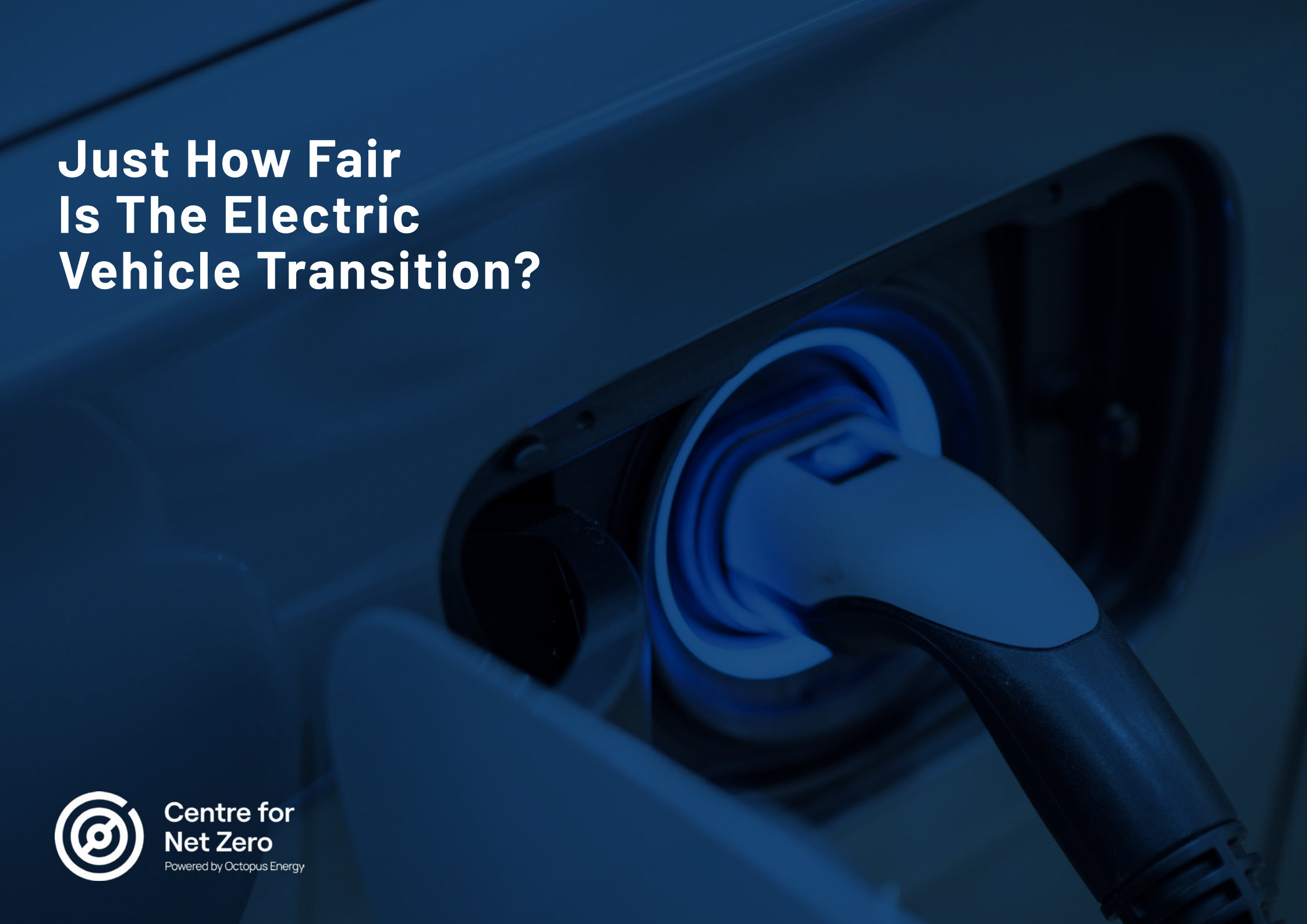
Just How Fair Is The Electric Vehicle Transition?



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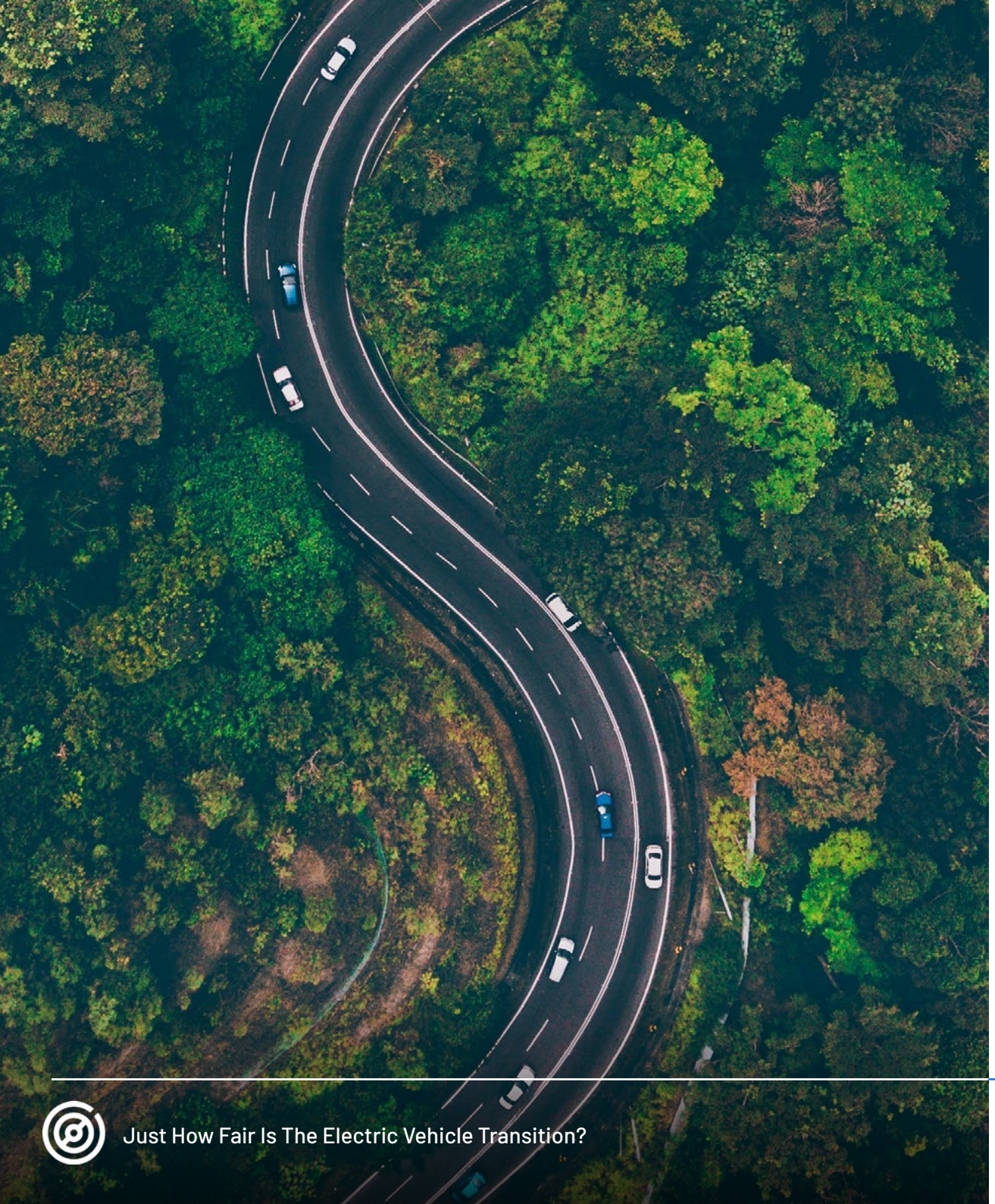


Introduction

Centre for Net Zero is building an agent-based model (ABM) for the energy transition to identify faster, fairer and more affordable paths to net zero. The first release of our simulation will inform a consolidated research paper to be published in November 2021. Ahead of this paper's release, we are publishing a series of interim research findings to share our learnings as we leverage our access to Octopus Energy data, and other public datasets and research, to develop the simulation in full.

These research findings provide a unique insight into current domestic energy behaviours and help improve understandings of expected future behaviours. In creating our ABM, we want to discover how a diversity of actors within the energy landscape make autonomous decisions that affect one another and influence the behaviour of the overall system. These insights will enable decision makers to take faster, bolder and more equitable climate action.

Key findings

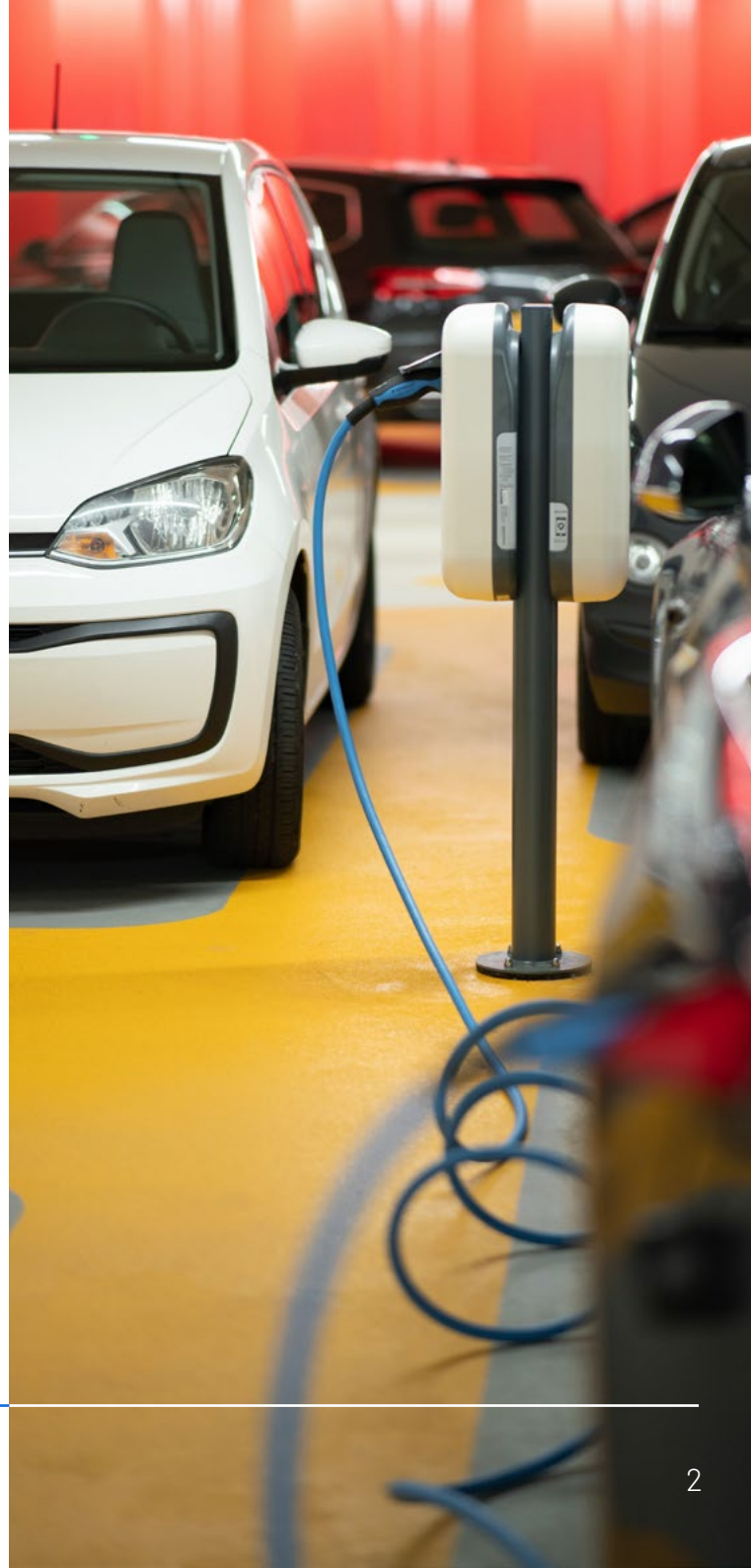
1. **Inclusivity is not a "nice to have". It fundamentally underpins public and political support for the net zero agenda.** Affordable and convenient private mobility is not, and should not, be limited to the middle-class or other privileged groups. While public and active transport undoubtedly have a larger role to play, they cannot meet the needs of all society.

2. **Prices for new electric vehicles (EVs) are 40% higher than average car purchase costs, with the vast majority of EVs sold costing upwards of £25,000**. While the Government's plug-in grant is welcome, it does not bridge the gap between EVs and traditional cars. Whilst this gap does not need to be closed in the long-term, grants must catalyse enough demand to encourage costs to fall quickly - known as a 'learning curve', whereby technologies become cheaper as they achieve scale. This has been widely documented in solar and wind generation, where unit costs have fallen rapidly over the past two decades.

3. **The establishment of a second-hand market for EVs will be critical to achieving a just transition.** Analysis of the Nissan Leaf shows that second hand prices can be 25-65% lower after two to five years. However we estimate that it will be 2024 at the earliest before 1% of UK cars are second-hand EVs. We need more monitoring and research into this nascent market.

4. **The low cost and convenience of charging at home is far from universal.** 8 million homes do not have access to off-street parking. But to date, the government has subsidised 200 off-street chargers for every one public on-street charger. Areas with the highest levels of deprivation show 80% lower take up of off-street charging than the most affluent areas. The issue also affects fleet operators where vehicles are parked at employee homes overnight. There are important roles for government and industry in tackling this.

5. **Fairness must not solely be about economic or regional issues.** There is thankfully growing interest in ensuring that EVs and their charging infrastructure work for a diversity of people, setting standards for charging methods and infrastructure that drives forward genuine inclusivity.



Why inclusivity is not a 'nice to have'

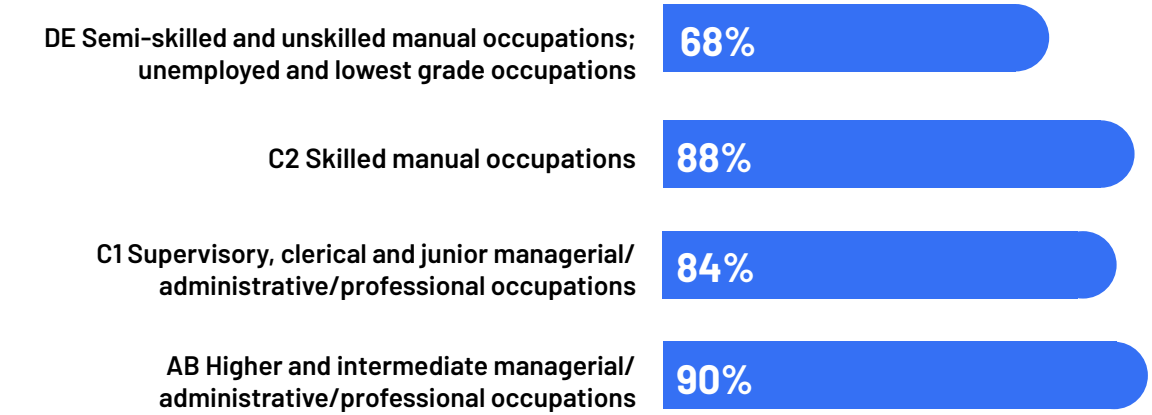
The UK's 40 million cars and vans generate 19% of its territorial greenhouse gas emissions. They also contribute to air quality, where UK levels of NO2 exceed safe levels in many regions, particularly the most deprived.

The Transport Decarbonisation Plan, published earlier this year, set out a vision of improved public and active transport, and while there is uncertainty over long term rates of car ownership, in all scenarios millions of electric vehicles will be required to decarbonise the way we move around.

The EV transition is beginning to gather pace, with more EV registrations in the last year than in all the time before that. However, the perception is often that electric cars are for middle class people who can afford them.

This is not what we want or need; cars are not currently the preserve of the middle class. While those in social groups DE are less likely to own a car, almost half (47%) of those with access to cars have manual professions or are unemployed (ONS groups C2 and DE).

Access to a car or van by social grade (2011)



Source: CNZ analysis of 2011 Census data for England & Wales

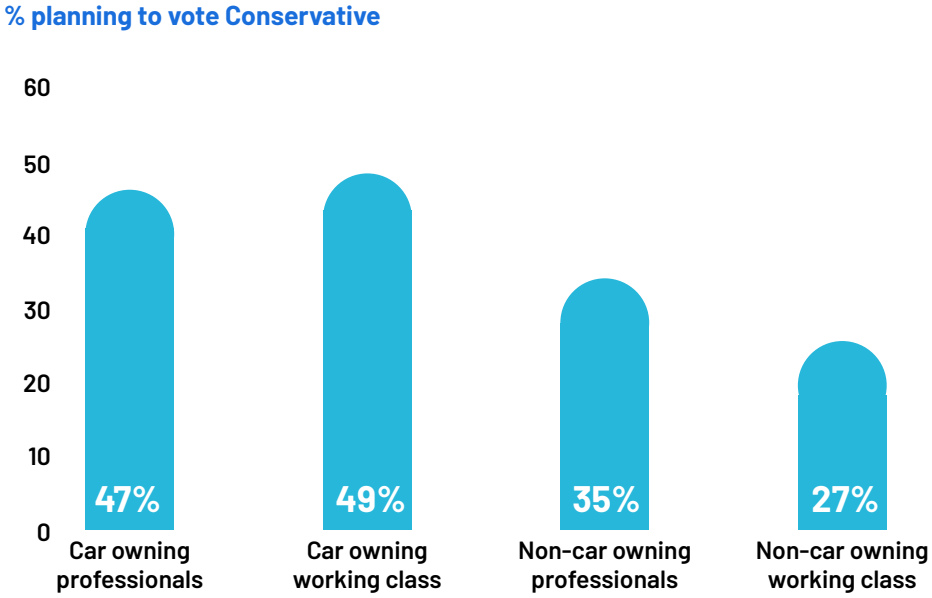
To make a significant reduction in carbon emissions we need people to give up their petrol and diesel vehicles en masse. To this end, the UK government committed in 2020 to ban sales of new petrol and diesel cars from 2030 and hybrids from 2035.

Fuel duty generates £28bn per year for the UK government, around 4% of total tax revenue. Levels of fuel duty have been frozen for more than ten years. As more vehicle owners transition from buying petrol and diesel to electricity, the UK government will come under pressure to recoup this lost revenue, possibly through increases in petrol and diesel prices, road pricing or a new tax on EV users. Already 'low emission zones' are starting to apply different charges for conventional and electric vehicles, with the risk that those penalised most heavily cannot afford, or do not have the flexibility, to change.

Across personal mobility, air quality and taxation there is clear potential for the EV transition to exacerbate existing inequalities in society.

Significantly, car ownership is a politically sensitive issue and any perceived unfairness has the potential to undermine political consensus and prevent wider progress in decarbonising transport and other sectors. As noted by Opinium, car ownership is a better indicator of voting intention than traditional measures such as occupation.

Two major hurdles to a more inclusive transition are i) the high up-front costs of electric vehicles and ii) challenges in charging electric vehicles conveniently and cheaply for households without off-street parking. While the former is the focus of this paper, we will return to the latter over the coming weeks.

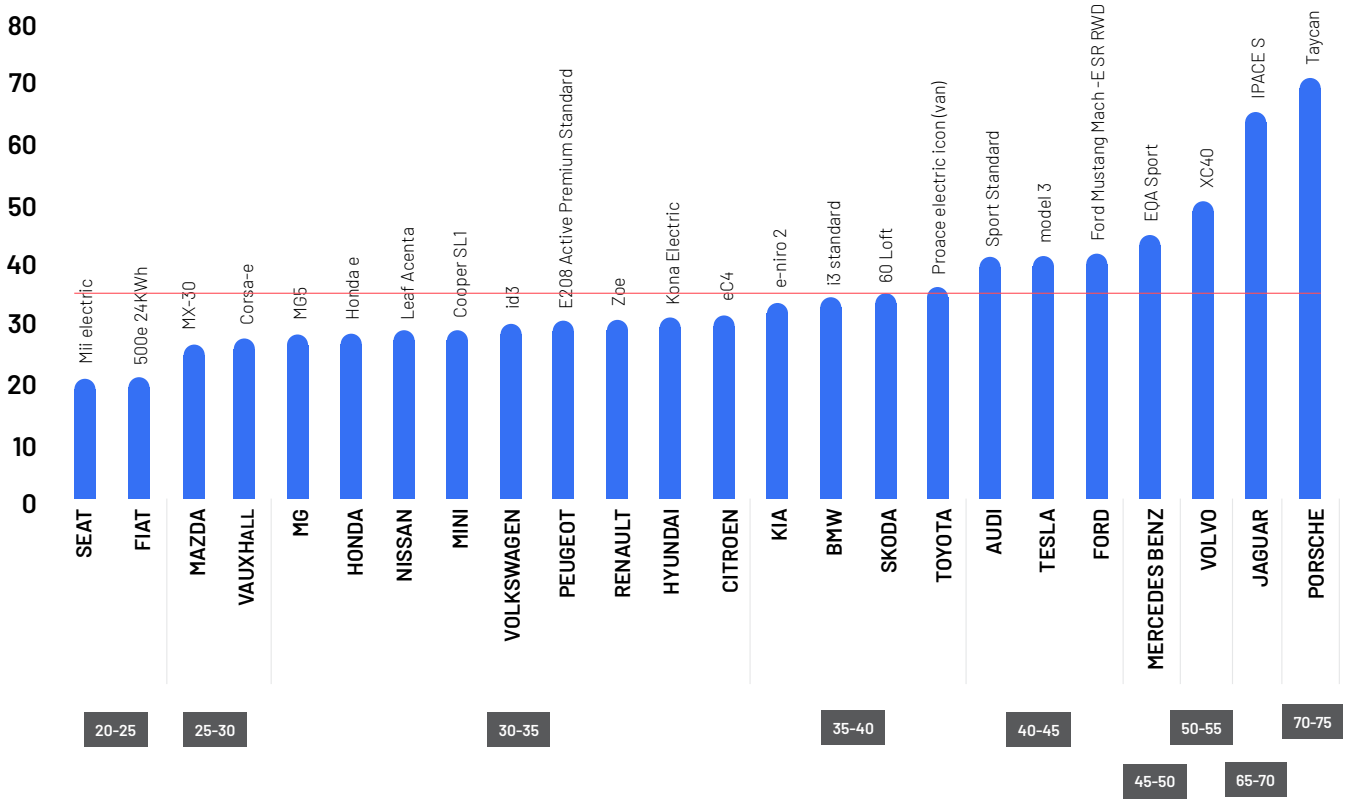


How much is an EV?

Electric vehicles are already at, or near, the point where they are cheaper over their lifetime than a petrol or diesel vehicle. Nonetheless, the higher upfront purchase cost remains an important barrier to adoption, particularly for low income groups who may not be able to afford the outlay or qualify for cost-effective financing.

There are already more than 50 EV models available to UK drivers, resulting in no single cost for an EV. Based on registrations of new EVs over the past three months, we estimate that people have paid at least £1.4bn for 41,000 EVs over that time, at an average weighted cost per vehicle of £34,245. These estimates are based on the cheapest model available for each brand, so costs will be higher in reality. The models we used in our analysis are presented on the right.

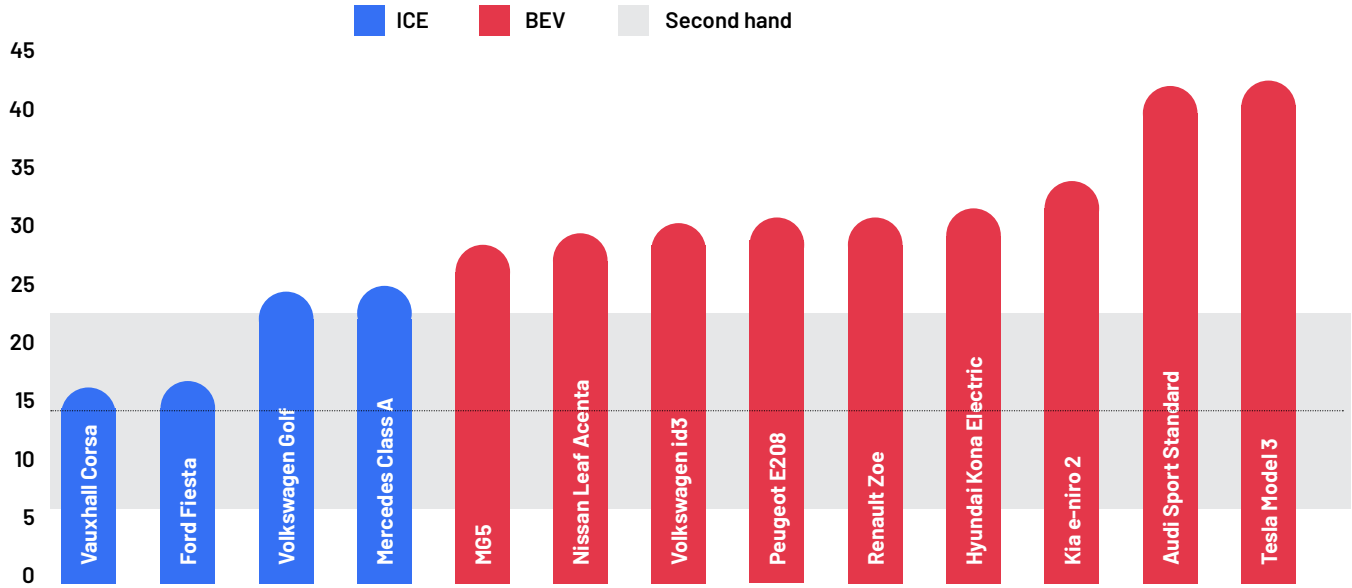
Car price ranges for different brands £k



While there are EVs available for £20,000 today, the most popular brands are not the cheapest. On the right we present the prices of the most popular BEVs and ICE cars being registered now along with the range of prices being paid for second-hand ICE vehicles.

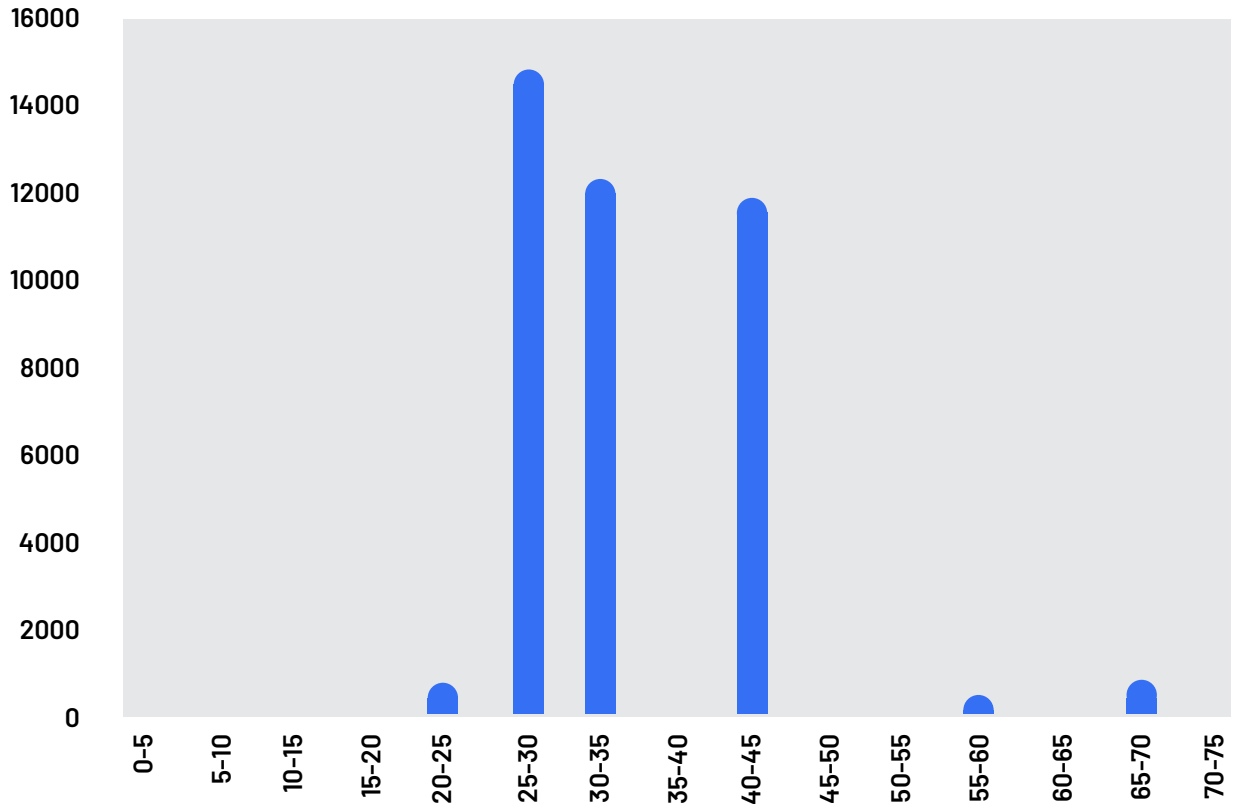
In the last three months, the BEV vehicles in the graph on the right have sold almost 31,000 units out of the total 41,000 (75% of the total). All these BEV models present higher prices than the on-the-road (OTR) costs of the most popular ICE vehicles. The second-hand market in the UK presents a wide range of prices, but the gross of vehicles sold in this market present prices between £5,000 and £20,000 with a median price of £12,000. It is evident that BEVs present higher up-front prices. Only the cheapest, most popular BEV models are close to these prices, but even with the help of the plug-in grant, BEV prices are higher than conventional ICEs. In fact, the majority of sales in the last quarter are concentrated around the £25,000 to £30,000 range if we consider that the cheapest model available has been sold for each brand.

Most popular ICE and BEV vehicles and second hand market ranges in £k



We have also considered the cheapest (OTR) costs for ICEs in this analysis, but in reality this price gap might be even higher since the price differential between models is larger in BEVs - mostly as a result of battery costs to increase drive range. Batteries will get cheaper, but are there any other mechanisms that can reduce BEV prices so these are more affordable for the less affluent consumers? The second-hand market might be the solution for many in the UK. Next we explore the state of the market today and how it is expected to grow in the future.

Number of BEV sales in each price range in £k



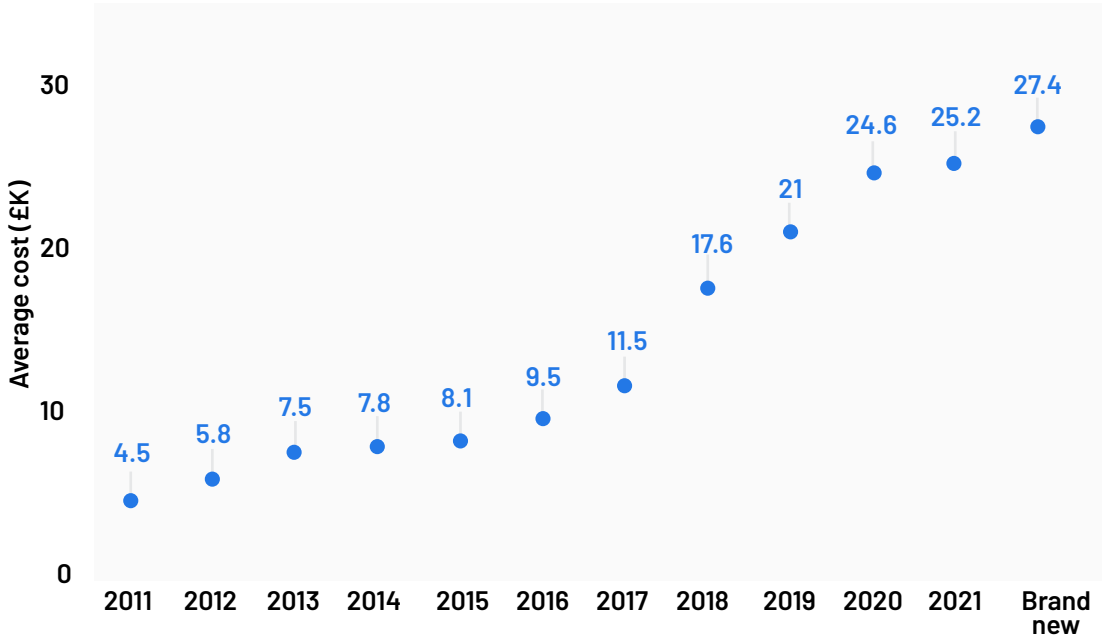
Is the second-hand market the answer?

The higher costs of electric vehicles prevent many consumers from considering them. Does the emergence of a second-hand market represent an opportunity for consumers that want to purchase a BEV but cannot afford it to date?

Despite the growing number of EVs being sold, they still make up the overwhelming minority of cars on the road. Looking at data from Autotrader, we found 350,000 second-hand ICE cars for sale, versus 4,100 BEVs and 4,700 plug-in hybrids. This number of vehicles is insufficient to provide a wide range of alternatives for buyers who might be looking for a specific model, appropriate battery range, appearance or location [Ref 1, Ref 2, Ref 3].

Looking again at Autotrader, we considered how costs fall over time based on analysis of 788 Nissan Leafs being offered for sale in September 2021. In the graph we can see significant cost reductions over time - 25% after two years and 65% after five years - though it should be noted that battery capacity levels on older vehicles are lower (particularly from 2017 for the Nissan Leaf). Moreover, studies have shown that battery efficiency can drop by 30% between 5-13 years, increasing costs per mile. So, while up-front costs of second-hand vehicles could be substantially lower, this may be partially offset by higher range anxiety and running costs.

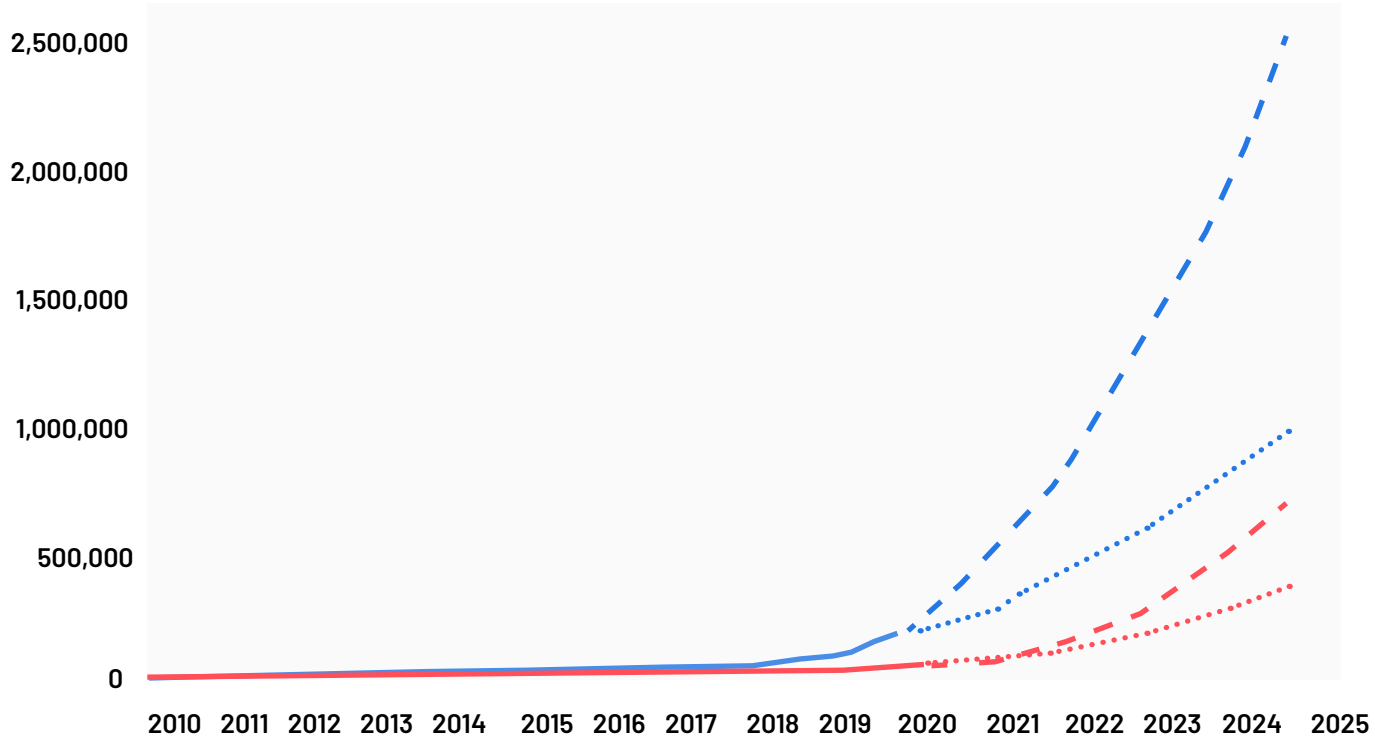
Estimated cost of a Nissan Leaf



In spite of the efficiency reduction, a study conducted by Element Energy for the European Union claims that second and third-hand BEV owners can benefit from TCO reductions of up to €9,000 over ICEs. The main constraint is the number of BEVs.

There appears to be a dearth of data and research into the dynamics of the second-hand EV market. Addressing this should be a priority. In the absence of much data, below we talk through a basic analysis of how the number of second-hand EVs may evolve. We took historic sales of new EVs to estimate the number of cars on the road. Then we applied an assumed rate of sale for these vehicles, based on DfT statistics for the entire UK car fleet. For simplicity we assumed that a car being sold doesn't affect its likelihood of being sold again. We used National Grid's Future Energy Scenarios to inform the high and low scenarios for new BEV sales. As might be expected, growth in second-hand EV availability is delayed relative to new car sales - by around three to four years.

First-owner (blue) and second-hand (orange) BEVs



Batteries use rare-earth elements, such as nickel, cobalt and lithium, whose extraction is very polluting and endangers the environment. Even though life long battery emissions are decreasing, there are concerns about the future uses of these batteries and how this might affect the environmental impacts of BEVs. Second life EV batteries are being considered as a viable alternative to reduce this environmental pressure and the second-hand BEV market can potentially contribute to this end.

Finally there is the issue of consumer confidence in the second-hand EV market. Where 'miles on the clock' has served as a proxy for degradation of ICE vehicles, potential degradation of batteries in BEVs can be more complex, with a range of factors that can impact battery capacity and efficiency such as charging patterns, temperature and use. We need to establish appropriate standards to ensure that people can understand the battery health of used electric vehicles. The UK government is already considering this issue and their delivery plan to 2035 emphasises the need for battery health monitoring.

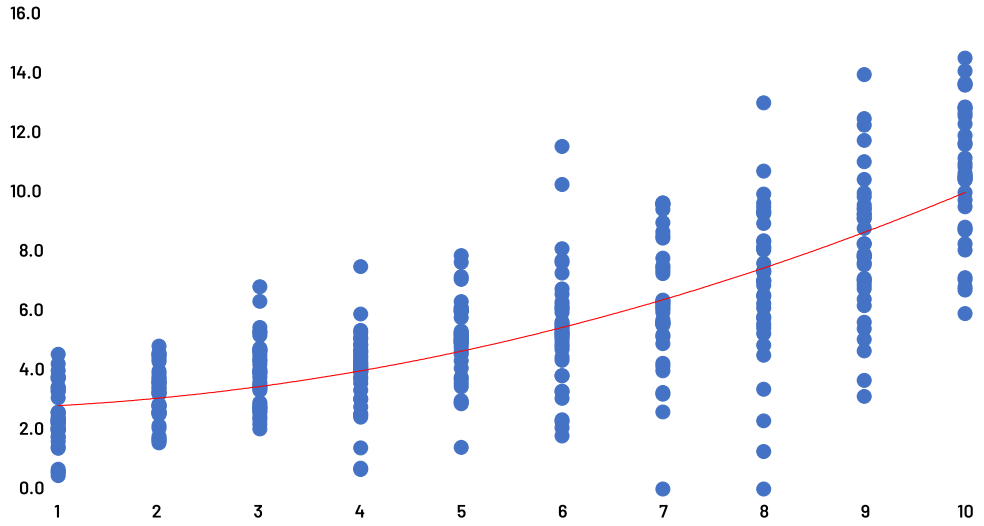
On and off-street parkers - the new dividing line?

The previous sections highlighted the importance of range and battery performance for the final consumer. These factors play a fundamental role when considering purchasing one BEV or another. Recent studies have also confirmed that the number of charging stations and the price paid for the electricity to fuel electric cars are also key elements that influence the take up of electric vehicles.

Access to charging stations is a critical factor in a fair and just transition. Approximately 140,000 charging points have been installed in private, off-street parking spots whereas only 25,000 public charging points are found in 15,000 locations across the country. There are more than 7.8 million households in the UK without off-street parking available who would need to have accessible, affordable and appropriate on-street charging stations to consider BEVs as an alternative to conventional ICEs.

The situation at the moment is not promising. We have done an analysis using the Electric vehicle charging device grant scheme statistics released by the Government in July 2021 to compare off-street charging grants by local authority with deprivation statistics in England, Wales, Scotland and Northern Ireland. The results show that highly deprived areas, where the index of multiple deprivation (IMD) is close to 1, have 80% fewer domestic charge points per 1,000 households than the least deprived areas. It is clear that there are social and economic factors that are prompting more off-street charging devices to be installed in more affluent areas. Targeted policies and measures to incentivise the installation of these devices in more deprived areas to ensure a fair transition have to be put in place in light of the results shown.

Domestic charge points per 1,000 households vs index of multiple deprivation (IMD) in the UK

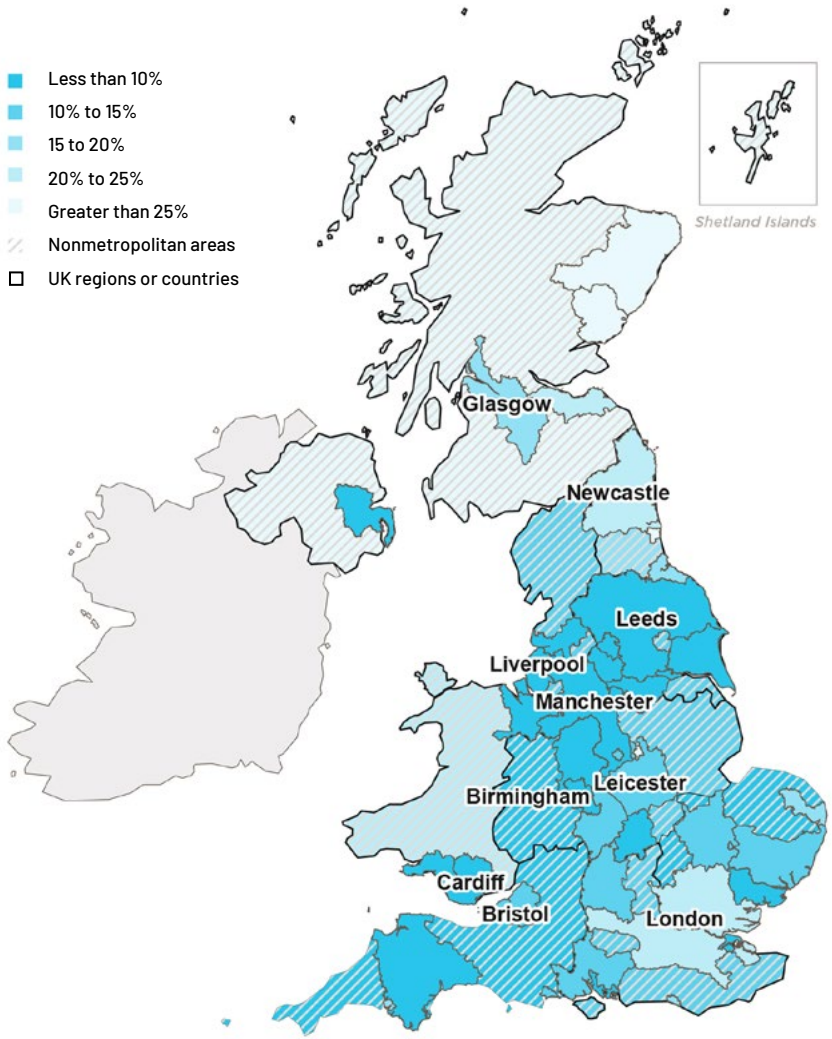


The on-street charging catchment presents its own hurdles: only 10% of households without off-street parking have a public charging point within a five minute walk. Local authorities are not specifically obliged to provide charging points to their residents. There are on-street grants available, but as of January 2018 only five councils in the whole of the UK had applied for the On-Street Residential Charge Point Scheme and to date, 200 off-street charging points have been installed per every on-street charging point in the UK. This possibly reflects the lack of clarity among local authorities in their role in supporting the BEV transition. As a response to this, the Government has committed to deliver more webinars and a support pack to Local Authority delegates to enhance their response towards the green transition.

A study conducted in 2020 by Nicholas and Lutsev pointed out that the charging infrastructure network needs to grow proportionally to the expected growth of BEVs in the UK, especially after banning ICE cars by 2035. They show different regions in the UK and illustrate the proportion of charging infrastructure they had in 2019 in regards to the total expected in 2025, as shown in the figure on the right. If this situation does not change, there won't be enough charging points for the larger part of the population who do not have access to off-street parking and depend on public, affordable charging stations to change their ICE vehicles to BEVs.

Some alternatives, like Fleetcharge, are easing this gap by creating new business models where private parking charging stations can be shared. More initiatives like this will hopefully increase opportunities available for drivers who do not have access to off-street parking.

Charging infrastructure in 2019 as a percentage of that needed by 2025



Fairness isn't just about economic and regional inclusion

It is quite common to view fairness in economic or regional terms. However it is also important to consider fairness through other lenses, including people who are at a disadvantage as a result of their age, physical and mental health or education.

These vulnerable groups should not be ignored, since they are as likely to need an EV as any other resident in the UK - and in the case of some physical disabilities - more likely. Drivers with vulnerabilities are confronted by the same hurdles when switching to BEVs, including high up-front costs, range anxiety and limited access to charge points. In addition to these, some other barriers are more specific to vulnerable groups, including manoeuvring and connecting the cable in the car and the socket, wheelchair accessibility in the charging bays, complex payment and set-up methods to charge the EV, lack of awareness and proper information and scarcity of on-street parking within an acceptable range from the household.

Although there is currently a clear gap in the literature in regards to vulnerabilities and EV adoption (only a couple of scientific references here and here), several organisations in the UK are giving voice to these groups of people who must not be left behind.

In their joint research paper with Ricardo, Motability estimated that there will be 2.7 million disabled drivers or passengers by 2035, with 1.35 million expected to be partially or wholly reliant on public charging infrastructure. As a response to this, Motability and Designability have partnered together to explore different solutions that different vulnerable groups might find helpful in transitioning to EVs. Indeed, a survey conducted by Urban Foresight concluded that 61% of disabled people would consider getting an EV today if charging was more accessible, compared to 25% without those changes.

Distribution network operators are also looking into these issues and are funding different projects to analyse and address the specific needs of the most vulnerable in the regions these companies operate. Examples include Enable, Smart and Fair?, and SSEN equal Electric Vehicles.

These projects should have a significant influence on the way the transition is planned. DfT recently announced that it has commissioned the British Standards Institute (BSI) to develop the standards for EV charge points across the country by 2022. In partnership with the Office for Zero Emission Vehicles (OZEV) and Motability, the project will develop consistent infrastructure standards including adequate space between bollards, suitable height for wheelchair users and size of the parking bay and kerb height.

Conclusion

The transition from fossil-fuel to electric vehicles is gathering pace, fuelled by the adoption of the affluent middle classes. As one of the most visible and emotive elements of the public's net zero journey, inclusivity is especially important. Any perception of unfairness risks undermining support for bold decarbonisation action.

Prices for new EVs are currently significantly higher than most people pay for their cars. Over the next 5-10 years new EV prices are expected to reach parity with those for new ICE cars, with mass-market affordability further bolstered by a significant second-hand market. While much has been written about the former, we believe there is a need for more monitoring and research to ensure the emergence of a vibrant and inclusive second-hand market.

As it stands, 8 million UK households - without off-street parking - cannot benefit from the low cost and convenience of charging at home. This risks becoming a fault line which slows the transition of individuals and businesses and creates resentment between groups. While there is no obvious silver bullet, we are pleased to see the recent actions of local government and industry in finding and exploring creative solutions. We believe that more empowered local authorities, with clearer expectations from central government, could bolster the disappointing take up of the On-Street Residential Charging Scheme.

Finally, while fairness is often conflated with individual affordability and regional disparities, we support recent efforts to ensure people with disabilities are considered in the design of electric vehicles, charging infrastructure and supporting services. We hope to see this translate into a more accessible EV industry which everyone can engage with confidently.

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