Department for Environment Food & Rural Affairs

Emissions Factors Toolkit v12.1

User Guide

August 2024

The Scottish Government
Riaghaltas na h-Alba

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

Llywodraeth Cymru
Welsh Government

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Change Log

Version	Date	Details of Changes Made
1	November 2023	Released with EFT v12.0
2	August 2024	Released with EFT v12.1

Table of Contents

Introduction 1

The Emissions Factors Toolkit (EFT) 2

About the EFT 2

Details of the Current EFT (Version 12.1) 5

Details of Historic Versions of the EFT 9

Using the EFT 18

Basic Operation 18

Advanced Options 27

Glossary and Definitions 36

Local Air Quality Management Helpdesk 38

Appendices 39

Appendix A: Calculation Procedure 39

Appendix B: EFT Process Map 40

Appendix C: Data Sources 41

Appendix D: EFT Vehicle Types 42

Introduction

This road traffic Emissions Factors Toolkit (EFT) user guide has been compiled by Bureau Veritas in the role of Project Manager for the Local Air Quality Management (LAQM) Helpdesk and should be used in conjunction with Version 12.1 of the Toolkit.

The EFT is published by Defra and the Devolved Administrations to assist local authorities in carrying out Review and Assessment of local air quality as part of their duties under the Environment Act 1995[1]. It is of particular interest for use in the assessment of measures implemented as part of LAQM Air Quality Action Plans (AQAPs), and policy interventions on road traffic emissions, such as the Clean Air Zones (CAZs) and other measures, that form part of the UK national plan on compliance with Air Quality Standards[2]. It is a tool that allows users to calculate road vehicle pollutant emission rates for oxides of nitrogen (NO_x) and particulate matter (PM - PM_{10} and $PM_{2.5}$), for a specified year, road type, vehicle speed and vehicle fleet composition. Carbon dioxide (CO_2) exhaust emission rates can also be calculated for petrol, diesel and alternative fuelled vehicles, with additional output provided for calculation of non-exhaust CO_2 equivalent (CO_2e) emissions related to the charging of electric and plug-in hybrid vehicles.

The purpose of this user guide is to explain in detail the methodology, datasets and assumptions used in the development of the EFT, and to provide guidance on its use. This user guide also consolidates information regarding previous versions of the EFT, their main changes and updates that have occurred over time.

[1] https://www.legislation.gov.uk/ukpga/1995/25/contents

[2] https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017

The Emissions Factors Toolkit (EFT)

About the EFT

The latest EFT can be downloaded from the LAQM website[3]. It provides fleet projections and emission rates for 2018 through to 2050 for England (not London), London, Northern Ireland, Scotland and Wales. Supporting LAQM tools (e.g. Background Mapping Data[4], NO_2 Adjustment for NO_x Sector Removal Tool[5], and the NO_x to NO_2 Calculator[6]) currently only support assessment years 2018-2030 inclusive. Therefore, where EFT calculated emissions are to be used after 2030 to inform air quality assessments, the appropriate caveats around the limitations of the analysis must be included to accompany the assessment.

The EFT takes into consideration the following information available from the National Atmospheric Emissions Inventory (NAEI)[7] and as provided by Transport for London (TfL) bespoke for London[8]:

- Fleet composition data for motorways, urban and rural roads in the UK.
- Euro composition based on European emission standards from pre-Euro I to Euro 6/VI (including Euro 6 subcategories).
- Vehicle size distributions.
- Scaling factors reflecting improvements in the quality of fuel and some degree of retrofitting.
- Technology conversions in the national fleet.

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[3] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

[4] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/background-maps/

[5] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/no2-adjustment-for-nox-sector-removal-tool/

[6] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

[7] https://naei.beis.gov.uk/

[8] Personal comms, March 2023.

- Primary NO_2 (f-NO_2) emission factors for road transport.

The EFT can be used to provide the following information:

- Emission rates as g/km/s, g/km, or kg(or tonnes)/year from the total traffic for NO_x, PM_{10}, $PM_{2.5}$ and CO_2.

- Calculation of PM_{10} and $PM_{2.5}$ from tyre and brake wear, and road abrasion emission sources.

- Source apportionment for Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs), or individual vehicle classes. This includes a breakdown of emissions for conventional (i.e. internal combustion engine), hybrid, electric and other alternative technology vehicles for the UK (depending on user information).

- Calculation of annual emissions in kg/yr for each vehicle type and Euro Emission Standard for NO_x, PM_{10} and $PM_{2.5}$, and annual emissions in tonnes/yr for exhaust CO_2.

- Calculation of non-exhaust CO_2 equivalent (CO_2e) emissions associated with the charging of batteries from plug-in electric vehicles. This accounts for charging emissions from battery electric cars, battery electric light goods vehicles (LGVs), plug-in hybrid cars and plug-in hybrid LGVs.

- Calculation of the fraction of primary NO_2 emissions (f-NO_2) for the provided input data.

Several 'Advanced Options' are also provided on the ‘Input Data’ sheet to allow the Advanced Users to modify the underlying Base fleet data assumptions applied within the tool and produce corresponding emissions outputs. This includes the ability for users to:

- Define bespoke Base fleet data to be applied across all links.

- Define bespoke Euro fleet data to be applied across all links.

- Project an observed Euro fleet baseline composition (e.g. from an Automatic Number Plate Recognition (ANPR) local traffic survey or similar) to a future assessment year.

All EFT calculations are based on the defined fleet composition for a given year (2018 to 2050), road type (i.e. urban, rural, motorway) and Area (i.e. England (not London), London, Northern Ireland, Scotland and Wales). The calculations procedure for generating the vehicle emissions in g/km, g/km/s and kg/year or tonnes/year can be found in Appendix A: Calculation Procedure, whilst an EFT process map can be found in Appendix B: EFT Process Map.

The EFT supports 41 unique vehicle categories, a full list of which is summarised below.

Petrol Cars	Petrol Hybrid Cars	Petrol Plugin Hybrid Cars
Diesel Cars	Diesel Hybrid Cars	Electric Cars
Petrol Taxis (black cabs)	Petrol Hybrid Taxis (black cabs)	Diesel Taxis (black cabs)
Electric Taxis (black cabs)	Petrol LGVs	Petrol Hybrid LGVs
Petrol Plugin Hybrid LGVs	Diesel LGVs	Electric LGVs
Rigid HGVs	Electric Rigid HGVs	Artic HGVs
Electric Artic HGVs	Conventional Buses	Hybrid Buses
Electric Buses	Biogas Buses	Conventional Coaches
Hybrid Coaches	Electric Coaches	Biogas Coaches
Conventional TfL Buses	Hybrid TfL Buses	Electric TfL Buses
Biogas TfL Buses	Motorcycles (Petrol & Electric)	E85 Bioethanol Cars
LPG Cars	E85 Bioethanol LGVs	LPG LGVs
Biodiesel Rigid HGVs	Biodiesel Artic HGVs	Biodiesel Bus
Biomethane Bus	Biodiesel Coaches	

It should be noted that not all vehicle types listed above are included in the base vehicle fleet data, and the ability for users to define their proportions is dependent upon the selected Area and Traffic Format; this is discussed further in Basic Operation and Appendix D: EFT Vehicle Types.

Details of the Current EFT (Version 12.1)

Note 1: *Updates to the EFT can include both minor and major changes that may affect the output of the Tool. In order to be confident that your outputs are the most up to date, it is strongly recommended that you use the latest Version/Issue of the Tool.*

Defra and the Devolved Administrations have provided an updated Emissions Factors Toolkit (Version 12.1) which replaces all previous versions, which should no longer be used.

The EFT is updated regularly in order to keep it current with the latest available data.

Version 12.1 incorporates the following changes relative to Version 12.0.1:

- Bug Fix - Fixed an issue whereby emissions from Diesel Hybrid Cars, Petrol Hybrid Taxis and Electric Taxis may have returned marginally higher emissions than expected in certain scenarios.
- Bug Fix - Fixed an issue regarding the calculation of NOx and CO_2 exhaust emissions for Euro V HDVs equipped with Exhaust Gas Recirculation (EGR) and Selective Catalytic Reduction (SCR) technologies.
- User Interface - Amended headers when selecting ‘All Vehicle Types’ on the Input Data sheet to show ‘E85 Bioethanol Cars’ and ‘E85 Bioethanol LGV’ instead of ‘Biomethane Cars’ and ‘Biomethane LGVs’.
- User Interface - Resolved an issue whereby a message may appear requesting link lengths to be input when selecting either CO_2 pollutant outputs or ‘Annual Link Emissions’ outputs for other pollutants, even when link lengths had been inputted.
- User Interface - Included a new message box to notify users of successful export, along with file location and filename, when using the ‘Export Outputs’ option.

Version 12 incorporates the following changes relative to Version 11:

- Update and extension of the Base Fleet Splits for all areas up until 2050, meaning it is now possible to output emissions up to 2050 for all areas.

- The fleet composition projections included in the tool outside of London were derived from the projections developed from the 2020 version of the National Atmospheric Emissions Inventory (NAEI)[7] programme in March 2022. This used information provided by DfT in December 2021 on future sales and activities of new petrol, diesel and electrically-powered cars and LGVs, combined with future forecasts in traffic (vehicle kilometres) including other vehicle types from DfT's National Transport Model.

- The default fleet assumptions and projections for London have been provided by Transport for London (TfL)[8], and are representative of London-specific policies, including the expansion of the Ultra Low Emission Zone (London-wide ULEZ) from August 2023.

> ***Note 2:*** *It should be noted that different policy assumptions are assumed in the London base fleet relative to the other non-London Areas. Therefore, the emissions output by the EFT for the London Area will differ to those output for the other non-London Areas, for the same data inputs.*

Please note that supporting LAQM tools (e.g. Background Mapping Data[4], NO_2 Adjustment for NO_x Sector Removal Tool[5], and the NO_x to NO_2 Calculator[6]) currently only support assessment years 2018-2030 inclusive. Therefore, where EFT calculated emissions are to be used after 2030 to inform air quality assessments, the appropriate caveats around the limitations of the analysis must be included to accompany the assessment.

- Use of the COPERT v5.6 NO_x and PM speed-based emissions factors, updated from COPERT v5.3, as taken form the European Environmental Agency (EEA) emission calculation tool.

- Update to the methodology for calculating CO_2 exhaust emissions. The updated methodology utilises COPERT v5.6 coefficient equations for Energy Consumption, standard information relating to calorific values of fuels and DfT/National Highways (NH) factors to account for improved engine efficiency up to 2050. The methodology for calculating indirect CO_2e emissions associated with the charging of the batteries of electric and plug-in hybrid cars and LGVs remains consistent with previous EFT versions.

- The emissions factors for PM non-exhaust emissions sources (i.e. from tyre and brake wear, and road abrasion) have been updated in line with information published in the EMEP/EEA Emissions Inventory Guidebook 2019[9].

- Emissions for Taxis (black cabs) can now be calculated in Areas outside of London.

- In the Traffic Format Primary Inputs section, 'Detailed Option 3' has been modified to allow users to define the proportion of Electric Cars within the fleet. 'Detailed Option 4' has been added, which allows users to define the proportion of Petrol/Diesel/Electric LGVs within the fleet (previously this could only be user defined using the 'Euro Compositions' advanced option). The 'All Vehicles' input format replaces the previous 'Alternative Technologies', and now allows users to define the proportions of all vehicle types currently supported by the EFT.

- The previous 'Euro Compositions' and 'Simple Entry Euro Compositions' Advanced Options, which allowed Advanced Users to specify user defined Euro compositions and vehicle size distributions, have been removed. These have been replaced by the 'Bespoke Euro Fleet' Advanced Option, which significantly streamlines the entry of user defined Euro composition and vehicle size distribution information (e.g. it is no longer necessary to enter user defined Euro compositions separately for NO_x and PM/CO_2).

- The Advanced Options 'Output % Contributions from Euro Classes' and '$NO_x/PM_{10}/PM_{2.5}$ Annual Emissions Euro Split' have been removed.

- A new Advanced Option 'Bespoke Base Fleet' has been added. This allows Advanced Users to input User Defined Base fleet data, which will be applied across all links entered as input. This user defined Base fleet data can be entered in formats consistent with data provided on the NAEI website[7] and from the TAG Data Book[10].

- The 'Export Outputs' option no longer requires the user to define a filename. When selected, an output file will be automatically created in the directory where the EFT is saved with the name 'EFTOutput_*date*_*time*.xlsb'.

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[9] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019

[10] https://www.gov.uk/government/publications/tag-data-book

- Other improvements to the front-end Graphical User Interface (GUI) of the ‘Input Data’ sheet. This includes removal of tick-boxes for selection of options, and re-grouping of Input/Output options into revised categories (Primary Inputs, Pollutants, Standard Outputs, Additional Outputs and Advanced Options).

- Improvements to the architecture of the both the excel and VBA sides of the tool. This means the tool is now able to run large datasets more quickly, particularly when utilising advanced options such as the primary fraction of NO_2 tool. This streamlining of the tool also means the file size of the tool has reduced by around 40%.

A list of the data sources used for the development of the current EFT is provided in Appendix C: Data Sources.

Details of Historic Versions of the EFT

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
12.1	July 2024	See above
12.0.1	December 2023	Version 12.0.1 was identical to Version 12.0 except for the following refinement: • Bug Fix - Change related to NO_x and CO_2 emissions from hybrid vehicles at speeds greater than 50 km/h
12.0	July 2023	See above
11.0	November 2021	Version 11 incorporates the following changes from Version 10: • Allows England (not London) users to define Input Years up to 2050 inclusive. 2031-2050 outputs are limited to England (not London) only (see below). Whilst the tool will provide emissions outputs for these years, please note that the input assumptions embedded within the tool for these years may not fully align with those applied for the purposes of NAEI projections. Please also note that supporting LAQM tools, e.g. Background Mapping Data, NO_2 Adjustment for NO_x Sector Removal Tool, and the NO_x to NO_2 Calculator only support assessment years 2018-2030 inclusive. Emissions outputs for the years 2031-2050 are therefore provided in support of climate assessments and appraisals only. Where emissions are to be used after 2030 to inform air quality assessments, the appropriate caveats around the limitations of the analysis must be included to accompany the assessment. Users seeking to run the tool between 2031-2050 will be asked to agree to the terms of use. • Updated basic fleet splits for England to extend the basic fleet data for Motorway, Urban and Rural road types out to 2050. The basic fleet splits are based on data provided by DfT/Highways England;

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		• Engine efficiency adjustment factors have been provided by DfT/HE and applied to exhaust CO_2 emission outputs up to 2050; and • When CO_2 output is selected, link length is required to be input and a notification shown. The CO_2 output creates an Output CO_2 Summary sheet inclusive of direct CO_2 emissions from tailpipe and indirect CO_2e emissions associated with the charging of the batteries of electric and plug-in hybrid cars and LGVs, in tonnes/annum. Within London, the default fleet split assumptions and euro class compositions are still based on bespoke vehicle fleet information and projections for London provided by TfL in early 2018. These datasets are inclusive of the impact from 2019 onwards of the Ultra-Low Emissions Zone (ULEZ) in central London, the TfL bus fleet meeting the ULEZ requirements London-wide in 2020 and all new taxis registered from 2018 onwards being Zero Emissions Capable (ZEC). They do not include the impact of the full ULEZ expansion to the North and South Circular Roads in 2021, nor the tightening of the Low Emission Zone (LEZ) standards for heavier vehicles in 2021. **It should be noted that the default fleet projections in EFT v11.0 are based on fleet growth assumptions which were current before the Covid-19 outbreak in the UK. In consequence, default fleet outputs from the tool do not reflect short- or longer-term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.**
Version 10.0 & 10.1	August 2020	Version 10 incorporates the following changes from Version 9: • Use of the latest COPERT 5.3 NO_x and PM emissions factors, updated from COPERT 5.0. Of note, this results in lower NO_x emissions for Euro 5 and 6 diesel LGVs, along with lower NO_x emissions for motorcycles; • Outside of London, the default fleet split assumptions, vehicle size distributions and Euro class compositions have been updated. These are based on a set of traffic activity projections

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		from the Department for Transport (DfT) (RTF 2018, rebased to 2017 NAEI)[11] and DfT car sale projections (April 2019) including the uptake of low carbon passenger cars and LGVs with electric and hybrid electric propulsion systems; • Updated and simplified Advanced Option 'Fleet Projection Tool'. The two different projection calculation options available in EFT v9 have been simplified into a single, refined projection methodology in line with the previous 'Option 1' method. The user-interface has also been streamlined to align with the typical resolution of information provided by Automatic Number Plate Recognition (ANPR) surveys, e.g. users are now only required to define Euro 6 vehicles as a single input category, without the need to define by individual sub-category (i.e. Euro 6, 6c, 6d), whilst the projected Euro 6 vehicles are split into sub-categories through application of typical proportional splits as embedded within the EFTs default fleet dataset; and • Minor bug fix relating to calculation of primary fraction of NO_2 from buses. Additionally, Version 10.1 incorporates the following changes: • Updated f-NO_2 values based on the latest available 'Primary NO_2 Emission factors for road transport (2020 version)' from the National Air Emissions Inventory (NAEI)[12] • Minor bug fix relating to calculation of primary fraction of NO_2 from buses in London. Within London, the default fleet split assumptions and euro class compositions are still based on bespoke vehicle fleet information and projections for London provided by TfL in early 2018. These datasets are inclusive of the impact from 2019 onwards of the Ultra-Low Emissions

[11] https://www.gov.uk/government/publications/road-traffic-forecasts-2018

[12] https://naei.beis.gov.uk/data/ef-transport

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		Zone (ULEZ)[13] in central London, the TfL bus fleet meeting the ULEZ requirements London-wide in 2020 and all new taxis registered from 2018 onwards being Zero Emissions Capable (ZEC). They do not include the impact of the full ULEZ expansion to the North and South Circular Roads in 2021, nor the tightening of the Low Emission Zone (LEZ) standards for heavier vehicles in 2021. It should be noted that the default fleet projections in EFT v10.1 are based on fleet growth assumptions which were current before the Covid-19 outbreak in the UK. In consequence, default fleet outputs from the tool do not reflect short- or longer-term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.
Version 9.0	May 2019	For Version 9 of the EFT, through close liaison with the NAEI and London Atmospheric Emissions Inventory (LAEI) teams, Road Traffic Emission Projection assumptions for NO_x and PM have undergone technical peer review. Version 9 incorporates: • Updated basic fleet assumptions for 2017-2030 in line with DfT, NAEI and TfL projections; • Updated Euro class compositions for 2017-2030 in line with DfT, NAEI, and TfL data (inclusive of Euro 6 subcategories); • An update to the fraction of exhaust PM_{10} emitted as $PM_{2.5}$ from 0.95 to 1; • Updated fuel scaling factors for PM; • Inclusion of a new Advanced Option 'Simple Entry Euro Compositions' that allows users to input User Defined Euro Classes in a simplified manner; • Inclusion of a new Advanced Fleet Option 'Fleet Projection Tool' that allows users to project their user defined Euro fleet

[13] https://tfl.gov.uk/modes/driving/ultra-low-emission-zone

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		information from a Base Year (e.g. a local Euro fleet derived from Automatic Number Plate Recognition (ANPR) surveys) to a future Projection Year. This option is only available outside of London; • Inclusion of Taxis (Black Cabs) as a vehicle option outside of London; • Inclusion of primary NO_2 fraction (f-NO_2) outputs weighted as a function of road length; • Inclusion of emissions based upon variable road gradient on each link; • Inclusion of emissions based upon variable HDV load on each link; • Inclusion of CO_2 emissions for User Defined Euro Classes, either entered via the Euro Compositions or Simple Entry Euro Compositions 'Advanced Options'.
Version 8.0.1	December 2017	Minor bug fixes and/or enhancements: • Correction on bus and coach split on London roads when entering data using the Alternative Technologies traffic format input option only; • Compatibility with Excel 2007 and 64-bit instances of Excel.
Version 8.0	November 2017	Updated NO_x and PM speed emission coefficient equations, taken form the European Environmental Agency (EEA) COPERT 5 emission calculation tool, including Euro 6 subcategories; Ability for the user to define LGV petrol/diesel percentage split via the Euro Compositions advanced option; Better representation of failure rates of both catalysts and Diesel Particulate Filters (DPFs). The input tables for the Euro Compositions Advanced Option no longer assume failure rates within the presented proportions (default failure rates are subsequently assumed as part of the calculation procedure). Also, when using the Output % Contributions from Euro Classes Advanced Option, the proportion of total emissions

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		attributable to failed catalysts and DPFs is now presented separately within brackets alongside the emissions for each Euro category; New NO_x, PM_{10} and $PM_{2.5}$ Annual Emissions Euro Split Advanced Options added, giving emissions by kg/yr, broken down by vehicle type and Euro emission standard, with contributions from failed catalysts and DPFs again split out; New Advanced Option that allows the user to output the fraction of primary NO_2 emissions (f-NO_2) for the provided input data; Basic fleet assumptions for 2015-2030 updated in line with DfT (2015) projections; Euro class compositions for 2015-2030 updated in line with DfT (2015) projections and TfL data (inclusive of Euro 6 subcategories); The 'Alternative Technologies' Advanced Option has been consolidated into the Traffic Format drop down menu on the Input Data sheet; and Minor bug fixes based upon user feedback on previous version 7.0: • Improved Clear Input Data button reliability on the Input Data sheet; • Added additional checks to validate user inputs to ensure the tool is run correctly.
Version 7.0	July 2016	Updated NO_x and PM speed emission coefficient equations for Euro 5 and 6 vehicles, taken from the European Environment Agency (EEA) COPERT 4v11 emission calculation tool, reflecting more recent evidence on the real-world emission performance of these vehicles; Streamlining of pollutants – removal of Hydrocarbons as an option in the EFT; CO_2 tailpipe emissions associated with alternative fuelled vehicles are included in emissions calculations, in addition to those from petrol and diesel vehicles. The applied CO_2 scaling factors for alternative technology vehicles are consistent with those applied in the LAEI[14]. The ability to output CO_2 when Alternative Technologies advanced user input option is selected has also been added;

[14] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2013

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		Updated fleet composition data, accounting for updates to traffic and fleet projections in London, based on information from TfL. This includes varying fleet data specific to the Central, Inner, Outer and Motorway areas of London; The ability to user define euro compositions individually for the Central, Inner, Outer and Motorway areas of London; The ability to enter up to at least 25,000 rows of input data, or up to 200,000 rows of input data, dependent upon selected output options; Bug fixes based upon user feedback on previous version 6.0.2: • Cosmetic changes to improve user experience, including the addition of a status bar when running the EFT, indicating EFT calculation progress; • User defined London Taxi euro proportions previously being incorrectly processed in emissions calculations; and • CO_2 emissions for buses/coaches in London previously reported as zero.
Issue 6.0.2	November 2014	Minor bug fixes and/or enhancements: • Error related to 100% HDV runtime error; • Error related to Alternative Vehicles Output for g/km/s and Annual Emissions.
Issue 6.0.1	July 2014	Minor bug fixes and/or enhancements: • Error in CO_2 Output: Output now as Tonnes/Year (not Kg/Year); • Traffic Format Selection: Selection of Alternative Technologies Format only allowed when Advanced Option 'Alternative Technologies' is selected; • Header Cells for User Defined Proportions/User Size Distributions are now 'fixed' in the UserEuro sheet when 'Populated With Defaults' and do not change based on Input Data Area/Year.
Version 6.0	June 2014	NO_x emission coefficients for Euro 5 and 6 diesel cars were taken from the EEA COPERT 4v10 emission calculation tool.

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		NO_x emission coefficients for Euro 5 and 6 LGVs (Vans) based on scaling of the diesel car emission factors. Hydrocarbon and PM speed emission equations for all vehicles updated using COPERT 4v10. Fleet composition updated, accounting for: • NAEI changes to uptake rates for newer vehicles and low emission vehicles based on information from DfT on projected sales of new cars and LGVs. • Revised forecasts in the vehicle mix on different road types based on the January 2013 DfT traffic projections (RS2013); • Revisions to traffic and fleet projections in London, based on information from TfL. Scaling factors updated to take into account the effects of changing fuel quality on emission factors, particularly the addition of small amounts of biodiesel and bioethanol at up to 10% strength blends in commercial petrol and diesel fuels. The factors are based on evidence of the effect of biofuels on pollutant emissions reviewed by the NAEI. Bug Fix: • For the 'Detailed Option 3' traffic format, corrected the functionality allowing users to specify the petrol/diesel split when the alternative technologies box is ticked.
Issue 5.2c	January 2013	Added 'Advanced Options' to the Input Data worksheet allowing Advanced Users to provide a User Defined Euro Compositions and Alternative Technologies, and output relative percentage contributions from Euro Classes.
Version 5.1.1	June 2012	Updated NO_x emission factor and vehicle fleet information. NO_x Emission Factors were taken from the EEA COPERT 4v8.1 emission calculation tool. Emission Factors for other pollutants were those published by the DfT on 29 June 2009.
Issue 4.2.2	November 2010	Bug Fix:

EFT Version/Issue	Release Date	Reason for Release/Summary of Changes
		• Bugs were related to PM_{10} and $PM_{2.5}$ emissions due to brake and tyre wear and only affected emissions calculated using the 'Traffic Fleet' option.
Issue 4.2.1	October 2010	Bug Fix: • Bug occurred when modelling specific vehicle classes (e.g. buses only).
Issue 4.2	June 2010	Updated version included advanced options for User Defined Traffic Fleet and Euro Composition information.
Version 4.1	February 2010	Updated vehicle exhaust emission factors based on DfT emissions factors published on 29th June 2009. Also included brake and tyre wear for PM_{10} and $PM_{2.5}$.

Local Authorities are not required to redo any work already carried out using previous versions but are advised to use the latest version for all future work.

Using the EFT

In order to use the EFT, you must enable macros in your MS Excel security settings before opening the spreadsheet.

Basic Operation

1. Go to the **Input Data** sheet using the tabs at the bottom of the workbook.

2. In the **Pollutants** box, select the pollutants for which you require emissions information.

Pollutants	Selected
NO_x	Y
PM_{10}	
$PM_{2.5}$	
CO_2	

Note 3: *Selecting CO_2 will provide the direct CO_2 emissions from tailpipes on the 'Output' sheet, consistent with all other user Input/Output options.*
Indirect CO_2e emissions associated with the charging of plug-in vehicles, relative to their fleet proportion and vehicle kilometres (vkm) travelled, are provided on the 'Output CO_2 Summary' sheet. This includes emissions from the charging of batteries from electric and plug-in hybrid electric vehicles (Cars and LGVs).
The 'Output CO_2 Summary' sheet also gives a breakdown of total CO_2 emissions for all links, per link and per vehicle type disaggregated by tailpipe emissions and emissions from charging. Aggregated outputs are provided for all vehicles and links entered in the input data and disaggregated for Battery Electric Cars, Battery Electric LGVs, Plug-in Hybrid Cars and Plug-in Hybrid LGVs.
Link length is a required input when selecting the CO_2 option.

3. In the **Standard Outputs** box, select your required output from the following categories:

Standard Outputs	Selected
Air Quality Modelling (g/km/s)	
Emissions Rates (g/km)	
Annual Link Emissions	
At least 1 must be selected	

Air Quality Modelling	Selecting this option provides outputs as total emissions as g/km/s for the pollutant(s) selected.
Emission Rates	Selecting this option provides outputs as total emissions as g/km for the pollutant(s) selected.
Annual Link Emissions	Selecting this option generates emissions of each pollutant per year for each road link in kg/yr for all pollutants with the exception of CO_2, which is in tonnes/yr. This option requires the length of each link to be specified.

4. In the **Additional Outputs** box, select your required output from the following categories:

Breakdown by Vehicle	All output options above are provided for each vehicle type on the road link for the possible 41 vehicle categories within the EFT, which include conventional (i.e. internal combustion engine), hybrid, electric and alternative technology vehicle types. If you specify the Basic Split option, then the emissions are based entirely on the vehicle fleet composition embedded in the EFT.
Source Apportionment	Selecting this option provides the relative percentage contribution from the specified vehicle types for the pollutant(s) selected.

PM by Source	Selecting this option generates a separate output sheet showing the proportion of particulate emissions from Exhaust, Brake, Tyre and Road Abrasion.
Primary NO_2 Fraction	Selecting this option allows the user to output the fraction of primary NO_2 emissions (f-NO_2) for the provided input data. Results are output on the 'Output_f-NO2' sheet, with f-NO_2 values provided at the individual link level and also as an average weighted or not weighted by link length according to the contribution each vehicle type makes to total NOx emissions from traffic associated with all links entered as input. Weighted averages are provided relative to the link lengths only if entered by the user for all links. The output results are representative of the full set of road links as entered on the Input Data sheet, inclusive of any user defined information as entered using the Bespoke Euro Fleet Advanced Option. Where users consider the EFT calculated f-NO_2 outputs to be representative of the study area, these values can be used in place of provided default values, e.g. in the NO_x to NO_2 Calculator[6]. The f-NO_2 values for each vehicle type that are employed as part of the calculation are consistent with those applied on the NAEI[7].
Export Outputs	Selecting this option will save the output in a new workbook. The file will be generated in the same directory as where the EFT is saved. The file is the same as that generated in the Output sheet with the name 'EFTOutput_*date_time*.xlsb'.

5. In the **Primary Inputs** box, enter the **Area**. This incorporates area specific information from detailed traffic surveys on fleet composition. The areas available are:
    a. England (Not London).
    b. London.
    c. Northern Ireland.
    d. Scotland.
    e. Wales.

6. In the **Primary Inputs** box, enter the **Year** for which you wish to predict emissions. The years 2018 to 2050 inclusive can be selected for all Areas.

7. In the **Primary Inputs** box, select the **Traffic Format** which aligns with the resolution of your available input data, using the drop-down box:

Primary Inputs	
Area	England (not London)
Year	2019
Traffic Format	Basic Split
All must be selected	

Basic Split	Assumes standard fleet composition for the selected road type, with specified %HDV (HGV and buses/coaches).
Detailed Option 1	Allows fleet input by %Car, %Taxi (black cab), %LGV, %HGV, %Bus and Coach, %Motorcycle.
Detailed Option 2	Allows fleet input by %Car, %Taxi (black cab), %LGV, %Rigid HGV, %Articulated HGV, %Bus and Coach, %Motorcycle.
Detailed Option 3	Allows fleet input by %Petrol Car, %Diesel Car, %Electric Car, %Taxi (black cab), %LGV, %Rigid HGV, %Articulated HGV, %Bus and Coach, %Motorcycle.
Detailed Option 4	Allows fleet input by %Petrol Car, %Diesel Car, %Electric Car, %Taxi (black cab), % Petrol LGV, %Diesel LGV, %Electric LGV, %Rigid HGV, %Articulated HGV, %Bus and Coach, %Motorcycle
All Vehicle Types	Allows users to input fleet data for All Vehicle types supported by the EFT (see 'About the EFT'). A full description of each type is available in the Glossary and Definitions table.

To further assist users in the selection of the appropriate **Traffic Format**, Appendix D: EFT Vehicle Types summarises the Vehicle Types that can be user defined, and within which corresponding input category (e.g. Car, LDV, etc), as a function of the selected **Area** (i.e. England (not London), London, Northern Ireland, Scotland, Wales) and **Traffic Format** (Basic Split, Detailed Option 1, Detailed Option 2, Detailed Option 3, Detailed Option 4, All Vehicle Types). It also details the Vehicle Types that are included within the EFT Base Fleet datasets.

Note 4: *Taxi refers to Black Cabs or 'Hackney Cabs'. Fleet information for Taxis can be entered for any selected Area, however the following considerations/key assumptions should be borne in mind when including Taxis in the EFT:*

- *This option should not be used to represent Minicabs or Uber vehicles. These vehicles should be included within the corresponding Car vehicle proportion(s).*
- *When using the EFT in Basic Split mode, a proportion of Taxis will be included within the vehicle fleet for the different road types of London. In areas outside of London, the NAEI vehicle fleet data does not include a proportion assigned to Taxis, therefore the user has to specify a proportion of Taxis within the fleet, otherwise Taxi emissions will not be output in Basic Split mode.*
- *Emissions for Diesel LGV N1(III) have been used to represent vehicles assigned as Taxis both inside and outside of London, and emissions for Euro 6 Petrol LGV N1 (III) has been used to represent Taxis that are Zero Exhaust Emission Vehicles (ZEEVs) both inside and outside of London.*
- *There is no engine failure rate available for Taxis. It is assumed that no proportion of any Taxis will emit at a higher rate than the assigned Euro class. Due to policies governing upkeep and vehicle age of licensed Taxis engine failure is less likely, therefore engine failure for Taxis is not accounted for within the EFT.*

8. Under the header **SourceID** enter a name for each of your road links (this can be anything you like). You can enter up to at least 25,000 road links, or up to 200,000 road links, dependent upon selected output options. The input SourceID doesn't have to be unique, although if there are duplicate names and the data are to be used in detailed dispersion modelling, this may cause errors.

9. Under the **Road Type** header, select a road type from the following list:

Urban (Not London)	Use this option for roads that are not motorways or similarly fast flowing roads in urban areas (by the DfT definition of an urban area with a population of 10,000 or more).
Rural (Not London)	Use this option for roads that are not motorways or similarly fast flowing roads outside urban areas.
Motorway (Not London)	Use this option for motorways and fast dual carriageways.
London – Central	Use this option for roads in 'Central London' as defined in the LAEI[15], which corresponds to the same area as the Central London Congestion Charge Zone (CCZ) implemented in February 2003.
London – Inner	Use this option for roads in 'Inner London' as defined in the LAEI[15]. This includes roads outside of the Central London CCZ up to, but not including, the north and south circular roads.
London – Outer	Use this option for roads in 'Outer London' as defined in the LAEI[15]. This includes roads from the north and south circular roads to the GLA boundary.
London – Motorway	Use this option for the M25 motorway only. Other motorways and fast dual carriageways in Greater London should be defined as either 'London – Inner' or 'London – Outer' as appropriate.

Please note that different policy assumptions are assumed in the London base fleet relative to the other non-London Areas. Therefore, the emissions output by the EFT for the London Area and associated Road Types will differ to those output for the equivalent Road Type in other non-London Areas, for the same data inputs.

[15] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019

Note 5: *The urban categorisation relates to the DfT definition of an urban area with a population of 10,000 or more. The London road types use the area categories defined in the LAEI*[15]*.*

10. Under **Traffic Flow** header, enter the number of vehicles on each road link. This will usually be vehicles per day (i.e. AADT (Annual Average Daily Traffic) flow) but can be any time period up to one day (24-hours).

11. Enter the percentage of the total traffic flow of each vehicle type in the categories depending on the **Traffic Format** selected. If a vehicle category has no vehicles – a '0' must be entered. The sum of all categories must be equal to 100 for the EFT to run.

12. Under the **Speed (kph)** header, enter the average traffic speed on each road link (this should relate to the same time period as the Traffic Flow). This can be between 5kph and 140kph. Where the maximum possible speed for a vehicle defined within emissions functions is below the specified speed, the emissions for the maximum speed in the range designated for that vehicle's emission factors will be used. Similarly, where the speed entered is below the minimum speed allowed for that vehicle type, the minimum will be assumed[16].

13. Under the **No of Hours** header, enter the time period used for the Traffic Flow (for example, if you entered the number of vehicles per day, this will be 24; but if you entered the number of vehicles per hour, this will be 1).

14. Under the **Link Length (km)** header enter the length of each road link. This is only required if the **Annual Link Emissions, Primary NO_2 Fraction** (see Advanced Options on page 27) or **CO_2 Pollutant** options have been selected.

15. Under the **% Gradient** header, a positive gradient between 0.1% and 30% can be entered, e.g. for a 3.5% gradient a value of 3.5 should be entered. It should be noted that whilst users can enter gradient values up to 30%, the impact on emissions is

[16] Please consult the Data Sources provided in Appendix C for more information.

capped at a 6% gradient, i.e. if the user enters a gradient above 6%, the output emission will be equivalent to a 6% gradient. A gradient should only be entered if HDV emissions on links with variable road gradients are being considered. If the gradient field is left blank, the EFT will assume that the road link has a gradient equal to 0%, i.e. no gradient – consistent with previous versions of the EFT.

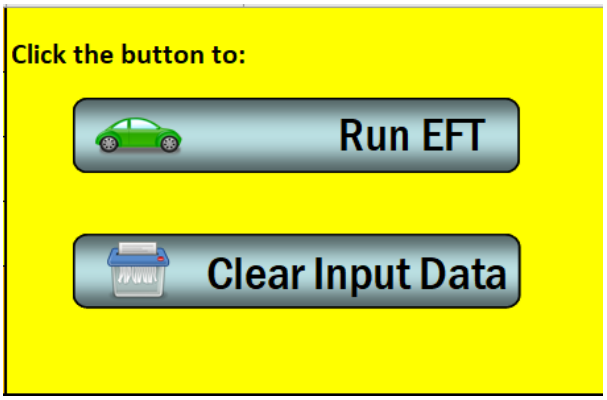
16. If a gradient value has been entered, then under the **Flow Direction** header a selection of either Up Hill, Down Hill or Two-Way Traffic should be made in accordance with the road link entered. Where Two Way Traffic is selected, the EFT will assume 50% of the vehicle flow as inputted for that road link is travelling Up Hill, and 50% is travelling Down Hill. If assuming no gradient, i.e. a gradient value of 0%, there is no need to enter a value under the Flow Direction header; however, if one is entered, this will not affect the output emission.

17. Under the **% Load** header a percentage load weighting of either 0%, 50% or 100% for HDV vehicles can be entered. A load weighting percentage should only be entered if calculating HDV emissions on links with variable loads. If the load field is left blank, the EFT will assume a load equal to 50% – consistent with previous versions of the EFT.

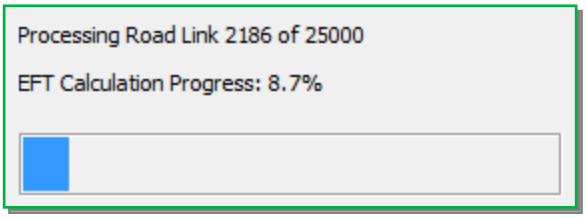
18. If you require the output to be saved in a new workbook, select Export Outputs in the Additional Outputs section. The file will be generated in the directory where you have saved the EFT with the name 'EFTOutput_*date*_*time*.xlsb'.

Additonal Outputs	Selected
Breakdown by Vehicle	
Source Apportionment	
PM by Source	
Primary NO_2 Fraction	
Export Outputs	Y

19. Click on **Run EFT** to run the calculations, or **Clear Input Data** to recommence data entry.



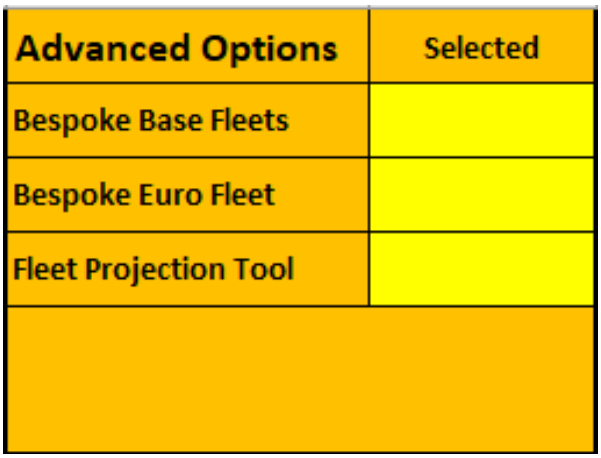
20. Upon running the EFT, a status bar will be displayed indicating EFT calculation progress.



21. When calculations are complete, you will automatically be taken to the **Output** sheet of the workbook, where the requested emission information for each SourceID and pollutant will be displayed.

Advanced Options

The following Advanced Options have been added to the EFT to provide greater choice in input options so that a user can more accurately represent the situation in their locality or test the impact of proposed intervention measures. It is recommended that these features are only used by experienced air quality practitioners. If you are unfamiliar with using vehicle emissions factors and are not comfortable with the underlying methodology and limitations of these features, their use is not recommended as results may be misinterpreted. Further information can be obtained from the LAQM Helpdesk at https://laqm.defra.gov.uk/helpdesk/.



Advanced Options	Selected
Bespoke Base Fleets	
Bespoke Euro Fleet	
Fleet Projection Tool	

- *Bespoke Base Fleets*

This option allows users to input User Defined Base fleet data, which will be applied across all links entered as input. This user defined Base fleet data can be entered in formats consistent with data provided on the NAEI website[7] and from the TAG Data Book[10] (Table A1.3.9). This may, for example, be useful for testing policy based scenarios.

The following procedure should be followed:

1. In the **Advanced Options** box of the **Input Data** sheet select **Bespoke Base Fleet** and select either **NAEI** or **TAG Data Book** split. Dependent upon the selected format, the relevant **Bespoke Base Fleet** sheet will be made visible, then read and click ‘OK’ on the pop-up notification.

2. Go to the **Bespoke Base Fleet** sheet that is generated.

3. Depending upon the selected **Bespoke Base Fleet Format** users can define Bespoke Base Fleet data proportions for the following vehicle categories:

NAEI Vehicle Split	TAG Data Book Vehicle Split
• Cars (Conventional Petrol / Hybrid Petrol / Plugin Hybrid Petrol / Diesel / Hybrid Diesel / Electric) • LGVs (Petrol / Diesel / Electric) • Taxi • Rigid HGV • Articulated HGV • Buses & Coaches • Motorcycles	• Cars • LGVs (Light Goods Vehicles) • OGV1 (Rigid Heavy Goods Vehicles up to 26 tonnes) • OGV2 (Rigid Heavy Goods Vehicles over 26 tonnes, and Articulated Heavy Goods Vehicles) • PSV (Public Service Vehicles)

- *TAG Bespoke Fleet*

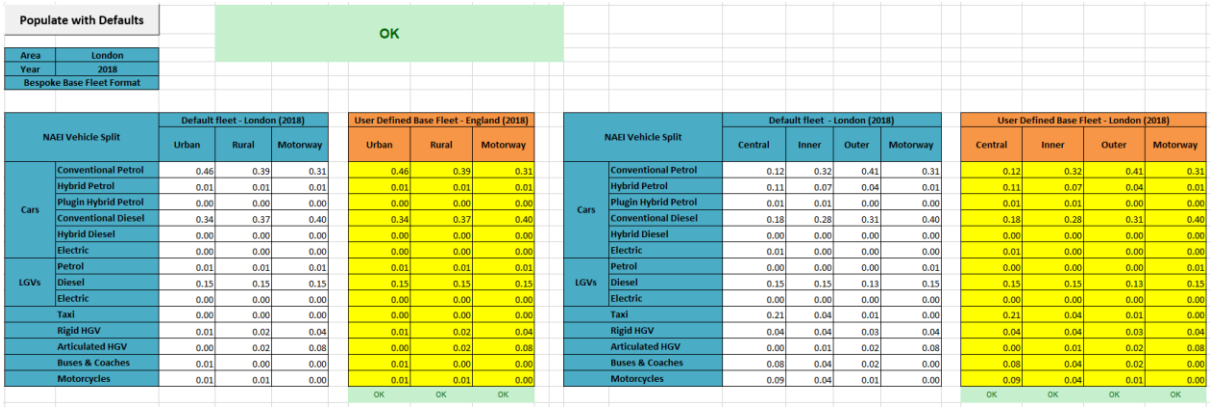
1. If using the TAG Bespoke Fleet sheet, the yellow boxes are to be populated using data in a format consistent with Table A1.3.9 of the TAG Data Book[10]. The proportions in each category of vehicles (Cars, LGV, OGV1, OGV2 and PSV) should always add up to 1 (100%). The text at the end of each column confirms whether the proportions add up to 1 (OK).

Year	2018		OK								
Cars			LGV			OGV1		OGV2		PSV	
Petrol	Diesel	Electric	Petrol	Diesel	Electric	Diesel	Electric	Diesel	Electric	Diesel	Electric
49%	36%	15%	2%	96%	2%	100%	0%	100%	0%	84%	16%
	OK			OK		OK		OK		OK	

An error message (Not equal to 1) will be shown if proportions in all yellow boxes do not add up to 1 and the EFT will not run.

- *NAEI Bespoke Fleet*

1. Users are advised to populate the blue boxes with the default Base fleet information first by clicking the '**Populate With Defaults**' button before manually editing the yellow boxes for those vehicle types they wish to alter.



Populate with Defaults

OK

Area	London
Year	2018
Bespoke Base Fleet Format	

NAEI Vehicle Split		Default fleet - London (2018)			User Defined Base Fleet - England (2018)		
		Urban	Rural	Motorway	Urban	Rural	Motorway
Cars	Conventional Petrol	0.46	0.39	0.31	0.46	0.39	0.31
	Hybrid Petrol	0.01	0.01	0.01	0.01	0.01	0.01
	Plugin Hybrid Petrol	0.00	0.00	0.00	0.00	0.00	0.00
	Conventional Diesel	0.34	0.37	0.40	0.34	0.37	0.40
	Hybrid Diesel	0.00	0.00	0.00	0.00	0.00	0.00
	Electric	0.00	0.00	0.00	0.00	0.00	0.00
LGVs	Petrol	0.01	0.01	0.01	0.01	0.01	0.01
	Diesel	0.15	0.15	0.15	0.15	0.15	0.15
	Electric	0.00	0.00	0.00	0.00	0.00	0.00
Taxi		0.00	0.00	0.00	0.00	0.00	0.00
Rigid HGV		0.01	0.02	0.04	0.01	0.02	0.04
Articulated HGV		0.00	0.02	0.08	0.00	0.02	0.08
Buses & Coaches		0.01	0.00	0.00	0.01	0.00	0.00
Motorcycles		0.01	0.01	0.00	0.01	0.01	0.00
					OK	OK	OK

NAEI Vehicle Split		Default fleet - London (2018)				User Defined Base Fleet - London (2018)			
		Central	Inner	Outer	Motorway	Central	Inner	Outer	Motorway
Cars	Conventional Petrol	0.12	0.32	0.41	0.31	0.12	0.32	0.41	0.31
	Hybrid Petrol	0.11	0.07	0.04	0.01	0.11	0.07	0.04	0.01
	Plugin Hybrid Petrol	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00
	Conventional Diesel	0.18	0.28	0.31	0.40	0.18	0.28	0.31	0.40
	Hybrid Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Electric	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
LGVs	Petrol	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	Diesel	0.15	0.15	0.13	0.15	0.15	0.15	0.13	0.15
	Electric	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taxi		0.21	0.04	0.01	0.00	0.21	0.04	0.01	0.00
Rigid HGV		0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04
Articulated HGV		0.00	0.01	0.02	0.08	0.00	0.01	0.02	0.08
Buses & Coaches		0.08	0.04	0.02	0.00	0.08	0.04	0.02	0.00
Motorcycles		0.09	0.04	0.01	0.00	0.09	0.04	0.01	0.00
						OK	OK	OK	OK

Upon running the EFT, a message will be shown if the blue boxes were not first pre-populated with the default Base fleet information asking if the user wishes to continue with the run.

2. The yellow boxes with headings in orange will be used in the calculations if the **Bespoke Base Fleet** option has been selected. The proportions in each column should always add up to 1 (100%). The text at the end of each column confirms whether the proportions add up to 1 (OK). Bespoke Base Fleet values can be defined separately for each **Road Type** (i.e. for London Central, Inner, Outer, Motorway, for all other Areas Urban (not London), Rural (not London), Motorway (not London)).

   An error message (Not equal to 1) will be shown if proportions in all yellow boxes do not add up to 1 and the EFT will not run.

3. Users must remember to enter the traffic fleet information for each road link and select any other relevant Input/Output options on the **Input Data** sheet in order to run the tool.

- *Bespoke Euro Fleet*

This option allows users to input Defined Euro Classes and Size Distribution information for the fleet used in the emission calculations, to more accurately reflect local conditions or test intervention measures under consideration. This may, for example, include testing the impact of implementing Low Emissions Zone (LEZs).

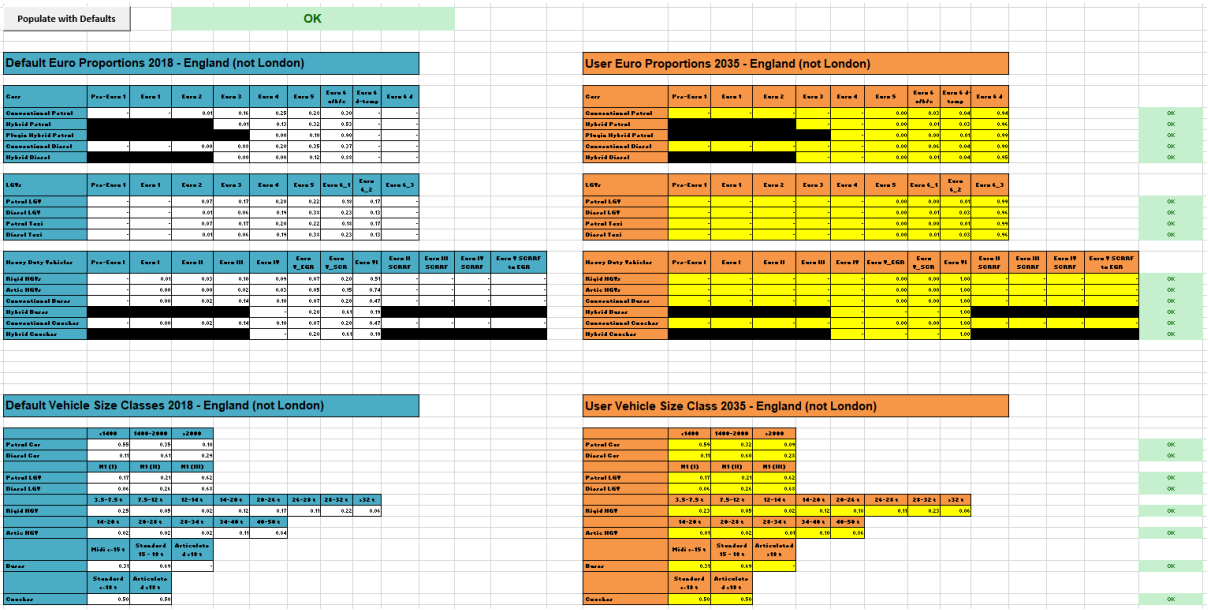
> ***Note 6:*** *By way of example, if a LEZ is proposed to restrict Heavy Duty Vehicles to Euro VI emissions standards, then the User Euro Proportions contained within the 'Bespoke Euro Fleet' or ' Bespoke Euro Fleet Lond' sheet of the EFT should be populated accordingly. Any EFT outputs generated will then be representative of the modified emissions associated with the LEZ scenario.*

The option is available for all areas. Before using this option, the **Area** and **Year** should first be selected on the **Input Data** sheet.

The following procedure should be followed:

1. In the **Advanced Options** box of the **Input Data** sheet select **Bespoke Euro Fleet**, then read and click 'OK' on the pop-up notification.

2. If undertaking user defined emissions calculations for non-London areas, go to the **Bespoke Euro Fleet** sheet that is generated. Alternatively, if undertaking user defined emissions calculations for London, go to the **Bespoke Euro Fleet Lond** sheet that is generated.



These display all of the Euro class splits that will be used in the calculation of emission factors for the selected Area. The boxes with headings in blue display the default proportions built into the Toolkit, based on the selected **Road Type**, **Area** and **Year**. Using the Euro Compositions option allows users to define the following information:

a. The Euro proportions for the fleet.
b. Vehicle size distributions for the fleet.

This is accomplished by manually populating the relevant User Defined yellow boxes (boxes with headings in orange).

3. Users must populate the blue boxes with the default Euro proportions first by clicking the **Populate With Defaults** button located towards the top of the **Bespoke Euro Fleet** sheet before manually editing the yellow boxes for those vehicle types they wish to alter.

Upon running the EFT, a message will be shown if the blue boxes were not first pre-populated with the default Euro proportions information asking if the user wishes to continue with the run.

4. The boxes with headings in orange will be used in the calculations if the **Bespoke Euro Fleet** option has been selected. The proportions in each box should always add up to 1 (100%). The text adjacent to each box confirms whether the proportions add up to 1 (OK).

   An error message (Not equal to 1) will be shown if proportions in all orange boxes do not add up to 1 and the EFT will not run.

5. Users must remember to enter the traffic fleet information for each road link and select any other relevant Input/Output options on the **Input Data** sheet in order to run the tool.

Note 7: *Unlike Fleet Data entered into the Input Data worksheet, which refer to vehicle mix by main vehicle type based on automatic or manual traffic count data, the Euro Class proportions entered into the 'Bespoke Euro Fleet' and 'Bespoke Euro Fleet Lond' sheets must be based on more detailed information on the age mix of vehicles seen on the road, e.g. from Automatic Number Plate Recognition activity data, or based upon future Euro fleet projections.*

Note 8: *Emission reductions that can be achieved by retrofitting HGVs with Selective Catalytic Reduction (SCR) systems have not been confirmed at this stage. As a result, if any proportion information is input next to boxes ending in SCRRF, the standard emission factor for the Euro class of that HGV will be used. It is intended that the EFT will be updated as and when further data becomes available on the likely effectiveness of such systems.*

Note 9: *Users are no longer required to consider failure rates when defining Euro compositions information in the Euro Compositions data input tables. Default consideration of catalyst and DPF failure rates is subsequently applied during the emissions calculation stage when running the EFT.*

- *Fleet Projection Tool*

This option allows users to project their user defined Euro fleet information from a Base Year (e.g. a local Euro fleet derived from ANPR surveys) to a future Projection Year. This option is only available outside of London.

When using the Fleet Projection Tool, the following procedure should be followed:

1. In the **Advanced Options** box of the **Input Data** sheet select **Fleet Projection Tool**, then read and click 'OK' on the pop-up notification.

2. Within the **Fleet Projection** sheet, users must first populate the red boxes with the default Euro class information for the selected Base Year (i.e. the year of the observed local Euro fleet data) using the **Pre-populate with Base Year Fleet** button, e.g. for a base year of 2019, first select 2019 from the Base Year drop down:

   Then click the **Pre-populate with Base Year Fleet** button:

3. Proceed to then update the yellow boxes with user defined Euro information for the Base Year (i.e. ANPR derived Euro fleet data).

4. The **Projection Year** will automatically align to the Year as defined on the **Input Data** sheet, e.g. for a projection year of 2022:

Note 10: *Within the Fleet Projection Tool, the entry of Euro proportions for the Base Year fleet has been simplified so that users only need to define the Euro proportions at the single Euro level, e.g. for Euro 6 vehicles, users no longer need to define Euro 6, 6c and 6d sub-category inputs separately. The same is also true of splits attributed to Diesel Particulate Filters (DPFs) and DPF Retro Fits (DPFRFs) for LDVs, and Exhaust Gas Recirculation (EGR) and Selective Catalytic Reduction (SCR) for Euro V HDVs. This is to better align the user-interface with the typical resolution of information provided by ANPR surveys. The projected Euro proportions are still split into sub-categories through application of typical proportional splits as embedded within the EFT's default fleet dataset.*

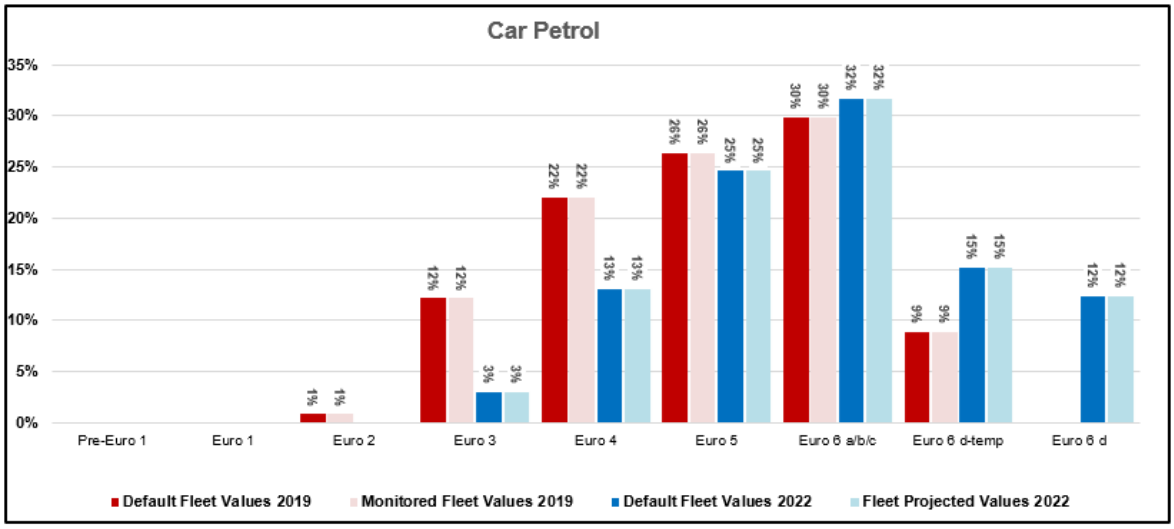
Note 11: *The projection method takes into account the local baseline Euro fleet and the national fleet projections. It is assumed that the local fleet will follow the same profile as the national fleet, and that the difference between the two fleets is due to the local fleet being either 'ahead' or 'behind' the national fleet in terms of Euro class uptake. Therefore, the assumption is that the 'gap' observed (in terms of number of years ahead or behind) between local and national fleets in the baseline year will remain the same in the Projection Year – i.e. if ANPR data show that the local fleet composition is currently cleaner than the national fleet composition (i.e. a higher proportion of newer Euro class vehicles in the fleet), the EFT will assume that this will remain the case in the Projection Year; and that the local fleet will remain 'ahead' of the national fleet.*

5. Projection will occur automatically based upon the information provided in Steps 1-4, with outputs provided in the corresponding **purple boxes**.

6. Users should confirm that the fleet projected values are acceptable using the selected projection method. To assist with this evaluation, a graphical representation of the default fleet and monitored local fleet proportions, for the user entered Base Year and Projection Year, is output within the EFT, e.g. for petrol cars:

Car Petrol

Scenario	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6 a/b/c	Euro 6 d-temp	Euro 6 d
Default Fleet Values 2019	-	-	0.01	0.12	0.22	0.26	0.30	0.09	-
Monitored Fleet Values 2019	-	-	0.01	0.12	0.22	0.26	0.30	0.09	-
Default Fleet Values 2022	-	-	-	0.03	0.13	0.25	0.32	0.15	0.12
Fleet Projected Values 2022	-	-	-	0.03	0.13	0.25	0.32	0.15	0.12



Note 12: *The vehicle type presented within the graph can be changed using the drop-down menu in the yellow box to the top left of the Scenario table. Once a vehicle type has been selected the corresponding data will be updated within the Scenario table and the graph.*

7. To run the EFT with the projected fleet data (i.e. the Fleet Projected Values as output to the purple boxes), select the **Transpose Projected Fleet to Bespoke Euro Fleet** button, then read and click 'OK' on the pop-up notification. The **Bespoke Euro Fleet** sheet will become visible and the User Euro Proportions orange boxes within the **Bespoke Euro Fleet** sheet will update with the Euro composition values as per the **Fleet Projection** boxes, with the orange boxes turning purple as a visual confirmation that the projected fleet has been copied across successfully:

Transpose Fleet Projected Values to SimpleUserEuro

8. The EFT can then be run as normal, with the user able to first make additional changes as required on either the **Bespoke Euro Fleet** and/or **Bespoke Base Fleet** sheets.

Note 13: *It is recommended that users always project the local Euro fleet forwards from the observed Base Year. By way of example, if a user has a Base Year of 2019 and wishes to project the local Euro fleet to 2021 and 2025 assessment years, two separate projections should be undertaken from the 2019 Base Year. This is in preference to projecting 2019 to 2021, then 2021 to 2025, which may lead to a greater uncertainty in the 2025 projection.*

Glossary and Definitions

Term	Definition
AADT	Annual Average Daily Traffic
AQAP	Air Quality Action Plan
CAZ	Clean Air Zone
CCZ	Congestion Charge Zone
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent, used to compare the emissions from various greenhouse gases on the basis of their global-warming potential
DESNZ	Department for Energy Security and Net Zero
DfT	Department for Transport
EEA	European Environment Agency
EFT	Emissions Factors Toolkit
f-NO_2	Fraction of primary NO_2 emissions
HDV	Heavy Duty Vehicles. It encompasses Rigid and Artic Heavy Goods Vehicles and Buses/Coaches
HGV	Heavy Goods Vehicles
HC	Hydrocarbons
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles. It encompasses cars, taxis (black cabs London), and vans
LGV	Light Goods Vehicles
LEZ	Low Emissions Zone
LGV	Light Goods Vehicles
NAEI	National Atmospheric Emissions Inventory
NO_2	Nitric oxide (NO) is mainly derived from road transport emissions and other combustion processes such as the electricity supply industry. NO is not considered to be harmful to health. However, once released to the atmosphere, NO is usually very rapidly oxidized, mainly by ozone (O_3), to nitrogen dioxide (NO_2), which can be harmful to health
NO_x	NO_2 and NO are both oxides of nitrogen and together are referred to as nitrogen oxides (NO_X)
OGV1	Rigid Heavy Goods Vehicles up to 26 tonnes
OGV2	Rigid Heavy Goods Vehicles over 26 tonnes, and Articulated Heavy Goods Vehicles
PM_{10}	Particulate Matter less than 10µm in aerodynamic diameter
$PM_{2.5}$	Particulate Matter less than 2.5µm in aerodynamic diameter

PSV	Public Service Vehicles
TfL	Transport for London
ULEZ	Ultra-Low Emission Zone
ZEC	Zero Emission Capable
ZEEV	Zero Exhaust Emission Vehicle

Local Air Quality Management Helpdesk

This Helpdesk has been set up on behalf of Defra and the Devolved Administrations to offer assistance to local authorities in managing air pollution in their area. The Helpdesk provides:

- Answers to local authorities' questions on air quality monitoring, modelling and emissions inventories;
- Information and guidance to assist local authorities in carrying out the LAQM Review and Assessment process required under Part IV of the Environment Act 1995; and
- Information and guidance to assist local authorities in preparing and implementing Air Quality Action Plans for improvement of local air quality.

Contact details for the LAQM Helpdesk can be found at: https://laqm.defra.gov.uk/helpdesk/

Appendices

Appendix A: Calculation Procedure

Emissions Calculations

The following documents the calculation procedure for generating the vehicle emissions in g/km, g/km/s and kg/year or tonnes/year (please see the User Guide for more information).

NOx and PM_{10} (Exhaust) COPERT 5.6

Vehicle Type	x	Emissions	x	Constants	x	Degradation[#]	x	Fuel	x	Euro Composition	x	Road Type	=	g/km						
Vehicle Type	x	Emissions	x	Constants	x	Degradation[#]	x	Fuel	x	Euro Composition	x	Road Type	/	(3600 x hours)	=	g/km/s				
Vehicle Type	x	Emissions	x	Constants	x	Degradation[#]	x	Fuel	x	Euro Composition	x	Road Type	/	(3600 x hours)	x	link length (km) x (3600x8760) / 1000 = kg/year				

[#] Degradation in emissions due to accumulated mileage only calculated for some petrol cars and petrol LGVs.

CO_2 (Energy Consumption) COPERT 5.6

Vehicle Type	x	Energy Consumption	x	Constants	x	Fuel	x	Euro Composition	x	Road Type	x	CO_2 / kg Fuel	=	g/km						
Vehicle Type	x	Energy Consumption	x	Constants	x	Fuel	x	Euro Composition	x	Road Type	x	CO_2 / kg Fuel	/	(3600 x hours)	=	g/km/s				
Vehicle Type	x	Energy Consumption	x	Constants	x	Fuel	x	Euro Composition	x	Road Type	x	CO_2 / kg Fuel	/	(3600 x hours)	x	link length (km) x (3600x8760) / 1,000,000 = tonnes/year				

The following documents the calculation procedure for generating the brake, tyre wear and road abrasion emissions for PM_{10} and $PM_{2.5}$ in g/km and g/km/s.

PM_{10} (Non-Exhaust)

Vehicle Type	x	Brake Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	=	g/km								
Vehicle Type	x	Tyre Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	=	g/km								
Vehicle Type	x	Road Abrasion		Emissions	x	Constants	x	Euro Composition	x	Road Type	=	g/km								
Vehicle Type	x	Brake Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	=	g/km/s						
Vehicle Type	x	Tyre Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	=	g/km/s						
Vehicle Type	x	Road Abrasion		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	=	g/km/s						
Vehicle Type	x	Brake Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	x	link length (km) x (3600x8760) / 1000 = kg/year						
Vehicle Type	x	Tyre Wear		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	x	link length (km) x (3600x8760) / 1000 = kg/year						
Vehicle Type	x	Road Abrasion		Emissions	x	Constants	x	Euro Composition	x	Road Type	/	(3600 x hours)	x	link length (km) x (3600x8760) / 1000 = kg/year						

$PM_{2.5}$

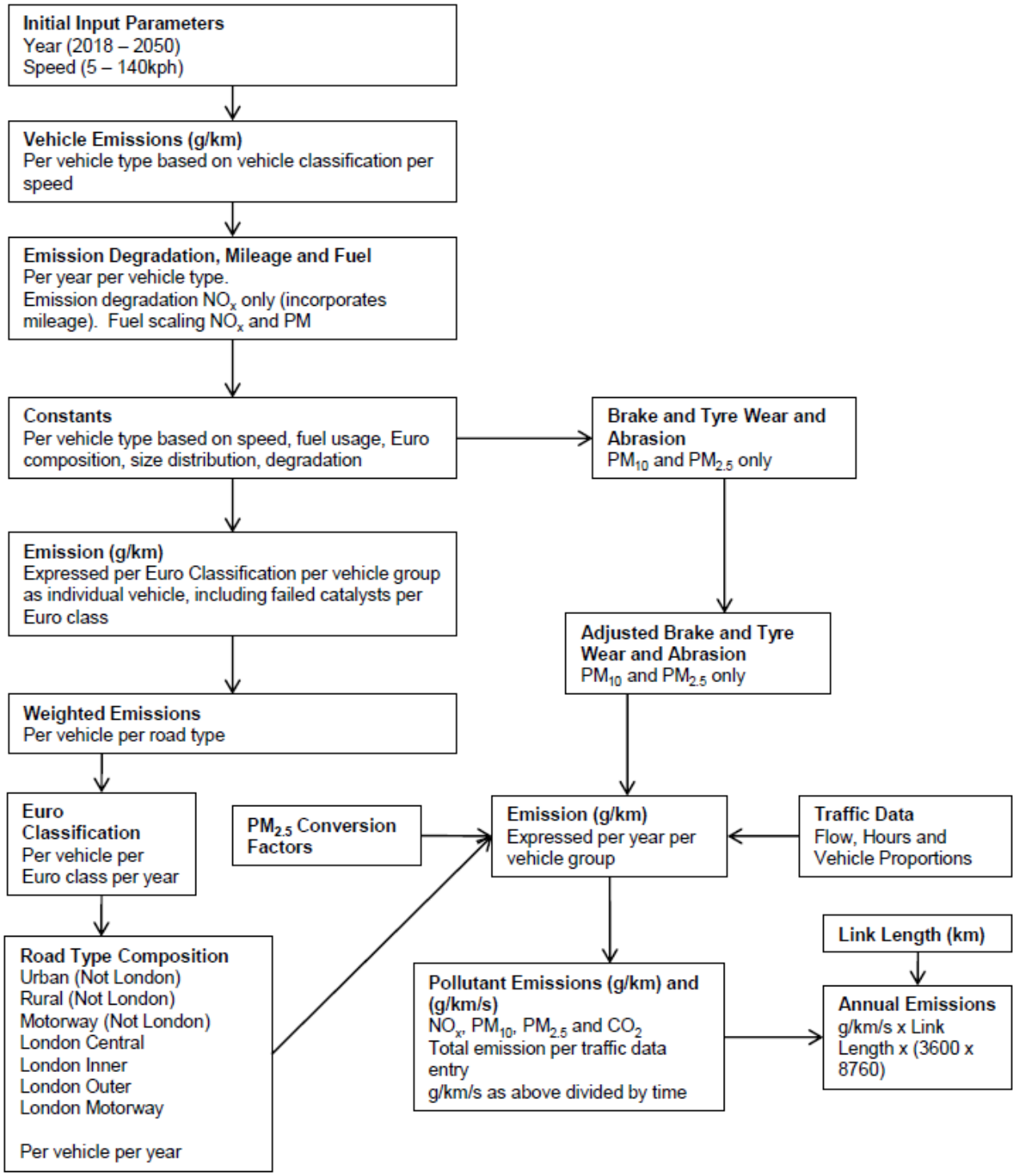
PM_{10} Exhaust		Emissions	x	1	=	$PM_{2.5}$ g/km
PM_{10} Brake Wear		Emissions	x	0.4	=	$PM_{2.5}$ g/km
PM_{10} Tyre Emissions		Emissions	x	0.7	=	$PM_{2.5}$ g/km
PM_{10} Road Abrasion		Emissions	x	0.54	=	$PM_{2.5}$ g/km

Non-exhaust CO_2e

Link Length (km)	x	No. Electric or PHEV vehicles per hour	x	8,760	x	Emissions (gCO_2e per km)	/	1,000,000	=	tonnes/year

Source: *EFT Version 12.1 - Background Information*

Appendix B: EFT Process Map



Appendix C: Data Sources

Source	Data Set	Date
Ricardo-E&E	UK (Outside London) Fleet Compositions (2018-2050)[17]	July 2022
Ricardo-E&E	UK (Outside London) Euro Compositions (2018-2050)[17]	July 2022
Ricardo-E&E	UK (Outside London) Vehicle Size Proportions (2018-2050)[17]	July 2022
Ricardo-E&E	HDV SCR/EGR Proportions[17]	July 2022
Ricardo-E&E	Treatment of Failed Catalytic Convertors[17]	July 2022
Ricardo-E&E	Primary NO_2 Emission Factors for Road Transport[12]	March 2023
Ricardo-E&E	NOx Degradation Factors	June 2023
EEA	COPERT 5.6 NO_x vehicle emissions[18]	September 2022
EEA	COPERT 5.6 PM vehicle emissions[18]	September 2022
EEA	COPERT 5.6 Energy Consumption (CO_2)[18]	September 2022
EEA	Non-Exhaust PM assumptions[18]	October 2019
TfL	London Fleet Compositions[19]	March 2023
TfL	London Euro Compositions[19]	March 2023
TfL	London Vehicle Size Proportions[19]	March 2023
TfL	Alternative Vehicle Emissions Assumptions and Scaling Factors	March 2023
DfT/HE	CO_2e Emissions Factors (2018-2050)	July 2021
DfT/HE	Engine efficiency factors for CO_2 (2018-2050)	July 2021

[17] The fleet composition projections included in the tool for the UK excluding London were derived from the projections developed from the 2020 version of the National Atmospheric Emissions Inventory (NAEI)[7] programme in March 2022. This used information provided by DfT in December 2021 on future sales and activities of new petrol, diesel and electrically-powered cars and LGVs, combined with future forecasts in traffic (vehicle kilometres) including other vehicle types from DfT's National Transport Model.

[18] Based on information from the EMEP/EEA Emissions Inventory Guidebook (2019), https://www.eea.europa.eu/publications/emep-eea-guidebook-2019

[19] London specific fleet and Euro composition projections, and vehicle size proportions for London, provided by TfL via personal communications in March 2023.

Appendix D: EFT Vehicle Types

Selected Area and Traffic Format											
England (Not London), Northern Ireland, Scotland and Wales						All Vehicle Types	London				
Basic Split	Detailed Option 1	Detailed Option 2	Detailed Option 3	Detailed Option 4	Included in Base Fleet?		Included in Base Fleet?	Basic Split	Detailed Option 1	Detailed Option 2	Detailed Option 3	Detailed Option 4
LDVs	Car	Car	Petrol Car	Petrol Car	y	Petrol Cars	y	LDVs	Car	Car	Petrol Car	Petrol Car
					y	Petrol Hybrid Cars	y					
					y	Petrol Plugin Hybrid Cars	y					
			Diesel Car	Diesel Car	y	Diesel Cars	y				Diesel Car	Diesel Car
					y	Diesel Hybrid Cars	n	Cannot be user defined				
			Electric Car	Electric Car	y	Electric Cars	y	LDVs	Car	Car	Electric Car	Electric Car
Cannot be user defined	Taxi (black cab)	Taxi (black cab)	Taxi (black cab)	Taxi (black cab)	n	Petrol Taxis (black cabs)	y		Taxi (black cab)	Taxi (black cab)	Taxi (black cab)	Taxi (black cab)
					n	Petrol Hybrid Taxis (black cabs)	y					
					n	Diesel Taxis (black cabs)	y					
					n	Electric Taxis (black cabs)	y					
LDVs	LGV	LGV	LGV	Petrol LGV	y	Petrol LGVs	y		LGV	LGV	LGV	Petrol LGV
Cannot be user defined					n	Petrol Hybrid LGVs	y					
					n	Petrol Plugin Hybrid LGVs	y					
LDVs	LGV	LGV	LGV	Diesel LGV	y	Diesel LGVs	y					Diesel LGV
				Electric LGV	y	Electric LGVs	y					Electric LGV
HDVs	HGV	Rigid HGV	Rigid HGV	Rigid HGV	y	Rigid HGVs	y	HDVs	HGV	Rigid HGV	Rigid HGV	Rigid HGV
Cannot be user defined					n	Electric Rigid HGVs	y					

<table>
<tr><th colspan="11">Selected Area and Traffic Format</th></tr>
<tr><th colspan="6">England (Not London), Northern Ireland, Scotland and Wales</th><th rowspan="2">All Vehicle Types</th><th colspan="5">London</th></tr>
<tr><th>Basic Split</th><th>Detailed Option 1</th><th>Detailed Option 2</th><th>Detailed Option 3</th><th>Detailed Option 4</th><th>Included in Base Fleet?</th><th>Included in Base Fleet?</th><th>Basic Split</th><th>Detailed Option 1</th><th>Detailed Option 2</th><th>Detailed Option 3</th><th>Detailed Option 4</th></tr>
<tr><td>HDVs</td><td>HGV</td><td>Artic HGV</td><td>Artic HGV</td><td>Artic HGV</td><td>y</td><td>Artic HGVs</td><td>y</td><td rowspan="15"></td><td></td><td rowspan="2">Artic HGV</td><td rowspan="2">Artic HGV</td><td rowspan="2">Artic HGV</td></tr>
<tr><td colspan="5">Cannot be user defined</td><td>n</td><td>Electric Artic HGVs</td><td>y</td></tr>
<tr><td rowspan="8">HDVs</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td><td>y</td><td>Conventional Buses[20]</td><td>n</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td><td rowspan="8">Bus & Coach</td></tr>
<tr><td>y</td><td>Hybrid Buses[20]</td><td>n</td></tr>
<tr><td>y</td><td>Electric Buses[20]</td><td>n</td></tr>
<tr><td>y</td><td>Biogas Buses[20]</td><td>n</td></tr>
<tr><td>y</td><td>Conventional Coaches</td><td>y</td></tr>
<tr><td>y</td><td>Hybrid Coaches</td><td>y</td></tr>
<tr><td>y</td><td>Electric Coaches</td><td>y</td></tr>
<tr><td>y</td><td>Biogas Coaches</td><td>y</td></tr>
<tr><td>LDVs</td><td>Motorcycle</td><td>Motorcycle</td><td>Motorcycle</td><td>Motorcycle</td><td>y</td><td>Motorcycles (Petrol & Electric)</td><td>y</td><td>LDVs</td><td>Motorcycle</td><td>Motorcycle</td><td>Motorcycle</td><td>Motorcycle</td></tr>
<tr><td colspan="5" rowspan="6">Cannot be user defined</td><td>n</td><td>E85 Bioethanol Cars</td><td>n</td><td colspan="5" rowspan="6">Cannot be user defined</td></tr>
<tr><td>n</td><td>LPG Cars</td><td>n</td></tr>
<tr><td>n</td><td>E85 Bioethanol LGVs</td><td>n</td></tr>
<tr><td>n</td><td>LPG LGVs</td><td>n</td></tr>
<tr><td>n</td><td>Biodiesel Rigid HGVs</td><td>n</td></tr>
<tr><td>n</td><td>Biodiesel Artic HGVs</td><td>n</td></tr>
</table>

[20] When calculating emissions for Road Types London Central, London Inner or London Outer, pollutant emission outputs for Conventional Buses, Hybrid Buses, Electric Buses and Biogas Buses will be labelled as Conventional TfL Buses, Hybrid TfL Buses, Electric TfL Buses and Biogas TfL Buses, respectively. This is because the Bus fleet has been defined separately by TfL for these London Road Types.

Selected Area and Traffic Format												
England (Not London), Northern Ireland, Scotland and Wales						All Vehicle Types	London					
Basic Split	Detailed Option 1	Detailed Option 2	Detailed Option 3	Detailed Option 4	Included in Base Fleet?		Included in Base Fleet?	Basic Split	Detailed Option 1	Detailed Option 2	Detailed Option 3	Detailed Option 4
					n	Biodiesel Bus	n					
					n	Biomethane Bus	n					
					n	Biodiesel Coaches	n					