

SHEFFIELD AND ROTHERHAM CLEAN AIR ZONE FEASIBILITY STUDY

SYSTRA'S CAR FLEET MODEL

29th November 2021

DRAFT



DOCUMENT CONTROL

APPROVAL					
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Supplementary Technical Note – Predicting the Emissions Profile of Private Car Traffic in Sheffield in Future Years

1. Introduction

1.1 Context

In 2017, the UK Government named Sheffield and Rotherham as one of 29 areas in England which contained locations where the annual average concentrations of Nitrogen Dioxide (NO₂) exceeded statutory limits and was projected to continue to do so beyond a 3-4 year horizon.

The two councils have therefore been developing a strategy which will help ensure that the two areas will become compliant with this statutory limit ‘in the shortest possible time’.

1.2 This Document

This note describes the fleet modelling and analysis which supports SYSTRA’s prediction of the emissions profile of the private car fleet (excluding taxis and private hire vehicles) in Sheffield traffic in 2022 and beyond, including the split by fuel type (petrol, diesel, battery electric vehicles (BEVs) and ‘Other’ (predominantly plug-in petrol hybrid vehicles (PHEVs) and Euro Class.

The proportion of diesel within this future car fleet is particularly important when considering NO_x emissions and NO₂ air concentrations, as a typical diesel car emits significantly more of these types of emissions into the atmosphere than a similarly-aged petrol or ultra-low emission vehicle (ULEV). Based on an average 2018 UK (non-London) fleet an average diesel car will emit nearly 8 times as much NO_x as a petrol car, when driving in typical urban conditions. Therefore, any reduction to the proportion of diesel in the car fleet over time will deliver a corresponding reduction in the NO_x emissions, without requiring any other change to the age profile of the car fleet.

This note focuses on the emissions profile of Sheffield car traffic, though many of the car fleet profile changes described in this note will also apply to the wider South Yorkshire area.

2. Fleet Profile of the Private Cars Observed in Sheffield Traffic in February 2019

The analysis starts from the profile of car traffic (excluding vehicles registered as Private Hire Vehicles¹) observed at six ANPR locations in Sheffield in February 2019.

The six locations are illustrated in the map below.

{Insert a map of Feb 2019 locations here}

Figure 1 Map Showing the Location of the ANPR Camera Locations (February 2019)

¹ The required improvement to the PHV fleet will be affected by the introduction of the proposed CAZ and the associated incentive schemes and so needs to be treated separately from ‘ordinary’ cars

Initial analysis (not reported in detail here) confirmed that there was little difference in the emission profiles of the car fleets observed at the six locations, so we have aggregated the data from all six cameras in the Sheffield car fleet modelling being reported here.

The profile of the total set of private cars observed at these two locations by fuel type and EURO class is summarised in the table and pie-chart below (using the standard CAZ definition of 'non-compliant' vehicles²).

² Pre-Euro 4 for petrol and pre-Euro 6 for diesel

Table 1 The fuel and emissions profile of private cars observed in Sheffield in February 2019

2019	Petrol	Diesel	BEV	Other	
Euro 6	19%	12%	0.2%	2.5%	
Euro 5	16%	21%	0.1%	0.9%	
Euro 4	11%	10%	0.0%	0.2%	
Pre-Euro 4	4.5%	2.2%	0.0%	0.0%	
Total	51%	46%	0.3%	3.6%	100.0%

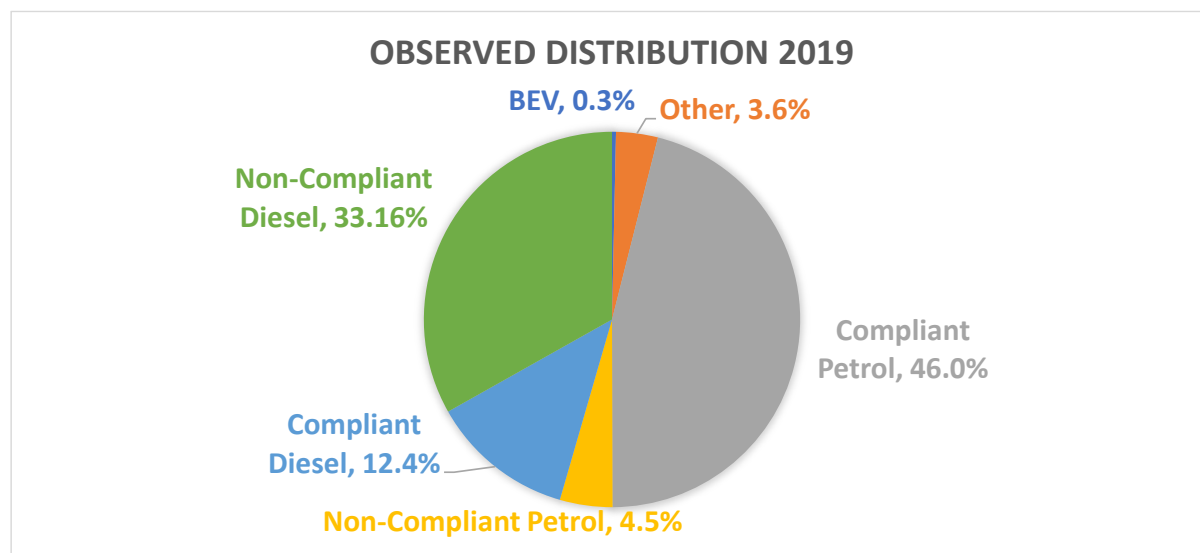


Figure 2 Profile of Observed Car Traffic (February 2019)

The data suggests that around 46% of the observed car traffic was diesel in February 2019.

3. Overview of the Car Fleet Modelling

SYSTRA’s car fleet model starts from an observed age and fuel-type (petrol, diesel, BEV, Other) profile and applies scrappage rates (including write-offs due to road accidents etc) by age and fuel type. These scrappage rates were calibrated using the DfT’s Annual Vehicle Licensing Statistics for 2017. The original car fleet model considered only three fuel types (Petrol, Diesel and ‘Other’), where ‘Other’ was a combination, of petrol hybrid, LPG, CNG, ethanol etc. This fuel type category was subsequently split into ‘Zero Emission’ (predominantly Battery Electric Vehicles (BEVs)) and ‘Non-Zero Other’, predominantly petrol hybrids. Due to a lack of data on the ‘life expectancy’ of BEVs, we have continued to use the calibrated scrappage rates for the original combined ‘Other’ category for both the BEVs and the ‘Non-Zero Other’ sub-categories.

The age profiles consist of twenty 1-year ‘age buckets’ (‘Less than 1 year old’, 1-2, ...,19-20), plus a final ‘>20 year-old’ age category. The starting profile (for 2020) is based on the fleet observed in February 2019 by the 6 ANPR cameras described above.

As the fleet rolls forward from one year to the next, the relevant number (by age and fuel type) get scrapped and the remainder move into the next age bucket. The exception to this is the '>20 year-old' bucket, where the vehicles either get scrapped or remain in that bucket (to be joined by the surviving vehicles from the 19-20 yr-old bucket).

The number of new vehicles entering the fleet (via the 'Less than 1 year old' bucket) and the fuel-split of these new registrations is controlled by the user. In the version used to inform the Sheffield & Rotherham Clean Air Plan FBC, the number and fuel split of new vehicles assumed in 2019, 2021 and 2022 are derived by applying SMMT February 2021 forecasts for the impacts of the Covid pandemic to the number of vehicles first registered in 2019 and observed in the 6-site ANPR car traffic.

The scrappage rates are adjusted each year to ensure that the size of the total fleet remains constant, so that if the user reduces the number of new vehicles entering the fleet in a given year, the scrappage rates for that year also reduce.

The fuel-type mix of these new cars in future years (ie from 2020 onwards) are controlled by user input assumptions.

Here we have assumed that the rapid decline in the %diesel in new car sales observed between 2017 and 2019 (from 54% of new car sales in 2017 to 38% in 20) will continue (achieved by multiplying the %diesel in new car sales by x0.84 each year), while the proportion of 'Other' (BEVs & Hybrids) will rises geometrically (ie by the same multiplicative factor each year) from its current (2019) level of around 7.5% in 2019 to 100% BEVs by 2030. This is achieved by applying a 26% per annum growth to the 'BEV + Other' proportion and a 29% per annum growth to the BEV proportion within this 'BEV + Other' category.

The resulting predicted profiles of new car sales are illustrated in Figure 3 below.

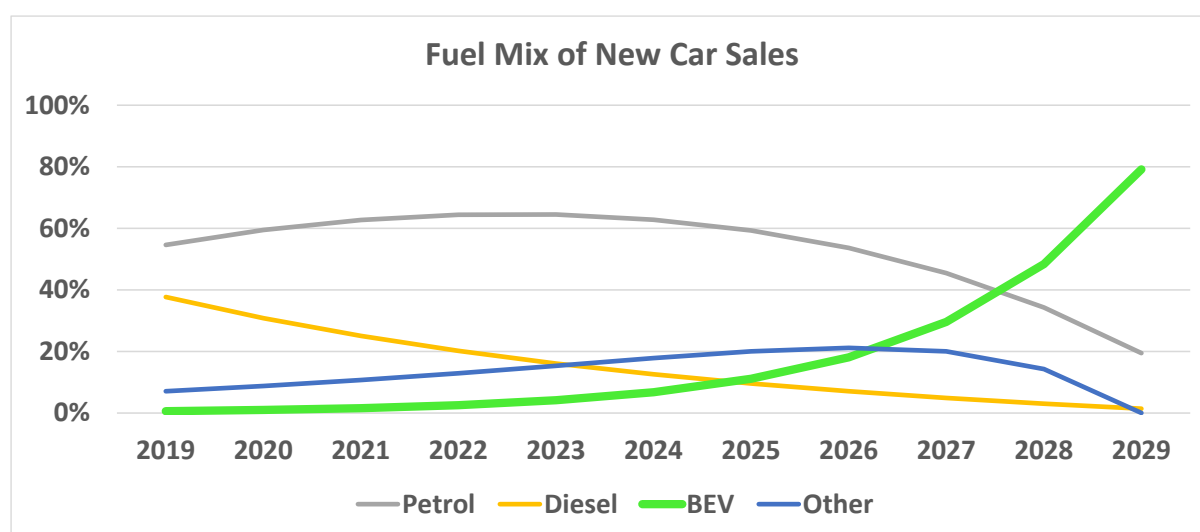


Figure 3 Predicted Fuel Mix of New Cars in Sheffield between now and 2030

Adding in these new car sales to the '<1-year old' bucket and applying the 'scrappage + aging' process to each year's profile produces the predicted private car profiles illustrated in Figure 4 below.

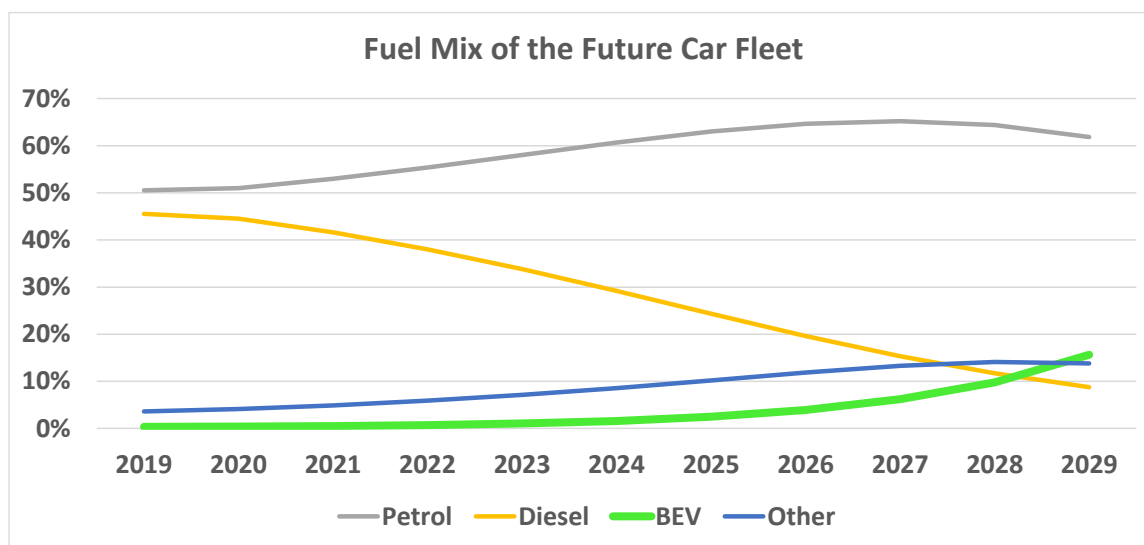


Figure 4 Predicted Fuel Mix Profile of Sheffield Car Traffic between now and 2030

The corresponding predicted emission profile by Euro class and fuel type for 2022 is summarised in Table 2 below, with the corresponding split between 'Compliant' and 'Non-Compliant' CAZ categories (based on the standard CAZ definition of non-compliance – ie pre-Euro 4 petrol and pre-Euro 6 diesel) illustrated in the pie-chart in Figure 5.

Table 2 The fuel and emissions profile of Sheffield car traffic predicted for Sept 2022

2022	Petrol	Diesel	BEV	Other	
Euro 6	33%	17%	0.6%	4.8%	
Euro 5	17%	17%	0.1%	0.9%	
Euro 4	5%	4%	0.0%	0.1%	
Pre-Euro 4	0.6%	0.2%	0.0%	0.0%	
Total	55%	38%	0.7%	5.9%	100.0%

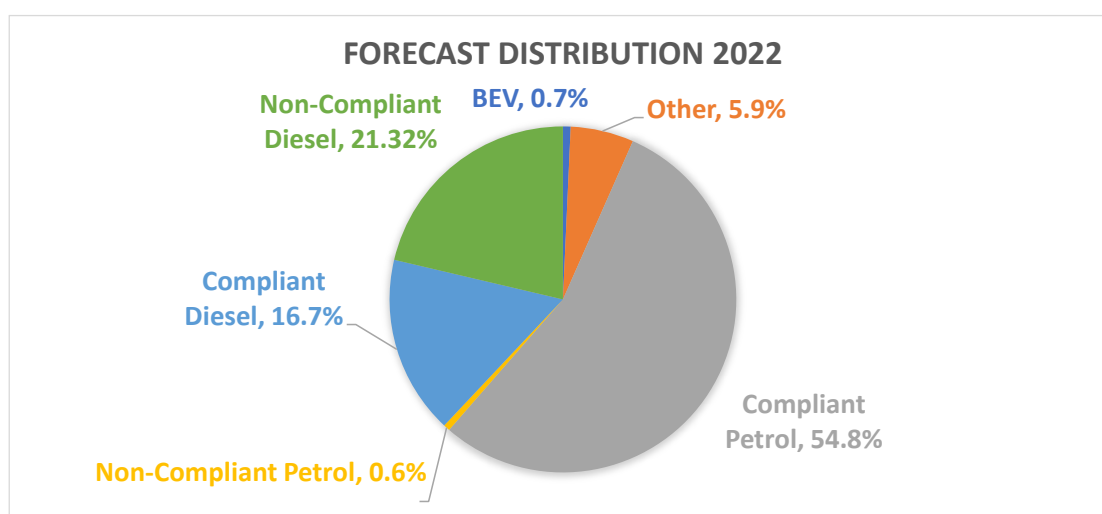


Figure 5 Split of Sheffield Car Traffic by Fuel Type and CAZ Compliance - 2022

4. Conclusions

This note has summarised the methodology used to predict the emissions profiles of Sheffield car traffic in 2022 (and beyond), based on SYSTRA's fleet model, calibrated using UK scrappage rates, the emissions and age profile of Sheffield car traffic observed in February 2019, SMMT forecasts of UK car sales between 2019 and 2022 and the geometric extrapolation of the recent growth in the % of battery electric vehicles within new car sales required to reach '100% BEVs by 2030'.

The most-important feature of this forecast in car traffic is the decline in non-compliant diesel vehicles, from 33% of Sheffield's private car traffic in 2019 to around 21% by 2022, due to a combination of a three years' of scrappage of the older non-compliant diesel cars over this time and a x1.7 increase in the two low emission categories (BEV and Other), (from under 4% to over 6.5% of Sheffield's car traffic).