Car-sharing in London – Vision 2020
Outlining the role Car-sharing (car club) business models can play in achieving London’s urban transport objectives, quantifying the potential membership & resulting impacts

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EXECUTIVE SUMMARY

Over the last decade London has achieved a leadership position in the rapidly growing field of car-sharing (car clubs). Over 140,000 Londoners are now members of round trip car-sharing clubs with some strong associated benefits. Annual research into round trip car-sharing members (conducted by CarPlus for TfL) has shown consistently that these members:

- Sell cars to join the club - each round-trip car-sharing car removes 17 privately owned vehicles from the streets, with car-sharing members saving £3,000 per year on car ownership costs;
- Drive less - members drive 57% less than car owners
- Use more sustainable travel; members regularly use the underground (53%) and cycle (33%)

Such positive behaviour change is a considerable achievement, but London faces increasing challenges that will need bold interventions to mitigate. The recent Roads Task Force found that:

- Congestion is estimated to cost London’s economy an estimated £4bn per year (TfL).
- Poor air quality from road based transport is making London one of the most polluted cities in the World, and leading to an estimated 4,200 premature deaths per year.
- London’s population is forecast to grow 14% 2011-2021, which could outweigh the relative decline in car ownership & usage in London witnessed over the past decade;

To meet these challenges, the Roads Task Force proposed both supply side measures, that will effectively impose a constraint on the network by reallocating road space from motorised transport to sustainable transport (with cycling being the main focus), and demand side measures, that will reduce the demands on the network. This research lays out a vision for the role that car-sharing could play in doing just this.

On the current trajectory we forecast that London’s existing round trip car-sharing market will reach 264,000 members by 2020. Strong growth was found to be most likely in areas where the following factors are present: high population density, high public transport accessibility levels, low car ownership levels, high population aged 30-44, higher education levels and high income levels.

Whilst achieving such numbers would represent on-going progress for the sector, they do not take the concept into the mainstream or come close to reaching the potential that exists. This research therefore looks at a wider opportunity for policy makers and the sector to boost these numbers through:

1) The potential adoption of new business models within the car-sharing sector - Car-sharing comes in different forms: round-trip (where the car is always returned to its dedicated parking bay at the end of a reservation), fixed one-way (where a reservation begins in one car-sharing parking bay and ends in a different parking bay) and floating one-way (where reservations can begin and end anywhere within a defined operating area).
2) Targeted interventions designed to boost the sector - Policy support analysed in this report includes: raising considered awareness of car-sharing (through marketing and integration with public transport systems); provision of parking with a 5-minutes’ walk of potential members; a car scrappage scheme incentivising joining car-sharing rather than buying a new car, and graduated parking permit charges for second and third cars per household;
Our research found that the addition of new business models had significant potential to grow the number of car-sharing members in the capital. When combined with round trip car-sharing it was found that there could be over 615,000 members by 2020. Further policy support could add 87,000 round-trip car-sharing members in 2020 and 98,000 one way giving a potential market size of 800,000 members which would, almost certainly make London the largest car sharing market in the world. Of these 800,000 members, 74% were found to come from Central and Inner London. To achieve greater adoption in Outer London will require action to improve one or more of the key growth factors listed above.

Achieving this vision could yield significant economic, social, and air quality gains, considering car-sharing members dispose or defer car ownership, drive less, and in cleaner cars. Our research quantified this at a potential £359.6m cost savings to those that choose car-sharing membership over car ownership, with £238.3m from round-trip, and £121.3m from one-way car-sharing. This would see 120,000 cars removed from London’s streets, with ~80,000 from round-trip (given one car-sharing car removes 17 private cars from the road), and ~40,000 from one-way operations, where one car was assumed to remove 9 vehicles. With a combination of the reduced mileage by car-sharing members, and cleaner cars used in car-sharing fleets, up to 5.6% of CO2 emissions could be removed from London’s roads, with 3.9% from round-trip, and 1.7% from one-way operations.

Whilst our research could be clear about the potential market size, there are two important caveats that need to be considered in light of these assumptions and impacts:

1) Our modelling makes some assumptions that challenge the political structure of London. For example, One-way car-sharing, where the average trip is 5-miles, would often cross borough boundaries. For the model therefore to be effective in London and achieve scale, a London-wide operating area and parking permit would be required.

2) It was not found possible to be as conclusive about the outcomes associated with one-way car sharing. Where the evidence base for round-trip car-sharing is well established, this is not the case for one-way car-sharing because of how new this model is (at scale, around 3 years old), and assumptions for London were based on observations from other cities (scaled to London). As such, market size and impacts of one-way were discussed in one segment, whereas in reality the fixed (e.g. Bollore) and flexible free floating (e.g. DriveNow) models are likely to result in varying outcomes. The research team found a growing number of studies starting to emerge from around the world with varying conclusions reached. Whilst some do conclude that one-way car-sharing also leads to a reduction in car ownership and potentially a reduction in miles driven there is also evidence that one-way trips substitute some public transport use, cycling and taxi journeys. Whilst acknowledging many of these are survey based with varying samples, further analysis would be required to fully analyse the outcomes/impacts and their desirability for London.

Both of the above pose challenges for policy makers and so this paper makes further recommendations on outstanding strategic questions requiring further discussion and analysis:

- Given the current evidence base for the different impacts of car-sharing models, what kind of market does London want to develop and prioritise investment in?
- Are different strategies required for Central/Inner and Outer London?
- What can be done to improve the key growth factors for Outer London?
- If one-way is to be developed to scale, how can a coherent operating area, with a London-wide parking permit, be agreed and implemented, and could it be EV/PHEV only?
- When planning for a market of this scale, what is the appropriate market structure?

Our analysis demonstrates a potential member growth from 137,000 to 800,000 2013-2020, but this level of growth is dependent on several pro-carsharing policies relative to private car usage

Various studies point towards car-sharing members saving money on private car ownership, and driving less overall; the impact in London by 2020 would be a potential £360m cost saving, with 120,000 cars (4.2%) removed from the streets, and a 5.6% reduction in CO2 emissions from cars; however far less data is available for one-way car-sharing compared to round-trip, which requires further analysis to fully analyse impacts to London
INTRODUCTION

London’s transportation network is regularly benchmarked globally, having consistently invested in and promoted sustainable mobility initiatives that have achieved modal shift away from the private car to sustainable travel, public transport in particular. For example, the use of public transport increased by 39% between 2001-2011 (TfL: Travel in London 5) rising from 6.5 to 9.1 million daily journeys, with significant (64%) growth in bus use contributing to this shift.

However, whilst London’s trips made by private transport modes reduced by 7% from 10.6 to 9.8 million per day over the same period, congestion and pollution continue to blight London’s development and aspirations for sustainability. Transport for London (TfL) estimate that congestion costs London in excess of £4 billion per year, and that air pollution causes over 4,200 premature deaths per year, both areas that could be drastically lowered by reducing traffic volumes on London’s roads.

With London’s population forecast to grow by over 14% from 2011 levels to 2021, crossing 9 million residents, there is a potential conflict with the Mayor’s desire to cut road transport emissions by over 60%, given the likely increase in required mobility. Achieving a significant reduction in use of the car will require some radical intervention in transport infrastructure and policy, including policies supporting reallocation of road space to cycling and public realm improvements for example.

Having already achieved success in modal shift by a combination of infrastructure development, policy, and economic/pricing tools to disincentivise road use, such as the congestion charge and low emission zone, there is an opportunity to build on this success by supporting the development of the car-sharing (car club) sector, to achieve a reduction in the number of private cars and miles driven in London, amongst several other benefits.

This paper outlines to what extent this can be achieved by 2020, and under what circumstances.

Background

In response to the aforementioned rising congestion, poor air quality set against a continued rising population, Transport for London and the Greater London Authority set up the Roads Task Force in 2012 to tackle these challenges.

Their recommendations were that this be achieved through a combination of improved and new infrastructure projects (e.g. a tolled tunnel underground), reallocation of capacity (e.g. from motorised vehicles to cyclists), intelligent systems and management (e.g. smart parking solutions), but perhaps most importantly – through behavioural change and demand management techniques.
This could build on the success achieved during the Olympic Games in 2012, but deployed on a much larger and continued scale, with new mobility business models such as car-sharing able to play a key component in delivering this behaviour change. However, with measures in the Roads Task Force to promote walking & cycling set against discouraging the frequency of driving a car, solutions such as car-sharing will need to play an increasing role in London’s transportation mix to enable Londoners to travel as they need to.

**Car Lite London – How Car Clubs Will Help More Londoners Drive Less**

In April 2014 and in response to the objectives of the roads task force, Zipcar UK published a paper written by Malcolm Fergusson entitled “Car Lite London – How Car Clubs Will Help More Londoners Drive Less” - analysing the current travel situation in London and historical trends, the benefits of using car clubs, and setting out potential policy proposals that could be considered to stimulate the growth of the car club sector in London.

In summary, the paper outlines how car clubs are part of the solution to mitigate London’s transportation challenge, to specifically tackle congestion, air quality, and parking pressures. With each round-trip car taking 17 privately owned cars off the road, members twice as likely to cycle or use public transport than the London average, and driving 7 times less short trips than car owners, the paper argues that car clubs can encourage travel behaviour change and smarter choices, as well saving members £3,000 per year compared to owning a car.

However, for car clubs to become mainstream, the paper argues that more can be done to accelerate adoption to achieve its full potential in 2020. The following five focus areas were proposed:

- **Integration through marketing** – TfL integrating the car club as one of its brands, with more visible presence on the TFL website, increased signage at bay locations, and wider general promotion;
- **Integration through systems** – integrating car club payment, analytics, and information systems as part of London’s multi modal platforms, currently through the Oyster card for example;
- **Behavioural incentives** – such as creating bundles of travel offers, such as discounted car club membership as part of a travelcard option, or a system similar to the national scrappage scheme in 2009, but providing discounted car club membership to those who dispose of private car ownership;
- **Stronger guidance and leadership on car club strategy** – more policy guidance and information sharing to allow boroughs to derive car club policy from a consistent information base to encourage more consistent and effective delivery;
- **Development planning** – provision of car club bays or membership at new developments consistently across London.

Subsequent discussions with TfL, GLA, and London Councils regarding the proposals in the Car Lite London report made it apparent that a full understanding of the various car club business models was required. This highlighted the need to quantify the potential in terms of car club member base, vehicles, and impacts in order to consider which strategic direction and resources should be allocated to support the growth of the sector.
As a result, Zipcar commissioned Frost & Sullivan to co-develop the vision for car-sharing in London in 2020, looking to present a viewpoint on the role car club business models can play in London’s urban transport solutions, with the first results presented at the Car Lite London event at City Hall on 10th July 2014 (www.carlitelondon.org).

**Car-sharing in London – vision 2020 objectives**

To support the future policy framework for car-sharing in London, the “vision 2020” project was set up to carry out detailed analysis of the growth potential of car-sharing in London in terms of members & vehicles, clearly outlining the assumptions inherent to achieving this potential.

In doing so, an explanation of the characteristics and differences of the main business models is provided, namely round-trip and one-way car-sharing, as well as the impacts that could result in terms of private car use, economic advantages, and air quality. This analysis also considers the vast differences in car-sharing usage and potential across London, with specific forecasts and assumptions for Central, Inner, and Outer London. This was essential to understand the different potential outcomes in terms of behaviour change in the context of current transport provision and relative attractiveness of car-sharing.

The objective of this two month exercise was to advise all relevant stakeholders on the market potential for car-sharing in London, utilising every available data source internal and external to the project team, to ensure evidence based policy can be made to support the growth of the car-sharing market in London as projected to 2020, and indeed beyond.

It is hoped the quantitative assessment, key findings, and recommendations from this exercise can be used to raise awareness of car-sharing to London’s transport authorities, but more importantly to suggest the policy interventions that could be considered to support the industry, and the estimated membership take up attributable to such policies. The resulting potential impacts can be considered in the business case development and justification for any policies targeted towards implementing our proposed vision 2020 for car-sharing in London.

**DEFINITIONS**

The round-trip car-sharing model, also referred to as station based car-sharing, involves the rental of a vehicle from a dedicated parking bay, and returning the vehicle to this location to conclude the rental. In London, this service is offered by Zipcar, City Car Club, Hertz 24/7, and eCarClub at the time of writing. As a guide, the average rental duration of this service in London is currently 6.2 hours, the average distance travelled 35 miles, with members making an average of 9.2 trips per active member per year at present (Carplus annual survey 2013-14). The business model usually includes an annual fee paid for by members, in addition to an hourly/daily fee levied for vehicle hire, inclusive of insurance, tax, fuel up to an agreed total mileage, and fees such as the London congestion charge where applicable.  

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*The objective of the “Car-sharing vision in London 2020” project is to advise relevant stakeholders on the market potential for car-sharing, based on available data sources and the expertise of the project team.*
One-way car-sharing has two main operating models. One is commonly referred to as fixed base, station to station, or A to B, with the main operating principle being members can commence a rental at one dedicated car-sharing station, and conclude their rental at another dedicated station within the city depending on availability, similar in logic to London’s cycle hire system for example. For this model to operate smoothly, it is required that there are 2-3 times as many parking bays as cars. Furthermore, the current preference of the use of electric vehicles in this model, as observed with Autolib in Paris, requires the dedicated use of charging stations in these locations. The model usually involves a membership fee varying on the length of duration up to a year, in addition to rental fees levied by the minute, and inclusive of all insurance, fuel (to an agreed limit), tax and parking, with dedicated parking stations at the origin & destination of the journey.

The other one-way car-sharing operating model is commonly referred to as free floating, flexible, A to Z, or on demand car-sharing, used spontaneously, with vehicles often only available to be booked by members up to 15 minutes in advance, if at all. Reservations must start and end within an agreed area or “home zone”, thus requiring parking provision/approval of public parking across the entire zone, with clear communication to users of any exceptions. In addition to a membership fee, usage per rental is charged on a per minute basis, often with discounted rates at 6, 9, or 24 hours for example, and inclusive of tax, insurance, parking within the home zone, and fuel to an agreed limit. A lower fee per minute is often levied when customers are parked, such as outside of the operating area, or where customers wish to keep the vehicle before making an onward journey for example.

At the time of writing, Bollore are the main operator of one-way fixed car-sharing, with their Autolib (Paris), Bluely (Lyon), and Bluecub (Bordeaux) operations in France, and who are reportedly seeking entry to the London market in 2015. For one-way flexible car-sharing, car2go and DriveNow are the largest providers, with operations in 26 and 5 cities respectively; DriveNow are reportedly seeking to commence operations in London in late 2014. Both models currently experience a similar dynamic in terms of rental patterns, with an average rental time of 30 minutes, distance of ~5 miles, and around 20 trips per year per member per year.

This research considers the one-way business models combined in terms of their membership, vehicles, and impact potential for London, mainly due to a lack of historical data available for either model. As such, when evaluating the full potential and impacts of one-way car-sharing, it is recommended to consider each business model independently as more data and evidence becomes available, especially if both are to launch in London.
SUMMARY OF THE METHODOLOGY USED FOR FORECASTING CAR-SHARING DEMAND

Considering the impact of demographic and urban environment characteristics: Central, Inner, and Outer London

Both round-trip and one-way car-sharing integrate with and rely on other modes of transport available locally; for example, the Transport for London bus route network is much denser in Central London than it is in the suburbs, reducing the requirement for car ownership. Equally, early adopters of car-sharing tend to have a number of common socio-economic characteristics, which can vary greatly between central and outer city districts, such as propensity to car ownership. To account for such differences that affect car-sharing demand, forecasting for each segment was made separately for Central, Inner and Outer London [a full methodology description is provided in the appendix].

Considering growth in car-sharing membership: round-trip and one-way

This paper forecast the development of the round-trip and one-way car-sharing segments independently, taking into account lack of historical data on one-way service usage in London at the time of writing in 2014. While there is emerging evidence of a certain overlap between the segments, in particular from studies in Paris and Montreal [6T and Communauto respectively], estimation of the extent of multiple round-trip and one-way memberships will require much closer co-operation of, and data sharing between, car-sharing operators. Therefore, no data sources were available to quantify such an overlap in London robustly, but it is acknowledged that there will be some dual membership of round-trip and one-way car-sharing operators.

Considering policy impacts: an uplift of the demand trend line

The intention of this paper is to provide a useful view of car-sharing demand for decision-makers to benchmark and define their policies, helping make London less dependent on private car ownership. Therefore, we carried out statistical analysis using historical data from a variety of London-specific public and proprietary sources to show what existing socio-demographic and neighbourhood factors have affected round-trip car-sharing membership most (Figure 1), thus establishing the “baseline” or “as-is” level of demand.
However, we also show how additional demand for car-sharing, or “the uplift”, can be generated as a result of implementing a set of co-ordinated policies encouraging car-sharing in London [Table 1 and, Table 2 each policy considered is in a separate column].

Table 1. Assumed Incremental Round-trip Car-sharing Adopters Resulting from Policy Implementation as a Percentage of the Population in Inner, Central and Outer London
Table 2. Assumed Incremental One-way Car-sharing Adopters Resulting from Policy Implementation as a Percentage of the Population in Inner, Central and Outer London

<table>
<thead>
<tr>
<th>Year</th>
<th>Assumed Incremental Adopters as % of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Graduated Parking Permit</td>
</tr>
<tr>
<td>2014</td>
<td>400,463</td>
</tr>
<tr>
<td>2015</td>
<td>404,705</td>
</tr>
<tr>
<td>2016</td>
<td>409,093</td>
</tr>
<tr>
<td>2017</td>
<td>413,477</td>
</tr>
<tr>
<td>2018</td>
<td>417,908</td>
</tr>
<tr>
<td>2019</td>
<td>422,387</td>
</tr>
<tr>
<td>2020</td>
<td>426,911</td>
</tr>
<tr>
<td></td>
<td>2,951,911</td>
</tr>
<tr>
<td></td>
<td>2,955,935</td>
</tr>
<tr>
<td></td>
<td>3,026,428</td>
</tr>
<tr>
<td></td>
<td>3,064,269</td>
</tr>
<tr>
<td></td>
<td>3,102,826</td>
</tr>
<tr>
<td></td>
<td>3,141,746</td>
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<tr>
<td></td>
<td>3,181,153</td>
</tr>
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<td>3,065,004</td>
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<td></td>
<td>3,147,224</td>
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<td>3,199,959</td>
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<tr>
<td></td>
<td>3,255,244</td>
</tr>
<tr>
<td></td>
<td>3,307,975</td>
</tr>
<tr>
<td></td>
<td>3,361,458</td>
</tr>
<tr>
<td></td>
<td>3,416,398</td>
</tr>
</tbody>
</table>

Table 3 shows a summary of the steps taken to forecast car-sharing demand until 2020, with the data sources and analysis described in more detail in the Appendix.

Table 3. A summary of the approach to forecasting car-sharing demand until 2020

<table>
<thead>
<tr>
<th>Establishing a baseline</th>
<th>Adding a policy-driven uplift</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analysing Historical Data:</td>
<td>3. Building up on the baseline:</td>
</tr>
<tr>
<td>• Data: locations of Zipcar members and vehicles + TfL, DVLA and 2011 UK Census</td>
<td>• Considering potential council and TfL policies contributing to uplift:</td>
</tr>
<tr>
<td>• Multiple linear regression to establish what factors affect membership most</td>
<td>Increasing awareness; Ensuring proximity;</td>
</tr>
<tr>
<td>• Six statistically-significant factors, approx. 70% of variance in membership explained</td>
<td>Graduated Parking Permit Charging;</td>
</tr>
<tr>
<td>• Higher membership linked to a higher % of population with NVQ4, age (20-34), public transport accessibility (PTAI)</td>
<td>Ultra Low Emission Zones (ULEZ);</td>
</tr>
<tr>
<td></td>
<td>Scrappage Schemes.</td>
</tr>
<tr>
<td>2. Forecasting the Baseline:</td>
<td>• Acknowledging variances in policy impacts: different characteristics of Central, Inner and Outer London factored in</td>
</tr>
<tr>
<td>• Round-trip: membership trend by deriving the compound annual growth rate (CAGR) from historical data</td>
<td></td>
</tr>
<tr>
<td>• One-way: benchmarking vs. car2go in the US, Autolib in Paris</td>
<td></td>
</tr>
</tbody>
</table>

To complete this analysis, historical socio-demographic and car-sharing usage data for London were analysed using multiple linear regression, and a compound annual growth rate (CAGR) was derived for forecasting round-trip car-sharing membership; one-way car-sharing membership in London was forecast using other early-adopter cities as benchmarks; the potential for generating additional demand from targeted policies was then factored in for both segments.
CAR-SHARING IN LONDON PROJECTIONS

Car-sharing Membership Growth in London to 2020

Using our methodology as outlined in the previous section, we forecast the potential membership base for car-sharing in London between 2013 and 2020, considering the assumed baseline growth of both car-sharing models, and to what extent policy support could increase this. The overall member growth trajectory is presented in Figure 2 below.

As Figure 2 demonstrates, under the assumption that at least two operators are present in the one-way car-sharing market by 2015 as expected, there would be more members of this model than the round trip model by 2017, owing to the additional use cases and flexibility afforded to customers. Equally, as suggested above, this assumes sufficient parking permission to facilitate the growth of this market, such as a London wide parking permit.

Overall, this demonstrates the total membership base for car-sharing in London could reach ~800,000 in 2020, based on the following assumptions:

- Round-Trip Baseline – an estimated increase in membership from 137,000 in 2013 to approximately 264,000 in 2020, representing a 92% growth in absolute terms and a 9.8% compound annual growth rate (CAGR);
- Round-Trip Policy – with the assumptions outlined above, it is estimated that 87,000 incremental memberships could be achieved through policy intervention. Whilst most of this is through raised awareness (36,000 by 2020), graduated parking charges in particular could also be successful in attracting members (29,000 by 2020);

Our analysis showed the potential for car-sharing to reach 800,000 members by 2020; this assumed a baseline of 264,000 for round-trip and 351,000 for one-way respectively, with a further 87,000 (round-trip) and 98,000 (one-way) members added through policy based initiatives, with raised awareness having the largest impact (57% of the total policy benefit).
One-Way (assuming required parking agreements are in place, considered a policy based decision): given the observations in Paris, Seattle, and Washington adjusted for London population density, it is deemed one-way car-sharing could attract over 351,000 members by 2020, based on two operators (one flexible, one fixed) entering the market and a London-wide parking permit;

One-Way Policy – it is estimated that an additional 98,000 members would be attracted to one-way car-sharing as a result of the policy measures considered, with the vast majority (70,000) as a result of increased awareness.

Overall, when considering both round-trip and one-way car-sharing, the initiative with the largest impact would be raised awareness of car-sharing through marketing, information, and systems integration. This would contribute an additional ~106,000 members in 2020 (57% of the total policy benefits), followed by the graduated parking permits policy, adding 38,000 members (21% of the total policy benefits). Our recommendation would be to prioritise these two initiatives to yield the highest incremental car-sharing membership adoption.

The growth of total car-sharing membership under our scenarios is shown in Figure 3, clearly showing the positive growth potential in all modelled scenarios. The relative immediate jump in membership from 2015 is explained by the market entry from two one-way operators, accelerating the growth thereafter with the potential impact of the policy initiatives outlined above.

Three scenarios were considered for the car-sharing market in 2020, the pessimistic to optimistic forecast ranged from 640,000 to 956,000 members respectively in 2020; the assumptions differed on the growth potential of one-way car-sharing, and the impact of policies to both models

Figure 3. Car-sharing Membership in London 2013-2020 Projection Scenarios
Figure 3 demonstrates that the forecast growth trajectories vary from between 640,000 members in 2020 in our pessimistic scenario and 956,000 members in the optimistic scenario. Under all scenarios, the baseline growth of round-trip car-sharing was assumed unchanged. However, different growth assumptions for one-way car-sharing and varying extent of policy impact on overall car-sharing membership were considered between scenarios.

**Car-sharing Vehicle Growth in London to 2020**

To forecast the number of vehicles that would be required to accommodate the estimated level of membership, it was assumed that a member to vehicle ratio average could be applied based on current observed car-sharing data. Currently, the average number of members per round-trip car-sharing vehicle in London is 75. For one-way car-sharing, it is in excess of 100 for DriveNow (300,000 members using 2,500 cars), and therefore is assumed that 100 members per vehicle would be a reliable average to take once the one-way operational model is operating at scale in London.

Therefore, the methodology for forecasting vehicle growth used the 75:1 average for round-trip car-sharing for all forward forecast years from 2014-2020, starting with the observed number of car-sharing vehicles in London (2,000 in 2014).

For one-way models, it was assumed the first two years would have a lower vehicle total upon market entry. Whilst no one-way operators are present in the London market to date, it was assumed the first operator (one-way flexible car-sharing) will launch with at least 200 cars in 2014, then rising to 550 by the end of 2015. It is expected that a second operator (one-way fixed car-sharing) will launch a pilot phase of 100 cars in 2015, thus assumed a total of 650 one way car-sharing vehicles in London by the end of 2015. It is assumed that both one-way providers would then follow an average of 100:1 members to vehicles from 2016-2020.

Based on these assumptions, the number of vehicles required is demonstrated below in Figure 4.
The total car-sharing vehicles required in 2020 would be 9,200, with 4,700 round-trip and 4,500 one-way vehicles; this was derived using an assumed member to vehicle ratio of 75 for round-trip and 100 for one-way car-sharing based on observations from present operators operating at scale.

The above assumptions would lead to a growth from 2,000 round-trip car-sharing vehicles to ~4,700 in 2020, and a rise from 200 (expected, not yet deployed) in 2014 to ~4,500 one-way car-sharing vehicles in 2020. The reason for the lower vehicle total required for one-way compared to round-trip despite higher membership for one way is the expected differential in the member to vehicle ratio (100 for one-way compared to 75 for round trip). The total car-sharing vehicles required in 2020 to accommodate this member growth would, therefore, be ~9,200.

“The London Doughnut” – Variances in Car-sharing membership across London

In order to forecast the market effectively based on current travel patterns and car-sharing preferences, it was essential to consider the vast differences across London. Londoners’ travel patterns vary significantly from Central to Outer London, with far higher car ownership (and usage) in Outer London for example. Furthermore, as can be seen by figure 5 below, already the distribution of Zipcar members is more concentrated in Central and Inner London.
As such, the vision 2020 project considered Central, Inner and Outer London individually in terms of their current characteristics in terms of travel, total addressable market (population & full driving license holders), car-sharing members & vehicles data, and assumptions on how this may change to 2020.

The definition used for these areas followed Transport for London’s definition, with Inner and Outer London delineated by borough boundaries. Central London was defined as TfL’s “Central Activity Zone”, which includes selected LSOAs from the Inner London boroughs of Islington, Camden, Lambeth, Kensington & Chelsea, Hackney, Southwark, Wandsworth, Tower Hamlets, Westminster, and the City of London Corporation. This is the area most commonly used by Transport for London to model Central London for transport planning purposes. The representative map of these areas is demonstrated below in Figure 7.
The majority of car-sharing members in London reside in Inner London (61%) in 2014; this majority will remain in 2020 under our forecast, but reduce to 57% of total membership, with 2% proportionate growth in Central and 3% in Outer London; this will see a rise from an estimated 171,000 members in 2014 to 800,000 in 2020.

There are 2.66 million cars in London—73% in Outer London, with 25% in Inner, and 3% in Central London; this is mirrored by the proportion of households with two or more cars being highest (25%) in Outer London, and the highest proportion of no car households (67%) found in Central London.

Census data shows that there were 2.66 million cars in London in 2011. However, our analysis at LSOA level showed that by far the majority of these were in Outer London—1.94 million (72.8%) of London’s cars. This is followed by Inner London, where there are 652,000 cars (24.5%), and Central London with 73,000 cars (2.7%).

This can be explained by a number of factors, not least the size of the land area being greater in Outer London, but also factors that make driving attractive relative to other modes. This includes higher supply of parking and lower congestion, and in some cases the lack of alternatives due to a lower public transport connectivity than in Inner and Central London. This was demonstrated in the varying Public Transport Accessibility Index (PTAI) by LSOA which generally reduces towards Outer London.

As a result, and in addition to the higher absolute volume of cars in Outer London, there is also a far higher proportion of households with 2 or more cars, which rises from just 6% of households with 2 or more cars in Central London, to 8% in Inner London, and 25% of Outer London households. Equally, this trend is matched with a declining proportion of households with no cars; 67% of Central London households have no cars, with 55% in Inner and 31% in Outer London.

There are 4.98 million driving license holders in London—61% of the population; of these license holders, 22% are in Inner and 75% in Outer London; this is closely matched by the number of cars, with 25% in Inner and 73% in Outer London.
As one would expect, as a result of the higher car presence in Outer London, data from the DVLA also shows the number of driving licenses matches this trend. In 2013, there were 4.98 million full driving license holders in London, thus 61% of London’s population are a full driving license holder. This represents a much higher total addressable market for car-sharing in London, with nearly twice as many license holders as cars in London. Of the driving license holders, just 3.5% were in Central London, with 21.5% in Inner, and 75% in Outer London, representing a similar pattern to the number of cars in these locations.

This is reflected in the modal share of cars in each respective area, with 10% of trips made in Central London being made by car/motorcycle, rising to 23% in Inner and 49% in Outer London (TfL LTDS 2011/12).

Therefore, it is assumed that, in the short term at least, car-sharing becomes relatively less attractive and viable at present as you move from Central to Outer London. Round-trip operators have faced some difficulty in establishing viable locations in some Outer London areas. One-way operators are likely to face even greater challenges in Outer London due to the higher requirement on density of cars and a contiguous home area, set against a preference for private car ownership due to relatively fewer barriers to car usage in outer London compared to inner London.

This has been reflected in our assumptions on the likely proportion and growth of car-sharing in these areas between 2014 and 2020, as is demonstrated in Table 4 below.

**Table 4. Car-sharing Members, Vehicles & Proportion of Driving License Projections**

<table>
<thead>
<tr>
<th>Area</th>
<th>Members 2014</th>
<th>Vehicles % License</th>
<th>Members 2020</th>
<th>Vehicles % License</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>27,597</td>
<td>383 (16%)</td>
<td>141,774</td>
<td>1,647 (76%)</td>
</tr>
<tr>
<td>Inner</td>
<td>104,018</td>
<td>1,312 (10%)</td>
<td>453,295</td>
<td>5,139 (39%)</td>
</tr>
<tr>
<td>Outer</td>
<td>39,483</td>
<td>506 (1%)</td>
<td>204,741</td>
<td>2,380 (5%)</td>
</tr>
<tr>
<td>London</td>
<td>171,098</td>
<td>2,201 (3%)</td>
<td>799,810</td>
<td>9,166 (15%)</td>
</tr>
</tbody>
</table>

Table 4 demonstrates that the proportion of car-sharing members & vehicles residing in Inner London will remain the highest of the three geographic areas of London. However, proportionately we believe there would be a slight increase in both Central and Outer London between 2014 and 2020 based on two main reasons:

- The introduction of one-way car-sharing, likely to increase share in Central and Inner London initially due to the business model characteristics mainly servicing urban mobility,
- Due to the volume of cars/addressable market in Outer London, some of the policy suggestions would impact here relatively higher, such as graduated parking permits and raised awareness, which is currently lowest in Outer London.

The key takeaways of Table 4 can be summarised as follows:

In our 2020 forecast of car-sharing members, 15% of driving license holders in London would be car-sharing members, up from 3% of license holders in 2014.
By 2020, Central and Inner London will effectively be fulfilling their full potential for car-sharing in London, with much higher longer term opportunities in Outer London if met with more disincentives to the use of private cars.

- Inner London would remain the highest area of car-sharing membership (57% of total) in 2020, but with an increasing proportion of members residing in Central (+1.6% to 18% of total) and Outer (+2.5% to 26% of total) London.
- Across Greater London, the rise from 171,098 members to 799,800 in 2020 would require an increase from 2,200 to ~9,200 vehicles, and imply a rise in the proportion of driving license holders who are car-sharing members from 3% to 15% from 2014 to 2020.

As the variance across Central, Inner, and Outer London shows, based on the assumed growth and relative attractiveness of car-sharing, by 2020 Central and Inner London will be close to fulfilling their full potential for car-sharing based on the high proportion of driving license holders that have adopted the service. This is especially true in Central London, whilst noting that a higher proportion of residents are likely to have registered their licenses at properties outside of Central London (giving rise to the somewhat inflated 2020 percentage licence holders for Central London, in Table 4).

Of course, Central and Inner London is also where congestion, air quality and parking stress issues are most acute. So, the need to establish confidence in impacts evidence, before committing to any particular strategy is essential.

There is also a much wider opportunity in Outer London that could be exploited in the longer term as the business models become more established, and if met with more disincentives to the use of private cars in these locations.

**IMPACTS ASSESSMENT**

Based on the available surveys and datasets available, it is clear that car-sharing can have positive behaviour change impacts when deployed effectively and at scale. Although varied by city and business model (e.g. whether round-trip or one-way), these are mainly focused around reducing the number of private cars on the road and associated mileage, which in turn has downstream benefits of reduced congestion and emissions.

Furthermore, potential cost saving and economic benefits can accrue to those using car-sharing, particularly given that car-sharing membership saves £3,000 per year compared to car ownership, and improves social inclusion by access to mobility without the need for considerable additional infrastructure.

However, whilst several datasets show the benefits of round-trip car-sharing, there is relatively little data available quantifying the impacts of one-way car-sharing in comparison. As such, and given that no one-way providers are operational yet in London, quantification of the impacts of this model was based on a combination of discussions with the one-way operators in other cities and those seeking to launch in London, in addition to observations and surveys from Paris and Montreal. In the case of any gaps, assumptions were based on a comparison to round-trip car-sharing, all of which is outlined below.
In the sections below, therefore, the impacts calculated for one-way car-sharing should be treated with some caution. Additional independent data will be required, before the evidence base for the impacts of one-way car-sharing can be regarded as conclusive. Where such data emerges from other world cities, great care should also be taken to understand how it does (and does not) relate to the particular circumstances of London.

Impacts Of Round-Trip Car-sharing

Reduction in Private Cars & Congestion

One of the most reported and important behaviour change benefits of car-sharing is the impact in reducing private cars from the road; several surveys point towards car-sharing members having sold their car as a direct result of joining a car-sharing, or having deferred their intended purchase of a vehicle as a consequence of their membership. In London, the most recent (January 2014) annual survey of members undertaken by Carplus (on all car-sharing operators’ members), showed that every round-trip car-sharing vehicle leads to a reduction in 7 private cars due to those that dispose of their vehicle, and a further 10 private car reduction for those deferring their purchase of a vehicle.

As a result of these 17 cars either sold or deferred for each car-sharing vehicle, it can be estimated that ~34,000 cars have already been taken off the road in London, based on the current 2,000 car-sharing cars in London multiplied by the 17 car reduction. Given that London currently only has round-trip car-sharing operators present, this figure can be considered completely applicable to round-trip car-sharing. At a forecast level of 4,672 round-trip car-sharing vehicles in 2020, this would assume 79,432 cars are removed from London’s roads in 2020 because of the growth of round-trip car-sharing, assuming the same level of private cars (17 per car-sharing car) are removed per car-sharing car.

Another resulting benefit from the adoption of car-sharing in London in this context is the reduction in mileage driven by members. It is observed that when people join car-sharing services they drive less miles. The Carplus annual survey shows that round-trip car-sharing members travel an average of 750 miles per year using car-sharing, and a further 1,415 miles using the primary household car, per year, on average (where a car is also owned).

This total of 2,165 miles per household is far less than the London average of 5,029 per year; thus round-trip car-sharing members travel 57% less miles than the London average. This can be explained firstly as many of the members have given up their household car as noted above, but also due to members’ travel preferences changing when they’re aware of the per trip cost they are paying for their journey, which results in the use of the car becoming far more discretionary.

Based on the observation of 17 round-trip car-sharing members selling or deferring purchase of a private car, there would be a reduction of ~80,000 cars from London’s roads in 2020, a reduction of 2.8% of the cars in London; however, the resulting annual mileage reduction could be over 658 million miles, given that car-sharing members drive less.
To understand the net impact per member (rather than household), the mileage reduction figures per household were converted to per member by dividing the average household mileage figures by the number of driving licenses per household in London, of which there are 1.53. This was used to estimate mileage per person rather than comparing to the household size as this would include children and those without a driving license or applicable for car-sharing. This reduced the London average mileage figure to 3,296 per person (5,029 / 1.53), compared to 1,419 miles for round-trip members (2,165 / 1.53).

This allowed us to make a comparison using the average mileage undertaken per car-sharing member against the London average, considering the forecast 2020 round-trip member base of ~350,000. This shows that the number of miles reduced in London from round-trip car-sharing could be 658 million per year by 2020. This was calculated by considering the difference between the observed car-sharing member mileage outlined above, and the London average.

**Air Quality Improvements**

The demonstrated reduction in miles on London’s roads could also lead to a significant improvement in air quality, through the resulting lower tailpipe emissions. Using the above assumption of 658 million miles reduced as a result of round-trip car-sharing members changing travel behaviour patterns, and multiplying by the UK average vehicle CO2 emissions per mile (assumed 215 grams in 2020, down from 258 grams in 2014), could result in up to 141,641 tonnes of CO2 reduced. That would represent a 3.6% reduction on the reported (TfL) CO2 emissions generated by cars on London’s roads (3.7 million tonnes in 2013, forecast to rise to over 3.9 million in 2020).

This reduced mileage would also lead to a 18 tonne reduction in PM10s, and 432 tonnes of NOX pollutants, both of which contribute significantly towards respiratory related diseases in London; round-trip car-sharing could reduce them by 4.6% based on comparing the reduced mileage to the national average.

In addition to reduced miles driven, car-sharing vehicles are proven to be less polluting than the national average. The Carplus survey shows that round-trip car-sharing vehicles in London emit 33% less CO2 than the national average, at 170 grams per mile compared to the average of 258 grams CO2 per mile. Comparing the average car-sharing miles driven in round-trip car-sharing vehicles as opposed to the national average, results in a further 12,611 tonnes of CO2 savings, representing a further 0.3% reduction in CO2 emissions on London’s roads.
Economic Benefits

One of the main attractions of car-sharing to potential members is the cost saving that can be derived in comparison to private car ownership. Carplus and Zipcar estimate that the typical London round-trip car-sharing member that disposes/defers car ownership saves £3,000 per year when joining a car-sharing service, when considering the many costs of driving such as depreciation, insurance, parking, tax, fuel and maintenance which are inclusive in the price of a car-sharing rental.

Considering the forecast 79,432 cars removed from the road mentioned above, applied to this £3,000 cost saving, realises £238m savings per year to round-trip car-sharing members that sell or defer private car ownership. This cost saving releases more disposable income that can be used more productively in the local London economy.

The total cars removed from the road as a result of round-trip car-sharing in 2020 would represent an estimated 2.8% of the total cars in London at that period. With congestion costing London’s economy in excess of £4bn per year (TfL), and assumed to rise to over £4.3bn in 2020, increased car-sharing adoption could deliver tangible improvements to London’s GDP.

Whilst no detailed speed/flow or traffic simulation modelling was undertaken as part of this study, it was considered that this could be reduced by at least 2.8% in line with the reduction in private vehicles on the roads, thus saving £120m. Furthermore, the reduced requirement for parking on London’s streets allows better use of the public realm, in addition to the economic and air quality benefits from reduced private car usage in London.

Car-sharing also provides a tangible benefit and alternative vehicle access to small and medium sized enterprises (SMEs), with the majority of Zipcar for Business customers being represented by this scale of company for example. With cashflow being tight in the early years of any business, a variable cost model of car access is far more attractive than a fixed price/term lease. However, there are also several benefits that can accrue to larger fleets, in reducing the absolute level of vehicles required, as well as cutting car travel costs, employees that use cars to travel, and resulting emissions. For example, Croydon Council working with Zipcar have saved over 42% in car travel costs, with a 52% reduction in employees using cars, 42% business miles reduction and 36% CO2 emission reduction. Whilst just one case study, it is clear that car-sharing can deliver real cost savings to businesses and improve fleet management efficiency in London.

Impacts Of One-Way Car-sharing

The estimated impacts below have been calculated based on the limited one-way car-sharing data that is currently available. As noted above, further validation of the impacts will be required as more data becomes available.
Reduction in Private Cars & Congestion

For one-way car-sharing, initial research shows the anticipated reduction in private vehicles to be less than round-trip. Survey findings from the Paris Autolib system have shown that each one-way car-sharing vehicle removes 3 private cars from the road through sale/disposal of the vehicle, and a further 6 deferring purchase for example, thus 9 private vehicles are removed from the road for each one-way car-sharing vehicle.

Using this assumption of 9 vehicles removed from the road applied to our 2020 forecast of 4,494 one-way car-sharing vehicles would result in 40,444 vehicles removed from the roads as a result of one-way car-sharing.

The 6T study from Paris showed an 11% net reduction in mileage by members from both car-sharing (Autolib) and private car mileage. If this were consistent in London, the average of 5,029 miles per household would reduce to 4,476 in households of one-way car-sharing members. This household mileage was converted to per member (4,476 / 1.53 based on the number of driving licenses per household), resulting in an implied 2,933 miles per year undertaken one-way car-sharing members in total, compared to the London average of 3,296.

With a forecast ~450,000 one-way members in 2020, this would yield a reduction in mileage on London’s roads of 163 million miles per year when considering the difference between the London average mileage, and the assumed total one-way car-sharing member mileage. It is recommended that this figure be monitored and assessed periodically following the launch of one-way operations in London.

Air Quality Improvements

Using the above assumption of 163 million miles reduced, and multiplying by the UK average vehicle CO2 emissions per mile (assumed 215 grams in 2020, down from 258 grams in 2014), could result in up to 35,082 tonnes of CO2 reduced. That would represent a 0.9% reduction on the reported (TfL) CO2 emissions generated by cars on London’s roads (3.7 million tonnes in 2013, forecast to rise to over 3.9 million in 2020).

This reduced mileage would also lead to a 4.5 tonne reduction in PM10s, and 107 tonnes of NOX pollutants reduced, both of which contribute significantly towards respiratory related diseases in London; one-way car-sharing could reduce them by 1.1% based on comparing the implied reduced mileage to the national average.

In addition, it is likely that one-way car-sharing vehicles are likely to result in more EVs and PHEVs being deployed in London, with fixed operators such as Bollore basing their business model on using EVs, and flexible operators such as DriveNow/car2go also using some electric cars in their fleets.
As such, it is assumed that one-way car-sharing vehicles will emit 66% less CO2 than the national average, at 72 grams per mile compared to the estimated national average in 2020 of 215 grams per mile. When considering the mileage that would be undertaken in a one-way car-sharing vehicle, and considering this lower average emissions than that of the vehicle foregone, results in a further 30,278 tonnes of CO2 removed from the roads per year – reducing CO2 emissions on London’s roads by 0.8%.

**Economic Benefits**

It was assumed that the cost savings for one-way members that sell or defer ownership of a private car would be the same as those specified for round-trip car-sharing - £3,000 per year. Considering the 40,444 vehicles removed from the road as mentioned above applied to this saving, yields a saving of £121 million to one-way car-sharing members that sell or defer ownership of a private car.

This reduction in privately owned cars would also deliver reductions in congestion; given that 40,444 cars would reduce the estimated cars in London in 2020 by 1.4%, it was assumed that congestion would fall by the same rate, whilst not undertaking any speed/flow or simulation modelling as part of this research. Given that congestion is estimated to cost London’s economy >£4.3bn in 2020, this 1.4% reduction would be worth over £61m to London’s economy in GDP/productivity.

**Summary of Impacts for Round-Trip & One-Way Car-sharing**

Subject to the assumed impacts of one-way car sharing being validated and borne out, car-sharing can deliver significant economic, social, and air quality benefits to London. Taking both business models benefits combined, this could see annual benefits of;

- 120,000 cars (4.2%) removed from London’s roads & streets;
- 821 million less miles travelled on London’s roads;
- 5.6% reduction in CO2 emissions (4.5% resulting from lower mileage driven by car-sharing members, and 1.1% from car-sharing cars being lower emitting than the national average);
- 5.7% reduction in both PM10s and NOX;
- A £360m reduction in car ownership costs to members;
- A £181m increase in GDP/productivity from reduced congestion on London’s roads;
- In general, a better use of public realm due to reduced parking requirements.

However, as can be seen from the table below, in most cases, the evidence base established thus far highlights that the benefits associated to round-trip car-sharing are larger than those of one-way car-sharing, owing to the different use cases and rental patterns as outlined above.
Table 5. Comparison of annual Round-Trip and One-Way Car-sharing benefits in London 2020

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Round-Trip</th>
<th>One-Way</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars Removed</td>
<td>79,432</td>
<td>40,444</td>
<td>119,876</td>
</tr>
<tr>
<td>Miles Removed</td>
<td>657.7m</td>
<td>162.9m</td>
<td>820.6m</td>
</tr>
<tr>
<td>CO2 Emissions (reduction)</td>
<td>154,252t (3.9%)</td>
<td>65,360t (1.7%)</td>
<td>219,612t (5.6%)</td>
</tr>
<tr>
<td>PM10s (reduction)</td>
<td>18t (4.6%)</td>
<td>5t (1.1%)</td>
<td>23t (5.7%)</td>
</tr>
<tr>
<td>NOX (reduction)</td>
<td>432t (4.6%)</td>
<td>107t (1.1%)</td>
<td>539t (5.7%)</td>
</tr>
<tr>
<td>Cost Saving</td>
<td>£238.3m</td>
<td>£121.3m</td>
<td>£359.6m</td>
</tr>
<tr>
<td>Congestion removed (£)</td>
<td>2.8% (£120.1m)</td>
<td>1.4% (£61.1m)</td>
<td>4.2% (£181.2m)</td>
</tr>
</tbody>
</table>

Whilst clearly this represents a positive opportunity for both car-sharing models to flourish in London and deliver several benefits, full appraisal and review of the impacts of one-way car-sharing is required, given the variance in findings to date, and the questions raised below.

**Impacts of Different Business Models**

It is clear there are several benefits and impacts that can be realised by the growth of the car-sharing sector in London by 2020. However, as referenced throughout this paper, whilst there is lots of evidence and research having been undertaken for round-trip car-sharing services, there is relatively little for one-way car-sharing. Undoubtedly, there are use cases and demand for one way car-sharing in London. However, from a city and transport planning perspective, recent initial surveys suggest the outcomes and modal share are less positive. For example, two recent studies monitoring the effects of one-way car-sharing in Paris (6T on Autolib) and Montreal (Communauto) suggested that some one-way car-sharing members were using the service at the expense of sustainable travel modes (public transport and cycling), as well as taxis.

There is also a potential issue around where one-way car-sharing might be most desirable for the city, e.g. outer London where private car ownership and usage is relatively higher versus Central/Inner London, where it is likely to gain most market traction due to the demographic and density requirements. With this in mind, and where parking is already constrained in London, consideration needs to be given over the governance of several operators competing at scale (which may include 1,000-2,000 cars per operator) at the same time in the same geography requiring London wide parking permits, especially if using electric vehicles which would require sufficient supporting infrastructure. Consideration and a review of operational data will also be required to test the effect of clustering of vehicles to specific locations/nodes, and potential “tidal flows” at specific locations and times of the day as observed in some cities using one-way services. This merits further discussion and analysis around these issues.

**Whilst several data points are available for round-trip, less data is currently available to analyse one-way. Some studies show a less positive impact for one-way car-sharing than that of round-trip, but also that members who register for both models are more likely to adopt sustainable travel instead of private car usage. The net impact in London could therefore be positive but more data is required to implement an evidence based policy recommendation.**
It might be the case, that the broadened use cases one-way could bring, would make it easier for Londoners to commit to car-sharing as an alternative to private car ownership. This could, potentially, accelerate the adoption of car-sharing membership overall, to make car-sharing a more attractive proposition if the business models are to be complementary. Again, ongoing review of data from both operating models would be required to prove this applicability for London, given the uniqueness of each city.

Finally, with car-sharing models priced by the minute or hour, this would also facilitate a move, in effect, towards road pricing, with members paying an agreed price to use cars in London; in the longer term this could become dynamic based on time of day, or which part of London the vehicle is driven for example.

Whilst the overall net implications of mode share impact cannot be quantified directly for London, it is clear more data is required to make an evidence based policy recommendation. However, with an increasing customer demand for flexible, on demand mobility choices, set against a growing preference for access as opposed to ownership of cars, it is possible that the net impact of car-sharing in London in 2020 with both one-way and round-trip business models is a positive one based on the observations noted above, whilst appreciating the further evidence required following the market entry of all aforementioned business models.

CONCLUSIONS & QUESTIONS TO BE ADDRESSED

Policy Required to Achieve London’s Car-sharing potential

Our analysis of the vision for car-sharing in London 2020 has thrown up several interesting findings, opportunities, and areas that require further evidence or analysis going forward. We have demonstrated firstly a clear appetite for car-sharing in London, and, secondly, the policy areas that can support the accelerated growth of the sector.

Specifically these were suggested to include a combination of pro car-sharing policies and disincentives to private car ownership, to be delivered by policy makers in partnership with car-sharing operators. Specifically this suggested;

1. Raising Considered Awareness - Information, marketing, and systems integration Increase considered awareness from the current 20% to 40%;
2. Proximity – Provision of parking within a 5 minute walk of potential car-sharing market would rise from 60 to 90% of Central London, 50 to 68% of Inner London and 20 of 26% of Outer London;
3. Scrappage Scheme – the opportunity for discounted car-sharing membership to those that prove they’ve disposed of a private vehicle
4. Graduated parking permit charges - increased residential parking permit charges to second or more vehicles in the household
5. Ultra Low Emission Zone (ULEZ) – early impacts of the proposed 2020 ULEZ would be realised as residents start to dispose of non-compliant vehicles before the launch

With an increasing presence of car-sharing models in Central and Inner London, there is an opportunity for policy makers to effectively manage the car supply and usage in these locations, potentially implementing dynamic pricing at times of peak demand; this becomes more relevant with both one-way and round-trip car-sharing due to the increased use case potential
Realising a growth in car-sharing membership in London to 800,000 by 2020 could achieve a 4% reduction in private cars, 6% reduction in CO2 emissions from cars, and save £360m; however several policy initiatives targeted at increased awareness, provision of parking and proximity to car-sharing vehicles are required, alongside disincentives for private car usage.

Subject to the evidence base being established for one-way, and the appropriate policy support, this could result in a forecast 800,000 members in London in 2020. With the sector having 137,000 members in 2013, this not only represents a significant growth potential for operators, but a great opportunity for policy makers to alter the travel behaviour patterns of Londoners. If there were to be 800,000 members in London by 2020, there is the potential to remove ~120,000 cars from London’s roads, reducing car CO2 emissions by up to 6%, and in the process saving £360m per year for members, which can be used productively in the local London economy.

Further Questions this Research Identifies

In order to achieve this potential, this research identified several areas that require further evidence, subsequent analysis, and policy decisions to achieve the vision for car-sharing in London to 2020. This further consideration should be given towards;

- Validating the evidence base of new car-sharing business models to evaluate what kind of market London wants to develop and prioritise investment in;
- Considering separate strategies for Central/Inner and Outer London, and requirements to improve the key growth factors for Outer London;
- If one-way is to be developed to scale, how can a coherent operating area, with a London-wide parking permit, be agreed and implemented, and could it be EV/PHEV only?
- When planning for a market of this scale, what is the appropriate market structure?

Further Validation of new Car-sharing business models

In order to assess the impacts of car-sharing business models in greater detail, it is recommended that London’s policy makers consider how to further validate the evidence base for car-sharing impacts, in order to support and deliver a bold car-sharing strategy for London. This should include the sources highlighted in this report, relevant findings from other cities, and most importantly the monitoring of new car-sharing business models entering London, in relation to defined success criteria.

As noted above, there are lots of sources and studies for round-trip car-sharing, but less available at present for one-way car-sharing, with varying impacts. As such, a consistent reporting, evidence and monitoring base for each business model should be considered as more car-sharing business models enter the market. This may require a move away from just survey based findings to more operational findings/rental patterns in total to inform a view on the realised impacts and behaviour change of car-sharing.

Increasing car-sharing attractiveness & deployment towards Outer London

Outer London presents significant challenges to car-sharing operators in the short term. Whilst this offers the greatest potential in terms of car ownership & license holders, more widespread adoption of car-sharing use can only be expected if there are the appropriate improvements in the key drivers identified earlier in this paper, such as public transport accessibility, and measures to discourage private car usage.
For example, the kind of measures seen in Central London related to congestion charging, low emission zones (and soon Ultra Low Emission zone), and difficulties/costs of parking, could also be considered moving towards outer London. This could also be met with plans to support making car-sharing more viable to operators in these locations, whether through parking and signage support, incentives to station vehicles, or as part of development planning guidance for example.

Similarly, targeting areas in outer London with a high reliance on the car at present, such as business parks and/or areas with specific gaps in public transport connectivity for example, could yield an increased car-sharing member base, if met with measures to reduce the use of the private car.

How to deliver Parking & Infrastructure Requirements for One-Way car-sharing

It is expected that there will be a preference by one-way car-sharing operators to launch in Central London and then expand towards Outer London as their scale increases, due to the requirement for a higher population and vehicle density to sustain the business model. With the combined effect of central/inner London locations and short trip distances (5-6 miles with an average rental duration of 30 minutes, compared to 35 miles and 4-6 hours for round-trip), the one-way car-sharing business model is clearly more applicable for a high proportion of electric or plug in hybrid vehicle service.

For any one-way car-sharing service (whether using conventional cars or EVs), many trips will cross Borough boundaries and so the need to establish a parking permit arrangement, which facilitated inter-Borough journeys and parking, is essential. Also, the risk of and measures to guard against potential “pinch points” for clustering of cars (e.g. transport hubs, the West End) and undesirable journeys (e.g. commuting) should be considered.

EV car-sharing will require a significant and reliable charging post network, which can be used readily by multiple operators and a range of vehicle types from different manufacturers. Such a service could be an effective way of promoting only ultra-low emission vehicle use in Central and Inner London in particular, as well as raising awareness and educating residents on the benefits and viability of using electric vehicles.

As the car-sharing market grows in London towards 2020, the impact on parking bays required needs to be considered. It is the view of the project team that this would be more than compensated by the reduced number of private cars from the road in 2020 (120,000) compared to the car-sharing market vehicle supply (~9,200), but given the current reliance on public parking bays and engagement with the boroughs, a more consistent and strategic approach to securing parking for car-sharing should be considered.

With the likely preference of one-way car-sharing in Central & Inner London, their market entry could be an effective way of promoting an increased (or in the long term sole) use of ultra-low emission vehicles in these areas.
Furthermore, with the potential rise in demand for parking with the expanded London car-sharing business models (both round-trip and one-way), consideration over the appropriate market structure should be considered. For example, consideration should be given to how several EV operators (at scale) could share the charging infrastructure, in a smooth manner that ensured a high quality, convenient service for all members.

**London Car-sharing Market Structure**

Given the growing market and importance of car-sharing at the proposed scale in 2020, and considering the potential impacts outlined above, it is worth considering the market structure for car-sharing in London. Given the market size could grow over 6 fold in terms of members and 4 fold in terms of vehicles, London’s policy makers may wish to give consideration to the desired number of providers, operating areas, applications for parking, and standards or best practice that operators should adhere to.

Given the growing importance of car-sharing as a part of the transportation mix in London at the 2020 levels, it may become essential to place more regulation or standardisation of the business models to ensure a common approach that Londoners can understand and make use of effectively. This could include a consistent evidence base, including those outlined in this paper, and guidance on parking, signing, and infrastructure (e.g. charging stations) in particular.

**Final considerations & Experience from Other Cities**

Whilst not directly addressed in the scope of this research in detail, some other considerations and recommendations could be considered to facilitate the growth of car-sharing in London, specifically using/mandating the services across the public sector, and benchmarking technology & partnerships being made in other major car-sharing cities.

**Further encouragement from the Public Sector**

Whilst targeted policy areas surrounding incentives for car-sharing and disincentives for private car ownership are considered in this paper, there are potentially far more ideas that could trigger the growth of car-sharing in London relative to private car use. This could range from soft measures such as signing and priority of car-sharing over private cars, to more technologically driven measures such as including car-sharing as part of a London wide journey planner, based on preferences of the end user with the flexibility of access to several other transportation modes, products and services.

Furthermore, an increased usage of car-sharing amongst public sector bodies to complement and improve efficiency of their fleets, would be a good way of increasing awareness of the benefits of car-sharing, thus leading to a higher support of the concept to their respective residents. This is clearly demonstrated by Croydon Council for example, having saved >£500k, reduced car users by 52% and emissions by 36% in three years, as well as providing car-sharing vehicles for the council during the day and residents during evenings/weekends, benefiting both the business and residents alike.
Further integration of car-sharing through technology & partnerships

There are several early examples of integrating car-sharing through technology & partnerships that have been delivered in other European cities, which have widened the use cases and accelerated growth of the car-sharing market. These case studies could be analysed with a view to deployment in London, including:

- Integration of car-sharing with public transport ticketing and/or fare structures, as shown in Germany by local solutions such as Switchh in Hamburg, and national solutions such as the Bahncard/Qixxit from Deutsche Bahn; similarly in the Netherlands this offering is delivered nationally by NS, Mobility Mixx, XXimo and Radiusz Mobility;
- Positioning car-sharing as an option amongst journey planning / mobility options within a city, as seen by Moovel in Germany, and Ridescout in the US in particular. This would require a combination of technology led integration but also a willingness to promote car-sharing amongst the city’s mobility options;
- Commercial interests & partnerships, such as between car-sharing companies and retailers. in Germany for example DriveNow have a partnership with a supermarket chain (REWE) that provides discounted car-sharing membership for customers, and a 5% rebate on the shopping bill for customers using DriveNow to get to the shop; this could be delivered in London for several common use cases requiring a car such as this.

London can build on these early examples to deliver a more efficient platform as a successor of the Oyster card for example, that combines the growing information and number of transport solutions in the city, and leverages private sector innovation around journey planning, booking, contactless payment validation and systems integration.

In conclusion, with the clear opportunity for car-sharing services in London to 2020 and beyond, the most effective policy tool to deliver growth of the sector in the short term is a raised awareness of the business models, through marketing and promotion of the service to Londoners. If this were to be offered through London’s transport authorities, this would require a common strategy for operators to adhere to in terms of the business model characteristics that London’s residents understand and can engage with, such as consistent access and billing method, clear guidance on vehicle locations, and understanding of how to register/book vehicles. This could facilitate a growth of the car-sharing industry beyond a niche sector and to target more use cases through enhanced convenience and understanding.

Whilst more detailed analysis may be required to prove some aspects of the impacts of car-sharing in London in 2020 and the differences between one-way and round-trip business models, we hope that this paper can be used to invigorate the vast potential for car-sharing in London, through associated measures to facilitate growth. Whilst not the focus of this paper, this can also be complemented by the continued expansion of new mobility business models such as ridesharing, taxi applications, and corporate car-sharing solutions that will continue to reduce reliance on private cars, and deliver behaviour change towards a more sustainable and Car Lite London.
APPENDIX

References


The LSOA Atlas by the Greater London Authority (April 2014)

2011 Public Transport Availability Level (PTAL) Data at LSOA Level by Transport for London (available under the Freedom of Information Act)

One-way car-sharing: which alternative to private cars? The case of Autolib in Paris (2014). A study by 6T (the full version is available for sale)

Communauto – “Electric one-way shared vehicles in Montreal”

Car2go public press-releases for Seattle and Washington DC

Annual Surveys of UK Car Club Members by Carplus (2009-2014)

Zipcar London proprietary fleet and membership data (2010 and 2013)
Sample of Demographic and Related Data for Lower Super Output Areas (LSOAs) in Greater London Used as Inputs for Analysis

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Mapping London Boroughs onto Central, Inner and Outer London

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Car-sharing Demand Forecasting Methodology in Detail

Forecasting a Baseline for the Round-Trip Market Potential

In order to forecast the potential market size of round-trip car-sharing, detailed analysis of publicly available and proprietary data on the distribution of car-sharing members and vehicles has been undertaken with a view of establishing the demographic and urban environment factors that affect round-trip car-sharing membership most.

Data collected from different sources was aggregated at LSOA level as defined by the 2011 UK Census, with each census block / neighbourhood representing an average of 1,500 people with similar demographic characteristics. Other data sources, such as longitudinal member and fleet data, were intersected with LSOA blocks in order to establish the corresponding cumulative car-sharing demand and vehicle availability. Overall, the LSOA Atlas data [a snapshot of which is shown in the Appendix] provided a total of 141 neighbourhood indicators, such as population density and levels of car ownership. Additional small area information on Public Transport Accessibility Levels (PTAL) and Public Transport Accessibility Index (PTAI) came from TfL while data on Indices of Multiple Deprivation (IMD) were sourced from GLA Economics.

The combined data set was analysed using multiple linear regression to model the relationship between car-sharing demand (the number of car-sharing members) as a dependent variable and a combination of independent variables representing the demographic and urban environment characteristics of a neighbourhood in the following form:

\[
\text{[Carsharing members per neighbourhood]} = \beta_0 + \sum_{i=0}^{n} \beta_i \times \text{[Neighbourhood Characteristic]} + \epsilon, \text{ where } \beta_i \text{ are regression coefficients and } \epsilon \text{ is the error}
\]

In order to undertake this analysis, the initial set of neighborhood characteristics - or predictors – was reduced to a long-list of the most relevant factors using the domain expertise of the project team. In addition, all values of the remaining neighbourhood characteristics were standardised by rescaling them to have a mean of zero and a standard deviation of one before running a regression analysis. That ensured a common scale with which to evaluate the contribution of each neighbourhood characteristic to explaining historical membership.

The final set of the six neighbourhood characteristics, which form a regression model explaining approximately 67% of variance in round-trip membership levels, are as follows:

- Percentage of residents with educational qualifications at Level 4 or above (higher education qualifications);
- Number of households with zero or one car;
- Population density per hectare;
- Income rank;
- Public Transport Accessibility Index (PTAI), a measure that takes into account walking access time and service availability;
- Number of residents aged 30 to 44.
This shows - in line with a number of previous research results - that the uptake of round-trip car-sharing tends to be higher in those neighbourhoods that are densely populated and well served by public transport, as well as have a larger proportion of young, highly-educated residents, who are not car owners.

If used for forecasting round-trip membership levels to 2020, the resulting regression model would have required detailed time-series data for all of the six neighbourhood characteristics. Instead, an approximation of a membership trend was made by deriving the compound annual growth rate (CAGR) for the average member count by LSOA between 2010 and 2013 from the existing usage data, separately for Central, Inner and Outer London in order to account for their distinct growth patterns and urban characteristics:

\[
[CAGR \text{ for Central London}] = \left(\frac{\text{Avg Members per Central LSOA in 2013}}{\text{Avg Members per Central LSOA in 2010}}\right)^{1/3} - 1
\]

\[
[CAGR \text{ for Inner London}] = \left(\frac{\text{Avg Members per Inner LSOA in 2013}}{\text{Avg Members per Inner LSOA in 2010}}\right)^{1/3} - 1
\]

\[
[CAGR \text{ for Outer London}] = \left(\frac{\text{Avg Members per Outer LSOA in 2013}}{\text{Avg Members per Outer LSOA in 2010}}\right)^{1/3} - 1
\]

Furthermore, it was assumed that, without any policy interventions, the CAGRs for 2010-13 were representative of the rate of growth expected between 2013 and 2020, and the following steps were repeated for Central, Inner and Outer London:

\[
[Avg \text{ Members per Central LSOA in 2020}] = [Avg \text{ Members per Central LSOA in 2013}] \times (1 + [CAGR \text{ for Central London}])^7
\]

\[
[Carsharing\ members\ in\ Central\ London\ in\ 2020] = [Avg \text{ Members per Central LSOA in 2020}] \times [Number\ of\ LSOAs\ in\ Central\ London],
\]

followed by aggregating the three resulting estimates:

\[
[Total\ carsharing\ members\ in\ 2020] = [Carsharing\ members\ in\ Central\ London\ in\ 2020] + [Carsharing\ members\ in\ Inner\ London\ in\ 2020] + [Carsharing\ members\ in\ Outer\ London\ in\ 2020]
\]

That provided a “baseline” growth trajectory, running from 137,000 round-trip members in 2013 (Carplus) to an estimated 264,000 in 2020. Such a baseline can be considered as the round-trip market growth potential achievable under the current market structure and dynamics and, therefore, without any policy interventions.
Forecasting a Baseline for the One-Way Market Potential

Given a lack of historical data available, forecasting a baseline for one-way car-sharing membership was performed by benchmarking membership growth against other cities that were further along the adoption curve, including Paris (Autolib), Washington DC and Seattle (car2go). The one-way membership levels from the benchmark cities were scaled to account for differences in population density (13,500 per sq. mile in London, compared to 7,400 in Seattle and 10,300 in Washington DC, and 13,483 in Paris) and provided a representative estimate of one-way member growth in London on a monthly basis. Furthermore, it was assumed that a flexible one-way car-sharing service was due to launch in London in the autumn of 2014, followed by the initial launch of a fixed one-way car-sharing service in the spring-summer of 2015. The assumed membership growth of one-way car-sharing in London, relative to these observations from other cities is shown in Figure 7.

Figure 7. Estimated growth of one-way car-sharing membership in London relative to other cities

Based on the above, flexible one-way car-sharing membership in London reaches 6,250 in the first month, then growing at an average rate of 22% per month in 2014/15, and 4% per month in 2015/16. As both Seattle and Washington DC only had two years’ worth of historical membership data available, a growth rate of 3% per month was assumed to continue in 2016/17, gradually slowing down to 0.5% in 2019/20. Under these assumptions, 175,000 flexible one-way car-sharing members would be in London in 2020.
Fixed one-way membership in London was modelled using Autolib data from Paris, again adjusted for population density. However, given the relatively high public funding and policy support already afforded to Autolib in Paris, Autolib membership data were scaled down by 40% to make them comparable with the expected market conditions in London. This would result in a growth from 3,000 one-way fixed car-sharing members in 2015 to over 177,000 in 2020. Put together, flexible and fixed one-way segments would account for approximately 352,000 members in 2020.

It is important to note that the above one-way car-sharing market potential would only be achievable assuming unrestricted parking provision for one-way operators across London. For illustration, the average one-way trip in the benchmark cities lasts thirty minutes and covers five miles, and that would normally involve crossing at least one London borough boundary.

**Forecasting Additional Market Potential Driven by Policy Interventions**

In addition to the baseline growth forecast for round-trip and assumed for one-way car-sharing outlined above, a combination of policy measures could accelerate the adoption of car-sharing in London. These were considered as outputs from the Car Lite London paper (www.carlitelondon.org), supported by subsequent discussions with London’s transport authorities, and considering the likely impact this would have on accelerating the market adoption of car-sharing in London.

The policy based factors were categorised as either incentives for using car-sharing, or disincentives for private car ownership & usage, which in turn would lead to increased relative attractiveness of car-sharing over private cars based on these policies. In summary, the vision 2020 team deemed the following policies as those that could yield the highest impact in London:

**Incentives for car-sharing**

- Considered Awareness - Information, marketing, and systems integration
  Increase considered awareness from the current 20% to 40%. The likely adoption due to raised awareness is deemed to be higher in Central (3% of those aware per year) than in Outer (0.5% of those aware per year) London. These policies were assumed to be applied from 2015 onwards;

- Proximity – Provision of parking within a 5 minute walk of potential car-sharing market
  would rise from 60 to 90% of Central London, 50 to 68% of Inner London and 20 of 26% of Outer London, impacting from 2015 onwards. The conversion of this into membership was assumed to be 24% of the additional population within a 5 minute walk per year for Central London, 2.5% for Inner and 2% for Outer London, reflecting the assumption that a far more visible and convenient presence is likely to have an impact in Central than Inner/Outer London;
• Scappage Scheme – the opportunity for discounted car-sharing membership (and indeed other mobility services such as cycle hire) to those that prove they’ve disposed of a private vehicle, implemented in 2016. It was assumed that this would apply to a higher percentage of central (up to 5% of those with one car, and 3% of those with 2 or more) than in Inner (up to 1% of car owners and 0.5% of 2 or more cars) and Outer London (up to 0.8% of those with 1 car and 0.4% for 2 or more cars). We assumed that the initial impact would be high in year one (2016), reducing in year two, then increasing in year 3 due to an imminent removal of the incentive, based on what was observed with the national scrappage scheme.

Disincentives to private car ownership

• Graduated Parking Permit Charges – increased residential parking permit charges to second or more vehicles in the household, which would be implemented from 2015 in Central, 2016 in Inner, and 2017 in Outer London, assuming that there is more willingness & need to implement in Central London first. It is assumed this policy would convert to car-sharing membership up to 20% of those with more than 2 cars in Central, 6% in Inner and 0.7% in Outer London by 2020.
• Ultra Low Emission Zone (ULEZ) – with the expected ULEZ to launch in London by 2020, the early impacts of this with residents disposing of non-compliant vehicles was considered to have a small impact from 2018 onwards in Central London only; it is assumed this will lead to 0.1% of Central London population joining a car club in 2018, and 0.6% in 2020.

In all of the policy assumptions, assumed levels of relevance were assigned based on the addressable market for that particular policy (e.g. driving license holders, or private car owners), and the likely adoption of car-sharing in Central, Inner and Outer London. As can be seen in Table 1 and Table 2, this assumed the impact of each policy would reduce towards Outer London, with the bar charts highlighting the resulting incremental adoption of car-sharing as a % of the population of that area.

This demonstrates the relatively higher adoption of car-sharing in Central and Inner London as a result of policy based initiatives; our analysis showed 28% of the additional membership from policy initiatives would come from Central, 51% from Inner London, and 22% from Outer London. However, it should be noted the potential for real behaviour change in the longer term is Outer London, where most of the private car owners reside, and where the majority of car trips in London are undertaken. Therefore, to have the largest impact in terms of policy will require targeting the above policies (and several others) towards Outer London in the long term to foster a growing car-sharing sector beyond Central and Inner London. With the favourable demographics and behaviour change away from private car usage already witnessed in central and inner London, these areas will be more attractive and viable for accelerated adoption of car-sharing in the short term.

In all of the policies it was assumed that a higher adoption rate would be assumed for round-trip than one way-car-sharing due to the observed higher rate of private car disposal amongst round-trip car-sharing members (e.g. 7 private cars sold per car-sharing member in London - Carplus) than those of one-way car-sharing services (e.g. 3 cars sold per 1 Autolib vehicle in Paris – 6T).
Therefore, other things being equal, the same policy may be likely to yield more members for round-trip car-sharing. The main exception to this is raising awareness, due to the increased potential frequency and volume of trip use cases that one-way is applicable to compared to round-trip car-sharing. This raised awareness would increase the membership base potential for one-way more than round-trip, accounting for 70% compared to 41% of the overall policy based uplift respectively.

The estimated additional number of members that could be applicable and willing to sign up for car-sharing as a result of these policy initiatives was 87,000 for round-trip car-sharing services, and 98,000 for one-way services.
Results of Fitting a Regression Model to the Expected Values of Neighbourhood Characteristics in 2020 at LSOA Level

1. **Adjusted R-squared**: the model's fit to the data is good, with 68% of the variance in the number of round-trip members explained.

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<td>,681</td>
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2. The below ANOVA table entities are the sum of squares, degrees of freedom and mean squares required for the statistics of the 2020 regression model. The **F-statistic (1723)** demonstrates that the proposed relationship between the number of round-trip members and the set of neighbourhood characteristics is statistically reliable and can be useful for prediction and explanation.

   **ANOVA**
   
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</table>

3. The **t-tests**: demonstrate that all the regression model coefficients - with the exception of POP2020 - are statistically significant at a 95% level, with the corresponding neighbourhood characteristics showing influence on the number of round-trip members.

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