Leicester City Council

Leicester and Leicestershire: Ultra-Low Emission Taxi

Feasibility Study • Final Report • February 2016

This report has been commissioned by Leicester City Council and prepared on behalf of the Leicestershire group of authorities by of Low Emission Strategies Ltd and of Mint Green Sustainability.

The photo of the TX5 prototype ULEV taxi on the front cover is courtesy of The London Taxi Company, Holyhead Road, Coventry CV5 8JJ

Executive Summary

We Are Proposing Radical Changes

This Feasibility Study, covering the City of Leicester and Leicestershire, has been prepared with the support of Low Emission Strategies Ltd. The Study provides evidence to show that working with taxi drivers and operators there is a strong case for the uptake of ultra-low emission vehicles (ULEVs) in the city, but not in the more rural areas. We intend to take radical steps in Leicester to support the progressive uptake of ULEV taxis. This will specifically include:

- Changing the Hackney Cab Licencing policy to require all new vehicle licences granted from 2017 to meet ULEV specification, i.e. carbon dioxide (CO_2) emissions below 75g/km.
- The City Council directly purchasing at least twenty ULEV Hackney Cabs in 2017 to lease to Hackney drivers, to accelerate the adoption of ULEV taxis.

Summary of Proposals

This study provides a clear pathway for converting diesel taxis to ULEVs in Leicester and Leicestershire. In doing so, this study meets impact, deliverability and value for money objectives set in the Office for Low Emission Vehicles Ultra Low Emission Taxi Programme. Study findings indicate that the following could be achieved by the end of 2020:

- 285 ULEV Hackney Cabs on Leicester's roads - costing £2.3 million
- 13 dedicated Hackney Cab fast 22kW chargers – costing £57,000
- 414 ULEV Private Hire Vehicles on Leicester's roads
- 22 fast 22kW chargers for private hire driver – costing £96,580

This will mean:

- 3,308t of Carbon Dioxide savings over and above EURO6 vehicles
- 13t Oxides of Nitrogen savings over and above EURO6 vehicles

Key Study Findings

Through extensive consultation involving online questionnaires and interviews with drivers, analysis of licencing data on over 2,500 vehicles and detailed technical assessment the key findings of the study are:

1. Both Hackney Carriages and Private Hire Vehicles in the city of Leicester have an operational profile that suits ULEV capabilities. Also, for both types of taxi, running cost and total cost of ownership are substantially lower for a ULEV than a comparable conventional vehicle. It is essential to inform and persuade drivers that ULEVs are the way forward through:
    - inspection and vehicle test drives
    - clear information on whole life costs
    - easy access to obtain the vehicles (availability, leasing or finance deals)
    - confidence in the vehicle charging infrastructure.

2. There is not a compelling financial case for the majority of taxis, both Hackney Carriages (HC) and Private Hire vehicles (PHV), in the districts around Leicester to switch to ULEVs. This is due to the higher mileages covered per day and the lower efficiency gains of hybrid systems outside urban areas. The study recommends a more targeted approach to ULEV introduction in the districts, focussing on private hire operators who purchase their vehicles, in order to get initial uptake. It is

expected that the future financial case will become clearer as a wider range of ULEVs become available and at lower cost.

3. We expect a proposed change in Licencing Policy in Leicester, from 1st January 2017, will result in 100% of hackney cabs being ULEV by 2025. Throughout this study we have used the examples of the Metrocab hybrid and Nissan Evalia electric vehicle which are expected to be available by the end of 2016. It is expected the London Taxi International will also be available in 2018.

4. Most drivers in Leicester have long enough stops during the day to "opportunity charge" using a 22kW fast charger, rather than needing the speed of a 43kW rapid charger. Availability of charge points is likely to be a more important factor than speed of charging. As providing a given capacity of rapid chargers is twice the cost of the same capacity in 22kW fast chargers, the study suggests a mix of mostly fast chargers at most locations with rapid chargers targeted at locations where physical space is limited.

5. A large proportion of the black cab fleet is due for replacement in the next 5 years. Therefore any measures to influence purchase of replacement vehicles need to be introduced quickly, and it may be expedient in the long run to allow some vehicles to be kept on the road a little longer in the short term, to increase the likelihood that they will be replaced with a ULEV.

6. Hackney cab drivers' main source of information is talking to other drivers. Therefore, word of mouth will be vitally important in persuading drivers to purchase a ULEV taxi. Providing ULEV taxis that drivers can test drive for a week or fortnight at a time is likely to be an effective strategy to generate direct word-of-mouth recommendations for these vehicles.

Improving Air Quality

Leicester City Council adopted its Air Quality Action Plan (2015 – 2026) in November 2015. The plan aims to reduce transport related air pollution in the city, especially Nitrogen Dioxide, to a level below the EU Limit Value as soon as possible. The plan includes provision to introduce a Low Emission Zone for buses and taxis in Leicester City Centre by the end of 2017, and an Ultra-Low Emission Zone (ULEZ) that includes cars, vans and lorries by 2026. The introduction of ULEVs into the taxi and private hire fleets is one of the key actions in the plan.

It is estimated transport related air pollution in Leicester causes over 162 premature deaths per year, and costs the city some £7.2 million per year to families, businesses and the Leicester economy as a whole. The areas where pollution levels exceed health based objectives includes some of the most deprived areas of Leicester.

Modelled road transport emissions in Leicester indicate that taxis are responsible for 6% of Oxides of Nitrogen (NOx) emissions and 3% of CO_2e[1] emissions within the city. In terms of NOx this is equal to three quarters of the emissions from all petrol cars in the city and about a sixth of the emissions from diesel cars.

[1] The 'e' in CO_2e stands for 'equivalent'. CO_2e is a measure of the combined global warming potential of nitrous oxide (N_2O), methane (CH_4) and carbon dioxide (CO_2), with N_2O and CH_4 included as an amount of CO_2 with an equivalent global warming potential.

Contents

Figures and tables:

1 Introduction

1.1 Study content and objectives

This study provides a clear evidence base for Leicester City Council's plans to increase the uptake of Ultra Low Emission Vehicles in the taxi fleet of the city and surrounding districts. It follows a logical sequence from understanding the context, through modelling uptake of vehicles, to considering impacts and implementation.

In carrying out the study, the study team have conducted primary research with taxi drivers and operators. An online questionnaire was filled in by 83 drivers, and interviews were carried out with a further 31 drivers and 6 taxi firm operators. This primary research was used to assess not just the details of taxi operations and the vehicles in use, but also the key drivers in vehicle purchasing behaviour and the way in which the drivers accessed information when buying a new vehicle.

As this study was completed in December 2015, before the revised OLEV content guidance was issued on 15th January 2016, the content differs to some extent from those studies carried out by the Energy Savings Trust. The original layout of the study has been revised as far as possible to mirror the EST studies, and the table below summarises the differences for ease of reference.

TABLE 1: CONTENT OF SECTIONS COMPARED TO EST FEASIBILITY STUDIES

Section of this study	Equivalent section(s) in EST studies
1. Introduction – Background on the study area, air quality issues, and other related initiatives. Detail on the make-up of the taxi fleet, its age profile and emissions standards.	Section (1), introduction, although EST studies do not cover related initiatives and emission standards are covered in section (2)
2. Taxi operations – Detail on the taxi operations based on the results of driver surveys, covering both HCs and PHVs. Also provides detailed information on drivers' vehicle purchasing behaviour.	Sections (2) and (3), which are different for the EST study as different data collection methods used for each, whereas this study surveyed all drivers. Also the EST studies do not include information on drivers' vehicle purchasing behaviour.
3. Regulation and incentives driving uptake – licensing requirements, plus bespoke analysis of total cost of ownership of ULEVs vs conventional taxis, driver attitudes, issues relating to overnight parking and charging, other possible incentives.	Section (4) on regulation, and section (7) on potential challenges to ULEV uptake.
4. Uptake scenarios – levels of ULEV uptake under different scenarios, and their impact on vehicle emissions.	Section (5) on uptake. In EST studies section (5) also provides estimates of the number of chargers required, whereas in this study point is covered in the following section on charging infrastructure. The EST studies do not provide detailed information on the impact of the uptake scenarios on vehicle emissions.
5. Infrastructure	Section (6)
6. Implementation	Section (8), although in the EST studies this includes cost estimates for infrastructure, whereas in this study these are provided in the previous infrastructure section.

1.2 Background – study area

Leicester City Council has commissioned this feasibility study in support of their Air Quality Action Plan (2015 – 2026). The plan aims to reduce transport attributable air pollution in the city, especially Nitrogen Dioxide, to a level below the EU target as soon as possible. It is estimated that 162 premature deaths per year in the city are due to air pollution. The introduction of Ultra Low Emission Vehicles (ULEV) into the taxi and private hire fleets is an important component to the plan.

The study covers the entire county of Leicestershire which has a population of 980,000. About a third (330,000) of the population are concentrated in the City of Leicester itself, with the surrounding principal urban area comprising a dense population of 520,000 in total. The largest town in the county is Loughborough, in the northern district of Charnwood, with a population of approximately 60,000. Other large Leicestershire towns include Ashby-de-la-Zouch, Coalville, Hinckley, Market Harborough, Melton Mowbray, Oadby, Wigston and Lutterworth. The rest of the county population is fairly evenly spread across many smaller towns, villages and hamlets. Including the city, there are eight districts in the county. The area of the county is 832 square miles with an average population density of 455/km^2, peaking at 4180/km^2 for the city.

Leicester City Council has worked in partnership with the councils of the surrounding districts to produce this study, as transport cannot be considered in isolation. The other councils covered by the study are Charnwood, Harborough, Hinckley and Bosworth, North West Leicestershire, Blaby, Melton and Oadby & Wigston. Together all of these councils make up the County Licensing Group, which aims to improve the taxi & private hire provision in the county.

Each council is responsible for managing licensing policies and enforcement in their area, and each is willing to work with the taxi & private hire firms to introduce ULEV and supporting infrastructure. Leicestershire County Council is the transport authority for the county responsible for introducing infrastructure changes including highway alterations.

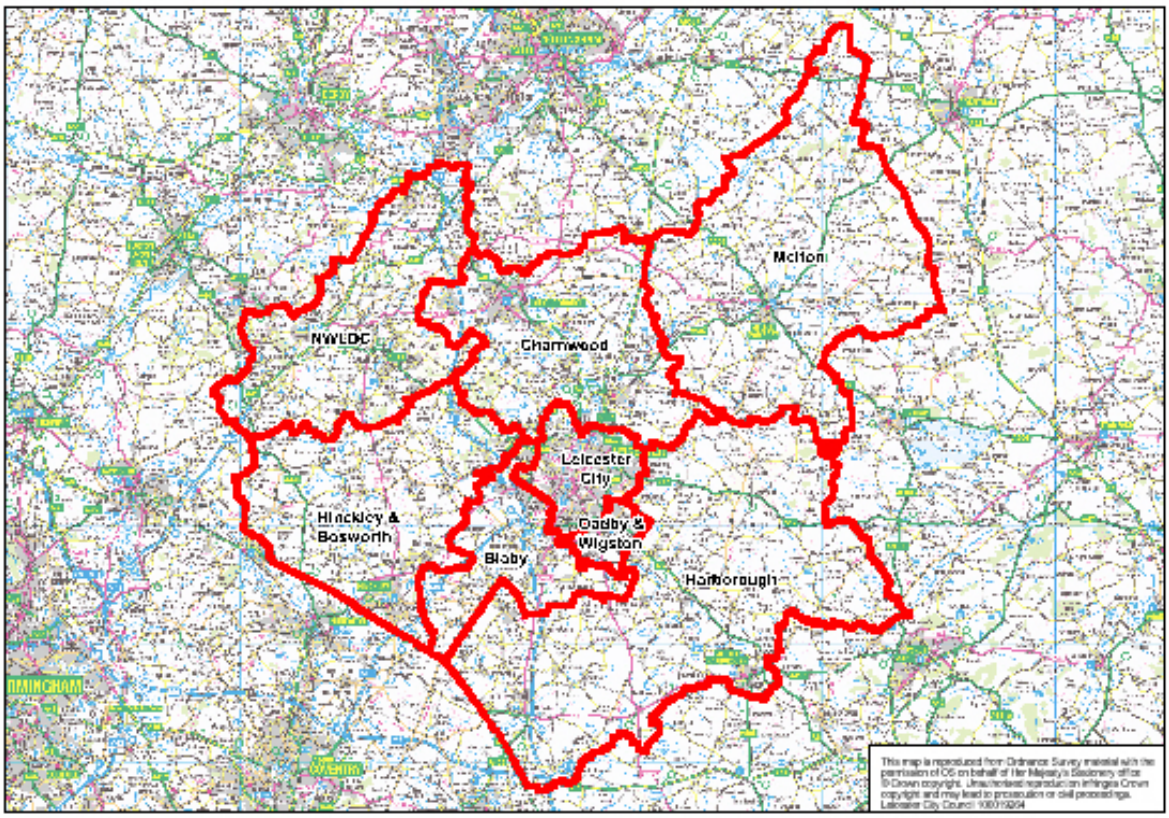


FIGURE 1: MAP OF LEICESTERSHIRE DISTRICTS

1.3 Air quality issues in the study area

The impact of transport related air pollution in Leicester is estimated to cost the city some £7.2 million per year worth of damage to families, businesses and the Leicester economy as a whole. The area where pollution levels exceed health based objectives covers about 3% of Leicester's population many of whom are amongst the most deprived of the city's residents.

In 2014 the highest annual recording for NO_2 was 60µg/m^3 at Glenhills Way junction in Leicester City. Leicester City is one of 18 urban areas in the UK which were named by the EU Supreme Court in 2015 as failing EU-wide NO_2 targets. Without intervention the DEFRA model suggests Leicester's NO_2 levels will not meet the desired 40µg/m^3 annual air quality objective until 2025.

Leicestershire County Council's 'Leicester and Leicestershire Integrated Transport Model' (LLITM) forecasts an average increase of around 16% in the overall vehicle kilometres travelled in the AM and PM peak hours between 2011 and 2021. This suggests that without improvement in the vehicle fleet, and the adoption of low emission vehicles, emissions will increase and air quality potentially worsen in the city.

There are 16 Air Quality Management Areas (AQMA) in the county as shown below. All but one of the AQMA is designated for vehicle derived Nitrogen Dioxide (NO_2, annual average) exceedances[2]. The Leicester City AQMA includes locations which will not achieve compliance with the EU Limit Value for NO_2 until 2025 unless early action is taken.

The full list of AQMAs, including links, is provided below:

- Blaby – AQMA 1 – Narborough Road South & Fosse Park
- Blaby – AQMA 2 – M1 in Enderby and Narborough
- Blaby – AQMA 3 – M1 between Thorpe Astley and Kirby Muxloe
- Charnwood – Loughborough AQMA
- Charnwood – Syston AQMA
- Harborough – Lutterworth AQMA
- Leicester City – Leicester AQMA
- North West Leicestershire – Castle Donnington
- North West Leicestershire –Coalville
- North West Leicestershire – Copt Oak
- North West Leicestershire – Kegworth
- North West Leicestershire – M1

Leicester City Council (LCC) has a designated Air Quality Management Area (AQMA), covering the City centre, the main arterial routes and sections of the outer ring road, due to elevated concentrations of Nitrogen Dioxide (NO2), exceeding the EU Limit Value (see map below). Road transport emissions are the predominant cause of these elevated concentrations.

[2] There is an AQMA designation in Charnwood for Sulphur Dioxide (SO_2) exceedance

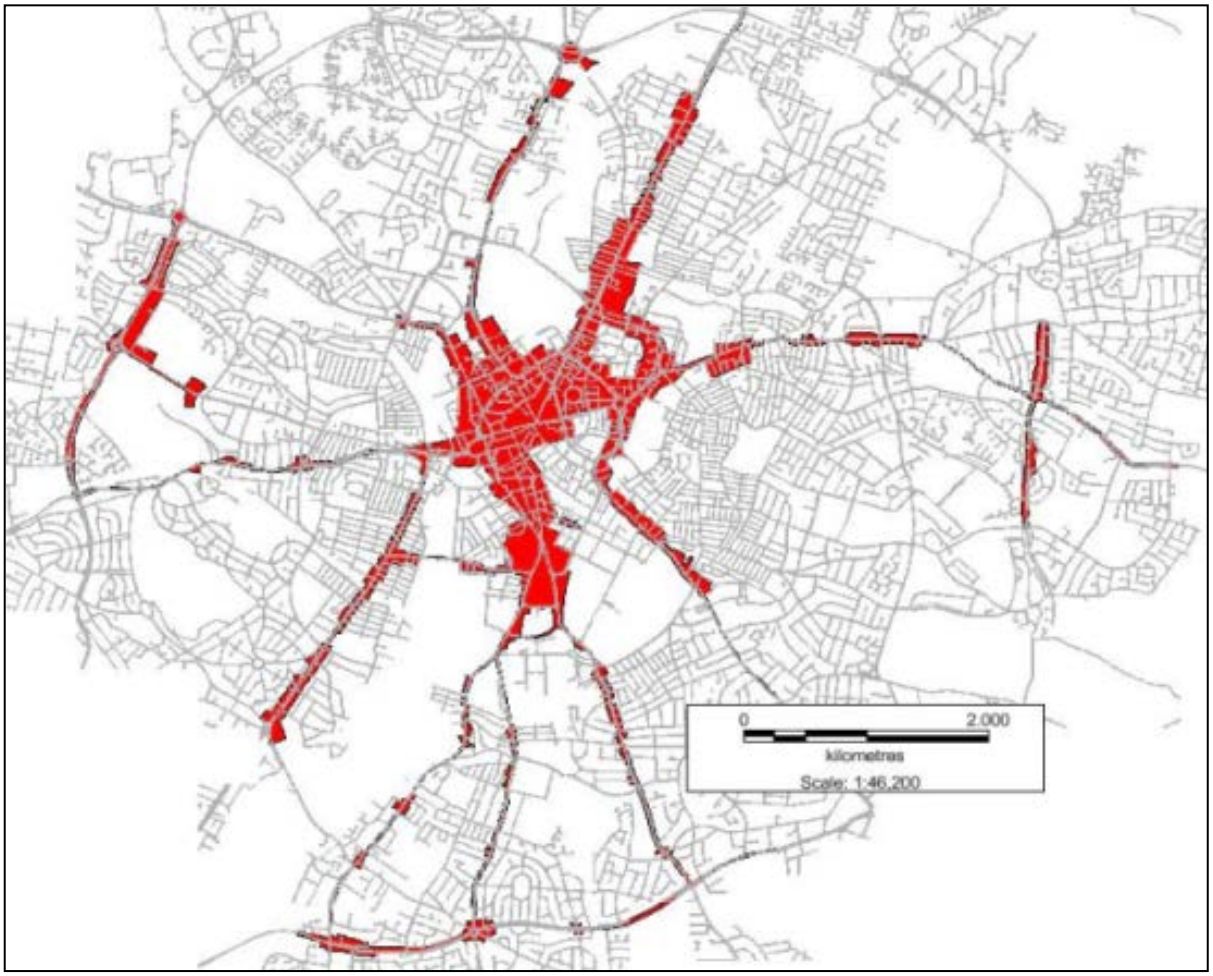
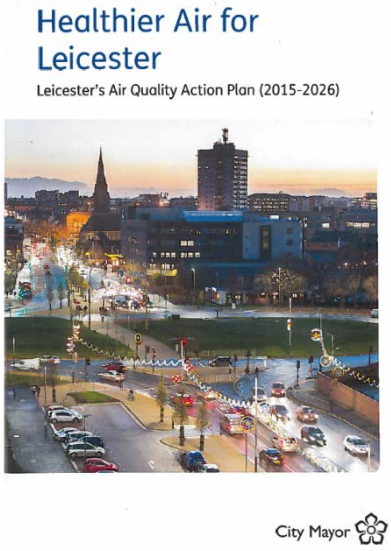


FIGURE 2: LEICESTER AIR QUALITY MANAGEMENT AREAS

1.4 Leicester Air Quality Action Plan (2015-2026) and other related initiatives

Leicester has a longstanding reputation for its commitment to sustainable development. It enjoys the distinction of being Britain's first 'Environment City', and has undertaken an ambitious, comprehensive and continuous programme of environmental improvement involving the whole community.



Leicester City Council has recently adopted its Healthier Air for Leicester – Leicester's Air Quality Action Plan (2015-2026) in order to reduce transport related air pollution in the city, especially Nitrogen Dioxide, to a level below the EU target as soon as possible. It is estimated that 162 premature deaths per year in the city are due to air pollution.

The plan has sixteen actions split over the following four themes, with a cost of about £100million to implement over the next ten years.

1. Reducing Transport Emissions
2. Promoting Sustainable Transport
3. Improving Traffic Management
4. Enhancing Planning & the Environment

Under the theme of Reducing Transport Emissions there are six actions to:

1. Lobby and work with central government to introduce national measures to progressively reduce polluting emissions from diesel vehicles
2. Introduce a city centre based Low Emission Zone for buses and taxis by the end of 2017 and work toward the introduction of an Ultra-Low Emission Zone for all vehicles over the period to 2026, or sooner if possible
3. Work with Bus, Freight, Rail and Taxi transport sectors to reduce their environmental impact
4. Increase the uptake of Ultra Low Emission Vehicles by residents and Business
5. Progressively reduce emissions by 50% by 2025 from the council's fleet operations
6. Implement a Sustainable Public Procurement Guide in 2016

Under actions 3, 4 & 5 the council bid into OLEV's Go Ultra Low Cities Scheme. This project builds on earlier work funded by the Clean Bus Technology Fund and Clean Vehicle Technology Fund, as well as the city's 'Choose how you move' campaign to promote sustainable modes of transport.

The introduction of Ultra Low Emission Vehicles (ULEV) into the taxi and private hire fleets is an important component to the plan. With the GoUltraLo Leicester project being focused on seven key objectives:

1. Create a comprehensive public charging infrastructure of over 10,800 charge points
2. Deliver an increased uptake of Ultra Low Emission Vehicles (ULEVs) with over 10,000 new registrations – via awareness raising, a range of incentives, and the promotion of a vibrant used ULEV market
3. Promote innovation in ULEV technology at the area's universities and research institutions
4. Achieve measurable improvements in air quality, meeting EU standards for NOx and reducing Greenhouse Gas (GHG) emissions
5. Link the GoUltraLo Leicester project to other initiatives promoting sustainable transport
6. Undertake effective monitoring, evaluation and review
7. Achieve 'exemplar' status for the city with respect to ULEV uptake

The project is backed by a 'commitment to deliver' from a strong partnership across Leicester and Leicestershire. This partnership is led by Leicester City Council and involves public authorities, businesses, world-class universities and research institutions, developers, investors, voluntary and community groups and the general public. The partners are committed to making significant investments in ULEVs for their fleets and employees.

Although OLEV did not award funding to the project, most of the targets and partnerships remain the same. The City Council is already committed to purchasing 200 ULEVs for its own fleet by 2021, and expanding its unique ULEV salary sacrifice scheme, which is open to its 16,000 employees and provided with £350,000 in direct funding.

Leicester City Council are also in early negotiations with a consortium led by British Gas to install a large number of electric vehicle chargers into the city and neighbouring districts. Any ULEV Taxi project will benefit from these partnerships and initiatives already established through the GoULtraLo Leicester bidding process. Not only do the partners represent a wide range of bodies who can support ULEV Taxis through their procurement processes, but as mentioned many are involved in ULEV research, and taxis will present further opportunities for this research, meaning that OLEV funding in this area will achieve the scheme's additional aim of stimulating investment in the UK automotive industry.

1.5 The taxi fleet in Leicestershire

The city of Leicester has 323 licensed Hackney Carriages (HCs) and 1,255 Private Hire Vehicles (PHVs) managed by 74 different operators. The surrounding districts have an additional total of 559 HCs and 489 PHVs, exact numbers are provided in Table 2 below.

TABLE 2: NUMBERS OF LICENSED TAXIS IN LEICESTER AND DISTRICTS

District	HCs	PHVs
Leicester	323	1255
Blaby	35	101
Charnwood	136	181
Harborough	88	46
Hinckley & Bosworth	118	38
Melton	58	24
NW Leicestershire	124	99
Total	**882**	**1744**

The analysis in the rest of this section (1.5) is based on vehicle data collected by the city and districts' licensing teams.

1.5.1 Hackney carriage fleet in Leicester

Hackney carriages within the city of Leicester are required to meet a full 'black cab' style specification with wheelchair access. The most popular manufacturer is LTI, with the TX2 and TX4 models, followed by Peugeot with the E7. The full breakdown is shown in Figure 3 below.

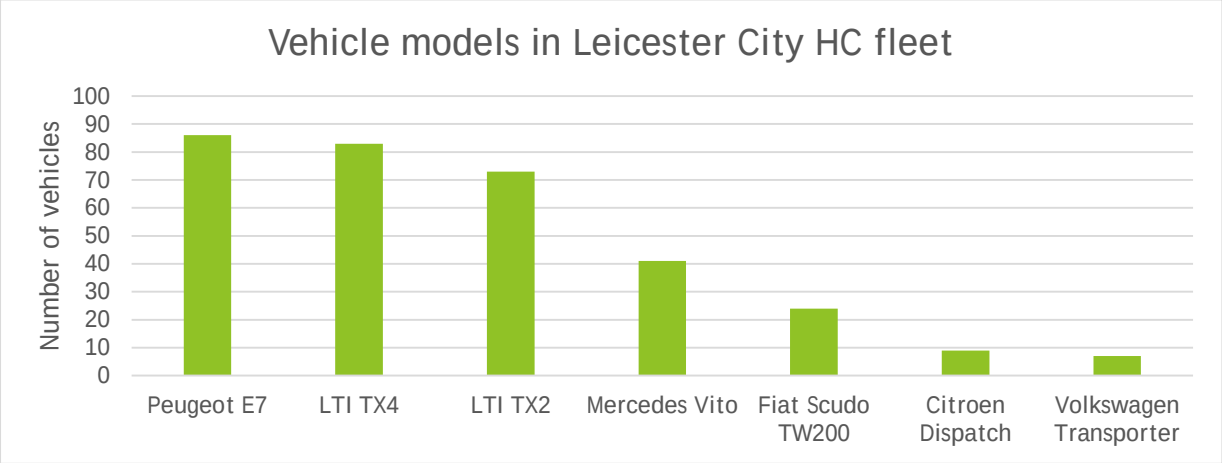


FIGURE 3: VEHICLE MODELS IN LEICESTER CITY HC FLEET

The HC fleet in the city is fairly old, with a lot of vehicles that will have to be replaced in the next few years, as shown in Figure 4 below.

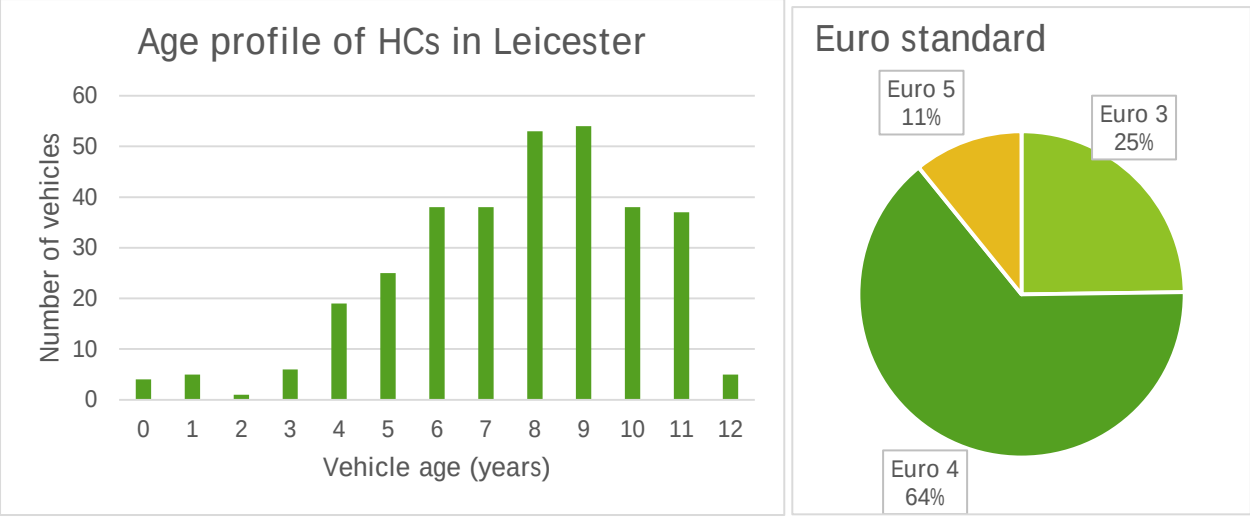


Figure 4: Age profile and Euro standard of HC fleet in Leicester

1.5.2 Private hire fleet in Leicester

The private hire fleet within the city shows a far wider range of vehicles, but there are a few clear favourites. The most popular is the Vauxhall Zafira, closely followed by the Toyota Avensis and Prius. In fact, hybrids make up around 10% of the fleet. Most of them are the Prius, but the Toyota Auris and Honda Insight are also represented. (See Figure 5 below, in which the Prius is highlighted red.)

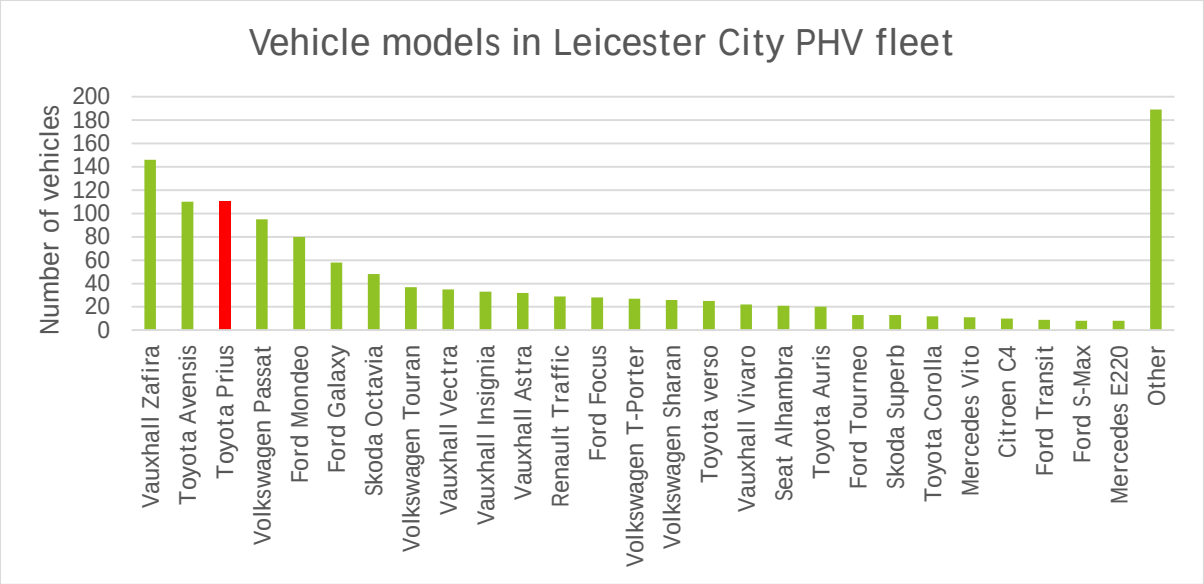


FIGURE 5: VEHICLE MODELS IN LEICESTER CITY PHV FLEET (PRIUS HYBRID SHOWN IN RED)

The PHV fleet is not as old as the HC fleet, as shown in Figure 6 below. This may be due to the higher cost of 'black cab' specification vehicles, but may also be a due to the historic growth in taxi numbers.

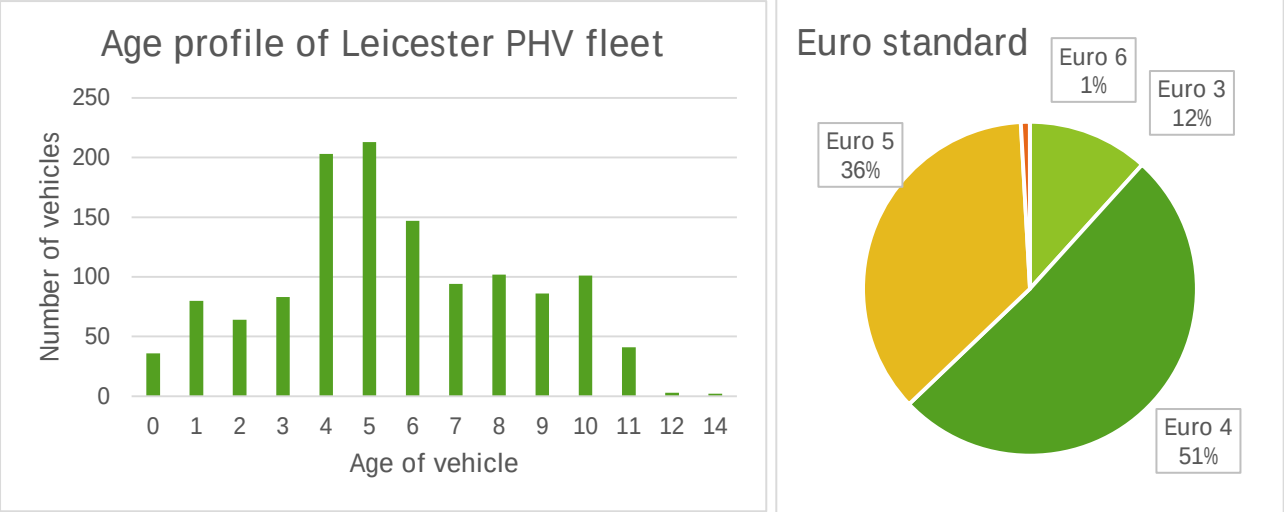


FIGURE 6: AGE PROFILE AND EURO STANDARD OF PHV FLEET IN LEICESTER

1.5.3 Hackney carriage fleet in the districts around Leicestershire

In the districts surrounding the city, the HCs are not required to meet the full 'black cab' specification, and so the range of vehicles used as HCs is much wider, as shown in Figure 7.

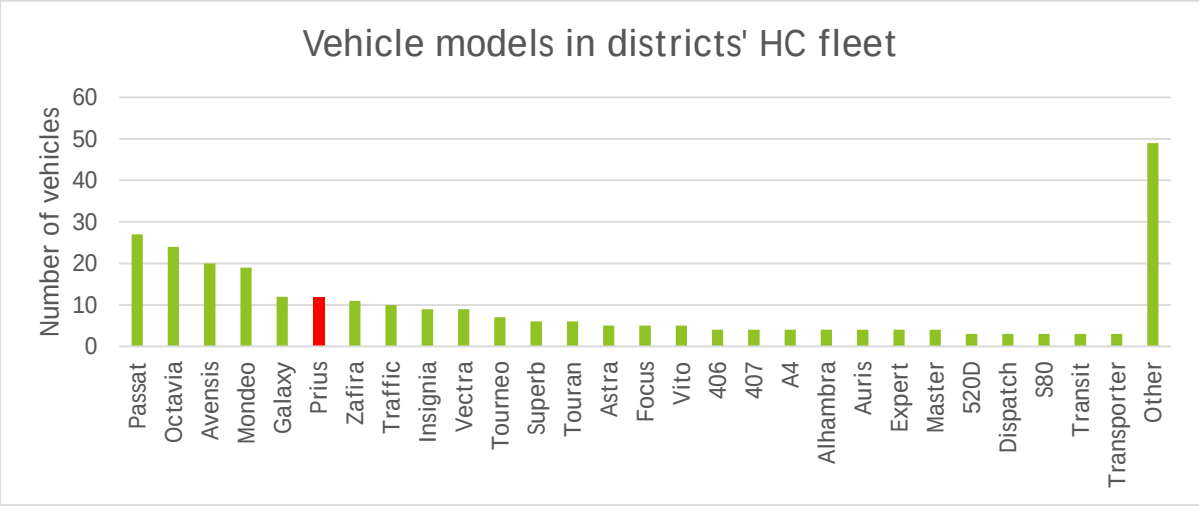
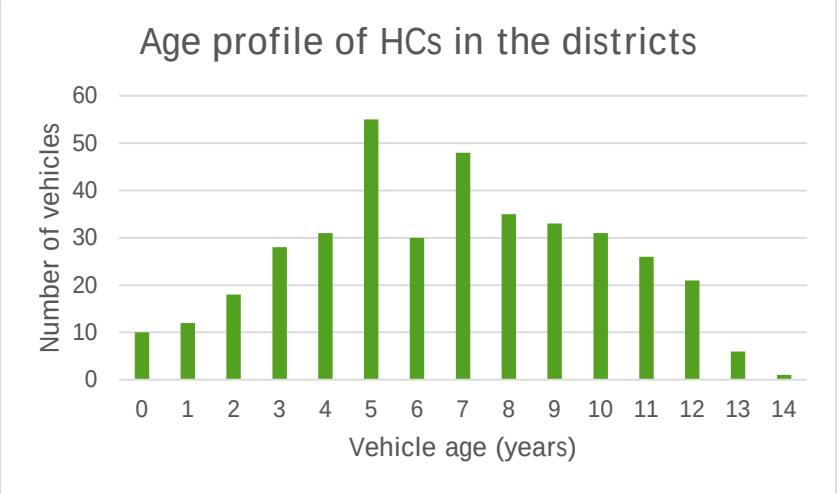


FIGURE 7: VEHICLE MODELS IN DISTRICTS' HC FLEET

The HCs in the districts are also not as old as those in the city, as shown in Figure 8 below. This may be a reflection of the fact that they are not as expensive as 'black cabs' and therefore replacement is less costly, but may also be due to the higher yearly mileage of the vehicles (see next section).



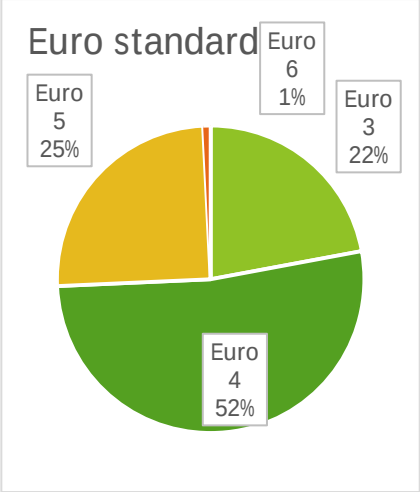


FIGURE 8: AGE PROFILE AND EURO STANDARD OF HCS IN THE DISTRICTS

1.5.4 Private hire vehicle fleet in the districts around Leicestershire

Private Hire Vehicles in the districts are notably different models to those in the city, as shown in Figure 9 below. The most popular model in the city, the Vauxhall Zafira, is hardly represented, the Toyota Avensis is half way down the rankings and there are no Prius's. Generally speaking, the vehicles seem to be models that are larger and more suited to longer journeys, with more luggage capacity for airport runs etc.

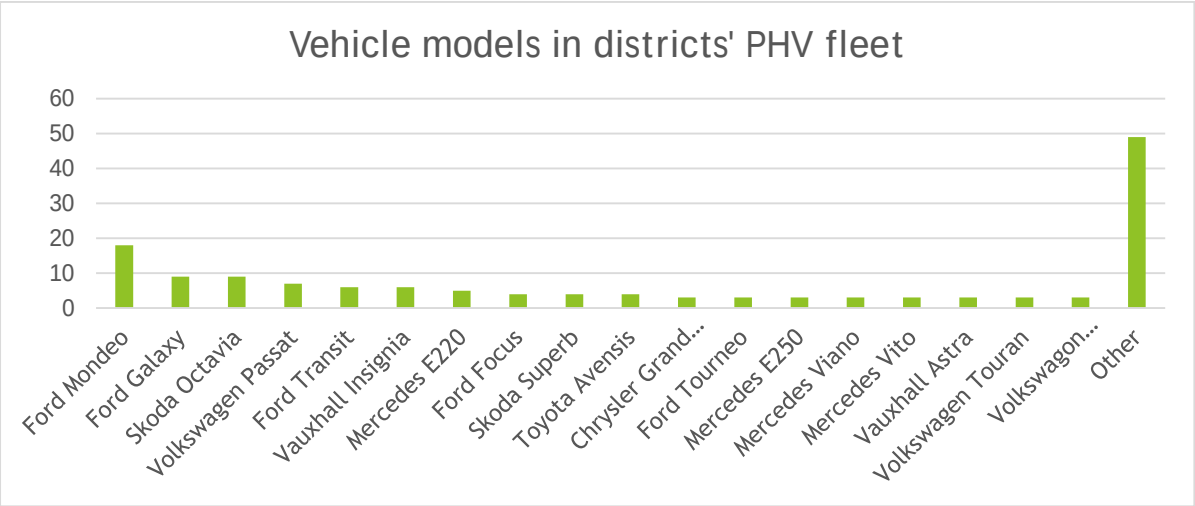
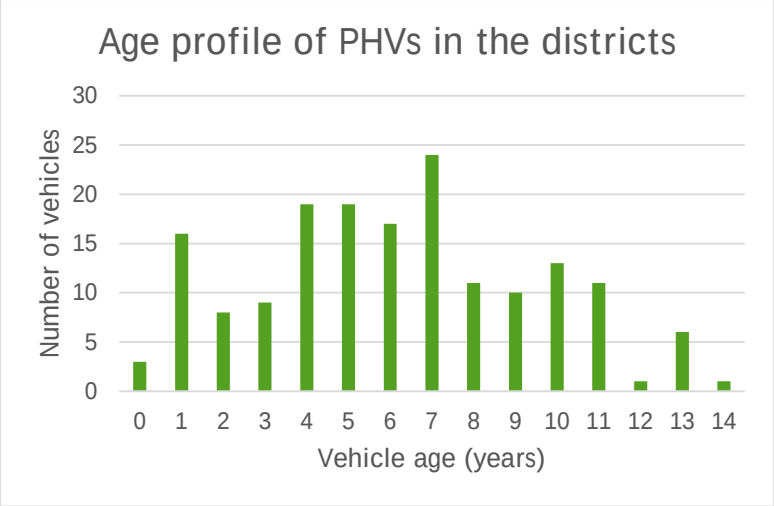


FIGURE 9: VEHICLE MODELS IN DISTRICTS' PHV FLEET

The age profile of the PHVs is similar to the HCs.



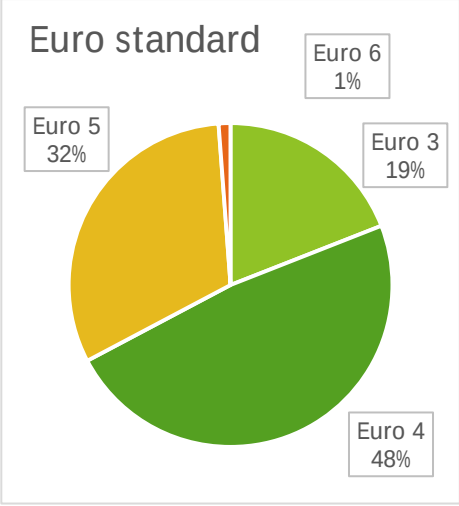


FIGURE 10: AGE PROFILE AND EURO STANDARD OF PHVS IN THE DISTRICTS

1.6 Taxis and air quality

Although taxis are a small proportion of the total vehicle fleet for Leicester (approx. 1-2%), they are responsible for a larger proportion of trips, being in near constant use while most cars make no more than 2 or 3 trips in the course of a day. Overall it is estimated that they are responsible for around 11% of traffic in the central city area in the AM peak and perhaps 2-3% elsewhere. As such, they are an important target for emission reduction measures.

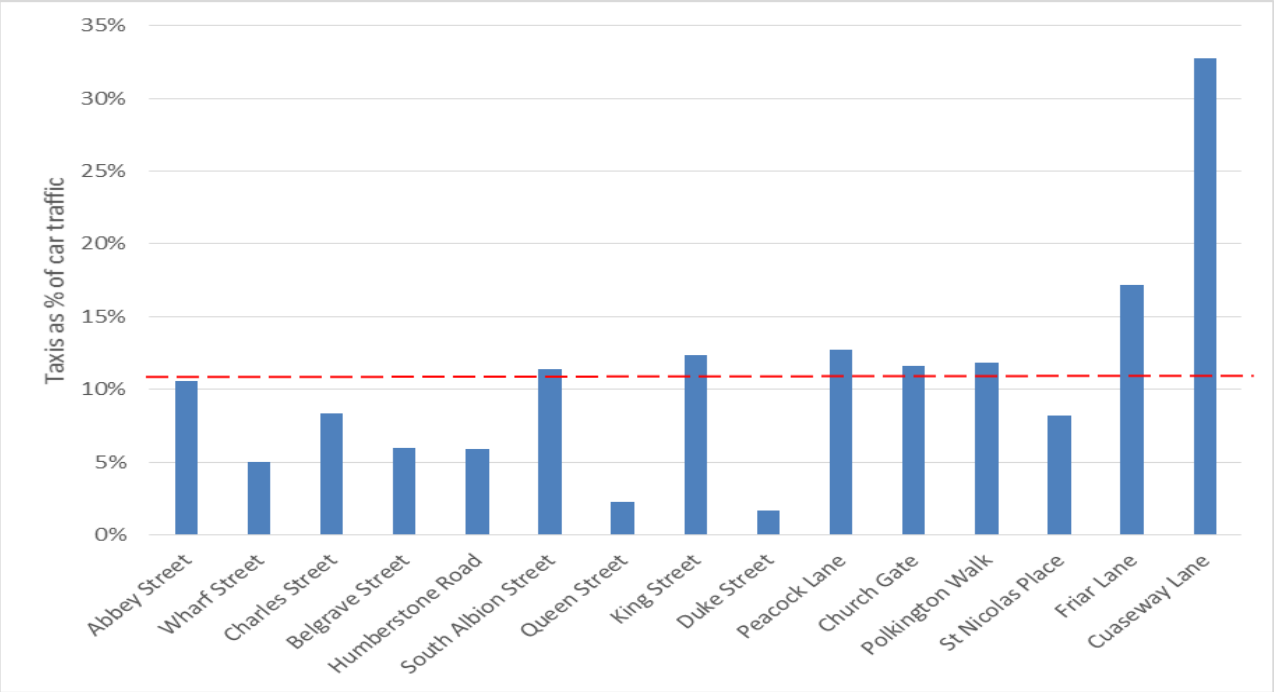


FIGURE 11: TAXIS AS A PERCENTAGE OF OVERALL TRAFFIC AT VARIOUS LOCATIONS IN LEICESTER

Using this estimated contribution of taxis to the overall traffic mix and the emission model developed for Leicester in the LestAir Study[3] suggests that taxis are responsible for 6% of Oxide of Nitrogen (NOx) emissions and 3% of CO_2 emissions within the city as shown in the charts below. In terms of NOx this is equal to three quarters of the emissions from all petrol cars in the city and about a sixth of the emissions from diesel cars. So although not one of the larger emission sources they are still significant.

Taxis make up around 1-2 % of the vehicle fleet in the urban areas, but recent studies indicated that due to their numerous trips within the urban area, their impact as contributors to air pollution has been greatly underestimated. Modelling carried out by Leicester City Council indicated that the introduction of ultra-low and zero emission taxis, cars and vans into the urban environment may potentially lead to the reduction of total NOx emissions by up to 2.0%, PM_{10} by up to 0.25% and CO_2 by up to 2.5% which will have a measureable impact on pollution reduction.

In March 2015 Leicester City Council launched its consultation on Healthier Air for Leicester – Leicester's Air Quality Action Plan (2015-2025). The plan contains a number of actions that reduce NO_2 emissions from transport. Using the 2014 LestAir study undertaken by Ricardo AEA, the actions were chosen on how effective they were at reducing NO_2 emissions. In particular use of ultra-low emission vehicles, including taxis, have been initially assessed by modelling scenarios and included as an action point in the Action Plan.

[3] LestAir – Low Emission Strategy: Business and Implementation Plan, 2014 (Ricardo/LES Ltd)

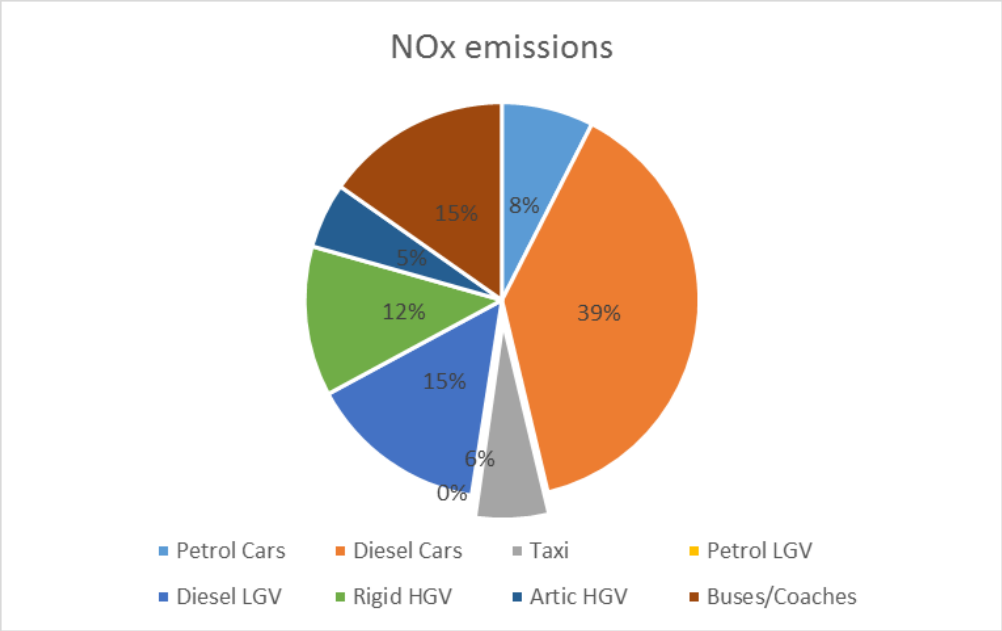


FIGURE 12: CONTRIBUTION OF DIFFERENT VEHICLE TYPES TO OVERALL NOX EMISSIONS IN LEICESTER

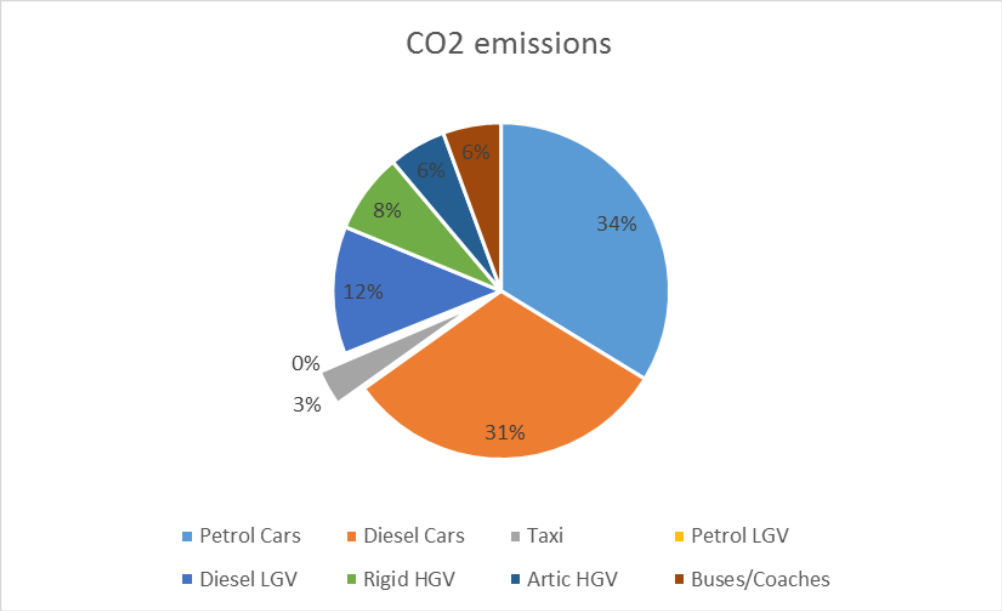


FIGURE 13: CONTRIBUTION OF DIFFERENT VEHICLE TYPES TO OVERALL CO2 EMISSIONS IN LEICESTER

Adopted in November 2015, the AQAP outlines Leicester's ambitions for 2026 through a number of actions relating to taxis which include:

- The introduction of a Low Emission Zone (LEZ) for the most polluting vehicles in the City Centre, encouraging bus and taxi operators to use the cleanest lowest emission vehicles as their first choice for fleet replacement. The LEZ will be implemented by the end of 2017.
- An Ultra-Low Emission Zone (ULEZ) for all motor vehicles will be implemented by 2026 at the latest and as soon as possible.
- This will be a key driver for investment in ULEVs and provide an incentive for taxi and PHV operators to engage with the ULEV Taxi Scheme.

- Continuing to develop fuelling infrastructure for ULEVs (including shared arrangements between different sectors).
- Provide discounted parking charges for ULEVs.
- Embed air quality considerations into the 2016 Local Plan.
- Implement Land Use Planning Practice Guidance by 2016 that promotes additional developer contributions for ULEV infrastructure.

While the take up of ULEV taxis in the districts surrounding Leicester is expected to be smaller than in Leicester, and therefore will have a marginal impact on air quality concentrations in the surrounding towns, it is believed that by normalising the use of ULEV taxis this will promote and increase the penetration of ultra-low emission vehicles in the County, leading to a reduction in road transport emissions which will benefit air quality.

2 Taxi operations – results of surveys and interviews

The types of vehicles used, their operations and the vehicle purchasing behaviour of the drivers were all researched for this study. This was done by means of driver questionnaires either via a face-to-face interview or completed online. In addition a number of Private Hire Operators were interviewed.

Screenshots of the online questionnaire are provided in Appendix A.

TABLE 3: NUMBER OF QUESTIONNAIRES/INTERVIEWS CONDUCTED

Questionnaires	Hackney drivers	Private Hire Drivers	Private Hire Operators
Leicester	40	54	2 (70 cars)
Other districts	10	10	4 (110 cars)

2.1 Hackney carriages and PHVs in the city of Leicester

The questionnaire data revealed a marked difference in the daily operations of HCs vs PHVs. As might be expected, city HCs cover fewer miles and have higher fuel consumption per mile. They are less likely to get occasional very long fares, and wait longer at taxi ranks. The full results are shown in Table 4 below (all values are averages of the responses given, and the results for the PHVs come from a very small sample).

TABLE 4: SUMMARY OF OPERATIONAL PARAMETERS OF TAXIS IN LEICESTER, COLLECTED FROM QUESTIONNAIRES

Question asked:	HCs	PHVs
What mpg do you get on average?	31	49
What is your typical annual mileage?	22,275	25,673
What is your typical daily mileage?	75	85
How many times in a day do you stop at a taxi rank?[4]	6	9
On a typical day, how long is your longest wait at a taxi rank? (For PHV's – how long do you wait between fares?)	82 (minutes)	53 (minutes)
In the last month, how long was the longest fare you carried?	62 (miles)	111 (miles)
In the last month, what was your highest daily mileage?	122	206

From the point of view of this study, the key point to note is that city HCs have an operational profile that could be fulfilled by a pure electric vehicle. The average daily mileage of 75 miles is achievable by most modern EVs on a single charge[5]. The data suggest that these vehicles would rarely have to turn down a long fare due to range constraint, and that if it were possible to charge at a taxi rank then daily duties could easily be accommodated.

Although they have a higher daily mileage, PHVs in the city also show an operational profile that could be fulfilled by a pure electric vehicle. The Nissan Leaf, and the Nissan Evalia (see section 3) would both manage a typical day's work with one 'opportunity charge' (see section 5 on infrastructure), although they might be forced to turn down a small number of longer fares.

[4] In the case of PHVs the phrase 'taxi rank' here denotes any regular stopping place, e.g. near the dispatch office.

[5] Most pure EVs have a range of around 100 miles on the test cycle. In practice range will be lower, and vehicles that are converted to meet the 'black cab' specification will be heavier due to their extra equipment. However, 67 miles is still within the likely capability in real world conditions.

2.2 Hackney Carriages and PHVs in districts around Leicestershire

The questionnaire responses revealed that both HCs and PHVs in the districts cover much higher mileages than taxis based in the city.

TABLE 5: OPERATIONAL PROFILE OF TAXIS OPERATING IN THE DISTRICTS

Question asked:	HCs	PHVs
What mpg do you get on average?	42	44
What is your typical annual mileage?	41,501	49,500
What is your typical daily mileage?	140	200
How many times in a day do you stop at a taxi rank?	7	NA[6]
On a typical day, how long is your longest wait at a taxi rank?	50 (minutes)	NA
In the last month, how long was the longest fare you carried?	196	222
In the last month, what was your highest daily mileage?	338	440

Although HCs show a lower daily and annual mileage than PHVs, both cover more distance than either type of taxi operating in the city. Although this may be biased to some extent by the fact that many of the responses came from Arrow Taxis based at East Midlands Airport, data from other operators confirms that the geographical nature of the districts means that taxis are more often used for journeys from one urban area to another, rather than predominantly intra-urban trips.

2.3 Vehicle turnover and purchasing decisions

Our questionnaire asked a number of questions about vehicle purchasing. These are listed below, along with the results and a discussion of the implications:

How old was your vehicle when you bought it?

Analysis of the vehicle data provided by the taxi licensing authorities shows that most HC vehicles are new (77%) or nearly new (22% are one year old) when first licensed[7]. However, only 40-50% of drivers questioned said their vehicle was under 3 years old when they started driving it. This suggests that although about half of HC drivers will buy a second-hand vehicle, when they do so they almost always (99% of the time) buy a vehicle that has already been licensed as a cab in the same district. The implication of this is that as vehicles are retired from the fleet altogether, they are exclusively being replaced by brand new vehicles.

Roughly how often do you replace your vehicle?

HC drivers in Leicester overwhelmingly said they replace their vehicle only once it is too old to be licensed again – this answer was given by 22 of 34 respondents. Comparing with PHV drivers in the city, there were only 4 questionnaire responses, however, interviews were conducted with two of the private hire company managers, and they both said that their drivers mostly only replaced their vehicles once they were too old to license.

This contrasted with HC drivers outside the city, none of whom gave this response – they almost all change vehicle after 3, 4 or 5 years. Similarly, the PHV drivers outside the city seemed more likely to change their vehicle regularly, with 70% of individual questionnaire respondents saying they change every three years. One private hire company manager, of Arrow Taxis at the East Midlands Airport, was interviewed. He said that they were moving towards company purchase of all vehicles, and these are bought new and changed every three years.

What are the top three things you consider when buying a new vehicle

The pie charts in Figure 14 below show the range of responses to this question[8]. In the case of HCs in Leicester, i.e. 'black cabs', purchase price, fuel economy and reliability are clearly the most important

[6] As in the city, PHV drivers are not permitted to stop at official taxi ranks, but in the case of the district the drivers surveyed indicated that they did not stop at any regular unofficial waiting places either.
[7] This pattern was remarkably consistent, showing identical percentages in the city and the districts.
[8] Note that the percentages show the percentage of respondents citing the given criteria. Since all respondents were asked for their top three criteria, the percentages add up to more than 100%. Also, the

factors. These factors are important to other drivers too, but a broader range of factors seem to also have an influence. This is probably because in the case of a black cab, factors such as luggage space and comfort exist within more tightly controlled ranges due the black cab specification, while the initial price is significantly higher.

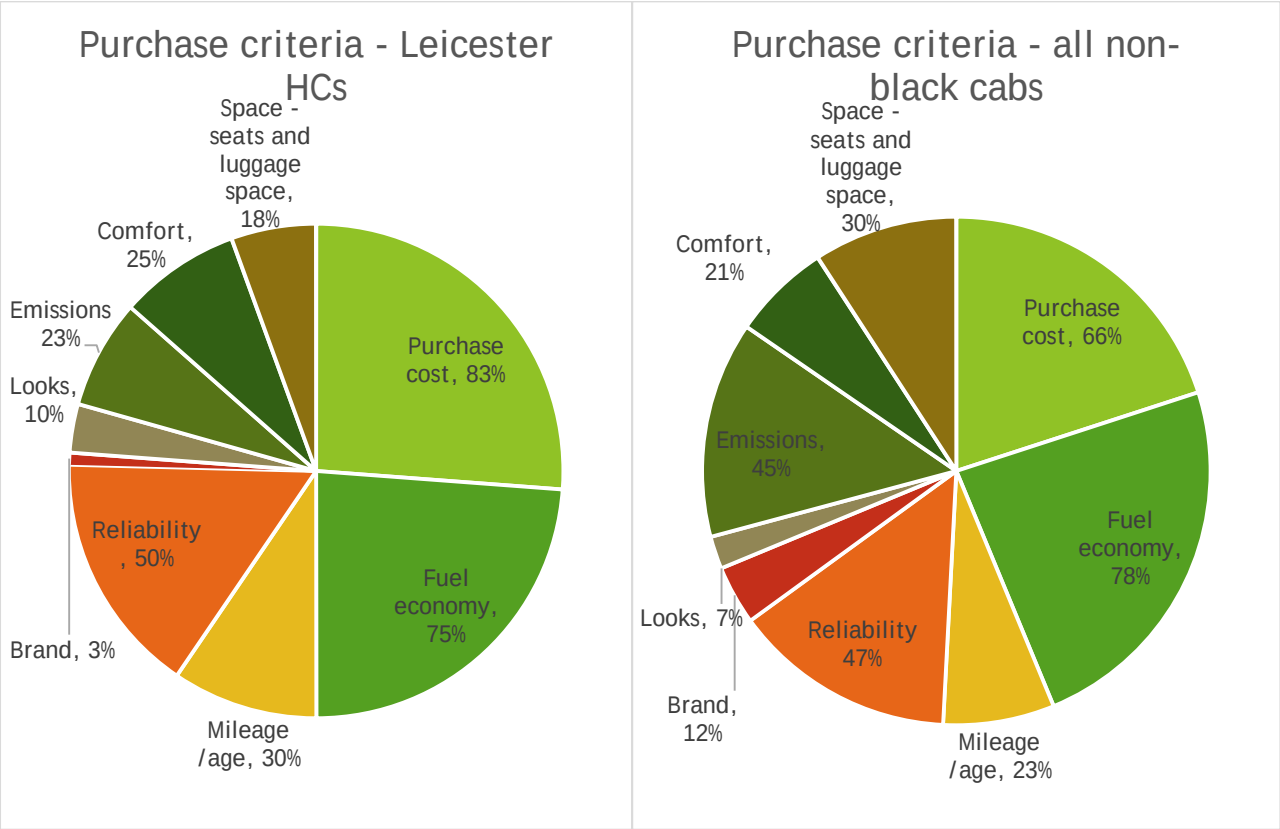


FIGURE 14: PURCHASE CRITERIA FOR NEW VEHICLES

What is your main source of advice and information when buying a vehicle?

The pie charts in Figure 15 below again show a difference between the city HCs, i.e. the 'black cabs', and all the other vehicles. Drivers of 'black cab' specification vehicles are most likely to get information from other drivers and specialist websites, whereas drivers of other vehicles mostly rely on general internet sites. This needs to be kept in mind when designing incentive programs.

pie chart for 'all non-black cabs' combines all responses other than those from Leicester HC drivers, as otherwise the sample would have been too small for meaningful results.

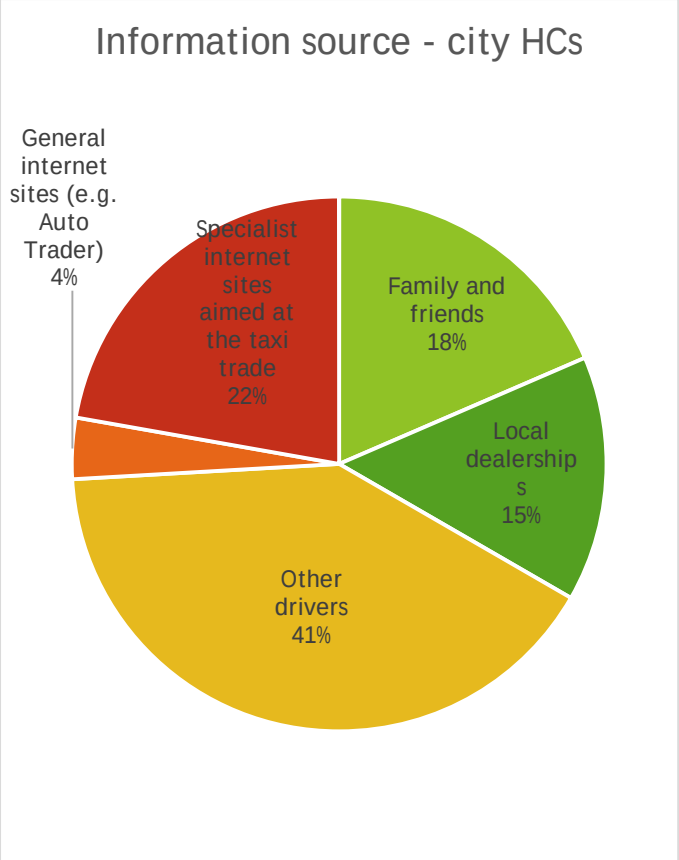


FIGURE 15: PRIMARY SOURCE OF INFORMATION AND ADVICE WHEN CHOOSING A NEW VEHICLE

3 Regulations and incentives driving uptake of ULEVs

The first point any taxi driver will consider in choosing a new vehicle is finances – purchase, fuel and maintenance costs. If a ULEV has a total cost of ownership lower than its conventional equivalent, then drivers will need good clear information, and possibly other incentives to persuade them to take a risk, but ultimately the ULEV option will be adopted by increasing numbers. However, if the costs of the ULEV are higher, only a heavy-handed ban on other vehicle types will result in ULEV adoption, and this may be at considerable political cost.

Section 3.2 therefore considers total cost of ownership for ULEVs vs conventional vehicles, looking separately at 'black cabs', PHVs in Leicester, and all taxis in the districts. Section 3.3 considers other incentives that could be used to persuade taxi drivers to use ULEVs. This is followed by section 4 which proposes low, medium and high scenarios for ULEV take up, based on specific assumptions.

3.1 Regulation – licensing requirements

The local authority partners already use their licensing powers to encourage the uptake of low emission vehicles, as summarised below, and this will be strengthened to encourage ultra-low and zero emission vehicles.

Leicester City Council – Includes incentives for the uptake of ULEV, EURO 5 and 6 compliant taxis and private hire vehicles (PHV). From April 2015 the £211 annual licencing fee has the following discounts applied:

- 100% ULEV
- 100% EURO 6
- 50% EURO 5

Vehicles are not allowed to be more than 11 years old. The council is about to consult on a number of changes to their licencing policy which includes lifting restrictions on numbers of licences issued and introducing a ULEV requirement in the conditions of fitness for all new vehicles licenced in 2017 onwards.

Melton Borough Council – 25% reduction on £202 annual licensing fee if the vehicle is Liquid Propane Gas, Petrol-electric hybrid, Compressed Natural Gas

Hinckley & Bosworth Borough Council - Since 28 April 2009 vehicles that are environmentally friendly receive a 10% discount on the annual licence fee.

North West Leicestershire District Council – Vehicles aged 6 years or older will not be licensed unless they are deemed to be in exceptional condition. Vehicles 6 years and older require 6 monthly examinations. No discounts currently offered relating to emissions, but are considering this within the next couple of years.

The County Licencing Group – Committed to regularly reviewing the different licensing policies and the incentives available for the increased uptake of ULEV.

3.2 Total Cost of Ownership for ULEVs versus conventional vehicles

The following sections compare the total cost of ownership of ULEVs and conventional equivalents. All the comparisons use a petrol price of £1.10/litre, diesel at £1.11/litre and electricity at £0.12/kWh. Depreciation has been estimated by finding equivalent vehicles for sale online, or other online sources. Maintenance costs have been estimated by reference to Which and the AA. Vehicle Excise Duty has been included (which is banded based on CO_2 emissions, and set at zero for ULEVs). Other parameters are specific to each comparison, see explanatory text.

3.2.1 Black Cabs (Hackney Carriages in Leicester)

The Office for Low Emission Vehicles (OLEV) currently has a list of only three black cabs it expects to be eligible for the Hackney Carriage grant. These are the Metrocab from Fraser Nash, the TX5 from LTI and a similar vehicle from Turkish company Karsan. Primary research for this report suggests that the Metrocab will be available in 2016, the TX5 in 2017, and the Karsan project currently has no production date. However, there is a company adapting the Nissan Evalia to the specification required for black cabs outside

London[9]. The Metrocab and Evalia have been used for the purpose of this analysis as they are closest to market and information was available for them.

TABLE 6: 'BLACK CAB' SPECIFICATION ULEVS USED FOR ANALYSIS

	**Metrocab** Available: Summer 2016 Power-train[10]: Range-extended electric Battery: 15 kWh Electric range: ~45 miles Range extender: 1 litre petrol engine (Euro 5) Price: ~£44,000 (£36,000 after grant) Conventional equivalent: LTI TX4
	**Nissan Evalia** Available: Hackney spec 2016 Power-train: Pure electric Battery: 24 kWh (30 kWh option available 2016) Electric range: ~70-106[11] miles Price: ~£44,000 (£36,000 after grant) Conventional equivalent: Peugeot E7

HCs in Leicester average around 75 miles per day, according to data collected from drivers in this study. Note that both the Metrocab and Evalia can comfortably cover this mileage with one 'opportunity charge' of 20-30 minutes from a 22kW fast charger. Annual mileage is estimated at 20,000, and most drivers will keep their vehicles for 5 years or more. The analysis below shows that there is a compelling financial case for drivers of these vehicles to switch to ULEVs.

As identified in section 1.5.1, the majority of these vehicles are either Peugeot E7s (based on Peugeot's Partner van) or LTI TX2/TX4 (the familiar 'black cab'). Nissan's Evalia, based on its ENV200 electric van, is very similar in size and appearance to the E7, and at least one company in the UK will be bringing a full 'black cab' spec version of the Evalia to market in 2016. The range of this vehicle is enough for the average daily use of a Leicester HC, but drivers will most likely want to opportunity charge for a few minutes each day to feel comfortable, especially in cold weather when they will be using the heater.

[9] There are no plans to convert the Nissan Evalia to London black cab specification, as this requires a modification to the turning circle which would be overly costly. This may be why it is not currently on OLEV's list. However, the planned conversion will meet black cab spec for all cities other than London. It should also be noted that as it is based on Nissan's ENV200 van, this taxi also qualifies for the £8,000 plug in van grant – this point may be important if Leicester fails in its bid for OLEV taxi funding.

[10] The term 'power-train' is used to describe the collection of principal components providing drive power to the wheels of a vehicle. When discussing conventional vehicles the term 'engine' would be sufficient for comparisons, but with a ULEV there may be any combination of engines, motors, regenerative braking systems, batteries etc.

[11] The Evalia power-train is the same as the Nissan Leaf, although a Hackney spec Evalia will be heavier than a Leaf. The US EPA provides a range of real world test data for the Leaf, and gives it a range of 106 miles in city traffic, but only 62 miles in congestion with the heater on. This range is for the 24 kWh battery – the new 30 kWh battery will extend this a further 25%, to 87-132 miles.

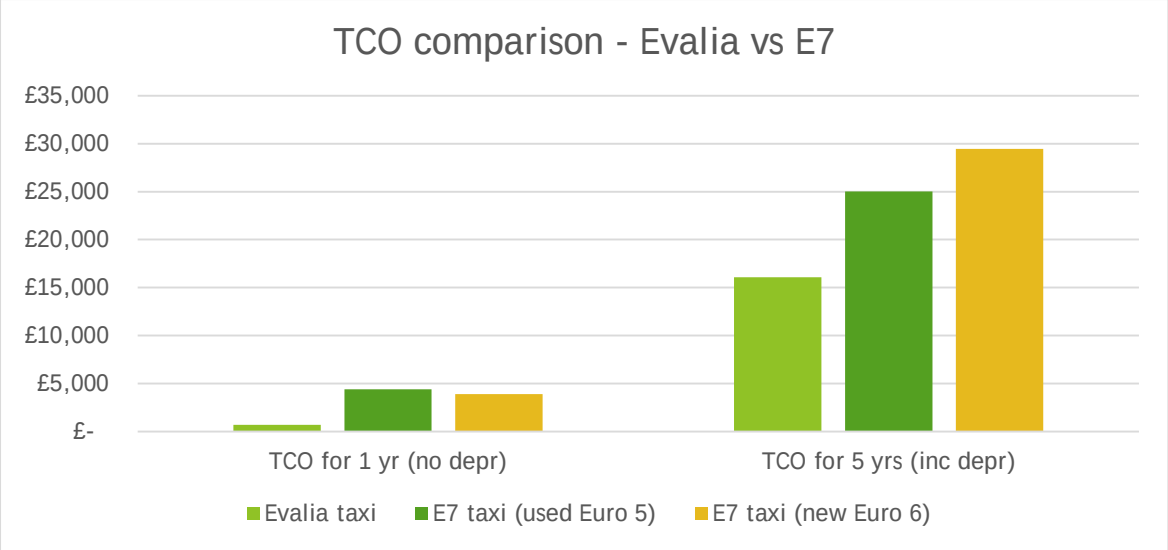


FIGURE 16: TOTAL COST OF OWNERSHIP COMPARISON BETWEEN NISSAN EVALIA AND PEUGEOT E7

Figure 16 above compares the total cost of ownership for the Evalia and the E7. The annual running costs for the Evalia are around £480, compared to £3,895 for a new E7, mainly due to fuel cost savings. Even allowing for the higher purchase price and depreciation on the Evalia (price is estimated at £36,000 after grant, compared to £27,000 for the E7) the Evalia still costs about half as much over 5 years once depreciation is included.

The Fraser-Nash 'Metrocab' is currently being trialled in London, and is due to go on sale more widely in summer 2016. Although no official announcement has yet been made on price, in private conversation Fraser-Nash have told the study team that they expect the price to be the same as a diesel equivalent black cab even before the £8,000 taxi grant. In this TCO comparison the study takes a conservative position, putting the price of the Metrocab at £36,000 after the grant (i.e. £44,000 base price) as against £40,000 for a new TX4. In practice it is not clear whether LTI will produce a diesel only Euro 6 TX model, or whether they will only offer the hybrid TX5, in which case drivers wanting an iconic 'black cab' may have to choose between a ULEV, or a used TX4, also shown here.

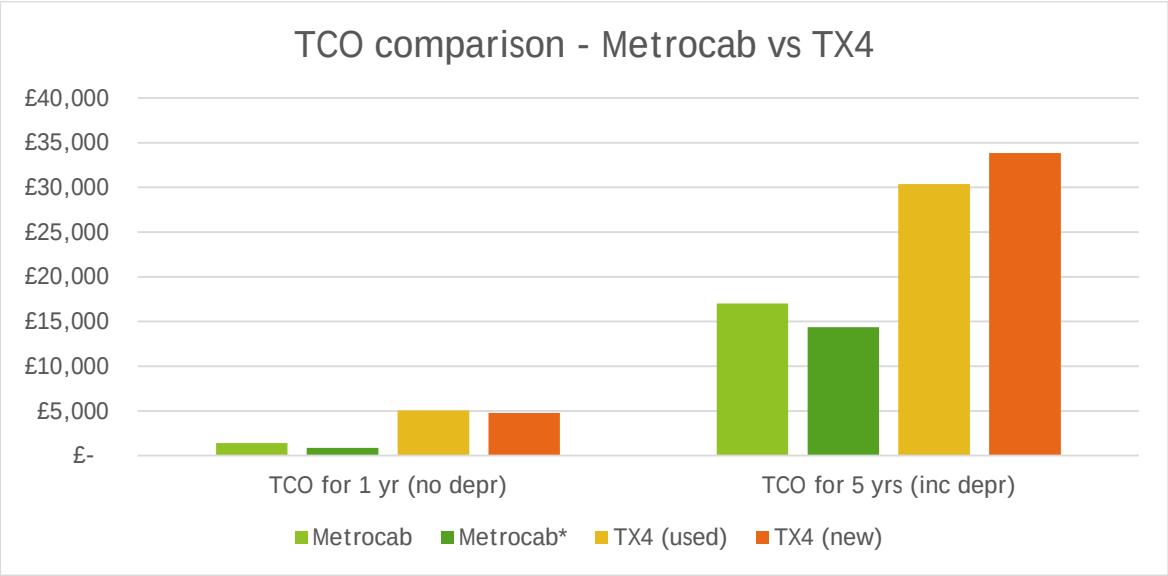


FIGURE 17: TOTAL COST OF OWNERSHIP COMPARISON OF METROCAB AND TX4

In Figure 17 above, it can be seen that TCO for the Metrocab is less than half that of the TX4, either new or used. The light green bar shows the Metrocab running on 2/3 electricity, and 1/3 on its petrol range extender – given the vehicle's 45 mile electric range, this would be the case if drivers simply charged

overnight. The dark green bar, marked 'Metrocab*', shows the effect of drivers taking a short opportunity charge during the day, allowing for 100% electric operation.

3.2.2 Private Hire Vehicles in the city of Leicester

As they are not restricted to the full wheelchair access specification of a city Hackney Carriage, most cars can be used as a private hire vehicle. Therefore, most of the ULEVs currently on the market could be considered here. However, in practice the range is limited by price.

The Prius is a model already well understood by taxi drivers, and therefore seems a good option. Other plug-in hybrids on the market are the Audi Sportback e-Tron and the Volkswagen Golf GTE.

The range of full electric vehicles is more limited, but the Nissan Leaf remains a stand-out and is shown here. The Nissan Evalia or ENV200 Combi are both based on the Leaf battery and power-train and offer a good alternative to the Leaf for a taxi driver who wants a larger 'people-carrier' style vehicle.

TABLE 7: ULEVS CHOSEN FOR TOTAL COST OF OWNERSHIP COMPARISON FOR PHVS

	**Plug-in Prius** Available: Now Power-train: Plug-in hybrid Battery: 4.4 kWh Electric range: ~15 miles Engine: 1.8 litre petrol engine (Euro 6) Price: £28,245 after grant Conventional equivalent: Prius, Avensis
	**Nissan Leaf** Available: Now Power-train: Pure electric Battery: 24 kWh (30 kWh option available 2016) Electric range: ~70-124 miles[12] Price: 24 kWh - £20,790 after grant[13] 30 kWh - £24,490 after grant[12] Conventional equivalent: Ford Focus, Vauxhall Astra

As already noted, PHVs within Leicester do a higher average daily mileage than HCs, 85 miles vs 75 miles respectively. However, this distance is still just within the range of all electric vehicles such as the Nissan Evalia and Leaf, and comfortably so if the driver can opportunity charge for 20-30 minutes per day.

For the purposes of this analysis two vehicles were compared, the Nissan Leaf and the Plug-In Prius.

[12] As noted in earlier note, this range of 70-124 miles is based on US EPA tests of the 24 kWh battery version. This range will be extended by around 25% in the 30kWh version.
[13] Including ownership of car and battery

The Total Cost of Ownership (TCO) in Figure 18 below therefore compares the Leaf, the Plug-in Prius, the standard Prius and the Toyota Avensis diesel. The red bar for the Plug-in Prius shows costs when charging overnight only, whereas the bar marked 'Plug-in Prius*' shows the costs when the driver recharges the battery twice each day.

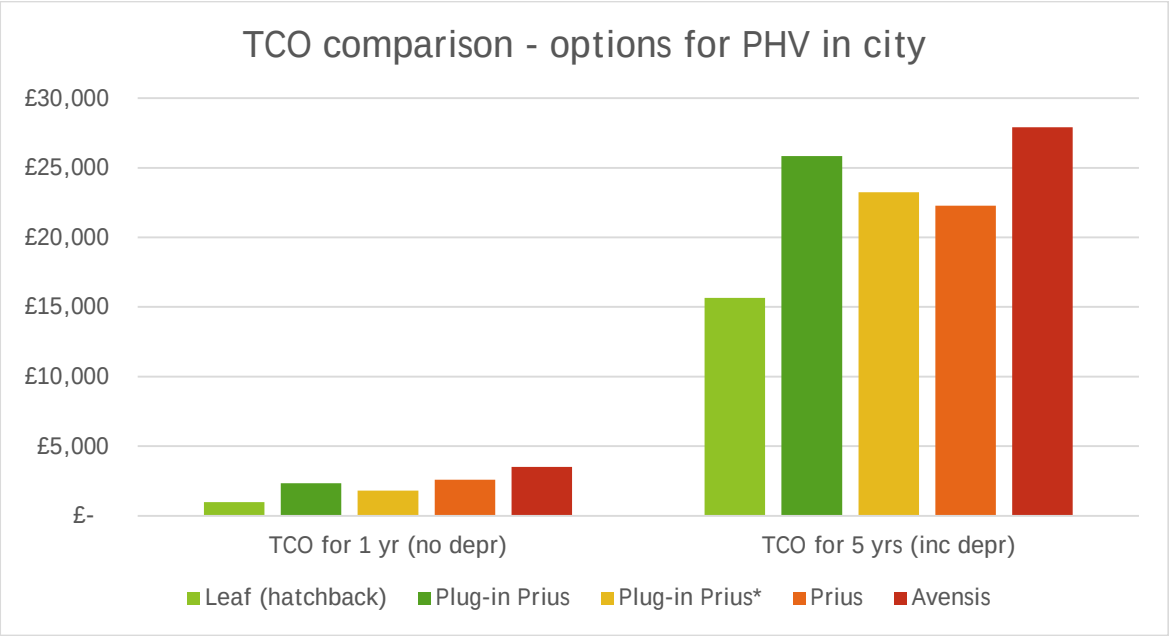


FIGURE 18: TOTAL COST OF OWNERSHIP COMPARISON FOR PHV VEHICLE OPTIONS IN CITY OF LEICESTER

It can be seen that the running cost savings for the Plug-in Prius are modest, even with opportunity charging. The Leaf, the conventional Prius and the Avensis are all similar in price (around £21,000 new), whereas the Plug-in Prius is around £7,500 more expensive even after the government grant. Other Plug-in hybrids are available with larger batteries, such as the Audi Sportback e-Tron, but still at a considerable cost premium. It seems likely that over the next few years the range of models available will increase, and costs will come down, at which point these technologies are likely to become more attractive.

3.2.3 HCs and PHVs in the districts outside Leicester

Taxis outside the city have considerably higher average daily mileages than those primarily operating within the city. They are also much more likely to get occasional very long fares of well over 100 miles. Based on this, it is concluded that pure electric vehicles are not suitable for these duties.

The comparison below therefore compares the Plug-in Prius with the standard Prius and the Toyota Avensis diesel. It differs from the comparison in Figure 18 as the assumed annual mileage is much higher, 40,000 miles as opposed to 25,000 miles. As before, the bar for 'Plug-in Prius*' shows the results if the driver is able to opportunity charge the battery twice during the day – an assumption that may be harder to achieve in practice outside the city, where charge points will be more widely dispersed.

As noted for vehicles in the city, plug-in hybrids may well become a more attractive option in the next few years, as more models become available and costs come down. However, even then, hybrids will never achieve the same savings on longer journeys as they do in congested urban areas where stop-start driving allows the hybrid to save relatively more energy.

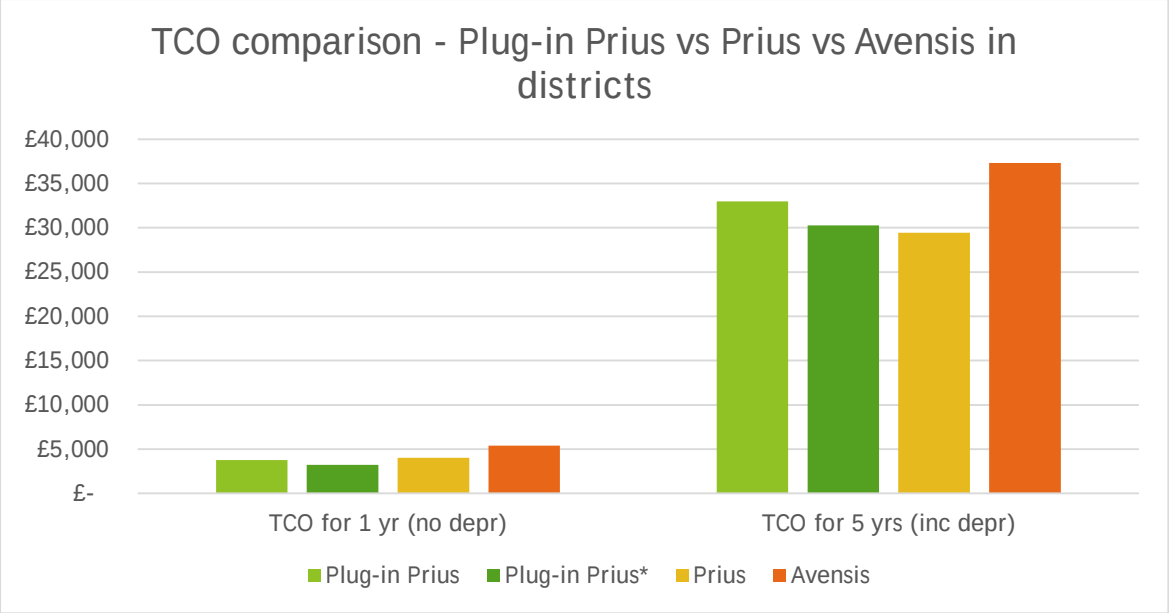


FIGURE 19: TOTAL COST OF OWNERSHIP - PLUG-IN PRIUS VS PRIUS VS AVENSIS IN THE DISTRICTS

3.3 Other considerations and incentives

3.3.1 Driver turnover

Driver turnover is low – of those questioned, 90% had been a taxi driver over 5 years, and 70% over 10 years. This has implications for communication and education efforts – it will be worth putting time and effort into personal communication, demonstration of vehicles etc, rather than just cheaper but broader media such as websites.

3.3.2 Vehicle turnover

Vehicle turnover is also low, which is extremely important when considering the likely uptake rate of new technologies. 13% of black cab drivers said they change their vehicle every 3 years, but 67% said they only change their vehicle once it is too old to be licensed, and the overall vehicle data shows that even when drivers change vehicles sooner, that vehicle will be sold to another driver and remain in the fleet.

Among other types of vehicle, drivers do change more often, but the vehicles still remain within the fleet until they are too old to be relicensed. 8% of non-black cab drivers change their vehicle every year, and 39% change every three years. Another 39% say they keep their vehicle until it is too old to be licensed again.

3.3.3 Driver willingness to try ULEVs

When asked whether they would be willing to consider a ULEV for their next vehicle, drivers were very open to the idea. As shown in Figure 20 below, black cab drivers were more cautious, with 40% saying yes and 45% maybe. Among other drivers, over half (59%) said yes, and 28% maybe. This difference is perhaps not surprising, as most drivers will be familiar with the Prius, but there are as yet no ULEV black cabs in the market.

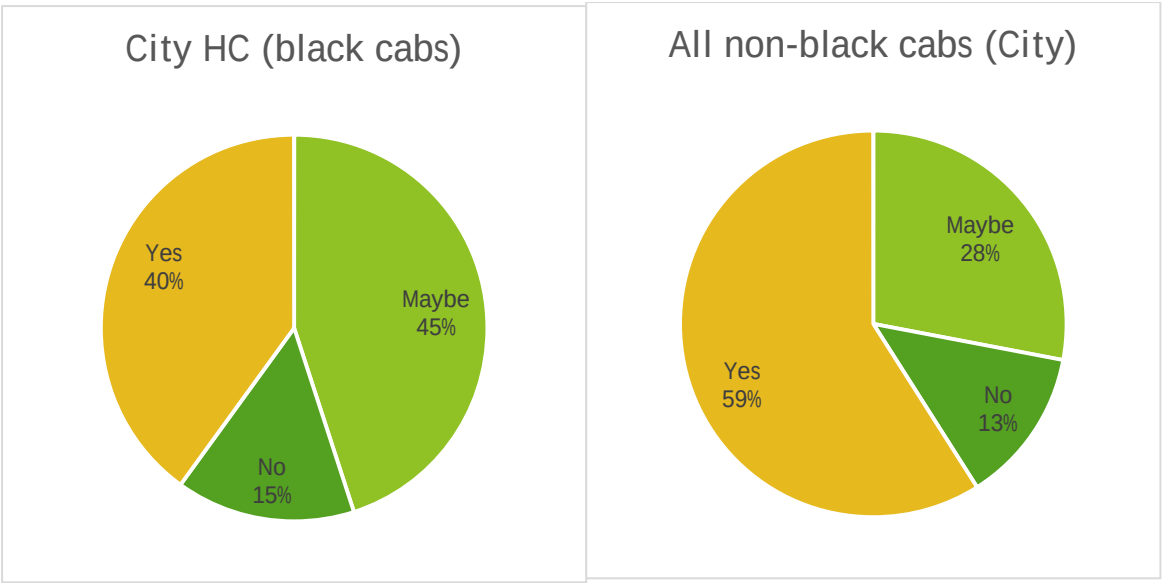


FIGURE 20: RESPONSES TO THE QUESTION, 'WOULD YOU CONSIDER AN EV OR PLUG-IN HYBRID FOR YOUR NEXT VEHICLE?'

3.3.4 Overnight parking and charging

Overnight charging of a ULEV taxi will clearly be challenging for drivers who do not have off-street parking at home. In the districts, 78% of drivers park in a garage or driveway, but in the city there are 37% of drivers who park on the street overnight. Most of these do usually park by their house, and Leicester City Council are pursuing a number of initiatives to bring overnight charging to those in terraces or flats. This includes a partnership with British Gas to roll out an effective vehicle recharging network in Leicester.

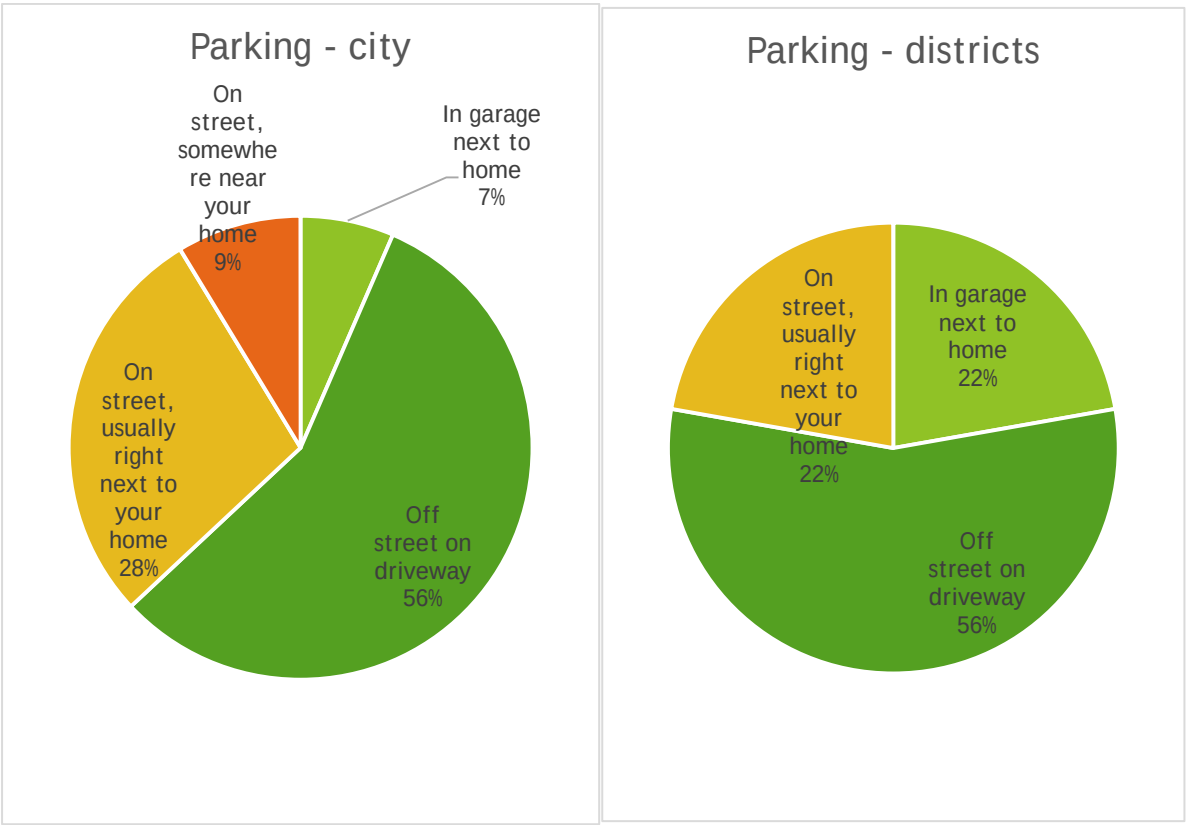


FIGURE 21: LOCATIONS OF OVERNIGHT PARKING FOR BLACK CABS AND OTHER TAXIS

3.3.5 Other incentives

A range of other incentives for taxi drivers to adopt ULEVs are under consideration. The full list was presented to drivers as part of the questionnaire, and drivers were asked to pick the top three that they felt would influence them – the results are illustrated in Figure 22 below.

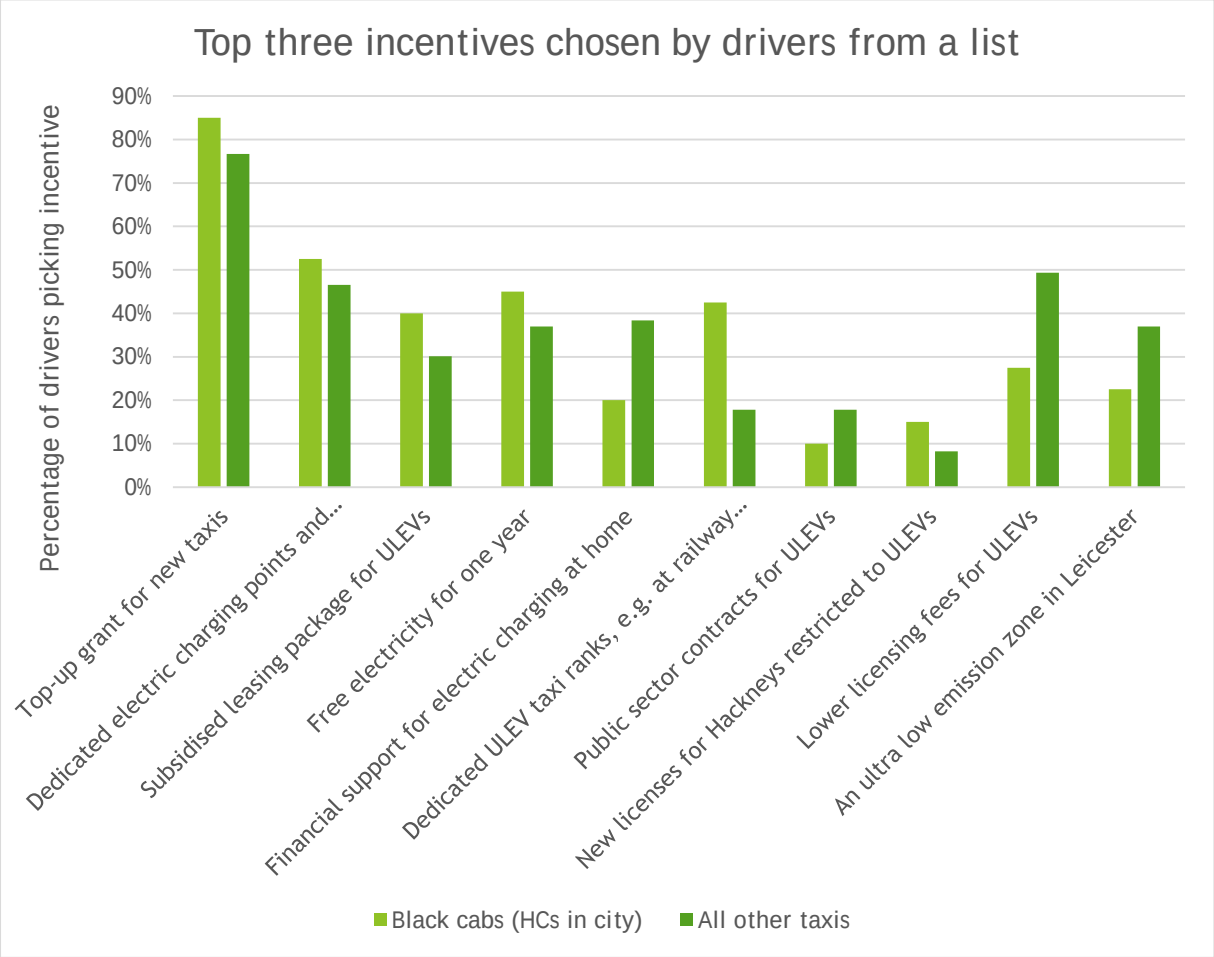


FIGURE 22: DRIVER RESPONSES TO SUGGESTED LIST OF ULEV INCENTIVES

Unsurprisingly, cash grants towards vehicles were the most popular. Dedicated charge points and parking spaces were the next most popular, as were dedicated taxi ranks, and this report confirms that these will be important if ULEV taxis are to be a viable option for many. The idea of a subsidised leasing package was also popular.

The least popular measure was the restriction of new licenses to ULEVs – unsurprisingly drivers were wary of showing support for possible regulation that would limit their choices.

Of other possible incentives, the only one that many drivers suggested was to extend the age limit for ULEVs, allowing them to be used for longer than conventional vehicles.

4 Uptake scenarios

In all of the projections below, the assumption about vehicle turnover is of critical importance. Even if it were possible to achieve 100% take up of ULEVs immediately, this would only apply to new vehicles entering the fleet. Given that vehicles in the city are allowed to be up to 11 years old in the city, and 6 years old (or older if in excellent condition) in the districts, it will take at least this long for the whole fleet to switch, and in practice considerably longer. Changes in regulation, as currently under consultation in Leicester, could speed up this process considerably, and this approach is also modelled.

4.1 Hackney Carriages in Leicester (black cabs)

In Figure 23 below, ULEV uptake is heavily dependent on vehicle turnover, which is based on the age profile of the current fleet. In the low and medium scenarios all vehicles make it to 11 years old and are then being replaced. In the high scenario, this age limit is reduced to 8 years from 2017 onwards. The high scenario therefore has a different profile for vehicle turnover compared to the low and medium scenarios, with a large number of vehicles needing to be replaced in 2018 following the lowering of the age limit. This is shown in detail in Table 8 below.

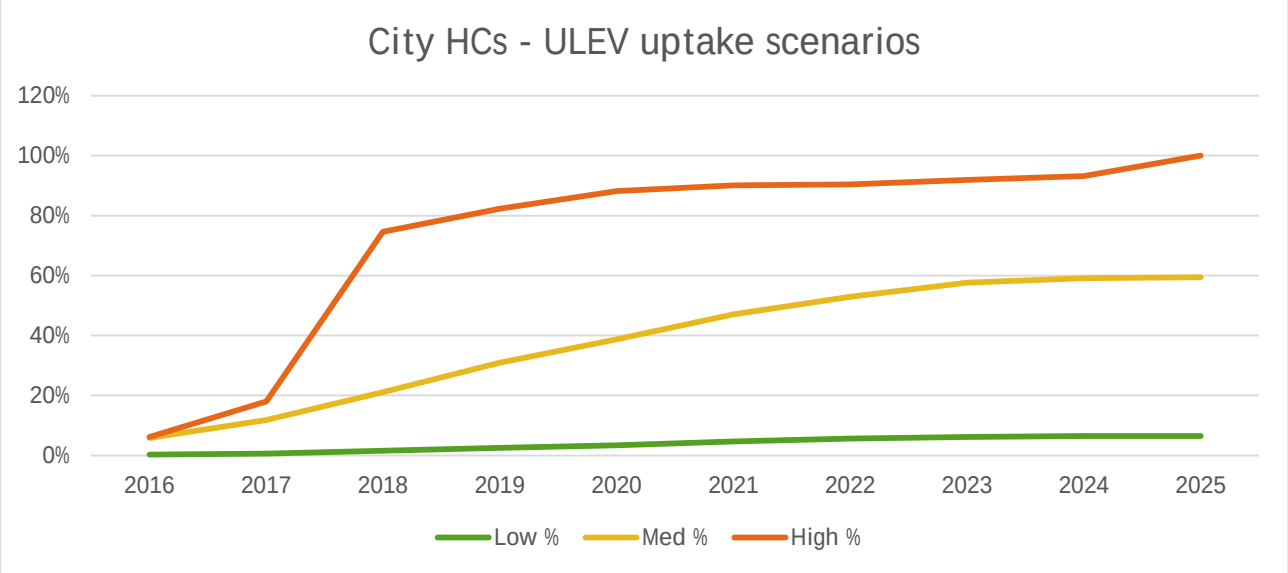


FIGURE 23: SCENARIOS FOR UPTAKE OF ULEVS IN CITY HC FLEET

TABLE 8: VEHICLE TURNOVER FOR DIFFERENT SCENARIOS, BASED ON VEHICLES REACHING MAXIMUM AGE

Scenario	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Low/Med	42	38	54	53	38	38	25	19	6	22
High	42	38	183	25	19	6	1	5	4	42

The three scenarios are based on the following assumptions:

Low – ULEV uptake in the HC fleet happens and increases at the same rate as hybrids were adopted by the PHV fleet (see section 4.2 below).

Medium – uptake of ULEVs starts at 40% of vehicle replacements, which is the % of drivers who said they would consider a ULEV as their next vehicle. Popularity then grows 5% year on year, due to word of mouth. This is not considered unreasonable given the clear cost savings associated with ULEVs.

High – this scenario is based on the regulatory changes currently under consultation in Leicester. The proposal is that from 2017, all vehicles being registered as taxis for the first time will have to be ULEVs[14].

[14] The council is also consulting on whether to lift the restriction on the number of HC licenses issued, which would see HC numbers increase over time. This has not been modelled, as speculation on any possible increase in fleet size lies outside the scope of this report.

In addition, in order to hit a 100% ULEV target by 2025, it is also assumed that the age limit for taxis is reduced from 11 to 8 years, meaning that no vehicles pre-dating the rule change could still be on the fleet in 2025. It is assumed that in 2016, before the rule change is introduced, 20 ULEVs come on to the fleet as a result of the council buying and leasing them to drivers.

The uptake of grants, and the associated cost, for each scenario is shown in Table **9** below.

TABLE 9: GRANT UPTAKE FROM 2016-2020 UNDER DIFFERENT SCENARIOS

Scenario	2016		2017		2018		2019		2020	
	Grants	Cost	Grants	Cost	Grants	Cost	Grants	Cost	Grants	Cost
Low	(1)	£8,000	1	£8,000	3	£24,000	3	£24,000	3	£24,000
Med	(19)	£152,000	19	£152,000	30	£240,000	32	£256,000	25	£200,000
High	20	£160,000	38	£304,000	183	£1,464,000	25	£200,000	19	£152,000

4.1.1 Impact of HC ULEV uptake scenarios on vehicle emissions

Approximately half of the taxi models are LTi TX2/TX4 with the other half being Peugeot E7 and a mixture of Mercedes Vito and VW Transporter. The emissions savings from switching to ULEVs have been modelled assuming that incoming ULEVs are 50% Metrocab and 50% Evalia. The baseline for comparison is that all vehicles coming into the fleet are Euro 6 – emission savings are those *over and above* what would happen as vehicles are naturally replaced by Euro 6, not the savings from replacing the current fleet.

For the purpose of calculating emissions savings it is assumed that the Metrocabs do 66% of their miles in electric mode. Based on the data collected, this should be quite easily achievable – as detailed in section 5.2, on a typical day a Metrocab should only need one 20 minute opportunity charge at a 22kW fast charger to do 100% in EV mode.

NOx

Based on the above assumptions, the model shows the Metrocab saves an average of 26 kg of NOx per vehicle per year. The Evalia saves an average of 21 kg of NOx per vehicle per year, and the overall average saving per ULEV is 24 kg/yr.

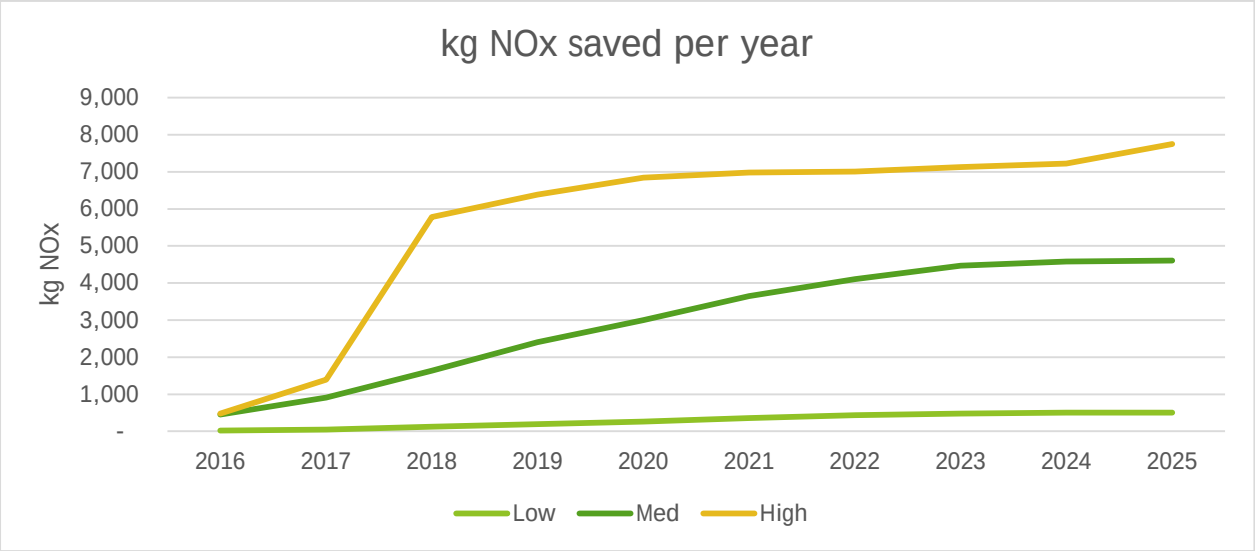


FIGURE 24: KG OF NOX SAVED PER YEAR BY DIFFERENT UPTAKE SCENARIOS OF ULEVS IN THE LEICESTER HC FLEET

The NOx emissions saving when all 100% are ULEV would be 7.75 tonnes per year, over and above what would be achieved by converting 100% of the fleet to Euro 6 diesel.

TABLE 10: TOTAL YEARLY NOX SAVINGS (KG) UNDER EACH SCENARIO 2016-2020

Scenario	2016	2017	2018	2019	2020
Low	24	48	120	192	264
Medium	456	912	1,632	2,400	3,000
High	480	1,392	5,784	6,384	6,840

Particulate Matter (PM)

Modelled PM savings are minimal, due to the very low PM from Euro 6 vehicles. The Evalia saves 160g per vehicle year, and the Metrocab 106g. The total saving once 100% are ULEV is 43kg/yr.

It should be noted that the above savings are based on the assumption that diesel taxis meet their Euro Standard limit. However, there is evidence to suggest that taxi operations, characterised by short journeys and idling, lead to a build-up of particulates in filters which then purge in the urban environment. These figures are therefore likely to be an underestimate.

CO_2e

Based on the above assumptions, the model shows the Metrocab saves an average of 6 t of CO_2e per vehicle per year. Each Evalia saves an average of 4.8 t of CO_2e per vehicle per year, and the overall average saving per ULEV is 5.4 tCO_2e/yr.

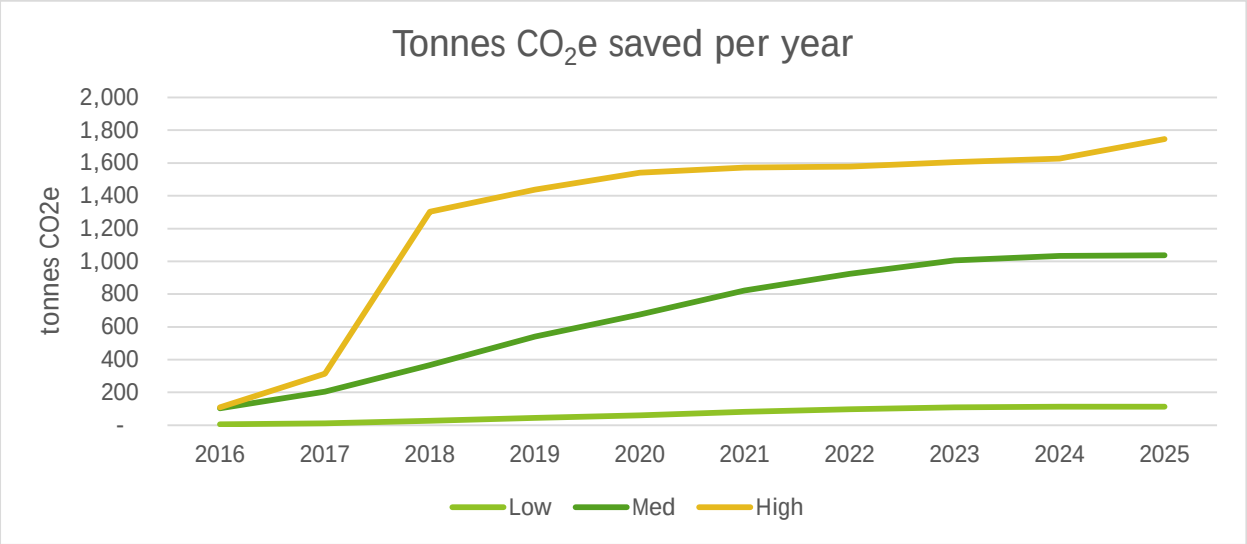


FIGURE 25: TONNES OF CO_2E SAVED PER YEAR BY DIFFERENT UPTAKE SCENARIOS OF ULEVS IN THE LEICESTER HC FLEET

The CO_2e emissions saving when all 100% are ULEV would be 1,745 tonnes per year, over and above what would be achieved by converting 100% of the fleet to Euro 6 diesel.

TABLE 11: TOTAL YEARLY CO_2E SAVINGS (TONNES) UNDER EACH SCENARIO 2016-2020

Scenario	2016	2017	2018	2019	2020
Low	5	11	27	43	59
Medium	103	205	367	540	676
High	108	313	1,302	1,437	1,540

4.2 Private hire vehicles in Leicester

Hybrids, mainly the Toyota Prius, already make up around 10% of the private hire fleet in Leicester. Furthermore, the percentage of new vehicles entering the fleet in a given year that are Prius's has been

rising year on year, and is currently around 20% - as illustrated in below. The trend shows that the Prius has grown in 'popularity' at about 1.6% year on year, purely by word of mouth between drivers.

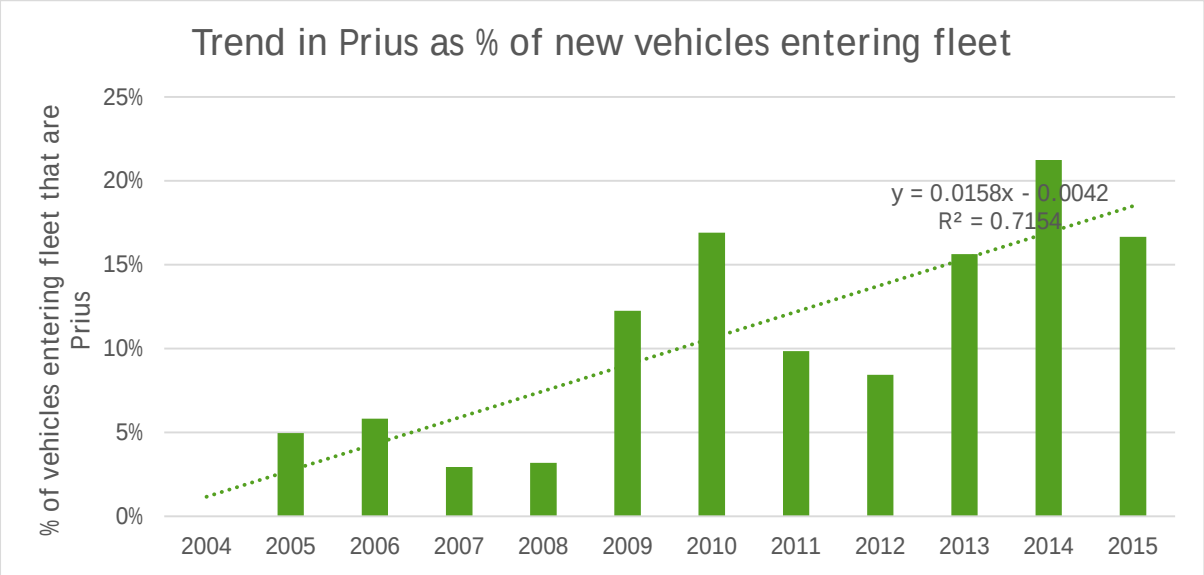


FIGURE 26: TREND IN PRIUS AS % OF NEW VEHICLES ENTERING THE CITY PHV FLEET

As with the HC projections, vehicle turnover is based on the age profile of the current fleet, with all vehicles making it to 11 years old and then being replaced. Unlike the HC fleet, the largest turnover of the PHV fleet is not expected for another 5 years or so (based on the current age of vehicles). Therefore there is the chance for learning to occur, and new ULEV models to come into the market, to supply a later surge of ULEV purchases.

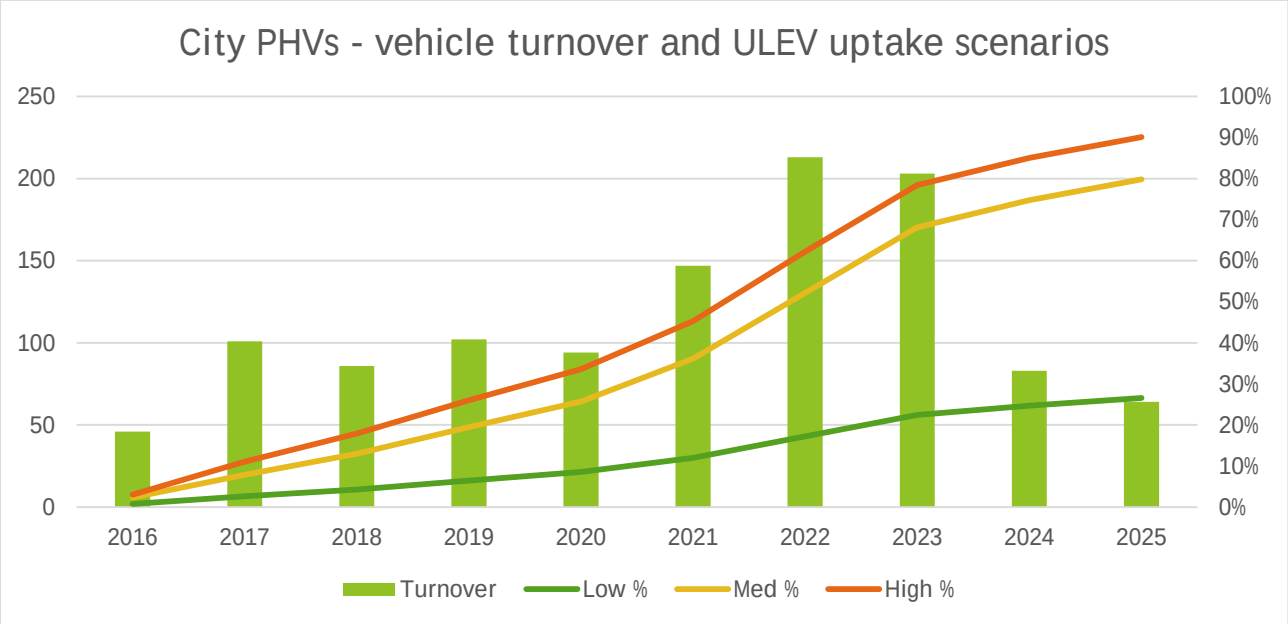


FIGURE 27: SCENARIOS FOR UPTAKE OF ULEVS IN CITY PHV FLEET

A similar set of assumptions are used for the scenarios illustrated in Figure 27 above as were used for HCs in the city, specifically:

Low – ULEV uptake happens and increases at the same rate as hybrids were adopted.

Medium – uptake of ULEVs starts at 59% of vehicle replacements, which is the % of drivers who said they would consider a ULEV as their next vehicle. Popularity then grows 5% year on year, due to word of mouth. This is not considered unreasonable given the clear cost savings associated with ULEVs.

High – uptake of ULEVs starts at 73% of vehicle replacements, which is the % of drivers who said they would consider a ULEV as their next vehicle plus 50% of the 'maybes'. Popularity then grows at 10% year on year.

TABLE 12: NUMBER OF NEW ULEVS COMING ONTO THE PHV FLEET EACH YEAR 2016-2020 UNDER EACH SCENARIO

Scenario	2016	2017	2018	2019	2020
Low	10	23	21	27	26
Medium	29	70	64	81	79
High	38	94	86	102	94

4.2.1 Impact of PHV ULEV uptake scenarios on vehicle emissions

The modelled emissions reductions assume all ULEVs are Leafs, and it is also assumed that 30% of the comparison Euro 6 vehicles are normal Prius, and 70% are Toyota Avensis. In the text below, detailed figures are given for the medium uptake scenario.

NOx

Each vehicle saves 15.6 kg of NOx per year. In the medium scenario, this amounts to 15 tonnes NOx per year saved over and above Euro 6 by 2025, even when 30% of those Euro 6 are petrol hybrids.

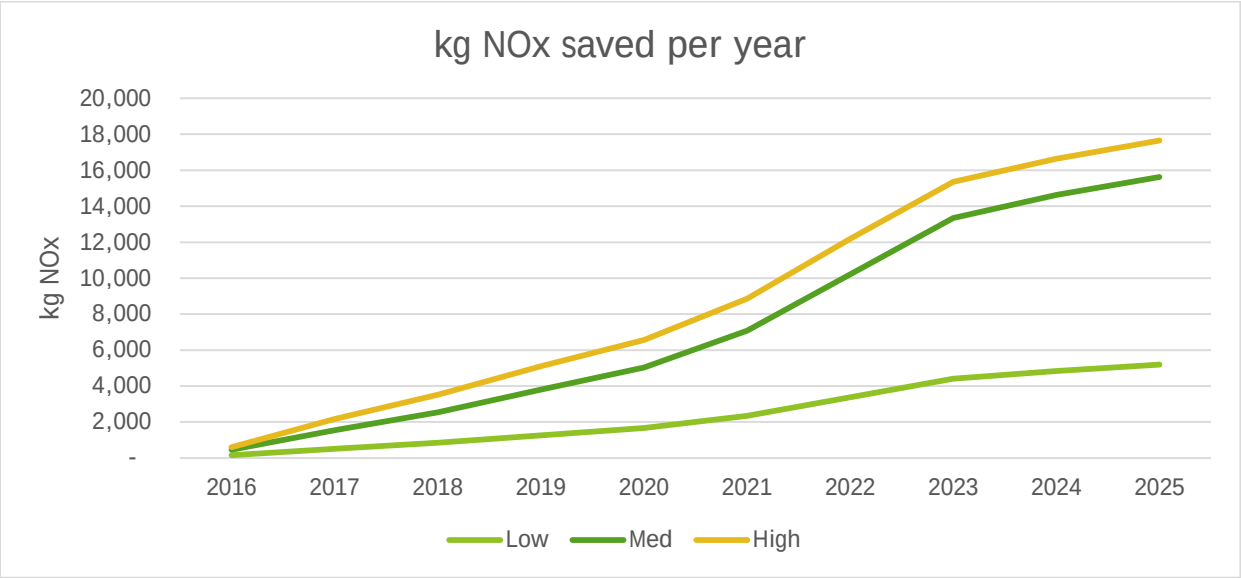


FIGURE 28: KG OF NOX SAVED PER YEAR BY DIFFERENT UPTAKE SCENARIOS OF ULEVS IN THE LEICESTER PHV FLEET

TABLE 13: KG OF NOX SAVED PER YEAR BY ULEV PHVS 2016-2020 UNDER DIFFERENT SCENARIOS

Scenario	2016	2017	2018	2019	2020
Low	156	515	842	1,264	1,669
Medium	452	1,544	2,543	3,806	5,039
High	593	2,168	3,510	5,101	6,568

PM

Each ULEV saves 200g of PM per year. In the medium scenario, this totals 192 kg/yr by 2025.

CO_2e

Each vehicle saves 4.2 tonnes CO_2e/yr. Ultimate savings in the medium scenario are 4,208 tonnes/yr.

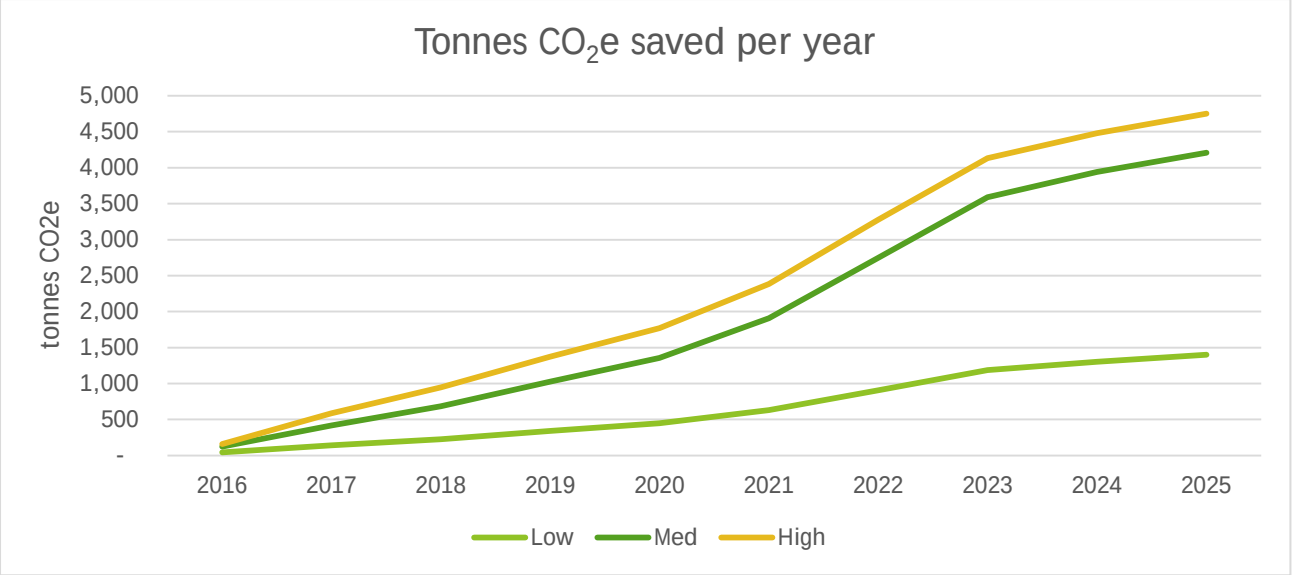


FIGURE 29: TONNES OF CO_2E SAVED PER YEAR BY DIFFERENT UPTAKE SCENARIOS OF ULEVS IN THE LEICESTER PHV FLEET

TABLE 14: TONNES OF CO2E SAVED PER YEAR BY ULEV PHVS 2016-2020 UNDER DIFFERENT SCENARIOS

Scenario	2016	2017	2018	2019	2020
Low	42	139	227	340	449
Medium	122	416	685	1,025	1,357
High	160	584	945	1,373	1,768

4.3 Vehicles in district taxi fleets

Given the lack of a compelling financial case for drivers in the districts to purchase any of the ULEV models currently in the market, no projections of ULEV uptake have been made. Despite their popularity with taxi drivers generally, standard hybrids like the Prius make up only 4% of the taxi fleet in the districts, compared to 10% in the city. All of that 4% are HCs, probably spending more time in urban traffic conditions and therefore able to recover more energy via their hybrid power-train.

Rather than expecting a widespread uptake of ULEVs across the fleet, the data collected in this report suggests ULEVs in the districts will need to be targeted at certain operations. Private Hire Operators who purchase and manage their vehicles centrally are likely to be the first adopters. Such companies may be in a position to run a fleet combining some fully electric vehicles and some suited to longer journeys, and allocate jobs to each accordingly. They may also be able to negotiate better deals on vehicle price, and access more favourable finance, all helping to make the financial case.

5 Infrastructure requirement

5.1 Summary of charge point types

Some public charging infrastructure is already available in Leicester, provided by the Plugged In Midlands programme, which has become part of Chargemaster's national 'Polar' network. These charge points, plus others provided by other companies, are shown in Figure 30 below, which is a screenshot from the 'Zapmap' website.

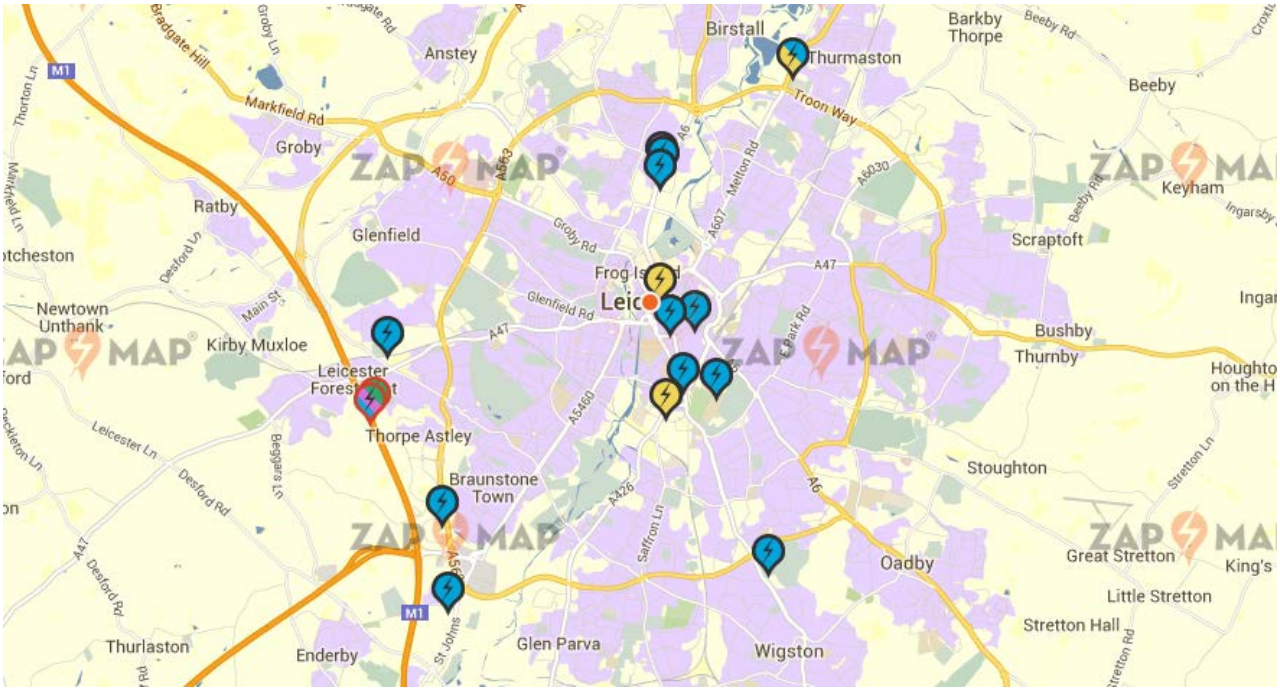


FIGURE 30: MAP OF CURRENT CHARGE POINTS IN LEICESTER (SOURCE WWW.ZAPMAP.COM)

There are three types of charge point appropriate to serve the taxi fleet (in addition to the standard 13A home charger that each driver will need for overnight charging). These are shown, along with their costs, in Table 15 below and illustrated in Figure 31.

TABLE 15: DETAILS OF CHARGE POINT TYPES

Type	***Rapid***	***Fast (22kW)***	***Fast (7kW)***
Capacity	43 kW (AC)	22 kW	7 kW
Cost	£30,000	£5,000	£2,500
Connection + civils	£5,780	£3,780	£3,280
Tot cost	£35,780	£8,780	£5,780
Cost per kW	**£416**	**£199**	**£412**
Notes	3 outlets with different connectors, 2 vehicles charging at once	Cost is for standalone post with 2 outlets	Cost is for standalone post with 2 outlets

Much of the public discussion about infrastructure focuses on the deployment of rapid chargers, as these are fast enough for 'while you wait' charging. However, as can be seen from the table, the cost per kW of installed capacity is twice as high for a rapid charger as it is for a fast (22kW) charger. Given that taxi drivers report that they usually have at least one wait of 30 minutes (more normally 60-90 minutes) per day, 22 kW fast chargers may be more appropriate, as for a given budget twice as much capacity, and four times as many locations can be provided.

FIGURE 31: EXAMPLES OF RAPID (LEFT) AND FAST (RIGHT) CHARGERS PROVIDED BY CHARGEMASTER

5.2 Number of charge-points required to support uptake scenarios

Given the uptake scenarios suggested in section 4, estimates were made of the number of charge points of different types that would be required to support the projected numbers of vehicles. In order to do this the following assumptions were made. (This section only applies to Leicester City although some examples have used Market Harborough data).

First, the mix of vehicles was considered. In the hackney fleet it was assumed that 50% of ULEVs would be Metrocabs (replacing the roughly 50% of the current fleet which are TX2 or TX4), and 50% would be Evalias (replacing the E7s, and assorted other similar vehicles).

Second, an estimate was made of how long each charge would need to be on average. In order to complete the average daily HC mileage of 75 miles on electric power, the Metrocab would need an additional 10 kWh above its initial full battery, in an estimated 'worst case'. The Evalia, with a larger battery and lower consumption per mile, would need only an extra 5 kWh. The average would therefore be 7.5 kWh for HCs. For PHVs the Evalia would need an extra 9 kWh to complete 85 miles, if conditions were poor.

Another consideration is the charging 'window'. None of the vehicles will want to charge early in the day, as it seems safe to assume that they will all charge overnight (if doing a day shift) and start the day with a full battery. Likewise, they are less likely to charge at the very end of the day, as by then they may well be past the time they need it.

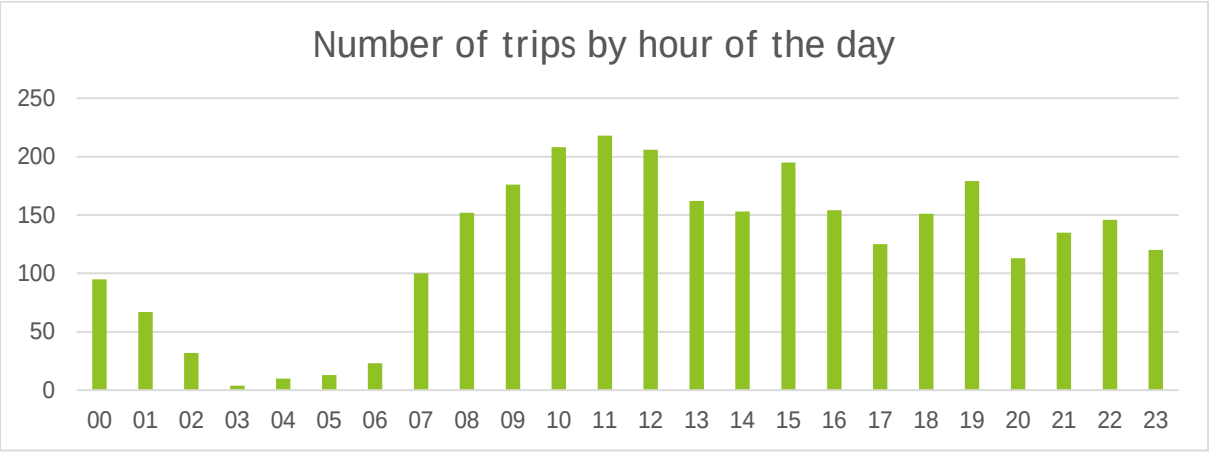


FIGURE 32: NUMBER OF TAXI TRIPS PER HOUR THROUGHOUT THE DAY, BASED ON PHV DATA IN MARKET HARBOROUGH

Figure 32 shows number of trips per hour throughout the day, based on data from a taxi firm in Market Harborough[15]. It confirms anecdotal evidence that there is a morning and evening peak in activity, and it suggests that the morning peak builds until around 11am. For the purposes of this exercise, therefore, it has been assumed that taxis will need to make their top-up charges between 11am and 5pm, a window of 360 minutes.

The length of time taken to provide a 7.5 kWh and 9 kWh charge was then calculated for each type of charge point. In addition, an extra 3 minutes was added to each charge, to reflect the time needed to change over from one cab to the next – assuming the next vehicle is ready and waiting. The 360 minute charge window was then divided by the number of minutes for each charge, to give the number of cabs that could be supported by one charge point. (Note, charge point here refers to a single outlet – many charge posts have two outlets, so half as many posts would be needed.)

One additional assumption was made, that only two thirds of vehicles would actually take an opportunity charge in the window on any given day. This reflects vehicles that are off the road, on a night shift, having a slow day or any other reason.

Figure 33 shows the number of charge points that would be required to support the 'high' uptake scenario for HCs in Leicester. Several points can be noted in the graph:

- First, the number of charge points is very low in the first few years – ideally during this time more capacity than needed would be installed to reassure drivers, and its usage observed to allow additional capacity to be more 'fine-tuned' to match demand.
- Second, although a rapid charger delivers charge at roughly double the speed of a 22 kW fast charger, it doesn't take twice as many fast chargers
- To deliver the same capacity as rapid chargers. This is because of the changeover time. Rapid chargers would take up to 15 minutes to deliver the charge required, fast chargers up to 30 minutes, but with charges being so short, the 3 minutes estimated 'changeover' time is quite significant, and it will be the same for both types of charger. (It might even be longer for a rapid charger.)

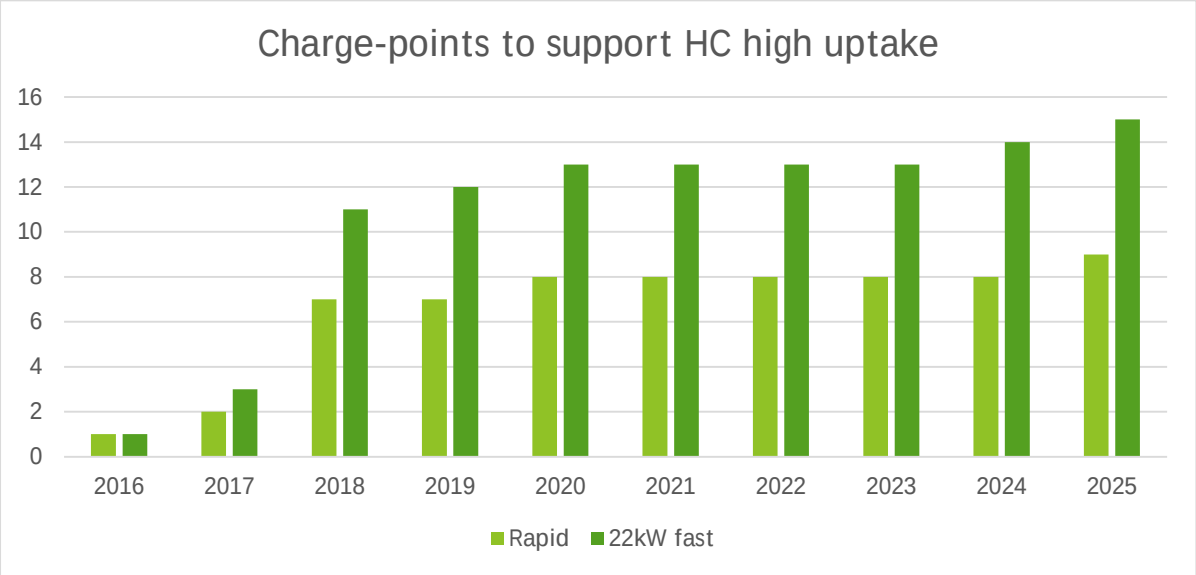


FIGURE 33: NUMBER OF CHARGE POINT OUTLETS REQUIRED TO SUPPORT A HIGH UPTAKE SCENARIO FOR CITY HCS

Overall, on these assumptions it would need only 9 rapid charge outlets, at a cost of £161,010, to support a 100% switchover of the HC fleet to ULEVs. However, the same ULEVs could be supported with 14 22kW fast charger outlets, at less than half the cost (£65,850) and with the added advantage of providing 14 different locations.

[15] This was the only taxi company we could get data from during the course of the study, but for future planning it is recommended that data is obtained from more firms to plan charge point provision.

TABLE 16: CHARGER INSTALLATION PROGRAMME OPTIONS TO SUPPORT HIGH HC UPTAKE SCENARIO 2016-2020

Year	Charger type	Fast (22 kWh)	Rapid (43 kWh)
2016	Installations in year	1	1
	Total cost	£4,390	£17,890
	Grant sought	£3,293	£13,418
2017	Installations in year	2	1
	Total cost	£8,780	£17,890
	Grant sought	£6,585	£13,418
2018	Installations in year	8	5
	Total cost	£35,120	£89,450
	Grant sought	£26,340	£67,088
2019	Installations in year	1	0
	Total cost	£4,390	£-
	Grant sought	£3,293	£-
2020	Installations in year	1	1
	Total cost	£4,390	£17,890
	Grant sought	£3,293	£13,418

Similarly, Figure 34 below illustrates that the high uptake scenario for PHVs would be supported with 33 rapid charge outlets, at a cost of £590,370. But if 22 kW fast charge outlets are used, 58 outlets could be installed at more locations, costing only £254,620. Table 17 on the following page outlines the first five years of the charger installation programme required, with the estimated cost and grant that could be sought under the OLEV programme.

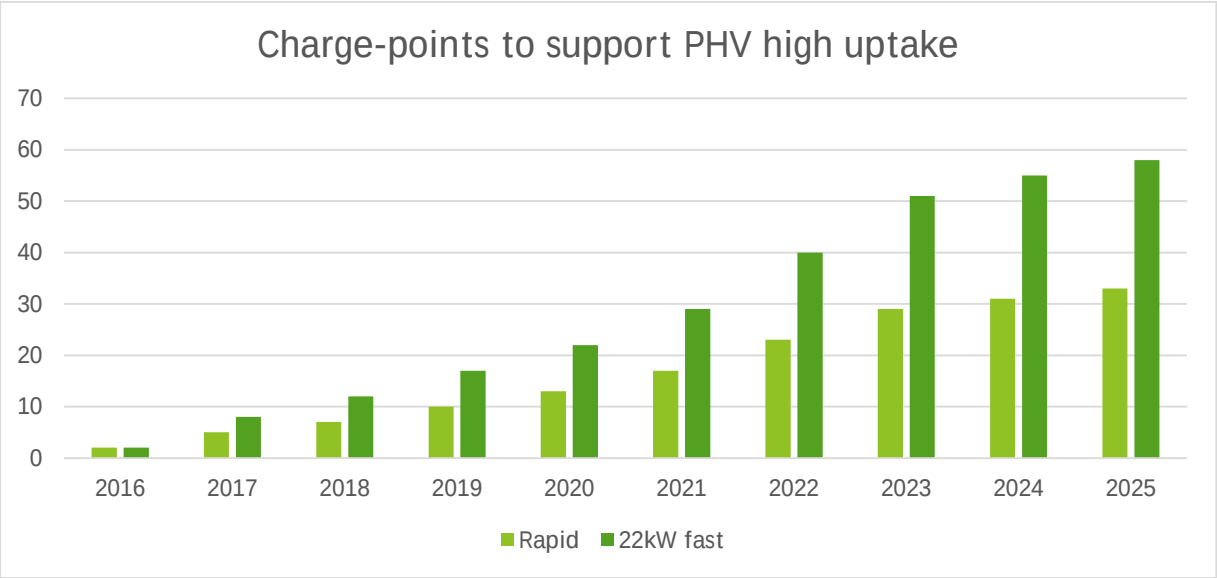


FIGURE 34: NUMBER OF CHARGE POINT OUTLETS REQUIRED TO SUPPORT A HIGH UPTAKE SCENARIO FOR CITY PHVS

Of course in practice the ideal solution will be a mix of rapid and fast chargers. Rapid chargers can provide extra capacity where physical space is at a premium, while fast chargers would allow a greater range of different locations for the same budget.

Equally important will be a real-time booking system that drivers can use to book short time slots (probably 15 minute for rapid chargers, 30 minute for fast chargers). It will also be important that the charging infrastructure is made available exclusively to taxi drivers, at least at the critical time from lunchtime through the afternoon.

TABLE 17: CHARGER INSTALLATION PROGRAMME OPTIONS TO SUPPORT HIGH PHV UPTAKE SCENARIO 2016-2020

Year	Charger type	Fast (22 kWh)	Rapid (43 kWh)
2016	Installations in year	2	2
	Total cost	£8,780	£35,780
	Grant sought	£6,585	£26,835
2017	Installations in year	6	3
	Total cost	£26,340	£53,670
	Grant sought	£19,755	£40,253
2018	Installations in year	4	2
	Total cost	£17,560	£35,780
	Grant sought	£13,170	£26,835
2019	Installations in year	5	3
	Total cost	£21,950	£53,670
	Grant sought	£16,463	£40,253
2020	Installations in year	5	3
	Total cost	£21,950	£53,670
	Grant sought	£16,463	£40,253

5.3 Charging infrastructure location

A great deal of work has already been done by Leicester City Council on charge point location, in support of its Go Ultra Low City bid. However, most of this work has focused on city car parks and infrastructure aimed at the general public. Charge points for taxi drivers need to be specifically tailored to their needs. The general grid capacity is good within the city centre however there are identified areas which would need upgrading, usually with the installation of a small substation. This requirement has been reduced by the recommendation of using 22kW fast chargers over 43kW rapid chargers.

5.3.1 Hackney Carriages

The ideal place for charging infrastructure for HCs ideally would be taxi ranks. However, this will in many cases require a redesign of the current queuing system. The busiest rank in the city is outside the train station, and cabs pay an additional fee to work this rank. While many drivers will wait for 30 minutes or more, several times per day, they wait in a moving queue along Conduit Street – not ideal for charging a ULEV. Figure 35 shows the location of city centre taxi ranks and a number of potential sites in nearby locations outside the inner ring road that can be used for charging infrastructure.

5.3.2 Private Hire Vehicles

PHVs do not use the official taxi ranks, although they may use some of the unofficial ones marked on the map. However, there are a number of locations around the city which receive high traffic from both PHVs and HCs, and would be worth investigating. The council car parks have strong advantages as charge point locations, especially in that they are part of the council's estate and therefore the council does not need to work with other landowners to put in the infrastructure. During the research for this study, drivers and operators specifically mentioned the following other sites:

- Hospitals
- Railway station
- Bus station
- Universities
- Highfields
- Narborough Road
- Broadstone Gate
- London Road
- Oadby Parade
- Grove Park
- Leicester City Football Club
- Leicestershire County Cricket Club
- Fosse Park

- Supermarkets
- Mosques

Supermarkets are of particular interest, as customers often take a taxi to do their shopping and ask the driver to wait outside, providing an ideal charging opportunity. Mosques are of interest as a large proportion of taxi drivers in the city are Muslim.

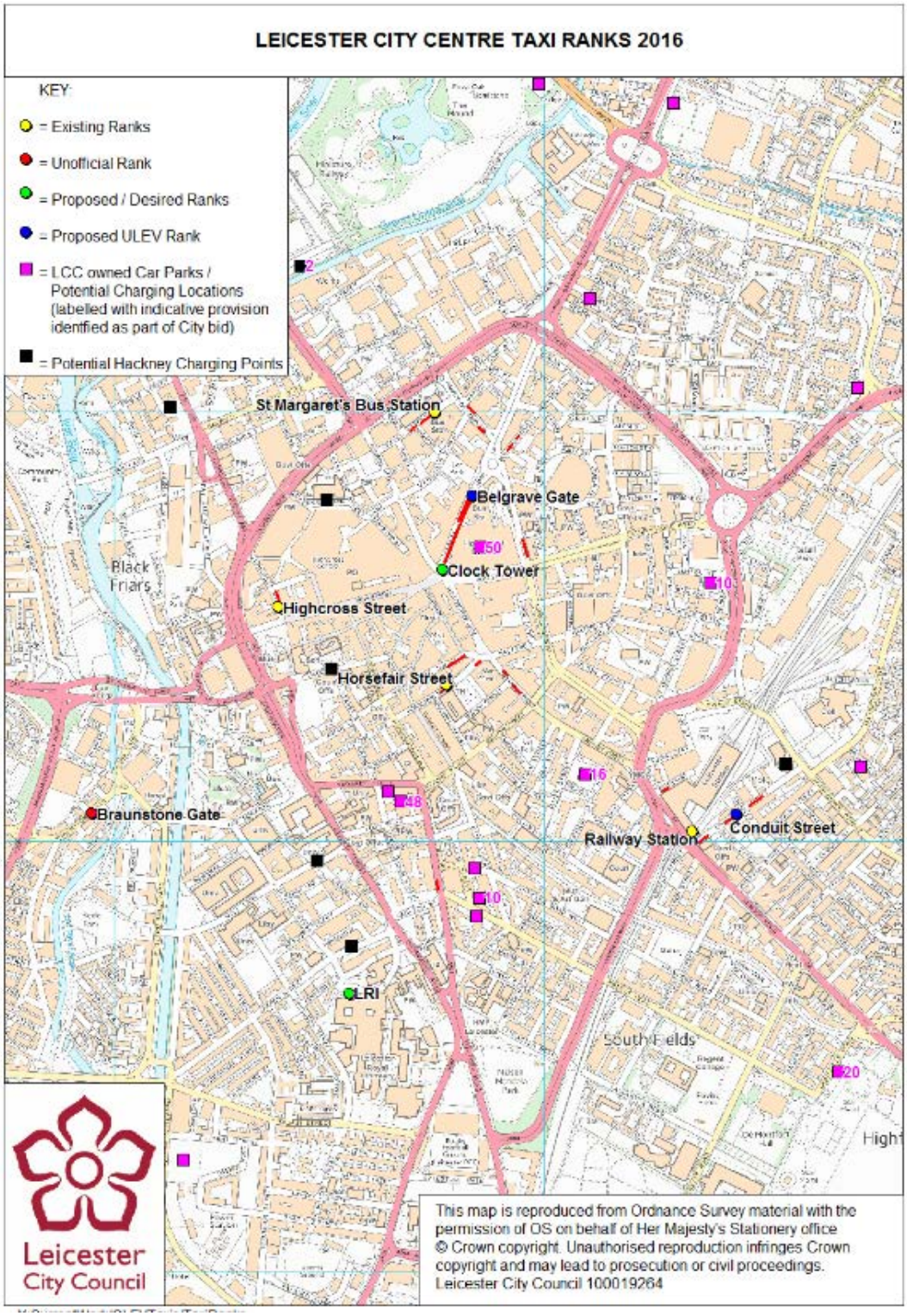


FIGURE 35: CURRENT AND PROPOSED TAXI RANKS AND CHARGE POINT LOCATIONS IN LEICESTER CITY CENTRE

5.3.3 Heatmaps

One way of targeting charging infrastructure more accurately would be to construct heatmaps. This is particularly appropriate for PHVs, given that they do not use taxi ranks so frequently. Private Hire Operators are required to retain records of all trips booked, and these are now usually kept electronically as most operators use cloud based software services for their booking systems. If the operator gives permission it is possible to obtain a download of anonymised trip data. This can be used to create a heatmap illustrating the hotspots for taxi activity, like the one in Figure 36 below.

The heatmap for Market Harborough confirms that the town centre and the railway station are the two locations used most intensively by taxis. It seems likely that this pattern may be repeated in most of the towns in the study area, suggesting that providing dedicated taxi charging infrastructure at town centre car parks owned by the local authority would be a practical and effective approach to providing charging infrastructure.

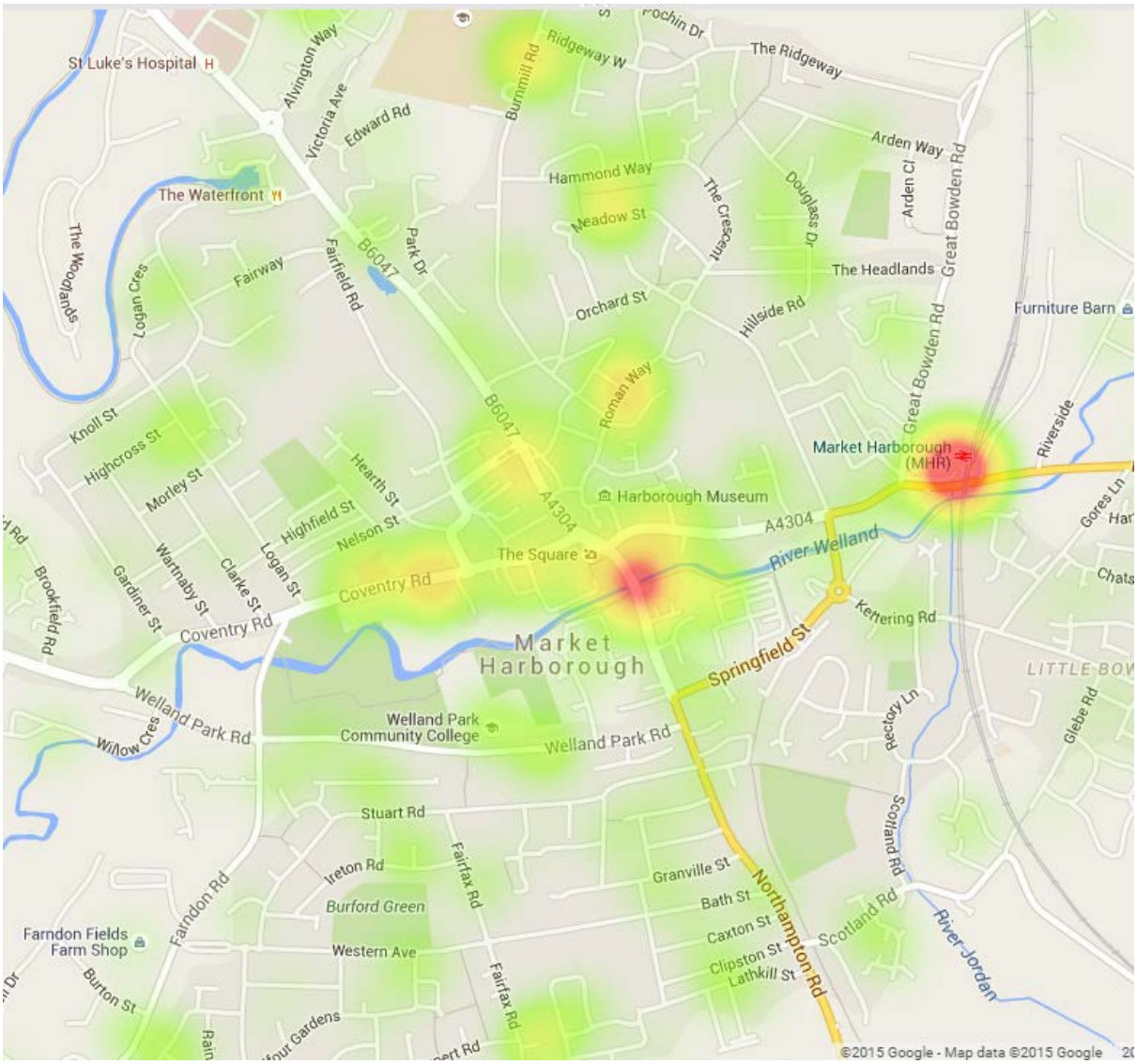


FIGURE 36: HEATMAP SHOWING ALL TAXI TRIP DESTINATIONS IN MARKET HARBOROUGH OVER A TWO WEEK PERIOD

6 Study Findings

6.1 Understanding Taxi Operations

In order to develop a scheme to increase the uptake of ULEV taxi we have found it important to understand the taxi operations within the city. This study has created this understanding by answering the following questions:

- Based on the ULEVs available for use as taxis, which taxi drivers in Leicester and the surrounding districts could practically use a ULEV?
- For those taxi drivers that could use a ULEV, what would it cost or save them to do so?
- For those drivers who would probably benefit financially from using a ULEV, what supporting infrastructure would be required to make it a practical proposition? And what other incentives would be most likely to persuade them to take the risk?
- Given the correct infrastructure and incentives, how many drivers in different groups might make the switch to ULEVs and when?
- On the basis of the answers to the above, what would be the impact on air quality?

The study team combined online questionnaires, interviews with drivers and analysis of licensing data on over 2,500 vehicles. As a result of this analysis the study team notes the findings below.

6.2 Ideal Conditions to Switch?

Some taxi operations offer ideal conditions for switching to the use of Ultra Low Emission Vehicles (ULEVs), especially Electric Vehicles (EVs). EVs typically have a high initial price but very low running costs. They are therefore most economically attractive to high mileage users. However, they are also typically limited to around 100 miles per day in range – a condition that rules them out for most 'high mileage' motorists. The ideal EV user would spend all their time in congested urban traffic, driving under 100 miles each day, but regularly day-in day-out so that their annual mileage is still very high. In other words, the ideal EV user is potentially a taxi driver.

6.2.1 Leicester City

Both Hackney Carriages and Private Hire Vehicles in the city of Leicester have an operational profile that suits ULEV capabilities. Also, for both types of taxi, running cost and total cost of ownership are substantially lower for a ULEV than a comparable conventional vehicle. It is essential to inform and persuade drivers that ULEVs are the way forward through:

- inspection and vehicle test drives
- clear information on whole life costs
- easy access to obtain the vehicles (availability, leasing or finance deals)
- confidence in the vehicle charging infrastructure.

6.2.2 District Councils

There is not a compelling financial case for the majority of taxis, both Hackney Carriages (HC) and Private Hire vehicles (PHV), in the districts around Leicester to switch to ULEVs. This is due to the higher mileages covered per day and the lower efficiency gains of hybrid systems outside urban areas. Most of the HC licencing conditions outside the City do not specify a wheelchair accessible vehicle. The study recommends a more targeted approach to ULEV introduction in the districts, focussing on private hire operators who purchase their vehicles, in order to get initial uptake. It is expected that the future financial case will become clearer as a wider range of ULEVs become available and at lower cost.

6.3 Licencing Policies to Encourage ULEV Uptake

Leicester City Council and some Leicestershire District Authorities have already introduced policies to promote the uptake of low emission taxis, including differential licence fees. Additional measures currently being considered include:

- restricting the issue of any new licences to ULEV taxis only (Leicester are proposing this)
- dedicated ULEV taxi ranks
- free electricity for an introductory period

- innovative ULEV leasing packages
- requirements for ULEV taxis in public sector contracts
- relaxation of age based criteria for ULEVs, while tightening them for conventional vehicles

We expect a proposed change in Licencing Policy in Leicester, from 1st January 2017, will result in 100% of hackney cabs being ULEV by 2025. Throughout this study we have used the examples of the Metrocab hybrid and Nissan Evalia electric vehicle which are expected to be available by the end of 2016. It is expected the London Taxi International will also be available in 2018.

6.4 ULEV Uptake

Given the findings in this report and a supportive policy environment, this analysis predicts that Leicester City Council would be able to disperse around 285 grants of £8,000 each to Hackney Carriages up to the end of 2020. Furthermore, with changes to licensing requirements in the 2020-2025 period, it will be possible to achieve 100% ULEV fleet of Hackney Carriages and over 75% ULEV fleet of private hire vehicles by 2025. A large proportion of the HC fleet is due for replacement in the next 5 years. Therefore any measures to influence purchase of replacement vehicles need to be introduced quickly, and it may be expedient to allow some vehicles to be kept on the road a little longer in the short term, to increase the likelihood that they will be replaced with a ULEV.

6.5 Charger Types

Most drivers in Leicester have long enough stops during the day to "opportunity charge" using a 22kW fast charger, rather than needing the speed of a 43kW rapid charger. Availability of charge points is likely to be a more important factor than speed of charging. Given that providing a given capacity of rapid chargers is twice the cost of the same capacity in 22kW fast chargers, the study suggests a mix of mostly fast chargers at most locations with rapid chargers targeted at locations where physical space is limited.

6.6 Air Quality Improvements

Ultimately, by 2025 and across both HCs and PHVs (in the High scenario), this will save an additional 25 tonnes of NOx, and 6,496 tonnes of CO_2e per year, *over and above* the savings that will come as the taxi fleet moves to the Euro 6 emissions standard.

TABLE 18: SUMMARY OF EMISSIONS SAVINGS IN 2020 AND 2025, HIGH SCENARIO

	2020		2025	
Savings from:	NOx	CO_2e	NOx	CO_2e
HC fleet	6.84	1,540	7.75	1,745
PHV fleet	6.57	1,768	17.64	4,750
Total	13.41	3,308	25.40	6,496

6.7 Communications

Hackney cab drivers' main source of information is talking to other drivers. Therefore, word of mouth will be vitally important in persuading drivers to purchase a ULEV taxi. Providing ULEV taxis that drivers can test drive for a week or fortnight at a time is likely to be an effective strategy to generate direct word-of-mouth recommendations for these vehicles.

7 Implementation of the Ultra-Low Emission Taxi Programme

7.1 Governance

Leicester City Council, in partnership with Leicestershire County Council and Leicestershire District Authorities has formed an Ultra-Low Emission Taxi Forum/Working Group to administer the application and defrayment of grants, co-ordinate the roll-out of identified infrastructure, develop and deliver policies and measures to support the take up of ultra-low emission taxis and undertake monitoring and evaluation of the Ultra-Low Emission Taxi Programme. In Leicester a taxi driver and operator forum has been created and has been briefed twice on development of this bid and wider issues.

7.2 Project Plan

The implementation plan will be discussed in greater detail should Leicester City Council and neighbouring authorities submit a delivery phase bid. However, issues that will be considered in the implementation plan would include:

7.2.1 Finance/ Resources

Leicester City Council would lead/co-ordinate the delivery phase grant application and administration on behalf of Leicestershire Authorities. Additional funding has been identified and secured through the LCC AQAP for match funding infrastructure provision in the city. The consideration of liabilities and project management resources would also be included.

The following will depend on the level of grant obtained for Leicestershire

7.2.2 Infrastructure Provision

Although much has been done through the Leicester City Council OLEV City Bid, AQAP and this feasibility study there are requirements for:

- detailed surveys of infrastructure locations
- consideration of support for home-charging for drivers
- identification of appropriate infrastructure types and manufacturers
- procurement of infrastructure
- consideration of maintenance and network management (e.g. Chargemaster as part of the POLAR Network etc..)

7.2.3 Supporting Policies and Measures

Leicester City Council have already started to consult on requiring ULEV taxis for all new Hackney Carriage licenses from 2017. However there are a number of supporting policies and measures which are needed in the City and also the District Councils to consider and implement including:

- Dedicated electric charging points and parking places, including fast and rapid charge facilities
- Subsidised leasing package for ultra-low emission taxis
- Free electricity for one year
- Financial support for electric charging at home
- Dedicated ultra-low emission taxi ranks e.g. at railway stations, airport, supermarket, town and city centres etc
- Public sector contracts for ultra-low emission taxis
- New licences only for ultra-low emission taxis
- Lower licensing fees for ultra-low emission taxis
- Ultra-Low Emission Zone in Leicester

7.2.4 Monitoring & Evaluation

There is good existing monitoring of air quality throughout the districts but new systems will need to be developed to ensure the right monitoring and evaluation is undertaken to ensure benefits of the replacement of diesel taxis with ULEVs of is realised. This will include:

- Review of all the data required

- Generation of monitoring and evaluation milestones
- Methods of collection
- Recording the data on databases or spreadsheets
- Reporting (internally and externally)

7.2.5 Publicity & Knowledge Transfer

A detailed communications plan will be generated for the project which will include:

- Dedicated website pages for taxi drivers, other stakeholders and the public
- Taxi driver orientated newsletter
- Taxi demonstrator events so driver can try out vehicles
- Dissemination events
- Press releases

7.2.6 Timescales

We will need OLEV delivery guidance to inform the timescales going forward.

Appendix A – Driver questionnaire

Leicestershire Ultra Low Emission Taxi study

The local authorities in Leicestershire are applying for government funds to help taxis in the county switch to plug-in-hybrid and electric vehicles. This will help air quality, and save drivers money.

These questions will help us understand how many taxis could switch to electric vehicles, and how much money they could save if they did. They will also help us to understand how best to communicate with taxi drivers.

*Required

About you

How old are you? *

- Under 30
- 30-45
- Over 45

How long have you been driving a taxi? *

- Less than 5 years
- 5-10 years
- Over 10 years

Are you .. *

- .. a licensed hackney carriage driver?
- .. a private hire driver driving for a firm?
- .. an independent private hire driver?

Which district are you licensed in?

- Charnwood
- Harborough
- Hinckley and Bosworth
- Leicester
- NW Leicestershire
- Other: _____

About your vehicle

Make *

Model *

Engine size *

- 1.3-1.5
- 1.6-1.8
- 1.9-2.1
- 2.1+

Fuel *

- Petrol
- Diesel
- LPG
- Hybrid
- Plug-in hybrid
- All electric

What mpg do you think you get on average?

Registration *

Year you started driving this vehicle *

Do you choose and buy your own vehicle? *

(Answer no to this question if your vehicle is chosen by your employer, even if you pay for it)

- Yes
- No

Continue »

25% completed

Leicestershire Ultra Low Emission Taxi study

*Required

Buying your vehicle

These questions will help us understand what is important to you when buying a new vehicle, and how quickly taxis are replaced.

Roughly how often do you replace your vehicle? *

- Every year
- Every 3 years
- Once the vehicle is too old to be licensed
- Other: _____

Last time you replaced your vehicle, what was the main trigger that made you decide it was time? *

- Accident or breakdown
- Generally increasing maintenance costs (failing reliability)
- Decreasing fuel efficiency
- Looks/cosmetic wear and tear
- Saw a good deal on another vehicle
- Other: _____

How old was your current vehicle when you bought it? *

- Brand new
- Less than 3 years
- 3-4 years
- More than four years

What are the top three things you take into consideration when choosing a new vehicle? *

- ☐ Purchase cost
- ☐ Fuel economy
- ☐ Mileage/age
- ☐ Reliability
- ☐ Brand
- ☐ Looks
- ☐ Emissions
- ☐ Comfort
- ☐ Space - seats and luggage space
- ☐ Other: _____

What is your main source of advice when buying a vehicle? *

- ○ General internet sites (e.g. Auto Trader)
- ○ Specialist internet sites aimed at the taxi trade
- ○ Other drivers
- ○ Family and friends
- ○ Local dealerships
- ○ Other: _____

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50% completed

Leicestershire Ultra Low Emission Taxi study

*Required

Your operations

These questions will help us understand what types of hybrid or electric vehicle would be practical for you. They will also help us understand where to install charging points for electric taxis.

What is your typical annual mileage? *

What is your typical daily mileage? *

What is the maximum mileage you've done in one day, in the last month or so? *

What is the longest single fare you've carried in the last month or so (by distance)? *

Where do you park your vehicle at night? *

- On street, usually right next to your home
- On street, somewhere near your home
- Off street on driveway
- In garage next to home
- In garage at a location other than home
- Other:

Which taxi rank do you most often stop at? (PHV drivers leave blank or state location where you most often wait between jobs)

On your last full day of driving, how many times did you wait at a taxi rank?

On your last full day of driving, how long was your longest wait between jobs (at taxi rank or other location) in minutes?

What do you think of, or what have you been told about, plug-in-hybrid and electric cars?

Would you consider buying a plug-in-hybrid or electric car as your next vehicle? *

If yes, what do you see as the main benefit; if no, what do you see as the main problem? If 'maybe', what would help you decide? *

Which of the following would make you more likely to buy a plug-in-hybrid or electric car?

In the options below, we've used the abbreviation ULET (Ultra Low Emission Taxi) to refer to a plug-in-hybrid or electric taxi

- [ ] Top-up grant for new taxis (£8K for disabled access Hackneys, £5K for PHV)
- [ ] Dedicated electric charging points and parking spaces, including rapid charge facilities
- [ ] Subsidised leasing package for ULETs
- [ ] Free electricity for one year
- [ ] Financial support for electric charging at home
- [ ] Dedicated ULET taxi ranks, e.g. at railway station, supermarket etc.
- [ ] Public sector contracts for ULETs
- [ ] New licenses for Hackneys restricted to ULETs
- [ ] Lower licensing fees for ULETs
- [ ] An ultra low emission zone in Leicester
- [ ] Other:

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75% completed

Leicestershire Ultra Low Emission Taxi study

Thank you!

If you would like to receive more information please fill in an email or mobile number below.

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100%: You made it.

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