

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

Note 10: GM CAP: Updating Behavioural Responses for Taxis



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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.

This note contains early work on revised behavioural response estimates which is superseded by later work – see Note 37 and Report T4 for the latest assumptions.

1 Introduction

1.1 This Technical Note provides details of updates to the behavioural responses for Taxis (private hire vehicles (PHVs) and Hackney Cabs) applied within the Demand Sifting Tool (DST) for the Greater Manchester Clean Air Plan (GM-CAP) since the Outline Business Case (OBC) submission. Note that the DST was initially created to inform the early 'sifting' of options and has subsequently been developed into a demand model tool to allow forecasting and appraisal.

1.2 The purpose of this note is to:

- Provide a summary of the behavioural responses applied at OBC stage;
- Discuss revised behavioural responses based on newly available information;
- Explain recent updates to the DST capturing revised behavioural responses and resultant changes in compliance levels; and
- Report ongoing assessments to further refine taxi assumptions to take account of emerging information.

Background to OBC Behavioural Assumptions

1.3 The OBC assumed that 100% of Hackney Cabs would become compliant, in the absence of evidence for potential behavioural responses of Hackney Cab drivers and operators. For PHVs, behavioural response assumptions were derived from Bristol-based Stated Preference Surveys, adjusted to the Greater Manchester (GM) scheme. A summary of the OBC behavioural responses for taxis is shown in **Table 0-1** .

Table 0-1 Background to OBC Behavioural Assumptions

Modelled Response	Private Hire Response	Hackney Cab Response
Pay Charge	30.2%	n/a
Change Mode	0.0%	n/a
Cancel Trip	0.0%	n/a
Upgrade	69.8%	100%

Source: Bristol Behavioural Responses adjusted to GM, includes taxi fund adjustments

Updated Behavioural Responses (July 2019)

1.4 Since the completion of the OBC, a review of behavioural responses was undertaken in May/June 2019 to take account of additional available information and to derive a method for identifying evidence-based behavioural response assumptions for Hackney Cabs. The review included consideration of behavioural responses from a recent Sheffield study. Details of this review were discussed in the Technical Note – GM-CAP: Behavioural Response Assumptions, which was provided to JAQU on 20/05/2019.

1.5 Sheffield Responses

1.5.1 The Sheffield based behavioural responses for taxis are shown in **Table 0-1** and the various charging levels considered by that study.

Table 0-1 Summary of Sheffield Behavioural Responses for Taxis

Scenario	Use same vehicle & pay the charge	Convert vehicle to run on LPG	Change to petrol-based vehicle	Change to Euro 6 diesel vehicle	Change to electric vehicle	Work/drive to different town/city	Leave trade/retire
GM Equivalent Response	(Pay Charge)	Upgrade			Cancel Trip		
PHV							
£5	16%	0%	16%	14%	35%	14%	5%
£10	5%	0%	12%	12%	45%	19%	7%
£10+Sub	0%	0%	11%	13%	45%	21%	11%
£20	3%	0%	13%	8%	39%	21%	16%
Hackney Cab							
£5	27%	11%	0%	29%	18%	7%	9%
£10	16%	12%	0%	30%	19%	7%	16%
£10+Sub	18%	9%	0%	27%	20%	7%	18%
£20	15%	15%	0%	23%	17%	9%	21%

Source: Sheffield Behavioural Responses Survey

1.5.2 The values above have been adjusted, by interpolation, to reflect the proposed GM charge of £7.50.

1.5.3 It is noted that the responses observed in Sheffield included an option to upgrade to an electric vehicle in response to the CAZ. Currently, in GM, this response is captured within the regular upgrade response, though it should be noted that an electric vehicle upgrade would have a different impact on emissions than simply upgrading to a compliant vehicle.

- 1.5.4 The Sheffield study has potential to better inform GM CAP than the use of the previous Bristol data with respect to taxis. The key reasons for this include:
- Sheffield related responses are likely to be more relevant in representing the diversity of income within the GM area due to the larger sample, providing the opportunity to better capture distinct minorities;
 - The Sheffield survey demonstrated distinct responses for trips with a frequency of less than once per month. Therefore the data period must be at least a month. This long period of data gathering is required in order to give a fair understanding of low-frequency trips; and
 - The range of charges considered in the GM and Bristol CAP research was varied, the Sheffield survey only assessed responses relating to £5, £10 and £20 charges for all vehicles. However, extrapolation from these data points can still provide a reasonable response model for taxis.
- 1.5.5 More robust results could be obtained using surveys and evidence gathering to be undertaken in GM directly and this will be considered prior to FBC.
- 1.6 Revised Responses (July 2019)
- 1.6.1 The OBC version of the DST allowed a range of responses for PHVs; all Hackney Cabs were assumed to upgrade.
- 1.6.2 Additional functionality was therefore required in the DST to allow modelling of the Sheffield based responses. The behavioural responses applied within the DST to reflect the inclusion of Sheffield data are shown in **Table 0-2**.
- 1.6.3 The Sheffield survey included several responses that equate to the cancelling of trips; relating to taxis operating outside the area (or leaving the trade) which may be considered more likely in the Sheffield context of a relatively small CAZ area, where drivers/operators could choose to work elsewhere from their home.
- 1.6.4 Given the size of the GM CAZ boundary, the likelihood of operating in a different town is very small. This is because most drivers will be resident within the CAZ and would therefore have to comply or pay to drive to an alternative destination anyway. Furthermore, demand for taxi travel is derived from the passenger rather than the driver; although individual drivers may choose to leave the trade, a significant change in the demand for taxi travel is not considered plausible. An assessment of the potential impact of the GM CAP on livelihoods will be undertaken in the economic appraisal and impacts assessments.
- 1.6.5 As a result, two tests were undertaken with the DST:
- DS1 – responses directly as per Sheffield; and
 - DS2 – cancel trip option removed and other options rebalanced.

Table 0-2 Updated Behavioural Response

Modelled Response	Private Hire Response	Hackney Cab Response	[DS1] Weighted Taxi Response	[DS2] Weighted Taxi Response (no cancel trip)
Pay Charge	9%	21%	18%	22%
Change Mode	0%	0%	0%	0%
Cancel Trip	23%	19%	20%	0%
Upgrade	68%	60%	62%	78%

Source: Sheffield Behavioural Responses applied directly, with weighting applied. Note excludes impacts of funds

1.7 Impact on Compliance

1.7.1 The DST was run with the updated responses as detailed in **Table 0-2**; the results are shown in **Table 0-3**. The inclusion of the Sheffield responses directly (DS1) does have a notable impact on the level of compliance identified. It is therefore important to note the following:

- Including the cancel trip response results in an overall reduction to the level of taxi journeys within GM, implying taxis operating in a different location (outside GM) or leaving the trade altogether. As discussed above, this is not considered plausible given the regional scale of the scheme and therefore test DS2 is considered more credible;
- As the 100% upgrade to Hackney Cabs has been replaced with a behavioural response, the overall level of non-compliant vehicles is slightly higher than in the OBC but the vast majority are compliant, as previously; and
- It should be noted that test DS2 is considered worst case, as it is possible that the imposition of minimum standards for taxis across GM (a potential policy currently under review) would further reduce the number of non-compliant vehicles, by ensuring the GM registered fleet align with particular standards including those impacting on emissions (this assumption is being reviewed to support the FBC submission). These tests take account of the impact of the CAZ-only, and do not consider the potential benefits offered by other proposals in the GM CAP affecting taxis.

Table 0-3 Impact on Compliance – 2023 Option 8

Scenario	Do Minimum	OBC (March 2019)	[DS1] Sheffield Responses	[DS2] Response (no cancel trip response)
AM Peak				
Compliant	19,767	24,801	24,059	24,475
Non-Compliant	5,297	264	470	589
Total	25,064	25,065	24,529	25,064
Interpeak				
Compliant	16,389	20,566	19,905	20,267
Non-Compliant	4,392	214	410	513
Total	20,781	20,780	20,315	20,780
PM Peak				
Compliant	20,218	25,376	24,525	24,985
Non-Compliant	5,418	261	520	652
Total	25,636	25,637	25,045	25,636

Source: Demand Sifting Tool – Trip volumes by compliance type

Further Ongoing Refinement of Behavioural Responses

1.8 The preceding sections contain details on the recent potential updates to the treatment of taxis within the DST up to July 2019. Since then there have been a number of additional enhancements to the treatment of taxis within the overall modelling process which are currently ongoing and will allow for additional improvements for the FBC submission. These relate specifically to an enhanced understanding of the vehicle fleet and the nature of taxi operations. These updates are discussed further below.

1.9 Updated Fleet Information

1.9.1 Since the completion of the OBC, additional taxi data has been gathered. This provides a more thorough understanding of the taxi market and a comprehensive method for estimating the impacts of taxi minimum standards. The information includes:

- Confirmation of the GM registered fleet for PHV and Hackney Cab with data provided for each local authority area within GM;
- FOI requests for other known authorities where out of area licencing is suspected for taxis operating within GM;

- Latest ANPR survey, providing an understanding of taxi movements within the wider vehicle fleet, and also including the matching of plates against the GM fleet to understand trip frequency; and
- Ability to split the taxi fleet, GM / Non-GM / visitors – This allowed separate responses for GM, visitors and non-GM registered taxis operating in GM.

1.9.2 Furthermore, a public “conversation” was undertaken which closed on the 30th June. Analysis of this data was used to inform our understanding of possible behavioural responses.

1.10 Taxi Cost Model

1.10.1 Further work was undertaken alongside the taxi fund project to improve the understanding of the taxi behavioural response, including the impact on taxi costs. This included the development of a cost model.

1.10.2 The cost model reflects the nature of the existing PHV and Hackney Cab fleet and considers in detail the impact on costs of different charge and fund combinations.

1.10.3 The approach is similar to that already being developed for the LGV and HGV markets to support the progression to the FBC submission.

Updated Behavioural Responses (October 2019)

1.11 Revised Responses

1.11.1 Following the behavioural response results published in July 2019, the taxi cost model has been developed and refined in order to provide a greater understanding of the possible driver behaviours. This section provides updates to the outputs following these refinements.

1.11.2 The refinements to the models include a CAZ plus funds response. This entails exploring the behavioural changes as a result of funding made available for upgrading vehicles on top of the original CAZ only charge. It is expected this additional factor is likely to alter the compliance rate due to the financial assistance to upgrade to a compliant vehicle.

1.11.3 Error! Not a valid bookmark self-reference. below shows the updated behavioural responses for the CAZ-only result.

Table 0-1 CAZ-only Updated Behavioural Responses - Hackney/PHV

Hackney Carriage			
Modelled Response	2021 ¹	2023	2025
Pay Charge	22.4%	26.4%	32.8%
Change Mode	0.0%	0.0%	0.0%
Cancel Trip	0.3%	0.0%	0.0%
Upgrade: Purchase - Upgrade	46.9%	38.3%	12.8%
Upgrade: Purchase - Retrofit	6.9%	6.1%	4.0%
Upgrade: Purchase Electric Hackney	22.3%	22.5%	21.3%
Upgrade: Change to Lease (Hackney)	1.3%	5.8%	15.8%
Upgrade: Change to Lease (Elec Hackney)	0.0%	0.8%	13.4%
Total Upgrade	77.3%	73.6%	67.2%
PHV			
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: Purchase - Upgrade	30.7%	25.3%	18.9%
Upgrade: Purchase Electric	38.9%	39.9%	40.9%
Upgrade: Change to Lease (Elec)	10.1%	7.2%	5.7%
Upgrade: Change to Lease (Private Hire)	4.0%	10.8%	15.6%
Total Upgrade	83.6%	83.3%	81.1%

Source: Cost Model

1.11.4 For 2021 CAZ plus funds, the funding available for upgrades is as follows:

- Zero Emission WAV Hackney - £10,000 ZEC

¹ Note: within the modelling all hackneys are assumed to be Wheelchair Accessible Vehicles (WAV) and so are assumed to be exempt until 2023

- Electric vehicles available to NL Hackney - £66,500
- Retrofit - £5,000
- Compliant non-WAV Hackney – £2,000
- Zero Emission non-WAV Hackney - £4,000

1.11.5 **Table 0-2** below provides the findings from the CAZ plus funds model run.

Table 0-2 CAZ + Updated Behavioural Responses - Hackneys/PHV

TAXI			
Modelled Response	2021	2023	2025
Pay Charge	As CAZ	25.7%	27.6%
Change Mode	As CAZ	0.0%	0.0%
Cancel Trip	As CAZ	0.0%	0.0%
Purchase - Upgrade	As CAZ	26.2%	11.7%
Purchase - Retrofit	As CAZ	13.5%	7.4%
Purchase Electric Hackney	As CAZ	30.1%	30.0%
Change to Lease (Hackney)	As CAZ	4.4%	14.9%
Change to Lease (Elec Hackney)	As CAZ	0.2%	8.3%
Total Upgrade	As CAZ	74.3%	72.4%
PHV			
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%
Purchase - Upgrade	34.6%	30.3%	31.2%
Purchase Electric	36.7%	36.8%	33%
Change to Lease (Elec)	9.6%	5.9%	3.1%
Change to Lease (Private Hire)	3.4%	10.8%	15%
Total Upgrade	84.3%	83.8%	82.3%

Source: Cost Model

1.12 Impact on Compliance

- 1.12.1 The DST was run with the updated responses to determine the impacts on compliance. The results are shown in Table 0-3, Table 0-4 and Source: Demand Sifting Tool
- 1.12.2 Table 0-5. The inclusion of CAZ plus funds shows compliance improvements across all three years. It should be noted that results are considered worst case, as it is likely that the imposition of minimum standards for taxis across GM (a potential policy currently under review) would further reduce the number of non-compliant vehicles, by ensuring the GM registered fleet align with particular standards including those impacting on emissions (this is an assumption being reviewed to support the FBC submission).
- 1.12.3 Hackneys and PHVs have been combined to provide a total compliant figure. The tables below show that there are minor increases in the CAZ plus funds compliant rates when compared to CAZ-only across all years.

Table 0-3 Impact on Compliance – 2021

Scenario	Do Minimum	CAZ-only	CAZ plus funds
AM Peak			
Compliant	14,764	21,776	21,834
Non-Compliant	10,050	3,038	2,979
Total	24,814	24,814	24,814
Interpeak			
Compliant	12,214	18,015	18,064
Non-Compliant	8,314	2,513	2,465
Total	20,528	20,528	20,528
PM Peak			
Compliant	15,093	22,260	22,320
Non-Compliant	10,273	3,106	3,046
Total	25,366	25,366	25,366

Source: Demand Sifting Tool

Table 0-4 Impact on Compliance – 2023

Scenario	Do Minimum	CAZ-only	CAZ plus funds
AM Peak			
Compliant	19,826	24,070	24,095
Non-Compliant	5,238	994	969

Total	25,064	25,064	25,064
Interpeak			
Compliant	16,438	19,955	19,976
Non-Compliant	4,343	826	805
Total	20,781	20,781	20,781
PM Peak			
Compliant	20,278	24,617	24,643
Non-Compliant	5,358	1,019	993
Total	25,636	25,636	25,636

Source: Demand Sifting Tool

Table 0-5 Impact on Compliance – 2025

Scenario	Do Minimum	CAZ-only	CAZ plus funds
AM Peak			
Compliant	23,365	24,955	25,001
Non-Compliant	2,059	470	424
Total	25,425	25,425	25,425
Interpeak			
Compliant	19,396	20,714	20,753
Non-Compliant	1,710	391	353
Total	21,105	21,105	21,105
PM Peak			
Compliant	23,864	25,486	25,534
Non-Compliant	2,103	481	434
Total	25,967	25,967	25,967

Source: Demand Sifting Tool

2 Conclusion

2.1.1 The inclusion of updated behavioural responses, based on the updated and refined cost model, for hackneys and PHVs has been applied to the DST. The key changes included:

- The OBC assumption was that 100% of hackney cabs upgrade. This has now been replaced by a behavioural response for hackney cabs, based on the cost model;

- Previous behavioural responses (based on Bristol SP) have been updated to reflect new more relevant data from the cost model; and
- The inclusion of the cost model for taxis has provided a more robust method for capturing the impacts of the funds and may also be of use for further refinements to the behavioural responses due to the CAZ.

2.1.2 Due to their complexity, there is still ongoing work relating to the behavioural assumptions for taxis which have not yet been fully incorporated into the modelling process. These include:

- Capturing the Taxi Minimum Licensing Standards for GM, currently under development. Depending on the outcome of consultation, it is possible that the application of Minimum Licensing Standards to the GM taxi fleet would further improve the level of compliant vehicles;
- The upgrade response to an electric vehicle is merged within the response to upgrade to a compliant vehicle. As upgrade to an electric vehicle may have much greater impact on air quality than simply upgrading to compliant, this is currently captured within the EMIGMA model where the air quality impacts of these journeys are isolated but there may be specific issues with regard to this upgrade choice that could merit further investigation.

2.1.3 Evidence from recent interviews with taxi operators and other research on the operating costs for taxis will be used to inform the development of sensitivity tests and potential further refinements to the cost model. This will provide a better understanding of how the taxi market operates and potentially result in refinements to the behavioural responses discussed above.