# Greater Manchester's Clean Air Plan to tackle Nitrogen Dioxide Exceedances at the Roadside

# Note 15: Implications of the EFT update for the GM CAP

# CONFIDENTIAL DRAFT

| Version Status: | 2nd DRAFT FOR APPROVAL | Prepared by: | Tony Morris 28th October 2019 |
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# 1    Introduction

1.1    The purpose of this Note is to describe the implications of the revised Emissions Factor Toolkit (EFT) for the Greater Manchester Clean Air Plan (GM CAP). The analysis has been undertaken by running a sensitivity test to investigate the impacts of changes to the EFT on forecast NOx emission totals from the 2023 OBC do-minimum modelling. The note describes the test and presents the results of the analysis.

# 2    Update to EFT

2.1    GM's methodology for calculating traffic emissions applies emissions factors derived from the Department for Environment, Food & Rural Affairs (DEFRA) Emission Factor Toolkit (EFT). The air quality modelling for the OBC used outputs from version 8.0 of the software, which was released in November 2017.

2.2    Subsequently, DEFRA released EFT v9.0 aligning the fleet figures in the EFT with those in the most recent Pollution Climate Mapping (PCM) base year projections (2017).

2.3    At the end of May 2019, JAQU issued an update to the toolkit, EFT version 9.1a. This is a non-standard EFT update, which has has been produced for local authorities (LAs) developing Clean Air Plans plans only (and thus is only available on Huddle). This version of EFT contains fleet figures derived from a recent Department for Transport (DfT) project to develop new passenger car fleet projections in light of emerging evidence regarding changes in consumer purchasing behaviour.

2.4    In particular, the update reflects the recent trends in new car sales, which have slowed overall and have also shown a shift away from diesel car purchases and towards petrol and electric cars.

2.5    Updates to the EFT between versions 8.0 and 9.1.a include:

- Updates to the basic fleet assumptions for 2017-2030 in line with DfT, National Atmospheric Emissions Inventory (NAEI) and Transport for London (TfL) projections;

- Updates to Euro class compositions for 2017-2030 in line with DfT, NAEI, and TfL data (inclusive of Euro 6 subcategories);

- Updated fuel scaling factors for Particulate Matter (PM); and

- An update of the basic fleet split assumptions and Euro class compositions for passenger cars for 2017-2030 in line with the latest DfT figures for the projected split (by vkms) of diesel, petrol and electric cars.

2.6    The updated tools also include several additional user options including:

- Inclusion of a new 'Advanced 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 Automatic Number Plate Recognition (ANPR) surveys) to a future projection year;

- Inclusion of a function for projecting the proportions of diesel, petrol and electric cars from a base year of traffic monitoring to an assessment year; and

- Inclusion of $CO_2$ emissions for User Defined Euro Classes, either entered via the Euro Compositions or Simple Entry Euro Compositions 'Advanced Options'.

2.7 Further details of the EFT updates are available in 'EFT v9.0 and v9.1a release summary', DEFRA May 2019.

2.8 Associated air quality modelling tools were also released, these included an updated '$NO_x$ to $NO_2$ Calculator' and the background maps.

## 3 JAQU recommendations for local authorities

3.1 JAQU's assessment is that the fleet projections in EFT v9.1a represent the best evidence currently available at a national level regarding the future of the vehicle fleet. JAQU have advised that second wave authorities still developing modelling, including GM, can use the updated EFT v9.1a in modelling provided this does not result in any delay to delivery against Ministerial Direction deadlines. Alternatively, they have advised that EFT v9.1a can be used to run a sensitivity test to provide reassurance that use of this updated tool would not change the overall conclusion of the assessment, again provided this does not result in any delay to delivery against Ministerial Direction deadlines.

3.2 It should be noted that, because JAQU deemed it necessary to provide $NO_2$ plan LAs with the latest DfT fleet projections as soon as possible, background maps have not been updated such that they are consistent with these fleet projections (and it is for this reason that EFT v9.1a has not been made publicly available). The latest (2017 base year) background maps are available on the LAQM website, and these maps are consistent with the fleet figures in EFT v9.0. JAQU's assessment is that it is acceptable for $NO_2$ plan LAs to use EFT v9.1a in conjunction with the 2017 base year background maps to calculate total roadside NO2 concentrations, provided that this is noted as an inconsistency in modelling methodology reports and the analytical assurance statement.

3.3 The GM modelling uses the 2015 projection background mapping because the 2017 wasn't published when the GM modelling was commenced. JAQU have confirmed that the guidance with respect to the use of inconsistent background maps/tools with the EFTv9.1 holds for all reference years, including the 2015 version.

3.4    The GM CAP OBC forecasts that compliance cannot be achieved until 2024 in the region. The relatively long forecasting window compared to other cities means that the impact of the trends underpinning the JAQU tools on the reliability of GM's modelling is potentially greater than for many cities developing plans.

## 4    GM approach to calculating traffic emissions at OBC

4.1    The base year (2016) fleet mix for the GM CAP study was derived using ANPR supplied by Greater Manchester Police (GMP). The Euro class composition for 2016 was obtained by identifying the date of registration from the licence plate number, which were matched against the date of enforcement of the relevant Euro standard to develop the Euro standard for that vehicle type. This approach was adopted because licence plates from GMP could not be issued onwards due to Data Protection, and therefore direct matching with the DVLA database was not possible.

4.2    The fleet mix for forecast years is estimated using a 'roll-over' model to adjust the base composition for forecast years. This approach keeps the vehicle age constant for any given future year (e.g. 2021), and then re-calculates the Euro standard at this point in time. The method conserves the age distribution of the vehicle population for each vehicle/fuel type. Details of the derived Euro and fuel fleets splits are provided in the GM CAP OBC supplementary report T3 (available at https://cleanairgm.com/outline-business-case) for each forecast year.

4.3    Additional project specific ANPR surveys have been undertaken in 2019 at areas of predicted exceedance, and a review of the data against assumptions of age and the projection methodology has been carried out. The results of this analysis are described in the accompanying note 'Note 5 - GM ANPR Surveys: Summary of Initial Findings'. The analysis shows that there are not major differences between observed levels of compliance in the overall GM fleet between the 2016 and 2019 surveys.

4.4    The road traffic emission factors for the OBC were derived using EFT version 8.0 by selecting the 'Advanced/Euro Composition' options. The appropriate Euro fleet splits were then entered in the 'UserEuro' worksheet to obtain emission rates in g/km for motorway and non-motorway road types, for speeds between 5kph and 115kph (at 5 kph intervals), for NOx and $NO_2$ to calculate f-$NO_2$, $PM_{10}$ and $PM_{2.5}$. These derived emission rates were then fed into GM's  in-house EMIGMA (EMissions Inventory for Greater Manchester) software to derive total emissions for each pollutant and vehicle type for each link in the highway model for each modelled scenario.

4.5    The EMIGMA software uses information about traffic speeds and flows from the highway model in association with the fleet-weighted emission rates (described above) to calculate mass road traffic emissions broken down by vehicle type, an approach accepted by the T-IRP.

4.6 The emission rates derived from the EFT represent the 'All Vehicle' figures from the 'Output' worksheet, which are calculated separately by vehicle type by setting the traffic flows in the 'Input Data' worksheet equal to 1 and the '% Petrol Car' figure equal to 100% to calculate petrol car rates, the '% Diesel Car' figure equal to 100% to calculate diesel car rates etc.

4.7 The allvehicle emission rates include contributions from alternative technologies based on national projections. This ensures that the increased proportions of EVs and hybrids in future years are captured in the emission factors that are input to the EMIGMA software, and therefore included in the forecasts.

4.8 These total emissions are then input into the dispersion model. The outputs of the dispersion model for $NO_x$ and $f-NO_2$ at every monitoring site and receptor were used to calculate the $f-NO_2$ ratio for every output location for the OBC.

## 5 Petrol/Diesel Car Splits

5.1 The EMIGMA software uses information about petrol/diesel splits to disaggregate compliant and non-compliant vehicle flows from the highway model by fuel type.(The petrol/diesel splits are also used as part of process for building the compliant and non-compliant higway assignment matrices, to reflect differences in compliance by method of propulsion.)

5.2 JAQU's guidance for forecasting petrol/diesel splits makes use of information about the ratios of petrol and diesel powered cars in the base and forecast years from national data, which is then applied to the local base year ratio (calculated from ANPR data) to obtain local forecast splits for each vehicle category.

5.3 Updated information about petrol/diesel splits from national data for input to the above process are not currently available. It was decided, therefore, to investigate the potential use of the new Petrol/Diesel projection tool in version 9.1.a of the EFT to forecast the Petrol/Diesel car splits in GM based on observations from our 2016 ANPR data. It appears, however, that the tool can sometime produce anomalous results, whereby forecast petrol/diesel splits do not change despite changes to the base year figures. (DEFRA have been notified about this, but the issue has yet to be resolved). As an alternative, therefore, we decided to adopt a 'mixed' approach, which used the guidance provided by JAQU (described above), but replaced the base and forecast year petrol/diesel car splits from the national data which are used in process with information about petrol/diesel splits for forecast years derived from version 9.1.a of the EFT for roads in "England, Outside London".

5.4 These updated forecasts produce a small increase in the forecast proportions of petrol cars for years 2018-2025 (compared to our earlier forecasts), as illustrated in **Table 5-1**.

**Table 5-1: Comparisons of GM Petrol/Diesel Split Forecasts in National Fleet Data (as applied at OBC) and the EFT v9.1a**

| | OBC Petrol/Diesel Splits based on Local Fleet Projection Methodology and National Fleet Data from Table 1 | | | | Revised Petrol/Diesel Splits based on Local Fleet Projection Methodology, but replacing National Fleet data from Table 1 with information about the Basic Fleet Split from Version 9.1.a of the EFT | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Cars inc Taxis | | Cars exc Taxis | | Cars inc Taxis | | Cars exc Taxis | |
| Percentage Journeys | Petrol Car % | Diesel Car % | Petrol Car % | Diesel Car % | Petrol Car % | Diesel Car % | Petrol Car % | Diesel Car % |
| GM 2016 | 50.7 | 49.3 | 54.1 | 45.9 | 50.7 | 49.3 | 54.1 | 45.9 |
| GM 2017 | 49.2 | 50.8 | 52.6 | 47.4 | 48.9 | 51.1 | 52.4 | 47.6 |
| GM 2018 | 48.2 | 51.8 | 51.7 | 48.4 | 50.2 | 49.8 | 53.7 | 46.3 |
| GM 2019 | 47.7 | 52.3 | 51.2 | 48.8 | 50.4 | 49.6 | 53.8 | 46.2 |
| GM 2020 | 47.7 | 52.3 | 51.1 | 48.9 | 50.7 | 49.3 | 54.2 | 45.9 |
| GM 2021 | 47.8 | 52.2 | 51.2 | 48.8 | 51.3 | 48.7 | 54.7 | 45.3 |
| GM 2022 | 48.1 | 51.9 | 51.5 | 48.5 | 51.9 | 48.1 | 55.3 | 44.7 |
| GM 2023 | 48.6 | 51.5 | 52.0 | 48.0 | 52.6 | 47.4 | 56.0 | 44.0 |
| GM 2024 | 49.2 | 50.8 | 52.7 | 47.4 | 53.4 | 46.6 | 56.8 | 43.2 |
| GM 2025 | 50.2 | 49.8 | 53.6 | 46.4 | 54.3 | 45.7 | 57.7 | 42.3 |

5.5 The results are in line with expectations, with the new projections showing lower diesel proportions in future years and the difference between the old and new projections increasing over time. The updated results for 2023 indicate that approximately 56% of cars (excluding taxis) are forecast to be petrol powered, with 44% of cars being diesel powered. The earlier forecasts assumed that 52% of cars would be petrol powered with 48% of cars being diesel powered.

## 6 Sensitivity test applying EFT v9.1a to 2023 GM OBC Do-Minimum

6.1 The revised petrol/diesel splits described above were used as inputs to the sensitivity test to produce revised $NO_x$ forecasts for the 2023 OBC do-minimum modelling. The sensitivity test was implemented in four steps:

- First updated emission factors and petrol/diesel splits were calculated as described above;

- Next, updated assignment matrices (for compliant and non-compliant vehicle types), which were consistent with the new fleet forecasts were formed;

- Next, the updated matrices were assigned to the highway networks and the networks 'converged'; and

- Finally, modelled flows and speeds from the assignments were input to EMIGMA to calculate mass emission totals for the test.

## 7 Inplications of The EFT Update for the GM CAP

7.1 Changes in modelled vehicle kilometre totals are shown in **Table 7-1**. The results show that non-compliant car vehicle kilometre totals for the test are approximately 5% lower compared to the OBC do-minimum forecast. Non-compliant Taxi vehicle kilometres are approximately 3% lower than OBC do-minimum. Compliant car and Taxi flows for the test are approximately 1% greater than the OBC do-minimum totals, in both the Regional Centre and across GM as a whole. This reflects the changes to the petrol/diesel splits highlighted in **Table 5-1**, and higher rates of compliance for petrol powered vehicles.

7.2 Modelled vehicle kilometre totals for other vehicle types (including LGVs) have not changed, as these vehicle types were assumed to be diesel powered in the modelling and are not therefore affected by the changes to the forecast petrol/diesel splits.

7.3 Changes in mass $NO_x$ emission totals are shown in

7.4

7.5 **Table 7-2**, for all vehicles combined. The results indicate that $NO_x$ emissions in the Regional Centre are approximately 0.5% lower for the test compared to the OBC do-minimum figure, with corresponding reductions of approximately 3% for GM as a whole.

7.6 In general, the $NO_x$ impacts of the test are less marked in the Regional Centre because the changes to the EFT mainly affect the proportions of petrol and diesel powered cars/taxis, and emissions from these vehicle types are proportionally lower in in the central area, where emissions from buses are more significant.

**Table 7-1: Annual Vehicle KM Totals for Compliant and Non-Compliant Vehicle Types (Millions, 2023)**

| Vehicle Type | Regional Centre | | | GM | | |
|---|---|---|---|---|---|---|
| | OBC DM | Sensitivity Test | % Change | OBC DM | Sensitivity Test | % Change |
| Compliant Car | 48 | 48 | 0.8% | 11,525 | 11,620 | 0.8% |
| Non-Compliant Car | 8 | 8 | -4.8% | 1,971 | 1,877 | -4.8% |
| All Car | 56 | 56 | 0.0% | 13,496 | 13,497 | 0.0% |
| Compliant LGV | 7 | 7 | 0.1% | 1,911 | 1,911 | 0.0% |
| Non-Compliant LGV | 3 | 3 | 0.1% | 903 | 903 | 0.0% |
| All LGV | 10 | 10 | 0.1% | 2,814 | 2,815 | 0.0% |
| Compliant OGV | 1 | 1 | 0.0% | 848 | 848 | 0.0% |
| Non-Compliant OGV | 0 | 0 | 0.1% | 185 | 185 | 0.0% |
| All OGV | 1 | 1 | 0.0% | 1,032 | 1,032 | 0.0% |
| Compliant Taxi | 3 | 3 | 0.9% | 677 | 683 | 0.8% |
| Non-Compliant Taxi | 1 | 1 | -3.1% | 189 | 184 | -2.8% |
| All Taxi | 4 | 4 | 0.0% | 866 | 866 | 0.0% |
| Bus | 6 | 6 | 0.0% | 118 | 118 | 0.0% |
| Total | 77 | 77 | 0.0% | 18,327 | 18,328 | 0.0% |

**Table 7-2: 2023 NOx Emissions (Tonnes Per Year)**

| Location | OBC Do Minimum | Sensitivity Test | % Change |
|---|---|---|---|
| Regional Centre | 55 | 55 | -0.5% |
| Greater Manchester | 6,385 | 6,217 | -2.6% |

**Notes:** *Totals may not sum due to rounding.*

## 8    Summary

8.1    This Note has investigated the implications of the revised Emissions Factor Toolkit for the GM CAP. The analysis has been undertaken by running a sensitivity test to investigate the impacts of changes to the EFT on forecast NOx emission totals from the 2023 OBC do-minimum modelling.

8.2    The results of the analysis indicate that mass $NO_x$ emissions across the County as a whole have reduced by approximately 3% compared to the OBC figure. The changes in petrol/diesel car splits will also have implications for $NO_2$ concentrations, with petrol cars having lower primary $NO_2$ emissions compared to diesel. The implications of this are reported separately in the note 'TfGM CAP Option for Consultation Modelling Summary v0.3 FINAL for JAQU 23-10-19'.

8.3    The revisions to the $NO_x$ to $NO_2$ calculator (v7.1) and background maps (2017-based) will also affect the modelled concentrations. However, understanding the implications for this is difficult, because these tools do not contain a 2016 reference year, only covering the range 2017-2030. TfGM specifically contacted JAQU to request that the updated maps and tools were built to include 2016, but our understanding is that this has not happened.

8.4    It is noted that EFT v9.1a does include 2016 functionality, although the v9.0, which is publicly available for LAQM usage, is restricted to 2017-2030.