ULEV CAR CLUB STUDY

FINAL REPORT

CONFIDENTIAL NOVEMBER 2016

FROST & SULLIVAN

WSP | PARSONS BRINCKERHOFF

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Transport for London

Confidential

Final Report
Date: November 2016

WSP | Parsons Brinckerhoff
70 Chancery Lane
London
WC2A 1AF

www.wspgroup.com
www.pbworld.com

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Signature				
Checked by	Glenn Higgs	Glenn Higgs	Glenn Higgs	Glenn Higgs
Signature				
Authorised by	Glenn Higgs	Glenn Higgs	Glenn Higgs	Glenn Higgs
Signature				
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PRODUCTION TEAM

CLIENT

Transport for London	Jo Boyd-Wallis
Transport for London	Naveed Ahmed

WSP | PARSONS BRINCKERHOFF

Project Manager	Matt Croucher
Project Director	Glenn Higgs

SUBCONSULTANTS – FROST & SULLIVAN

Car Club Industry Expert	Martyn Briggs

DISCLAIMER

THE INFORMATION IN THIS REPORT IS CORRECT AS OF MAY 2016 WHEN THE ANALYSIS AND REPORTING WAS COMPLETED

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STUDY AIMS AND OBJECTIVES

- To understand the potential for Ultra Low Emission Vehicle (ULEV) uptake (in terms of vehicle number and type) for the full range of car club operations currently running and set to launch in London
- To understand the likely charging requirements of car clubs in London, in the context of a target of 1 million members and 50 per cent ULEVs by 2025, which would equate to 10,000 car club vehicles and 5,000 ULEV car club vehicles.
- To inform TfL's strategic guidance on Charging Infrastructure Locations

METHODOLOGY

A key focus of this study has been stakeholder engagement, as the primary means of understanding the views from the Car Club Coalition on their plans, aspirations, and perceived barriers and opportunities for introducing ultra-low emission vehicles (ULEVs) into car club fleets.

The methods of engagement were guided one-to-one interviews with car club operators and industry bodies, and a workshop with London Boroughs. For the car club operators the interviews were structured around four topic areas: future growth projections, infrastructure, operational considerations and commercial considerations. The Borough workshop featured two breakout sessions. The first sought to understand their strategic objectives and aspirations for the role of ULEV car clubs. The second sought to understand their views on the issues and opportunities concerning the delivery of ULEV car clubs.

The findings were analysed, grouped into common sets of responses indicative of key themes, quantitative data went onto inform the projections for ULEV uptake and infrastructure requirements. For simplicity we classified operators in one of three categories:

- Back-to-Base / Return/ Round Trip
- Fixed One-way (Point-to-Point)
- Floating One-way/ Flexible

Electric vehicle charge point (EVCP) types:

- Slow (3kW)
- Fast (7-22kW)
- Rapid (43-50kW)

FINDINGS FROM CAR CLUB OPERATORS AND INDUSTRY BODIES

- Car Club Operators - 12 current and prospective future car club operators in London were invited to take part in the study. Every operator (100%) responded and was interviewed between November 2015 and January 2016.
- London Boroughs and Public Bodies – 29 Boroughs, the GLA and London Councils were invited to participate in a stakeholder workshop on 26th November, and to provide written feedback to a survey via email. 18 (62%) responded and/or attended the stakeholder workshop.

INFRASTRUCTURE REQUIREMENTS

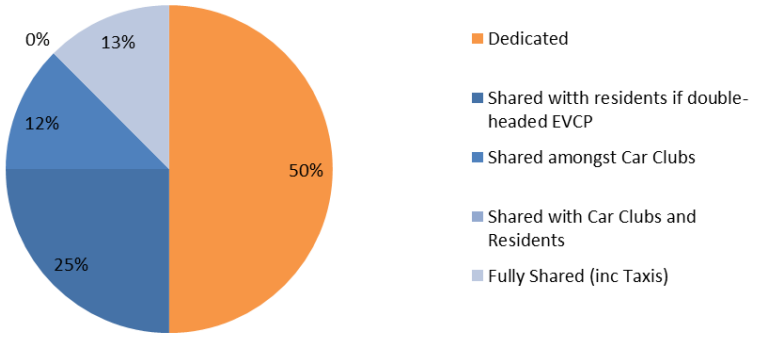
Access to Bays - A clear preference for bays dedicated specifically to an operator emerged, particularly amongst Back-to-Base Operators. Though many feel some degree of shared access to a bay and EVCP can work. Floating operators are more open to shared bay access, but more dependent on a higher number of bays with EVCPs. See Figures below.

Network Integration - There was a clear consensus amongst operators that a single integrated network of EVCPs is required, potentially delivered by multiple operators, provided it is fully interoperable and with a single point of reference for charge point status. One operator suggested a parallel sector specific network (i.e. for one-way only vehicles) would be most appropriate.

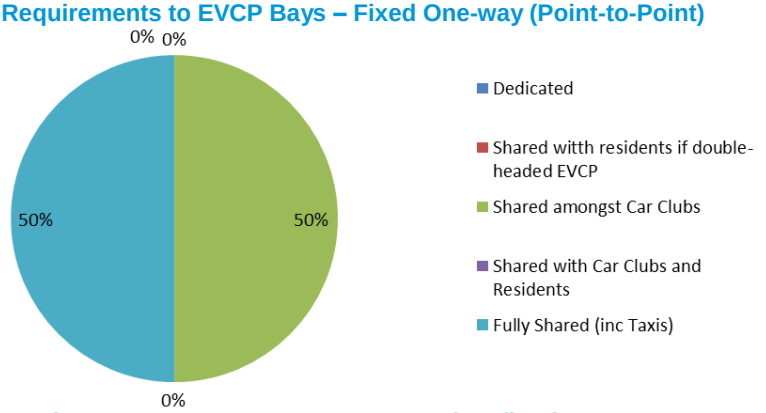
Charge Point Type - There was a clear preference amongst operators for Fast Chargers (100% of respondents), and mixed feelings on Slow Chargers – most felt they were inadequate, though some considered they may have a role for overnight charging if they were widely available. The operators thought that rapids could play an important part in a wider network – particularly for floating car club models, potentially configured as hubs.

Charge Point Requirements per ULEV - Reasonably consistent requirements were specified for EVCP to vehicle ratios dependent on the car club operating model.

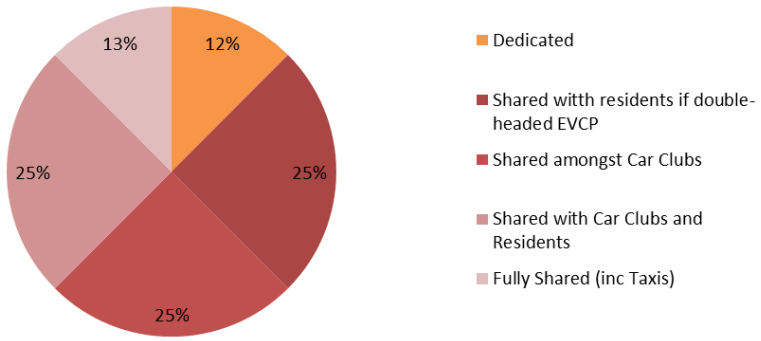
Access Requirements to EVCP Bays - Back to Base/ Return/ Round Trip



Access Requirements to EVCP Bays – Fixed One-way (Point-to-Point)



Access Requirements to EVCP Bays – One way free floating



Operator Stated Charging Requirements (Ratio of ULEV car club vehicles to EVCP)

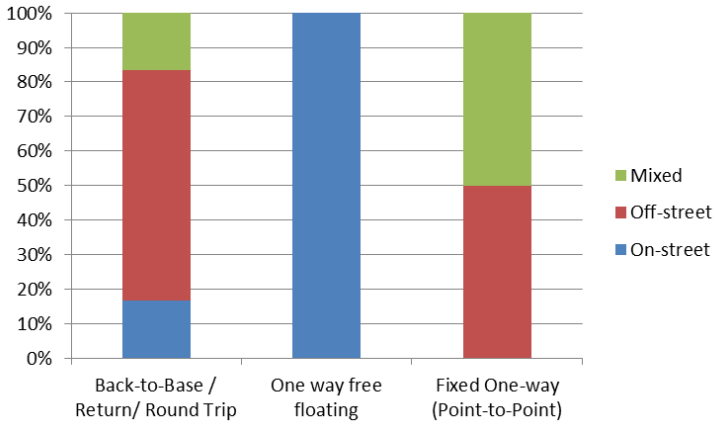
OPERATING MODELS	MINIMUM	DESIRABLE	CHARGE POINT OCCUPANCY	CHARGE POINT AVAILABILITY FOR OTHER USERS
Back-to-Base / Return/ Round Trip	1:1		75-100%	Typically Dedicated – some may allow limited access via booking systems
Fixed One-way (Point-to-Point)	1:2	1:2.5	50-75%	Some access via booking systems
Floating One-way/ Flexible	1:2.5	1:10	<25%	Fully Accessible

Back-to-Base is predicated on a single EVCP bay per vehicle, with more limited scope for sharing the space. Fixed one-way requires some contingency and allowances for tidal flows of vehicles. Floating one-way requires widespread provision of EVCP bays, particularly in the longer term where the aspiration is for users to charge the vehicles and minimise artificial redistribution.

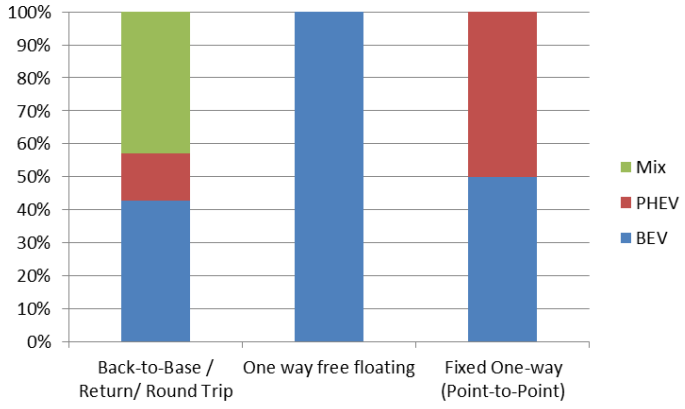
Bay Location - The type of car club model has a bearing on the requirements /preferences for the bay locations and their associated charging infrastructure. A number of operators expressed a clear preference for on-street bays, but felt they were not likely to be deliverable (due to Borough concerns over loss of parking spaces, delivery timescales etc.) in the numbers required at present due to, so may have to compromise.

Car Club Locations - Operators were unable to provide specific details on where they anticipated growth at more localised levels, but in broad terms expected a continued focus on Central and Inner London Boroughs, and in areas with higher population densities, good public transport accessibility and with more limited parking for residents. A number of operators are aiming for London-wide coverage though, and other models are targeting local and regional centres, public transport hubs and other attractors.

Type of location for ULEV car club bays by operating model



Operators preferred ULEV by car club model type



Estimated EVCP Requirements by Area - By applying the ratios of EVCPs per ULEV car club vehicle to the projected growth, it is possible to derive outline figures for the EVCPs required in central/ inner / outer London Boroughs to support ULEV car clubs. These estimates would suggest that by 2025 there would be a minimum requirement for around 160 EVCPs in a typical Outer London Borough, 550 EVCPs in a typical Inner London Borough and 800 EVCPs in a

typical Central London Borough (in a Mid Growth Scenario, where 68% of the car club fleet are ULEVs by 2025).

OPERATIONAL CONSIDERATIONS

Vehicle Types - All operators felt ULEVs were suitable for playing a part in their current or future car club fleets in London. Most felt that a full battery electric vehicle (BEV) would be the most suitable option. Some felt the versatility of the PHEV was better suited to their model. Some were more cautious about the role of ULEVs within their car club fleet, and saw them having a niche role.

Vehicle Usage - Many observe very little difference in in trip purpose between ULEVs and ICEs, with only slightly shorter trips. Lower utilisation rates compared to ICEs were a particular concern amongst some back-to-base operators.

Cost and Operational Implications – the higher up-front costs of ULEVs often necessitates strong relationships with OEMs, or pump priming via a Local Authority or private organisation. There are reduced running costs, though some feel these savings are offset by operational complexities of ULEVs. Incentivising users to plug the vehicle into re-charge represents a further cost.

Some operators felt that large marketing budgets and resources are required when launching a ULEV car club fleet at scale, which could mean there may be only space for a few larger operators in the marketplace in the mid to longer term.

Vehicle Charging - Most are reliant on, or would prefer, the user to be responsible for plugging in and charging the ULEVs. In principle recharging ULEV car club vehicles should be more convenient than having to refuel an ICE vehicle in London, where petrol stations are scarce, and necessitate intermediate refuelling. ULEVs can charge at their destination (where it is a bay based service of an EVCP is available).

ULEVs are taken out of service when charge falls below a threshold (varies by operator between 15%-50%) – vehicle removed from listings on apps. In Paris less than 5% of the Autolib fleet are out of action at any time.

COMMERCIAL CONSIDERATIONS

Private Operators find it more expensive (additional ~£1k per year per vehicle) to operate BEVs than ICEs, and face much higher total costs of ownership for PHEVs. The use of ULEVs relative to ICEs tends to yield up to 25% lower utilisation for round-trip services, and can add 20-40% incremental costs per month for one-way services, relative to ICEs.

PERCEIVED ROLE OF PUBLIC SECTOR

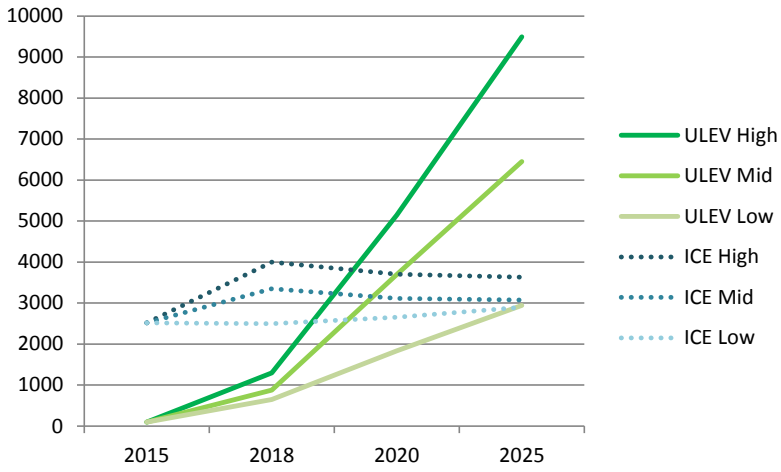
A recurring view from stakeholders was that the public sector can improve the charging infrastructure provision by setting clear policy, guidance, service level agreements to manage obligations, and by establishing a framework to ensure effective maintenance of the network.

FLEET GROWTH PROJECTIONS

Projected fleet growth figures provided by operators were aggregated to determine the possible scale of future car club operations, and identify what proportion operators anticipate being ULEVs. The aggregated projections did not necessarily account for competition amongst other operators in the marketplace, the possibility of market failures or the demand-side, and whether there is a large enough customer base to support each operators planned growth. To account for these factors we developed High, Mid and Low Growth Scenarios.

- High Growth Scenario: based on the targets of the operators, there would be 11 car club operators offering ~13,000 vehicles (72% ULEV) by 2025
- Mid Growth Scenario: 11 operators with ~9,500 vehicles, (68% ULEV) by 2025
- Low Growth Scenario: 7 car club operators offering ~5,800 vehicles (50% ULEV) by 2025

ULEV and ICE Car Club fleet sizes 2015-2025



The findings from the operator survey indicate there is likely to be a clear trend towards an increasing proportion of ULEV vehicles within the car club fleets across London between 2015 (4% of fleet) and 2025 (50-72% of the fleet), with over 13,000 car club vehicles in operation in total.

The low /mid scenarios estimated ~5,800-9,500 vehicles within the total car club fleet, accounting for competition amongst operators, market failures and demand-side issues. The high and mid-range scenarios both forecast ULEVs to overtake ICEs as the dominant vehicle in car clubs by 2019/2020. Floating operators all forecast their fleets will be fully electric by 2025, whilst point-to-point operator forecasts anticipate them being over 95% electric. Back-to-base operators forecast ~25% of their fleets being electric by 2025.

FINDINGS FROM BOROUGHS AND LOCAL AUTHORITIES

Small group discussions were undertaken at a workshop for boroughs, with attendees sub-divided into Central, Inner and Outer London boroughs. As well as the stakeholder workshop, nine boroughs provided more detailed feedback to surveys.

Strategic Objectives and Aspirations - The study has found that there are varying aspirations and expectations for future ULEV car club deployment amongst Boroughs. There are some real advocates, whilst others are far more cautious or sceptical. This reflects the varying characteristics and priorities across the different boroughs. Whilst views were not necessarily shared amongst all central, inner or outer London boroughs, some common themes did emerge amongst each:

Central – The Boroughs consulted generally felt ULEVs help in meeting their sustainability agenda. However their key focus is on reducing car trips and some do not necessarily see car clubs as a means of achieving this, so are cautious on car club development, or place it as a low priority. Some were unsure access to cars was required in central London as there is excellent access to public transport. A number expressed concerns that one-way car clubs would result in more short journeys, and had become similar to taxis, so may increase car usage. A further concern was that for central Boroughs car club bays entail taking scarce car parking spaces away from residents to open them up to non-residents (in-bound visitors and commuters). They saw a useful role for car clubs as part of private car free developments.

Inner - The Boroughs consulted generally felt car clubs are an important part of a wider sustainable transport strategy, alongside promoting walking, cycling and public transport. They were positive about the role of ULEVs within car club fleets, but expressed some concerns over floating car club models, regarding their potential substitution effect from other more sustainable modes. The support for car clubs is based on providing transport

choices for residents, and facilitating a private car free lifestyle, reducing pressure on parking. In terms of the suitability of different car club vehicle types – some felt that the operators need to lead as they know what is deliverable in their marketplace.

Outer - The aspirations for car clubs commonly agreed amongst the outer London boroughs consulted were to; improve air quality, reduce congestion, enable development where parking supply is an issue and free up space to improve the public realm. They were keen to see more ULEV car club vehicles, as being ultra-low emission also helps to sell car clubs politically, but many are mindful of the commercial concerns from operators that a less dense population and more limited public transport network can limit the commercial viability for an operator in outer London. They recognised that seed funding may be required. A concern was that for many operators it isn't commercially viable at the moment in Outer London. Boroughs noted that travel behaviours are different in outer London – with longer trip distances, so PHEVs may have a greater role. New developments were seen as a good route to new car club sites using S106.

Infrastructure and Locations – Whilst views were not necessarily shared amongst all central, inner or outer London boroughs, some common themes did emerge amongst each:

Central – The Boroughs consulted commented that whilst ULEVs are attractive compared to ICE vehicles, the retrofitting of bays in central London is challenging, citing recent experience retrofitting car club bays in Westminster, and raised concerns over funding, street clutter and uncertainty over infrastructure choices. There were concerns that one-way car clubs required a larger number of parking spaces. There was a strong view that infrastructure should not be publicly funded if they are being used solely by private operators who are generating profits. Concerns were raised about the resource burden on Boroughs in delivering new car club bays, and the added complexities of the differing operating models and integration amongst charging operators. There were some concerns over operators often wanting to locate car clubs in areas with good public transport versus Boroughs wanting them in areas with poorer public transport accessibility. There were concerns that designating some existing EVCPs for car clubs only would impact negatively on residents, with most of the benefit derived by non-residents. There were also concerns over managing parking enforcement, particularly with the point to point/floating car club models in areas where a single CPZ covers large areas.

Inner - The Boroughs consulted suggested that ULEV car clubs could be located in targeted areas, such as areas of poor air quality or high demand for EV's. There were concerns over the delivery challenges in installing EVCPs on-street, so some felt there was likely to be a greater need for more off-street. Most boroughs spoken to for this study are piloting or assisting operators in delivering ULEV car clubs, but resource is limited which may impact the support they can provide to car clubs. The locations are largely driven by operators based on commercial attractiveness, but in some case Boroughs do negotiate to insist on bays also being provided in under-served areas. It was noted that where a car club bay is likely to result in a net loss in parking revenue this presents an additional delivery challenge. There was a strong view that funding for charging infrastructure should be from the private sector and developer contributions. Resourcing challenges and the range of technical expertise required to deliver EVCP car club bays were also highlighted as an issue.

Outer – The Boroughs consulted felt that differing car club strategies would be needed across Outer London depending on highly localised factors. Good public transport accessibility is often considered a prerequisite for car club growth and this is patchy in areas, particularly South London. There were concerns about the scope for delivering the on-street bays preferred by operators, as there is often resident and political resistance to the loss of bays. As such the role of off-street bays for ULEV car clubs was considered important by some. Some felt that hubs of fast chargers and some rapid chargers at

strategic locations were key for supporting most car club models, particularly the floating car clubs. Most felt seed funding may be required in outer London to help operators make the case for the ULEV model in areas not as commercially viable as is in Central/Inner London. It is considered there is an overreliance on public sector funding support, which is not sustainable. New developments were seen as key source for providing new car clubs through developer contributions.

Prevailing Operating Models - Currently Back to Base is the predominant model amongst Outer London Boroughs, whilst Inner London Boroughs host a range of operating models.

Anticipated Bay Locations - Boroughs had varying aspirations or expectations for where they foresaw ULEV car club vehicles being located. Most felt their locational requirements would not differ significantly from conventional ICE vehicles, though some anticipated they would be more focused around public transport hubs or in off-street locations.

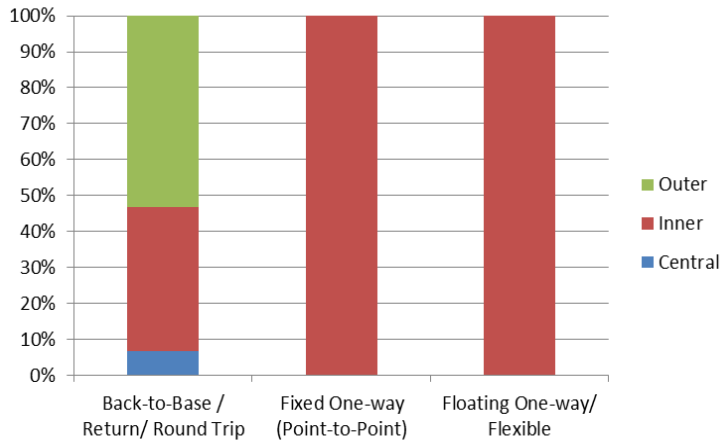
Anticipated Car Club Growth - The study had a limited sample size, but projections from the boroughs that took part in the study indicate that at an aggregate level the ambitions/ expectations of Boroughs for ULEV car club growth is lower than operators.

At the time of writing many boroughs do not yet have firm plans or definitive views on the role, scope, scale and deliverability of the differing car club models, in what is a rapidly evolving sector. The complexities of low emission vehicles and their associated infrastructure add to the complexities of forward planning from the borough perspective.

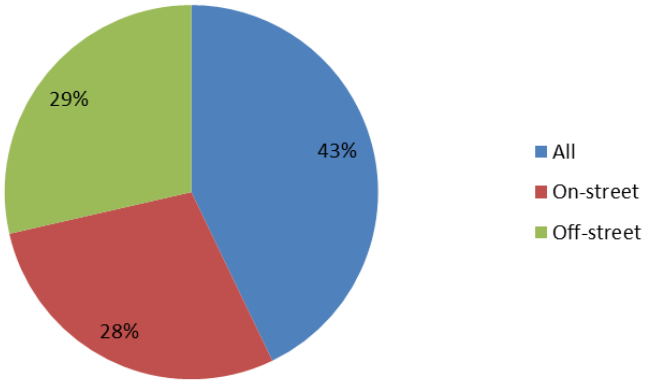
CONCLUSIONS

A key finding of the study is the apparent discrepancy between Operators and Boroughs in their aspirations/plans for the scale of car clubs envisaged in the period to 2025. The more cautious nature of

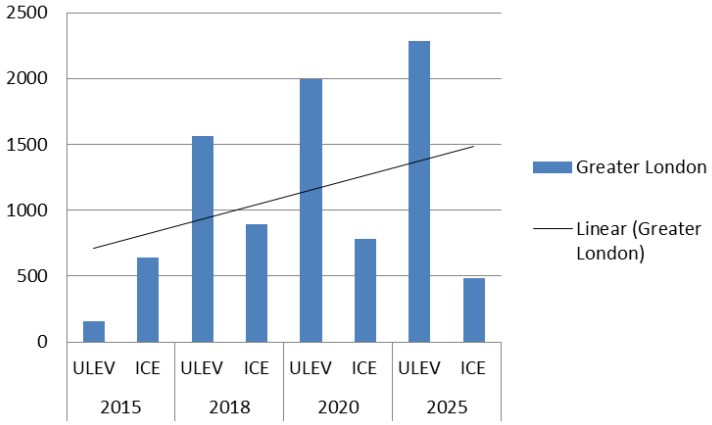
Existing ULEV Car Club Operating Models by Central/Inner/Outer London Boroughs



ULEV car club bay location types anticipated by Boroughs



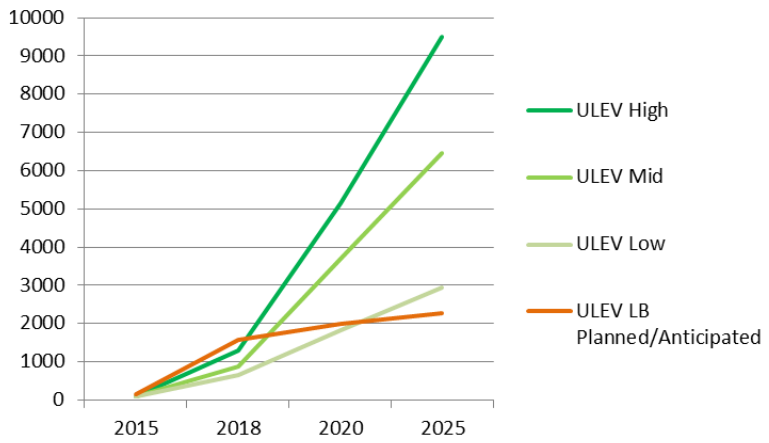
Estimated total future car club vehicles based on Borough projections (scaled up from sample)



Boroughs planned/anticipated car club growth however is often not primarily, or exclusively, due to concerns about ULEVs, but about car clubs more fundamentally.

Borough projections for growth in ULEV car clubs is broadly in line with the aspirations of operators up to 2018. But many Boroughs felt it was currently very difficult to plan with any degree of certainty beyond 2018, whereas the operators have aspirations for growth up to 2025, and see ULEVs playing a large role provided the supporting infrastructure is provided.

ULEV Car Club fleet sizes 2015-2025; All Operator forecast scenarios compared to Borough planned/anticipated



The Borough feedback articulated a range of concerns around the delivery of car club bays generally, including the challenges posed by the loss of resident's bays, parking revenues, resource burden on the Borough and concerns over greater car use, particularly for short journeys in the case of point-to-point/floating models. The added challenge of delivering EVCPs and managing the installation, TMOs, operation, funding and interoperability amongst charge point operators and differing car club models further complicates delivery from a Borough perspective.

NEXT STEPS

- There was some scepticism at an academic/philosophical level amongst Boroughs about the role of car clubs more generally in the context of wider sustainable transport, with many grappling with the role of car clubs, particularly the floating and point to point models. **Robust evidence from London based trials** was called for in order to inform their planning and help them make the case for the role of car clubs. The Car Club Strategy under development by CarPlus may provide some of the evidence sought by Boroughs.
- **Further assessments of Boroughs plans/aspirations for ULEV car clubs** should be undertaken from a larger and more complete sample of detailed responses from Borough, building on the high level indications undertaken through this study. At the time of writing many Boroughs do not yet have firm plans or definitive views on the role, scope, scale and deliverability of the car club models, in what is a rapidly evolving sector, with many citing the lack of a robust evidence base on which to base their planning. The complexities of low emission vehicles and their associated infrastructure adds to the complexities of forward planning from the Borough perspective. So this step might logically follow the preceding task.
- A **more detailed analysis of EVCP demand at a street by street level** could be undertaken by combining TfL's previous study forecasting future EV uptake and the associated EVCP requirements.
- A next step for Boroughs is to **determine the most suitable car club model type/s** for their Borough/areas of their Borough, based on their own wider vision and objectives, accounting for the needs of their residents, businesses and their own fleets.
- A next step could be to ask Boroughs to **identify prospective sites** to fulfil the desirable and minimum EVCPs and bays to support a ULEV car club fleet in line with TfL targets.
- Encourage Boroughs who do not already do so to **ensure the opportunity to make most effective use of new developments to promote ULEV car clubs** is taken. With further consideration given to pooling contributions to deliver larger and more coordinated car club networks. Specifications for longer contract commitments and particular vehicle types should be required of developers.

1 BACKGROUND

1.1 WIDER CONTEXT

ULTRA LOW EMISSION VEHICLES (ULEVS) IN LONDON

The EU sets statutory limits on air quality and requirements for reducing CO2 emissions and the Mayor has made commitments to reducing air pollutant and CO2 emissions. In September 2014, TfL published its Transport Emission Roadmap (TERM) which outlines plans for how London could reduce its CO2 and air pollutant emissions, within which 'Driving the uptake of Low Emission Vehicles' is a key measure. Ultra-Low Emission Vehicles (ULEVs) have the potential to make a significant contribution to improving London's air quality and to reducing carbon dioxide emissions from transport as they are a low emission alternative to petrol and diesel vehicles.

In July 2015, TfL published the ULEV Delivery Plan which aims to deliver a step-change in ULEV uptake, helping to realise the Mayor's ambition for London to be the electric vehicle capital of Europe. The vision of the Delivery Plan is for ULEVs to be a core part of London's sustainable transport system. ULEVs should be the preferred option for all vehicle travel, including public transport, taxis and private hire, private cars and vans and commercial operators, including car clubs.

THE SHARING ECONOMY, LOW EMISSION VEHICLES AND LONDON

Our attitudes and usage of cars in cities is evolving, owing to a combination of policy, socio-demographics, and new technologies. This convergence of trends is leading to a reduction in the use of private cars in urban areas, and to an increasingly multi-modal combination of transportation, accessing transport on-demand that best fits the requirement of each trip.

One of the key mechanisms facilitating this shift away from car ownership to car usage is the growth of the car club sector. Car clubs offer members access to a shared vehicle on a pay-as-you-go basis, providing an alternative to private vehicle ownership. There are already over 5.3 million users of car clubs globally, and this figure is projected to rise to over 26m by 2020[1].

London is in a leading position, with 165,000 members, representing 84% of the UK's total membership[2], and making London Europe's largest single market for car clubs based on membership.

In May 2015, London's Car Club Coalition (facilitated by TfL) published a new Car Club Strategy for London. The Car Club Strategy sets out the aim to increase the number of members from 162,000 (August 2015) to 1 million by 2025, reducing reliance on private vehicle ownership to bring about reductions in congestion, vehicle journeys, parking and emissions. Car club members make fewer trips, and many sell their cars or defer private car ownership, and use cleaner vehicles (the current London car club fleet is 33% lower emissions than the London wide average[3]).

[1] Frost & Sullivan
[2] Carplus
[3] CarPlus

CAR CLUBS AND ULEVS

In addition, the Strategy commits the industry to increasing the uptake of ULEVs in car clubs fleets. Increasing the number of ULEVs in car club fleets presents an opportunity to increase the number of ULEVs on London's streets and provide more Londoners with the opportunity to drive a ULEV without having to purchase one.

However, their adoption within London's car club fleets has been relatively slow to date, owing to a combination of cost, range anxiety, infrastructure uncertainty, and operational issues, resulting in less than 5% of the London car club fleet being ULEV compared to ~13% of the global car club fleet[4].

1.2 STUDY ORIGIN

To encourage an increased take up of ULEVs in London's car clubs requires a full understanding of the current adoption and experiences from the operators themselves, and their experiences and plans for using ULEVs.

This study was commissioned in response to the following policies and strategies:

The Car Club Strategy (March 2015) – Action 7: Driving the uptake of Low Emission Vehicles

- ULEVs in Car Clubs - Environmental Benefits, Increasing familiarity

And; *TfL ULEV Delivery Plan (July 2015)* – Action 3: Work with car clubs to achieve a target of 50% ULEVs in the London car club fleet by 2025

- Undertake research on the complex operational needs of all models of car clubs for charging infrastructure and the needs of their customers
- Dependent on OLEV support, put in place the right supporting charging infrastructure from April 2016 and support open access to this infrastructure

1.3 STUDY OBJECTIVES

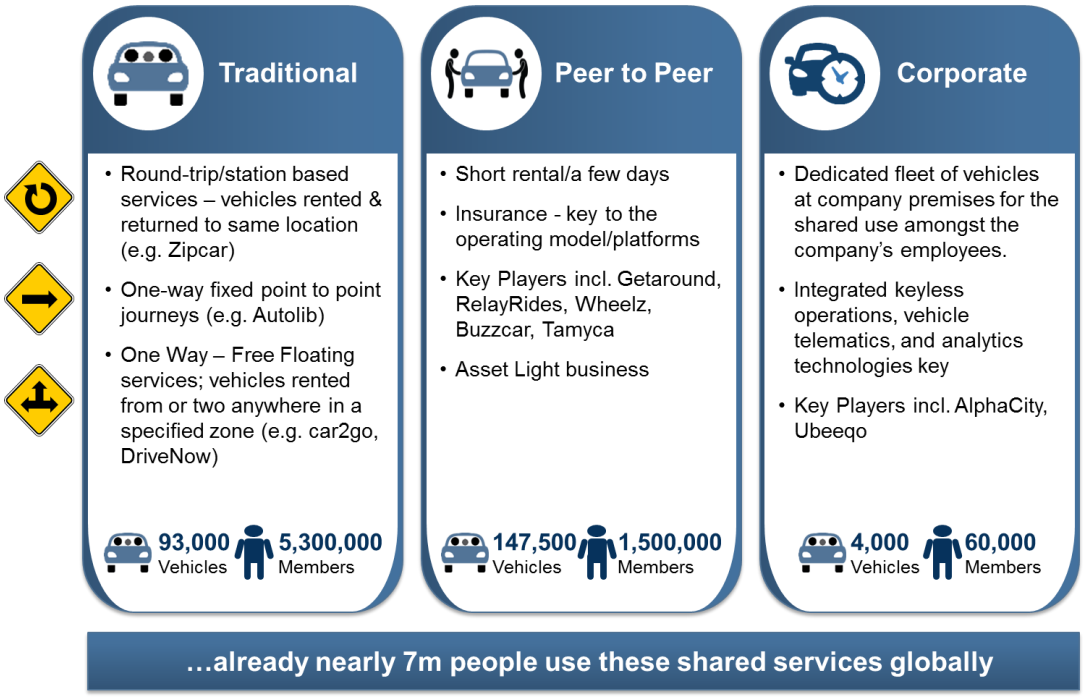
- → To understand the potential for ULEV uptake (in terms of vehicle number and type) for the full range of car club operations currently running and set to launch in London
- → To understand the likely charging requirements of car clubs in London, in the context of 1 million members and 50 per cent ULEVs target by 2025, which equates to 10,000 car club vehicles and 5,000 ULEV car club vehicles.
- → To inform TfL's strategic guidance on Charging Infrastructure Locations

1.4 INTRODUCTION TO CAR CLUB OPERATING MODELS

BUSINESS MODELS

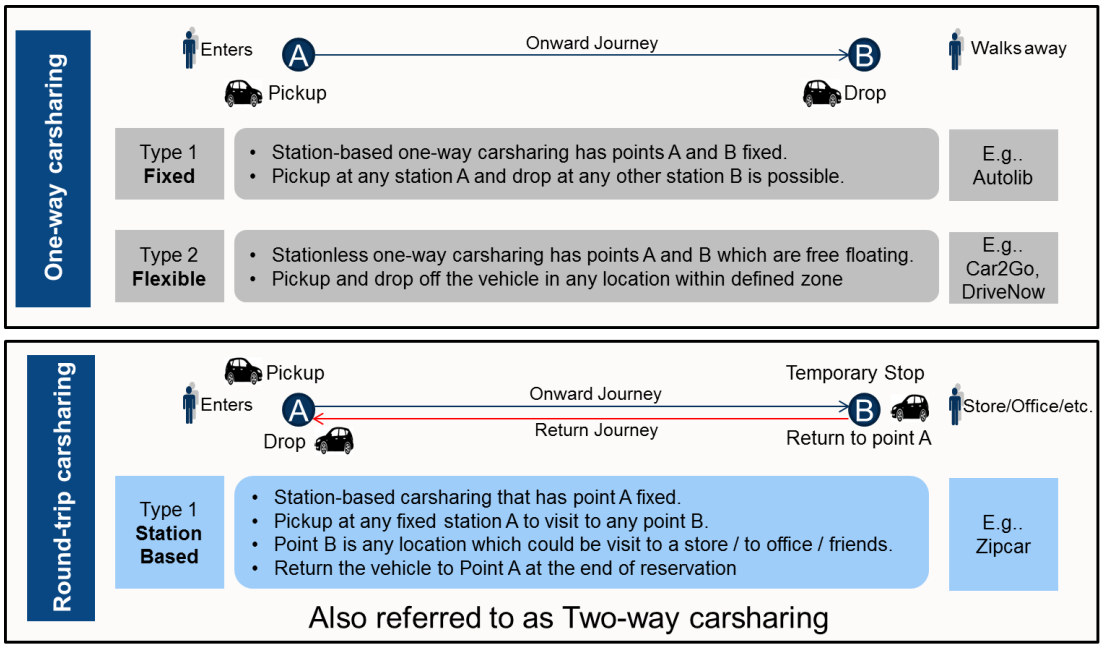
There are already several well established vehicle sharing business models catering to several customer groups and use cases, by the minute, hour or longer term corporate car sharing/leasing.

[4] Frost & Sullivan



CAR CLUB DEFINITIONS – ONE-WAY AND ROUND-TRIP CAR SHARING

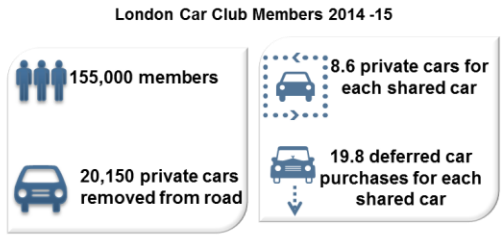
Within the scope of this project are the three types of car clubs; two types offering one-way trips (point to point, or flexible), and station based, round-trip car sharing (e.g. Zipcar, City Car Club).

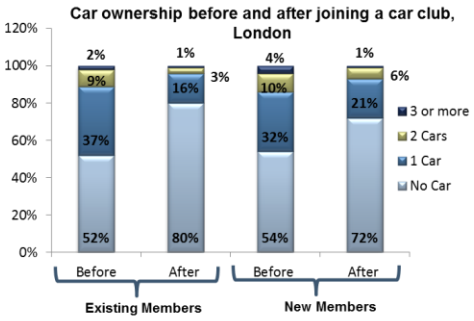


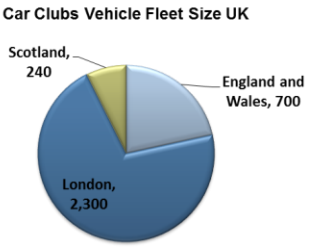
Source: Frost & Sullivan analysis

IMPACT OF TRADITIONAL CAR SHARING IN UK

Car sharing has removed close to 23,690 private cars off the road in the whole of UK from 2014 to 2015 – 20,150 of them from London alone





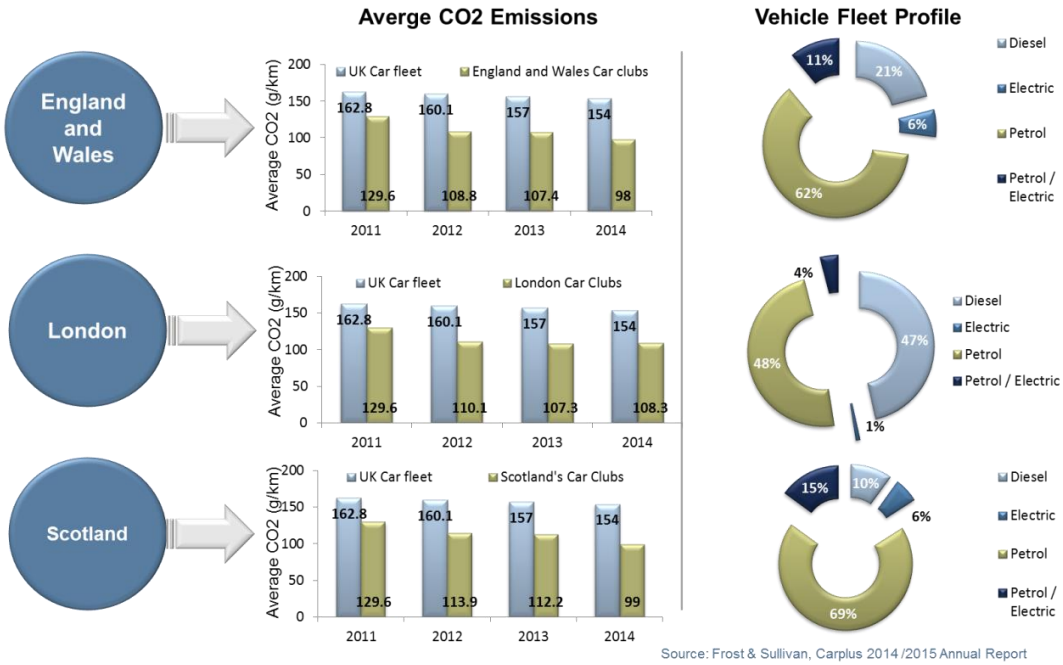


Market Share: Key Participants, London, 2014

Source: Frost & Sullivan, Carplus 2014 /2015 Annual Survey

CAR SHARING VEHICLE FLEET PROFILES

Almost 94% of the car clubs in the UK have Euro 5 compliant fleets; and 6% of fleets in Scotland and the rest of England are Electric, but just 1% of London's fleet are electric. This is much higher in the rest of Europe (13%). This may be due to a number of factors, including differing levels of funding support, infrastructure provision and local governance arrangements. The added complexity of London's 33 boroughs, each with differing parking policies, may also be a factor.



Source: Frost & Sullivan, Carplus 2014 /2015 Annual Report

1.5 ELECTRIC VEHICLE CHARGE POINT (EVCP) INFRASTRUCTURE TYPES

KEY CHARGING INFRASTRUCTURE RESEARCH

The following key documents were reviewed and considered as part of this study:

- Electric vehicle charging scheme study, WSP Parsons Brinckerhoff
- Rapid charging network study, Element Energy
- ULEV uptake and infrastructure impacts, Element Energy & WSP Parsons Brinckerhoff

ULEV VEHICLE TYPES

A range of ultra-low emission vehicle (ULEV) types are available to purchase. For the purposes of this study ULEVs include the following subsets of vehicle types, in accordance with the DfT/OLEV approved list of low emission vehicles eligible for the Plug-in Car Grant:

- Battery Electric Vehicles (BEVs) – also known as full battery electric vehicles or electric vehicles (EV's)
- Plug-in Hybrid Electric Vehicles (PHEVs)
- Range-Extended Electric Vehicles (RE-EV's)

Non-plug in hybrid vehicles, such as the non-plug in Toyota Prius, are not considered to be ultra-low emission vehicles.

CHARGING TYPES/ FORMATS

A range of EVCPs are available and in use across London, in a variety of different formats and sites, each of which has significant bearing on their operational suitability and functionality as part of a ULEV car club infrastructure, these include:

- On-street/ Off-street (Public)/ Off-street (Private)
  - Public Networks – e.g. Source London, Polar, POD Point
  - Private networks – e.g. Zip Car - Car Club operator only
- Charge point types
  - Slow (3kW)
  - Fast (7-22kW)
  - Rapid (43-50kW)

2 METHODOLOGY

This section briefly outlines the approach taken in undertaking this study.

DESKTOP REVIEW

The information reviewed in the desktop study assisted in developing the stakeholder questions and informed the subsequent discussions. The information was also be used in the subsequent analysis and assessment to supplement the stakeholder research and help fill any information gaps. The documents and data we reviewed included the following:

- Car club operator information collected by TfL
- Data on existing car clubs – CarPlus
- A Car Club Strategy for London, May 2015
- EV Uptake & Infrastructure Impacts research: undertaken for TfL by WSP | PB (as yet unpublished)
- Residential EV Charging research: undertaken for TfL/boroughs by WSP | PB
- Car-sharing in London – Vision 2020: produced by Frost & Sullivan for Zipcar
- TfL rapid charging network research undertaken for TfL by Element Energy (as yet unpublished)

STAKEHOLDER ENGAGEMENT

A key focus of this study has been stakeholder engagement, as the primary means of understanding the views from the Car Club Coalition on their plans, aspirations, and perceived barriers and opportunities regarding introducing ULEVs into car club fleets for the different models.

We consulted with all members of the Car Club Coalition to understand their current plans, aspirations, barriers and opportunities for introducing ULEVs into their fleets. The consultation was structured around four topic areas (future growth projections, infrastructure, operational considerations and commercial considerations) and related to the different models, uptake projections and where the uptake is planned / expected in London.

In discussion with TfL, we agreed the consultation questions and structure. Certain topics and questions were only applicable to particular stakeholders, therefore the set of questions needed to be tailored for the separate discussions with operators, boroughs and the other Coalition members. However, the aim was to maintain as much consistency as possible to gain a comprehensive understanding of how views vary across common topic areas for the different types of stakeholders.

See Appendix A for the structured set of questions used for each interview conducted.

The stakeholders contacted included:

- Existing and future London car club operators
- London boroughs
- London Councils
- Carplus

- British Vehicle Rental and Leasing (BVRLA)

The methods of engagement were:

- Guided interviews: face to face and by telephone
- Borough Workshop

GUIDED INTERVIEWS

The questionnaire was piloted with one public sector and one private sector stakeholder, to ensure that it covered all the main areas and could be completed within a reasonable time period.

- **Car Club Operators** - 12 current and prospective future car club operators in London were invited to take part in the study. Every operator (100%) responded and was interviewed between November 2015 and January 2016.
- **Key Industry Bodies -** we also interviewed both the BVRLA and CarPlus in November 2015 (100%).

See Appendix B for Stakeholder Interview Transcripts.

STAKEHOLDER WORKSHOP

A workshop was held for boroughs on **26th November** at London Councils offices in Southwark, to maximise the number of authorities we could engage with in the available time-frame.

See Appendix C for further information on workshop attendees.

The workshop agenda and programme was structured as follows:

1. Scene Setting – car club models, market and EV charging infrastructure
2. Feedback on initial findings
3. Divide into Central / Inner / Outer London discussion groups
4. Break-out Session 1- Strategic Objectives and Aspirations
5. Break out Session 2 - Infrastructure and Locations – Issues and Opportunities

Boroughs were invited to complete a short email based survey prior to the workshop, with a further opportunity to complete the surveys after the workshop.

- **London Boroughs and Public Bodies** – 29 Boroughs, the GLA and London Councils were invited to participate in a stakeholder workshop and provide written feedback to a survey via email. 18 (62%) responded and/or attended the stakeholder workshop.

ANALYSIS, ASSESSMENT & MAPPING

The findings of the interviews and workshop were analysed, and as far as possible grouped into common sets of responses which were indicative of key themes, elsewhere responses provided more quantitative data which went onto inform the projections for ULEV uptake and infrastructure requirements:

3 FINDINGS FROM CAR CLUB OPERATORS AND INDUSTRY BODIES

Following the stakeholder interviews with current and prospective future car club operators in London (new entrants to the market), we collated and analysed the responses, to draw out key trends, issues, requirements and aggregated figures for anticipated future fleet composition.

The responses are grouped under the following topics:

- Infrastructure requirements
- Operational considerations
- Commercial considerations
- Perceived role of the public sector
- Baseline and projected future composition of car club fleets
- Planned/Anticipated locations of ULEVs
- Other

3.1 CAR CLUB OPERATORS

For simplicity we have sought to classify each of the operators in one of three categories:

- Back-to-Base / Return/ Round Trip
- Fixed One-way (Point-to-Point)
- Floating One-way/ Flexible

We recognise that in some cases Fixed One-way operators can effectively also serve as Back-to-Base models, but they are principally one-way operators.

Table 1 Car Club Operators (Current and Prospective) – Car Club Model Types

CORE OPERATING MODEL TYPE	POSSIBLE FUTURE MODEL TYPE
Back-to-Base / Return/ Round Trip	
Co-Wheels	Floating One-way/ Flexible
Enterprise Car Club	
E-Car-Club	
Hertz 24/7	
Ubeeqo	
Zipcar	Floating One-way/ Flexible
Fixed One-way (Point-to-Point)	
BlueCity	
Go!Drive	Floating model on trial in Islington
Floating One-way/ Flexible	
Car2go	

DriveNow
Ovo

The following figures highlight the composition of the current and prospective future operators by operating model type.

Figure 1 Car Club Operators in London (Current and Prospective) by Core Operating Model

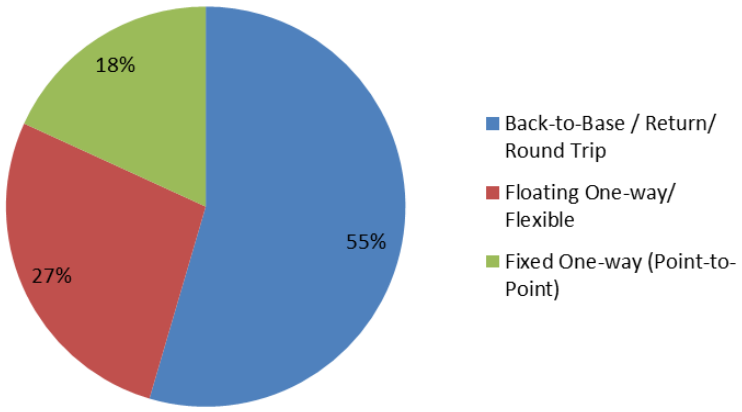
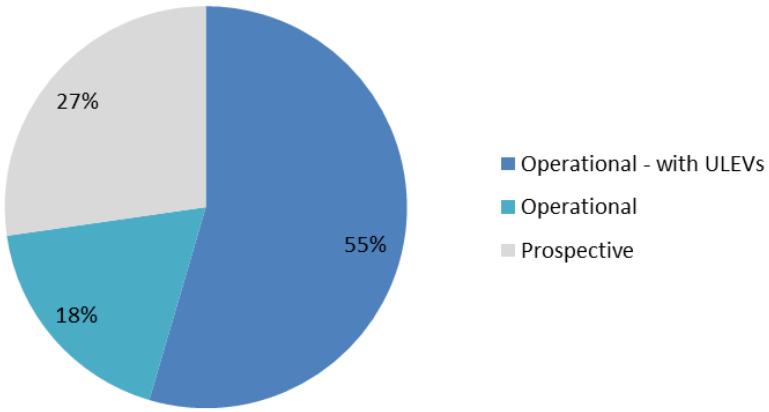


Figure 2 illustrates that just over half of current and prospective operators have first-hand experience of operating with ULEVs within their fleet.

Figure 2 Car Club Operators Currently Operating and Prospective Operators



3.2 INFRASTRUCTURE REQUIREMENTS

ACCESS TO BAY WITH EVCP

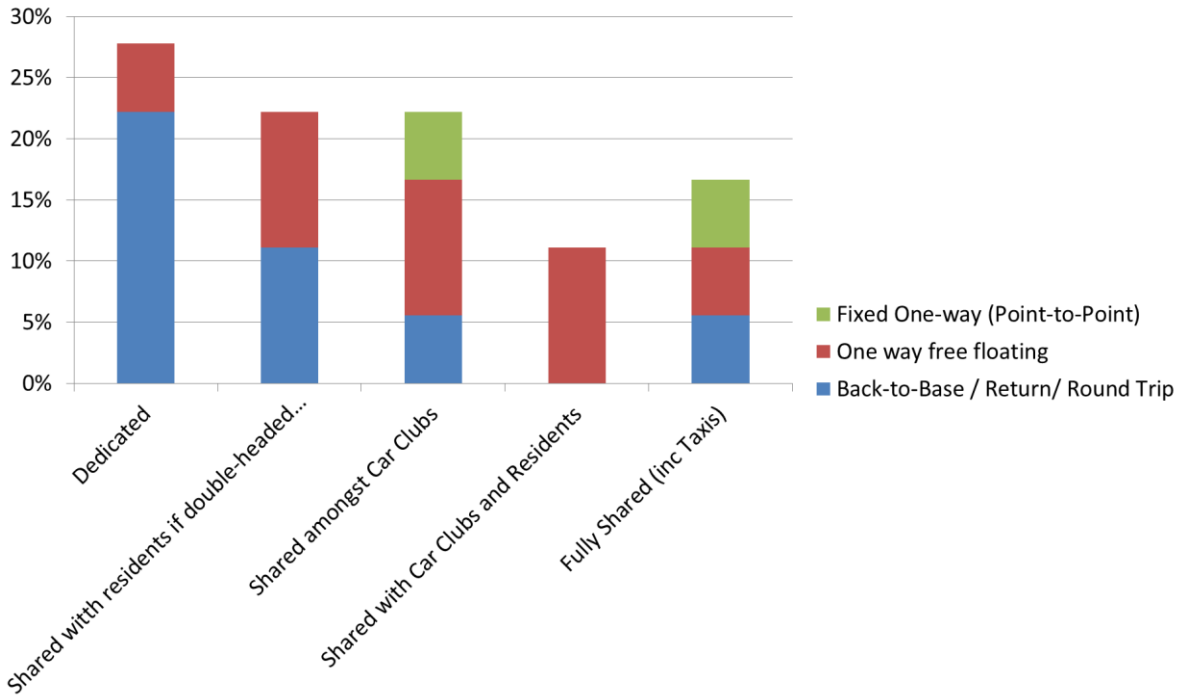
The views of operators varied with regard to the type of access required to car club bays with EVCPs to support their operations, though some trends were evident in the feedback provided.

In order to compare responses we grouped them into five different categories of bay access:

1. Dedicated to specific operator
2. Shared with residents if double-headed EVCP
3. Shared amongst Car Clubs
4. Shared with Car Clubs and Residents
5. Fully Shared (inc Taxis)and residents

Note some respondents referenced multiple possible scenarios they felt could be compatible for their operations.

Figure 3 Access Requirements



Back to base operators are more reliant on dedicated bays for their model, whilst floating and one-way models are more amenable to some forms of shared access to EVCPs, though the findings were less definitive than might have been anticipated in this regard.

Figure 4 Access Requirements to EVCP Bays - Back to Base/ Return/ Round Trip

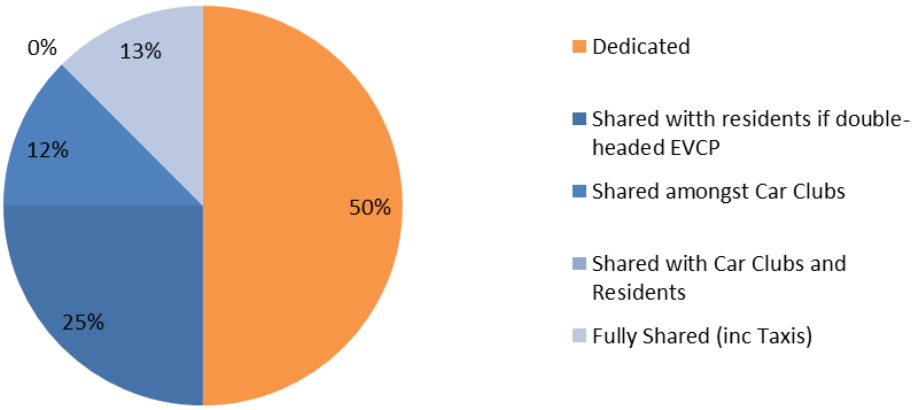


Figure 5 Access Requirements to EVCP Bays – Fixed One-way (Point-to-Point)

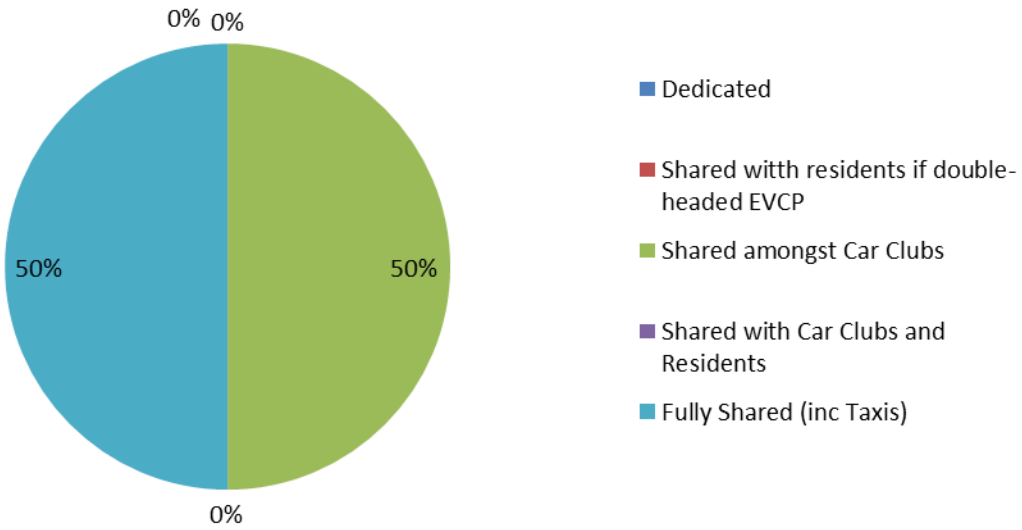
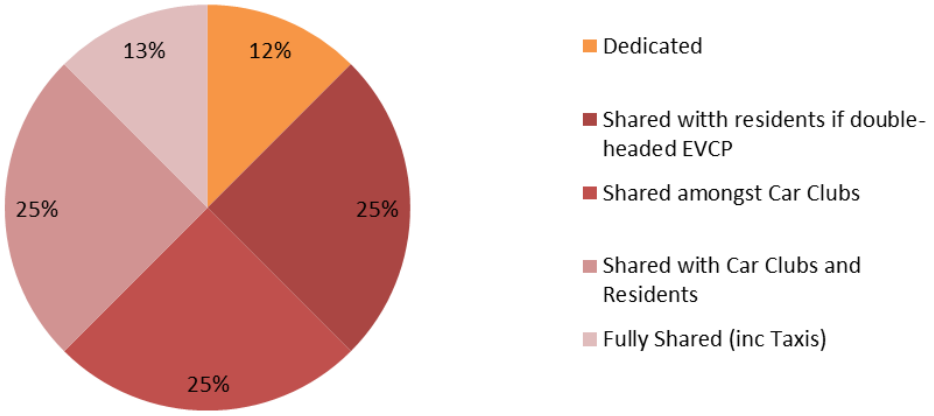


Figure 6 Access Requirements to EVCP Bays – One way free floating



Key Findings

Preference for bays dedicated specifically to an operator, particularly amongst Back to Base Operators.

Views varied though – some advocate network of car club bays with EVCPs dedicated to a single operator: "*the bay is part of the benefit*", and "*at the moment you can share with EV owners as there are not many of them, but as it grows that stops working viably …you need a 2.5 to 1 ratio* [bays per car club vehicle]*….if you add more use cases like residents, then we need more chargers*".

Many feel some degree of shared access to a bay and EVCP can work. *"Concerned that each operator needing its own dedicated infrastructure is far less efficient and adds lots of cost".*

Floating operators are naturally more open to shared bay access, but are more dependent on a higher number of bays with EVCPs.

Some of the more salient feedback and discussion points are summarised below:

- The type of car club model (Back to Base, Fixed One-way, Floating) not surprisingly had a significant bearing on their requirements for more dedicated spaces. In broad terms:
    - Back to Base were more likely to require a bay dedicated exclusively to their vehicle (40%).
    - Floating and Fixed One-way operators were more likely to advocate a shared network, where the point was either available to residents, other car club operators, both, and in some cases including taxis (86%).
- However despite often declaring a preference for dedicated bays, most Back to Base operators felt at least some form of shared option might be workable for them, including sharing bays with other car club operators and/or with residents/private users.

- Operators were most amenable to sharing access to an EVCP where a double-headed point is provided, with one bay dedicated for car clubs and the other is publicly accessible.

- Many operators commented that any form of shared access complicates operations.

- Opportunities for flexible/other car clubs to utilise the bay to charge whilst the station based cars are not located there – to make more effective use of EVCP bays during the periods when their host vehicle is away and the bay is empty.

- Some concerns expressed that sharing bays/EVCPs with taxis and Uber vehicles may result in a shortage of bays for car club vehicles, i.e. locations with high taxi activity.

- Some reference to the concept of a 'clearing-house', such as in Germany, where available car club EVCPs can be accessed *"using whatever card the user has, rather than having to carry a wallet full of charge cards".*

NETWORK AND INTEGRATION OF CHARGING POINTS/ NETWORK OPERATORS

Key Findings

A clear consensus amongst operators that a single integrated network of EVCPs is required. It could potentially be delivered by multiple operators though, provided it is fully interoperable and with a single point of reference for charge point status (i.e. occupied/unoccupied).

Some suggest a parallel sector specific network (i.e. for one-way only vehicles) would be most appropriate.

Some of the more salient feedback and discussion points are summarised below:

- Feedback from customers is that the current situation regarding the existing charge point network is confusing.

- *"Ideally customers would see where available charge points are to end their car club booking via live feed from all EVCPs across London, which is not currently available. Information could be communicated via an app or the car dashboard, and if there is a car club vehicle occupying the bay it would be marked as not available, but everyone should have that access – not limited to selected operators. If it's not done centrally then no one will know what charging stations are available and when. Consensus that a single integrated network where operators can see availability and service status of charge points, rather than have to go to 3 dashboards. It has to be a total integrated network."*

- Some would prefer a sector specific network (i.e. for one-way only), with the necessary connectivity to book a vehicle, and to know which kind of vehicle is occupying a bay at any time (i.e. the operator, model, status of charge).

- Some referenced the challenge posed by there being several EVCP networks that are actively competing, and so having vested interests.

- In future when payment for electricity is required for electricity it will further complicate matters if the several parallel and disconnected EVCP networks are in operation.

CHARGE POINT REQUIREMENTS

Operators were asked about the suitability of the differing EVCPs available in supporting their operations. The charge point types are:

- Slow (3kW)
- Fast (7-22kW)
- Rapid (43-50kW)

Key Findings

Clear preference for Fast Chargers (100% of respondents).

Mixed feelings on Slow Chargers – most felt they were inadequate, though some considered they may have a role for overnight charging if they were widely available.

Rapids play an important part in a wider network – particularly for floating car club models, potentially configured as hubs.

Some of the more salient feedback and discussion points are summarised below:

- Clear preference for fast charging; at the moment 7kw is generally sufficient, though 22kw is preferable.
- Mixed feelings on slow chargers, most felt it would be a retrograde step to rely on these, and that they were now obsolete as an option.
- Some felt slow chargers could play a part for overnight charging, particularly if they were very widely available. Some noted that in their experience slow chargers had proven adequate to serve even a heavily utilised pool vehicle, but still felt they were not ideal.
- Several considered rapid chargers play an important role as part of a wider EVCP network - particularly for floating models. Some respondents were more sceptical towards Rapids, either feeling they were not necessary or had reservations about using them due to the possible damage to vehicle batteries.
- Several highlighted the need to future proof the network to account for growing battery sizes and the resultant increase in charge durations. 7kw in short term is ok, but could be future proofed by installing 22kw.
- *"Timings permitted to be at bays is a factor. If for example 22kw fast chargers were limited to 30-60 mins stays, they may be more effective as intermediate points, whereas a 7kw fast charger might support 4-8 hour stays, or more, between bookings"*
- General consensus that EVCPs should be double-headed to enable shared access with residents etc.
- Some concerns were raised that Source London points are being replaced with IER models, which may have a proprietary BluePoint only plug, and highlighted that this presents an unworkable risk to a car club operator if they are reliant on use of these EVCPs.

CHARGING REQUIREMENTS PER ULEV

By applying the ranges of EVCP ratios identified by the operators for their respective car club models (Table 2) to their projected ULEV car club numbers, it is possible to derive some outline figures for EVCP demand by Central / Inner / Outer London areas.

Table 2 Charging Requirements (Ratio of ULEV car club vehicles to EVCP) by Operating Model

CAR CLUB OPERATING MODELS	MINIMUM EVCP REQUIREMENT	DESIRABLE EVCP REQUIREMENT	CHARGE POINT OCCUPANCY	CHARGE POINT AVAILABILITY FOR OTHER USERS
Back-to-Base / Return/ Round Trip	1:1		75-100%	Typically Dedicated – some may allow limited access via booking systems
Fixed One-way (Point-to-Point)	1:2	1:2.5	50-75%	Some access via booking systems
Floating One-way/ Flexible	1:2.5	1:10	<25%	Fully Accessible

The following tables provide an indication of the number of ULEV car club bays and charge points required based on the forecast ULEV car club vehicles per Central, Inner and Outer London area.

In practice it may not be necessary for every bay to be fitted with an EVCP, if in future there is a wider spread proliferation of EVCPs across London, in which case floating car club models may be able to make wider use of these points. The provision of a comprehensive rapid charging network may also alleviate the need for EVCPs at ratios specified by operators.

The operators were however consistently in favour of fast charger provision within the car club bays, with many stating this was either essential to their operating model, or a strong preference, whilst recognising some alternatives, such as slow chargers and the use of rapids had a part to play.

Table 3 Estimated EVCP Requirements by Area (High Growth Scenario)

	CENTRAL		INNER		OUTER	
	Minimum	Desirable	Minimum	Desirable	Minimum	Desirable
2018	165	406	104	324	27	71
2020	650	1545	441	1310	129	323
2025	1181	2984	830	2678	258	727

Table 4 Estimated EVCP Requirements by Area (Mid Growth Scenario)

	CENTRAL		INNER		OUTER	
	Minimum	Desirable	Minimum	Desirable	Minimum	Desirable
2018	108	251	68	198	17	43
2020	472	1106	313	904	88	208
2025	811	1991	554	1712	166	434

Table 5 Estimated EVCP Requirements by Area (Low Growth Scenario)

	CENTRAL		INNER		OUTER	
	Minimum	Desirable	Minimum	Desirable	Minimum	Desirable
2018	69	114	46	91	13	20
2020	200	338	136	274	40	62
2025	332	608	221	480	64	104

Key Findings

Reasonably consistent requirements specified for EVCP to vehicle ratios dependent on car club operating model.

Back-to-Base is predicated on a single EVCP bay per vehicle, with more limited scope for sharing the space.

Fixed One-way requires some contingency and allowances for tidal flows of vehicles.

Floating one-way requires widespread provision of EVCP bays, particularly in the longer term where the aspiration is for users to charge the vehicles and minimise artificial redistribution.

Some of the more salient feedback and discussion points are summarised below:

- Rapid chargers were considered an integral part of the wider network by some operators when describing their projected ratio of EVCPs per vehicle, particularly amongst floating models.
- Others pointed out that sharing infrastructure with residents would alter current assumptions, potentially requiring more charging points to satisfy the additional demand.

CHARGE POINT DELIVERY CHALLENGES

Key Findings

Challenges in delivering EVCPs widely acknowledged.

General feeling of frustration with current infrastructure.

Some of the more salient feedback and discussion points are summarised below:

- Many operators bemoaned the state of existing EVCP infrastructure.
- All recognised the challenges in delivering EVCPs, including the cost and resourcing requirements.
- Several referenced the variable nature of boroughs in terms of their resources and level of engagement in growing and maintaining their EVCPs.
- Challenges in identifying suitable sites for EVCPs in some locations - central London in particular. In some cases operators had found that less than 10% of possible bays were suitable for EVCP installation. The required depth for the installation of an EVCP can prove problematic, with existing cables or basements proving to be common obstacles.

Pavement width is also a factor. It is also preferred to avoid close proximity to street lights where possible.

ROLE OF NEW DEVELOPMENTS

Key Findings

Consensus that the inclusion of requirements for car clubs bays/networks within planning application for new developments will be fundamental in growing membership.

Some of the more salient feedback and discussion points are summarised below:

- New development has an "*Important role to play*", though several operators commented that the requirement for a car club as part of a new development varies a lot from borough to borough.
- Some pointed out the challenge is then delivering the car club so it's a meaningful resource. Some boroughs direct developers straight to operators, whereas it can work better if the borough instead pools contributions to secure a more sizeable pot of funding, to enable the delivery a larger co-ordinated network.
- It was also suggested boroughs should specify vehicle type and length of commitment for the Developers as part of the planning condition. Some are just for 1-2 years. Most tend to be 3 years minimum commitment. 5 years would be good.
- Some commented that the role of new developments was less useful for floating car clubs as vehicles really need to be on street to be viable, though it was accepted there may be scope to deliver on-street car club bays as part of some developments.

3.3 OPERATIONAL CONSIDERATIONS

SUITABILITY OF ULEV TYPES FOR THE DIFFERENT OPERATIONAL MODELS

Key Findings

All operators felt ULEVs were suitable for playing a part in their current or future car club fleets in London.

Most felt that a full battery electric vehicle (BEV) would be the most suitable option. Some felt the versatility of the PHEV was better suited to their model.

Some were more cautious about the role of ULEVs within their car club fleet, and saw them having a niche role.

Some mentioned the challenges posed by having ULEVs within their fleet; *"At the moment every [ICE] car can do every trip. You start to decouple the fleet when you add EV's."*

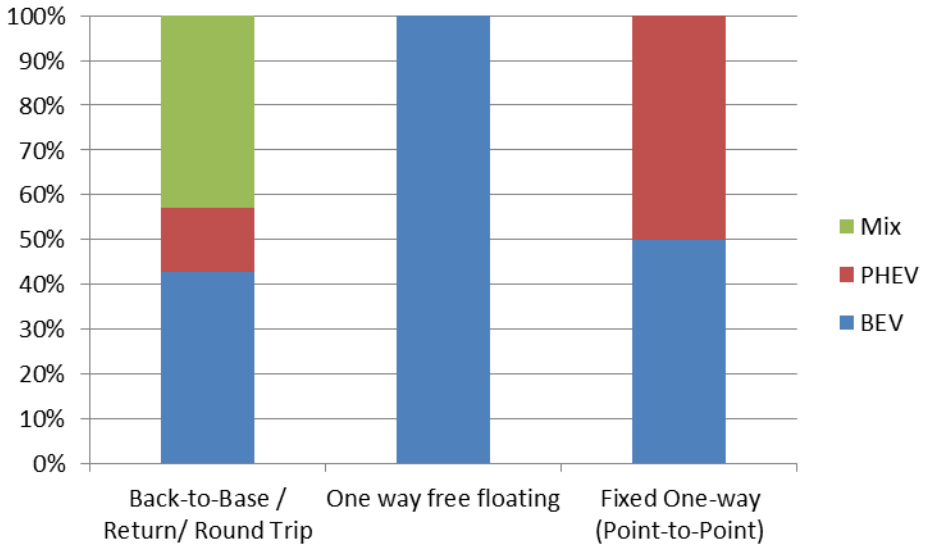
Some of the more salient feedback and discussion points are summarised below:

- Most felt that a full battery electric vehicle (BEV) would be the most suitable option, either because they were integral to their business model, or due to their efficiency for urban driving conditions and the short distance journeys typically made by car club members, or because PHEVs were considered too expensive.

- Some operators felt the versatility of the PHEV was better suited to their model, particularly where longer distance weekend use was a more significant.

- Some were more cautious about the role of ULEVs within their car club fleet, and saw them having a niche role or were uncertain which ULEV type would be most appropriate at this stage.

Figure 7 Operators preferred ULEV by car club model type



- Many felt the BEV was optimal for their model, one operator was keen to emphasise that the "*one thing that's not an issue is the [electric] vehicles, we're not waiting on further battery development etc.*"

- Several commented that the different ULEV models available within each category (BEV, PHEV and RE-EV) are highly variable in terms of quality, range etc. depending on the type of model, Original Equipment Manufacturer (OEM) etc.

- Some mentioned the challenges posed by having ULEVs within their fleet; *"At the moment every [ICE] car can do every trip. You start to decouple the fleet when you add EV's. "*

- Several commented that ULEV vans were less developed than cars, with fewer models, and further challenges concerning payload size.

- Some back-to-base operators considered that the scope for ULEV vehicles is more limited, and described an analysis of their customer base by consumer segment:

    - "People doing weekend trips doing long miles were discounted. "*If people really are going a long way then they're not interested for ULEVs*".

    - Then they looked at usage patterns of people using the remainder of the fleet, and considered that when these were back to back reservations with a need for longer range, or relatively fast charging between the bookings, it would prevent them from being operated by ULEV.

- They were also concerned that when a vehicles range drops below 50% it would pose a psychological barrier to prospective users, even if that range was sufficient for their journey, and so discourage a further portion of their customer base.

- Their conclusion was therefore that the number of UELVs within the fleet was constrained by these factors, but that they did see a role for offering ULEVs in certain areas (central and inner London), in a similar way that vans are offered at a lower density to standard ICE cars.

IMPLICATIONS FOR/OF: TRIP PURPOSE, TRIP DISTANCE, VEHICLE RANGE, VEHICLE UTILISATION RATE

Key Findings

Many observe very little difference in trip purpose between ULEVs and ICEs.

Slightly shorter trips for ULEVs.

Lower utilisation rate compared to ICEs a particular concern amongst some back-to-base operators, though the number of reservations may be higher.

More frequent short trips versus ICE usage necessitates optimising the charge time to maintain vehicle availability.

~20-25% vehicle utilisation estimated for ULEVs (in both back-to-base and floating models).

Some of the more salient feedback and discussion points are summarised below:

- Many observe very little difference in trip purpose or usage by members whether it is a ULEV or ICE.

- Some note slightly shorter trips, or proportionately more use in the congestion charging zone. The vast majority of trips are well within range of a BEV, so range is unlikely "*to cause that much of a problem especially in and around London"*.

- "Given the type of models and general charging models if you go too long distance may as well hire privately rather than a car club."

- Vehicle utilisation rates were a particular concern amongst some operators

    - Back-to-Base

        - *"Lower [utilisation rates] in ULEVs for sure, as we expect far less overnight trips which pushes up our utilisation rate at the moment.*

        - *"We are assuming they would be used as an hourly service only; therefore a lower utilisation rate than our ICEs. The number of reservations actually might be higher because of that, but the number of hours might be lower. If we get this right then we'd have to be optimising the charge time to ensure we maximise the revenue*."

        - "*[We're] not seeing the utilisation . . .that we would like, where we have double bays of petrol and EV's, 9 times out of 10 they'll take the ICE over the EV. Car clubs are a low margin model, and any extra cost pushes*

operators over the edge. It's not just cost, it's a lack of awareness and demand for the vehicles."

- *"Pure EV operators will wax lyrical but they haven't got a means of comparison with ICEs."*
- "*On-street –~30 times a month – around 25% (difficult to know for ULEVs)."*

- Floating
  - Forecast between 20-25% *"at extreme upper limit. 25% is the maximum possible utilisation for a floating model".*

WHAT ARE THE VARYING COST AND OPERATIONAL IMPLICATIONS OF ULEVS AND HOW DOES THIS VARY ACROSS OPERATING MODELS?

Key Findings

Higher up-front costs of ULEVs, often necessitates strong relationships or tie-ups with OEMs, or pump priming via a Local Authority or private organisation.

Reduced running costs and lower cost of servicing, maintenance and repair (SMR), some feel these savings are offset by operational complexities of ULEVs, which can result in lower utilisation.

Incentivising users to plug the vehicle into re-charge represents a further opportunity cost.

Large marketing budgets and resources required when launching a ULEV car club fleet at scale, could mean there is only space for a few larger operators in the marketplace in the mid to longer term.

Likely to see an increase in 3 way partnerships between car club operators, infrastructure provider and OEMs.

Some of the more salient feedback and discussion points are summarised below:

- Responses from operators regarding the cost and operational implications of ULEVs in car clubs varied, some emphasised the lower running costs, whilst others were more pragmatic and felt these were offset by their higher up front cost and less certain resale values.
- Upfront costs for ULEVs are higher, some suggested up to 30-40% more.
- Running cost per mile is significantly cheaper with ULEVs, and often not paying for electricity in many areas.
- Some suggested that servicing, maintenance and repair is around 15% lower for ULEVs over a 3-4 year operating period.
- Floating car club operators typically saw ULEV vehicles as more operationally suitable to their operating models.
- Some back-to-base operators considered that the increased operational complexities (lower utilisation etc.) more than offset the cost savings from running costs.

- Commercial relationships and deals with OEMs to secure heavily discounted vehicles are key in many cases to making the ULEV car club fleet viable.

- Most operators lease the vehicles

    - Extra cost of leasing an EV can be around £1k per car per year versus ICE. In some cases operators are not making a great deal more than £1k a year per car, so is a big additional cost

    - Difficult to introduce ULEVs without some support – either in the form of discounts from the OEM as part of commercial arrangement to promote the vehicle, or from a Local Authority or private organisation. Local Authorities often contribute small seed funding/pump priming (i.e. DEFRA funding).

- Some operators purchase ULEVs, or benefit from corporate tie ups with OEMs:

    - Biggest issue is uncertainty over residual value – some feel these represent big differentials for ULEVs, though others commented that "*residual values are now pretty strong for ULEVs so that's not as much of an issue any more, definitely for the Leaf, i3 and Tesla, and anyway most manufacturers will do a buy back on a pretty healthy level so commercially it may be coming more acceptable*".

    - Some complexities associated with buy back schemes with OEMs due to uncertain residual values. OEMs will often seek to put some risks back onto operators

- Other additional operational factors for ULEV car clubs include:

    - Can be necessary to incentivise users to plug the vehicle back into re-charge, often with offers of free driving time, but this represents a further opportunity cost.

    - Some felt a big marketing budget (£50 a head acquisition cost per customer) was necessary when launching a ULEV car club fleet at scale, and suggested this could mean there was only space for a few larger operators in the marketplace in the mid to longer term

    - It was suggested that as the market evolves we are likely to see an increase in 3 way partnerships of car club operators, infrastructure providers, and OEMs. "*Sharing the risk makes it work*".

CHARGING FOR ELECTRICITY AND PAYMENT MECHANISMS

Key Findings

Passing electricity costs onto customer is challenging, as the costs of doing so are currently disproportionate to value of the electricity consumed.

Some felt that incorporating the costs within the parking and permit costs was the best approach.

Most felt payment will be via contactless payment cards, RFIDs, Apps on Smartphones. Further payment innovations anticipated in the near future building on contactless payment.

Some of the more salient feedback and discussion points are summarised below:

- Operators recognise that the cost of capturing and billing for electricity is so expensive and the cost of the electricity is not a lot so it is hard to find a model that works unless parking is wrapped into it as well. Some Boroughs are including the cost of electricity in the price of a parking permit, but each borough is different. "*You either include all of the services as one price or split them out - separate parking, permit, and energy components charged variably. Included in the permit price wrapped into one should probably be way to do it."*

- Bollore are already responsible for the cost of electricity on Source London EVCPs signed over to them.

- Consensus that customers cannot be expected to pay for electricity at the EVCP, electricity should either be free or be wrapped up within the booking fee, as part of an itemised billing per journey.

- Most felt payment will be via contactless payment cards, RFIDs, Apps on Smartphones. Further payment innovations anticipated in the near future building on contactless payment. "*Ideally customer would have to do nothing and EVCP would just recognise vehicle, with no requirement to swipe Touchless payment cards, RFIDs etc*".

PRICING

Key Findings

Operators felt unable to comment on pricing whilst significant uncertainties remained around the Source London network tariffs/access charges.

Some felt customers weren't willing to pay more to drive an EV, and that many expect them to be cheaper.

Some of the more salient feedback and discussion points are summarised below:

- Most operators were unable to go into specifics on pricing, pointing to the uncertainties over infrastructure access and the access costs levied on car club users by the infrastructure owners (principally Bollore (Source London) and Chargemaster (Polar)).

- Lots of concern and uncertainty expressed by operators with regards Source London, including:

    - the likely tariffs rates. Concerns that a £5 per hour charge will be applied, which several felt would not be viable for them commercially; "*24 hours in a day. Autolib will say 9 trips per day so let's say it's 10 for ease, at 30 mins a trip. That's 5 hours driving per day. So it is parked for 19 hours a day. So at £5 per hour, that's £95 – it's more money than you'll make from the members using the car and you've not even bought the car yet*."

    - *"Want full clarity on the service levels for infrastructure, the cost – and it has to be locked into at least 5 years (not variable pricing)".*

- Several operators made the point that *"members won't pay more to drive EV, in fact they expect it to be cheaper as they know it's cheaper per mile to run".*

BOOKING A SPACE

Key Findings

Clear distinction in booking requirements between operating models.

Back to base models are bay based anyway and so no further booking is required, provided no other ULEVs have access to the bay.

Floating car clubs are not reliant on access to a specific bay as users can leave the car anywhere, and not on an EVCP, though the guarantee of a parking space was recognised as an additional service in its own right that customers may value.

Fixed one-way operations benefit from the capability of booking spaces.

Density of EVCP network is decisive.

Some concerns were expressed about the capabilities of available technologies for booking spaces, risk of it being obstructed etc.

Some of the more salient feedback and discussion points are summarised below:

- Clear distinction between models, most felt the ability to book a space would be a desirable feature for point to point/ fixed one-way models. Some are bookable 30 mins prior to use only. *"I think it's important to give users a sense of security, but at same time being on demand so don't want it too long unavailable"*.

- All fixed/B2b models are bay based anyway so have space bookings as a matter of course. Floating car club operators all felt booking spaces would not be necessary for their models, as users are not required to leave the vehicles in a particular location or on an EVCP anyway.

- A suggested approach to securing a bay for a back to base bay model by one operator was to dedicate EVCP bays to use by their ULEV only, so no booking is required.

- An operator considered that the guarantee of a parking space at the other end of a fixed one way trip is a distinct service in its own right, and so *"if that were important to a given member on a given trip, then being able to see space vacant where I'm going then book it and pay a fee then that's sensible, as it provides a better member experience and could be chargeable to members".*

- Some concerns about practicality of booking spaces when it comes to point to point models, as if they are blocked/occupied when you arrive it leaves you nowhere to go.

- Some doubts expressed over the capabilities of technologies available for pre-booking space, though others feel well these are well established.

- Density of EVCP network a key factor, where coverage is dense enough booking is not necessary. It is operationally easier to have more infrastructure rather than having to intensively manage EVCPs.

CHARGING THE VEHICLE - WHO AND HOW?

Key Findings

Most are reliant on, or would prefer, the user to be responsible for plugging in and charging the ULEVs.

Clear distinction between operating models, back-to-base and fixed-one-way entail users returning the vehicle to a bay, so simply need to be plugged in in-situ, floating car club users are not obliged to park at an EVCP bay.

Most floating car clubs are keen to incentivise drivers to recharge the vehicle, some feel this lessens the customer experience.

Redistribution and recharging requires 1 member of staff per 10-17 vehicles.

Availability of rapid chargers and/or dedicated fast chargers is key for floating car clubs.

Aim is to have most vehicles charging overnight. Some top-up charging during the day for high utilisation vehicles and those that have not been on an overnight charge.

Some of the more salient feedback and discussion points are summarised below:

- Back to base and fixed one-way entail the user driving from one charging post to another, so means charging can take place as a matter of course.
- Intermediate stops for refuelling were considered not to be a good option by several, as they represent an inconvenience to the customer.
- Some operators, particularly floating models, are keen to incentivise users to charge, as they are not otherwise required to, offering free or discounted car club usage.
- Others feel strongly that incentivise users to charge is not the way to go as impacts on customer experience/convenience
- Redistribution (i.e. to account for tidal nature of some flows and ensure even distribution across the local area) and recharging of vehicles when they are not returned to an EVCP bay in the case of floating car clubs require 1 member of staff per 10-17 vehicles (not just recharging, also cleaning and redistribution).
- Floating car clubs use a combination of their own private fast chargers, public rapid chargers and public network of fast chargers. Redistribution takes place as staff take vehicles to recharge. "*Rapids never more than 10 mins away . . . naturally spread across the business area without much redistribution, which is proven by the [low[level of staff."*
- Availability of rapid chargers and or dedicated fast chargers is key for floating car clubs.
- Aim is to have most vehicles charging overnight. Some top-up charging during the day for high utilisation vehicles & those that have not been on an overnight charge.

ENSURING THERE IS ENOUGH CHARGE AND THAT THE CUSTOMER CHOOSES/IS ALLOCATED THE CORRECT VEHICLE

Key Findings

ULEVs taken out of service when charge falls below a threshold (varies by operator between 15%-50%) – vehicle removed from listings on apps.

Issue with determining whether vehicle has enough charge is the operator doesn't know where they are going, even on a return trip/ fixed and pre-booked one-way trip, don't know what route they'll take.

Asking users to estimate their mileage likely to be ineffective, people don't think in miles travelled, likely to overestimate requirements.

Many stated educating the drivers of ULEVs capabilities is key – providing them information to make an informed decision.

In future technologies will be available to monitor battery charge remotely in real time, enabling better optimisation of fleet management.

Some of the more salient feedback and discussion points are summarised below:

- The threshold for taking a vehicle out of service to recharge varied across operators. Some floating model operators listed them as available until their charge fell to 15-20%, others said "below 25% of charge".
- Fixed one-way operators re-direct customers to alternative vehicles nearby when its charge falls below 50%.
- In Paris less than 5% of the Autolib fleet are out of action at any time.
- In future operators would anticipate being able to read charge capacities of vehicles remotely and optimise charging window and booking. New apps etc being introduced/already in place to 'right size' the cars for each trip.
- Issue with determining whether vehicle has enough charge is the operator doesn't know where they are going, even if on a return trip or a fixed and pre-booked one-way trip, don't know what route they'll take.
- Asking users to estimate their mileage likely to be ineffective, people don't think in miles travelled, likely to overestimate requirements. People rarely think about range and mileage at present when booking vehicles. *"If we were to try and incorporate into the booking then people will probably inflate their mileage . . . a tendency to overstate it to be safe*".
- Provide customer with information to make informed decision, and market appropriately as city cars, for making trips around town, then we don't need to ask them about mileage.
- Corporate users who are quite disciplined in terms of charging at night, don't need to restrict access as much.

IMPLICATIONS OF A MIXED FLEET ON CUSTOMER CHOICE

Key Findings

Having to recharge ULEV car club vehicles can be more convenient than having to refuel an ICE vehicle in London, where petrol stations are scarce, and necessitate intermediate refuelling. ULEVs can charge at their destination (where it is a bay based service of an EVCP is available).

First time customers often won't choose a ULEV car club vehicle, but once a user has tried a ULEV are much more likely to return to it.

Some of the more salient feedback and discussion points are summarised below:

- "*Petrol vehicles also have to go and refuel. For car club members, this is really inconvenient especially in London, as the fuel stations are sparse and not normally on your route from A-B. If you had a really good charging network then you completely do away with the need to refuel out of your way, and make it easier for a customer to understand as part of the rental. People can't find a fuel station so makes it easier with a charging point.*"

- First time car club customers tend to use ICEs, but "*are more likely to return to EV once they've used once and like it, so there is still an initial perception issue but it quite quickly goes away when people try it*".

3.4 COMMERCIAL CONSIDERATIONS

Further to the aforementioned infrastructure and operational differences of using ULEVs in car clubs relative to ICE vehicles, there are a number of commercial differences that influence car club operator's decision making in terms of the current and future uptake of ULEVs in their fleet.

Our stakeholder interviews prompted operators by outlining several perceived opportunities and challenges faced commercially to utilising ULEVs relative to ICEs, and sought their insight in developing additional factors and examples of how ULEVs currently compare to ICE vehicles commercially.

Beyond highlighting the positive/negative aspects of using ULEVs commercially today, the objective was to showcase specific examples or variances, gauge opinion on how this could change over time or be mitigated by third parties. This research highlighted a combination of qualitative findings and viewpoints, with some specific quantifiable variances for specific vehicles or operators.

FINANCIAL CONSIDERATIONS OF ULEVS E.G. PURCHASE/LEASE COSTS, OPERATIONAL COSTS/SAVINGS, DISPOSAL AND RESIDUAL VALUES

Key Findings

Private Operators find it more expensive (additional ~£1k per year per vehicle) to operate BEVs than ICEs, and much higher total costs of ownership for PHEVs

OEM backed operators do not have this challenge and are more open to using ULEVs, to gain operational information on the vehicles and market new vehicle products, with their main concern being around the charging infrastructure costs & access arrangements

The first and arguably most important aspect discussed with operators was the financial attractiveness of using ULEVs in car club fleets, relative to ICE vehicles, and how this may change over time.

There were some common findings amongst the operators; the main concern applicable to all operators was the charging infrastructure costs being challenging to integrate into a car club business plan. It was specifically cited the cost and charging density requirement for car clubs (especially one-way) make it difficult to deliver a fully on street proposition funded by operators, and uncertainty over the access and costs of the public charging infrastructure were also precluding the mass deployment of ULEVs in the short term.

On the benefits, it was agreed by most operators that lower fuel costs, congestion charge exemption and lower maintenance were the main benefits in the short term of using ULEVs. No operator was able to quantify the extent of these benefits relative to ICEs thus far.

However, several of the challenges were applicable to one or select groups of car club operator, which can be classified as contracted / owned by a single OEM, or multi-make fleet operators.

The multi-make fleet operators stated that the challenges of using ULEVs included:

- Purchase & lease costs of the car & battery being higher than ICEs upfront.
- The uncertainty over residual value cited as the major financial concern by several operators, with ULEVs experiencing a higher depreciation than ICEs due to a current lack of demand for the vehicles second hand.
- Total cost of ownership (TCO) is therefore higher of the ULEV vehicles: one operator stated this is £1k per year higher for BEVs than ULEVs, and higher for PHEVs, and another stated the TCO is currently double for ULEVs than ICEs in their fleet, positioning ULEVs in the premium vehicle segment which is not what they intend to offer.
- Repairs have been more expensive in ULEVs than ICEs, and the cost of replacing parts is higher and takes longer; an example of charging cables being stolen/broken was cited, and costing over £300 to replace.
- A lack of vehicle models available by OEMs today; car club operators deemed Renault/Nissan as the only viable retailers for EV's at present which limits the volume discounts that are available compared to ICEs, and poses a risk when remarketing the vehicles (companies like a diverse fleet to maintain higher residual values when disposing of the vehicles).
- More member services are required to service the fleet (to move them to/from charging posts where required), and to take the additional customer calls that are received for EV's relative to ICEs from customers querying the charging procedure.

Amongst the OEMs operating ULEVs in car clubs, it was cited by some in addition that this helps with fleet average CO2 benefits by having and using EV's in the fleet, and for marketing these new products and gaining information on their use in a commercial business. Furthermore, they can overcome the challenge of higher purchase cost of the vehicle by obtaining the vehicles at lower rates than any third party operator would be able to, improving the business case for ULEVs when operated by OEM backed car clubs.

CUSTOMER APPEAL AND COMMERCIAL ADVANTAGE OF ULEVS IN THE FLEET

Key Findings

Whilst not a primary consideration, some operators noted the new technology and enjoyment of driving ULEVs relative to ICEs is part of the rationale in their deployment in car clubs

Our research prompted operators to consider the customer appeal in using ULEVs in car clubs, and whether this does/could bear any commercial advantage as a rationale for their deployment in fleets above using ICE vehicles.

Some operators agreed with this notion, with some recurring themes including:

- ULEVs being fun to drive, and whilst there can be initial scepticism, this is soon overcome once the customer has driven a ULEV (specifically BEVs).
- When faced with using a BEV or an ICE (in a mixed fleet operation), the usage of BEVs is lower initially, but once they use them, the return rate is higher than with ICEs;

Not all operators agreed ULEVs had much of an additional customer appeal than ICEs in car clubs, citing:

- The majority of customers care principally about getting from A to B, not the power type of the vehicle.
- Customers are unsure of how to charge and use the vehicles and therefore it leads to an educational requirement from operators rather than a commercial advantage, which is hard to scale.
- The recent drop in fuel prices has not helped the view / necessity of ULEVs over ICEs from a customer view.

COMMERCIAL KEY PERFORMANCE INDICATOR DIFFERENCES

Key Findings

Operators stated that the use of ULEVs relative to ICEs tends to yield up to 25% lower utilisation for round-trip services, and can add 20-40% incremental costs per month; in one-way services.

ULEVs tend to be used more frequently but for shorter distance trips.

To gauge the commercial sensitivity of operating ULEVs relative to ICEs, our research prompted stakeholders to comment on a number of potential variances in commercial key performance indicators with respect to operating ULEVs in their fleet compared to ICEs. The following areas were highlighted:

- Utilisation of ULEVs vs ICE fleet – for round trip operators, some reported a lower (up to 25%) utilisation of their fleet with ULEVs, especially when given a choice of ULEV or ICE, potentially due to range concerns or general customer perceptions of the vehicles. However, for one-way the pattern was similar, with one noting higher frequency of trips but for shorter distances, evening out the overall utilisation.

- Proportion of members who have tried a ULEV option – this varied depending on how many ULEVs in the operator's current fleet, but was deemed that most have only tried ULEVs a few times, with no clear trend to conclude.

- Average trip distance: was reported to be lower in ULEVs than ICEs in fleets operating both; one specified example was 20 miles ULEV compared to 30 miles in an ICE on average.

- Current charge length and procedure – this would vary depending by operating models; round trip operators would charge the vehicles at the end of a rental utilising a charging point as part of the parking space; one way providers would require to mandate this at the end of a rental also (for fixed providers), or to require fleet operators to charge the vehicles in floating systems (one operator stated every other day would suffice).

- Average range left in vehicles at the end of each trip – one operator reported 70-80% charge left on average after each rental (a one-way provider), but this would vary depending on operational type. Most reported it was not an issue and that most vehicles came back with sufficient charge with a few exceptions.

- Pricing of ULEVs vs ICEs: all operators using ULEVs currently charge the same for these vehicles as their ICE fleet, with no current plans to vary the pricing plans; it was noted that whilst the vehicles could be priced higher than ICEs, this may preclude take up and damage utilisation further, and indeed some customers expect ULEVs to be priced lower to account for perceived lower running costs due to fuel savings. No operators disclosed exact pricing figures but noted benefits from OEM backed operators, and a lack of choice for multi-make providers precluding their further take up.

- Operational costs per month – It was generally agreed the operational costs of ULEVs were higher, with estimates ranging from 20-40% incremental costs.

- What are/can manufacturers offer to promote the uptake of ULEVs in car clubs: independent / multi-brand operators were largely positive about the deals emerging from OEMs that manufacture ULEVs, e.g. buy back agreements are now being offered to car club operators which were not available before for ULEVs; OEM backed operators will use ULEVs where the product is available in their parent companies model range and can obtain vehicles through direct production and access channels.

3.5 PERCEIVED ROLE OF PUBLIC SECTOR

Key Findings

A recurring view from stakeholders that the public sector can improve the charging infrastructure provision by setting clear policy, guidance, service level agreements to manage obligations, and a framework to ensure effective maintenance of the network.

In order to achieve the full potential of ULEVs in car clubs, and the London car club strategy target of 50% of car club fleets by 2025, the public sector can play an important role in facilitating the take up of ULEVs.

Our stakeholder interviews collected several opinions and suggestions for the role of the public sector in facilitating ULEVs in car clubs, including:

- In a similar way that the car club coalition has been positively received by operators and is a key driver in keeping innovation coming for ULEVs in car clubs, a similar borough car club coalition setup could be arranged; borough officers could attend on a quarterly basis if they want to obtain operator insights with a central focus for information sharing.

- Parking is as much of an important issue as EVCPs – the two are of course linked; if boroughs agreed on a number of spaces they were aiming for / willing to offer to operators, then EV infrastructure conversations could follow, such as what proportion of these spaces can become EVCP enabled. The access to these bays is a pre-requisite for expansion of ULEV fleets; this is currently hampered by several borough stakeholders and should be streamlined.

- Local authorities could enforce a minimum number of ULEVs in car club fleets for areas with operator contracts, as some are starting to bring in already.

- The infrastructure needs to be in place to facilitate growth of ULEVs, and restrictions / conditions managed by a third party like TFL to ensure that operators and all parties fulfil their obligations on infrastructure, vehicles, and maintenance (otherwise ULEV take up will be lower)

- Standardisation of charging is required; TfL may need to make a call on this otherwise several charging providers and vehicle manufacturers will continue to take alternative approaches which is not sustainable.

- Fragility of the existing infrastructure is a big issue, due to constant down time of the charging posts; there needs to be clear guidelines on maintenance, so a borough or procurement team can easily rectify issues and access repairs.

- In addition to the clear view / target on members and vehicles that has been promoted through the car club strategy, a similar statement needs to be provided on charging infrastructure in terms of number of points, and what is required practically to deliver it.

3.6 CURRENT FLEET AND FUTURE GROWTH PROJECTIONS

Based on the information shared by operators during the interviews, and any further supplementary information they provided, we have aggregated each of their projected/target fleet growth figures to provide an indication of the possible scale of future car club operations, and identify what proportion operators anticipate being ULEVs.

It is important to note however that the aggregated sum of each operator's projections does not necessarily account for competition amongst other operators in the marketplace, the possibility of market failures or the demand-side, and whether there is a large enough customer base to support each operators planned growth.

As the sector evolves it seems likely the market will consolidate to a degree, with a number of larger operators emerging and consolidating their position within particular geographic areas. There may however also continue to be a number of niche offerings/ distinct sub-sectors, the market is still evolving.

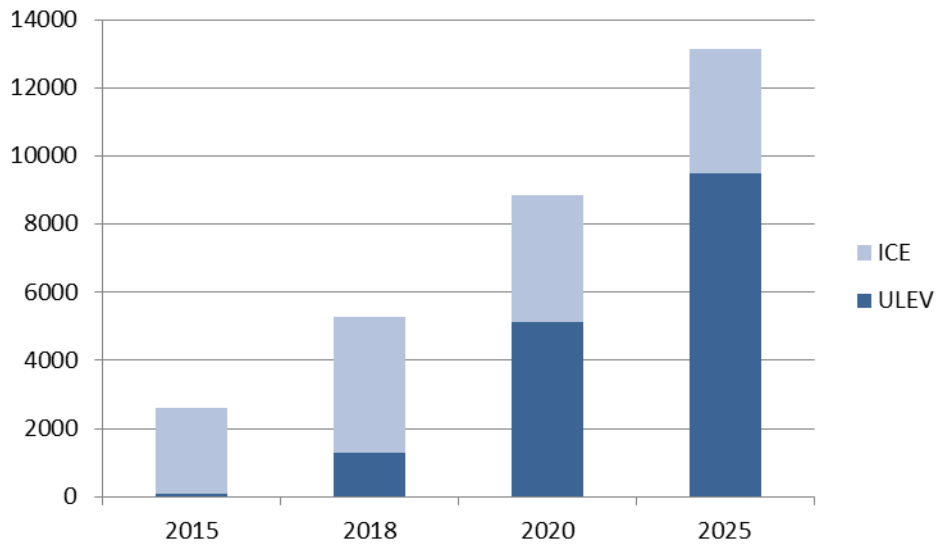
To account for these factors we have developed three scenarios for car club growth in London:

- → **High Growth Scenario** – based directly on the growth targets as stated by the operators
- → **Mid Growth Scenario** – based on all operators entering the market, but some with lower observed fleet sizes than their estimates
- → **Low Growth Scenario** - a more pessimistic scenario which assumes fewer operators and lower growth to fleet sizes than estimated

GROWTH SCENARIOS

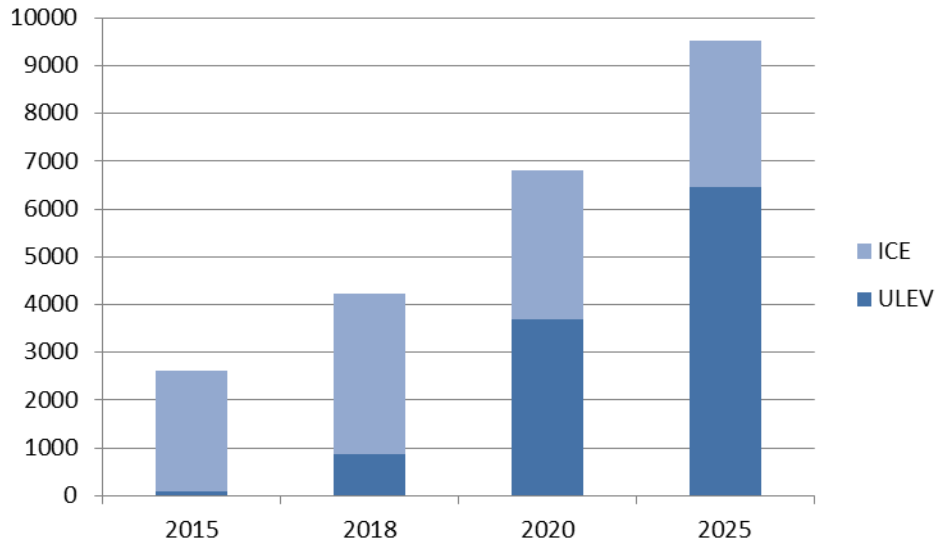
Based on the information shared by operators during the interviews, and any further supplementary information they provided, we have aggregated the projected future car club fleet size for London, including the composition of vehicles types, to derive Figures 3-5.

Figure 8 High Growth Scenario (Operator stated) for London Car Club Fleet Size and Vehicle Type



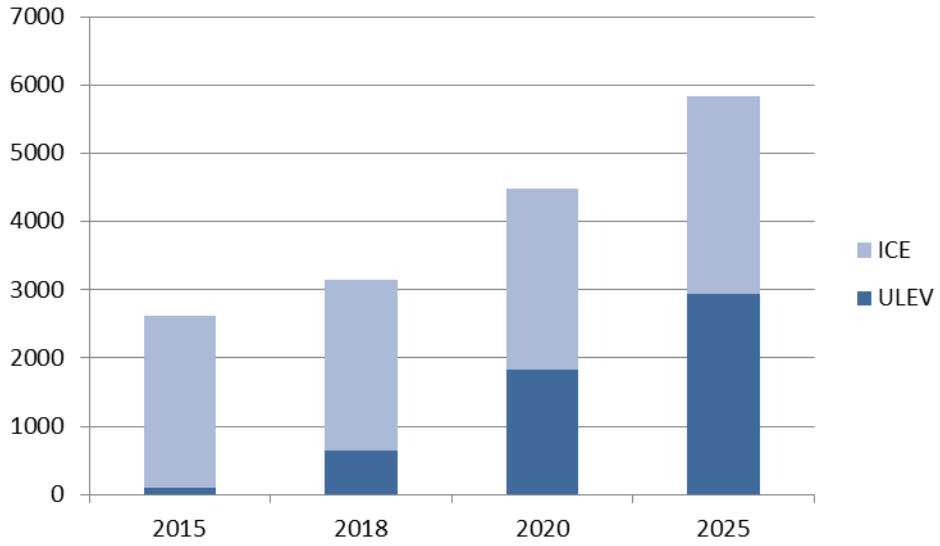
High Growth Scenario (Operator Stated): based on the targets or aspirations of the operators, there would be 11 car club operators offering 13,125 vehicles, with 72% ULEV by 2025

Figure 9 Mid Growth Scenario for London Car Club Fleet Size and Vehicle Type



Mid Growth Scenario: 11 operators with 9,522 vehicles, 68% of which ULEV by 2025

Figure 10 Low Growth Scenario for London Car Club Fleet Size and Vehicle Type



Low Growth Scenario: 7 car club operators offering 5,837 vehicles, 50% of which would be ULEV by 2025

Figures 11 and 12 below report all of the growth scenarios for comparative purposes. For further details on the composition of these forecasts see Appendix D.

Figure 11 ULEV and ICE Car Club fleet sizes 2015-2025; All Scenarios

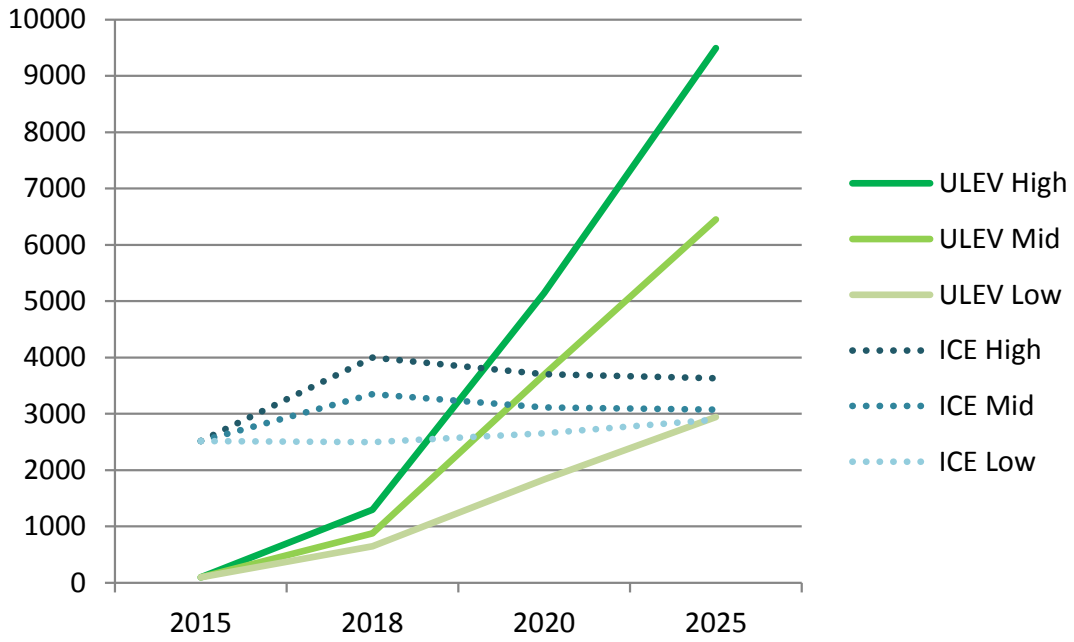
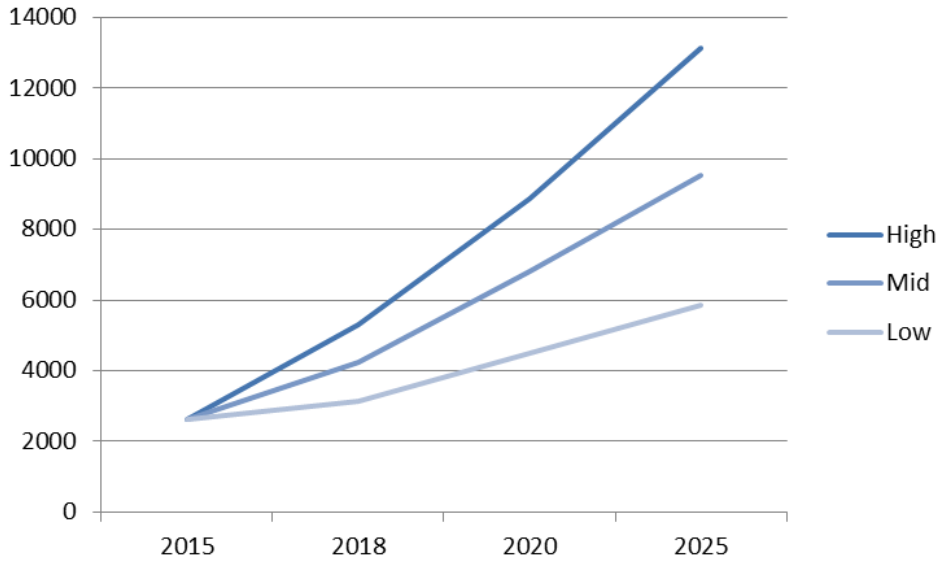


Figure 12 Total Car Club fleet sizes 2015-2025; All Scenarios



Floating operators all forecast their fleets will be fully electric by 2025, whilst point-to-point operator forecasts anticipate them being over 95% electric. Back-to-base operators forecast ~25% of their fleets being electric by 2025.

Key Findings

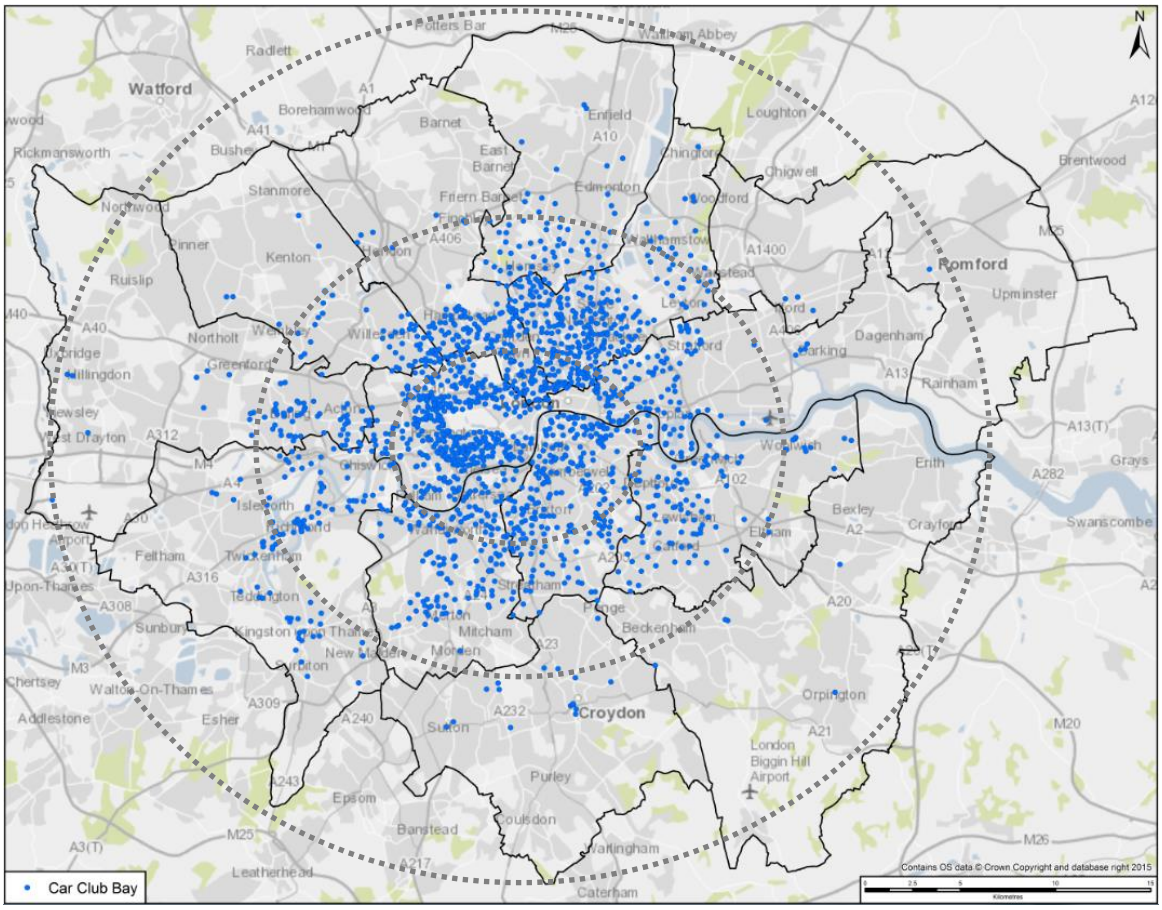
Indicates a clear trend towards an increasing proportion of ULEV vehicles within the car club fleets across London between 2015 (4% of fleet), to 2025 (50-72% of the fleet), with over 13,000 car club vehicles in operation in total; our low /mid scenarios estimated ~5,800-9,500 to account for competition amongst operators, market failures and demand-side issues.

High and Mid-range scenarios both forecast ULEVs to overtake ICEs as the dominant vehicle in car clubs by 2019-2020

3.7 CURRENT LOCATIONS OF CAR CLUB BAYS

The existing distribution of car club bays is as follows:

Figure 13 Existing distribution of car club bays



Source: CarPlus (October 2015)

Table 6 Current distribution of bays across London

AREA	TOTAL BAYS	
Central	854	*49%*
Inner	779	*45%*
Outer	110	*6%*
Overall	1,743	*100%*

Note: Central/ Inner/ Outer definition is based on the concentric rings shown

Note: 75 vehicles are not assigned to specific boroughs / areas

Table 7 Type of car club bays across London

BOROUGH	LOCATION TYPE	TOTAL BAYS	
Central	On-street	646	76%
	Off-street	66	8%
	Unspecified	142	17%
Inner	On-street	533	68%
	Off-street	114	15%
	Unspecified	132	17%
Outer	On-street	89	81%
	Off-street	20	18%
	Unspecified	1	1%

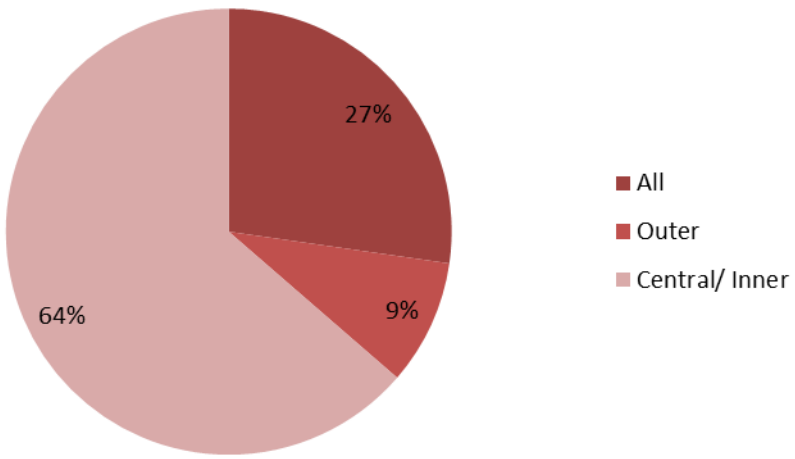
Note: Central/ Inner/ Outer definition is based on the areas identified in Figures 13-15.
Note: 75 vehicles are not assigned to specific boroughs / areas

The data shows that the proportion of car club bays accommodated in off-street locations increases from Central London to Outer London, though they only increase slightly and unspecified in central and inner Boroughs may be on-street.

3.8 PROJECTED LOCATIONS OF CAR CLUB ULEVS

Operators were unable to provide specific details on where they anticipated growth at more localised levels, but were able to describe in broad terms whether their focus was likely to be London-wide (all), Central/inner London or Outer London.

Figure 14 Operators anticipated locations within London for ULEV car club vehicles



Based on the operators responses, their projected car club growth forecasts and our interpreted mid and low range scenarios were apportioned between central, inner and outer London.

The estimated split of projected future ULEV car club vehicles amongst Central/ Inner/ Outer London Boroughs with the following figures is based on our interpretation of the operator interviews and how these allocations may evolve over time.

Figure 15 Operators anticipated distribution of Car Club vehicles by location (High Growth Scenario)

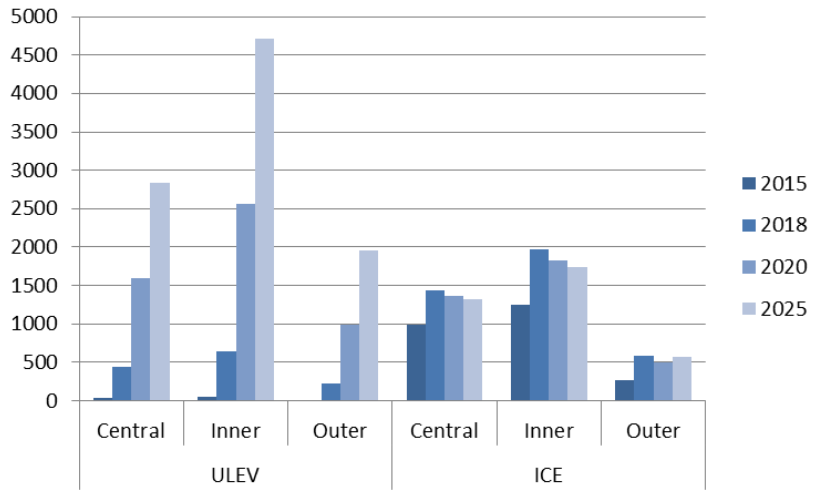


Table 8 Operators anticipated distribution of Car Club vehicles by location (High Growth Scenario)

		2018	2020	2025
ULEV	Central	436	1593	2830
	Inner	644	2563	4709
	Outer	218	991	1954
ICE	Central	1439	1366	1325
	Inner	1978	1830	1740
	Outer	579	505	566

- In 2018, of 1,297 ULEV car club vehicles projected 50% are in Inner London, 34% in Central and 17% in Outer London.
- In 2020, of 5,147 ULEV car club vehicles projected 50% are in Inner London, 31% in Central and 19% in Outer London.
- In 2025, of 9,494 ULEV car club vehicles projected 50% are in Inner London, 30% in Central and 21% in Outer London.

Figure 16 Operators anticipated distribution of Car Club vehicles by location (Mid Growth Scenario)

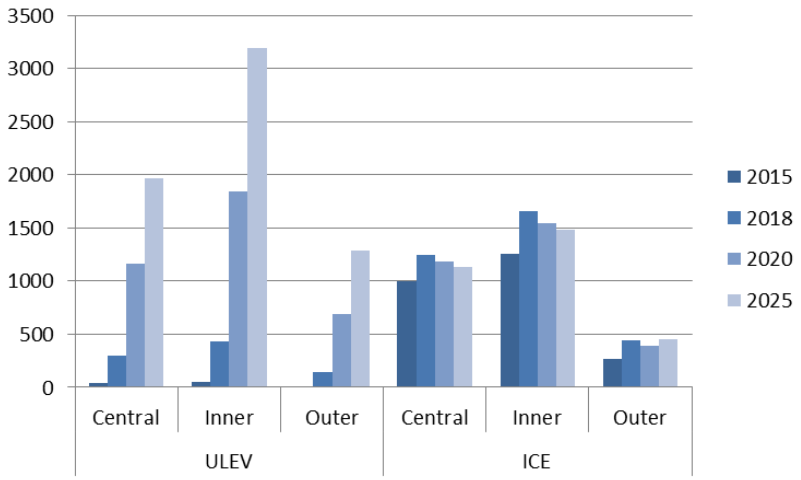


Table 9 Operators anticipated distribution of Car Club vehicles by location (Mid Growth Scenario)

		2018	2020	2025
ULEV	Central	296	1166	1968
	Inner	435	1840	3196
	Outer	146	689	1284
ICE	Central	1251	1180	1135
	Inner	1658	1541	1480
	Outer	437	392	457

- In 2018, of 878 ULEV car club vehicles projected 50% are in Inner London, 34% in Central and 17% in Outer London.
- In 2020, of 3,695 ULEV car club vehicles projected 50% are in Inner London, 32% in Central and 19% in Outer London.
- In 2025, of 6,449 ULEV car club vehicles projected 50% are in Inner London, 31% in Central and 20% in Outer London.

Figure 17 Operators anticipated distribution of Car Club vehicles by location (Low Growth Scenario)

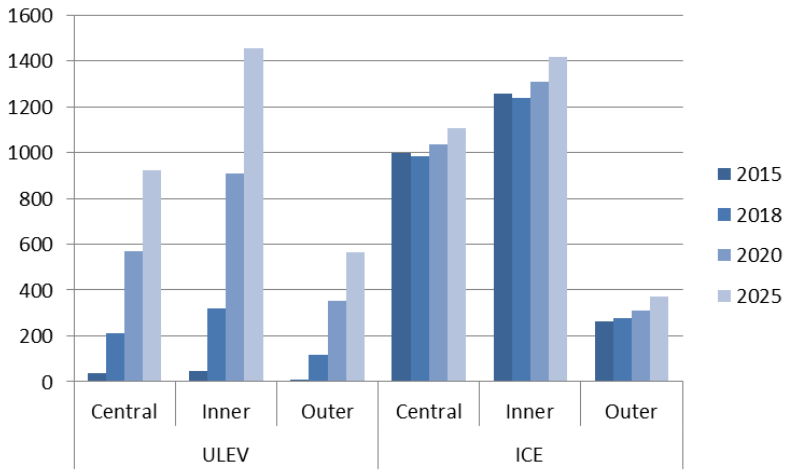


Table 10 Operators anticipated distribution of Car Club vehicles by location (Low Growth Scenario)

		2018	2020	2025
ULEV	Central	210	571	924
	Inner	322	909	1453
	Outer	116	353	565
ICE	Central	983	1034	1106
	Inner	1239	1310	1415
	Outer	276	311	374

- In 2018, of 649 ULEV car club vehicles projected 50% are in Inner London, 32% in Central and 18% in Outer London.
- In 2020, of 1,833 ULEV car club vehicles projected 50% are in Inner London, 31% in Central and 19% in Outer London.
- In 2025, of 2,942 ULEV car club vehicles projected 50% are in Inner London, 31% in Central and 19% in Outer London.

Figure 18 Operators anticipated distribution of ULEV Car Club vehicles by location (High Growth Scenario)

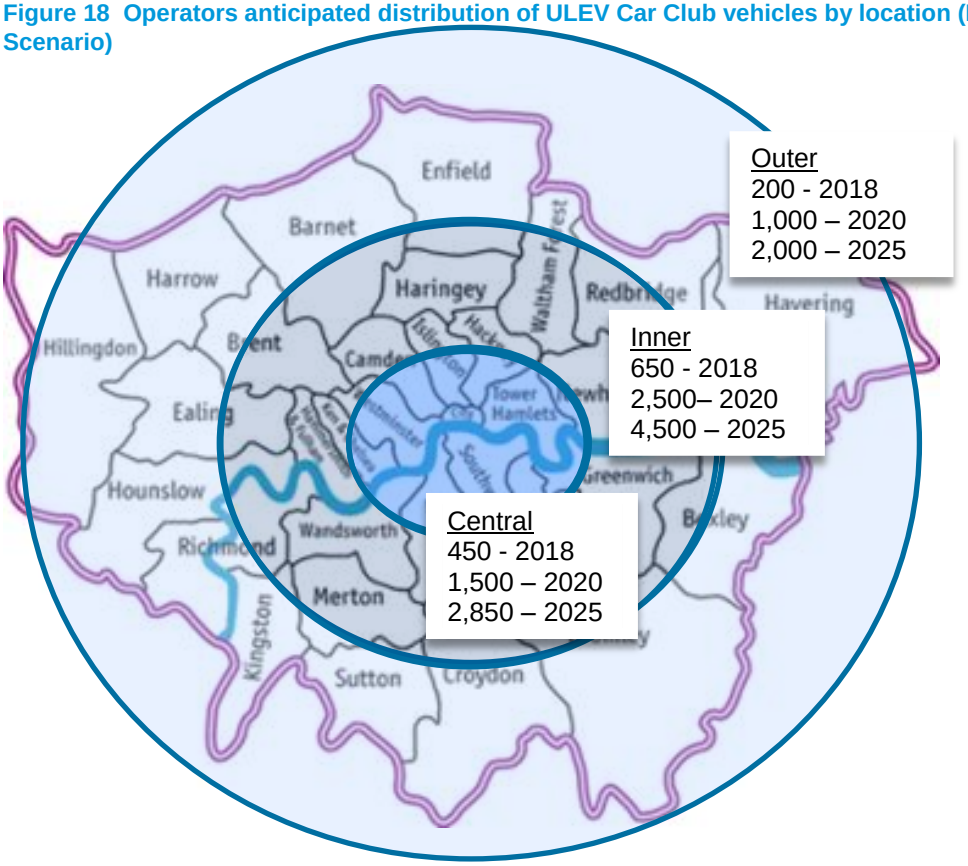


Figure 19 Operators anticipated distribution of ULEV Car Club vehicles by location (Mid Growth Scenario)

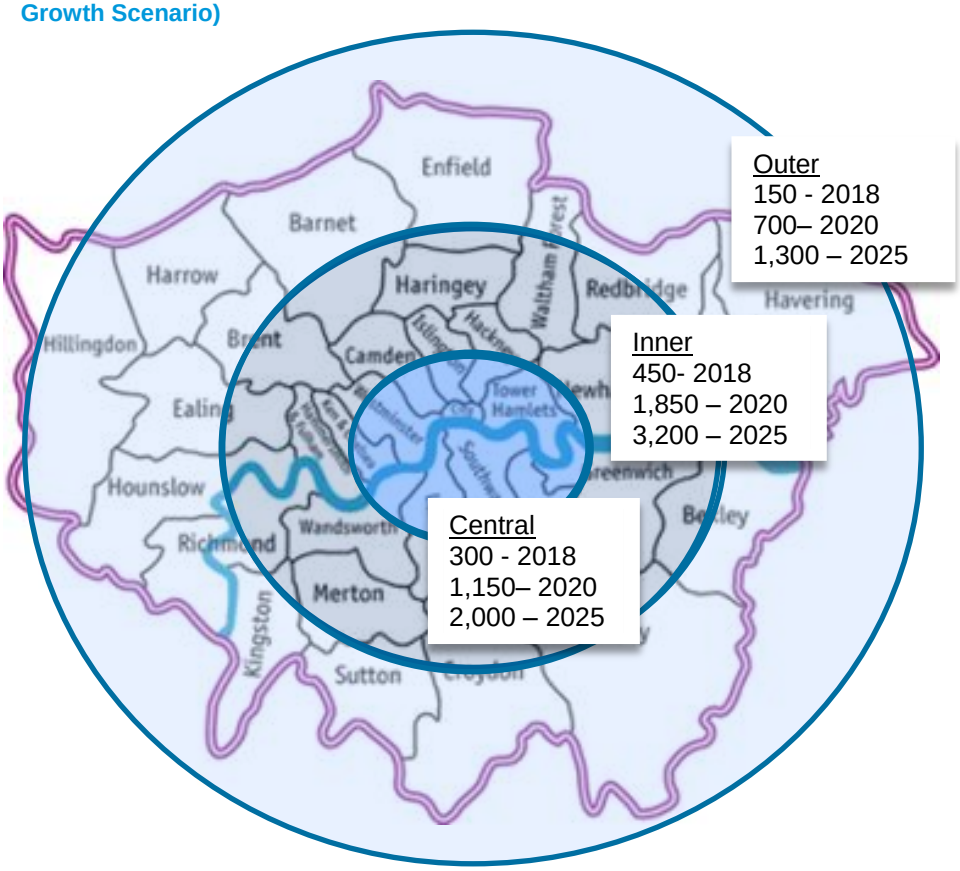
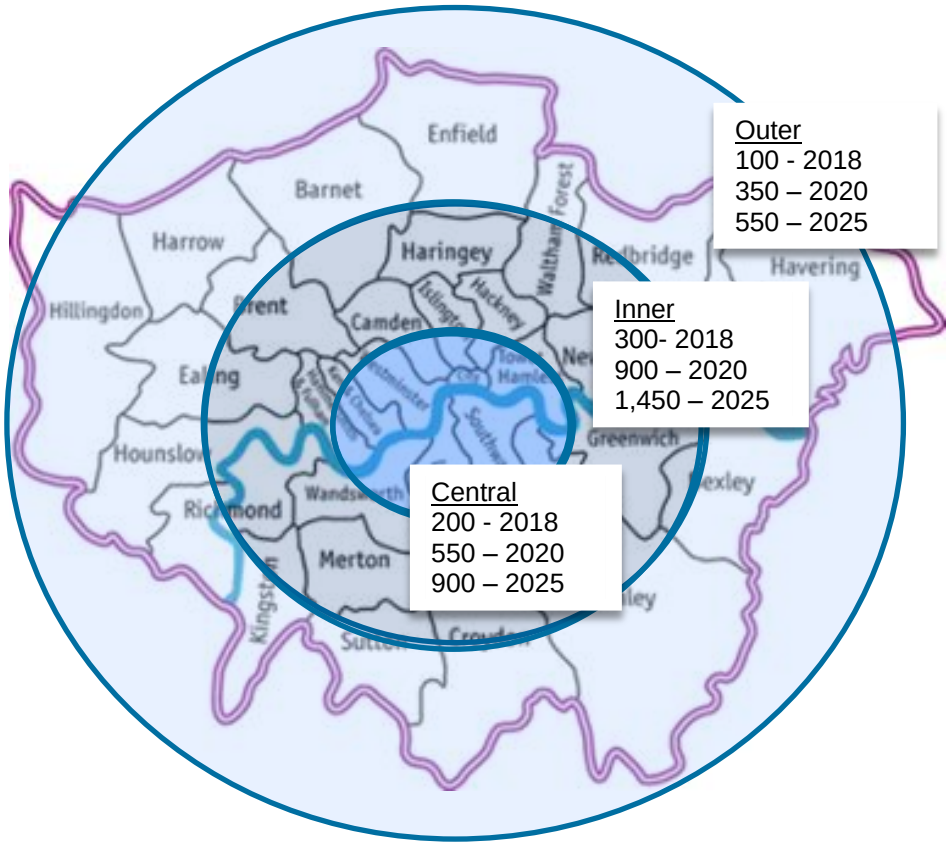


Figure 20 Distribution of ULEV Car Club vehicles by location (Low Growth Scenario)



Key Findings

Continued focus on Central and Inner London Boroughs is anticipated, higher population densities, better public transport accessibility, shorter trips and more limited parking for residents were all cited as key factors.

A number of operators are aiming for London-wide coverage though, and other models are targeting local and regional centres, public transport hubs and other attractors in Outer London. One operator is targeting Outer London specifically.

EMISSIONS BENEFITS

Key Findings

London's car clubs have the potential to reduce London's car based CO_2 emissions by up to 0.7% per year by 2025, owing to the use of greener vehicles in car club fleets than the London average, and the lower average mileage of car club members, even when accounting for those who did not previously drive.

The projected ULEV car club uptake described earlier were segmented based on the vehicle type (ICE, PHEV/REX-EV, and BEVs), and car club operating type (station based and one-way car clubs); to determine some indicative figures for emissions savings. The emissions savings were determined based on the:

- → Lower than average emissions of car club vehicles versus average UK car emissions
- → Reduced Km's driven on average by car club members.

Lower Emissions

Car club vehicles on average emit lower CO_2 emissions than the average UK vehicle fleet, before ULEVs are even introduced into the mix, as car club operators maintain a younger fleet, and many put an emphasis on fuel economy.

As a base case we therefore quantified the emissions of the current London car club fleet, and compared it to what the equivalent mileage completed by the UK average vehicle would have equated to in terms of emissions.

Fewer Vehicle Kilometres

Car club members on average also drive fewer kilometres upon joining a car club, relative to before they were members, even when accounting for the proportion of members who previously drove fewer kilometres. This is likely due to a combination of reduced vehicle ownership brought about by car club membership, and a corresponding gradual change in behaviour away from car ownership and more frequent/habitual use, to occasional use and the greater use of alternative modes.

The base scenario therefore considers the current car club fleet mileage in London, and determines the additional mileage that would have been travelled were the reductions in kilometres not realised.

Analysis

Emissions analysis was undertaken across all scenarios (low-mid-high) between 2015 (base case) and 2025. In order to estimate the baseline and future scenarios, assumptions were taken based on the inputs and further insight gathered from the car club operators and credible secondary sources – see table below.

Table 11 Key Inputs to emissions calculations

KEY INPUTS	SOURCE
Car Club Fleet 2014/15 split by powertrain type (BEV, PHEV, ICE)	Carplus
BEVs - 87g/km (well-to-wheel)	Go Ultra-low
PHEVs -115g/km (well-to-wheel)	Mitsubishi Outlander
Real world (manufacturer reported tailpipe emissions uplifted by 21%) car club average emissions per vehicle	Carplus annual survey 2014/15
Real world (manufacturer reported tailpipe emissions uplifted by 21%)	UK average fleet emissions per vehicle (190g CO_2/km)

Average annual distance travelled per round-trip car club car per year – 11,311 miles/ 18,203 km	Car club operator data reported in Carplus annual survey 2014/15
Average annual distance travelled per one-way car club car per year – 8,193 miles / 13,186km	Frost & Sullivan analysis
Reduction in distance travelled in car based modes – Round Trip Members – 37%	Carplus Annual Survey 2014/15
Reduction in distance travelled in car based modes – One-Way Members – 11%	6T Autolib study (2014)

Round trip and one-way car sharing models were treated separately given the differences in operation and behavioural changes exhibited by members, and using the fleet projections obtained by car club operators shown in the previous section.

Well to wheel emissions values were applied to be consistent with DECC methodology, and therefore existing car club operator emissions values for ICE vehicles were increased by 20g/km to account for the power generation needed to provide the fuel (source: Go Ultra-Low); for BEVs the Go Ultra-low current fleet average of 87g/km was used which considers the power generation needed to provide the electricity; for PHEVs this logic was applied to a Mitsubishi Outlander, generating an average of 115g/km.

In the baseline and forecast scenarios, all emissions values per car were reduced by 1% per annum to reflect the average fleet reduction observed in the last 5 years, and assuming this will continue to 2025 at the same rate for all powertrain types. The resulting emissions values are outlined in the table below (*note: the Carplus survey methodology uses tailpipe emissions to calculate the resulting emissions savings rather than well to wheel values*).

Table 12 Emissions by vehicle type (grams $C0_2$ per km)

VEHICLE TYPE	2015	2018	2020	2025
UK AVERAGE CAR	206.2	200.5	196.7	187.2
ICE (Car Club)	149.7	145.8	143.2	136.6
PHEV / REX	115.0	111.6	109.3	103.5
BEV	87.0	84.4	81.9	79.4

Lower Emissions

→ *Total Car Club Vehicle fleet x (Average km travelled per vehicle per year x tonnes CO_2 / km per car club car)*

- Output is the total car club fleet emissions (tonnes of CO_2)
- This was calculated for ICE/PHEV/BEV using the above formula varied for each powertrain segment using the relevant "real world" well to wheel emissions values as demonstrated above
- This was calculated for all years (2015-2025) based on the projected fleet levels for each segment and in each scenario (low-mid-high)
- Round trip and one-way models were calculated separately to reflect the varying distances travelled per vehicle, and powertrain fleet mix

The comparable emissions that would have been generated if these trips were made in the UK average car were calculated as follows:

- *Total Car Club Vehicle fleet * (Average km travelled per vehicle per year * tonnes CO_2 / km per UK average car)*
  - Output was comparable total fleet emissions if the car club fleet were at UK average fleet emissions levels

The saving generated was therefore the difference between the car club fleet emissions and what would have been generated by a fleet of the same size composed of vehicles with average UK levels of emissions.

The potential emissions reductions range from **7,400 to 17,500 tonnes of CO_2** in 2025, representing a saving of between 0.2% and 0.5% of the car based transport emissions in London.

Fewer Kilometres

- (*Average Round Trip vehicle distance per car per year * 1.37*[5]*) – average round trip vehicle distance per car per year = distance saving per round trip car club vehicle per year*
- *(Average One-Way vehicle distance per car per year *1.11*[6]*) – average one-way vehicle distance per car per year = distance saving per one-way car club vehicle per year*
  - Output is the difference in total mileage based on current average car club mileage and including the reported average percentage reductions in mileage.
  - These equate to a 6,735 km saving per year for Round trip car clubs and a 1,450 km saving per year for One-way

We then quantified the emissions that would have been generated had those kilometres been travelled in a UK average vehicle:

- *Car club vehicle fleet * average saving per vehicle per year*
- *(Total kms saved by car club vehicles * g/ CO_2/km) /1,000,000 (to convert to tonnes)*

On this basis the roundtrip car club fleet this saves 23-33 million kms per year in 2025, and *between 4,200 (low) and 6,100 (high) t/ CO_2 per year from round-trip car clubs*

The One way vehicle car club fleet saves between 3.5 -12 million kms per year in 2025, and *between 650 (low) and 2,300 (high) t/ CO_2per year from one-way car clubs*

Therefore, the combined emissions saving resulting from the lower distance travelled in car club cars relative to what would have been travelled had they not been available is **4,900 and 8,300 t/ CO_2 per year**, representing a potential to decrease London's emissions from car based modes by a further 0.1% - 0.2% per year by 2025.

The greener vehicles and lower mileage combined equate to a reduction in CO_2 emissions in London of between 12,200 and 25,800 t/CO_2 per year by 2025. This would represent a 0.3% to 0.7% annual reduction in London's emissions from car based travel .The outputs of this analysis are summarised below.

[5] 37% = average km reduction for Round trip car club members
[6] 11% = average km reduction in One-way car club members

Table 13 Car Club Emissions Reductions based on Fleet size/composition, all scenarios, 2015-2025

EMISSIONS REDUCTIONS	BASE	LOW			MID			HIGH		
	2015	2018	2020	2025	2018	2020	2025	2018	2020	2025
Reductions derived from vehicles (Tonnes CO_2 per year)	2,669	3,323	5,870	7,359	4,577	8,810	12,485	5,786	11,578	17,465
Reductions derived from lower mileage (Tonnes CO_2 per year)	3,257	3,478	4,273	4,890	4,088	5,276	6,564	4,710	6,315	8,336
Total emissions reductions (Tonnes CO_2 per year)	5,926	6,801	10,143	12,249	8,665	14,086	19,049	10,496	17,893	25,801
Reduction to London's car based emissions	0.2%	0.2%	0.3%	0.3%	0.2%	0.4%	0.5%	0.3%	0.5%	0.7%

- Car club vehicles are greener than the UK average – with the proportion of ULEVs in car club fleets projected to grow to between 56%-72% by 2025, the emissions differential between car clubs and the UK average will continue to widen, and could save up to 5,784 t/CO_2/year from round trip car club models, and up to 11,681 t/CO_2/year from one-way car sharing

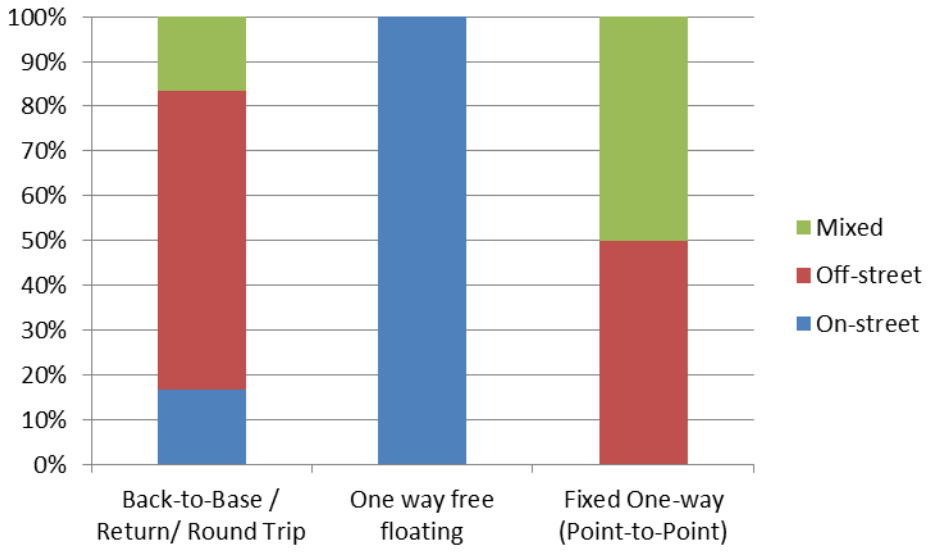
- Car club members exhibit behaviour change, driving less in car club vehicles than private vehicles; when applying this to the car club vehicle fleet (by calculating the resulting carbon reduction from this assumed lower distance travelled per car club vehicle), a reduction of 6,082 t/ CO_2 in station based and 2,253 t/CO_2 from one-way services could be achieved, given the proportionate reduction in station based mileage is higher.

- Therefore, combined, London's car clubs could reduce between 12,249-25,801 t/CO_2 per year from the roads, representing a 0.3%-0.7% reduction in London's total CO_2 emissions from cars.

TYPE OF LOCATION

As indicated in the figure below, the type of car club model has a bearing on the requirements or preferences for the locations of their car club vehicles, and their associated bays and charging infrastructure.

Figure 21 Type of location for ULEV car club bays by operating model



A number of operators expressed a clear preference for on-street bays, but felt they were not deliverable in the numbers required at present, or may have to compromise:

"40% of our customers say they hear about us by physically seeing the cars on street"

3.9 OTHER

Key Findings

Operators cautious of focusing on one solution such as ULEVs, and that car clubs should focus on bringing mass market appeal that is representative of fleets available from vehicle manufacturers. Furthermore, the rapid evolution of technology in cars will play an increasing role in the development of the car club sector.

In addition to the areas highlighted in our structured stakeholder interviews, there were some additional insights and suggestions that were provided, on London specific and industry wide issues.

The key inputs and suggestions were:

- The significant variance in costs of parking for car clubs in London (for on street and especially off street) make it difficult to provide a consistent business case for ULEVs pan-London, for example if a space alone costs £5k per year with additional requirements for connecting cars with Wi-Fi repeaters then it is tough to deliver in practice.

- There could be seismic changes in technology by 2025 that question the validity of EV's; one operator is trialling 2 hydrogen vehicles in their car club for example, and the point

was raised that there may need more proof/validation that electrification was the preferred mass market direction for London and indeed the automotive industry.

- Electric vehicles need to be mass market for rental companies and OEMs to get interested.
- Car clubs can help to educate customers on electric vehicles if done at scale, and ensure an efficient charging network is delivered at the same time.
- Some operators felt a more aggressive target on ULEV requirements could be achieved by car club operators (e.g. 100% ULEV by 2025 was noted by 3 operators), as this would make the emphasis/action greater amongst the industry.
- It was noted that car sharing using ULEVs was harder to attract female customers than the standard model based on another cities experience; this required a dedicated marketing campaign to target female customers which should be considered when looking at ULEVs for London – will it be attractive to male & female customers.

4 FINDINGS FROM BOROUGHS AND LOCAL AUTHORITIES

4.1 STRATEGIC OBJECTIVES AND ASPIRATIONS

Small group discussions were undertaken at a workshop for boroughs, with attendees sub-divided in Central, Inner and Outer London boroughs. The nature of the discussions and issues and objectives raised were then fed back to group.

The workshop featured two breakout sessions for group discussion:

- → The first sought to understand the **strategic objectives and aspirations** for boroughs and where ULEV car clubs might fit in.
- → The second sought to understand their views on the issues and opportunities concerning the **infrastructure and location** of ULEV car club bay provision, EVCP requirements and the suitability/deliverability of differing locations.

The points raised by boroughs at the Workshop are detailed below, with the key findings shown in boxes.

CENTRAL LONDON

ULEVs help in meeting their sustainability agenda.

Focus on reducing car trips so some are cautious on car club development.

Some of the more salient feedback and discussion points are summarised below:

- → Aspirations: ULEV car clubs are attractive to boroughs as fits with sustainability agenda.
- → Policy aims: most are focused on reducing car usage, however that doesn't mean car clubs are the way to do this; in terms of priorities cars are at the bottom and car clubs are included in this (Camden, K&C).

- Concern that one-way car clubs become too similar to taxis, which could increase car usage overall.
- Larger number of parking spaces need to be allocated for one-way and the bays would not benefit residents solely but other boroughs also.
- Most of the boroughs have excellent access by public transport, thus question the need for car clubs altogether; slightly different issues and opportunities depending on where the borough is, how much is in Central vs. Inner.
- There is a lack of data for car sharing services and how to manage them; the only way to find out and take a view is to pilot; there is a concern that data from other models/areas is very different to Central London.
- Type of journey is important - traditional car clubs are typically not used during the week. They tend to be used more for weekends & long journeys. One way results in more short journeys, which we want to prevent; it also is hard to implement in areas with one CPZ covering the borough (e.g. K&C).

INNER LONDON

Car clubs are an important part of a wider sustainable transport strategy.

Positive about ULEVs in car club fleets.

Some concerns over floating car club models.

Some of the more salient feedback and discussion points are summarised below:

- All consider car clubs as part of a wider transport strategy.
- Supportive of the car club coalition – but parking needs to be borough specific.
- If we are going to allow/encourage some car trips – they should ideally be EV.
- Positive for ULEVs in car clubs subject to the operating model; No preference would be given to any particular operating models because they used EV.
- Don't see a particular consumer uptake of EV's yet which may preclude expansion into car clubs by operators; this may change with the growing concern over air quality.
- Some concern over the trips, length, and substitution effect from 1 way models, and the best/only way to dispel this is data from other London boroughs. In the absence of that the best way is to undertake a pilot with set rules/service levels and reporting – Hackney referenced their 3 year pilot with DriveNow.
- The support for car clubs is based on adding transport choices for residents, and facilitating a private car free lifestyle, reducing pressure on parking.

OUTER LONDON

Keen for ULEV car club vehicles, help to sell car clubs politically.

Mindful of the commercial concerns from operators; seed funding may be required.

Concern was a feeling that for many operators it isn't commercially viable at the moment.

Some of the more salient feedback and discussion points are summarised below:

- Aspirations from car clubs commonly agreed were to – improve air quality, reduce congestion, enable development where parking supply issue, public realm – free up street space to do other things.
- Shared aspiration for high proportion of ULEVs in car club fleets.
- ULEVs help to sell car clubs politically, but in outer London it is more to target people with 2 cars to reduce to 1, rather than targeting those with none at all.
- Mixed levels of support politically. At strategic level people get the point of car clubs, at councillor level more contentious.
- Concern was a feeling that for many operators it isn't commercially viable at the moment; an appetite from boroughs yes, but no operator is willing to increase ULEVs independently.
- People travel differently in outer London – longer trips, PHEVs could be more suitable.
- Floating model might be "where we need to get to" in longer term and more appropriate for outer London (due to flexibility/reduced need for private cars), but concerns around clustering and mode shift impacts – all referenced further evidence need; B2B model also has a part to play for day trips.
- Familiarity with Car Club Coalition Strategy – though delivering the member targets is seen as challenging for Outer London.

4.2 INFRASTRUCTURE & LOCATIONS

CENTRAL LONDON

Whilst ULEVs are attractive, the retrofitting of bays in central London is challenging.

Concerns over funding, street clutter, and the infrastructure type in particular.

Some of the more salient feedback and discussion points are summarised below:

- Funding – there's a strong view that public sources should not be paying for charge points that are/potentially used solely by private operators, if it is benefiting them in terms of revenue.
- There are issues around different car club models using the infrastructure and concerns over implications on interoperability – how easy or transparent will it be to the public for when the points are in use, how much it costs (each operator), what is optimal model; this is complicated when move away from back to base scenario.
- EV infrastructure may seem simple in terms of converting back to base bays as they are already allocated, but out of 150 locations in Westminster alone only 11 were found to be suitable, so it is tougher than first envisaged.
- If we have to create new car club bays – there is the TMO and admin that goes with that; there's a further admin burden and hassle with the emerging models (1 way flexible fixed), and again further challenges on how to integrate with Source and other charging operators.
- Enforcement on point-to-point models could be challenging on the parking regulations – how is it delivered and policed, especially if across multiple boroughs.
- Maximising utilisation and the potential role of plug in systems in all car club models is required.
- Streetscape is a concern particularly in areas such as the West End, South Kensington and Oxford Street. Current EV charging hardware can be bulky. The street lighting system for EV charging could be the solution to this. However, the cost could be prohibitive. You might need to scale the infrastructure so that there are sufficient charging lampposts to avoid a need for dedicated bays, but there is still the designation requirement/hassle.

- General concern if the charging infrastructure in question (3kw, 7kw) is the right way to go, should it be more petrol station installed rapid chargers, where fewer of them in volume but shorter charging duration; furthermore as battery life becomes better it could be a more viable long term investment.
- Potential conflict in that operators want car clubs where public transport is good; we want it where public transport is not so good.
- EV points are for residents with EV vehicles, most traditional car clubs have ICE engines. It gets complicated once you start to mix the two. With only 17 EV charging bays (Southwark), reallocating some of them to car clubs would impact residents negatively and potentially benefit non-residents.
- Car clubs can be used as part of a car free development strategy, not allowing private cars at developments but only car clubs if the coverage is good enough.

INNER LONDON

ULEVs could be located in targeted areas, but may need to be off-street.

Most boroughs are piloting or assisting operators in delivering ULEV car clubs, but resource is limited.

Some of the more salient feedback and discussion points are summarised below:

- No borough actively discourages areas for car club usage – there's trade off to be had; EV's could become part of that process (e.g. positioning EV's in areas where a particular air quality issue or demand for EV's).
- On street parking is used by the majority of car club bays now, but EV may work better in off street locations due to implementation challenges and the size/admin required.
- The locations are largely driven by operators based on commercial attractiveness, but in some areas (e.g. Shoreditch) it allows for negotiation by boroughs to insist on bays in under-served parts of the borough
- In terms of Mixed car club vehicle types – operators need to lead on what is deliverable as they know their market better than us.
- Parking permits would need to be different for EV's, potentially cross borough (which is challenging).
- 7kw chargers are the minimum viable, with a preference for a mixture of rapids/fast, with interoperable access and payment/billing.
- Most boroughs have a policy of promoting introduction of ULEVs in car clubs; the minimum in some boroughs is piloting, or offering assistance on locations and implementation.
- There is a tricky cost/revenue discussion on parking; whilst set by each borough, concerns amongst parking teams if it is having a detrimental effect on revenue.
- Funding for charging infrastructure should be largely private sector and S106.
- Resourcing: an expanded knowledge/skill set would be required for EV car clubs, but there is not growing resources at borough level; brings boroughs extra complication as it's not core transport planning (it also covers environmental health, sustainability, parking, energy) a challenge to identify appropriate officer to designate responsibilities to.

OUTER LONDON

Car club strategies will differ across each outer borough depending on Highly localised factors, i.e. density. There's no one size fits all strategy.

Growth of ULEVs will be dependent on infrastructure funding and member take up.

Some of the more salient feedback and discussion points are summarised below:

- Different strategies needed across different areas of each borough. Highly localised factors influence the suitability of different models. There's no one size fits all strategy. Depends on density to a large extent.
- Good PT access important for car clubs; in areas of Outer (especially South) London this is not currently the case, so challenging to promote car clubs.
- Operators have a preference for on street visible bays. However it's more likely/politically easier in Outer London to develop in car parks off street. Challenge is many council owned car parks are being sold for development.
- New developments a key area to come forward with car clubs generally through S106.
- A key concern is having lots of different network operators, private charging networks for exclusive use by different operators, creates a complicated environment for users.
- Types of charge points – fast EVCPs in a hub format is preferred, with some rapids at strategic locations is key to many models especially floating.
- Car club strategy: Number of charge points and car club bays documented is challenging to accommodate. Technology would evolve over course of target period (2025) which may lessen challenges.
- Concerns from some that the number of EVCPs required to support a floating model in particular would be challenging. Though some felt as technology evolved it may prove less problematic, as costs fall.
- Car clubs with EV's limits ability to find suitable spaces, as not every car club bay could support a charging point; also concern over the Source London network charges – a parallel network may be required.
- Funding – over reliance on public sector support, LIP can't sustain it long term. More sustainable solution is needed. Try to capture some of the infrastructure revenue from car club bays is an option.
- All recognise that over time there will need to be more on-street bays. Some felt that as membership grows it will become easier to make the case.
- Charging infrastructure is a concern, and who pays.
- Seed funding may be required in outer London to help operators to make the case for ULEV model in areas where not as commercially viable as it is in Central or Inner London locations.
- New developments seen a good route to new car club sites through S106.

There was a general feeling amongst the Boroughs that it would be useful and important for the findings of this study to be fed back to Boroughs, and that establishing a dialogue between Operators and Boroughs is essential in helping the two understand each other's challenges and shared aspirations.

4.3 ANALYSIS OF BOROUGH SURVEYS

Key Findings

Varying aspirations and expectations for future ULEV car club deployment amongst Boroughs, whilst others are far more cautious or sceptical.

Back to Base us the predominant model amongst Outer London boroughs.

Inner London boroughs host a range of operating models.

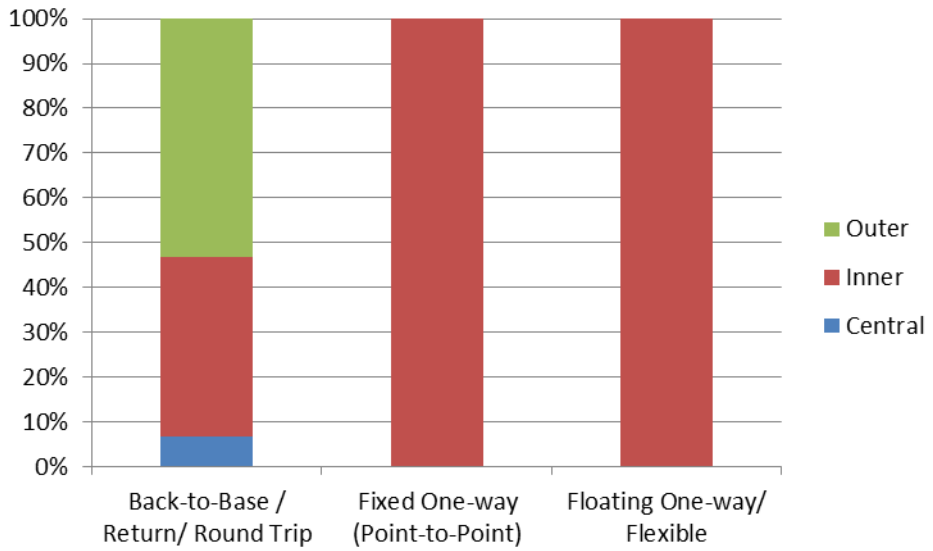
Limited sample size, but projections indicate that at an aggregate level the ambitions/expectations of boroughs for ULEV car club growth is lower than operators.

As well as the feedback provided by the stakeholder workshop, nine boroughs provided more detailed feedback to surveys concerning their existing car club operations, planned future car clubs, model types and estimates for future ULEV car club provision.

The sample of respondents is composed of 1 central, 3 inner and 5 outer London boroughs. This is a limited sample size (27%), but nonetheless provides a useful illustration for the possible scale of ULEV car club growth envisaged by a cross section of boroughs.

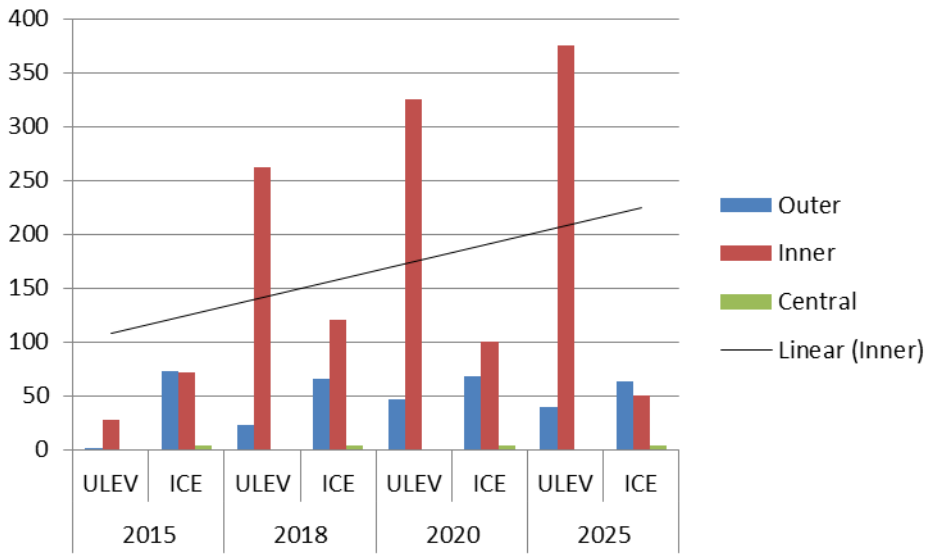
Back-to-Base is by far the most common and established operating model (83%), followed by Floating one-way (11%) and Fixed One-way (6%). As demonstrated in the figure below, the latter two models are both only present within the Inner London boroughs in this sample.

Figure 22 Existing ULEV Car Club Operating Models by Central/Inner/Outer London Boroughs



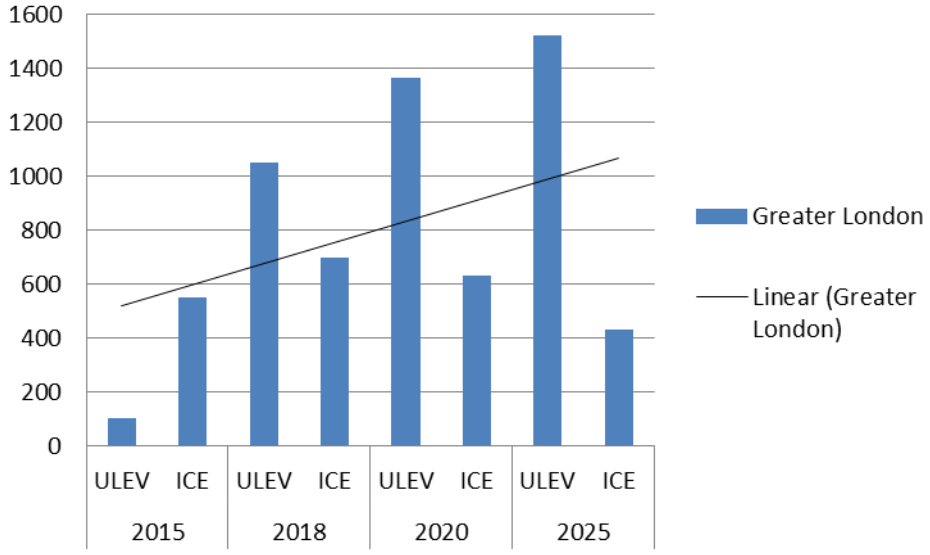
The figure below reports the total projected ICE and ULEV car club vehicles amongst the boroughs who responded. It is important to note that most boroughs emphasised that their figures were high level estimates only, and in many cases they stated they were unsure of the likely trajectory of ULEV car clubs beyond the short term.

Figure 23 Estimated future ICE and ULEV car club vehicles (by Central, Inner, Outer London Borough zones), from a sample of London Boroughs



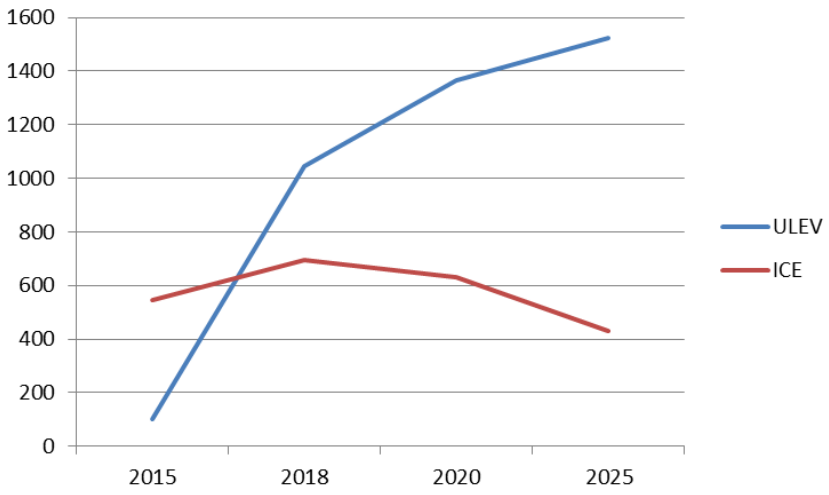
If we assume the 9 boroughs who responded to the more detailed survey are broadly reflective of the mix of views amongst boroughs throughout London, and scale up their estimates by a factor of 3.67 *[sample size divided by total number of boroughs]*, it provides an illustrative example of the total number of ULEV car club vehicles that boroughs might envisage delivering up to 2025 – see the figure below.

Figure 24 Estimated total future car club vehicles in London based on Borough projections (scaled up from sample)



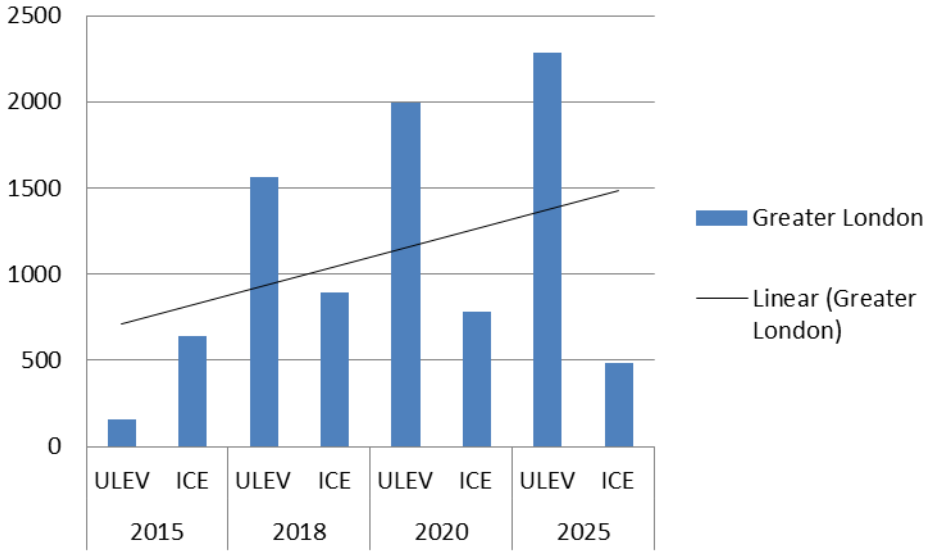
The figure below highlights that many boroughs anticipate ULEV vehicles growing to make up an increasingly large proportion of the overall car club fleets.

Figure 25 Estimated total future car club vehicles based on Borough projections (scaled up from sample)



It is important to note however that the sample of boroughs included a relatively large proportion of Outer London boroughs, which may be skewing the figures. Also the only respondent for a Central London borough projected very limited growth in car clubs, which may not be representative of other central and inner London boroughs. The assessment below therefore discounts the response from the Central borough and derives the projections by taking an average for Inner and Outer London boroughs from the sample, and factoring that up by the number of Central/ Inner and Outer London boroughs.

Figure 26 Estimated total future ICE and ULEV car club vehicles in London based on Borough projections (scaled up from sample, accounting for high proportion of Outer Boroughs in sample)

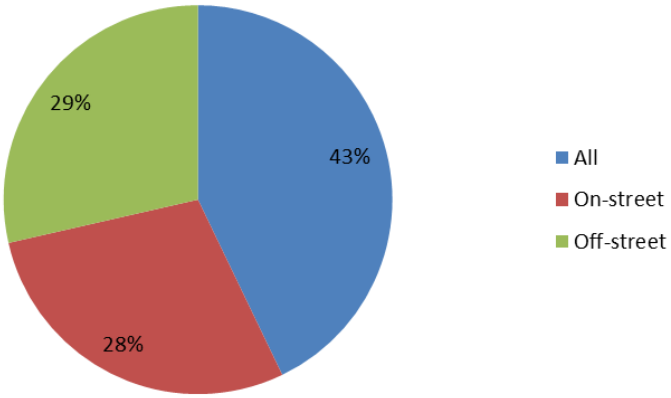


This is a necessarily simplistic approach to derive a high level indication of the scale of car clubs, and more specifically ULEV car clubs, that boroughs are considering, for comparative purposes against the operator forecast and TfL's own targets. Further assessments from a more complete set of detailed responses should be undertaken to refine this assessment.

At the time of writing it is duly acknowledged however that many boroughs do not yet have firm plans or definitive views on the role, scope, scale and deliverability of the differing car club models, in what is a rapidly evolving sector. The complexities of low emission vehicles and their associated infrastructure add to the complexities of forward planning from the borough perspective.

Boroughs had varying aspirations or expectations for where they foresaw ULEV car club vehicles being located – as demonstrated in the figure below.

Figure 27 ULEV car club bay location types anticipated by Boroughs



Most felt their locational requirements would not differ significantly from conventional ICE vehicles, though some anticipated they would be more focused around public transport hubs or in off-street locations.

5 CONCLUSIONS

A number of common themes have emerged throughout the study, with Car Club operators and their counterparts at London boroughs sharing a number of views when it comes to the opportunities presented by ULEVs in car clubs, as well as a common appreciation for some of the obstacles to delivering them. There were however also a number of areas of differing perspectives.

AMBITIOUS ULEV TARGETS BY OPERATORS

All operators felt ULEVs were suitable for playing a part in their current or future car club fleets in London. Most felt that a full battery electric vehicle (BEV) would be the most suitable option, either because they were integral to their business model, or due to their efficiency for urban driving conditions and the short distance journeys typically made by car club members, or because PHEVs were considered too expensive. Some operators felt the versatility of the PHEV was better suited to their model, particularly where longer distance weekend use was more significant.

Many felt the BEV was optimal for their model, one respondent was keen to emphasise that the *"one thing that's not an issue is the [electric] vehicles, we're not waiting on further battery development etc."*

Some were more cautious about the role of ULEVs within their car club fleet, and saw them having a niche role; *"At the moment every [ICE] car can do every trip. You start to decouple the fleet when you add EV's."*

Concerns over lower utilisation of ULEVs were cited by some operators, though it seems likely ULEVs will find a role in most models to a varying degree – with the main pre-condition being the availability of suitable infrastructure.

There are also still significant cost differentials associated with incorporating ULEVs in their fleets. ULEVs also add further challenges and complexities to the car club model in many cases. The need for close relationships with OEMs, and adequate resources to market and sustain an operation at scale were recurring themes – and have informed our assumptions in interpreting the growth projections.

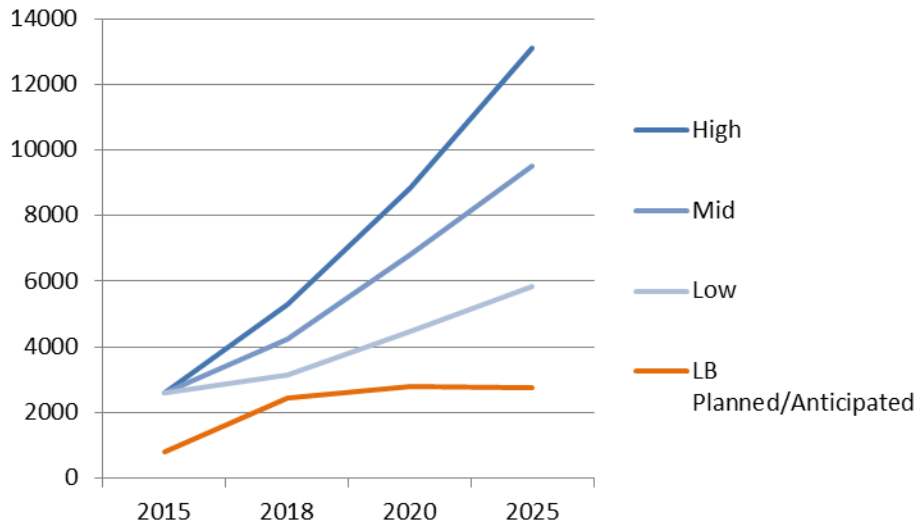
EVOLVING MARKET

An important consideration when it comes to the supply side projections by operators is that they do not necessarily account for competition amongst other operators in the marketplace, the possibility of market failures or the demand-side, and whether there is a large enough customer base to support each operators planned growth. As the sector evolves it seems likely the market will consolidate to a degree, with a number of larger operators emerging and consolidating their position within particular geographic areas. There may however also continue to be a number of niche offerings/ distinct sub-sectors, the market is still evolving.

DISCREPANCIES BETWEEN OPERATOR AMBITIONS AND BOROUGHS PLANS – BUT IT'S NOT ALL DOWN TO ULEVS

A key finding of the study is the apparent discrepancy between operators and boroughs in their aspirations/plans for the scale of car clubs envisaged in the period to 2025, as demonstrated by Figure 28 below, which compares the growth scenarios based on operator projections with the plans or aspirations declared by a sample of London boroughs.

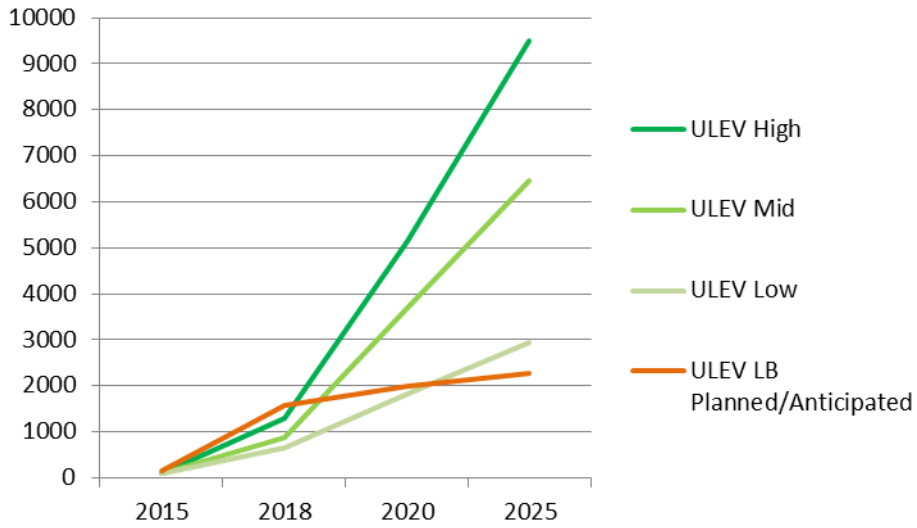
Figure 28 Total Car Club fleet sizes 2015-2025; All Scenarios compared to Borough planned/anticipated



However the more cautious nature of boroughs planned/anticipated car club growth is often not primarily, or exclusively, due to a concern about ULEVs, but about car clubs more fundamentally,

as demonstrated by Figure 29, which indicates that boroughs see ULEV car clubs more in line with the aspirations of operators, as opposed to the overall car club fleet shown in Figure 28. In the period to 2018 their ambitions are broadly similar, but many boroughs felt it was very difficult to plan with any degree of certainty beyond that period, hence the figure plateaus.

Figure 29 ULEV Car Club fleet sizes 2015-2025; All Scenarios compared to Borough planned/anticipated



Operators and boroughs both envisage ULEVs making up a growing portion of fleets, or at least want them to – not withstanding concerns of delivery and maintenance and funding of EVCPs

A number of boroughs however have significant reservations about the role and impact of car clubs more generally – and whether they are conflicting with regards to an overarching strategy of promoting cycling, walking and public transport. Central London boroughs in particular were concerned that car club vehicle trips would often end in their boroughs, at the expense of spaces for local residents.

INFRASTRUCTURE AND ACCESS REQUIREMENTS

There are clear distinctions between the types of infrastructure required by the differing car club models. Back to base operators are more reliant on dedicated bays for their model, whilst floating and one-way models are more amenable to some forms of shared access to EVCPs, though the findings were less definitive than might have been anticipated in this regard.

Each car club model has its own pros and cons with regards to ULEVs. Floating car clubs are more infrastructure hungry, but also more willing and able to share it. Back to Base is potentially less flexible in EVCP usage, and may necessitate some duplication of EVCP networks, but some opportunities to make more efficient use of empty back-to-base bays whilst vehicles are away were discussed.

ULEVs are less well suited to back to base models where the primary use is weekend bookings out of London. PHEVs might represent a solution in these instances, but the business case is less compelling, owing to the higher upfront costs of these vehicles. For shorter trips typical of fixed one-way (point to point) and floating models, BEVs were often considered optimal in many ways, due to low running costs and the ability to charge in situ, with no intermediate charging relative to petrol vehicles.

The Borough feedback articulated a range of concerns around the delivery of car club bays generally, including the challenges posed by the loss of resident's bays, parking revenues, resource burden on the Borough and concerns over greater car use, particularly for short journeys in the case of point-to-point/floating models. The added challenge of delivering EVCPs and managing the installation, TMOs, operation, funding and interoperability amongst charge point operators and differing car club models further complicates delivery from a Borough perspective

CAUSES FOR OPTIMISM

Recharging ULEV car club vehicles should in principle be more convenient than having to refuel an ICE vehicle in London, as petrol stations are scarce, and necessitate intermediate refuelling (i.e. in an additional stop between their origin and destination)., whereas ULEVs can charge at their destination (where it is a bay based service of an EVCP is available).

First time customers often won't choose a ULEV car club vehicle, but once a user has tried a ULEV are much more likely to return to it.

NEXT STEPS

- There was some scepticism at an academic/philosophical level amongst Boroughs about the role of car clubs more generally in the context of wider sustainable transport, with many grappling with the role of car clubs, particularly the floating and point to point models. **Robust evidence from London based trials** was called for in order to inform their planning and help them make the case for the role of car clubs. The Car Club Strategy under development by CarPlus may provide some of the evidence sought by Boroughs.
- **Further assessments of Boroughs plans/aspirations for ULEV car clubs** should be undertaken from a larger and more complete sample of detailed responses from Borough, building on the high level indications undertaken through this study. At the time of writing many Boroughs do not yet have firm plans or definitive views on the role, scope, scale and deliverability of the car club models, in what is a rapidly evolving sector, with many citing the lack of a robust evidence base on which to base their planning. The complexities of low emission vehicles and their associated infrastructure adds to the complexities of forward planning from the Borough perspective. So this step might logically follow the preceding task.
- A **more detailed analysis of EVCP demand at a street by street level** could be undertaken by combining TfL's previous study forecasting future EV uptake and the associated EVCP requirements.
- A next step for Boroughs is to **determine the most suitable car club model type/s** for their Borough/areas of their Borough, based on their own wider vision and objectives, accounting for the needs of their residents, businesses and their own fleets.
- A next step could be to ask Boroughs to **identify prospective sites** to fulfil the desirable and minimum EVCPs and bays to support a ULEV car club fleet in line with TfL targets.
- Encourage Boroughs who do not already do so to **ensure the opportunity to make most effective use of new developments to promote ULEV car clubs** is taken. With further consideration given to pooling contributions to deliver larger and more coordinated car club networks. Specifications for longer contract commitments and particular vehicle types should be required of developers.