passenger flights for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

8.25. CAA statistics include excess passenger baggage in the ‘freight’ category, which would under **Option 1** result in a degree of under-allocation to passengers. **Option 2** therefore appears to provide the more reasonable means of allocation.

8.26. **Option 2** was selected as the preferred methodology for freight allocation for the 2008 update, when this analysis was originally performed. The same methodology has been applied in subsequent updates and is included in all of the presented emission factors for 2018.

Average Emission Factors for All Air Freight Services

8.27. Table 37 presents the final average air freight emission factors for all air freight for the 2018 GHG Conversion Factors. The emission factors have been calculated from the individual factors for freight carried on passenger and dedicated freight services, weighted according to their respective proportion of the total air freight tonne km. The factors presented here do not include the distance or radiative forcing uplifts applied to the emission factors provided in the 2018 GHG Conversion Factor data tables (discussed later).

Mode	% Total Air Freight tkm		All Air Freight $kgCO_2$/tkm
	Passenger Services	Cargo Services	
Domestic flights	5.1%	94.9%	2.8
Short-haul flights	24.1%	75.9%	0.9
Long-haul flights	85.9%	14.1%	0.6

Notes: % Total Air Freight tkm based on CAA statistics for 2016 (T0.1.6 All Services)

Table 37: Final average CO_2 emission factors for all air freight for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

Air Transport Direct Emission Factors for CH_4 and N_2O

Emissions of CH_4

8.28. Total emissions of CO_2, CH_4 and N_2O are calculated in detail and reported at an aggregate level for aviation as a whole are reported from the UK GHG inventory. Therefore, the relative proportions of total CO_2 and CH_4 emissions from the UK GHG inventory for 2016 (see Table 38) were used to calculate the specific CH_4 emission factors per passenger km or tonne-km relative to the corresponding CO_2 emission factors. The resulting air transport emission factors for the 2018 GHG Conversion Factors are presented in Table 39 for passengers and Table 40 for freight.

	CO_2		CH_4		N_2O	
	Mt CO_2e	% Total CO_2e	Mt CO_2e	% Total CO_2e	Mt CO_2e	% Total CO_2e
Aircraft - domestic	1.63	98.98%	0.0013	0.08%	0.015	0.94%
Aircraft - international	33.66	99.06%	0.0022	0.01%	0.318	0.94%

Table 38: Total emissions of CO_2, CH_4 and N_2O for domestic and international aircraft from the UK GHG inventory for 2016

Emissions of N_2O

8.29. Similar to those for CH_4, emission factors for N_2O per passenger-km or tonne-km were calculated on the basis of the relative proportions of total CO_2 and N_2O emissions from the UK GHG inventory for 2016 (see Table 38), and the corresponding CO_2 emission factors. The resulting air transport emission factors for the 2018 GHG Conversion Factors are presented in Table 39 for passengers and Table 40 for freight. The factors presented here do not include the distance or radiative forcing uplifts applied to the emission factors provided in the 2018 GHG Conversion Factor data tables (discussed later).

Air Passenger Mode	Seating Class	CO_2 gCO_2/pkm	CH_4 gCO_2e/pkm	N_2O gCO_2e/pkm	Total GHG gCO_2e/pkm
Domestic flights	**Average**	**144.6**	**0.1**	**1.4**	**146.1**
Short-haul flights	**Average**	**78.7**	**0.0**	**0.7**	**79.5**
	Economy	77.4	0.0	0.7	78.2
	First/Business	116.2	0.0	1.1	117.3
Long-haul flights	**Average**	**103.1**	**0.0**	**1.0**	**104.1**
	Economy	78.9	0.0	0.7	79.7
	Economy+	126.3	0.0	1.2	127.5
	Business	228.9	0.0	2.2	231.1
	First	315.7	0.0	3.0	318.7
International flights (non-UK)	**Average**	**88.6**	**0.0**	**0.8**	**89.5**
	Economy	67.9	0.0	0.6	68.5
	Economy+	108.6	0.0	1.0	109.6
	Business	196.8	0.0	1.9	198.7
	First	271.5	0.0	2.6	274.1

Notes: Totals may vary from the sums of the components due to rounding in the more detailed dataset.

Table 39: Final average CO_2, CH_4 and N_2O emission factors for all air passenger transport for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

Air Freight Mode	CO_2 $kgCO_2/tkm$	CH_4 $kgCO_2e/tkm$	N_2O $kgCO_2e/tkm$	Total GHG $kgCO_2e/tkm$
Passenger Freight				
Domestic flights	1.6040	0.0013	0.0152	1.6205
Short-haul flights	0.9727	0.0001	0.0092	0.9820
Long-haul flights	0.5712	0.0000	0.0054	0.5766
Dedicated Cargo				
Domestic flights	2.8932	0.0023	0.0274	2.9229
Short-haul flights	0.9349	0.0001	0.0088	0.9438
Long-haul flights	0.7568	0.0000	0.0072	0.7640
All Air Freight				
Domestic flights	2.8275	0.0023	0.0268	2.8565
Short-haul flights	0.9440	0.0001	0.0089	0.9530
Long-haul flights	0.5974	0.0000	0.0057	0.6031

Notes: Totals may vary from the sums of the components due to rounding in the more detailed dataset.

Table 40: Final average CO_2, CH_4 and N_2O emission factors for air freight transport for 2018 GHG Conversion Factors (excluding distance and RF uplifts)

Indirect/WTT Emission Factors from Air Transport

8.30. Indirect/WTT emissions factors for air passenger and air freight services include only emissions resulting from the fuel lifecycle (i.e. production and distribution of the relevant transport fuel). These indirect/WTT emission factors were derived using simple ratios of the direct CO_2 emission factors and the indirect/WTT emission factors for aviation turbine fuel (kerosene) and the corresponding direct CO_2 emission factors for air passenger and air freight transport in sections “Business travel – air” and “Freighting goods”.

Other Factors for the Calculation of GHG Emissions

Great Circle Flight Distances

8.31. We wish to see standardisation in the way that emissions from flights are calculated in terms of the distance travelled and any uplift factors applied to account for circling and delay. However, we acknowledge that a number of methods are currently used.

8.32. A 9% uplift factor has previously been used in the UK Greenhouse Gas Inventory to scale up Great Circle distances (GCD) for flights between airports to take into account indirect flight paths and delays, etc. This factor (also provided previously with previous GHG Conversion Factors) comes from the IPCC Aviation and the global Atmosphere 8.2.2.3, which states that 9-10% should be added to take into account non-direct routes (i.e. not along the straight line great circle distances between destinations) and delays/circling. DfT has indicated (in discussions with their Aviation team) that recent analysis for DfT has suggested that a lower uplift of 8% is more appropriate for flights arriving and departing from the UK and this is the factor that has been used since the 2014 update, and therefore also in the 2018 GHG Conversion Factors.

8.33. It is not practical to provide a database of origin and destination airports to calculate flight distances in the GHG Conversion Factors. However, the principal of adding a factor of 8% to distances calculated on a Great Circle is recommended (for consistency with the existing approach) to take into account of indirect flight paths and delays/congestion/circling. This is the methodology recommended to be used with the GHG Conversion Factors and is applied already to the emission factors presented in the 2018 GHG Conversion Factors tables.

Non-CO_2 impacts and Radiative Forcing

8.34. The emission factors provided in the 2018 GHG Conversion Factors sections “Business travel – air” and “Freighting goods” refer to aviation's direct CO_2, CH_4 and N_2O emissions only. There is currently uncertainty over the other non-CO_2 climate change effects of aviation (including water vapour, contrails, NO_X, etc.) which have been indicatively accounted for by applying a multiplier in some cases.

8.35. Currently there is no suitable climate metric to express the relationship between emissions and climate warming effects from aviation, but this is an active area of research. Nonetheless, it is clear that aviation imposes other effects on the climate which are greater than that implied from simply considering its CO_2 emissions alone.

8.36. The application of a ‘multiplier’ to take account of non-CO_2 effects is a possible way of illustratively taking account of the full climate impact of aviation. A multiplier is not a straight forward instrument. In particular, it implies that other emissions and effects are directly linked to production of CO_2, which is not the case. Nor does it reflect accurately the different relative contribution of emissions to climate change over time, or reflect the potential trade-offs between the warming and cooling effects of different emissions.

8.37. On the other hand, consideration of the non-CO_2 climate change effects of aviation can be important in some cases, and there is currently no better way of taking these effects into account. A multiplier of 1.9 is recommended as a central estimate, based on the best available scientific evidence, as summarised in Table 41 and the GWP_{100} figure (consistent with UNFCCC reporting convention) from the ATTICA research presented in Table 42 below[58] and in analysis by Lee et al (2009) reported on by the Committee on Climate Change (2009)[59].

From CCC (2009): “The recent European Assessment of Transport Impacts on Climate Change and Ozone Depletion (ATTICA, http://ssa-attica.eu) was a series of integrated studies investigating atmospheric effects and applicable climate metrics for aviation, shipping and land traffic. Results have been published which provide metrics to compare the different effects across these sectors in an objective way, including estimates of Global Warming Potentials (GWPs) and Global Temperature Potentials (GTPs) over different time horizons (20, 50 and 100 years). Table 42 shows the 20-year and 100-year GWPs, plus 100-year GTPs, for each forcing agent from aviation. Based on estimates of fuel usage and emission indices for 2005, the emission equivalent of each agent for these metrics is given on the right, and on the

[58] R. Sausen et al. (2005). Aviation radiative forcing in 2000: An update on IPCC (1999) Meteorologische Zeitschrift 14: 555-561, available at: http://elib.dlr.de/19906/1/s13.pdf

[59] CCC (2009). Meeting the UK Aviation target – options for reducing emissions to 2050, http://www.theccc.org.uk/publication/meeting-the-uk-aviation-target-options-for-reducing-emissions-to-2050/

bottom right is the overall ratio of total CO_2-equivalent emissions to CO_2 emissions for aviation in 2005."

8.38. It is important to note that **the value of this 1.9 multiplier is subject to significant uncertainty** and should only be applied to the CO_2 component of direct emissions (i.e. not also to the CH_4 and N_2O emissions components). The 2018 GHG Conversion Factors provide separate emission factors including this radiative forcing uplift in separate tables in sections "Business travel – air" and "Freighting goods"

		RF [mW/m^2]							
Year	Study	CO_2	O_3	CH_4	H_2O	Direct Sulphate	Direct Soot	Contrails	Total (w/o) Cirrus
1992	IPCC (1999)	18.0	23.0	−14.0	1.5	−3.0	3.0	20.0	48.5
2000	IPCC (1999) scaled to 2000	25.0	28.9	−18.5	2.0	−4.0	4.0	33.9	71.3
2000	TRADEOFF	25.3	21.9	−10.4	2.0	−3.5	2.5	10.0	47.8

Notes: Estimates for scaling CO2 emissions to account for Radiative Forcing impacts are not quoted directly in the table, but are derived as follows: IPCC (1999) = 48.5/18.0 = 2.69 ≈ 2.7; TRADEOFF = 47.8/25.3 = 1.89 ≈ 1.9

Table 41: Impacts of radiative forcing according to R. Sausen et al. (2005)

	Metric values			CO_2e emissions ($MtCO_2$e/yr.) for 2005			LOSU
	GWP_{20}	GWP_{100}	GTP_{100}	GWP_{20}	GWP_{100}	GTP_{100}	
CO_2	1	1	1	641	641	641	High
Low NO_x	120	-2.1	-9.5	106	-1.9	-8.4	Very low
High NO_x	470	71	7.6	415	63	6.7	Very low
Water vapour	0.49	0.14	0.02	123	35	5.0	–
Sulphate	-140	-40	-5.7	-25	-7	-1.0	–
Black carbon	1600	460	64	10	2.8	0.38	–
Contrail	0.74	0.21	0.03	474	135	19	Low
AIC	2.2	0.63	0.089	1410	404	57	Very low
				CO_2e/CO_2 emissions for 2005			
Low NO_x, inc. AIC				4.3	1.9	1.1	Very low
High NO_x, inc. AIC				4.8	2.0	1.1	Very low
Low NO_x, exc. AIC				2.1	1.3	1.0	Very low
High NO_x, exc. AIC				2.6	1.4	1.0	Very low

Source: Adapted by CCC (2009) from Lee et al. (2009) Transport impacts on atmosphere and climate; Aviation, Atmospheric Environment. The level of scientific understanding (LOSU) is given for each process in the right column. Values are presented for both high and low GWP values for NOx reflecting the wide uncertainties in current estimates. The ratios on the bottom right are presented both including and excluding aviation induced cloudiness (AIC) because of uncertainties both in estimates of the magnitude of this effect and in the future incidence of AIC due to air traffic. The different time horizons illustrate how a unit emission of CO_2 increases in importance relative to shorter-lived effects as longer timescales are considered.

Notes: GWP = Global Warming Potential, GTP = Global Temperature Potential

Table 42: Findings of ATTICA project

9. Bioenergy and Water

Summary of changes since the previous update

9.1. There are no major changes for the bioenergy and water factors in the 2018 update.

General Methodology

9.2. The 2018 GHG Conversion Factors provide tables of emission factors for: water supply and treatment; biofuels; and biomass and biogas.

9.3. The emission factors presented in the tables incorporate emissions from the fuel life-cycle and include net CO_2, CH_4, N_2O emissions and Indirect/WTT emissions factors. These are presented for biofuels, biomass and biogas.

9.4. The basis of the different emission factors is discussed in the following sub-sections.

Water

9.5. The emission factors for water supply and treatment in sections “Water supply” and “Water treatment” of the 2018 GHG Conversion Factors were sourced from Water UK (for reporting in 2008, 2009, 2010 and 2011) and are based on submissions by UK water suppliers. Water UK represents all UK water and wastewater service suppliers at national and European level.

9.6. Water UK (2011) gives total GHG emissions from water supply, waste water treatment, offices and transport. In the 2012 update of the GHG Conversion Factors, these emissions were split between Water supply and Water treatment using the same proportional split from previous years. However, since this publication, Water UK has discontinued its “Sustainability Indicators” report and so no longer produces further updates to these emission factors. Therefore, the Conversion Factors have been unchanged since the 2012 GHG Conversion Factors values.

Biofuels

9.7. Biofuels are defined as “net carbon zero” or “carbon neutral” as any CO_2 expelled during the burning of the fuel is cancelled out by the CO_2 absorbed by the feedstock used to produce the fuel during growth[60]. Therefore, all direct emissions from biofuels provided in the GHG Conversion Factors dataset are only made up of CH_4 and N_2O emissions.

9.8. Unlike the direct emissions of CO_2, CH_4 and N_2O are not offset by adsorption in the growth of the feedstock used to produce the biofuel. In the absence of other information, these emissions factors have been assumed to be equivalent to those produced by combusting the corresponding fossil fuels (i.e. diesel, petrol or CNG) from the “Fuels” section.

[60] This is a convention required by international GHG Inventory guidelines and formal accounting rules

9.9. The indirect/WTT/fuel lifecycle emission factors for biofuels were based on UK average factors from the Quarterly Report (2015/16)[61] on the Renewable Transport Fuel Obligation (RTFO). These average factors and the direct CH_4 and N_2O factors are presented in Table 43.

Biofuel	Emissions Factor, gCO_2e/MJ				
	RTFO Lifecycle (1)	Direct CH_4 (2)	Direct N_2O (2)	Total Lifecycle	Direct CO_2 Emissions (Out of Scope (3))
Biodiesel	12.33	0.01	0.59	12.93	75.30
Bioethanol	30.32	0.22	0.11	30.65	71.60
Biomethane	10.00	0.08	0.03	10.11	55.28
Biodiesel (from used cooking oil)	11.56	0.01	0.59	12.17	75.30
Biodiesel (from Tallow)	14.03	0.01	0.59	14.63	75.30

Notes:

(1) Based on UK averages from the RTFO Quarterly Report (2015/16) from DfT

(2) Based on corresponding emission factors for diesel, petrol or CNG.

(3) The Total GHG emissions outside of the GHG Protocol Scope 1, 2 and 3 is the actual amount of CO_2 emitted by the biofuel when combusted. This will be counter-balanced by /equivalent to the CO_2 absorbed in the growth of the biomass feedstock used to produce the biofuel. These factors are based on data from Forest Research, the Forestry Commission's research agency (previously BEC), (2016)

Table 43: Fuel lifecycle GHG Conversion Factors for biofuels

9.10. The net GHG emissions for biofuels vary significantly depending on the feedstock source and production pathway. Therefore, for accuracy, it is recommended that more detailed/specific figures are used where available. For example, detailed indirect/WTT emission factors by source/supplier are provided and updated regularly in the Quarterly Reports on the RTFO, available from GOV. website at: https://www.gov.uk/government/organisations/department-for-transport/series/biofuels-statistics.

9.11. In addition to the direct and indirect/WTT emission factors provided in Table 43, emission factors for the out of scope CO_2 emissions have also been provided in the 2018 GHG Conversion Factors (see table and the table footnote), based on data sourced from Forest Research, the Forestry Commission's research agency (previously BEC), (2016)[62].

Other biomass and biogas

9.12. A number of different bioenergy/biomass types can be used in dedicated biomass heating systems, including wood logs, chips and pellets, as well as grasses/straw or

[61] These cover the period from April 2015 - April 2016, and were the most recent figures available at the time of production of the 2018 GHG Conversion Factors. The report is available from the GOV. website at: https://www.gov.uk/government/collections/biofuels-statistics

[62]. Carbon emissions of different fuels; available at: https://www.forestry.gov.uk/fr/beeh-abslby

biogas. Emission factors produced for these bioenergy sources are presented in the "Bioenergy" section of the 2018 GHG Conversion Factors.

9.13. All indirect/WTT/fuel lifecycle emission factors here, except for wood logs, are sourced from the Ofgem carbon calculators[63]. These calculators have been developed to support operators determining the GHG emissions associated with the cultivation, processing and transportation of their biomass fuels.

9.14. Indirect/WTT/fuel lifecycle emission factors for wood logs, which are not covered by the Ofgem tool, were obtained from the Biomass Environmental Assessment Tool ($BEAT_2$)[64], provided by Defra.

9.15. The direct CH_4 and N_2O emission factors presented in the 2018 GHG Conversion Factors are based on the emission factors used in the UK GHG Inventory (GHGI) for 2015 (managed by Ricardo Energy & Environment).

9.16. In some cases, calorific values were required to convert the data into the required units. The most appropriate source was used and this was either from the Forest Research, DUKES (Table A.1) or Swedish Gas Technology Centre 2012 (which is also backed up by other data sources). The values used and their associated moisture contents are provided in Table 44.

9.17. In addition to the direct and indirect/WTT emission factors provided, emission factors for the out of scope CO_2 emissions are also provided in the 2018 GHG Conversion Factors (see "Outside of scopes" and the relevant notes on the page), also based on data from sourced from Forest Research, the Forestry Commission's research agency (previously BEC) (2016)[65].

Biomass	Moisture content	Net calorific value (GJ/tonne)	Source
Wood chips	25% moisture	13.6	Forest Research
Wood logs	Air dried 20% moisture	14.7	DUKES
Wood pellets	10% moisture	16.85	DUKES
Grass/Straw	10% moisture	13.4	DUKES
Biogas	Based on 65% CH_4	20	Swedish Gas Technology Centre
Landfill gas	Based on 40% CH_4	12.3	Swedish Gas Technology Centre

Table 44: Fuel sources and properties used in the calculation of biomass and biogas emission factors

[63] Ofgem carbon calculator tools: https://www.ofgem.gov.uk/publications-and-updates/uk-bioliquid-carbon-calculator and https://www.ofgem.gov.uk/publications-and-updates/uk-solid-and-gaseous-biomass-carbon-calculator

[64] Biomass Environmental Assessment Tool, $BEAT_2$: https://www.forestry.gov.uk/fr/beeh-9uynmd

[65] Carbon emissions of different fuels; available at: https://www.forestry.gov.uk/fr/beeh-abslby

10. Overseas Electricity Emission Factors

Summary of changes since the previous update

10.1. There have been no new methodological changes to this section, the overseas electricity factors have not been provided after the 2015 update due to a change in the licencing conditions for the underlying International Energy Association (IEA) dataset upon which they were based. Instead these can be purchased from the IEA[66].

10.2. The conversion factors supplied by the IEA for electricity supplied to the grid can be purchased by organisations. Since this year (from 2017/18) the emissions associated with electricity losses during transmission and distribution of electricity between the power station and an organisation's site(s) are also provided in the IEA dataset, these are also now no longer provided in the UK GHG Conversion Factors dataset.

10.3. The conversion factors supplied by the IEA do not include the emissions associated with the extraction, refining and transportation of primary fuels before their use in the generation of electricity (WTT emissions). These are still available in the 2018 GHG Conversion Factors.

Direct Emissions and Emissions resulting from Transmission and Distribution Loses from Overseas Electricity Generation

10.4. UK companies reporting on their emissions may need to include emissions resulting from overseas activities. Whilst many of the fuel emission factors are likely to be similar for fuels used in other countries, electricity emission factors vary considerably.

10.5. The dataset on electricity emission factors from the IEA, provided from the IEA website, has previously been identified as the best available consistent dataset for electricity emissions factors. These factors are a time series of combined electricity CO_2 emission factors per kWh GENERATED (Scope 2), and also corresponding emission factors for losses in Transmission and Distribution (T&D) (Scope 3). As stated these can be purchased from the IEA website.

Indirect/WTT Emissions from Overseas Electricity Generation

10.6. In addition to the GHG emissions resulting directly from the generation of electricity, there are also indirect/WTT emissions resulting from the production, transport and distribution of the fuels used in electricity generation (i.e. indirect/WTT / fuel lifecycle emissions as included in the “Fuel” section). The average fuel lifecycle emissions per unit of electricity generated will be a result of the mix of different sources of fuel/primary energy used in electricity generation.

10.7. Average indirect/WTT emission factors for UK electricity were calculated and included in “UK electricity” by using the “Fuels” sections indirect/WTT emission factors and data on the total fuel consumption by type of generation for the UK. This information was not available for the overseas emission factors. As an approximation therefore, the indirect/WTT (Scope 3) emission factors for different countries are estimated as being roughly a similar ratio of the direct CO_2 emission factors as for the UK (which is 16.0%).

[66] Available here: http://www.iea.org/bookshop/729-CO2_Emissions_from_Fuel_Combustion

11. Hotel Stay

Summary of changes since the previous update

11.1. A number of factors have been added to the 2018 GHG Conversion Factors which can be used to report emissions associated with an overnight hotel stay. These complement the existing emission factors for business travel. The emission factors are provided for a range of countries on a 'room per night' basis. Due to changes in the underlying data source used for the Hotel Stay emission factors since the 2017 update, the values and range of factors available has changed quite significantly. However, the underlying methodological basis of this source is largely unchanged.

Direct emissions from a hotel stay

11.2. All the hotel stay emission factors presented in the 2018 GHG Conversion Factors are in CO_2e. These are taken directly from the Cornell Hotel Sustainability Benchmarking Index (CHSB) Tool, produced by the International Tourism Partnership (ITP) and Greenview.

11.3. The factors use annual data from hotel companies comprising of 6,202 hotels from eleven international hotel organisations: Brighton Management, Hilton Worldwide, Host Hotels & Resorts, Hyatt Hotels Corporation, InterContinental Hotels Group, Mandarin Oriental Hotel Group, Marriott International, Park Hotel Group, Saunders Hotel Group, Six Senses Hotels Resorts Spas, the Hongkong and Shanghai Hotels and Wyndham Worldwide.

11.4. For the 2018 GHG Conversion Factors the average benchmark for each country, for all hotel classes included within the tool, was used.

11.5. The following five steps were carried out in the CHSB study to arrive at the emission factors included within the 2018 GHG Conversion Factors:

a. **Harmonising.** The data received was converted into the same units and then converting to kg CO_2e.

b. **Validity tests** were carried out to remove outliners or errors from the data sets received.

c. **Geographic segmentation**. The data sets were grouped by location; either on a city, country or regional basis.

d. **Market segmentation**. Hotels were grouped by market segment, applying a revenue-based approach and a standardised industry methodology.

e. **Minimum output thresholds**. A minimum threshold of eight hotels per geographical region was required before it was populated within the tool. If there were less than eight hotels, these were excluded from the final outputs.

11.6. It should be noted that there are certain limitations with the CHSB tool used to derive the 2018 GHG Conversion Factors. The main limitations are detailed below:

a. The factors are skewed toward large, more upmarket hotels and to branded chains. This is because it was mainly large owners or operators of hotels who submitted the aggregated data sets. The tool contains only 83 hotels within the economy or midscale segment.

b. The data sets used to derive the factors have not been verified and therefore it cannot be concluded to be 100% accurate.

c. The factors do not distinguish a property's amenities with the exception of outsourced laundry services, which are taken into consideration. The factors are an aggregation of all types of hotels within the revenue-based segmentation and geographic location. Which means it is very difficult to compare two hotels since some may contain distinct attributes, (such as restaurants, fitness centres, swimming pool and spa) while others do not.

d. The provision of conversion factors is limited by the availability of data in different parts of the world. The datasets used are updated each year, therefore it is expected that a wider range of countries will be covered in the future.

e. At present there is no breakdown of CH_4 and N_2O emissions, plus there are also no indirect/ WTT factors.

11.7. For more information about how the factors have been derived, please visit https://www.hotelfootprints.org, where you will also find more granular data available by city and segment.

12. Material Consumption/Use and Waste Disposal

Summary of changes since the previous update

12.1. There have been three methodological updates to this section since last year's (2017) update:

a. *Steel closed loop source:* The impacts for closed loop steel recycling have been updated using new Lifecycle Assessment data from the World Steel Association and the methodology has been improved. The new data directly provides Lifecycle Inventory emissions factors per kg of steel recycled, whereas these were previously derived based on emissions for different grades of recycled steel.

b. *Construction and demolition metals closed loop source:* The updated metals recycling factors for construction and demolition have been standardised using the updated closed loop steel recycling factor. The methodology has changed, and is now based directly on emissions from metals recycling (see above); previously this had been based on published estimated savings from recycling metals.

c. *Glass landfill / green and mixed organics composting:* These factors had previously been taken directly from published studies that used a methodology different from that used for the other waste factors. The approach has now been standardised, with these factors using MELMod (landfill emissions model) factors for the landfill emissions and BEIS transport factors for associated transport emissions (see below for discussion of transport distance assumptions).

Emissions from Material Use and Waste Disposal

12.2. Since 2012 the greenhouse gas emission factors for material consumption / use and waste disposal have been aligned with the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard ('the Scope 3 Standard')[67]. This sets down rules on accounting for emissions associated with material consumption and waste management.

12.3. The company sending waste for recycling may see a reduction in waste management emissions, but does not receive any benefit to its carbon account from recycling as the figures for waste disposal no longer include the potential benefits where primary resource extraction is replaced by recycled material. Under this accounting methodology, the organisation using recycled materials will see a reduction in their account where this use is in place of higher impact primary materials.

12.4. Whilst the factors are appropriate for accounting, they are therefore not appropriate for informing decision making on alternative waste management options (i.e. from a waste management perspective they do not indicate the lowest or highest impact option).

[67] http://www.ghgprotocol.org/standards/scope-3-standard

12.5. All figures expressed are kilograms of carbon dioxide equivalent (CO_2e) per tonne of material. This includes the Kyoto protocol basket of greenhouse gases. Please note that biogenic[68] CO_2 has also been excluded from these figures.

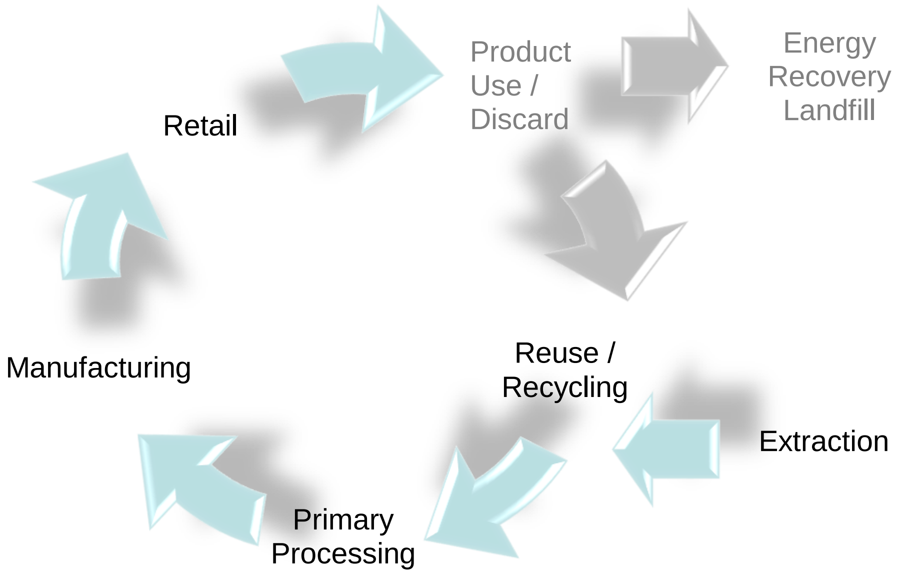
12.6. The information for material consumption presented in the GHG Conversion Factor tables has been separated out from the emissions associated with waste disposal in order to allow separate reporting of these emission sources, in compliance with the Scope 3 Standard.

12.7. It is important that businesses quantify emissions associated with both material use and waste management in their Scope 3 accounting, to fully capture changes due to activities such as waste reduction.

12.8. The following subsections provide a summary of the methodology, key data sources and assumptions used to define the emission factors.

Material Consumption/Use

12.9. Figure 4 shows the boundary of greenhouse gas emissions summarised in the material consumption table.



Notes: Arrows represent transportation stages; greyed items are excluded.

Figure 4: Boundary of material consumption data sets

12.10. The factors presented for material consumption cover all greenhouse gas emissions from the point of raw material extraction through to the point at which a finished good is manufactured and provided for sale. Commercial enterprises may therefore use these figures to estimate the impact of goods they procure. Organisations involved in manufacture of goods using these materials should note that if they separately report emissions associated with their energy use in forming products with these materials, there is potential for double counting. As many of the data sources used in preparing

[68] Biogenic CO_2 is the CO_2 absorbed and released by living organisms during and at the end of their life. By convention, this is assumed to be in balance in sustainably managed systems.

the tables are confidential we are unable to publish a more detailed breakdown. However, the standard assumptions made are described below.

12.11. Emission factors are provided for both recycled and primary materials. To identify the appropriate carbon factor, an organisation should seek to identify the level of recycled content in materials and goods purchased. Under this accounting methodology, the organisation using recycled materials in place of primary materials receives the benefit of recycling in terms of reduced Scope 3 emissions.

12.12. These figures are estimates to be used in the absence of data specific to your goods and services. If you have more accurate information for your products, then please refer to the more accurate data for reporting your emissions.

12.13. Information on the extraction of raw materials and manufacturing impacts are commonly sourced from the same reports, typically life cycle inventories published by trade associations. The sources utilised in this study are listed in Appendix 1 to this report. The stages covered include mining activities for non-renewable resources, agriculture and forestry for renewable materials, production of materials used to make the primary material (e.g. soda ash used in glass production) and primary production activities such as casting metals and producing board. Intermediate transport stages are also included. Full details are available in the referenced reports.

12.14. Emission factors provided include emissions associated with product forming.

12.15. Table 45 identifies the transportation distances and vehicle types which have been assumed as part of the emission factors provided. The impact of transporting the raw material (e.g. forestry products, granules, glass raw materials) is already included in the manufacturing profile for all products. The transportation tables and Greenhouse Gas Protocol guidelines on vehicle emissions have been used for most vehicle emission factors.

Destination / Intermediate Destination	One Way Distance	Mode of transport	Source
Transport of raw materials to factory	122km	Average, all HGVs	Department for Transport (2010)[69] Based on average haulage distance for all commodities, not specific to the materials in the first column.
Distribution to Retail Distribution Centre & to retailer	96km		McKinnon (2007)[70] IGD (2008)[71]

Table 45: Distances and transportation types used in EF calculations

[69] Department for Transport (2009) *Transport Statistics Bulletin: Road Freight Statistics 2008* National Statistics Table 1.14d. Available at: http://www.dft.gov.uk/pgr/statistics/datatablespublications/freight/goodsbyroad/roadfreightstatistics2008

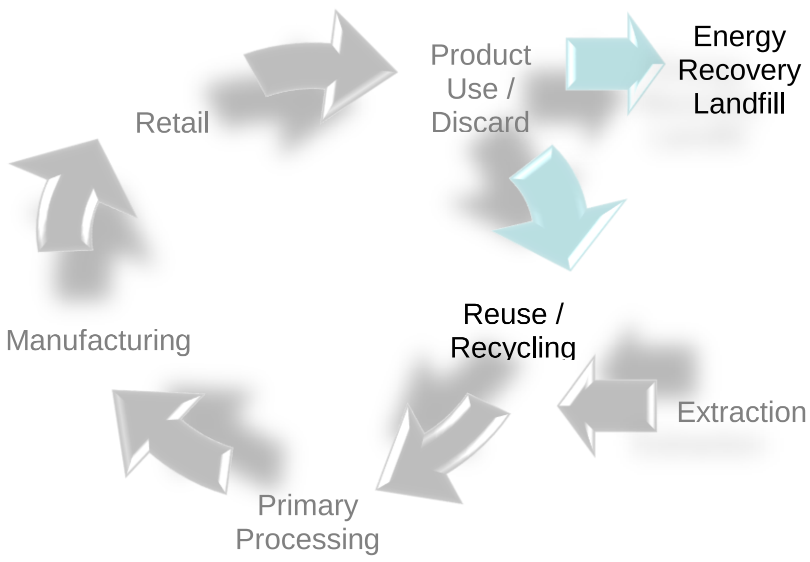
[70] McKinnon, A.C. (2007) Synchronised Auditing of Truck Utilisation and Energy Efficiency: A Review of the British Government's Transport KPI Programme. Available at: http://www.greenlogistics.org/SiteResources/77a765d8-b458-4e5f-b9e0-1827e34f2f1f_Review%20of%20Transport%20KPI%20programme%20(WCTR%202007).pdf

[71] IGD (2008) UK Food & Grocery Retail Logistics Overview Date Published: 15/01/2008. Available at: http://www.igd.com/our-expertise/Supply-chain/Logistics/3457/UK-Food--Grocery-Retail-Logistics-Overview/

12.16. Transport of goods by consumers is excluded from the factors presented, as is use of the product.

Waste Disposal

12.17. Figure 5 shows the boundary of greenhouse gas emissions summarised in the waste disposal table.



Notes: Arrows represent transportation stages; greyed items are excluded.

Figure 5: Boundary of waste disposal data sets

12.18. As defined under the Scope 3 standard, emissions associated with recycling and energy recovery are attributed to the organisation which uses the recycled material or which uses the waste to generate energy. The emissions attributed to the company which generates the waste cover only the collection of waste from their site. This does not mean that these emissions are zero, or are not important; it simply means that, in accounting terms, these emissions are for another organisation to report.

12.19. The final emissions factor data summarised in the tables has been revised to be in line with company reporting requirements in the Scope 3 Standard. Under this standard, in order to avoid double-counting, the emissions associated with recycling are attributed to the user of the recycled materials, and the same attribution approach has also been applied to the emissions from energy generation from waste. Only transportation and minimal preparation emissions are attributed to the entity disposing of the waste.

12.20. Landfill emissions remain within the accounting scope of the organisation producing waste materials. Factors for landfill are provided within the waste disposal sheet in the 2018 GHG Conversion Factors. As noted above, these factors are now drawn directly from MELMod, which contains information on landfill waste composition and material properties, with the addition of collection and transport emissions.

12.21. Figures for Refuse Collection Vehicles have been taken from the Environment Agency's Waste and Resource Assessment Tool for the Environment (WRATE)[72].

12.22. Transport distances for waste were estimated using a range of sources, principally data supplied by the Environment Agency for use in the WRATE tool (2005). The distances adopted are shown in Table 46.

Destination / Intermediate Destination	One Way Distance	Mode of transport	Source
Household, commercial and industrial landfill	25km by Road	26 Tonne GVW Refuse Collection Vehicle, maximum waste capacity 12 tonnes	WRATE (2005)
Inert landfill	10km by Road		WRATE (2005)
Transfer station / CA site	10km by Road		
MRF	25km by Road		
MSW incinerator	50km by Road		
Cement kiln	50km by Road		
Recyclate	50km by Road	Average, all HGVs	WRATE (2005)
Inert recycling	10km by Road		WRATE (2005)

Table 46: Distances used in calculation of emission factors

12.23. Road vehicles are volume limited rather than weight limited. For all HGVs, an average loading factor (including return journeys) is used based on the HGV factors provided in the 2017 Conversion Factors. Waste vehicles leave a depot empty and return fully laden. A 50% loading assumption reflects the change in load over a collection round which could be expected.

[72] Environment Agency (2010), Waste and Resource Assessment Tool for the Environment. Available at: www.environment-agency.gov.uk/research/commercial/102922.aspx

13. Fuel Properties

Summary of changes since the previous update

13.1. No significant changes were made this year.

General Methodology

13.2. Information on standard fuel properties of key fuels is also provided in the GHG Conversion Factors for:

a. Gross Calorific Value (GCV) in units of GJ/tonne and kWh/kg

b. Net Calorific Value (NCV) in units of GJ/tonne and kWh/kg

c. Density in units of litres/tonne and kg/m^3.

13.3. The standard emission factors from the UK GHG Inventory in units of mass have been converted into different energy and volume units for the various data tables using information on these fuel properties (i.e. Gross and Net Calorific Values (CV), and fuel densities in litres/tonne) from BEIS's Digest of UK Energy Statistics (DUKES) 2017[73].

13.4. The fuel properties of most biofuels are predominantly based on data from JEC - Joint Research Centre-EUCAR-CONCAWE collaboration, "Well-to-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context" Version 4a, 2014 (Report EUR 26236 EN - 2014)[74]. The exception is for methyl-ester based biodiesels and bioethanol, where values for NCV and GCV are taken from DUKES 2017.

13.5. Fuel properties, both density and CV, for wood chips (25% moisture content) come from the Forest Research (previously Biomass Energy Centre (BEC)[75]. The density of wood logs (20% moister content), wood chips (25% moister content) and grasses/straw (25% water content) are also sourced from the Forest Research[76].

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[73] Available at: https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[74] Available at: http://iet.jrc.ec.europa.eu/about-jec/

[75] Available at: https://www.forestry.gov.uk/fr/beeh-9ukqcn

[76] Available at: https://www.forestry.gov.uk/fr/beeh-absg5h

Appendix 1. Additional Methodological Information on the Material Consumption/Use and Waste Disposal Factors

This section explains the methodology for the choice of data used in the calculation of carbon emissions used in the waste management 2018 GHG Conversion Factors. Section 1.1 details the indicators used to assess whether data met the data quality standards required for this project. Section 1.2 states the sources used to collect data. Finally, Section 1.3 explains and justifies the use of data which did not meet the data quality requirements.

1.1 Data Quality Requirements

Data used in this methodology should, so far as is possible, meet the data quality indicators described in Table 1.1 below.

Data Quality Indicator	Requirement	Comments
Time-related coverage	Data less than 5 years' old	Ideally, data should be less than five years old. However, the secondary data in material eco-profiles is only periodically updated. In cases where no reliable data is available from within the five-year period, the most recent data available have been used. In cases where use of data over five years old creates specific issues, these are discussed below under "Use of data below the set quality standard". All data over five years old has been marked in the references with an asterisk within the 2.0 Data Sources section.
Geographical coverage	Data should be representative of the products placed on the market in the UK	Many datasets reflect European average production.
Technology coverage	Average technology	A range of information is available, covering best in class, average and pending technology. Average is considered the most appropriate but may not reflect individual supply chain organisations.
Precision/ variance	No requirement	Many datasets used provide average data with no information on the range. It is therefore not possible to identify the variance.
Completeness	All datasets must be reviewed to ensure they cover inputs and outputs pertaining to the life cycle stage	
Representative-ness	The data should represent UK conditions	This is determined by reference to the above data quality indicators
Consistency	The methodology has been applied consistently.	

Data Quality Indicator	Requirement	Comments
Reproducibility	An independent practitioner should be able to follow the method and arrive at the same results.	
Sources of data	Data will be derived from credible sources and databases	Where possible data in public domain will be used. All data sources referenced
Uncertainty of the information		Many data sources come from single sources. Uncertainty will arise from assumptions made and the setting of the system boundaries.

Table 1-1: Data Quality Indications for the waste management GHG factors

1.2 Data Sources

Data has been taken from a combination of trade associations, who provide average information at a UK or European level, data from the Ecoinvent database and reports / data from third parties (e.g. academic journals, Intergovernmental Panel on Climate Change). Data on wood and many products are taken from published life cycle assessments as no trade association eco-profile is available. Data sources for transport are referenced in Section 12. Data on waste management options has been modelled using SimaPro 8.2.3.[77] and WRATE.

Some data sources used do not meet the quality criteria. The implications of this are discussed in the following section.

1.3 Use of data below the set quality standard

Every effort has been made to obtain relevant and complete data for this project. For the majority of materials and products data which fits the quality standards defined in Section 1.1 above are met. However, it has not always been possible to find data which meets these standards in a field which is still striving to meet the increasing data demands set by science and government. This section details data which do not meet the expected quality standard set out in the methodology of this project but were never-the-less included because they represent the best current figures available. The justification for inclusion of each dataset is explained. The most common data quality issues encountered concerned data age and availability.

Wood and Paper data

Published data on wood products is sparse, an issue highlighted by the Waste and Resources Action Programme (WRAP) in 2006 and 2010[78]. Data used in this report for material consumption is based on studies from the USA, where production processes may not be representative of activity in the UK (e.g. different fuel mix to generate electricity). This data should therefore be viewed with caution. Data on different types of wood has been used in combination with

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[77] SimaPro (2015). Life Cycle Assessment Software. Available at: http://www.lifecycles.com.au/#!simapro/c1il2

[78] WRAP (2006) Environmental Benefits of Recycling and WRAP (2010) Environmental Benefits of Recycling – 2010 update. WRAP; Banbury. Available at: http://www.wrap.org.uk/sites/files/wrap/Executive_summary_Environmental_benefits_of_recycling_-_2010_update.d1af1398.8671.pdf

information on the composition of wood waste in the UK[79] to provide a figure which represents a best estimate of the impact of a typical tonne of wood waste.

Many trade associations publish data on the impact of manufacturing 100% primary and 100% recycled materials. However, for various reasons, the bodies representing paper and steel only produce industry average profile data, based on a particular recycling rate.

Furthermore, paper recycling in particular is dependent on Asian export markets, for which information on environmental impacts of recycling or primary production is rare. This means that the relative impact of producing paper from virgin and recycled materials is difficult to identify. The figure for material consumption for paper represents average production, rather than 100% primary material, so already accounts for the impact of recycling. Caution should therefore be taken in using these numbers.

Plastics data

Whilst not an issue from a data quality perspective, Plastics Europe are in the process of updating the Life Cycle Inventories for plastic polymers. Again, as the publications are updated the factors for material consumption for plastics can be updated.

Data on polystyrene recycling does not meet the age criteria, as it originates from one 2002 study. This will be updated as new sources are identified.

Textiles and footwear

The BIO IS study draft[80] is the most relevant data source to calculate the carbon factors for textiles even though the report is not published. This is because the factor proposed is based upon the market share of all textile products in Europe, categorised by product types and fibre types. The factor is considered to be representative of household textiles in general rather than specific fibres. It is understood that this will be published by the EU.

Information for footwear comes from one study from the USA. As with wood, this may not reflect UK impacts, and so the results should be viewed with caution.

Oil Data

Vegetable oil factors are based on studies of rapeseed oil. There is discussion in scientific journals on which is the appropriate oil to use when assessing environmental impacts, since growth is strongest in palm oil manufacture and use. However, palm oil has particular properties (e.g. high ignition point) which mean its use as a standalone product, rather than as an ingredient in other products, is limited.

Mineral oil will be included in the waste management 2018 GHG Conversion Factors. Although there is no available data on waste arising for mineral oil, this waste stream is banned from landfill. Therefore, it is assumed that all collected mineral oil is recycled or combusted and the data on recycled mineral oil is used both for the arising and the recycled figure.

Excluded Materials and Products

For some materials and products, such as automotive batteries and fluorescent tubes, no suitable figures have been identified to date.

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[79] WRAP (2009) Wood Waste Market in the UK WRAP; Banbury. Available at:
http://www.wrap.org.uk/sites/files/wrap/Wood%20waste%20market%20in%20the%20UK.pdf

80 Bio IS (2009) *Environmental Improvement Potentials of Textiles (IMPRO-Textiles)*
http://susproc.jrc.ec.europa.eu/textiles/docs/120423%20IMPRO%20Textiles_Publication%20draft%20v1.pdf

2.0 Data Sources

Material	Reference	
	Material Consumption	Waste Disposal
Aluminium cans and foil	European Aluminium Association (2013) Environmental Profile Report for the European Aluminium Industry *CE Delft (2007) Environmental Indices for the Dutch Packaging Tax 2018 GHG Conversion Factors Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0 *Environment Agency (2008) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1 *Wilmshurst, N. Anderson, P. and Wright, D. (2006) WRT142 Final Report Evaluating the Costs of 'Waste to Value' Management	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
Steel Cans	World Steel Association (2017) Lifecycle Inventory Data for Steel Products 2018 GHG Conversion Factors *Swiss Packaging Institute (1997) BUWAL *ERM (2008) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
Mixed Cans	Estimate based on aluminium and steel data, combined with data returns from Courtauld Commitment retailers (confidential, unpublished)	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
Glass	*Enviros (2003 (a)) Glass Recycling - Life Cycle Carbon Dioxide Emissions *Enviros (2003 (b)) Glass Recycling - Life Cycle Carbon Dioxide Emissions	

Material	Reference	
	Material Consumption	Waste Disposal
Wood	* Pöyry Forest Industry Consulting Ltd and Oxford Economics Ltd (2009) Wood Waste Market in UK * Merrild H, and Christensen T. H. (2009) Recycling of wood for particle board production: accounting of greenhouse gases and global warming contributions CORRIM (2013) Particleboard: A Life-Cycle Inventory of Manufacturing Panels from Resource through Product *ERM (2008) Single trip pallet no biogenic CO_2 Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0 2018 GHG Conversion Factors *Gnosys (2009) Life Cycle Assessment of Closed Loop MDF Recycling * ERM (2008) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
Aggregates	*WRAP (2008) Lifecycle Assessment of Aggregates	

Paper and board	2018 GHG Conversion Factors Procarton (2013) Carbon footprint for cartons FEFCO (2012) European database for Corrugated Board Life Cycle Studies DEFRA (2012) Streamlined LCA of Paper Supply Systems CPI (2016) Filename: CPI_WRAP_Papermaking_2016 12 Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0 Wencong Yue, Yanpeng Cai, Qiangqiang Rong, Lei Cao and Xumei Wang (2014) A hybrid MCDA-LCA approach for assessing carbon foot-prints and environmental impacts of China's paper producing industry and printing services" "Wang & Mao (2012) Risk Analysis and Carbon Footprint Assessments of the Paper Industry in China" * Swiss Centre for Life Cycle Inventories (2007) Ecoinvent v2 *CEPI (2008) Key Statistics 2007 European Pulp and Paper Industry * Oakdene Hollins (2008) CO2 impacts of transporting the UK's recovered paper and plastic bottles to China *ERM (2008) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1 * ERM (2010) LCA of Example Milk Packaging Containers *European Commission (2010) European Life Cycle Database 3 *Chen, C., Gan, J., Qui, R., (2017) Energy Use and CO2 Emissions in China's Pulp and Paper Industry: Supply Chain Approach *Chen, S., Ren, L., Liu, Z., Zhou, C., Yue, W., and Zhang, J (2011)	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009

Material	Reference	
	Material Consumption	**Waste Disposal**
	Life cycle assessment and type III environmental declarations for newsprint in China. Acta Scientiae Circumstantiae, 31, (6) 1331–1337. * WRAP (2010) Realising the value of recovered paper: An Update	
Books	Estimate based on paper	
Scrap Metal	*British Metals Recycling Association (website[81]) Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0 *Giurco, D., Stewart, M., Suljada, T., and Petrie, J., (2006) Copper Recycling Alternatives: An Environmental Analysis	*ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
WEEE - Large, small, mixed, fridges and freezers	* Huisman, J., et al (2008) Review of Directive 2002/96 on Waste Electrical and Electronic Equipment * ISIS (2008) Preparatory Studies for Eco-design Requirements of EuPs (Tender TREN/D1/40-2005) LOT 13: Domestic Refrigerators & Freezers * The Environment Agency (2005) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1	*ISIS (2008) Preparatory Studies for Eco-design Requirements of EuPs (Tender TREN/D1/40-2005) LOT 13: Domestic Refrigerators & Freezers *WRATE (2005)

[81] http://www.recyclemetals.org/about_metal_recycling. No longer online.

Food and Drink Waste	2018 GHG Conversion Factors *Bingemer, HG and Crutzen, PJ (1987) The Production of Methane from Solid Waste *DEFRA (2011) Greenhouse Gas Impacts of Biowaste Management - WR0210 *Cranfield University (Unpublished) Greenhouse Gas Impacts of Biowaste Management *Kranert, M. & Gottschall, R. Entsorgergemeinschaft der Deutschen Entsorgungswirtschaft e.V. (2007) Grünabfälle – besser kompostieren oder energetisch verwerten? EdDE-Dokumentation Nr. 11 * Williams AG, Audsley E and Sandars DL (2006) Determining the Environmental Burdens and Resource Uses in the Production of Agricultural and Horticultural Commodities. Main Report. Defra Research Project IS0205 *AIC (2009) Fertiliser Statistics 2009 Report *Greenhouse Gas Inventory Data - Detailed data by Party * Davis, J. and Haglund, C. (1999) Life Cycle Inventory (LCI) of Fertiliser Production * Brook Lyndhurst (2009) London's Food Sector GHG Emissions - Final Report *AEA Technology (2005) Food transport: The Validity of Food Miles as an Indicator of Sustainable Development *Tassou, S, Hadawey, A, Ge, Y and Marriot, D (2008) FO405 Greenhouse Gas Impacts of Food Retailing "Wood, S and Cowie A (2004) A Review of Greenhouse Gas Emission Factors for Fertiliser Production." *Zaher, U, Khachatryan, H, Ewing, T.; Johnson, R.; Chen, S.;	*AFOR (2009) Market survey of the UK organics recycling industry - 2007/08; WRAP, Banbury (Substitution rates for compost) *Williams AG, Audsley E and Sandars DL (2006) Determining the Environmental Burdens and Resource Uses in the Production of Agricultural and Horticultural Commodities. Main Report. IS0205, DEFRA (avoided fertiliser impacts) *Kranert, M. & Gottschall (2007) Grünabfälle – besser kompostieren oder energetisch verwerten? Eddie (information on peat) * DEFRA (unpublished) (information on composting impacts) *ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009

Material	Reference	
	Material Consumption	**Waste Disposal**
	Stockle, C.O. (2010) Biomass assessment for potential bio-fuels production: Simple methodology and case study *Mitaftsi, O and Smith, S R (2006) Quantifying Household Waste Diversion from Landfill Disposal by Home Composting and Kerbside Collection *Enviros Consulting (2006) Production of Guidelines for Using Compost in Crop Production - A Brief Literature Review *Prasad, M (2009) EPA STRIVE Programme 2007-2013 A Literature Review on the Availability of Nitrogen from Compost in Relation to the Nitrate Regulations SI 378 of 2006 Small Scale Study Report *US EPA (2005) Landfill Gas Emissions Model (LandGEM) V3.02 * Environment Agency (2005) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1 *DEFRA and ONS (2009) Family food and expenditure survey *DECC and DEFRA (2011) Anaerobic Digestion Strategy and Action Plan *WRC (2010) National Food Waste Programme (Work Package 1.1) Comparison of the Sustainability of Food Waste Disposal Options *WRAP (2011) The Water and Carbon Footprint of UK Household Food Waste	
Garden Waste	2018 GHG Conversion Factors DEFRA (2013) Family food and expenditure survey	

Material	Reference	
	Material Consumption	**Waste Disposal**
Plastics:	*WRAP (2008) LCA of Mixed Waste Plastic Recovery Options * WRAP (2006) A review of supplies for recycling, global market demand, future trends and associated risks *PriceWaterhouseCoopers & Ecobilan (2002) Life Cycle Assessment of Expanded Polystyrene Packaging. Case Study: Packaging system for TV sets Plastics Europe (2014) Ecoprofiles DEFRA / BEIS (2017) Company GHG Reporting Guidelines *The Environment Agency (2008) Waste and Resources Assessment Tool for the Environment (WRATE) Version 1 Ecoinvent (2013) Plastics Processing options	
HDPE, LDPE and LLDPE	Plastics Europe (2014) Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers High-density Polyethylene (HDPE), Low-density Polyethylene (LDPE), Linear Low-density Polyethylene (LLDPE) Plastics Europe, Brussels	*WRAP (2008) LCA of Mixed Waste Plastic Management Options; WRAP, Banbury
PP (excel forming)	Plastics Europe (2014) Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers Polypropylene (PP). Plastics Europe, Brussels	*WRAP (2008) LCA of Mixed Waste Plastic Management Options; WRAP, Banbury
PVC (excel forming)	*Boustead (2006) Eco-profiles of the European Plastics Industry Polyvinyl Chloride (PVC) (Suspension). Plastics Europe, Brussels	*WRAP (2008) LCA of Mixed Waste Plastic Management Options; WRAP, Banbury
PS (excel forming)	Plastics Europe (2015) Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers Polystyrene (High Impact) (HIPS). Plastics Europe, Brussels	*PWC (2002) Life Cycle Assessment of Expanded Polystyrene Packaging, Umps

Material	Reference	
	Material Consumption	**Waste Disposal**
PET (excel forming)	Plastics Europe (2010) Eco-profiles and Environmental Product Declarations of the European Plastics Manufacturers Polyethylene Terephthalate (PET). Plastics Europe, Brussels	*WRAP (2010) LCA of Example Milk Packaging Systems; WRAP, Banbury
Average plastic film (inch bags)	*Based on split in AMA Research (2009) Plastics Recycling Market UK 2009-2013, UK; Cheltenham	*WRAP (2008) LCA of Mixed Waste Plastic Management Options; WRAP, Banbury
Average plastic rigid (inch bottles)		
Clothing	*BIO IS (2009) Environmental Improvement Potentials of Textiles (IMPRO-Textiles), EU Joint Research Commission	*Farrant (2008) Environmental Benefit from Reusing Clothes, ELCD data sets, http://lca.jrc.ec.europa.eu. (c) European Commission 1995-2009
Footwear	*Albers, K., Canapé, P., Miller, J. (2008) Analysing the Environmental Impacts of Simple Shoes, University of Santa Barbara, California	
Furniture	WRAP (2015) Benefits of Reuse	
Batteries (Post Consumer Non-Automotive)		*DEFRA (2006) Battery Waste Management Life Cycle Assessment, prepared by ERM; WRAP, Banbury
Paint	*Althaus et al (2007) Life Cycle Inventories of Chemicals, Final report ecoinvent data v2.2 *CBI (2009) CBI Market Survey The paints and other coatings market in the United Kingdom and CBI, The Netherlands Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0	-
Vegetable Oil	*Schmidt, J (2010) Comparative life cycle assessment of rapeseed oil and palm oil International Journal of LCA, 15, 183-197 *Schmidt, Jannick and Weidema, B., (2008) Shift in the marginal supply of vegetable oil International Journal of LCA, 13, 235-239	
Mineral Oil	*IFEU (2005) Ecological and energetic assessment of re-refining used oils to base oils: Substitution of primarily produced base oils including semi-synthetic and synthetic compounds; GEIR	
Plasterboard	*WRAP (2008) Life Cycle Assessment of Plasterboard, prepared by ERM; WRAP; Banbury	
Concrete	*Hammond, G.P. and Jones (2008) Embodied Energy and Carbon in Construction Materials Prc Instn Civil Eng, WRAP (2008) Life Cycle Assessment of Aggregates *WRAP (2008) LCA of Aggregates	

Material	Reference	
	Material Consumption	Waste Disposal
Bricks	*Environment Agency (2011) Carbon Calculator *USEPA (2003) Background Document for Life-Cycle Greenhouse Gas Emission Factors for Clay Brick Reuse and Concrete Recycling *Christopher Koroneos, Aris Dompros, Environmental assessment of brick production in Greece, Building and Environment, Volume 42, Issue 5, May 2007, Pages 2114-2123	
Asphalt	*Aggregain (2010) CO_2 calculator Mineral Products Association (2011) Sustainable Development Report	
Asbestos	Swiss Centre for Life Cycle Inventories (2014) Ecoinvent v3.0	
Insulation	*Hammond, G.P. and Jones (2008) Embodied Energy and Carbon in Construction Materials Prc Instn Civil Eng *WRAP (2008) Recycling of Mineral Wool Composite Panels into New Raw Materials	

Greenhouse Gas Conversion Factors

Industrial Designation or Common Name	Chemical Formula	Lifetime (years)	Radiative Efficiency (Wm^{-2} ppb^{-1})	Global Warming Potential with 100 year time horizon (previous estimates for 1st IPCC assessment report)	Possible source of emissions
Carbon dioxide	CO_2	Variable	1.4×10^{-5}	1	Combustion of fossil fuels
Methane	CH_4	12	3.7×10^{-4}	25 (23)	Decomposition of biodegradable material, enteric emissions.
Nitrous Oxide	N_2O	114	3.03×10^{-3}	298 (296)	N_2O arises from Stationary Sources, mobile sources, manure, soil management and agricultural residue burning, sewage, combustion and bunker fuels
Sulphur hexafluoride	SF_6	3200	0.52	22,800 (22,200)	Leakage from electricity substations, magnesium smelters, some consumer goods
HFC 134a (R134a refrigerant)	CH_2FCF_3	14	0.16	1,430 (1,300)	Substitution of ozone depleting substances, refrigerant manufacture / leaks, aerosols, transmission and distribution of electricity.
Dichlorodifluoro-methane CFC 12 (R12 refrigerant)	CCl_2F_2	100	0.32	10900	
Difluoromono-chloromethane HCFC 22 (R22 refrigerant)	$CHClF_2$	12	0.2	1810	

No single lifetime can be determined for carbon dioxide because of the difference in timescales associated with long and short cycle biogenic carbon. For a calculation of lifetimes and a full list of greenhouse gases and their global warming potentials please see:

Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Avery, M. Tignor and H.L. Miller (eds.) (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom Table 2.14. Lifetimes, radiative efficiencies and direct (except for CH_4) global warming potentials (GWP) relative to CO_2. Available at: http://www.ipcc.ch/ipccreports/assessments-reports.htm

Appendix 2. Updated full time series – Electricity and Heat and Steam Factors

The tables below provide the fully updated and consistent time series data for electricity, heat and steam emission factors. This is provided for organisations wishing to use fully consistent time series data for purposes OTHER than for company reporting (e.g. policy analysis).

Data Year	Electricity Generation (1)	Total Grid Losses (2)	UK electricity generation emissions (3), ktonne		
	GWh	%	CO_2	CH_4	N_2O
1990	280,234	**8.08%**	205,804	2.856	3.628
1991	283,201	**8.27%**	202,390	2.697	3.599
1992	281,223	**7.55%**	190,393	2.559	3.380
1993	284,350	**7.17%**	173,966	2.527	2.884
1994	289,126	**9.57%**	169,592	2.657	2.735
1995	299,196	**9.07%**	166,590	2.735	2.686
1996	313,070	**8.40%**	166,524	2.759	2.507
1997	311,220	**7.79%**	154,069	2.660	2.173
1998	320,740	**8.40%**	158,723	2.844	2.253
1999	323,872	**8.25%**	150,921	2.855	1.972
2000	331,553	**8.38%**	163,027	3.026	2.210
2001	342,686	**8.56%**	173,424	3.286	2.449
2002	342,338	**8.26%**	168,088	3.239	2.323
2003	354,225	**8.47%**	180,433	3.420	2.559
2004	349,312	**8.71%**	178,534	3.419	2.470
2005	350,778	**7.25%**	176,880	4.038	2.607
2006	349,211	**7.21%**	185,915	4.133	2.820
2007	352,778	**7.34%**	183,729	4.099	2.622
2008	348,876	**7.43%**	179,103	4.381	2.470
2009	338,983	**7.86%**	157,790	4.247	2.128
2010	343,841	**7.42%**	162,530	4.457	2.201
2011	329,253	**7.89%**	149,602	4.405	2.246
2012	324,823	**8.00%**	163,594	4.830	2.854
2013	318,753	**7.57%**	151,074	5.301	2.729
2014	298,064	**8.11%**	126,937	5.991	2.345
2015	297,575	**8.40%**	106,519	7.418	2.173
2016	297,203	**7.85%**	84,007	7.856	1.532

Notes:

(1) Based upon calculated **total** for **all** electricity generation (GWh supplied) from DUKES (2016) Table 5.5, with a reduction of the total for autogenerators based on unpublished data from the BEIS DUKES team on the share of this that is actually exported to the grid (~16% in 2015).

(2) Based upon calculated net grid losses from data in DUKES (2016) Table 5.1.2 (long term trends, only available online).

(3) Emissions from UK centralised power generation (excluding Crown Dependencies and Overseas Territories) listed under UNFCC reporting category 1A1a and autogeneration - exported to grid (UK Only) listed under UNFCC reporting category 1A2f from the UK Greenhouse Gas Inventory for 2012 (Ricardo-AEA, 2014), with data from the GHGI for 2015 (Ricardo Energy & Environment, 2017) for the 2015 data year. Also includes an accounting (estimate) for autogeneration emissions not specifically split out in the NAEI, consistent with the inclusion of the GWh supply for these elements also.

Table 47: Base electricity generation emissions data - most recent datasets for time series

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
1990	0.73440	0.00025	0.00386	0.73851	0.06453	0.00002	0.00034	0.06489	0.79893	0.00028	0.00420	0.80340	**4.08%**
1991	0.71465	0.00024	0.00379	0.71868	0.06443	0.00002	0.00034	0.06479	0.77908	0.00026	0.00413	0.78347	**5.48%**
1992	0.67702	0.00023	0.00358	0.68083	0.05526	0.00002	0.00029	0.05557	0.73228	0.00025	0.00387	0.73640	**5.60%**
1993	0.61180	0.00022	0.00302	0.61505	0.04725	0.00002	0.00023	0.04750	0.65905	0.00024	0.00326	0.66255	**5.55%**
1994	0.58657	0.00023	0.00282	0.58962	0.06210	0.00002	0.00030	0.06242	0.64867	0.00025	0.00312	0.65204	**5.52%**
1995	0.55679	0.00023	0.00268	0.55970	0.05555	0.00002	0.00027	0.05584	0.61234	0.00025	0.00294	0.61553	**5.26%**
1996	0.53191	0.00022	0.00239	0.53451	0.04880	0.00002	0.00022	0.04904	0.58070	0.00024	0.00261	0.58355	**5.08%**
1997	0.49505	0.00021	0.00208	0.49734	0.04184	0.00002	0.00018	0.04204	0.53689	0.00023	0.00226	0.53938	**5.06%**
1998	0.49486	0.00022	0.00209	0.49718	0.04535	0.00002	0.00019	0.04557	0.54022	0.00024	0.00229	0.54275	**3.74%**
1999	0.46599	0.00022	0.00181	0.46802	0.04191	0.00002	0.00016	0.04209	0.50790	0.00024	0.00198	0.51011	**4.21%**
2000	0.49171	0.00023	0.00199	0.49392	0.04500	0.00002	0.00018	0.04520	0.53671	0.00025	0.00217	0.53913	**4.10%**
2001	0.50607	0.00024	0.00213	0.50844	0.04738	0.00002	0.00020	0.04761	0.55346	0.00026	0.00233	0.55605	**2.95%**
2002	0.49100	0.00024	0.00202	0.49326	0.04418	0.00002	0.00018	0.04438	0.53518	0.00026	0.00220	0.53764	**2.40%**
2003	0.50938	0.00024	0.00215	0.51177	0.04713	0.00002	0.00020	0.04735	0.55650	0.00026	0.00235	0.55912	**0.61%**
2004	0.51110	0.00024	0.00211	0.51345	0.04876	0.00002	0.00020	0.04899	0.55986	0.00027	0.00231	0.56244	**2.10%**
2005	0.50425	0.00029	0.00221	0.50675	0.03939	0.00002	0.00017	0.03958	0.54364	0.00031	0.00239	0.54634	**2.32%**
2006	0.53238	0.00030	0.00241	0.53509	0.04140	0.00002	0.00019	0.04161	0.57378	0.00032	0.00259	0.57669	**2.11%**
2007	0.52081	0.00029	0.00222	0.52331	0.04124	0.00002	0.00018	0.04144	0.56205	0.00031	0.00239	0.56475	**1.46%**
2008	0.51337	0.00031	0.00211	0.51579	0.04121	0.00003	0.00017	0.04140	0.55458	0.00034	0.00228	0.55720	**3.06%**
2009	0.46548	0.00031	0.00187	0.46766	0.03970	0.00003	0.00016	0.03989	0.50518	0.00034	0.00203	0.50755	**0.84%**
2010	0.47269	0.00032	0.00191	0.47492	0.03791	0.00003	0.00015	0.03809	0.51060	0.00035	0.00206	0.51301	**0.77%**
2011	0.45437	0.00033	0.00203	0.45674	0.03892	0.00003	0.00017	0.03912	0.49329	0.00036	0.00221	0.49586	**1.85%**
2012	0.50364	0.00037	0.00262	0.50663	0.04378	0.00003	0.00023	0.04404	0.54742	0.00040	0.00285	0.55067	**3.52%**
2013	0.47395	0.00042	0.00255	0.47692	0.03879	0.00003	0.00021	0.03903	0.51274	0.00045	0.00276	0.51595	**4.33%**
2014	0.42587	0.00050	0.00234	0.42872	0.03761	0.00004	0.00021	0.03786	0.46348	0.00055	0.00255	0.46658	**6.44%**
2015	0.35796	0.00062	0.00218	0.36076	0.03282	0.00006	0.00020	0.03307	0.39077	0.00068	0.00238	0.39383	**6.57%**

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
2016	0.28266	0.00066	0.00154	0.28486	0.02409	0.00006	0.00013	0.02428	0.30675	0.00072	0.00167	0.30913	**5.57%**

Notes: * The 2017 update uses data on the contribution of electricity from the different interconnects, hence these figures are based on a weighted average emission factor of the emission factors for France, the Netherlands and Ireland, based on the % share supplied.

The dataset above uses the most recent, consistent data sources across the entire time series.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

$\Rightarrow$ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES)[82],

Table 48: Base electricity generation emission factors (excluding imported electricity) – fully consistent time series dataset

Data Year	Emission Factor, $kgCO_2e$ / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid, plus imports)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
1990	0.70907	0.00025	0.00372	0.71304	0.0623	0.00002	0.00033	0.06265	0.77137	0.00027	0.00405	0.77569	**4.08%**
1991	0.68251	0.00023	0.00362	0.68636	0.06153	0.00002	0.00033	0.06188	0.74404	0.00025	0.00395	0.74824	**5.48%**
1992	0.64475	0.00022	0.00341	0.64838	0.05263	0.00002	0.00028	0.05293	0.69738	0.00024	0.00369	0.70131	**5.60%**
1993	0.58162	0.00021	0.00287	0.5847	0.04492	0.00002	0.00022	0.04516	0.62654	0.00023	0.00309	0.62986	**5.55%**
1994	0.558	0.00022	0.00268	0.5609	0.05907	0.00002	0.00028	0.05937	0.61707	0.00024	0.00296	0.62027	**5.52%**
1995	0.53163	0.00022	0.00255	0.5344	0.05304	0.00002	0.00025	0.05331	0.58467	0.00024	0.00280	0.58771	**5.26%**
1996	0.50906	0.00021	0.00228	0.51155	0.0467	0.00002	0.00021	0.04693	0.55576	0.00023	0.00249	0.55848	**5.08%**
1997	0.47383	0.0002	0.00199	0.47602	0.04005	0.00002	0.00017	0.04024	0.51388	0.00022	0.00216	0.51626	**5.06%**
1998	0.48028	0.00022	0.00203	0.48253	0.04402	0.00002	0.00019	0.04423	0.52430	0.00024	0.00222	0.52676	**3.74%**
1999	0.45017	0.00021	0.00175	0.45213	0.04048	0.00002	0.00016	0.04066	0.49065	0.00023	0.00191	0.49279	**4.21%**

[82] Slight differences in the CONSUMED figure shown in the table and the figure which can be calculated using the Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES) in the table is due to rounding. The CONSUMED figure in the table is considered to be more accurate.

Data Year	Emission Factor, kgCO₂e / kWh												% Net Electricity Imports
	For electricity GENERATED (supplied to the grid, plus imports)				Due to grid transmission /distribution LOSSES				For electricity CONSUMED (includes grid losses)				
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	TOTAL
2000	0.47488	0.00022	0.00192	0.47702	0.04346	0.00002	0.00018	0.04366	0.51834	0.00024	0.00210	0.52068	**4.10%**
2001	0.49315	0.00023	0.00208	0.49546	0.04617	0.00002	0.00019	0.04638	0.53932	0.00025	0.00227	0.54184	**2.95%**
2002	0.48093	0.00023	0.00198	0.48314	0.04327	0.00002	0.00018	0.04347	0.52420	0.00025	0.00216	0.52661	**2.40%**
2003	0.5068	0.00024	0.00214	0.50918	0.04689	0.00002	0.0002	0.04711	0.55369	0.00026	0.00234	0.55629	**0.61%**
2004	0.50189	0.00024	0.00207	0.5042	0.04789	0.00002	0.0002	0.04811	0.54978	0.00026	0.00227	0.55231	**2.10%**
2005	0.49453	0.00028	0.00217	0.49698	0.03863	0.00002	0.00017	0.03882	0.53316	0.00030	0.00234	0.53580	**2.32%**
2006	0.5228	0.00029	0.00236	0.52545	0.04065	0.00002	0.00018	0.04085	0.56345	0.00031	0.00254	0.56630	**2.11%**
2007	0.5144	0.00029	0.00219	0.51688	0.04073	0.00002	0.00017	0.04092	0.55513	0.00031	0.00236	0.55780	**1.46%**
2008	0.50003	0.00031	0.00206	0.5024	0.04014	0.00002	0.00016	0.04032	0.54017	0.00033	0.00222	0.54272	**3.06%**
2009	0.46229	0.00031	0.00186	0.46446	0.03943	0.00003	0.00016	0.03962	0.50172	0.00034	0.00202	0.50408	**0.84%**
2010	0.46971	0.00032	0.0019	0.47193	0.03767	0.00003	0.00015	0.03785	0.50738	0.00035	0.00205	0.50978	**0.77%**
2011	0.44909	0.00033	0.00201	0.45143	0.03847	0.00003	0.00017	0.03867	0.48756	0.00036	0.00218	0.49010	**1.85%**
2012	0.49497	0.00037	0.00257	0.49791	0.04303	0.00003	0.00022	0.04328	0.53800	0.00040	0.00279	0.54119	**3.52%**
2013	0.46314	0.00041	0.00249	0.46604	0.03791	0.00003	0.0002	0.03814	0.50105	0.00044	0.00269	0.50418	**4.33%**
2014	0.41142	0.00049	0.00227	0.41418	0.03633	0.00004	0.0002	0.03657	0.44775	0.00053	0.00247	0.45075	**6.44%**
2015	0.34915	0.00061	0.00212	0.35188	0.03201	0.00006	0.00019	0.03226	0.38116	0.00067	0.00231	0.38414	**6.57%**
2016	0.28088	0.00066	0.00153	0.28307	0.02394	0.00006	0.00013	0.02413	0.30482	0.00072	0.00166	0.30720	**5.57%**

Notes: * The updated 2016 methodology uses data on the contribution of electricity from the different interconnects, hence these figures are based on a weighted average emission factor of the emission factors for France, the Netherlands and Ireland, based on the % share supplied.

The dataset above uses the most recent, consistent data sources across the entire time series.

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) / (1 - %Electricity Total Grid LOSSES)

Emission Factor (Electricity LOSSES) = Emission Factor (Electricity CONSUMED) - Emission Factor (Electricity GENERATED)

⇒ Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES)

Table 49: Base electricity generation emissions factors (including imported electricity) – fully consistent time series dataset

Data Year	$kgCO_2/kWh$ supplied heat/steam Method 1 (DUKES: 2/3rd - 1/3rd)	$kgCO_2/kWh$ supplied power Method 1 (DUKES: 2/3rd - 1/3rd)
2001	0.233	0.466
2002	0.225	0.45
2003	0.228	0.457
2004	0.221	0.443
2005	0.214	0.428
2006	0.223	0.445
2007	0.223	0.447
2008	0.218	0.435
2009	0.214	0.428
2010	0.21	0.421
2011	0.24	0.48
2012	0.194	0.388
2013	0.197	0.393
2014	0.193	0.386
2015	0.192	0.384
2016	0.186	0.372

Table 50: Fully consistent time series for the heat/steam and supplied power carbon factors as calculated using DUKES method

Appendix 3. Major Changes to the Conversion Factors

The following table provides a summary of major changes in emission factors for the 2018 GHG Conversion Factors, compared to the equivalent factors provided in the 2017 GHG Conversion Factors, and a short explanation for the reason for the change. We have considered major changes to be those greater than 5% for Scope 1 and 2 emission sources most fuels and electricity and greater than 10% for Scope 3 most other emission sources.

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
Fuels						
1	CNG	CH_4	All	-8%	Lower weighted EF due to change in distribution of emissions between natural gas users and due to gas power stations now having a greater share.	Section 2
2	LNG	CH_4	All	-8%	As above	Section 2
3	LPG	CH_4	All	-6%	Dominated by road transport trend - improved emissions standards/fleet turnover.	Section 2
4	Natural gas	CH_4	All	-8%	See CNG and LNG above	Section 2
5	Aviation spirit	CH_4	All	222%	The NAEI methodology has changed to revert to default Guidebook values in place of local proxy data.	Section 2

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per “unit” of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
6	Diesel (average biofuel blend)	CH_4	All	-19%	Dominated by road transport trend - improved emissions standards/fleet turnover.	Section 2
7	Diesel (100% mineral diesel)	CH_4	All	-19%	As above	Section 2
8	Marine gas oil	CH_4	All	-35%	Output from new BEIS shipping study - method change in NAEI.	Section 2
9	Coal (domestic)	CH_4	All	12%	Change to calculation from default EF to NAEI units, now using year specific CV to domestic coal in place of long term average across multiple users.	Section 2
10	Coking coal	CH_4	All	-81%	No domestic use of coke in 2016 so weighted average is for industrial sources only.	Section 2
11	LPG	N_2O	All	-15%	Dominated by road transport trend - improved emissions standards/fleet turnover.	Section 2
12	Fuel oil	N_2O	All	6%	Impact of inclusion of fishing vessels (new source in NAEI16).	Section 2
13	Petrol (average biofuel blend)	N_2O	All	81%	Correction to calculation for N_2O to take out cold start "fuel consumption".	Section 2
14	Petrol (100% mineral petrol)	N_2O	All	81%	As above	Section 2
15	Processed fuel oils - residual oil	N_2O	All	6%	Impact of inclusion of fishing vessels (new source in NAEI16).	Section 2

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
16	Waste oils	N_2O	All	5%	Due to a method change: now uses CV for gas oil (annual) in place of a long term average for fuel oil. Now fully consistent with energy conversions used for the inventory fuel use, and for other pollutants.	Section 2
17	Marine gas oil	N_2O	All	78%	Output from new BEIS shipping study - method change in NAEI.	Section 2
18	Marine fuel oil	N_2O	All	85%	As above	Section 2
19	Coal (industrial)	N_2O	All	9%	Method change to use year specific CV for conversions from energy to mass units, change to distribution of sources impacts weighted average.	Section 2
20	Coking coal	N_2O	All	-21%	No domestic use of coke in 2016 so weighted average is for industrial sources only.	Section 2
Bioenergy						
21	Wood pellets	CO_2e	Tonnes	19%	Revisions to CV.	Section 9
22	Grass/straw	CO_2e	All	-37%	Higher proportion from power stations compared to agriculture - stationary combustion.	Section 9
23	Bioethanol	All	All	27%	Correction to calculation for N_2O emissions for conventional fuel in the Fuels workbook to take out cold start "fuel consumption". Results in a big increase in a small number.	Section 9
24	Biodiesel (from UCO)	All	All	73%	As above	Section 9

Ref. number	Emission factor	GHG	Unit (all units are kgCO_2e per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
25	Biodiesel (from Tallow)	All	All	73%	As above	Section 9
Refrigerants and other						
No changes						Section 4
Passenger Vehicles						
26	Cars by market segment- Dual Purpose cars, Unknown fuel	CH_4	km and miles	-13%	Continued uptake of Euro 6 vehicles causes reduction in EFs for petrol and diesel cars.	Section 5
27	Cars by size: Large car, Hybrid	CO_2	km and miles	24%	Increase in gCO_2/km from 2016 (21) to 2017 (163) and changes in the registrations of hybrid cars.	Section 5
28	Cars by size: Large car, Hybrid	CO_2e	km and miles	24%	As above	Section 5
29	Cars by size: Medium car, LPG	CH_4	km and miles	-13%	Continued uptake of Euro 6 vehicles causes reduction in EFs for petrol and diesel cars.	Section 5
30	Cars by size: Large car, LPG	CH_4	km and miles	-13%	As above	Section 5
31	Cars by size: Average car, LPG	CH_4	km and miles	-13%	As above	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
32	Upper medium cars- PHEV	CO_2	km and miles	26%	Spike in the new petrol PHEVs registered in 2016 mean that the fuel split of petrol/diesel has altered significantly, affecting the balance of fuel EFs which feed this calculation. Also affects CO_2 emissions as petrol cars use fuel more quickly and so increases emissions factors.	Section 5
33	Upper medium cars- PHEV	CH_4	km and miles	38%	As above	Section 5
34	Upper medium cars- PHEV	CO_2e	km and miles	26%	As above	Section 5
35	Cars by market segment-- PHEV	N_2O	km and miles	71.4% to 100%	Change to kg per kWh (net CV) for diesel and petrol factors causes recalculations for N_2O emissions.	Section 5
36	Cars by size- PHEV	N_2O	km and miles	75% to 84.6%	As above	Section 5
37	All Motorcycles	CH_4	km and miles	-9.2% to -5.4%	Fleet turnover to vehicles with lower emissions.	Section 5
Delivery vehicles						
38	Petrol Vans- All classes	CH_4	km and miles	-48%	Large reduction due partly to a correction in the NAEI for catalyst repair rates of petrol LGVs but also due to fleet turnover with new vehicles satisfying more stringent EURO standard requirements.	Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
39	Petrol Vans- All classes	N_2O	km and miles	-29%	As above	Section 6
40	CNG Vans- Average class	CH_4	km and miles	-47%	As above	Section 6
41	CNG Vans- Average class	N_2O	km and miles	-29%	As above	Section 6
42	LPG Vans- Average class	CH_4	km and miles	-51%	As above	Section 6
43	LPG Vans- Average class	N_2O	km and miles	-29%	As above	Section 6
44	Unknown fuel- All Vans	CH_4	km and miles	-36%	This is due to the petrol and diesel changes seen above.	Section 6
45	HGVs (all diesel)- Rigid (>3.5 - 7.5 tonnes)	CH_4	km and miles	-28.6%	The change in CH_4 emissions is due to changes in emission factors to COPERT 4v11.	Section 6
46	HGVs (all diesel)- Rigid (>7.5 tonnes-17 tonnes)	CH_4	km and miles	-27.6%	As above	Section 6
47	HGVs (all diesel)- Rigid (>17 tonnes) and All rigids	CH_4	km and miles	-20.5%	As above	Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
48	HGVs (all diesel)- Articulated (>3.5 - 33t)	CH_4	km and miles	-28%	As above	Section 6
49	HGVs (all diesel)- Articulated (>33t)	CH_4	km and miles	-19.3%	As above	Section 6
50	HGVs (all diesel)- All artics	CH_4	km and miles	-18.3%	As above	Section 6
51	HGVs (all diesel)- All HGVs	CH_4	km and miles	-21.5%	As above	Section 6
52	HGVs refrigerated (all diesel)	Same magnitude of changes as for HGVs (all diesel)				Section 6
UK Electricity						
53	UK Electricity	CO_2	kWh	-19%	There was a significant decrease in coal generation and a significant increase in mainly gas generation since the previous year.	Section 3
54	UK Electricity	CH_4	kWh	6%	Higher CH_4 emissions from power generation from NAEI data.	Section 3
55	UK Electricity	N_2O	kWh	-27%	There was a significant decrease in coal generation and an increase in gas generation since the previous year.	Section 3

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
56	UK Electricity	CO_2e	kWh	-19%	As above	Section 3
UK electricity for EVs						
57	Cars by market segment- PHEV, BEV	CO_2e and CO_2	km and miles	-25.8% to -17.2%	Changes are mainly due to the changes in electricity but also changes in the market of electric vehicles can significantly contribute.	Section 5
58	Cars by market segment- PHEV, BEV	N_2O	km and miles	-33.3% to -17.4%	As above	Section 5
59	Cars by size- PHEV, BEV	CO_2e and CO_2	km and miles	-22.6% to -12.6%	As above	Section 5
60	Cars by size- PHEV, BEV	N_2O	km and miles	-30.8% to -22.2%	As above	Section 5
61	All Vans- BEV	CO_2e and CO_2	tonne.km	-19.5% to -12.9%	As above	Section 5
62	All Vans- BEV	N_2O	tonne.km	-27.7% to -20.8%	As above	Section 5
Heat and Steam						
63	Onsite and district heating	CH_4	kWh	-34%	Changes in CHP fuel mix and in assumptions for CH_4 and N_2O emissions for certain fuels.	Section 3
64	Onsite and district heating	N_2O	kWh	-20%	As above	Section 3

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
WTT- fuels						
65	CNG	CO_2e	All	-8% to -6%	Reduction in LNG imports as a proportion of total supply compared to 2017 update.	Section 2
66	Natural gas	CO_2e	All	-10% to -8%	As above	Section 2
WTT- bioenergy						
67	WTT-Bioethanol	CO_2e	All	-5%	Changes to DfT data (Table RTFO 05)	Section 9
68	WTT -Biodiesel	CO_2e	All	-23%	Changes to DfT data (Table RTFO 05)	Section 9
69	WTT -Biodiesel (from UCO)	CO_2e	All	-23%	Changes to DfT data (Table RTFO 05)	Section 9
Transmission and distribution						
70	UK Electricity T&D Losses	CO_2	kWh	-27%	The increase in lower GHG electricity generation was enhanced by a decrease in losses from the grid.	Section 3
71	UK Electricity T&D Losses	N_2O	kWh	-35.0%	As above	Section 3
72	UK Electricity T&D Losses	CO_2e	kWh	-27%	As above	Section 3
UK electricity T&D for EVs						
73	Cars by market segment- PHEV, BEV	CO_2e and CO_2	km and miles	-32.4% to -14.9%	Big change in CO_2 electricity factor causes most of the change here.	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
74	Cars by market segment- PHEV, BEV	N_2O	km and miles	-50% to -25%	As above	Section 5
75	Cars by size- PHEV, BEV	CO_2e and CO_2	km and miles	-29.4% to -20.4%	As above	Section 5
76	Cars by size- PHEV, BEV	N_2O	km and miles	-50% to -25%	As above	Section 5
77	All Vans- BEV	CO_2e and CO_2	tonne.km	-26.6%	As above	Section 5
78	All Vans- BEV	N_2O	tonne.km	-36.4% to -28.6%	As above	Section 5
WTT- UK elec						
79	WTT - UK Electricity	CO_2e	kWh	-25%	As for Scope 2 emissions	Section 3
80	WTT - UK Electricity T&D Losses	CO_2e	kWh	-32%	As above	Section 3
WTT- overseas electricity (generation)						
81	WTT- overseas electricity (generation) - Electricity: Ireland	CO_2e	kWh	-11%	Reflects trend in electricity conversion factor as reported by SEAI (Sustainable Energy Authority of Ireland.	Section 10

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
82	WTT- overseas electricity (generation) - Electricity: France	CO_2e	kWh	25%	Reflects trend in electricity conversion factor as reported by RTE (the French transmission system operator).	Section 10
83	WTT- overseas electricity (generation) - Electricity: Netherlands	CO_2e	kWh	-6%	Reflects trend in electricity conversion factor as reported by CBS (the Netherlands Central Statistics Bureau).	Section 10
WTT- overseas electricity (T&D)						
84	WTT T&D losses - Electricity: Australia	CO_2e	kWh	19%	Reflects changes in reported losses from the IEA energy balance data set and estimated trends in CO_2 per unit of electricity.	Section 10
85	WTT T&D losses - Electricity: Canada	CO_2e	kWh	12%	As above	Section 10
86	WTT T&D losses - Electricity: Cyprus	CO_2e	kWh	21%	As above	Section 10

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per “unit” of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
87	WTT T&D losses - Electricity: Estonia	CO_2e	kWh	-16%	As above	Section 10
88	WTT T&D losses - Electricity: Finland	CO_2e	kWh	-11%	As above	Section 10
89	WTT T&D losses - Electricity: France	CO_2e	kWh	23%	As above	Section 10
90	WTT T&D losses - Electricity: Greece	CO_2e	kWh	16%	As above	Section 10
91	WTT T&D losses - Electricity: Ireland	CO_2e	kWh	-13%	As above	Section 10
92	WTT T&D losses - Electricity: Israel	CO_2e	kWh	36%	As above	Section 10

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
93	WTT T&D losses - Electricity: Luxembourg	CO_2e	kWh	32%	As above	Section 10
94	WTT T&D losses - Electricity: Malta	CO_2e	kWh	64%	As above	Section 10
95	WTT T&D losses - Electricity: Saudi Arabia	CO_2e	kWh	13%	As above	Section 10
96	WTT T&D losses - Electricity: Singapore	CO_2e	kWh	-13%	As above	Section 10
97	WTT T&D losses - Electricity: Slovak Republic	CO_2e	kWh	105%	As above	Section 10
98	WTT T&D losses - Electricity: Sweden	CO_2e	kWh	-17%	As above	Section 10
WTT- heat and steam						
N/A						

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
Water supply						
No changes						Section 9
Water treatment						
No changes						Section 9
Business travel- air						
99	Domestic flight- average passenger, with and without RF	CO_2e, CO_2, N_2O; CH_4	passenger.km	12%	Overall increase (~11.5%) reflects the increased use of small planes, and also shorter average flight distances. Larger increase in CH_4 is due to changes in emission factors for CH_4 used in the UK GHGI.	Section 8
100	Long-haul Business class, with and without RF	CO_2e, CO_2, N_2O	passenger.km	8%	Increase is due to a range of input data changes: decrease in load factors, increase to calculated EFs from EUROCONTROL small emitters tool for key aircraft, changes in shares of different aircraft, and increase in allocation of CO_2 between passenger and freight for passenger services.	Section 8
WTT- Business travel- air						
101	WTT - Flights	As for Business travel- air				Section 8
Business travel- sea						
102	Foot passenger	CH_4	passenger.km	-14%	Output from new BEIS shipping model is very different to previous estimates.	Section 7
103	Car passenger	CH_4	passenger.km	-17%	As above	Section 7

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
104	Average (all passenger)	CH_4	passenger.km	-18%	As above	Section 7
105	Foot passenger	N_2O	passenger.km	78%	As above	Section 7
106	Car passenger	N_2O	passenger.km	77%	As above	Section 7
107	Average (all passenger)	N_2O	passenger.km	78%	As above	Section 7
WTT- Business travel- sea						
No changes						Section 7
Business travel- land						
108	Cars by market segment- Dual Purpose cars, Unknown fuel	CH_4	km and miles	-13%	Continued uptake of Euro 6 vehicles causes reduction in EFs for petrol and diesel cars.	Section 5
109	Cars by size: Large car, Hybrid	CO_2	km and miles	24%	There is a massive increase in gCO_2/km from 2016 (21) to 2017 (163) and changes in the registrations of hybrid cars.	Section 5
110	Cars by size: Large car, Hybrid	CO_2e	km and miles	24%	As above	Section 5
111	Cars by size: Medium car, LPG	CH_4	km and miles	-13%	Continued uptake of Euro 6 vehicles causes reduction in EFs for petrol and diesel cars.	Section 5

Ref. number	Emission factor	GHG	Unit (all units are kgCO_2e per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
112	Cars by size: Large car, LPG	CH_4	km and miles	-13%	As above	Section 5
113	Cars by size: Average car, LPG	CH_4	km and miles	-13%	As above	Section 5
114	Motorbike: all sizes	CH_4	km and miles	-9.2% to -5.4%	Fleet turnover to vehicles with lower emissions.	Section 5
115	Local bus (not London)	CH_4	passenger.km	-33%	A ~20% reduction in Euro III bus vkm and the removal of all Euro II buses from the fleet cause the majority of CH_4 reductions. This reason causes a large drop in emissions because there is a large drop in emissions per km from Euro III to Euro IV+ vehicles (Euro IV EFs are roughly 5% of Euro III).	Section 5
116	Local London bus	CH_4	passenger.km	-33%	As above	Section 5
117	Average local bus	CH_4	passenger.km	-40%	As above	Section 5
118	Local bus (not London)	N_2O	passenger.km	13%	The decline in vkm causes a small increase in N_2O emissions due to the more efficient conversion of NOx to N_2O in later EURO standard models which now contribute a greater % to total bus vkm.	Section 5
119	Local London bus	N_2O	passenger.km	15%	As above	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
120	Average local bus	N_2O	passenger.km	15%	As above	Section 5
121	Cars by market segment- PHEV, BEV	CO_2e and CO_2	km and miles	-24.9% to -14.9%	Big change in CO_2 electricity factor causes most of this change.	Section 5
122	Cars by market segment- PHEV, BEV	N_2O	km and miles	-31.7% to -17.9%	As above	Section 5
123	Cars by size- PHEV, BEV	CO_2e and CO_2	km and miles	-23.2% to -14.9%	As above	Section 5
124	Cars by size- PHEV, BEV	N_2O	km and miles	-28.8% to -11.9%	As above	Section 5
125	National rail	CH_4	passenger.km	33%	Increase in CH_4 emissions from electricity consumption (this factor is a combination of electric and diesel trains).	Section 5
126	International rail	CH_4	passenger.km	50%	Increase in the CH_4 emissions are due to the change in the CO_2 electricity factor.	Section 5
127	Light rail and tram	CH_4	passenger.km	13%	As above	Section 5
128	Light rail and tram	N_2O	passenger.km	-19%	Decrease in the N_2O emissions due to the change in the CO_2 electricity factor and due to a decrease in ORR data.	Section 5
129	London underground	CO_2e	passenger.km	-20%	Due to change in data published by TfL.	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
130	London underground	CO_2	passenger.km	-20%	As above	Section 5
131	London underground	N_2O	passenger.km	-29%	As above	Section 5
Freighting goods						
132	All Vans- BEV	CO_2e and CO_2	tonne.km	-20.1% to -13.6%	Big change in CO_2 electricity factor causes most of this change.	Section 6
133	All Vans- BEV	N_2O	tonne.km	-28.9% to -21.5%	As above	Section 6
134	Sea tanker, all types	CH_4	passenger.km	up to -50%	Output from new BEIS shipping model is very different to previous estimates.	Section 6
135	Cargo ship, all types	CH_4	passenger.km	up to -50%	As above	Section 6
136	Sea tanker, all types	N_2O	passenger.km	up to 86%	As above	Section 6
137	Cargo ship, all types	N_2O	passenger.km	up to 86%	As above	Section 6
138	Freight train	No significant changes				Section 6
139	Vans	See delivery vehicles above (the tonne.km magnitude of change is the same as the km and miles changes)				Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
140	HGVs (all diesel)- Rigid (>3.5 - 7.5 tonnes)	CH_4	tonne.km	-26.4% to -21.7%	Lower CH_4 implied EF is due to an increase in vkm from HGVs and reduced emissions. In addition, changes are due to the uptake of EURO VI HGVs into the fleet which have lower CH_4 and higher N_2O emissions. Finally, the loading factors were revised by DfT in RFS as part of a methodological review which causes significant shifts for lots of HGV categories.	Section 6
141	HGVs (all diesel)- Rigid (>7.5 tonnes-17 tonnes)	CH_4	tonne.km	-27.5%	As above	Section 6
142	HGVs (all diesel)- Rigid (>17 tonnes)	CH_4	tonne.km	-32% to -12%	As above	Section 6
143	HGVs (all diesel)- All rigids	CH_4	tonne.km	-23% to -15.3%	As above	Section 6
144	HGVs (all diesel)- Articulated (>3.5 - 33t)	CH_4	tonne.km	-28% to -20%	As above	Section 6
145	HGVs (all diesel)- Articulated (>33t) - average	CH_4	tonne.km	-34.9%	As above	Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
146	HGVs (all diesel)- All artics- average	CH_4	tonne.km	-36%	As above	Section 6
147	HGVs (all diesel)- All HGVs	CH_4	tonne.km	-23% to -19.4%	As above	Section 6
148	HGVs (all diesel)- Rigid (>7.5 tonnes-17 tonnes)- Average	CO_2e and CO_2	tonne.km	16.6%	As above	Section 6
149	HGVs (all diesel)- Rigid (>7.5 tonnes-17 tonnes)- Average	N_2O	tonne.km	24%	As above	Section 6
150	HGVs (all diesel)- All rigids- Average	N_2O	tonne.km	20%	As above	Section 6
151	HGVs refrigerated (all diesel)	Same magnitude of changes as for HGVs (all diesel)				Section 6
152	HGVs (all diesel)- all categories	CH_4 and N_2O	km and miles	See delivery vehicles- same magnitude of changes		Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
153	Short-haul flights	CO_2e, CO_2, N_2O; CH_4	tonne.km	14%	Overall change (increase of ~14%) reflects the demise of the ATP and use of larger aircraft; also larger share of freight carried on passenger services (with higher EF). Larger increase for CH_4 is due to changes in emission factors for CH_4 used in the UK GHGI.	Section 6
154	Long-haul flights	CO_2e, CO_2, N_2O	tonne.km	-15%	Decrease reflects the reintroduction of B748 with higher freight efficiency, changes to relative allocation of emission between passengers and freight in passenger services, and larger relative share of dedicated freight services (with lower emission factors).	Section 6
WTT passenger vehicles & business travel- land						
155	WTT - Hybrid Cars by size: Large car	CO_2e	km	23%	There is a massive increase in gCO_2/km from 2016 (21) to 2017 (163) and changes in the registrations of hybrid cars.	Section 5
156	WTT- cars by market segment- Upper medium- PHEV	CO_2e	km and miles	26.6%	Huge spike in the petrol PHEVs registered in 2016 mean that the fuel split of petrol/diesel has altered significantly, affecting the balance of fuel EFs which feed this calculation. Also affects CO_2 as petrol cars use fuel more quickly and so increases emission factors.	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per “unit” of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
157	WTT- cars by market segment-Executive-PHEV	CO_2e	km and miles	13.30%	Small sample size causes big shift in emission factors of executive PHEVs as more are sold in 2016.	Section 5
158	WTT- Light rail and tram	CO_2e	passenger.km	-17%	WTT emissions are linked to the direct emissions so proportionate decrease.	Section 5
159	WTT- London Underground	CO_2e	passenger.km	-25%	As above	Section 5
160	WTT - All Motorcycles	No significant changes				Section 5
161	WTT - All buses and coaches	No significant changes				Section 5
WTT delivery vehicles & freighting goods						
162	WTT- all Vans-BEV	CO_2e	tonne.km	-25.7% to -19.6%	Big change in CO_2 electricity factor causes most of this change.	Section 6
163	WTT - Freight train	No significant changes				Section 6
164	WTT- Vans	No significant changes				Section 6
165	WTT- Freight flights	As for Freighting goods				Section 6
166	WTT-HGVs (all diesel)- Rigid (>17 tonnes) Average	CO_2e	tonne.km	20%	Increase in WTT factors is due to change in source for this data in 2017 update (and increased EFs) and due to new accounting for biofuel component in final results from 2017.	Section 6

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
167	WTT- HGVs (all diesel)- All rigids- Average	CO_2e	tonne.km	17%	As above	Section 6
168	WTT- HGVs (all diesel)- Articulated (>33t) Average	CO_2e	tonne.km	17%	As above	Section 6
169	WTT- HGVs refrigerated (all diesel)	CO_2e	tonne.km	Same magnitude of changes as for WTT- HGVs (all diesel)		Section 6
Hotel Stay						
170	[Changes due to the data source, see: https://scholarship.sha.cornell.edu/cgi/viewcontent.cgi?article=1255&context=chrpubs](https://scholarship.sha.cornell.edu/cgi/viewcontent.cgi?article=1255&context=chrpubs)					Section 11
Managed assets- electricity						
171	See "UK electricity" (which is identical for managed assets electricity)					Section 3
Managed assets- vehicles						
172	Managed Cars by size and market segment	See business travel - land (the values are identical to these)				Section 5
173	Managed cars - PHEV, BEV					Section 5
174	Managed Vans- PHEV, BEV	See freighting goods (the values are identical to these)				Section 5
175	Managed motorbikes	CH_4	km and miles	-9.2% to -5.4%	Fleet turnover to vehicles with lower emissions.	Section 5

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
176	Managed Vans	See delivery vehicles (the tonne.km magnitude of change is the same as the km and miles changes).				Section 5
177	Managed HGV refrigerated (all diesel)	See Delivery vehicles for changes in km				Section 5
178	Managed HGV (all diesel)					Section 5
Outside of scopes						
179	Diesel (average biofuel blend)	CO_2	All	-15%	The litres of biodiesel consumed this year has increased by 15% causing the percentage of biodiesel within the diesel blend to be more (11% more) and therefore the emissions associated with the biodiesel are proportionately more.	Section 9
Waste: Material use						
180	Metals - closed loop source	CO_2e	tonne	430%	Complete change of method. Driven by the changes in steel closed loop recycling (updated data). Have also changed method and references (using metal specific factors with recycling data whereas previous approach used an estimate of CO_2 saved only rather than emitted from recycling).	Section 12
181	Metal: mixed cans - Closed loop source	CO_2e	tonne	21%	Driven by the changes in steel closed loop recycling (updated data).	Section 12

Ref. number	Emission factor	GHG	Unit (all units are $kgCO_2e$ per "unit" of GHG, unless stated)	Magnitude of change vs 2017 update	Reason for change	For more information see:
182	Metal: scrap metal - Closed loop source	CO_2e	tonne	43%	As above	Section 12
183	Metal: steel cans - Closed loop source	CO_2e	tonne	53%	Old method used data from World Steel (2009) for virgin steel and subtracted a factor derived based on comparing impact of varying steel grades (recycled content %). New version uses data from WSA (2017) which has published direct cradle to gate figure for recycled steel.	Section 12
Waste: Waste disposal						
184	Glass - landfill	CO_2e	tonne	-65%	New model based on zero landfill gas and standardised landfill transport (collection, transfer station and on site vehicle movements). This replaces a data point taken from a 2003 Enviros report and is more systematic and reproducible.	Section 12
185	Organic: food and drink waste, Organic: garden waste and Organic: mixed food and garden waste - Composting	CO_2e	tonne	71%	New factor is general, based on collection from households, transport to site and on-site movements. Previous figures were replaced by using a 2009 study done by ORA, WRAP and MEL.	Section 12

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Introduction

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Expiry:	31/07/2019	Factor set:	Standard Set
Version:	1.01	Year:	2018

Department for Business, Energy & Industrial Strategy

Department for Environment Food & Rural Affairs

UK Government GHG Conversion Factors for Company Reporting

Welcome to the UK Government Conversion Factors for greenhouse gas (GHG) reporting. These factors are suitable for use by UK-based organisations of all sizes and international organisations reporting on UK operations. Therefore, the scope of the factors is defined such that it is relevant to emissions reporting. The factors may also be used for other purposes, but users do this at their own risk.

For new users of the conversion factors, ensure that you have first read Defra's 'Environmental reporting guidelines' and the information on the rest of this sheet. Then follow the informative text at the top of each tab to report your emissions across Scopes 1, 2 and 3. It is not necessary to read the 'What's new' guidance.

If you have used the conversion factors before, ensure you have read the 'What's new' guidance to understand the changes that have been made to the factors over the last year. Following the 'What's new' guidance will ensure that reporting is consistent and comparable year on year. Please note - activity-specific 'What's new' information is repeated in the relevant activity tabs.

For information about how the conversion factors have been derived, please refer to the accompanying 'Methodology paper' to the conversion factors.

Please note - factors that are: (a) not available, will be marked with an empty, light shaded cell:
(b) have an invalid combination of criteria, will be marked with an empty, dark shaded cell:

How is this spreadsheet organised?

After the three introductory worksheets, each worksheet presents the emission factors for a single type of emissions-releasing activity (for example, using electricity or driving a passenger vehicle). These emissions-releasing activities are categorised into three groups known as scopes. Each activity is listed as either Scope 1, Scope 2 or Scope 3. Scope 1, Scope 2 and Scope 3 are colour coded. Refer to the 'Index' tab for links to each sheet.

- **Scope 1 (direct emissions)** emissions are those from activities owned or controlled by your organisation. Examples of Scope 1 emissions include emissions from combustion in owned or controlled boilers, furnaces and vehicles; and emissions from chemical production in owned or controlled process equipment.
- **Scope 2 (energy indirect)** emissions are those released into the atmosphere that are associated with your consumption of purchased electricity, heat, steam and cooling. These indirect emissions are a consequence of your organisation's energy use, but occur at sources you do not own or control.
- **Scope 3 (other indirect)** emissions are a consequence of your actions that occur at sources you do not own or control and are not classed as Scope 2 emissions. Examples of Scope 3 emissions are business travel by means not owned or controlled by your organisation, waste disposal, materials or fuels your organisation purchases. Deciding if emissions from a vehicle, office or factory that you use are Scope 1 or Scope 3 may depend on how you define your operational boundaries. Scope 3 emissions can be from activities that are upstream or downstream of your organisation. More information on Scope 3 and other aspects of reporting can be found in the Greenhouse Gas Protocol Corporate Standard.

How are individual worksheets in this spreadsheet organised?

Each worksheet provides the following information:

- **Guidance** on calculating emissions from this activity
- **An example** of how to calculate emissions from this activity
- **The emission factors for this activity**
- **Frequently asked questions**

How do I calculate my GHG emissions for a particular activity?

Navigate to the sheet relating to the activity that you wish to calculate emissions for. Read the guidance and then collect or estimate activity data for your organisation (for example, the amount of electricity used or distance travelled). Then multiply this activity data by the relevant (emission) conversion factor. This gives an estimate of the GHG emissions for that activity.

GHG emissions = activity data x emission conversion factor

Which gases can I report on using these factors?

There are seven main GHGs that contribute to climate change, as covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). Different activities emit different gases and you should report on the Kyoto Protocol GHG gases produced by your particular activities.

All conversion factors presented here are in units of 'kilograms of carbon dioxide equivalent of Y per X' (kg CO_2e of Y per X), where Y is the gas emitted and X is the unit activity. CO_2e is the universal unit of measurement to indicate the global warming potential (GWP) of GHGs, expressed in terms of the GWP of one unit of carbon dioxide.

The GWPs used in the calculation of CO_2e are based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) over a 100-year period (this is a requirement for inventory/national reporting purposes).

As a minimum, for each activity there is a factor that can be used to calculate emissions of all relevant GHGs combined (kg CO_2e per unit activity).
Additionally, for many activities, this factor is then split into separate factors for each gas (that is, kg CO_2e of CO_2/CH_4/N_2O per unit activity) which sum to the total kg CO_2e per unit activity. These gas-specific factors can be used if desired.

Which year of emissions should I report on with these factors?

You should use the version of the factors that correlates with the data on which you are reporting (for example, factors labelled as 2017 should be used for data from calendar year 2017). If you are reporting on an April to March year, the factors from the calendar year in which the greatest portion of your data falls should be applied (for example, the 2017 factors should be applied to data in reporting year 01/04/17 – 31/03/18, the 2016 factors should have been applied to data in reporting year 01/04/16 – 31/03/17). Users that operate a July to June reporting year should apply the newest set of available factors.

For reference, the 2017 Conversion Factors can be found here

For technical queries, please contact Climatechange Statistics at Climatechange.Statistics@beis.gov.uk.
NOTE: The scope of the factors is defined to be relevant to emissions reporting, although the factors may also be used for other purposes. Regardless of this, their usage is at the users' own risk.

What's new

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Expiry:	31/07/2019	Factor set:	Standard Set
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Annual update and republication

We annually publish a new set of factors at the end of May. Compared to the previous year's factors, changes may be made due to new data availability, methodology improvements or corrections to errors in methodology.

In general, our policy is not to revise previously published EFs in the downloadable spreadsheets based on new data or methodology improvements. However, we may republish previously published factors in the downloadable spreadsheets, if the update to the previously published factor is considered significant or if the primary cause of that update is an error rather than new data or methodology improvements, taking into account all the circumstances including timing.

If previously published factors are updated and republished in the downloadable spreadsheets, then this will be clearly signposted in the accompanying text. For present purposes, we define an error as "implementation of a calculation that was not as intended" and a methodology improvement as "intentional change in the implementation of a calculation". Decisions on how to act on any republished factors are a matter for the user.

What's new in 2018?

A summary of the key changes in the 2018 Government Greenhouse Gas (GHG) Conversion Factors for Company Reporting (hereafter the 2018 update) is provided below. Further information will be provided in the methodology paper accompanying the new 2018 factors, which will be published on the GOV.UK website in July 2018.

1 HEAT & STEAM MODEL REBUILD

What and why?

Improvements were made to the heat & steam model used to derive the emission factors, to make formulae clearer, more concise and easier to trace – which assists the QA process. The previous model included hard coded values that were not clearly documented. These have been changed so that imported data is clearly labelled. The model uses the same three underlying data sets: IPCC CO_2e values, DUKES Combined Heat&Power (CHP) data, Joint Research Center Well-to-Wheel values for Municipal Solid Waste (MSW). These data, together with emission factors from other Conversion Factor workbooks are used to:

• Compile a list of emission factors per fuel type contained in the DUKES (Digest of UK Energy Statistics) data
• Determine the amount of each fuel type used for heat to build a fuel mix emission factor which is used to derive emission factors per MWh heat. Previously the model also calculated the emission factors for MWh power in this same sheet, as well as heat and power emission factors via the PowerStation displacement and boiler displacement methods. These calculations are still contained in the workbook, but since they do not form part of the model's output they have been relegated to an 'Other methods' methodology section.
• Report on:

a. kg CO_2 per kWh heat & steam
b. kg CO_2e (from CH4) per kWh heat & steam
c. kg CO_2e (from N2O) per kWh heat & steam
d. kg CO_2e (Total direct) per kWh heat & steam
e. kg CO_2e (WTT) per kWh heat & steam

Implications

There have been a number of revisions to the output factors from this model, as a result of the upgrade and underlying data changes

2 ADDITION OF UREA IN HGVs AND BUSES MODELS

What and why?

Due to global concerns on the increase in the atmospheric concentration of greenhouse gases (GHG) and air quality pollutants, regulations have been implemented for the automotive industry to ensure new engines reduce their emissions of key GHG and air quality pollutants. NOx is one of the most harmful air quality pollutants, as it reacts with other gases in the atmosphere to form small particles and ozone.
A technology developed to enable manufacturers to meet diesel engine emissions standards for NOx is selective catalytic reduction (SCR). This uses a urea solution to effectively remove NOx and NO_2 from diesel engines exhaust gases; this process occurs over a specially formulated catalyst. Urea solution is a colourless liquid that is made from a mixture of high-purity urea (32.5%) and deionised water (67.5%) and is injected into the vehicle's exhaust system before harmful NOx emissions are generated from the tail pipe. When the fuel is burnt, urea solution is injected into the SCR catalyst to convert the NOx into a less harmful mixture of nitrogen and water vapour. In the SCR catalytic converter, the urea present becomes ammonia when heated, then reacts with the NOx and produce nitrogen, water and a small amount of carbon dioxide.

Implications

Emissions from the consumption of urea in heavy duty vehicles and buses is estimated in the conversion factors for the first time and are included in the estimates for overall CO_2 emission factors.

3 CHANGES TO OVERSEAS ELECTRICITY

What and why?

Conversion factors for transmission and distribution losses for overseas electricity use are no longer included in the conversion factors. These are now calculated and published by the IEA and as such are not duplicated here.

Implications

Users requiring these data should source the information directly from the IEA.

4 CHANGES TO MATERIALS AND WASTE

What and why?

Materials

Steel closed loop source

Key referenced for closed loop steel recycling has been updated, and the methodology has been improved. This more recent and improved data directly provides LCI emissions factors per kg of steel recycled, whereas these were previously derived based on emissions for different grades of recycled steel.

Construction and demolition metals closed loop source

The updated metals recycling factors for construction and demolition have been standardised using the updated closed loop steel recycling factor. The methodology has changed, and is now based directly on emissions from metals recycling; previously this had been based on published estimated savings from recycling metals.

Waste

Glass landfill / green and mixed organics composting

These factors had previously been taken directly from published studies that used a methodology different from that used for the other waste factors. The new factors are based on a standardised approach using data on transport emissions to and on site and MELMod factors for landfill emissions.

Implications

There have been a number of revisions to the output factors from this model, as a result of the upgrade and underlying data changes

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Version:	Date	Changes
1.00	31/05/2018	
1.01	08/06/2018	Added missing data for: Passenger vehicles / Cars (by market segment) / Executive / Plug-in Hybrid Electric Vehicle

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Index for navigation and sheet guide

Introduction		
Introduction	Goto	Introduction to the factors and guidance for novice users on how to calculate emissions using these factors.
Index	Goto	This sheet.
What's new	Goto	Guidance for repeat users on what has been updated over the previous year.
Scope 1 factors		
Fuels	Goto	Fuels conversion factors should be used for primary fuel sources combusted at a site or in an asset owned or controlled by the reporting organisation.
Bioenergy	Goto	Bioenergy conversion factors should be used for 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.
Refrigerant & other	Goto	Refrigerant and process conversion factors should be used for the purpose of reporting leakage from air-conditioning and refrigeration units or the release to the atmosphere of other gases that have a global warming potential.
Passenger vehicles	Goto	Passenger vehicles conversion factors should be used to report travel in cars and on motorcycles owned or controlled by the reporting organisation. This does not include vehicles owned by employees that are used for business purposes.
Scope 2 factors		
UK electricity	Goto	UK electricity conversion factors should be used to report on electricity used by an organisation at sites owned or controlled by them. This is reported as a Scope 2 (indirect) emission. The conversion factors in this listing are for the electricity supplied to the grid that organisations purchase - this does not include the emissions associated with the transmission and distribution of electricity.
UK electricity for EVs	Goto	UK electricity conversion factors for electric vehicles should be used to report on electricity used by an organisation at sites owned/controlled by them (where this is not already reported), or public recharging stations. This is reported as a Scope 2, indirect emission. The conversion factors in this listing are for the electricity supplied to the grid that organisations purchase (or from public charging stations) - they do not include the emissions associated with the transmission and distribution of electricity. **Care should be taken to avoid double counting with an organisation's general electricity consumption.**
Scope 3 factors		
Transmission and distribution	Goto	Transmission and distribution (T&D) conversion factors should be used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it)
UK electricity T&D for EVs	Goto	Transmission and distribution (T&D) factors for electric vehicles should be used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it).
Water supply	Goto	Water supply conversion factors should be used to account for water delivered through the mains supply network.
Water treatment	Goto	Water treatment conversion factors should be used for water returned to the sewage system through mains drains.
Material use	Goto	Material use conversion factors should be used to report on consumption of procured materials based on their origin (that is, comprised of primary material or recycled materials). For primary materials, these factors cover the extraction, primary processing, manufacture and transportation of materials to the point of sale, not the materials in use. For secondary materials, the factors cover sorting, processing, manufacture and transportation to the point of sale, not the materials in use. These factors are useful for reporting efficiencies gained through reduced procurement of material or the benefit of procuring items that are the product of a previous recycling process.
Waste disposal	Goto	Waste-disposal figures should be used for end-of-life disposal of different materials using a variety of different disposal methods.
Business travel- air	Goto	Air conversion factors should be used to report Scope 3 emissions for individuals flying for work purposes.
WTT- business travel- air	Goto	WTT business travel – air conversion factors should be used to account for the upstream Scope 3 emissions associated with extraction, refining and transportation of the aviation fuel to the plane before take-off.
Business travel- sea	Goto	Sea-based conversion factors should be used to report travel for business purposes on ferries.
Business travel- land	Goto	Land-based conversion factors should be used for travel for business purposes in assets not owned or directly operated by a business. This includes mileage for business purposes in, for example, cars owned by employees, public transport and hire cars.
Freighting goods	Goto	Freighting goods factors should be used specifically for the shipment of goods over land, by sea or by air through a third-party company. Factors are available for a whole vehicle's worth of goods or per tonne of goods shipped via a specific transport mode.
Managed assets- vehicles	Goto	Managed assets conversion factors for vehicles should be used to report emissions from vehicles that are used by a reporting organisation, but are not owned by them and generally do not appear on the organisation's balance sheet. The emissions from managed assets are reported as a Scope 3 emissions source.
Other		
Conversions	Goto	The conversion values should be used to change units of, for example, energy, mass and volume into alternative units. This is particularly useful where an organisation is collecting data in units of measure that do not have conversion factors that can be directly used to determine a carbon emission total.
Fuel properties	Goto	The fuel properties can be used to determine the typical calorific values/densities of most common fuels.

Fuels

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Emissions source:	Fuels	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 1	Version:	1.0	Year:	2018

Fuels conversion factors should be used for primary fuel sources combusted at a site or in an asset owned or controlled by the reporting organisation.

Guidance

● Gross calorific value (CV)/net CV basis - typically organisations should use gross CV for each kWh of energy reported (most energy billing is provided on a gross CV basis).

● 'Diesel (average biofuel blend)'/'diesel (100% mineral oil)' - typically organisations purchasing forecourt fuel should use 'diesel (average biofuel blend)'. It should be noted that any fuel an organisation reports in Scope 1 that has biofuel content must have the 'outside of scopes' portion reported separately as per the 'WBCSD/WRI GHG Protocol (chapter 9)'. See information about the outside of scopes emissions in the example section below.

● If any fuel type or unit has no result in the table, this is an indication the conversion factor is not available or does not exist (such as coal in litres).

Example of calculating emissions from fuels

Company A needs to report the Scope 1 emissions from its natural gas and diesel use.

● For natural gas consumption it selects a kWh conversion factor on a gross CV basis - this is the basis of most energy bills. It reports in CO_2e for all fuels combusted at its premises.

● It is faced with two different types of diesel conversion factors, *'100% mineral fuel'* and *'diesel (average biofuel blend)'*. Since it fills up its vehicles at a national chain of filling stations, it selects the average biofuel blend (this is the correct conversion factor for standard forecourt fuel, which contains a small blend of biofuel).

The activity data (that is, litres) is multiplied by the appropriate conversion factor to produce company A's fuel emissions.

Since company A is reporting a type of fuel that has biofuel content, it should also account for the 'biogenic' part of this fuel. To calculate this, it must also multiply the total litres of fuel used by the 'outside of scopes' fuel factor for 'forecourt fuels- diesel (average biofuel blend)' and report as a separate line item within its report called 'outside of scopes'. This will not be included in the organisation's emissions total, but displayed separately within the emissions report. This ensures that the organisation is being transparent with regard to all potential sources of CO_2 from its activities.

For more information refer to the 'Outside of scopes' tab for guidance.

Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Gaseous fuels	CNG	tonnes	2746.63	2741.56	3.63	1.44
		litres	0.48066	0.47977	0.00063	0.00025
		kWh (Net CV)	0.20437	0.20399	0.00027	0.00011
		kWh (Gross CV)	0.18396	0.18362	0.00024	0.00010
	LNG	tonnes	2746.63	2741.56	3.63	1.44
		litres	1.24282	1.24053	0.00164	0.00065
		kWh (Net CV)	0.20437	0.20399	0.00027	0.00011
		kWh (Gross CV)	0.18396	0.18362	0.00024	0.00010
	LPG	tonnes	2937.32	2933.41	2.00	1.91
		litres	1.51906	1.51703	0.00104	0.00099
		kWh (Net CV)	0.23030	0.22999	0.00016	0.00015
		kWh (Gross CV)	0.21448	0.21419	0.00015	0.00014
	Natural gas	tonnes	2746.63	2741.56	3.63	1.44
		cubic metres	2.04652	2.04275	0.00270	0.00107
		kWh (Net CV)	0.20437	0.20399	0.00027	0.00011
		kWh (Gross CV)	0.18396	0.18362	0.00024	0.00010
	Other petroleum gas	tonnes	2589.60	2587.04	1.17	1.39
		litres	0.94857	0.94764	0.00043	0.00051
		kWh (Net CV)	0.20005	0.19985	0.00009	0.00011
		kWh (Gross CV)	0.18404	0.18386	0.00008	0.00010

Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Liquid fuels	Aviation spirit	tonnes	3,213.91	3,127.67	56.45	29.80
		litres	2.28586	2.22451	0.04015	0.02119
		kWh (Net CV)	0.25698	0.25008	0.00451	0.00238
		kWh (Gross CV)	0.24413	0.23758	0.00429	0.00226
	Aviation turbine fuel	tonnes	3,181.15	3,149.67	1.69	29.80
		litres	2.53883	2.51370	0.00135	0.02378
		kWh (Net CV)	0.26072	0.25814	0.00014	0.00244
		kWh (Gross CV)	0.24768	0.24523	0.00013	0.00232
	Burning oil	tonnes	3,165.26	3,149.67	7.75	7.85
		litres	2.53627	2.52377	0.00621	0.00629
		kWh (Net CV)	0.25963	0.25835	0.00064	0.00064
		kWh (Gross CV)	0.24665	0.24544	0.00060	0.00061
	Diesel (average biofuel blend)	tonnes	3,132.15	3,087.27	0.50	44.38
		litres	2.62694	2.58935	0.00042	0.03717
		kWh (Net CV)	0.26349	0.25972	0.00004	0.00372
		kWh (Gross CV)	0.24768	0.24414	0.00004	0.00350
	Diesel (100% mineral diesel)	tonnes	3,209.22	3,164.33	0.50	44.38
		litres	2.68779	2.65020	0.00042	0.03717
		kWh (Net CV)	0.26910	0.26534	0.00004	0.00372
		kWh (Gross CV)	0.25296	0.24942	0.00004	0.00350
	Fuel oil	tonnes	3,228.84	3,216.99	4.10	7.75
		litres	3.17799	3.16633	0.00404	0.00763
		kWh (Net CV)	0.28544	0.28439	0.00036	0.00068
		kWh (Gross CV)	0.26831	0.26733	0.00034	0.00064
	Gas oil	tonnes	3,478.44	3,190.00	3.48	284.96
		litres	2.97049	2.72417	0.00298	0.24335
		kWh (Net CV)	0.29417	0.26978	0.00029	0.02410
		kWh (Gross CV)	0.27652	0.25359	0.00028	0.02265
	Lubricants	tonnes	3,182.00	3,171.09	3.23	7.69
		litres				
		kWh (Net CV)	0.28130	0.28033	0.00029	0.00068
		kWh (Gross CV)	0.26442	0.26351	0.00027	0.00064
	Naphtha	tonnes	3,142.87	3,131.33	3.41	8.13
		litres				
		kWh (Net CV)	0.24881	0.24790	0.00027	0.00064
		kWh (Gross CV)	0.23637	0.23550	0.00026	0.00061
	Petrol (average biofuel blend)	tonnes	3,002.28	2,983.62	9.45	9.22
		litres	2.20307	2.18943	0.00690	0.00674
		kWh (Net CV)	0.24607	0.24457	0.00076	0.00074
		kWh (Gross CV)	0.23377	0.23234	0.00072	0.00070
	Petrol (100% mineral petrol)	tonnes	3,153.66	3,135.00	9.45	9.22
		litres	2.30531	2.29167	0.00690	0.00674
		kWh (Net CV)	0.25349	0.25199	0.00076	0.00074
		kWh (Gross CV)	0.24082	0.23939	0.00072	0.00070
	Processed fuel oils - residual oil	tonnes	3,228.84	3,216.99	4.10	7.75
		litres	3.17799	3.16633	0.00404	0.00763
		kWh (Net CV)	0.28544	0.28439	0.00036	0.00068
		kWh (Gross CV)	0.26831	0.26733	0.00034	0.00064
	Processed fuel oils - distillate oil	tonnes	3,478.44	3,190.00	3.48	284.96
		litres	2.97049	2.72417	0.00298	0.24335
		kWh (Net CV)	0.29417	0.26978	0.00029	0.02410
		kWh (Gross CV)	0.27652	0.25359	0.00028	0.02265
	Refinery miscellaneous	tonnes	2,944.82	2,933.33	3.39	8.09
		litres				
		kWh (Net CV)	0.25911	0.25810	0.00030	0.00071
		kWh (Gross CV)	0.24615	0.24519	0.00028	0.00068
	Waste oils	tonnes	3,225.59	3,171.09	3.23	51.28
		litres				
		kWh (Net CV)	0.28515	0.28033	0.00029	0.00453
		kWh (Gross CV)	0.26804	0.26351	0.00027	0.00426
	Marine gas oil	tonnes	3,249.28	3,205.99	0.81	42.48
		litres	2.77479	2.73782	0.00070	0.03627
		kWh (Net CV)	0.27479	0.27113	0.00007	0.00359
		kWh (Gross CV)	0.25830	0.25486	0.00006	0.00338
	Marine fuel oil	tonnes	3,159.49	3,113.99	1.28	44.22
		litres	3.10973	3.06495	0.00126	0.04352
		kWh (Net CV)	0.27931	0.27529	0.00011	0.00391
		kWh (Gross CV)	0.26255	0.25877	0.00011	0.00367

Activity	Fuel	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Solid fuels	Coal (industrial)	tonnes	2,452.29	2,427.50	6.73	18.06
		kWh (Net CV)	0.34191	0.33846	0.00094	0.00252
		kWh (Gross CV)	0.32482	0.32153	0.00089	0.00239
	Coal (electricity generation)	tonnes	2,261.32	2,247.66	0.62	13.04
		kWh (Net CV)	0.32750	0.32552	0.00009	0.00189
		kWh (Gross CV)	0.31112	0.30924	0.00009	0.00179
	Coal (domestic)	tonnes	2,881.65	2,630.61	214.41	36.63
		kWh (Net CV)	0.36288	0.33127	0.02700	0.00461
		kWh (Gross CV)	0.34473	0.31470	0.02565	0.00438
	Coking coal	tonnes	3,064.56	3,043.79	7.45	13.32
		kWh (Net CV)	0.36483	0.36236	0.00089	0.00159
		kWh (Gross CV)	0.34659	0.34424	0.00084	0.00151
	Petroleum coke	tonnes	3,396.50	3,386.49	2.92	7.08
		kWh (Net CV)	0.35993	0.35887	0.00031	0.00075
		kWh (Gross CV)	0.34193	0.34092	0.00029	0.00071
	Coal (electricity generation - home produced coal only)	tonnes	2,261.32	2,247.66	0.62	13.04
		kWh (Net CV)	0.34028	0.33822	0.00009	0.00196
		kWh (Gross CV)	0.32326	0.32131	0.00009	0.00186

FAQs

I need a conversion factor for 'therms', how can I convert the kWh conversion factors to suit my needs?

We provide a specific conversion table at the back of these listings to allow organisations to convert the conversion factors into different units where required. Please see the **'Conversions'** tab.

I need a conversion factor for my specific % biofuel blend, rather than the "average biofuel blend" factor that is reported here.

The steps taken to calculate this by hand are straightforward and can be illustrated using the following worked example (consistent for all biofuels, conventional fuels, scopes and units):

Company B wants to report on its Scope 1 fuel emissions (in $kgCO_2e$/litre) from a specific biodiesel blend of X%. Using 2018 values, it is known that:

●100% mineral diesel conversion factor = 2.672 $kgCO_2e$/litre

●100% biodiesel conversion factor (see Bioenergy sheet) = 0.020 $kgCO_2e$/litre

Therefore, X% biodiesel blend conversion factor = (X% x 0.020) + [(1-X%) x 2.672]

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Bioenergy

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Emissions source:	Bioenergy	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 1	Version:	1.0	Year:	2018

Bioenergy conversion factors should be used for 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.

Guidance

● Within the Scope 1 conversion factors for biofuels, the CO_2 emissions value is set as net '0' to account for the CO_2 absorbed by fast-growing bioenergy sources during their growth. The Scope 1 conversion factors presented in this listing contain values for N_2O and CH_4 emissions (which are not absorbed during growth).

● Although the Scope 1 conversion factors contain a '0' value for CO_2 emissions, organisations must account for the impact of the CO_2 released through combustion of the fuel. Organisations should refer to the 'outside of scopes' listing in the 'outside of scopes' tab to find the true values for CO_2 emissions. These emissions should be calculated in the same way as the Scope 1 emissions, but should be listed as a separate line item within its report called 'outside of scopes'. This should not be included within the organisation's emissions total, but displayed separately within the emissions report. This ensures that the organisation is being transparent with regard to all potential sources of CO_2 from its activities.

For more information refer to the 'outside of scopes' tab for guidance.

Example of calculating emissions from bioenergy

Company B reports its emissions from standard biodiesel use in its delivery vehicles. It has data on how many litres have been consumed and it needs to publicly report its Scope 1 emissions.

The activity data (litres of fuel) is multiplied by the appropriate conversion factor to produce company B's Scope 1 biodiesel emissions.

Activity	Fuel	Unit	kg CO_2e
Biofuel	Bioethanol	litres	0.00887
		GJ	0.41670
		kg	0.01117
	Biodiesel	litres	0.03460
		GJ	1.04543
		kg	0.03889
	Biomethane	litres	
		GJ	0.10473
		kg	0.00513
	Biodiesel (from used cooking oil)	litres	0.03460
		GJ	1.04543
		kg	0.03889
	Biodiesel (from tallow)	litres	0.03460
		GJ	1.04543
		kg	0.03889

Activity	Fuel	Unit	kg CO_2e
Biomass	Wood logs	tonnes	61.52297
		kWh	0.01506
	Wood chips	tonnes	56.88051
		kWh	0.01506
	Wood pellets	tonnes	70.47328
		kWh	0.01506
	Grass/straw	tonnes	48.92418
		kWh	0.01314

Activity	Fuel	Unit	kg CO_2e
Biogas	Biogas	tonnes	1.22604
		kWh	0.00022
	Landfill gas	tonnes	0.69238
		kWh	0.00020

FAQs

I need a conversion factor for my specific % biofuel blend, rather than the "average biofuel blend" factor that is reported here.

The steps taken to calculate this by hand are straightforward and can be illustrated using the following worked example (consistent for all biofuels, conventional fuels, scopes and units):

Company B wants to report on its Scope 1 fuel emissions (in kgCO_2e/litre) from a specific biodiesel blend of X%. Using 2017 values, it is known that:
●100% mineral diesel conversion factor (see Fuels sheet) = 2.672 kgCO_2e/litre
●100% biodiesel conversion factor = 0.020 kgCO_2e/litre

Therefore, X% biodiesel blend conversion factor = (X% x 0.020) + [(1-X%) x 2.672]

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Refrigerant & other

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Emissions source:	Refrigerant & other	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 1	Version:	1.0	Year:	2018

Refrigerant and other conversion factors should be used for the purpose of reporting leakage from air-conditioning, refrigeration units or the release to the atmosphere of other gases that have global warming potential (GWP).

Guidance

- The refrigerants and gases in the table are slightly different to the other conversion factors because the gases emitted have a global warming influence themselves. The conversion factor allows the GWP of that gas to be expressed in terms of kilogrammes of carbon dioxide equivalent (kgCO_2e). This is slightly different to most of the factors where the emissions occur after combustion/use of the fuel/material. However, these conversions can be used in the normal way for reporting purposes.

- The Kyoto Protocol and Montreal Protocol listed gases are based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) over a 100-year period (this is a requirement for inventory/national reporting purposes) [1].

[1] From 01 Jan 2019, when the Kigali amendment comes into force, HFCs and HFC blends will be both Kyoto Protocol and Montreal Gases.

Example of calculating emissions from refrigerants and other process gases with a GWP

Each year, company D needs to report on the refrigerants that leak from its air-conditioning equipment (sometimes called fugitive emissions) at its headquarters. These are considered to be Scope 1 emissions. To calculate the leakage, Company D simply notes how much it has had to 'top-up' the refrigerant over the last year.

The 'top-up' data (in kg) is multiplied by the applicable conversion factor to the refrigerant type to produce company D's direct emissions from refrigerant.

Activity	Emission	Unit	kg CO_2e
Kyoto protocol - standard	Carbon dioxide	kg	1
	Methane	kg	25
	Nitrous oxide	kg	298
	HFC-23	kg	14800
	HFC-32	kg	675
	HFC-41	kg	92
	HFC-125	kg	3500
	HFC-134	kg	1100
	HFC-134a	kg	1430
	HFC-143	kg	353
	HFC-143a	kg	4470
	HFC-152a	kg	124
	HFC-227ea	kg	3220
	HFC-236fa	kg	9810
	HFC-245fa	kg	1030
	HFC-43-I0mee	kg	1640
	Perfluoromethane (PFC-14)	kg	7390
	Perfluoroethane (PFC-116)	kg	12200
	Perfluoropropane (PFC-218)	kg	8830
	Perfluorocyclobutane (PFC-318)	kg	10300
	Perfluorobutane (PFC-3-1-10)	kg	8860
	Perfluoropentane (PFC-4-1-12)	kg	9160
	Perfluorohexane (PFC-5-1-14)	kg	9300
	Sulphur hexafluoride (SF6)	kg	22800
	HFC-152	kg	53
	HFC-161	kg	12
	HFC-236cb	kg	1340
	HFC-236ea	kg	1370
	HFC-245ca	kg	693
	HFC-365mfc	kg	794

Activity	Emission	Unit	kg CO_2e
Kyoto protocol- blends	R404A	kg	3922
	R407A	kg	2107
	R407C	kg	1774
	R407F	kg	1825
	R408A	kg	3152
	R410A	kg	2088
	R507A	kg	3985
	R508B	kg	13396
	R403A	kg	3124

Activity	Emission	Unit	kg CO_2e
Montreal protocol - standard	CFC-11/R11 = trichlorofluoromethane	kg	4750
	CFC-12/R12 = dichlorodifluoromethane	kg	10900
	CFC-13	kg	14400
	CFC-113	kg	6130
	CFC-114	kg	10000
	CFC-115	kg	7370
	Halon-1211	kg	1890
	Halon-1301	kg	7140
	Halon-2402	kg	1640
	Carbon tetrachloride	kg	1400
	Methyl bromide	kg	5
	Methyl chloroform	kg	146
	HCFC-22/R22 = chlorodifluoromethane	kg	1810
	HCFC-123	kg	77
	HCFC-124	kg	609
	HCFC-141b	kg	725
	HCFC-142b	kg	2310
	HCFC-225ca	kg	122
	HCFC-225cb	kg	595
	HCFC-21	kg	151

Activity	Emission	Unit	kg CO_2e
Other perfluorinated gases	Nitrogen trifluoride	kg	17200
	PFC-9-1-18	kg	7500
	Trifluoromethyl sulphur pentafluoride	kg	17700
	Perfluorocyclopropane	kg	17340

Activity	Emission	Unit	kg CO_2e
Fluorinated ethers	HFE-125	kg	14900
	HFE-134	kg	6320
	HFE-143a	kg	756
	HCFE-235da2	kg	350
	HFE-245cb2	kg	708
	HFE-245fa2	kg	659
	HFE-254cb2	kg	359
	HFE-347mcc3	kg	575
	HFE-347pcf2	kg	580
	HFE-356pcc3	kg	110
	HFE-449sl (HFE-7100)	kg	297
	HFE-569sf2 (HFE-7200)	kg	59
	HFE-43-10pccc124 (H-Galden1040x)	kg	1870
	HFE-236ca12 (HG-10)	kg	2800
	HFE-338pcc13 (HG-01)	kg	1500

Activity	Emission	Unit	kg CO_2e
Other refrigerants	PFPMIE	kg	10300
	Dimethylether	kg	1
	Methylene chloride	kg	9
	Methyl chloride	kg	13
	R290 = propane	kg	3
	R600A = isobutane	kg	3
	R1234yf*	kg	< 1
	R1234ze*	kg	< 1

* There is no specific figure available, however it is known that the GWP factor is less than 1 kg CO_2e

Activity	Emission	Unit	kg CO_2e
Montreal protocol - blends	R406A	kg	1943
	R409A	kg	1585
	R502	kg	4657

FAQs

Is there any guidance to help me calculate the refrigerant leakage for my particular air conditioning system?

Further guidance on how to calculate refrigerant leakage is provided in Defra's 'Environmental reporting guidelines'.

Do I need to report all refrigerant types and gases with global warming potential in Scope 1?

No, only Kyoto Protocol gases need to be reported under Scope 1, all non-Kyoto gases (e.g. Montreal Protocol gases) should be reported separately.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Passenger vehicles

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Emissions source:	Passenger vehicles	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 1	Version:	1.0	Year:	2018

Passenger vehicles conversion factors should be used to 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.

Guidance

● For vehicles where an organisation has data in litres of fuel or kWh electricity consumed, the 'fuels' or 'electricity' conversion factors should be applied, which provide more accurate emissions results.

● For vehicles that run on biofuels, please refer to the 'bioenergy' conversion factors. It should be noted that any vehicle running on biofuel should also have an 'outside of scopes' CO_2 figure reported separately. See the 'Outside of scopes' tab for more detail on this.

● The market segment conversion factors related to the vehicle market segments specifically defined by the UK Society of Motor Manufacturers and Traders (SMMT).

● Where a vehicle is used by an organisation, but it isn't owned by the organisation, then the emissions from the vehicle can be reported in Scope 3 instead of Scope 1, using the same factors. These factors can also be found in the Scope 3 under 'Business travel-land' or 'managed assets- vehicles').

● For vehicles using electricity (i.e. Plug-in Hybrid Electric Vehicles / Range-Extended Electric Vehicles and Battery Electric Vehicles) the emission factors presented here only include the conventional fuel use (i.e. petrol or diesel), where relevant, and you should IN ADDITION use the emission factors provided in the 'UK electricity for EVs' and 'UK electricity T&D for EVs' tables to calculate the emissions due to the average electricity consumption.

● Please see the FAQs at the bottom of this page for further information on the conversion factors for passenger vehicles.

Example of calculating emissions from passenger vehicles

Company E reports the emissions from the mileage travelled in its company cars, a Scope 1 emission.
Company E uses conversion factors appropriate to each of its cars. For example, for its 1.6-litre diesel car, it uses a 'medium car: diesel' factor. It owns some vehicles for which engine size and fuel type data are not available, so it uses the 'average car: unknown fuel type' factor.

In some cases, the company knows what model the car is. In this case, it may choose to apply a conversion factor by market segment instead (found in the 'cars (by market segment)' table).

The activity data (km) is multiplied by the appropriate conversion factors to produce company E's passenger vehicle emissions.

			Diesel				Petrol				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by market segment)	Mini	km	0.11096	0.1091	0.00001	0.00185	0.14114	0.14039	0.00033	0.00042	0.14093	0.14017	0.00033	0.00043					0.0	0.0	0.0	0.0
		miles	0.17858	0.17558	0.00002	0.00298	0.22715	0.22594	0.00054	0.00067	0.22681	0.22559	0.00053	0.00069					0.0	0.0	0.0	0.0
	Supermini	km	0.13725	0.13539	0.00001	0.00185	0.15743	0.15668	0.00033	0.00042	0.1544	0.15348	0.00029	0.00063	0.02255	0.02245	0.00007	0.00003	0.0	0.0	0.0	0.0
		miles	0.22089	0.21789	0.00002	0.00298	0.25336	0.25215	0.00054	0.00067	0.24849	0.24701	0.00046	0.00102	0.0363	0.03613	0.00011	0.00006	0.0	0.0	0.0	0.0
	Lower medium	km	0.15048	0.14862	0.00001	0.00185	0.18284	0.18209	0.00033	0.00042	0.16669	0.16539	0.00017	0.00113	0.06675	0.06644	0.00021	0.0001	0.0	0.0	0.0	0.0
		miles	0.24217	0.23917	0.00002	0.00298	0.29425	0.29304	0.00054	0.00067	0.26828	0.26617	0.00028	0.00183	0.10742	0.10692	0.00033	0.00017	0.0	0.0	0.0	0.0
	Upper medium	km	0.16849	0.16663	0.00001	0.00185	0.20956	0.20881	0.00033	0.00042	0.17869	0.1771	0.00009	0.0015	0.07362	0.07326	0.00022	0.00014	0.0	0.0	0.0	0.0
		miles	0.27116	0.26816	0.00002	0.00298	0.33726	0.33605	0.00054	0.00067	0.28758	0.28502	0.00015	0.00241	0.11847	0.1179	0.00035	0.00022	0.0	0.0	0.0	0.0
	Executive	km	0.18125	0.17939	0.00001	0.00185	0.23952	0.23877	0.00033	0.00042	0.19502	0.19341	0.00009	0.00152	0.0868	0.0864	0.00027	0.00013				
		miles	0.2917	0.2887	0.00002	0.00298	0.38548	0.38427	0.00054	0.00067	0.31384	0.31126	0.00014	0.00244	0.1397	0.13905	0.00043	0.00022				
	Luxury	km	0.22177	0.21991	0.00001	0.00185	0.33702	0.33627	0.00033	0.00042	0.27753	0.2762	0.00017	0.00116	0.10494	0.10446	0.00032	0.00016	0.0	0.0	0.0	0.0
		miles	0.35691	0.35391	0.00002	0.00298	0.54238	0.54117	0.00054	0.00067	0.44664	0.4445	0.00027	0.00187	0.1689	0.16812	0.00052	0.00026	0.0	0.0	0.0	0.0
	Sports	km	0.17521	0.17335	0.00001	0.00185	0.24626	0.24551	0.00033	0.00042	0.23456	0.23363	0.00028	0.00065	0.0804	0.08003	0.00025	0.00012	0.0	0.0	0.0	0.0
		miles	0.28198	0.27898	0.00002	0.00298	0.39632	0.39511	0.00054	0.00067	0.37749	0.37599	0.00045	0.00105	0.12939	0.12879	0.0004	0.0002	0.0	0.0	0.0	0.0
	Dual purpose 4X4	km	0.21194	0.21008	0.00001	0.00185	0.24684	0.24609	0.00033	0.00042	0.21795	0.21627	0.00007	0.00161	0.07593	0.07558	0.00023	0.00012	0.0	0.0	0.0	0.0
		miles	0.34108	0.33808	0.00002	0.00298	0.39725	0.39604	0.00054	0.00067	0.35075	0.34805	0.00011	0.00259	0.1222	0.12163	0.00038	0.00019	0.0	0.0	0.0	0.0
	MPV	km	0.18452	0.18266	0.00001	0.00185	0.20096	0.20021	0.00033	0.00042	0.18945	0.18791	0.00011	0.00143					0.0	0.0	0.0	0.0
		miles	0.29696	0.29396	0.00002	0.00298	0.32342	0.32221	0.00054	0.00067	0.30487	0.30241	0.00017	0.00229					0.0	0.0	0.0	0.0

			Diesel				Petrol				Hybrid				CNG				LPG			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km	0.14533	0.14347	0.00001	0.00185	0.15565	0.1549	0.00033	0.00042	0.10957	0.10843	0.00022	0.00092								
		miles	0.23389	0.23089	0.00002	0.00298	0.25049	0.24928	0.00054	0.00067	0.17635	0.1745	0.00036	0.00149								
	Medium car	km	0.17353	0.17167	0.00001	0.00185	0.19386	0.19311	0.00033	0.00042	0.11538	0.11404	0.00017	0.00117	0.16324	0.16107	0.00167	0.0005	0.18217	0.18160	0.00007	0.00050
		miles	0.27927	0.27627	0.00002	0.00298	0.312	0.31079	0.00054	0.00067	0.18569	0.18354	0.00027	0.00188	0.26271	0.25922	0.00269	0.0008	0.29317	0.29226	0.00011	0.00080
	Large car	km	0.2152	0.21334	0.00001	0.00185	0.28411	0.28336	0.00033	0.00042	0.16134	0.15977	0.0001	0.00147	0.23851	0.23634	0.00167	0.0005	0.26704	0.26647	0.00007	0.00050
		miles	0.34634	0.34334	0.00002	0.00298	0.45723	0.45602	0.00054	0.00067	0.25964	0.25712	0.00016	0.00236	0.38385	0.38036	0.00269	0.0008	0.42975	0.42884	0.00011	0.00080
	Average car	km	0.17753	0.17567	0.00001	0.00185	0.18368	0.18293	0.00033	0.00042	0.12568	0.12438	0.00017	0.00113	0.17925	0.17708	0.00167	0.0005	0.20022	0.19965	0.00007	0.00050
		miles	0.28572	0.28272	0.00002	0.00298	0.29561	0.2944	0.00054	0.00067	0.20227	0.20017	0.00028	0.00182	0.28847	0.28498	0.00269	0.0008	0.32222	0.32131	0.00011	0.00080

			Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km	0.15201	0.15087	0.00023	0.00092	0.02255	0.02245	0.00007	0.00003	0.0	0.0	0.0	0.0
		miles	0.24465	0.24280	0.00036	0.00149	0.03630	0.03613	0.00011	0.00006	0.0	0.0	0.0	0.0
	Medium car	km	0.18327	0.18193	0.00016	0.00117	0.07120	0.07086	0.00021	0.00013	0.0	0.0	0.0	0.0
		miles	0.29494	0.29279	0.00027	0.00188	0.11457	0.11403	0.00034	0.00020	0.0	0.0	0.0	0.0
	Large car	km	0.23373	0.23216	0.00010	0.00147	0.07717	0.07681	0.00024	0.00012	0.0	0.0	0.0	0.0
		miles	0.37615	0.37363	0.00016	0.00236	0.12418	0.12361	0.00038	0.00019	0.0	0.0	0.0	0.0
	Average car	km	0.18064	0.17934	0.00017	0.00113	0.07096	0.07062	0.00022	0.00012	0.0	0.0	0.0	0.0
		miles	0.29072	0.28862	0.00028	0.00182	0.11419	0.11365	0.00035	0.00019	0.0	0.0	0.0	0.0

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Motorbike	Small	km	0.08463	0.08248	0.00185	0.0003
		miles	0.1362	0.13274	0.00298	0.00048
	Medium	km	0.1031	0.10012	0.00238	0.0006
		miles	0.16594	0.16114	0.00383	0.00097
	Large	km	0.13528	0.1332	0.00149	0.0006
		miles	0.21771	0.21436	0.00238	0.00097
	Average	km	0.11529	0.11279	0.00191	0.00059
		miles	0.18553	0.18151	0.00307	0.00095

FAQs

Do the conversion factors take into account the age of vehicles?

The conversion factors are based on information from the Department for Transport which regularly analyses the mix of cars on the road in the UK through Driver and Vehicle Licensing Agency (DVLA) records and automatic number plate recognition (ANPR) data. The conversion factors are updated each year to reflect changes in the spectrum of cars of different types and ages being driven.

I know the average fuel consumption of my passenger vehicles in miles per gallon (mpg) and mileage; can this be used to improve my calculations?

The mpg of the vehicle should be used to convert the distance travelled into litres of fuel used (refer to the 'conversions' listing to find values to assist this calculation). The conversion factor for litres of fuel can then be applied. This will give a more accurate view of the actual emissions from the vehicle (the conversion factors for vehicle mileage represent the average mpg of the whole UK vehicle population). Therefore, knowing your vehicle's actual mpg and using this value will yield more precise results.

I know the average gCO_2/km of my passenger vehicles as well as mileage; can this be used to improve my calculations?

If you know the manufacturer's gCO_2/km data, this may be used as an alternative (and more precise) calculation for your passenger vehicle's emissions. The factors provided by manufacturers should be uplifted. Please see the methodology paper on the correct uplift factor to use.

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?

Method 1: Energy consumption

Emissions = Total energy consumption (fuel, electricity) x Emission Factors (fuel, electricity)

	Scope	Car	Car	Van	Van	Includes
		Plug-in Hybrid Electric Vehicle	Battery Electric Vehicle	Plug-in Hybrid Electric Vehicle	Battery Electric Vehicle	
Fuels	Scope 1	YES	NO	YES	NO	Scope 1 emissions from use of petrol or diesel.
WTT- fuels	Scope 3	YES	NO	YES	NO	WTT Scope 3 emissions from use of petrol and diesel.
UK Electricity	Scope 2	YES	YES	YES	YES	Scope 2 emissions from use of electricity.
Transmission and distribution	Scope 3	YES	YES	YES	YES	Scope 3 emissions from T&D losses from use of electricity.
WTT- UK & overseas elec	Scope 3	YES	YES	YES	YES	Scope 3 emissions from WTT emissions from use of electricity.

Method 2: Generic vehicle emission factors

Emissions = Total activity for vehicle category (in km, miles or tonne-km) x Emission Factor

***Note:* the emission factors already account for the average share of driving using electricity or conventional fuel for plug-in hybrid electric vehicles, so the total number of km / miles / tonne-km should be used in calculations.**

Sum of elements: **A + C** *OR* **B + C**

		Scope	Car	Car	Van	Van	Includes
			Plug-in Hybrid Electric Vehicle	Battery Electric Vehicle	Plug-in Hybrid Electric Vehicle	Battery Electric Vehicle	
A	Passenger vehicles	Scope 1	YES	NO			Only Scope 1 emissions from petrol or diesel use.
A	Delivery vehicles	Scope 1			YES	NO	Only Scope 1 emissions from petrol or diesel use.
A	UK electricity for EVs	Scope 2	YES	YES	YES	YES	Only Scope 2 emissions from electricity use.
A	UK electricity T&D for EVs	Scope 3	YES	YES	YES	YES	Only Scope 3 emissions from electricity T&D losses.
	OR						
B	Business travel- land	Scope 3	YES	YES			Sum of Scope 1 and Scope 2, plus Scope 3 electricity T&D losses.
B	Freighting goods	Scope 3			YES	YES	Sum of Scope 1 and Scope 2, plus Scope 3 electricity T&D losses.
B	Managed assets- vehicles	Scope 3	YES	YES	YES	YES	Sum of Scope 1 and Scope 2, plus Scope 3 electricity T&D losses.
	AND						
C	WTT- pass vehs & travel- land	Scope 3	YES	YES			Only Scope 3 WTT emissions (all fuel types, electricity)
C	WTT- delivery vehs & freight	Scope 3			YES	YES	Only Scope 3 WTT emissions (all fuel types, electricity)

Note: The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?

At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

UK electricity

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Emissions source:	UK electricity	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 2	**Version:**	1.0	**Year:**	2018

UK electricity conversion factors should be used to report on electricity used by an organisation at sites owned/controlled by them. This is reported as a Scope 2, indirect emission. The conversion factors in this listing are for the electricity supplied to the grid that organisations purchase - they do not include the emissions associated with the transmission and distribution of electricity.

Guidance

- The year displayed alongside the electricity factors is the reporting year for which users should apply these factors. This is based on a calendar reporting year.
- We advise that organisations also account for the transmission and distribution (T&D) losses of the electricity they purchase, which occur between the power station and their site(s). They should do so using the 'transmission and distribution' factors for UK electricity. The emissions from T&D should be accounted for in Scope 3.
- Organisations that generate renewable energy or purchase green energy should refer to Annex G of Defra's 'Environmental reporting guidelines' for information on how to account for their electricity use.
- If an organisation voluntarily reports the electricity used at a site/for an asset in its supply chain that is not directly under its ownership or control, it may report this electricity in Scope 3. A duplicate set of conversion factors have been provided for this purpose in the Scope 3 listing, under 'managed assets- electricity'.

Why has the electricity factor changed?

The UK electricity factor is prone to fluctuate from year to year as the fuel mix consumed in UK power stations (and auto-generators) and the proportion of net imported electricity 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. Given the importance of this factor, the explanation for fluctuations will be presented here henceforth.

In the 2017 GHG Conversion Factors, there was a 15% decrease in the UK electricity CO_2e factor compared to the previous year because there was a decrease in coal generation, and an increase in gas and renewables generation, in 2015 (the inventory year for which the 2017 GHG Conversion Factor was derived). In this 2018 update, the CO_2e factor has decreased again (compared with 2017) by 19% due to a decrease in coal generation and an increase mainly in natural gas and to a much lower extend renewable generation.

Example of calculating emissions from UK electricity

Company G reports the emissions from the electricity it uses, which can be found by reading its electricity meters or gathering data from utility bills.
The kWh electricity use is multiplied by the 'electricity generated' figure appropriate to the reporting year to produce company G's UK Scope 2 electricity emissions.

Activity	Country	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Electricity generated	Electricity: UK	kWh	2018	0.28307	0.28088	0.00066	0.00153

FAQs

I am not publishing a company report, but I need a factor for 'electricity consumption' instead of 'electricity generation' what should I do?

For company reporting purposes, organisations should use the 'electricity generation' figures for Scope 2 electricity and may use the 'T&D' factors for reporting Scope 3 losses. However, for other reporting contexts (where specific scopes do not need to be reported) the 'electricity consumption' figure can be calculated by adding together the 'electricity generation' and the 'T&D' values within each year.

What factor do I need for my CRC Energy Efficiency Scheme (CRC) reporting?

CRC reporting is now aligned with UK Government GHG Conversion Factors for Company Reporting. You should use the 'UK electricity generation CO_2 only' factor which needs to be added to the 'CO_2 only T&D- UK electricity' factor to get the overall factor that should be used for CRC reporting.

I previously used a 5-year grid rolling average factors. These factors are based on 1-year average factors and look quite different, what should I do?

Please refer to the 'What's new in 2013' section of the 'What's new' tab of the 2013 GHG Conversion factors spreadsheet for full instructions on how to rebaseline your data to compensate for the changes made.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

UK electricity for EVs

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Emissions source:	UK electricity for EVs	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 2	Version:	1.0	Year:	2018

UK electricity conversion factors for electric vehicles should be used to report on electricity used by an organisation at sites owned/controlled by them (where this is not already reported), or public recharging stations. This is reported as a Scope 2, indirect emission. The conversion factors in this listing are for the electricity supplied to the grid that organisations purchase (or from public charging stations) - they do not include the emissions associated with the transmission and distribution of electricity.
Care should be taken to avoid double counting with an organisation's general electricity consumption.

Guidance

● We advise that organisations also account for the transmission and distribution (T&D) losses of the electricity used by electric vehicles, which occur between the power station and their site(s)/public recharging points. They should do so using the 'UK electricity T&D for EVs' factors for UK electricity. The emissions from T&D should be accounted for in Scope 3.

● Organisations that generate renewable energy or purchase green energy should refer to Annex G of Defra's 'Environmental reporting guidelines' for information on how to account for their electricity use.

● If an organisation voluntarily reports the electricity used at a site/for an asset in its supply chain that is not directly under its ownership or control, it may report this electricity in Scope 3. The Scope 3 conversion factors in 'Managed assets- vehicles' include the electricity consumption (as well as all other emission components) of plug-in electric vehicles.

● To avoid double-counting of emissions, do not include activity/emissions resulting from the use of plug-in electric vehicles that are charged predominantly on your organisation's premises if you are also already reporting the emissions resulting from your electricity consumed there.

● Please see the FAQs at the bottom of this page for further information on the conversion factors for electric vehicles.

Example of calculating emissions from UK electricity for electric vehicles (EVs)

Company E reports the emissions from the mileage travelled in its plug-in electric company cars, which will include a Scope 2 emission (as well as a Scope 1 emission for plug-in hybrid electric vehicles).

Company E uses conversion factors appropriate to each of its cars. For example, for its medium sized battery electric car, it uses a 'medium car: Battery Electric Vehicle' factor. It also owns some plug-in hybrid electric vehicles for which it is not sure on the appropriate size category, so it uses the 'average car: plug-in hybrid electric vehicle' factor.

In some cases, the company knows what model the car is. In this case, it may choose to apply a conversion factor by market segment instead (found in the 'cars (by market segment)' table).
The activity data (km or miles) is multiplied by the appropriate conversion factors to produce company E's passenger vehicle Scope 2 emissions. The company also needs to calculate the Scope 1 emissions due to the use of petrol and diesel in its plug-in hybrid electric vehicles, so it uses the conversion factors also provided in the 'Passenger vehicles' and 'Delivery vehicles' tables for this.

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by market segment)	Mini	km					0.05311	0.05270	0.00012	0.00029
		miles					0.08548	0.08482	0.00020	0.00046
	Supermini	km	0.04368	0.04334	0.00010	0.00024	0.04815	0.04778	0.00011	0.00026
		miles	0.07029	0.06975	0.00016	0.00038	0.07750	0.07690	0.00018	0.00042
	Lower medium	km	0.03581	0.03554	0.00008	0.00019	0.05898	0.05852	0.00014	0.00032
		miles	0.05763	0.05719	0.00013	0.00031	0.09491	0.09418	0.00022	0.00051
	Upper medium	km	0.04130	0.04098	0.00010	0.00022	0.04756	0.04719	0.00011	0.00026
		miles	0.06646	0.06595	0.00015	0.00036	0.07653	0.07594	0.00018	0.00041
	Executive	km	0.04275	0.04242	0.00010	0.00023				
		miles	0.06880	0.06827	0.00016	0.00037				
	Luxury	km	0.05054	0.05015	0.00012	0.00027	0.07173	0.07117	0.00017	0.00039
		miles	0.08135	0.08072	0.00019	0.00044	0.11544	0.11455	0.00027	0.00062
	Sports	km	0.03996	0.03965	0.00009	0.00022	0.09154	0.09084	0.00021	0.00049
		miles	0.06432	0.06382	0.00015	0.00035	0.14733	0.14619	0.00034	0.00080
	Dual purpose 4X4	km	0.04916	0.04878	0.00011	0.00027	0.08205	0.08142	0.00019	0.00044
		miles	0.07911	0.07850	0.00018	0.00043	0.13206	0.13104	0.00031	0.00071
	MPV	km					0.06536	0.06486	0.00015	0.00035
		miles					0.10520	0.10438	0.00025	0.00057

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km	0.04368	0.04334	0.00010	0.00024	0.05033	0.04994	0.00012	0.00027
		miles	0.07029	0.06975	0.00016	0.00038	0.08100	0.08037	0.00019	0.00044
	Medium car	km	0.03936	0.03906	0.00009	0.00021	0.05893	0.05847	0.00014	0.00032
		miles	0.06335	0.06286	0.00015	0.00034	0.09483	0.09410	0.00022	0.00051
	Large car	km	0.04869	0.04832	0.00011	0.00026	0.07191	0.07135	0.00017	0.00039
		miles	0.07836	0.07776	0.00018	0.00042	0.11573	0.11483	0.00027	0.00063
	Average car	km	0.04531	0.04496	0.00011	0.00024	0.05993	0.05947	0.00014	0.00032
		miles	0.07292	0.07236	0.00017	0.00039	0.09644	0.09570	0.00022	0.00052

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Vans	Class I (up to 1.305 tonnes)	tonne.km					0.30342	0.30107	0.00071	0.00164
		km					0.04641	0.04605	0.00011	0.00025
		miles					0.07469	0.07411	0.00018	0.00040
	Class II (1.305 to 1.74 tonnes)	tonne.km					0.31693	0.31448	0.00074	0.00171
		km					0.06366	0.06317	0.00015	0.00034
		miles					0.10245	0.10166	0.00024	0.00055
	Class III (1.74 to 3.5 tonnes)	tonne.km					0.31137	0.30896	0.00073	0.00168
		km					0.09369	0.09296	0.00022	0.00051
		miles					0.15077	0.14960	0.00035	0.00082
	Average (up to 3.5 tonnes)	tonne.km					0.31681	0.31436	0.00074	0.00171
		km					0.06381	0.06332	0.00015	0.00034
		miles					0.10269	0.10190	0.00024	0.00055

FAQs

I am not publishing a company report, but I need a factor for 'electricity consumption' instead of 'electricity generation' for my electric vehicles what should I do?
For company reporting purposes, organisations should use the 'electricity generation' figures for Scope 2 electricity and may use the 'T&D' factors for reporting Scope 3 losses. However, for other reporting contexts (where specific scopes do not need to be reported) the 'electricity consumption' figure can be calculated by adding together the 'electricity generation' (from 'UK electricity for EVs') and the 'T&D' values (from 'UK electricity T&D for EVs') within each year.

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?
Please refer to the 'Passenger vehicles' FAQ for tables providing this information.

What emission factors to I use for range-extended electric vehicles?
The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?
At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Transmission and distribution

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Emissions source:	Transmission and distribution	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Transmission and distribution (T&D) factors should be used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it).

Guidance

● To account for electricity emissions fully, organisations should account for the T&D loss associated with its purchased power.

● The year displayed alongside the T&D factors is the reporting year for which users should apply these factors. This is based on a calendar reporting year.

● Transmission and distribution losses are no longer published for overseas electricity, since these are now calculated and published by the IEA.

Calculating emissions from T&D

Company H reports the emissions from T&D losses associated with its electricity use - this is a Scope 3 emission.

For every kWh of electricity company H purchases, it reports its associated energy losses using the T&D factor for that year.

Every kWh company H uses is multiplied by the appropriate T&D conversion factor to produce its Scope 3 T&D emissions impact.

Activity	Type	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
T&D- UK electricity	Electricity: UK	kWh	2018	0.02413	0.02394	0.00006	0.00013

Activity	Type	Unit	Year	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Distribution - district heat & steam	5% loss	kWh	2018	0.00987	0.00980	0.00003	0.00003

FAQs

Is reporting T&D compulsory?

As with other Scope 3 impacts, reporting T&D is voluntary. However, it is considered best practice for UK reporting.

I am not publishing a company report, but I need a factor for ‘electricity consumption’. What should I do?

For company reporting purposes, organisations should use the ‘electricity generation’ figures for Scope 2 electricity and may use the ‘T&D’ factors for reporting Scope 3 losses. However, for other reporting contexts (where specific scopes do not need to be reported) the ‘electricity consumption’ figure (as published in 2011 and 2012 conversion factors) can be calculated by adding together the ‘electricity generation’ and ‘T&D’ values within each year for each country.

What factor do I need for my CRC Energy Efficiency Scheme (CRC) reporting?

CRC reporting is now aligned with UK Government GHG Conversion Factors for Company Reporting. You should use the 'UK electricity generation CO_2 only' factor, which needs to be added to the 'CO_2 only T&D- UK electricity' factor to get the overall factor that should be used for CRC reporting.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

UK electricity T&D for EVs

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Emissions source:	UK electricity T&D for EVs	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 3	Version:	1.0	Year:	2018

Transmission and distribution (T&D) factors for electric vehicles should be used to report the Scope 3 emissions associated with grid losses (the energy loss that occurs in getting the electricity from the power plant to the organisations that purchase it).

Guidance

- To account for electricity emissions from electric vehicles fully, organisations should account for the T&D loss associated with the electricity used to charge them.
- To avoid double-counting of electricity T&D emissions, do not include activity/emissions resulting from the use of plug-in electric vehicles that are charged predominantly on your organisation's premises if you are also already reporting the

Calculating emissions from T&D

Company E reports the emissions from T&D losses associated with the mileage travelled in its plug-in electric company cars, which will include a Scope 3 emission.
Company E uses conversion factors appropriate to each of its cars. For example, for its medium sized battery electric car, it uses a 'medium car: Battery Electric Vehicle' factor. It also owns some plug-in hybrid electric vehicles for which it is not sure
In some cases, the company knows what model the car is. In this case, it may choose to apply a conversion factor by market segment instead (found in the 'cars (by market segment)' table).
The activity data (km or miles) is multiplied by the appropriate conversion factors to produce company E's passenger vehicle Scope 3 emissions for the electricity T&D lossess associated with its electric vehicles.

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by market segment)	Mini	km					0.00452	0.00449	0.00001	0.00002
		miles	0.00000				0.00729	0.00723	0.00002	0.00004
	Supermini	km	0.00372	0.00369	0.00001	0.00002	0.00410	0.00407	0.00001	0.00002
		miles	0.00598	0.00594	0.00001	0.00003	0.00661	0.00655	0.00002	0.00004
	Lower medium	km	0.00306	0.00303	0.00001	0.00002	0.00503	0.00499	0.00001	0.00003
		miles	0.00491	0.00487	0.00001	0.00003	0.00809	0.00803	0.00002	0.00004
	Upper medium	km	0.00352	0.00349	0.00001	0.00002	0.00405	0.00402	0.00001	0.00002
		miles	0.00566	0.00562	0.00001	0.00003	0.00653	0.00647	0.00002	0.00004
	Executive	km	0.00365	0.00362	0.00001	0.00002	0.00000			
		miles	0.00586	0.00582	0.00001	0.00003	0.00000			
	Luxury	km	0.00430	0.00427	0.00001	0.00002	0.00612	0.00607	0.00002	0.00003
		miles	0.00694	0.00688	0.00002	0.00004	0.00983	0.00976	0.00002	0.00005
	Sports	km	0.00341	0.00338	0.00001	0.00002	0.00780	0.00774	0.00002	0.00004
		miles	0.00548	0.00544	0.00001	0.00003	0.01256	0.01246	0.00003	0.00007
	Dual purpose 4X4	km	0.00419	0.00416	0.00001	0.00002	0.00700	0.00694	0.00002	0.00004
		miles	0.00675	0.00669	0.00002	0.00004	0.01126	0.01117	0.00003	0.00006
	MPV	km	0.00000				0.00557	0.00553	0.00001	0.00003
		miles	0.00000				0.00897	0.00890	0.00002	0.00005

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km	0.00372	0.00369	0.00001	0.00002	0.00429	0.00426	0.00001	0.00002
		miles	0.00598	0.00594	0.00001	0.00003	0.00691	0.00685	0.00002	0.00004
	Medium car	km	0.00336	0.00333	0.00001	0.00002	0.00502	0.00498	0.00001	0.00003
		miles	0.00540	0.00536	0.00001	0.00003	0.00808	0.00802	0.00002	0.00004
	Large car	km	0.00415	0.00412	0.00001	0.00002	0.00613	0.00608	0.00002	0.00003
		miles	0.00669	0.00663	0.00002	0.00004	0.00986	0.00979	0.00002	0.00005
	Average car	km	0.00386	0.00383	0.00001	0.00002	0.00511	0.00507	0.00001	0.00003
		miles	0.00622	0.00617	0.00002	0.00003	0.00822	0.00816	0.00002	0.00004

			Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Vans	Class I (up to 1.305 tonnes)	tonne.km					0.02586	0.02566	0.00006	0.00014
		km					0.00395	0.00392	0.00001	0.00002
		miles					0.00636	0.00631	0.00002	0.00003
	Class II (1.305 to 1.74 tonnes)	tonne.km					0.02702	0.02680	0.00007	0.00015
		km					0.00542	0.00538	0.00001	0.00003
		miles					0.00873	0.00866	0.00002	0.00005
	Class III (1.74 to 3.5 tonnes)	tonne.km					0.02654	0.02633	0.00007	0.00014
		km					0.00798	0.00792	0.00002	0.00004
		miles					0.01284	0.01275	0.00003	0.00006
	Average (up to 3.5 tonnes)	tonne.km					0.02701	0.02679	0.00007	0.00015
		km					0.00544	0.00540	0.00001	0.00003
		miles					0.00876	0.00869	0.00002	0.00005

FAQs

Is reporting T&D compulsory?

As with other Scope 3 impacts, reporting T&D for EVs is voluntary. However, it is considered best practice for UK reporting.

I am not publishing a company report, but I need a factor for 'electricity consumption'. What should I do?

For company reporting purposes, organisations should use the 'electricity generation' figures for Scope 2 electricity and may use the 'T&D' factors for reporting Scope 3 losses. However, for other reporting contexts (where specific scopes do not need to be reported) the 'electricity consumption' figure can be calculated by adding together the 'electricity generation' (from 'UK electricity for EVs') and the 'T&D' values (from 'UK electricity T&D for EVs') within each year.

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?

Please refer to the 'Passenger vehicles' FAQ for tables providing this information.

What emission factors to I use for range-extended electric vehicles?
The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?
At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Water supply

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Emissions source:	Water supply	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Water supply conversion factors should be used to account for water delivered through the mains supply network.

Guidance

- To provide a full picture of your Scope 3 water emissions, you should also refer to the 'Water treatment' tab as both portions, supply and treatment, should be reported on for water.

Example of calculating emissions from water supply

Company J reports its emissions from mains water, a Scope 3 emissions source. It gathers data from its utility bills and water meters.

Company J multiplies the water used (cubic metres (m^3)) by the appropriate year's conversion factor called 'water supply' to produce its emissions.

Activity	Type	Unit	kg CO_2e
Water supply	Water supply	cubic metres	0.344
		million litres	344.0

For information about how the conversion factors have been derived, please refer to the Methodology paper' that accompanies the conversion factors.

Water treatment

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Emissions source:	Water treatment	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Water treatment conversion factors should be used for water returned into the sewage system through mains drains.

Guidance

- To provide a full picture of your Scope 3 water emissions, you should also refer to the 'Water supply' listing as both portions, supply and treatment, should be reported on for water.

Example of calculating emissions from water treatment

Company J report its emissions from mains water treatment, a Scope 3 emissions source. It gathers data from its utility bills.
Company J multiplies the volume of water disposed of via the drains (in cubic metres (m^3)) by the appropriate year's conversion factor called 'water treatment' to produce its emissions.

Activity	Type	Unit	kg CO_2e
Water treatment	Water treatment	cubic metres	0.708
		million litres	708.0

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Material use

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Emissions source:	Material use	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 3	Version:	1.0	Year:	2018

Material use conversion factors should be used to report on consumption of procured materials based on their origin (that is, comprised of primary material or recycled materials). For primary materials, these factors cover the extraction, primary processing, manufacturing and transporting materials to the point of sale, not the materials in use. For secondary materials, the factors cover sorting, processing, manufacturing and transporting to the point of sale, not the materials in use. These factors are useful for reporting efficiencies gained through reduced procurement of material or the benefit of procuring items that are the product of a previous recycling process.

Guidance

- To calculate the emissions from procured materials made from a variety of materials, the emissions may be added up and should be apportioned by the required weights of each material.
- These factors cannot be used to determine the relative merit of different recycling or waste management options.
- All of the factors in the tables are positive numbers, because these figures do not consider avoided burdens. They account for 'cradle-to-gate' emissions. Therefore, the recycled material values (which, in some cases, could be negative values) do not include avoided emissions from not using primary materials.

IMPORTANT: These data are intended ONLY for use in preparing and submitting company GHG reports. They are not suitable for assessing or comparing the impacts of different waste management options.

Example of calculating material use emissions

Company K reports its emissions from purchasing steel cans made from primary metals (to be filled with a product and sold). At a separate site, company K wishes to report the emissions from purchasing metals that are the product of a previous closed-loop recycling process (also to be filled with a product and sold). For the procurement of cans that have been newly manufactured, it selects the 'metal steel cans' material type and selects the 'primary material production' conversion factor. For the procurement of cans that are made from second-generation metals that have already been recycled, it selects the 'metal steel cans' row and the 'closed-loop' conversion factor. The carbon benefits of procuring the second generation metals quickly becomes clear.

The activity data for each site (tonnes of metal procured) are multiplied by the relevant conversion factor to produce company K's Scope 3 procured material emissions.

			Primary material production	Re-used	Open-loop source	Closed-loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Construction	Aggregates	tonnes	7.8123	2.21	3.2292	3.2292
	Average construction	tonnes	69.3242		6.0291	
	Asbestos	tonnes	27			
	Asphalt	tonnes	39.2125	1.7383		28.6892
	Bricks	tonnes	241.8123		3.2292	
	Concrete	tonnes	131.8123		3.2292	3.2292
	Insulation	tonnes	1861.8123			1852.1422
	Metals	tonnes	4305.3067			1781.806
	Soils	tonnes				1.0192
	Mineral oil	tonnes	1401			676
	Plasterboard	tonnes	120.05			32.17
	Tyres	tonnes	3335.5719	731.2179	308.4002	
	Wood	tonnes	416.1972	38.6462	259.2227	93.9837

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Other	Books	tonnes	955.6535			795.4032
	Glass	tonnes	895		19	529
	Clothing	tonnes	22310	152.25	152.25	
	Food and drink	tonnes	4060.1636			

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Organic	Compost derived from garden waste	tonnes	16			
	Compost derived from food and garden waste	tonnes	16.9118			

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Electrical items	WEEE - fridges and freezers	tonnes	3814.3675			
	WEEE - large	tonnes	537.2419			
	WEEE - mixed	tonnes	1148.421			
	WEEE - small	tonnes	1759.6002			
	Batteries	tonnes	12094.2797			

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Metal	Metal: aluminium cans and foil (excl. forming)	tonnes	12873.608			3012.5707
	Metal: mixed cans	tonnes	6556.808			2191.6352
	Metal: scrap metal	tonnes	3829.5038			1762.8181
	Metal: steel cans	tonnes	3003.608			1729.8589

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Plastic	Plastics: average plastics	tonnes	3119.0225		656.607	2301.7403
	Plastics: average plastic film	tonnes	2577.1364		604.3039	1775.3704
	Plastics: average plastic rigid	tonnes	3186.3635		604.3039	2492.4999
	Plastics: HDPE (incl. forming)	tonnes	3180.3494		604.3039	2157.0453
	Plastics: LDPE and LLDPE (incl. forming)	tonnes	2603.608		604.3039	1775.3704
	Plastics: PET (incl. forming)	tonnes	4055.8519		604.3039	3188.5478
	Plastics: PP (incl. forming)	tonnes	3075.2358		604.3039	2486.9982
	Plastics: PS (incl. forming)	tonnes	3780.9205		1650.3656	3178.8031
	Plastics: PVC (incl. forming)	tonnes	3416.0558		604.3039	2467.8182

			Primary material production	Re-used	Open-loop source	Closed loop source
Activity	Material	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e
Paper	Paper and board: board	tonnes	844.4816			795.4032
	Paper and board: mixed	tonnes	872.2746			795.4032
	Paper and board: paper	tonnes	955.6535			795.4032

FAQs

Can I use these factor for my waste?

No, these factors are not appropriate. For specific end-of-life figures, please see the 'Waste disposal' tab.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Waste disposal

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Emissions source:	Waste disposal	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 3	Version:	1.0	Year:	2018

Waste disposal figures should be used for end-of-life disposal of different materials using a variety of different disposal methods.

Guidance

- To calculate the emissions from multiple waste streams, the emissions sub totals may be added up.
- These factors cannot be used to determine the relative lifecycle merit of different waste management options. This is because the benefits of energy recovery and recycling are attributed to the user of the recycled materials, not the producer of the waste, in line with GHG Protocol Guidelines.
- For landfill, the factors in the tables include collection, transportion and landfill emissions ('gate to grave'). For combustion and recycling, the factors consider transport to an energy recovery or materials reclamation facility only. This is in line with GHG Protocol Guidelines, with subsequent emissions attributed to electricity generation or recycled material production respectively.

IMPORTANT: These data are intended ONLY for use in preparing and submitting company GHG reports. They are not suitable for assessing or comparing the impacts of different waste management options.

Example of calculating emissions from waste disposal

Company K sends 0.5 tonnes of food waste to landfill each year, but has a white paper recycling scheme in place.

To calculate the emissions from the food waste, it selects the 'organic: food and drink waste'category and the appropriate 'landfill' factor. It multiplies this factor by the 0.5 tonnes of food waste and to get a waste disposal sub-total. For the white paper, it selects the 'paper and board: paper' category and the closed-loop factor (since the paper is sent for recycling into other paper products). This is multiplied by the mass of the white paper recycled to give a further waste disposal sub-total.

Company K's total waste emissions are calculated by adding the two waste disposal subtotals together.

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO2e
Construction	Aggregates	tonnes	1.0192	1.0192	1.0192			1.277	
	Average construction	tonnes	1.0192	1.37	1.0192				
	Asbestos	tonnes						1.277	
	Asphalt	tonnes	1.0192	1.37	1.0192			1.277	
	Bricks	tonnes		1.0192				1.277	
	Concrete	tonnes		1.0192	1.0192			1.277	
	Insulation	tonnes			1.0192			1.277	
	Metals	tonnes			1.0192			1.277	
	Soils	tonnes			1.0192			17.6204	
	Mineral oil	tonnes			21.3842	21.3842			
	Plasterboard	tonnes			21.3842			71.95	
	Tyres	tonnes	21.3842	21.3842	21.3842				
	Wood	tonnes	64.3758	21.3842	21.3842	21.3842	21.3842	828.1303	

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO_2e	kg CO2e
Other	Books	tonnes			21.3842	21.3842	21.3842	1041.9017	
	Glass	tonnes		21.3842	21.3842	21.3842		9	
	Clothing	tonnes	21.3842		21.3842	21.3842		445.0414	

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Refuse	Municipal waste	tonnes		21.3842	21.3842	21.3842		586.5313	21.3842
	Organic: food and drink waste	tonnes				21.3842	10.2586	626.9729	21.3842
	Organic: garden waste	tonnes				21.3842	10.2586	579.0571	21.3842
	Organic: mixed food and garden waste	tonnes				21.3842	10.2586	587.4424	21.3842
	Commercial and industrial waste	tonnes			21.3842	21.3842		99.7729	21.3842

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Electrical items	WEEE - fridges and freezers	tonnes		21.3842				16.58	
	WEEE - large	tonnes		21.3842		21.3842		16.58	
	WEEE - mixed	tonnes		21.3842		21.3842		16.58	
	WEEE - small	tonnes		21.3842		21.3842		16.58	
	Batteries	tonnes		64.6365				75.4919	

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Metal	Metal: aluminium cans and foil (excl. forming)	tonnes			21.3842	21.3842		9	
	Metal: mixed cans	tonnes			21.3842	21.3842		9	
	Metal: scrap metal	tonnes			21.3842	21.3842		9	
	Metal: steel cans	tonnes			21.3842	21.3842		9	

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Plastic	Plastics: average plastics	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: average plastic film	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: average plastic rigid	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: HDPE (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: LDPE and LLDPE (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: PET (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: PP (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: PS (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	
	Plastics: PVC (incl. forming)	tonnes		21.3842	21.3842	21.3842		9	

			Re-use	Open-loop	Closed-loop	Combustion	Composting	Landfill	Anaerobic digestion
Activity	Waste type	Unit	kg CO_2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e	kg CO2e
Paper	Paper and board: board	tonnes			21.3842	21.3842	21.3842	1041.9017	
	Paper and board: mixed	tonnes			21.3842	21.3842	21.3842	1041.9017	
	Paper and board: paper	tonnes			21.3842	21.3842	21.3842	1041.9017	

FAQs

Can I use these factors for goods my organisation procures?

No, these factors are not appropriate. For specific procurement factors, please see the 'Material' use tab.

How do I calculate the weight of my waste?

There are a variety of different methods to work out the amount of waste your organisation generates. Waste transfer/consignment notes from your commercial waste collector are a good place to start as it may have specific information on the waste that has been collected from you. Alternatively, the commercial waste collector may be able to advise on an average weight you can apply given the waste infrastructure you have on site or you can conduct a waste audit - this is where a member of staff samples the composition of your waste and weighs the waste and/or recycling generated on a regular basis.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Business travel- air

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Emissions source:	Business travel- air	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 3	Version:	1.0	Year:	2018

Air conversion factors should be used to report Scope 3 emissions for individuals flying for work purposes.

Guidance

- Radiative forcing (RF) is a measure of the additional environmental impact of aviation. These include emissions of nitrous oxides and water vapour when emitted at high altitude.
- Organisations should include the influence of radiative forcing RF in air travel emissions to capture the maximum climate impact of their travel habits. However, it should be noted that there is very significant scientific uncertainty around the magnitude of the additional environmental impacts of aviation. Further information on this uncertainty is provided in the accompanying 'Methodology paper'.
- Organisations should produce comparable reporting. Therefore, they should avoid reporting with uplifted air travel conversion factors in one year and without in another year as this may skew the interpretation of their reporting.

Example of calculating emissions from air travel

Company L reports its emissions from flights over the course of a year. To do so it requests a report from its dedicated travel agent, which reports the distances travelled for domestic, short-haul and long-haul flights, in each class of travel (ranging from economy to first class).

A subsidiary of company L does not use the same travel agent. Instead, it uses its expenses system to note the flight type, distance and class of travel each time an employee flies.

The company then multiplies the distance (km) travelled in each class for each category of journey by the appropriate conversion factor. Company L uses the factor set inclusive of the influence of RF. Where the 'haul' of the journey is known, but the class is unknown, the company uses the 'average passenger' factor.

				With RF				Without RF			
Activity	Haul	Class	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Flights	Domestic, to/from UK	Average passenger	passenger.km	0.29832	0.29672	0.00012	0.00148	0.15777	0.15617	0.00012	0.00148
	Short-haul, to/from UK	Average passenger	passenger.km	0.16236	0.16155	0.00001	0.0008	0.08584	0.08503	0.00001	0.0008
		Economy class	passenger.km	0.1597	0.1589	0.00001	0.00079	0.08443	0.08363	0.00001	0.00079
		Business class	passenger.km	0.23955	0.23835	0.00001	0.00119	0.12665	0.12545	0.00001	0.00119
	Long-haul, to/from UK	Average passenger	passenger.km	0.21256	0.2115	0.00001	0.00105	0.11237	0.11131	0.00001	0.00105
		Economy class	passenger.km	0.16279	0.16197	0.00001	0.00081	0.08607	0.08525	0.00001	0.00081
		Premium economy class	passenger.km	0.26046	0.25916	0.00001	0.00129	0.1377	0.1364	0.00001	0.00129
		Business class	passenger.km	0.47208	0.46972	0.00002	0.00234	0.24958	0.24722	0.00002	0.00234
		First class	passenger.km	0.65115	0.6479	0.00002	0.00323	0.34425	0.341	0.00002	0.00323
	International, to/from non-UK	Average passenger	passenger.km	0.18277	0.18185	0.00001	0.00091	0.09663	0.09571	0.00001	0.00091
		Economy class	passenger.km	0.139965	0.13927	0.000005	0.00069	0.073995	0.0733	0.000005	0.00069
		Premium economy class	passenger.km	0.22395	0.22283	0.00001	0.00111	0.1184	0.11728	0.00001	0.00111
		Business class	passenger.km	0.4059	0.40388	0.00001	0.00201	0.21459	0.21257	0.00001	0.00201
		First class	passenger.km	0.55987	0.55708	0.00002	0.00277	0.29599	0.2932	0.00002	0.00277

FAQs

How do you define domestic, short-haul, long-haul and international flights?

Broadly speaking the definition of domestic flights, are those within the UK, short-haul are those within Europe, long-haul are outside of Europe and international flights are those between non-UK destinations.

Why is the impact of flying in business class higher than economy?

Air travel factors are calculated on the basis of the area of the plane each passenger takes up. If a plane is comprised totally of business-class seats, as opposed to more closely packed economy class seats, fewer passengers can fly. Therefore, each passenger takes a larger share of the emissions.

Our organisation only has data on spend. How can I use this to calculate our air travel?

There are no confirmed industry benchmarks that provide accurate CO_2e/£ spend data for air travel. We recommend that organisations improve their data collection processes so that they can report on distance (for which CO_2e/km figures are available). Alternatively, organisations may, over a number of years, collect their own data and generate their own benchmarks.

My organisation has previously reported using factors without RF, what should I do?

Users should generally use the 'with RF' factors, which incorporate a 90% increase in emissions to include the effect of radiative forcing. If the user's historical data do not include RF, then they should rebaseline their historical dataset to include the effect going forward. However, users should be aware of the very significant scientific uncertainty surrounding the quantification of these impacts. If organisations do not wish to include RF, then they should continue to select the 'Without RF' factors.

My organisation has previously reported using factors without the distance uplift, what should I do?

All the factors include the distance uplift of 8% to compensate for planes not flying using the most direct route (such as flying around international airspace and stacking). Historical factors have also included a distance uplift, though it was 9% for 2012 and before. If users did not previously include the distance uplift, then they should rebaseline their historical dataset. However, if users wish to continue to not include the distance uplift, then it should be manually removed from the current factors.

Tell me more about the international factors that were introduced in 2015

In the 2015 update, a brand new set of aviation factors were introduced where aviation factors are now being presented for international flights between non-UK destinations. This is a relatively high-level analysis and allows users to choose a different factor for air travel if flying between countries outside of the UK. All factors presented are for direct (non-stop) flights only. This analysis was only possible for passenger air travel. However, in the interests of consistency with the air freight travel, international freight factors have been included. These factors have been set equal to the current UK, long-haul freight factors. See the 'Freighting goods' and 'WTT- delivery vehs & freight' tabs for these factors.

Please note - the international factors included are an average of short and long-haul flights, which explains the difference between the UK factors and the international ones.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

WTT- business travel- air

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Emissions source:	WTT- business travel (air)	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Well-to-tank (WTT) business travel – air conversion factors should be used to account for the upstream Scope 3 emissions associated with extraction, refining and transportation of the aviation fuel to the plane before take-off.

Guidance

- These factors are to be used to report WTT emissions of business travel by air, not the impact of the WTT for fuel used in aeroplanes freighting goods (this can be found in 'Well to tank- delivery vehs & freight').

- Factors are provided with/without radiative forcing (RF) for consistency with the 'Business travel - air' factors. However, for WTT- business travel – air then RF has no effect and so the factors are the same.

Example of calculating emissions from WTT business travel – air

Company L reports its emissions from flights over the course of a year. It decides to also report the Scope 3 WTT impact of the flight fuel. To do so, it requests a report from its dedicated travel agent that reports the distances travelled for domestic, short-haul and long-haul flights, in each class of travel (ranging from economy to first-class).

The company then multiplied the km travelled in each class, for each category of journey by the appropriate conversion factor (as found in the 'WTT business travel- air' listing). Where the haul of the journey is known, but the class is unknown, the company may use an 'average passenger' factor.

				With RF	Without RF
Activity	Haul	Class	Unit	kg CO_2e	kg CO_2e
WTT- flights	Domestic, to/from UK	Average passenger	passenger.km	0.03267	0.03267
	Short-haul, to/from UK	Average passenger	passenger.km	0.01779	0.01779
		Economy class	passenger.km	0.0175	0.0175
		Business class	passenger.km	0.02624	0.02624
	Long-haul, to/from UK	Average passenger	passenger.km	0.02329	0.02329
		Economy class	passenger.km	0.01783	0.01783
		Premium economy class	passenger.km	0.02853	0.02853
		Business class	passenger.km	0.05172	0.05172
		First class	passenger.km	0.07134	0.07134
	International, to/from non-UK	Average passenger	passenger.km	0.02002	0.02002
		Economy class	passenger.km	0.01533	0.01533
		Premium economy class	passenger.km	0.02453	0.02453
		Business class	passenger.km	0.04447	0.04447
		First class	passenger.km	0.06134	0.06134

FAQs

Tell me more about the international factors that were introduced in 2015

In the 2015 update, a brand new set of aviation factors were introduced where aviation factors are now being presented for international flights between non-UK destinations. This is a relatively high-level analysis and allows users to choose a different factor for air travel if flying between countries outside of the UK. All factors presented are for direct (non-stop) flights only. This analysis was only possible for passenger air travel. However, in the interests of consistency with the air freight travel, international freight factors have been included. These factors have been set equal to the current UK, long-haul freight factors. See the 'Freighting goods' and 'WTT- delivery vehs & freight' tabs for these factors.

Please note - the international factors included are an average of short and long-haul flights, which explains the difference between the UK factors and the international ones.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Business travel- sea

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Emissions source:	Business travel- sea	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Sea-based conversion factors should be used to report travel for business purposes on ferries.

Guidance

- The business travel- sea conversion factors are for use for passenger travel, not for freighting goods. Full freight factors are available in the ‘Freighting goods’ listing.

Example of calculating emissions from business travel- sea

Company M is based on the Isle of Wight and wishes to report the emissions of business travel on the ferry.

Company M uses the conversion factors appropriate for ferry journeys. It has two options – for a passenger travelling by car on a ferry or as a foot passenger.

The total km travelled on the ferry is multiplied by the appropriate conversion factors to produce company M's Scope 3 emissions at sea.

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Ferry	Foot passenger	passenger.km	0.01874	0.01848	0.00001	0.00025
	Car passenger	passenger.km	0.12953	0.12774	0.00004	0.00175
	Average (all passenger)	passenger.km	0.11287	0.11131	0.00004	0.00152

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Business travel- land

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Emissions source:	Business travel- land	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	Scope 3	**Version:**	1.0	**Year:**	2018

Land-based conversion factors should be used for travel for business purposes in assets not owned or directly operated by a business. This includes mileage for business purposes in cars owned by employees, public transport, hire cars, and so on.

Guidance

● Users should be mindful of the difference between vehicle km conversion factors and passenger km conversion factors. Vehicle km conversion factors should be applied to a whole vehicle (such as a car or taxi) being used for business purposes. Passenger km factors should be used when single passengers are travelling by means of mass transport (such as by train) and the aim is to report emissions on a single-person basis, not account for the whole vehicle.

● It should be noted that the conversion factors for cars and vans (excluding plug-in electric vehicles) are the same as those in the 'passenger vehicles' and 'delivery vehicles' listings. Where a car or van is not owned or controlled by the reporting organisation, the vehicles should be accounted for in Scope 3 as opposed to Scope 1, but the conversion factors and their categories remain the same.

● The conversion factors for electric cars and vans are the same as those in the 'passenger vehicles' and 'delivery vehicles' listings PLUS the emissions from the electricity consumption . Where a car or van is not owned or controlled by the reporting organisation, the vehicles should be accounted for in Scope 3 as opposed to Scope 1 (for petrol/diesel use) and Scope 2 (for electricity use), but the conversion factors and their categories remain the same.

● To avoid double-counting of emissions, do not include activity/emissions resulting from the use of plug-in electric vehicles that are charged predominantly on your organisation's premises if you are also already reporting the emissions resulting from your electricity consumed there.

● Please see the FAQs at the bottom of this page for further information on the conversion factors for electric vehicles.

● The market segment conversion factors related to the vehicle market segments are specifically defined by the UK Society of Motor Manufacturers and Traders (SMMT).

Example of calculating emissions from business travel - land

The members of company N's large sales team travel extensively on public transport. The company accounts for this in Scope 3 using appropriate conversion factors for bus, tube and rail transport.
In each case, the total km travelled for each mode of transport is multiplied by the appropriate conversion factor to produce company N's Scope 3 emissions for land-based modes of transport

			Diesel				Petrol				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by market segment)	Mini	km	0.11096	0.1091	0.00001	0.00185	0.14114	0.14039	0.00033	0.00042	0.14093	0.14017	0.00033	0.00043					0.05765	0.05720	0.00014	0.00031
		miles	0.17858	0.17558	0.00002	0.00298	0.22715	0.22594	0.00054	0.00067	0.22681	0.22559	0.00053	0.00069	0.00000				0.09277	0.09205	0.00022	0.00050
	Supermini	km	0.13725	0.13539	0.00001	0.00185	0.15743	0.15668	0.00033	0.00042	0.1544	0.15348	0.00029	0.00063	0.06995	0.06948	0.00018	0.00029	0.05225	0.05185	0.00012	0.00028
		miles	0.22089	0.21789	0.00002	0.00298	0.25336	0.25215	0.00054	0.00067	0.24849	0.24701	0.00046	0.00102	0.11258	0.11182	0.00029	0.00047	0.08410	0.08345	0.00020	0.00045
	Lower medium	km	0.15048	0.14862	0.00001	0.00185	0.18284	0.18209	0.00033	0.00042	0.16669	0.16539	0.00017	0.00113	0.10562	0.10501	0.00030	0.00031	0.06401	0.06351	0.00015	0.00035
		miles	0.24217	0.23917	0.00002	0.00298	0.29425	0.29304	0.00054	0.00067	0.26828	0.26617	0.00028	0.00183	0.16997	0.16899	0.00048	0.00050	0.10301	0.10221	0.00024	0.00056
	Upper medium	km	0.16849	0.16663	0.00001	0.00185	0.20956	0.20881	0.00033	0.00042	0.17869	0.1771	0.00009	0.0015	0.11843	0.11773	0.00032	0.00038	0.05161	0.05121	0.00012	0.00028
		miles	0.27116	0.26816	0.00002	0.00298	0.33726	0.33605	0.00054	0.00067	0.28758	0.28502	0.00015	0.00241	0.19060	0.18947	0.00052	0.00061	0.08305	0.08241	0.00019	0.00045
	Executive	km	0.18125	0.17939	0.00001	0.00185	0.23952	0.23877	0.00033	0.00042	0.19502	0.19341	0.00009	0.00152	0.13320	0.13244	0.00038	0.00038	0.00000			
		miles	0.2917	0.2887	0.00002	0.00298	0.38548	0.38427	0.00054	0.00067	0.31384	0.31126	0.00014	0.00244	0.21437	0.21314	0.00061	0.00062	0.00000			
	Luxury	km	0.22177	0.21991	0.00001	0.00185	0.33702	0.33627	0.00033	0.00042	0.27753	0.2762	0.00017	0.00116	0.15980	0.15889	0.00045	0.00046	0.07784	0.07724	0.00018	0.00042
		miles	0.35691	0.35391	0.00002	0.00298	0.54238	0.54117	0.00054	0.00067	0.44664	0.4445	0.00027	0.00187	0.25719	0.25572	0.00073	0.00074	0.12528	0.12431	0.00029	0.00068
	Sports	km	0.17521	0.17335	0.00001	0.00185	0.24626	0.24551	0.00033	0.00042	0.23456	0.23363	0.00028	0.00065	0.12377	0.12306	0.00035	0.00036	0.09935	0.09858	0.00023	0.00054
		miles	0.28198	0.27898	0.00002	0.00298	0.39632	0.39511	0.00054	0.00067	0.37749	0.37599	0.00045	0.00105	0.19919	0.19805	0.00056	0.00058	0.15988	0.15865	0.00037	0.00086
	Dual purpose 4X4	km	0.21194	0.21008	0.00001	0.00185	0.24684	0.24609	0.00033	0.00042	0.21795	0.21627	0.00007	0.00161	0.12928	0.12851	0.00036	0.00041	0.08905	0.08836	0.00021	0.00048
		miles	0.34108	0.33808	0.00002	0.00298	0.39725	0.39604	0.00054	0.00067	0.35075	0.34805	0.00011	0.00259	0.20805	0.20682	0.00058	0.00065	0.14331	0.14220	0.00034	0.00077
	MPV	km	0.18452	0.18266	0.00001	0.00185	0.20096	0.20021	0.00033	0.00042	0.18945	0.18791	0.00011	0.00143	0.00000				0.07093	0.07038	0.00017	0.00038
		miles	0.29696	0.29396	0.00002	0.00298	0.32342	0.32221	0.00054	0.00067	0.30487	0.30241	0.00017	0.00229	0.00000				0.11416	0.11327	0.00027	0.00062

			Diesel				Petrol				Hybrid				CNG			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km	0.14533	0.14347	0.00001	0.00185	0.15565	0.1549	0.00033	0.00042	0.10957	0.10843	0.00022	0.00092				
		miles	0.23389	0.23089	0.00002	0.00298	0.25049	0.24928	0.00054	0.00067	0.17635	0.1745	0.00036	0.00149				
	Medium car	km	0.17353	0.17167	0.00001	0.00185	0.19386	0.19311	0.00033	0.00042	0.11538	0.11404	0.00017	0.00117	0.16324	0.16107	0.00167	0.0005
		miles	0.27927	0.27627	0.00002	0.00298	0.312	0.31079	0.00054	0.00067	0.18569	0.18354	0.00027	0.00188	0.26271	0.25922	0.00269	0.0008
	Large car	km	0.2152	0.21334	0.00001	0.00185	0.28411	0.28336	0.00033	0.00042	0.16134	0.15977	0.0001	0.00147	0.23851	0.23634	0.00167	0.0005
		miles	0.34634	0.34334	0.00002	0.00298	0.45723	0.45602	0.00054	0.00067	0.25964	0.25712	0.00016	0.00236	0.38385	0.38036	0.00269	0.0008
	Average car	km	0.17753	0.17567	0.00001	0.00185	0.18368	0.18293	0.00033	0.00042	0.12568	0.12438	0.00017	0.00113	0.17925	0.17708	0.00167	0.0005
		miles	0.28572	0.28272	0.00002	0.00298	0.29561	0.2944	0.00054	0.00067	0.20227	0.20017	0.00028	0.00182	0.28847	0.28498	0.00269	0.0008

			LPG				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Cars (by size)	Small car	km					0.15201	0.15087	0.00022	0.00092	0.06995	0.06948	0.00018	0.00029	0.05463	0.05420	0.00013	0.00030
		miles					0.24465	0.2428	0.00036	0.00149	0.11258	0.11182	0.00029	0.00047	0.08790	0.08722	0.00021	0.00047
	Medium car	km	0.18217	0.1816	0.00007	0.0005	0.18327	0.18193	0.00017	0.00117	0.11392	0.11325	0.00031	0.00036	0.06396	0.06346	0.00015	0.00035
		miles	0.29317	0.29226	0.00011	0.0008	0.29494	0.29279	0.00027	0.00188	0.18332	0.18225	0.00050	0.00057	0.10293	0.10213	0.00024	0.00056
	Large car	km	0.26704	0.26647	0.00007	0.0005	0.23373	0.23216	0.0001	0.00147	0.13001	0.12924	0.00036	0.00041	0.07803	0.07743	0.00018	0.00042
		miles	0.42975	0.42884	0.00011	0.0008	0.37615	0.37363	0.00016	0.00236	0.20922	0.20799	0.00058	0.00065	0.12559	0.12462	0.00029	0.00068
	Average car	km	0.20022	0.19965	0.00007	0.0005	0.18064	0.17934	0.00017	0.00113	0.12012	0.11941	0.00033	0.00038	0.06504	0.06454	0.00015	0.00035
		miles	0.32222	0.32131	0.00011	0.0008	0.29072	0.28862	0.00028	0.00182	0.19332	0.19218	0.00053	0.00061	0.10468	0.10386	0.00025	0.00057

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Motorbike	Small	km	0.08463	0.08248	0.00185	0.0003
		miles	0.1362	0.13274	0.00298	0.00048
	Medium	km	0.1031	0.10012	0.00238	0.0006
		miles	0.16594	0.16114	0.00383	0.00097
	Large	km	0.13528	0.1332	0.00148	0.0006
		miles	0.21771	0.21436	0.00238	0.00097
	Average	km	0.11529	0.11279	0.00191	0.00059
		miles	0.18553	0.18151	0.00307	0.00095

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Taxis	Regular taxi	passenger.km	0.15344	0.15211	0.00001	0.00132
		km	0.21482	0.21296	0.00001	0.00185
	Black cab	passenger.km	0.2142	0.21295	0.00001	0.00124
		km	0.32129	0.31943	0.00001	0.00185

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Bus	Local bus (not London)	passenger.km	0.12007	0.11907	0.00004	0.00096
	Local London bus	passenger.km	0.07211	0.07162	0.00002	0.00047
	Average local bus	passenger.km	0.10097	0.10017	0.00003	0.00077
	Coach	passenger.km	0.02801	0.02758	0.00002	0.00041

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Rail	National rail	passenger.km	0.04424	0.04383	0.00008	0.00033
	International rail	passenger.km	0.01226	0.01216	0.00003	0.00007
	Light rail and tram	passenger.km	0.03967	0.03937	0.00009	0.00021
	London Underground	passenger.km	0.0376	0.03731	0.00009	0.0002

FAQs

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?

Please refer to the 'Passenger vehicles' FAQ for tables providing this information.

Note: The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?

At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Freighting goods

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Emissions source:	Freighting goods	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	Scope 3	Version:	1.0	Year:	2018

Freighting goods factors should be used specifically for the shipment of goods over land, by sea or by air through a third-party company. Factors are available for a whole vehicle's worth of goods or per tonne of goods shipped via a specific transport mode.

Guidance

- Where possible users should report on litres of fuel and/or kWh of electricity used for freight rather than on a km basis as this is a more accurate calculation - these conversion factors may be found in the 'Fuels' and 'UK Electricity' tabs.
- For vehicles that run on electricity, care should be taken not to double-count emissions from electricity use that is already captured from reporting of an organisations on-site electricity consumption.
- Users that are able to gather data on a vehicle km basis should use these data in preference to tonne km data.
- There are two types of air-freight factors: with/without radiative forcing (RF), which is the influence of the other climate change effects of aviation (such as water vapour and nitrogen oxides). Organisations should include the influence of RF in air-freight emissions to capture the maximum climate impact of their travel habits. However, it should be noted that there is very significant scientific uncertainty around the magnitude of the additional environmental impacts of aviation. Further information on this uncertainty is provided in the accompanying 'Methodology paper'.
- Please see the FAQs at the bottom of this page for further information on the conversion factors for freighting goods vehicles, including electric vehicles.

			0% Laden				50% Laden				100% Laden				Average laden			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
HGV (all diesel)	Rigid (>3.5 - 7.5 tonnes)	tonne.km					0.47776	0.47101	0.00016	0.00660	0.25773	0.25435	0.00008	0.00330	0.48674	0.47985	0.00016	0.00673
		km	0.45835	0.45131	0.00016	0.00687	0.49759	0.49056	0.00016	0.00687	0.53683	0.52980	0.00016	0.00687	0.49680	0.48977	0.00016	0.00687
		miles	0.73764	0.72631	0.00026	0.01106	0.80079	0.78948	0.00026	0.01106	0.86394	0.85263	0.00026	0.01106	0.79952	0.78821	0.00026	0.01106
	Rigid (>7.5 tonnes-17 tonnes)	tonne.km					0.26706	0.26341	0.00008	0.00356	0.14999	0.14817	0.00004	0.00178	0.35810	0.35304	0.00012	0.00495
		km	0.55083	0.54226	0.00020	0.00838	0.62830	0.61972	0.00020	0.00838	0.70576	0.69719	0.00020	0.00838	0.60661	0.59803	0.00020	0.00838
		miles	0.88647	0.87268	0.00032	0.01349	1.01115	0.99734	0.00032	0.01349	1.13581	1.12202	0.00032	0.01349	0.97624	0.96244	0.00032	0.01349
	Rigid (>17 tonnes)	tonne.km					0.20232	0.19937	0.00007	0.00288	0.11910	0.11763	0.00003	0.00144	0.17927	0.17673	0.00006	0.00248
		km	0.76810	0.75450	0.00032	0.01328	0.93372	0.92013	0.00032	0.01328	1.09934	1.08575	0.00032	0.01328	0.96034	0.94674	0.00032	0.01328
		miles	1.23614	1.21425	0.00051	0.02137	1.50268	1.48081	0.00051	0.02137	1.76922	1.74735	0.00051	0.02137	1.54552	1.52363	0.00051	0.02137
	All rigids	tonne.km					0.23502	0.23244	0.00008	0.00250	0.13842	0.13713	0.00004	0.00125	0.21334	0.21103	0.00007	0.00223
		km	0.65294	0.64422	0.00027	0.00846	0.79425	0.78552	0.00027	0.00846	0.93555	0.92683	0.00027	0.00846	0.80746	0.79873	0.00027	0.00846
		miles	1.05081	1.03677	0.00043	0.01362	1.27822	1.26417	0.00043	0.01362	1.50562	1.49159	0.00043	0.01362	1.29948	1.28543	0.00043	0.01362
	Articulated (>3.5 - 33t)	tonne.km					0.12903	0.12726	0.00002	0.00175	0.07723	0.07635	0.00001	0.00087	0.14054	0.13857	0.00002	0.00194
		km	0.64923	0.63814	0.00012	0.01097	0.80877	0.79768	0.00012	0.01097	0.96830	0.95722	0.00012	0.01097	0.79282	0.78173	0.00012	0.01097
		miles	1.04483	1.02699	0.00019	0.01765	1.30159	1.28374	0.00019	0.01765	1.55833	1.54050	0.00019	0.01765	1.27592	1.25807	0.00019	0.01765
	Articulated (>33t)	tonne.km					0.09774	0.09629	0.00002	0.00143	0.06090	0.06018	0.00001	0.00072	0.08348	0.08231	0.00001	0.00115
		km	0.67174	0.65855	0.00015	0.01305	0.89126	0.87807	0.00015	0.01305	1.11078	1.09758	0.00015	0.01305	0.94395	0.93075	0.00015	0.01305
		miles	1.08106	1.05983	0.00024	0.02100	1.43434	1.41312	0.00024	0.02100	1.78763	1.76638	0.00024	0.02100	1.51914	1.49790	0.00024	0.02100
	All artics	tonne.km					0.09875	0.09706	0.00002	0.00167	0.05909	0.05824	0.00001	0.00084	0.08525	0.08386	0.00001	0.00137
		km	0.71260	0.69741	0.00015	0.01504	0.88712	0.87194	0.00015	0.01504	1.06164	1.04646	0.00015	0.01504	0.93428	0.91909	0.00015	0.01504
		miles	1.14682	1.12237	0.00024	0.02420	1.42768	1.40325	0.00024	0.02420	1.70854	1.68411	0.00024	0.02420	1.50358	1.47913	0.00024	0.02420
	All HGVs	tonne.km					0.13136	0.12945	0.00003	0.00188	0.07807	0.07712	0.00002	0.00094	0.11360	0.11146	0.00005	0.00209
		km	0.68567	0.67340	0.00020	0.01207	0.84520	0.83293	0.00020	0.01207	1.00473	0.99246	0.00020	0.01207	0.87287	0.86061	0.00020	0.01207
		miles	1.10348	1.08373	0.00032	0.01942	1.36022	1.34047	0.00032	0.01942	1.61696	1.59721	0.00032	0.01942	1.40475	1.38502	0.00032	0.01942

			With RF				Without RF			
Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Freight flights	Domestic, to/from UK	tonne.km	5.8333	5.80197	0.00243	0.0289	3.085	3.05367	0.00243	0.0289
	Short-haul, to/from UK	tonne.km	1.9469	1.93718	0.00007	0.00965	1.02929	1.01957	0.00007	0.00965
	Long-haul, to/from UK	tonne.km	1.23205	1.22591	0.00004	0.0061	0.65135	0.64521	0.00004	0.0061
	International, to/from non-UK	tonne.km	1.23205	1.22591	0.00004	0.0061	0.65135	0.64521	0.00004	0.0061

FAQs

My organisation has previously reported using factors without the distance uplift or radiative forcing. What should I do?

All the factors include the distance uplift of 8% to compensate for planes not flying using the most direct route (such as flying around international airspace and stacking). Historical factors have also included a distance uplift, though it was 9% for 2012 and before. Users should generally include the distance uplift of 8% and the radiative forcing (RF) increase of 90% in the emissions reporting (that is, use the 'with RF' factors). Organisations that have not previously applied the distance uplift and RF will need to rebaseline their historical dataset to make their historical data comparable and to include the two effects going forward. However, for organisations that have not and do not wish to include the distance uplift and the RF, should select the ‘Without RF’ factor and manually remove the 8% distance uplift.

Tell me more about the international flight factors that were introduced in 2015

In the 2015 update, a brand new set of aviation factors were introduced where aviation factors are now being presented for international flights between non-UK destinations. This analysis was only possible for passenger air travel. However, in the interests of consistency with the air-freight travel, international freight factors have been included this year. These factors have been set equal to the current UK, long-haul freight factors.

Please note - the international factors included are an average of short and long-haul flights, which explains the difference between the UK factors and the international ones.

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?

Please refer to the 'Passenger vehicles' FAQ for tables providing this information.

Note: The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?

At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Managed assets- vehicles

[illegible]

Activity	Type	Unit	Diesel				Petrol				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
			kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed cars (by market segment)	Mini	km	0.11096	0.10910	0.00001	0.00185	0.14114	0.14039	0.00033	0.00042	0.14093	0.14017	0.00033	0.00043					0.05765	0.05720	0.00014	0.00031
		miles	0.17858	0.17558	0.00002	0.00298	0.22715	0.22594	0.00054	0.00067	0.22681	0.22559	0.00053	0.00069	0.00000				0.09277	0.09205	0.00022	0.00050
	Supermini	km	0.13725	0.13539	0.00001	0.00185	0.15743	0.15668	0.00033	0.00042	0.15440	0.15348	0.00029	0.00063	0.06995	0.06948	0.00018	0.00029	0.05225	0.05185	0.00012	0.00028
		miles	0.22089	0.21789	0.00002	0.00298	0.25336	0.25215	0.00054	0.00067	0.24849	0.24701	0.00046	0.00102	0.11258	0.11182	0.00029	0.00047	0.08410	0.08345	0.00020	0.00045
	Lower medium	km	0.15048	0.14862	0.00001	0.00185	0.18284	0.18209	0.00033	0.00042	0.16669	0.16539	0.00017	0.00113	0.10562	0.10501	0.00030	0.00031	0.06401	0.06351	0.00015	0.00035
		miles	0.24217	0.23917	0.00002	0.00298	0.29425	0.29304	0.00054	0.00067	0.26828	0.26617	0.00028	0.00183	0.16997	0.16899	0.00048	0.00050	0.10301	0.10221	0.00024	0.00056
	Upper medium	km	0.16849	0.16663	0.00001	0.00185	0.20956	0.20881	0.00033	0.00042	0.17869	0.17710	0.00009	0.00150	0.11843	0.11773	0.00032	0.00038	0.05161	0.05121	0.00012	0.00028
		miles	0.27116	0.26816	0.00002	0.00298	0.33726	0.33605	0.00054	0.00067	0.28758	0.28502	0.00015	0.00241	0.19060	0.18947	0.00052	0.00061	0.08305	0.08241	0.00019	0.00045
	Executive	km	0.18125	0.17939	0.00001	0.00185	0.23952	0.23877	0.00033	0.00042	0.19502	0.19341	0.00009	0.00152	0.13320	0.13244	0.00038	0.00038	0.00000			
		miles	0.29170	0.28870	0.00002	0.00298	0.38548	0.38427	0.00054	0.00067	0.31384	0.31126	0.00014	0.00244	0.21437	0.21314	0.00061	0.00062	0.00000			
	Luxury	km	0.22177	0.21991	0.00001	0.00185	0.33702	0.33627	0.00033	0.00042	0.27753	0.27620	0.00017	0.00116	0.15980	0.15889	0.00045	0.00046	0.07784	0.07724	0.00018	0.00042
		miles	0.35691	0.35391	0.00002	0.00298	0.54238	0.54117	0.00054	0.00067	0.44664	0.44450	0.00027	0.00187	0.25719	0.25572	0.00073	0.00074	0.12528	0.12431	0.00029	0.00068
	Sports	km	0.17521	0.17335	0.00001	0.00185	0.24626	0.24551	0.00033	0.00042	0.23456	0.23363	0.00028	0.00065	0.12377	0.12306	0.00035	0.00036	0.09935	0.09858	0.00023	0.00054
		miles	0.28198	0.27898	0.00002	0.00298	0.39632	0.39511	0.00054	0.00067	0.37749	0.37599	0.00045	0.00105	0.19919	0.19805	0.00056	0.00058	0.15988	0.15865	0.00037	0.00086
	Dual purpose 4X4	km	0.21194	0.21008	0.00001	0.00185	0.24684	0.24609	0.00033	0.00042	0.21795	0.21627	0.00007	0.00161	0.12928	0.12851	0.00036	0.00041	0.08905	0.08836	0.00021	0.00048
		miles	0.34108	0.33808	0.00002	0.00298	0.39725	0.39604	0.00054	0.00067	0.35075	0.34805	0.00011	0.00259	0.20805	0.20682	0.00058	0.00065	0.14331	0.14220	0.00034	0.00077
	MPV	km	0.18452	0.18266	0.00001	0.00185	0.20096	0.20021	0.00033	0.00042	0.18945	0.18791	0.00011	0.00143	0.00000				0.07093	0.07038	0.00017	0.00038
		miles	0.29696	0.29396	0.00002	0.00298	0.32342	0.32221	0.00054	0.00067	0.30487	0.30241	0.00017	0.00229	0.00000				0.11416	0.11327	0.00027	0.00062

Activity	Type	Unit	Diesel				Petrol				Hybrid				CNG				LPG				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
			kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed cars (by size)	Small car	km	0.14533	0.14347	0.00001	0.00185	0.15565	0.1549	0.00033	0.00042	0.10957	0.10843	0.00022	0.00092									0.15201	0.15087	0.00022	0.00092	0.06995	0.06948	0.00018	0.00029	0.05463	0.05420	0.00013	0.00030
		miles	0.23389	0.23089	0.00002	0.00298	0.25049	0.24928	0.00054	0.00067	0.17635	0.1745	0.00036	0.00149									0.24465	0.2428	0.00036	0.00149	0.11258	0.11182	0.00029	0.00047	0.08790	0.08722	0.00021	0.00047
	Medium car	km	0.17353	0.17167	0.00001	0.00185	0.19386	0.19311	0.00033	0.00042	0.11538	0.11404	0.00017	0.00117	0.16324	0.16107	0.00167	0.0005	0.18217	0.1816	0.00007	0.0005	0.18327	0.18193	0.00017	0.00117	0.11392	0.11325	0.00031	0.00036	0.06396	0.06346	0.00015	0.00035
		miles	0.27927	0.27627	0.00002	0.00298	0.312	0.31079	0.00054	0.00067	0.18569	0.18354	0.00027	0.00188	0.26271	0.25922	0.00269	0.0008	0.29317	0.29226	0.00011	0.0008	0.29494	0.29279	0.00027	0.00188	0.18332	0.18225	0.00050	0.00057	0.10293	0.10213	0.00024	0.00056
	Large car	km	0.2152	0.21334	0.00001	0.00185	0.28411	0.28336	0.00033	0.00042	0.16134	0.15977	0.0001	0.00147	0.23851	0.23634	0.00167	0.0005	0.26704	0.26647	0.00007	0.0005	0.23373	0.23216	0.0001	0.00147	0.13001	0.12924	0.00036	0.00041	0.07803	0.07743	0.00018	0.00042
		miles	0.34634	0.34334	0.00002	0.00298	0.45723	0.45602	0.00054	0.00067	0.25964	0.25712	0.00016	0.00236	0.38385	0.38036	0.00269	0.0008	0.42975	0.42884	0.00011	0.0008	0.37615	0.37363	0.00016	0.00236	0.20922	0.20799	0.00058	0.00065	0.12559	0.12462	0.00029	0.00068
	Average car	km	0.17753	0.17567	0.00001	0.00185	0.18368	0.18293	0.00033	0.00042	0.12568	0.12438	0.00017	0.00113	0.17925	0.17708	0.00167	0.0005	0.20022	0.19965	0.00007	0.0005	0.18064	0.17934	0.00017	0.00113	0.12012	0.11941	0.00033	0.00038	0.06504	0.06454	0.00015	0.00035
		miles	0.28572	0.28272	0.00002	0.00298	0.29561	0.2944	0.00054	0.00067	0.20227	0.20017	0.00028	0.00182	0.28847	0.28498	0.00269	0.0008	0.32222	0.32131	0.00011	0.0008	0.29072	0.28862	0.00028	0.00182	0.19332	0.19218	0.00053	0.00061	0.10468	0.10386	0.00025	0.00057

Activity	Type	Unit	Diesel				Petrol				CNG				LPG				Unknown				Plug-in Hybrid Electric Vehicle				Battery Electric Vehicle			
			kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed vans	Class I (up to 1.305 tonnes)	km	0.14918	0.14731	0.00001	0.00185	0.2265	0.22535	0.00028	0.00087																	0.05036	0.04997	0.00012	0.00027
	Class II (1.305 to 1.74 tonnes)	km	0.23471	0.23284	0.00001	0.00185	0.25225	0.2511	0.00028	0.00087																	0.06908	0.06855	0.00016	0.00037
	Class III (1.74 to 3.5 tonnes)	km	0.27491	0.27305	0.00001	0.00185	0.3046	0.30344	0.00028	0.00087																	0.10167	0.10088	0.00024	0.00055
	Average (up to 3.5 tonnes)	km	0.2568	0.25493	0.00001	0.00185	0.24917	0.24802	0.00028	0.00087	0.24986	0.24742	0.0014	0.00104	0.27457	0.27347	0.00006	0.00104	0.25654	0.2547	0.00002	0.00182					0.06924	0.06871	0.00016	0.00037

Activity	Type	Unit	0% Laden				50% Laden				100% Laden				Average laden			
			kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed HGV (all diesel)	Rigid (>3.5 - 7.5 tonnes)	km	0.45835	0.45131	0.00016	0.00687	0.49759	0.49056	0.00016	0.00687	0.53683	0.52980	0.00016	0.00687	0.49680	0.48977	0.00016	0.00687
	Rigid (>7.5 tonnes-17 tonnes)	km	0.55083	0.54226	0.00020	0.00838	0.62830	0.61972	0.00020	0.00838	0.70576	0.69719	0.00020	0.00838	0.60661	0.59803	0.00020	0.00838
	Rigid (>17 tonnes)	km	0.76810	0.75450	0.00032	0.01328	0.93372	0.92013	0.00032	0.01328	1.09934	1.08575	0.00032	0.01328	0.96034	0.94674	0.00032	0.01328
	All rigids	km	0.65294	0.64422	0.00027	0.00846	0.79425	0.78552	0.00027	0.00846	0.93555	0.92683	0.00027	0.00846	0.80746	0.79873	0.00027	0.00846
	Articulated (>3.5 - 33t)	km	0.64923	0.63814	0.00012	0.01097	0.80877	0.79768	0.00012	0.01097	0.96830	0.95722	0.00012	0.01097	0.79282	0.78173	0.00012	0.01097
	Articulated (>33t)	km	0.67174	0.65855	0.00015	0.01305	0.89126	0.87807	0.00015	0.01305	1.11078	1.09758	0.00015	0.01305	0.94395	0.93075	0.00015	0.01305
	All artics	km	0.71260	0.69741	0.00015	0.01504	0.88712	0.87194	0.00015	0.01504	1.06164	1.04646	0.00015	0.01504	0.93428	0.91909	0.00015	0.01504
	All HGVs	km	0.68567	0.67340	0.00020	0.01207	0.84520	0.83293	0.00020	0.01207	1.00473	0.99246	0.00020	0.01207	0.87287	0.86061	0.00020	0.01207

Activity	Type	Unit	0% Laden				50% Laden				100% Laden				Average laden			
			kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed HGV refrigerated (all diesel)	Rigid (>3.5 - 7.5 tonnes)	km	0.54533	0.53830	0.00016	0.00687	0.59214	0.58511	0.00016	0.00687	0.63894	0.63191	0.00016	0.00687	0.59120	0.58417	0.00016	0.00687
	Rigid (>7.5 tonnes-17 tonnes)	km	0.65536	0.64678	0.00020	0.00838	0.74775	0.73917	0.00020	0.00838	0.84015	0.83157	0.00020	0.00838	0.72188	0.71330	0.00020	0.00838
	Rigid (>17 tonnes)	km	0.91352	0.89992	0.00032	0.01328	1.11108	1.09748	0.00032	0.01328	1.30862	1.29502	0.00032	0.01328	1.14282	1.12922	0.00032	0.01328
	All rigids	km	0.77712	0.76839	0.00027	0.00846	0.94565	0.93692	0.00027	0.00846	1.11420	1.10547	0.00027	0.00846	0.96141	0.95268	0.00027	0.00846
	Articulated (>3.5 - 33t)	km	0.75195	0.74086	0.00012	0.01097	0.93717	0.92608	0.00012	0.01097	1.12239	1.11130	0.00012	0.01097	0.91865	0.90756	0.00012	0.01097
	Articulated (>33t)	km	0.77775	0.76455	0.00015	0.01305	1.03261	1.01941	0.00015	0.01305	1.28745	1.27425	0.00015	0.01305	1.09377	1.08057	0.00015	0.01305
	All artics	km	0.82486	0.80967	0.00015	0.01504	1.02748	1.01229	0.00015	0.01504	1.23010	1.21491	0.00015	0.01504	1.08222	1.06703	0.00015	0.01504
	All HGVs	km	0.80368	0.79141	0.00020	0.01207	0.99117	0.97890	0.00020	0.01207	1.17866	1.16639	0.00020	0.01207	1.02370	1.01143	0.00020	0.01207

Activity	Type	Unit	kg CO_2e	kg CO_2	kg CH_4	kg N_2O
Managed motorbikes	Small	km	0.08463	0.08248	0.00185	0.0003
		miles	0.1362	0.13274	0.00298	0.00048
	Medium	km	0.1031	0.10012	0.00238	0.0006
		miles	0.16594	0.16114	0.00383	0.00097
	Large	km	0.13528	0.1332	0.00148	0.0006
		miles	0.21771	0.21436	0.00238	0.00097
	Average	km	0.11529	0.11279	0.00191	0.00059
		miles	0.18553	0.18151	0.00307	0.00095

Small km
Small miles
Medium km
Medium miles
Large km
Large miles
Average km
Average miles

FAQs

Do the conversion factors take into account the age of vehicles?

The conversion factors are based on information from the Department for Transport, which regularly analyses the mix of cars/vans on the road in the UK through Driver and Vehicle Licensing Agency (DVLA) records and automatic number plate recognition (ANPR) data. The conversion factors are updated each year to reflect changes in the spectrum of cars/vans of different types and ages being driven.

I know the average mpg of my passenger vehicles as well as mileage. Can this be used to improve my calculations?

The miles per gallon (mpg) of the car should be used to convert the distance travelled into litres of fuel used (refer to the 'conversions' listing to find values to assist this calculation). The conversion factor for litres of fuel can then be applied. This will give a more accurate view of the actual emissions from the car (the conversion factors for car mileage represent the average mpg of the whole UK car population, so knowing your car's actual mpg and using this value will yield more precise results).

I'm confused about whether I should use these factors or the Scope 1 vehicle factors. I know this is related to my organisational boundary, but I'm still unsure if these conversion factors are appropriate for my organisation's vehicles or not.

This tab is for use by organisations using the financial control or equity share boundaries that lease assets from another party. In these cases, check the lease type. If it is an operating lease, use the conversion factors on this tab to report vehicle emissions as Scope 3. Otherwise, use the other conversion factors in the 'Passenger travel' and 'Delivery vehicles' tabs and report emissions as Scope 1. For further information, please read the 'Leased assets guidance'.

Which tables do I need to use to capture all the emissions resulting from the use of my plug-in electric vehicles?

Please refer to the 'Passenger vehicles' FAQ for tables providing this information.
Note: The Plug-in Hybrid Electric Vehicle category also includes Range-Extended Electric Vehicles (also known as REEVs, ER-EVs or REX).

Why are emission factors for certain types of electric vehicle missing?

At the moment there are only a limited number of electric vehicle models on the market, and certain categories are not yet represented **by battery electric vehicle or plug-in hybrid electric vehicles**. Emission factors will be added in future updates for these vehicle types, when models in these categories become available in the UK market/fleet.

For information about how the conversion factors have been derived, please refer to the 'Methodology paper' that accompanies the conversion factors.

Conversions

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Emissions source:	None	**Expiry:**	31/07/2019	**Factor set:**	Standard Set
Scope:	-	**Version:**	1.0	**Year:**	2018

The conversion values should be used to change units (such as those for energy, mass and volume) into alternative units. This is particularly useful where an organisation is collecting data in units of measure that do not have conversion factors that can be directly used to determine a carbon emission total.

Using the abbreviation table

The abbreviation table simply demonstrates common abbreviations that may be found within the carbon reporting arena and their long-hand form. This table is entirely for reference.

Using the conversions table

To convert from the units of measure in the columns on the left hand side of the table to the units of measure in the column headers in the same tables, simply multiple by the factor displayed where the two units meet on the table.

For example, to convert from kWh to GJ, multiply the kWh value by 0.036.

Abbreviation		Symbol	Number	Standard form
	Kilo	k	1,000	10^{3}
	Mega	M	1,000,000	10^{6}
	Giga	G	1,000,000,000	10^{9}
	Tera	T	1,000,000,000,000	10^{12}
	Peta	P	1,000,000,000,000,000	10^{15}

Energy		GJ	kWh	therm	toe	kcal
	Gigajoule, GJ		277.78	9.47817	0.02388	238,903
	Kilowatt-hour, kWh	0.0036		0.03412	0.00009	860.05
	Therm	0.10551	29.307		0.00252	25,206
	Tonne oil equivalent, toe	41.868	11,630	396.83		10,002,389
	Kilocalorie, kcal	0.000004186	0.0011627	0.000039674	0.000000100	

Volume		L	m^3	cu ft	Imp. gallon	US gallon	Bbl (US,P)
	Litres, L		0.001	0.03531	0.21997	0.26417	0.0062898
	Cubic metres, m^3	1000		35.315	219.97	264.17	6.2898
	Cubic feet, cu ft	28.317	0.02832		6.2288	7.48052	0.17811
	Imperial gallon	4.5461	0.00455	0.16054		1.20095	0.028594
	US gallon	3.7854	0.0037854	0.13368	0.83267		0.023810
	Barrel (US, petroleum), bbl	158.99	0.15899	5.6146	34.972	42	

Weight/mass		kg	tonne	ton (UK)	ton (US)	lb
	Kilogram, kg		0.001	0.00098	0.00110	2.20462
	tonne, t (metric ton)	1000		0.98421	1.10231	2204.62368
	ton (UK, long ton)	1016.04642	1.01605		1.12000	2240
	ton (US, short ton)	907.18	0.90718	0.89286		2000
	Pound, lb	0.45359	0.00045359	0.00044643	0.00050	

Length / distance		m	ft	mi	km	nmi
	Metre, m		3.2808	0.00062137	0.001	0.00053996
	Feet, ft	0.30480		0.000	0.0003048	0.00016458
	Miles, mi	1609.34	5280		1.60934	0.86898
	Kilometres, km	1000	3280.8	0.62137		0.53996
	Nautical miles, nmi or NM	1852	6076.1	1.15078	1.852	

Length / distance		m	ft	in	cm	yd
	Metre, m		3.28084	39.37008	100	1.09361
	Feet, ft	0.30480		12	30.48000	0.33333
	Inch, in	0.02540	0.08333		2.54000	0.02778
	Centimetres, cm	0.01	0.03281	0.39370		0.01094
	Yard, yd	0.91440	3	36	91.44000	

Fuel properties

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Emissions source:	None	Expiry:	31/07/2019	Factor set:	Standard Set
Scope:	-	Version:	1.0	Year:	2018

The fuel properties can be used to determine the typical calorific values/densities of most common fuels.

		Year	Net CV	Gross CV	Density*	Density*	Net CV	Gross CV	Notes:
			GJ/tonne	GJ/tonne	kg/m^3	litres/tonne	kWh/kg	kWh/kg	
Commonly Used Fossil Fuels	Aviation Spirit	2018	45.02	47.39	711.24	1,406	12.51	13.17	
	Aviation Turbine Fuel	2018	43.93	46.24	798.09	1,253	12.20	12.84	
	Burning Oil	2018	43.89	46.20	801.28	1,248	12.19	12.83	
	Coal (domestic)	2018	28.59	30.09	850.00	1,176	7.94	8.36	
	Coal (electricity generation)	2018	24.86	26.17			6.91	7.27	1
	Coal (electricity generation - home produced coal only)	2018	23.92	25.18			6.65	7.00	2
	Coal (industrial)	2018	25.82	27.18			7.17	7.55	
	Coking Coal	2018	30.24	31.83			8.40	8.84	
	Diesel (100% mineral diesel)	2018	42.93	45.67	837.52	1,194	11.93	12.69	
	Diesel (average biofuel blend)	2018	42.79	45.50	838.80	1,192	11.89	12.64	
	Fuel Oil	2018	40.72	43.32	984.25	1,016	11.31	12.03	
	Gas Oil	2018	42.57	45.29	853.97	1,171	11.83	12.58	
	LPG	2018	45.92	49.30	517.16	1,934	12.75	13.70	
	Naphtha	2018	45.47	47.87	672.04	1,488	12.63	13.30	
	Natural Gas	2018	48.38	53.75	0.75	1,342,097	13.44	14.93	
	Other petroleum gas	2018	46.60	50.65	366.30	2,730	12.95	14.07	
	Petroleum coke	2018	33.97	35.76			9.44	9.93	
	Petrol (100% mineral petrol)	2018	44.79	47.14	730.99	1,368	12.44	13.10	
	Petrol (average biofuel blend)	2018	43.92	46.16	734.04	1,340	12.20	12.82	

		Year	Net CV	Gross CV	Density*	Density*	Net CV	Gross CV
			GJ/tonne	GJ/tonne	kg/m^3	litres/tonne	kWh/kg	kWh/kg
Other fuels	Biodiesel (ME)	2018	37.20	38.70	890.00	1,124	10.33	10.75
	Biodiesel (BtL or HVO)	2018	44.00	46.32	780.00	1,282	12.22	12.87
	Bioethanol	2018	26.80	29.70	794.00	1,259	7.44	8.25
	BioETBE	2018	36.30	39.63	750.00	1,333	10.08	11.01
	Biogas	2018	20.00	22.22	1.15	869,565	5.56	6.17
	Biomethane	2018	49.00	54.44	0.73	1,376,922	13.61	15.12
	CNG	2018	48.38	53.75	175.00	5,714	13.44	14.93
	Grasses/Straw	2018	13.40	15.68	160.00	6,250	3.72	4.35
	Landfill Gas	2018	12.30	13.66	1.30	769,231	3.42	3.79
	LNG	2018	48.38	53.75	452.49	2,210	13.44	14.93
	Wood Chips	2018	13.60	14.76	253.00	3,953	3.78	4.10
	Wood Logs	2018	14.71	16.26	425.00	2,353	4.09	4.52
	Wood Pellets	2018	16.85	18.29	650.00	1,538	4.68	5.08

		Year	Net CV	Gross CV	Density*	Density*	Net CV	Gross CV
			GJ/tonne	GJ/tonne	kg/m^3	litres/tonne	kWh/kg	kWh/kg
Gases	Methane (CH_4)	2018	50.00	55.55	0.72	1,394,700	13.89	15.43
	Carbon Dioxide (CO_2)	2018	0.00	0.00	1.9770	505,817	0.00	0.00

1 Gross CV and Net CV taken from Coal 'Power stations - home produced plus imports', DUKES 2015 (July 2016), Tables A.2 and A.3 respectively.

2 Gross CV and Net CV taken from Coal 'Power stations' (home produced coal only), DUKES 2015 (July 2016), Tables A.2 and A.3 respectively.

* Please note that these units are referring to volume/mass, which is the inverse of density (known as Specific Volume).

35+ PLANNING APPLICATION

PROPOSED SOUND INSULATION GRANT SCHEME

NEW SCHEME

We recognise that aircraft noise is a key issue for local communities, particularly for those residents living closest to the Airport.

We have undertaken a review of the current scheme and also those offered by other UK and international airports.

Our proposed new scheme would:

- cover a larger geographic area, meaning more households will be eligible;
- take account of additional noise metrics;
- remove the need for the householder to contribute; we would pay up to 100% of the cost; and
- be based on a tiered system to provide the highest funding for the noisiest areas to support those who are most impacted.

The grant would pay for noise insulation measures such as double glazing, mechanical ventilation and loft insulation.

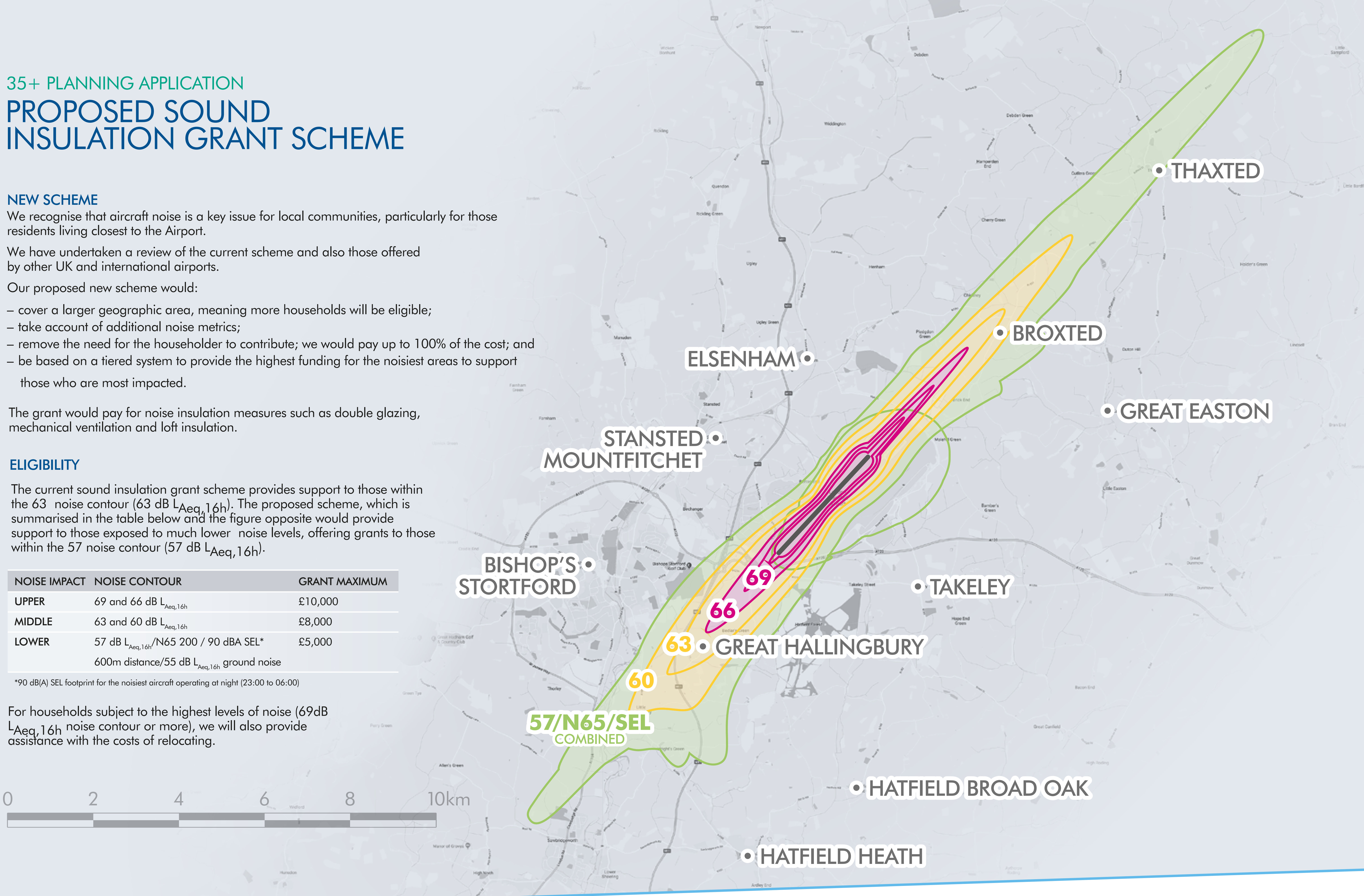
ELIGIBILITY

The current sound insulation grant scheme provides support to those within the 63 noise contour (63 dB $L_{Aeq,16h}$). The proposed scheme, summarised in the table below and the figure opposite would provide support to those exposed to much lower noise levels, offering grants to those within the 57 noise contour (57 dB $L_{Aeq,16h}$).

NOISE IMPACT	NOISE CONTOUR	GRANT MAXIMUM
UPPER	69 and 66 dB $L_{Aeq,16h}$	£10,000
MIDDLE	63 and 60 dB $L_{Aeq,16h}$	£8,000
LOWER	57 dB $L_{Aeq,16h}$/N65 200 / 90 dBA SEL*	£5,000
	600m distance/55 dB $L_{Aeq,16h}$ ground noise	

*90 dB(A) SEL footprint for the noisiest aircraft operating at night (23:00 to 06:00)

For households subject to the highest levels of noise (69dB $L_{Aeq,16h}$ noise contour or more), we will also provide assistance with the costs of relocating.



MAG London Stansted Airport

UTT/18/0460/FUL – STANSTED AIRPORT
Birchanger, Elsenham, Stansted, Takeley parishes

(MAJOR)

PROPOSAL:	**Airfield works comprising two new taxiway links to the existing runway (a Rapid Access Taxiway and a Rapid Exit Taxiway), six additional remote aircraft stands (adjacent Yankee taxiway); and three additional aircraft stands (extension of the Echo Apron) to enable combined airfield operations of 274,000 aircraft movements (of which not more than 16,000 movements would be Cargo Air Transport Movements (CATM)) and a throughput of 43 million terminal passengers, in a 12-month calendar period**
LOCATION:	**Stansted Airport**
APPLICANT:	**Stansted Airport Limited (STAL)**
AGENT:	**Mr A Andrew, STAL**
EXPIRY DATE:	**30 November 2018**
CASE OFFICER:	**Karen Denmark**

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1. NOTATION

1.1 Within Development Limits, Ancient Woodland, Local Wildlife Site, site covers area of Policies AIR1-7 in the adopted Uttlesford Local Plan (2005).

2. DESCRIPTION OF SITE

2.1 The application site relates to Stansted Airport, including all land airside and landside. Physical works are only proposed airside adjacent to the runway.

3. PROPOSAL

3.1 The proposal relates to the construction of a rapid access taxiway (RAT), a rapid exit taxiway (RET), and a total of 9 additional stands over two locations. These additional facilities would enable the optimal use of the runway, improving efficiency in the peak hours. The stands are required to provide overnight parking for home-based airlines. The proposal also seeks to uplift passenger numbers from the currently consented 35 million passengers per annum (mppa) to 43mppa.

3.2 The airport currently has planning permission for a total of 274,000 aircraft movements. This is restricted to no more than 243,500 passenger air transport movements (PATMs), no more than 20,500 cargo air transport movements (CATMs). There was a further condition limiting the number of “general aviation” movements to 10,000 per annum. This limit applies to aircraft not carrying “for hire or reward” passengers or cargo, or non-scheduled air transport services where the passenger seating capacity does not exceed ten.

3.3 This application does not propose to increase the number of aircraft movements from 274,000. Originally it sought a unified total of 274,000 which could have consisted of any combination of flights. The Environmental Statement was carried out with a specific assumption of an increase in passenger flights to 253,000 PATMs in 2028 at 43mppa, with “other” flights being reduced to 5000 per annum. Officers sought clarification with regards to the description and it was subsequently confirmed that no more than 16,000 CATMs were proposed. This would permit 258,000 ATMs for passenger and/or general aviation movements.

4. ENVIRONMENTAL IMPACT ASSESSMENT

4.1 The application with an Environmental Statement in line with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. This consists of Volume 1 which is the Environmental Statement (ES) and two volumes of appendices. There is also a Non-Technical Summary (NTS).

Regulation 4(5) of those Regulations requires the local planning authority to ensure that they have, or have access as necessary to, sufficient expertise to examine the environmental statement.

In this regard, the case officer has worked in conjunction with:

officers from: Essex County Council (ECC), Hertfordshire County Council (HCC), East Herts District Council (EHDC), Place Services (ECC), Network Rail, Highways England (HE), Natural England, and UDC’s Environmental Health Manager (Protection), Senior Health Improvement Officer, and the Communities Manager.

Further expertise has been provided to ECC and HE by Jacobs and AECOM respectively.

Officers have also been advised by consultants from:

WYG (air quality) (WYG), and Bickerdike Allen Partners LLP (BAP).

Consultation advice has been given by:

Thames Water and Environment Agency (EA).

5. APPLICANT’S CASE

5.1 The application is also accompanied by a Transport Statement, a Planning Statement, Design and Access Statement, and a Statement of Community Involvement.

6. RELEVANT SITE HISTORY

6.1 (The 2008 Planning Permission, also referred to as Generation (Gen) 1): UTT/0717/06/FUL – Extension to the passenger terminal; provision of additional aircraft stands and taxiways, aircraft maintenance facilities, offices, cargo handling facilities, aviation fuel storage, passenger and staff car parking and other operational and industrial support accommodation; alterations to airport roads, terminal forecourt and the Stansted rail, coach and bus station; together with associated landscaping and infrastructure as permitted development under application UTT/1000/01/OP but without complying with condition MPPA1 and varying condition AMT1 to 264,000 ATMs. Refused 2006, allowed on appeal 2008.

6.2 (The 2003 Planning Permission): UTT/1000/01/OP - Extension to the passenger terminal; provision of additional aircraft stands and taxiways, aircraft maintenance facilities, offices, cargo handling facilities, aviation fuel storage, passenger and staff car parking and other operational and industrial support accommodation; alterations to airport roads, terminal forecourt and the Stansted rail, coach and bus station; together with associated landscaping and infrastructure. Approved 2003.

6.3 UTT/1150/80/SA – Outline application for expansion of Stansted Airport by provision of new passenger terminal complex with capacity of about 15mppa east of existing runway, cargo handling and general aviation facilities, hotel accommodation, taxiways (including widening of proposed taxiway) to be used as an emergency runway), associated facilities (including infrastructure for aircraft maintenance and other tenants' developments) and related road access. Approved by Secretaries of State 5 June 1985.

7. POLICIES

The Development Plan - Uttlesford Local Plan (2005)

7.1 S4 – Stansted Airport Boundary
AIR1 – Terminal Support Area
AIR2 – Cargo Handling/Aircraft Maintenance Area
AIR3 – Southern Ancillary Area
AIR4 – Northern Ancillary Area
AIR5 – Long Term Car Park
AIR6 – Landscaped Areas
AIR7 – Public Safety Zone
GEN1 – Access
GEN3 – Flood Protection
GEN4 – Good Neighbourliness
GEN5 – Light Pollution
GEN6 – Infrastructure Provision to Support Development
GEN7 – Nature Conservation
ENV2 – Development affecting Listed Buildings
ENV4 – Ancient Monuments and Sites of Archaeological Interest
ENV7 – The Protection of the Natural Environment – Designated Sites
ENV9 – Historic Landscapes
ENV11 – Noise Generators
ENV12 – Protection of Water Resources
ENV13 – Exposure to Poor Air Quality

National Policies

7.2 NPPF (2018)
Planning Practice Guidance

7.3 Aviation Policy Framework (March 2013)
Beyond the Horizon: The future of UK aviation – Next steps towards an Aviation Strategy (April 2018)
Beyond the Horizon: The future of UK aviation (June 2018)

Other Policy

Regulation 19 Uttlesford Local Plan
The Spatial Vision: Theme 2 – Support Sustainable Business Growth
SP2 – The Spatial Strategy 2011 - 2033

SP11 – London Stansted Airport
Airports National Policy Statement (June 2018)
Stansted Airport Sustainable Development Plan

8. CONSULTATION

8.1 The application has been advertised and two periods of consultation have been carried out, the first ending on 30 April 2018 and the second on 30 August 2018. The Council has also engaged proactively with statutory consultees. This report has had regard to consultation responses. In addition, the Council will be holding three sessions over two days of public speaking as part of a further consultation period. These are to be held on 6 and 7 November 2018.

9. APPRAISAL

The issues to consider in the determination of the application are:

A The principle of the development
B Surface Access and Transport
C Air Noise
D Ground Noise
E Surface Access Noise
F Air Quality
G Socio-Economic Impacts
H Carbon Emissions
I Climate Change
J Public Health and Wellbeing
K Water Resources and Flood Risk
L Non-significant Topics
M Cumulative Effects
N Other issues

A The principle of the development

9.1 The Local Plan sets out limits on the physical extent of the airport. Section 16 of the Plan sets out the background to the airport. The airport is within an area covered by Local Plan general Policy S4 which relates to the airport as a whole and includes the area of the application. S4 makes provision for individual area policies called development zones. The zones ensure that all airport direct and associated uses can be accommodated within the airport boundary. Industrial and commercial development unrelated to the airport will not be permitted on the site. The adopted Uttlesford Local Plan splits the airport into 6 separate policy sections. These policies, AIR1 to AIR6 relate to the types of development that will be permitted in each area of each of those policies, or not permitted in respect of Policy AIR6.

9.2 In terms of physical development, the proposed rapid access taxiway (RAT) and rapid exit taxiway (RET) and aircraft stands fall within the area covered by Policy S4 and outside the development zones. The adopted policy is silent in terms of specific development in this area although the extent of its coverage does support development directly related to or associated with Stansted Airport. Policies AIR1 to AIR6, whilst applying to different areas of the airport, are not specifically relevant to the proposals in this application.

9.3 The NPPF (2018, paragraph 213, requires that due weight be given to existing local policies according to their degree of consistency with that Framework. NPPF paragraph 104 requires planning policies (e) provide for any large scale transport facilities that need to be located in the area, and the infrastructure and wider development required to support their operation, expansion and contribution to the wider economy. Paragraph 104(f) requires planning policies to recognise the importance of maintaining a national network of general aviation (GA) airfields, and the Government's General Aviation Strategy. The Local Plan, paragraph 1.2, makes clear that because Stansted Airport is in Uttlesford, national airports policy is particularly significant to the District. Policy S4 provides for Stansted Airport but does not itself provide for infrastructure required to support its intensified operation, expansion and contribution to the wider economy. Policy S4 and the development zone Policies AIR1-6 have been assessed as being in accordance with the NPPF and can be afforded full weight, subject to their compliance with the government's policy in respect of aviation.

9.4 The NPPF (2018) is a material consideration. It establishes the presumption of sustainable development. The three overarching strands, economic, social and environmental objectives, are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives).

9.5 Whilst the NPPF has a balanced view towards sustainable development, the Aviation Policy Framework and the governments approach towards aviation development in general, recognises that there is the potential for environmental impacts which would need to be weighed against the social and economic benefits of such proposals.

9.6 As referred to above, the Local Plan, paragraph 1.2 informs the background of Policy S4 and makes clear that because Stansted Airport is in Uttlesford, national airports policy is particularly significant to the District. The particularly significant national airports policies are the Aviation Policy Framework (2013) and the recent "Beyond the Horizon" (June 2018).

9.7 The Aviation Policy Framework (2013) (APF) is a material consideration (see paragraph 5.6) and refers to Stansted Airport (see, for example, paragraph 1.41). Paragraph 1.60 states the government's "strategy for a vibrant aviation sector: short term" comprising a suite of measures focused on: making best use of existing capacity; encouraging new routes and services; better integrating airports into the wider transport network.

9.8 The APF recognises the role the aviation industry has in the economy, helping to deliver connectivity. Aviation is recognised for bringing benefits to society and individuals, including travel for leisure and visiting family and friends. One of the main objectives of that Framework is to ensure that the UK's air links continue to make it one of the best connected countries in the world so that it can compete successfully for economic growth opportunities.

9.9 Paragraphs 5 to 10 state the benefits of aviation. Paragraph 10 sets out the short to medium term priority of making better use of existing runway capacity at all UK airports. However, this expansion should not happen at any cost and it is recognised that this needs to be a balanced approach with the economic benefits being weighed against the environmental impacts. In particular, the APF highlights contributing to reducing global emissions, limiting noise and better industry/stakeholder collaboration.

9.10 In April 2018, the government published its response to its call for evidence in July 2017 on its emerging aviation strategy, and in June 2018, it published a document setting out its current position on making best use of existing runways. The April 2018 document is entitled “Beyond the horizon: The future of UK aviation. Next steps towards an Aviation Strategy”. The June 2018 document is entitled “Beyond the horizon: The future of UK aviation. Making best use of existing runways” (BTH June 2018).

9.11 BTH June 2018, paragraph 1.4 referred to Stansted at paragraph 1.4, footnote 2. The government “Policy Statement” is at paragraphs 1.25-1.29. The Policy Statement is a material consideration. Paragraph 1.26 states:

“Airports that wish to increase either the passenger or air traffic movement caps to allow them to make best use of their existing runways will need to submit applications to the relevant planning authority. We expect that applications to increase existing planning caps by fewer than 10 million passengers per annum (mppa) can be taken forward through local planning authorities under the Town and Country Planning Act 1990. As part of any planning application airports will need to demonstrate how they will mitigate against local environmental issues, taking account of relevant national policies, including any new environmental policies emerging from the Aviation Strategy. This policy statement does not prejudge the decision of those authorities who will be required to give proper consideration to such applications. It instead leaves it up to local, rather than national government, to consider each case on its merits.”

9.12 Paragraph 1.27 states that applications to increase caps by 10mppa or more or deemed nationally significant, would be considered under the Planning Act 2008. The application is to increase the cap by less than 10mppa and is to increase the cap by 8mppa (from 35mppa to 43mpp). At the time of writing this report, a third party called “Stop Stansted Expansion” (SSE) has made a claim for judicial review of a decision by the Secretary of State to not direct that the application be deemed to be a nationally significant infrastructure project.

9.13 Paragraph 1.29 develops the APF (2013) strategy measure of making best use of existing capacity into a more recent particular statement of policy on best use in bold that:

“Therefore, the government is supportive of airports beyond Heathrow making best use of their existing runways. However, we recognise that the development of airports can have negative as well as positive local impacts, including noise levels. We therefore consider that any proposals should be judged by the relevant planning authority, taking careful account of all relevant considerations, particularly economic and environmental impacts and proposed mitigations. This policy does not prejudge the decision of those authorities …”

9.14 The BTH (June 2018) Policy Statement is evidence based and was consulted on. It can be given full weight. The Policy Statement supports making best use of existing capacity having regard to all relevant considerations.

9.15 Current information that the Council has indicates that the emerging Aviation Strategy Green Paper will be published for consultation in late autumn.

9.16 The Airports National Policy Statement (2018) (ANPS) has been presented to Parliament under the Planning Act 2008 and for the purposes of nationally significant infrastructure projects seeking consent under that Act. It recognises the capacity problems at airports in London and the South East. This is starting to result in adverse impacts on the UK economy, and affecting the country's global competitiveness (paragraph 1.2).

9.17 Paragraph 1.12 states that:

"The Airports NPS provides the primary basis for decision making on development consent applications for a Northwest Runway at Heathrow Airport, and will be an important and relevant consideration in respect of applications for new runway capacity and other airport infrastructure in London and the South East of England."

9.18 Paragraph 1.41 states, however:

"The Airports NPS does not have effect in relation to an application for development consent for an airport development not comprised in an application relating to the Heathrow Northwest Runway, and proposals for new terminal capacity located between the Northwest Runway at Heathrow Airport and the existing Northern Runway and reconfiguration of terminal facilities between the two existing runways at Heathrow Airport."

9.19 Paragraphs 1.38-1.39 also explain the relationship of the NPS policy with the APF (2013). Paragraph 1.38 states:

"The Airports NPS sets out Government policy on expanding airport capacity in the South East of England, in particular by developing a Northwest Runway at Heathrow Airport. Any application for a new Northwest Runway development at Heathrow will be considered under the Airports NPS. Other Government policy on airport capacity has been set out in the Aviation Policy Framework, published in 2013. The Airports NPS does not affect Government policy on wider aviation issues, for which the 2013 Aviation Policy Framework and any subsequent policy statements still apply."

9.20 Paragraph 1.39 then states:

"On 21 July 2017, the Government issued a call for evidence on a new Aviation Strategy.[22] Having analysed the responses, the Government has confirmed that it is supportive of airports beyond Heathrow making best use of their existing runways. However, we recognise that the development of airports can have positive and negative impacts, including on noise levels. We consider that any proposals should be judged on their individual merits by the relevant planning authority, taking careful account of all relevant considerations, particularly economic and environmental impacts."

Footnote 22 identifies: *"the new Aviation Strategy as "Beyond the Horizon: The Future of Aviation".*

9.21 Paragraph 1.42 states:

"As indicated in paragraph 1.39 above, airports wishing to make more intensive use of existing runways will still need to submit an application for planning permission or development consent to the relevant authority, which should be judged on the application's individual merits. However, in light of the findings of the Airports Commission on the need for more intensive use of existing

infrastructure as described at paragraph 1.6 above, the Government accepts that it may well be possible for existing airports to demonstrate sufficient need for their proposals, additional to (or different from) the need which is met by the provision of a Northwest Runway at Heathrow. As indicated in paragraph 1.39 above, the Government's policy on this issue will continue to be considered in the context of developing a new Aviation Strategy."

9.22 At a general level, the APF (2013) set out the Aviation Forecasts in paragraphs 1.50 – 1.56 and paragraph 1.54 concluded that the major South East Airports would be likely full by 2030, and possibly either later or sooner.

9.23 More recently and also at a general level, Section 2 of the ANPS (July 2018) sets out the overall need for additional airport capacity in the UK in overall terms (see paragraphs 2.9 and 2.33). Section 2 is a material planning consideration. Section 2 highlights the overall economic benefits of both air freight and tourism. Paragraphs 2.10-2.18 explain the need for new airport capacity. It considers that aviation demand is likely to increase significantly between now and 2050. All major airports in the South East are expected to be full by the mid-2030s, with four out of the five full by the mid-2020s. Demand is expected to outstrip capacity by at least 34% (paragraph 2.12). The government states that not increasing capacity would be damaging to the economy and result in negative impacts on passengers (paragraphs 2.16-17).

9.24 The ANPS also refers to the work of the Airports Commission which published its final report in July 2015. In line with paragraph 2 of the APF, Paragraph 2.28 of the ANPS states:

"The Commission's remit also required it to look at how to make best use of existing airport infrastructure, before new capacity becomes operational. The Commission noted in its final report that a new runway will not open for at least 10 years. It therefore considered it imperative that the UK continues to grow its domestic and international connectivity in this period, which it considered would require more intensive use of existing airports other than Heathrow and Gatwick."

9.25 The BTH (June 2018), paragraph 1.4, explains that the 2017 forecasts by the Department for Transport, include London airports including Stansted, and "reflect the accelerated growth experienced in recent years and that demand was 9% higher in London in 2016 than the Airports Commission forecast. This has put pressure on existing infrastructure…". The Department "UK Aviation Forecasts" (October 2017), paragraph 1.3, states that the "purpose of these forecasts is primarily informing longer term strategic policy rather than providing detailed forecasts at each individual airport in the short term; the uncertainty reflected by future demand growth scenarios at the national level is compounded at the level of the individual airport", and the forecasts are provided for continuity and transparency of forecasting methodology.

9.26 It is reasonable to consider that the requirement for more intensive use of other airports, such as Stansted, by making best use of their infrastructure, is a government imperative based on evidence and consultation and so can be given significant weight here.

9.27 The Regulation 19 Uttlesford Local Plan is a material consideration. It carries limited weight at the present time due to it being at an early stage in the plan-making process. Furthermore, a further period of consultation is due to be undertaken between 16 October and 27 November 2018 on an Addendum of

Focussed Change covering three issues, none specifically related to this proposal. The Spatial Vision identifies the importance of Stansted Airport in the London Stansted Cambridge Corridor. This also states that the environmental impact of London Stansted Airport will be effectively managed. It further sets out the need for safe and affordable environmentally sustainable alternatives to the use of the car for access to and from the airport.

9.28 Theme 2 of the Regulation 19 Plan is to "Support Sustainable Business Growth". This aims to accommodate development by utilising the permitted capacity of the existing runway and provide for the maximum number of connecting journeys by air passengers and workers to be made by public transport. It also aims to ensure that appropriate surface infrastructure and service capacity will be provided without impacting on capacity to meet the demands of other network users (such as commuters) and enabling local residents to access rail, bus and coach services to and from the airport.

9.29 Policy SP2 states that "Sustainable growth of London Stansted Airport will be supported in principle, subject to conformity with the environmental and transport framework set out in Policy SP11 – London Stansted Airport."

9.30 Policy SP11 is broken up into different sections, not all of which directly relate to this application. The sections relevant to this application are:

"Policy SP 11: London Stansted Airport

Sustainable growth of London Stansted Airport will be supported in principle and is designated as a Strategic Allocation in the Local Plan. The Strategic Allocation (see Policies Map) includes land within the existing airport operational area and incorporates the North Stansted Employment Area. The wider strategic allocation serves the strategic role of London Stansted Airport and associated growth of business, industry and education, including aviation engineering, distribution and service sectors and the airport college which are important for Uttlesford, the sub-regional and national economy.

Access to London Stansted Airport

London Stansted Airport's role as a national, regional and local transport interchange will be maintained. The necessary local and strategic transport infrastructure and rail, coach, bus, pedestrian and cycle capacity to accommodate the passenger and employee trips and other journeys via connections at the airport must be maintained and enhanced. An integrated approach must be demonstrated within the framework of a surface access strategy.

To assist development of new rapid transit options between the airport and new and existing communities, land will be safeguarded to allow access at the terminal. The council will seek financial contributions from the airport operator for the delivery of an appropriate scheme.

Airport Development

Proposals for the development of the airport and its operation, together with any associated surface access improvements, will be assessed against the Local Plan policies as a whole. Proposals for development will only be supported where all of the following criteria are met:

1. They are directly related to airport use of development, apart from within the North Stansted Employment Area;
2. They contribute to achieving the latest national aviation policies;
3. They are in accordance with the latest permission;
4. Do not result in a significant increase in Air Transport Movements or air passenger numbers that would adversely affect the amenities of surrounding occupiers, or the local environment or transport networks (in terms of, noise, disturbance, air quality and climate change impacts);
5. Achieve further noise reduction or no increase in day or night time noise in accordance with the airport's most recent Airport Noise Action Plan (approved by the Secretary of State on a five yearly basis);
6. Include an effective noise control, monitoring and management scheme that ensures that current and future operations at the airport are fully in accordance with the policies of this Plan and any planning permission that has been granted;
7. Include proposals which will over time result in a proportionate diminution and betterment of the effects of aircraft operations on the amenity of local residents and occupiers and users of sensitive premises in the area, such as through measures to be taken to encourage fleet modernisation or otherwise;
8. Incorporate sustainable transportation and surface access measures in particular which minimise use of the private car, and maximise the availability and use of sustainable transport modes and seek to meet modal shift targets, all in accordance with the London Stansted Sustainable Development Plan;
9. Incorporate suitable road access for vehicles including any necessary improvements required as a result of the development and demonstrate that the proposals do not adversely affect the adjoining highway network; and will not lead to detriment to the amenity of the area and neighbouring occupiers;
10. Be consistent with the latest Sustainable Development Plan for the Airport.

London Stansted Airport Strategic Allocation

Development proposals at the London Stansted Airport Strategic Allocation will ensure:

15. Appropriate strategic landscaping will be provided both on and off site, which shall have regard to the potential for significant visual prominence within the wider area of built development and which does not increase risk to aviation operations arising from structures, lighting, bird strike or open water and having regard to operational and national security considerations; and
16. The height and design of buildings will reflect the site's countryside setting, its visibility from surrounding countryside; and
17. Provision is made for sustainable drainage and the disposal of surface water in order to prevent any harm occurring to neighbouring land.

Strategic Landscape Areas

*Development will not be permitted within those areas identified as strategic landscape areas on the Policies Map Inset." **

* (NB, the numbering does not match that in the Regulation 19 Plan as there has been a formatting error in the document)

9.31 Members are reminded that the Regulation 19 Local Plan has not yet been submitted for examination and thus not tested for soundness. With regards to Draft Policy SP11 20 people/organisations have made comments on the policy. The key issues raised are:

- Whether it is possible in practice to have “sustainable growth” of London Stansted Airport.
- Strengthening of the policy with a requirement for specific ongoing noise impact reduction and for Stansted to take responsibility for working with communities to reduce the community noise burden.
- Concerns over the best way to word the criteria of the policy for Airport Development to be “in accordance with the latest permission”
- Objection to the references to the Stansted Airport Sustainable Development Plan and Stansted Airport Noise Action Plan which are produced by Stansted Airport and UDC has no control over their contents and which could be inconsistent with UDC policy.
- Objection to allowing off airport parking
- Support for allowing off airport parking but object to aspects of criteria

9.32 As can be seen above, the adopted Uttlesford Local Plan Policy S4 makes no provision except in development zones for expansion of existing airport infrastructure at Stansted. The reasoned justification refers to the particular significance of national airports policy. The material consideration of the APF (2013) supports making better use of existing runway capacity and through measures to make best use of existing capacity. The most recent particular Policy Statement guidance, the BTH (June 2018), supports in paragraphs 1.25-1.29, making best use of existing runways, taking account of all relevant considerations. It is reasonable to attribute significant weight to the national policy of supporting best use of existing runways, whereas the APF offers general policy support for maximising the capacity of the airport at both local and national level, subject to the environmental impacts being managed or mitigated.

9.33 It is on this basis that the applicant is applying for an increase in passenger numbers from the permitted 35mppa to 43mppa. This would be achieved within the context of the currently permitted aircraft movements of 274,000. This limit is currently made up of 243,500 passenger aircraft movements (ATM), 20,500 cargo aircraft movements and 10,000 general aviation movements. However, it is proposed that the current caps become unified and include a maximum of 16,000 cargo aircraft movements.

9.34 The basis of the current annual caps is the 2008 Planning Permission (reference UTT/0717/06/FUL; appeal reference APP/C1570/A/06/2032278), granted by the joint decision of the Secretaries of State for Communities and Local Government and for Transport, and is subject to: condition MPPA 1, Passenger Throughout, caps that throughout to 35mppa; condition ATM1, Air Transport Movements, caps those movements at 264,000 ATMs, and condition ATM2 caps general aviation aircraft movements at 10,000; each cap applying in any twelve month period.

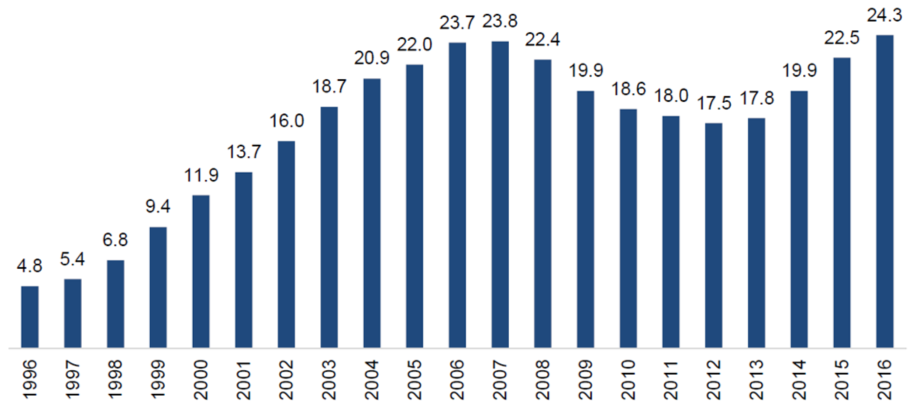
9.35 It is reasonable to consider that the 2008 Planning Permission is a realistic fall back position. The forecast demand for throughput show that it is likely that the 35mppa cap would be reached during 2022-23 (see figure 4.13 of the ES below).

9.36 Looking forwards, the BTH (June 2018) includes at paragraph 1.4 a summary of the Department for Transport “UK Aviation Forecasts” (October 2017), paragraph 1.3 of those forecasts makes clear that their “purpose … is primarily informing longer term strategic policy rather than providing detailed forecasts at each individual airport in the short term; the uncertainty reflected by future demand growth scenarios at the national level is compounded at the level of the individual airport”.

9.37 Section 2 of the ANPS (July 2018) sets out overall level of need in particular between paragraphs 2.10 and 2.18 and addresses the alternatives at paragraphs 2.21, 2.2 and 2.28. Paragraph 2.22 states that the Airports Commission noted that “the need for make best use of existing infrastructure would remain” and 2.28 states that it is imperative to grow the domestic and international connectivity in the 10 years before a new runway at Heathrow was operational and that this would require more intensive use of existing airports.

9.38 The Department for Transport “UK Forecasts” referred to in paragraph 1.4 of BTH (June 2018) commence at a baseline 2016 with 24mppa identified at Stansted (Table 10) and address forecasts at 10 year increments: 2030, 2040 and 2050 but without intervening increments. Paragraph 1.4 states that “While the department aims to accurately reflect existing planning restrictions on the expansion of airports, the forecasts should not be considered a cap on the development of individual airports. In some circumstances, more recent airport specific data and forecasts might be used, in conjunction with additional relevant information, to inform planning decisions”.

9.39 MAG purchased Stansted Airport in 2013 and following that date it has recorded specific local information about it and seen rapid intensification: there has been an initial slow and recently a more rapid increase in passenger throughput. The Environmental Statement, Chapter 4, sets out Aviation Forecasts (February 2018) in annual increments to 2028, by an independent aviation specialist: ICF Aviation Services Group. Passenger numbers increased from 17.8m in 2013 to 24.3mppa in 2016. To the year ending July 2018, actual throughput was measured at 27mppa (7.3% up on the previous year) according to CAA data, being a higher percentage than the Department for Transport’s scenario forecasts. Data to 2016 is set out in Figure 4.5 in the Environmental Statement (see below).



Source: CAA

Figure 4.5: 1996-2016 Historical passenger growth at Stansted Airport (mppa)

(Reproduced from page 4-7 of Environmental Statement Volume 1)

9.40 Aircraft sizes have also increased over the years, with the average passenger aircraft size being 184 seats at Stansted in 2016. This had an average loading of 87%, around 160 passengers per PATM. This is an increase from 77% loading and 133 passengers per PATM since 2006. PATMs in 2016 were approximately 152,000 and CATMs were 14,000.

9.41 Forecasts were calculated assessing relationships between air travel demand and Gross Domestic Product (GDP). The post-Brexit Oxford Economics' central case was used. Demand was then allocated to the London airports based on a historical base of 2016, local catchment, existing network, and price and operational considerations. In terms of capacity, ES paragraph 4.7, bullet 1, notes that Heathrow is considered to be at capacity with no new runway being operational until 2030. Paragraph 4.47 notes that Gatwick is expected to reach its capacity of 300,000 ATMs (currently at 277,000 in 2016 (ES), and at 286,000 in June 2017 (Gatwick website)). Luton is currently capped at 18mppa with throughput of approximately 14.5mppa in 2016. London City airport is capped at 6.5mppa (throughput of approximately 4.5mppa in 2016). London Southend is assumed to be capped at 2mppa. Passenger throughput at Southend declined in 2016 to 875,549 from a previous high of 1.1mppa in 2014.

9.42 Figures 4.11 and 4.12 in the Environmental Statement sets out the passenger demand forecasts for the London airports. Comparison between the two shows a level of unmet demand in the London area from 2022, assuming existing constraints remain in place.

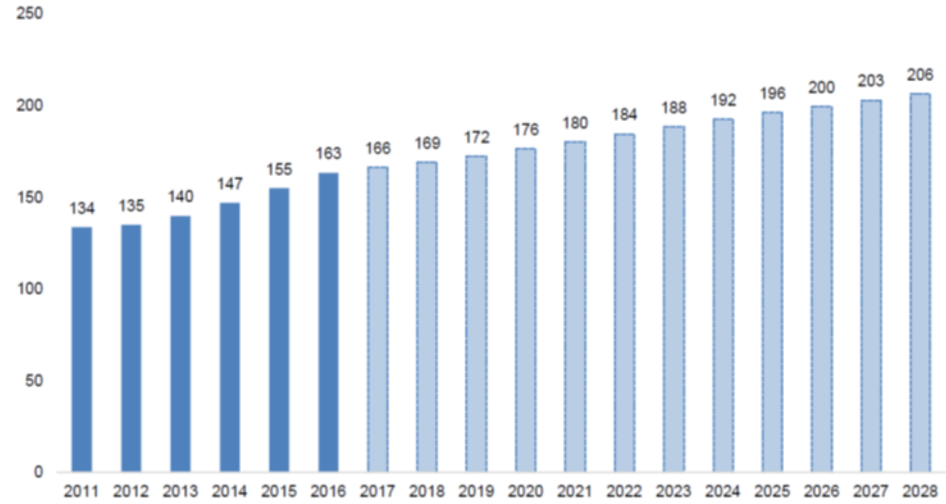


Figure 4.11: London passenger demand forecast (mppa, unconstrained)

(Reproduced from page 4-13 of Environmental Statement Volume 1)

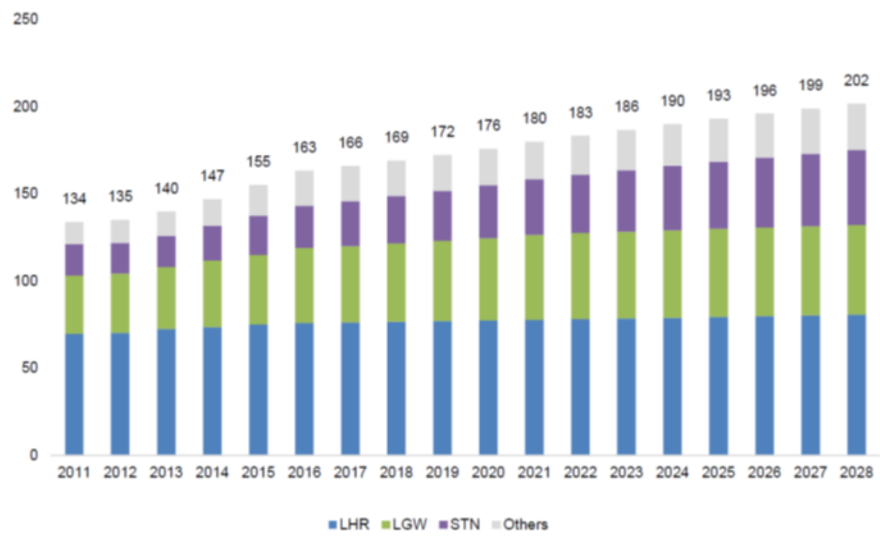


Figure 4.12: London passenger demand forecast (mppa, constrained)

(Reproduced from page 4-14 of Environmental Statement Volume 1)

9.43 The expected growth is envisaged to be accommodated by larger planes with the potential for average loadings to be 170 passengers per ATM in comparison to 160 at present. This would be coupled with long-haul route development.

9.44 The proposal includes the construction of a new RAT and RET and 9 additional aircraft stands. Paragraphs 4.15-4.19 of the Planning Statement set out the reasons for the additional infrastructure.

9.45 Principally, the RAT and RET provide facilities which would permit the optimisation of the runway. The runway is capable of handling large, wide body aircraft but the majority of aircraft are smaller narrow body aircraft. The layout of the runway does not provide for best use of the runway, requiring aircraft to have longer than necessary taxiing periods. The additional RAT and RET would enable aircraft to enter and exit the runway at more optimal points. This would have additional benefits such as reduced fuel burn time, reduction in noise and pollution associated with that burn time and the taxiing movements.

9.46 The additional stands are required to provide for increased parking, typically overnight, in the busy summer periods. This will enable more airport-based aircraft to be operational in the peak morning period.

9.47 Figures 4.13 and 4.14 from the Environmental Statement show the proposed forecasts for passenger growth and ATM forecasts.

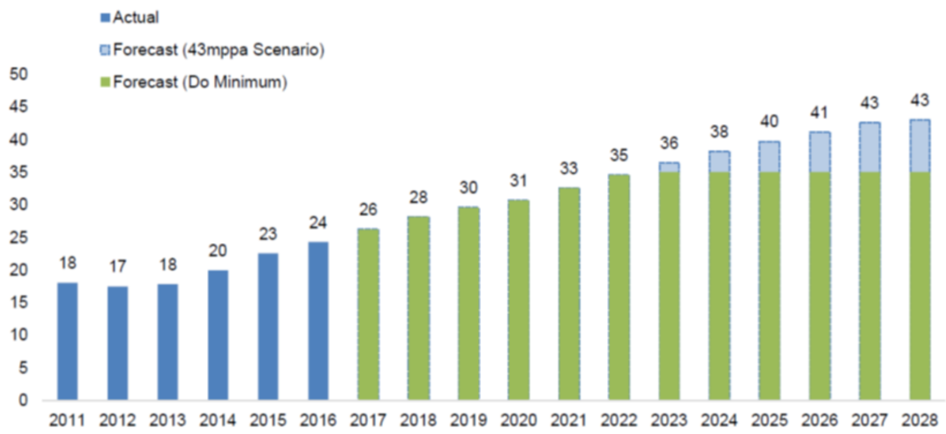


Figure 4.13: Stansted passenger forecast (mppa, constrained)

(Reproduced from page 4-14 of Environmental Statement Volume 1)

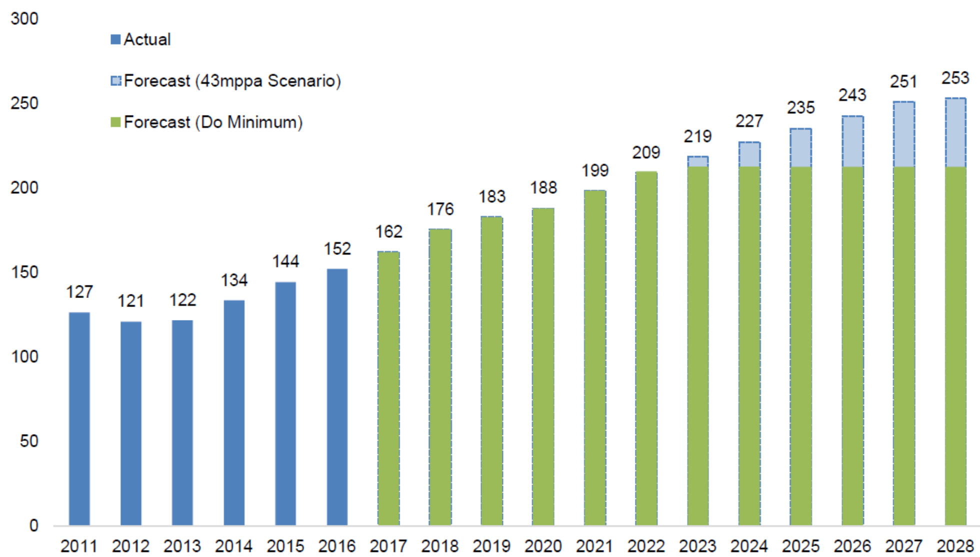


Figure 4.14: Stansted PATMs forecast (000s, constrained)

(Reproduced from page 4-15 of Environmental Statement Volume 1)

9.48 Figures 4.13 and 4.14 differ between 2016 and 2028 from the forecast trajectory between 2016 and 2030 of the Department for Transport "UK Aviation Forecasts" (October 2017). The ES compares, at paragraphs 4.65-4.70 of Chapter 4, its forecast with those for the airport of the Department. The ES forecasting approach reflects paragraph 1.3 of the Department's Forecasts which states that "at the airport level the department's forecasts may also differ from local airport forecasts. The latter may be produced for different purposes and may be informed by specific commercial and local information – such information is particularly relevant in the short-term. For example, an airport might have reached an agreement with an airline to increase frequencies or routes". As anticipated by the Department, the ES forecasts differ, as ES paragraph 4.69 explains, due to differences in forecasting methodologies including the absence of short-term adjustments from the Department forecasts referred to in ES paragraph 4.49, such as route development.

9.49 It is reasonable to consider that the ES and Figures above appropriately show the forecast growth of Stansted airport based on the local and commercial knowledge of the applicant.

9.50 The NPPF (2018), paragraph 8 sets out the three mutually dependant objectives of sustainable development: economic; social; and environmental. Paragraph 8(a) states that the economic objective includes identification and provision of infrastructure. Paragraph 80, requires that significant weight be placed on the need to support economic growth. BTH (June 2018), paragraph 1.29, requires that careful account be taken of all relevant considerations, particularly economic impacts.

9.51 In addition to the forecasts addressed in the ES, ANPS (July 2018), Section 2, paragraphs 2.1-2.9, set out the overall importance of aviation to the UK economy. ES, Chapter 11, Socio-Economic Impacts, addresses the economic benefits from the application. In particular, between paragraphs 11.44-11.171. Table 11.14 summarises the socio-economic impacts and includes:

- an increased range and frequency of flights; enabling an additional 1.2 million business passengers to travel through the airport and contribute to attractiveness of the area for inward investment;
- enabling 2.2 million foreign leisure passengers to arrive through the airport and 4.6 million UK passengers to make leisure trips abroad. In-bound leisure passengers support about 13,00 jobs and would provide a GVA of about £336m in 2028; enabling 800 tonnes of cargo to be carried; employing 300 people to build the development (£23.4 GVA over 10 months) and generating an additional 5,400 (and GVA of £357.3m) over the Do Minimum scenario.

9.52 As set out in the BTH (June 2018) the making of best use of the existing runway capacity (here, of Stansted Airport) has to take account of relevant environmental considerations. This means that, within the NPPF (2018), the economic benefits of the proposals must be weighed against the environmental and social objectives. In order to assess the environmental objective, the environmental impacts arising from the application are assessed in the accompanying Environmental Statement covering the principal environmental issues in respect of the proposals. The remainder of this report will discuss each chapter of the ES.

Approach of the Environmental Statement

9.53 As set out above, Regulation 4(5) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 requires the local planning authority to ensure they have, or have access as necessary to, sufficient expertise to examine the environmental statement. The expertise provided has been sufficient or the local planning authority to examine the environmental statement.

9.54 The Environmental Statement (ES) assesses the environmental impacts of the proposals across a range of topics. The approach of the ES is to consider the baseline of existing environmental conditions. This is generally set at 2016 with slight variations depending on the availability of baseline data.

9.55 The ES considers how the baseline conditions may change over time before the proposed development is implemented. Therefore, where possible, the existing baseline data has been extrapolated and modelled to identify the likely ‘projected baseline’ conditions in 2021 (the commencement date for construction) and 2023 (the date at which 35mppa is projected to be reached).

9.56 The projected 35mppa baseline is referred to as the ‘Do Minimum’ scenario rather than ‘Do Nothing’ scenario. This is because certain planned changes to the airport will occur prior to the 35mppa cap being reached in 2023, with or without the operational development to the existing runway and lifting of the existing annual passenger cap. These planned developments will either be built out under the extant parts of the 2003 and 2008 planning permissions or implemented by the applicant in accordance with its permitted development rights under Class F of Part 8 of the Town and Country Planning (General Permitted Development) (England) Order 2015. These developments include:

- New Arrivals Terminal (permitted 2017) – works anticipated to commence in 2019 with completion in summer 2020
- Echo apron and stands – granted under the 15mppa+ planning permission (reference UTT/1000/01/OP). This last element has commenced and anticipated to be completed by late 2018
- Additional car parks – land for additional surface car parking exists on the south side of the airfield and there is future potential for multi-level parking on existing car parks. One such example is the multi-level car park currently under construction in the Green short stay car park.

9.57 All planned permitted developments are assumed to be in place and operational by 2020. Therefore, there will be no cumulative construction or other ‘in combination’ effects. The year 2023 is envisaged as being the transitional year, the point at which the existing 35mppa cap is envisaged to be reached and the environmental impacts would then differ between the Do Minimum (35mppa) and development case (43mppa) scenarios. Final assessment is made of impacts in 2028, the year it is envisaged 43mppa would be reached. The primary comparison to be made is between the ‘Do Minimum’ and the ‘development case’ in line with the assessment made by the Generation 1 planning inspector in his report of 14 January 2008. The local planning authority is considering the impacts of the proposals over and above the permitted development, ie the difference between Do Minimum and the ‘development case’. This is because the Do Minimum scenario already has planning permission and is expected to go ahead irrespective of the decision in respect on this application, and in light of the ES forecasts, reasonably represents a fall-back position.

9.58 Table 2.3 (page 2-19) of the ES sets out the assumptions for existing baseline, construction baseline and the Do Minimum baseline.

	2016 (Existing baseline)	2021 (Construction baseline)	2023 (Do Minimum baseline)
Total passengers ('000s)	24,300	32,600	35,000
Passenger ATMs ('000s)	152	199	213
Cargo AMTs ('000s)	12	13	14
Other ('000s)	16	19	19
Total Movements ('000s)	181	231	247

9.59 Table 2.4 (page 2-20) sets out the summary key statistics between the Do Minimum and Development Case.

	2023 Transitional Year		2028 Principal Assessment Year	
	Do Minimum Scenario	Development Case	Do Minimum Scenario	Development Case
Total passengers ('000s)	35,000	36,400	35,000	43,000
Passenger ATMs ('000s)	213	219	212	253
Cargo ATMs ('000s)	14	14	17	16
Other ('000s)	19	20	20	5
Total Movements ('000s)	247	253	249	274

9.60 Table 2.5 (page 2-22) sets out the Impact Magnitude Matrix which sets out how impacts are assessed.

Sensitivity/value of receptor	Magnitude of effect or impact			
	High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

9.61 Table 2.6 sets out the significance criteria which determine the level of magnitude of effect or impact.

Level of significance	Description
Major	Very large or large change in environmental or socio-economic conditions, which is irreversible and pronounced. Effects, both adverse and beneficial, which are likely to be important considerations at a national, regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and/or breaches of legislation. **Major effects are deemed significant in the context of EIA.**
Moderate	Intermediate change in environmental or socio-economic conditions leading to measurable effects, both adverse and beneficial, which are likely to be important considerations at a local or district level. **Moderate effects are deemed significant in the context of EIA.**
Minor	Small change in environmental or socio-economic conditions. These effects may be raised as local issues but are unlikely to be of importance in the decision making process. **Minor effects are not normally deemed significant in the context of EIA.**
Negligible	No discernible change in environmental or socio-economic conditions. An effect that is likely to have a negligible or neutral influence, irrespective of other effects. **Negligible effects are not significant in the context of EIA.**

Development Programme and Construction Environmental Management

9.62 Physical infrastructure works are required as part of the proposals. These consist of the construction of a Rapid Access Taxiway (RAT) and Rapid Exit Taxiway (RET) and nine aircraft stands, six in the middle part of the airfield (known as the Yankee Remote Stands) and three to the north of the existing Echo Stands. The total area of land required for the development is around 7 hectares and this will be made impermeable by the development. The ES sets out the timetable for construction as being a 12 month period starting in 2021 and to be completed by mid-2022.

9.63 Physical infrastructure works result in short-term impacts which would include noise and disturbance in respect of vehicular movements and the construction works. Environmental impacts will arise as a result of noise, dust, vibration and waste materials. Due to the nature of the works these will need to be undertaken at night when sensitivities are higher. The environmental impacts will be considered in each of the topic chapters.

9.64 The issue of the additional infrastructure has been raised in many of the representations. These claim that the additional infrastructure works result in the proposals being contrary to the government's support for best use of existing runways as this infrastructure would increase airport capacity.

9.65 The 2008 Planning Permission for 35mppa (UTT/0717/06/FUL) included a RAT and RET for 25mppa and an additional RAT and RET being required for runway operations at 35mppa. Whilst the 25mppa infrastructure has been constructed, the RAT and RET proposed for 35mppa, located at the northern end of the runway, have not been carried out. Therefore, the current application proposals do not increase the area of infrastructure required for optimised use of the runway, rather they propose to relocate the RAT and RET to enable more efficient operations better suited to the way the airport operates today.

B Surface Access and Transport

9.66 Chapter 6 of the ES assesses the environmental impacts of surface access. This chapter needs to be read in conjunction with the accompanying Transport Assessment (Volume 3 of the ES) and the updates and additional information contained in the Consultation Response and Clarifications document produced in July 2018.

9.67 Adopted Uttlesford Local Plan Policy GEN1 sets out the requirements for development in terms of access. Essentially, these are the requirement for the main road network to be able to accommodate the traffic flows safely, design mustn't impact on other road users, and the proposals encourage movement by means other than the private car. The policy is generally consistent with the NPPF, although there is more emphasis in the NPPF to sustainable transport modes whilst acknowledging that there will be differences in opportunities between rural and urban areas. The NPPF is more positively worded in seeking to minimise the need to travel and maximise cyclist and pedestrian and public transport opportunities. This policy should therefore be given moderate weight.

9.68 Policy GEN6 requires development proposals to make appropriate provision for supporting infrastructure, including transport provision. This policy is generally consistent with the NPPF, but the latter recognises the need for viability of development to be considered. In addition, there is a requirement to take into account the Community Infrastructure Regulations. The policy should be given moderate weight.

9.69 The provisions for infrastructure can be made by the applicant or, where cumulative impacts result in mitigation being required, by financial contribution. All provisions (including financial contributions) are required to meet all the tests as set out in the CIL Regulations and paragraph 56 of the NPPF (2018). These tests are:

a) Necessary to make the development acceptable in planning terms;
b) Directly related to the development; and
c) Fairly and reasonably related in scale and kind to the development.

9.70 The NPPF (2018) has an overall presumption in favour of sustainable development. Paragraph 8 sets out the parameters for assessing if development is sustainable. Section 9 promotes sustainable transport. Paragraph 103 requires that the planning system actively manage patterns of growth in support of the objectives identified in paragraph 102 (a)-(e). Measures include opportunities to promote first walking, cycling and then facilitating access to public transport, and to ensure the environmental impacts of traffic and transport infrastructure are identified, assessed and taken into account, including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains (see paragraphs 108 and 110). In addition to economic impacts, BTH (June 2018), paragraph 1.29, requires that careful account is taken of all relevant considerations, particularly environmental impacts and proposed mitigations.

9.71 Section 5 of the ANPS (July 2018) sets out the assessment of impacts in relation to the Northwest Runway at Heathrow. The assessments will not be the same for development proposals at Stansted Airport, but the principles in relation to the assessments will be similar and therefore it is appropriate to consider the approach set out in that document.

9.72 Paragraph 5.5 of the ANPS states:

"The Government's objective for surface access is to ensure that access to the airport by road, rail and public transport is high quality, efficient and reliable for passengers, freight operators and airport workers who use transport on a daily basis. The Government also wishes to see the number of journeys made to airports by sustainable modes of transport maximised as much as possible. This should be delivered in a way that minimises congestion and environmental impacts, for example on air quality."

9.73 Alternative means of transport to the private car and minimising environmental impacts are fundamental principles of sustainable development. As set out in the Transport Assessment (Volume 3 of the ES), in 2017 around 51.2% of air passengers used public transport, and around 27% of staff (paragraph 2.66). Table 4.2 (as amended in the Addendum) shows that the public transport mode share for air passengers has been consistently around the 49-51% mark since 2010. This has been roughly evenly split between rail and coach services with fluctuations and variations depending on marketing strategies by the operators. Since 2000, the most significant changes have been the reduction in the private car/hire car/taxi mode share for air passengers from about 66% to 49% (2017) and an increase in the bus/coach mode share from 7% to 21% (also 2017).

9.74 The Surface Access Chapter of the ES assesses the potential impacts of operational and construction traffic and access to the airport by road, including public transport, and rail. The baseline is 2016 with survey data setting out the current position. Three scenarios are then considered:

- 2021/22 – 12 month construction period
- 2028 Do Minimum (35mppa) scenario; and
- 2028 Development Case (43mppa)

9.75 Assessments include trip generation, impacts on highways including impacts on pedestrians due to severance, delay, amenity, fear and intimidation and accidents and safety. Impacts on public safety and walking and cycling are also undertaken.

9.76 Assumptions have been made as set out on page 6-19 of the ES. These include public transport mode share remaining constant for air passengers, a 10% modal shift to public transport by employees and retention of existing passenger and employee origins for future years to take account of modelling uncertainty.

9.77 Assessments have been made in respect of the strategic highway network (M11 and A120), airport roads, and local roads. As agreed in principle with ECC, highway peaks of 07:00 – 08:00 and 17:00 – 18:00 and an airport peak of 16:00 – 17:00 have been assessed. The AM peak arrival period for passengers is 05:00 – 06:00. In addition, assessments have been undertaken in respect of the rail network. The peak hours on the rail network are 07:00 – 10:00 and 16:00 – 19:00, and an assessment daily from 00:00 to 23:59.

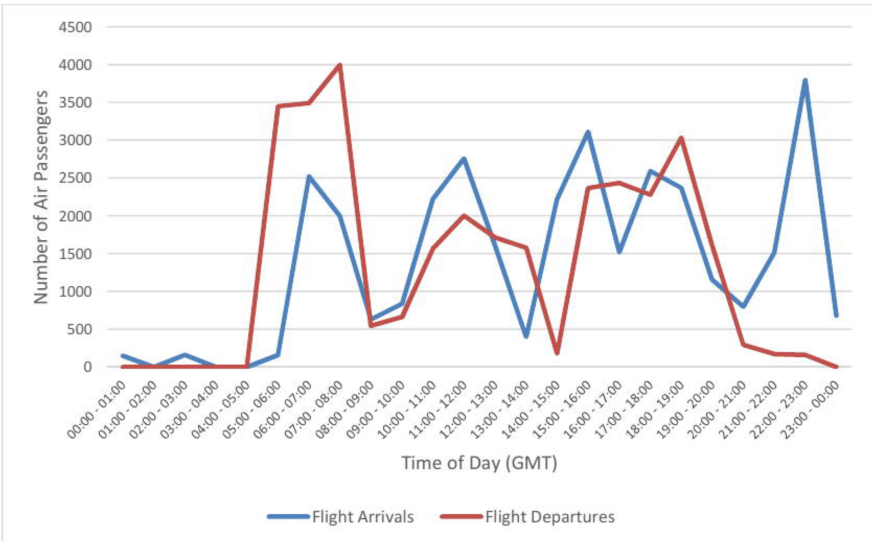
Surface Access Assumptions and Scene Setting

9.78 Operational phase surface access impacts are assessed in two scenarios – the Do Minimum whereby passenger numbers are expected to reach 35mppa in 2023 (already granted consent) and then remain constant. The Development Case scenario sees passenger numbers continuing to increase from 2023 to 43mppa in 2028.

9.79 The Transport Assessment which informs Chapter 6 of the ES is based on summer operations (March to October), which is normal modelling for airport assessments.

9.80 Current runway operations at the airport have a peak of departures in the 06:00 – 09:00 time slot. There is a smaller peak between 10:00 – 14:00 and then again between 16:00 – 20:00. Arrivals have peaks and troughs throughout the day centred around 07:00, 11:00, 15:00; 17:00 – 18:00 and 22:00. Figure 4.3 in the Transport Assessment shows the 2016 Daily Flight Profiles.

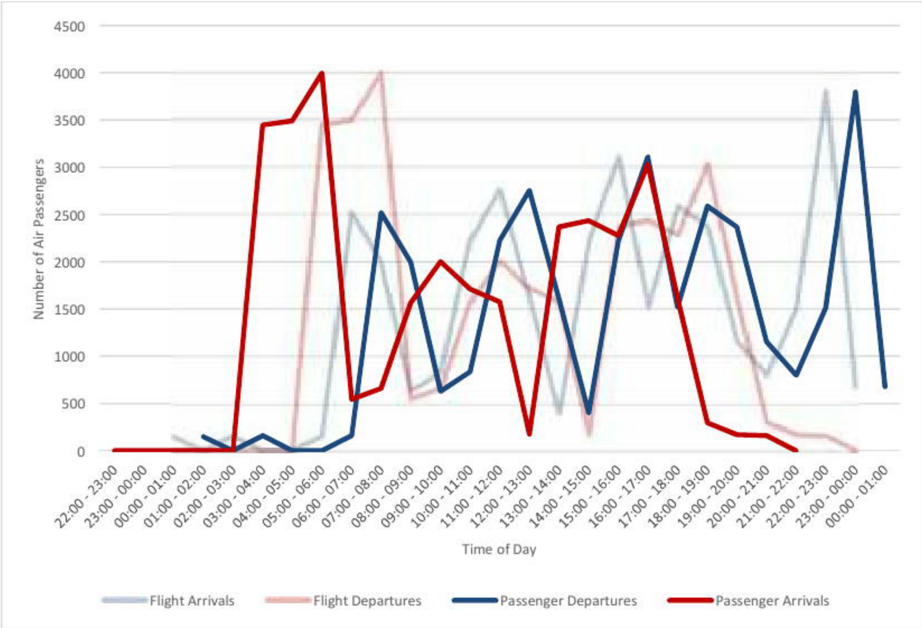
Figure 4.3: 2016 Daily Flight Profiles – Arrivals and Departures



(Reproduced from Environmental Statement Volume 3, page 29)

9.81 Figure 4.4 shows the same data with the passenger arrival and departures superimposed. NB, in Figure 4.4 the information shown in Figure 4.3 is the lighter colour red and blue. Figure 4.4 shows the 2-hour “lead in” time needed for departing passengers and the 1-hour “lag” time for arriving passengers.

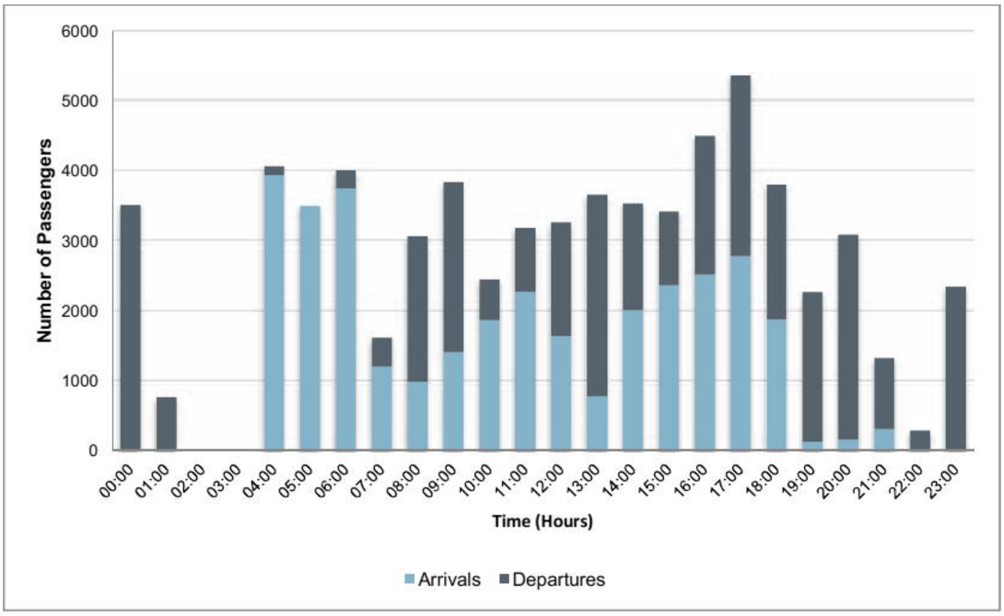
Figure 4.4: 2016 Surface and Flight Arrivals and Departure Profiles



(Reproduced from Environmental Statement Volume 3, page 30)

9.82 Table 4.5 shows the average daily profile for surface airport arrivals and departures in 2016.

Figure 4.5: Average Daily Profile for Surface Airport Arrivals and Departures (2016)



(Reproduced from Environmental Statement Volume 3, page 31)

9.83 Table 4.7, page 32, sets out the average typical daily passenger surface arrival and departure profile on an hourly basis. The assumption, based on typical average, is that the number of arrivals and departures are the same. An average day will see 66,684 passengers passing through the airport. Of these, 33,342 arriving/departing by car, including taxi, 18,004 by train and 15,338 by coach.

Taking into account “lead” and “lag” times, peak arrivals are 04:00 – 06:00 and peak departures are after midnight.

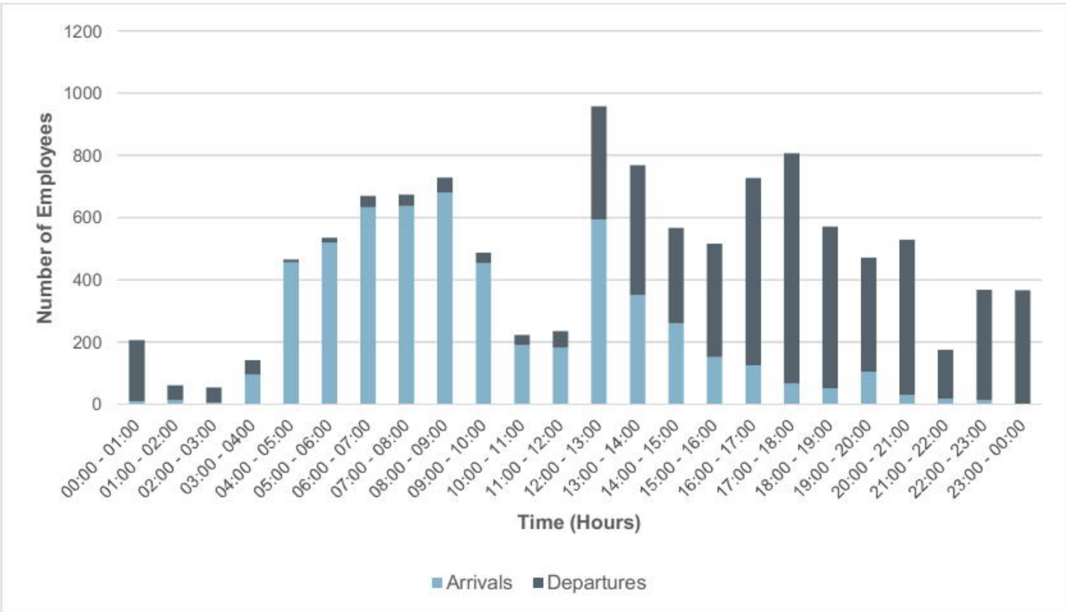
9.84 In terms of employees, baseline data was established via staff travel survey data. This established there were 10,963 employees in 2015. Transport modes were 64.9% by private car, 5.7% car passenger, 26.9% public transport and 2.5% were classified as other. A small number of staff do cycle to work.

9.85 Historical data shows that car use has fallen from 87.6% in 2002/3 with a steady decline to the present rate of 64.9%. Car passengers have fluctuated between a low of 4.1% in 2002/3 to a high of 7.1% in 2011. Public transport use has increased from 7% in 2002/3 to its current level.

9.86 Employees predominantly come from Essex, Hertfordshire and Greater London. Around 24.5% live in East Hertfordshire, 18.3% in Uttlesford, 15% in Braintree District, and 7.4% in Harlow.

9.87 Working patterns indicate that around 66% of employees work 5 days a week and 25.2% work 3-4 days a week. Figure 4.6 shows the average day surface arrivals and departure profile for employees. The data from the 2015 survey were applied to the employee population data to derive a consistent 2016 baseline.

Figure 4.6: Employee Average Day – Surface Arrivals and Departures Profile (2016)



(Reproduced from Environmental Statement Volume 3, page 36)

9.88 This demonstrates that the peak employee arrivals at the airport is 08:00 – 09:00, peak departures is 17:00 – 18:00, and the peak combined is 12:00 – 13:00 reflecting shift change over times.

9.89 Miscellaneous activities within the airport boundary have also been included within the transport data. These include, but are not limited to,

- External visitors, eg Enterprise House
- Visitors to Aerozone

- Non-airport related users of hotel facilities, eg conferences, use of bars/restaurants/leisure facilities
- Stansted Express season ticket holders who park in the Green short stay car park and commute by rail
- Minibus services from off-airport car park operators
- Service and delivery trips
- Cargo

Highways

9.90 Impacts on highways have been considered in the ES and the accompanying Transport Assessment and Transport Assessment Addendum. These consider the impacts of the proposals on the strategic and local road network, including J8 of the M11.

9.91 The baseline assessment year is 2016 and conditions have been established by means of desktop research, site visits and a range of traffic surveys and publicly available data. Traffic counts are a mix of commissioned Automated Traffic Counts (ATCs) supplied from ECC and Manual Classified Counts (MCCs conducted by Intelligent Data Collection in 2015, HE TRIS data traffic counts (2016) Annual Average Daily Traffic Flow (AADT); and ATC and MCC conducted by Nation Wide Data Collection (2017) on behalf of the applicant.

9.92 TEMPro (v7.2) has been used to estimate growth rates from the 2016 baseline. In addition, 2016 passenger and employee information for Stansted Airport was added to account for the growth of airport traffic, not captured using TEMPro v7.2. Cumulative schemes also include the development of Northside which has not yet had a planning application submitted.

9.93 Assessments have been made of AADT flows for an extensive external road network, including M11 J8. In addition, peak hour analysis has been undertaken with a four hour AM peak of 06:00-10:00 and a PM peak of 15:00-19:00.

9.94 Average car occupancy rates of 1.6 passengers per vehicle have been used. The ES Addendum notes that the average rates were based on a misinterpretation of survey data and the actual average loading should be 1.8. The revised figure has not been used to adjust the figures as it is considered that the lower figure of 1.6 gives a more robust worst case scenario.

9.95 Flows on the local and strategic road networks have been assessed for the 07:00-08:00 AM peak hour and the 17:00-18:00 PM peak hour. This data is set out in Tables 7.9 and 7.10 respectively in the Transport Assessment (pages 91-92). It will be noted that the % increase between 2016 to 2028mppa is significantly larger than the % in the final column. This is because the tables assess the impacts from baseline to the consented 35mppa. The final column assesses the difference between the consented 35mppa and the proposed development of 43mppa.

Table 7.9: Traffic Impact – AM Network Peak (07:00-08:00)

Link	2016 Existing Baseline	2028 (35mppa)	% increase (2016 to 2028 35mppa)	2028 (43mppa)	% increase (2028 35mppa to 2028 43mppa)
Parsonage Road	233	281	20.6%	282	0.3%
Stansted services	458	600	31.0%	624	0.4%
Bamber's Green	47	55	17.0%	55	0.0%
Thremhall Avenue	1273	1749	37.4%	1954	11.7%
Molehill Green Road	139	163	17.3%	163	0.0%
Church Road (B)	332	361	8.7%	368	1.9%
Round Coppice Road	533	1050	97.0%	1069	1.8%
Hall Road	202	238	17.8%	238	0.0%
A120 (east of Stansted Airport)	2916	3610	23.8%	3669	1.6%
A120 (east of M11 J8)	4171	5228	25.3%	5433	3.9%

Table 7.10: Traffic Impact – PM Network Peak (17:00-18:00)

Link	2016 Existing Baseline	2028 (35mppa)	% increase (2016 to 2028 35mppa)	2028 (43mppa)	% increase (2028 35mppa to 2028 43mppa)
Parsonage Road	368	432	17.4%	435	0.7%
Stansted services	604	623	3.1%	687	10.3%
Bamber's Green	79	93	17.7%	93	0.0%
Thremhall Avenue	1786	2509	40.5%	2958	17.9%
Molehill Green Road	180	212	17.8%	212	0.0%
Church Road (B)	479	637	33.0%	647	1.6%
Round Coppice Road	686	1172	70.8%	1227	4.7%
Hall Road	291	355	22.0%	355	0.0%
A120 (east of Stansted Airport)	3725	4379	17.6%	4497	2.7%
A120 (east of M11 J8)	5329	5818	9.2%	6266	7.7%

9.96 In terms of the strategic highway network, flows to and from the airport have been analysed and the percentage increase in traffic flows for the AM and PM peak are shown in Tables 7.11 and 7.13 respectively (pages 93-94).

Table 7.11: Percentage Increase in Junction Link Traffic Flows (07:00-08:00)

Road Link	% Increase	
	2016 baseline to 2028 35mppa	2028 35mppa to 2028 43mppa
M11 Junction 8 Motorway Services	20%	3%
A120 West (Bishop's Stortford Bypass)	24%	1%
M11 North of J8	18%	1%
A120 East of J8	23%	3%
B1256 Dunmow Road	18%	0%
M11 South of J8	25%	2%
Priory Wood West	51%	3%
Priory Wood East	17%	0%
Round Coppice Road South	50%	2%
Long Border Road	18%	0%
Round Coppice Road North	35%	2%

Table 7.13 Percentage Increase in Junction Link Traffic Flows (17:00-18:00)

Road Link	% Increase	
	2016 baseline to 2028 35mppa	2028 35mppa to 2028 43mppa
M11 Junction 8 Motorway Services	12%	9%
A120 West (Bishop's Stortford Bypass)	20%	2%
M11 North of J8	15%	4%
A120 East of J8	15%	12%
B1256 Dunmow Road	18%	0%
M11 South of J8	11%	11%
Priory Wood West	17%	12%
Priory Wood East	18%	1%
Round Coppice Road South	37%	6%
Long Border Road	18%	0%
Round Coppice Road North	23%	6%

9.97 Employee growth is projected to grow from a 2016 baseline of 11,600 to 13,200 in 2028 in a Do Minimum scenario (35mppa) and 16,200 in 2028 in the Development Case scenario (43mppa).

9.98 The forecast increase in passenger numbers would have impacts on both the strategic and local road network. The responsibility for these falls to Highways England and Essex County Council respectively. There are also potential impacts on the local road network in Hertfordshire for which Hertfordshire County Council is responsible.

9.99 Sensitivity testing has been carried out in respect of the strategic road network, in particular the M11 junction 8 (J8). This was required to better understand the impact of airport growth from 35mppa to 43mppa and whether the proposed mitigation was appropriate against a background of proposed growth in the Uttlesford Local Plan.

9.100 The testing indicated that performance at the junction is due to deteriorate with or without the airport expansion to 43mppa. The applicant's proposed J8 mitigation measures (for the Interim+ scenario) would improve network performance at

43mppa compared to the 2033 'do minimum' scenario with 35mppa and with ECC's Interim J8 scheme in place. However, the modelling confirms that the network is currently close to capacity, and will be over capacity in 2033. The sensitivity testing also indicates that minor adjustments to the modelled assumptions have significant impacts, particularly to the west of J8 and to the B1256. There is, therefore, a need for the mitigation measures.

9.101 The key locations on the Strategic Road Network (SRN) most likely to experience severe adverse impacts as a result of the airport's proposed expansion are M11 junction 8 interchange and the A120 Priory Wood roundabout which is the next junction a short distance east of the M11. The A120 to the west of the M11 is a local highway managed by Essex County Council (ECC), and forms a bypass of Bishop's Stortford. Birchanger Motorway Service Area is served directly off the M11 J8 gyratory.

9.102 ECC are currently preparing to implement a major improvement to a short section of the A120 west of M11 J8 to support economic growth. These improvements are likely to be able to accommodate some of the traffic growth arising from the airport expansion beyond the current 35mppa limit. However, they are not sufficient to cater for 43mppa. Further improvements are therefore necessary to address the potentially severe impacts on the SRN at M11 J8 and at the A120 Priory Wood roundabout. A mitigation scheme was therefore submitted by the applicant which, in terms of capacity and safety should be adequate to address these impacts.

9.103 The mitigation works relate to additional carriageway widening on key approach/exit arms to/from the M11 J8 signalised roundabout and a series of amendments to lane allocations and limited physical adjustment designed to enhance the capacity of the junction, along with the separate signalisation of the westbound entry of Priory Wood Roundabout. HE has concluded that the additional capacity achieved through these amendments provide mitigation that more than compensates for the additional traffic anticipated to arise from the proposed increase in operations of the airport.

9.104 In parallel with the ECC scheme and the airport's additional improvements, calls have been made for more extensive improvements to the M11 to be included in a future Roads Investment Strategy (RIS). The next RIS covering the period 2020 to 2025 is currently being prepared on behalf of the Department for Transport (DfT). Study work is still progressing to support the development of the next RIS, which is not due to be published by DfT until the latter part of 2019, so it is not yet known whether a scheme to upgrade the M11 or its junctions could be included. However, the possibility of such a scheme being included has had to be acknowledged in the context of this application.

9.105 In light of the above, HE are minded therefore to recommend conditions to be attached to any planning permission. These relate to delivery of the specific set of mitigation improvements to the SRN as proposed by the applicants. In proposing these conditions, HE are, however, mindful of the need to adopt a flexible approach that will enable the sensible coordination or adaptation of works for the benefit both of users of the road network and the airport, and to respond to factors that are currently unknown.

9.106 Such an approach is especially relevant to future RIS programmes and timetables. As such, while the recommended conditions relate to specific improvement plans HE's aim is principally to achieve the required outcomes within an appropriate timetable but to allow either: (i) for the proposals to be reviewed and, if appropriate, revised to better achieve the outcomes in the light of emerging conditions; or (ii) for the possibility of the proposals to be superseded by another more extensive scheme or schemes that would achieve the same outcomes. In the event of the latter HE believe a financial contribution by the applicant equivalent to the cost of the proposed mitigation scheme would therefore be appropriate

9.107 The majority of the impact would be on the strategic road network, the M11 and A120. However, employees are likely to increase impacts on local roads and those roads closest to the airport would experience the greatest of those impacts.

9.108 ECC carried out sensitivity testing on local roads, focussing on Takeley because it has the highest concentration of employees close to the airport. The sensitivity testing resulted in higher figures attributed to the growth from 35mppa to 43mppa. However, this resulted in an estimated impact of 1.7%, which ECC consider is acceptable.

9.109 In addition to the J8 measures as summarised above, mitigation measures would be required for the local roads to resolve issues at potential hot spots. ECC recommends a local road fund of £800,000 be set up, which could be secured by way of s106 Legal Obligation. The mechanism for allocating the funding would be the Stansted Airport Transport Forum. The Highways Working Group of the SATF takes an overview of network safety and access by road, bicycle and on foot, and is chaired by Essex County Council.

9.110 Alongside this, monitoring of the airport road network is recommended to ensure that early action is taken if congestion on the airport network itself occurs, as this could impact harmfully on the strategic or local road network. Such monitoring already takes place by the applicant because they are responsible for this element of the highway network.

9.111 In terms of the Hertfordshire local road network, HCC is satisfied that the technical work demonstrates that the proposal should not have a significant impact upon the wider Hertfordshire highway network. However, there are concerns about uncertainties given the significant time frame for growth and the fact that unforeseen impacts could arise.

9.112 The Local Roads Fund currently has a radius of 5 miles, which includes local roads in the Hertfordshire area, and therefore, the mitigation proposed above is considered to be appropriate to cover the concerns of HCC.

Bus/Coach Services

9.113 In terms of coach and bus services, these are operated by private companies. At present there are 6 routes operated under franchise arrangements by National Express and Airport Bus Express to and from various destinations in London. In addition, there are 6 other routes operated under a regional franchise by National Express to Cambridge/Thetford/Norwich, Heathrow/Gatwick/Brighton, Luton/Oxford, Ipswich/Colchester/Heathrow, Luton/Coventry/Birmingham, and Cambridge/Nottingham/Liverpool. There is a night shuttle bus serving Golders Green, Tottenham Hale, Edmonton Green and Enfield which provides Airport Travel Card holders with a free service that arrives at the airport at 03:40 in readiness for a 04:00 start.

9.114 Coach demand in respect of arrivals has been between 150,000 and 200,000 passengers per month and a similar demand for departures.

9.115 There are 12 local bus services operating via the Airport. These are to Basildon, Southend, Chelmsford, Bishop's Stortford, Saffron Walden, Colchester and Harlow Town. These provide a total of 204 bus services per week day, 199 on Saturday and 118 on Sunday.

9.116 During the construction period it is envisaged that there may be a small increase in the number of workers in the local area using public transport. However, this is assessed as having a negligible impact on the bus and rail network.

9.117 In terms of the operational phase, the predicted growth in bus and coach travel demand is set out in Table 6.26 in the ES (page 6-47).

	07:00-08:00		17:00-18:00		05:00-06:00		16:00-17:00	
	Inbound (air depart)	Outbound (air arrival)	Inbound (air depart)	Outbound (air arrival)	Inbound (air depart)	Outbound (air arrival)	Inbound (air depart)	Outbound (air arrival)
2028 35mppa	509	285	632	627	1250	32	729	862
2028 43mppa	749	208	823	811	1446	31	897	1078
Change	**240**	**-77**	**191**	**184**	**198**	**-1**	**168**	**219**
% change	**47.2%**	**-27.0%**	**30.2%**	**29.3%**	**15.8%**	**-3.1%**	**23.0%**	**25.4%**

9.118 Bus and coach patronage/loading data is not readily available and as such an assessment of capacity has not been undertaken. However, increases in demand are unlikely to adversely affect bus and coach services. Indeed, it is likely to act as a catalyst for improving services with operators increasing services to meet demand. On a quarterly basis, bus and coach operators attend commercially confidential meetings with local authority and airport staff as part of the work of the Transport Forum's Bus and Coach Working Group. At these meetings, existing services and potential improvements and enhancements are discussed and evaluated. These can include rebranding, fresh marketing, new buses or coaches, timetable enhancements, route extensions and new routes. Subject to a proven business case, funding may be available from the £2m pot committed by the airport operator under the Generation 1 unilateral undertaking signed in 2008, or from the car park levy.

9.119 Increases in demand for services may require improvements to be carried out to the bus/coach station at the Airport. These improvements are likely to include extra bays, revised bay allocation management (in terms of managing queue interactions) and weatherproofing for passengers. These can be delivered as part of the mitigation measures secured by way of s106 Legal Obligation, and overseen by the Bus and Coach Working Group.

9.120 ECC has suggested new or additional routes to specific locations, and whilst these aspirations are welcomed, it will be necessary for there to be a viable business case for bus/coach operators to deliver the services. These can be explored further through the SATF's Bus and Coach Working Group, which ECC chairs. The Working Group is also attended by officers from UDC and Herts CC.

9.121 HCC and EHDC have also identified key routes that they would wish to see delivered, in particular a new east-west express coach service linking St Albans, Hatfield, Stevenage, Welwyn Garden City, Hertford, Ware and Stansted Airport. Again, the aspiration is welcomed. However, employment data clearly identifies that there is no significant demand for bus routes from these locations with very low numbers of employees coming from the Hertfordshire area outside of Bishop's Stortford, which is well served by public transport links to the airport. This proposal could be explored further through the Bus and Coach Working Group.

9.122 A key funding mechanism for SATF is the Transport Levy which is raised from car parking transactions at the airport (currently 25p per passenger parking transaction and £10 per annum for staff parking).

9.123 It is proposed to extend the Transport Levy to the Kiss and Fly transactions at 10p per transaction. The combined income from the levy is predicted to be around £12m of funding to 2028, increasing to £20m in 2033 (assuming operations remain at 43mppa). This is in addition to the Bus Fund, a ring fenced sum of money. This was originally £2m as part of the 2008 Unilateral Undertaking.

9.124 A third source of funding for the bus network comes from the sale of airport travel cards to staff. This is predicted to increase to £1.4m per year at peak employment. This is a minimum increase assuming the same levels of staff public transport use and no future improvements. This would generate in at least £15.5m worth of revenue generated for bus operators from airport staff alone.

9.125 The Bus and Coach Working Group is proposed to be refreshed and the terms of reference updated. This would enable flexibility in the delivery of sustainable transport options given the changes in technology and approaches to delivery of services. Approximately £1m of the original Bus Fund has been spent in improving services associated with passenger growth from around 17mppa to 26mppa. The applicant is proposing to top up the ring fenced bus fund to £2m.

9.126 The principles of funding and the refresh of the Bus and Coach Working Group and terms of reference are accepted by the consultees. However, negotiations are still on-going regarding the appropriate level of funding to be secured by way of the s106 Legal Obligation.

Walking and Cycling

9.127 Given the rural location of the airport there are limited options for accessing the airport by walking and cycling, especially by passengers. In 2015 the percentage of employees walking to work was 0.6% and those cycling 0.4%.

9.128 STAL currently operates a Staff Travel Plan which forms part of the legal obligations in respect of the development of the Airport. This is proposed to continue and would form part of the obligations in a new s106 Legal Obligation if planning permission was to be granted.

9.129 STAL promotes the use of walking and cycling for employees, a source of funding for which is the car park levy. Stansted Airport's Cycling and Walking Strategy (2016) forms part of the overarching Sustainable Development Plan (SDP) for the airport. It includes the following measures:

- Improve cycle access from the west and north to Bishop's Stortford, Birchanger, Stansted Mountfitchet and Elsenham

- Cycle crossing facilities on J8 of M11 motorway
- Extend the Sawbridgeworth – Bishop's Stortford link; and
- Storage, shower and secure parking at key locations on site, including Northside.

9.130 Given the relatively low walk and cycle mode share, only modest increases in these trips between the 2028 Do Minimum and Development Case scenarios are considered feasible and any improvements to infrastructure and quality of access will occur gradually over time through the implementation of the walking and cycling strategy measures. These measures will be promoted and overseen by the Highways Working Group.

9.131 ECC Highways acknowledges that cycling will contribute a small proportion of the modal share, but consider there is a potential to increase the number of employees accessing the airport by bike, particularly to the south, east and west of the airport. They consider that a Walking and Cycling Strategy should be produced as part of the Airport Surface Access Strategy. This should include improving the airport highway network for cyclists and provide funding to support the implementation of cycle routes to key villages where there is a concentration of employees, such as Takeley.

9.132 Similarly, HCC has identified routes from various locations in Bishop's Stortford, and an ambitious project linking the airport to Bishop's Stortford, Sawbridgeworth, Harlow, Gilston, Ware and Hoddesdon. These schemes have not been demonstrated by HCC as being required in direct connection with the airport expansion, particularly given the low percentages of staff cycling to work.

9.133 Mitigation measures are best delivered in line with the recommendations of ECC with a Walking and Cycling Strategy. The funding and delivery of such measures identified as being required would be via SATF, funded by the Transport Levy.

Rail

9.134 Baseline data provided by Abellio Greater Anglia (AGA) in respect of rail services indicate that an average daily loading of passengers from Stansted Airport towards London Liverpool Street was 10,011. From London Liverpool Street to Stansted Airport average daily loadings were 11,329 passengers per day. Assessments have been carried out over 24 hour periods, with emphasis on peak periods of 07:00 – 10:00 and 16:00 – 19:00.

9.135 Current rolling stock is in the form of two train types, Class 379 (2011) and 317/5. The latter is made up of 8 carriages (2 x 4-car units) whilst the former can consist of 4, 8 or 12 carriages. Class 317/5 has a total capacity of 964 passengers, made up of 584 seated and 380 standing. Class 379 (2011) have capacities of 345, 690 and 1035 respectively. Four carriage trains have a seating capacity of 209 and 136 standing.

9.136 Table 6.8 sets out the baseline train loadings for 2016 on the Stansted Express.

	Depart Liverpool Street – Stansted Airport			Depart Stansted Airport – Liverpool Street		
	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily
Line loading (seating capacity only)	23%	94%	40%	75%	37%	39%
Line loading (total capacity incl. standing)	14%	57%	24%	45%	22%	23%

9.137 The assessment is carried out on the basis that there will be no physical infrastructure constructed during the assessment period, apart from completion of the third track between Tottenham Hale and Angel Road (Meridian Water). Works to lay the third track are currently underway. The Anglian Route Study (2016) produced by Network Rail indicated that based on current rolling stock there is expected to be a capacity gap of approximately 1000 passengers by 2023 and 2100 by 2043 in the peak hour on the Cambridge and Stansted services into Liverpool Street.

9.138 The study concluded that lengthening two of the Cambridge and Stansted services from eight carriages to 12 carriages between 08:00 and 08:59 would meet the capacity gap by the end of Control Period 6 (CP6: 2019 – 2024). This has resulted in the franchisee investing in a new fleet of Stansted Express trains from 2019 which will all be 12 carriages long.

9.139 In respect of CrossCountry services from Stansted Airport to Birmingham New Street, these services run at a frequency of 1 per hour. Loading data was supplied by DfT in the form of average loading on each service (not specifically in relation to Stansted Airport) and is set out in Table 6.9.

	Arrive at Cambridge from Stansted Airport			Depart from Cambridge to Stansted Airport		
	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily
Line loading (seating capacity only)	39%	54%	29%	33%	77%	35%
Line loading (total capacity incl. standing)	32%	43%	23%	27%	62%	28%

9.140 AGA has also provided train loading data for the off-peak Stansted to Cambridge service which runs half-hourly to the Cross Country service. The data shows that these services operate with significant spare seating capacity during the day. Under the new franchise, this service will be extended to Norwich once the new “bi-mode” trains are delivered.

9.141 The ES set out a growth rate of 1.5% across the rail network, as agreed with Network Rail. An assumption of 26% rail mode share was made in the ES and Network Rail requested a stress test of 35% mode share. Tables 3.1 and 3.2 in Annex 6 – Transport Assessment Addendum set out the line loadings for the Stansted Airport – London Liverpool Street line using the stress test mode share.

Table 3.1 – Forecast Stansted Express Line Loadings (35% Rail Mode Share) – Seating Capacity

	Depart Liverpool Street – Stansted Airport			Depart Stansted Airport – Liverpool Street		
	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily
2028 (35mppa)	16%	68%	29%	56%	26%	28%
2028 (43mppa)	23%	73%	34%	56%	32%	32%
2028 (43mppa) Sensitivity Test	29%	86%	41%	66%	43%	41%

Table 3.2 – Forecast Stansted Express Line Loadings (35% Rail Mode Share) – Total Capacity (incl. standing)

	Depart Liverpool Street – Stansted Airport			Depart Stansted Airport – Liverpool Street		
	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily
2028 (35mppa)	11%	48%	20%	39%	18%	19%
2028 (43mppa)	16%	51%	24%	39%	23%	22%
2028 (43mppa) Sensitivity Test	20%	60%	29%	46%	30%	29%

9.142 Paragraph 3.20 of Annex 6 does point out that presenting the information in this format does dilute the impact of the airport's increased passenger throughput on train capacity, particularly on the busiest services. Hourly data presented to Network Rail (not included in the application due to sensitivity of the data) show that demand may exceed seating availability on four Stansted Express services heading northbound during the PM peak, should airport passenger rail mode share rise to 35% by 2028 with the growth of the airport to 43mppa. Whilst this would impact on seating availability, there would be sufficient standing capacity to accommodate the passenger numbers.

9.143 As an indicator of rail demand to/from the airport, ticket sales information, as set out in Table 3.3 in Annex 6, indicates that around 25% of rail journeys from London Liverpool Street are to Stansted Airport, and around 42% from Stansted Airport to London Liverpool Street. Around 9% of ticket sales in both directions relate to journeys from Tottenham Hale to or from Stansted Airport. In 2018 only 1% of journeys were from Stratford. Other train journeys from other stations accounted for 5-6% of ticket sales.

9.144 The increase in demand for Stansted Express services for the proposals when compared to the Do Minimum scenario is shown as being 8% in demand in both directions. This would be of minor negative significance. In terms of impacts on the Stansted to Cambridge route, the increase in demand is calculated to be an additional 177 inbound daily passengers and 177 outbound daily passengers in the Development Case scenario. This would have a negligible effect on services on this line.

9.145 Impacts on interchanging at Tottenham Hale Station have been considered, although no detail in respect of platform capacity has been supplied to the applicant. An assessment of the daily demand via the interchange to and from the underground station and services to/from Stansted Airport has been made. The following table is a summary of Tables 3.5 – 3.7 of Annex 6, which assesses the 2016 baseline against the 2028 Do Minimum and Development Case sensitivity tests.

	AM Peak		PM Peak		Daily	
	To underground	From underground	To underground	From underground	To underground	From underground
2016 baseline	2%	8%	2%	6%	14%	24%
2028 Do Minimum	4%	10%	9%	8%	18%	30%
2028 Development Case	4%	16%	11%	9%	22%	37%

9.146 The difference between the 2028 Do Minimum and Development Case sensitivity test scenarios results in there being 5 less passengers going to the underground and 23 more passengers coming from the underground in the AM peak. In the PM peak the numbers are 11 extra to and 15 extra from the underground. The daily figures are 141 to and 204 from the underground. This is viewed as being a negligible impact on Tottenham Hale Station.

9.147 It is noted that representations have been received in respect of existing capacity issues at Tottenham Hale Station, including concerns raised by Network Rail. However, existing problems at the station are not a matter for this application to resolve. In respect of future growth, Network Rail confirms that the additional information in respect of this issue has been considered and they have no objections to the proposals.

9.148 Capacity at Stansted Airport rail station is deemed to be sufficient to meet future rail demand. Platform 1 can accommodate two trains simultaneously in formations of up to 12 carriages and platform 2 can accommodate four carriage trains, currently used by Cross Country services.

9.149 Network Rail has been consulted on the proposals and they have confirmed that they are satisfied with the findings in the ES and the additional information submitted. They accept the conclusions that higher capacity rolling stock on the London services can accommodate passenger growth from the airport in the timescale assessed. They do not object to the application, but do note that increased rail passengers resulting from increased air passengers would mean that longer term rail capacity schemes on the West Anglia Main Line are likely to be needed sooner. These are capacity schemes that would be required with or without the expansion of the airport.

Construction Impacts

9.150 Paragraph 6.142 of the ES sets out that approximately 27,700 construction vehicles (two-way) are estimated over the 12 month construction period. The average and peak daily construction traffic flows would be around 100 and 200 respectively. HGV movements are not expected to exceed a peak of around 20 two-way movements per hour at any point of the day.

9.151 Construction vehicles would enter and exit the airport via Long Border Road and Bassingbourn Roundabout directly from the A120. The proposed construction pound would be located close to the CEMEX concrete plant off Long Border Road.

9.152 Construction work would be undertaken during the day and night with night activities being limited to Monday to Friday. The exception will be the works required for the RAT and RET which will require 96 six hour periods on 48 consecutive Saturday/Sunday nights during the construction period when the runway will need to be closed.

9.153 Construction vehicles are estimated to increase traffic flows by around 0.7% and this would be of negligible significance. As such, this is expected to have a negligible impact on pedestrian movement, capacity, severance, delay, fear and intimation and amenity. The same negligible impacts are predicted for cyclists and public transport.

9.154 The impact of construction traffic has been assessed by ECC Highways who have raised no objections in respect of this issue.

C Air Noise

9.155 Chapter 7 of the ES assesses the impacts of air noise. This chapter needs to be read in conjunction with the accompanying noise assessment set out in Appendix 7 (Volume 2 of the ES) and the updates and additional information contained in Annex 3 of the Consultation Response and Clarifications document produced in July 2018.

9.156 Air noise is produced by aircraft on departure from the start of the departure roll along the runway and, on arrival, it ceases at the point of departure onto a taxiway. All taxiing is defined as ground noise, as is all noise generated by aircraft and servicing equipment on stands.

9.157 Adopted Uttlesford Local Plan Policy ENV11 states that noise generating development will not be permitted if it would be liable to affect adversely the reasonable occupation of existing or proposed noise sensitive development nearby, unless the need for the development outweighs the degree of noise generated. This policy is generally consistent with the NPPF but the NPPF is more specific with regard to existing businesses recognising the need to balance the needs of business and the protection of existing amenities. The policy therefore carries moderate weight.

9.158 Paragraph 170(e) of the NPPF (2018) states that development should contribute to and enhance the environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution. Paragraph 180(a) states that planning decisions should ensure that new development is appropriate for its location taking account of likely effects as well as the potential sensitivity of the site or wider area to impacts that could arise. In doing so, they should mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life.

9.159 In March 2010 DEFRA published the Noise Policy Statement for England (NPSE). This sets out the aims of the Noise Policy as:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

9.160 It emphasises the need to balance the consideration of the economic and social benefit of the activity under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focussing solely on the noise impact without taking into account other related factors.

9.161 Section 5 of the ANPS (July 2018) sets out the assessment of impacts in relation to the Northwest Runway at Heathrow. The assessments will not be the same for development proposals at Stansted Airport, but the principles in relation to the assessments will be similar and therefore it is appropriate to consider the approach set out in the document.

9.162 Paragraph 5.44 identifies that the impact of noise from airport expansion is a key concern for communities affected. High exposure to noise is an annoyance, can disturb sleep, and can also affect people's health. Paragraph 5.45 notes that it is not just the number of aircraft overhead that results in aircraft noise but also engine technologies and airframe design, the paths the aircraft take when approaching and departing from the airport, and the way in which the aircraft are flown.

9.163 There is recognition that over recent decades there have been reductions in aviation noise (air and ground) due to technological and operational improvements and that this trend is expected to continue. It notes that new generation aircraft coming into service have a noise footprint typically 50% smaller on departure than the ones they are replacing, and at least 30% smaller on arrival.

9.164 The government recognises that evidence has shown that people's sensitivity to noise has increased in recent years, and there has been growing evidence that exposure to high levels of aircraft noise can adversely affect people's health.

9.165 Paragraph 5.47 states that the government wants to strike a fair balance between the negative impacts of noise and the positive impacts of flights, which reflects the aims of the NPSE.

9.166 There is no European or national legislation which sets legally binding limits on aviation noise emissions. Stansted Airport, as a noise-designated airport, is required to produce annual noise exposure maps. The International Civil Aviation Organisation introduced the concept of a 'Balanced Approach' to noise management (resolution A33/7). This is given legal effect in the UK through EU Regulation 598/2014 – the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach. This has four pillars:

i) Reduction of noise at source
ii) Land use planning and management
iii) Operational procedures
iv) Operational restrictions

9.167 The Balanced Approach operates by a preference for measures within Pillar i) before Pillar ii) and so on. Operational restrictions include the current night flight restrictions and are a last resort when measures within Pillars i) – iii) are deemed insufficient mitigation.

9.168 BTH (June 2018), paragraph 1.22 identifies that it is important that communities surrounding airports seeking to make best use of their existing runways share in the economic benefits of this, and that adverse impacts such as noise are mitigated where possible. Paragraph 1.29 states that careful account be taken of such relevant considerations.

9.169 Chapter 3 of the Aviation Policy Framework (2013) relates to noise and other local environmental impacts. Whilst this document predates the NPPF and the ANPS it is still the government's current policy and it also sets out, at paragraph 3.3, the aspiration to "strike a fair balance between the negative impacts of noise (on health, amenity (quality of life) and productivity) and the positive economic impacts of flights". It expects the benefits of aviation growth to be shared between the aviation industry and local communities. This means that the industry must continue to reduce and mitigate noise as airport capacity grows. As noise levels fall with technology improvements the aviation industry should be expected to share the benefits from these improvements.

9.170 Paragraph 3.12 sets out the policy of the APF to "limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise, as part of a policy of sharing benefits of noise reduction with industry." The government's recently revised objective for aviation noise as set out in its Air Navigation Guidance 2017 (to the CAA) is to "limit and where possible reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise". There is no more detailed definition of the terms used.

9.171 Paragraph 3.21 of the APF identifies that some people consider themselves annoyed by aircraft noise even though they live some distance from an airport in locations where aircraft are at relatively high altitudes, other people living closer to an airport seem to be tolerant of aircraft noise and may choose to live closer to the airport to be near to employment or to benefit from the travel opportunities.

9.172 It is clear from the representations received that people living some distance from the airport consider themselves to be adversely affected by noise from aircraft. This is despite them being a considerable distance outside of the 57dB 16hrLeq noise contour, or even the 51dB 16hrLeq. Annoyance at distance can be heightened by increased overflying against a relatively tranquil background.

9.173 Noise in respect of Stansted Airport is controlled and monitored under a variety of conditions and legislation, including legislation outside of the scope of the planning system. For example, the Aerodromes (Noise Restrictions) (Rules and Procedures) Regulations 2003 requires the airport operator to produce strategic noise maps and to adopt a Noise Action Plan (NAP) approved by Defra, to be updated every five years. In respect of night noise, this is controlled by the Night flight restrictions at Heathrow, Gatwick and Stansted. This sets a noise quota and flights quota and the current regulations were set in October 2017 and run to

October 2022. The operation of the night flight restrictions is separate to this planning application and is not affected by it. DfT consultation on new post-2022 restrictions is expected to start in the second half of 2019.

9.174 In terms of controlling day time noise levels, a condition on the 2008 Planning Permission sets a maximum area of 33.9km2 for the daytime noise contour of 57dB Laeq,16h. This is monitored by the strategic noise maps mentioned in paragraph 9.173above. In addition, condition ATM1 limits the number of air transport movements (ATMs) to 264,000 per 12 calendar month period, of which no more than 243,500 shall be passenger ATMs (PATMs) and no more than 20,500 shall be Cargo ATMs (CATMs). There is a further limit of not more than 10,000 ATMs per 12 calendar month period for aircraft taking off or landing which are not carrying passengers or cargo, or non-scheduled air transport services where the passenger seating capacity does not exceed 10 (known as General Aviation (GA)).

9.175 For the purposes of the ES aircraft noise modelling has been produced by the CAA's Environmental Research and Consultancy Department (ERCD), using their Aircraft Noise Contour (ANCON) model (current version 2.3). The ERCD is a specialist body within the CAA with national and international expertise on the assessment of aircraft noise. They produce noise contours for the designated London airports, and they generated the noise contours used by the Airports Commission. Their work is robust, authoritative and also impartial.

9.176 Aircraft noise modelling in the UK commonly uses the aggregate daily 16-hour noise levels experienced over the busy 92-day summer period between 16 June and 15 September, when effects are likely to be the most acutely felt. However, it is increasingly accepted that noise is not experienced in an averaged manner and whilst the use of LAeq 16hr remains government policy (reinforced by SoNA 2014), other metrics such as those that measure actual numbers of overflights are being used as supplementary indicators.

9.177 Further comparative modelling has been undertaken for a typical busy summer day in recognition of non-uniform responses to aggregation. The baseline is modelled against the 2028 Do Minimum and Development Case scenarios. This modelling does not indicate any materially different effects over the aggregate modelling outcomes for either daytime or night-time movements.

9.178 All assessments of potential impacts are made on the basis of assumptions made on the likely fleet mix. These assumptions have been challenged by those making representations, including SSE. The Council's expert advisors (BAP) note that fleet sensitivity tests have been carried out and that changes to the rate of the uptake of new variant aircraft of up to 10% will be insignificant. They consider that there is no reason to distrust the tests and that the assumptions appear reasonable.

9.179 The NPSE sets out the principles for the effective management of noise. Using NPSE descriptions, Table 7.3 of the ES (page 7-13) sets out the Airborne aircraft noise effect levels.

Effect level *	Noise level (dB)		Typical Action
	Daytime	Night-time	
NOEL	LAeq, 16h ≤ 51	LAeq, 8h ≤ 45	None required
LOAEL	51 < LAeq, 16h ≤ 63	45 < LAeq, 8h ≤ 54	Identify, mitigate and reduce to a minimum
SOAEL	63 < LAeq, 16h ≤ 69	54 < LAeq, 8h ≤ 63	Avoid
UAEL	LAeq, 16h ≥ 63	LAeq, 8h ≥ 63	Prevent

* NOEL – No observed level of effect
* LOAEL – Lowest observed adverse effect level
* SOAEL – Significant observed adverse effect level
* UAEL – Unacceptable adverse effect level

9.180 For the purposes of this planning application, the air noise study area is approximately 25km x 30km which contains all dwellings and other noise sensitive properties forecast to experience noise at or above LOAEL.

9.181 In terms of perception, the Council's Environmental Health Manager (Protection) advises that it is widely accepted that a 1dB increase in sound pressure level would not be perceptible. A 3dB increase would be just perceptible as an apparent change in loudness. So although a 3dB increase is a doubling of sound pressure, this increase is only just perceptible to the human ear. It should be noted that a 5dB increase will be clearly noticeable and a 10dB increase is typically considered twice as loud, so 85dB will sound twice as loud as 75dB.

9.182 A range of assessments have been carried out to assess potential noise impacts. These include the traditional 57dB LAeq, 16hr noise contours, plus 54dB and 51dB contours to reflect increased intolerance at lower noise levels. In addition, new assessments of Nx values (number above) have been produced. These identify the number of incidents above a certain noise level, for example the N65 identifies the number of times 65dB LAmax is exceeded. However, whilst it is known that noise levels will be at least 65dB LAmax these assessments do not establish the maximum noise level. Therefore, those falling within these areas could be affected by noise levels of 65.1dB LAmax or in excess of 85dB LAmax for example.

9.183 Different sensitivity criteria have been used for different types of receptor and these are set out in Table 7.4, reproduced below.

Receptor	Significance Criteria	Value of Δ* denoting significance			
		Negligible	Minor	Moderate	Major
Dwellings and other residential buildings Healthcare facilities	Day (07:00 – 23:00) Change in LAeq, 16h ≥ΔdB where outdoor LAeq, 16h >51dB	< 3dB	≥ 3dB	≥ 6dB	≥ 9dB
	Night (23:00 – 07:00) Change in LAeq, 8h ≥ΔdB where outdoor LAeq, 8h >45dB and SEL > 90dBA				
Education facilities	Day (07:00 – 23:00) Change in LAeq, 16h ≥ΔdB where outdoor LAeq, 16h >51dB or outdoor LAmax >75dB	< 3dB	≥ 3dB	≥ 6dB	≥ 9dB
Places of worship Community facilities	Day (07:00 – 23:00) Change in LAeq, 16h ≥ΔdB where outdoor LAeq, 16h >51dB	< 3dB	≥ 3dB	≥ 6dB	≥ 9dB

*Δ (delta) represents the change in noise level

9.184 Within the air noise study area 20 schools, 5 healthcare facilities, 8 places of worship and 4 community facilities have been identified (see Table 7.5 in Chapter 7 of the ES).

9.185 Baseline data for 2016 has been established by way of attended daytime and night time noise surveys and unattended noise surveys in various locations including towns and villages within the vicinity of the airport and further afield such as Thaxted, Great Easton and Stebbing.

9.186 Stansted Airport has one runway which is designated as either Runway 04 (for operations in a north easterly direction) or Runway 22 (for operations in a south westerly direction). Based on 20 year average operations the assessments are carried out on the basis of 73% of operations on Runway 22 and 27% on Runway 04.

9.187 Assessments are carried out in respect of 2016 (baseline), 2023 Do Minimum and Development Case (36.4mppa) scenarios, 2028 Do Minimum and Development Case scenarios, and an additional assessment at 2024 Development Case (38.1mppa) scenario as this is considered to be the peak noise year.

9.188 The 57dB LAeq, 16h noise contours for the scenarios are as follows:

Scenario	**Size of 57dB LAeq, 16h contour ***
2016 Baseline	24.3km2
2023 Do Minimum	30.3km2
2023 Development Case	31.2km2
2024 Development Case	32.0km2
2028 Do Minimum	25.5km2
2028 Development Case	28.7km2

* Permitted noise contour as per 2008 consent is 33.9km2.

9.189 In terms of population affected by noise in accordance with the NPSE assessment criteria, Tables 7.14 and 7.15 give details of numbers of people affected by the proposals.

Table 7.14: Population within Daytime Observed Adverse Effect Level contours*

Year	dB LAeq, 16h		
	LOAEL: 51	SOAEL: 63	UAEL: 69
2016 Baseline	12,600	200	0
2023 Do Minimum	16,944	384	0
2023 Development Case	17,634	384	0
2028 Do Minimum	11,884	284	0
2028 Development Case	15,336	334	0
25+ Permission	15,480	484	0

* All changes in numbers of people within LOAEL and SOAEL categories to be viewed in the context of noise level changes between cases being **imperceptible.**

Table 7.15 Population within Night Time Observed Adverse Effect Level contours*

Year	dB LAeq, 8h		
	LOAEL: 45	SOAEL: 54	UAEL: 63
2016 Baseline	17,800	1050	0
2023 Do Minimum	24,830	2334	<50
2023 Development Case	25,430	2834	<50
2028 Do Minimum	22,630	2084	<50
2028 Development Case	21,980	2734	0
25+ Permission	15,980	1384	0

* All changes in numbers of people within LOAEL and SOAEL categories to be viewed in the context of noise level changes between cases being **imperceptible.**
(The increase in number in the 2028 Development Case for SOAEL: 54 shows the disproportionate geographical effect of an increased area of summer night contour over Thaxted and as shown in Figure 7.9 and paragraphs 7.234-5 of the ES)

9.190 These tables indicate that there will be an increase in population during the daytime above the LOAEL when compared to the Do Minimum Scenario, being 15,336 in the Development Case scenario compared to 11,884 in the Do Minimum. In terms of night time the figures are 22,630 in the DM scenario and 21,980 in the DC scenario, a reduction.

9.191 Whilst the LOAEL is considered to be the level above which adverse effects on health and quality of life can be detected, the ES argues that the noise level changes are not perceptible as they would be <1dB (between 0.5 and 0.6dB), and as such the increases would have a negligible effect.

9.192 In respect of night time impacts, the DC scenario is predicted to impact on a lower number of people (<3%) and this is argued to be a negligible impact in a positive sense. In terms of SOAEL, the noise level changes are also imperceptible and the change in population exposed to SOAEL is a minor effect. This is considered to be the case for both daytime and night time, despite the fact that the population affected by night time noise would increase by <33%.

9.193 Further analysis of the SOAEL night time contours indicate that the increase arises from the contour affecting a slightly larger area of Thaxted. The noise increases would result from an additional 3 flights between the DM and DC cases and noise levels would increase between 0.5 and 0.6dB, which is considered to be an imperceptible change.

9.194 It is acknowledged that noise from aircraft overflying isn't perceived as an average but rather a number of specific noisy events. In order to understand these impacts Nx (number above) contours have been produced. These indicate the number of events at which a certain noise level would be reached. As explained earlier, these only recognise the number of events above that noise level but do not identify the maximum noise level. Therefore, properties within these contours are likely to be experiencing different noise levels depending on their position in relation to the noise source.

9.195 The daytime Nx contour is N65, the number of overflights that exceed 65 dB(A). The night time Nx contour is N60, the number of overflights that exceed 60 dB(A). These are produced at values of 25, 50, 100 and 200 movements per day. These are equivalent to:

- 200: 13 overflights per hour, or one every 5 minutes;
- 100: 6 overflights per hour, or one every 10 minutes;
- 50: 3 overflights per hour, or one every 20 minutes; and
- 25: 1.5 overflights per hour, or one every 40 minutes

9.196 In the DC scenario there would be 72 additional movements during the day (712 between 07:00 and 23:00) compared to the DM scenario (640 between 07:00 and 23:00). The 2016 Baseline gives rise to contour areas for N65 25 and 50 values which are larger than those for either of the 2028 DC or DM scenarios. It is only at N65 values of 100 and 200 that the 2028 contours extend to greater areas than those of the 2016 Baseline Year. This is because in 2028 the areas closest to the runway will be experiencing increased numbers of overflights at 65dB(A) or above.

9.197 The night time overflights analysis indicates that there would be little difference between the DM and DC scenarios. In 2016 there were 82 night time movements on a peak summer night. This is expected to increase to 104 and 107 in 2028 for the DM and DC scenarios. As previously discussed, night time flights are outside the scope of the planning system and are subject to government controls. However, the difference between the DM and DC scenarios is negligible. This is because in 2028 the full effect of the night flight restrictions are assumed to bite irrespective of whether planning permission is granted for the Development Case.

9.198 In terms of non-residential properties, the principal area of concern is educational facilities, an issue raised in the representations received. Analysis indicates that at the majority of schools the internal LAmax is not expected to exceed 60 dB LAmax with open windows (allowing for a 12 dB reduction from external free field level through an open window), due to the noise benefits associated with new generation, quieter aircraft. Four schools would experience arrival and/or departure overflights at a level exceeding 72dB LAmax, namely:

- Howe Green School
- Spellbrook Primary School
- The Leventhorpe School
- Mandeville Primary School

9.199 In practice, the primary cause of noise exceedances above the recommended internal level of 60 dB LAmax is departures and arrivals by the B737-800. These occur currently and will do so in the future, irrespective of this application. The application however would permit some additional movements, over and above the DM case in 2028. For the B737-800 and similar aircraft types, the application would allow around one additional movement per hour, over and above what is forecast under the DM case in 2028, assuming a worst case 100% single mode runway operation. This is significantly less than forecast in the previous 25+ mppa application. The replacement of this type of aircraft over time by the B737Max should alleviate this effect. However, the B737Max on arrival is expected to produce maximum noise levels slightly higher than recommended at Spellbrook Primary School (73dB LAmax).

9.200 ECC has raised concerns about the potential for noise breaching the noise threshold level of 55dB LAeq30 on any school site. It hasn't been clarified as to whether this is an internal or external measurement, but the assumption has been taken that it is an internal one. Where this level is breached ECC would require a noise consultant to be employed to review the planning application against the DfE's "Building Bulletin 93: Acoustic Design of Schools – Performance Standards" to formulate mitigation measures that could be incorporated into s106 Legal Obligation. However, it should be noted that these standards are for new education facilities and not for retrofitting.

9.201 The findings of the ES are generally accepted by the Council's Environmental Health Manager and the consultants BAP. This has included consideration of the proposed mitigation scheme which would be a revised and updated version of the current Sound Insulation Grant Scheme (SIGS). It has been confirmed by the applicant that all of the potentially affected population within the 55dB Lnight contour for the 2028 DC operations would be included as per current World Health Organisation night noise guidelines.

9.202 Mitigation measures are already in place to minimise noise impacts and these would continue. These include:

- A daytime noise contour with a maximum area of 33.9km2
- Conditions restricting the number of ATMS per annum, currently controlled by types of ATMS
- Director's Notices relating to the use of Air Start units, Ground Power Units, air conditioning units and other ground servicing equipment
- A Noise Action Plan
- Sustainable Development Plan
- Sound Insulation Grant Scheme

9.203 These mitigation measures are proposed to be retained and improved, particularly in respect of the SIGS as described in the previous section of this report. The applicant also refers to the Night Noise Surcharges and Noise Penalty Limits as mitigation for ground noise.

9.204 The current SIGS is a mitigation measure contained in the current legal obligation. This offers assistance with the cost of moving for those households within the 69dB LAeq, 16h contour. It also offers to pay 50% of the total cost of acoustic insulation for dwellings exposed to noise levels in excess of:

- 63dB LAeq, 16h;
- 57dB LAeq, 8h (night time); and
- 90dB(A) SEL departure footprint for the noisiest aircraft (QC/2) operating at night (23:30 to 06:00)

9.205 The current scheme covers 1088 properties, of which 648 have taken up the option and benefitted from insulation. The revised and updated scheme, which can be secured by way of a s106 Legal Obligation, proposes to remove the requirement for the householder to contribute financially to the cost of insulation works; will be a three-tiered offer, to target greatest support to those who are most impacted with increased grant payments. The qualification criteria are set out in Table 7.24 (page 7-72).

Noise Impact	Noise Contour	Grant Maximum
Upper	69 and 66 dB LAeq, 16h	£10,000
Middle	63 and 60 dB LAeq, 16h	£8,000
Lower	57 dB LAeq, 16h/N65 200/ 90 dBA SEL* 600m distance/55 dB LAeq, 16h ground noise	£5,000

* 90 dB(A) SEL footprint for the noisiest aircraft operating at night (23:00 to 06:00)

9.206 This revised mitigation scheme would be available to 50 properties in the upper category, 400 in the medium and 1600 in the lower categories. In addition, 5 schools, 2 healthcare facilities, 8 places of worship (7 if Ebenezer Chapel is no longer to be used as a church) and 3 community facilities would be eligible, unlike under the current scheme.

9.207 There may be practical reasons as to why SIGS may not be appropriate mitigation for an educational facility. Therefore, alternative mitigation measures may be required, which would require engagement with the relevant bodies to identify any appropriate measures. These could be secured by way of an appropriately worded condition or s106 Legal Obligation if planning permission were to be granted.

9.208 The applicant operates a noise penalty scheme, the limits of which are set by DfT as part of the airport's designation under the Civil Aviation Act 1982. Subject to consultation with stakeholders and agreement with DfT, the scheme would be tightened. Table 7.22 sets out the existing and proposed departure noise limits.

When	Times	Noise limit: (dB(A))	
		Current	Proposed
Day	07:00 to 23:00	94	89
Day Shoulder Period	06:00 to 07:00	89	84
Night Shoulder Period	23:00 to 23:30	89	84
Night	23:30 to 06:00	87	84

9.209 The fining structure would remain as current practice, as set out in Table 7.23.

Period	Time	Noise Limit	Fine ≤3 dB above limit	Additional fine >3 dB, per dB(A) or part
Daytime	07:00 to 23:00	89 dB(A)	£1000	£250
Night time	23:00 to 07:00	84 dB(A)	£1000	£1000

9.210 The fines would be paid into the Stansted Airport Community Trust Fund which would be given over to community projects. This is discussed in further detail under Chapter 14. The operation of the scheme and the fund allocation mechanism can be secured by s106 Legal Obligation if planning permission is granted.

9.211 The principle of the mitigation scheme as currently existing and proposed, is in line with the principles of the APF which seeks to ensure that future growth in aviation shares the benefits with local communities. It is also a measure whereby noise levels are reduced and financial mitigation is provided to those communities where the noise limits are exceeded.

9.212 Overall, it is reasonable to consider that the assessment methodology, approach and level of detail contained in the ES is satisfactory. The ES is comprehensive and UDC's consultants advise that they have no doubts over its integrity. The ES demonstrates that the proposed noise impacts should not be materially different between the DM and DC scenarios. Therefore, it can reasonably be concluded there are no grounds to object to the proposed application on noise impact grounds, subject to securing appropriate mitigation by means of conditions and/or s106 Legal Obligation.

D Ground Noise

9.213 Chapter 8 of the ES assesses the impacts of ground noise. This chapter needs to be read in conjunction with the accompanying ground noise assessment set out in Appendix 8.1 (Volume 2 of the ES).

9.214 Paragraphs 9.157 to 159 above set out the policy position with regards to noise.

9.215 This chapter assesses the impacts of the temporary construction period noise as well as the permanent operational noise. The principal sources of ground noise are:

- Aircraft taxiing or holding with main engines in operation at any point between the parking stand and the point at which the aircraft commences its departure roll (start of roll) or exits the runway on arrival. This includes engine start-up and shut down when parked on the stand and all holding on the taxiways and aprons;

- Aircraft auxiliary power units (APUs) for supplying cabin air and electrical power, and other aircraft services mainly when the main engines are not operating;
- Mobile ground power units (GPUs) which supply the required electrical power to the aircraft and other equipment such as PCA units that supply pre-conditioned air during turnarounds when fixed electrical ground power (FEGP) is not available;
- Aircraft engine ground run (EGR) tests; and
- Fixed plant and equipment

9.216 Due to controls in place regarding the use of GPUs, plus due to the nominal noise impact arising from fixed plant and equipment which is subject to noise attenuation where required, these sources of noise are not considered as part of calculations of the overall ground noise impact.

9.217 Ground noise has been assessed in a similar way as air noise in that the LAeq, 16h metric has been used for daytime noise between 07:00 and 23:00, and the LAeq, 8h metric has been used for night time noise between 23:00 and 07:00. The same predicted aircraft movements and fleet mix have been used for assessing potential impacts in respect of ground noise. This includes an aggregated typical day of operations based on the 92 day summer period referred to in the air noise section.

9.218 Forecast ground noise levels have been compared to:

- The background noise levels prevailing at any assessment position in the absence of noise due to ground activities at the airport
- Threshold levels that reflect the onset of community annoyance to aircraft ground noise, ie 55 dB LAeq, 16h for daytime and 45 dB LAeq, 8h for night time

9.219 Key assumptions include all of the permitted 15 stands on Echo Apron E being operational in 2023 in both the DM and DC scenarios, and also in 2028 DM scenario. The 2028 DC scenario assumes that the additional 3 stands proposed on Echo Apron will also be in use. Echo Apron is located to the west of the bund west of Molehill Green. The proposed stands at Yankee Apron would be used for overnight parking of home-based towed aircraft and would not require the use of APUs. These stands are located towards the centre of the airfield and their use should have a negligible effect on overall ground noise levels.

9.220 Noise certification levels relate to airborne aircraft and noise levels for ground operations are not measured. As such the ERCD confirm that it is appropriate to predict ground noise levels on the basis of departure noise levels. The ground noise study area is approximately 8km x 8km, much smaller than the air noise study area because aircraft engines are at lower power and ground noise is more readily attenuated such as by natural screening.

9.221 Noise assessments have been carried out in respect of 9 locations and background noise levels have been established with a mix of attended and unattended daytime and night time surveys.

9.222 Tables 8.9 and 8.10 set out the calculated noise levels for daytime and night time at the monitoring points. For ease of reference, the case officer has added an extra column to the right end of the two tables below to indicate the difference between 2016 baseline and the 2028 DC scenario.

Table 8.9: Calculated daytime levels at various points

Receptor location	**Daytime, LAeq, 16h**						**Baseline v 2028 DC**
	25+Full capacity	2016 baseline	DM 2023	DC 2023	DM 2028	DC 2028	
P1 – Molehill Green	56.7	53.4	55.7	55.8	55.4	56.4	+3
P2 – Gaunts End	56.2	53.6	55.3	55.4	54.9	55.8	+2.2
P3 – Tye Green	56.2	54.2	55.4	55.6	54.8	55.5	+1.3
P4 – Ash Pub	54.8	54.1	55.1	55.3	54.5	52.1	-2
P5 – Bury Lodge	53.5	53.6	54.5	54.7	54.0	48.7	-4.9
P6 – Warmans Farm	49.9	48.9	50.0	50.2	49.4	47.9	-1
P7 - Takeley	46.3	44.3	45.4	45.6	44.9	45.6	+1.3
P8 - Elsenham	44.8	42.8	44.0	44.2	43.5	44.1	+1.3
P9 – Brick End	44.8	42.3	43.8	44.0	43.4	44.3	+2

Table 8.10: Calculated night time levels at various points

Receptor location	**Night time, LAeq, 8h**						**Baseline v 2028 DC**
	25+Full capacity	2016 baseline	DM 2023	DC 2023	DM 2028	DC 2028	
P1 – Molehill Green	51.5	49.9	52.1	52.3	52.3	52.5	+2.6
P2 – Gaunts End	51.0	50.1	51.7	51.9	51.8	51.9	+1.8
P3 – Tye Green	51.1	50.9	51.7	51.9	51.7	51.6	+0.7
P4 – Ash Pub	49.6	50.4	51.1	51.4	51.1	48.2	-2.2
P5 – Bury Lodge	48.3	49.7	50.5	50.7	50.5	44.8	-4.9
P6 – Warmans Farm	44.8	45.4	46.1	46.3	46.1	44.0	-1.4
P7 - Takeley	41.1	41.0	41.8	42.0	41.8	41.7	+0.7
P8 - Elsenham	39.6	39.3	40.4	40.6	40.4	40.2	+0.9
P9 – Brick End	39.5	38.8	40.3	40.5	40.4	40.4	+1.6

9.223 The above tables indicate that in 2016 baseline none of the receptors experienced daytime noise levels above the threshold of 55dB LAeq 16h, although Tye Green and the Ash Public House are approaching this level at 54.2 and 54.1dB respectively. In terms of night time noise, receptors P1-P6 experienced noise levels exceeding the threshold of 45dB LAeq 8h.

9.224 The location which would experience the greatest increase in noise levels is Molehill Green with an increase of 3dB for daytime noise and 2.6dB for night time noise in the DC scenario compared to the baseline. However, it should be noted that an increase in noise levels would also arise in the DM 2028 scenario and that the difference in noise levels at this location would be 1dB in daytime and 0.2dB in night time.

9.225 In the DC scenario three receptors would exceed the daytime 55dB LAeq, 16h threshold, compared to just one receptor in the DM scenario. In the DM scenario

Molehill Green (P1) would experience a noise level of 0.4dB above the threshold. However, in the DC scenario this noise level would be 1.4dB above the threshold. In addition, Gaunts End (P2) would experience noise levels 0.8dB above the threshold and Tye Green (P3) 0.5dB above the threshold compared to noise levels of 54.9dB and 54.8dB respectively in the DM scenario.

9.226 Similarly, in the DC scenario four receptors would exceed the night time 45dB LAeq, 8h threshold, compared to six receptors in the DM scenario. Two receptors, Bury Lodge and Warmans Farm would experience betterment with noise levels falling below the night time threshold. See table below for a breakdown in the information.

Receptor	Baseline	2028 DM	Exceed 45dB LAeq, 8h	2028 DC	Exceed 45dB LAeq, 8h	Difference between DM & DC
P1 Molehill Green	49.9	52.3	+7.3	52.5	+7.5	+0.2
P2 Gaunts End	50.1	51.8	+6.8	51.9	+6.9	+0.1
P3 Tye Green	50.9	51.7	+6.7	51.6	+6.6	-0.1
P4 Ash Pub	50.4	51.1	+6.1	48.2	+3.2	-2.9
P5 Bury Lodge	49.7	50.5	+5.5	44.8	-0.2	-5.7
P6 Warmans Farm	45.4	46.1	+1.1	44.0	-1.0	-2.1

9.227 The applicant contends that the reduction in noise levels during the night time period arises because of:

- There being virtually no increase in the number of movements between the 2028 DC and the DM scenario operating conditions due to the overriding constraints imposed by the Government's Night Noise Regulations
- The significant reduction in GA movements under the DC scenario. This has the benefit of bringing into use a greater proportion of new generation lower noise aircraft, replacing small numbers of general aviation and corporate movements which are typically by older generation, noisier aircraft.

9.228 Similarly, the contention made in respect of the reduction in daytime noise levels at the Ash Pub, Bury Lodge and Warmans Farm is directly related to the reduction in GA movements which take place on the northside apron. Receptors P4 – P6 are located in closer proximity to the area of the airfield generally associated with GA movements and are therefore more affected by these movements. Reductions in GA movements would be beneficial to these properties.

9.229 The applicant's conclusion in respect of operational noise is that there should be no adverse effects, with only minor adverse effects arising at Molehill Green due to a daytime increase of 1dB between the DM and DC scenario and an exceedance of the threshold of only 0.1dB.

9.230 The Environmental Health Manager has reviewed the ES and concludes that a comparison of data sets shows negligible impact in the 2028 DC scenario compared to the 25+ permission. The level change when compared to the DM scenario is concluded by him to be equally negligible. Comparisons with the

2016 baseline show increases of +3dB in the worse location (Molehill Green) during the day and +2.5dB at night. As this is a marginal increase over time and that the resultant level when compared to the DM scenario, there should be little impact.

9.231 In terms of night time noise, the noise levels would increase above the 45dB LAeq, 8h in 2028. Comparing ground noise contours with and without the development in place, shows they are virtually indistinguishable throughout the surrounding community, except where benefits will arise from reduced activity associated with the northside apron should permission be granted. In those areas ground noise levels are expected to reduce. It remains the case that night time aircraft movements at Stansted are subject to Government control under the Night Noise Regulations and, as a consequence, the airport will reach its cap on movements before 2028 whether or not permission is granted for this application.

9.232 Mitigation measures in respect of ground noise are partially covered by those set out in the air noise section above.

9.233 In terms of ground noise, the findings of the ES are not disputed and the proposed mitigation measures are considered to be acceptable. The Environmental Health Manager (Protection) has recommended a condition requiring a noise envelope contour to not exceed the predicted Do Minimum 54dB LAeq, 8h contour s set out in the ES. This would ensure that the overall population exposed to the SOAEL at night does not increase over what could occur if the application did not proceed.

9.234 Whilst the principle of a night noise contour at 54dB LAeq, 8h could potentially be welcomed, in this instance this would not relate to the development applied for. The application relates to the increase in passenger numbers and a change to the mix of ATMs per annum. However, it does not relate to any changes to the permitted number of flights at night, these being controlled by the Night Noise Regulations. On this basis, such a condition would fail to meet the test of being relevant to planning and to the development to be permitted (paragraph 55 of the NPPF).

Construction noise

9.235 Construction noise would only occur in the period 2021-2 in respect of the engineering works applied for in this application. Other engineering works already have the benefit of planning permission and are envisaged to be carried out prior to this timeframe. In addition, other works may come forward either as a result of other applications or as permitted development. However, the ES considers the potential impacts in respect of ground noise for the engineering works as applied for. The main focus of the construction noise assessment is the key sensitive night time period.

9.236 Table 8.25 sets out the calculated construction noise levels at the sensitive receptors together with the change assessed by the applicant.

Receptor Location	Night time noise level, LAeq, 1h (dB)			
	Baseline	Construction	Combined	Change
P1 – Molehill Green	41.0	43.1	45.2	+0.2
P2 – Gaunts End	31.0	45.7	45.8	+0.8
P3 – Tye Green	48.0	42.3	49.0	+1.0
P4 – Ash Pub	33.0	43.2	43.6	No change*
P5 – Bury Lodge	47.0	42.3	48.3	+1.3
P6 – Warmans Farm	40.0	40.1	43.1	No change*
P7 – Takeley	43.0	35.9	43.8	No change*
P8 – Elsenham	48.0	35.1	48.2	+0.2
P9 – Brick End	35.0	31.5	36.3	No change*

* Baseline level lower than 45dB threshold

9.237 The above table indicates that all locations will experience increases in noise levels, ranging from an increase of 0.2dB to 10.6dB at the Ash Public House. However, these have been assessed as having a negligible significance as the increases would either result in noise levels remaining below the threshold of 45dB or would give rise to increases of less than 3dB above existing levels. These are reasonable conclusions to have reached and these findings are not disputed.

E Surface Access Noise

9.238 Chapter 9 of the ES assesses the impacts of surface access noise. This chapter needs to be read in conjunction with the accompanying transport assessment (Volume 3 of the ES) and the traffic data set out in Appendix 9.1 (Volume 2 of the ES).

9.239 Paragraphs 9.157 to 159 in the Air Noise section above set out the policy position with regards to surface access noise.

9.240 This chapter assesses the surface access noise impacts arising from the proposed construction and operational phases of the development. Whilst rail is a form of surface access which generates noise, this has been scoped out of the assessment. The basis for this decision is the fact that the proposed capacity changes at the airport will not lead to any change to the activity on the railway. AGA separately proposes to introduce 12-car Stansted Express trains in 2019 but without any changes to the number of trains per day. This alteration to existing capacity will occur with or without the development the subject of this application.

9.241 The Design Manual for Roads and Bridges (DMRB) sets out the noise assessment procedures for undertaking highway works such as building new roads. This provides thresholds at which potential impacts may start to become apparent, based on changes in 18-hour daytime noise levels (06:00-24:00) over both short and long term scenarios. For the proposed development, the long term changes are appropriate to assess as the forecast growth of the airport would lead to gradual increases in traffic flows to 2028. Specifically, the proposed development differs from the type of development that DMRB primarily relates to. The DMRB requires a two-stage process to be undertaken, the short term on the opening of the new road and long term operational effects. In this instance there is no new road and therefore no short-term effects.

9.242 Calculations are based on the Department for Transport calculation of Road Traffic Noise (CRTN). The assessment is based on noise levels as defined at 10m from the edge of the carriageway. The method adopted is universally applied and considered to be acceptable.

9.243 In carrying out the assessment the 2028 DC scenario has been compared with the 2028 DM scenario. A further assessment is made comparing the 2028 DC with 2016 baseline.

9.244 Comparisons of the 2028 DC and 2028 DM scenarios show that noise levels would increase between 0.1dB and 0.7dB, with the largest increase being at Thremhall Avenue. Comparisons between the 2028 DM and 2016 baseline indicate that increases will be larger, ranging from 0.7dB to 3.8dB, the largest increase being at Round Coppice Road.

9.245 The changes in noise levels would be negligible, with the exception of the 3.8dB increase at Round Coppice Road in comparison to baseline levels. The nearest receptor to this road is the Novotel Hotel, more than 150m from the road. The ES states that it should be noted that this increase primarily occurs as a result of the permitted uplift of the baseline (2016) level of annual passenger throughput up to 35mppa under the 2028 DM scenario, coupled with the proposed employment allocation at Northside, rather than as a result of the additional uplift in annual passengers triggered by the proposed 43mppa development.

9.246 The other building that would be affected by the proposals is the Stansted College building which opened in September 2018. However, the ES states that the design of the building includes high performance glazing and mechanical ventilation, due to the building's proximity to the runway. These features have been included on all elevations, not just those facing the runway. On this basis, it is concluded that the increases in Round Coppice Road traffic should not have any significant effects on staff and pupils within the College.

9.247 In conclusion, the ES considers that the impacts of surface access noise would be negligible. Cumulative impacts have been taken into consideration and no mitigation is identified as being required. These are reasonable conclusions to have reached and these conclusions are not disputed.

F Air Quality

9.248 Chapter 10 of the ES assesses the impacts of air quality resulting from development-related traffic. This chapter needs to be read in conjunction with the accompanying appendices 10.1 to 10.5 (Volume 2 of the ES) and the Technical Note, Annex 4A of the Consultation Response and Clarifications Document, July 2018. In addition, the information contained in Annex 1 of this document (as amended by Revision to Annex 1: Information for Epping Forest July 2018) now requires the potential impacts on Epping Forest to be discussed under Air Quality and not Biodiversity.

9.249 Adopted Uttlesford Local Plan Policy ENV13 identifies poor air quality zones, which are not within the application site. It also states that development that would involve users being exposed on an extended long-term basis to poor air quality near ground level will not be permitted. This policy is generally consistent with the NPPF, although the latter document sets out a requirement that any development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan. The policy therefore carried moderate weight.

9.250 Uttlesford District Council has designated one AQMA in Saffron Walden. Given the distance between the application site and the AQMA is it considered that the proposals should not result in significant impacts to the AQMA.

9.251 Adopted Uttlesford Local Plan Policy ENV7 seeks to protect designated sites, such as Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR). Development will only be permitted where the need for development outweighs the particular importance of the nature conservation value of the site or reserve. The policy also seeks to protect other areas of nature conservation significance, such as local wildlife sites, ancient woodlands and other wildlife habitats. This policy is only partially consistent with the NPPF with the emphasis shifting from the need for development to the benefits needing to clearly outweigh the harm. In addition, there are additional requirements under the Habitats and Species Regulations (2010) which relate to European designated sites. Therefore, the policy has little weight.

9.252 Paragraph 181 of the NPPF states:

"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

9.253 Paragraph 175 seeks to protect biodiversity, including protected species, SSSIs, ancient woodland and ancient or veteran trees, and to conserve or enhance biodiversity.

9.254 The APF (2013) sets out the government's position in respect of air quality in and around airports. It identifies sources of pollution around airports as including aircraft engines, airport-related traffic on local roads and surface vehicles at the airport. The most important pollutants are oxides of nitrogen (NOx) and particulate matter (PM).

9.255 It recognises that limits in respect of PM are largely met, but challenges remain with nitrogen dioxide, while pressures from increasing pollution, transport and land use mean that considerable efforts to improve air quality to protect health and the environment continue to be needed.

9.256 Paragraph 3.51 of the APF states that studies have shown that NOx emissions from aviation-related operations reduce rapidly beyond the immediate area around the runway. Road traffic remains the main problem with regard to NOx in the UK.

9.257 Paragraph 1.9 of "Beyond the Horizon" (June 2018) states:

“Most of the concerns raised can be addressed through our existing policies as set out in the 2013 Aviation Policy Framework, or through more recent policy updates such as the new UK Airspace Policy or National Air Quality Plan. For the majority of environmental concerns, the government expects these to be taken into account as part of existing local planning application processes. It is right that decisions on the elements which impact local individuals such as noise and air quality should be considered through the appropriate planning process and CAA airspace change process.”

9.258 In the area near to the airport, adjacent East Herts District Council’s adopted Local Plan has saved Policy ENV27 which relates to air quality which states:

“(I) The Council will have regard to the potential effects of a development on local air quality when determining planning applications. Consideration will be given to the impact caused by both the operational characteristics of the development (industrial, commercial and domestic) and the traffic generated by it, and development which will significantly increase air pollution will not be permitted. Where development proposals are likely to involve emissions into the air, submission of appropriate details will be required to enable a full judgement of the impact of the development to be made.
(II) Any development within designated Air Quality Management Areas must have regard to the strategy for reduction of pollutants in such areas and to guidelines for ensuring air quality is thereafter maintained at acceptable levels as set out in the national air quality strategy.”

9.259 The East Herts District Plan has been the subject of Examination and the Inspector’s Final Report and Schedule of Main Modifications was received on 9 July 2018. In respect of Policy EQ4, the Inspector considered that the criteria within the policy were not precise or comprehensive enough to be effective. Modification MM/24/01 rewrites the policy to make it more comprehensive, taking account of legislation and national policy on air quality. This modification results in the policy being sound.

9.260 Modification MM/24/01 states:

“I. The effect of development upon air quality is a material consideration. All applications should take account of the Council’s Air Quality Planning Guidance Document, which details when an air quality assessment is required.
II. All development should take account of the Council’s Air Quality Action Plan, local Air Quality Strategies, Local Transport Plans, as well as national air quality guidance.
III. All developments should include measures to minimise air quality impact at the design stage and should incorporate best practice in the design, construction and operation of all developments.
IV. Where development (on its own or cumulatively) will have a negative impact on local air quality during either construction or operation, mitigation measures will be sought that will remove overriding impacts, such as an air quality neutral or negative development. Evidence of mitigation measures will be required upfront.
V. Where on-site mitigation is not sufficient, appropriate off-site mitigation measures may be required. Where adequate mitigation cannot be provided, development will not normally be permitted.
VI. Developments must not:

- *Lead to a breach or worsening of a breach of UK or EU limit values;*

- *Lead to a breach or worsening of a breach of an Air Quality objective or cause the declaration of an Air Quality Management Area or;*
- *Prejudice the implementation of any Air Quality Action Plan or local air quality strategy."*

9.261 Following receipt of the Inspector's Final Report on the Examination of the East Herts District Plan, an Extraordinary Council meeting was arranged for Tuesday 11 September with the intention that the Council would be asked to determine to adopt the Local Plan. However, the SoS issued a Holding Direction on that date which prevented EHDC from adopting the Local Plan. Subsequently, on 12 October, the Holding Direction was lifted although, at the time of writing the report, the District Plan had not been adopted, although UDC was advised that EHDC proposed to hold an Extraordinary meeting of the Council on 23 October 2018 with a view to adopting the Plan. Notwithstanding this, given the fact that Policy EQ4 has been tested and found to be sound it carries significant weight.

9.262 East Herts District Council has designated three AQMAs and the one of concern in respect of this application is the Bishop's Stortford AQMA which is centred on the Hockerill traffic lights junction close to the town centre. East Herts has published an Air Quality Action Plan (AQAP) 2017/18 – 2019/20. SP6 of the AQAP states that air quality measures will be taken into consideration on all planning applications, particularly when these are within or closely adjoining an AQMA. SP9 of the AQAP seeks to ensure that developers have taken sufficient steps to minimise any increase in air pollution.

9.263 The ANPS (2018) sets out where planning considerations in respect of air quality are likely to be relevant. These are:

- within or adjacent to Air Quality Management Areas, roads identified as being above limit values, or nature conservation sites (including Natura 2000 sites and Sites of Special Scientific Interest);
- where there would be effects sufficient to bring about the need for new Air Quality Management Areas or change the size of an existing Air Quality Management Area, or bring about changes to exceedances of the limit values, or have the potential to have an impact on nature conservation sites; and
- after taking into account mitigation, where there would be a significant air quality impact in relation to Environmental Impact Assessment and / or to a deterioration in air quality in a zone or agglomeration.

9.264 The ES assesses the impacts of NO2, PM10 and PM2.5 for human health and NOx for the natural environment. The study area is 15km x 15km centred on the airport and focusses on the potential impacts of the development on major roads and the main towns around the airport.

9.265 Within the study area 244 representative receptors were selected for assessment (49 schools/nurseries, 7 hospitals/care homes and 188 dwellings). Sensitive ecological receptors have also been identified with 6 falling within the study area.

9.266 Paragraph 10.37 of the ES addressed Epping Forest Special Area of Conservation (SAC) which is some distance south of the airport. Following an objection from Natural England, further work has been undertaken with regards to the potential impacts of increased airport related traffic on air quality within Epping Forest SAC. This issue was originally covered in the Biodiversity section of ES Chapter 16 (Non-Significant Topics). In light of Natural England's recent advice, this is now being treated as an elevated concern within the air quality general topic area.

9.267 It is established throughout the ES that the construction period is expected to be 2021/2 and therefore predicted to take place prior to exceeding the currently permitted 35mppa limit. Construction works would be located away from sensitive receptors. In addition, vehicular movements would not be significant and therefore should not give rise to a level of increase of emissions which would result in harmful impacts on sensitive receptors. Therefore, the construction phase, with its proposed mitigation by way of a Construction Environmental Management Plan should ensure adverse harm would not arise as a result of pollutants.

9.268 With regards to the operational phase, the following pollution sources were assessed:

- Aircraft main engines in the landing and take-off (LTO) cycle;
- Aircraft auxiliary power units (APUs) while in use on the ground
- Ground support equipment (GSE), namely airside vehicles which handle aircraft turn-arounds, load and unload baggage and cargo, and conduct inspections and essential maintenance of airfield infrastructure, particularly the runway which is in constant use;
- Other airport sources, including car parks, airport heating plant and the fire training ground; and
- Road vehicles using the local and strategic highway network around the airport.

9.269 The applicant created a model to allow for the prediction of effects at future years using industry standard modelling software which was also used to inform the recommendations made by the Airports Commission. This model requires verifying to the existing monitored levels which is achieved through replicating the existing emissions sources in the area and including them in the modelled input, then adding them to the background levels which make up all other sources not included in the model. The applicant has included sources from aircraft and vehicles on the local highway network in their model and obtained the emissions for each of these from appropriate sources.

9.270 The background pollutant concentrations used for the modelling were taken from the National Air Emissions Inventory with the road transport and aviation emissions subtracted from the background so as not to double count. The model has been verified to local monitoring to ensure that the results from the model are accurately representing the actual monitored levels. This verification showed that the modelled concentrations of NO2 were significantly under-predicted within Bishop's Stortford and Stansted Mountfitchet. However, the Council's air quality consultant confirms that the report provides enough information to consider the effect of the scheme with the required elevated background and that the effect of the scheme (inclusive of the enhanced verification factor) should be 'negligible' with increases in pollution levels being ≤0.1µg/m3.

9.271 The applicant was required to carry out sensitivity analysis for multiple years to ensure the meteorological data for the baseline year was representative. Sensitivity testing was undertaken for 2014, 2015 and 2016 and demonstrated that the baseline data was representative.

9.272 It is a generally accepted principle that emissions will reduce in future years as technology becomes more efficient and more sustainable transport measures are encouraged amongst the general population. However, the rate at which emissions will improve is disputed and the DEFRA predictions which the applicant has used for their assessment are potentially over optimistic. To provide a sensitivity analysis, the applicant was requested to carry out analysis using existing baseline emissions in future year scenarios assuming that there will be no reduction in emissions. Whilst the results from this sensitivity modelling were higher than those in the original ES, the relative significance of the effect as a result of the scheme did not change and remains in the ‘negligible’ band.

9.273 The Council’s consultants concluded that, based on the information within the ES and the additional information supplied, there should be no predicted increase in pollutant levels at modelled receptors in Stansted Mountfitchet. The scheme would increase pollutant emissions as a result of additional vehicle movements within the Bishop’s Stortford Air Quality Management Area where levels of pollutants are already above the level where health effects are likely to be observed in the most sensitive members of the population. These health effects should be considered against the benefits of the scheme and an appropriate balance of mitigation sought.

9.274 Adopted Uttlesford Local Plan Policy ENV13 predates current legislation in respect of air quality. The draft policy in the Regulation 19 Plan has yet to be tested for soundness. However, in this instance the impacts will arise in Bishop’s Stortford which is within the administrative district of East Herts District Council. The East Herts District Plan has been examined and the soundness of their policy in respect of air quality was been found to be sound and has significant weight.

9.275 Policy ENV27 of the Regulation 19 East Herts District Plan requires applications to be supported by an Air Pollution Assessment in line with the Council’s Air Quality Planning Guidance Document. This sets out a requirement for Major Developments to be accompanied by a detailed air quality assessment to determine the impact on public health and the local environment. The methodology to be used for the determination of pollutant concentration change should meet the requirements of the Defra Technical Guidance Note (TG.16) (Defra 2016). The use of the ADMS-Airports model is an appropriate assessment in this instance.

9.276 The Air Quality Planning Guidance Document then requires the calculation of pollutant emission costs (known as damage cost) from the development to be carried out using the most recent Defra Emissions Factor Toolkit. This will determine the level of mitigation required. To date, this work has not been carried out.

9.277 However, it should be recognised that DEFRA’s “Valuing impacts on air quality: Supplementary Green Book guidance” is a supplementary document to DEFRA’s Green Book which cost assesses various elements of development proposals as a balancing exercise, and not just air quality impacts in isolation. However, paragraphs 1.6 and 2.1 explain that a damage costs approach is a recommended approach only. Therefore, there is no requirement to follow that approach. The NPPF (2018) does not require that approach to be followed for Air Quality and instead seeks to limit the need to travel and offer genuine transport solutions and mitigate impacts through measures such as traffic and travel management. Decisions should take account of AQMAs. See paragraphs 103 and 181.

Paragraph 181 explains that new development inside an AQMA needs to be consistent with the air quality action plan. The application is not inside an AQMA and has addressed transport measures.

9.278 The application includes measures consistent with the NPPF and reflecting the detail of those in the East Herts Air Quality Planning Guidance for developments in the EHDC area classified as Major such as local sourcing of staff, products and raw materials, development of car sharing initiatives, provision of low emission shuttle bus, provision of low emission fuelling infrastructure (electric car charging points), provision of new or enhanced public transport services to the site, and supporting sustainable travel initiatives. The applicant is already undertaking many of these initiatives. For example, their Staff Travel Plan encourages car sharing. The Transport Forum helps to support sustainable forms of travel by funding new public transport services or routes. The Airport's Sustainable Development Plan also includes "Meet the Buyers" events where local companies have the opportunity to promote themselves to secure local business contracts.

9.279 The continuation of those mitigation measures in respect of air quality effects, in particular in relation to sustainable travel initiatives, would be required if planning permission is granted, and this could be secured by way of s106 Legal Obligation.

9.280 Turning to impacts on ecological features as a result of air quality, an assessment in accordance with the DMRB HA 207/07 and the Environment Agency's H1 Guidance has been carried out in light of paragraph 10.34 of the ES stating that deposition of pollutants derived from NOx emissions contributes to acidification and/or eutrophication of sensitive habitats leading to a loss of biodiversity. Nitrogen deposition rates and information on sensitive habitats for the designated sites were taken from the APIS (Air Pollution Information System) website.

9.281 The DMRB guidance recommends the reduction in total nitrogen deposition rates of 2% per year based on predicted improvements in vehicle technologies. Sensitivity testing using 2016 road traffic emission factors for future assessment years was also carried out following discussions between the Council's consultant and the applicant.

9.282 The original conclusions of the ES, paragraphs 10.127-132, were that there would be no significant effects on any of the identified ecological receptors within the study area. The conclusion of the sensitivity testing found that exceedances of the NO2 air quality standard are predicted at a few more receptor locations compared to the ES: at 5 receptors out of the 244 assessed in 2023 rather than one; and six receptors in 2028 rather than zero. The change in concentrations due to the proposed development at all of these locations would be very small, no greater than 0.1µg/m3.

9.283 Exceedances of the NOx air quality standard are also predicted at the western boundary of Elsenham Woods SSSI. No exceedances are predicted at any of the other ecological receptors, including the Hatfield Forest SSSI and NNR. The predicted changes in nitrogen deposition at the Hatfield Forest SSSI and NNR and the Elsenham Woods SSSI would be less than 1% of the relevant lower critical loads for those site and therefore no significant effects are anticipated.

9.284 The Council's consultant confirms that they have no concerns with regards to ecological receptors.

9.285 In terms of ecological receptors, the assessment has also been considered by Natural England. They welcome the precautionary approach carried out in the sensitivity testing and note the results but raise concerns regarding the use of TEMPro as this may not accurately reflect the actual environmental conditions over the mid-longer term that ecological receptors needs to function within.

9.286 With regards to impacts on Hatfield Forest SSSI and NNR, Natural England welcomes the commitment to continue to monitor impacts on the receptor and would wish to ensure that this continues beyond the 35mppa limit. This could be secured by way of s106 Legal Obligation with a requirement to identify and implement mitigation measures if required.

9.287 Elsenham Woods SSSI is already subject to nitrogen deposition that significantly exceeds the Critical load for its SSSI woodland habitat feature. In recognition that the proposed 35mppa+ development is predicted to increase road traffic and nitrogen deposition onto Elsenham Wood SSSI, Natural England advises it would be appropriate for Stansted Airport to undertake any necessary measures to reduce NOx outputs and nitrogen depositions. This would be consistent with the aims and targets of the Airport Sustainable Development Plan to 'reduce air pollution' deposition within the woodland habitats of the Airport owned Elsenham Woods SSSI. This could be secured by way of a condition or s106 Legal Obligation.

9.288 The Council's Ecologist has advised that monitoring of Elsenham Woods SSSI should become part of any consent should planning permission be granted. They have also advised that the Elsenham SSSI Management Plan should be updated in accordance with the Airport Sustainable Development Plan. Whilst this is recognised as being beneficial to the Elsenham Woods SSSI there needs to be a distinction between the applicants' statutory duty as the owner of Elsenham Woods SSSI under legislation outside of the planning system, and the requirements as mitigation in respect of any planning permission granted.

9.289 In terms of Quendon Wood SSSI and High Wood Dunmow SSSI, Natural England accepts the conclusions of no significant impact.

9.290 With regards to Epping Forest SSSI, this is divided up into units given its scale. Units 103 and 201 are close to the M11 between junctions 6 and 7 and SSSI unit 106 is within 200m of the M25. This proximity necessitates further assessment in accordance with DMRB guidance and consideration within the ES.

9.291 The original additional information submitted made no reference to units 103 and 201 and as such Natural England assumed that distance measurements have been taken from the centre line of the carriageway and that this distance is regarded to be greater than 200m thus eligible for screening out in strict adherence to DMRB guidelines.

9.292 An additional Technical Note was submitted on 10 August covering the SSSI receptors between junctions 6 and 7 of the M11. The plan attached to the Technical Note indicates that unit 201 (for some reason appears to be referred to as receptor 13 in the report) is within 200m of the M11, whereas unit 103 is beyond the 200m range. Using modelling of traffic flows between junctions 8 and 7 of the M11, which is likely to result in a conservative estimate as it ignores traffic leaving the motorway at junction 7, predicted traffic flows in 2028 in the DC scenario are predicted to be 5,149 AADT (2-way). This is predicted to increase nitrogen deposition by 0.08kgN/ha/yr, which is below 1% of the minimum critical load. Levels of deposition drop off rapidly away from the road.

9.293 Natural England notes that Epping Forest SSSI unit 201 is mainly Oak-Hornbeam woodland with additional interest provided by the ponds. For the purposes of this assessment, the woodland habitat (including ground flora, veteran trees and epiphytes) and wetlands are the main SSSI interest features that need to be considered from an air quality perspective. In this context and at this location, the minimum Critical load threshold for Nitrogen is correctly identified as 10kgN/Ha/Year. Natural England note that the deposition rates fall below the 1% threshold of significance. They also note that this area of Epping Forest is already subject to Nitrogen deposition that significantly exceeds the Critical load for its SSSI woodland and wetland habitat features and this development is likely to contribute to prolonging the exceedances of Nitrogen loading.

9.294 Natural England acknowledges that the strict application of current guidelines (eg, DMRB) for SSSI and EIA-linked assessments provide an accepted justification for not regarding the impact as ‘significant’ and therefore not requiring further assessment or mitigation. Ideally, mindful of sustainability and SSSI targets, this section of M11 adjacent to Epping Forest SSSI unit 201 should be subject to periodic traffic monitoring and linked AQ modelling to verify the predictions to see whether further assessment and remediation is necessary. In light of the context, Natural England does not expect this provision, but for the record would support a solution that included this provision within any Highways-linked obligation. However, given the level of predicted impact it is not considered that this level of mitigation can be justified in respect of this application.

9.295 Epping Forest is also designated as a Special Area of Conservation (SAC) and therefore an assessment under the Conservation of Habitats and Species Regulations 2010 (as amended) is required. On 10 May 2018, Natural England provided Advice on the Scope of an Appropriate Assessment that it considered was required because critical loads of Nitrogen Oxides and Nitrogen deposition are currently exceeded for the SAC and a likely significant effect, alone or in combination, from the traffic resulting from the application could not be discounted. Of particular importance is unit 105 which is located within 200m of the stretch of the M25 between junctions 25 and 26.

9.296 Natural England notes that the predicted contributions to NOx Critical Levels and Nitrogen deposition Critical Loads from the M25 are well below 1%, and so it is reasonable to conclude for SSSI unit 105 that the proposed development ‘alone’ can avoid a likely significant effect on the SAC features within SSSI unit 105, however with reference to the Wealden case there was still a need to consider whether there is a likely significant effect ‘in combination’ with other plans and projects.

9.297 For SSSI unit 109, also located between junctions 25 and 26 of the M25, Natural England notes distance measurements have been taken from the centre line of the carriageways and this distance is greater than 200m. Strict adherence to the DMRB guidelines (HA 2007) indicates that it is acceptable to screen out any further HRA assessment for SSSI unit 109, either ‘alone’ and/or ‘in combination’.

9.298 Natural England welcomed the detail provided in the Habitats Regulations Assessment to enable further consideration of the ‘in combination’ effects and advises that if the background concentration/deposition is currently exceeding the environmental benchmark and the new development contribution will cause an additional small increase then, a decision will have to be made on a case by case basis. For this case, the complexities involved with the likely ‘in combination effects’ associated with the HMA Local Plans and the highlighted concerns about the ecological sensitivity of Epping Forest SAC (and SSSI) features has required this proposed development to be considered in more detail.

9.299 The revised Epping Forest District Council traffic assessments and linked Local Plan HRA are not yet available for consideration. To enable Natural England to meet the consultation timescales for this application the council has provided advice based on the information that is available, rather than requesting a further extension to the consultation period to allow for this additional third party ‘in combination’ information. Natural England notes the reasonable assumption that the M25 carries a wide range of longer distance trips and acknowledges that the local road B1393, which runs through Epping north to M11 J8 has no direct connection for traffic to access the M25 at this assessed location. Natural England notes the predicted AADT increase of 12 for the B1393 that can be attributed to the Stansted Airport 35+ development, which is very small compared with the predicted increases >1000 AADT that have been attributed to the Local Plan growth (available HRA figures). Based on assurances from the applicants that the assessments have adhered to available standard guidelines it is reasonable to conclude that the Stansted Airport development would not significantly contribute to traffic levels on the local Epping road network, whereas the growth associated with HMA Local Plans will significantly contribute to the local roads and potentially other major roads including the M25. With an absence of locally validated ‘in combination’ traffic and AQ assessments for the B1393 at this stage. Natural England is minded to accept the use of TEMPro growth for assessment purposes and note for future reference the predicted AADT contributions that would be required to meet 1% NOx threshold.

9.300 The Epping Forest Survey Note (Appendix 3 of the document Revision to Annex 1: Information for Epping Forest July 2018) helpfully provides additional detail that supports Natural England’s previous advice. Natural England notes that a condition survey undertaken in 2009 confirms that the ‘zone of influence’ within the SSSI unit 105 is Nitrogen polluted when considering its Lichen Indicator Scores and other notable field signs (eg, signs of stress, elevated insect damage and dominance nitrogen-loving field layer where present). This aligns with their observations and concerns that ‘Epping Forest SSSI unit 105 (within SAC) has been subject to Nitrogen deposition above Critical Loads for a prolonged period resulting in Natural England identifying the unit as a ‘SSSI Threat’ and an ‘SAC IPENS (Improvement Programme for England’s Natura 2000 sites) issue’ since at least 2009. This is reducing the capacity for sensitive SAC features and their supporting habitats to maintain or achieve favourable condition and/or favourable conservation status.’

9.301 Natural England note the applicant’s evidence of the lack of clear trend between the % lichen cover and the change in the distance from the M25, but also recognise the increase from ‘Nitrogen Polluted’ to ‘Very Nitrogen Polluted’ (based on Lichen Indicator Score / Nitrogen Air Quality Index) with increasing proximity to the M25 (ie, comparing c200m with c50m distances from the M25). Natural England’s considers that the assessment helpfully contributes to their understanding of how the features of this specific area of the SSSI, SAC are performing at different distances from the M25 and also demonstrates the challenges within the short timescales of the planning process to obtain definitive proof that elevated NOx and Nitrogen deposition from development will cause a significant and quantifiable impact.

9.302 When considering the ‘in combination’ figures generated by TEMPro for the Stansted 35+ traffic on the M25, Natural England notes the maximum increase in nitrogen deposition into this discrete area of SSSI unit 105 of the SAC is predicted to be 0.02kgN/ha/yr. This is well below the 1% level of the Critical Load for this woodland area of the SAC and the modelled reductions in Nitrogen deposition at increasing distances from the M25 is a reasonable assumption based on general studies. Natural England state that it is not yet clear to them what the likely increase in Nitrogen deposition will be from the B1393 onto this area of the SSSI unit 105 that can be attributed to the increased traffic generated by the HMA Local Plans. It is anticipated that the effect of the forthcoming Local Plans on the local roads and the adjacent SAC areas (including the B1383 and SSSI unit 105) will have to be considered as part of their HRA assessment process.

9.303 However, based on available and submitted information, Natural England broadly accepts, in its further representation of 31 August 2018, that the application of the distance criteria and the 1% significance threshold at this location for this development and generally accepts that the Stansted 35+ development can avoid an adverse effect on the integrity of Epping Forest SAC, either alone and in combination with other relevant plans or projects.

9.304 This does not mean that Natural England could then rule out a likely impact on the SSSI features within SSSI unit 105 caused by this scale of development-linked Nitrogen deposition if it were considered in combination with unexpected levels of growth beyond TEMPRo assumptions, but it merely acknowledged that the strict application of current guidelines (eg, DMRB) for SSSI and EIA-linked assessments provide an accepted justification for not regarding the impact as ‘significant’ and therefore not requiring further assessment or mitigation. Ideally, mindful of sustainability and SSSI targets, this section of M25 adjacent to Epping Forest SSSI unit 105 should be subject to periodic traffic monitoring and linked AQ modelling to verify the predictions to see whether further assessment and remediation is necessary. In light of the context, Natural England advised that it does not expect this provision, but for the record would support a solution that included this provision within any Highways-linked obligation.

9.305 Notwithstanding the advice of Natural England on 31 August 2018 that it “broadly accepts the application of the distance criteria and the 1% significance threshold at [location unit 105] for this development and generally accepts that the Stansted 35+ can avoid an adverse effect on the integrity of Epping Forest SAC, either alone or in combination with other relevant plans or projects”, in parallel and to ensure that the Council complies with Regulation 63 of the Conservation of Habitats and Species Regulations (2017), and pursuant to the Advice of Natural England in relation to its scope and in light of its representations, Place Services was commissioned to carry out an Appropriate Assessment (https://uttlesford.moderngov.co.uk/documents/s8354/Place%20Services.pdf). This Assessment (11 October 2018) concluded in paragraphs 4.5 to 4.32 and Table 4.34 that, alone, the 35+ Project “Do Minimum” scenario there is no potential for Adverse Effects on Integrity of the Epping Forest SAC due to changes in air quality from traffic generation as a result of increased traffic flow on the M25 from the 35+ project along under the "Do Something" scenario. It also concluded, at paragraphs 4.37 to 4.59, in particular paragraphs 4.58-4.59, that the 35+ development, acting in combination with the plan and projects in Table 4.56 "only makes an insignificant contribution to perpetuating the situation of the Critical Loads and Levels being exceeded". Paragraph 4.58 assessed in conclusion such contribution of emissions from the 35+ development as "de Minimis". The Conclusion summarises the assessment, at paragraph 5.3, along or in combination: the Annex I SAC will not be reduced by the Project; there will be no direct adverse effects by the Project on Annex II species; there will only be "de Minimis" indirect adverse effects on SAC Annex II species; there will be no change to habitat composition from the Project; and the Project will not interrupt or degrade the processes that support the SAC and species justifying designation. That conclusion was also supported by particular advice summarised in paragraphs 5.4-5.6 that included further vegetation surveys. The conclusion at paragraph 5.7 is that the application will have no Adverse Effect on the Integrity of the Epping Forest SAC objectives, alone or in combination. Therefore, Regulation 63 does not prevent the development, subject to other considerations, being granted consent and Uttlesford District Council can demonstrate its compliance with the UK Habitats Regulations 2017. In addition, paragraph 177 of the NPPF (2018) does not prevent the development engaging the paragraph 11 presumption in favour of sustainable development since an appropriate assessment is not required and has now been done.

9.306 The conclusions of Natural England are also noted, but their request for monitoring at Epping Forest appears to not have taken account of the Appropriate Assessment above and would not satisfy the tests as set out in Paragraph 56 of the NPPF due to the fact that the proposals would not result in any significant impact on this ecological receptor.

G Socio-Economic Impacts

9.307 In more detail that has been set out above in relation to the economic contribution of the application proposals and need, Chapter 11 of the ES assesses the socio-economic impacts of the proposal. This chapter needs to be read in conjunction with the accompanying appendices 11.1 and 11.2 (Volume 2 of the ES).

9.308 The NPPF (2018) sets out the principles of sustainable development and the document must be read as a whole. In respect of economic development, paragraph 80 states:

"Planning policies and decisions should help create the conditions in which businesses can invest, expand and adapt. Significant weight should be placed on the need to support economic growth and productivity, taking into account both local business needs and wider opportunities for development. The approach taken should allow each area to build on its strengths, counter any weaknesses and address the challenges of the future. This is particularly important where Britain can be a global leader in driving innovation, and in areas with high levels of productivity, which should be able to capitalise on their performance and potential."

9.309 The ANPS (2018) sets out the importance of aviation to the UK economy in Section 2. This includes employment and economic benefits, including those associated with freight and tourism.

9.310 Paragraph 2.9 refers to the position in respect of Brexit. It states:

"The importance of aviation to the UK economy, and in particular the UK's hub status, has only increased following the country's decision to leave the European Union. As the UK develops its new trading relationships with the rest of the world, it will be essential that increased airport capacity is delivered, in particular to support development of long haul routes to and from the UK, especially in emerging and developing economies."

9.311 Notwithstanding the benefits of the aviation industry, the government recognises that there are constraints due to capacity issues. Aviation demand is likely to increase significantly between now and 2050 and all major airports in the south east of England are expected to be full by the mid-2030s, with four out of five full by the mid-2020s (paragraph 2.12).

9.312 Paragraph 2.14 states that the consequences of not increasing airport capacity in the South East of England would be detrimental to the UK economy and the UK's hub status. Restrictions on international connectivity would result in airlines seeking to maximise profits with routes being prioritised to other locations. In addition, operating at capacity means there would be little resilience to unforeseen disruptions, leading to increased delays.

9.313 Paragraph 2.16 sets out the Government's position with regards to not expanding airport capacity. It states:

"The Government believes that not increasing capacity will impose costs on passengers and on the wider economy. The Airports Commission estimated that direct negative impacts to passengers, such as fare increases and delays, would range from £21 billion to £23 billion over 60 years. Without expansion, capacity constraints would impose increasing costs on the rest of the economy over time, lowering economic output by making aviation more expensive and less convenient to use, with knock-on effects in lost trade, tourism and foreign direct investment."

9.314 Chapter 1 of the APF (2013) sets out the aviation industry's contribution to the UK economy, including the fact that it provides better access to markets, enhances communications and business interactions, facilitates trade and investment and improves business efficiency through time savings, reduced costs and improved reliability for business travellers and air freight operations.

9.315 One of the main aviation objectives is to ensure that the UK's air links continue to make it one of the best connected countries in the world. This includes increasing links to emerging markets so that the UK can compete successfully for economic growth opportunities. This will increase in importance following Brexit.

9.316 In addition to national and aviation policy, the importance of economic development is set out in a raft of local strategies, policies and guidance including:

- The London-Stansted-Cambridge-Corridor (LSCC) Growth Commission
- South East LEP Strategic Economic Plan
- Economic Plan for Essex
- Haven Gateway Partnership A120 Campaign
- Uttlesford District Council Regulation 19 Local Plan

- Uttlesford Economic Development Strategy
- Uttlesford Corporate Plan 2017-21
- Local Plans for surrounding local authorities
- Stansted Airport Sustainable Development Plan

9.317 The methodology for assessing socio-economic impacts is the same used in the ES accompanying the Generation 1 application as well as a range of other aviation projects and endorsed by the Airports Commission.

9.318 The ES assesses the impacts on the following:

- User benefits
- Wider socio-economic effects
- Employment effects
- Employment study areas
- Airport related employment
- Construction employment

9.319 In terms of user benefits, the ES argues that the increase in access to air services will increase business investment, support business growth and tourism. It predicts that in the DC scenario there would be an increase of 1.2 million business passengers and 6.8 million leisure passengers in comparison with the DM scenario.

9.320 Given the capacity constraints within the London airports system, it is contended by the applicant that this proposal would enable an extra 8 million passengers to access flights whose demand would not otherwise be met. As such, the development case is assessed by the ES as being moderately beneficial.

9.321 The ES predicts that the potential to provide for an additional 1.2 million business passengers per annum would increase the attractiveness of the area for investment. In addition, in terms of business efficiency and productivity, this is predicted to produce an increase in annual UK GVA of £1.2 billion. As around 79% of the passengers will be from the East of England and London the impact at that level is estimated to be £0.95 billion. The wider impacts are predicted to be £5.6 billion at UK level and £4.4 billion at the London and East of England level. Therefore, this is seen as being a major beneficial impact.

9.322 In respect of in-bound tourism, the average spend of a visitor arriving by air is around £700 per visit, and this rises to £860 per business passenger. The predicted increase of 1.1 million leisure passengers into the UK would result in an additional estimated spend of £779 million in 2028. This additional expenditure is estimated to support an additional 13,900 jobs in the tourism industry which would create GVA of £336 million (2016 prices) in 2028. On the basis that these passengers would not be able to visit the UK due to capacity constraints without this planning permission, the proposed development is assessed as being major beneficial.

9.323 In respect of international trade, all UK airports account for 48% of exports and 46% of imports by value, but less than 1% of the total volume of exports and imports which reflects the high value, low weight characteristics of air freight. In 2016, goods with a value of £6.3 billion were exported through Stansted to non-EU destinations, while goods with a value of £6 billion were imported. Overall, Stansted accounted for 5% of all non-EU trade carried through UK airports in volume terms but almost 7% in value terms.

9.324 The ES concludes that the proposals would result in an additional 800 tonnes of cargo passing through the airport, representing an increase of 0.2% on the Do Minimum scenario, thus being a minor beneficial effect.

9.325 It should be noted that the 2008 consent permits 20,500 CATMs and this application seeks to limit the number of CATMs to 16,000. Therefore, it is considered that the proposals would be neutral in their impacts in terms of cargo as this growth could happen without the benefit of this planning permission being granted. Indeed, it could be argued that the proposals would result in a negative impact in respect of cargo due to the reduction in the number of CATMs per annum. However, in reality the moving annual total of CATMs has only exceeded 14,000 once in information provided by MAG to UDC under Condition ATM5 of the Generation 1 planning permission.

9.326 The employment effects would arise from both the construction and the operational phases of the proposals. The construction period (2021-2) is predicted to give rise to almost 200 direct jobs and 100 indirect jobs over the period. This is predicted to give an estimated £16.2m GVA for direct employment and £7.2 million GVA for indirect employment. These benefits are assessed as being negligible given the size of the construction industry and the short length of the construction period.

9.327 The operational phase of the proposal is estimated to give rise to an additional 3,000 direct on-airport jobs and 2,400 indirect and induced jobs in comparison to the DM scenario. This is predicted to give a GVA of £198.5 million for direct employment and £158.8 million for indirect and induced employment, totalling £357.3 million. The benefits are assessed as being moderately beneficial.

9.328 Representations contend, by contrast, that the socio-economics chapter is not balanced, and that economic downsides (for example net tourism deficit and impacts on residential property market) are not considered. The applicant has responded that the comparison between the DM and DC scenarios is very small and any consequential effects on the net demand for housing in the study area can only be very minor.

9.329 Generalised concerns are also raised with regards to the potential impacts of Brexit and that the ES does not take this into account. However, and specifically, the economic forecasts that underpin the ICF traffic forecasts were provided by Oxford Economics in July 2016, following the Brexit Referendum result. The economic forecasts were predicated on Oxford Economics' central case. This is where the UK leaves the EU on unfavourable terms, without negotiating a significant trade deal and the trade relationship between the UK and the EU therefore reverts to WTO rules.

9.330 Essex County Council's Economic Growth, Regeneration and Skills Department has assessed the application. They consider that the increase in capacity and the development of new airfield infrastructure is important to the growth of the Essex economy. Further Foreign Direct Investment opportunities will arise from new access to international markets, such as those airlines recently signed up to operate from the airport.

9.331 The proposals would lead to the creation of further direct and indirect employment opportunities associated with the airport, providing additional jobs for the residents of Essex. The proposals would also increase supply chain opportunities for businesses related to the operation of the airport. ECC welcomes the opportunities to work with the applicant in order to identify initiatives and programmes of support to promote both business and employment growth in Essex.

9.332 In terms of skills, the applicant's commitment to STEM (science, technology, engineering and maths) engagements and its collaboration with Harlow College with the new Stansted Airport College opening in September is welcomed. In addition, their approach to apprenticeships is also recognised, although greater understanding of the numbers of Apprenticeships and Associated apprenticeship Standards was sought. This information has not been clarified, but there is a commitment from the applicant to continue the STEM opportunities, such as working with Harlow College/Stansted Airport College. The applicant continues to operate the Aerozone facility which enables school children to get an appreciation of the range of job opportunities available at an airport.

9.333 In respect of tourism, ECC recognises the benefits the proposals would bring to the local and regional economy of Essex, including tourism and leisure. Measures to promote Essex as a tourism destination are desired and in this regarding ECC has requested a yearly sum of £6000. However, they have failed to demonstrate how this request meets the tests set on in paragraph 56 of the NPPF. Notwithstanding this, the applicant has expressed a willingness to explore measures to promote Essex but does not agree that this needs to be as a result of this application.

9.334 The findings of this chapter of the ES are therefore reasonably considered to be sound and would deliver in respect of the economic growth aspirations of national and local policy.

H CARBON EMISSIONS

9.335 Chapter 12 of the ES assesses the carbon emissions impacts of the proposal.

9.336 The NPPF (2018) sets out the principle of moving to a low carbon economy as one of the overarching objectives of the environmental strand of sustainability in paragraph 8(c), and in paragraphs 153-154 although this is predominantly aimed at energy sources and use within development.

9.337 The Government's objective for aviation, set out in paragraph 2.4 of the APF (2013) is "to ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions."

9.338 The Government's response to its call for evidence on a new Aviation Strategy (April 2018) sets out that the government, at a global level, will consider their overarching framework for tackling UK aviation's carbon emissions to 2050 and how this can ensure that aviation contributes its fair share to action on climate change.

9.339 This states that UK aviation accounted for around 7% of the UK's total greenhouse gas emissions in 2016, an increase from around 5% in 2005 and that this is likely to continue to increase in proportion to other sectors, such as energy and manufacturing which are easier to decarbonise.

9.340 Paragraphs 6.12 and 6.13 state:

"*In the UK, the Climate Change Act 2008 sets a legally binding target for the UK to reduce its greenhouse gas emissions by at least 80% by 2050, compared to 1990 levels. This target includes UK domestic aviation (flights which take off and land in the UK) but does not include emissions from international aviation. The government will use the Aviation Strategy to re-examine how the aviation sector can best contribute its fair share to emissions reductions at both the UK and global level.*

Globally, international aviation's carbon emissions currently account for less than 2% of total emissions, but these could increase by two to four times between now and 2050. Internationally, the UK is committed to taking action to ensure that aviation plays its part in contributing to the 'well below two degrees goal' established by the Paris Agreement in 2015, and to the International Civil Aviation Organisation's (ICAO's) goal of carbon neutral growth from 2020. Significant progress has been made towards this objective. Most notably, the UK played a crucial role in reaching agreement at the ICAO Assembly in October 2016 on the first ever sector based global climate change deal for aviation, an offsetting scheme involving the purchasing of emissions reduction credits from other sectors, known as the Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA. The Aviation Strategy will consider what further action the UK wants to encourage across ICAO's full range of policy measures."

9.341 The carbon emissions section then discusses the EU Emissions Trading Scheme (ETS), the future of which is uncertain as far as the UK is concerned. The government says that it will be seeking an approach that is at least as ambitious as the existing scheme and provides a smooth transition for the relevant sectors. Since 2012, the ETS has had its scope reduced to only cover flights within the European Economic Area, which at Stansted is currently about 89-90% of the total number of flights. The government's position is that international aviation emissions are best tackled at an international level. Stronger action at the UK level without an equivalent level of action internationally is likely to impose greater costs on airlines flying to and from the UK, thereby putting UK airlines at a greater competitive disadvantage compared to foreign airlines and potentially increasing fares.

9.342 The government says that it will consider all cost effective measures to ensure that the sector continues to contribute to the UK's emissions reductions obligations. This could include operational measures such as alternatives to engine power when taxiing and the higher uptake of renewable fuels in conjunction with carbon pricing.

9.343 The APF (2013) is now showing its age in relation to topics such as carbon emissions. However, this document also sets out the desire that this topic should be dealt with at an international level.

9.344 BTH (June 2018) the Government states that it will be using the Aviation Strategy to progress wider policy on carbon emissions. In the same document, the Government does recognise that airports making best use of their existing runways could lead to increased air traffic and emissions. Using the Committee on Climate Change's planning assumption of limiting aviation emissions to 37.5Mt of CO_2 in 2050 (the carbon capped scenario), Government modelling indicates that emissions in 2050 would total 40.8Mt taking into account "best use" and Heathrow Runway 3. The Government accepts that there is uncertainty over future climate change policy and international arrangements to reduce $CO_2$and other greenhouse gases, but remains confident that measures such as single engine taxiing and higher uptake of renewable fuels will lead to the 37.5Mt cap being met in 2050. Under a carbon traded scenario requiring compensatory reductions elsewhere in the global economy, the Government sees nothing to prevent the UK meeting its obligations.

9.345 The ANPS (2018) also sets out that the government has undertaken significant work in respect of assessing carbon emissions in considering the future growth of aviation. Paragraph 5.70 states:

"The Government's key objective on aviation emissions, as outlined in the Aviation Policy Framework, is to ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions. This must be achieved while minimising the risk of putting UK businesses at a competitive international disadvantage. The development of the Heathrow Northwest Runway scheme being considered under the Airports NPS does not override this objective."

9.346 The approach taken in Chapter 12 of the ES is aligned with the carbon emissions assessment principles as undertaken by the Airport Commission Appraisal Framework (ACAF) when it examined the options for meeting the UK's international connectivity needs.

9.347 The ACAF identified five areas where carbon emissions may change as a result of an airport scheme. These are set out in Table 12.1 of the ES.

ACAF categories	Relevance to the proposed scheme	Scheme phase
Increased airport capacity leading to a net change in air travel	Aircraft in the air and on the ground (LTO* and CCD**)	Operation
Departure and arrival route changes through altered flight operations	Not impacted by the proposed scheme	Operation
Construction of new facilities and surface access infrastructure	Embodied carbon from construction materials	Construction
	Energy consumption during construction	Construction
Airside ground movements and airport operations	Power and heat generation on-site	Operation
	Consumption of energy generated off-site	Operation
Changes in non-aviation transport patterns brought about by a scheme	Transport associated with staff commuting and passenger travel	Operation

*LTO: Aircraft on the ground and in the landing and take-off cycle (below 3000 ft)
**CCD: aircraft in the climb, cruise and descent cycle (above 3000 ft)

9.348 Table 12.10 in the ES sets out the baseline and predicted carbon emissions for the DM scenarios for 2023 and 2028.

	Unit	Base 2016	DM 2023	DM 2028
Passenger number	mppa	24.3	35	35
ATM	no	180,619	246,568	248,820
Carbon				
Flights	$MtCO_2$	1560	2304	2274
Landside activities	$MtCO_2e$	0.003	0.004	0.004
Airside activities	$MTCO_2e$	0.007	0.010	0.010
Surface access transport	$MTCO_2e$	0.170	0.211	0.189
Total	**MtCO2e**	**1.740**	**2.529**	**2.478**
Per passenger	**$kgCO_2e$/ passenger**	**107**	**113**	**110**

9.349 In respect of emissions three scenarios were used, pessimistic, central and best practice.

Pessimistic: The pessimistic scenario assumed a small amount of improvements in aircraft and engine efficiency to represent a conservative projection of future aviation improvements. The assumed improvement rate in this scenario is consistent with the bottom-up approach (where carbon emissions have been calculated from operational data provided by STAL) used for 2016-28.
Best practice: The best practice scenario assumed improvements in all three improvements areas (aircraft and engine efficiency, air traffic management and operations, sustainable aviation fuels) and reflects the assumptions set out by Sustainable Aviation in their Sustainable Aviation Carbon Road-Map report
Central: The central scenario represents a centred projection of improvement between the pessimistic and best practice scenario.

9.350 Using the pessimistic approach, Table 12.11 sets out the carbon emissions for the DM and DC scenarios for 2023 and 2028. The improved carbon intensity (reduced emissions per passenger) in the DC scenario compared to the DM one is principally due to increased passenger throughput using the same terminal infrastructure.

	Unit	2016-2028 Pessimistic				
		Base 2016	DM 2023	DC 2023	DM 2028	DC 2028
Passenger number	mppa	24.3	35	36.4	35	43
ATM	no	180,619	246,568	252,607	248,820	273,966
Carbon						
Flights	$MtCO_2$	1560	2304	2.304	2274	2.504
Landside	$MtCO_2e$	0.003	0.004	0.004	0.004	0.006
Airside	$MTCO_2e$	0.007	0.010	0.010	0.010	0.011
Transport	$MTCO_2e$	0.170	0.211	0.211	0.189	0.232
Total	**MtCO2e**	**1.740**	**2.529**	**2.529**	**2.478**	**2.753**
Emissions per passenger	**$kgCO_2e$/ passenger**	**107**	**113**	**110**	**110**	**106**

9.351 In 2028 the difference between the DM and DC scenario (rounded up) would be 0.3 $MtCO_2e$. When expressed as a value per passenger, the development case would see an improvement in emissions by 4 $kgCO_2e$.

9.352 The total emissions from flights for 2050 under the three scenarios are 2.031 $MtCO_2$ (pessimistic), 1.768 $MtCO_2$ (central) and 1.484 $MtCO_2$ (best practice). These reductions from 2028 are predicated upon technology improvements, operational improvements and use of sustainable aviation fuels.

9.353 The construction phase will contribute an estimated 0.22 $MtCO_{2e}$ including emissions from the production of concrete and fuel use by construction plant on site. This represents 0.9% of Stansted's 2022 total annual emissions in the year during which construction is planned to be completed. This would fall within the UK's third carbon budget (2018-2022) of 2,544 $MtCO_2e$ proposed by the CCC. This would account for approximately 0.001% of the total allocated budget, and for approximately 0.09% of all UK construction in 2022.

9.354 Flight carbon accounts for 89% of carbon emissions at Stansted Airport in 2016 and would account for 91% in the DC scenario. The majority can be attributed to the emissions taking place in the CCD cycle of aircraft departing from Stansted Airport.

9.355 By 2028, between the DM and DC scenarios there would be a 23% increase in mppa, a 10% increase in ATMs and a 10% increase in flight carbon emissions. As such, the carbon intensity of the DC scenario would improve by around 4% (flights only) in 2028 from 105kgCO_2/passenger to 100kgCO_2/passenger compared with the DM scenario. In the DC scenario, after 2028, passenger numbers would remain around 43mppa and the carbon intensity per passenger would fall to between 56kgCO_2/passenger (best practice) and 77kgCO_2/passenger (pessimistic).

9.356 By 2050, the annual flight emissions from Stansted are projected to reduce to between 1.5$MtCO_2$ (best practice scenario) and 2.0$MtCO_2$ (pessimistic scenario). This represents between 4% and 5.3% of the 37.5$MtCO_2$ target for UK aviation by 2050.

9.357 Transport carbon emissions relating to employee and passenger travel to Stansted are the second largest source of emissions after flights, accounting for 6% of the airport's total annual emissions in 2016 and 5% of the total annual emissions in 2023 and 2028. It is predicted that the DC scenario would increase for the DC scenario between 2023 and 2028 as increases in passenger numbers would outweigh the vehicle efficiency improvements.

9.358 Carbon emissions relating to gas consumption accounted for 0.2% of the airport's annual carbon emissions in 2016. Electricity consumption is reported as zero carbon emissions reflecting the airport's 100% 'green' tariff supply contract.

9.359 In respect of landside operations, emissions are predicted to rise from around 0.003$MtCO_2e$ in 2016 to 0.0045 in the DM scenario and to 0.0055 in the DC scenario. Airside operations would see an increase from 0.7$MtCO_2e$ in 2016 to just under 0.010 in 2028 in the DM scenario and around 0.011$MtCO_2e$ in the DC scenario.

9.360 The ES concludes, at paragraphs 12.93 and 12.94, that Stansted Airport's share of UK aviation carbon emissions would rise from 4% in 2016 to between 4% and 5.3% of the UK's aviation emissions target in 2050, that this would not be a substantial change, and with annual aviation carbon emissions predicted to decrease between 2028 and 2050. It is considered that the DC scenario is unlikely to materially impact the UK's ability to meet its 2050 national aviation target of 37.5MtCO_2e.

9.361 Concerns have been raised with regards to carbon emissions in the representations. In respect of CORSIA, the applicant confirmed that their projections are not presented with CORSIA implemented.

9.362 Concerns have been raised also in respect of the improvement factors used in the scenarios produced by Sustainable Aviation. However, comparisons between the three approaches and other studies carried out in respect of Heathrow NW runway and by the CCC (UK aviation target) demonstrate that the approaches are comparable. The three scenarios predict improvements in the range of 0.9% and 1.94%. This compares with Heathrow where improvements were predicted to be between 0.9% to 1.95%, and CCC where they were predicted to be between 0.9% an 1.8%. As such, this authority has no reason to dispute the predictions shown in the ES. Notwithstanding this, the topic is an international and national level issue as advised in the Aviation Strategy. Indeed, paragraph 6.24 of the 2018 Aviation Strategy call for evidence response states:

"The government's Aviation Strategy presents an opportunity to take stock of the considerable progress made in recent years by both industry and government and to look ahead at what further action is required between now and 2050. The government will look again at what domestic policies are available to complement its international approach and will consider areas of greater scientific uncertainty, such as the aviation's contribution to non-carbon dioxide climate change effects and how policy might make provision for their effects."

9.363 It is reasonable to conclude that the application proposals will not materially impact on the ability of the government to meet its national carbon reduction target.

I Climate Change

9.364 Chapter 13 sets out the potential impacts with regards to climate change. This is a new requirement as set out in the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 which requires an assessment of the risk of major accidents and/or disasters relevant to the development concerned, including those caused by climate change, in accordance with scientific knowledge. This chapter needs to be read in conjunction with Appendices 13.1 to 13.3 in ES Volume 2.

9.365 Paragraph 8(c) of the NPPF (2018) sets out climate change as an objective of the environmental objective of sustainable development. Section 14 of the NPPF (2018) sets out the government's planning policy in respect of climate change. In paragraph 150 it states that developments should be planned for in ways that avoid increased vulnerability to a range of impacts arising from climate change and can help to reduce greenhouse gas emissions, such as through its location, orientation and design. The latter part of the policy is not relevant to the proposals as no buildings are proposed as part of the development.

9.366 The APF (2013), Section 2, Climate Change Impacts, provides guidance on climate change and, as with carbon emissions, paragraph 2.4 sets out the government's objective similarly, together with a series of measures at different levels.

9.367 The Aviation Policy Framework states that *"the Government's objective is to ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions."* This will require action at a global level. European and national level actions are also set out in the document.

9.368 Paragraph 2.55 of the APF refers to the Climate Change Act (2008) committing the UK to build resilience to the expected impacts of climate change. A Climate Change Risk Assessment is required to be produced every five years. In 2012 the CAA, NATS and ten airports published climate change adaptation reports under the Climate Change Act Reporting Power and this will be repeated every five years.

9.369 The reports identify climate variables that pose risks to the industry, including increases in extreme weather affecting operations; increases in temperature leading to runway damage; increased rainfall posing flood risk and changes in wind patterns affecting air traffic movements.

9.370 The government's position with regards to climate change is set out in the 2018 Aviation Strategy call for evidence response in paragraphs 6.12 and 6.13, quoted in paragraph 9.340 above.

9.371 The ANPS sets out the government policy in respect of climate change. It states that climate change mitigation is essential to minimise the most dangerous impacts of climate change, as previous global greenhouse gas emissions will already mean some degree of continued climate change for at least the next 30 years. Climate change is likely to mean that the UK will experience on average hotter, drier summers and warmer, wetter winters. There is potentially an increased risk of flooding, drought, heatwaves, intense rainfall events and other extreme events such as storms and wildfires, as well as rising sea levels.

9.372 The ANPS states that new development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. These must be considered when planning design, build and operation. Any ES should use the latest UK Climate Projections and should cover the estimated lifetime of the new infrastructure. Any adaptation measures should be based on the latest set of UK Climate Projections, the most recent UK Climate Change Risk Assessment, consultation with statutory consultation bodies, and any other appropriate climate projection data.

9.373 The ES chapter reviews the meteorological data for the area, both local and regional, for the period 1981-2010. A review of weather related incidents has also been undertaken, including a high level assessment of events for the period 2014-17. The assessment uses the Met Office's UK Climate Projections 2009 (UKCP09) to assess the potential weather patterns for the 2020's and 2050's.

9.374 The data indicates that the frequency of hot days, dry spells and heavy rainfall will increase in the future compared to the baseline, whilst the number of cold days will decrease. The change between baseline and 2020's is not vastly different, but there is a significant change when looking forward to the 2050's. The use of de-icing is predicted to decrease, which would be an environmental benefit.

9.375 Table 13.8 sets out the operational stage in-combination climate change effects by environmental topic. No in-combination effects were identified for the noise topics, nor public health and wellbeing topic.

Environmental topic	In-combination climate change effect	Existing or embedded mitigation
Surface access and transport	Adverse effect from increased stress on existing road and rail network in combination with increase in frequency of extreme weather events negatively impacting surface access and transport (eg damage to cabling and rails, inundation from flooding)	Existing mitigation is outline in the STAL Climate Change Adaptation Progress Report (CCAPR) and includes emergency contingency plans and coordination with road and rail operators (see risk ID CCA27)
Air quality	Adverse effects from increased prevalence of hotter and drier conditions in combination with increase in vehicle and aircraft emissions may result in changes in concentrations of nitrogen oxides (NO_x), fine particulate matter (PM_{10} and $PM_{2.5}$) and ozone (O_3). Unclear whether the concentrations will increase or decrease.	Airlines have new, cleaner fleet on order. In cases where air quality targets are not met, an action plan to restore compliance is put in place by local authorities, which may include actions with which STAL would be expected to comply. Whilst ozone is likely to increase there are limited mitigation measures available to STAL.
Socio-economic effects	Adverse effect from increase in frequency of extreme weather events in combination with direct and indirect job creation during operation leading to increased stress on local infrastructure.	Existing mitigation is outlined in the STAL CCAPR and includes emergency contingency plans and coordination with road and rail operators (see risk ID CCA27).

9.376 Mitigation measures identified (other than the CCAPR) are operational matters which would lie outside of the planning system. These include monitoring of resilience plans, weather trends, local data and risks to infrastructure. Mitigation in respect of high temperatures, strong winds and high precipitation impacts and risks are:

- To review the demand placed on energy supplies to heat and cool buildings with mechanical and ventilation systems (HVAC)
- To review temperature thresholds for cooling systems within the main terminal building, satellite piers, and ancillary buildings, to ensure effective and efficient provision of cooling given projections for increased passenger numbers and higher temperatures in the future;
- To review allowances for maximum aircraft operating temperatures in collaboration with the airline operators to determine whether they are within tolerance of hot day (>25^{o}C) occurrences which are likely to increase due to climate change
- To check weather data and potential impacts on operations

9.377 On the basis of the information submitted in the ES, it is considered that the applicant has reasonably met the requirements of the EIA Regulations and no significant effects are identified.

9.378 It is acknowledged that representations have raised issues in respect of climate change and also carbon emissions. This was also the case in respect of the Generation 1 application where the Inspector stated that the Inquiry into STAL's appeal against the Council's refusal to grant planning permission was not the forum for challenging the merits of current government policy or for debate on the direction of future policy. He stated that they were matters for Parliament and outside the scope of the appeal. Whilst these two issues remain to be dealt with at a national level by the government, the Inspector's comments remain valid in respect of the consideration of this application.

J Public Health and Wellbeing

9.379 Chapter 14 of the ES reviews public health and wellbeing and should be read in conjunction with the Health Impact Assessment contained in Appendix 14.1 (ES Volume 2). This is a new requirement set out in paragraph 4(2)(a) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. This stipulates that the ES must identify, describe and assess in an appropriate manner in light of each individual case, the direct and indirect significant effects of the proposed development on population and public health.

9.380 The NPPF (2018) sets out the government's principles for sustainable development. In terms of the social strand there is a requirement that developments support communities' health, social and cultural well-being.

9.381 Paragraph 180 of the NPPF (2018) states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

9.382 The Appraisal of Sustainability which accompanies the ANPS demonstrates that airport expansion will attract additional air traffic, which impacts upon quality of life and wellbeing, in particular through noise, air quality, housing, community facilities, and access to nature and cultural heritage. Whilst this application does not seek to increase ATMs it does seek to alter the composition of the ATMs, most notably a reduction in cargo flights and general aviation movements.

9.383 The construction and use of airports infrastructure has the potential to affect people's health, wellbeing and quality of life. Infrastructure can have direct impacts on health because of traffic, noise, vibration, air quality and emissions, light pollution, community severance, dust, odour, polluting water, hazardous waste and pests. It can also impact on sites of local or regional interest for biodiversity which also play a role in the wellbeing of communities.

9.384 The APF states the Government's intention that decisions in respect of aviation should be in accordance with sustainable development principles. This means making the necessary decisions now to realise its vision of stimulating economic growth and tackling the deficit, maximising wellbeing and protecting our environment, without negatively impacting on the ability of future generations to do the same.

9.385 'Health' is commonly defined as *"a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity"* (WHO).

9.386 The basis of the assessment in this application is to apply a broad socio-economic model of health that encompasses conventional health impacts such as disease, accidents and risk, along with wider health determinants vital to achieving good health and wellbeing such as employment and local amenity. It considers both physical and mental health, and also addresses equality and social impacts where possible. It considers three broad domains of public health practice:

- Health protection (ie environmental pollution and standards set to protect health)
- Health promotion (ie healthy lifestyles, socio-economic status and equalities); and
- Health care (ie provision, effectiveness and equality of access to healthcare services)

9.387 The assessment follows a source-pathway-receptor approach to identify and assess health impacts that are plausible and directly attributable to the proposed development. Table 14.1 sets out the potential health pathways summary.

Health pathway	**Potential for impact**	**Impact type***
Construction		
Exposure to air pollution including dust, noise, ground or water contamination	The proposed physical infrastructure to be constructed is minimal, with no potential for significant environmental impacts identified in ES Chapter 5 or in the relevant ES topic chapters. Construction-stage health pathways are therefore not considered to give rise to any likely significant health or wellbeing effects and are scoped out of the further assessment in this chapter.	Temporary. Direct, indirect or secondary
Construction traffic (safety, amenity, severance)		
Construction workforce (housing/services demand, crime, infectious diseases)		
Construction employment, supply chain spending		

Health pathway	Potential for impact	Impact type*
Operation		
Airport/aircraft air pollutant emissions	Change in air quality at residential and other sensitive locations	Direct
	Impact on habitats and resulting change in amenity value of green/ recreational space	Direct
Airport/aircraft noise	Change in noise environment at residential and other sensitive locations	Direct
	Change in amenity value of green/ recreational space	Direct
Surface access road traffic generation	Contribution to air pollution and noise exposure	Direct
	Change in amenity value of green/ recreational space	Direct
	Change in road safety	Direct
	Change in capacity or demand for public transport	Direct
	Community severance	Direct
	Impacts on non-motorised users (NMUs)	Direct
	Change in congestion, access to services	Direct
Governance (airport and regulator)	Public participation and empowerment concerning operational impacts	Direct
Increase in airport's economic activity with more passengers and flights	Direct employment generation	Direct
	Education/training opportunities	Direct
	Supply chain spending – indirect employment/wealth generation	Indirect
	Additional employees' impact on services, housing capacity, community cohesion	Indirect
Increase in flight capacity and/or connections	Increased opportunity for leisure travel and social connections	Direct
	Increased opportunity for business travel with economic benefit, with resulting employment/wealth benefit	Indirect, secondary
Flood risk	Risk to life or property; displacement from housing; impaired access to services	Direct
Water contamination	Drinking water contamination	Direct

* Impact type is 'permanent' (ie persisting for the foreseeable future) unless otherwise specified

9.388 *Socio-economics:*

As discussed earlier in this report, the proposals would give rise to an additional 3000 direct employment opportunities and 2400 indirect or induced opportunities. Direct and indirect/induced employment has the potential to offer important long-term health and wellbeing benefits affecting up to 5,400 people.

9.389 Indirect quality of life, wellbeing and possibly health benefits would also be associated with the predicted £357m of GVA per annum by 2028. These would arise through increase personal wealth and increased public revenue enabling spending on public services that affect health.

9.390 It is predicted that around 2.3 million additional leisure trips would be enabled by the proposals by 2028. These trips have social and family benefits, or offer cultural, recreational or educational experiences. This can improve general and mental health and thus quality of life.

9.391 The regional level benefits are assessed as having a major beneficial effect, supporting actions to address the Essex health objectives for 'people not in education, employment or training', 'loneliness and social isolation' and the Hertfordshire objective 'economic wellbeing'.

9.392 *Surface access:*

9.393 Additional demands placed on surface access should not result in adverse impacts on road safety, active travel or community severance. There should be negligible impacts in terms of road safety in respect of Junction 8 of the M11 and its link roads. Negligible impacts on driver delay on local minor and trunk roads and a minor impact on Junction 8 were identified.

9.394 In terms of impacts on health and wellbeing, the proposals should not result in adverse impacts in terms of road traffic growth. There should be no significant adverse impact on health and wellbeing due to increased congestion and reduced access to services is therefore considered unlikely.

9.395 The surface access chapter indicates that there would be a minor adverse impact on some rail, bus and coach travel services from the proposed development due to the increased usage. However, it is also recognised that local bus and coach service operators can respond quickly to new demand and that the proposed development may provide a catalyst for public transport improvements. Therefore, any adverse wellbeing impact is likely to be very minor, if present.

9.396 Overall, the magnitude of impact on health and wellbeing is considered to be negligible and would not result in a significant impact in terms of demands on surface access.

9.397 *Air Quality:*

The predicted negligible changes in air quality should have no measurable extra adverse health outcomes per annum, with an increase of fewer than one emergency hospital admission or an effect on mortality equivalent to fewer than one additional death at typical ages predicted.

9.398 Vulnerable individuals, such as those in healthcare facilities or with existing respiratory diseases, will in some cases have greater susceptibility to health impacts from air pollutant changes. The ES argues that this cannot be quantified from statistical risks applicable to the general population, but given the negligible magnitude of air pollutant concentration changes predicted additional risks are unlikely to be significant.

9.399 *Noise:*

The predicted changes in air noise are considered to not result in any measured adverse health outcomes for ischemic heart disease (IHD), stroke or dementia, with an increase of fewer than one additional annual incident case predicted.

9.400 Approximately four to six additional cases of hypertension prevalent within the population are predicted, and additional cases of depression or anxiety associated with high annoyance are also possible. The magnitude of change predicted is very small, being less than 1% of the baseline rate.

9.401 An increase of around 339 people who consider themselves highly annoyed by aircraft noise is predicted, which is around a 28% increase compared to the do minimum scenario. However, a small reduction in the number of people with high sleep disturbance is predicted due to the very limited change in the L_{night} contours with the proposed development. The increase in the population predicted to be affected by noise should fall within the area designated for the revised SIGS mitigation package.

9.402 There would be a 13% increase in the number of daytime noise events above the assessment threshold at the most-affected school, Howe Green; the most-affected church, St Giles in Great Hallingbury; and the most-affected healthcare facility, Falcon House residential care home in Little Hallingbury. There may be minor potential for increased disruption to learning, to the care environment at Falcon House, or an impact on the quality of life for worshippers at the affected churches.

9.403 Overall, the magnitude of impact on health is considered to be minor adverse. The magnitude of impact on wellbeing and quality of life, taking into account the predicted changes in annoyance and sleep disturbance, is considered to be a minor adverse effect.

9.404 *Amenity, Green Space and Physical Activity:*

Significant reductions to the amenity of green space resulting in significant effects on quality of life and wellbeing are unlikely as a result in increases in noise due to the negligible increases predicted.

9.405 Some areas of the countryside, including parts of Hatfield Forest, will be affected by a greater level of activity exceeding 25 events a day with noise events greater than 65dB. The magnitude of impact would result in a minor adverse effect on quality of life and wellbeing due to reduction in the amenity of green space. The impacts would adversely affect actions to address the Hertfordshire objective ‘Open space provision’ and NPPF objective ‘Open space provision and rights of way’.

9.406 *Flood Risk and Water Contamination:*

No impact on health and wellbeing due to water contamination or flooding is predicted.

9.407 *Governance:*

The application is accompanied by a Statement of Community Involvement detailing the consultation and public engagement undertaken by the applicant.

9.408 The applicant engages actively with local stakeholders through the quarterly Stansted Airport Consultative Committee, Parish and District Council liaison meetings, annual community impact surveys, outreach events, complaints monitoring and a noise track keeping system, and reporting of all air quality and noise impacts. Any adverse wellbeing and quality of life impacts due to poor governance are minimised and a negligible impact is predicted overall.

9.409 Mitigation measures have been briefly discussed in the relative chapters. These include:

- Travel Plan – joint working with public transport providers
- A new SIGS for dwellings and other noise-sensitive properties
- A Community Fund to support projects for cultural and community wellbeing (see attached map for proposed funding areas)
- Stansted Airport College – complements the Airport Employment and Skills Academy

9.410 Further mitigation is not required as a result of the findings of the ES, but the applicant is seeking to develop a closer working relationship with the Directors of public health/local public health teams, potentially via participation in the Stansted Airport Consultative Committee. This approach is supported by ECC.

9.411 Discussions have been ongoing with various parties as to how the Community Fund could be refreshed and operated to ensure effective mitigation in terms of public health and wellbeing. This mitigation can be secured by way of s106 Legal Obligation with appropriate terms of reference to ensure community involvement with the relevant stakeholders. Previously, the fund has operated successfully under clauses of the 2003 s106 agreement and the 2008 unilateral undertaking. Although both these time-limited obligations have now expired, the applicant has continued to voluntarily top up the fund each year in addition to the accumulated noise funds.

J Water Resources and Flood Risk

9.412 Chapter 15 of the ES discusses the potential impacts on water resources and flood risk. This should be read in conjunction with the Flood Risk Assessment (FRA) in Appendix 15 (Volume 2) and the response to ECC LLFA consultation response set out in Annex 5: Water Technical Note in the Consultation Response and Clarifications document.

9.413 Adopted Uttlesford Local Plan Policy GEN3 seeks to direct new development to areas of low flood risk and to ensure that new development does not increase flood risk to other areas. This policy is only partly consistent with the NPPF with approaches to flooding issues having developed considerably in the time since the policy was adopted. Therefore, the policy has limited weight with full weight being given to the NPPF and associated guidance.

9.414 Policy ENV12 seeks to prevent development which would cause contamination of groundwater, particularly in protection zones, or result in contamination of surface water. This policy is consistent with the NPPF and carries full weight.

9.415 The NPPF (2018) sets out the government's approach with regards to flood risk and how decisions should be made in respect of development proposals. In this instance, the physical infrastructure works are located within an area designated as Flood Zone 1 which has a low probability of flooding (less than 1 in 1,000 annual probability of river flooding in any year).

9.416 The ANPS (2018) refers to the NPPF for the approach to flood risk. It identifies that there is the potential for airport expansion to result in increased risk from climate change effects, particularly to increased surface water runoff rate and pressure on potable water supply. There may also be effects on groundwater.

9.417 Sensitive receptors have been identified as:

- Stort River catchment, Pincey Brook and other associated ordinary watercourses that are tributaries to the main rivers
- Existing groundwater within the study area (generally the airport boundary)
- Human health and wellbeing, in respect of:
    - Flood risk from all sources, including fluvial, pluvial, groundwater, sewer or other artificial sources
    - Water quality, notably in respect of the risk of contamination from the use of glycol as a de-icer on the airport, as well as traces of oils, hydrocarbons and aircraft fuels
    - Water supply and capacity, notably the potential increased demand on potable water supply
- Existing drainage asserts (water utility infrastructure) for the airport which traverse the study area

9.418 The new airfield infrastructure being proposed is located within the largest drainage catchment at Stansted which feeds into Balancing Pond C, which consists of three ponds located between the A120 and the B1256.

9.419 The conclusion of the FRA is that the risk of flooding is low or negligible from all sources, but possible in respect of culverts. The existing infrastructure can be adapted to ensure surface water drainage flows are in line with the required greenfield run-off rates. In terms of the construction phase and operational phases the impacts are considered to be negligible.

9.420 The LLFA has not raised an objection to the proposals on the basis of the FRA, the Drainage Strategy and run-off rates as set out in the original submissions and subsequent update.

9.421 In terms of potential contamination, the construction phase could potentially alter ground conditions resulting in a deterioration of surface water quality or a reduction in flows in the water courses. The sensitivity of underlying groundwater is considered high due to the regional importance of groundwater resources but the risk of vertical migration of pollutants from the construction works is low. Therefore, there could be a short term negligible to minor adverse effect, before mitigation.

9.422 Mitigation for the construction phase is proposed by way of a Construction Environmental Management Plan, which is standard mitigation for this type of impact. This would reduce the potential impacts to negligible.

9.423 In terms of operational impacts, potential contaminants are glycol (de-icer) and small traces of oil, hydrocarbons and aircraft fuel. Contaminated water is currently managed within Balancing Pond C which has three compartments termed ‘clean’, ‘dirty’ and ‘overflow’. Subsequently, discharged water is pumped through the Thames Water (TWUL) sewerage network for treatment at Rye Mead Waste Water Treatment Works (WWTW) at the rates agreed with TWUL.

9.424 It is proposed that this arrangement would continue as a result of the proposed development. In respect of this the LLFA raised an objection on the basis that the proposed pollution risk had not been fully addressed. In addition, TWUL raised concerns with regards to proposed discharge rates.

9.425 Additional information has been supplied by the applicant in respect of pollution controls and these have been assessed by the LLFA who now raises no objections. In respect of flow rates, the applicant, outside of the planning system, is addressing this issue with additional information passed to the Asset Planners at Thames Water for review. In terms of impact, the contaminated flow is anticipated to increase by around 1.9% as a result of the additional 7.02ha increase in hardstanding over the existing 36.8ha.

9.426 The ES concludes that there is likely to be a direct, long term negligible effect due to the additional surface water discharges from the site, prior to the implementation of additional mitigation.

9.427 In terms of impacts on potable water supplies, the demand will fluctuate throughout the construction phase. Nevertheless, given the context of daily water consumption throughout the airport, this is envisaged as being minimal and representing a negligible effect on the local water supply network.

9.428 Water efficiency measures across the airport have seen water consumption reduce by around 50,000m^3 since 2008. The average consumption per passenger has reduced from 30 litres to 28 litres. In respect of the operational phase, a worst case scenario has been used which envisages no further improvements to water efficiency across the airport. On this basis it is predicted that the airport would consume 1,172.5 million litres of water in the 2028 DM case and 1.474 million litres in the 2028 DC scenario.

9.429 The ES specifies that Anglian Water does not raise concerns with regards to the volume of water consumption, but rather the rate of supply. It has been proposed that the rate of supply is reduced but the period over which it is supplied is extended. This would reduce the pressure on the existing AW mains, but should allow the airport's private water supply network to continue to operate in a similar manner to existing. This would be a private arrangement between the applicant and AW outside of the planning system. This is viewed as having a minor adverse effect, which would reduce to negligible with the implementation of additional water efficiency measures which could reduce consumption by around 20%. Anglian Water has not responded to the consultation and therefore case law states that assumptions must be made that the statutory consultee has no issues to raise.

9.430 Demands on foul water infrastructure in respect of the additional infrastructure are not required to be considered as part of the planning process as these now fall outside of the planning system. However, in the winter period when glycol is being used then the development is likely to increase the amount of contaminated water which would need to be treated at Rye Mead WWTW. Thames Water has raised concerns that the potential increase in flows could result in upgrades to the WWTW that are either not technically feasible or not cost effective.

9.431 The applicant's response on this matter is that in line with the latest connection charges rules introduced on 1 April 2018 under the Water Industry Act 1991 (as amended 2014) any offsite reinforcement works to sewers or waste water treatment works will now be captured by Thames Water through adjustments to the infrastructure charges, not through any planning agreements or conditions.

9.432 Thames Water has subsequently responded that the new connection charge rules are not applicable to Wastewater Treatment. However, it has confirmed that a study is currently being undertaken to investigate the potential options to accommodate increased wastewater flows from predicted growth, both in respect of this application and additional housing associated with Uttlesford and East Herts new Local Plans. The results of the study are not expected until December 2018, but a technical option is believed to be feasible.

9.433 Contaminated flows are processed by Water and Sewerage Undertakers as part of Trade flows (ie contaminated surface water). Sewer network capacity and treatment capacity is a commercial agreement whereby the applicant will be required to fund any upgrades needed to accommodate increase discharge rates (if capacity does not currently exist). This would be outside of the planning system.

9.434 The EA has raised issues relating to the Uttlesford District Council Water Cycle Study update. They state that the assumptions in the ES will need to be reviewed following the publication of the update. This would certainly be the case if the revised WCS had been published. However, this is not envisaged to be completed until February 2019, with an interim note at the end of October 2018. The WCS interim note will include a high level sensitivity test for 43mppa at Stansted Airport.

9.435 The EA understands that the foul water from Stansted Airport is treated at Bishops Stortford Waste Water Treatment Works (WWTWs). The consented discharge of final effluent from Bishops Stortford WWTWs discharges into the Water Framework Directive (WFD) designated water body of Great Hallingbury Brook. The EA advises that this water body currently has a Poor classification, with Very Certain confidence, for Phosphate. Source Appointment GIS (SAGIS) modelling indicates that 94.2% of the phosphate input into this water body is the result of WWTW load. All other Phys-chem determinants are at High, Very Certain, status.

9.436 The EA has reviewed data submitted through Operator Self-Monitoring for the final effluent of Bishops Stortford WWTWs which indicates that the airport is currently operating within the industry standard for phosphorus; concentration levels of the final effluent were within 1-2milligrams per litre (mg/l) of phosphorus. However, unless the phosphate treatment process is improved, then increased total volumes of foul water to Bishops Stortford WWTWs will further add to the phosphate load for Great Hallingbury Brook.

9.437 Additionally, the EA has concerns regarding deterioration of the other Phys-chem elements, specifically Ammonia and Dissolved Oxygen. Their guidance allows for a 10% deterioration of water quality, providing there is no deterioration of the WFD Classification status.

9.438 Whilst the EA acknowledges that STAL is correct in their understanding of the new charging rules introduced 01 April 2018, as detailed in Section 10.11 (STAL Response Column) they state that STAL do need to be aware that it is up to the developer to demonstrate that their proposal will have no detrimental impact with regards to WFD.

9.439 The EA has therefore recommended a condition be imposed requiring the applicant to undertake modelling to ensure that the increased passenger numbers and associated increase in total foul water volumes will not result in a deterioration of the water body known as Great Hallingbury Brook.

K NON-SIGNIFICANT TOPICS

9.440 Chapter 16 of the ES discusses what is termed as non-significant topics, those where significant effects are not envisaged and therefore scoped out of the main report. These are:

- Biodiversity
- Land and soil (including contamination)
- Cultural Heritage (including archaeology and built heritage assets)
- Landscape (including visual impacts)
- Waste
- Major Accidents and/or Disasters

9.441 *Biodiversity:*

In respect of biodiversity, the issue of air quality impacts on biodiversity, in particular local SSSIs and Epping Forest SAC, is discussed in the Air Quality section of this report.

9.442 Policy GEN7 seeks to protect wildlife and planning permission will only be granted when the need for the development outweighs the harm. Where protected species would be affected then mitigation measures would need to be secured by way of a condition or legal obligation. This policy is only partially consistent with the NPPF with the latter document clarifying and strengthening the requirements in protecting and enhancing the natural environment. The policy therefore has little weight.

9.443 Paragraph 8(c), environment objective, of the NPPF (2018) considers improving biodiversity. Chapter 15 of the NPPF relates to conserving and enhancing the natural environment. Paragraph 175(a) states that if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused.

9.444 The Biodiversity and ecological conservation section of the ANPS sets out the government's policies in respect of biodiversity, the main aims of which are to halt overall biodiversity loss, support healthy, well-functioning ecosystems, and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.

9.445 On-site ecology is limited to four areas of airfield grassland and, at one location, the potential disturbance/displacement of protected species (common lizard and great crested newt). Surveys reveal that this is likely to be a 'low' population of common lizards, with a high number of juveniles suggesting that this is a breeding population. Two great crested newts were found during the reptile surveys.

9.446 Mitigation in respect of the protected species is to re-survey the land prior to the construction works being undertaken and translocation under licence from Natural England. Translocation, if necessary, will be to an off-site receptor site (Monk's Farm, Burton End) which is within the applicant's ownership and had planning permission granted under reference UTT/16/0837/FUL for the creation of new aquatic and terrestrial habitats. This would be in accordance with Policy GEN7 and the NPPF. ECC Ecologist has advised that the site should be monitored and that this should be secured by condition or s106 Legal Obligation.

9.447 Whilst there is a monitoring programme associated with the consent granted under UTT/16/0837/FUL, this is only for a period of 5 years. Therefore, if planning permission is granted there is the potential for the translocation works to take place towards the end of the current monitoring programme. As such, it is considered reasonable to require a condition relating to the monitoring of the translocation site should planning permission be granted.

9.448 With regards to non-statutory wildlife sites, the ES identifies that there are 10 sites within 2km of the application boundary, six of which fall within the airport boundary. The main focus of the ES is in respect of air quality impacts on the SSSIs, which has been discussed previously.

9.449 The potential impacts on special verges have been raised as a concern by a consultee. Adopted Uttlesford Local Plan Policy ENV9 states that development likely to harm such environments will not be permitted unless the need for the development outweighs the historic significance of the site. The policy is consistent with the NPPF (2018) and the added criteria for the assessment of substantial and less than substantial harm for designated assets is also relevant in respect of this policy. The policy therefore carries full weight.

9.450 In this instance, the potential for harm is not direct but rather potential harm from increased vehicular movements or fly parking. Some fly parking may be directly related to the application and the Transport Forum has and will continue to work with other stakeholders on a measured response. Therefore, it is not considered that the potential harm to special verges would outweigh the benefits of the proposal. The less than substantial harm to special verges would be outweighed by the public benefits of the proposals.

9.451 In relation to potential impacts on Hatfield Forest, there is already a requirement in the 2008 Legal Obligation for the applicant to carry out air quality monitoring at the site. Planning permission has been granted and consent has been obtained from Natural England to install the monitoring equipment. It is considered appropriate to require the continued monitoring of Hatfield Forest if planning permission is granted, with the requirement to implement agreed mitigation measures if harm related to the development is identified and mitigation is required.

9.452 *Land and Soil (including ground conditions and contamination)*

Approximately 7ha of land is required for the provision of new infrastructure in relation to the proposals. This is land within the airport boundary and immediately adjacent to the runway. It is noted that representations have been made in respect of the loss of land for the growing of crops. However, given its airside location and the operational safety issues regarding the use of this land for crops this is not a material planning consideration.

9.453 Whilst this proposal would result in the loss of greenfield areas, there are no specific planning policies relating to such land, other than those in respect of biodiversity and protected habitats.

9.454 Approximately 46,000m^3 of spoil would be generated by the excavation works for the new taxiways and stands. This is not expected to be contaminated spoil and is therefore proposed to be used for landscaping within the airport boundary. In the event that the spoil cannot be used within the airport boundary then it would be stored for use elsewhere. Details of how the spoil will be utilised should be included in a CEMP which can be secured by way of a condition if planning permission is granted.

9.455 The proposed development is not envisaged to give rise to increased risk of contamination and as such no significant effects on land and soil are predicted.

9.456 *Cultural Heritage*

Significant archaeological investigations have previously been carried out within the airport boundary. These have found evidence of a medieval settlement and the location of Stansted Park.

9.457 Adopted Uttlesford Local Plan Policy ENV4 seeks to protect sites of archaeological interest and where preservation is not possible or feasible then archaeological investigation works will be required. The policy is consistent with the NPPF (2018) and carries full weight. Chapter 16 of the NPPF (2018) seeks to conserve and enhance the historic environment. A balanced judgement is required when considering applications which will affect the significance of a non-designated heritage asset. This includes assessing whether the harm arising from the proposals is substantial or less than substantial. The level of harm must then be weighed against the public benefits arising from the proposals.

9.458 Adopted Uttlesford Local Plan Policy ENV2 seeks to protect the setting of listed buildings. This policy is consistent with the NPPF (2018) as it is in line with statutory duties as set out in the Planning (Listed Buildings and Conservation Areas) Act 1990. The policy therefore has full weight. Similarly, paragraphs 193-6 of the NPPF (2018) set out the planning considerations in respect of assessing planning applications affecting listed buildings, including their setting. Where less than substantial harm would arise the harm should be weighed against the public benefits of the proposal.

9.459 The assessment of impacts on archaeology concludes that there would only be a negligible impact on archaeology as long as standard mitigation measures were followed during the construction works.

9.460 The application has been considered by ECC's Principal Historic Environment Advisor who advises that there would not be any impacts on archaeology and no conditions are recommended requiring investigation prior to development.

9.461 With regards to listed buildings, there are two Grade II listed buildings within the airport boundary. These are currently within the setting of the wider airport and this would not change as a result of the proposals. There would not be any harm arising from the proposed development in terms of the physical works. Therefore, it is not considered that there should be any adverse impacts on listed buildings.

9.462 *Landscape*:

Adopted Uttlesford Local Plan Policy S4 has a presumption in favour of development directly related to or associated with Stansted Airport. Policy GEN2 relates to development which needs to be compatible with its surroundings and should minimise its impacts on neighbours. Adopted Uttlesford Local Plan Policy GEN4 seeks to protect the occupiers of surrounding properties from impacts relating to noise, vibrations, smell, dust, light, fumes and other pollutants. This policy has been assessed as being compatible with the NPPF (2018) and carries full weight. Adopted Uttlesford Local Plan Policy GEN5 seeks to prevent development resulting in adverse impacts with regards to light pollution. This policy has no compatibility issues with the NPPF (2018) and carries full weight. The majority of impacts have already been discussed in detail in previous topic chapters.

9.463 The construction works would be compatible with airfield operations and should not result in any visual impacts. Construction lighting would be required, but this should be seen in the context of the existing airfield lighting and therefore should not give rise to any harm.

9.464 The operational phase would see an intensification of use of the airfield, the impacts of which have already been discussed. Whilst there would be an increase in flights from the current level of operations, the ATMs already have the benefit of planning permission with the 2008 consent.

9.465 As such, the proposals should not give rise to any adverse impacts and would comply with policies S4, GEN2, GEN4 and GEN5.

9.466 *Waste:*

Construction waste would predominantly be spoil which would be reused within the airport boundary. In addition, it is proposed that there would be a CEMP in place during the construction works to ensure best environmental practices are undertaken.

9.467 With regards to operational waste, the applicant requires all new development to incorporate appropriate waste management and recycling facilities, and resource efficiency is considered in procurement decisions. They are working towards a minimum target of 70% operational waste being recycled by 2020 as well as sending zero waste to landfill.

9.468 In 2017 the airport produced approximately 6,909 tonnes of waste (including hazardous waste; excluding cabin waste), corresponding to approximately 0.26kg waste per passenger.

9.469 The airport has a Waste Strategy 2014-2030 which sets out its monitoring and targeting of waste. It sets out waste reduction measures to be carried out across the airport.

9.470 Given the existing measures in place, plus the proposals within the Waste Strategy, it is not considered that the proposals should give rise to any significant environmental impacts in terms of waste.

9.471 *Major Accidents and/or Disasters:*

The airfield is governed by a rigorous safety regime, licensed by the CAA. The risk of a major aviation safety breach, accident or related disaster involving an aircraft because of the proposed development is determined to be negligible.

9.472 Construction works will at some points be carried out whilst the runway is operational. There are strict operational controls in place to ensure work place safety. The likelihood of an accident occurring as a result of the construction activity is minimal.

9.473 Public Safety Zones are designated on land either end of the runway and there are policy objectives which seek to ensure that there is no increase in the number of people living, working or congregating in these zones. These zones are not envisaged to be altered as a result of the proposed development. Public Safety Zone policy is administered by the DfT, and the extent of each zone is reviewed periodically.

9.474 Bird control measures are in place at the airport to mitigate the potential for accidents from bird strike. These risks are not envisaged to increase as a result of the proposed development.

9.475 Airfield lighting is installed in accordance with other legislation outside the control of the planning system. Therefore, there is no potential for increased risk of accidents in relation to lighting.

9.476 The airport suffers no exceptional climatic conditions that regularly affect its operations (eg extended periods of fog or high winds) and it currently offers an excellent level of resilience during adverse weather conditions. In addition, the surrounding area is free of natural or physical obstructions that might impact on aircraft range or payload. The proposed development has no bearing on these existing conditions. As such, the risk of major accidents and/or disasters occurring at the airport in the construction and operational phases is negligible.

L Cumulative Effects

9.477 Chapter 17 of the ES considers the cumulative effects of the proposals. These fall within two categories:

9.478 **Type 1 –** The interactive effects resulting from the associated effects of individual components or activities of the proposed development on a sensitive receptor, for example noise, airborne dust or traffic effects on a single receptor/group of receptors; and

Type 2 – The combined effects of several schemes which may on an individual basis be insignificant (negligible or minor), but additively, have a significant (moderate or major) effect.

9.479 A list of schemes considered with regards to cumulative effects is set out in the ES. This is a list of consented schemes envisaged to be delivered within the foreseeable future which have the benefit of planning permission. In all cases, the addition of these schemes has already been factored into the future environmental baseline within any assessments based on traffic data.

9.480 Developments outside of the administrative boundary of Uttlesford have not been included in the cumulative assessment. Given the location of potential schemes in relation to the airport, the cumulative impacts are most likely to arise in respect of effects where traffic data would be used. By using TEMPro for the traffic model it ensures that traffic generation from with schemes outside of the district are factored into the environmental baseline for future years.

9.481 In addition to committed schemes, proposed works which already has the benefit of planning permission, or are proposed to be carried out under permitted development, are included. These include:

- Stansted Transformation Phase 1 – improvements to the terminal
- Stansted Transformation Phase 2
    - Arrivals terminal
    - Conversion of existing terminal to departures terminal
- Airfield: Runway Rehabilitation (part of Phase 3) – expected to take place in 2022-23
- New car parks
    - Two new 'meet and greet' surface car parks
    - Two short stay multi-storey car parks
    - The extension of an existing surface car park
    - New staff car park

9.482 Whilst there is the potential for some overlap between the construction phase and the cumulative schemes, the ES concludes that there should not be any significant environmental effects arising. CEMPs would be in place in respect of each of the projects which would require the monitoring and mitigation of any adverse effects that could arise from issues such as noise, HGV movements, waste, erosion, sedimentation and pollution.

9.483 Table 17.3 sets out the cumulative impact assessment matrix (see attached at end of report). This concludes that for the majority of topics the residual impacts and combined cumulative effects should be negligible. In respect of socio-economic impacts, the residual impacts were concluded to be minor-major beneficial and the cumulative effects moderately beneficial. In terms of public health and wellbeing, the residual impacts should be negligible – major beneficial and the cumulative effects are considered to be the same. Negligible – minor adverse residual impacts and cumulative effects are predicted in relation to water resources. These conclusions are reasonable.

M Other issues

9.484 *Education:*

ECC Education has requested a financial contribution in respect of the provision of Early Years and Child Care facilities. They consider that an additional 5,500 employees would generate a requirement for an additional 220 EYCC places. However, this calculation has only assessed the total amount of additional employment without any analysis of the origin of the additional employees, working patterns or the potential for child care facilities being made in locations other than the immediate area around the airport.

9.485 There is a suggestion that a new facility should be provided within the airport. However, discussions between officers, the applicant and ECC have revealed that such a facility was provided previously but was not successful and subsequently closed.

9.486 Given the flawed analysis by ECC, which has not been reassessed despite requests to do so, it is not considered that the proposed request would meet the NPPF or CIL Regulations tests. Therefore, it would not be appropriate to request the financial contribution of £3,194,180 for the 220 EYCC places.

9.487 *Rapid Transit System*

One of the requirements set out in the Regulation 19 Uttlesford Local Plan Policy SP11 is "*To assist development of new rapid transit options between the airport and new and existing communities, land will be safeguarded to allow access at the terminal. The council will seek financial contributions from the airport operator for the delivery of an appropriate scheme.*"

9.488 There is an ambition to develop an RTS connecting proposed new settlements across North Essex, including the settlement West of Braintree, proposed Easton Park and Stansted Airport, and potentially Gilston located in the East Herts district. To date the feasibility study work on the Stansted Airport to West of Braintree section is on-going and no firm conclusions have been reached about mode or proposed route(s).

9.489 ECC has set out a requirement in their response for the applicant, in agreement with the local highway authority to identify and reserve land required to accommodate any future Rapid Transport System, and form an east-west link between the airport and any future growth locations identified in the Local Plan(s).

9.490 The ES has not identified a significant increase in demand as to warrant the development of an RTS to serve the airport, either in isolation or in combination. Furthermore, the stages reached in the preparation of the relevant local plans mean that there are still uncertainties as to where new growth will be proposed in plans yet to be examined or still being examined and not yet adopted, with the potential for main modifications. Given the uncertainties around future development, and the fact that the development does not generate a requirement for the RTS, it would be inappropriate to require the applicant to safeguard the land as part of this application.

9.491 The potential provision of the RTS will need to be explored by way of the Local Plan process.

10 Conclusion

10.1 In paragraph 1.26 of Beyond the Horizon (June 2018), the government expects applications to increase existing planning caps by fewer than 10 million passengers to be taken forward under the Town and Country Planning Act 1990. The application was made in February 2018 and proposes to change the existing cap by increasing the passenger numbers that can go through Stansted Airport by 8mppa, from 35mppa to 43mppa.

10.2 The application is made against a backdrop of national and local policy support for, and new particular national policy for, making best use of the existing runway infrastructure, as set out in the Aviation Policy Framework (2013), and the most recent Policy Statement on best use of existing capacity, taking careful account of relevant considerations, particularly economic and environmental impacts and proposed mitigations taking account also of relevant national policies in “Beyond the Horizon” (June 2018).

10.3 The application is for EIA development and Regulation 3 of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 requires that the planning authority not grant planning permission unless an EIA has been carried out in respect of that development. The application is accompanied with an ES which demonstrates the applicant’s case that the proposals represent sustainable development and would not result in significant adverse impacts. This ES has been assessed for its adequacy in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 and has been considered to be adequate notwithstanding some omissions and inadequacies (see section 10 below).

10.4 Regulation 4(5) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 requires the local planning authority to ensure they have, or have access as necessary to, sufficient expertise to examine the environmental statement. In this regard, the case officer has worked in conjunction with officers from Essex County Council (ECC), Hertfordshire County Council (HCC), East Herts District Council (EHDC), Place Services (ECC), Network Rail, Highways England (HE), Natural England, and UDC’s Environmental Health Manager (Protection), Senior Health Improvement Officer and the Communities Manager. Further expertise has been provided to ECC and HE by Jacobs and AECOM respectively. Officers have also been advised by consultants from WYG (air quality) and Bickerdike Allen Partners LLP (BAP). Consultation advice has been given by Thames Water and the Environment Agency (EA).

10.5 Regulation 63 of the Conservation of Habitats and Species Regulations 2017 requires the competent authority, before deciding to give any permission for a plan which is:

a. Is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and
b. Is not directly connected with or necessary to the management of that site,

make an appropriate assessment of the implications of the plan or project for that site in view of that site’s conservation objectives. Natural England is satisfied that the application is broadly acceptable, alone and/or in combination with the Regulations, in particular, in relation to Epping Forest SAC. An Appropriate Assessment has concluded that only a de Minimis effect from nitrogen deposited on vegetation on a particular unit in that SAC, resulting from vehicles related to the development passing along the nearby M25, occurs and that as such adverse effects will not arise.

Development Plan

10.6 Section 38(6) of the Planning Act 2004 requires that the determination be made in accordance with the provisions of the development plan unless material considerations indicate otherwise.

10.7 Paragraphs 9.78 to 9.105 set out the planning balance in respect of the Development Plan.

Material Considerations

10.8 The Regulation 19 Uttlesford District Plan is a material consideration but carries limited weight at this time. The Spatial Vision identifies the importance of Stansted Airport in the London Stansted Cambridge Corridor and Policy SP11 – London Stansted Airport reflects this. This policy is subject to 20 objections and has not yet been tested for soundness. Notwithstanding this, the emphasis of the policy at the present time is to support sustainable growth of the airport. This assessment will be made in respect of adopted policies, the NPPF and other material considerations.

10.9 The NPPF (2018), Aviation Policy Framework (2013), the emerging Aviation Strategy (April 2018), and Beyond the Horizon, The Future of UK Aviation, Making best use of existing runways (June 2018), are material considerations. In summary, the first supports sustainable development and the last provides government support for making best use of existing runways, taking careful account of all relevant considerations, particularly economic and environmental impacts and proposed mitigations. The NPPF (2018), Beyond the Horizon (April and June 2018) carry substantial weight because each have an evidence base, are up to date, and were widely consulted on. The Aviation Policy Framework (2013) carries substantial weight insofar as it is the government's policy in respect of aviation. However, some aspects may be slightly dated in their approach and also overtaken by the more recent particular Policy Statement in "Beyond the Horizon" (June 2018).

Growth and Need

10.10 The ES sets out the predicted growth of the airport from the baseline of 2016 with a DM scenario of the consented 35mppa and a predicted growth to 43mppa, as applied for in this application. The ES then assesses the impacts of the additional growth from 35mppa to 43mppa with a DM and DC scenario for 2023, the year at which the divergence is predicted to occur, and 2028, the year in which the level of growth is predicted to reach the limits applied for. The approach by the ES to growth and need of the particular airport is reasonable.

Surface Access

10.11 The impacts on the strategic and local road networks have been considered in conjunction with Highways England, ECC and HCC. Overall, it is predicted that there would be no significant adverse impacts on either the strategic or local road networks subject to appropriate mitigation being secured by way of s106 Legal Obligation. The mitigation measures include a scheme for alterations to the M11 Junction 8 which is considered to be acceptable to Highways England. Other mitigation measures relate to funding for improvements to local roads, including the improvements to cycling and walking links, and bus and coach services and infrastructure. The funding mechanisms would be overseen by the SATF and its working groups. Funding would come from the Transport Levy plus sums of ring fenced capital funding.

10.12 These funding mechanisms have previously been incorporated into earlier s106 Legal Obligations (or equivalents) and have been assessed as being the most appropriate mechanism for delivering the mitigation measures. However, the terms of reference for SATF working groups, in particular the Bus and Coach Group need to be refreshed to enable future flexibility given the changes in technology and service delivery that are being explored. Whilst specific routes and services have been identified by consultees it is not considered that this is an appropriate way of delivering the mitigation as the services are reliant on third party bus and coach companies who will need a business case for delivering a new or improved service. The SATF will also need to be reassured that any proposal represents value for money before agreeing to release funding.

Noise:

10.13 Air noise is an area of great complexity given different perceptions to noise across the population. The government recognises that evidence has shown that people's sensitivity to noise has increased in recent years, and there has been growing evidence that exposure to high levels of noise can adversely affect people's health.

10.14 There is also recognition that over recent decades there have been reductions in aviation noise (air and ground) due to technological and operational improvements and that this trend is expected to continue. The government, therefore, wants to strike a fair balance between the negative impacts of noise and the positive impacts of flights. They expect airports looking to make best use of their existing runways to share in the economic benefits of expansion with the communities by way of reducing noise impacts.

10.15 Impacts from air noise and ground noise from aircraft and associated operations, construction operations and vehicles associated with the proposed growth of the airport have been considered in the ES.

10.16 The ES demonstrates that there will be an increase in population within the LOAEL category in daytime, as set out in the NPSE. There will be a reduction of population affected by night time noise. However, whilst there will be an increase of people affected, the increases in noise levels will be around 0.5 and 0.6dB and therefore imperceptible.

10.17 Noise contours only tell part of the story and relate to average noise levels across a specific time period, 16 hours in the day and 8 hours at night. However, noise isn't perceived on an average basis but rather in terms of the number of events. Averaging can hide impacts from increases in numbers of events. In order to enable an assessment of overflight impacts Nx contours were produced, N65 for daytime (number of flights exceeding 65dB(A)) and N60 for night time (number of flights exceeding 60dB(A)). These demonstrate that there will be an increase of 72 movements per day. The N65 contours at levels of 100 and 200 (the number of overflights) closest to the airport enlarge at 2028 in comparison to the 2016 baseline as these areas will experience the increased number of overflights.

10.18 There are concerns in respect of noise levels at four schools, Howe Green School, Spellbrook Primary School, The Leventhorpe School and Mandeville Primary School. Spellbrook Primary School is predicted to experience noise levels slightly higher than the recommended 73dB LAmax when B737Max are in operation.

10.19 The mitigation measure for properties, including schools, community buildings and places of worship, affected by noises is a revised and updated SIGS. This offers financial support for noise insulation measures. The current scheme requires funding from property owners and covers 1088 properties. The revised scheme offers maximum grants and would not require funding from the owner.

The scheme would be available for over 2000 properties offering different levels of grants according to the noise levels experienced at the property.

10.20 An additional mitigation measure in respect of daytime noise is a noise contour which currently has a maximum area of 33.9km2. Operations at the airport are not predicted to exceed this contour and the ES predicts that this would reduce over time with the introduction of quieter aircraft. Therefore, it is considered that to ensure the operations at the airport share the benefits with the local community it is appropriate to impose a noise contour condition which reduces in size over time. If, as a consequence of slower uptake of quieter aircraft for example, noise levels do not reduce at the rate set out in the ES then operations at the airport would be curtailed by the noise contour.

10.21 Night noise is controlled by measures put in place by the government and is not a matter for the local authority to seek to control. Night movements are predicted to increase from 82 movements per night to 104 and 107 in the DM and DC scenario under the current restrictions. These levels would be reached irrespective of planning permission being granted for this proposal.

10.22 An additional mitigation measure is the imposition of fines for flights exceeding noise levels. The fines are proposed to be paid into a Community Fund which would be given over to community projects to improve health and wellbeing.

10.23 In terms of air noise, the assessment methodology, approach and level of detail contained in the ES is satisfactory and the proposed mitigation measures are adequate. As such the proposals should not result in significant adverse impacts in respect of air noise.

10.24 Ground noise comes from various sources including the use of power units, plant and equipment and also construction. Comparison of the data sets shows increases in noise levels indicate an increase at Molehill Green (the worst affected location) of +3dB during the daytime and +2.5dB at night from the 2016 baseline. However, the comparison between the DC and DM scenarios indicates an imperceptible change.

10.25 Construction is predicted to take place between 2021-2 and the main focus of the assessment was the key sensitive night time period. This showed increases at the receptors of between 0.2dB and 10.6dB. Whilst the increase of 10.6dB (at the Ash Public House) is a large increase, the noise level experienced at that receptor would still be below the 45dB threshold where annoyance is expected to be experienced.

10.26 Some of the mitigation measures associated with air noise would also be applicable to receptors affected by ground noise. The findings of the ES are not disputed and the proposed mitigation measures are considered to be acceptable.

10.27 Surface access noise assessments did not include rail on the basis that the new rolling stock which would accommodate that additional growth in passenger numbers would be coming on-line with or without the proposed development.

10.28 Comparisons between the 2028 DC and DM scenarios indicate that noise levels would increase by 0.1dB and 0.7dB with the largest increase being at Thremhall Avenue. In comparison to the 2016 Baseline, increases of 3.8dB would be experienced at Round Coppice Road. The receptors at this point are the Novotel Hotel, located more than 150m from the road, and Stansted College which has been designed with noise protection measures incorporated into the fabric of the building.

10.29 Surface noise impacts are therefore considered to be negligible and no mitigation is required.

10.30 *Air Quality:*

Air quality is an area of concern raised in many of the representations. There are two particular areas to consider, impacts on AQMA, (focussing on human health), and impacts on sensitive ecological receptors. There is an AQMA located in Saffron Walden in the Uttlesford district which would not be impacted by the proposals. In addition, there is an AQMA located at Hockerill junction in Bishop's Stortford which would experience an increase in traffic.

10.31 The local plan policy position in East Herts has recent been clarified with EHDC expecting to adopt their new District Plan on 23 October 2018. The proposed policy in the East Herts District Plan refers to a requirement for applications to be accompanied by an Air Pollution Assessment in line with the Council's Air Quality Planning Guidance Document. However, whilst this policy has full weight in East Herts it is a material planning consideration in Uttlesford and there is no policy basis for any such assessment in national planning policy, for example the NPPF (2018) and the National Planning Policy Guidance.

10.32 The impacts at Hockerill are predicted to be negligible, even after sensitivity testing. However, the benefits of the proposal would need to be weighed against the potential health impacts resulting from this negligible increase.

10.33 Mitigation measures aimed at improving sustainable links to the airport, such as a 50% mode share of employees and passengers accessing the airport by public transport, and the improvement to bus services, are measures that improve air quality. Bishop's Stortford is well connected to the airport by both direct rail and bus services. The continuation of air quality measures would be secured by way of s106 Legal Obligation if planning permission were to be granted. On balance, the benefits of the mitigation measures outweigh the negligible harm arising from air quality impacts.

10.34 In terms of impacts on ecological receptors, there are two principal areas of concern, local SSSIs and Epping Forest SAC and SSSI. In terms of impacts on SSSIs, the impacts are predicted to be negligible when comparisons between the DM and DC scenario are made. However, mitigation measures for Hatfield Forest and Elsenham Woods by way of monitoring, and the implementation of additional mitigation measures if identified as being required as a result of the monitoring, would be secured by way of s106 Legal Obligation if planning permission were to be granted.

10.35 NE raised concerns about the alone and in-combination impacts on Epping Forest SAC. Additional work was carried out in this respect by the applicant that demonstrated that the impacts would be negligible. To ensure the Council can comply with Regulation 63 of the Conservation of Habitats and Species Regulations (2017), Place Services was commissioned to carry out an Appropriate Assessment (11 October 2018). This concluded that the project for the development will not have an adverse effect on the integrity of Epping Forest SC as no failure of the conservation objectives is predicted, either alone or in combination.

Socio-economics

10.36 The ES sets out the benefits arising in respect of socio-economics. Concerns were raised in respect of the potential impacts of Brexit and the fact that the negative impacts, such as tourism deficit, were not considered. The ES was based on the Oxford Economics scenario whereby the UK leaves the EU on unfavourable terms, without negotiating a significant trade deal and the trade relationship between the UK and the EU therefore reverts to WTO rules.

10.37 The benefits of the proposals are recognised by a variety of parties, and the ECC Economic Growth and Skills Department consider that the increase in capacity is important to growth in Essex. In addition, the proposals increase job and skills training opportunities as well as supports local businesses and employment growth in Essex.

10.38 The findings of the socio-economics chapter of the ES are considered to be sound and would deliver in respect of the economic growth aspirations of national and local policy.

10.39 *Carbon emissions:*

The policy in respect of carbon emissions sets out that this is an issue best dealt with at a national level. The ES used the pessimistic approach for assessing the impacts of carbon emissions as a result of the proposals. This indicates that the difference between the DM and DC scenario would be 0.3MtCO_2e. When assessed as a value per passenger, the development case would see an improvement in emissions by 4 kgCO_2e.

10.40 The ES concludes that Stansted Airport's share of UK aviation carbon emissions would rise from 4% in 2016 to between 4% and 5.3% of the UK's aviation emissions target in 2050, with annual aviation carbon emissions predicted to decrease between 2028 and 2050. It is considered that the DC scenario is unlikely to materially impact the UK's ability to meet its 2050 national aviation target of 37.5MtCO_2e.

10.41 The findings of the ES in this respect are not disputed, and as already stated, this is an issue to be addressed at a national level by the government.

10.42 *Climate Change:*

National policy in respect of aviation and climate change focusses on the vulnerability of the asset in extreme weather arising from climate change impacts. In addition, the APF seeks to ensure the aviation sector makes a significant and cost-effective contribution towards reducing global emissions. However, this aspect requires intervention at a global and national level and is not appropriate for discussion at a local level.

10.43 In terms of resilience of the airport in respect of climate change, mitigation measures to ensure the continued operation of the airport are identified. On this basis, the applicant has met the requirements of the EIA Regulations and no significant effects are identified.

10.44 *Public Health and Wellbeing:*

Decisions in respect of aviation growth are required to be in accordance with sustainable development principles, and this includes maximising wellbeing and protecting our environment, without negatively impacting on the ability of future generations to do the same.

10.45 The ES follows a source-pathway-receptor approach to identify and assess health impacts that are plausible and directly attributable to the proposed development.

10.46 Benefits, both direct and indirect, would arise from increased employment, quality of life and wellbeing from the predicted £357m GVA per annum by 2028, additional leisure trip opportunities and the associated family and social benefits arising from these.

10.47 Impacts on health and wellbeing are not predicted in relation to surface access, congestion or potential for reduced access to services.

10.48 Less than one additional emergency hospital admission and less than one additional death per annum are predicted as a result of impacts in respect of air quality. A less than 1% increase from the baseline in hypertension, depression or anxiety is predicted.

10.49 An increase of around 339 people who consider themselves highly annoyed by aircraft noise is predicted, which is around a 28% increase compared to the DM scenario. However, those affected at night is predicted to be very limited due to the controls set out in the Night Noise Regulations.

10.50 A predicted 13% increase in daytime noise events above the assessment threshold are predicted at Howe Green School, St Giles Church in Great Hallingbury, and Falcon House Care Home in Little Hallingbury. In this respect, the impacts are considered to be minor adverse. Similar impacts are considered in respect of the quality of life and wellbeing in association with amenity of green space.

10.51 Mitigation in the form of a Community Fund is proposed which it is envisaged would cover all the parishes in Uttlesford and the parishes falling within a 10 mile radius of the airport (whole parishes included where part of the parish falls outside of the radius). The Community Fund would be available for health and wellbeing projects within the parishes. (see attached map for proposed areas for funding)

10.52 *Water Resources and Flood Risk:*

The airport has significant drainage infrastructure in place, including the balancing ponds located between the A120 and B1256. As a result of the new infrastructure an increase in capacity will be required and the proposals have been assessed by the LLFA as being acceptable and not increasing the risk of flooding.

10.53 Water efficiency measures are proposed to be increased on the airport and Anglian Water, as the utility provider, has not commented on the application.

10.54 In terms of demands on foul water infrastructure, Thames Water has identified that increased capacity will be required in association with the predicted housing growth and as a result of the proposals in this application. A technical option is believed to be feasible and Thames Water does not object to the proposals. Likewise, the EA does not object to the proposals, subject to a condition in respect of modelling to ensure that the increased passenger numbers and associated increase in total foul water volumes will not result in a deterioration of the water body known as Great Hallingbury Brook.

10.55 *Non-Significant Topics:*

Non-significant topics relate to biodiversity, land and soil, cultural heritage, landscape, waste and major accidents and/or disasters.

10.56 Contamination and spoil are not considered to be issues resulting in significant impacts. Likewise, archaeology is not an issue in the location of the proposed airfield infrastructure works. Similarly, the construction works would not be harmful to the character of the area and would not result in harm to the landscape.

10.57 Waste would be dealt with in accordance with the Airport's Waste Strategy. This sets out its monitoring and targeting of waste, including reduction measures to be implemented across the airport. Therefore, no significant impacts are predicted.

10.58 Major accidents and/or disasters are not predicted to increase as a result of the proposals, not least because of the stringent safety regimes in place outside of the planning system.

10.59 In terms of biodiversity, translocation of protected species will be required as a result of the infrastructure works. This would be to a translocation site owned by the applicant and monitoring would be required after translocation has taken place. As a result no significant impacts would arise in respect of biodiversity.

Cumulative Effects:

10.60 Cumulative effects of the proposals with committed schemes have been assessed. This includes works proposed under permitted development by the applicant within the airport boundary.

10.61 Cumulative effects are assessed as being negligible. In respect of socio-economic impacts, the residual impacts were concluded to be minor-major beneficial and the cumulative effects moderately beneficial. In terms of public health and wellbeing, the residual impacts should be negligible – major beneficial and the cumulative effects are considered to be the same. Negligible – minor adverse residual impacts and cumulative effects are predicted in relation to water resources.

Consistency

10.62 Paragraph 213 of the NPPF (2018) states that, "existing policies [in adopted Local Plans] should not be considered out-of-date simply because they were adopted or made prior to the publication of this Framework. Due weight should be given to them, according to their degree of consistency with this Framework (the closer the policies in the plan to the policies in the Framework, the greater the weight that may be given)."

10.63 Policies S4 and AIR1-6 relate to proposed development within the airport boundary. S4 relates to the whole airport site and is a strategic policy and

Policies AIR1-6 are site specific. These have been assessed as being in accordance with the NPPF and can be afforded full weight, subject to their compliance with government's policy in respect of aviation.

10.64 Policy GEN1 relates to highway safety and alternative transport options rather than the private car. The policy is generally consistent, although there is more emphasis in the NPPF to sustainable transport modes whilst acknowledging that there will be differences in opportunities between rural and urban areas. Uttlesford is a rural area where there are challenges in providing public transport for a dispersed population, but at the same time airport demand boosts services along certain transport corridors. The NPPF is more positively worded in seeking to minimise the need to travel and maximise cyclist and pedestrian and public transport opportunities. This policy should therefore be given moderate weight.

10.65 Policy GEN2 relates to design and as such is only partially relevant to the application. The policy is generally in conformity with the NPPF and the areas where it doesn't strictly comply are areas around sense of place, mix of uses and function, which would not be applicable in this instance. The criteria applicable to the application are e) – water and energy consumption; g) – waste; h) environmental impacts on neighbours. Insofar as it is relevant to the application, the policy should be given full weight.

10.66 Policy GEN3 relates to flooding and is only partly consistent with the NPPF with approaches to flooding issues having developed considerably in the time since the policy was adopted. Therefore, the policy has limited weight with full weight being given to the NPPF and associated guidance.

10.67 Policy GEN4 relates to good neighbourliness and seeks to protect existing properties and users from harm arising from nuisance. This can include noise, pollution, light pollution and fumes. The policy has been assessed as being consistent with the NPPF and should be given full weight.

10.68 Policy GEN5 seeks to protect against harmful impacts arising from light pollution. This policy has no compatibility issues with the NPPF and should be given full weight.

10.69 Policy GEN6 relates to securing infrastructure required in association with proposed development. This policy is generally consistent with the NPPF, but the latter recognises the need for viability of development to be considered. In addition, there is a requirement to take into account the Community Infrastructure Regulations. The policy should be given moderate weight.

10.70 Policy GEN7 relates to nature conservation, seeking to protect and enhance biodiversity. The policy is only partially consistent with the NPPF with the latter document clarifying and strengthening the requirements in protecting and enhancing the natural environment. The policy therefore has little weight.

10.71 Policy ENV2 is consistent with the NPPF as it is in line with statutory duties as set out in the Planning (Listed Buildings and Conservation Areas) Act 1990. The NPPF gives additional assessment criteria relating to the assessment of substantial and less than substantial harm. The policy therefore carries full weight.

10.72 Policy ENV4 relates to the protection of archaeological remain and scheduled protected ancient monuments. The policy is consistent with the NPPF and therefore carries full weight. The assessment of substantial and less that substantial harm for designated assets is also relevant in respect of this policy.

10.73 Policy ENV7 relates to the protection of designated ecological assets. The policy is only partly consistent with the NPPF with the emphasis shifting from the need for development to the benefits needing to clearly outweigh the harm. In addition, there are additional requirements under the Habitats and Species Regulations (2010) which relate to European designated sites. Therefore, the policy has little weight.

10.74 Policy ENV9 relates to the protection of historic landscapes. The assessment criteria for the assessment of substantial and less than substantial harm for designated assets is also relevant in respect of this policy. It is consistent with the NPPF and therefore carries full weight.

10.75 Policy ENV11 seeks to protect existing uses from noise generators. The policy is generally consistent with the NPPF but the NPPF is more specific with regard to existing businesses recognising the need to balance the needs of business and the protection of existing amenities. The policy therefore carries moderate weight.

10.76 Policy ENV12 relates to the protection of water resources in respect of pollution. The policy is consistent with the NPPF and carries full weight.

10.77 Policy ENV13 seeks to prevent development in areas of poor air quality. This is generally consistent with the NPPF, although the latter document sets out a requirement that any development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan. The policy therefore carried moderate weight.

The Planning Balance

10.78 S70(2) of The Town and Country Planning Act 1990 requires the local planning authority, in dealing with a planning application, to have regard to:

(a) the provisions of the development plan, so far as material to the application,
(aza) a post-examination draft neighbourhood development plan, so far as material to the application,
(b) any local finance considerations, so far as material to the application, and
(c) any other material considerations.

10.79 S38(6) of the Planning and Compulsory Purchase Act 2004 requires that, if regard is to be had to the development plan for the purpose of any determination to be made under the planning Acts, the determination must be made in accordance with the plan unless material considerations indicate otherwise.

10.80 Policy S4 supports the principle of development directly related to or associated with Stansted Airport that Policy S4 covers. The proposed infrastructure applied for in this application is directly related to the airport and therefore comply with Policy S4. Policies AIR1-6 do not directly relate to any of the areas where infrastructure is proposed to be constructed and likewise to not specifically relate to a proposed uplift in passenger numbers.

10.81 Other policies relevant to the consideration of this application fall within two general categories – general policies and environmental policies.

10.82 Policy GEN1, which received moderate weight due to its compatibility with the NPPF, states that development will only be permitted if all of the following criteria are met:

a) Access to the main road network must be capable of carrying the traffic generated by the development safely
b) The traffic generated by the development must be capable of being accommodated on the surrounding transport network
c) The design of the site must not compromise road safety and must take account of the needs of cyclists, pedestrians, public transport users, horse riders and people whose mobility is impaired
d) It must be designed to meet the needs of people with disabilities if it is development to which the general public expect to have access
e) The development encourages movement by means other than driving a car.

10.83 The proposal does not propose any new or alterations to access to the main road network so criterion a) is not relevant. Similarly, there are no alterations to the layout of the site itself proposed within the application so criteria c) and d) are also not relevant. In terms of traffic generation, the proposals have been considered by the highway authorities for Essex and Hertfordshire and Highways England who have all concluded that the proposals, subject to appropriate mitigation measures would comply with criterion b).

10.84 In terms of criterion e), the application site is already well served by public transport, and there are commitments to use best endeavours to maintain and/or increase sustainable transport mode shares. Furthermore, whilst limited options exist for access by walking and/or cycling, the Stansted Area Transport Forum and the reporting sub-groups (bus and coach, highways and rail) have the ability to authorise funding for sustainable transport improvements, including schemes which incentivise walking and/or cycling. The schemes are funded by two means; two fixed capital ring fenced sums, one associated with bus and coach improvements and the other related to local roads. In addition, there is funding secured by way of a transport levy, a on every car parking transaction, and a fixed annual sum for staff parking. These mechanisms already exist and have performed well and, if planning permission were to be granted are proposed to be carried forward in a new s106 Legal Obligation. As such, the mitigation measures proposed result in the proposals complying with Policy GEN1. Furthermore, they would comply with the sustainable transport objectives of the NPPF.

10.85 Policy GEN2 sets out various design criteria and proposals are required to meet all aspects. However, as these are generally related to physical structures or developments freely accessible by members of the public. In this instance the proposed physical works relate to infrastructure within the airfield and therefore the majority of the criteria are not relevant to the proposals. However, criterion e) relates to energy and water consumption, g) relates to waste and h) relates to environmental impacts. Insofar as these criteria are relevant to the proposals, the statutory consultees have confirmed that they have no objections to the proposals and as such they comply with Policy GEN2.

10.86 Policy GEN3 relates to flood protection and is only partially compatible with the NPPF and therefore only has limited weight. In terms of flood protection, the proposals have been considered by the LLFA who confirm that they have no objections to the proposals. This would be subject to appropriate mitigation measures being secured by condition relating to increased storage capacity for surface water runoff. Insofar as the policy relates to the prevention of increased risk of flooding the proposals comply with Policy GEN3 and with the requirements set out in the NPPF.

10.87 Policy GEN4 does not permit development where it will give rise to nuisance, such as noise, pollution or cause material disturbance or nuisance to occupiers of surrounding properties. In this regard, the proposals do not comply with Policy GEN4 due to the impacts arising from noise and air pollution. Paragraph 180 requires decisions to mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development.

10.88 Currently the applicant operates a Sound Insulation Grant Scheme (SIGS) which covers around 1080 properties. A new, enhanced scheme is proposed in relation to this application which would increase the funding available and around 2000 properties would be eligible for grants.

10.89 Other mitigation measures currently in place are a limit on the number of flights, capped at 274,000, and a noise contour. Outside of the planning system there are also controls on night flights which are not affected by this application. The Aviation Policy Framework and subsequent documents in relation to the development of the aviation strategy recognises the need for airports wishing to make better use of their runways to pass on the benefits of quieter aircraft. Currently, the 57dB leq noise contour has a maximum area of 33.9sqkm. The airport is operating well inside that limit, and could continue to do so up to and including their current cap of 35mppa. Therefore, if planning permission were to be granted, it is appropriate to require the applicant to put forward a scheme to reduce the size of the contour in line with the increase of their operations. This can be secured by way of a condition and the Council would seek a reduction to 28.7sqkm, in line with the predictions in the ES. These measures would ensure that the proposals would comply with the NPPF and the APF.

10.90 Policy GEN5 does not permit lighting schemes unless the level of lighting is the minimum necessary and glare and light spillage from the site is minimised. Whilst no details of lighting is included in the application, given the location and nature of the proposals it is acknowledged by the applicant that additional lighting will be required in this location. Given the operational requirements of the applicant, as regulated by bodies and legislation outside of the control of the planning system, the lighting will be the minimum necessary. The location of the infrastructure works is within the operational airfield and therefore an area which already has significant lighting requirements. Therefore, in this context the proposals comply with Policy GEN5.

10.91 Policy GEN6 states that development will not be permitted unless appropriate infrastructure which arises as a result of the proposals is secured. In this case, the proposed development would result in impacts on the strategic highway network which would require mitigation works to be carried out. A mitigation scheme has been identified and could be secured by way of a clause in s106 Legal Obligation, as recommended by HE. However, given the potential lead-in time before the requirement for the mitigation package being required to be delivered, there is the potential that the proposed identified mitigation may not be the appropriate mechanism. Therefore, a secondary clause is proposed which requires a reassessment of the situation at the time the mitigation is required and the implementation of an alternative scheme, or if funding for a strategic mitigation measure for the M11 J8 being forthcoming, a financial contribution towards that scheme would be required as alternative mitigation.

10.92 Additional mitigation measures associated with surface access will also be required. These would be delivered through the Stansted Area Transport Forum. The funding mechanisms will be a mix of fixed capital sums to be spent over a period of time and funds raised by the Transport Levy. By securing the mechanisms by way of s106 Legal Obligation the proposal would meet the requirements of Policy GEN6.

10.93 Policy GEN7 does not permit development that would have a harmful effect on wildlife, protected species or habitats suitable for protected species unless the need for development outweighs the importance of the feature for nature conservation. Mitigation and/or compensation measures are acceptable provided they can be secured by way of condition and/or s106 Legal Obligation. The proposal will result in direct impacts on protected species and their habitat through the development of the new infrastructure. Mitigation by means of translocation to an off-site receptor has been put forward by the applicant. The off-site receptor is within the control of the applicant and the mitigation measures proposed would be appropriate.

10.94 Policy ENV2 seeks to protect, inter alia, the setting of listed buildings. The location of the proposed infrastructure is such that impacts are unlikely to arise. Indirect impacts in terms of increased flights would arise from the proposals. On balance, it is considered that the proposals comply with Policy ENV2.

10.95 Policy ENV4 seeks to protect archaeological remains in situ, unless the need for development outweighs the importance of the archaeology. In this instance, whilst there are areas within the airport boundary where significant archaeological remains have been discovered, it is considered that there is little scope for there to be any in the locations of the proposed infrastructure. On that basis, the proposals would comply with Policy ENV4.

10.96 Policy ENV7 does not permit development which would adversely affect nationally or locally designated sites unless the need for development outweighs the particular importance of the nature conservation value of site or reserve. Any potential impacts on such sites would be indirect as a result of pollution, in particular in respect of Hatfield Forest SSSI and East End Wood SSSI. In this instance there would need to be a balance between the potential harm, although no significant levels of harm have been identified in the ES, and the need for the development. Both sites are currently experiencing harm due to pollutants and mitigation measures in the form of long-term monitoring are proposed to be continued, with appropriate mitigation being identified and implemented if required. Given the limited weight that can be applied to this policy due to the shift in national policy towards assessing the benefits of the proposal against the harm, the proposals can be considered to comply with Policy ENV7. In terms of the NPPF, this states that unless the benefits of development outweigh the harm to designated sites then planning permission should be refused. The APF sets out that the social and economic benefits of aviation growth need to be weighed against the environmental impacts. On the basis that no significant impacts have been identified and mitigation measures involving monitoring and implementing mitigation if harm is arising as a result of the proposals, it is considered that the proposals comply with the NPPF and the APF.

10.97 Wider potential impacts were identified by Natural England in respect of Epping Forest SSSI and SAC, the latter designation requiring the Council to undertake an Appropriate Assessment. The additional information submitted by the applicant, and the Appropriate Assessment, confirm that the proposals would not adversely affect the integrity of the Epping Forest SAC either alone or in combination. In addition, there would not be any adverse impacts on Epping Forest SSSI.

10.98 Policy ENV9 does not permit proposals likely to harm significant local historic landscapes, in this instance protected lanes, unless the need for development outweighs the historic significance of the site. The proposals would not have a direct impact on historic landscapes, but there is the potential for indirect impacts arising from activities such as fly parking. The applicant, by way of the Stansted Area Transport Forum, operates a mechanism for trying to resolve or at least minimise fly parking issues. As such, any potential impact on historic landscapes would be minimal and the proposal can be considered to comply with Policy ENV9.

10.99 Policy ENV11 prevents noise generating development particularly where it would adversely affect the reasonable occupation of existing or proposed noise sensitive development nearby. The exception is where the need for the development outweighs the degree of noise generated. In respect of aircraft noise, the impacts arising affect people in different ways. Some people can live very close to the airport and not consider themselves to be affected by noise, whereas people living some distance from the airport, where aircraft are overflying at heights in excess of 5,000 ft consider themselves to be adversely affected. In order to assess noise impacts a series of analytical measures are used in the form of various noise contours. Historically noise contours have been set at 57dB leq and the current noise contour must not exceed 33.9sqkm. The assessment of the application using a mix of contour types has demonstrated that the proposals would not exceed the current conditioned noise contour, and will reduce in the future. On the basis of the assessment the proposals would not give rise to increased noise and would result in a reduction of the existing 57dB leq noise contour to no more than 28.7sqkm by the end of 2028, which could be secured by way of a condition. On balance, it is considered that the proposals comply with Policy ENV11.

10.100 Policy ENV12 does not permit development likely to cause contamination of groundwater unless effective safeguards are provided. An analysis of the predicted impacts has indicated that contamination is not likely and as such the proposals comply with Policy ENV12.

10.101 Policy ENV13 does not permit development where users would be exposed on an extended long-term basis to poor air quality outdoors near ground level. The development itself does not result in a scheme where users would be exposed to poor air quality. However, the vehicular movements associated with surface access to the airport, plus the pollution from aircraft, would result in impacts on the local area. On the basis that this policy is specifically directed towards two specific areas adjacent to the M11 and the A120, the proposals technically comply with the requirements of the policy.

10.102 However, on air quality issues, the NPPF states that decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas. Opportunities to improve air quality or mitigate impacts should be identified.

10.103 Uttlesford only has one AQMA this is located in Saffron Walden where impacts are unlikely to arise as a result of the development proposals. However, Bishop's Stortford, falling under the administration of East Hertfordshire District Council, has an AQMA based around the Hockerill junction, and a further one located in Sawbridgeworth. The East Herts adopted policy is Policy ENV27 which states, inter alia, that development which will significantly increase air pollution will not be permitted. East Herts District Plan Policy EQ4, which has been tested for soundness but not yet adopted, states that the effect of development on air quality is a material consideration. The policy refers to that Council's Air Quality Action Plan and Air Quality Planning Guidance.

10.104 The ES identifies additional traffic would flow through the Hockerill AQMA but this increase would result in negligible impacts on the AQMA. EHDC does not have a mitigation plan for the AQMA but seeks to ensure that appropriate alternative sustainable transport measures are incorporated into developments affecting the AQMA. As discussed above, the applicant already provides sustainable transport initiatives by way of funding for new bus and coach routes, funding towards local schemes for improving walking and cycling opportunities. Additional funding for schemes could be secured in respect of the current proposals and appropriate sustainable transport schemes can be identified and financed by way of the SATF and the Working Groups. On this basis, the proposals comply with the requirements of the NPPF.

10.105 Overall, the proposals comply with the relevant local plan policies. The proposals also comply with the material considerations of national policy, the policies as set out in the NPPF (2018), the APF (2013) and the BTH (June 2018), and insofar as it is relevant ANPS (2018). The APF sets out the government's primary objective which is to achieve long-term economic growth. The aviation sector is seen as a major contributor to the economy and its growth is supported but within a framework which maintains a balance between the benefits of aviation and its costs, particularly its contribution to climate change and noise. Whilst issues around climate change and carbon emissions are to be dealt with at a government level, it is considered that this application balances the primary objective of economic growth with the impacts of aviation. Appropriate mitigation measures are identified and could be secured by way of conditions or s106 Legal Obligation.

Overall Conclusion:

10.106 The ES has demonstrated that there would be negligible impacts arising from the proposals. These have been assessed and tested by various consultees and issues arising have been addressed and appropriate mitigation measures identified.

10.107 Section 38(6) of the Planning Act 2004 requires that the determination be made in accordance with the provisions of the development plan unless material considerations indicate otherwise. The application accords with the development plan.

10.108 It is considered that the proposal represents a sustainable form of development in line with the NPPF (2018) paragraph 8 and accords with the NPPF.

10.109 The application makes best use of the existing runway infrastructure in accord with Beyond the Horizon (June 2018) and the Aviation Framework (2013).

10.110 No other matters sufficiently outweigh these considerations.

10.111 It is therefore recommended that the application be approved subject to s106 Legal Obligation and conditions, as set out below.

11 Adequacy of the ES

11.1 Uttlesford District Council commissioned ESIA-Consult Ltd to undertake an Independent Peer Review of the Environmental Statement submitted with the application (https://uttlesford.moderngov.co.uk/documents/s8353/ES%20Review.pdf). The evaluation was undertaken by Martin Broderick (principal reviewer) and Dr Bridget Durning (secondary reviewer). The ES was assessed using a grading system A-F which are used to establish whether the document overall passes or fails the assessment.

11.2 The Assessment Grades are as follows:

A = indicates that the work has generally been well performed with no important omissions
B = is generally satisfactory and complete with only minor omissions and inadequacies
C = is regarded as just satisfactory despite some omissions or inadequacies
D = indicated that parts are well attempted but, on the whole, just unsatisfactory because of omissions or inadequacies
E = Not satisfactory, significant omissions or inadequacies
F = Very unsatisfactory, important task(s) poorly done or not attempted
N/A = Not applicable in the context of the ES or the project

11.3 The results of the assessments are as follows:

Section in proforma	**Overall grade for that section**	**Area where more information required**
1 Description of the development	**B/C**	The description of the development is generally satisfactory and complete. However, there are some omissions or inadequacies relating to raw materials usage, waste arisings and discussions of limitations.
2 Description of the environment	**B/C**	The description of the environment is generally satisfactory and complete. However, there are some omissions or inadequacies relating to addressing uncertainty, assessment of alternatives and need to provide a policy compliance schedule.
3 Scoping, consultation and effect identification	**C**	There are omissions and inadequacies relating to showing where responses to consultation comments have been addressed in ES. Also no

		discussion of hazards and potential for accidents.
4 Prediction and evaluation of effects	**B/C**	The prediction and evaluation of effects is generally satisfactory and complete. However, there are some omissions or inadequacies relating to using more up to date guidance i.e. noise and discussions of consequential impacts.
5 Alternatives	**D**	This section is unsatisfactory because design and size not considered and there is no tabulated comparison of these alternatives.
6 Mitigation and monitoring	**C/D**	Limitations of mitigation measures not explicitly discussed. An overarching EMP needs to be produced that links the CEMP, CoCP and CTMP to STALs ISO14001 EMS.
7 Non-Technical Summary	**B/C**	The NTS is generally satisfactory and complete. However, there is one omission relating to discussion of the confidence which can be placed in the assessment.
8 Organisation and Presentation of information	**C**	The Table of Contents is not adequate and there are no contact details provided in ES.
Overall Grade (A-F)	**C**	**The documentation evaluated is overall graded as C i.e. as just satisfactory despite some omissions and inadequacies.**

11.4 The final grading of the assessment is noted and analysis indicates that the overall grading of C/D is dragged down due to “design and size not considered and there is no tabulated comparison of these alternatives”.

11.5 Regulation 18(3)(d) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 requires an environmental statement to include:

“*a description of the reasonable alternatives studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment*”

11.6 The reviewer has marked this section of the ES down due to “design, technology, location size, and scale, layout of site, management arrangements” not being considered.

11.7 The proposal is for a throughput of a specific number of passengers and the assessment has been made on that basis. The “Do Minimum”, also known as “Do Nothing”, compared to the “Do Something” or “Development Case” scenarios are the most appropriate assessments to be undertaken. This is noted by the reviewer at section 5.4, but again this has been graded as D with no explanation as to why this grading was reached. However, in respect of comparing the “no action do-nothing” alternative with the proposals at 5.2, this section has been graded C/D with the downgrading attributed to the fact that there is no tabulation of advantages/disadvantages being provided.

11.8 In terms of physical infrastructure such as the RAT and RET, the way in which the runway operates limits the alternative positions and options that can be considered.

11.9 Therefore, it is officer's view that this criterion should be more realistically be graded as C as a minimum. This would result in the overall grading for the ES being B/C – is regarded as generally satisfactory with only some omissions or inadequacies.

11.10 The Assessment included a suggested condition that a comprehensive Environmental Management Plan be linked to the applicant's Environmental Management System (EMS) which is certified under the international standard ISO 4001:2015. However, the EMS would deal with issues controlled by legislation outside of the planning system. Therefore, it is not considered appropriate to impose the recommended condition as this would be duplicating requirements, which is not the role of the planning system.

RECOMMENDATION – CONDITIONAL APPROVAL SUBJECT TO S106 LEGAL OBLIGATION:

(I) The applicant be informed that the Planning Committee would be minded to refuse planning permission for the reasons set out in paragraph (III) unless the freehold owner enters into a binding obligation to cover the matters set out below under Section 106 of the Town and Country Planning Act 1990, as amended by the Planning and Compensation Act 1991, in a form to be prepared by the Assistant Director – Legal and Governance, in which case he shall be authorised to conclude such an obligation to secure the following:

- **i) Noise mitigation – new Sound Insulation Grant Scheme to be introduced (see map attached)**
- **ii) Transport:**
  - **a. Providing capacity and safety improvements OR an equivalent funding for a package for the M11 and associated junctions**
  - **b. Providing funding for a package of transport related improvements for:**
    - **i. Local Roads Network Fund**
    - **ii. Local Bus Network Development Fund**
  - **c. Continue to provide the existing Transport Levy and increase it by the addition of a contribution from every transaction from the Express Set Down (forecourt) area**
  - **d. Rail users discount scheme, with a higher rate of discount and revised eligibility criteria**
  - **e. Revised targets for public transport mode share and 'Kiss and Fly' access for passengers and staff access by single occupancy private car with penalty clauses for missed targets**
  - **f. Update and revise working arrangements for the Transport Forum**
  - **g. Updated and revised Airport Surface Access Strategy and Travel Plan production schedule**
  - **h. Commitment to improve bus and coach station**
  - **i. Monitor STAL road network and provide mitigation if required as a result of adverse impacts arising on the local road network**
- **iii) Skills, education and employment – To provide, support and maintain a package of measures to secure local socio-economic benefits:**
  - **a. Airport Employment Academy**
  - **b. Aerozone**
  - **c. Stansted Airport College**
  - **d. Local Supply Chain Support**
- **iv) Ecology – protect and enhance environmentally sensitive sites**

a. Produce and implement a Management and improvement Plan for East End Wood
b. Continue to monitor, and provide mitigation if required as a result of adverse impacts arising, Hatfield Forest
c. Monitoring of water quality of the biological interests of local brooks

v) Public Health and Wellbeing – provide funding for a Community Fund for public health and wellbeing projects (see draft proposals attached)

vi) Payment of monitoring fee

(II) In the event of such an obligation being made, the Assistant Director Planning shall be authorised to grant permission subject to the conditions set out below

(III) If the freehold owner shall fail to enter into such an obligation within a reasonable period of time, the Assistant Director Planning shall be authorised to refuse permission in his discretion anytime thereafter for the non-delivery of:

i) Noise mitigation – new Sound Insulation Grant Scheme to be introduced

ii) Transport:
a. Providing capacity and safety improvements OR an equivalent funding for a package for the M11 and associated junctions
b. Providing funding for a package of transport related improvements for:
i. Local Roads Network Fund
ii. Local Bus Network Development Fund
c. Continue to provide the existing Transport Levy and increase it by the addition of a contribution from every transaction from the Express Set Down (forecourt) area
a. Rail users discount scheme, with a higher rate of discount and revised eligibility criteria
b. Revised targets for public transport mode share and 'Kiss and Fly' access for passengers and staff access by single occupancy private car with penalty clauses for missed targets
c. Update and revise working arrangements for the Transport Forum
d. Updated and revised Airport Surface Access Strategy and Travel Plan production schedule
e. Commitment to improve bus and coach station

iii) Skills, education and employment – To provide, support and maintain a package of measures to secure local socio-economic benefits:
a. Airport Employment Academy
b. Aerozone
c. Stansted Airport College
d. Local Supply Chain Support

iv) Ecology – protect and enhance environmentally sensitive sites
a. Produce and implement a Management and improvement Plan for East End Wood
b. Continue to monitor, and provide mitigation if required as a result of adverse impacts arising, Hatfield Forest
c. Monitoring of water quality of the biological interests of local brooks

v) **Public Health and Wellbeing – provide funding for a Community Fund for public health and wellbeing projects**

Conditions:

STAL is accepting of the conditions, and in particular the pre-commencement conditions as per the Town and Country Planning (Pre-commencement Conditions) Regulations 2018.

1. The development hereby permitted shall be begun before the expiration of 3 years from the date of this decision.

   REASON: To comply with the requirements of Section 91 of the Town and Country Planning Act 1990 as amended by Section 51 of the Planning and Compulsory Purchase Act 2004.

2. Prior to reaching 35mppa and following consultation with the Environment Agency a scheme for the provision and implementation of water resource efficiency measures, during the operational phases of the development shall be submitted to and agreed, in writing, with the Local Planning Authority. The scheme shall include a clear timetable for the implementation of the measures in relation to the operation of the development. The scheme shall be implemented and the measures provided and made available for use in accordance with such timetables as may be agreed..

   The scheme shall include the identification of locations for sufficient additional water meters to inform and identify specific measures in the strategy. The locations shall reflect the passenger, commercial and operational patterns of water use across the airport:

   REASON: In order to secure a sustainable form of development, as set out in paragraph 150 of the National Planning Policy Framework and Policy GEN2(e) of the Uttlesford Local Plan (adopted 2005).

3. Prior to the commencement of construction works, a Construction Environmental Management Plan shall be submitted to and approved in writing by the local planning authority. The construction works shall subsequently be carried out strictly in accordance with the approved CEMP, unless otherwise agreed in writing.

   The CEMP must incorporate the findings and recommendations of the Environmental Statement and must incorporate the following plans and programmes:.

   (a) External Communications Plan
      (i) External communications programme
      (ii) External complaints procedure
   (b) Pollution Incident Prevention and Control Plan
      (i) Identification of potential pollution source, pathway and receptors
      (ii) Control measures to prevent pollution release to water, ground and air (including details of the surface/ground water management plan)

(iii) Control measures for encountering contaminated land
(iv) Monitoring regime
(v) Emergency environmental incident response plan
(vi) Incident investigation and reporting
(vii) Review/change management and stakeholder consultation

(c) Site Waste Management Plan
(i) Management of excavated materials and other waste arising
(ii) Waste minimisation
(iii) Material re-use

(d) Nuisance Management Plan (Noise, Dust, Air Pollution, Lighting)
(i) Roles and responsibilities
(ii) Specific risk assessment – identification of sensitive receptors and predicted impacts
(iii) Standards and codes of practice
(iv) Specific control and mitigation measures
(v) Monitoring regime for noise

(e) Management of Construction Vehicles
(i) parking of vehicles of site operatives
(ii) routes for construction traffic

REASON: To protect amenity of neighbouring properties and in the interests of highway safety, in accordance with Uttlesford Local Plan Policies GEN1, GEN2, GEN4, ENV11 (adopted 2005).

4. Prior to commencement of the development, a detailed surface water drainage scheme for the airfield works hereby approved based on the calculated required attenuation volume of 256m^3,must be submitted to and approved in writing by the local planning authority. The scheme must be implemented in accordance with the approved details as part of the development, and should include but not be limited to:

- Detailed engineering drawings of the new or altered components of the drainage scheme.
- A final drainage plan which details exceedance and conveyance routes, and location and sizing of any drainage features.
- A written report summarising the scheme as built and highlighting any minor changes to the approved strategy.

REASON: To prevent surface water flooding both on- and off-site, in accordance with the National Planning Policy Framework. This condition must be 'pre-commencement' to ensure that the development is only carried out in accordance with the above details.

5. A Biodiversity Management Strategy (BMS) in respect of the translocation site at Monks Farm shall be submitted to, and approved in writing by, the local planning authority prior to the commencement of construction works.

The content of the BMS shall include the following:

- Description and evaluation of features to be managed
- Ecological trends and constraints on site that might influence management
- Aims and objectives of management
- Appropriate management options for achieving aims and objectives
- Prescriptions for management actions

- Preparation of a work schedule (including an annual work plan capable of being rolled forward over a five year period)
- Details of the body or organisation responsible for implementation of the Strategy
- Ongoing monitoring and remedial measures

The Strategy shall also set out (where the results from monitoring show that conservation aims and objectives of the BMS are not being met) how contingencies and/or remedial action will be identified, agreed and implemented so that the development still delivers the fully functioning biodiversity objectives of the originally approved scheme. The approved Strategy will be implemented by the developer in accordance with the approved details.

REASON: To conserve protected and priority species and allow the Local Planning Authority to discharge its duties under the UK Habitats Regulations 2017, the Wildlife and Countryside Act 1981 as amended, and Policy GEN7 of the Uttlesford Local Plan (adopted 2005) and the NPPF.

6. All ecological mitigation and enhancement measures and/or works shall be carried out in accordance with the details contained in the Stansted – Ecology Mitigation Strategy (RPS, February 2018) forming part of the ES Appendix 16.2 to the satisfaction of the local planning authority.

REASON: To conserve and enhance protected and priority species and allow the Local Planning Authority to discharge its duties under the UK Habitats Regulations, the Wildlife and Countryside Act 1981 as amended and s40 of the NERC Act 2006 (Priority habitats and species) and s17 Crime and Disorder Act 1998, and in accordance with Policy GEN7 of the Uttlesford Local Plan (adopted 2005) and the NPPF.

7. The area enclosed by the 57dB(a) Leq, 16h (0700-2300) contour shall not exceed 33.9 sq km for daytime noise.

By the end of the first calendar year that annual passenger throughput exceeds 35million, or by 31 December 2024, whichever is the sooner, a strategy shall be submitted to, and agreed with, the local planning authority, which defines the measures to be taken by STAL or any successor or airport operator to reduce the area of the noise contour by the end of 2028 for daytime noise to 28.7sq km for the area exposed to 57dB(A) Leq 16h (0700-2300). Thereafter, from 2029, the area enclosed by the 57dB(A) Leq 16hr (0700-2300) contour shall not exceed 28.7sqkm for daytime noise.

REASON: In the interests of protecting the amenity of local residents, in accordance with Uttlesford Local Plan Policy ENV11, and in accordance with the principle of the aviation industry sharing the benefits of improvements to technology with local communities, as set out in the Aviation Policy Framework.

For the purposes of condition 7, the noise contour shall be calculated by the CAA's Environmental Research and Consultancy Department (ERCD) Aircraft Noise Contour (ANCON) model (current version 2.3). (or as may be updated or amended) and using the standardised average mode.

8. The passenger throughput at Stansted Airport shall not exceed 43 million passengers in any 12 calendar month period. From the date of this permission, the airport operator shall report the monthly and moving annual total numbers of

passengers in writing to the local planning authority no later than 28 days after the end of the calendar month to which the data relate.

REASON: To ensure the predicted effects of the development are not exceeded, in accordance with policies in the Uttlesford Local Plan and the NPPF.

9. There shall be at Stansted Airport a limit on the number of occasions on which aircraft may take-off or land at Stansted Airport of 274,000 Air Transport Movements during any 12 calendar month period, of which no more than 16,000 shall be CATMs (Cargo Air Transport Movements). From the date of the granting of planning permission, the developer shall report the monthly and moving annual total numbers of Aircraft Movements, PATMs (Passenger Air Transport Movements) and CATMs in writing to the local planning authority no late than 28 days after the end of the calendar month to which the data relate.

REASON: To protect the amenity of residents who live near the airport and who are affected by, or may be affected by aircraft noise, in accordance with Uttlesford Local Plan Policy ENV11 (adopted 2005) and to ensure the predicted effects of the development are not exceeded.

For the purposes of condition 9, the limit shall not apply to aircraft taking off or landing in any of the following circumstances:

a) the aircraft is required to land at the airport because of an emergency, a divert or any other circumstance beyond control of the operator and commander of the aircraft; and
b) the aircraft is engaged on the Head of State's flight, or on a flight operated primarily for the purposes of the transport of government Ministers or visiting Heads of State or dignitaries from abroad.

10. Within 6 months from the date of this permission a scheme for the installation of electric vehicle charging points at the airport shall be submitted to and approved in writing by the local planning authority. The scheme shall indicate the numbers, locations and programme for installation. Subsequently, the charging points shall be installed in accordance with the approved details and retained thereafter.

REASON: To ensure adequate mitigation measures are in place to address the predicted increase in air pollution as a result of the development, in accordance with paragraph 181 of the NPPF.