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

# Note 7: Freight Cost Model



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|---|---|---|---|
| **Version Status:** | APPROVED | **Prepared by:** | Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester |
| **Authorised by:**<br>**Date:** | Ian Palmer<br>1st November 2019 | | |

## 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.

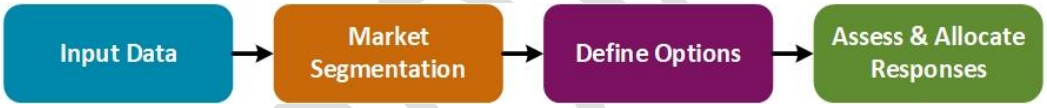
# 1 Introduction

1.1 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 develop a response model (the model) in order to test how vehicle owners would react to the proposed Clean Air Zone (CAZ) charge. This technical note outlines the methodology and key assumptions incorporated in the development of the model. The model itself and this note may be subject to further change as input data and assumptions are strengthened based on continuing research in the build up to the submission of the FBC.

# 2 Methodology

2.1 The methodology of the model from input data through to the vehicle owner responses is outlined in **Figure 2-1** and discussed below.

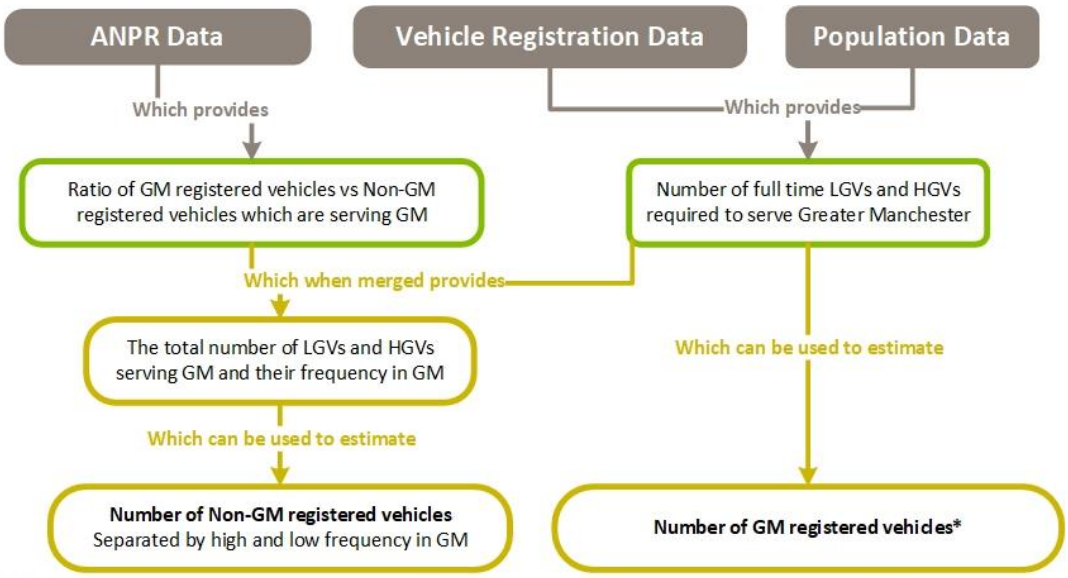
**Figure 2-1 Model methodology**




## 2.2 Input Data

2.2.1 The inputs included a data set of registration plates captured by ANPR cameras in 2019 and vehicle registration lists for Greater Manchester published by the Driver and Vehicle Licensing Agency (DVLA). **Figure 2-2** outlines the methodology for how the input data was estimated while **Table 2-1** displays the figures used.

**Figure 2-2 Freight input data**




*All GM based HGVs are assumed to operate in GM five days per week. Vans based in GM are assumed to operate in GM with a frequency according to that observed in the ANPR data.

**Table 2-1 Freight input data (non-compliant vehicle numbers at CAZ implementation shown in brackets)**

| | LGVs (non-compliant) | HGVs (non-compliant) |
|---|---|---|
| GM registered | 135,746 (75,414) | 25,737 (7,367) |
| Registered outside of GM | 141,682 (54,947) | 45,055 (9,285) |
| **Total** | **277,428 (130,360)** | **70,792 (16,652)** |

## 2.3 Market Segmentation

2.3.1 Segmenting the market allows the model to allocate vehicle owners to different decisions/responses. The 'right' level of segmentation depends on the data available (in order to estimate the proportion of the market belonging to each segment) as well as how strongly different divisions of the market vary in their operations/types. For this model, the market was segmented into the characteristics shown in **Table 2-2**.

**Table 2-2 Market segmentation**

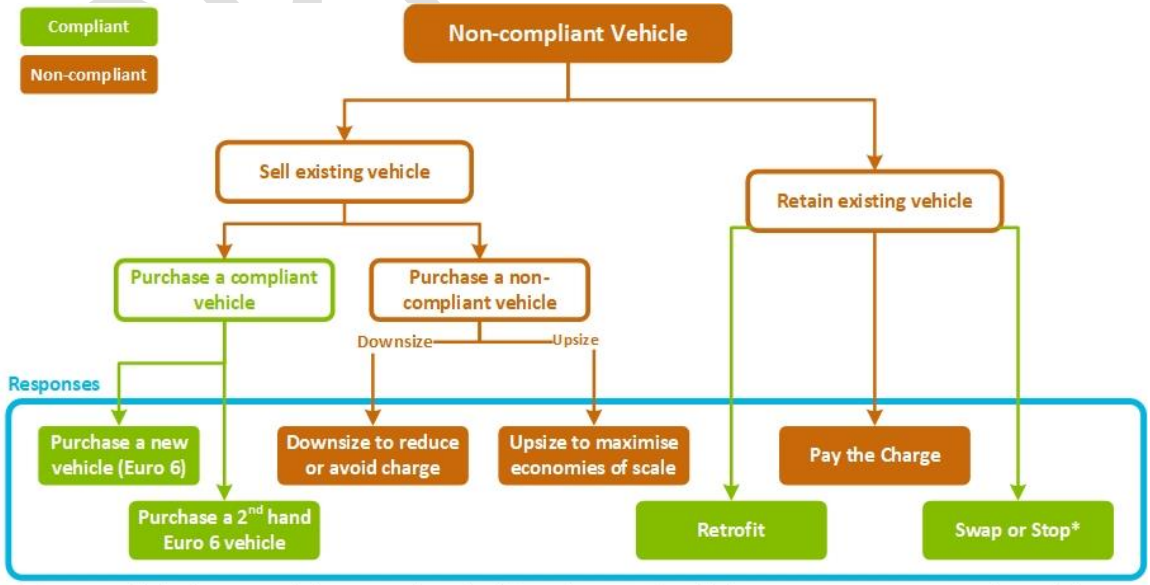
| Characteristics | Segments | Source |
|---|---|---|
| **Vehicle registration location** | • Greater Manchester<br>• North West<br>• Other | ANPR data |
| **Frequency (in GM)** | • Low<br>• High | ANPR data |
| **Vehicle type** | • Based on gross weight: | ANPR data |

| | | |
|---|---|---|
| | – 1.6 t (LGV)<br>– 3.5 t (LGV)<br>– 7.5 t (HGV)<br>– 18 t (HGV)<br>– 26 t (HGV)<br>– 32 t (HGV)<br>– 44 t (HGV – Artic) | |
| **Vehicle ownership** | • SME<br>• Large organisation | Department for Transport (Van Statistics) and Consultant opinion |
| **Sector** | • HGV's (9 sectors)<br>• LGV's (16 sectors) | Special Goods Vehicle Count survey (based in London) for HGV's and SMMT sector distribution for LGV's |
| **Vehicle age** | • New to 23 years old | ANPR data |

## 2.4 Define Options

2.4.1 A list of possible responses to CAZ has been identified which aims to capture a high percentage of the actual responses from the market. The responses/options available to vehicle owners that have been included in the model are shown in **Figure 2-3**.

**Figure 2-3 Freight vehicle owner 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.

2.4.2 Depending on the characteristics of the vehicle owner, some options have been assumed to be unfeasible. The following assumptions based on industry experience of the GM market were made regarding available options:

- Retrofit is not available. In reality, a retrofit option is likely to be available and a feasible option for certain makes of vehicle however the model does not disaggregate vehicles to manufacturer/make level. It can however be used to test the attractiveness of retrofit schemes for indicative purposes.
- Only SMEs are assumed to purchases second hand vehicles. Large organisations are assumed to only purchase brand new vehicles when upgrading.
- Only SMEs are assumed to consider downsizing from a 1.6 ton van to an estate car to avoid the charge.
- The 'Swap or Stop' option is only available to vehicles registered outside of Greater Manchester. Large organisations are assumed to have compliant vehicles in their fleet which can be 'swapped' in place of the non-compliant vehicle for Greater Manchester trips if they are of low frequency. Vehicles of low frequency in GM belonging to SMEs that are based outside of the North West are assumed to 'stop' these trips which will then be absorbed by a compliant vehicle.

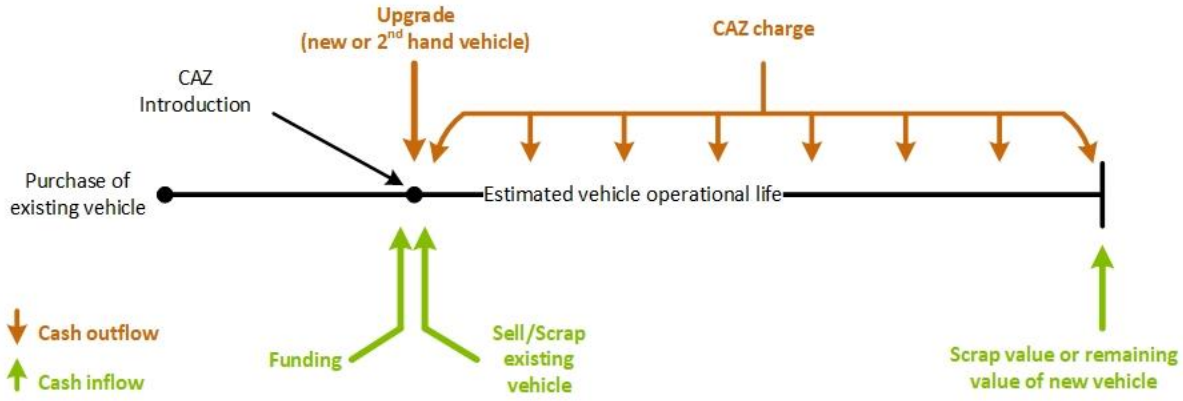
## 2.5 Assess & Allocate Responses

2.5.1 Each market segment was allocated to an option based on which was estimated to be best financially for the vehicle owner. The cost/value of each option was determined using a discounted cash flow model which is illustrated in **Figure 2-4**. The cash flows included in each option are shown in **Table 2-3**.

**Table 2-3 Cash flows included for each option available**

| Option | Sell existing vehicle | Purchase new vehicle | Purchase Retrofit | Funding | CAZ Charge | Remaining vehicle value |
|---|---|---|---|---|---|---|
| Do nothing (pay the charge) | | | | | ✓ | ✓ |
| Upgrade vehicle | ✓ | ✓ | | ✓ | | ✓ |
| Retrofit existing vehicle | | | ✓ | ✓ | | ✓ |

**Figure 2-4 Schedule of cash flows for assessing options**




# 3 Key evidence and assumptions review

3.1.1 This section aims to review the key evidence and assumptions incorporated in the model. It is worth noting that those assumptions are based on the best available knowledge and existing data. A full list of assumptions is provided in the Appendix.

## 3.2 Vehicle data and categorisation

3.2.1 It is important to recognised that different vehicle owners will make different decisions based on multiple factors. A week's worth of data had been collected by ANPR cameras installed in multiple locations in GM, which provides the model with a large sample size and key information such as vehicle ages, types and weights.

3.2.2 All vehicles recorded by the cameras are categorised into groups based on organisation size, commodity sector, vehicle size and vehicle age.

3.2.3 Vans are categorised into different commodity sector based on proportions provided by a recent report[1] issued by The Society of Motor Manufacturers & Traders (SMMT) in 2019. HGVs are categorised into corresponding sectors based on results of Specialised Goods Vehicle Counts (SGVC) conducted by AECOM's freight team in previous studies.

3.2.4 According to the SMMT, vehicles purchased from new tend to be de-fleeted after a certain age from large organisations and the majority of second and third life vehicles are typically operated by SMEs. Therefore, vehicles are further categorised into "SMEs" and "Large Organisations" based on vehicles age profile.

## 3.3 Sector and replacement age

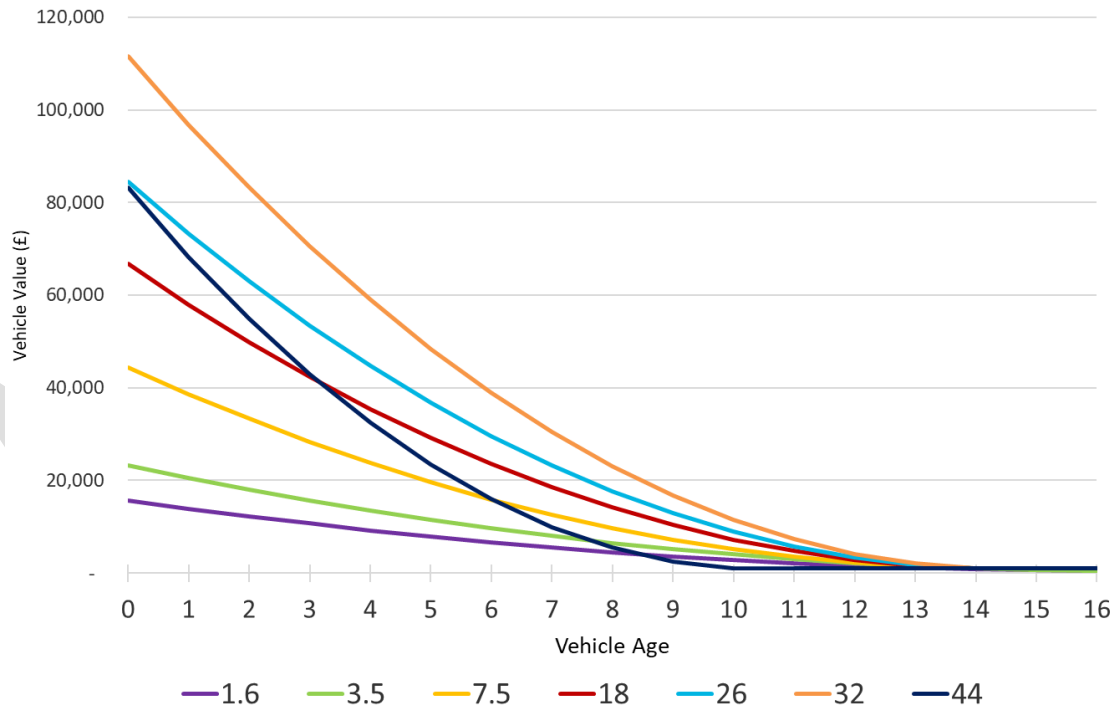
[1] Light Commercial Vehicles Delivering for The UK Economy 2019 report

3.3.1 Based on the commodity sectors, the replacement ages are varied for both vans and HGVs. For example, the construction sector tends to keep vehicles runs vehicles until they are much older than those in the financial sector. The average age at which vehicles are scrapped was estimated from the ANPR data. Sector scrapping ages are based off this market average.

## 3.4 Vehicle Values and depreciation

3.4.1 Vehicle purchasing and remaining values are key parts of the cash-flow cost model. **Figure 3-1** displays the vehicle purchasing values, based on weight categories varying from 1.6t to 44t, acquired from a Cost Table[2] published by Motor Transport in 2018. Depreciated values along vehicle lifetimes are incorporated in the model with a double-declining-balance depreciation method adopted. The depreciation rate shown in the figure represents that vehicle values depreciate considerably during the early stage of usage and gradually become steadier when approaching the end of the vehicle's life. The value of a typical estate car is also incorporated in the model acquired from Auto Trader data.

**Figure 3-1 Freight vehicle values**




## 3.5 Vehicle utilisation (operating days)

3.5.1 It is assumed that vans are operated 5 days a week and 46 weeks per year, however for HGVs it is assumed that the vehicles are operated with a slightly higher intensity. The number of days per year that HGVs are assumed to operates is 253 which is in line with JAQU's recommendation.

[2] https://motortransport.co.uk/wp-content/uploads/2018/12/MT-cost-tables-2018.pdf

# 4 Model limitations

## 4.1 Impacts of market distortion

4.1.1 The vehicle values shown in **Figure 3-1** represent the existing market and do not consider what the implementation of the CAZ will do to vehicle values and costs. It is likely that the value of compliant second-hand vehicles will significantly increase while the value of non-compliant vehicles (i.e. Euro V engines) will decrease. The magnitude of these changes in value will depend on the markets access to the broader national market and the extent and nature of CAZ implementation in other areas around the country.

## 4.2 Consideration of operation costs and revenues (profit margins)

4.2.1 The operational revenue or profit margins of the companies are not considered as part of the model. This is a limitation as it does not allow for more accurate representation of the benefits/costs from downsizing or upsizing options. Consideration of profit margin variances between sectors and organisation sizes would help to put other costs in perspective and inform the attractiveness of each option by segment. Such information was not available however to be robustly implemented in the model.

4.2.2 Despite not including this dimension, the overall approach is fit for purpose and represents a significant improvement in our understanding of the freight market and the likely impact of the CAP.

# 5 Model results

5.1.1 The model has produced a set of responses for a base case scenario (no funding) as well as a funding scenario for CAZ implementation years of 2021 for HGVs and 2023 for LGVs. These results form the basis of the response input to the Demand Sifting Tool. The inputs to the Demand Sifting Tool are shown in brackets where 'Change Mode' refers to when vehicle owners change from a LGV to an Estate Car or from a HGV to an LGV. Upsizing or downsizing with the same vehicle type is categorised as 'Pay Charge'. Charges for LGVs and HGVs are assumed to be £10 and £60 per day respectively. These results may be subject to change as and when the model is further developed and input data and assumptions are strengthened in the build up to the FBC submission.

**Table 5-1 Freight vehicle responses**

| Response | LGV's | HGV's |
|---|---|---|
| Do Nothing (Pay Charge) | 26.5% | 1.9% |
| Purchase - Upgrade (Upgrade) | 51.4% | 73.0% |
| Purchase - Upsize (Pay Charge) | 3.6% | 0.9% |
| Purchase - Downsize (Change Mode) | 4.6% | 0.2% |

| | | |
|---|---|---|
| Swap or Stop (Upgrade) | 13.9% | 24.0% |
| Total | **100.0%** | **100.0%** |

## Appendix – Freight Cost Model Assumptions

| | | | |
|---|---|---|---|
| **Assumption Quality** | **GREEN** | **High Quality** | Reliable assumption, well understood and/or documented; anything up to a validated & recent set of actual data. |
| | **AMBER** | **Mid Quality** | Some evidence to support the assumption; may vary from a source with poor methodology to a good source that is a few years old. |
| | **RED** | **Low Quality** | Little evidence to support the assumption; may vary from an opinion to a limited data source with poor methodology. |

| | | | |
|---|---|---|---|
| **Assumption Impact** | **GREEN** | **Limited Impact** | Marginal assumptions: their changes have no or limited impact on the outputs |
| | **AMBER** | **Medium Impact** | Assumptions with a relevant, even if not critical, impact on the outputs |
| | **RED** | **Critical Impact** | Core assumptions of the analysis; the output would be drastically affected by their change. |

| ID | Area | Description | Source | Quality RAG | Impact RAG | Comments |
|---|---|---|---|---|---|---|
| **Input Data** | | | | | | |
| I1 | Scaling ANPR | The ANPR data is assumed to be a representative mix of vehicle type and ages for the entire area of Greater Manchester in 2019. Additionally, the week-long survey is assumed to be representative of an entire year. | ANPR | **AMBER** | **RED** | |
| I2 | ANPR Frequency | It has been assumed that the ANPR data is representative for the wider GM area regarding the frequency (days per week) with which vehicles be in the charging zone. Regardless of frequency, it has also been assumed that GM registered HGV's will be charged every day of operations, even if it is just to/from the depot to the SRN on their way in/out of GM. | ANPR | **AMBER** | **AMBER** | It is possible that the ANPR data over-estimates the number of low frequency vehicles given that they may be operating in GM full time but have only been captured by the ANPR cameras once during the week-long survey. This assumption impacts the number of vehicles registered outside of GM but assumed to serve GM. |
| I3 | Non-GM registered vehicles | The vehicle frequency and ratio of GM vs Non-GM vehicles from the ANPR data has been used to estimate the number of Non-GM registered vehicles that will be impacted by the charge. | ANPR | **AMBER** | **RED** | |
| I4 | Vehicle growth | It has been assumed that there will be no growth in vehicles serving GM from 2019 onwards. | - | **RED** | **GREEN** | There is likely to be growth in the number of vehicles operating in GM however these are likely to be compliant vehicles and not be impacted by the proposed CAZ charge. |
| I5 | Operational Costs | The only operational costs included in the model are the proposed CAZ charge and vehicle depreciation. It is assumed that the operational revenues and costs for a vehicle owner will remain the same regardless if they keep their non-compliant vehicle, upgrade to a compliant vehicle or any other option. | | **AMBER** | **AMBER** | It is likely that operational costs would reduce to some degree when using a new vehicle compared with an older model however it is rare for a vehicle owner to change from a very old vehicle to a brand new one. Additionally, older vehicles are likely to do less mileage per year and thus |

| ID | Area | Description | Source | Quality RAG | Impact RAG | Comments |
|---|---|---|---|---|---|---|
| | | | | | | improvements in operational costs are less of a factor. |
| **CAZ Implementation** | | | | | | |
| C1 | CAZ Charge | The base case assumptions for CAZ charges is £10 per day for Vans and £60 per day for HGVs. | - | GREEN | RED | |
| C2 | CAZ Charge Introduction | It is assumed that the charge will be implemented on the first day of 2022 for HGVs and the first day of 2023 for Vans under the base case scenario. | - | GREEN | AMBER | Shifting the implementation date earlier or later significantly impacts the supply and demand for second hand compliant vehicles. |
| C3 | Decommissioning | It is assumed that vehicle owners will be under the impression that CAZ will not be decommissioned and that they will have to pay the charge for the entire life of their non-compliant vehicle. | | AMBER | AMBER | |
| C4 | Operational Days | The number of operational days for vehicles assumed to be operating full time in GM is 253 days for HGV's which is in line with the OBC and JAQU assumptions. For LGV's it is 230 (5 days per week, 46 weeks per year) which aligns more closely the number of days the vehicle driver would work. | JAQU and Consultant Opinion | GREEN | AMBER | |
| **Market Assumptions** | | | | | | |
| M1 | Vehicle prices | Vehicle prices used for each vehicle type have been for the most common manufacturer and make in each category according SMMT Vehicle cost tables. The price of a second-hand compliant vehicle is assumed to be equal to the value of vehicles manufactured in the year after Euro 6 engines were introduced. | SMMT | AMBER | RED | Consideration has not been given to any market distortion due to CAZ where second hand compliant vehicle may become far more expensive while non-compliant vehicles may be far less valuable than in the current market. It is however possible to test theories relating to distortion within the model. |

| ID | Area | Description | Source | Quality RAG | Impact RAG | Comments |
|---|---|---|---|---|---|---|
| M2 | Leasing | The option to lease a vehicle has not been included in the model. It is assumed for current leased vehicles that the owner of the leased vehicle will respond based on the vehicle user's needs. | | AMBER | AMBER | |
| M3 | Market Segmentation - Ownership | A relationship between vehicle age and ownership (SME or Large Organisation) has been assumed where the older a vehicle is the more likely it is to be owned by an SME. Variations of this relationship have been iterated in order to match the overall split of SME vs Large statistics from the Department for Transport. It is estimated that just over 50 percent of Vans are owned by SME's while it is the consultant's opinion from previous experience that approximately 80% of HGVs are owned by large organisations. | DfT (2017) and Consultant Opinion/previous work | GREEN | RED | |
| M4 | Retrofitting | The functionality exists in the model to test varying values for Retrofitting however these are not included in the base case. | | AMBER | AMBER | |
| M5 | Cost of Transaction | A cost of transaction is applied to all transactions of £800. This represents a number of factors such as time spent looking for vehicles/customers, collecting/delivering vehicles advertising, quality assurance and registration as well as general risk associated with the transaction etc. | Consultant Opinion | AMBER | GREEN | |
| M6 | Market Sectors | The Market Sectors and the percentage of vehicles allocated to each have been determined by using SMMT classifications (for LGV's) and AECOM SGVC surveys conducted in London (for HGV's). | Consultant Opinion | GREEN | GREEN | |
| **Funding, Loans and Financial Assumptions** | | | | | | |
| F1 | Discount Rate | A discount rate of 3.5% is assumed for all cash flows in the model. This is consistent with the UK's Green Book. | Green Book UK | GREEN | AMBER | |
| F2 | Fund eligibility | Funding can be applied in the model to certain vehicle types or owners in the form of a one-off payment in conjunction with the purchase of a compliant vehicle. Under the base case scenario, no funding is assumed however if there was funding offered, the existing vehicle would be required to be scrapped. | - | GREEN | AMBER | |
| F3 | Inflation | Costs such as vehicle purchasing are inflated at 2% per annum. | - | GREEN | AMBER | |

| ID | Area | Description | Source | Quality RAG | Impact RAG | Comments |
|---|---|---|---|---|---|---|
| F4 | Swap or Stop trips | It is assumed that if a vehicle falls into the 'low' usage category and is not registered in GM, if the vehicle is owned by a large organisation the trip can be completed by a compliant vehicle owned by that organisation. If the vehicle is owned by a small organisation the trip may be cancelled however the trip will then be completed by a different organisation with a compliant vehicle, thus in the view of Greater Manchester is the same as being upgraded. | - | AMBER | AMBER | |
| F5 | Depreciation | The formula used to depreciate is called the Sum of Years which is a non-linear method. Second hand values generated by the depreciation formula have been validated against values identified in the Market Research technical notes. | - | AMBER | AMBER | https://corporatefinanceinstitute.com/resources/knowledge/accounting/types-depreciation-methods/ |
| **Personal preference and non-financial factors** | | | | | | |
| P1 | Trip weighting | The base case results consider all vehicles regardless of how frequently they operate in GM however the model does have the functionality to weight responses toward those operating in GM full time. | | AMBER | GREEN | |