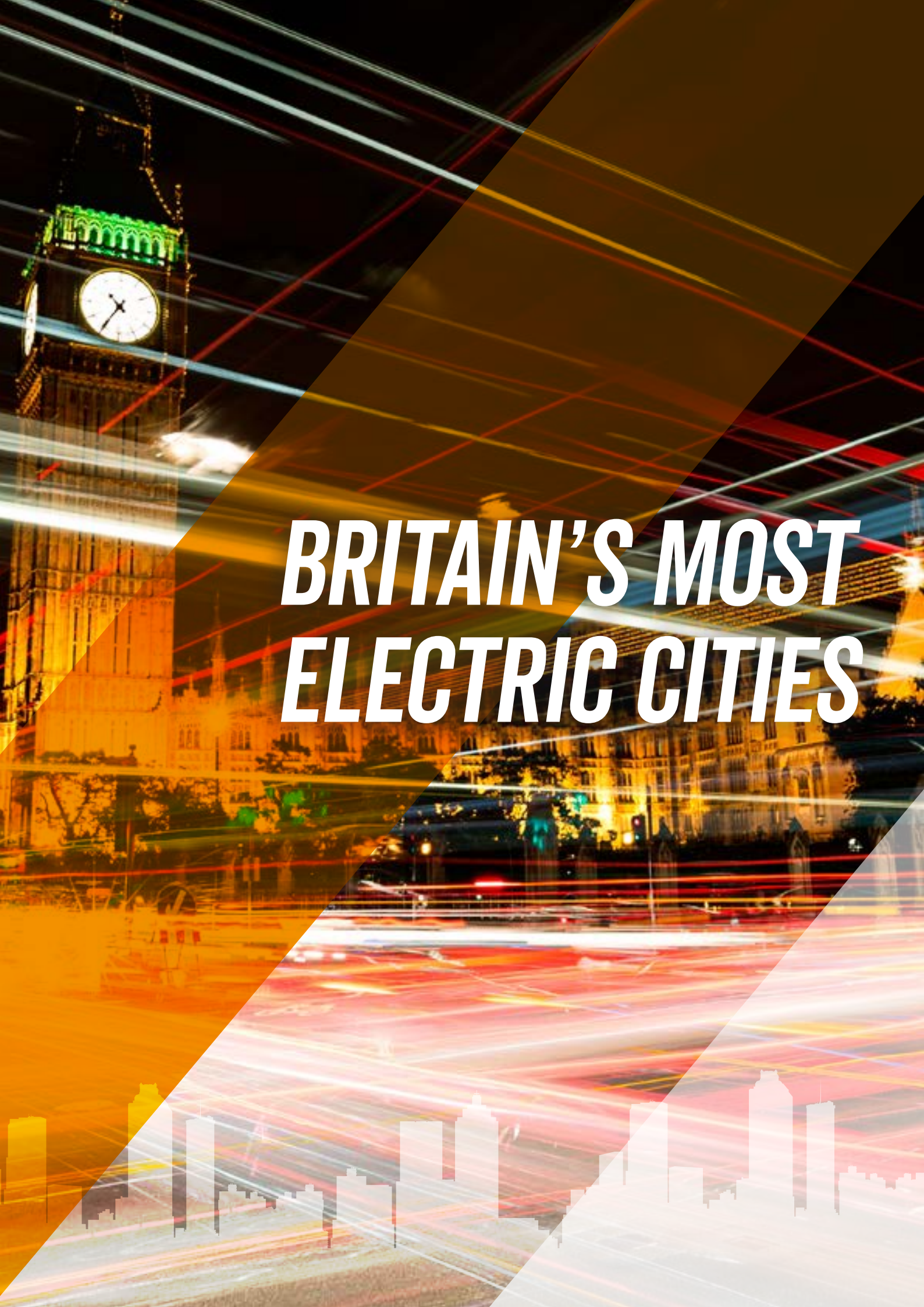


BRITAIN'S MOST ELECTRIC CITIES

BRITAIN'S MOST ELECTRIC CITIES

This report explores the relationship between geographic location and adoption of electric vehicles, and identifies actions that may be useful for policy and industry audiences.

An all electric future came a step closer last month when the Prime Minister announced that sales of new cars and vans wholly powered by petrol and diesel would be banned from 2030 – five years earlier than the previous deadline.

Though some hybrids will continue to be sold legally until 2035 there's no doubting that the UK intends to be a world leader in the transition to clean, green forms of transport.

In the days after the Government's announcement, searches for electric vehicles increased 500 per cent according to one car buying website, suggesting that those who claim their 'next car will be electric' are starting to act.

And yet, the reality is, adoption of electric vehicles is low. As of the end of September 2020, there were 373,600 plug-in models on the road, of which 164,100 were pure electric cars or Battery Electric Vehicles (BEVs). That's out of a total UK car parc of approximately 35 million[1], meaning that barely one per cent of cars on the road today can claim any environmental credentials, and only one in 200 is pure electric.

But the signs are encouraging. Pure electric models accounted for 6.7% of total new car registrations in the year to September and the Government has allocated £582 million for grants that may be even more generous than those currently available.

[1] *Society of Motor Manufacturers and Traders (SMMT)*

The task of readying Britain for an all-electric fleet has been described as Herculean. The Government has said it will invest £1.3bn to accelerate the rollout of charge points (there are 20,197 at present) and £500 million on the development and production of electric vehicle batteries.

In the meantime, the number of pure electric models continues to expand (205 at the last count) and all the forecasts point to a period of explosive growth over the next few years.

But will this growth be seen evenly across the UK, or will certain parts of the country go electric sooner than others? Is there a risk of a 'green gap' opening up, similar to the digital divide which has seen some areas enjoy superfast broadband speeds while others are left behind? That is the question we set out to address in this report.

EXECUTIVE SUMMARY

Different parts of the country are adopting electric vehicles at dramatically contrasting rates. There is a positive correlation between average household income and electric vehicle adoption. There is also a positive correlation between the number of EV charging points and electric vehicle share. Attitudinal differences to climate change could explain some of the differences between cities. There may be a need to target incentives and investments regionally in order to prevent a 'green gap' from emerging whereby wealthier parts of the country are able to enjoy the benefits of EV ownership sooner than others.

HALFORDS AND ELECTRIFICATION

Halfords believes that smart, independent transportation is vital to our wellbeing and to the environment. We are on a mission to support a sustainable future by championing all forms of electric transport, helping our customers as they make their transportation choices.

We are investing in education and community engagement programmes to help people make climate-smart choices; evolving our product and services offer to make the switch to electric vehicles easier for customers; and supporting new forms of electric mobility such as e-scooters and e-bikes.

We're also investing heavily in electric skills. The UK motor industry will need to double the rate of electric vehicle training if it is to provide the servicing, maintenance and repair infrastructure the nation is going to need in the near future. We're ramping up training for our staff to help them serve customers as they make the transition to electric forms of transport, whether that be electric vehicles, eBikes or eScooters.

ELECTRIC CITIES

The purpose of this research is to understand which parts of the UK are ahead of the curve in adopting electric vehicles and which are lagging the UK average.

We have prepared two league tables, one for pure electric vehicles (also referred to as Battery Electric Vehicles or BEVs), and one for Ultra Low Emission Vehicles (ULEVs), which includes BEVs and hybrids including plug-in hybrids (PHEVs).

We have also started to examine the factors that influence adoption in the hope that it may be helpful for policymakers and regional leaders.

OUR RESEARCH PARTNER - RAND EUROPE

RAND Europe is a not-for-profit research organisation whose mission is to help improve policy and decision-making through research and analysis. Their research is empirical, objective and nonaligned to political or partisan interests.

James Fox
Dr James Fox is a Research Leader and RAND Europe's QA Manager. He holds a Master's degree in Civil Engineering from Imperial College London, an MSc in Transportation from the University of London, and a Ph.D. from the Institute for Transport Studies at the University of Leeds. He has twenty years of experience in estimating multi-modal variable demand models in urban, regional and national contexts and in the development of forecasting systems for these models.

METHODOLOGY

We undertook a review of possible data sources for calculating the electric vehicle share by city, metropolitan area and London borough. Two candidate data sources were considered, National Travel Survey (NTS) data and the Vehicle Statistics Database (VSD).

The NTS data is collected annually and records information on households, the individuals in each household, vehicles owned by each household and trips made by household members. The VSD is a record of all licenced (i.e. taxed) vehicles and as such represents a close to full sample. It is drawn from the information collected when owners tax their vehicles.

The advantages and disadvantages of each dataset are summarised in the following tables.

Table 1: Advantages and disadvantages of NTS data for calculating Electric Share

Advantages	***Disadvantages***
Allows calculations to be made on a mileage basis, as well as mode share or percentage of cars/vehicles	*Only collected in England from 2013 onwards, so Welsh, Scottish and Northern Irish cities could not be included*
The NTS collects annual mileage information for all vehicles in the sample which could support analysis of differences by vehicle type at more aggregate geographies	*Due to significant data cleaning and processing requirements, there is a significant lag between completing collection of the data and it being available for analysis*
Collects detailed socio-economic information which could provide insights into the factors influencing EV usage	*The sample-based nature of the data combined with the low current EV share mean the sample sizes are too small to look at differences in the share of EVs at the city level*

Table 2: Advantages and disadvantages of Vehicle Statistics Database data for calculating Electric Share

Advantages	***Disadvantages***
Collected UK-wide	*Does not allow a mileage measure to be directly calculated*
Close to a full sample and so can support analysis of differences in across cities	*Data allows share of vehicles to be calculated but does not directly provide the share of cars*
Data release is timelier than the NTS	*Company owned vehicles may have clustered registration patterns which can bias the results*
The data is provided by quarter facilitating graphical trend analysis	

While the NTS data allows the share of mileage made by electric vehicles to be calculated, the samples of electric vehicles were too small at the city level to generate reliable data. Therefore, the Vehicle Statistics Database was deemed the most suitable dataset as it provides a full sample, covers all of the UK, is released in a timely fashion, and is provided quarterly, facilitating trend analysis.

The VSD records vehicle ownership and therefore an ownership-based measure has been used; specifically we have calculated:

- *The Battery Electric Vehicle (BEV) share of total vehicles*
- *The Ultra-Low Emission Vehicle (ULEV) share of total vehicles*

It is noted that BEVs form a subset of ULEVs, for example a fully electric vehicle is both a BEV and a ULEV, whereas a hybrid vehicle may be a ULEV but is not a BEV. The focus on this study is BEVs and so later analysis focuses on the BEV share.
BEV, ULEV and total vehicle numbers include cars, motorcycles, Light Goods Vehicles, Heavy Goods Vehicles, buses and coaches. Analysis presented in Annex A demonstrates that cars comprised 84% of total vehicles registered in the UK at the end of 2019.

Within the analysis, BEV and ULEV totals by local authority are from 2020 quarter 2 (Q2) whereas the total vehicle numbers are from the end of 2019 because we have had to combine different licensing datasets. It is judged that given the close proximity of these two windows, and that total vehicles numbers are changing much more slowly than BEVs and ULEVs, this should not have affected the overall analysis and results of this study.

The vehicle licensing information was obtained from Department for Transport (DfT) vehicle licensing statistics that are accessible online. These statistics are split by quarter and by local authority, with values currently available up to 2020 Q2. In London the figures are split by borough. The split by local authority is sufficiently detailed to allow ownership figures for medium to large sizes cities to be obtained directly.

The key limitation that emerged during data processing is that company registrations of BEVs and ULEVs are clustered in certain cities and this can bias the figures.

To achieve the desired spread of data on cities across the UK we used a four-stage approach to identify which cities to include in the league tables:

1. ***Identify initial list of cities.***
   An initial list was determined by sampling the one or two largest cities by population from each Government Office Region (GOR). For most GORs two cities were selected but the objective was to arrive at a list of twenty in total and so some lower population second ranked cities were omitted.

2. ***Identify biased data points.***
   We reviewed the share of ULEVs that were company owned and identified cities where the share of electric vehicles is biased by company registrations.

3. ***Substitute biased data.***
   We replaced the cities where registrations are biased by high company registrations with the next largest cities in that GOR for which the ownership figures are not also biased by company registrations.

4. ***Agreed final list of cities.***
   We then included a few more large population cities, London as a whole, and the London boroughs with the highest and lowest shares of electric vehicles.

ELECTRIC CITY LEAGUE TABLES

Table 3: Battery Electric Vehicles (BEV): share of all vehicles

Rank	City	BEV share
1	**Barnet**	**0.86%**
2	Wandsworth	0.72%
3	Overall London	0.56%
4	City of Edinburgh	0.46%
5	Nottingham	0.39%
6	City of Bristol	0.35%
7	Brighton and Hove	0.34%
	Overall UK	**0.34%**
8	Derby	0.34%
9	Sheffield	0.32%
10	Newcastle upon Tyne	0.30%
11	Belfast	0.27%
12	Basildon	0.26%
13	Southampton	0.25%
14	Glasgow City	0.23%
15	Cardiff	0.22%
16	Sunderland	0.21%
17	Coventry	0.21%
18	Manchester	0.20%
19	Northampton	0.19%
20	Barking and Dagenham	0.18%
21	Liverpool	0.18%
22	Bradford	0.18%
23	Stoke on Trent	0.14%
24	Luton	0.13%
25	Wolverhampton	0.13%
26	Plymouth	0.12%
27	Kingston Upon Hull	0.11%

The highest ranked 'cities' are both London boroughs with BEV shares more than twice the UK average. The EV share across London as whole is also significantly above the UK average. Barking and Dagenham is the London borough with the lowest BEV share, it has a share just over half the UK average.

Derby has a BEV share around the UK average, however looking at the ULEV ownership statistics 76% of ULEVs in the city are company owned compared with 51% across the UK as a whole so company registrations are likely to also be boosting the BEV share. The BEV share in the lowest ranked cities is just one-third of the UK average.

We have also calculated a league table for ULEV ownership. In contrast to BEVs, for ULEVs we can obtain ownership figures split by private and company ownership at the local authority level. Given that the BEV analysis demonstrated that company ownership could bias the ownership statistics at the local authority level we decided to focus on private ULEV shares for the league table.

Table 4: Privately owned Ultra-Low Emission Vehicles (ULEV): share of all vehicles

Rank	City	BEV share
1	**Wandsworth**	**1.60%**
2	Barnet	1.42%
3	Overall London	1.03%
4	City of Edinburgh	0.61%
5	Brighton and Hove	0.53%
6	Havering	0.52%
7	City of Bristol	0.43%
	Overall UK	**0.39%**
8	Sheffield	0.38%
9	Luton	0.37%
10	Newcastle upon Tyne	0.35%
11	Nottingham	0.34%
12	Cardiff	0.31%
13	Leeds	0.30%
14	Milton Keynes	0.28%
15	Derby	0.27%
16	Sunderland	0.26%
17	Manchester	0.24%
18	Glasgow City	0.23%
19	Liverpool	0.21%
20	Wolverhampton	0.20%
21	Belfast	0.18%
22	Stoke on Trent	0.18%
23	Birmingham	0.18%
24	Leicester	0.18%
25	Plymouth	0.17%
26	Peterborough	0.13%
27	Kingston Upon Hull	0.13%

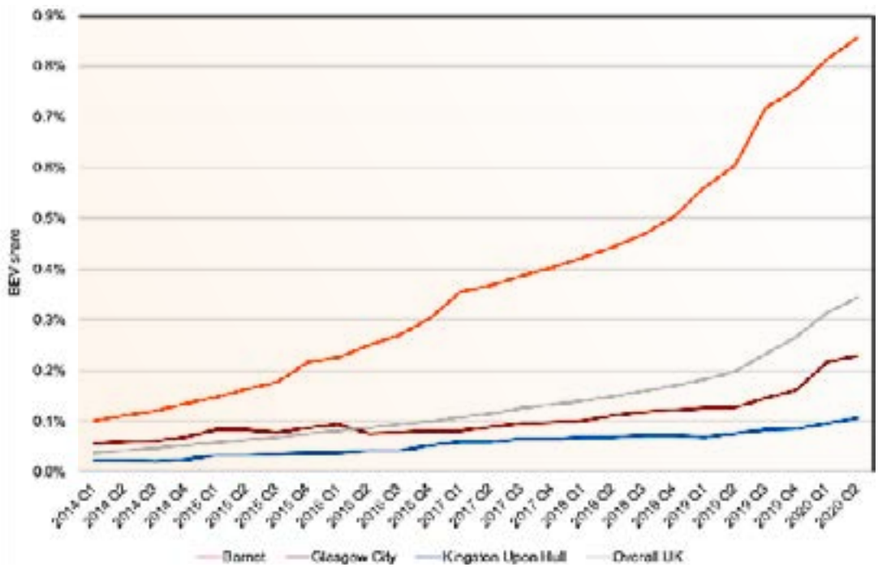
The top two cites/boroughs are the same as in the BEV league table though for privately owned ULEVs it is Wandsworth, not Barnet, where the highest ULEV share is observed. It is notable that the London borough with the lowest private ULEV share (Havering) the share is still noticeably higher than the UK-wide average.

In general, the positions of cities at the top, middle and bottom of the BEV and ULEV league tables are similar with Hull taking the bottom spot in both tables.

TRENDS IN SHARES OF ELECTRIC VEHICLES

The evolution of the BEV Share for the top, middle and bottom ranked cities has been plotted alongside the overall UK shares in Figure 2.

Figure 2: Trends in BEV Share in top, middle and bottom ranked cities



While the BEV Share has increased since the start of 2014 in all three cities and the UK overall the differences in the relative shares between the three cities have persisted over time. For example, in 2014 Q1 Barnet's EV share was less than an eighth of its 2020 QA value, however like in 2020 Q2 Barnet had an EV share that was significantly higher than that observed for Glasgow and Hull.
The UK Government introduced the Plug-in Car Grant in January 2011. This reduced the purchase price of BEVs by providing a grant of up to 25% of the car purchase price, capped at £5,000. From 1 April 2015 this grant increased to up to 35% but the cap remained at £5,000[2]. However, for vehicles priced at £20,000 and above this change had no impact on the subsidy. Given most BEVs are priced above £20,000 this change will not have had much impact on total BEV ownership.

There has been an uptick in electric vehicle share over the last four quarters in all three cities, a pattern also seen in the overall UK figures. This is in part due to the launch of the Tesla Model 3 in the middle of 2019, which became the bestselling EV in the UK in 2019.[3]

2 https://en.wikipedia.org/wiki/Government_incentives_for_plug-in_electric_vehicles#United_Kingdom (accessed 29/10/20).
3 https://www.nextgreencar.com/electric-cars/statistics/ (accessed 29/10/20).

ANALYSIS

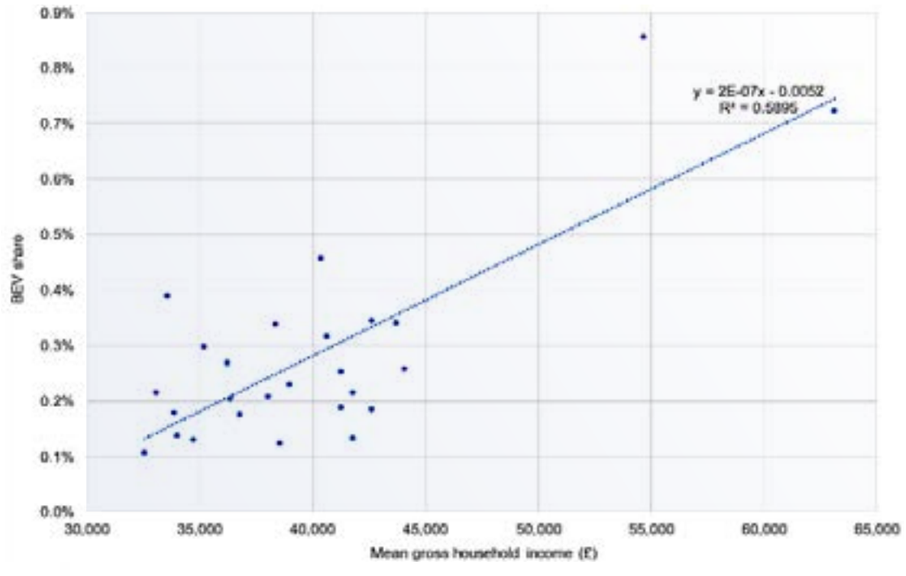
In this section we have explored three factors that may help explain the variation in EV shares between cities: household income; provision of charging points; and, differences in attitudes to the environment. Such analysis provides greater understanding of the role of different factors in shaping the use of BEVs, which could help inform measures that cities might take to encourage greater uptake. Of course, other factors may influence the BEV share, such as the age profile of the population and fraction of the population with higher education, and these could be explored in further work.

We have omitted the City of London from the analysis in this section as this borough is an outlier whose exceptionally high BEV share is strongly influenced by the location of the borough within the London CCZ.
As the analyses presented in this section explore how the variation in BEV share might be explained by other variables we have also omitted the spatially aggregate London-wide and UK datapoints.

HOUSEHOLD INCOME

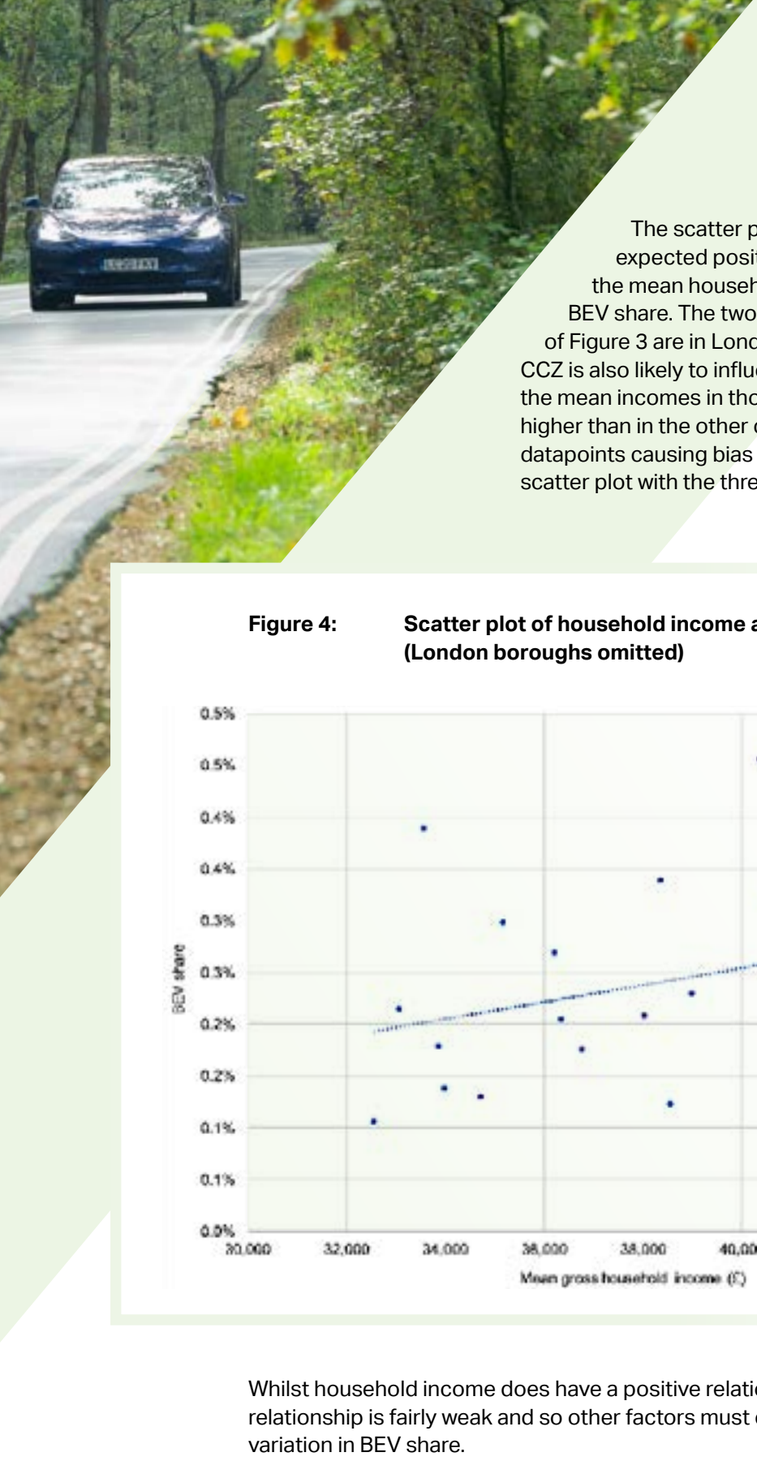
Historically household income has been the most important variable in explaining the growth in car ownership in the UK over time.[4] Even after accounting for government grants, BEVs are usually more expensive than their petrol/diesel equivalents and so it is reasonable to expect some relationship between mean household income in a city and the BEV share. Figure 3 presents a scatter plot of mean gross household income and the BEV share.

Figure 3: Scatter plot of household income and BEV share for cities



See Annex for sources.

4. Fox, J, B. Patruni, A. Daly and H. Lu (2017) Updating the National Car Ownership Model for Great Britain, RAND Europe Cambridge.

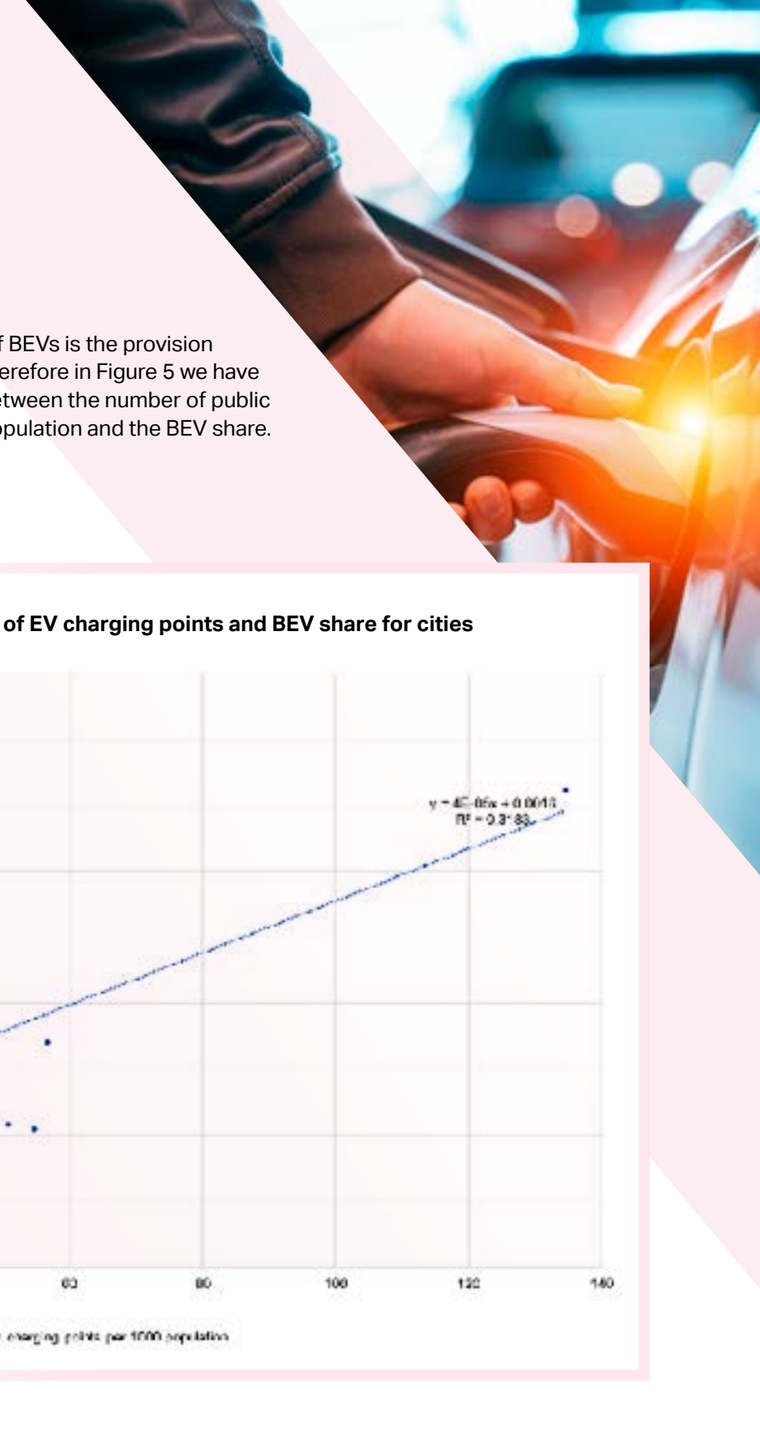


The scatter plot demonstrates the expected positive relationship between the mean household income of the city and BEV share. The two datapoints at the top right of Figure 3 are in London where proximity to the CCZ is also likely to influence BEV ownership and the mean incomes in those two boroughs are much higher than in the other cities. To avoid the London datapoints causing bias Figure 4 presents the scatter plot with the three London boroughs omitted.

Figure 4: **Scatter plot of household income and BEV share for cities (London boroughs omitted)**

Whilst household income does have a positive relationship to the BEV share the relationship is fairly weak and so other factors must contribute to the full range of variation in BEV share.

The mean household income in a city says nothing about how incomes are distributed across different households and given the relatively high purchase price of BEVs at present the fraction of higher income persons is likely to be particularly important in this context. Further work could explore the availability of income distribution data and explore the relationships of fractions of higher income households to the BEV share.



ELECTRIC VEHICLE CHARGE POINTS

A barrier to greater uptake of BEVs is the provision of public charging points. Therefore in Figure 5 we have examined the relationship between the number of public changing points per 1000 population and the BEV share.

Figure 5: **Scatter plot of EV charging points and BEV share for cities**

See Annex for sources.

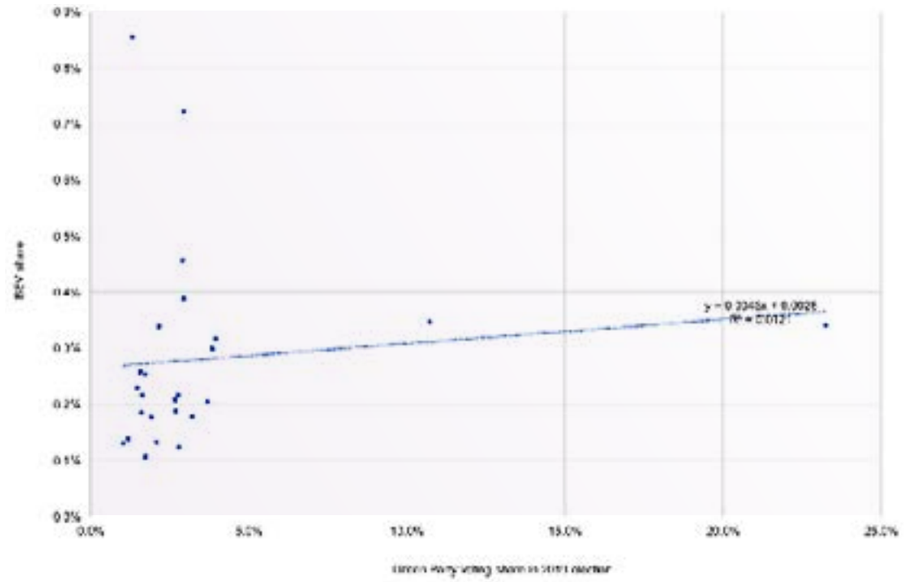
As might be expected there is a positive relationship between the number of EV charging points and the BEV share. The highest EV sharing point provision is observed in Wandsworth. It is notable that Barnet has an even higher BEV share but significantly lower public charging point provision. The comparison of these two London boroughs suggests charging point provision only partly contributes to the BEV share.

ATTITUDINAL DIFFERENCES

It seems likely that attitudinal differences to the environment and related concerns around climate change explain some of the differences between cities. For example, the 7th and 8th ranked cities, Bristol and Brighton and Hove, have been cities where the Green Party has performed better than average, particularly Brighton which currently has a Green Party MP.

To explore this further we downloaded the voting results from the 2019 General Election and processed the results to obtain the Green Party voting share. We then investigated the relationship between the Green Party voting share and the BEV share. Of course, this is a simple approximation to attitudes to BEVs and a further study could explore the availability of attitudinal data that more directly captures attitudes to BEVs.

Figure 6: Scatter plot of 2019 Green Party share and BEV share for cities



See Annex for sources.

Figure 6 (particularly the R^2 measure of 0.012) indicates the relationship between the Green Party voting share and the EV share is weak and there is no obvious correlation between these two variables. The point to the far right is Brighton and Hove, and the point with 11% share is Bristol. Focussing on the remaining points to the left it can be seen that the Green Party share does not explain the remaining variation in the data.

We tested removing the two data points with a Green Party vote share over 10%. However, the relationship between Green Party vote share and BEV share remained weak.

CONCLUSIONS

At present the EV share is too low to allow NTS data to be used to analyse the EV share at a city level. However, it is clear from the trend analysis that the growth in EV share is accelerating and therefore within a few years it should be possible to use NTS data to make detailed analysis of EV trips at the city level.

We decided to use VSD data to define the electric vehicle share in this study. The highest shares are observed in London, and overall London has a BEV share 65% above the UK average. Edinburgh, Nottingham, Bristol and Brighton and Hove also have Electric Shares above the overall UK average.

The lowest Electric Share cities have BEV share around one-third of the UK average, with Hull, Plymouth, Wolverhampton, Luton and Stoke-on-Trent having the lowest shares.

We have tabulated the privately owned ULEV shares. These correlate closely with the BEV shares with London shares noticeably above the UK average.

TRENDS IN ELECTRIC VEHICLE SHARE

While the BEV share of total vehicles remains relatively low it has grown steadily since 2014, and the growth seems to have accelerated through 2019 and the first half of 2020. The launch of the highly successful Tesla Model 3 in mid-2019 may have contributed to this accelerated growth.

The relative differences in the EV share between the top, middle and bottom ranked cities have persisted over the 2014 to 2020 period.

DIFFERENCES IN ELECTRIC VEHICLE SHARE BY CITY

If London boroughs are included, a significant relationship between the mean household income of the city and the BEV share is identified. However, these results may be biased by the combination of high-income boroughs and an additional CCZ effect. When London boroughs are excluded from the analysis only a weak relationship between household income and BEV share is identified. However, the lowest share city (Hull) is also the lowest income city and so it is clear variations in household income do play some role in BEV influencing the figures. It should also be noted that two cities could have the same average income but quite different income distributions. Further work would be valuable to explore the relationship between household income distributions and BEV ownership, the NTS data would be ideal for this analysis but it would be necessary to aggregate data over cities.

The provision of electric charging points does appear to have a positive relationship with the BEV share, where cities with a greater number of charging points have a greater electric share, but proving causation was not possible with the available data.

Attitudes towards the environment and climate change do not appear to play a role in explaining variations in BEV share. Whilst Brighton and Hove is one of the higher ranked cities for both BEV share and attitudes to climate change - which is consistent with the hypothesis that these factors are related - when we analysed the 2019 Green Party voting share for all the selected cities no relationship between Green Party vote share and BEV shares could be identified. Further work could explore the relationship between the BEV share and other city characteristics such as the age distribution and the fraction of the population with higher education. It would also be interesting to explore further possible relationships between attitudes to the environment and the BEV share.

DISCUSSION

Whilst the penetration of electric vehicles is low, their share of the UK car parc is accelerating fast. However, it is clear from this study that rates of adoption vary dramatically across the country. For example, the adoption rate is twelve times greater in Wandsworth than in the lowest ranked city, Kingston upon Hull.

The UK government has long recognised that incentives are required to speed up the transition from ICE to electric vehicles and following the announcement of the 2030 deadline for phasing out sales of new petrol/diesel vehicles it has pledged to invest over £1.8 billion in infrastructure and grants. However, this analysis suggests there may be a need to target incentives and investments regionally in order to prevent a 'green gap' from emerging whereby wealthier parts of the country are able to enjoy the benefits of EV ownership – including cleaner air – sooner than others.

As an example, there is a positive correlation between the number of EV charging points and electric vehicle share, suggesting that local authorities should be redoubling their efforts to invest in charging infrastructure in order to drive more widespread adoption. This may require regionally targeted support from central government.

The existing government Plug In Grant for low emission vehicles currently offers 35% off the cost of the vehicle, up to a maximum of £3,000. With electric car prices starting at around £17,000 Halfords believes the grant is insufficient to encourage less well-off households to make the switch to electric.

What this research shows is that a more targeted approach to EV incentives may be required if the whole country is join the green transport revolution. This may mean introducing an element of regional targeting and means testing.

The launch of Green Number Plates ON December 8 presents an opportunity for local authorities to implement incentives designed to stimulate EV adoption, such as free entry into designated zones, use of bus lanes, and free parking. Again, there may need to be additional investment in certain parts of the country in order to level up EV adoption.

ANNEX – LIST OF DATA SOURCES

National Travel Survey data

National Travel Survey data can be obtained from the UK data service:
https://beta.ukdataservice.ac.uk/datacatalogue/series/series?id=2000037
(accessed 30/10/20).

Vehicle Statistics Data

https://www.gov.uk/government/collections/vehicles-statistics
(accessed 30/10/20).

BEVs by quarter and local authority:	Table VEH0132b
ULEVs by quarter and local authority:	Table VEH0132a
Total vehicles at end of 2019:	Table VEH0105

Population Data

https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland

Household Income Data

England and Wales:
https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/smallareaincomeestimatesformiddlelayersuperoutputareasenglandandwales

Scotland and Northern Ireland:
https://www.averagesalarysurvey.com/

Voting Data from 2019 General Election

https://commonslibrary.parliament.uk/constituency-data-election-results/