Epping Forest Special Area of Conservation

Air Quality Assessment Modelling Methodology for 2020 Habitat Regulations Assessment
Technical Note

Epping Forest District Council

20 August 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Helen Venfield Principal Consultant	James Riley Technical Director (Ecology)	Michele Hackman Regional Director (Air Quality)	Michele Hackman Regional Director

Revision History

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Prepared for:

Epping Forest District Council

Prepared by:

AECOM Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44(0)1256 310200
aecom.com

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1. Introduction

1.1 An air quality assessment was undertaken in 2018/19 to assess the potential impact of road traffic emissions on the Epping Forest Special Area of Conservation (EFSAC) and used to inform the Habitats Regulations Assessment 2019 (HRA 2019), prepared to support the Epping Forest Local Plan Submission Version (LPSV). The methodology has been updated for the Habitats Regulations Assessment 2020 (HRA 2020).

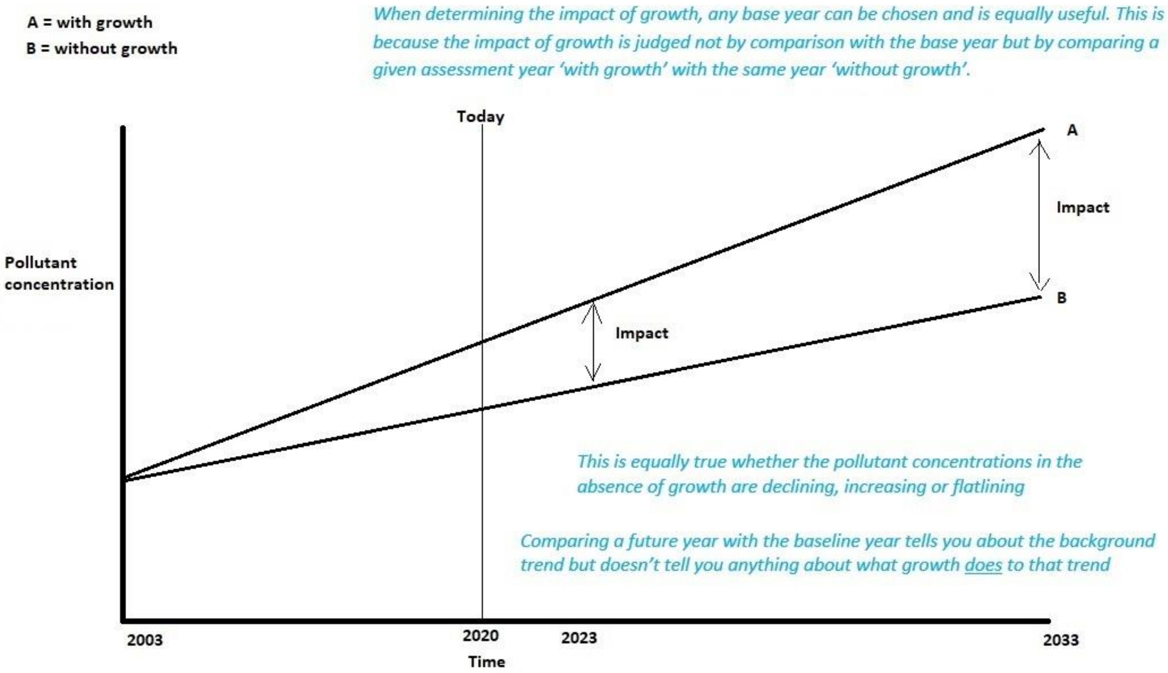
1.2 Key road links within 200m of the EFSAC were included in the model to inform both the HRA 2019 and HRA 2020. . Habitats within EFSAC are sensitive to concentrations of oxides of nitrogen (NOx) and ammonia (NH_3) and nutrient nitrogen levels and these can be affected by emissions from road traffic. These pollutants were assessed for the 2019 HRA and continue to be the focus of the 2020 air quality assessment.

1.3 Epping Forest District Council (EFDC) and the technical team have taken the opportunity to review the assumptions applied in the 2018/19 modelling assessment to ensure that the most appropriate information is used to provide a robust analysis of the likely future traffic conditions. The following scenarios are discussed in the HRA, with a full list of modelled scenarios presented in Appendix A:

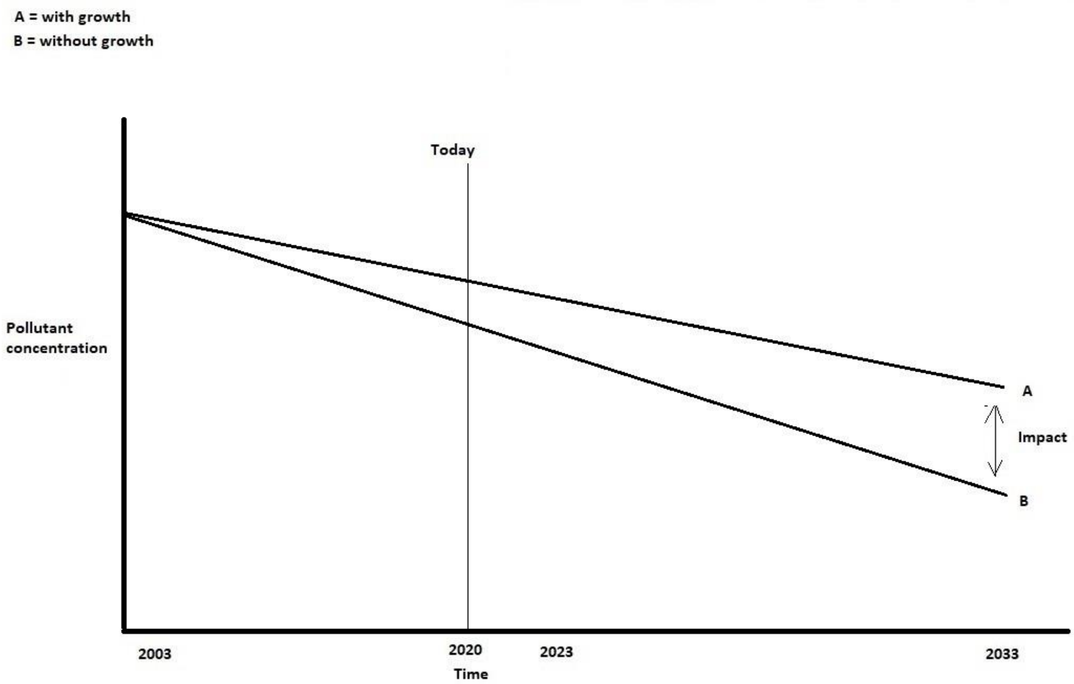
- ***Scenario 2 2017*** 2017 Baseline for verification (monitoring data collected in 2018-19, annualised to 2017);
- Projected End of Plan (2033)
  - ***Scenario 3 Future Base*** baseline (no Local Plan);
  - ***Scenario 4*** with Local Plan;
  - ***Scenario 4.5ULEZev*** with Local Plan and mitigation;
- Interim year (2024)
  - ***Scenario 6 Base*** baseline (no Local Plan);
  - ***Scenario 6a*** with Local Plan;
  - ***Scenario 6aULEZev10*** with Local Plan and mitigation.

1.4 The impact of the Local Plan is assessed by comparing the scenarios (both with and without mitigation) against the ‘future base’ scenario for the appropriate year. The ‘future base’ includes growth in traffic that would be expected if the Local Plan were not to go ahead.

Figure 1: Illustration of long-term increasing (top) and decreasing (bottom) pollutant trends and the calculated impact assessed in HRA



NB the slope of the line in the graph is purely for illustration



NB the slope of the line in the graph is purely for illustration

2. Model set-up

2.1 The detailed dispersion model, ADMS-Roads (version 5.0.0.1, released March 2020) has been used to model concentrations of both NOx and NH_3 from road traffic in the EFSAC. Meteorological data for 2017 from Stansted airport has been used in the modelling assessment, as it was in the 2019 HRA. Details are provided in Table 1.

Table 1: General ADMS-Roads Model Conditions

Variable	*ADMS-Roads Model Input*
Surface roughness	1 m at dispersion site; 0.2m at meteorological measurement site
Minimum Monin-Obukhov length for stable conditions	10 m
Terrain types	Flat
Receptor locations	x, y coordinates determined by GIS, z=0m
Emissions	NO_x, NH_3
Road traffic emission factors	NOx – Emission Factor Toolkit (EFT) Version 9.0 NH_3 - Calculator for Road Emissions of Ammonia (CREAM) For both tools, 2017 emission factors have been applied in the baseline scenario to match the monitoring data, 2024 emission factors in interim year scenarios, and 2030 emission factors in end-of-plan scenarios
Meteorological data	1 year (2017) hourly sequential data from Stansted Airport meteorological station
Emission profiles	Variation in traffic flow: 20% AM peak: 0700-1000h (3 hours) 38% Inter-peak: 1000-1600h (6 hours) 21% PM peak: 1600-1900h (3 hours) 22% Off-peak: 1900-0700h (12 hours)
Receptors	Selected receptors / transects and gridded receptors with kriging interpolation to produce contour plots
Model output	Long-term annual mean NO_x concentrations Long-term annual mean NH_3 concentrations

3. Representation of queuing traffic

3.1 The junctions included in the air quality modelling study are presented in Appendix B. The methodology used to estimate emissions from queuing traffic for the HRA 2019 was based on the Cambridge Environmental Research Consultancy (CERC) methodology. The CERC methodology is one of a number of valid approaches to modelling emissions from queueing traffic. Since the original modelling was completed EFDC/AECOM have verified with CERC the application of the methodology given in CERC's note 60, from 2004.

3.2 The method provides an estimate of the number of vehicles per lane that would pass a point when travelling at 5km/h, assuming an average vehicle length of 4m, which equates to a traffic flow of 30,000 Annual Average Daily Traffic (AADT) if the queue was continuous for 24 hours per day. CERC clarified that this should be applied instead of the forecast traffic flow, not additionally. As the 2019 HRA applied the 30,000 AADT flow for queuing traffic as well as the forecast vehicle flow, there was a 'double-counting' of emissions where queuing traffic was modelled. The 2020 air quality modelling has been amended to reflect this clarification.

3.3 The updated air quality model uses the appropriate vehicle flows for each of the time periods. The queue length for each time period has traffic speeds reduced to 5km/h for the duration of said period. This methodology is in-line with the LAQM.TG(16) methodology considering emissions of NOx for idling traffic ('*the EF may be assumed to be equal to that corresponding to the vehicle travelling at 5km/h (the lowest possible speed in the EFT*)' - paragraph 7.249), whilst also taking into account the diurnal variation in traffic flows and queue lengths. This provides a precautionary approach to estimating emissions of NOx from queuing traffic as it assumes the lowest possible speed in the EFT.

3.4 Queue length parameters previously reported, in the 2019 HRA, followed TfL's VISSIM Model Audit Process (VMAP) guidelines, which limited reported queue length outputs to 500m.. Applying this approach meant that the length of the queues on some links may have been underestimated. The updated methodology removes this limiting parameter and any queue lengths exceeding 500m are included in the revised VISSIM outputs and subsequent air quality modelling.

3.5 The removal of the TfL VMAP 500m queue length parameter increases reported and assessed queueing on some links and responds to representations made during the 2019 Examination Hearings, regarding the potential underestimation of certain queue lengths. This methodology is precautionary as the maximum of the modelled 10-minute queue lengths during each time period is applied for the duration of each time period.

3.6 The HRA 2019 calculated forecast traffic flows using factors from observed traffic counts to convert peak hour flows into 24-hour weekday rather than AADT flows. Recognising that modelling should also account for average weekend flows in any calculation, the updated methodology combines observed weekday and weekend traffic count data to derive appropriate expansion factors to calculate AADT flows. The 24-hour AADT flows are presented in Appendix C.

3.7 A further step has been taken, using the observed traffic count data, to apportion the total AADT flows into four time periods for air quality modelling so as to account for the variation in traffic flow through the day. This information is presented in Table 2.

Table 2: Time periods and distribution of AADT in air quality modelling

Period	Time	Duration	Traffic Flow (% of AADT)
AM peak	0700-1000h	3 hours	20%
Inter-peak	1000-1600h	6 hours	38%
PM peak	1600-1900h	3 hours	21%
Off-peak	1900-0700h	12 hours	22%

3.8 Given that there is no information on how emissions of NH_3 from road traffic vary with vehicle speed and that the emission factors have a greater level of uncertainty associated with them than those for NOx, it is not considered appropriate or even possible to estimate emissions of this pollutant from queuing traffic in the same way as emissions of NOx from road traffic. The approach taken to considering NH_3 is set out at paragraphs 5.6 – 5.13.

4. Vehicle fleet mix

4.1 An updated version of Defra's Emission Factor Toolkit (EFTv9.0) was published in May 2019. Version 9.0 provides an Advanced Fleet Option 'Fleet Projection Tool' that allows users to project their own, user defined, Euro fleet information from a Base Year to a future Projection Year, rather than using the generic average fleet mix. The guidance published alongside the toolkit gives the specific example of how this could be used as being '*a local Euro fleet derived from Automatic Number Plate Recognition (ANPR) surveys*.' The EFT also provides options to specify the Euro classification of the fleet used in the emission calculations to, as set out in the EFT guidance '*..more accurately reflect local conditions..*'. The use of this tool is considered to be beneficial in understanding the local conditions pertaining to the EFSAC and therefore allow a more targeted approach to any mitigation measures required and to support future monitoring.

4.2 ANPR surveys were undertaken in 2017 and 2019 and have been analysed to derive an 'Epping Forest SAC' (EFSAC) vehicle fleet mix in terms of vehicle type and Euro standards. The EFT v9.0 'Fleet Projection Tool' has been used to derive the evolution of the future vehicle fleet that would be expected to operate in the Forest.

4.3 The use of the ANPR datasets has multiple benefits to the air quality modelling assessment:

- Source apportionment – the predominant source of pollution can be accurately identified to inform more bespoke mitigation measures;
- Vehicle fleet evolution – The EFT v9.0 fleet projection tool has been used to inform future model scenarios, and specific mitigation measures which may affect the vehicle fleet composition;
- Periodic future ANPR surveys are proposed to track the evolution of the vehicle fleet in terms of emission standards and vehicle type. These will be scheduled to support the national requirement for Local Plans to be reviewed every five years. Should the vehicle fleet be found to have evolved in a different way to that which has been predicted in the air quality modelling, revised modelling will be undertaken to determine whether a) there is a need to update the Local Plan and b) whether proposed interventions set out in the Council's adopted Air Pollution Mitigation Strategy are required to be implemented or amended.

Analysis of current EFSAC vehicle fleet

4.4 Analysis of the 2019 ANPR data and the EFT's Basic Fleet Split for rural, urban and outer London roads indicated that the vehicle fleet using the roads through the EFSAC is most similar to the outer London fleet, as defined in EFT v9.0 for 2019. The HDV proportions from the ANPR survey data were between 2% and 2.5% whereas the HRA 2019 assumed 6-9% depending on the road link.

4.5 In terms of Euro Class split, the 2019 ANPR data shows that the car and LGV fleet using the roads through the EFSAC is for the main part newer than that in the EFT outer London fleet, but older than the EFT UK average outside of London. Older vehicles with less rigorous Euro standards are typically more prevalent in the local vehicle fleet for both 2017 and 2019 than the EFT default projections used in the HRA 2019.

4.6 Further details regarding the analysis of the 2017 and 2019 ANPR data are presented in the AECOM Technical Note, 'Comparing 2017 and 2019 ANPR Vehicle Composition with EFT National Default Fleets', February 2020 (see Appendix D).

Projection of EFSAC vehicle fleet

4.7 The Advanced Option 'Simple Entry Euro Compositions' in EFT v9.0 has been used to input User Defined Euro Classes (2017 ANPR data) for the 2017 baseline modelling scenario to reflect local conditions. The NO_x/NO_2 results from the baseline modelling assessment were verified against monitoring data as set out in LAQM.TG(16), annualised to the same year.

4.8 The vehicle fleet used in the future assessment years is derived from the 2019 ANPR data using the Advanced Option 'Fleet Projection Tool' in EFT v9.0. This tool is designed specifically to allow the users to project their user defined Euro fleet information from the ANPR derived Euro fleet data to a future Projection Year. 'Option 1' was used to project the EFSAC vehicle fleet – this allowed the vehicle fleet to evolve in future years, in line with national estimates, but recognising that the local vehicle fleet was overall 'older' than the national fleet as identified in both the 2017 and 2019 ANPR surveys.

4.9 Further details regarding the projection of the EFSAC vehicle fleet to 2033 are presented in the AECOM Technical Note, 'Use of ANPR data to inform the projected vehicle fleet in EFSAC', March 2020 (see Appendix E).

4.10 The vehicle fleet composition for all scenarios assessed in the HRA 2020 are presented in Appendix F for the basic fleet split in terms of fuel and vehicle type, and Appendix G for the Euro standard fleet split, which provides an understanding of the age of vehicles.

5. Emission factors

Nitrogen Oxides

5.1 Updated NOx emission factors from the latest version of the EFT v9.0 were published in May 2019. These are used in the assessment rather than the superseded emission rates from v8.0.1 which were used in the 2019 HRA. The release of v9.0 of the EFT was accompanied by a number of updated tools (e.g. 'NOx-to-NO_2 toolkit') which are also used with the updated EFT. Version 10.0 of the EFT was released in August 2020, after the completion of the modelling exercise, and was therefore not used in the HRA 2020. .

5.2 There has previously been reason to consider the EFT future emission predictions with caution, including for example, because research has indicated that Euro 6 vehicles were not performing as expected[1] . Since then, various changes have been made to improve the EFT nationally, including the use of the COPERT emission factors[2] , and more recently the update to version 9.0 of the tool[3].

5.3 Recent research has been undertaken which shows that EFT v9.0 now reflects decreasing measured concentrations of NOx and NO_2 in the UK[4]. However, the research also suggests that EFT v9.0 future fleet predictions may overestimate future emissions of NOx from road traffic:

'*…on balance, the EFT is unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the EFT. This does not mean that there will be no locations where the EFT over-states the rate of decline, but the most likely situation at most locations appears to be that the EFT will under-predict the rate at which NOx emissions fall in the near future.*'

5.4 This research suggests that the future EFSAC vehicle fleets derived from ANPR data and used in the modelling to inform the HRA 2020 and the Council's Air Pollution Mitigation Strategy provide an appropriately conservative fleet composition for use in the EFSAC model studies. As the future fleets are based upon recorded ANPR data and projected using information within the EFT v9.0 for the closest 'year' of assessment, the assumptions are considered to already include a level of caution. Following the recent evidence that suggests that the EFT standard fleets are likely to underpredict improvements in emissions, and the EFSAC projections give rise to higher emissions than the standard EFT fleets, the EFSAC fleet scenarios build in adequate conservatism whilst also remaining realistic. Therefore, the ANPR projections are considered to be cautious enough to not require an additional sensitivity test.

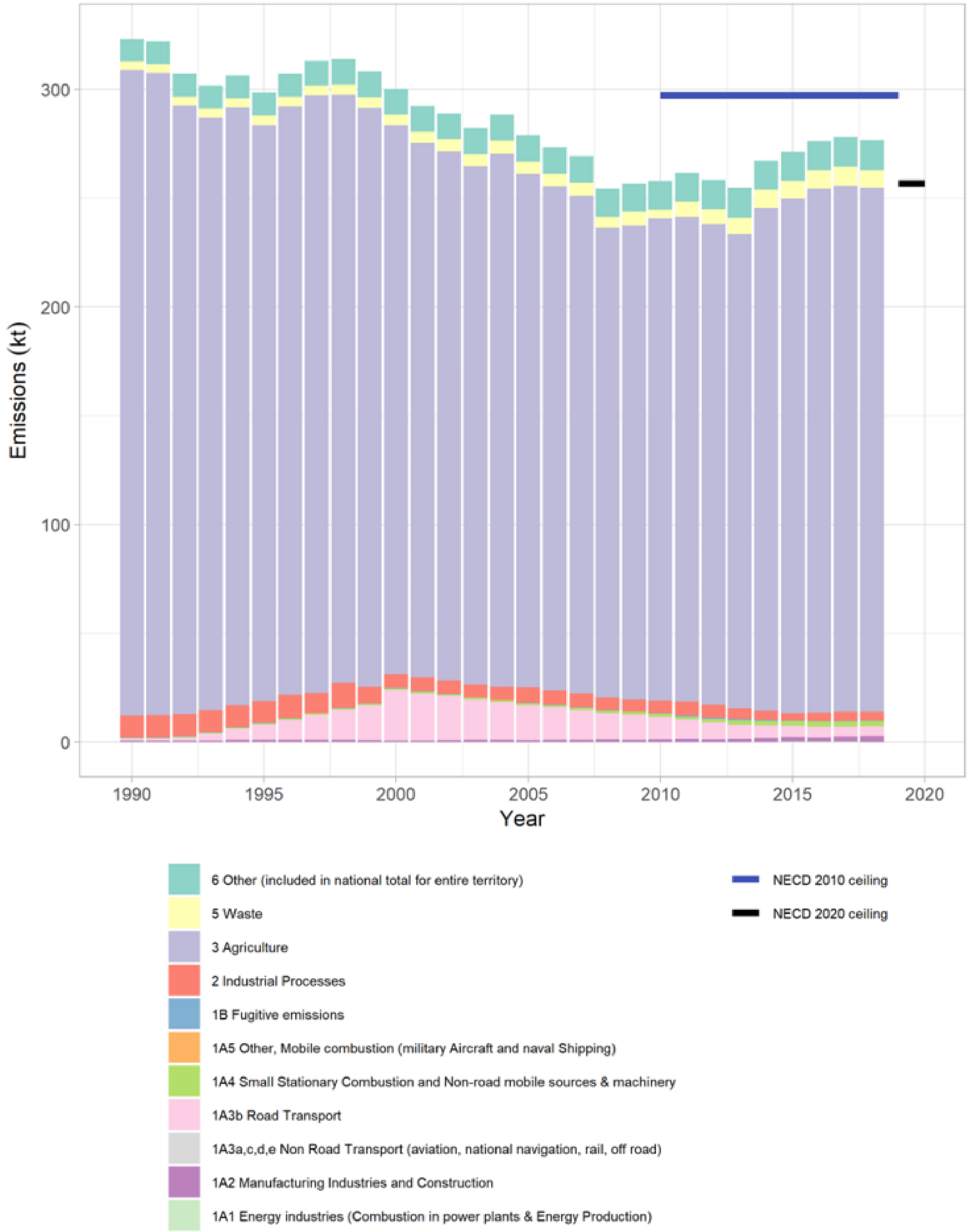
5.5 The future years assessed are 2024 (interim year) and 2033 (end of plan). The end of plan scenarios are assessed using emission rates for 2030 rather than 2033 as this is the latest year for which information is available in the EFT. Therefore, there is no assumption made for further beneficial changes in the vehicle fleet mix that would arise recognising that the last years of the Plan period are immediately before the scheduled implementation of the UK Government's ban on the sale of petrol, diesel and hybrid vehicles. The interim year is assessed using emission rates for 2024.

[1] Carslaw et al., 'Trends in NOx and NO_2 emissions and ambient measurements in the UK.' Prepared for Defra (version 3rd March 2011, available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat05/1103041401_110303_Draft_NOx_NO2_trends_report.pdf
[2] https://copert.emisia.com/
[3] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[4] 'Performance of Defra's Emission Factor Toolkit 2013 - 2019', Air Quality Consultants, February 2020. Available at: https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=7fba769d-f1df-49c4-a2e7-f3dd6f316ec1

Ammonia

5.6 Agriculture is the most significant source of ammonia emissions nationally, contributing 87% of emissions in the UK in 2018 whilst waste contributed 3% of UK emissions, and road transport less than 2%, as shown in Figure 2. In general, agriculture is a diffuse source of ammonia – the locations of and emissions from agricultural sources are key to determining concentrations at a particular location.

Figure 2: Total UK Emissions by Source Sectors Ammonia (NH3), 1990-2018[5]



5.7 Ammonia emissions can be emitted from road vehicles equipped with catalyst devices, the purpose of which is to control NOx emissions. Ammonia is an unintended by-product of the NOx reduction process on the

[5] UK Informative Inventory Report (1990 to 2018), Ricardo Energy & Environment, March 2020. Available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat07/2003131327_GB_IIR_2020_v1.0.pdf

catalyst and was more pronounced for early generation petrol cars with catalysts (Euro 1 and 2). Factors for later petrol vehicle Euro standards and diesel light duty vehicles are lower. The NH_3 factors for heavy duty vehicles are also low but increase for later Euro V and VI standards due to ammonia slip from the Selective Catalytic Reduction (SCR) system.

5.8 The Institute of Air Quality Management's (IAQM) guidance on assessment of air quality impacts on designated nature conservation sites (2020)[6] provides support for this view. In the May 2020 update it acknowledges that 'as road transport is a source of ammonia, albeit a small source compared to agriculture at a national level, consideration should be given to including it and its contribution to local nitrogen deposition.' However, the guidance does not endorse nor recommend the use of a specific tool or methodology to estimate emissions of ammonia. Furthermore, Natural England's internal guidance (Approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, 2018) describes an assessment methodology that is based on the assumption that the only traffic emission of relevance to N deposition is NOx. Highways England's LA 105 air quality guidance does not consider ammonia or its contribution to nitrogen deposition. Assessments for Highways England must follow this guidance.

5.9 Unlike NOx, there is no national tool to estimate emissions of ammonia from road traffic. Emission rates of NH_3 are not included in the EFT as NH_3 from traffic is not an emission of concern for human health. Although it is acknowledged that not including emissions of ammonia may underestimate the traffic-related impact on nitrogen deposition to sensitive ecosystems, there is much less information available regarding emissions of ammonia from road traffic vehicles than NOx, and the information that is available has a high degree of uncertainty. Whilst emissions of NOx from road vehicles are regulated according to Euro standards, emissions of ammonia are not, meaning that emissions from individual vehicle types are highly uncertain as measurements are rarely made as it is not required for regulatory purposes in relation to human health.

5.10 The National Atmospheric Emissions Inventory (NAEI) provides NH_3 emission factors from road traffic based on information from the EMEP/EEA Emissions Inventory Guidebook (2016, July 2018 update)[7] and COPERT 5 source. The figures provided are fleet averages for a single year. These data were previously used in the 2019 HRA as they were the best available at the time of modelling, however there was no account taken for the variation in emission rates in future years according to changes in Euro standards.

5.11 In February 2020, Air Quality Consultants developed and published the Calculator for Road Emissions of Ammonia (CREAM) tool[8], '*in order to allow tentative predictions regarding trends in traffic-related ammonia emissions over time*'[9]. The tool is based upon remote sensing results, published real-world fuel consumption data and ambient measurements recorded in Ashdown Forest (2014-2016). However, to the best of our knowledge, the CREAM tool and methodology have not been peer reviewed.

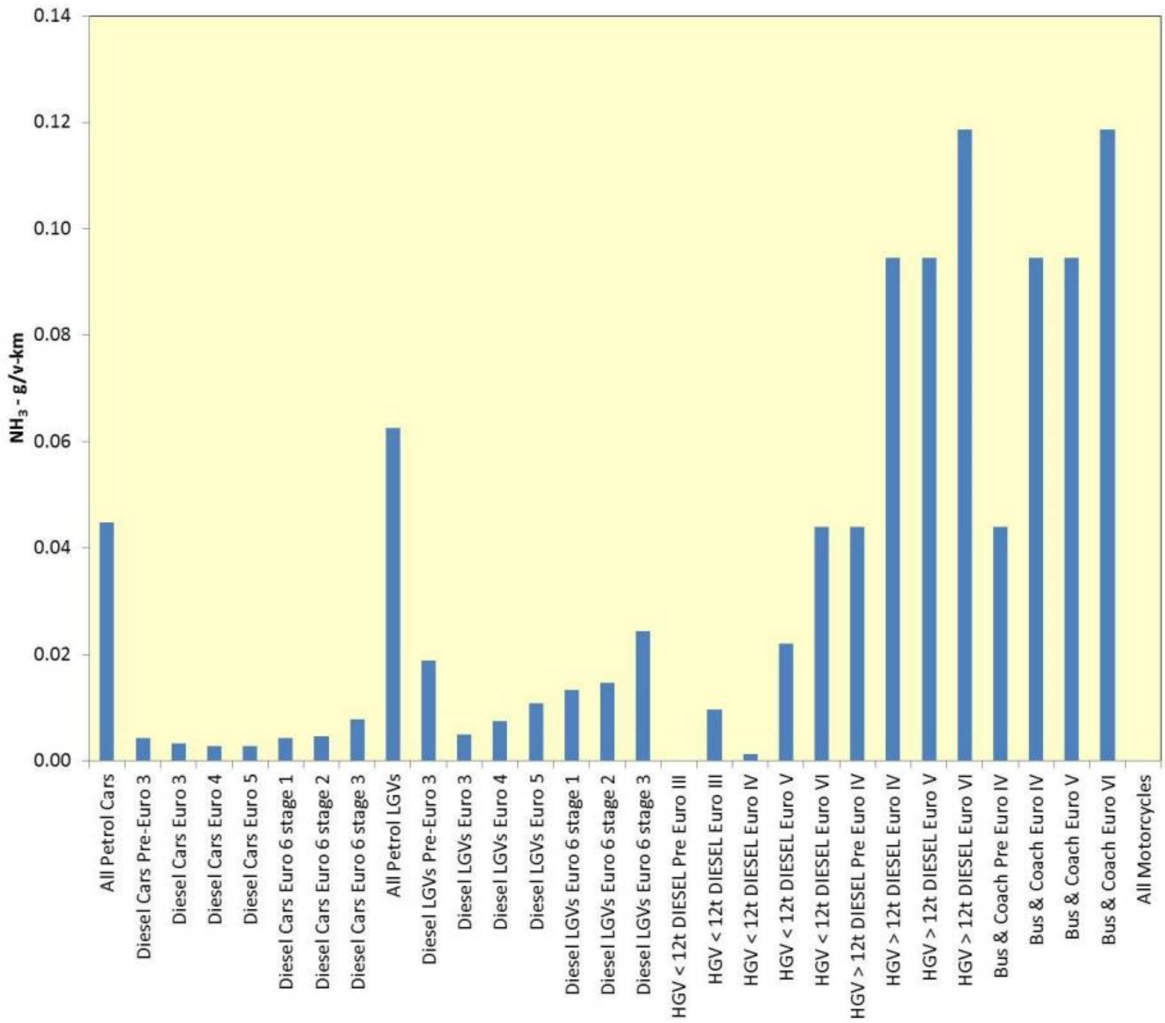
5.12 The report that was published along-side the CREAM tool states that:

> "*It should be recognised that these emissions factors remain uncertain. Using them to make future year predictions will clearly be an improvement on any assessment which omits ammonia. They are also considered to be more robust than the emissions factors contained in the EEA Guidebook, which risk significantly under-predicting ammonia emissions. The emissions factors contained in the CREAM model can be considered to provide the most robust estimate of traffic-related ammonia possible at the present time, but they may be updated in the future as more information becomes available*."

5.13 In the absence of an alternative tool from Defra, Natural England or other nature conservation bodies, emission factors for ammonia from the CREAM tool have been used in the 2020 air quality modelling. As CREAM is a 'locked' tool, it was not possible to apply the bespoke EFSAC vehicle fleet information regarding Euro standards in the same way as it has for the EFT. The 'London - Outer' fleet composition was adopted as the EFSAC is considered to be most similar to the EFT outer London fleet, and the two tools share the same default fleet data (see AECOM 'Vehicle Fleet Projection' report for comparison). The predicted emissions per vehicle are presented in Figure 3.

[6] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf
[7] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-b-i/view
[8] Air Quality Consultants, CREAM V1A, February 2020. Available at: https://www.aqconsultants.co.uk/resources/calculator-for-road-emissions-of-ammonia
[9] Air Quality Consultants, 'Ammonia Emissions from Roads for Assessing Impacts on Nitrogen-sensitive Habitats', February 2020. Available at: https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=3aa4ec2e-ee4e-4908-bc7a-aeb0231b4b37

Figure 3: Predicted emissions of ammonia per vehicle in CREAM tool[8]



6. Comparison with monitoring data

Nitrogen Oxides

6.1 A revised verification of the modelling outputs has been undertaken using the full nine month set of site-specific monitoring data undertaken in 2018-2019 (the HRA 2019 used verified data based on six months of data). This has been annualised to 2017, to correspond with the traffic flows and ANPR data collected and used in the 2017 baseline model, in-line with Defra guidance (LAQM.TG(16)).

6.2 Table 3 provides a comparison of modelled and monitored concentrations of NOx up to 10m from the roadside. Overall the model was found to underestimate monitored concentrations. A verification factor of 1.86 was calculated with an RMSE of 6.3 $\mu g/m^3$ (compared against an RMSE of 9.8 $\mu g/m^3$ before adjustment at the same sites).

6.3 It is worth noting that even after adjustment, model performance at the roadside is weakest. This is in line with the IAQM guidance[10] which flags that concentrations within 2m of the road '*can be unreliable*' and '*may not represent areas of relevance to the assessment*'.

[10] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf

Table 3: Comparison of measured and monitored NOx Concentrations (µg/m³) – 2017 annual mean equivalent concentrations

Site ID	Modelled Road NOx Contribution (µg/m³)	Monitored Road NOx Contribution (µg/m³)	Modelled Vs. Monitored NOx (Roads) %	Adjustment factor	Adjusted Modelled NOx Roads (µg/m³)	Adjusted Modelled Vs. Monitored NOx (Roads) %
T1_N0	36.0	55.7	-35%	1.5	67.0	20%
T1_N5	26.5	32.5	-19%	1.2	49.3	51%
T1_N10	14.7	23.2	-36%	1.6	27.4	18%
T2_N0	28.5	85.8	-67%	3.0	53.1	-38%
T2_N5	19.6	35.8	-45%	1.8	36.5	2%
T2_N10	17.7	28.2	-37%	1.6	32.9	17%
T2_N0	28.5	85.8	-67%	3.0	53.1	-38%
T2_N5	19.6	35.8	-45%	1.8	36.5	2%
T2_N10	17.7	28.2	-37%	1.6	32.9	17%
T4_N0	14.7	45.8	-68%	3.1	27.4	-40%
T4_N5	9.6	24.7	-61%	2.6	17.8	-28%
T4_N10	6.1	18.2	-66%	3.0	11.4	-38%
T5_N0	8.2	26.0	-69%	3.2	15.2	-42%
T5_N5	6.2	14.4	-57%	2.3	11.5	-20%
T5_N10	4.4	12.5	-64%	2.8	8.3	-34%
T6_N0	44.5	65.3	-32%	1.5	83.0	27%
T6_N5	32.3	29.8	8%	0.9	60.2	102%
T6_N10	21.9	26.1	-16%	1.2	40.8	56%
T7_N0	15.7	44.1	-65%	2.8	29.2	-34%
T7_N5	10.9	28.8	-62%	2.6	20.3	-29%
T7_N10	8.2	21.1	-61%	2.6	15.2	-28%
T8_N0	16.1	40.0	-60%	2.5	30.0	-25%
T8_N5	10.2	22.5	-54%	2.2	19.1	-15%
T8_N10	7.6	21.3	-65%	2.8	14.1	-34%
T10_N10	10.9	12.0	-9%	1.1	20.3	69%
T11_N0	8.6	41.3	-79%	4.8	16.1	-61%

T11_N5	6.4	18.1	-64%	2.8	12.0	-34%
T11_N10	4.3	15.9	-73%	3.7	8.0	-50%
Overall calculated NOx adjustment factor				**1.86**		

Ammonia

6.4 Defra monitors NH_3 concentrations as part of the UK Eutrophying and Acidifying Atmospheric Pollutant (UKEAP) at 95 sites across the UK. DELTA samplers (DEnuder for Long-Term Atmospheric sampling) are used at 59 of these sites. DELTA samplers are considered to provide the most robust estimates of NH_3 concentrations but require an electrical supply to operate so are not practical for many rural or habitat sensitive monitoring sites. A secondary network of ALPHA samplers (Adapted Low-cost Passive High Absorption) are employed at a further 49 sites to assess regional and local scale variability in NH_3 concentrations.

6.5 The ALPHA method is calibrated against the DELTA method at 12 sites within the network with a bias adjustment factor of 0.33, which is applied to the ALPHA results. .

6.6 A comparison of measurements made in 2018 with both ALPHA and DELTA of samplers indicates that the NH_3 measurements made using ALPHA samplers have a greater level of uncertainty associated with them than the more robust DELTA samplers (Table 4). The ALPHA sampler measurements were in the range -23% to +38% of the DELTA sampler measurements. There appears to be more variation in the ratios than would be the case with NO_2 diffusion tube results (compared with chemiluminescent analysers[11]), bearing in mind that national bias adjustment factors have already been applied to the ALPHA results.

Table 4: Measured Ammonia Concentrations (µg/m^3) by DELTA and ALPHA Samplers at UKEAP sites in 2018

Site	DELTA	ALPHA	Ratio
Auchencorth Moss	0.98	1.26	1.29
Glensaugh	0.37	0.35	0.92
Lynclys Common	2.39	2.36	0.99
Moorhouse	0.58	0.75	1.29
Rothmansted	1.16	1.48	1.28
Stoke Ferry	2.11	2.92	1.38
Sourhope	1.19	0.92	0.77

6.7 Diffusion tubes were used to measure NH_3 in the National Acid Monitoring Network up until 2000. The tubes have been used to measure NH_3 for many decades but with mixed success. Some studies found them to perform satisfactorily whilst others found them to substantially overestimate NH_3 at ambient levels. Although NH_3 diffusion tubes can be shown to perform adequately, CEH recommends that any implementation should be supported by ongoing reference data[12].

6.8 Due to their ready availability and ease of deployment, ammonia diffusion tubes were used to monitor concentrations of the pollutant in EFSAC from May 2018 to February 2019 with some tubes co-located with

[11] Chemiluminescent analysers measure the concentration of nitrogen oxide (NO), nitrogen oxides (NOx) and nitrogen dioxide (NO_2).
[12] CEH, Development and types of passive samplers for monitoring atmospheric NO_2 and NH_3 concentrations, The Scientific World , 2001.

an ALPHA sampler to enable bias adjustment of the results to improve their accuracy. The locations of the tubes were agreed with the Conservators of Epping Forest.

6.9 A three-month co-location study was undertaken from December 2018 to February 2019 at the London Cromwell Road UKEAP network site in order to derive a bias adjustment factor for the EFSAC diffusion tube survey. The Cromwell Road monitoring station is equipped with the ALPHA passive sampler that measures gaseous ammonia on a monthly basis. A bias adjustment factor of 0.59 was calculated, indicating that the diffusion tubes overestimated NH_3 concentrations by approximately 40% on average in comparison to the ALPHA sampler. This bias adjustment factor was applied to the diffusion tube results.

6.10 At some of the monitoring sites in EFSAC, three tubes were exposed, whilst at other sites, only one tube per month was exposed. There was a large variation in the individual measurements made at the sites with three tubes, during many of the months of the survey indicating that the precision (ability of a measurement to be consistently reproduced) of the tubes was poor.

6.11 It should therefore be noted that NH_3 measurements made using diffusion tubes, as undertaken in EFSAC, have a much higher level of uncertainty associated with them compared with diffusion tubes for NO_2 and ALPHA samplers for NH_3. This greater level of uncertainty should be borne in mind when considering the modelling results..

6.12 A comparison of the modelled and monitored concentrations (annualised to 2017) is presented in Table 5 for monitoring locations up to 10m from the road. The comparison shows that the model both under- and over-estimates concentrations across the EFSAC. The difference between modelled and measured concentrations, before any adjustment, is less for NH_3 than for NO_x. As such, and given the level of uncertainty of the diffusion tube results, an adjustment factor has not been applied to the modelled ammonia concentrations.

Table 5: Comparison of measured and monitored NH_3 Concentrations (μg/m³) – 2017 annual mean equivalent concentrations

Site ID	Modelled Road NH_3 Contribution (μg/m³)	Monitored Road NH_3 Contribution (μg/m³)	Modelled Vs. Monitored NH_3 (Roads) %
T1_A0 (Tri)	1.09	1.20	-9%
T1_A5	0.84	0.92	-9%
T1_A10	0.49	0.90	-46%
T3_A0 (Tri)	1.54	1.70	-10%
T3_A5	0.88	1.22	-28%
T3_A10	0.56	0.42	33%
T4_A0 (Tri)	0.73	1.29	-44%
T4_A5	0.47	0.86	-45%
T4_A10	0.29	0.63	-53%
T6_A0 (Tri)	1.64	1.92	-15%
T6_A5	1.20	0.83	45%
T8_A0 (Tri)	0.89	1.13	-21%
T8_A5	0.56	0.72	-22%
T8_A10	0.41	0.48	-14%

7. Background concentrations and deposition rates

7.1 The updated NOx background maps issued to accompany EFT v9.0 (based on 2017 traffic data) are used in the air quality modelling. Background concentrations of NOx for the year 2024 are used for the interim year scenarios and for 2030 for the end-of-plan scenarios. In-line with best practice, the trunk and primary A road contributions within the grid square have been removed since emissions from these sectors are included in the air quality model.

7.2 Background NH_3 concentrations and nitrogen deposition rates for the 3-year average 2016-2018 have been used for all scenarios. This information was obtained from the APIS website for the 5 km grid square containing the relevant receptor. Future trends in background concentrations of ammonia are more uncertain than that for NOx. As a precautionary approach, no change was projected in background ammonia concentrations or nitrogen deposition in future years.

7.3 However, with regard to background concentrations and nitrogen deposition rates over the duration of a Local Plan period, the 2020 IAQM guidance states that '*it seems reasonable to either assume no change or to assume that emissions will change in line with the requirements of the 2016 National Emissions Ceiling Directive*'. The approach taken in the EFSAC modelling is therefore considered to be a precautionary approach as it is reasonable to anticipate a decrease in background total nitrogen deposition by 2033 due to decreasing NOx emissions resulting in decreasing wet and dry deposition of nitrogen. Measures that are also expected to contribute towards a decrease within this timescale are the penetration of 'cleaner' vehicles in the national fleet e.g. Euro 6 (reduced NOx emissions), and the implementation of mitigation measures outlined in the 2019 Clean Air Strategy[13] for agricultural ammonia emissions. The UK Government's decision to ban the sale of petrol, diesel and hybrid vehicles from 2035 is also likely to have a beneficial effect.

8. Deposition velocities

8.1 The deposition rate used in the assessment for the HRA 2019 was based on published guidance in the Design Manual for Roads and Bridges (DMRB), Volume 11, Chapter 3, Part 1 Air Quality which was current at the time. This guidance was updated in November 2019 and now contains deposition rates for short and tall vegetation.

8.2 Nitrogen deposition has been calculated for all scenarios based on both 'heathland' and 'tall vegetation' deposition velocity factors. The data are presented as contour plots for selected scenarios, with the appropriate deposition velocity used for the appropriate area.

8.3 The deposition rates of NO_2 and NH_3 applied are consistent with those presented in the IAQM guidance, "A guide to the assessment of air quality impacts on designated nature conservation sites" (v1.1 May 2020)[14], and the Air Quality Technical Advisory Group (AQTAG) guidance[15]:

- grassland: NO_2 deposition velocity = 0.0015 m/s;
- forest: NO_2 deposition velocity = 0.003 m/s;
- grassland: NH_3 deposition velocity = 0.02 m/s;
- forest: NH_3 deposition velocity = 0.03 m/s.

8.4 It should be noted that the deposition rates of NO_2 given in Highways England's recently released and updated DMRB guidance for air quality, LA 105[16], are consistent with those cited in the 2020 IAQM guidance (grassland and similar habitats: 1 $\mu g/m^3$ of NO_2 = 0.14 kg N/ha/year; forests and similar habitats: 1 $\mu g/m^3$ of NO_2 = 0.29 kg N/ha/year). Highways England's LA 105 air quality guidance does not consider ammonia or its contribution to nitrogen deposition, and therefore does not cite deposition rates for NH_3.

8.5 The AQTAG / IAQM deposition velocities provide a constant rate at which the pollutant deposits to the specific surface. Research has, however, shown that the deposition rate of NH_3 is concentration dependent, with lower deposition velocities at higher concentrations. One study demonstrated that deposition velocities were a factor of 10 lower close to the source and a factor of two lower at 60m from the source before approaching what was expected beyond 100m from the source17. This research suggests that simple scaling techniques are not appropriate for this purpose thereby implying that a simple scaling factor to estimate deposition from NH_3 is likely to result in an overestimate of the contribution of ammonia to nitrogen deposition and that overestimate is likely to be large close to the source.

8.6 Given the uncertainty relating to the NH_3 measurements using diffusion tubes in EFSAC and the greater uncertainty in NH_3 emissions from road traffic relative to those of NOx, the nitrogen deposition calculations with NH_3 contributions included using a simple scaling factor to estimate deposition rates should be treated with caution.

[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf
[14] https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2020.pdf
[15] Air Quality Technical Advisory Group, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air.
[1616] https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90
[17] Cape et al., 'Concentration-dependent deposition velocities for ammonia: moving from lab to field', http://nora.nerc.ac.uk/id/eprint/2777/1/N2777_Cape.pdf

9. Modelled Mitigation Measures

Modal shift

9.1 The modal shift assumptions applied to the 'end of plan' scenario with mitigation in place, adopt a precautionary approach through the consideration of reasonable improvements to sustainable transport choices across the district and neighbouring destinations e.g. Harlow and London. The analysis considers the sustainable access policy requirements and proposed improvements to provide a balance of what can be reasonably delivered by developers and public transport operators to encourage modal shift at all new development. No consideration at this stage has been made for modal shift in background / existing traffic on the network nor have the significantly more ambitious modal shift targets to be delivered through the development of Harlow and Gilston Garden Town. The modal shift used in the EFSAC air quality modelling equates to an approximate reduction of 5%-7% in Local Plan related new development traffic growth and is deemed an appropriate approach to test the impact of reasonable sustainable modal shift.

Clean Air Zone

9.2 The purpose of a Clean Air Zone (CAZ) is to improve air quality, and more specifically to reduce levels of NO_2 and particulate matter to help achieve the UK's national air quality objectives[18]. They are designed to deliver the cleanest possible fleet (in terms of NOx and particulate matter) by mandating minimum emission standards for vehicles using roads within a CAZ.

9.3 The Central London fleet mix – in terms of Euro standards – was applied to the EFSAC vehicle fleet in order to demonstrate the efficacy of a CAZ in EFSAC. This is considered appropriate as the EFSAC is in close proximity to outer London (5-10 km north-east of the North Circular Road), and there are plans to expand the Ultra-Low Emissions Zone (ULEZ) from 25 October 2021 up to the North Circular Road[19].

9.4 The vehicle fleet mix in terms of Euro standards for all modelled scenarios is presented in Appendix G.

Electric vehicles

9.5 Whilst emissions of NOx from road vehicles are regulated according to Euro standards, emissions of ammonia are not. This means that emissions of ammonia from individual vehicle types are highly uncertain, particularly as measurements are rarely made as it is not required for regulatory purposes.

9.6 As such, the only way that emissions of ammonia from road traffic can be limited with certainty, is by reducing on-road emissions altogether e.g. switching to electric vehicles. An analysis of the modelled data at the transects indicated that the dominant source of ammonia emissions, as modelled using the CREAM tool, was petrol cars, accounting for 67% to 80% of road traffic emissions of road traffic ammonia in the 'end of plan' unmitigated scenario (scenario 4.5). It was subsequently calculated that, based on the current available information, a 30% reduction in petrol cars would need to be achieved, in addition to the CAZ, to be able to demonstrate no adverse effect on the integrity of the EFSAC as a result of Local Plan development.

Other measures not modelled

9.7 Consideration was given to restricting access through the EFSAC to HDVs and / or LGVs. The ANPR data analysis showed that less than 2% of the traffic using the roads in EFSAC are HDVs, and approximately 19% are LGVs (predominantly diesel).

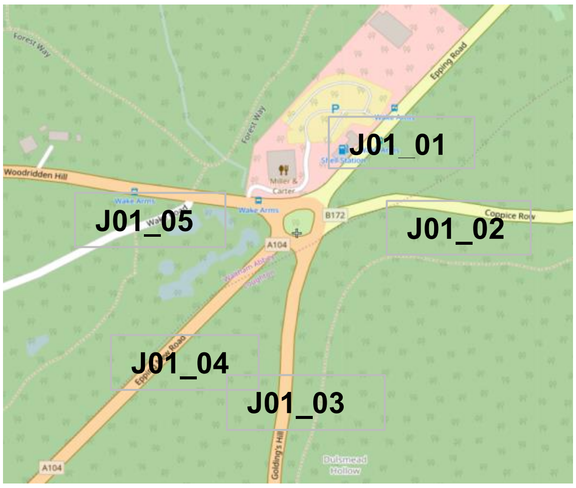
9.8 Analysis of emissions data from the unmitigated 'end of plan' scenario indicated that on their own, neither of these measures would sufficiently reduce modelled emissions of NOx and ammonia to conclude no adverse effect on the integrity of the EFSAC as a result of Local Plan development These measures were therefore not prioritised for modelling, although they are included as potential measures in the Council's emerging Air Pollution Mitigation Strategy as they would provide some air quality improvement benefits.

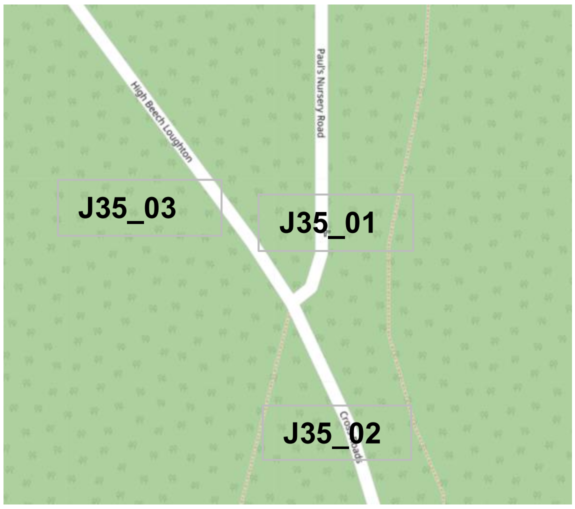
[18] https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf
[19] The ULEZ boundary around central London will be extended to create a larger zone up to, but not including, the North and South Circular Roads https://tfl.gov.uk/modes/driving/low-emission-zone/about-the-lez

Appendix A – EFSAC modelled scenarios

Scenario	Description
Scenario 2	2017 Baseline
Scenario 3	2033 Baseline (includes growth from 2017, but no further Local Plan development)
Scenario 4	2033 with Local Plan (no change to Honey Lane junction)
Scenario 4.5	2033 with Local Plan (no change to Honey Lane junction but with modal shift)
Scenario 4.5ULEZ	2033 with Local Plan (As Scenario 4.5 and with ULEZ)
Scenario 4.5ev	2033 with Local Plan (As Scenario 4.5 and with 30% shift of petrol to electric cars)
Scenario 4.5ULEZev	2033 with Local Plan (As Scenario 4.5 and with ULEZ and 30% shift of petrol to electric cars)
Scenario 5	2033 with Local Plan (with changes to Honey Lane junction and modal shift)
Scenario 5a	2033 with Local Plan (As Scenario 5 and with ULEZ)
Scenario 6	2024 baseline (includes growth from 2017, but no further Local Plan development)
Scenario 6a	2024 with Local Plan (no change to Honey Lane junction)
Scenario 6b	2024 with Local Plan (with changes to Honey Lane junction)
Scenario 6ev	2024 with Local Plan (As Scenario 6a and with 20% shift of petrol to electric cars)
Scenario 6ev10	2024 with Local Plan (As Scenario 6a and with 10% shift of petrol to electric cars)
Scenario 7a	2033 with Local Plan (As Scenario 5a and with 30% shift of petrol to electric cars)

Appendix B – EFSAC modelled junctions





Appendix C – EFSAC 24hour AADT by link road and scenario

Link	Scenario 2 2017	Scenario 3 2033 Base	Scenario 4 2033 w LP	Scenario 4.5ULEZev 2033 w LP & mitigation	Scenario 6 2024 Base	Scenario 6a 2024 w LP	Scenario 6aULEZev10 2024 w LP & mitigation
J01_01	17,851	19,886	24,331	24,083	18,922	20,140	20,140
J01_02	8,067	8,987	9,419	9,419	8,551	8,838	8,838
J01_03	19,589	21,822	22,912	22,839	20,764	21,304	21,304
J01_04	14,559	16,219	18,255	18,102	15,433	15,929	15,929
J01_05	24,193	26,951	29,218	29,152	25,644	26,532	26,532
J33_01	2,127	2,369	2,425	2,425	2,254	2,289	2,289
J33_02	24,193	26,951	29,174	29,109	25,644	26,506	26,506
J33_03	2,127	2,369	2,724	2,702	2,254	2,472	2,472
J33_04	24,193	26,951	29,547	29,459	25,644	26,723	26,723
J35_01	1,042	1,161	1,506	1,484	1,104	1,304	1,304
J35_02	2,084	2,321	3,793	3,749	2,209	2,948	2,948
J35_03	1,063	1,185	2,326	2,304	1,127	1,684	1,684
J36_01	14,559	16,219	18,255	18,109	15,433	15,920	15,920
J36_02	2,084	2,321	3,106	3,077	2,209	2,626	2,626
J36_03	14,559	16,219	18,927	18,781	15,433	16,259	16,259
J36_04	2,084	2,321	3,851	3,822	2,209	3,000	3,000

Appendix D – Comparing 2017 and 2019 ANPR Vehicle Composition with EFT National Default Fleets

Epping Forest Special Area of Conservation

Comparing 2017 and 2019 ANPR Vehicle Composition with EFT National Default Fleets
Technical Note

Epping Forest District Council

20 February 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Max Nancarrow Senior Consultant Alistair Thorpe Principal Consultant	Zadie Astill Senior Consultant Helen Venfield Principal Consultant	Michele Hackman Regional Director	Michele Hackman Regional Director

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Distribution List

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Prepared by:

AECOM Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44(0)1256 310200
aecom.com

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1. Introduction

1.1 This Technical Note has been prepared by AECOM on behalf of Epping Forest District Council (EFDC) to provide a comparison between the local vehicle fleet captured using Automatic Number Plate Recognition (ANPR) and the default national fleet inherent within two versions of Defra's Emissions Factors Toolkit[1] (EFT), for the years 2017 and 2019. This is in order to establish the variability between both the ANPR survey data and the EFT, and the variability between EFT versions themselves (version 8.0.1 and version 9.0). The implications that this variability may have on the resultant emissions calculations applied to the Local Plan modelling are discussed, and recommendations are made for the approach to be adopted in future modelling.

1.2 The comparison of Defra's EFT version 8.0.1, version 9.0 and the Epping Forest Special Area of Conservation (EFSAC) specific ANPR survey data establishes if there are grounds for applying an 'EFSAC' area vehicle fleet in the air quality modelling.

1.3 The first stage of analysis compares the 'Basic Fleet Split' information contained within EFT v8.0.1 and v9.0 and the local ANPR survey data in terms of the relative proportions of general vehicle categories within the national rural vehicle fleet (the road type used within the 2019 Habitats Regulations Assessment (HRA) air quality modelling for the Local Plan Submission Version).

1.4 The second stage of analysis considers the Euro emissions standards within each of the different vehicle categories. The Euro standard of each individual vehicle within a given category contributes to the overall emission rate calculated. In general, an older fleet with a greater prevalence of lower Euro standards (e.g. Pre-Euro 1 to Euro 3) will result in a higher emission rate than a newer fleet that is made up of more of the higher Euro standard vehicles (e.g. Euro 4 to 6d).

1.5 The third section considers whether the ANPR data indicates that the EFSAC is most like the EFT's average urban, rural or outer London vehicle fleet in terms of the relative proportions of general vehicle categories and the distribution of vehicles by Euro standard.

1.6 All discussion regarding emissions rates within this report is limited to emissions of NOx as there are no road traffic emissions of ammonia in Defra's EFT.

[1] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

2. Background and Methodology

Emission Factors Toolkit (EFT)

2.1 EFT Version 8.0.1, released in November 2017, incorporated European Environment Agency (EEA) COPERT 5[2] emission factors, and information on the UK fleet composition collected as part of updating the National Atmospheric Emissions Inventory (NAEI)[3]. The underlying fleet composition data are based on Department for Transport (DfT) data and projection figures from 2015. Version 8.0.1 took account of Euro 6 subcategories and incorporated a better representation of failure rates of both catalysts and Diesel Particulate Filters (DPFs) compared to earlier releases. The input tables for the 'Euro Compositions Advanced Option' no longer assumed 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 attributable to failed catalysts and DPFs is now presented separately within brackets alongside the emissions for each Euro category.

2.2 EFT Version 9.0 was released in May 2019, refining and updating the basic fleet assumptions with the latest DfT data. Version 9.0 was also released with the inclusion of a new Advanced Fleet Option 'Fleet Projection Tool' that 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.

2.3 The vehicle fleet applied in the 2017 baseline model for the 2019 HRA modelling was previously taken from the EFT v8.0.1 for 'Rural' roads, due to the rural nature of the area. One of the limitations of this approach is that both versions of the EFT assume that there are no electric cars or LGVs using rural roads, which effectively increases the emissions rates applied.

ANPR Surveys

2.4 An ANPR survey was conducted on 23 February 2017, a neutral day and at a time where there were no school holidays, in line with best practice, to capture the local fleet composition of traffic travelling within the EFSAC. The dataset contains approximately 39,000 unique vehicles and a total of 259,000 observations / movements. This data represents a single day of trips observed.

2.5 A further ANPR survey was undertaken for three days (15 to 17 October 2019) at eight different locations within the Epping Forest SAC in order to capture the majority of vehicles passing through the SAC. The survey dates were considered to be neutral days and at a time where there were no school holidays, in line with best practice. The 2019 dataset contains approximately 55,000 unique vehicles and a total of 160,000 observations / movements.

2.6 Of the two ANPR surveys, the percentage of successful DVLA matches was higher for 2019 (97.5% of 56,681 registration plates) than for 2017 (81.8% of 47,998 registration plates).

Data Analysis

2.7 Basic fleet split information was extracted from EFT versions 8.0.1 and 9.0 for both 2017 and 2019. The EFT disaggregates the vehicle fleet into 14 basic vehicle categories, namely:

- Petrol Car;
- Diesel Car;
- Taxi (black cab)[4];
- Petrol Light Goods Vehicle (LGV);
- Diesel LGV;
- Rigid Heavy Goods Vehicle (HGV);
- Articulated HGV;
- Bus and coach;

[2] https://copert.emisia.com/
[3] https://naei.beis.gov.uk/
[4] This vehicle category was only applicable to areas in London within EFT v8.0.1, but could be used outside of London in v9.0.

- Motorcycle;
- Hybrid Car (Petrol);
- Plug-In Hybrid Car (Petrol);
- Hybrid Car (Diesel);
- Electric Car; and
- Electric LGV

2.8 NO_x Euro emissions standards proportions of each of these 14 vehicle categories were extracted for 2017 and 2019 from EFT versions 8.0.1 and 9.0.

2.9 The ANPR survey data were analysed to extract the equivalent Basic Fleet Split and Euro emissions standards information for comparison with the EFT versions. The DVLA match data was processed to assign each matched vehicle to the equivalent EFT vehicle category. This was done based on type approval category[5], fuel type and gross vehicle weight. Where insufficient information was provided in the DVLA data to assign vehicles to an appropriate EFT category, other data fields were used to try to infill the gaps (e.g. vehicle wheel plan, number of axles, vehicle body shape). Euro emissions standards were also extracted from the DVLA data. Where Euro standard information was missing, infilling was carried out using vehicle registration date and vehicle type to assign an appropriate Euro standard.

2.10 An anonymised vehicle identifier was used to cross-reference the DVLA match data against the ANPR observation data so that the number of observations of each individual vehicle could be quantified. The use of total vehicle observations as opposed to individual vehicle counts is considered to better represent vehicle-kilometres travelled and also gives more weight to those vehicles that travel more frequently and / or greater distance. All subsequent analyses concerning the ANPR data has therefore been carried out on total vehicle observations rather than unique vehicles.

[5] https://www.vehicle-certification-agency.gov.uk/vehicletype/definition-of-vehicle-categories.asp

3. Vehicle Fleet Split

3.1 The results of the Basic Fleet Split comparisons between EFT versions 8.0.1 and 9.0, and the 2017 ANPR survey data are presented in Table 1 and Figure 1. The same comparisons for 2019 are presented in Table 2 and Figure 2. Whilst the EFT requires the user to input the percentage of heavy duty vehicles (HDV, heavy goods vehicles (HGV) plus buses and coaches), the total HDV percentage have been set at the 'default' (national average) percentages for rural roads. All discussion regarding emission rates is with reference to NOx emissions.

Basic Fleet Split 2017

3.2 The EFT analysis in this section is undertaken for the default rural fleet of 2017.

3.3 Between EFT versions 8.0.1 and 9.0, there are minor updates to the fleet make-up, with the main change being a reduction in diesel cars, which is compensated by small increases in the percentages of petrol cars and diesel LGVs.

3.4 The 2017 ANPR data exhibits a larger percentage of the fleet as petrol cars than the default assumptions for a rural fleet contained in the EFT, and comparatively a lesser proportion of the fleet as diesel cars. This would reduce the overall NOx emission rate calculated for a fleet derived from the ANPR data as compared to the default EFT assumptions.

3.5 Diesel LGVs are more prevalent within the ANPR survey data than the EFT default rural fleet. The proportion of petrol LGVs is low in both versions of the EFT (0.5%) and even lower in the EFSAC fleet from the 2017 ANPR data (0.1%).

3.6 The overall total percentage of HDV is relatively low in the 2017 ANPR data (2.5%) compared to that in the EFT national rural fleet in 2017 (5.5%). The HDV percentage applied in the 2019 HRA modelling was higher than this, varying between 6 to 9% across the EFSAC roads. This was derived from the Automatic Traffic Counter (ATC) data that was collected in 2017 and is discussed further in Appendix A. Use of the 2017 ANPR data with the lower HDV percentage would result in lower emission rates for the HDV categories than was estimated for the 2019 HRA.

3.7 The percentage of motorcycles are similarly lower in the ANPR data compared to the EFTs.

3.8 The ANPR data captures a greater percentage of the fleet as electric cars and hybrids, albeit small, than is the case within the EFT rural fleet. This would serve to reduce the overall emission rates.

Table 1. Basic Vehicle Split Comparisons Between EFT v8.0.1, 9.0 and 2017 ANPR

Vehicle Type	Proportion of Vehicle Fleet in 2017		
	EFT v8.0.1 (Rural – not London)	EFT v9.0 (Rural – not London)	Local 2017 ANPR Data*
Petrol Car	36.0%	36.3%	40.1% (+3.8%)
Diesel Car	40.5%	39.7%	36.0% (-3.7%)
Taxi (black cab)	0.0%	0.0%	0.7% (+0.7%)
Petrol LGV	0.5%	0.5%	0.1% (-0.3%)
Diesel LGV	15.0%	15.5%	18.2% (+2.7%)
Rigid HGV	2.6%	2.6%	2.0% (-0.6%)
Articulated HGV	2.4%	2.4%	0.3% (-2.1%)
Bus and coach	0.5%	0.5%	0.2% (-0.3%)
Motorcycle	0.9%	0.9%	0.1% (-0.8%)
Hybrid Car (Petrol)	1.1%	1.1%	1.4% (+0.3%)
Plug-In Hybrid Car (Petrol)	0.6%	0.4%	0.7% (+0.3%)
Hybrid Car (Diesel)	0.1%	0.1%	0.1% (-0.1%)
Electric Car	0.0%	0.0%	0.1% (0.1%)
Electric LGV	0.0%	0.0%	0.0% (<0.1%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding.

Basic Fleet Split 2019

3.9 The EFT analysis in this section is undertaken for the default rural fleet of 2019.

3.10 Between EFT versions 8.0.1 and 9.0, there are minor updates to the fleet make-up, with the main change to the rural fleet being a reduction in diesel cars, which is offset by small increases in the percentages of petrol cars and diesel LGVs.

3.11 The 2019 ANPR data exhibits a larger percentage of the fleet as petrol cars than the default assumptions contained in the EFT for the rural fleet, and comparatively a lesser proportion of the fleet as diesel cars. However, the total percentage of the vehicle fleet represented by cars is consistent across the ANPR data and the EFTs (approximately 75%). The relatively higher proportion of petrol cars in the ANPR data would reduce the overall NOx emission rate calculated for a fleet derived from the ANPR data as compared to the default EFT rural fleet assumptions.

3.12 Diesel LGVs are more prevalent within the 2019 ANPR survey data than the EFT default rural fleet. This is consistent with the 2017 ANPR data. The proportion of petrol LGVs is low in both versions of the EFT (0.4%) and even lower in the 2019 ANPR data (0.2%).

3.13 The total percentage of HDV is relatively low in the 2019 ANPR data (2.0%) and is broadly consistent with the 2017 ANPR data. Both rigid and articulated HGV percentages are somewhat lower in the ANPR than the EFT default rural fleet (1.0% and 2.2% lower, respectively). Use of the 2019 ANPR data HDV percentage rather than the percentage specified in the 2019 HRA modelling (6-9%) from the ATC data would result in lower emission rates for the HDV categories.

3.14 The percentage of motorcycles are similarly lower in the ANPR data compared to the EFTs.

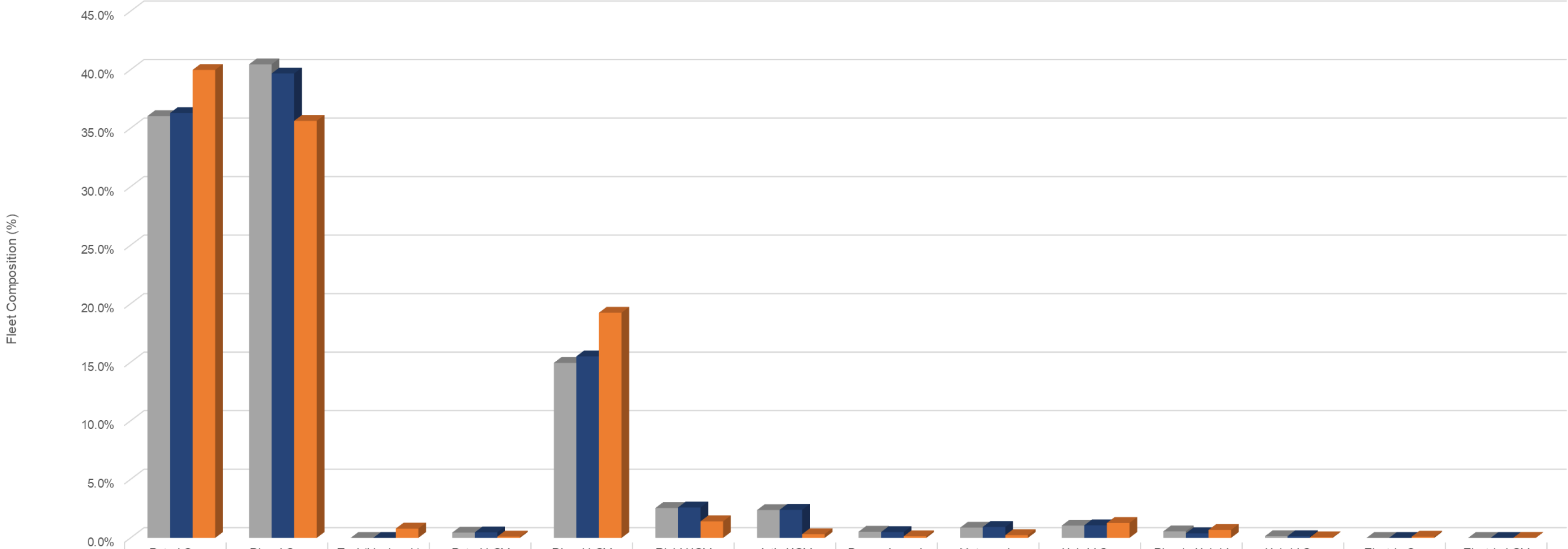
3.15 The ANPR data captures a greater percentage of the fleet as electric cars and hybrids, albeit small, than is the case within the EFT rural fleet. This would serve to reduce the overall emission rates.

Table 2. Basic Vehicle Split Comparisons Between EFT v8.0.1, 9.0 and 2019 ANPR

	Proportion of Vehicle Fleet in 2019		
Vehicle Type	EFT v8.0.1 (Rural – not London)	EFT v9.0 (Rural – not London)	Local 2019 ANPR Data*
Petrol Car	33.7%	34.0%	43.8% (+9.8%)
Diesel Car	41.9%	40.8%	31.5% (-9.3%)
Taxi (black cab)	0.0%	0.0%	0.5% (+0.5%)
Petrol LGV	0.4%	0.4%	0.2% (-0.2%)
Diesel LGV	15.0%	15.8%	18.0% (+2.2%)
Rigid HGV	2.5%	2.6%	1.6% (-1.0%)
Articulated HGV	2.4%	2.4%	0.2% (-2.2%)
Bus and coach	0.5%	0.5%	0.2% (-0.3%)
Motorcycle	0.8%	0.9%	0.0% (-0.9%)
Hybrid Car (Petrol)	1.6%	1.6%	2.4% (+0.7%)
Plug-In Hybrid Car (Petrol)	0.8%	0.7%	1.2% (+0.5%)
Hybrid Car (Diesel)	0.4%	0.4%	0.1% (-0.3%)
Electric Car	0.0%	0.0%	0.3% (+0.3%)
Electric LGV	0.0%	0.0%	0.0% (<0.1%)

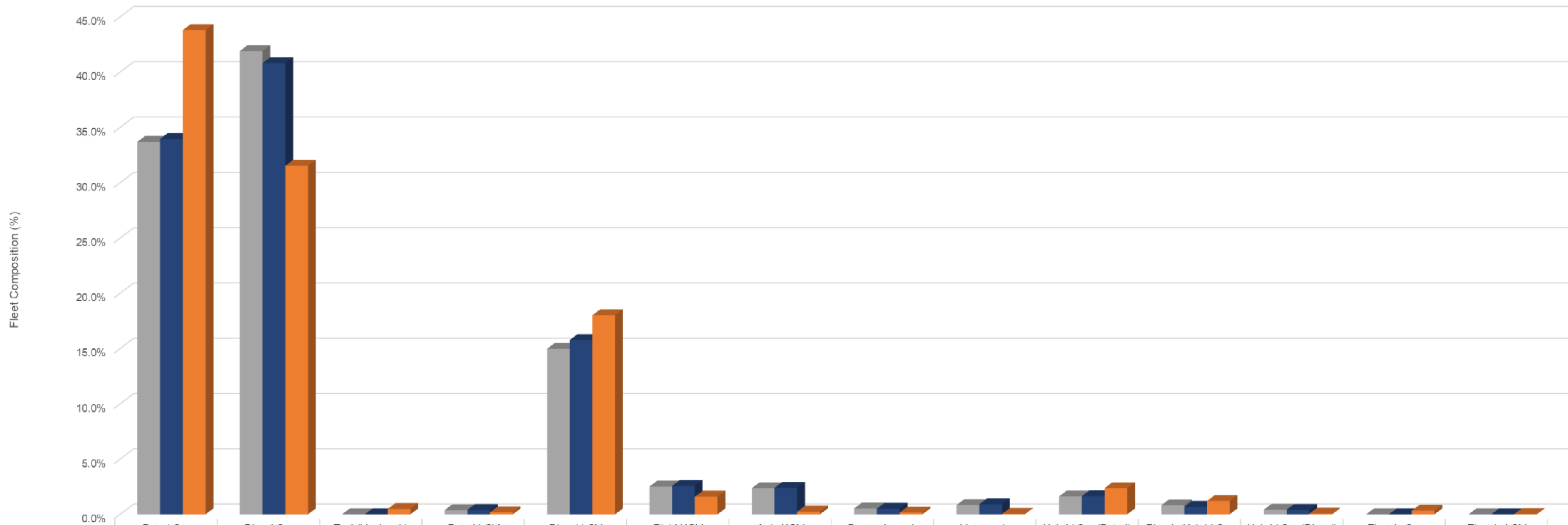
* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding.

Figure 1. Basic Fleet Split Comparisons Between EFT v8.0.1, 9.0 and 2017 ANPR Data



	Petrol Car	Diesel Car	Taxi (black cab)	Petrol LGV	Diesel LGV	Rigid HGV	Artic HGV	Bus and coach	Motorcycle	Hybrid Car (Petrol)	Plug-In Hybrid Car (Petrol)	Hybrid Car (Diesel)	Electric Car	Electric LGV
EFT v.8.0.1 (2017)	36.0%	40.5%	0.0%	0.5%	15.0%	2.6%	2.4%	0.5%	0.9%	1.1%	0.6%	0.1%	0.0%	0.0%
EFT v9.0 (2017)	36.3%	39.7%	0.0%	0.5%	15.5%	2.6%	2.4%	0.5%	0.9%	1.1%	0.4%	0.1%	0.0%	0.0%
ANPR 2017	40.0%	35.6%	0.8%	0.1%	19.2%	1.4%	0.3%	0.1%	0.2%	1.3%	0.7%	0.1%	0.1%	0.0%

Figure 2. Basic Fleet Split Comparisons Between EFT v8.0.1, 9.0 and 2019 ANPR Data



	Petrol Car	Diesel Car	Taxi (black cab)	Petrol LGV	Diesel LGV	Rigid HGV	Artic HGV	Bus and coach	Motorcycle	Hybrid Car (Petrol)	Plug-In Hybrid Car (Petrol)	Hybrid Car (Diesel)	Electric Car	Electric LGV
EFT v.8.0.1 (2019)	33.7%	41.9%	0.0%	0.4%	15.0%	2.5%	2.4%	0.5%	0.8%	1.6%	0.8%	0.4%	0.0%	0.0%
EFT v9.0 (2019)	34.0%	40.8%	0.0%	0.4%	15.8%	2.6%	2.4%	0.5%	0.9%	1.6%	0.7%	0.4%	0.0%	0.0%
ANPR 2019	43.8%	31.5%	0.5%	0.2%	18.0%	1.6%	0.2%	0.2%	0.0%	2.4%	1.2%	0.1%	0.3%	0.0%

Impact of Basic Fleet Breakdown on Emissions of NOx

3.16 To assess the potential impact of variations in the fleet breakdown on the resultant road vehicle emissions, NO_x emission rates were calculated using the EFTs for an arbitrary road link of 10,000 Annual Average Daily Traffic (AADT) flow and a speed of 40 km/h. The 'Detailed Option 3' traffic format was used, which requires percentages of petrol cars, diesel cars, black cab taxis (EFT version 9.0 only), LGVs, rigid HGVs, articulated HGVs, buses/coaches, and motorcycles to be specified.

3.17 Since it is not possible to input taxis as a separate vehicle class in EFT version 8.0.1, the taxis were grouped with diesel cars in the version 8.0.1 runs, as the surveyed taxis were all diesel fuelled.

3.18 NO_x emissions calculated using fleet breakdowns derived from the different data sources are presented in Table 3 and Table 4. For the EFT calculations, the default HDV proportions are applied as presented in Table 1 and Table 2, whilst for the ANPR runs the percentage HDV is derived from the ANPR observations[6].

Table 3. Calculated NO_x Emissions (g/km/s) Using Standard EFT Fleet Split Assumptions

Year	Road Type	Traffic Flow	Fleet Split	Speed (kph)	EFT V8.0.1	EFT V9
2017	Rural (not London)	10000	See Table 1 [a]	40	0.05812	0.05828
2019	Rural (not London)	10000	See Table 2 [b]	40	0.04889	0.04921

[a] Fleet split taken from Table 1, columns EFT v8.0.1 and EFT v9.0. [b] Fleet split taken from Table 2, columns EFT v8.0.1 and EFT v9.0.

Table 4. Calculated NO_x Emissions (g/km/s) Using ANPR Data Fleet Split

Year	Road Type	Traffic Flow	Fleet Split	Speed (kph)	EFT V8.0.1	EFT V9
2017	Rural (not London)	10000	See Table 1 [a]	40	0.05217	0.05239
2019	Rural (not London)	10000	See Table 2 [a]	40	0.04125	0.04154

[a] Fleet split taken from Table 1, column Local 2017 ANPR data. [b] Fleet split taken from Table 2, , column Local 2019 ANPR data.

3.19 In all calculations, using EFT v9.0 results in similar but marginally higher road NO_x emission rates compared to EFT v8.0.1, although all of the differences are less than 1%. The highest NO_x emission rates in both 2017 and 2019 are calculated using EFT v9.0 and the standard EFT rural fleet split assumptions therein.

3.20 Using the ANPR data to determine the vehicle fleet split (HDV/LDV) results in calculated emission rates that are lower (by between 10 and 16%) than both versions of the EFT using default rural fleet splits for 2017[6] and 2019. This is primarily due to the lower proportions of diesel cars, and rigid and articulated HGVs in the ANPR-derived fleet split compared to the EFT default rural fleet. Despite the higher proportion of diesel LGVs in the ANPR fleet, the impact on emissions is much smaller than the reduction in emissions due to the lower proportions of diesel cars and HGVs.

[6] Note that the user-defined HDV proportions in the current study are marginally lower than those applied in the 2019 HRA (6 to 9%), however they are greater than those derived from the ANPR data, therefore the conclusions of the analysis relative to the 2019 HRA remain valid.

4. Vehicle Euro Class Breakdown

4.1 Table 5 to Table 10 present comparisons of the vehicle fleet Euro Class breakdown derived from the two versions of the EFT (rural roads) and the ANPR data for 2017 and 2019. The tables cover for conventional light-duty vehicles, hybrid light-duty vehicles and taxis, heavy-duty vehicles, and buses and coaches.

4.2 Figure 3 to Figure 14 are located in Appendix C, and present the comparisons of the vehicle fleet Euro Class breakdown in graphical form.

Light-Duty Vehicles

4.3 The Euro Class breakdown for conventional cars (Table 5) obtained from EFT versions 8.0.1 and 9.0 for the rural fleet agree closely with one another. A notable difference between version 8.0.1 and 9.0 is the sub-division of Euro 6 cars into the additional Euro 6c and 6d classes. However, the sum of the Euro 6 sub-divisions obtained from version 9.0 compares closely to the Euro 6 total from version 8.0.1 for the conventional car categories.

4.4 The ANPR data for both 2017 and 2019 indicate that the local car fleet is older than the corresponding national rural default figures contained in the EFT databases. For example, in 2019 the percentages of Euro 3 and Euro 4 petrol and diesel cars derived from the ANPR data are up to 4.2% higher than the equivalent Euro classes in EFT version 9.0. Correspondingly, the percentages of the newest vehicles (i.e. Euro 6 and its sub-divisions) are lower than the EFT projections.

4.5 A similar pattern is evident in the LGV data (Table 6); the percentages of Euro 3 and Euro 4 LGVs (and Euro 5 diesel LGVs) in the 2017 and 2019 ANPR data are higher than the respective EFT rural fleet proportions, whereas Euro 5 and Euro 6 proportions are lower. This indicates that the local LGV fleet is older than the national rural average.

4.6 The Euro Class breakdown obtained from EFT versions 8.0.1 and 9.0 for the rural fleet show a close agreement for the full-hybrid cars category, the only real difference being the additional disaggregation of the Euro 6 category in version 9.0 (Table 7). For plug-in hybrid cars, the 2017 EFT percentage of Euro 6 cars for rural roads is collectively around 20% higher in version 9.0 than in version 8.0.1, suggesting the uptake of these vehicles has been more rapid than was previously anticipated. A similar pattern is shown for 2019. The ANPR data for full hybrid and plug-in hybrid petrol cars indicates that the local vehicle fleet is older than the national average figures of the EFT rural fleet. There are higher proportions of Euro 3 to Euro 5 full hybrids in both years of ANPR data compared to the corresponding EFT projections. Correspondingly, the percentage of Euro 6 vehicles is lower. For plug-in hybrid cars the same pattern is evident, with much higher proportions of Euro 5 vehicles compared to the EFT rural fleet.

4.7 Consistent with the other car categories, the ANPR data for diesel hybrid cars indicates an older local fleet than the national rural default projections (Table 8). The percentages of Euro 5 diesel hybrids in the 2017 and 2019 ANPR survey data are approximately 40% higher than the EFT rural default figures, and the Euro 6 percentages correspondingly lower.

4.8 The taxi (black cab) Euro Class breakdown for areas outside of Inner London was newly introduced in version 9.0 of the EFT and therefore comparisons with EFT version 8.0.1 are not possible. As is evident for the other light-duty vehicle categories, the local taxi fleet as determined from the ANPR data is older than the EFT projection (Table 8). In 2017, the percentages of Euro 3 and Euro 4 taxis are approximately 21% higher than the corresponding EFT figures, respectively, whilst the percentages of Euro 5 and Euro 6 vehicles are 12% and 30% lower than EFT figures. A similar pattern is seen for taxis in the 2019 data; however, the percentage of Euro 6 vehicles derived from the ANPR data is around 40% lower than the EFT fleet projection.

4.9 Overall, the analysis of the Euro Class breakdown of the local light-duty vehicle fleet, based on both the 2017 and 2019 ANPR surveys, suggest that the local fleet is older than the rural fleet default projections contained within the EFT. Higher proportions of earlier Euro standard vehicles using ANPR data would result in higher vehicle NOx emission rates than using the EFT default rural fleet proportions.

Heavy-Duty Vehicles

4.10 The Euro Class breakdown for heavy-goods vehicles (Table 9) determined from EFT versions 8.0.1 and 9.0 for the national rural fleet show a close agreement for all Euro standards. Version 9.0 of the EFT assumes a slightly higher percentage of Euro VI rigid HGVs compared to version 8.0.1 offset by slightly lower percentages of Euro V EGR and SCR vehicles. For articulated HGVs this pattern is reversed, with a slightly lower percentage of Euro VI vehicles and corresponding higher percentages of Euro V vehicles assumed in version 9.0.

4.11 For rigid HGVs, the ANPR data for 2017 and 2019 indicate that the local vehicle fleet is older than the rural fleet national average. The proportion of Euro VI rigid HGVs are 22% and 14% lower than the EFT projections for 2017 and 2019, respectively. This is offset by increased proportions of Euro III, Euro IV and Euro V vehicles.

4.12 For articulated HGVs, the 2017 ANPR data indicates a local articulated HGV fleet older than the default EFT rural fleet, with Euro VI vehicles approximately 28% lower in the ANPR data than the EFT. By contrast, in 2019, there is a very close agreement between the ANPR data and EFT with the ANPR-derived proportions for all Euro standards agreeing to within 1% of the EFT projections.

4.13 For buses and coaches, there is very close agreement in the Euro Class breakdown between the two versions of the EFT. The ANPR data indicates lower percentages of Euro VI buses and coaches than the national average rural fleet projections for both 2017 and 2019, indicating that the local vehicle fleet is older. The lower percentages of Euro VI buses are largely offset by relative higher percentages of Euro IV and Euro V vehicles.

4.14 Overall, the analysis of the Euro Class breakdown of the local heavy-duty vehicle fleet, based on both the 2017 and 2019 ANPR surveys, suggests that the local fleet is older than the default rural projections contained within the EFT. Higher proportions of earlier Euro standard vehicles using ANPR data would result in higher vehicle NOx emission rates than using the EFT default rural fleet proportions.

Table 5. Euro Class Split Comparisons Between EFT v8.0.1, v9.0 and ANPR, 2017 and 2019: Petrol and Diesel Cars

Euro Standard	Petrol cars			Diesel cars			Petrol cars			Diesel cars		
	2017 EFT 8.0.1	2017 EFT v9.0	2017 ANPR Data*	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro 1**	1.3%	1.3%	1.3% (-0.1%)	0.0%	0.0%	0.0% (<0.1%)	1.2%	1.2%	1.2% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro 1	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro 2	0.8%	0.8%	0.1% (-0.7%)	0.2%	0.2%	0.0% (-0.2%)	0.2%	0.2%	0.0% (-0.2%)	0.1%	0.1%	0.0% (<0.1%)
Euro 3	10.5%	10.3%	18.1% (+7.9%)	5.5%	5.4%	8.5% (+3.1%)	4.5%	4.5%	9.4% (+5.0%)	2.4%	2.3%	4.4% (+2.1%)
Euro 4	22.9%	22.5%	30.4% (+7.9%)	19.3%	18.8%	21.9% (+3.1%)	15.3%	15.1%	21.9% (+6.8%)	12.6%	12.4%	16.6% (+4.2%)
Euro 5	33.1%	33.2%	31.0% (-2.2%)	39.9%	40.0%	42.4% (+2.4%)	27.6%	27.9%	24.4% (-3.5%)	32.7%	32.9%	32.2% (-0.7%)
Euro 6	31.3%	19.8%	11.9% (-7.9%)	35.1%	22.4%	17.1% (-5.3%)	51.1%	16.6%	14.0% (-2.7%)	52.3%	18.2%	16.3% (-2.0%)
Euro 6c	-	12.1%	7.2% (-4.8%)	0.0%	13.2%	10.1% (-3.1%)	-	34.6%	29.0% (-5.5%)	-	34.1%	30.4% (-3.7%)
Euro 6d	-	-	-	0.0%	0.0%	0.0% (<0.1%)	-	-	-	-	0.0%	0.0% (<0.1%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. ** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 6. Euro Class Split Comparisons Between EFT v8.0.1, 9.0 and 2017 ANPR, 2017 and 2019: Petrol and Diesel LGVs

Euro Standard	Petrol LGVs			Diesel LGVs			Petrol LGVs			Diesel LGVs		
	2017 EFT 8.0.1	2017 EFT v9.0	2017 ANPR Data*	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro 1**	1.6%	1.6%	1.2% (-0.4%)	0.0%	0.0%	0.0% (<0.1%)	1.4%	1.4%	1.2% (-0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro 1	0.1%	0.1%	0.0% (-0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro 2	2.2%	2.2%	0.0% (-2.2%)	1.0%	1.0%	0.1% (-0.9%)	1.0%	1.0%	0.0% (-1.0%)	0.4%	0.4%	0.0% (-0.4%)
Euro 3	11.1%	11.0%	44.4% (+33.4%)	5.3%	5.3%	12.5% (+7.2%)	5.9%	6.0%	26.8% (+20.8%)	2.4%	2.4%	6.3% (+3.9%)
Euro 4	19.8%	19.7%	42.5% (+22.8%)	19.6%	19.5%	26.4% (+6.9%)	14.9%	15.2%	13.8% (-1.4%)	12.4%	12.7%	16.0% (+3.3%)
Euro 5	33.8%	33.8%	6.7% (-27.1%)	41.6%	41.5%	53.0% (+11.5%)	29.1%	29.6%	7.3% (-22.4%)	30.1%	30.9%	35.8% (+4.9%)
Euro 6	31.4%	31.5%	5.2% (-26.3%)	32.6%	32.7%	8.0% (-24.7%)	47.7%	21.9%	23.9% (+1.9%)	54.7%	19.0%	14.9% (-4.2%)
Euro 6c	0.0%	0.0%	0.0% (<0.1%)	-	0.0%	0.0% (<0.1%)	0.0%	24.8%	27.0% (+2.2%)	-	34.6%	27.0% (-7.6%)
Euro 6d	-	-	-	-	0.0%	0.0% (<0.1%)	-	-	-	-	0.0%	0.0% (<0.1%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. EFT version 8.0.1 does not contain Euro Class information for taxis for areas outside of Inner London. ** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 7. Euro Class Split Comparisons Between EFT v8.0.1, 9.0 and ANPR, 2017 and 2019: Petrol Hybrid Cars

Euro Standard	Full Hybrid Petrol Cars			Plug-in Hybrid Petrol Cars			Full Hybrid Petrol Cars			Plug-in Hybrid Petrol Cars		
	2017 EFT 8.0.1	2017 EFT v9.0	2017 ANPR Data*	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro 1**	1.1%	1.1%	1.2% (+0.2%)	1.1%	1.1%	1.2% (+0.2%)	1.1%	1.1%	1.2% (+0.1%)	1.1%	1.1%	1.2% (+0.2%)
Euro 1	-	-	-	-	-	0.0% (<0.1%)	-	-	0.0% (<0.1%)	-	-	-
Euro 2	-	-	-	-	-	0.0% (<0.1%)	-	-	0.0% (<0.1%)	-	-	-
Euro 3	0.4%	0.4%	12.2% (+11.8%)	-	-	0.0% (<0.1%)	0.1%	0.1%	4.1% (+4.0%)	-	-	-
Euro 4	9.3%	9.0%	12.2% (+3.2%)	-	-	0.0% (<0.1%)	4.0%	4.0%	6.9% (+3.0%)	-	-	-
Euro 5	28.2%	28.0%	41.9% (+13.8%)	31.1%	9.5%	55.6% (+46.1%)	14.7%	14.9%	20.7% (+5.8%)	17.9%	4.7%	23.3% (+18.6%)
Euro 6	61.1%	31.9%	16.8% (-15.1%)	67.8%	63.2%	30.5% (-32.7%)	80.1%	17.2%	14.4% (-2.8%)	81.0%	32.4%	25.9% (-6.5%)
Euro 6c	-	29.7%	15.7% (-14.0%)	-	26.2%	12.7% (-13.6%)	-	62.8%	52.6% (-10.1%)	-	61.9%	49.5% (-12.4%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. ** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 8. Euro Class Split Comparisons Between EFT v8.0.1, 9.0 and ANPR, 2017 and 2019: Diesel Hybrid Cars and Taxis

Euro Standard	Diesel Hybrid Cars			Taxis			Diesel Hybrid Cars			Taxis		
	2017 EFT 8.0.1	2017 EFT v9.0	2017 ANPR Data*	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro 1	-	-	-	-	0.0%	0.0% (<0.1%)	-	-	-	-	0.0%	0.0% (<0.1%)
Euro 1	-	-	-	-	0.0%	0.0% (<0.1%)	-	-	-	-	0.0%	0.0% (<0.1%)
Euro 2	-	-	-	-	1.0%	0.0% (-1.0%)	-	-	-	-	0.4%	0.0% (-0.4%)
Euro 3	-	-	-	-	5.3%	26.7% (+21.4%)	-	-	-	-	2.4%	18.5% (+16.1%)
Euro 4	-	-	-	-	19.5%	40.4% (+20.8%)	-	-	-	-	12.7%	37.0% (+24.3%)
Euro 5**	14.2%	14.2%	56.0% (+41.9%)	-	41.5%	29.8% (-11.7%)	4.8%	4.9%	45.9% (+41.0%)	-	30.9%	33.9% (+3.0%)
Euro 6	85.8%	37.2%	19.1% (-18.1%)	-	32.7%	3.2% (-29.5%)	95.2%	11.3%	6.4% (-4.9%)	-	19.0%	3.8% (-15.2%)
Euro 6c	-	48.7%	24.9% (-23.7%)	-	0.0%	0.0% (0.0%)	-	83.8%	47.7% (-36.1%)	-	34.6%	6.9% (-27.7%)
Euro 6d	-	0.0%	0.0% (<0.1%)	-	0.0%	0.0% (0.0%)	-	0.0%	0.0% (<0.1%)	-	0.0%	0.0% (<0.1%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. ** Euro 5 diesel hybrid cars category includes vehicles with failed catalysts.

Table 9. Euro Class Split Comparisons Between EFT v8.0.1, 9.0 and ANPR, 2017 and 2019: Heavy-Goods Vehicles

Euro Standard	Rigid HGVs			Articulated HGVs			Rigid HGVs			Articulated HGVs		
	2017 EFT 8.0.1	2017 EFT v9.0	2017 ANPR Data*	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro I	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro I	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro II	1.4%	1.4%	0.1% (-1.3%)	0.2%	0.2%	0.5% (+0.3%)	0.6%	0.5%	0.0% (-0.5%)	0.0%	0.0%	0.3% (+0.3%)
Euro III	8.8%	8.5%	12.1% (+3.6%)	1.8%	1.9%	1.9% (<0.1%)	4.4%	4.1%	4.9% (+0.8%)	0.6%	0.7%	1.5% (+0.8%)
Euro IV	8.2%	7.9%	17.9% (+10.0%)	2.8%	2.9%	11.3% (+8.4%)	4.7%	4.4%	9.5% (+5.1%)	1.1%	1.2%	0.9% (-0.3%)
Euro V EGR	6.7%	6.4%	8.9% (+2.5%)	5.9%	6.1%	10.9% (+4.8%)	4.9%	4.6%	6.6% (+2.1%)	3.1%	3.3%	3.2% (-0.1%)
Euro V SCR	20.0%	19.2%	26.7% (+7.5%)	17.7%	18.3%	32.7% (+14.4%)	14.6%	13.7%	19.9% (+6.2%)	9.3%	9.8%	9.5% (-0.3%)
Euro VI	54.8%	56.7%	34.3% (-22.4%)	71.6%	70.6%	42.7% (-27.8%)	70.9%	72.7%	59.1% (-13.5%)	85.8%	85.0%	84.7% (-0.3%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. ** Pre-Euro I category includes vehicles with failed catalysts.

Table 10. Euro Class Split Comparisons Between EFT v8.0.1, 9.0 and ANPR, 2017 and 2019: Buses and Coaches

Euro Standard	Buses and Coaches			Buses and Coaches		
	2017 EFT v8.0.1	2017 EFT v9.0	2017 ANPR Data*	2019 EFT v8.0.1	2019 EFT v9.0	2019 ANPR Data*
Pre-Euro I	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro I	0.0%	0.0%	0.0% (<0.1%)	0.0%	0.0%	0.0% (<0.1%)
Euro II	3.3%	3.3%	0.0% (-3.3%)	1.6%	1.6%	0.0% (-1.6%)
Euro III	13.2%	13.1%	14.7% (+1.6%)	7.6%	7.5%	2.8% (-4.8%)
Euro IV	10.5%	10.4%	28.6% (+18.2%)	7.2%	7.1%	19.8% (+12.7%)
Euro V EGR	8.2%	8.2%	12.1% (+3.9%)	6.4%	6.3%	11.5% (+5.2%)
Euro V SCR	24.7%	24.6%	36.3% (+11.8%)	19.2%	18.9%	34.6% (+15.6%)
Euro VI	40.1%	40.4%	8.2% (-32.2%)	58.0%	58.6%	31.3% (-27.2%)

* Numbers in brackets represent variance from EFT v9.0. Percentages may not add up to exactly 100% due to rounding. ** Pre-Euro I category includes vehicles with failed catalysts.

Impact of Euro Class Breakdown on Emissions

4.15 To assess the potential impact of variations in the Euro Class breakdown on the resultant road vehicle emissions, NO_x emission rates were calculated using the two version of the EFT for an arbitrary road link of 10,000 vehicles AADT and a speed of 40 km/h. The 'Detailed Option 3' traffic format was used, which requires percentages of petrol cars, diesel cars, black cab taxis (EFT version 9.0 only), LGVs, rigid HGVs, articulated HGVs, buses/coaches, and motorcycles to be specified. To enable the effect only of changes in Euro Class breakdown to be assessed the default EFT fleet proportions for the relevant year were used in all calculations. Since it is not possible to input taxis as a separate vehicle class in EFT version 8.0.1 the taxis were grouped with diesel cars in the version 8.0.1 runs, as the surveyed taxis were all diesel fuelled.

4.16 NO_x emissions calculated using Euro Class breakdowns derived from the different data sources are presented in Table 11 and Table 12. For the EFT default Euro Class calculations, the default Euro standard proportions are applied, whilst for the ANPR runs the Euro split is derived from the ANPR observations.

4.17 Comparing the NO_x emissions in Table 11 and Table 12 it can be seen that the use of Euro Class breakdown derived from ANPR observations results in higher emission rates than using the EFT default breakdowns. This would be expected as the previous discussion of ANPR data suggested an older vehicle fleet (i.e. greater proportions of earlier Euro standards) across the majority of vehicle types than the EFT figures. This is consistent for both the 2017 and 2019 data.

4.18 The use of EFT version 9.0 results in slightly higher NO_x emission rates compared to EFT version 8.0.1; this is consistent with the observations from the Basic Fleet Split analysis (see para 3.2).

Table 11. Calculated NO_x Emissions (g/km/s) Using Standard EFT Euro Class Assumptions

Year	Road Type	Traffic Flow	Fleet Split	Speed (kph)	EFT V8.0.1	EFT V9
2017	Rural (not London)	10000	See Table 1 [a]	40	0.05812	0.05828
2019	Rural (not London)	10000	See Table 2 [b]	40	0.04889	0.04921

[a] Fleet split taken from Table 1, columns EFT v8.0.1 and EFT v9.0. [b] Fleet split taken from Table 2, columns EFT v8.0.1 and EFT v9.0.

Table 12. Calculated NO_x Emissions (g/km/s) Using ANPR Euro Class Breakdown

Year	Road Type	Traffic Flow	Fleet Split	Speed (kph)	EFT V8.0.1	EFT V9
2017	Rural (not London)	10000	See Table 1 [a]	40	0.06715	0.06750
2019	Rural (not London)	10000	See Table 2 [b]	40	0.05366	0.05373

[a] Fleet split taken from Table 1, columns EFT v8.0.1 and EFT v9.0. [b] Fleet split taken from Table 2, columns EFT v8.0.1 and EFT v9.0.

Combined Impact of Basic Fleet and Euro Class Breakdowns on Emissions

4.19 Table 13 presents the total NO_x emissions considering the combined effect of both basic fleet split and Euro Class breakdown derived from the ANPR surveys.

4.20 Comparing the calculated emissions in Table 13 with those presented in Table 4, calculated applying the local basic fleet split only, it can be seen that the combined effect of using the local basic fleet split and Euro Class breakdown results in higher emissions than the use of the local basic fleet split alone. This would be expected since the analysis of the ANPR data indicated that the local fleet comprises larger proportions of older vehicles than the default assumptions contained in the EFT.

4.21 Comparing the calculated emissions in Table 13 with those presented in Table 11, calculated using the EFT default basic fleet split and default Euro Class breakdown, it can be seen that the combined effect of using the local basic fleet split and local Euro Class breakdown results in lower emissions than the use of the default EFT assumptions. This is because the effect of the local ANPR basic fleet split in reducing emissions relative to the EFT default assumptions outweighs the effect of local ANPR Euro Class breakdown in increasing emissions relative to the EFT default assumptions. It would appear that the vehicle emission rates are more strongly influenced by the *proportion* of HGVs within the vehicle fleet than the Euro standard makeup of the vehicle fleet.

4.22 In 2017, the total NO_x emission rate calculated using EFT version 9.0 and the application of ANPR basic fleet and Euro Class figures is 0.04530 g/km/s. This is approximately 8% lower than the emission rate calculated using the EFT default figures (0.04921 g/km/s).

Table 13. Calculated NO_x Emissions (g/km/s) Using ANPR Basic Fleet and Euro Class Breakdowns

Year	Road Type	Traffic Flow	Fleet Split	Speed (kph)	EFT V8.0.1	EFT V9
2017	Rural (not London)	10000	See Table 1 [a]	40	0.05678	0.05717
2019	Rural (not London)	10000	See Table 2 [b]	40	0.04505	0.04530

[a] Fleet split taken from Table 1, column Local 2017 ANPR data. [b] Fleet split taken from Table 2, column Local 2019 ANPR data

5. Road Type

5.1 The analyses in sections 3 and 4 have been undertaken relative to the EFT's rural road vehicle fleet, however as shown, there are intrinsic differences in the EFSAC ANPR data and the EFT's rural fleet e.g. relative split between petrol and diesel cars, proportion of electric vehicles. In this section, the 2019 ANPR data are compared against the vehicle fleet for rural, urban and outer London roads, in terms of both the Basic Fleet Split and the breakdown between Euro Classes.

5.2 The purpose of the comparison is to ascertain whether the vehicle fleet operating on the roads through the EFSAC can be considered to be most like the national average for rural, urban or outer London roads[7]. The conclusions of the analysis will be used to inform the projection of the vehicle fleet that will be expected to use the roads in EFSAC in future years, and in turn, will inform any appropriate mitigation measures. Note that the analysis is undertaken using the current version of the EFT only, v9.0, as this is the tool that will used in the upcoming air quality modelling study. The EFT v9.0 provides the ability to project the Euro class distribution for future years, however it does not project the proportion of vehicles in terms of the basic fleet split.

Basic Fleet Split

5.3 Table 14, Table 15 and Table 16 present a comparison of the 2019 ANPR derived fleet with the EFT v9.0 rural, urban and outer London Basic Fleet Splits, respectively. The comparison is undertaken with the HDV percentage defined in EFT v9.0 to equal the 2019 ANPR percentage (2.0%), therefore there is no difference for rigid HGV, articulated HGV, buses and coaches, and it is presented as <0.1%.

5.4 The greatest difference between the 2019 ANPR fleet and the EFT rural (not London) fleet is the relative proportions of petrol and diesel cars (+8.6% and -10.8% respectively). There is also a slightly greater proportion of diesel LGVs in the 2019 ANPR data (+1.7%). There are more petrol hybrid and electric cars present in the 2019 ANPR fleet than in the EFT's rural fleet, though (to a lesser extent) fewer hybrid diesel cars.

5.5 The difference between the relative proportions of petrol and diesel cars in the 2019 ANPR fleet and the EFT urban (not London) fleet is smaller relative to the EFT rural fleet (+2.9% and -5.7% respectively). There is also a greater proportion of diesel LGVs in the 2019 ANPR data (+3.0%). Similarly, there are more petrol hybrid and electric cars present in the 2019 ANPR fleet than in the EFT's urban fleet, though (to a lesser extent) fewer hybrid diesel cars.

5.6 Whilst there are no black cab taxis included in the EFT's rural or urban fleets, 0.5% of the 2019 ANPR fleet was found to comprise of these vehicles, presumably because of the location of the EFSAC relative to London. This is in addition to the greater proportion of diesel LGVs in the 2019 ANPR fleet.

5.7 The 2019 ANPR fleet shows a similar proportion of the fleet as petrol cars compared to the outer London fleet, with the lower proportion of diesel cars and black cab taxis (-4.8% and -1.6% respectively) largely off-set by the greater proportion of diesel LGVs (+6.9%). There are more petrol hybrid cars present in the 2019 ANPR fleet than in the EFT's outer London fleet, and (as with the EFT rural and urban fleets), fewer hybrid diesel cars. The proportion of electric vehicles is marginally less in the 2019 ANPR fleet than in outer London fleet.

5.8 The proportion of motorcycles in the 2019 ANPR fleet was found to be less than 0.1%, and is thus smaller than the proportion present in the EFT's rural, urban and outer London fleets (-0.9%, -1.1%, -1.5% respectively).

[7] Other road types have been excluded from the comparison, as they are not considered to be appropriate in this case (namely, motorways, inner London and

Table 14. Basic Vehicle Split Comparisons Between EFT 9.0 Rural Fleet and 2019 ANPR

Vehicle Type	Proportion of Vehicle Fleet in 2019*		
	EFT v9.0 (Rural – not London)	Local 2019 ANPR Data*	Difference of ANPR 2019 from EFT v9.0 Rural fleet
Petrol Car	35.2%	43.8%	+8.6%
Diesel Car	42.3%	31.5%	-10.8%
Taxi (black cab)	0.0%	0.5%	+0.5%
Petrol LGV	0.4%	0.2%	-0.2%
Diesel LGV	16.3%	18.0%	+1.7%
Rigid HGV	1.6%	1.6%	<0.1%
Articulated HGV	0.2%	0.2%	<0.1%
Bus and coach	0.2%	0.2%	<0.1%
Motorcycle	0.9%	0.0%	-0.9%
Hybrid Car (Petrol)	1.7%	2.4%	+0.7%
Plug-In Hybrid Car (Petrol)	0.7%	1.2%	+0.5%
Hybrid Car (Diesel)	0.4%	0.1%	-0.4%
Electric Car	0.0%	0.3%	+0.3%
Electric LGV	0.0%	0.0%	<0.1%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 15. Basic Vehicle Split Comparisons Between EFT 9.0 Urban Fleet and 2019 ANPR

Vehicle Type	Proportion of Vehicle Fleet in 2019*		
	EFT v9.0 (Urban – not London)	Local 2019 ANPR Data*	Difference of ANPR 2019 from EFT v9.0 Urban fleet
Petrol Car	40.9%	43.8%	+2.9%
Diesel Car	37.2%	31.5%	-5.7%
Taxi (black cab)	0.0%	0.5%	+0.5%
Petrol LGV	0.4%	0.2%	-0.2%
Diesel LGV	15.0%	18.0%	+3.0%
Rigid HGV	1.6%	1.6%	<0.1%
Articulated HGV	0.2%	0.2%	<0.1%
Bus and coach	0.2%	0.2%	<0.1%
Motorcycle	1.1%	0.0%	-1.1%
Hybrid Car (Petrol)	2.0%	2.4%	+0.4%
Plug-In Hybrid Car (Petrol)	0.8%	1.2%	+0.4%
Hybrid Car (Diesel)	0.4%	0.1%	-0.3%
Electric Car	0.2%	0.3%	+0.1%
Electric LGV	0.1%	<0.1%	<0.1%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 16. Basic Vehicle Split Comparisons Between EFT 9.0 Outer London Fleet and 2019 ANPR

	Proportion of Vehicle Fleet in 2019*		
Vehicle Type	EFT v9.0 (Outer London)	Local 2019 ANPR Data*	Difference of ANPR 2019 from EFT v9.0 Outer London fleet
Petrol Car	43.3%	43.8%	+0.5%
Diesel Car	36.3%	31.5%	-4.8%
Taxi (black cab)	2.1%	0.5%	-1.6%
Petrol LGV	0.2%	0.2%	<0.1%
Diesel LGV	11.1%	18.0%	+6.9%
Rigid HGV	1.6%	1.6%	<0.1%
Articulated HGV	0.2%	0.2%	<0.1%
Bus and coach	0.2%	0.2%	<0.1%
Motorcycle	1.5%	0.0%	-1.5%
Hybrid Car (Petrol)	2.0%	2.4%	+0.4%
Plug-In Hybrid Car (Petrol)	0.3%	1.2%	+0.9%
Hybrid Car (Diesel)	0.6%	0.1%	-0.5%
Electric Car	0.4%	0.3%	<0.1%
Electric LGV	0.2%	0.0%	-0.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Vehicle Euro Class Breakdown

5.9 A further comparison regarding the proportion of Euro standards by vehicle type has been undertaken between the EFT's average fleets and the 2019 ANPR fleet. The distribution of Euro standards within the EFT are set as a national UK average outside of London, and so are the same for both rural and urban fleets.

5.10 With regard to petrol cars in the 2019 ANPR fleet (Table 17), there is a greater proportion of higher Euro standards (Euro 4 onwards), and a smaller proportion of lower Euro standards (up to and including Euro 3) relative to the outer London EFT fleet. The differences are within ±3.5% for all Euro standards. The distribution of Euro standards in the 2019 ANPR fleet relative to the EFT UK average fleet (all road types outside of London) is more variable (±6.8%), with a greater prevalence of Euro 3 and Euro 4 cars.

5.11 There is a greater proportion of Euro 6 diesel cars (Table 17) in the 2019 ANPR fleet, and a smaller proportion of lower Euro standards (up to and including Euro 5) relative to the outer London EFT fleet. The differences are up to approximately ±10% across the Euro standards. The distribution of Euro standards in the 2019 ANPR fleet relative to the EFT UK average fleet (both rural and urban roads) is less variable (±4.2%), although with a greater prevalence of Euro 3 and Euro 4 cars.

5.12 For petrol LGVs (Table 18), the variance in proportions of Euro standards present in the 2019 ANPR fleet is up to ±22.4% relative to the EFT rural/urban fleet, and up to ±17.8% relative to the EFT outer London fleet. The 2019 ANPR fleet has a greater proportion of Euro 6 petrol LGVs than both of the EFT fleets (>10% compared to outer London). However, there is a much smaller proportion of Euro 5 and a greater proportion of Euro 3 petrol LGVs than both of the EFT fleets presented (-15.7% to +17.8% compared to outer London, and -22.4% to +20.8% compared to rural/urban).

5.13 With regard to diesel LGVs (Table 18), the 2019 ANPR fleet is similar to the outer London EFT fleet (±1.7%). The 2019 ANPR fleet is overall older than the EFT rural/urban fleet, with a greater proportion of Euro 3-5 diesel LGVs, and an equivalent lesser proportion of Euro 6.

5.14 The full and plug-in hybrid petrol car 2019 ANPR fleet is older than both the rural/urban and outer London EFT fleets, with a greater proportion of Euro 3-5 petrol hybrid cars, and a smaller proportion of Euro 6 petrol hybrid cars (Table 19). A similar trend is seen for diesel hybrid cars (Table 20).

5.15 With regard to taxis (Table 20), the 2019 ANPR fleet is overall older than the EFT fleets. The outer London EFT fleet assumes almost a third of taxis are Zero Emission Capable (ZEC), with emissions estimated to be equivalent to a Euro 6 petrol LGV. This type of vehicle has not (as yet) been disaggregated in the 2019 ANPR dataset.

5.16 The 2019 ANPR rigid HGV fleet (Table 21) is overall older than both the rural/urban and the outer London EFT fleets, showing greater proportions of Euro III, IV, V EGR and V SCR and a smaller proportion of Euro VI vehicles.

5.17 The 2019 ANPR articulated HGV fleet (Table 21) is very similar to the rural/urban fleet with regards to Euro standards (±0.8%), whereas it has a greater proportion of Euro VI articulated HGVs compared to the outer London EFT fleet.

5.18 Overall the 2019 ANPR bus and coach fleet (Table 22) is older than the rural/urban and outer London EFT fleets, with a much smaller proportion of vehicles of Euro VI standard (-27.2% relative to rural/urban EFT fleet and -20.0% relative to outer London EFT fleet).

Epping Forest SAC 'road type'

5.19 The analysis of the 2019 ANPR data and the EFT's Basic Fleet Split for rural, urban and outer London roads suggests that the vehicle fleet using the roads through the EFSAC is most similar to the outer London fleet, as defined in EFT v9.0 for 2019.

5.20 Taking into account the greater prevalence of diesel LGVs in the 2019 ANPR data, the outer London EFT fleet shows a similar split between petrol and diesel LDVs, whereas the rural EFT fleet does not allow for any electric vehicles, and has the greatest difference in petrol/diesel split for cars when compared to the 2019 ANPR data.

5.21 In terms of Euro Class split, the 2019 ANPR data shows that the car and LGV fleet using the EFSAC is broadly newer than that in the EFT outer London fleet, but older than the EFT UK average outside of London. The hybrid vehicles, taxis, rigid HGV and bus and coach fleets using the EFSAC roads are in general older than both of the EFT fleets considered here. The articulated HGVs using the EFSAC road are newer than those in the EFT outer London fleet, but overall very similar in terms of Euro Class split to the EFT national fleet.

Table 17. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Petrol and Diesel Cars

Euro Standard	Petrol cars					Diesel cars				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0		2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro 1**	1.2%	1.9%	1.2%	<0.1%	-0.7%	-	-	-	<0.1%	<0.1%
Euro 1	-	0.4%	-	<0.1%	-0.4%	-	0.2%	-	<0.1%	-0.2%
Euro 2	0.2%	3.3%	-	-0.2%	-3.3%	0.1%	0.8%	-	<0.1%	-0.8%
Euro 3	4.5%	11.9%	9.4%	+5.0%	-2.5%	2.3%	9.0%	4.4%	+2.1%	-4.6%
Euro 4	15.1%	21.2%	21.9%	+6.8%	+0.7%	12.4%	26.7%	16.6%	+4.2%	-10.1%
Euro 5	27.9%	22.1%	24.4%	-3.5%	+2.3%	32.9%	34.5%	32.2%	-0.7%	-2.3%
Euro 6	16.6%	12.7%	14.0%	-2.7%	+1.3%	18.2%	7.8%	16.3%	-2.0%	+8.5%
Euro 6c	34.6%	26.4%	29.0%	-5.5%	+2.6%	34.1%	20.9%	30.4%	-3.7%	+9.5%
Euro 6d	-	-	-	-	-	-	-	-	<0.1%	<0.1%

Note: Percentages may not add up to exactly 100% due to rounding.

** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 18. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Petrol and Diesel LGVs

Euro Standard	Petrol LGV					Diesel LGV				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0		2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro 1**	1.4%	12.8%	1.2%	-0.1%	-11.5%	-	-	-	<0.1%	<0.1%
Euro 1	-	-	-	<0.1%	<0.1%	-	-	-	<0.1%	<0.1%
Euro 2	1.0%	3.2%	-	-1.0%	-3.2%	0.4%	-	-	-0.4%	<0.1%
Euro 3	6.0%	9.0%	26.8%	+20.8%	+17.8%	2.4%	5.4%	6.3%	+3.9%	+0.9%
Euro 4	15.2%	22.6%	13.8%	-1.4%	-8.8%	12.7%	17.7%	16.0%	+3.3%	-1.7%
Euro 5	29.6%	23.0%	7.3%	-22.4%	-15.7%	30.9%	35.9%	35.8%	+4.9%	-0.1%
Euro 6	21.9%	13.8%	23.9%	+1.9%	+10.1%	19.0%	13.8%	14.9%	-4.2%	+1.0%
Euro 6c	24.8%	15.6%	27.0%	+2.2%	+11.4%	34.6%	27.2%	27.0%	-7.6%	-0.2%
Euro 6d	-	-	-	-	-	-	-	-	<0.1%	<0.1%

Note: Percentages may not add up to exactly 100% due to rounding. EFT version 8.0.1 does not contain Euro Class information for taxis for areas outside of Inner London.

** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 19. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Petrol Hybrid Cars

Euro Standard	Full Hybrid Petrol Cars					Plug-in Hybrid Petrol Cars				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0		2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro 1**	1.1%	1.1%	1.2%	+0.1%	+0.1%	1.1%	0.9%	1.2%	+0.2%	+0.3%
Euro 1	-	-	-	<0.1%	<0.1%	-	-	-	-	-
Euro 2	-	-	-	<0.1%	<0.1%	-	-	-	-	-
Euro 3	0.1%	0.2%	4.1%	+4.0%	+3.9%	-	-	-	-	-
Euro 4	4.0%	5.4%	6.9%	+3.0%	+1.6%	-	-	-	-	-
Euro 5	14.9%	19.4%	20.7%	+5.8%	+1.3%	4.7%	7.2%	23.3%	+18.6%	+16.1%
Euro 6	17.2%	15.9%	14.4%	-2.8%	-1.5%	32.4%	31.6%	25.9%	-6.5%	-5.7%
Euro 6c	62.8%	58.1%	52.6%	-10.1%	-5.4%	61.9%	60.3%	49.5%	-12.4%	-10.8%

Note: Percentages may not add up to exactly 100% due to rounding.

** Pre-Euro 1 category includes vehicles with failed catalysts.

Table 20. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Diesel Hybrid Cars and Taxis

Euro Standard	Diesel Hybrid Cars					Taxis				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0		2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro 1	-	-	-	-	-	-	-	-	<0.1%	<0.1%
Euro 1	-	-	-	-	-	-	-	-	<0.1%	<0.1%
Euro 2	-	-	-	-	-	0.4%	-	-	-0.4%	<0.1%
Euro 3	-	-	-	-	-	2.4%	6.1%	18.5%	+16.1%	+12.4%
Euro 4	-	-	-	-	-	12.7%	25.6%	37.0%	+24.3%	+11.4%
Euro 5**	4.9%	5.7%	45.9%	+41.0%	+40.2%	30.9%	19.2%	33.9%	+3.0%	+14.7%
Euro 6	11.3%	25.6%	6.4%	-4.9%	-19.2%	19.0%	18.3%	3.8%	-15.2%	-14.5%
Euro 6c	83.8%	68.6%	47.7%	-36.1%	-21.0%	34.6%	-	6.9%	-27.7%	+6.9%
Euro 6d	-	-	-	<0.1%	<0.1%	-	-	-	<0.1%	<0.1%
ZEC***	n/a	n/a	n/a	n/a	n/a	-	30.8%	-	<0.1%	-30.8%

Note: Percentages may not add up to exactly 100% due to rounding.

** Euro 5 diesel hybrid cars category includes vehicles with failed catalysts.

*** Zero Emission Capable ZEC. In EFT v9.0, emissions for Diesel LGV N1 III are used to represent vehicles assigned as Taxis both inside and outside of London, and emissions for Euro 6 Petrol LGV N1 III are used to represent vehicles assigned as ZEC Taxis both inside and outside of London

Table 21. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Heavy Goods Vehicles

Euro Standard	Rigid HGV					Articulated HGV				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0		2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro I	-	-	-	<0.1%	<0.1%	-	-	-	<0.1%	<0.1%
Euro I	-	0.1%	-	<0.1%	-0.1%	-	-	-	<0.1%	<0.1%
Euro II	0.5%	0.7%	-	-0.5%	-0.7%	-	0.5%	0.3%	+0.3%	-0.2%
Euro III	4.1%	2.8%	4.9%	+0.8%	+2.1%	0.7%	1.8%	1.5%	+0.8%	-0.3%
Euro IV	4.4%	6.4%	9.5%	+5.1%	+3.1%	1.2%	8.4%	0.9%	-0.3%	-7.5%
Euro V EGR	4.6%	4.9%	6.6%	+2.1%	+1.7%	3.3%	5.1%	3.2%	-0.1%	-2.0%
Euro V SCR	13.7%	14.7%	19.9%	+6.2%	+5.2%	9.8%	15.4%	9.5%	-0.3%	-5.9%
Euro VI	72.7%	70.3%	59.1%	-13.5%	-11.2%	85.0%	68.9%	84.7%	-0.3%	+15.8%

Note: Percentages may not add up to exactly 100% due to rounding.

** Pre-Euro I category includes vehicles with failed catalysts.

Table 22. Euro Class Split Comparisons Between EFT v9.0 and 2019 ANPR: Buses and Coaches

Euro Standard	Buses & Coaches				
	2019 EFT v9.0		2019 ANPR Data	Difference of ANPR 2019 from EFT v9.0	
	Rural & Urban	Outer London		Rural & Urban	Outer London
Pre-Euro I	-	-	-	<0.1%	<0.1%
Euro I	-	-	-	<0.1%	<0.1%
Euro II	1.6%	0.2%	-	-1.6%	-0.2%
Euro III	7.5%	1.3%	2.8%	-4.8%	+1.5%
Euro IV	7.1%	3.6%	19.8%	+12.7%	+16.2%
Euro V EGR	6.3%	10.9%	11.5%	+5.2%	+0.6%
Euro V SCR	18.9%	32.7%	34.6%	+15.6%	+1.9%
Euro VI	58.6%	51.3%	31.3%	-27.2%	-20.0%

Note: Percentages may not add up to exactly 100% due to rounding.

** Pre-Euro I category includes vehicles with failed catalysts.

6. Concluding Remarks and Recommendations

6.1 This Technical Note has been prepared by AECOM on behalf of Epping Forest District Council (EFDC) to provide a comparison between the local vehicle fleet captured using Automatic Number Plate Recognition (ANPR) and the default vehicle fleets inherent within two versions of Defra's Emissions Factors Toolkit (EFT), for the years 2017 and 2019.

6.2 The analyses have established the variability between both the ANPR datasets and the EFT, and between the EFT versions themselves (version 8.0.1 and version 9.0), and the implications these may have on the resultant emissions calculations.

6.3 It has been demonstrated that the use of the newer EFT, version 9.0, tends to produce slightly higher road NO_x emissions in the scenarios tested as compared to EFT v8.0.1, which was used in the 2019 HRA air quality modelling. This was consistent for both 2017 and 2019 ANPR fleet data.

6.4 The basic fleet split derived from the ANPR data shows a lower percentage of heavy-duty vehicles in the local fleet than would be anticipated using the EFT default fleet split for rural roads. The HDV proportions from the ANPR survey data were between 2% and 2.5% whereas the 2019 HRA used 6-9% depending on the road link. Using the locally-derived vehicle fleet split therefore results in lower total NO_x emissions than was modelled in the 2019 HRA.

6.5 Analysis of the ANPR data has revealed that the local vehicle fleet is generally older than the national default assumptions inherent within the EFT for rural/urban roads. Vehicles of earlier Euro standards are typically more prevalent in the local vehicle fleet for both 2017 and 2019 than the EFT default projections. This pattern is common across all vehicle categories. The 2019 local LDV fleet is in general newer than the EFT's outer London LDV fleet.

6.6 Application of the locally-derived Euro Class breakdown produces higher total NO_x emissions than using EFT default proportions for urban/rural roads; however, when the combined effect of the local basic fleet split and Euro Class breakdown is taken into account the calculated road NO_x emissions are lower than using EFT defaults for rural roads. It is therefore apparent that the difference in the basic fleet split between the ANPR survey data and the EFT has a greater influence on emissions than Euro Class breakdown.

6.7 For 2017, road NO_x emissions calculated using EFT version 9.0 are as follows:

- Using the default fleet split and Euro Class breakdown (as was used for the 2019 HRA assessment): 0.05812 g/km/s
- Using the locally-derived fleet split and Euro Class breakdown (best estimate of accrual): 0.05678 g/km/s
- **This represents approximately a 1.9% reduction in road NO_x emission rate when the local ANPR data are applied.**

6.8 For 2019, road NO_x emissions calculated using EFT version 9.0 are as follows:

- Using the default fleet split and Euro Class breakdown (which would be used if ANPR data were not available): 0.04921 g/km/s
- Using the locally-derived fleet split and Euro Class breakdown (best estimate of accrual): 0.04530 g/km/s
- **This represents approximately a 7.9% reduction in road NO_x emission rate when the local ANPR data are applied.**

6.9 The percentage reduction in NO_x emission rate using the locally-derived fleet split and Euro Class breakdown is greater in 2019 than 2017. There are a number of reasons for this, including the higher proportion of petrol-fuelled cars in the 2019 local vehicle fleet, the lower proportion of heavy-duty vehicles in the fleet, and the penetration of newer vehicles into the vehicle fleet (i.e. more Euro 6 / Euro VI vehicles).

6.10 As the ANPR data has shown the local vehicle fleet operating in the EFSAC to be different from those defined in the EFT in terms of both basic fleet split and Euro class split, it is recommended that the 2017 ANPR data is used to derive the vehicle fleet for the updated 2017 baseline air quality modelling scenario. This scenario will be undertaken with the purpose of calculating appropriate verification factors to account for model bias.

6.11 Consideration of the local vehicle fleet compared with the EFT’s outer London fleet has been limited to consider only the basic vehicle fleet and the Euro class splits for 2019. The analysis indicates that, in terms of the basic fleet split, the local EFSAC vehicle fleet is most like that defined in the EFT for outer London.

6.12 Whilst the EFT v9.0 provides the ability to project the Euro class distribution for future years, it does not project the proportion of vehicles in terms of the basic fleet split. Therefore, it is recommended that the EFT outer London fleet is used to inform the projection of the fleet that will be expected to use the roads in EFSAC in future years, and in turn, will inform any appropriate mitigation measures.

Appendix A

2019 HRA modelling heavy duty vehicle (HDV) percentage

For the purpose of an air quality assessment, and when using Defra's EFT, heavy duty vehicles (HDV) include vehicles over 3.5 tonnes and so include rigid and articulated HGVs, buses and coaches.

For the 2019 HRA, HDV percentages were derived from ATC data, with vehicles classified according to the table below[8]. HDVs were considered to include vehicles in classes 4-10. This gave percentages relative to total traffic flow varying between 6% to 9% across the roads within EFSAC.

The 2017 and 2019 ANPR data classifies HDVs as buses and coaches, plus HGVs greater than 3.5 tonnes. The average HDV percentage across the EFSAC roads is calculated to be 2.5% from the 2017 ANPR data and 2.0% from the 2019 ANPR data. These percentages are in-line with HDV proportions as a percentage of Annual Average Traffic Data (AADT) flow as measured at DfT count points in the vicinity of the EFSAC. These data are presented in Appendix B.

Further scrutiny of the ANPR HDV data and the HDV percentages derived from the ATC data indicates that the latter most likely included some LGVs less than or equal to 3.5 tonnes as classes 4 and 5 in the table below were included in the HDV category; the vehicle classes used in the ATC were misaligned relative to the EFT vehicle classes.

CLASS	ABBREV.	DESCRIPTION	LENGTH	COBA	AQMA	MANUAL
1	MC	Motorcycle	SHORT Up to 5.5m	N/A	MC	MC
2	SV	Cars, taxis, 4WD, vans		CAR & LGV	CAR	CAR & LGV1
3	SVT	Class 2 plus trailer	MEDIUM 5.5m to 14.5m			
4	TB2	2 axle truck / bus		OGV1 & PSV	LGV & MGV	LGV2 & PSV
5	TB3	3 axle truck / bus		OGV1		MGV & PSV
6	T4	4 axle truck		OGV2	HGV RIGID	HGV1
7	ART3	3 axle articulated	LONG 11.5m to 19.0m		HGV ARTIC	HGV2
8	ART4	4 axle articulated				
9	ART5	5 axle articulated				
10	ART6	6+ axle articulated				

[8] The ANPR Survey states that: "Vehicles recorded by the ATC are placed into one of ten classes based on axle spacing and pattern. This scheme is based on the AustRoad94 algorithm and modified for UK traffic, referred to as ARX. The table aligns the ARX classifications with the AQMA (air quality management standard) and the Essex 9-class, as used in the manual junction counts undertaken by Essex Highways."

Appendix B

DfT count data – Annual Average Daily Traffic Flows in the vicinity of EFSAC

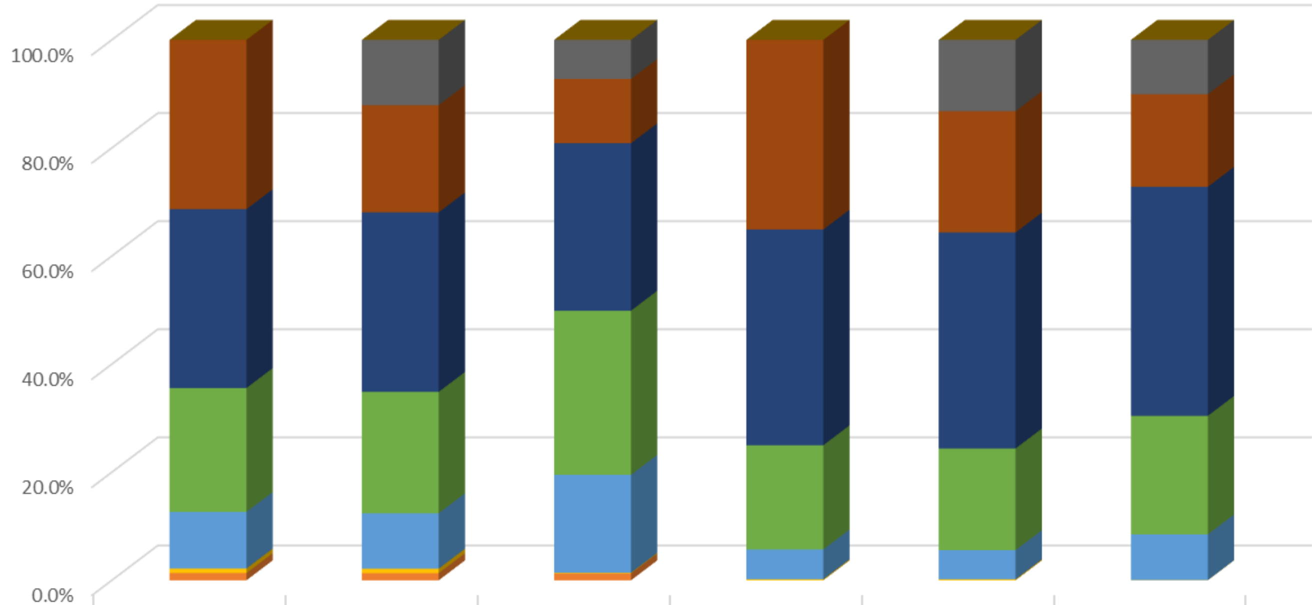
https://roadtraffic.dft.gov.uk/#6/55.254/-6.053/basemap-regions-countpoints

count point id	year	local authority name	road name	start junction road name	end junction road name	estimation method detailed	buses and coaches	all HGVs	all motor vehicles	HGVs+ buses+coaches	%HDV
58084	2016	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	88	562	22497	650	2.9%
58084	2011	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	116	681	20375	797	3.9%
58084	2010	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	137	559	22242	696	3.1%
58084	2009	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	104	548	22536	652	2.9%
58084	2008	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	116	614	22730	730	3.2%
58084	2004	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	163	812	20646	975	4.7%
58084	2000	Essex	A121	A104	A121 Honey Lane roundabout	Manual count	135	653	18139	788	4.3%
930090	2009	Essex	B172			Manual count	10	104	7800	114	1.5%
930090	2008	Essex	B172			Manual count	12	114	7066	126	1.8%
930090	2007	Essex	B172			Manual count	28	171	7217	199	2.8%
930090	2006	Essex	B172			Manual count	10	165	7341	175	2.4%
930090	2005	Essex	B172			Manual count	25	123	7138	148	2.1%
930090	2004	Essex	B172			Manual count	11	214	8872	225	2.5%
930090	2003	Essex	B172			Manual count	22	209	7187	231	3.2%
16638	2017	Essex	A121	Baldwin's Hill	A104	Manual count	81	534	17908	615	3.4%
16638	2013	Essex	A121	Baldwin's Hill	A104	Manual count	119	428	17794	547	3.1%
16638	2011	Essex	A121	Baldwin's Hill	A104	Manual count	159	443	18577	602	3.2%

count point id	year	local authority name	road name	start junction road name	end junction road name	estimation method detailed	buses and coaches	all HGVs	all motor vehicles	HGVs+ buses+coaches	%HDV
16638	2009	Essex	A121	Baldwin's Hill	A104	Manual count	127	470	18580	597	3.2%
16638	2007	Essex	A121	Baldwin's Hill	A104	Manual count	155	491	18178	646	3.6%
16638	2003	Essex	A121	Baldwin's Hill	A104	Manual count	167	602	16591	769	4.6%
940922	2009	Essex	B1393			Manual count	70	427	18925	497	2.6%
940922	2008	Essex	B1393			Manual count	68	537	19064	605	3.2%
940922	2006	Essex	B1393			Manual count	65	516	19341	581	3.0%
940922	2005	Essex	B1393			Manual count	116	400	18564	516	2.8%
940922	2004	Essex	B1393			Manual count	99	585	17882	684	3.8%
940922	2003	Essex	B1393			Manual count	141	618	19689	759	3.9%
940922	2002	Essex	B1393			Manual count	99	642	21768	741	3.4%
940922	2001	Essex	B1393			Manual count	115	578	20319	693	3.4%
940922	2000	Essex	B1393			Manual count	130	429	20760	559	2.7%
6198	2018	Essex	A104	A1069	A121	Manual count	33	170	14579	203	1.4%
6198	2014	Essex	A104	A1069	A121	Manual count	37	234	13658	271	2.0%
6198	2010	Essex	A104	A1069	A121	Manual count	40	192	17464	232	1.3%
6198	2007	Essex	A104	A1069	A121	Manual count	94	324	18776	418	2.2%
6198	2005	Essex	A104	A1069	A121	Manual count	61	293	16044	354	2.2%
6198	2004	Essex	A104	A1069	A121	Manual count	66	351	15016	417	2.8%
6198	2002	Essex	A104	A1069	A121	Manual count	44	447	15145	491	3.2%
6198	2000	Essex	A104	A1069	A121	Manual count	30	289	15908	319	2.0%

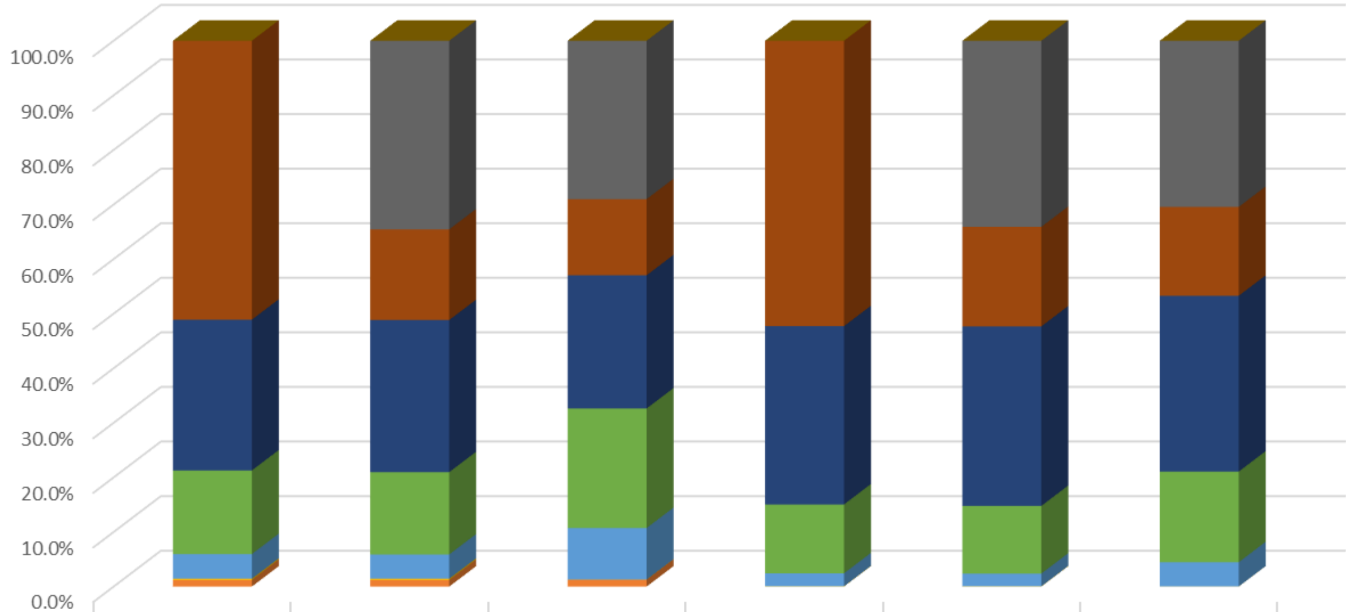
Appendix C

Figure 3. Comparison of Euro Class Breakdown for Conventional Petrol and Diesel Cars, 2017



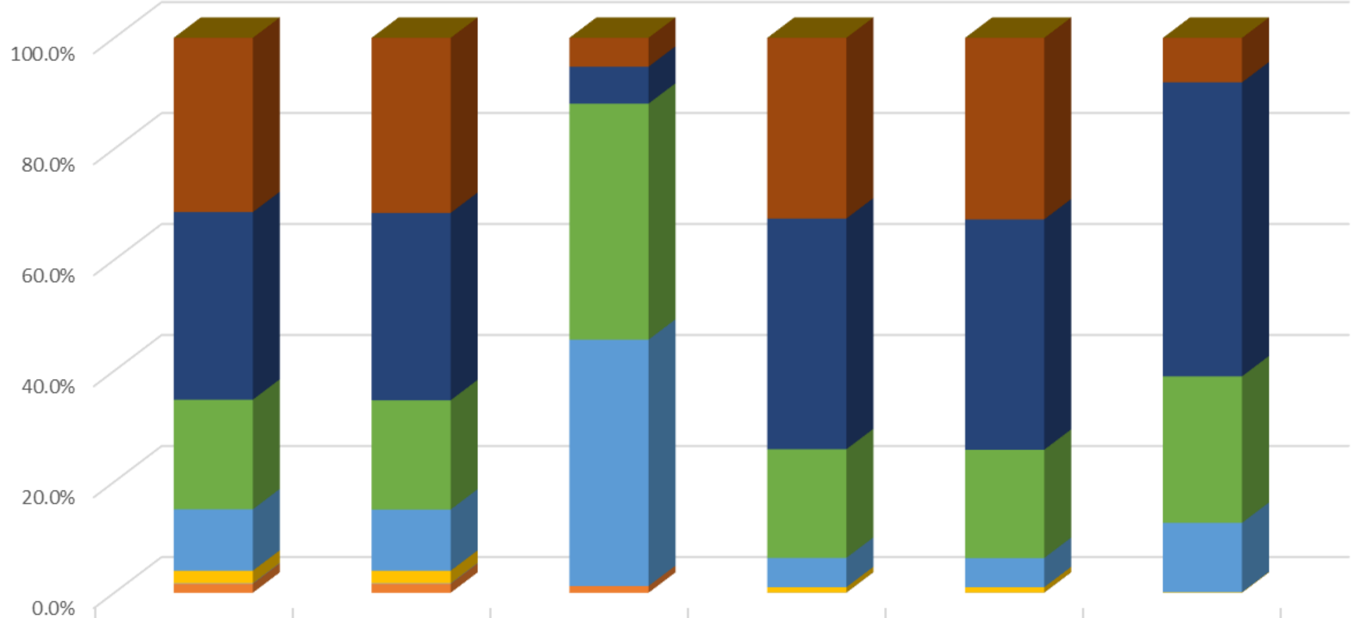
	EFT v8.0.1 Petrol Car	EFT v9.0 Petrol Car	ANPR 2017 Petrol Car	EFT v8.0.1 Diesel Car	EFT v9.0 Diesel Car	ANPR 2017 Diesel Car
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	12.1%	7.2%	0.0%	13.2%	10.1%
Euro 6	31.3%	19.8%	11.9%	35.1%	22.4%	17.1%
Euro 5	33.1%	33.2%	31.0%	39.9%	40.0%	42.4%
Euro 4	22.9%	22.5%	30.4%	19.3%	18.8%	21.9%
Euro 3	10.5%	10.3%	18.1%	5.5%	5.4%	8.5%
Euro 2	0.8%	0.8%	0.1%	0.2%	0.2%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.3%	1.3%	1.3%	0.0%	0.0%	0.0%

Figure 4. Comparison of Euro Class Breakdown for Conventional Petrol and Diesel Cars, 2019



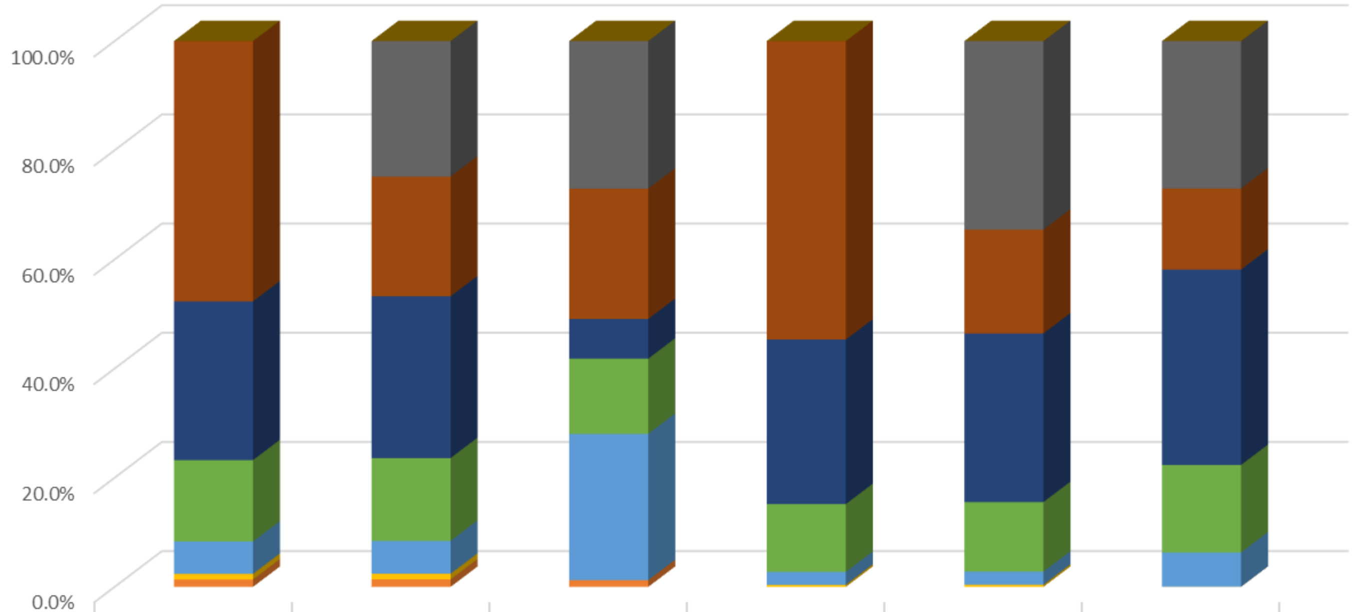
	EFT v8.0.1 Petrol Car	EFT v9.0 Petrol Car	ANPR 2019 Petrol Car	EFT v8.0.1 Diesel Car	EFT v9.0 Diesel Car	ANPR 2019 Diesel Car
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	34.6%	29.0%	0.0%	34.1%	30.4%
Euro 6	51.1%	16.6%	14.0%	52.3%	18.2%	16.3%
Euro 5	27.6%	27.9%	24.4%	32.7%	32.9%	32.2%
Euro 4	15.3%	15.1%	21.9%	12.6%	12.4%	16.6%
Euro 3	4.5%	4.5%	9.4%	2.4%	2.3%	4.4%
Euro 2	0.2%	0.2%	0.0%	0.1%	0.1%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.2%	1.2%	1.2%	0.0%	0.0%	0.0%

Figure 5. Comparison of Euro Class Breakdown for Conventional Petrol and Diesel LGVs, 2017



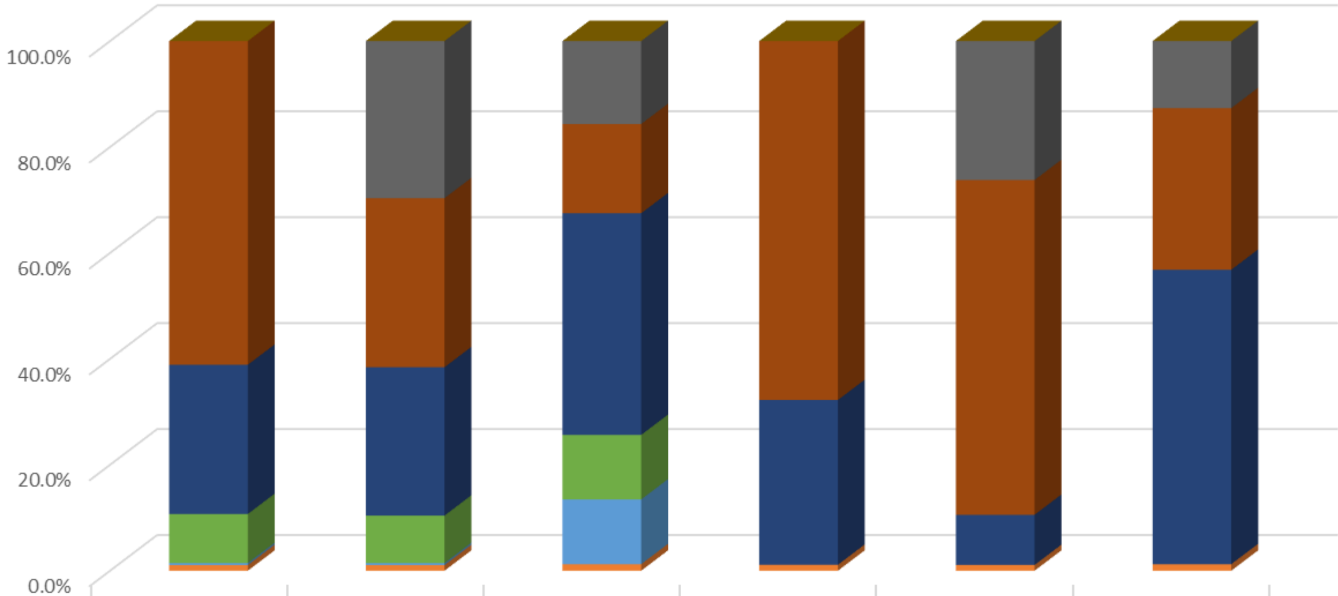
	EFT v8.0.1 Petrol LGV	EFT v9.0 Petrol LGV	ANPR 2017 Petrol LGV	EFT v8.0.1 Diesel LGV	EFT v9.0 Diesel LGV	ANPR 2017 Diesel LGV
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6	31.4%	31.5%	5.2%	32.6%	32.7%	8.0%
Euro 5	33.8%	33.8%	6.7%	41.6%	41.5%	53.0%
Euro 4	19.8%	19.7%	42.5%	19.6%	19.5%	26.4%
Euro 3	11.1%	11.0%	44.4%	5.3%	5.3%	12.5%
Euro 2	2.2%	2.2%	0.0%	1.0%	1.0%	0.1%
Euro 1	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.6%	1.6%	1.2%	0.0%	0.0%	0.0%

Figure 6. Comparison of Euro Class Breakdown for Conventional Petrol and Diesel LGVs, 2019



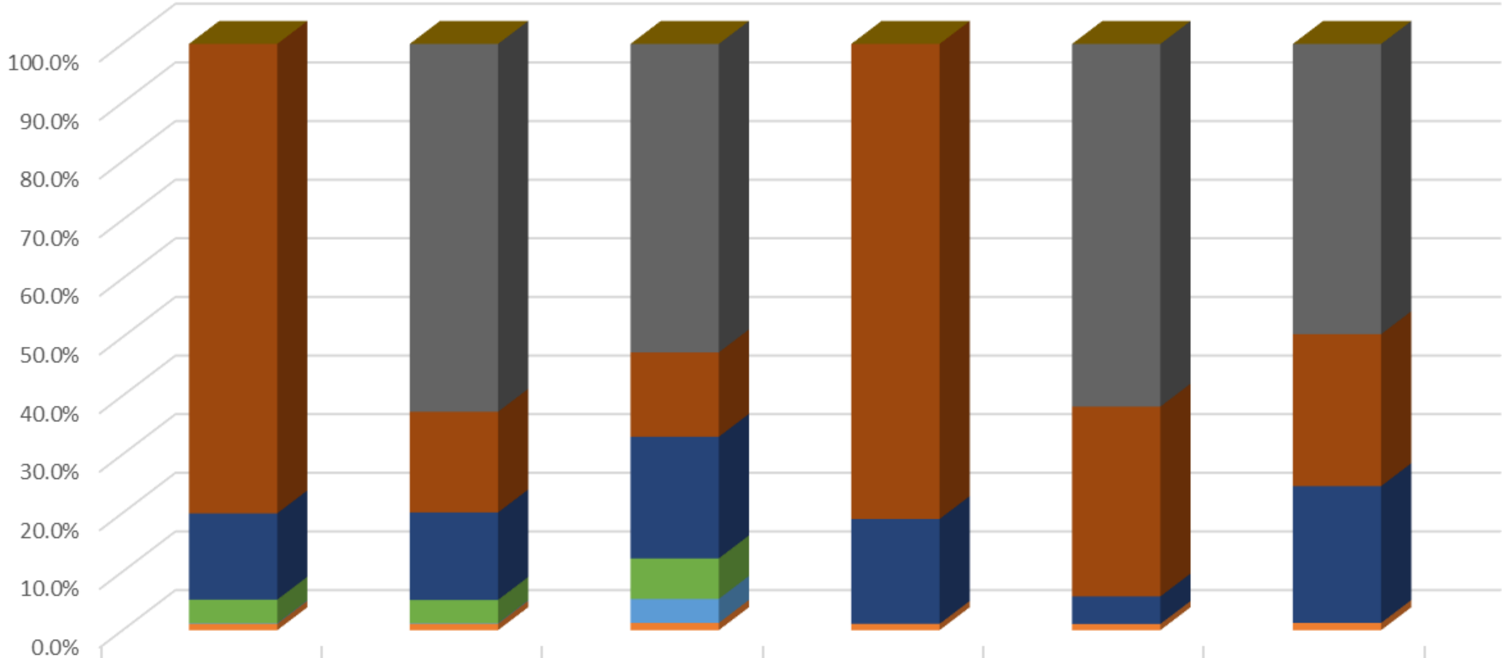
	EFT v8.0.1 Petrol LGV	EFT v9.0 Petrol LGV	ANPR 2019 Petrol LGV	EFT v8.0.1 Diesel LGV	EFT v9.0 Diesel LGV	ANPR 2019 Diesel LGV
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	24.8%	27.0%	0.0%	34.6%	27.0%
Euro 6	47.7%	21.9%	23.9%	54.7%	19.0%	14.9%
Euro 5	29.1%	29.6%	7.3%	30.1%	30.9%	35.8%
Euro 4	14.9%	15.2%	13.8%	12.4%	12.7%	16.0%
Euro 3	5.9%	6.0%	26.8%	2.4%	2.4%	6.3%
Euro 2	1.0%	1.0%	0.0%	0.4%	0.4%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.4%	1.4%	1.2%	0.0%	0.0%	0.0%

Figure 7. Comparison of Euro Class Breakdown for Full Hybrid and Plug-in Hybrid Petrol Cars, 2017



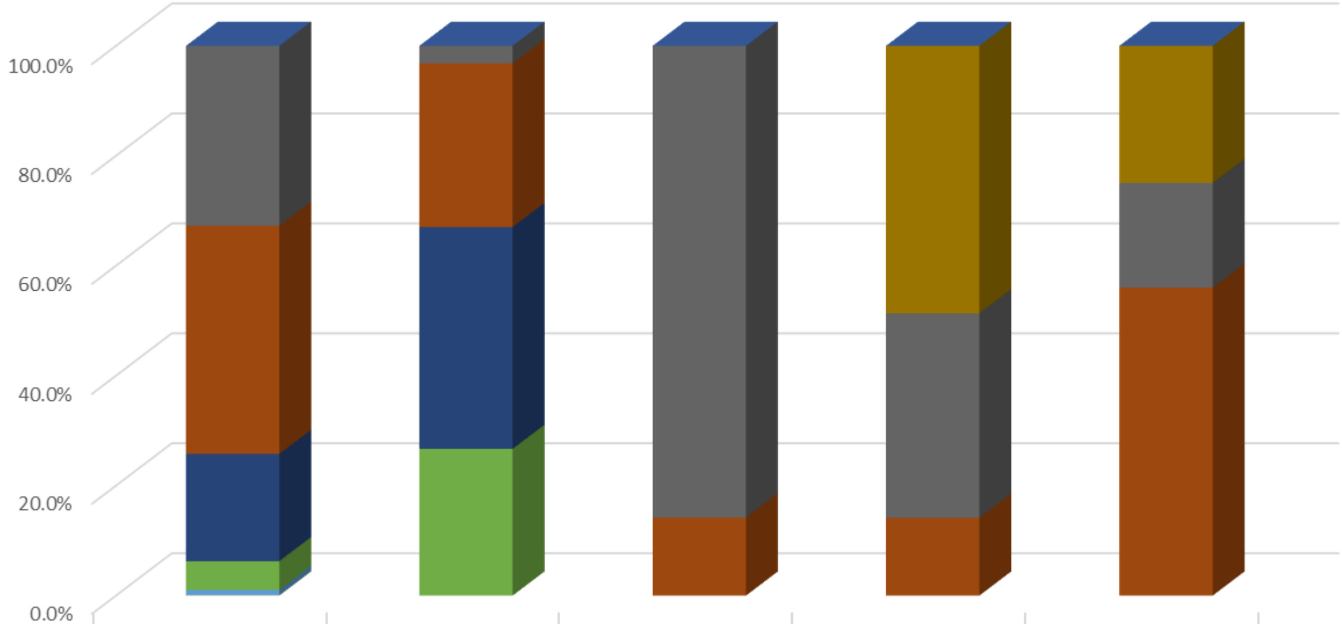
	EFT v8.0.1 Hybrid Car Petrol	EFT v9.0 Hybrid Car Petrol	ANPR 2017 Hybrid Car Petrol	EFT v8.0.1 Plug-In Hybrid Car (Petrol)	EFT v9.0 Plug-In Hybrid Car (Petrol)	ANPR 2017 Plug-In Hybrid Car (Petrol)
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	29.7%	15.7%	0.0%	26.2%	12.7%
Euro 6	61.1%	31.9%	16.8%	67.8%	63.2%	30.5%
Euro 5	28.2%	28.0%	41.9%	31.1%	9.5%	55.6%
Euro 4	9.3%	9.0%	12.2%	0.0%	0.0%	0.0%
Euro 3	0.4%	0.4%	12.2%	0.0%	0.0%	0.0%
Euro 2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.1%	1.1%	1.2%	1.1%	1.1%	1.2%

Figure 8. Comparison of Euro Class Breakdown for Full Hybrid and Plug-in Hybrid Petrol Cars, 2019



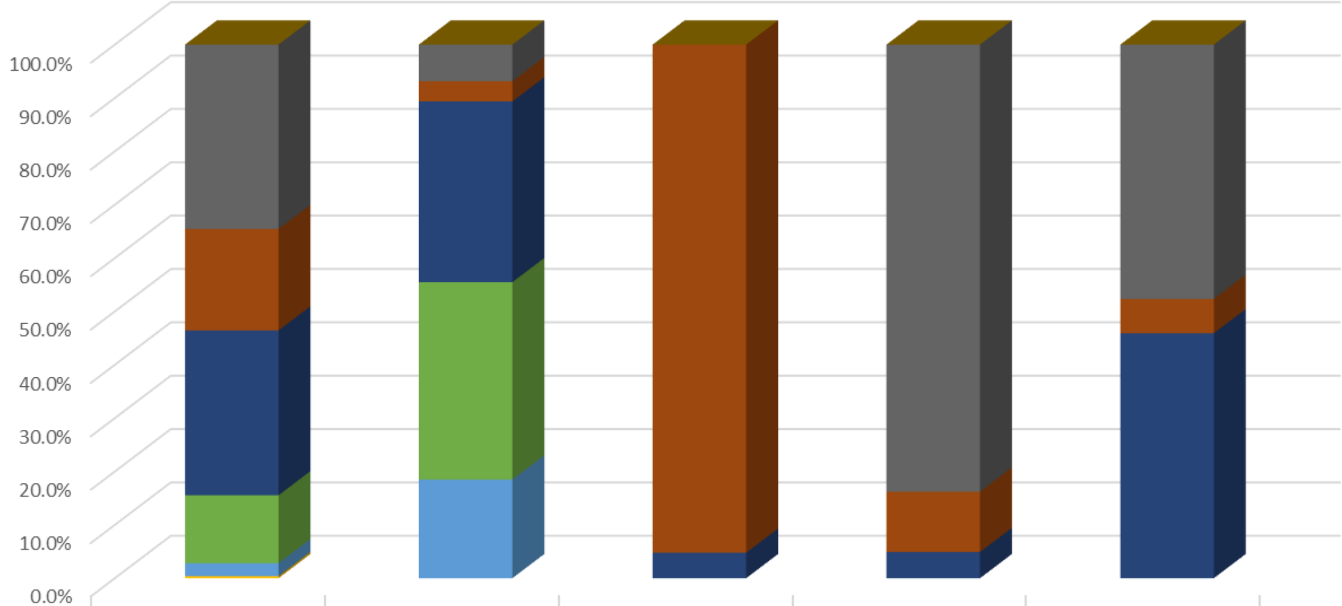
	EFT v8.0.1 Hybrid Car Petrol	EFT v9.0 Hybrid Car Petrol	ANPR 2019 Hybrid Car Petrol	EFT v8.0.1 Plug-In Hybrid Car (Petrol)	EFT v9.0 Plug-In Hybrid Car (Petrol)	ANPR 2019 Plug-In Hybrid Car (Petrol)
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	62.8%	52.6%	0.0%	61.9%	49.5%
Euro 6	80.1%	17.2%	14.4%	81.0%	32.4%	25.9%
Euro 5	14.7%	14.9%	20.7%	17.9%	4.7%	23.3%
Euro 4	4.0%	4.0%	6.9%	0.0%	0.0%	0.0%
Euro 3	0.1%	0.1%	4.1%	0.0%	0.0%	0.0%
Euro 2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	1.1%	1.1%	1.2%	1.1%	1.1%	1.2%

Figure 9. Comparison of Euro Class Breakdown for Taxis and Diesel Hybrid Cars, 2017



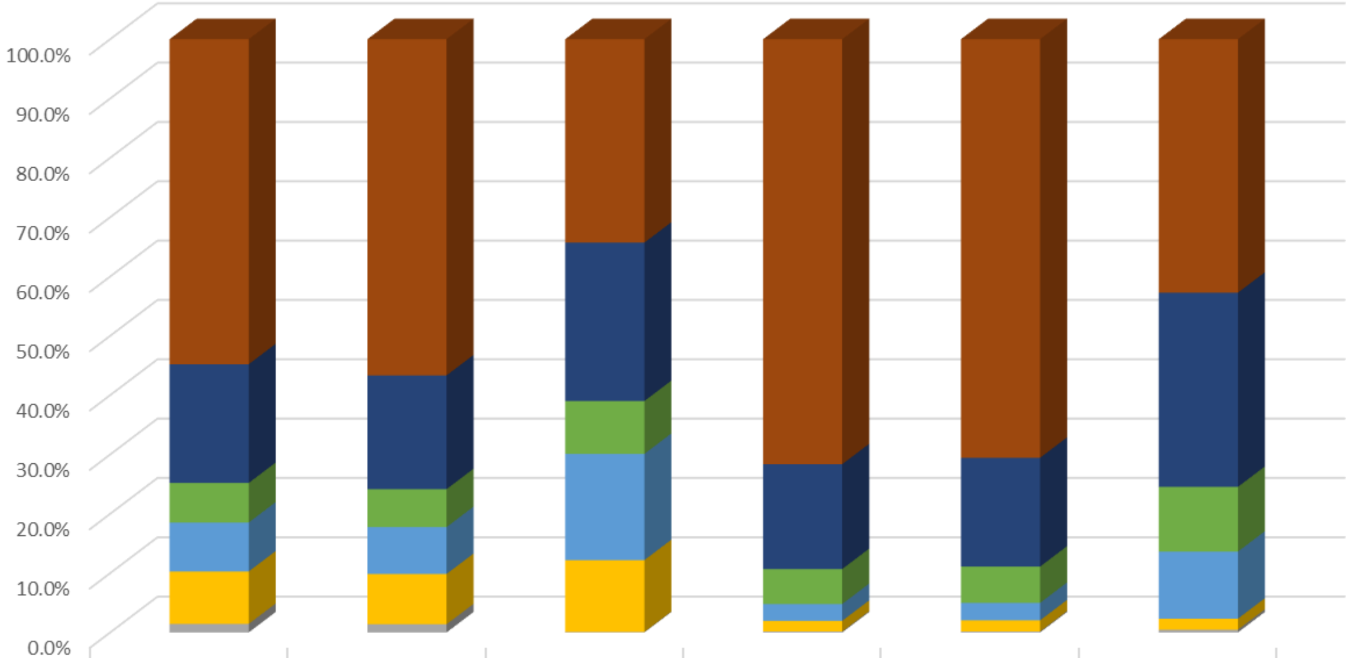
	EFT v9.0 Taxi (black cab)	ANPR 2017 Taxi (black cab)	EFT v8.0.1 Hybrid Car (Diesel)	EFT v9.0 Hybrid Car (Diesel)	ANPR 2017 Hybrid Car (Diesel)
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	0.0%	0.0%	0.0%	48.7%	24.9%
Euro 6	32.7%	3.2%	85.8%	37.2%	19.1%
Euro 5	41.5%	29.8%	14.2%	14.2%	56.0%
Euro 4	19.5%	40.4%	0.0%	0.0%	0.0%
Euro 3	5.3%	26.7%	0.0%	0.0%	0.0%
Euro 2	1.0%	0.0%	0.0%	0.0%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 10. Comparison of Euro Class Breakdown for Taxis and Diesel Hybrid Cars, 2019



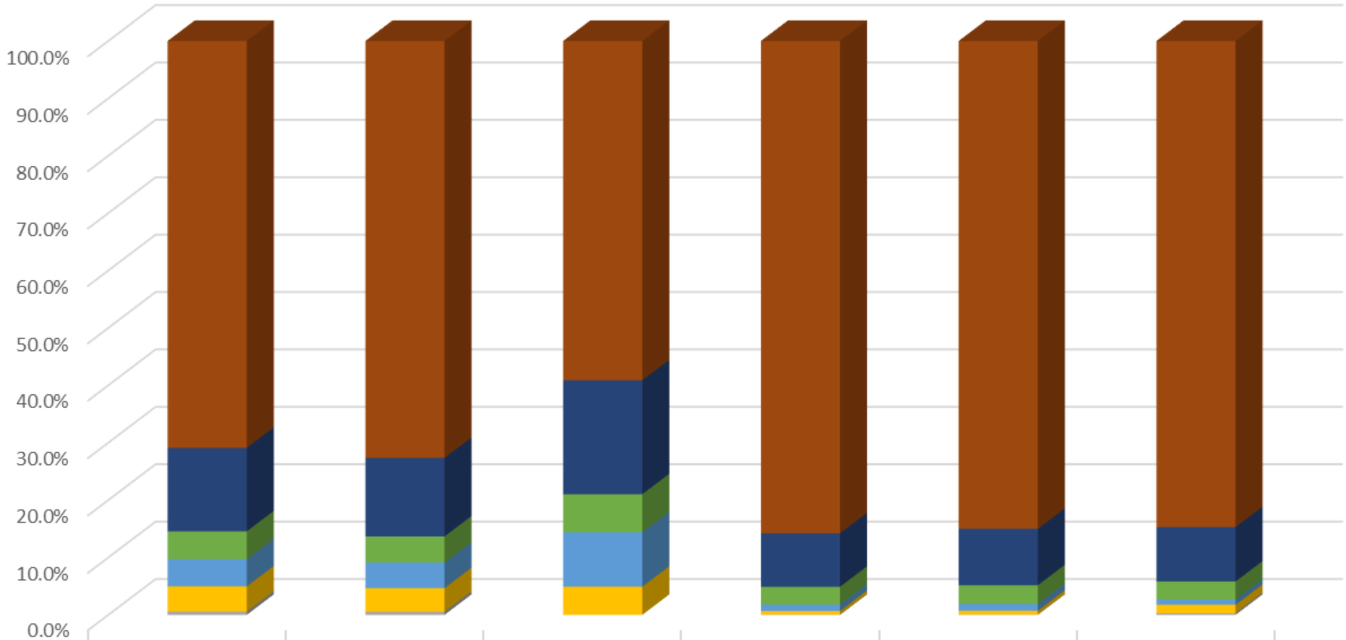
	EFT v9.0 Taxi (black cab)	ANPR 2019 Taxi (black cab)	EFT v8.0.1 Hybrid Car (Diesel)	EFT v9.0 Hybrid Car (Diesel)	ANPR 2019 Hybrid Car (Diesel)
Euro 6d	0.0%	0.0%	0.0%	0.0%	0.0%
Euro 6c	34.6%	6.9%	0.0%	83.8%	47.7%
Euro 6	19.0%	3.8%	95.2%	11.3%	6.4%
Euro 5	30.9%	33.9%	4.8%	4.9%	45.9%
Euro 4	12.7%	37.0%	0.0%	0.0%	0.0%
Euro 3	2.4%	18.5%	0.0%	0.0%	0.0%
Euro 2	0.4%	0.0%	0.0%	0.0%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro 1	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 11. Comparison of Euro Class Breakdown for Rigid and Articulated HGVs, 2017



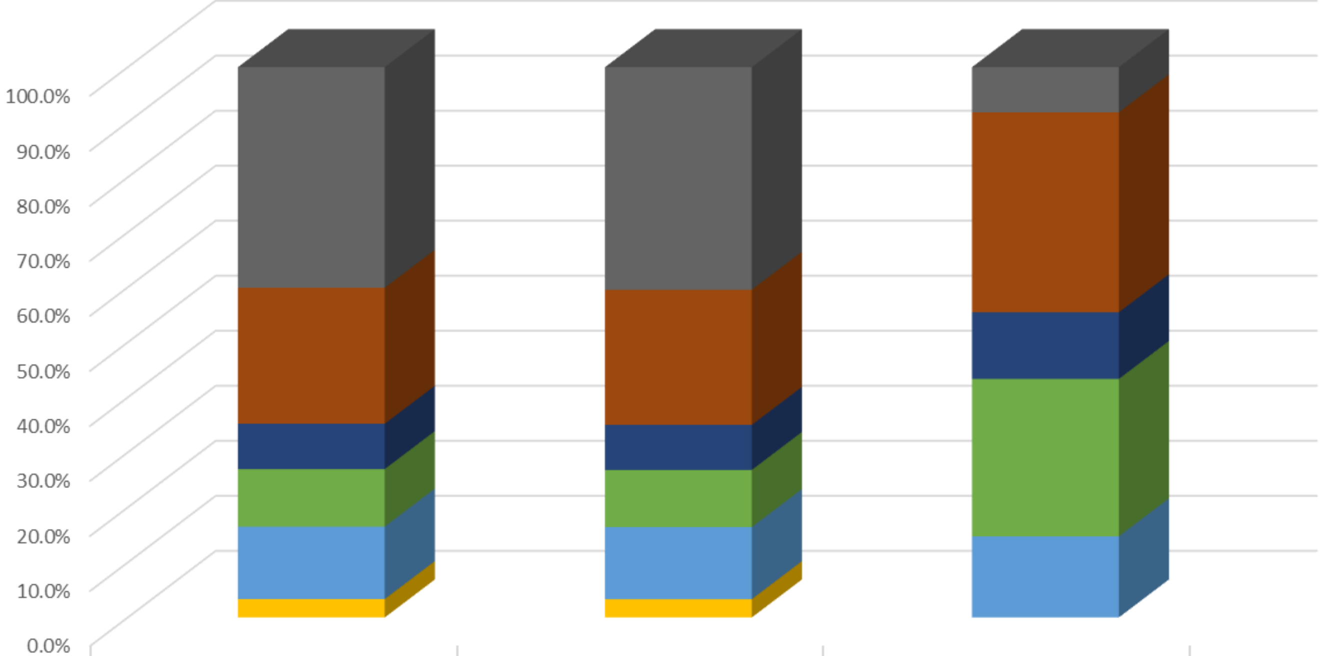
	EFT v8.0.1 Rigid HGV	EFT v9.0 Rigid HGV	ANPR 2017 Rigid HGV	EFT v8.0.1 Articulated HGV	EFT v9.0 Articulated HGV	ANPR 2017 Articulated HGV
Euro VI	54.8%	56.7%	34.3%	71.6%	70.6%	42.7%
Euro V SCR	20.0%	19.2%	26.7%	17.7%	18.3%	32.7%
Euro V EGR	6.7%	6.4%	8.9%	5.9%	6.1%	10.9%
Euro IV	8.2%	7.9%	17.9%	2.8%	2.9%	11.3%
Euro III	8.8%	8.5%	12.1%	1.8%	1.9%	1.9%
Euro II	1.4%	1.4%	0.1%	0.2%	0.2%	0.5%
Euro I	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro I	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 12. Comparison of Euro Class Breakdown for Rigid and Articulated HGVs, 2019



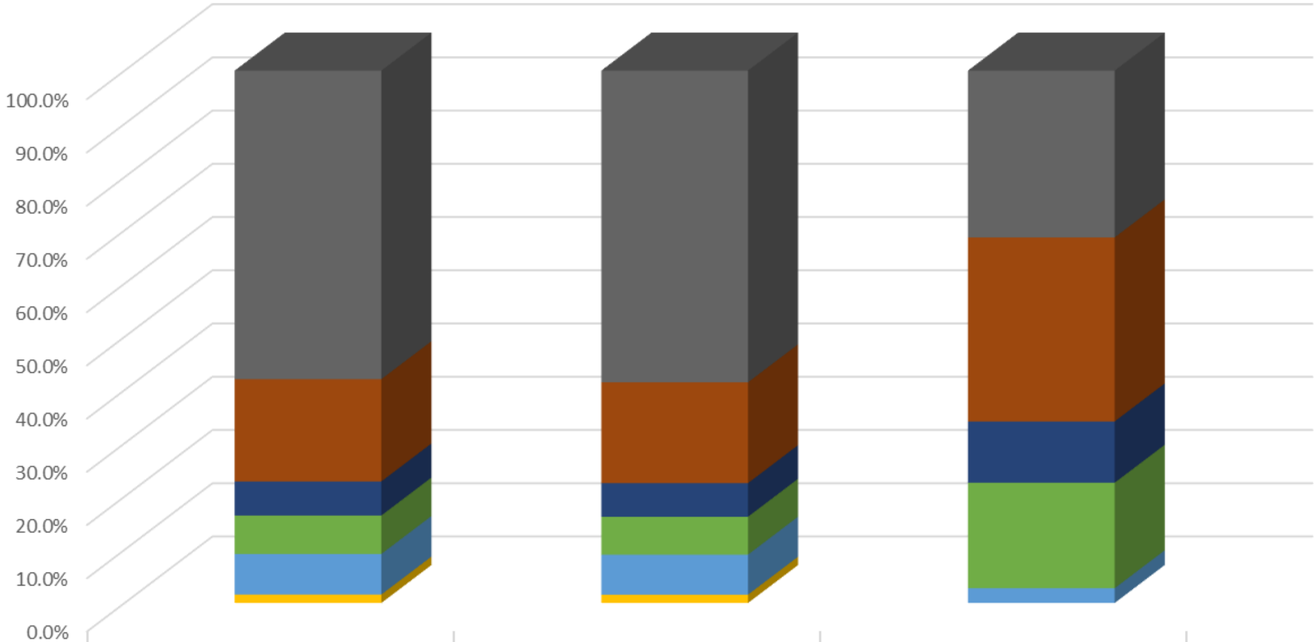
	EFT v8.0.1 Rigid HGV	EFT v9.0 Rigid HGV	ANPR 2019 Rigid HGV	EFT v8.0.1 Articulated HGV	EFT v9.0 Articulated HGV	ANPR 2019 Articulated HGV
Euro VI	70.9%	72.7%	59.1%	85.8%	85.0%	84.7%
Euro V SCR	14.6%	13.7%	19.9%	9.3%	9.8%	9.5%
Euro V EGR	4.9%	4.6%	6.6%	3.1%	3.3%	3.2%
Euro IV	4.7%	4.4%	9.5%	1.1%	1.2%	0.9%
Euro III	4.4%	4.1%	4.9%	0.6%	0.7%	1.5%
Euro II	0.6%	0.5%	0.0%	0.0%	0.0%	0.3%
Euro I	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pre-Euro I	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Figure 13. Comparison of Euro Class Breakdown for Buses and Coaches, 2017



	EFT v8.0.1 Bus and coach	EFT v9.0 Bus and coach	ANPR 2017 Bus and coach
Euro VI	40.1%	40.4%	8.2%
Euro V SCR	24.7%	24.6%	36.3%
Euro V EGR	8.2%	8.2%	12.1%
Euro IV	10.5%	10.4%	28.6%
Euro III	13.2%	13.1%	14.7%
Euro II	3.3%	3.3%	0.0%
Euro I	0.0%	0.0%	0.0%
Pre-Euro I	0.0%	0.0%	0.0%

Figure 14. Comparison of Euro Class Breakdown for Buses and Coaches, 2019



	EFT v8.0.1 Bus and coach	EFT v9.0 Bus and coach	ANPR 2019 Bus and coach
Euro VI	58.0%	58.6%	31.3%
Euro V SCR	19.2%	18.9%	34.6%
Euro V EGR	6.4%	6.3%	11.5%
Euro IV	7.2%	7.1%	19.8%
Euro III	7.6%	7.5%	2.8%
Euro II	1.6%	1.6%	0.0%
Euro I	0.0%	0.0%	0.0%
Pre-Euro I	0.0%	0.0%	0.0%

Appendix E – Use of ANPR Data to Inform the Projected Vehicle Fleet in EFSAC

Epping Forest Special Area of Conservation

Use of ANPR data to inform the projected vehicle fleet in EFSAC
Technical Note

Epping Forest District Council

17 March 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
Helen Venfield Principal Consultant	Alistair Thorpe Principal Consultant	Michele Hackman Regional Director	Michele Hackman Regional Director

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1	17/03/2020	V1	MH	Michele Hackman	Regional Director

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Prepared for:

Epping Forest District Council

Prepared by:

AECOM Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44(0)1256 310200
aecom.com

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1. Introduction

1.1 This Technical Note has been prepared by AECOM on behalf of Epping Forest District Council (EFDC) to explain how the 2019 Automatic Number Plate Recognition (ANPR) from the Epping Forest Special Area of Conservation (EFSAC), and Defra's Emission Factors Toolkit (EFT) have been used to inform the projection of the vehicle fleet to future years.

1.2 A separate Technical Note, 'Comparing 2017 and 2019 ANPR Vehicle Composition with EFT National Default Fleets', has been issued, presenting an analysis of the variability between the 2017 and 2019 ANPR datasets and between the EFT versions (version 8.0.1 and version 9.0), together with the implications that these may have on the resultant emissions calculations. The latest version of the EFT (v9.0) will be used for all further work.

1.3 The basic fleet split derived from the ANPR data showed a lower percentage of heavy-duty vehicles (HDV) in the local fleet than would be anticipated using the EFT default fleet split for rural roads. The HDV proportions from the ANPR survey data were between 2% and 2.5% whereas the 2019 HRA used 6-9% depending on the road link. Using the locally-derived vehicle fleet split therefore results in lower total NO_x emissions than was modelled in the 2019 HRA.

1.4 Analysis of the ANPR data revealed that the local vehicle fleet in EFSAC is generally older than the national default assumptions inherent within the EFT for rural/urban roads across all vehicle categories.

1.5 The EFSAC local vehicle fleet, as informed by the 2019 ANPR data, was also compared with the EFT's outer London fleet due to the proximity of the EFSAC to outer London. The 2019 local light duty vehicle (LDV) fleet was found to be newer than the EFT's outer London LDV fleet. In terms of the basic fleet split, the local vehicle fleet was found to be most like that defined in the EFT for outer London.

1.6 It was concluded that the ANPR data showed the local vehicle fleet operating in the EFSAC to be different from those defined in the EFT in terms of both basic fleet split and Euro class split. Therefore, it was recommended that the 2017 ANPR data be used to derive the vehicle fleet for the updated 2017 baseline air quality modelling scenario, and that 2019 ANPR data be used to inform the future local vehicle fleet in EFSAC.

1.7 For air quality modelling for future years, the EFT v9.0 provides the ability to project the Euro class distribution for future years, however it does not project the proportion of vehicles in terms of the basic fleet split. It was therefore recommended that the EFT outer London fleet be used to inform the projection of the fleet that will be expected to use the roads in EFSAC in future years, and in turn, inform any appropriate mitigation measures.

1.8 This Technical Note outlines the rationale and the methodology used to project the vehicle fleet that, based on current expectations, is likely to operate on the roads within Epping Forest SAC in future years.

2. Background and Overview

Emission Factor Toolkit (EFT)

2.1 EFT Version 9.0 was released in May 2019, refining and updating the basic fleet assumptions with the latest DfT data. Version 9.0 was also released with the inclusion of a new Advanced Fleet Option 'Fleet Projection Tool' that 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.

2.2 The vehicle fleet applied in the 2017 baseline model for the 2019 HRA modelling was previously taken from the EFT v8.0.1 for 'Rural' roads, due to the rural nature of the area. One of the limitations of this approach is that both versions of the EFT assume that there are no electric cars or LGVs using rural roads, which effectively increases the emissions rates applied.

ANPR Surveys

2.3 An ANPR survey was conducted on 23 February 2017, a neutral day and at a time where there were no school holidays, in line with best practice, to capture the local fleet composition of traffic travelling within the EFSAC. The dataset contains approximately 39,000 unique vehicles and a total of 259,000 observations / movements. This data represents a single day of trips observed.

2.4 A further ANPR survey was undertaken for three days (15 to 17 October 2019) at eight different locations within the Epping Forest SAC in order to capture the majority of vehicles passing through the SAC. The survey dates were considered to be neutral days and at a time where there were no school holidays, in line with best practice. The 2019 dataset contains approximately 55,000 unique vehicles and a total of 160,000 observations / movements.

2.5 Of the two ANPR surveys, the percentage of successful DVLA matches was higher for 2019 (97.5% of 56,681 registration plates) than for 2017 (81.8% of 47,998 registration plates).

Data Analysis

2.6 The ANPR survey data were analysed to extract the equivalent Basic Fleet Split and Euro emissions standards information for comparison with the EFT versions. The DVLA match data was processed to assign each matched vehicle to the equivalent EFT vehicle category. This was done based on type approval category[1], fuel type and gross vehicle weight. Where insufficient information was provided in the DVLA data to assign vehicles to an appropriate EFT category, other data fields were used to try to infill the gaps (e.g. vehicle wheel plan, number of axles, vehicle body shape). Euro emissions standards were also extracted from the DVLA data. Where Euro standard information was missing, infilling was carried out using vehicle registration date and vehicle type to assign an appropriate Euro standard.

2.7 An anonymised vehicle identifier was used to cross-reference the DVLA match data against the ANPR observation data so that the number of observations of each individual vehicle could be quantified. The use of total vehicle observations as opposed to individual vehicle counts is considered to better represent vehicle-kilometres travelled and also gives more weight to those vehicles that travel more frequently and / or greater distance. All subsequent analyses concerning the ANPR data has therefore been carried out on total vehicle observations rather than unique vehicles.

2.8 Similar local vehicle fleets were identified for both 2017 and 2019 ANPR data, as shown in Table 1. This provides confidence in the data collection methodology and validity of the data as representative of the fleet using the roads through EFSAC. An evolution of the vehicle fleet from diesel cars to petrol, hybrid and electric cars can be observed.

[1] https://www.vehicle-certification-agency.gov.uk/vehicletype/definition-of-vehicle-categories.asp

Table 1. Basic Vehicle Split Comparisons Between 2017and 2019 ANPR fleets

	Proportion of Vehicle Fleet		
Vehicle Type	**Local 2017 ANPR Data***	**Local 2019 ANPR Data***	**% Change in vehicle fleet from 2017 to 2019**
Petrol Car	40.1%	43.8%	+3.7%
Diesel Car	36.0%	31.5%	-4.5%
Taxi (black cab)	0.7%	0.5%	-0.2%
Petrol LGV	0.1%	0.2%	+0.1%
Diesel LGV	18.2%	18.0%	-0.2%
Rigid HGV	2.0%	1.6%	-0.4%
Articulated HGV	0.3%	0.2%	-0.1%
Bus and coach	0.2%	0.2%	<0.1%
Motorcycle	0.1%	<0.1%	-0.1%
Hybrid Car (Petrol)	1.4%	2.4%	1.0%
Plug-In Hybrid Car (Petrol)	0.7%	1.2%	0.5%
Hybrid Car (Diesel)	0.1%	0.1%	<0.1%
Electric Car	0.1%	0.3%	0.2%
Electric LGV	<0.1%	<0.1%	<0.1%

* Percentages may not add up to exactly 100% due to rounding.

2.9 The analysis of the 2019 ANPR data and the EFT's Basic Fleet Split for rural, urban and outer London roads indicated that the vehicle fleet using the roads through the EFSAC is most similar to the outer London fleet, as defined in EFT v9.0 for 2019. Taking into account the greater prevalence of diesel LGVs in the 2019 ANPR data, as shown in Table 2, the outer London EFT fleet shows a similar split between petrol and diesel LDVs. The rural EFT fleet, however, does not allow for any electric vehicles, and has the greatest difference in petrol/diesel split for cars when compared to the 2019 ANPR data.

2.10 In terms of Euro Class split, the 2019 ANPR data shows that the car and LGV EFSAC fleet is for the main part newer than that in the EFT outer London fleet, but older than the EFT UK average outside of London. The hybrid vehicles, taxis, rigid HGV and bus and coach fleets using the EFSAC roads are in general older than both of the EFT fleets considered. The articulated HGVs using the EFSAC roads are newer than those in the EFT outer London fleet, but overall very similar in terms of Euro Class split to the EFT national fleet.

2.11 For air quality modelling for future years, the EFT v9.0 provides the ability to project the Euro class distribution for future years, however it does not project the proportion of vehicles in terms of the basic fleet split. This report outlines how the EFT is used to inform the projection of the fleet that is expected to use the roads in EFSAC in future years, and in turn, will inform any appropriate mitigation measures.

Table 2. Basic Vehicle Split Comparisons Between EFT 9.0 Outer London Fleet and 2019 ANPR

	Proportion of Vehicle Fleet in 2019*		
Vehicle Type	EFT v9.0 (Outer London)	Local 2019 ANPR Data*	Difference of ANPR 2019 from EFT v9.0 Outer London fleet
Petrol Car	43.3%	43.8%	+0.5%
Diesel Car	36.3%	31.5%	-4.8%
Taxi (black cab)	2.1%	0.5%	-1.6%
Petrol LGV	0.2%	0.2%	<0.1%
Diesel LGV	11.1%	18.0%	+6.9%
Rigid HGV	1.6%	1.6%	<0.1%
Articulated HGV	0.2%	0.2%	<0.1%
Bus and coach	0.2%	0.2%	<0.1%
Motorcycle	1.5%	<0.1%	-1.5%
Hybrid Car (Petrol)	2.0%	2.4%	+0.4%
Plug-In Hybrid Car (Petrol)	0.3%	1.2%	+0.9%
Hybrid Car (Diesel)	0.6%	0.1%	-0.5%
Electric Car	0.4%	0.3%	<0.1%
Electric LGV	0.2%	<0.1%	-0.2%

Note: Percentages may not add up to exactly 100% due to rounding.

3. Methodology

Euro standards

3.1 The 2019 ANPR data have formed the basis upon which the future EFSAC vehicle fleet will be developed. The EFT v9.0 includes a 'Fleet Projection Tool'. There are two options when using this tool[2]:

> ***Option 1** assumes 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.*
>
> ***Option 2** assumes that the local fleet composition will gradually shift and converge towards the national fleet composition and mirror it at a specific point in time (referred to as the "Convergence Year" hereafter) – assuming the convergence will occur a number of years after the Projection Year, and no later than 2030 (the latest year of assessment currently available in the EFT). Whilst similar to Option 1 in terms of first determining the gap between local and national fleets, the EFT then considers that this gap will eventually close towards the Convergence Year.*

3.2 Option 1 has been selected for the projection of the EFSAC vehicle fleet so as to allow the vehicle fleet to evolve in future years, in line with national estimates, but recognising that the local vehicle fleet was overall 'older' than the national fleet in both 2017 and 2019.

Basic Fleet Split

3.3 EFT v9.0 does not provide a means of projecting the Basic Fleet Split to future years. Therefore the proportion of the EFSAC fleet derived from the 2019 ANPR data will be maintained for all HDV, LGV and motorcycles for all future scenarios.

3.4 However, the composition of the car fleet (petrol-diesel split, alternative technologies) is projected to change for future emissions scenarios. This is undertaken by following the change in car fleet relative to the outer London vehicle fleet. Outer London was selected based on the proximity of EFSAC to London, and the previous comparisons of the ANPR data identified similarities between the EFSAC ANPR data and the EFT 9.0 default outer London fleet. The EFT utilises bespoke vehicle fleet information and projections for London provided by Transport for London (TfL) in early 2018, taking account of the Mayor's announcement to bring the Ultra-Low Emission Zone (ULEZ) forward to 2019[2].

[2] Defra 'Emissions Factors Toolkit v9 User Guide', May 2019. Available at: https://laqm.defra.gov.uk/documents/EFTv9-user-guide-v1.0.pdf

4. Future EFSAC Vehicle Fleet

‘End of Plan’ vehicle fleet

4.1 Scenarios 3- 5 are to be modelled for the end of the Local Plan, 2033. Defra’s EFT provides information up to and including 2030, therefore the ‘end of plan’ vehicle fleets and emission factors are based upon 2030 information, with no change in vehicle fleet projected from 2030 to 2033.

4.2 Table 3 shows the EFT v9.0 basic fleet split for outer London compared to the projected end of plan fleet within the EFSAC. In line with the methodology described above, the proportion of the fleet present as LGV, HDV (rigid, artic, buses/coaches), and motorcycles remains unchanged from the 2019 ANPR fleet (Table 2). An increase in the proportion of hybrid and electric cars is predicted, relative to conventional petrol and diesel cars. The uptake in these alternative fuelled cars has been projected at the same rate as that predicted in outer London in the EFT v9.0. Based upon the previous analysis of the ANPR and EFT vehicle fleets, this is considered to be the most realistic approach. Furthermore, the approach used to project the vehicle fleet to future years is consistent with Joint Air Quality Unit (JAQU) guidance for assessing the efficacy of Clean Air Zones (CAZ).

4.3 Option 1 of the Fleet Projection Tool in EFT v9.0 is used to project the euro standard distribution of vehicles to future years from the 2019 ANPR data. As such, the EFSAC fleet remains ‘older’, and therefore more polluting, than the EFT default vehicle fleets in the same year.

4.4 Table 4 to Table 9 show the EFT v9.0 Euro class split for outer London compared to the projected end of plan fleet within the EFSAC. Overall, there is a greater proportion of the fleet present at lower Euro standards for conventional and hybrid petrol cars, diesel LGV, taxis, buses and coaches within the EFSAC fleet than the outer London fleet. Conversely, there is a greater proportion of the fleet present at higher Euro standards for conventional and hybrid diesel cars, petrol LGVs and artic HGVs.

Table 3. Basic Vehicle Split Comparisons Between EFT 9.0 Outer London 2030 Fleet and Projected ‘End of Plan’ Fleet

	Proportion of Vehicle Fleet *		
Vehicle Type	EFT v9.0 2030 (Outer London)	Projected ‘End of Plan’ Fleet	Difference of Projected Fleet from EFT v9.0 2030 (Outer London)
Petrol Car	36.7%	39.5%	+2.8%
Diesel Car	28.9%	26.0%	-2.9%
Taxi (black cab)	2.0%	0.5%	-1.5%
Petrol LGV	0.2%	0.2%	<0.1%
Diesel LGV	11.1%	18.0%	+6.9%
Rigid HGV	2.8%	1.6%	-1.2%
Articulated HGV	1.1%	0.2%	-0.9%
Bus and coach	1.9%	0.2%	-1.7%
Motorcycle	1.4%	<0.1%	-1.4%
Hybrid Car (Petrol)	4.0%	5.4%	+1.4%
Plug-In Hybrid Car (Petrol)	4.2%	4.2%	<0.1%
Hybrid Car (Diesel)	2.6%	2.2%	-0.4%
Electric Car	1.9%	1.9%	<0.1%
Electric LGV	1.2%	<0.1%	-1.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 4. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Petrol and Diesel Cars

Euro Standard	Petrol cars			Diesel cars		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro 1	-		-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	-	-	-	-	-
Euro 4	0.6%	0.3%	-0.3%	0.4%	0.1%	-0.3%
Euro 5	1.4%	2.2%	+0.8%	3.6%	1.9%	-1.6%
Euro 6	2.2%	3.3%	+1.1%	3.3%	3.0%	-0.3%
Euro 6c	95.8%	94.2%	-1.6%	12.0%	11.0%	-1.0%
Euro 6d	-	-	-	80.8%	84.0%	+3.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 5. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Petrol and Diesel LGVs

Euro Standard	Petrol LGVs			Diesel LGVs		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	-	-	-	-	-
Euro 4	0.3%	-	-0.3%	-	0.3%	+0.3%
Euro 5	2.7%	1.1%	-1.6%	0.9%	5.9%	+4.9%
Euro 6	0.5%	0.9%	+0.4%	2.2%	3.4%	+1.3%
Euro 6c	96.5%	98.0%	+1.6%	8.3%	10.4%	+2.1%
Euro 6d	-	-	-	88.6%	80.0%	-8.6%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 6. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Petrol Hybrid Cars

Euro Standard	Full Hybrid Petrol Cars			Plug-In Hybrid Cars		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	-	-	-	-	-
Euro 4	-	-	-	-	-	-
Euro 5	0.5%	0.6%	<0.1%	0.0%	0.1%	+0.1%
Euro 6	1.1%	2.4%	+1.3%	0.3%	0.9%	+0.6%
Euro 6c	98.3%	97.0%	-1.3%	99.6%	98.9%	-0.7%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 7. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Diesel Hybrid Cars and Taxis

Euro Standard	Diesel Hybrid Cars			Taxis		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	-	-	-	-	-
Euro 4	-	-	-	-	-	-
Euro 5	0.1%	0.3%	+0.3%	1.1%	4.1%	+2.9%
Euro 6	3.4%	1.4%	-2.0%	11.4%	7.2%	-4.3%
Euro 6c	12.5%	12.0%	-0.5%	-	17.2%	+17.2%
Euro 6d	84.1%	86.3%	+2.2%	-	69.5%	+69.5%
Zero Emission Capable				87.4%	-	-87.4%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 8. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Rigid and Artic HGVs

Euro Standard	Rigid HGVs			Artic HGVs		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro I	-	-	-	-	-	-
Euro I	-	-	-	-	-	-
Euro II	-	-	-	-	-	-
Euro III	-	-	-	-	-	-
Euro IV	-	0.2%	+0.2%	-	-	-
Euro V EGR	0.3%	0.3%	<0.1%	0.4%	-	-0.4%
Euro V SCR	1.0%	0.9%	-0.1%	1.3%	-	-1.3%
Euro VI	98.7%	98.6%	-0.1%	98.2%	99.9%	+1.7%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 9. Euro Class Split Comparisons Between EFT v9.0 Outer London 2030 and EFSAC 'End of Plan': Buses and Coaches

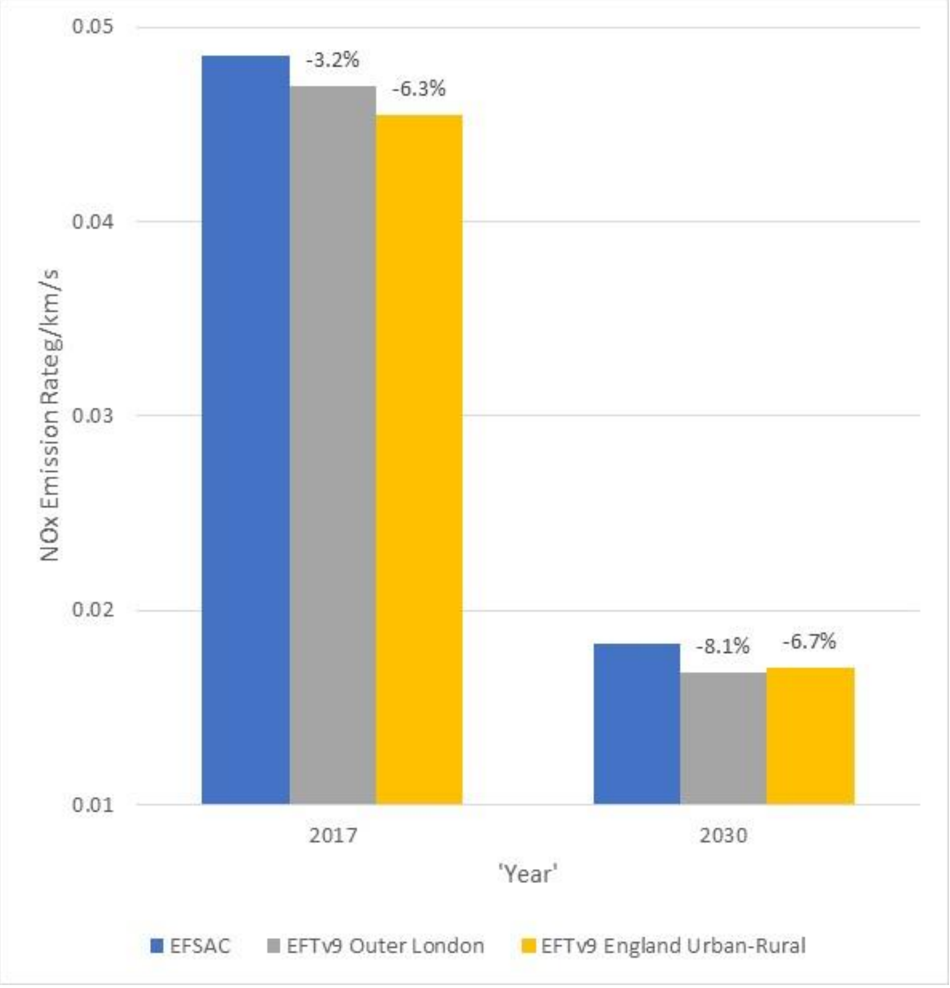
Euro Standard	Buses and Coaches		
	2030 EFT v9.0	EFSAC 'End of Plan'	Difference of EFSAC 'End of Plan' from EFT v9.0
Pre-Euro I	-	-	-
Euro I	-	-	-
Euro II	-	-	-
Euro III	-	-	-
Euro IV	-	1.8%	+1.8%
Euro V EGR	0.2%	1.9%	+1.7%
Euro V SCR	0.7%	5.8%	+5.1%
Euro VI	99.1%	90.4%	-8.6%

Note: Percentages may not add up to exactly 100% due to rounding.

4.5 Figure 1 shows the emission rates for a road within the EFSAC, applying the EFSAC-specific Euro standard split, and the EFT's default outer London and urban/rural Euro standard splits. Higher emission rates can be seen for the EFSAC compared to the EFT.

4.6 For 2017, the outer London, Urban / Rural fleet emission rates are 3.2% and 6.3% lower than the 2017 EFSAC emission rate, respectively. For the 'end of plan' year (2030), the outer London, Urban / Rural fleet emission rates are 8.1% and 6.7% lower than the EFSAC 'end of plan' emission rate, respectively.

Figure 1. Comparison of emission rates for a road within EFSAC for different road types



Note: Percentage changes are shown relative to the EFSAC fleet for the same 'year'

'Interim Year' vehicle fleet

4.7 Scenario 6 is to be modelled for an interim year between the adoption and end of the Local Plan. Following the review of temporal scales, the year of assessment has been revised to 2024. Therefore the 'interim year' vehicle fleet and emission factors are based upon 2024 information.

4.8 Table 10 shows the EFT v9.0 basic fleet split for outer London in 2024 compared to the projected 'interim year' fleet within the EFSAC. As for the end of year fleet, and in line with the methodology described above, the proportion of the fleet present as LGV, HDV (rigid, artic, buses/coaches), and motorcycles remains unchanged from the 2019 ANPR fleet (Table 2). An increase in the proportion of hybrid and electric cars is predicted, relative to conventional petrol and diesel cars. The uptake in these alternative fuelled cars has been projected at the same rate as that predicted in outer London in the EFT v9.0.

Table 10. Basic Vehicle Split Comparisons Between EFT 9.0 Outer London 2024 Fleet and Projected 'End of Plan' Fleet

Vehicle Type	Proportion of Vehicle Fleet *		
	EFT v9.0 2024 (Outer London)	Projected 'Interim Year' Fleet	Difference of Projected Fleet from EFT v9.0 2024 (Outer London)
Petrol Car	38.5%	41.0%	+2.5%
Diesel Car	33.3%	30.2%	-3.1%
Taxi (black cab)	2.0%	0.5%	-1.5%
Petrol LGV	0.2%	0.2%	<0.1%
Diesel LGV	11.0%	18.0%	+7.0%
Rigid HGV	2.9%	1.6%	-1.3%
Articulated HGV	1.1%	0.2%	-0.9%
Bus and coach	1.9%	0.2%	-1.7%
Motorcycle	1.4%	<0.1%	-1.4%
Hybrid Car (Petrol)	3.1%	4.5%	+1.4%
Plug-In Hybrid Car (Petrol)	1.4%	1.4%	<0.1%
Hybrid Car (Diesel)	1.7%	1.2%	-0.5%
Electric Car	1.0%	1.2%	+0.2%
Electric LGV	0.5%	<0.1%	-0.5%

Note: Percentages may not add up to exactly 100% due to rounding.

4.9 Again, Option 1 of the Fleet Projection Tool in EFT v9.0 is used to project the euro standard distribution of vehicles to future years from the 2019 ANPR data. As such, the EFSAC fleet remains 'older', and therefore more polluting, than the EFT default vehicle fleets in the same year.

4.10 Table 11 to Table 16 show the EFT v9.0 Euro class split for outer London in 2024 compared to the projected 'interim year' fleet within the EFSAC. Overall, there is a greater proportion of the fleet present at higher Euro standards for conventional diesel cars and artic HGVs only.

Table 11. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Petrol and Diesel Cars

Euro Standard	Petrol cars			Diesel cars		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro 1	-		-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	0.4%	-	-0.4%
Euro 3	1.8%	0.9%	-0.9%	0.9%	0.3%	-0.6%
Euro 4	5.4%	5.7%	+0.3%	11.0%	2.9%	-8.1%
Euro 5	15.9%	16.3%	+0.4%	20.9%	17.5%	-3.4%
Euro 6	9.9%	12.0%	+2.1%	6.4%	13.3%	+6.8%
Euro 6c	67.1%	65.1%	-2.0%	19.4%	25.5%	+6.1%
Euro 6d	-	-	-	41.0%	39.9%	-1.1%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 12. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Petrol and Diesel LGVs

Euro Standard	Petrol LGVs			Diesel LGVs		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	1.4%	5.3%	+3.9%	1.0%	0.8%	-0.2%
Euro 4	7.1%	2.3%	-4.8%	2.3%	3.8%	+1.5%
Euro 5	17.1%	21.8%	+4.7%	17.2%	23.2%	+5.9%
Euro 6	6.1%	12.7%	+6.6%	8.2%	11.5%	+3.3%
Euro 6c	68.4%	58.0%	-10.4%	20.6%	25.8%	+5.2%
Euro 6d	-	-	-	50.7%	35.0%	-15.8%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 13. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Petrol Hybrid Cars

Euro Standard	Full Hybrid Petrol Cars			Plug-In Hybrid Cars		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	0.2%	+0.2%	-	-	-
Euro 4	0.8%	0.7%	-0.1%	-	-	-
Euro 5	6.0%	5.5%	-0.5%	0.9%	2.3%	+1.4%
Euro 6	6.2%	8.7%	+2.4%	5.3%	10.1%	+4.9%
Euro 6c	87.0%	85.0%	-2.0%	93.8%	87.6%	-6.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 14. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Diesel Hybrid Cars and Taxis

Euro Standard	Diesel Hybrid Cars			Taxis		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro 1	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-
Euro 3	-	-	-	-	3.8%	+3.8%
Euro 4	-	-	-	6.2%	13.5%	+7.3%
Euro 5	0.9%	2.3%	+1.4%	10.8%	17.7%	+6.8%
Euro 6	9.5%	6.5%	-3.0%	14.9%	17.8%	+2.9%
Euro 6c	28.8%	50.2%	+21.4%	-	47.2%	+47.2%
Euro 6d	60.8%	41.0%	-19.7%	-	-	-
Zero Emission Capable				68.1%	-	-68.1%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 15. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Rigid and Artic HGVs

Euro Standard	Rigid HGVs			Artic HGVs		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro I	-	-	-	-	-	-
Euro I	-	-	-	-	-	-
Euro II	0.1%	-	-0.1%	-	-	-
Euro III	0.6%	0.5%	-0.1%	0.5%	0.1%	-0.4%
Euro IV	2.1%	2.2%	<0.1%	1.8%	0.1%	-1.7%
Euro V EGR	0.9%	2.2%	+1.3%	1.9%	0.4%	-1.5%
Euro V SCR	2.7%	6.6%	+3.9%	5.6%	1.1%	-4.6%
Euro VI	93.5%	88.6%	-5.0%	90.2%	98.4%	+8.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Table 16. Euro Class Split Comparisons Between EFT v9.0 Outer London 2024 and EFSAC 'Interim Year': Buses and Coaches

Euro Standard	Buses and Coaches		
	2024 EFT v9.0	EFSAC 'Interim Year'	Difference of EFSAC 'Interim Year' from EFT v9.0
Pre-Euro I	-	-	-
Euro I	-	-	-
Euro II	-	-	-
Euro III	0.5%	-	-0.5%
Euro IV	0.6%	7.9%	+7.3%
Euro V EGR	1.7%	6.6%	+4.8%
Euro V SCR	5.2%	19.7%	+14.5%
Euro VI	92.0%	65.9%	-26.2%

Note: Percentages may not add up to exactly 100% due to rounding.

Sensitivity Tests

4.11 As presented above, and in the ANPR Technical Note ('Comparing 2017 and 2019 ANPR Vehicle Composition with EFT National Default Fleets', February 2020), the use of the EFSAC ANPR vehicle fleet is shown to estimate increased emissions when compared against the EFT v9.0 average rural, urban and outer London average fleets.

4.12 There has previously been reason to consider the EFT future emission predictions with caution, for example with regard to Euro 6 vehicles not performing as expected[3]. Since then, various changes have been made to improve the EFT, including the use of the COPERT emission factors[4], and more recently the update to version 9.0 of the tool[5].

4.13 Recent research has been undertaken which shows that EFT v9.0 is now corresponding with decreasing measured concentrations of NOx and NO_2 in the UK[6]. Moreover, the research suggests that EFT v9.0 future fleet predictions may overestimate future emissions of NOx from road traffic:

[3] Carslaw et al., 'Trends in NOx and NO_2 emissions and ambient measurements in the UK.' Prepared for Defra (version 3rd March 2011, available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat05/1103041401_110303_Draft_NOx_NO2_trends_report.pdf
[4] https://copert.emisia.com/
[5] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html
[6] 'Performance of Defra's Emission Factor Toolkit 2013 - 2019', Air Quality Consultants, February 2020. Available at: https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=7fba769d-f1df-49c4-a2e7-f3dd6f316ec1

'*…on balance, the EFT is unlikely to over-state the rate at which NOx emissions decline in the future at an 'average' site in the UK. In practice, the balance of evidence suggests that NOx concentrations are most likely to decline more quickly in the future, on average, than predicted by the EFT. This does not mean that there will be no locations where the EFT over-states the rate of decline, but the most likely situation at most locations appears to be that the EFT will under-predict the rate at which NOx emissions fall in the near future.*'

4.14 This research suggests that the future EFSAC vehicle fleets presented in this report provide an appropriately conservative fleet composition for use in the EFSAC model studies. As the future fleets are based upon recorded ANPR data and projected using information within the EFT v9.0 for the closest 'year' of assessment, without any reduction in the difference between the local and national fleets, the assumptions are considered to already include a level of caution. Following the recent evidence that suggests that the EFT standard fleets are likely to underpredict improvements in emissions, and the EFSAC projections give rise to higher emissions than the standard EFT fleets, the EFSAC fleet scenarios build in adequate caution whilst also remaining realistic. Therefore, the ANPR projections are considered to be cautious enough to not require an additional sensitivity test.

Appendix F – EFSAC fleet mix by road and year with/without mitigation

2017

Link	% Petrol Car	% Diesel Car	% Taxi (black cab)	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	% Full Hybrid Petrol Cars	% Plug-In Hybrid Petrol Cars	% Full Hybrid Diesel Cars	% Battery EV Cars	% Battery EV LGV
J01_01	44.8	34.2	0.8	16.2	1.7	0.2	0.2	0.1	1.3	0.5	<0.1	0.1	<0.1
J01_02	38.3	36.2	0.7	21.2	1.3	<0.1	0.2	0.1	1.4	0.5	0.1	0.1	<0.1
J01_03	42.2	36.9	0.3	15.1	2.7	0.4	0.2	0.1	1.5	0.5	0.1	0.1	<0.1
J01_04	42.2	36.6	1.3	15.5	1.3	0.2	0.1	0.1	1.9	0.7	0.1	0.1	<0.1
J01_05	35.1	37.8	0.4	21.0	2.8	0.5	0.2	0.1	1.4	0.5	0.1	0.1	<0.1
J33_01	43.1	31.7	0.5	21.2	1.4	0.1	0.1	<0.1	1.3	0.5	<0.1	0.2	<0.1
J33_02	35.1	37.8	0.4	21.0	2.8	0.5	0.2	0.1	1.4	0.5	0.1	0.1	<0.1
J33_03	36.7	41.7	0.6	17.3	0.5	<0.1	0.1	<0.1	2.1	0.8	0.1	0.1	<0.1
J33_04	35.1	37.8	0.4	21.0	2.8	0.5	0.2	0.1	1.4	0.5	0.1	0.1	<0.1
J35_01	36.5	40.9	0.5	17.7	0.7	<0.1	0.2	0.1	2.3	0.9	0.1	0.1	<0.1
J35_02	44.1	37.8	0.7	14.1	0.7	<0.1	0.2	<0.1	1.7	0.6	<0.1	<0.1	<0.1
J35_03	44.1	37.8	0.7	14.1	0.7	<0.1	0.2	<0.1	1.7	0.6	<0.1	<0.1	<0.1
J36_01	42.2	36.6	1.3	15.5	1.3	0.2	0.1	0.1	1.9	0.7	0.1	0.1	<0.1
J36_02	45.7	39.5	0.3	10.8	0.4	<0.1	0.2	0.4	1.9	0.7	0.1	0.1	<0.1
J36_03	41.2	35.9	1.0	17.5	1.4	0.1	0.2	<0.1	1.8	0.7	0.1	0.1	<0.1
J36_04	44.1	37.8	0.7	14.1	0.7	<0.1	0.2	<0.1	1.7	0.6	<0.1	<0.1	<0.1

2024 without mitigation

Link	% Petrol Car	% Diesel Car	% Taxi (black cab)	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	% Full Hybrid Petrol Cars	% Plug-In Hybrid Petrol Cars	% Full Hybrid Diesel Cars	% Battery EV Cars	% Battery EV LGV
J01_01	43.8	29.1	0.7	16.5	1.7	0.2	0.1	<0.1	4.3	1.4	1.2	0.9	<0.1
J01_02	36.4	28.9	0.4	24.2	1.9	0.1	0.2	<0.1	4.6	1.4	1.1	0.9	<0.1
J01_03	42.0	31.1	0.3	16.6	1.9	0.4	0.2	<0.1	4.0	1.4	1.2	0.9	<0.1
J01_04	43.4	28.9	0.7	16.8	1.5	0.1	0.1	0.1	4.8	1.5	1.2	1.0	<0.1
J01_05	36.8	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	0.9	<0.1
J33_01	36.8	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	0.9	<0.1
J33_02	36.8	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	0.9	<0.1
J33_03	36.8	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	0.9	<0.1
J33_04	36.8	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	0.9	<0.1
J35_01	40.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	0.9	<0.1
J35_02	40.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	0.9	<0.1
J35_03	40.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	0.9	<0.1
J36_01	43.4	28.9	0.7	16.8	1.5	0.1	0.1	0.1	4.8	1.5	1.2	1.0	<0.1
J36_02	45.3	31.0	0.2	13.7	0.8	<0.1	0.2	<0.1	5.1	1.5	1.2	1.0	<0.1
J36_03	42.8	29.3	0.7	16.8	1.1	0.1	0.1	<0.1	5.2	1.5	1.2	1.0	<0.1
J36_04	40.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	0.9	<0.1

2024 with 10% shift of petrol cars to electric cars

Link	% Petrol Car	% Diesel Car	% Taxi (black cab)	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	% Full Hybrid Petrol Cars	% Plug-In Hybrid Petrol Cars	% Full Hybrid Diesel Cars	% Battery EV Cars	% Battery EV LGV
J01_01	39.4	29.1	0.7	16.5	1.7	0.2	0.1	<0.1	4.3	1.4	1.2	5.3	<0.1
J01_02	32.8	28.9	0.4	24.2	1.9	0.1	0.2	<0.1	4.6	1.4	1.1	4.6	<0.1
J01_03	37.8	31.1	0.3	16.6	1.9	0.4	0.2	<0.1	4.0	1.4	1.2	5.1	<0.1
J01_04	39.0	28.9	0.7	16.8	1.5	0.1	0.1	0.1	4.8	1.5	1.2	5.4	<0.1
J01_05	33.1	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	4.6	<0.1
J33_01	33.1	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	4.6	<0.1
J33_02	33.1	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	4.6	<0.1
J33_03	33.1	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	4.6	<0.1
J33_04	33.1	31.4	0.3	21.1	2.1	0.5	0.2	0.1	4.2	1.3	1.1	4.6	<0.1
J35_01	36.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	4.9	<0.1
J35_02	36.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	4.9	<0.1
J35_03	36.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	4.9	<0.1
J36_01	39.0	28.9	0.7	16.8	1.5	0.1	0.1	0.1	4.8	1.5	1.2	5.4	<0.1
J36_02	40.8	31.0	0.2	13.7	0.8	<0.1	0.2	<0.1	5.1	1.5	1.2	5.5	<0.1
J36_03	38.5	29.3	0.7	16.8	1.1	0.1	0.1	<0.1	5.2	1.5	1.2	5.3	<0.1
J36_04	36.2	31.2	0.4	18.8	0.6	<0.1	0.1	<0.1	5.0	1.5	1.2	4.9	<0.1

2033 without mitigation

Link	% Petrol Car	% Diesel Car	% Taxi (black cab)	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	% Full Hybrid Petrol Cars	% Plug-In Hybrid Petrol Cars	% Full Hybrid Diesel Cars	% Battery EV Cars	% Battery EV LGV
J01_01	42.2	24.9	0.7	16.5	1.7	0.2	0.1	<0.1	5.2	4.3	2.2	2.0	<0.1
J01_02	35.0	25.0	0.4	24.2	1.9	0.1	0.2	<0.1	5.4	4.0	2.0	1.8	<0.1
J01_03	40.4	26.9	0.3	16.6	1.9	0.4	0.2	<0.1	5.0	4.2	2.2	1.9	<0.1
J01_04	41.8	24.6	0.7	16.8	1.5	0.1	0.1	0.1	5.7	4.3	2.2	2.0	<0.1
J01_05	35.3	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	1.9	<0.1
J33_01	35.3	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	1.9	<0.1
J33_02	35.3	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	1.9	<0.1
J33_03	35.3	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	1.9	<0.1
J33_04	35.3	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	1.9	<0.1
J35_01	38.6	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	1.9	<0.1
J35_02	38.6	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	1.9	<0.1
J35_03	38.6	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	1.9	<0.1
J36_01	41.8	24.6	0.7	16.8	1.5	0.1	0.1	0.1	5.7	4.3	2.2	2.0	<0.1
J36_02	43.6	26.5	0.2	13.7	0.8	<0.1	0.2	<0.1	6.1	4.6	2.3	2.0	<0.1
J36_03	41.2	25.1	0.7	16.8	1.1	0.1	0.1	<0.1	6.1	4.4	2.2	2.1	<0.1
J36_04	38.6	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	1.9	<0.1

2033 with 30% shift of petrol cars to electric cars

Link	% Petrol Car	% Diesel Car	% Taxi (black cab)	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	% Full Hybrid Petrol Cars	% Plug-In Hybrid Petrol Cars	% Full Hybrid Diesel Cars	% Battery EV Cars	% Battery EV LGV
J01_01	29.5	24.9	0.7	16.5	1.7	0.2	0.1	<0.1	5.2	4.3	2.2	14.6	<0.1
J01_02	24.5	25.0	0.4	24.2	1.9	0.1	0.2	<0.1	5.4	4.0	2.0	12.3	<0.1
J01_03	28.3	26.9	0.3	16.6	1.9	0.4	0.2	<0.1	5.0	4.2	2.2	14.0	<0.1
J01_04	29.3	24.6	0.7	16.8	1.5	0.1	0.1	0.1	5.7	4.3	2.2	14.6	<0.1
J01_05	24.7	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	12.5	<0.1
J33_01	24.7	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	12.5	<0.1
J33_02	24.7	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	12.5	<0.1
J33_03	24.7	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	12.5	<0.1
J33_04	24.7	27.4	0.3	21.1	2.1	0.5	0.2	0.1	5.0	4.0	2.1	12.5	<0.1
J35_01	27.0	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	13.5	<0.1
J35_02	27.0	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	13.5	<0.1
J35_03	27.0	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	13.5	<0.1
J36_01	29.3	24.6	0.7	16.8	1.5	0.1	0.1	0.1	5.7	4.3	2.2	14.6	<0.1
J36_02	30.6	26.5	0.2	13.7	0.8	<0.1	0.2	<0.1	6.1	4.6	2.3	15.1	<0.1
J36_03	28.9	25.1	0.7	16.8	1.1	0.1	0.1	<0.1	6.1	4.4	2.2	14.4	<0.1
J36_04	27.0	27.0	0.4	18.8	0.6	<0.1	0.1	<0.1	6.0	4.3	2.2	13.5	<0.1

Appendix G – EFSAC Euro Class Split used in EFSAC air quality modelling

Petrol and Diesel Cars

Euro Standard	Petrol cars					Diesel cars				
	2017 ANPR Data*	EFSAC 'Interim Year'	EFSAC 'End of Plan'	EFSAC CAZ 'Interim Year'	EFSAC CAZ 'End of Plan'	2017 ANPR Data*	EFSAC 'Interim Year'	EFSAC 'End of Plan'	EFSAC CAZ 'Interim Year'	EFSAC CAZ 'End of Plan'
Pre-Euro 1	1.3%	-	-	-	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-	-	-	-	-
Euro 2	0.1%	-	-	<0.1%	-	-	-	-	<0.1%	-
Euro 3	18.1%	0.9%	-	0.2%	-	8.5%	0.3%	-	0.1%	-
Euro 4	30.4%	5.7%	0.3%	6.7%	0.6%	21.9%	2.9%	0.1%	2.0%	-
Euro 5	31.0%	16.3%	2.2%	13.7%	1.4%	42.4%	17.5%	1.9%	3.2%	1.0%
Euro 6	11.9%	12.0%	3.3%	10.2%	2.2%	17.1%	13.3%	3.0%	11.8%	1.1%
Euro 6c	7.2%	65.1%	94.2%	69.2%	95.8%	10.1%	25.5%	11.0%	36.8%	6.5%
Euro 6d	-	-	-	-	-	-	39.9%	84.0%	46.1%	91.4%

Note: Percentages may not add up to exactly 100% due to rounding.

Petrol and Diesel LGVs

Euro Standard	Petrol LGVs 2017 ANPR Data*	Petrol LGVs EFSAC 'Interim Year'	Petrol LGVs EFSAC 'End of Plan'	Petrol LGVs EFSAC CAZ 'Interim Year'	Petrol LGVs EFSAC CAZ 'End of Plan'	Diesel LGVs 2017 ANPR Data*	Diesel LGVs EFSAC 'Interim Year'	Diesel LGVs EFSAC 'End of Plan'	Diesel LGVs EFSAC CAZ 'Interim Year'	Diesel LGVs EFSAC CAZ 'End of Plan'
Pre-Euro 1	1.2%	-	-	-	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-	-	-	-	-
Euro 2	-	-	-	<0.1%	-	0.1%	-	-	-	-
Euro 3	44.4%	5.3%	-	0.4%	-	12.5%	0.8%	-	0.1%	-
Euro 4	42.5%	2.3%	-	8.9%	0.3%	26.4%	3.8%	0.3%	1.5%	-
Euro 5	6.7%	21.8%	1.1%	17.4%	2.7%	53.0%	23.2%	5.9%	7.6%	0.9%
Euro 6	5.2%	12.7%	0.9%	6.0%	0.5%	8.0%	11.5%	3.4%	9.4%	2.2%
Euro 6c	-	58.0%	98.0%	67.2%	96.5%	-	25.8%	10.4%	23.5%	8.3%
Euro 6d	-	-	-	-	-	-	35.0%	80.0%	57.9%	88.6%

Note: Percentages may not add up to exactly 100% due to rounding.

Petrol Hybrid Cars

Euro Standard	Full Hybrid Petrol Cars 2017 ANPR Data*	Full Hybrid Petrol Cars EFSAC 'Interim Year'	Full Hybrid Petrol Cars EFSAC 'End of Plan'	Full Hybrid Petrol Cars EFSAC CAZ 'Interim Year'	Full Hybrid Petrol Cars EFSAC CAZ 'End of Plan'	Plug-In Hybrid Cars 2017 ANPR Data*	Plug-In Hybrid Cars EFSAC 'Interim Year'	Plug-In Hybrid Cars EFSAC 'End of Plan'	Plug-In Hybrid Cars EFSAC CAZ 'Interim Year'	Plug-In Hybrid Cars EFSAC CAZ 'End of Plan'
Pre-Euro 1	1.2%	-	-	-	-	1.2%	-	-	-	-
Euro 1	-	-	-	-	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-	-	-	-	-
Euro 3	12.2%	0.2%	-	<0.1%	-	-	-	-	-	-
Euro 4	12.2%	0.7%	-	0.8%	<0.1%	-	-	-	-	-
Euro 5	41.9%	5.5%	0.6%	6.0%	0.5%	55.6%	2.3%	0.1%	0.9%	<0.1%
Euro 6	16.8%	8.7%	2.4%	6.2%	1.1%	30.5%	10.1%	0.9%	5.3%	0.3%
Euro 6c	15.7%	85.0%	97.0%	87.0%	98.3%	12.7%	87.6%	98.9%	93.8%	99.6%

Note: Percentages may not add up to exactly 100% due to rounding.

Diesel Hybrid Cars and Taxis

Euro Standard	Diesel Hybrid Cars: 2017 ANPR Data*	Diesel Hybrid Cars: EFSAC 'Interim Year'	Diesel Hybrid Cars: EFSAC 'End of Plan'	Diesel Hybrid Cars: EFSAC CAZ 'Interim Year'	Diesel Hybrid Cars: EFSAC CAZ 'End of Plan'	Taxis: 2017 ANPR Data*	Taxis: EFSAC 'Interim Year'	Taxis: EFSAC 'End of Plan'	Taxis: EFSAC CAZ 'Interim Year'	Taxis: EFSAC CAZ 'End of Plan'
Pre-Euro 1	-	-	-	-	-	-	-	-	-	-
Euro 1	-	-	-	-	-	-	-	-	-	-
Euro 2	-	-	-	-	-	-	-	-	-	-
Euro 3	-	-	-	-	-	26.7%	3.8%	-	-	-
Euro 4	-	-	-	-	-	40.4%	13.5%	-	6.2%	-
Euro 5	56.0%	2.3%	0.3%	0.9%	0.1%	29.8%	17.7%	4.1%	10.8%	1.1%
Euro 6	19.1%	6.5%	1.4%	12.4%	1.1%	3.2%	17.8%	7.2%	14.9%	11.4%
Euro 6c	24.9%	50.2%	12.0%	38.5%	6.6%	-	47.2%	17.2%	-	-
Euro 6d	-	41.0%	86.3%	48.2%	92.2%	-	-	69.5%	-	-
ZEC	-	-	-	-	-	-	-	-	68.1%	87.4%

Note: Percentages may not add up to exactly 100% due to rounding.

Rigid and Artic HGVs

Euro Standard	Rigid HGVs: 2017 ANPR Data*	Rigid HGVs: EFSAC 'Interim Year'	Rigid HGVs: EFSAC 'End of Plan'	Rigid HGVs: EFSAC CAZ 'Interim Year'	Rigid HGVs: EFSAC CAZ 'End of Plan'	Artic HGVs: 2017 ANPR Data*	Artic HGVs: EFSAC 'Interim Year'	Artic HGVs: EFSAC 'End of Plan'	Artic HGVs: EFSAC CAZ 'Interim Year'	Artic HGVs: EFSAC CAZ 'End of Plan'
Pre-Euro I	-	-	-	-	-	-	-	-	-	-
Euro I	-	-	-	-	-	-	-	-	-	-
Euro II	0.1%	-	-	-	-	0.5%	-	-	0.0%	-
Euro III	12.1%	0.5%	-	<0.1%	-	1.9%	0.1%	-	0.0%	-
Euro IV	17.9%	2.2%	0.2%	0.1%	-	11.3%	0.1%	-	0.1%	-
Euro V EGR	8.9%	2.2%	0.3%	0.4%	0.2%	10.9%	0.4%	-	0.1%	-
Euro V SCR	26.7%	6.6%	0.9%	1.1%	0.7%	32.7%	1.1%	-	0.2%	-
Euro VI	34.3%	88.6%	98.6%	98.4%	99.0%	42.7%	98.4%	100.0%	99.6%	100.0%

Note: Percentages may not add up to exactly 100% due to rounding.

Buses and Coaches

Euro Standard	Buses and Coaches				
	2017 ANPR Data*	EFSAC 'Interim Year'	EFSAC 'End of Plan'	EFSAC CAZ 'Interim Year'	EFSAC CAZ 'End of Plan'
Pre-Euro I	-	-	-	-	-
Euro I	-	-	-	-	-
Euro II	-	-	-	-	-
Euro III	14.7%	-	-	<0.1%	-
Euro IV	28.6%	7.9%	1.8%	<0.1%	-
Euro V EGR	12.1%	6.6%	1.9%	0.3%	-
Euro V SCR	36.3%	19.7%	5.8%	0.8%	-
Euro VI	8.2%	65.9%	90.4%	98.9%	100.0%

Note: Percentages may not add up to exactly 100% due to rounding.