

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

## Note 28: Taxi & PHV Cost Model



Salford City Council



Oldham  
Council

TRAFFORD  
COUNCIL



**Warning:** Printed copies of this document are uncontrolled

<b>Version Status:</b>	APPROVED	<b>Prepared by:</b>	Transport for Greater Manchester on behalf of the 10 Local Authorities of Greater Manchester
<b>Authorised by:</b>	Ian Palmer		
<b>Date:</b>	1 <sup>st</sup> 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.

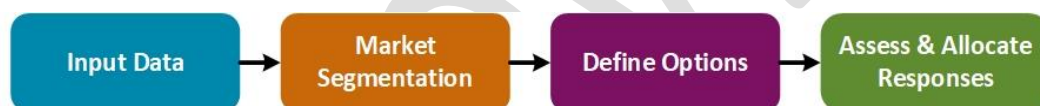
## 1 Introduction

- 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 taxi owners would react to the proposed Clean Air Zone (CAZ) charge. This technical note aims to outline the methodology and key assumptions incorporated in the development of the model. The model itself and the results produced thus far are subject to change as the model is strengthened based on continuing research.

## 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.

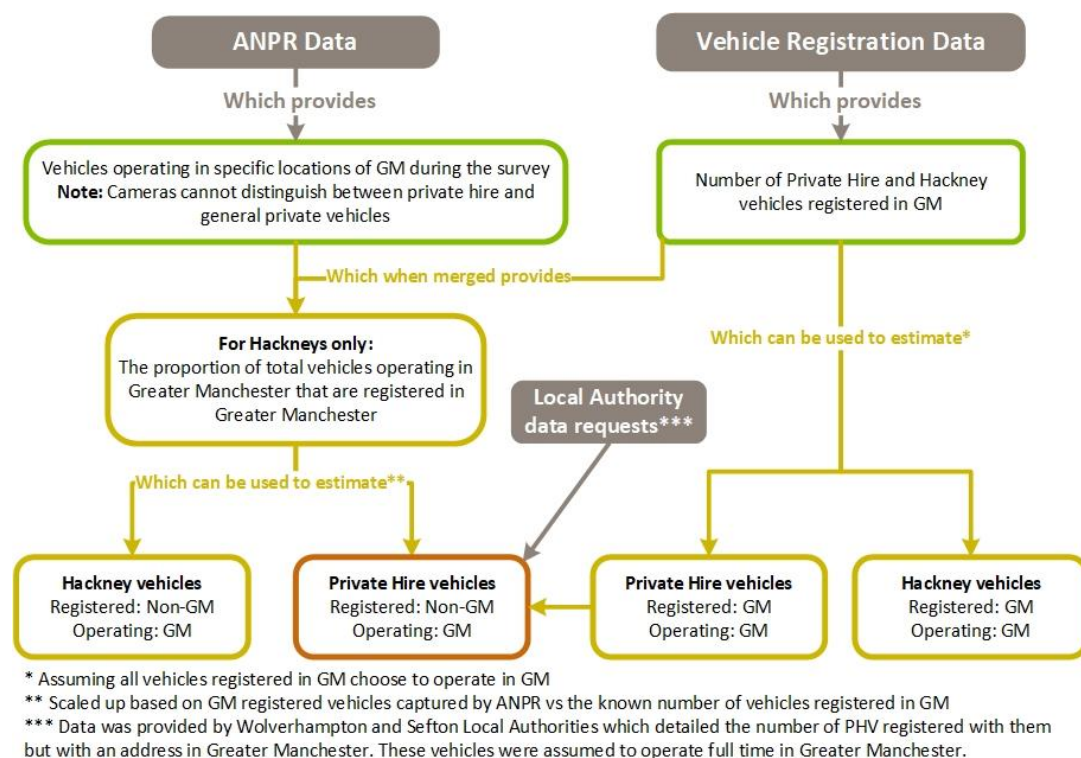
**Figure 2-1 Model methodology**



### 2.2 Input Data

- 2.2.1 The inputs available to the model to determine the number of vehicles that would be impacted by the CAZ (i.e. the number of vehicles operating in Greater Manchester) included a data set captured by ANPR cameras over a one-week survey and vehicle registration lists by Local Authority. Using the assumption that all vehicles registered in Greater Manchester choose to operate in Greater Manchester, the vehicle registration data provides the number of traditional black taxis (Hackneys), 'Non-London' Hackneys (NL Hackneys), i.e. vehicles which operate as Hackneys but are not the traditional TX4 body type and private hire vehicles operating in Greater Manchester that are also registered in Greater Manchester. What remains unknown is the number of vehicles operating in Greater Manchester that are registered elsewhere. **Figure 2-2** outlines how this was estimated. The resulting number of vehicles which are modelled is outlined in **Table 2-1**.

**Figure 2-2 Data input process**



**Table 2-1 Taxi input data in 2021 (Non-compliant)**

	Hackney	Private Hire	Total
GM registered	2,080 (1,629)	12,401 (5,331)	<b>14,481 (6,960)</b>
Registered outside of GM	296 (232)	4,773 (2,052)	<b>5,069 (2,283)</b>
<b>Total</b>	<b>2,376 (1,861)</b>	<b>17,174 (7,382)</b>	<b>19,550 (9,243)</b>

## 2.3 Market segmentation

2.3.1 Segmenting the market allows the model to allocate vehicle owners to different decisions/responses. Generally, the more the market is segmented the more complex it is however too little segmentation treats the entire market as a large group who act homogeneously. 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** along with what source was used.

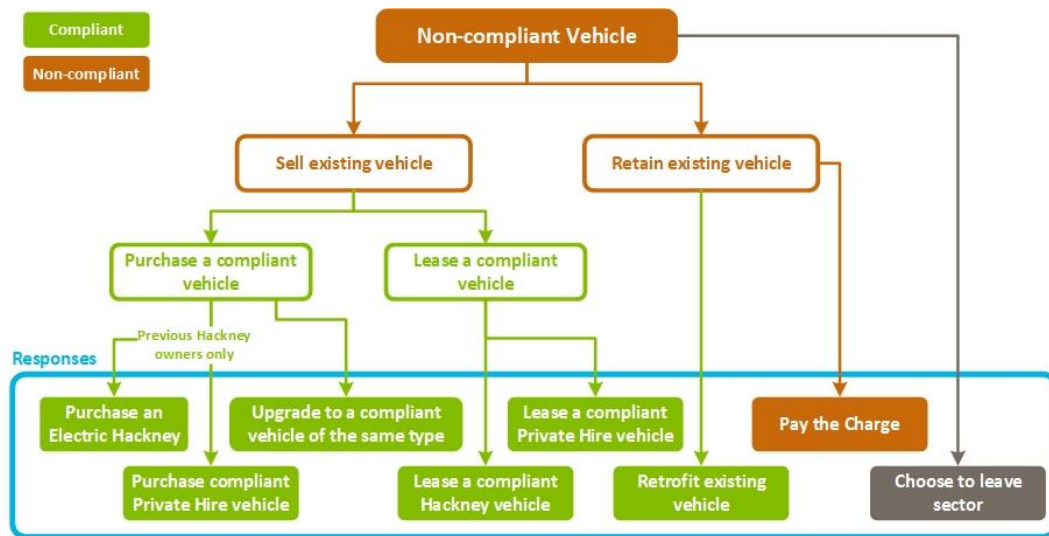
**Table 2-2 Market segmentation**

Characteristics	Segments	Source
<b>Vehicle registration location</b>	<ul style="list-style-type: none"> <li>• Greater Manchester</li> <li>• Non-Greater Manchester</li> </ul>	ANPR data (Hackneys only, Private Hire vehicles registered outside of Greater Manchester were unable to be identified)
<b>Frequency (in GM)</b>	<ul style="list-style-type: none"> <li>• Occasional</li> <li>• Full time</li> </ul>	ANPR data
<b>Vehicle type</b>	<ul style="list-style-type: none"> <li>• Hackney</li> <li>• Private Hire</li> </ul>	Vehicle registration lists
<b>Vehicle ownership</b>	<ul style="list-style-type: none"> <li>• Driver owner</li> <li>• Shared driver owner</li> <li>• Operator owner</li> <li>• Third party operator</li> </ul>	Department for Transport (Taxi and Private Hire vehicle statistics – 2017) and Consultant opinion
<b>Operations (usage)</b>	<ul style="list-style-type: none"> <li>• Low (part time)</li> <li>• Medium</li> <li>• High</li> <li>• Intensive (24/7)</li> </ul>	Department for Transport (Taxi and Private Hire vehicle statistics – 2017)
<b>Vehicle age</b>	<ul style="list-style-type: none"> <li>• New to 23 years old</li> </ul>	Vehicle registration lists

## 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 Options available to vehicle owners**



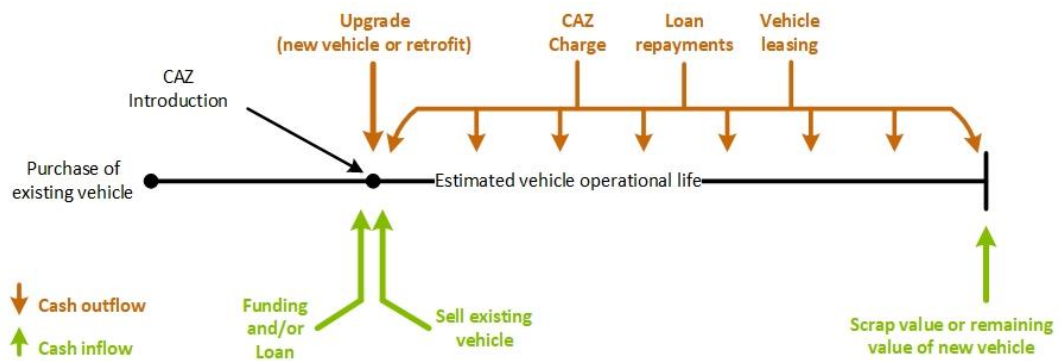
Assess options and allocate market segments

2.4.2 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 (Hackney and Private Hire)**

Option/ Response	Sell existing vehicle	Purchase new vehicle	Purchase Retrofit	Lease compliant vehicle	Funding and/or Loan	CAZ Charge	Remaining vehicle value
Do nothing (pay the charge)						✓	✓
Upgrade vehicle	✓	✓			✓		✓
Retrofit existing vehicle			✓		✓		✓
Lease a compliant vehicle	✓			✓			
Leave sector	All other options are unfeasible due to cost						

**Figure 2-4 Financial analysis of options**

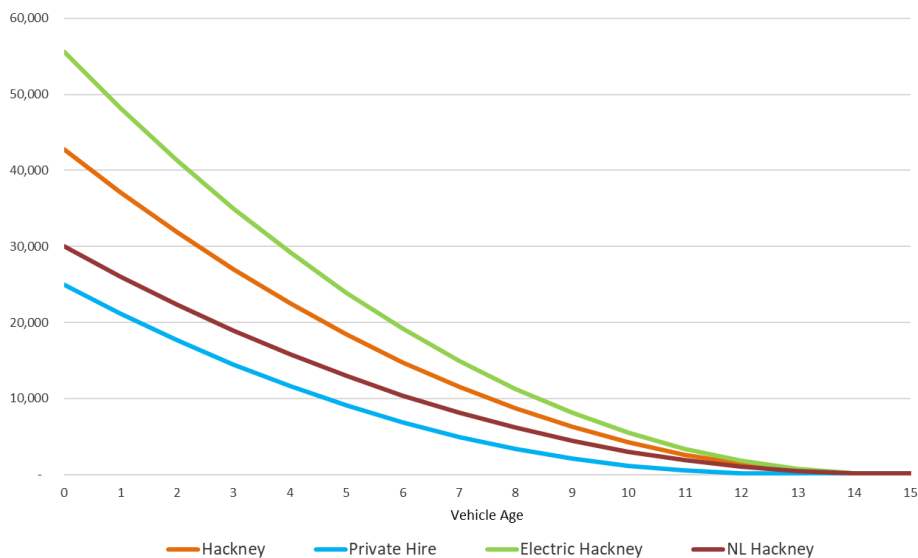


### 3 Key assumptions

#### 3.1 Vehicle prices and depreciation

3.1.1 The assumptions behind vehicle values have been informed by 'Note 19: Taxi and PHV Fleet Research' technical note which conducted research on vehicles cost using CabDirect. The purchase prices were then depreciated using the sum of years depreciation method. This produced a value curve for each vehicle which are shown in **Figure 3-1**. It is assumed that second hand vehicles are approximately four years old and the value produced by the curve has been validated using estimated costs for second hand vehicles in the 'Analysis of Taxi Market' technical note.

**Figure 3-1 Vehicle values**



### 3.2 Preferred responses

- 3.2.1 For options which are estimated to be similar in terms of financial benefit to the vehicle owner (within £5,000), a set of preferences has been assumed with the number of vehicle owners in that segment distributed between all options but weighted towards their assumed preferred options. The preferences allow for some consideration of operational cash flows such as reduced cost of fuel for electric vehicles or high wages for hackney drivers relative to private hire drivers. The preferences follow those shown in **Table 3-1**.

**Table 3-1 Vehicle owner preferences**

Preference	Response
1.	Upgrade vehicle
2.	Do nothing (pay the charge)
3.	Retrofit vehicle
4.	Change to lease

### 3.3 Prohibitions of some responses

- 3.3.1 To more accurately reflect the market and likely responses of different market segments, some options have been prohibited from being selected by certain market segments. Examples of these prohibitions are shown in **Table 3-2**.

**Table 3-2 Prohibitions**

Market segment	Prevented from choosing
All sectors	Switching to other vehicle types (i.e. Hackney to PHV)
Operator or Third-Party Owners	Change to leasing vehicles
Operator or Third-Party Owners	Purchasing second hand vehicles

### 3.4 Electric vehicle fuel cost savings

- 3.4.1 A provision for reduced cost of fuel has been included in the model based on an estimate of £25 per week (for a vehicle operating 12 hours per day, 5 days per week). The annual cost saving is then calculated for each usage category which is shown in **Table 3-3**.



**Table 3-3 Fuel cost saving from electric vehicles**

	Hours per day	Days per week	Weeks per year	Electric discount
<b>Low</b>	4	3	46	£230
<b>Medium</b>	8	5	46	£767
<b>High</b>	12	6	48	£1,440
<b>Intensive</b>	20	7	50	£2,917

#### 4 **Model Limitations**

##### 4.1 Data relating to Private Hire vehicles operating in Greater Manchester but registered elsewhere

4.1.1 The input data for this model is relatively reliable for Hackney vehicles with known registration numbers in Greater Manchester as well as an indication of the number of vehicles operating in Greater Manchester but registered elsewhere due to the ANPR survey. Given that registration of Hackney vehicles in Greater Manchester has no known benefits to registering in other nearby locations, the assumptions that all vehicles registered in Greater Manchester will choose to operate primarily in Greater Manchester is reasonable.

4.1.2 Regarding the data relating to Private Hire vehicles, the number of vehicles registered in Greater Manchester is known and assumed to primarily operate in Greater Manchester, similarly to the Hackney vehicles. However, the ANPR cameras were unable to determine if a vehicle was a Private Hire Vehicle and thus was unable to provide an indication of the proportion of Private Hire vehicles operating in Greater Manchester which are registered elsewhere. Although this may not impact estimates relating to funding given only those vehicles registered in Greater Manchester will be eligible, it will impact on the estimated number of vehicle owners which will upgrade their vehicle and thus the changes to air quality resulting from the implementation of CAZ.

4.1.3 To estimate the number of Private Hire Vehicles registered outside of Greater Manchester, inquiries were made to Wolverhampton and Sefton local councils as it is known that these councils receive a disproportionate number of private hire registration applications. These councils were able to provide data relating to the number of registrations which had a listed address in Greater Manchester. These vehicles were assumed to operating in Greater Manchester and were included in the modelling.

4.1.4 Wolverhampton and Sefton are not the only councils where such registration issues arise and therefore it is possible that the total number of PHVs operating in GM could be underestimated. Similarly, therefore the improvements as a consequence of the CAP could be underestimated.

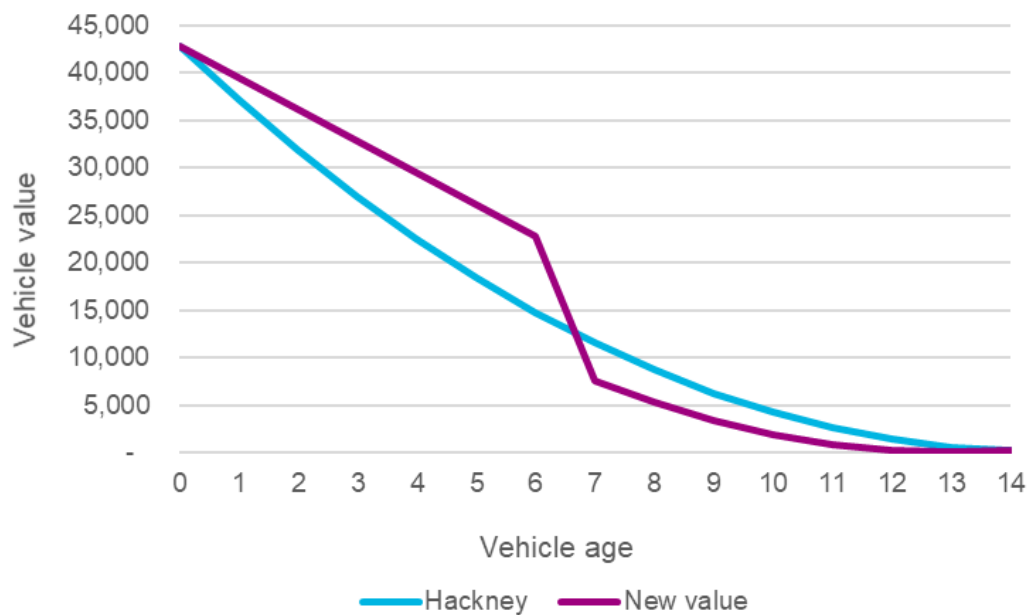
#### 4.2 Data relating to vehicle ownerships and operations

4.2.1 Currently, the model distributes vehicles to ownership types based on the vehicle's age which is then validated against survey results published in 'The Conversation' relating to fleet sizes. It is our opinion that, as vehicles become older, they are more likely to be owned by drivers or under a Shared Driver owner scheme rather than by an operator or large third party. There is very limited data relating to the distribution of how intensively vehicles are used which is likely to affect the tendency of the owner to choose a particular response.

#### 4.3 Impacts of market distortion

4.3.1 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. **Figure 4-1** illustrates what could happen to the market once CAZ is introduced in the scenario where majority of vehicle owners do not have access to wider market (i.e. other UK cities implement a similar CAZ scheme meaning that supply of second-hand compliant vehicles is restricted while demand for non-compliant vehicles reduces). This figure also assumes that all vehicles less than six years old at the introduction of CAZ will be compliant while all vehicles older than six will be non-compliant which is not entirely correct. As shown, the price for second hand compliant vehicles could increase by as much as 30 percent or around £10,000. This would make it significantly more difficult for non-compliant vehicle owners to achieve compliancy, particularly in the absence of a retrofit option.

**Figure 4-1 Indicative market distortion of vehicle values due to CAZ**



#### 4.4 Variations in operational revenue/profit between segments

4.4.1 The operational revenue or profit margins of the vehicle owners are not considered as part of the cost model. This includes between Hackney and Private Hire vehicles as well as different ownership types. This could be a limitation as an operator that owns a fleet of vehicles who operates and earns revenue from each vehicle 24 hours per day can spread the cost of the charge more easily than a driver owner that works shifts which may mean the operator owner is less likely to upgrade their vehicles. Additionally, any potential reduction in revenue for operating a Private Hire vehicle when compared to a Hackney is not considered however the reduced cost of owning a Private Hire vehicle compared to a Hackney is included, this may skew results in favour of owning a Private Hire vehicle.

#### 4.5 Social and cultural factors

4.5.1 When analysing inputs such as funding grants or the availability of loans to vehicle owners, the model does not consider any non-financial factors when estimating the take up of these options. It is possible that social or cultural factors present in the vehicle ownership market will impact on the likelihood of vehicle owners to accept grants or loans or any other conditions currently assumed in the model.

#### 4.6 Vehicle market segmentation for Non-London Style Hackney and Private Hire vehicles

4.6.1 There a broad number of vehicle manufacturers and makes which can be licensed as a Hackney, depending on the local council, or a Private Hire Vehicle. Those vehicles which hold a 'Hackney' licence but are not traditional 'London' style Hackney Caps are considered Non-London Hackney vehicles in the model. Given the range of differing vehicles and thus vehicle values in the Non-London Hackney and Private Hire Vehicle markets, prospective vehicle owners may be able to purchase cheaper vehicles than modelled or may prefer to purchase more expensive vehicles than modelled. The vehicle which was most common to both markets was used as the benchmark in the model.

#### 4.7 Electric vehicle infrastructure

4.7.1 The uptake of electric vehicles has only been considered in the model from a cost perspective. What is not considered is the level of infrastructure to be provided and if it will be considered adequate for prospective electric vehicle owners. The assumption in the model is that a lack of infrastructure will not be a barrier to electric vehicle uptake.

### 5 **Model opportunities**

#### 5.1 Minimum Licensing Standards (MLS)

5.1.1 The model includes functionality to implement MLS at the same time as the CAZ to assess likely responses under these conditions. Under MLS conditions, the 'Do nothing' response is restricted to owners of vehicles less than 10 years old only. The purchase of second-hand vehicles remains an option as they are assumed to be less than five years old and thus are able to be registered.

#### 5.2 Sensitivity testing

5.2.1 In any model there are many assumptions which are informed by sources or data of varying quality and reliability. These assumptions are often set to the 'most likely' case which provides a set of outputs that can be considered the base case. There are a number of assumptions in this model which can be varied slightly to assess the impact on the outputs including:

- Charging amounts and terms (which can also be varied between Hackney's and Private Hires);
- Availability of Funding and thus total funding pool required;
- Availability of Loans and variance in loan terms;
- Second hand compliant vehicle prices;
- The cost at which vehicle owners would be happy to accept to choose their desired response;

- The cost at which vehicles owners would be forced out of the market (initial – due to liquidity issues - or long term);
- Cost of leasing vehicles; and
- Transaction costs.

### 5.3 Analysis of impacts on specific market segments

- 5.3.1 Model outputs can be disaggregated to assess particular market segments which are likely to respond in a certain way. This could indicate which market segments are financial impacted the most by the introduction of CAZ.

## 6 **Model results**

- 6.1 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 and 2023. These results form the basis of the response input to the Demand Sifting Tool after consideration has been given to exemptions for wheelchair accessible vehicles (WAVs). The results for the scenario where CAZ is implemented in 2021 and vehicle owners are not provided funding is shown in **Table 6-1**. These results are subject to change as and when the inputs and assumptions to the model are updated based on continuing research.

**Table 6-1 Taxi responses (CAZ implemented in 2021)**

Decision	Hackney	NL Hackney	Private Hire
Do Nothing (non-compliant that choose to pay)	26.5%	17.6%	12.1%
Purchase – Upgrade	34.7%	61.1%	30.7%
Purchase – Retrofit	12.8%	0.0%	0.0%
Purchase Electric Hackney	26.0%	17.9%	38.9%
Change to Lease	0.0%	2.9%	4.0%
Change to Lease (Electric)	0.0%	0.0%	10.1%
Leave Sector	0.0%	0.5%	4.3%