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

Note 37: Vehicle Population Estimates

Version Status:	APPROVED	**Prepared by:**	Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester
Authorised by: **Date:**	Ian Palmer 11th August 2020		

COVID-19 Pandemic Statement

This work has not considered the impact of the COVID-19 pandemic. Whilst we are continuing, where possible, to develop the Greater Manchester Clean Air Plan, the pandemic has already had an impact on our ability to keep to the timescales previously indicated and there may be further impacts on timescales as the impact of the pandemic becomes clearer.

We are also mindful of the significant changes that could result from these exceptional times. We know that the transport sector has already been impacted by the pandemic, and government policies to stem its spread. The sector's ability to recover from revenue loss, whilst also being expected to respond to pre-pandemic clean air policy priorities by upgrading to a cleaner fleet, will clearly require further thought and consideration.

The groups most affected by our Clean Air Plan may require different levels of financial assistance than we had anticipated at the time of writing our previous submission to Government.

More broadly, we anticipate that there may be wider traffic and economic impacts that could significantly change the assumptions that sit behind our plans. We have begun to consider the impacts, and have committed to updating the government as the picture becomes clearer over time.

We remain committed to cleaning up Greater Manchester's air. However, given the extraordinary circumstances that will remain for some time, this piece of work remains unfinished until the impact of the COVID-19 pandemic has been fully considered by the Greater Manchester Authorities.

1 Introduction

1.1 Overview

1.1.1 Greater Manchester (GM) district authorities have been mandated by the Government to produce a Clean Air Plan (CAP) to set out how they will target and mitigate areas of poor air quality within their boundaries. Arup and AECOM have been commissioned by Transport for Greater Manchester (TfGM) to understand and forecast how vehicle owners react to the proposed Clean Air Zone (CAZ) charge.

1.1.2 This Technical Note discusses the key vehicle volumetric information used in the project which are used to understand the behavioural responses for vehicle owners to the Greater Manchester Clean Air Plan (GM-CAP).

1.1.3 The purpose of this note is to:

- Provide a summary on each mode considered and where the input data has been sourced;
- Discuss methodology used for projecting vehicle fleet information to forecast future year volumes and determining levels of compliance for each mode modelled;
- Report on the vehicle volumes modelled in terms of baseline and future scenarios in relation to mode and compliance; and
- Identify volumetric impacts relating to the GM CAZ and proposed Funds.

1.1.4 Note that all forecasts contained within this note represent the position as it stood before the Covid 19 pandemic. Separate analysis is being conducted to better understand the potential impact of Covid 19 on the GM CAP, which could affect the forecast vehicle volumes presented in this note.

1.2 Structure of Technical Note

1.2.1 This technical note will discuss the background and methodology of vehicle volumes by mode. This will include key models and tools applied to the GM CAP and subsequent impacts from the GM CAZ and Funds. Compliance with the GM CAP has been applied and assessed for three forecast years (2021, 2023 & 2025) and modelled for each mode. The modes discussed within this note are as follows:

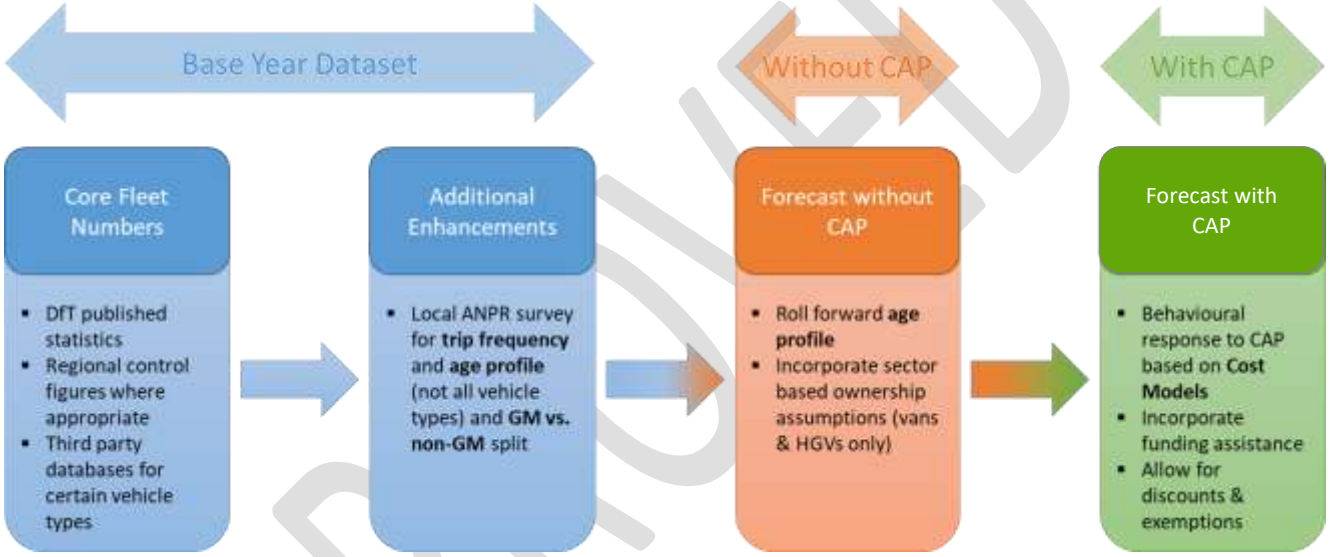
- Heavy Goods Vehicles (HGVs);
- Light Goods Vehicles (LGVs);
- Hackney Carriages;
- Private Hire Vehicles (PHVs);
- Local Bus Services;
- Coaches; and

- Minibuses.

1.3 Structure of each Chapter

1.3.1 Each chapter of this report follows a consistent structure (see **Figure 1-1**) where the key data used to understand the vehicle fleet is discussed, along with baseline volumetric information. The chapters then discuss the impacts of projecting vehicle volumes into the future, without the CAZ. The remaining section of each chapter discusses the impacts on vehicle volumes of the CAZ and funds, also discussing any key supplementary information used to inform the identification of the funds.

Figure 1-1 Structure of Chapter



1.3.2 The vehicle volumes quoted within this Technical Paper are based on the modelling discussed within Technical Paper 29 (Autumn 2019), unless otherwise stated, where updated volumetric data is available.

2 HGVs

2.1 Mode Overview

2.1.1 This section discusses the vehicle volumetric information associated with Heavy Goods Vehicles (HGVs) which has been utilised by the GM CAP project.

2.1.2 HGVs are defined as any goods vehicle with a Maximum Gross Weight (MGW) of over 3.5 tonnes. Rigid HGVs can be divided into vehicles with 32 tonne, 26 tonne, 18 tonne and 7.5 tonne MGW. Non-compliant HGVs are to be charged in 2021 by the GM CAZ at a cost of £60 daily charge. Due to the operation of HGVs as a primarily long-distance vehicle, this mode has the potential to be impacted by multiple CAZs. Detailed research on HGVs has been carried out as part of the Clean Commercial Vehicle Fund (CCVF)-Case for Measure and Cost Response Model reports.

2.1.3 Analysis of the Commercial vehicles market in business-as-usual conditions is provided in *Technical Paper 3 – Analysis of the Freight Market*, submitted to JAQU in July 2019, and provides details of the operation of Commercial vehicles within Greater Manchester. *Technical Paper 7 – LGV and HGV Cost Model* also provides details of the tools developed to assess the impacts of the GMCAP on Commercial Vehicles.

2.2 Sources of Vehicle Volume Data

2.2.1 HGV vehicle numbers have been inputted using two main datasets: firstly, the Automatic Number Plate Recognition (ANPR) survey, undertaken across a week in January 2019, covering a total of 42 locations and all GM districts and secondly Vehicle Licensing Statistics data, available from the Department for Transport (DfT). The ANPR survey was designed to provide a representative profile of the vehicle fleet operating in Greater Manchester in terms of:

- Vehicle type (including fuel use); and
- Age profile

2.2.2 Registration plates collected were submitted to the Driver and Vehicle Licensing Agency (DVLA) who processed the data set to append anonymised information concerning each vehicle identified. The DVLA dataset parameters enable further refinement in identifying vehicle type and size which was not conducted at OBC stage. Data gathered was extracted, anonymised and assessed. Analysis was conducted to summarise the data by vehicle type, registered location, fuel type and compliance.

2.2.3 The data outputs generated the number of GM and non-GM registered vehicles, separated by high and low frequency. This was also compared against market research of the commercial vehicles market serving a conurbation the size of Greater Manchester. The number of days per year that HGVs are assumed to operate (253) is in line with JAQU's recommendation.

2.2.4 **Table 2-1** presents the number of HGVs serving Greater Manchester in 2019, including splits by compliant and non-compliant vehicles.

Table 2-1 2019 HGV Volumes

Modelled Response	GM Based	Non-GM Based	Total
Compliant	12,212	29,852	**42,064**
Non-Compliant	13,525	15,203	**28,728**
Total	**25,737**	**45,055**	**70,792**

Source: Technical Paper 29

2.3 Changes to HGVs Over Time

2.3.1 Projection of the estimated HGV numbers, as set out in Table 2-1, was undertaken to forecast the natural change in compliant vehicles into the future, without any interventions applied (Do Minimum – No GM CAP). This was undertaken to understand the market's proportion of natural upgrades. It should be noted that the Cost Response Models assume no growth in overall vehicle volumes. Natural upgrades have been incorporated into the modelling years (2021,2023,2025) through retention of a constant age profile with the number of non-compliant vehicles reducing over time. These are summarised in **Table 2-2**.

2.3.2 The results show that natural vehicle upgrades occurring in two years are forecast to grow the proportion of compliant vehicles serving GM from 42,064 (59%) in 2019 to 54,140 (76%) by 2021. This results in an 8.5% annual change in the split between compliant and non-compliant HGVs serving the GM market.

Table 2-2 HGV Projection without GM CAP (Natural turnover)

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	18,370	35,770	54,140
	Non-Compliant	7,367	9,285	16,652
	Total	**25,737**	**45,055**	**70,792**
2023	Compliant	19,706	37,485	57,191
	Non-Compliant	6,030	7,570	13,600
	Total	**25,737**	**45,055**	**70,792**
2025	Compliant	21,956	40,748	62,704
	Non-Compliant	3,781	4,307	8,088
	Total	**25,737**	**45,055**	**70,792**

Source: Technical Paper 29
Note: All years indicate the beginning of the year apart from HGV CAZ year 2 (2021 which indicates the end of 2021

2.4 Change in HGV Volumes Due to GM CAP

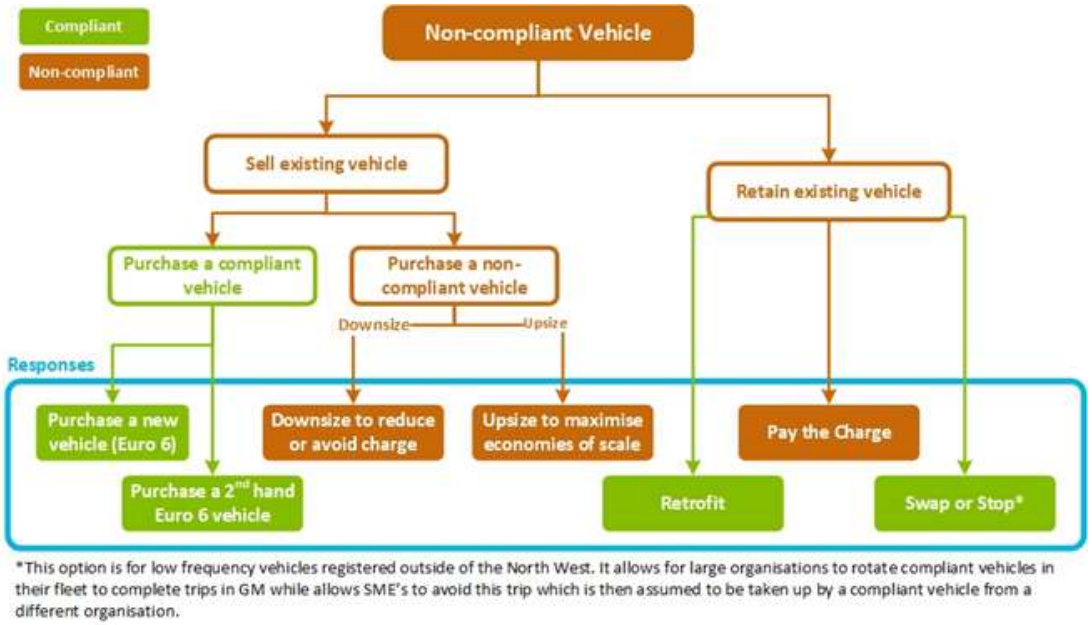
2.4.1 The introduction of the GM CAP will have a notable impact on the volume of compliant HGVs operating within Greater Manchester as they respond to the planned £60 CAZ charge for HGVs. To assess the likely behavioural responses associated with the introduction of the CAZ and associated funds, a Cost Response Model for commercial vehicles has been developed (discussed in *Technical Paper 7*).

2.4.2 The input data from the DVLA and ANPR survey, as well as population data, were segmented to understand different impacts of the GM CAZ on groups based upon vehicle registration location, frequency of travel in the CAZ, vehicle type, business sector and vehicle age. The behavioural responses generated for the GM CAP for HGVs are as follows:

- Pay Charge;
- Change mode (downsize to LGV);
- Cancel Trip; and
- Upgrade Vehicle.

2.4.3 The list of possible options available to HGV owners and operators have been captured in **Figure 2-1** and explains how HGV owners might respond to the GM CAP.

Figure 2-1 HGV Vehicle Owner/operator options



*This option is for low frequency vehicles registered outside of the North West. It allows for large organisations to rotate compliant vehicles in their fleet to complete trips in GM while allows SME's to avoid this trip which is then assumed to be taken up by a compliant vehicle from a different organisation.

CAZ Only Impacts

2.4.4 The CAZ only scenario tested estimates the impact of implementing a GM CAZ without any supporting mitigation measures. The assumption from a CAZ only scenario is that there would be a lower proportion of owners and operators upgrading their vehicles and a higher number paying the charge due to the lack of financial assistance for vehicle upgrades for those whom do not have readily available or accessible capital.

2.4.5 **Table 2-3** shows that a higher proportion of HGV owners (97%) upgrade their vehicles when the CAZ is implemented for HGVs (2021). HGV vehicle upgrades fall marginally in 2023 before rising again 2025. The increase in stay-and-pay in 2023 is a model effect, due to the cross-sectional modelling approach, and is not likely to manifest in reality. Cancelled trips and change mode (to LGV) are both below 1% across all model years.

Table 2-3 HGV CAZ Only Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	2.8%	4.8%	1.9%
Change Mode	0.2%	0.0%	0.0%
Cancel Trip	0.0%	0.0%	0.0%
Upgrade Vehicle	97.0%	95.2%	98.1%

Source: Technical Note 29 (Trip based responses applied in Demand Sifting Tool)

2.4.6 The application of the CAZ only scenario and the upgrade responses discussed above will lead to an increase in the number of compliant HGVs travelling in the CAZ and a decrease in the number of non-compliant HGVs. The CAZ only vehicle volumes are shown in **Table 2-4**.

Table 2-4 HGV CAZ Only Vehicle Volumes

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	25,482	44,509	69,991
	Non-Compliant	255	546	801
	Total	**25,737**	**45,055**	**70,792**
2023	Compliant	25,330	44,610	69,940
	Non-Compliant	407	445	851
	Total	**25,737**	**45,055**	**70,792**
2025	Compliant	25,660	44,838	70,498
	Non-Compliant	76	217	293
	Total	**25,737**	**45,055**	**70,792**

Source: Technical Note 29

CAZ Plus Funds Impacts

2.4.7 As shown in **Table 2-5,** the CAZ plus Funds[1] scenario tested is consistent with the CAZ only scenario tested for HGVs with a 1% drop in those that pay the charge and a 2% increase in those upgrading their vehicle in 2021. As seen in the CAZ only scenario, there is a marginal increase in those paying the charge in 2023 before falling in 2025.

Table 2-5 HGV CAZ plus funds Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	2.7%	4.8%	1.9%
Change Mode	0.1%	0.0%	0.0%
Cancel Trip	0.0%	0.0%	0.0%
Upgrade Vehicle	97.2%	95.2%	98.1%

Source: Technical Note 29 (Trip based responses applied in Demand Sifting Tool)

[1] Funding for HGV varied by weight category: 7.5t = £2,500, 18t = £3,500, 26t = £4,500, 32t = £5,500, 44t = £4,500

2.4.8 In 2021, the number of compliant HGVs serving GM is expected to rise significantly as a result of the implementation of the CAZ and associated mitigation funding for HGVs with 99% of the fleet modelled to be Compliant compared to 71% without the CAZ and mitigation funding. The compliance split between HGVs based and not based in GM is modelled to be the same proportion by 2021 under the 'CAZ plus Funds' scenario.

2.4.9 The application of the CAZ with Funds scenario results in additional compliance above the CAZ only scenario with additional vehicle upgrade as shown in **Table 2-6**.

Table 2-6 HGV CAZ plus funds Vehicle Volumes

Year	Modelled Response	GM Based	Non-GM Based	Total
2021*	Compliant	25,504	44,509	70,012
	Non-Compliant	233	546	780
	Total	**25,737**	**45,055**	**70,792**
2023	Compliant	25,330	44,610	69,940
	Non-Compliant	407	445	851
	Total	**25,737**	**45,055**	**70,792**
2025	Compliant	25,660	44,838	70,498
	Non-Compliant	76	217	293
	Total	**25,737**	**45,055**	**70,792**

Source: Technical Note 29
**Note: Year 2021 indicate that CAZ applies at the end of 2021 (i.e. beginning of 2022)*

2.5 Discounts and Exemptions

2.5.1 There are no discounts or exemptions applicable for HGVs that affect sufficient volumes of vehicles to be applied in the modelling.

2.6 Vehicles Eligible for the Funds

2.6.1 The core funding request to JAQU for the CCVF and Vehicle Finance measures for HGVs and LGVs is £88m. This funding would include £80m for LGVs and £8m for HGVs. The current assumption is that, for each vehicle group, the funding allocation would be split between grants and vehicle finance interventions on a 70:30 ratio. **Table 2-7** Sets out the proposed per vehicle grant offer for HGVs.

Table 2-7 Proposed per vehicle grant offer for HGVs

Vehicle Type		Grant Available
HGV upgrade	7.5t	£2,500
	18t	£3,500
	26t	£4,500
	32t	£5,500
	44t (articulated)	£4,500
HGV retrofit	All	Up to £18,000

2.6.2 From analysis of the Commercial vehicles Cost Response Model, it was identified that within GM, there are in the region of 350 retrofittable HGVs which would be likely to access the funds. This assumption was developed in Autumn 2019 and is based on some retrofit technologies pending approval receive that approval. It is also possible that further retrofit solutions come to market over the funding period. GM has estimated that around 4,100 HGVs would be in-scope for support in 2021. Of these, it is estimated that around 2,100 would access this support, as set out in **Table 2-8**. This was derived by constraining the number of vehicles upgrading to the funding cap based on additional eligibility criteria. With those vehicles most likely to access funding identified first, this was based on Euro standards and assumed older vehicles would access the fund first.

Table 2-8 Forecast uptake of HGV funding

Vehicle type	***Number taking funding***	***Cost***
7.5t	500	£1.2m
18t	700	£2.4m
26t	400	£1.7m
32t	400	£2.1m
44t (articulated)	100	£0.5m
All HGVs	**2,100**	**£8m**

Source: Commercial Vehicles Case For Measure (Aug 2020)

3 LGVs

3.1 Mode Overview

3.1.1 This section discusses the vehicle volumetric information associated with Light Goods Vehicles (LGVs) which has been utilised by the GM CAP project.

3.1.2 LGVs are goods vehicles with an MGW of 3.5 tonnes or less and are commonly known as vans. For the purpose of this analysis, LGVs have been categorised into 3.5 tonnes and 1.6 tonnes gross vehicle weight. Non-compliant LGVs are to be charged from 2023 by the GM CAZ at a cost of £10 daily charge. LGVs serve a wide variety of purposes, including construction, removals, food, communications pick-up, parcel home delivery and supermarket home delivery vans. Detailed research on LGVs has been carried out as part of the Clean Commercial Vehicle Fund (CCVF) - Case for Measure and Cost Response Model reports.

3.1.3 Analysis of the Commercial vehicles market is provided in *Technical Paper 3 – Analysis of the Freight Market*, submitted to JAQU in July 2019, and provides details of the operation of Commercial vehicles within Greater Manchester. *Technical Paper 7 – LGV and HGV Cost Model* also provides details of the tools developed to assess the impacts of the GMCAP on Commercial Vehicles.

3.2 Sources of Vehicle Volume Data

3.2.1 LGV vehicle numbers have been inputted using two main datasets: firstly, the Automatic Number Plate Recognition (ANPR) survey, undertaken across a week in January 2019, covering a total of 42 locations and all GM districts and secondly Vehicle Licensing Statistics data, available from the Department for Transport (DfT). The ANPR survey was designed to provide a representative profile of the vehicle fleet operating in Greater Manchester in terms of:

- Vehicle type (including fuel use); and
- Age profile

3.2.2 Registration plates collected were submitted to the Driver and Vehicle Licensing Agency (DVLA) who processed the data set to append anonymized information concerning each vehicle identified. The DVLA dataset parameters enable further refinement in identifying vehicle type and size which was not conducted at OBC stage. Data gathered was extracted, anonymised and assessed. Analysis was conducted to summarise the data by vehicle type, registered location, fuel type and compliance

3.2.3 The data outputs generated the number of GM and non-GM registered vehicles, separated by high and low frequency. These were also compared against the commercial vehicles research which identified expected number of vehicles serving a conurbation the size of Greater Manchester.

3.2.4 **Table 3-1** presents the number of LGVs serving Greater Manchester in 2019, including splits by compliant and non-compliant vehicles.

Table 3-1 – Number of LGVs Serving GM (2019)

Modelled Response	GM Based	Non-GM Based	Total
Compliant	27,290	74,147	101,437
Non-Compliant	108,456	67,535	175,991
Total	**135,746**	**141,682**	**277,428**

Source: Technical Paper 29

3.2.5 In 2019, there were 277,428 LGVs serving Greater Manchester[2] with 101,437 (37%) deemed compliant and 175,991 (63%) non-compliant. Vehicles based in Greater Manchester had a lower level of compliance with only 27,290 (20%) LGVs deemed compliant and 108,456 (80%) non-compliant. Overall, there were more LGVs serving GM that were not based in GM (141,682) in comparison with LGVs based in the city region (135,746).

3.3 Changes to LGVs Over Time

3.3.1 Projection of the existing LGV numbers was undertaken to forecast the natural change in compliant vehicles into the future, based on without any interventions applied (Do Minimum – No GM CAP) as shown in Table 3-1. This was undertaken to understand the market's proportion of natural upgrades. It should be noted that the Cost Response Models assume no growth in overall vehicle volumes. Natural upgrades have been incorporated into the modelling years (2021,2023,2025) through retention of a constant age profile with the number of non-compliant vehicles reducing over time. These are summarised in **Table 3-2**.

3.3.2 The results show that natural vehicle upgrades occurring across the four-year period are forecast to increase the proportion of compliant vehicles serving GM from 101,437 (37%) in 2019, to 124,637 (45%) in 2021 and 147,067 (53%) in 2023. This results in an 8% annual change in the split between compliant and non-compliant LGVs serving the GM market with a fully compliant LGV fleet expected by 2035 without market intervention based on the change experienced between LGV modelled years.

[2] Based upon 2019 ANPR splits

Table 3-2 LGV Projection without GM CAP (Natural turnover)

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	44,329	80,308	124,637
	Non-Compliant	91,417	61,374	152,791
	Total	**135,746**	**141,682**	**277,428**
2023	Compliant	60,332	86,735	147,067
	Non-Compliant	75,414	54,947	130,360
	Total	**135,746**	**141,682**	**277,428**
2025	Compliant	80,366	96,152	176,518
	Non-Compliant	55,379	45,530	100,909
	Total	**135,746**	**141,682**	**277,428**

Source: Technical Paper 29, Note: All years indicate beginning of the year

3.4 Change in LGV Volumes Due to GM CAP

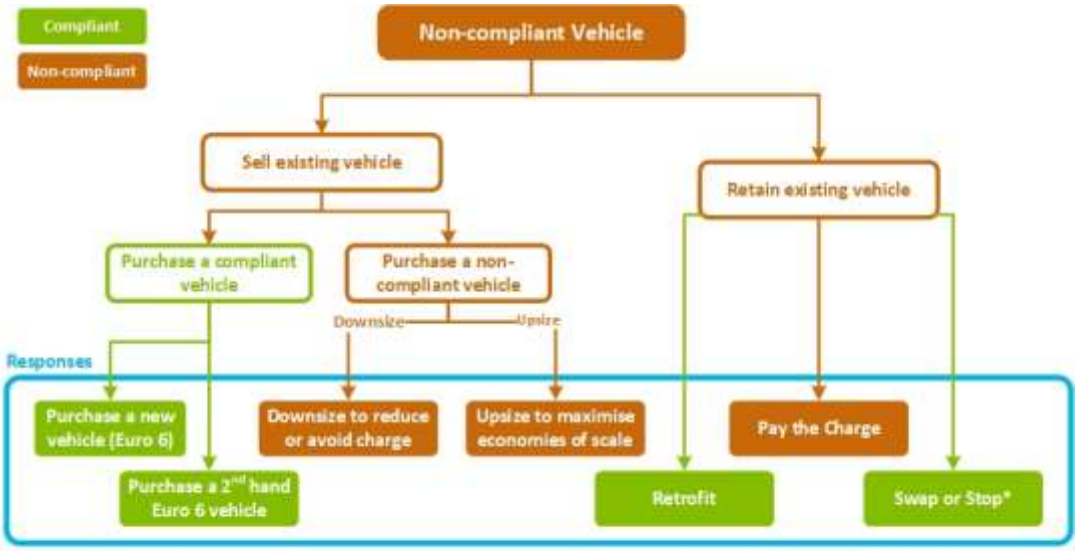
3.4.1 The introduction of the GM CAP will have a notable impact on the volume of compliant LGVs operating within Greater Manchester as they respond to the planned £10 CAZ charge for LGVs to be introduced in 2023 (after a temporary exemption expires). To assess the likely behavioural responses associated with the introduction of the CAZ and associated funds, a Cost Response Model for commercial vehicles was developed (discussed in *Technical Paper 7*).

3.4.2 The input data from the DVLA and ANPR survey, as well as population data, were segmented to understand different impacts the GM CAZ would have for categories based upon vehicle registration location, frequency, vehicle type, vehicle ownership, sector and vehicle age. The behavioural responses generated for the GM CAP for LGVs are as follows:

- Pay Charge;
- Change mode (downsize to estate car or upsize to HGV);
- Cancel Trip; and
- Upgrade Vehicle.

3.4.3 The list of possible options available to LGV owners and operators have been captured in **Figure 3-1** and explains how LGV owners might respond to GM CAP.

Figure 3-1 LGV Vehicle Owner/operator options



*This option is for low frequency vehicles registered outside of the North West. It allows for large organisations to rotate compliant vehicles in their fleet to complete trips in GM while allows SME's to avoid this trip which is then assumed to be taken up by a compliant vehicle from a different organisation.

CAZ Only Impacts

3.4.4 The CAZ only scenario shows the impact of implementing a GM CAZ without any supporting mitigation measures. **Table 3-3** shows that a higher proportion of LGV owners (73.2%) are forecast to upgrade their vehicles in 2025 after the CAZ has been implemented and operating for two years from 2023. This leads to a fall in the number of vans paying the CAZ charge in 2025.

3.4.5 In the year of the CAZ implementation for vans, there nearly 5% of LGVs change mode (by downsizing to a car or upsizing to an HGV) however by 2025, once the CAZ is well-established for this group, this option is no longer predicted to be taken.

Table 3-3 LGV CAZ Only Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	n/a	30.1%	26.8%
Change Mode	n/a	4.6%	0.0%
Cancel Trip	n/a	0.0%	0.0%
Upgrade Vehicle	n/a	65.3%	73.2%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

3.4.6 The application of the CAZ only scenario and the upgrade responses discussed above leads to an increase in the number of compliant LGVs. The CAZ only vehicle volumes are shown in **Table 3-4**.

Table 3-4 LGV CAZ Only Vehicle Volumes

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	n/a	n/a	n/a
	Non-Compliant	n/a	n/a	n/a
	Total	**n/a**	**n/a**	**n/a**
2023	Compliant	97,210	130,308	227,518
	Non-Compliant	38,535	11,374	49,909
	Total	**135,746**	**141,682**	**277,428**
2025	Compliant	108,739	132,691	241,430
	Non-Compliant	27,007	8,991	35,998
	Total	**135,746**	**141,682**	**277,428**

Source: Technical Note 29

CAZ Plus Funds Impacts

3.4.7 As shown in **Table 3-5,** the CAZ plus Funds[3] scenario shows more than half of those choosing to pay the charge in the CAZ only scenario switch to vehicle upgrades with the mitigation funding modelled after CAZ implementation (2023). Similar behaviour between scenarios is evident for those changing modes with a small amount of activity (3.4%) during the CAZ implementation year before reducing to 0% in 2025. Small proportional increases between 2023 and 2025 in those paying the charge and vehicle upgrades can be attributed to the fall in those changing modes. Vehicle upgrades remain stable between 2023 and 2025, compared with the CAZ only scenario, as those choosing to naturally upgrade their vehicles in later years are forecast to bring forward their investment to access mitigation funding.

Table 3-5 LGV CAZ plus Funds Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	n/a	12.2%	13.6%
Change Mode	n/a	3.4%	0.0%
Cancel Trip	n/a	0.0%	0.0%
Upgrade Vehicle	n/a	84.5%	86.4%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

[3] Modelling is based on a £3,500 eligible for all LGVs with scrappage required.

3.4.8 In 2023, the number of compliant LGVs serving GM is expected to rise significantly as a result of the implementation of the CAZ and associated mitigation funding for HGVs with 88% of the fleet modelled to be Compliant compared to 53% without the CAZ and mitigation funding. There is a larger shift in GM-based vans becoming compliant, increasing by 39% compared with non-GM based vans at 31%. This is likely to be because the mitigation funding is restricted to GM-based vans.

3.4.9 The application of the CAZ with Funds scenario results in additional compliance above the CAZ only scenario with additional vehicle upgrade as shown in **Table 3-6**.

Table 3-6 LGV CAZ plus funds Vehicle Volumes

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	n/a	n/a	n/a
	Non-Compliant	n/a	n/a	n/a
	Total	**n/a**	**n/a**	**n/a**
2023	Compliant	113,515	130,308	243,823
	Non-Compliant	22,231	11,374	33,605
	Total	**135,746**	**141,682**	**277,428**
2025	Compliant	118,589	132,691	251,280
	Non-Compliant	17,156	8,991	26,148
	Total	**135,746**	**141,682**	**277,428**

Source: Technical Paper 29

3.5 Discounts and Exemptions

3.5.1 LGVs are eligible for a temporary exemption to end 2022. There are no other additional discounts or exemptions applicable for LGVs that affect sufficient volumes of vehicles to be applied in the modelling.

3.6 Vehicles Eligible for the Funds

3.6.1 The current assumption is that, for each vehicle group, the funding allocation would be split between grants and vehicle finance interventions on a 70:30 ratio. **Table 3-7** sets out the proposed per vehicle grant offer for LGVs.

Table 3-7 Proposed per vehicle grant offer for HGVs

Vehicle Type		Grant Available
LGV upgrade	All	£3,500

3.6.2 Of the 58,800 vehicles in scope, it is estimated that around 23,100 would access this support, 8% of all LGVs serving GM and 18% of all non-compliant LGVs serving GM, as set out in **Table 3-8**.

Table 3-8 Forecast uptake of LGV funding

Vehicle type	***Number taking funding***
1.6t	5,680
3.5t	17,456
All LGVs	**23,135**

Source: Commercial Vehicles Case for Measure Report (August 2020)

4 Hackney Carriages

4.1 Mode Overview

4.1.1 This section discusses the vehicle volumetric information associated with Hackney Carriages which has been utilised by the GM CAP project.

4.1.2 Hackney Carriages, alongside Private Hire Vehicles (PHVs), offer a flexible form of door-to-door public transportation between locations of the passengers' choice. Hackney Carriages can be distinguished from PHVs in their licensing and operating. Hackney Carriages can be hailed by passengers in the street, pick up fares from taxi ranks and pre-bookings from within their licensing authority or an origin outside their area. Licensing Local Authorities can regulate Hackney Carriage fare tariffs and supply through issue of licenses unlike PHVs. Detailed research on Hackney Carriages has been carried out as part of the Clean Taxi Fund (CTF) - Case for Measure and Cost Response Model reports.

4.1.3 Analysis of the Taxi market is provided in *Technical Paper 19 - GM CAP Taxi and PHV Fleet Research*, submitted to JAQU in Autumn 2019, and provides details of the operation of Hackney Carriages within Greater Manchester. *Technical Paper 28 - Taxi & PHV Cost Model* also provides details of the tools developed to assess the impacts of the GM CAP on taxis.

4.1.4 Note that in addition to the GM CAP, GM's ten local licensing authorities are consulting on proposals to implement Common Minimum Licensing Standards (MLS) across the region. As the consultation is planned to be undertaken alongside the GM CAP, the impact of MLS proposals has been included in the with-GM CAP scenario tests and is discussed in **Section 4.6.**

4.2 Sources of Vehicle Volume Data

4.2.1 For Hackney Carriages, there are two key sources of data which have been used to understand vehicle operations within Greater Manchester. These include:

- GM Vehicle Licensing database (held by GM authorities), providing a record of local authority taxi licensing data (2019 version); and
- The 2019 GM automatic number plate recognition (ANPR)survey which included Hackney Carriages within the data assessed.

4.2.2 The ANPR survey was designed to provide a representative profile of the vehicle fleet operating in Greater Manchester in terms of:

- Vehicle type (including fuel use); and
- Age profile.

4.2.3 Registration plates collected were submitted to the Driver and Vehicle Licensing Agency (DVLA) who processed the data set to append anonymized information concerning each vehicle identified. The DVLA dataset parameters enable further refinement in identifying vehicle type and size which was not conducted at OBC stage. Data gathered was extracted, anonymised and assessed. Analysis was conducted to summarise the data by vehicle type, registered location, fuel type and compliance.

4.2.4 The data outputs generated the number of GM and non-GM registered vehicles, separated by high and low frequency. The total number of Hackneys serving Greater Manchester in 2019 are shown in **Table 4-1**.

4.2.5 In 2019, there were 2,376 Hackney Carriages serving Greater Manchester with 237 (10%) deemed compliant and 2,139 (90%) non-compliant. Vehicles licensed with one of the ten GM local authorities are as likely to be compliant as non-GM-licensed vehicles (10% compliant).

Table 4-1 – Number of Hackney Carriages Serving GM (2019)

Modelled Response	GM Licensed	Non-GM Licensed	Total
Compliant	207	29	**237**
Non-Compliant	1,873	266	**2,139**
Total	**2,080**	**296**	**2,376**

Source: Technical Paper 29

4.3 Changes to Hackney Carriages Over Time

4.3.1 A projection of existing Hackney Carriage numbers was undertaken to forecast the natural change in compliant vehicles into the future based on a scenario without any interventions applied (Do Minimum – No GM CAP or MLS) to understand the market's proportion of natural upgrades. It should be noted that the Cost Response Models assume no growth in overall vehicle volumes. Natural upgrades have been incorporated into the modelling years (2021, 2023, 2025) through retention of a constant age profile with the number of non-compliant vehicles reducing over time. These are summarised in **Table 4-2**.

Table 4-2 Hackney Carriage Fleet Projection without GM CAP (Natural turnover)

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	207	29	237
	Non-Compliant	1,873	266	2,139
	Total	**2,080**	**296**	**2,376**
2023	Compliant	887	126	1,013
	Non-Compliant	1,193	170	1,363
	Total	**2,080**	**296**	**2,376**
2025	Compliant	1,325	188	1,513
	Non-Compliant	755	107	863
	Total	**2,080**	**296**	**2,376**

Source: Technical Paper 29
Note: All years indicate beginning of the year

4.4 Change in Hackney Carriage Volumes Due to GM CAP

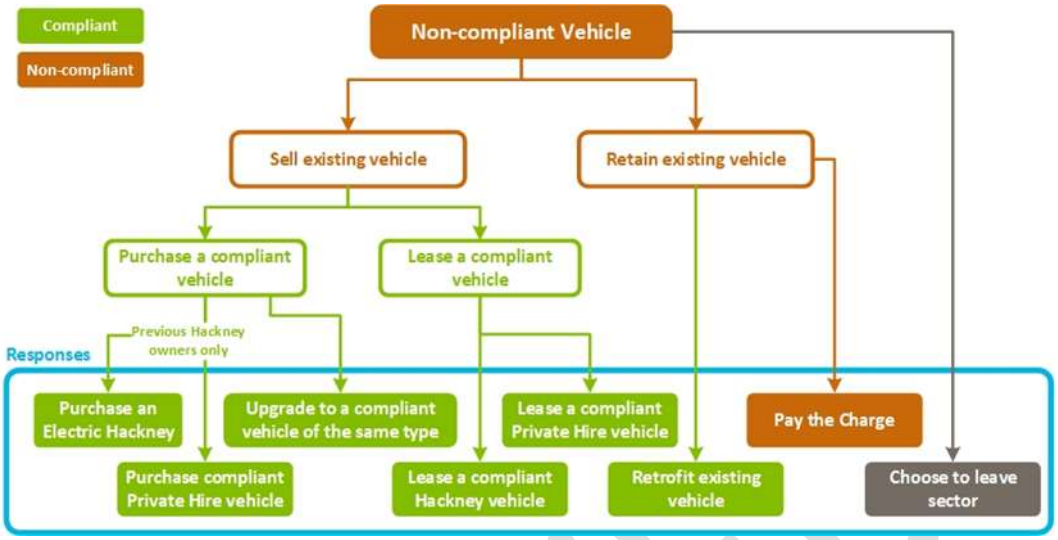
4.4.1 The introduction of the GM CAP (without and MLS) will have a notable impact on the volume of compliant hackney carriages operating within Greater Manchester. To assess the likely behavioural responses associated with the introduction of the CAZ and associated funds. A Cost Response model for taxis was developed (discussed in *Technical Paper 28*).

4.4.2 The input data from the DVLA and ANPR survey, as well as population data, were segmented to understand different impacts the GM CAZ would have for categories based upon vehicle registration location, frequency, vehicle type. Vehicle ownership, sector and vehicle age. The behaviour responses generated for the GM CAP for Hackney Carriages are as follows:

- Pay Charge;
- Cancel Trip; and
- Upgrade Vehicle.

4.4.3 The list of possible options available to taxi owners and operators have been captured in **Figure 4-1** and explains how taxi owners might respond to GM CAP.

Figure 4-1 Taxi vehicle owner/operator options (without MLS)



CAZ Only Impacts

4.4.4 The CAZ only scenario shows the impact of implementing a GM CAZ without any supporting mitigation measures. The assumption from a CAZ only scenario is that there would be a lower proportion of owners and operators upgrading their vehicles and a higher number paying the charge than in a with-Funds scenario due to the lack of financial assistance for vehicle upgrades for those whom do not have readily available or accessible capital. It should be recognised that a working assumption to classify all Hackney Carriages as Wheelchair Accessible Vehicles (WAVs) has been made in the modelling to reflect the near total (93%) accessible fleet and thus all are assumed to be exempt from CAZ charges until 2023. In practice, there is a small fleet of around 300 non-WAV vehicles that would be in scope for charging from 2021 and thus some change would be expected earlier than forecast here.

4.4.5 **Table 4-3** shows the behavioural responses for Hackney Carriages under the CAZ only scenario across the three model years (2021, 2023 and 2025). Although the Pay Charge proportion increases across the model years, the number of those choosing to pay the charge remains static. The proportion of Hackney Carriage owners choosing to upgrade their vehicles reduces over the period due to initial upgrades being carried out prior to the introduction of the CAZ charge (2023). In 2025, the CAZ is well established and therefore there is a drop in the number of owners upgrading their vehicles.

Table 4-3 Hackney Carriages CAZ Only Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	n/a	26.4%	32.8%
Change Mode	n/a	0.0%	0.0%
Cancel Trip	n/a	0.0%	0.0%
Upgrade Vehicle	n/a	73.6%	67.2%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

4.4.6 The application of the CAZ only scenario and the upgrade responses discussed above will lead to an increase in the number of compliant Hackney Carriages. The CAZ only vehicle volumes are shown in **Table 4-4**.

Table 4-4 Hackney Carriages CAZ Only Vehicle Volumes

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	n/a	n/a	n/a
	Non-Compliant	n/a	n/a	n/a
	Total	n/a	n/a	n/a
2023	Compliant	1,767	241	2008
	Non-Compliant	313	55	368
	Total	**2,080**	**296**	**2,376**
2025	Compliant	1,833	258	2,091
	Non-Compliant	247	38	285
	Total	**2,080**	**296**	**2,376**

Source: Technical Paper 29 (Excludes MLS)

CAZ Plus Funds Impacts

4.4.7 As shown in **Table 4-5**, the CAZ plus Funds scenario shows that approximately a quarter of Hackney Carriage owners are still forecast to choose to pay the charge, albeit there is a slight reduction compared to the CAZ only scenario. The growth in the proportion of vehicles paying the charge over the model years is consistent with the CAZ only scenario. However, since the introduction of the CAZ charge and availability of mitigation funds in 2023 and 2025, there is a higher proportion of those upgrading their vehicles in the CAZ plus Funds scenario as owners take advantage of the financial support available. Additionally, there is further

divergence in 2025 with 5% more upgrading their vehicle in the CAZ plus Funds scenario.

Table 4-5 Hackney Carriages CAZ plus Funds Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	n/a	25.7%	27.6%
Change Mode	n/a	0.0%	0.0%
Cancel Trip	n/a	0.0%	0.0%
Upgrade Vehicle	n/a	74.3%	72.4%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

4.4.8 The application of the CAZ plus Funds scenario results in additional compliance above the CAZ only scenario with additional vehicle upgrade as shown in **Table 4-6**.

Table 4-6 Hackney Carriages CAZ plus funds Vehicle Volumes

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	n/a	n/a	**n/a**
	Non-Compliant	n/a	n/a	**n/a**
	Total	**n/a**	**n/a**	**n/a**
2023	Compliant	1,777	241	2018
	Non-Compliant	303	55	358
	Total	**2,080**	**296**	**2,376**
2025	Compliant	1,877	258	2,135
	Non-Compliant	203	38	240
	Total	**2,080**	**296**	**2,376**

Source: Technical Paper 29 (Excludes MLS)

4.4.9 Based on vehicle numbers, there are significantly more compliant Hackney Carriages in 2023 in the CAZ plus Funds scenario (85%) compared with Do-Minimum (43%). Due to the high number of GM licensed Hackney Carriages (2,080) compared to non-GM based Hackney Carriages (296) modelled in 2023, the CAZ charge and mitigation funding is likely to have a significant impact on the Hackney Carriage market.

4.5 Discounts and Exemptions

4.5.1 All Wheelchair Accessible Vehicle Hackney Carriages licensed with one of the ten GM local authorities (WAV) are eligible for an exemption from the CAZ end 2022. As most Hackney Carriages are already WAV (over 93%), for modelling purposes, all Hackney Carriages were assumed to be exempt until 2023.

4.6 Minimum Licensing Standards

Currently each Local Authority sets their own licensing standards for Hackney and PHV operators, drivers, and vehicles. This disparity in standards has, in some cases, led applicants to seek out authorities where they can get their licenses cheaper, quicker or with fewer restrictions, risking undermining local licensing policies designed to protect public safety and the environment. GM are currently considering the introduction of Minimum Licensing Standards (MLS) across GM. These standards include a move to Zero Emissions Capable (ZEC) vehicles. An overview of the MLS proposed roadmap to ZEC is shown in **Figure 4-2**. Note, this currently excludes Taxis licenced outside of GM.

Figure 4-2 MLS Proposed Roadmap to Zero Emissions Capable Vehicles

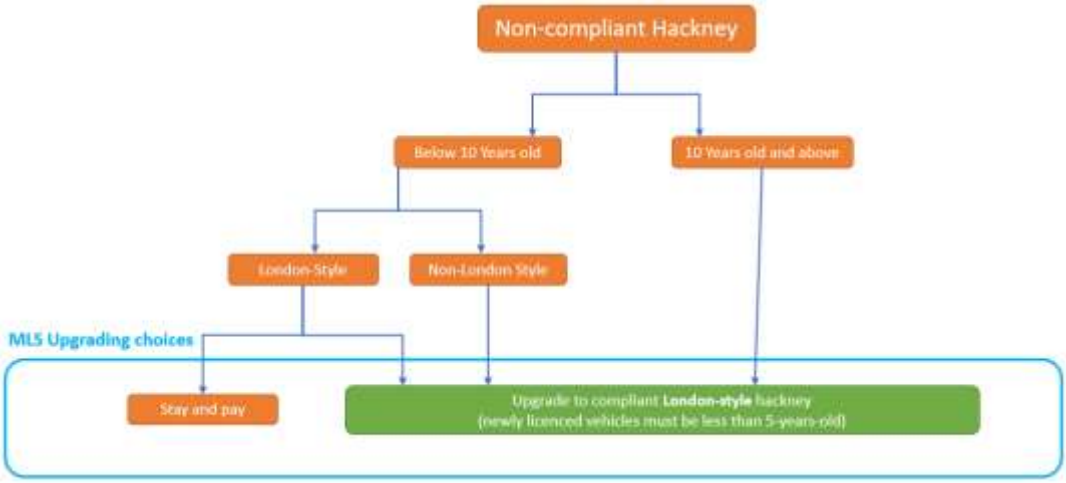
4.6.1 Based on the Roadmap to ZEC discussed above, this impacts a significant number of Hackney Carriages. A summary of the number of affected vehicles is shown in **Table 4-7**. Note that some compliant vehicles may also be affected by the MLS but as these vehicles are already compliant with the CAP they have not been considered here.

Table 4-7 Impact of MLS on choices available to non-compliant vehicle owners in the GM CAZ

MLS Standard	Impact	Number of affected vehicles
10 year age limit	Affected non-compliant vehicles must upgrade and can no longer choose to stay and pay	670
Hackneys to be London-style WAV	Affected non-compliant vehicles must upgrade and can no longer choose to stay and pay	Up to 245

4.6.2 Further analysis of the vehicle fleet was undertaken in the context of the proposed MLS, which if delivered in combination with the GM CAP would also result in the uptake of additional compliant vehicles due to the vehicle standards set under MLS and the timescales required for compliance to these standards. A series of enhancements were applied to the Taxi Cost Response Model to reflect MLS impacts and included the further disaggregation of the non-compliant vehicles to align with the MLS requirements. This further disaggregation is shown in **Figure 4-3**. Also, **Appendix C** explains the differences between MLS and Non-MLS scenarios.

Figure 4-3 Taxi vehicle owner/operator options (with MLS)



4.6.3 The Taxi Cost Response Model was reassessed under a scenario of MLS and GM CAP. **Table 4-8** presents the impact on compliant vehicle volumes.

Table 4-8 Vehicle Volumes with the introduction of MLS and GM CAP (Year CAZ applies)

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2023	Compliant	1979	278	2256
	Non-Compliant	101	18	119
	Total	**2,080**	**296**	**2,376**

Source: Summer 2020 Update (with MLS)

4.7 Vehicles Eligible for the Funds

4.7.1 The fund offer for Hackneys is shown in **Table 4-9.**

Table 4-9 Proposed per-vehicle Grant and Finance offers for Hackney Carriages

Upgrade type	Upgrade to	Offer	Grant / Finance available
Hackney Carriage upgrade (any non-compliant, licensed Hackney Carriage)	WAV Hackney Carriage (Hackney license) – Replacement vehicle	Plug-in vehicle grant (OLEV) AND Running costs grant or equivalent Vehicle Finance subsidy	Up to £7,500 (via OLEV) AND A grant of up to £10,000 towards the running costs for a purpose built, WAV ZEC vehicle; or Up to £7,500 (via OLEV); and An average subsidy £10,000 capped at £14,000
Hackney Carriage LPG retrofit (any retrofittable vehicle)	Hackney Carriage (Hackney license) - Retrofit existing vehicle	Grant	A grant of up to £5,000 per vehicle for LPG conversion

Source: Clean Taxi Case for Measure (August 2020)

4.7.2 From analysis of the Hackney Carriage fleet from the Taxi Cost Response Model, it was identified that within GM, there are in the region of up to 50 retrofittable hackneys which would be likely to access the funds. A review of eligible Hackney Carriages that would likely access the funds was also reviewed and is presented in **Table 4-10**.

Table 4-10 – Hackneys Number taking Fund

Offer	Number taking funding
Plug-in vehicle grant of up to £7,500 (funded by OLEV); and Running costs grant of £10,000 or equivalent Vehicle Finance subsidy	1,029
LPG retrofit grant of £5,000	21
Total Hackney Carriage	**1,050**

Source: Clean Taxi Case for Measure (August 2020)

5 Private Hire Vehicles

5.1 Mode Overview

5.1.1 This section discusses the vehicle volumetric information associated with Private Hire Vehicles (PHVs) which has been utilised by the GM CAP project.

5.1.2 In addition to Hackney Carriages, Private Hire Vehicles (PHVs), offer a flexible form of door-to-door public transportation between locations of the passengers' choice. PHVs can be distinguished from Hackney Carriages in their licensing and operating. PHVs traditionally must be booked through a licensed operator. Technological advancements in the PHV sector has seen the introduction of digital booking platforms that connects the driver and passenger with large companies, such as Uber, championing this platform and now operating worldwide. This change has seen strong growth in the PHV market over recent years. In contrast to Hackney Carriages, licensing authorities have no power to restrict the number of PHVs that they license. Detailed research on PHVs has been carried out as part of the Clean Taxi Fund (CTF) - Case for Measure and Cost Response Model reports.

5.1.3 Analysis of the Taxi market is provided in *Technical Paper 19 - GM CAP Taxi and PHV Fleet Research*, submitted to JAQU in Autumn 2019, and provides details of the operation of PHVs within Greater Manchester. *Technical Paper 28 - Taxi & PHV Cost Model* also provides details of the tools developed to assess the impacts of the GMCAP on taxis.

5.2 Sources of Vehicle Volume Data

5.2.1 PHVs vehicle numbers have been derived using two main datasets:

- firstly, local authority taxi licensing data was provided to determine the number of PHVs registered to GM local authorities; and
- the Automatic Number Plate Recognition (ANPR) survey, undertaken across a week in January 2019, covering a total of 42 locations and all GM districts and secondly Vehicle Licensing Statistics data, available from the Department for Transport (DfT).

5.2.2 In addition, a Freedom of Information request was made to local authorities where it is known many GM-based PHVs are licenced. This included requests to Wolverhampton and Sefton.

5.2.3 The ANPR survey was designed to provide a representative profile of the vehicle fleet operating in Greater Manchester in terms of:

- Vehicle type (including fuel use); and
- Age profile.

5.2.4 Registration plates collected were cross referenced with the GM licensing fleet list to understand the trip making of the GM licenced fleet. This was only available for the GM licensed fleet. The data outputs generated the number of GM registered vehicles. In addition, following receipt of the overall number of licensed vehicles to Wolverhampton and Sefton, an estimate of the non-GM registered vehicles was established. **Table 5-1** provides an overview of the existing PHV fleet.

5.2.5 In 2019, there were 17,174 PHVs serving Greater Manchester[4] with 4,979 (29%) deemed compliant and 12,196 (71%) non-compliant. Vehicles licensed with one of GM's ten local authorities are as likely to be compliant as non-GM licensed vehicles (29% compliant). In contrast with other modes and similar to Hackney Carriages, there were more PHVs serving GM that were licensed within GM (12,401) compared to those licensed outside of GM (4,773).

Table 5-1 – Number of PHVs Serving GM (2019)

Modelled Response	GM Licensed	Non-GM Licensed*	Total
Compliant	3,595	1,384	**4,979**
Non-Compliant	8,806	3,390	**12,196**
Total	**12,401**	**4,773**	**17,174**

*Source: Technical Paper 29. *Note: Non-GM fleet information estimated based on FOI request data.*

5.3 Changes to PHVs Over Time

5.3.1 A projection of the existing PHV numbers was undertaken to forecast the natural change in compliant vehicles into the future based on a scenario without any interventions applied (Do Minimum – No GM CAP) as shown in Table 5-1 to understand the market's proportion of natural upgrades. It should be noted that the Cost Response Models assume no growth in overall vehicle volumes. Natural upgrades have been incorporated into the modelling years (2021, 2023, 2025) through retention of a constant age profile with the number of non-compliant vehicles reducing over time. These are summarised in **Table 5-2**.

[4] Based upon 2019 ANPR splits

Table 5-2 PHV Fleet Projection without GM CAP (Natural turnover)

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	7,070	2,721	**9,792**
	Non-Compliant	5,331	2,052	**7,382**
	Total	**12,401**	**4,773**	**17,174**
2023	Compliant	9390	3614	**13,004**
	Non-Compliant	3011	1159	**4,170**
	Total	**12,401**	**4,773**	**17,174**
2025	Compliant	10695	4117	**14,812**
	Non-Compliant	1706	657	**2,362**
	Total	**12,401**	**4,773**	**17,174**

Source: Technical Paper 29. Note: All years indicate beginning of the year

5.4 Change in PHV Volumes Due to GM CAP

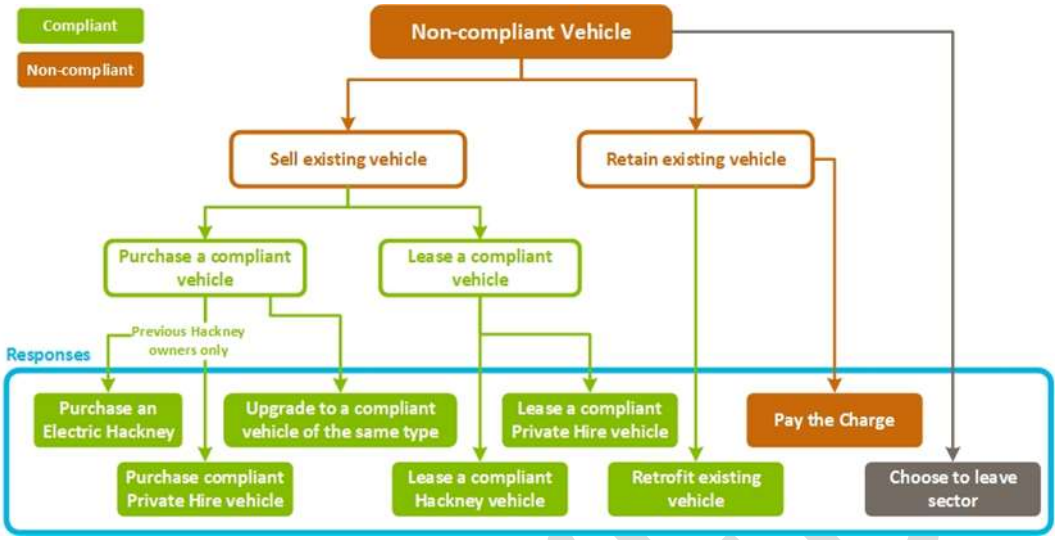
5.4.1 The introduction of the GM CAP will have a notable impact on the volume of compliant PHVs operating within Greater Manchester. To assess the likely behavioural responses associated with the introduction of the CAZ and associated funds, a Cost Response Model for taxis was developed (discussed in *Technical Paper 28*).

5.4.2 The input data from the DVLA and ANPR survey, as well as population data, were segmented to understand the different impacts of the GM CAZ on vehicles based upon vehicle registration location, frequency of travel, vehicle type, vehicle ownership and vehicle age. The behavioural responses generated for the GM CAP for PHVs are as follows:

- Pay Charge;
- Cancel Trip (Leave Sector); and
- Upgrade Vehicle.

5.4.3 The list of possible options available to taxi owners and operators have been captured in **Figure 5-1** and explains how taxi owners might respond to GM CAP.

Figure 5-1 Taxi vehicle owner/operator options



CAZ Only Impacts

5.4.4 The CAZ only scenario shows the impact of implementing a GM CAZ without any supporting mitigation measures. The assumption from a CAZ only scenario is that there would be a lower proportion of owners and operators upgrading their vehicles and a higher number paying the charge than in a with-Funds scenario due to the lack of financial assistance for vehicle upgrades for those whom do not have readily available or accessible capital. It should be recognised that a working assumption to classify all PHVs as Non-Wheelchair Accessible Vehicles (WAVs) has been made in the modelling to reflect that there are very few (5%) accessible PHVs operating within GM. As a result, for modelling purposes it is assumed that no PHVs are exempt from CAZ charges until 2023. In practice, any WAV PHVs would be eligible for an exemption to end 2022.

5.4.5 **Table 5-3** shows the behavioural responses for PHVs under the CAZ only scenario across the three model years (2021, 2023 and 2025). Consistent with Hackney Carriages, although the Pay Charge proportion increases across the model years, the number of those choosing to pay the charge remains static. PHV owners choosing to upgrade their vehicles reduces over the period due to initial upgrades being carried out prior to the introduction of the CAZ charge (2021). In 2025, the CAZ is well established and therefore there is a drop in the number of owners upgrading their vehicles.

Table 5-3 PHV CAZ Only Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	12.1%	16.2%	18.9%
Change Mode	0.0%	0.0%	0.0%
Cancel Trip	4.3%	0.5%	0.0%
Upgrade Vehicle	83.6%	83.3%	81.1%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

5.4.6 The application of the CAZ only scenario and the upgrade responses discussed above will lead to an increase in the number of compliant PHVs. The CAZ only vehicle volumes are shown in **Table 5-4**.

Table 5-4 PHV CAZ Only Vehicle Volumes

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	11675	4450	16,126
	Non-Compliant	726	323	1,049
	Total	**12,401**	**4,773**	**17,174**
2023	Compliant	11,899	4,563	16,462
	Non-Compliant	502	211	713
	Total	**12,401**	**4,773**	**17174**
2025	Compliant	12,071	4,641	**16,712**
	Non-Compliant	330	132	**462**
	Total	**12,401**	**4,773**	**17,174**

Source: Technical Paper 29. (Excludes MLS)

CAZ Plus Funds Impacts

5.4.7 As shown in **Table 5-5**, just over a tenth of PHV owners are choosing to pay the charge in 2021 albeit there is a slight reduction in the CAZ plus Funds scenario. The growth in the proportion of vehicles paying the charge over the model years is consistent with the CAZ only scenario. However, since the introduction of the CAZ charge and availability of mitigation funds in 2021, there is a higher proportion of those upgrading their vehicles in the CAZ plus Funds scenario as owners take advantage of the financial support available.

Table 5-5 PHVs CAZ plus Funds Behavioural Responses

Modelled Response	2021	2023	2025
Pay Charge	11.4%	15.8%	17.7%
Change Mode	0.0%	0.0%	0.0%
Cancel Trip	4.3%	0.4%	0.0%
Upgrade Vehicle	84.3%	83.8%	82.3%

Source: Technical Paper 29 (Trip based responses applied in Demand Sifting Tool)

5.4.8 The application of the CAZ with Funds scenario results in additional compliance above the CAZ only scenario with additional vehicle upgrade as shown in **Table 5-6**.

Table 5-6 PHVs CAZ plus Funds Vehicle Volumes

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	11,724	4,450	**16,174**
	Non-Compliant	677	323	**1,000**
	Total	**12,401**	**4,773**	**17,174**
2023	Compliant	11,917	4,563	**16,480**
	Non-Compliant	484	211	**695**
	Total	**12,401**	**4,773**	**17,174**
2025	Compliant	12,095	4,641	**16,737**
	Non-Compliant	306	132	**438**
	Total	**12,401**	**4,773**	**17,174**

Source: Technical Paper 29. (Excludes MLS)

5.4.9 Based on vehicle numbers, there are significantly more compliant PHVs in 2021 in the CAZ plus Funds scenario (94%) compared with Do-Minimum (57%). Due to the high number of GM licensed PHVs (12,401) compared to non-GM licensed PHVs (4,773) modelled in 2021, the CAZ charge and mitigation funding is likely to have a significant impact on the PHV market.

5.5 Discounts and Exemptions

5.5.1 The following discounts and exemptions are proposed for PHVs:

- CAZ charge to PHVs are capped weekly at a maximum of five charged days to take account PHV drivers using their vehicles for personal trips outside of their working week; and

- WAV exemption until end 2022 – though noting that due to the relatively small number of WAV PHVs, for modelling purposes all PHVs are assumed to be Non-WAV and so this exemption has not been applied to PHVs within the modelling.

5.6 Minimum Licensing Standards

Currently each Local Authority sets their own licensing standards for Hackney and PHV operators, drivers, and vehicles. This disparity in standards has, in some cases, led applicants to seek out authorities where they can get their licenses cheaper, quicker or with fewer restrictions, risking undermining local licensing policies designed to protect public safety and the environment. GM are currently considering the introduction of Minimum Licensing Standards (MLS) across GM. These standards include a move to Zero Emissions Capable (ZEC) vehicles. An overview of the MLS proposed roadmap to ZEC is shown in **Figure 5-2**. Note, this currently excludes those Taxis licenced outside of GM.

Figure 5-2 MLS Proposed Roadmap to Zero Emissions Capable Vehicles

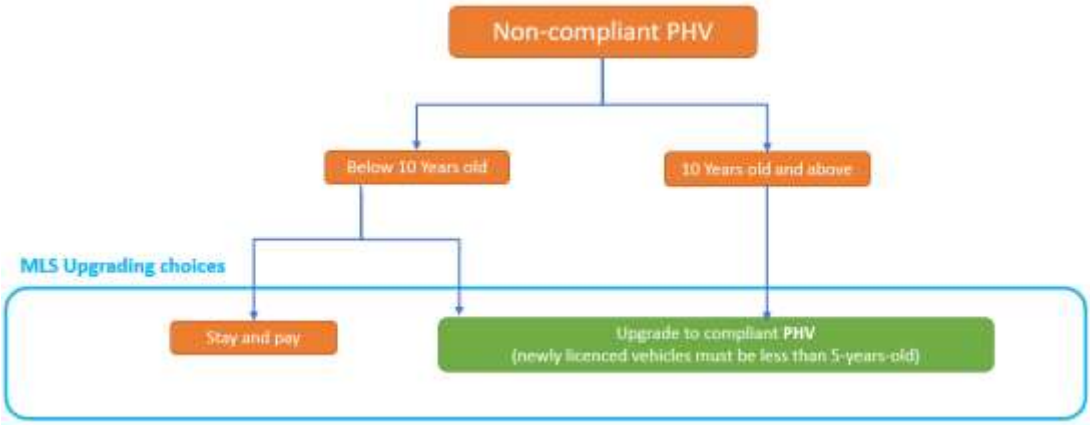
5.6.1 Based on the Roadmap to ZEC discussed above, this impacts a significant number of PHVs. A summary of the number of affected vehicles is shown in **Table 5-7**.

Table 5-7 Number of PHCs Impacted by MLS

MLS Standard	Impact	Number of affected Vehicles
10 year age limit	Affected non-compliant vehicles must upgrade and can no longer choose to stay and pay	1,625

5.6.2 Further analysis of the vehicle fleet was undertaken in the context of the proposed MLS, which if delivered in combination with the GM CAP would also result in the uptake of additional compliant vehicles due to the vehicle standards set under MLS and the timescales required for compliance to these standards. A series of enhancements were applied to the Taxi Cost Response Model to reflect MLS impacts and included the further disaggregation of the non-compliant vehicles to align with the MLS requirements. This further disaggregation is shown in **Figure 4-3**. Also, **Appendix C** explains the differences between MLS and Non-MLS scenarios.

Figure 5-3 Taxi vehicle owner/operator options (with MLS)



5.6.3 The Taxi Cost Response Model was reassessed under a scenario of MLS and GM CAP. **Table 4-8** presents the impact on compliant vehicle volumes.

5.6.4 Table 5-7 Vehicle Volumes with the introduction of MLS and GM CAP

Year	Modelled Response	GM Licensed	Non-GM Licensed	Total
2021	Compliant	11,724	4,460	16,182
	Non-Compliant	677	313	992
	Total	**12,401**	**4,773**	**17,174**

Source: 2020 Update (with MLS)

5.7 Vehicles Eligible for the Funds

5.7.1 The funding offer for PHVs is shown in **Table 5-8**.

Table 5-8 Proposed per-vehicle Grant and Finance offers for PHVs

Upgrade type	Upgrade to	Offer	Grant available
PHV (WAV) upgrade	PHV WAV – Replacement vehicle	Grant or equivalent Vehicle Finance subsidy	A grant of up to £5,000 for a compliant 6+ seater vehicle; or An average subsidy of £5,000, with the subsidy per vehicle capped at £7,000
PHV (non-WAV) upgrade	Replacement to ZEC PHV	Plug-in vehicle grant (OLEV); and Running costs grant	Up to £3,000 (via OLEV); and A grant of up to £2,500 towards the running costs for a ZEC vehicle.
	Replacement to hybrid or plug-in hybrid	Grant or equivalent Vehicle Finance subsidy	A grant of up to £2000 for a hybrid or plug-in hybrid vehicle; or An average subsidy of £2,000, with the subsidy per vehicle capped at £3,000.
	Replacement to compliant diesel or petrol		A grant of up to £1,000 for a compliant ICE vehicle; or An average subsidy of £1,000, with the subsidy per vehicle capped at £2,000.
	Replacement to compliant diesel or petrol minibus		A grant of up to £5,000 for a compliant 6+ seater vehicle; or An average subsidy of £5,000, with the subsidy per vehicle capped at £7,000

Source: Clean Taxi Case for Measure (August 2020)

5.7.2 Analysis from the outputs of the Cost Response Model has identified the overall number of PHVs that would be eligible for funding **Table 5-8**. This excludes the PHVs that are licensed outside of GM (e.g. Wolverhampton & Sefton licensed).

Table 5-8 – Forecast Update of PHV Funding

Offer	Number taking funding
£1,000 for a compliant petrol/diesel	Not assessed
£2,000 for a compliant hybrid or plug-in hybrid (not eligible for plug-in vehicle grant)	2,824
£2,500 running costs grant for ZEC	1,827
£5,000 for a 6+ seater vehicle	Not assessed
Total PHV	**4,652**

Source: Clean Taxi Case for Measure (August 2020)

6 Buses

6.1 Mode Overview

6.1.1 This section discusses the vehicle volumetric information associated with buses which has been utilised by the GM CAP project.

6.1.2 According to DfT Vehicle Classifications, a bus is considered to fall within vehicle category M, which includes 'Motor vehicles with at least four wheels designed and constructed for the carriage of passengers.' with buses found under classification M3 as they comprise more than eight seats and exceed 5 tonnes. For the purposes of the CAP, it is considered a bus if it is a registered bus operating on a registered bus service in GM.

6.1.3 Analysis of the bus market is provided in *Technical Paper 11*, submitted to JAQU in July 2019, and provides details of the operation of buses within Greater Manchester. Since the submission of the OBC, and as part of the Clean Bus Fund programme, TfGM has conducted a comprehensive data gathering exercise with all bus operators that provide services that are wholly within or intersect GM boundaries. This has enabled TfGM to establish a detailed breakdown of the fleet of vehicles in use across GM.

6.2 Sources of Vehicle Volume Data

6.2.1 For Buses, there are three key sources of data which have been used to understand vehicle operations within Greater Manchester. These include:

- Bus service timetable data for 2015 and 2019 from TfGM's AS400 database;
- Mapped bus routing data from TfGM's bus route mapping system (GMBusRoutes); and
- Information about the bus fleet composition in Greater Manchester from TfGM's Punctuality and Reliability Monitoring Survey (PRMS).

6.2.2 The mapped bus routing data was converted into the SATURN highway model used for GM CAP. This was compared to the modelled service route lengths to correct any anomalies in the data. Details of the bus fleet composition in GM was obtained from TfGM's Punctuality and Reliability Monitoring Survey for 2019/20 (PRMS), which is used to measure the performance and reliability of scheduled bus services within the County. Data collection for the survey is carried out through 'on-site' observations of services departures at bus stops and stations. Emissions data was derived from the PRMS and determined the number of compliant vehicles operating in GM. These data sources were used to support the majority of analysis contained within *Technical Paper 11* and was used to establish the overall quantum of buses based in Greater Manchester (2019), which is in the region of 1,944 vehicles, of which just 12% (233) are considered compliant Euro 6 vehicles. The modelling is based on bus fleet data from 2019, but the

latest delivery plan is based on the most up to date fleet information which was collected in early 2020.

6.2.3 The collation of bus existing sources does not provide information on the number of buses based outside of GM, though operating within GM, or the frequency of operation of the buses serving GM.

6.3 Forecasting the Fleet Mix

6.3.1 For modelling purposes, details of the bus fleet composition in Greater Manchester was obtained using information from TfGM's Punctuality and Reliability Monitoring Survey for 2019/20 (PRMS), which is used to measure the performance and reliability of scheduled bus services within the County.

6.3.2 Data collection for the survey is carried out through 'on-site' observations of service departures at bus stops and stations. The survey records the punctuality of scheduled services for reporting purposes and also records the emission standards that vehicles are compliant with to assist with monitoring carbon emissions.

6.3.3 Information about the emission standards of bus services from the PRMS was available at 3 levels:

- Service level, where data was available for individual services
- Operator level, where data was not available for a specific service, but where average data was available for the operator running the service
- Network level, where data was not available for the service or operator, and where GM-wide average figures have been used.

6.3.4 Data was available at service level for approximately 38% of the bus services in the 2019 bus routing file and at operator level for 49% of services. Information was available at the network level for 13% of services.

6.3.5 The Euro emission standards were used to infer the year of registration for services by using lookup tables to determine the year in which the Euro standards were introduced (for buses). Where emission limits applied for several years then services were divided equally across the period to estimate the fleet age profile for the base year modelling.

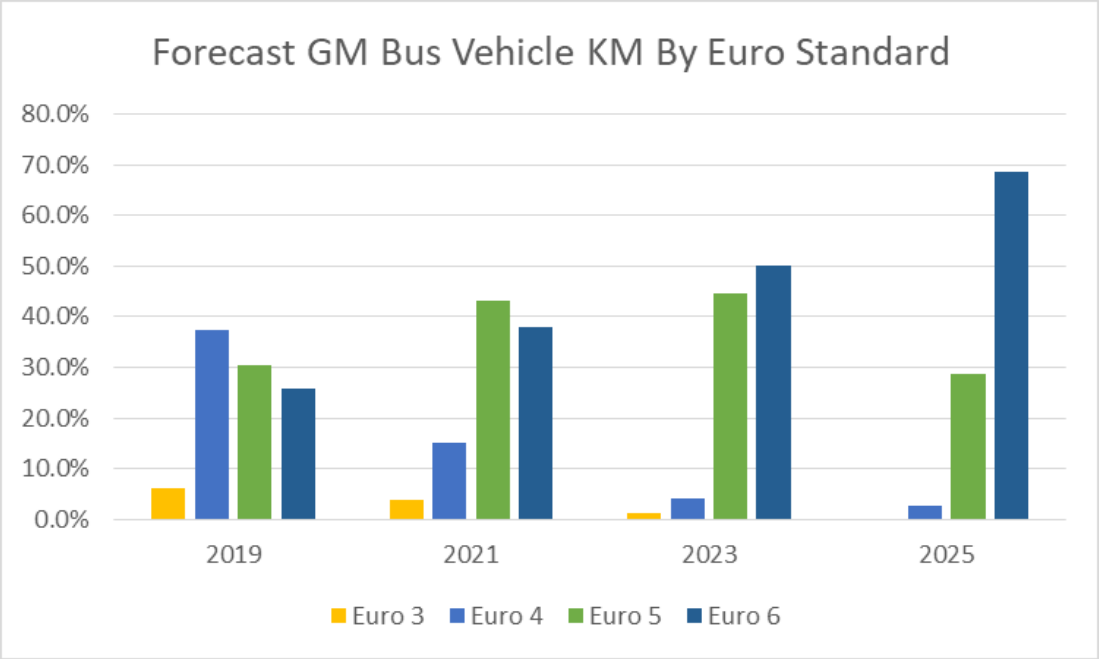
6.3.6 The forecast year fleet mix of the bus services (i.e. the percentages of buses that are compliant with different emission standards) was determined by assuming that the age profile for each service (i.e. the percentage of buses that are x years old) would be unchanged in the future. Adopting this approach, for example, if 5% of the buses for a given service in 2019 were 3 years old (or had been retrofitted to have the emission standard equivalent to a 3 year old bus), then it was assumed that 5% of buses for that service would also be 3 years old in the forecast year and would therefore meet the equivalent emission standard for that date. This allowed estimates of the proportions of vehicles meeting the different Euro standards in each the forecast year to be made, based on their age. The impacts of these assumptions are considered further in the Analytical Assurance Statement.

6.3.7 Details of the local fleet composition from the process are shown below in **Table 6-1** and are summarized in **Figure 6-1**, which shows how the bus fleet mix is forecast to change over time. The figures also highlight the relatively high proportions of older buses in the GM fleet, with only about 26% of total bus mileage being operated by vehicles meeting Euro 6 standards in 2019.

Table 6-1 Bus Fleet Composition by Euro Standard and Year (Percentage Vehicle Mileage, Do Minimum scenario)

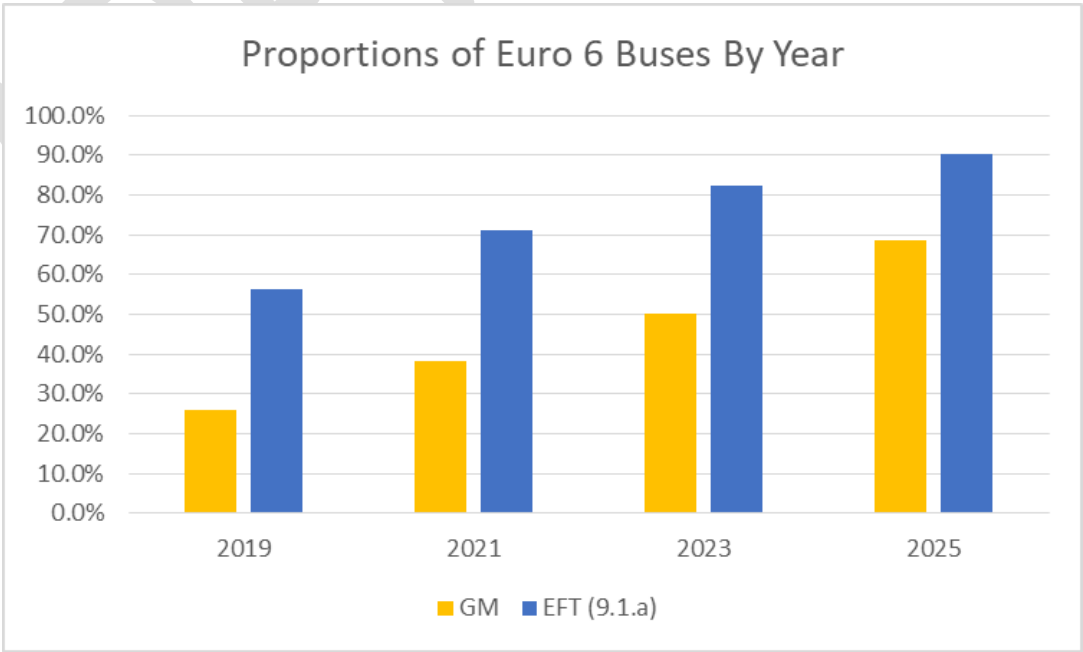
Euro Standard	2019	2021	2023	2025
Pre-Euro 1	0.0%	0.0%	0.0%	0.0%
Euro 1	0.0%	0.0%	0.0%	0.0%
Euro 2	0.0%	0.0%	0.0%	0.0%
Euro 3	6.2%	3.7%	1.2%	0.0%
Euro 4	37.3%	15.2%	4.2%	2.8%
Euro 5	30.6%	43.0%	44.5%	28.8%
Euro 6	25.9%	38.0%	50.1%	68.5%
Total	100.0%	100.0%	100.0%	100.0%

Figure 6-1 GM Bus Vehicle KM By Euro Standard, Do Minimum scenario



6.3.8 Comparisons of the forecast proportions of Euro 6 compliant buses operating within Greater Manchester with the default proportions from the Version 9.1.a of the Emission Factor Toolkit for buses in England (not London) are presented in **Figure 6-2**. This shows that the GM bus fleet is older than the national non-London fleet as assumed in the EFT.

Figure 6.2 Comparisons of Euro 6 Bus Proportions by Year, Do Minimum scenario



6.4 Forecasting Assumptions

6.4.1 The bus services in the forecast year models for 2021, 2023 and 2025 are assumed to be the same as the 2019 services and frequencies, so that the bus volumes and flows are the same in all years. The fleet mix, however, is projected forward using the fleet roll-over methodology described above. The do-minimum forecasts therefore include changes in the fleet composition and engine technology over time, which deliver improvements to air quality in the baseline (without measure) scenarios.

6.4.2 The proposed GM CAP includes funds to retrofit or replace the older (Euro 4 and 5) bus fleet with Euro 6 compliant vehicles and it is assumed that all operators will upgrade their remaining non-compliant vehicles. As such, the do-something (with measures) modelling has assumed that all buses (100%) will be compliant with Euro 6 emission standards in each of the forecast years when the CAP goes live.

7 Coaches

7.1 Mode Overview

7.1.1 This section discusses the vehicle volumetric information associated with coaches which has been utilised by the GM CAP project.

7.1.2 According to DfT Vehicle Classifications, a coach is considered to fall within vehicle category M, which includes 'Motor vehicles with at least four wheels designed and constructed for the carriage of passengers.' with coaches found under classification M3 as they comprise more than eight seats and exceed 5 tonnes. A coach can be further defined by the function of the vehicle and the type of service offered. For example, the vehicle is not permitted to carry standing passengers and includes physical characteristics such as rear or underfloor engines to limit noise levels as well as a separate compartment for luggage from passengers. Also, for funding purposes, a coach that operates on a registered bus service is classified as a bus and eligible for that funding.

7.1.3 Analysis of the coach market is provided in *Technical Paper 4*, submitted to JAQU in July 2019, which provides details of the operation of coaches within Greater Manchester.

7.2 Sources of Vehicle Volume Data

7.2.1 For coaches, there are two key sources of data which have been used to understand vehicle operations within Greater Manchester. These include:

- A coach database (Transport Resources International database[5]), providing a record of coaches in operation across the UK in 2019 (February 2020 database version); and
- The 2019 GM automatic number plate recognition (ANPR)survey which included coaches within the data assessed.

7.2.2 The coach database provides a detailed set of data around the number of coaches in operation across the UK and includes details of the coaches owned by each operator which is based on geographical location. This enables an understanding of the coaches operating within Greater Manchester. This database was used to support the majority of analysis contained within *Technical Paper 4* and was used to establish the overall quantum of coaches based in Greater Manchester (2019) which is in the region of 697 vehicles, of which just 33% (233) are classified as compliant Euro 6 vehicles.

[5] Transport Resources Limited. Database purchased from http://www.dougjack.co.uk/

7.2.3 The coach database does not provide information on the number of coaches based outside of GM, though operating within GM, or the frequency of operation of the coaches serving GM. To support a greater understanding of coaches operating within GM, the ANPR survey data, collected in 2019 was utilised to establish:

- The number of coaches based outside GM, though were observed operating within GM; and
- Typical frequency of operation of coaches serving GM.

7.2.4 The ANPR data was expanded for GM based vehicles by comparing the number of unique coaches observed in the ANPR to the number of GM based vehicles from the coach database (expansion factor of 2.83 derived). As no existing source was available to expand the non-GM coach data, the expansion factor from the OGV data (expansion factor 1.77) was applied. This provided an estimate of the total number of coaches serving GM in 2019 and is summarised in **Table 7-1**.

Table 7-1 – Number of Coaches Serving GM (2019)

Modelled Response	GM Based	Non-GM Based	Total
Compliant	233	529	**762**
Non-Compliant	464	448	**912**
Total	**697**	**977**	**1,674**

Source: Forthcoming Note, Technical Paper 38, Coaches and Minibuses Analysis

7.3 Changes to Coaches Over Time

7.3.1 Without intervention there will be a natural turnover of the coach fleet serving GM. Based on a typical lifespan of a coach of up to 20 years (based on HGV data), and assuming the same fleet age composition, the coach fleet was projected into the future. This was applied for each year by removing the oldest vehicles and replacing with a new one (keeping the overall age profile consistent). This naturally leads to an increase in Euro 6 (compliant) coaches over time. The coach fleet serving GM was therefore projected from 2019 to 2021, 2023 and 2025. These projections are presented in **Table 7-2**.

Table 7-2 Forecast Do Minimum (without CAP) Compliant Coaches 2021, 2023, 2025

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	327	581	**908**
	Non-Compliant	370	396	**766**
	Total	**697**	**977**	**1,674**
2023	Compliant	386	600	**986**
	Non-Compliant	311	377	**688**
	Total	**697**	**977**	**1,674**
2025	Compliant	480	648	**1,128**
	Non-Compliant	217	329	**546**
	Total	**697**	**977**	**1,674**

Source: Forthcoming Note, Technical Paper 38, Coaches and Minibuses Analysis

7.4 Change in Coach Volumes Due to GM CAP

7.4.1 As the coaches are not represented as a distinct mode within the transport modelling to support the air quality assessment, detailed behavioural responses due to the CAZ & funds were not developed for this mode, though a cost assessment spreadsheet tool was developed to understand the likely cost implications to support the consideration of the fund offer (discussed in **section 7.6**).

7.5 Discounts and Exemptions

7.5.1 Coaches registered within GM will be eligible for an exemption until end 2022.

7.6 Vehicles Eligible for the Funds

7.6.1 The funding offer for coaches is:

- A grant of up to £16,000 for a compliant 6+ seater vehicle;
- Access to vehicle finance with an average subsidy of £16,000, with the subsidy per vehicle capped at £23,000; or
- A grant of up to £16,000 towards a retrofit to a compliant standard via a CVRAS certified system.

7.6.2 The current assumption is that, for each vehicle group, the funding allocation would be split between grants and loans on a 70:30 ratio.

7.6.3 From analysis of the UK coach fleet database, it was identified that within GM, there are in the region of 120 Euro 5 coaches which are thought to be retrofittable (based on a market review conducted in 2019). It is likely that the majority of these will take up the funding because the funding will cover most or all of the cost of retrofitting. The number of coaches eligible for funding in 2021 is presented in **Table 7-3**, identifying those retrofittable vehicles, plus the remaining GM registered and non-compliant coaches eligible for replacement funds.

Table 7-3 – Coaches Eligible for Funding

Funding Eligibility (2023 fleet)	Eligible for Funding
Retrofittable Vehicles	120
Remaining Non-compliant GM based coaches	191
Total	**311**

Source: Case for Measure (August 2020)

8 Minibuses

8.1 Mode Overview

8.1.1 This section discusses the vehicle volumetric information associated with minibuses which has been utilised by the GM CAP project.

8.1.2 According to DfT Vehicle Classifications, a minibus is considered to fall within vehicle category M, which includes 'Motor vehicles with at least four wheels designed and constructed for the carriage of passengers.' with minibuses found under classification M2 as they not comprise more than eight seats (excluding the driver) and have a maximum weight not exceeding 5 tonnes. A minibus is legally defined as "a vehicle with between 9 and 16 passenger seats"[6]. A minibus can be further defined by the function of the vehicle and the type of service offered. For example, the vehicle is not permitted to carry standing passengers.

8.1.3 Note that for the purposes of the GM CAP, those minibuses that operate as a licensed PHV or Hackney Carriage are classified as such and not included in the numbers presented below.

8.1.4 Analysis of the minibus market is provided in *Technical Paper 18*, submitted to JAQU in August 2019, and provides details of the operation of minibuses within Greater Manchester.

8.2 Sources of Vehicle Volume Data

8.2.1 For minibuses, there are two key sources of data which have been used to understand vehicle operations within Greater Manchester. These include:

- Analysis of DVLA registered vehicle database records based on Q2 2016 obtained in 2018[7]; and
- Information obtained from the Minibus Market Analysis report, published in 2014, and based on DVLA data from 2012[8].

8.2.2 The availability of readily available data on the minibus market has been one of the challenges with comparisons amongst different datasets and the potential for double counting between owner and operator types. The *Technical Paper 18* informed the total quantum of minibuses operating in GM, the vehicle models and fuel and engine type information which has been used to derive vehicle compliance.

[6] *https://www.gov.uk/driving-a-minibus*
[7] DfT (2018) *Analysis of DVLA registered vehicle database records* (version Q2 2016) by DfT
[8] *Minibus Market Analysis*; Transport and Travel Research. (2014)

8.2.3 The DVLA dataset used to undertake this analysis provides minibus data based on vehicles registered per GM local authority. Recently collected ANPR data (2019) was also used to understand further detail in minibus travel within GM and included review of vehicle age profiles to understand the level of compliant vehicles operating in Greater Manchester. The ANPR data was expanded by 1.47 for GM and 1.56 for Non-GM (based on LGV expansion factors) to determine the total number of minibuses serving GM. 10% of minibuses captured by the ANPR are identified as taxis and so were excluded from the minibus fleet data, as these vehicles are captured within the taxi mode **Table 8-1** provides a breakdown of the 2019 Minibus volumes.

Table 8-1 – Number of Minibuses Serving GM (2019)

Modelled Response	GM Based	Non-GM Based	Total
Compliant	130	306	436
Non-Compliant	1,903	805	2,707
Total	**2,032**	**1,111**	**3,143**

Note: Values above exclude those minibuses that operate as PHVs
Source: Forthcoming Note, Technical Paper 38, Coaches and Minibuses Analysis

8.3 Changes to Minibuses Over Time

8.3.1 Without intervention there will be a natural turnover of the minibus fleet serving GM. Based on a typical lifespan of a minibus of up to 20 years (in line with vans assumption), and assuming the same fleet age composition, the minibus fleet was projected into the future. This was applied for each year by removing the oldest vehicles and replacing with a new one (keeping the overall age profile consistent). This naturally leads to an increase in Euro 6 (compliant) minibuses over time. The minibus fleet serving GM was therefore projected from 2019 to 2021, 2023 and 2025. These are presented in **Table 8-2**.

Table 8-2 Forecast Do Minimum (without CAP) Compliant Minibuses 2021, 2023, 2025

Year	Modelled Response	GM Based	Non-GM Based	Total
2021	Compliant	265	366	631
	Non-Compliant	1,768	744	2,512
	Total	**2,032**	**1,111**	**3,143**
2023	Compliant	417	413	830
	Non-Compliant	1,616	698	2,313
	Total	**2,032**	**1,111**	**3,143**
2025	Compliant	707	507	1,215
	Non-Compliant	1,324	604	1,928
	Total	**2,032**	**1,111**	**3,143**

Note: Values above exclude those minibuses that operate as PHVs
Source: Forthcoming Note, Technical Paper 38, Coaches and Minibuses Analysis

8.4 Change in Minibus Volumes Due to GM CAP

8.4.1 As the minibus are not represented as a distinct mode within the transport modelling to support the air quality assessment, detailed behavioural responses due to the CAZ & funds were not developed for this mode. However, a cost assessment spreadsheet tool was developed to support the consideration of the fund offer.

8.5 Discounts and Exemptions

8.5.1 A permanent exemption is proposed for Community Minibuses i.e.: Minibus operators that hold a valid permit issued under section 22 of the Transport Act 1985[9]; and

8.5.2 Minibuses are eligible for an exemption from the CAZ until end 2022 unless they operate as a licensed PHV or Hackney Carriage.

8.6 Vehicles Eligible for the Funds

8.6.1 The funding offer for minibuses is:

- A grant of up to £5,000 per vehicle; or
- access to vehicle finance with an average subsidy of £5,000 per vehicle, with the subsidy capped at £7,000.

[9]DVLA, Section 19 and 22 permits and obligations: not for profit passenger transport - https://www.gov.uk/government/publications/section-19-and-22-permits-not-for-profit-passenger-transport

8.6.2 The current assumption is that, for each vehicle group, the funding allocation would be split between grants and loans on a 70:30 ratio. There are currently no CVRAS approved retrofit solutions for minibuses.

8.6.3 A review of the number of minibuses operating within GM who would be eligible for funding was undertaken. Of the total GM registered vehicles, 27% of minibuses fall under the Community Minibus classification. These vehicles would be exempt from the CAZ so would not need to access funding support. Accounting for these individuals. The total remaining GM registered minibuses that would be eligible for funding is summarised in **Table 8-3**.

Table 8-3 GM based vehicles eligible for funding

Year	Number of minibuses eligible for funding
2023 – GM Based Non-Compliant vehicles	1,018

Note: Values above exclude those minibuses that operate as PHVs
Source: August 2020 Update

9 Summary

9.1.1 This Technical Paper has set out the vehicle volumetric data relevant to each key mode of travel considered by the GM CAP. The analysis has focused on the number of vehicles in each mode, how they project into the future. The assessment has also presented the behavioural responses associated with the CAZ, plus funds, and how these influence the number of compliant vehicles operating within Greater Manchester.

9.1.2 In addition, there are a number of areas of additional analysis which utilise the vehicle volumetric information discussed within this technical note. These include:

- Assessment of the eligibility for the funding packages to support the GM CAP;
- DIA Analysis; and
- Economic Appraisal.

9.1.3 The behavioural responses calculated by the Cost Response Models, impact on the vehicle volumes and how they respond to the GM CAP. However, the traffic modelling which supports the air quality impacts and assess the main modes of travel impacted by the CAZ & Funds (HGV/LGV/Hackney/PHV) are also impacted by these vehicle numbers, through the derivation of the behavioural responses to the CAZ.

9.1.4 The vehicle volumetric information for these models deals in the unit of trips (PCUs) rather than vehicles. For the purpose of comparison, summary trip values from the Demand Sifting Tool (DST), which informs the air quality traffic modelling is presented in **Appendix A**.

Appendix A - Demand Sifting Tool Volumetric Information (Trips)

The main content of this technical paper presents vehicle volumes in the form of the number of impacted vehicles. These vehicle volumes inform the behavioural responses which are generated by the Cost Response Models, which then supply the Demand Sifting Tool (DST), which assess the impact on vehicle trips by mode. This appendix presents the trip-based analysis from the DST based on the vehicle volumes presented within the main report.

HGV

Table A3 Impact on Compliance – 2021

Peak	Scenario	Do-Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	22,771	28,368	28,379
	Non-Compliant	9,256	3,647	3,641
	Total	**32,026**	**32,015**	**32,021**
Interpeak	Compliant	24,795	30,861	30,873
	Non-Compliant	10,078	4,000	3,994
	Total	**34,873**	**34,861**	**34,867**
PM Peak	Compliant	11,980	14,716	14,722
	Non-Compliant	4,870	2,128	2,125
	Total	**16,850**	**16,844**	**16,847**

Source: DST – Trip volumes by compliance type

Table A4 Impact on Compliance - 2023

	Scenario	Do-Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	26,645	30,094	30,094
	Non-Compliant	5,809	2,360	2,360
	Total	**32,455**	**32,455**	**32,455**
Interpeak	Compliant	29,018	32,755	32,755
	Non-Compliant	6,327	2,589	2,589
	Total	**35,344**	**35,344**	**35,344**
PM Peak	Compliant	14,021	15,706	15,706
	Non-Compliant	3,057	1,372	1,372
	Total	**17,078**	**17,078**	**17,078**

Source: DST – Trip volumes by compliance type

Table A5 Impact on Compliance - 2025

	Scenario	Do-Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	29,990	31,761	31,761
	Non-Compliant	2,894	1,123	1,123
	Total	**32,883**	**32,883**	**32,883**
Interpeak	Compliant	32,664	34,583	34,583
	Non-Compliant	3,152	1,233	1,233
	Total	**35,816**	**35,816**	**35,816**
PM Peak	Compliant	15,784	16,649	16,649
	Non-Compliant	1,523	659	659
	Total	**17,307**	**17,307**	**17,307**

Source: DST – Trip volumes by compliance type

LGV

Table A8 Impact on Compliance – 2023 Option 8

	Scenario	Do Minimum	OBC (March 2019)	[DS1] (Sheffield SP)	[DS2] (Cost Model)
AM Peak	Compliant	36,294	48,985	41,273	43,670
	Non-Compliant	17,876	2,705	8,953	10,499
	Total	**54,170**	**51,690**	**50,226**	**54,169**
Interpeak	Compliant	35,439	47,690	40,248	42,559
	Non-Compliant	17,455	2,811	8,840	10,335
	Total	**52,894**	**50,501**	**49,088**	**52,893**
PM Peak	Compliant	30,757	41,353	34,916	36,915
	Non-Compliant	15,149	2,483	7,699	8,990
	Total	**45,906**	**43,836**	**42,615**	**45,906**

Source: DST – Trip volumes by compliance type

Source: Operating Cost Model

Table A9 Impact on Compliance (£10 charge) - 2023

	Scenario	Do Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	35,089	45,248	48,235
	Non-Compliant	16,589	5,714	2,929
	Total	**51,678**	**50,962**	**51,164**
Interpeak	Compliant	34,263	44,068	46,951
	Non-Compliant	16,198	5,701	3,013
	Total	**50,460**	**49,770**	**49,965**
PM Peak	Compliant	29,736	38,223	40,718
	Non-Compliant	14,058	4,974	2,647
	Total	**43,794**	**43,196**	**43,365**

Source: DST – Trip volumes by compliance type

Table A10 Impact on Compliance - 2025

	Scenario	Do Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	42,664	50,465	51,872
	Non-Compliant	11,409	3,608	2,201
	Total	**54,073**	**54,073**	**54,073**
Interpeak	Compliant	41,649	49,186	50,545
	Non-Compliant	11,138	3,601	2,242
	Total	**52,787**	**52,787**	**52,787**
PM Peak	Compliant	36,147	42,661	43,835
	Non-Compliant	9,667	3,153	1,978
	Total	**45,813**	**45,813**	**45,813**

Hackney Carriage

Table A11 Impact on Compliance - 2023

	Scenario	Do Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	1,433	2,372	2,380
	Non-Compliant	1,290	352	343
	Total	**2,723**	**2,723**	**2,723**
Interpeak	Compliant	1,188	1,965	1,972
	Non-Compliant	1,070	293	286
	Total	**2,258**	**2,258**	**2,258**
PM Peak	Compliant	1,465	2,424	2,433
	Non-Compliant	1,320	362	352
	Total	**2,785**	**2,785**	**2,785**

Table A12 Impact on Compliance - 2023

	Scenario	Do Minimum	CAZ Only	CAZ plus funds
AM Peak	Compliant	2,166	2,531	2,560
	Non-Compliant	551	185	157
	Total	**2,717**	**2,717**	**2,717**
Interpeak	Compliant	1,798	2,101	2,124
	Non-Compliant	457	154	131
	Total	**2,255**	**2,255**	**2,255**
PM Peak	Compliant	2,212	2,585	2,614
	Non-Compliant	563	190	161
	Total	**2,775**	**2,775**	**2,775**

PHV

Table A15 Impact on Compliance – 2021

	Scenario	Do Minimum	CAZ only	CAZ plus funds
AM Peak	Compliant	14,027	21,038	21,097
	Non-Compliant	8,026	1,015	956
	Total	**22,053**	**22,053**	**22,053**
Interpeak	Compliant	11,604	17,405	17,453
	Non-Compliant	6,640	840	791
	Total	**18,244**	**18,244**	**18,244**
PM Peak	Compliant	14,339	21,506	21,566
	Non-Compliant	8,205	1,037	977
	Total	**22,544**	**22,544**	**22,544**

Source: Demand Sifting Tool

Table A16 Impact on Compliance – 2023

	Scenario	Do Minimum	CAZ only	CAZ plus funds
AM Peak	Compliant	18,393	21,698	21,715
	Non-Compliant	3,948	643	626
	Total	**22,341**	**22,341**	**22,341**
Interpeak	Compliant	15,250	17,990	18,004
	Non-Compliant	3,273	533	519
	Total	**18,523**	**18,523**	**18,523**
PM Peak	Compliant	18,813	22,193	22,210
	Non-Compliant	4,038	657	641
	Total	**22,851**	**22,851**	**22,851**

Source: Demand Sifting Tool

Table A17 Impact on Compliance – 2025

	Scenario	Do Minimum	CAZ only	CAZ plus funds
AM Peak	Compliant	21,200	22,423	22,441
	Non-Compliant	1,508	285	267
	Total	**22,708**	**22,708**	**22,708**
Interpeak	Compliant	17,598	18,614	18,629
	Non-Compliant	1,252	237	222
	Total	**18,850**	**18,850**	**18,850**
PM Peak	Compliant	21,652	22,902	22,920
	Non-Compliant	1,540	291	273
	Total	**23,193**	**23,193**	**23,193**

Source: Demand Sifting Tool

Appendix B Annual Trip Volumes (chargeable days)

The vehicle volumetric data discussed within the main report was also utilized to calculate the annual trip volumes to understand the number of chargeable days the CAZ charge applies. These takes the vehicle volumes discussed in the main report, for the year the CAZ is introduced, with annualization factors applied. Annual forecasts through to 2030 are provided by applying the natural turnover of the fleet, which results in further improvements in compliance. These are discussed below by vehicle mode, for Commercial Vehicles and Taxis.

HGV - Annual Trip Volumes (chargeable days)

The annual number of chargeable trips was identified from analysis of the vehicle volumes from the commercial vehicles Cost Response Model by reviewing the number of non-compliant vehicles serving GM and the frequency of operation of those vehicles. The Commercial vehicles Cost Response Model identified the following non-compliant HGVs in each forecast year (see **Table B1**).

Table B1 Number of Non-Compliant HGVs by year

Year	CAZ Only	CAZ Plus Funds
2021	19,931	19,931
2022-CAZ	801	780
2023	452	452
2024	324	324
2025	248	248
2026	179	179
2027	104	104
2028	23	23
2029	3	3
2030	-	-
2031	-	-

** 2022-CAZ year indicate that CAZ is implemented at the end of 2021 (i.e., beginning 2022).*
Source: Technical Paper 29

The Cost Response Model includes the disaggregation of the HGV fleet into low frequency and high frequency. This is based on the review of the ANPR data. Annualisation factors shown in **Table B2** were applied to the HGV non-compliant vehicle numbers to determine the annual number of chargeable trips.

Table B2 HGV annualization factors by trip frequency

Trip Frequency	Weekly Trip (days)	Operational Weeks	Annualisation Factor ie: days operated in CAZ per year
Low	1	50.6	50.6
High	5	50.6	253

Source Commercial Vehicles Cost Response Model (Technical Paper 29)

The resultant total number of chargeable HGV trips is presented in **Table B3**.

Table B3 Number of Annual Chargeable HGV Journeys

Year	CAZ Only	CAZ Plus Funds
2021	3,744,141	3,744,141
2022=CAZ	93,435	87,982
2023	24,938	24,938
2024	16,392	16,392
2025	12,534	12,534
2026	9,047	9,047
2027	5,243	5,243
2028	1,163	1,163
2029	159	159
2030	-	-
2031	-	-

Source: Technical Paper 29

LGV - Annual Trip Volumes (chargeable days)

The annual number of chargeable trips for LGVs was identified from analysis of the vehicle volumes from the commercial vehicles Cost Response Model by reviewing the number of non-compliant vehicles serving GM and the frequency of vehicle operations. The Commercial vehicles Cost Response Model identified the following non-compliant LGVs in each forecast year (see **Table B4**).

Table B4 Number of Non-Compliant LGVs by year

Year	CAZ Only	CAZ Plus Funds
2021	152,791	152,791
2022	140,953	140,953
2023-CAZ	49,909	33,605
2024	40,330	28,505
2025	29,301	22,711
2026	21,610	17,961
2027	16,122	13,908
2028	10,624	9,459
2029	6,438	5,974
2030	5,052	5,052
2031	4,053	4,053

Source: Technical Paper 29

The Cost Response Model includes the disaggregation of the LGV fleet into low frequency and high frequency. This is based on the review of the ANPR data. Annualisation factors shown in **Table B5** were applied to the LGV non-compliant vehicle numbers to determine the annual number of chargeable trips.

Table B5 LGV annualisation factors by trip frequency

Trip Frequency	Weekly Trip (days)	Operational Weeks	Annualisation Factor ie: days operated in CAZ per year
Low	1	46	46
High	5	46	230

Source: Commercial Vehicles Cost Response Model

9.1.5 The resultant total number of chargeable LGV trips is presented in **Table B6**.

Table B6 Number of Annual Chargeable LGV Journeys

Year	CAZ Only	CAZ Plus Funds
2021	24,433,765	24,433,765
2022	22,584,864	22,584,864
2023 - CAZ	6,306,459	2,572,132
2024	4,672,502	1,952,806
2025	2,842,567	1,326,791
2026	1,813,047	973,666
2027	1,243,084	734,010
2028	755,949	488,025
2029	405,069	298,460
2030	232,376	232,376
2031	186,421	186,421

Source: Technical Paper 29

Hackney Carriages

9.2 Annual Trip Volumes (chargeable days)

9.2.1 The annual number of chargeable trips was identified from analysis of the vehicle volumes from the Cost Response Models by reviewing the number of non-compliant vehicles serving GM and the frequency of vehicle operations. The Taxi Cost Response Model identified the following non-compliant Hackney Carriages in each forecast year (see **Table B7**).

Table B7 Non-Compliant Hackney Carriages vehicles following CAZ & Funds

Year	CAZ Only	CAZ Plus Funds
2021	1,861	1,861
2022	1,648	1,648
2023 - CAZ	368	358
2024	317	302
2025	262	230
2026	189	144
2027	114	75
2028	70	51
2029	34	30
2030	16	16

** 2022-CAZ year indicate that CAZ is implemented at the end of 2021 (i.e., beginning 2022).*
Source: Technical Paper 29 (excludes MLS)

9.2.2 To identify the annual number of chargeable trips, the vehicle fleet was disaggregated into various operating categories including:

- Split of fleet into intensity of operation;
- Split fleet by ownership model (e.g. Driver / independent owner); and
- Distribution of ownership by vehicle age

9.2.3 Following the application of this disaggregation, the following annualisation factors were identified in **Table B8.**

Table B8 Hackney Annualisation Factors based on Operation type and intensity of operation

Frequency		Days per week	Weeks per year	Yearly Trips
GM operation frequency: Full Time	Low	3	46	138
	Medium	5	46	230
	High	6	48	288
	Intensive	7	50	350
GM operation frequency: Occasional	Low	-	-	30
	Medium	-	-	51
	High	-	-	63
	Intensive	-	-	77

Source: Taxi Cost Response Model

9.2.4 By combining the vehicle numbers and frequency information, an estimation of annual chargeable trips was identified as shown in **Table B9**.

Table B9 – Annual Number of Chargeable Hackney Trips

Year	CAZ Only	CAZ Plus Funds
2021	-	-
2022	-	-
2023 - CAZ	88,455	84,348
2024	76,266	71,219
2025	62,937	54,234
2026	45,379	34,008
2027	27,311	17,688
2028	16,699	11,958
2029	8,081	7,115
2030	3,912	3,834
2031	-	-

Source: Technical Paper 29 (Excludes MLS)

PHV

9.3 Annual Trip Volumes (chargeable days)

9.3.1 The annual number of chargeable trips was identified from analysis of the vehicle volumes from the Cost Response Models by reviewing the number of non-compliant vehicles serving GM and the frequency of vehicle operations. The Taxi Cost Response Model identified the following non-compliant PHVs in each forecast year (see **Table B10**).

Table B10 Non-Compliant PHV vehicles following CAZ & Funds

Year	CAZ Only	CAZ Plus Funds
2021	9,631	9,631
2022-CAZ	1,049	1,000
2023	1,023	974
2024	927	878
2025	704	655
2026	480	441
2027	372	342
2028	259	251
2029	168	168
2030	102	102
2031	65	65

Source Technical Paper 29 (Excludes MLS)
** 2022-CAZ year indicate that CAZ is implemented at the end of 2021 (i.e., beginning 2022). However PHV vehicle profile at beginning of 2021 .*

9.3.2 To identify the annual number of chargeable trips, the vehicle fleet was disaggregated into various operating categories including:

- Split of fleet into intensity of operation;
- Split fleet by ownership model (e.g. Driver / independent owner); and
- Distribution of ownership by vehicle age.

9.3.3 Following the application of this disaggregation, the following annualisation factors were identified in **Table B11.**

Table B11 PHV Annualisation Factors based on Operation type and intensity of operation

Frequency		Days per week	Weeks per year	Yearly Trips
GM operation frequency: Full Time	Low	3	46	138
	Medium	5	46	230
	High	5	52	261
	Intensive	5	52	261
GM operation frequency: Occasional	Low	-	-	30
	Medium	-	-	51
	High	-	-	57
	Intensive	-	-	57

Source: Taxi Cost Response Model

9.3.4 By combining the vehicle numbers and frequency information, an estimation of annual chargeable trips was identified as shown in **Table B12**.

Table B12 – Annual Number of Chargeable PHV Trips

Year	CAZ Only	CAZ Plus Funds
2021	-	-
2022-CAZ	194,236	183,401
2023	189,436	178,648
2024	171,719	161,102
2025	130,373	120,155
2026	88,978	80,966
2027	68,906	62,693
2028	48,038	45,965
2029	31,109	30,809
2030	18,849	18,667
2031	11,953	11,838

Source Technical Paper 29 (Excludes MLS)

Appendix C - MLS Approach

The table below summarises how MLS has been applied within the modellling.

Table of upgrade options for Hackney Cabs with and without MLS, with GM CAP

	Upgrade requirements…	
	With MLS	**Without MLS**
Compliant London-style Hackney Cab <10 years old	No upgrade required	No upgrade required
Compliant London-style Hackney Cab >10 years old	Must upgrade to a newer vehicle (<5 years old) to continue operating • ZEC London-style Hackney without funding support • Euro 6 diesel London-style Hackney without funding support (until 2024 only, from 2025 must be ZEC)	No upgrade required
Non-compliant London-style Hackney Cab <10 years old	Can choose to stay and pay or upgrade: • ZEC London-style Hackney (<5 years old) with funding support • Euro 6 diesel London-style Hackney (<5 years old) without funding support (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade: • ZEC London-style Hackney with funding support • Euro 6 diesel Hackney without funding support
Non-compliant London-style Hackney Cab >10 years old	Must upgrade to a newer vehicle to continue operating: • ZEC London-style Hackney (<5 years old) with funding support • Euro 6 diesel London-style Hackney (<5 years old) without funding support (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade: • ZEC London-style Hackney with funding support • Euro 6 diesel London-style Hackney without funding support
Compliant non-London-style Hackney Cab <10 years old	Must upgrade to a London-style Hackney Cab to continue operating: • ZEC London-style Hackney (<5 years old) without funding support • Euro 6 diesel London-style Hackney (<5 years	No upgrade required

	old) without funding support (until 2024 only, from 2025 must be ZEC)	
Compliant non-London-style Hackney Cab >10 years old	Must upgrade to a London-style Hackney Cab to continue operating: • ZEC London-style Hackney (<5 years old) without funding support • Euro 6 diesel London-style Hackney (<5 years old) without funding support (until 2024 only, from 2025 must be ZEC)	No upgrade required
Non-compliant non-London-style Hackney Cab <10 years old	Must upgrade to a London-style Hackney Cab to continue operating: • ZEC London-style Hackney (<5 years old) with funding support • Euro 6 diesel London-style Hackney (<5 years old) without funding support (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade: • ZEC London-style Hackney with funding support • Euro 6 diesel London-style Hackney without funding support • Euro 6 diesel non-London-style Hackney without funding support • Euro 4 or newer petrol non-London-style Hackney without funding support
Non-compliant non-London-style Hackney Cab >10 years old	Must upgrade to a London-style Hackney Cab to continue operating: • ZEC London-style Hackney (<5 years old) with funding support • Euro 6 diesel London-style Hackney (<5 years old) without funding support (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade: • ZEC London-style Hackney with funding support • Euro 6 diesel London-style Hackney without funding support • Euro 6 diesel non-London-style Hackney without funding support • Euro 4 or newer petrol non-London-style Hackney without funding support

Note that this assumes the GM CAP funding package as currently proposed in the option for consultation. This package assumes MLS applies and may need to be revised if MLS is not implemented eg may consider bringing in funding offer for non-London style cabs in line with PHV offer

London-style is assumed to include London Taxi Company vehicles and any other vehicles compatible with proposed MLS for Hackney Cabs. Non-London-style is assumed to include any other vehicle currently operating as a licensed Hackney Cab in GM but not compatible with the proposed vehicle-type standards under MLS.

Table of upgrade options for PHVs with and without MLS, with GM CAP

	Upgrade requirements…	
	With MLS	**Without MLS**
Compliant PHV <10 years old	No upgrade required	No upgrade required
Compliant PHV >10 years old	Must upgrade to a newer vehicle (<5 years old) to continue operating without funding support • ZEC • ICE (until 2024 only, from 2025 must be ZEC)	No upgrade required
Non-compliant PHV <10 years old	Can choose to stay and pay or upgrade to a newer compliant vehicle (<5 years old) with funding support • ZEC • ICE (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade to a compliant vehicle with funding support
Non-compliant PHV >10 years old	Must upgrade to a newer vehicle (<5 years old) to continue operating with funding support • ZEC • ICE (until 2024 only, from 2025 must be ZEC)	Can choose to stay and pay or upgrade to a compliant vehicle with funding support

Note that this assumes the GM CAP funding package as currently proposed in the option for consultation.