

Charging ahead!

The need to upscale UK electric vehicle charging infrastructure

April 2018





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Recently, the global electric vehicle (EV) fleet passed a milestone when the total number exceeded two million vehicles.¹ While this remains a very small percentage of the overall passenger light duty parc (0.2%), the number of EVs has grown dramatically since 2010. The UK is witnessing a similar growth story. Since 2012 the EV stock has grown at nearly 100% compound annual growth rate (CAGR). In other words it is doubling year-on-year, albeit from a low base. The UK government is also making EV development a priority. It has proposed legislation to support EV adoption, it is funding incentives for EV purchases and in the Autumn 2017 Budget announced more spending on charge points. Mounting concern about air pollution is further driving policy to support the adoption of this technology.

However, based on the findings of our research, a number of significant challenges are emerging that could stymie the growth of EVs in the UK.² This report highlights four pinch points which, if unaddressed, will constrain EV adoption rates in the UK:

- the need for residential power grid reinforcement and / or the deployment of smart technologies to support home charging
- the need to support EV adoption rates in cities by upscaling public charging infrastructure
- the need to improve BEV (battery electric vehicles) sales through lower vehicle prices and increased availability of public charging
- the need to educate the public on home charging and the economic benefits of EVs to boost BEV sales

Ultimately, we believe a road map needs to be agreed by government and industry leaders to provide a framework for the roll-out of the charging infrastructure the country needs. This will offer much needed confidence to the sector and drivers. If the UK is to be a world leader in new automotive technologies and wishes to pioneer the transition to a low carbon economy, delivering this road map will be critical. Failure to do so could undermine the momentum of EV adoption rates.

¹ In this paper the term, Electric Vehicles (EVs), refers to Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).

² Our survey consisted of interviews with over 1,000 respondents across the UK who were vehicle drivers (from internal combustion engine to EVs). The survey was undertaken by [PwC Research](#), our in-house team for primary research.

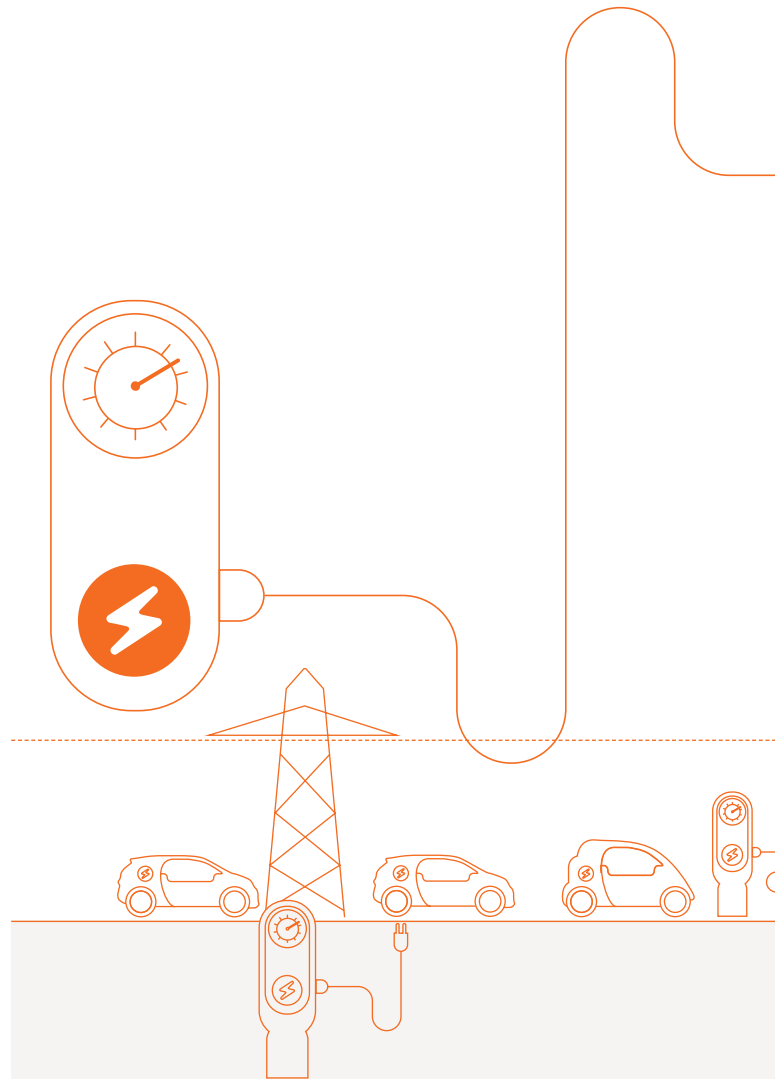
Low carbon policies are gaining momentum

In recent months there has been a flurry of high profile announcements from industry and government, illustrating the push towards a low carbon economy.

The UK government followed in France's footsteps declaring the sale of new petrol and diesel cars will be banned by 2040. Oxford city council stated it was consulting on plans to ban diesel and petrol cars from the city centre by 2020. The Scottish government has gone further, pledging to phase out new petrol and diesel vehicles across Scotland by 2032. Volvo announced it would only manufacture electric or hybrid vehicles from 2019. Other automotive manufacturers have since followed suit, including Volkswagen which plans to invest some \$12bn by 2025 to develop and manufacture battery electric and plug-in hybrid vehicles.

The UK government has also reaffirmed its commitment to "develop one of the best electric vehicle charging networks in the world."³ In June 2017 the government announced the introduction of the Automated and Electric Vehicles Bill which will set requirements for the provision of charging points. This was followed by the Autumn 2017 Budget where the Chancellor of the Exchequer pledged £400m for a national charging network, £100m to a grant for plug-in-hybrids and £40m for research into creating new technologies for electric car charging. Government support for electric vehicles was further reinforced in early 2018 with the announcement of the Automotive Sector Deal, which prioritises the development of electric power trains.⁴

As for business, responses depend on whether the impact of EVs is part of their core or non-core operations. With regard to the former, both Shell and BP are planning to install charge points across their UK retail networks. Shell has also acquired an EV charging infrastructure operator, NewMotion, is partnering with Ionity (a venture between German automotive manufacturers) for super fast highway charging, and is considering opening a 'no petrol' service station in London in 2018. In terms of non-core operations, Southern Rail has begun an upgrade project of its free-to-use EV charging point network, installing them at key stations.



³ The Clean Growth Strategy: Leading the way to a low carbon future, October 2017.

⁴ Industrial Strategy, Automotive Sector Deal



UK public charging infrastructure is lagging behind EV stock growth

In recent years the EV stock in the UK has grown rapidly. As illustrated in Figure 1, the total number of BEVs (battery electric vehicles) and PHEVs (plug-in hybrid electric vehicle) reached 86,000 in 2016, split 34% and 64% respectively and overall representing about 1.4% of the UK vehicle fleet.

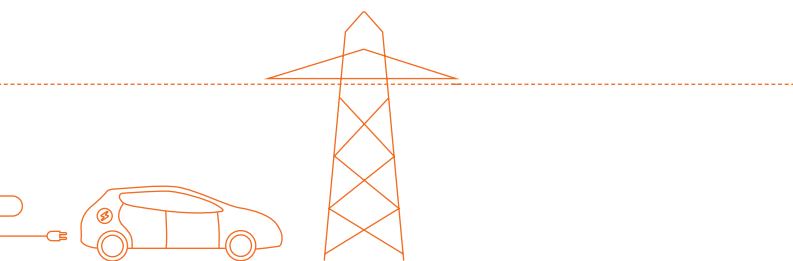
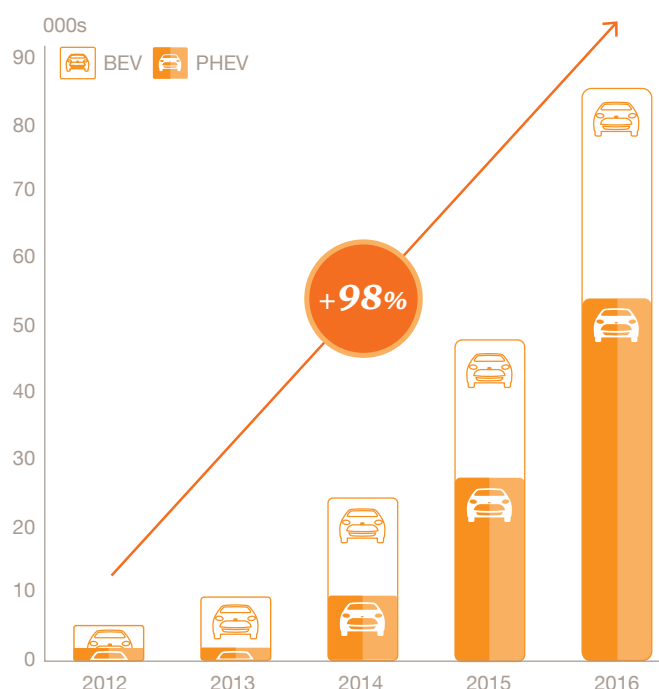
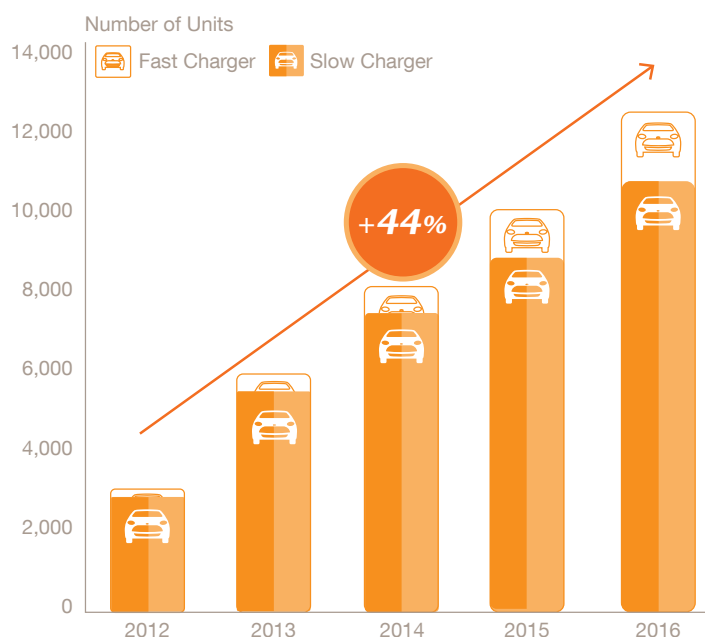


Figure 1: BEV / PHEV Stock for UK
2012 – 2016



Source: IEA Global EV Outlook 2017

Figure 2: Publicly Accessible Slow / Fast Charger Stock for UK 2012 – 2016



Source: IEA Global EV Outlook 2017

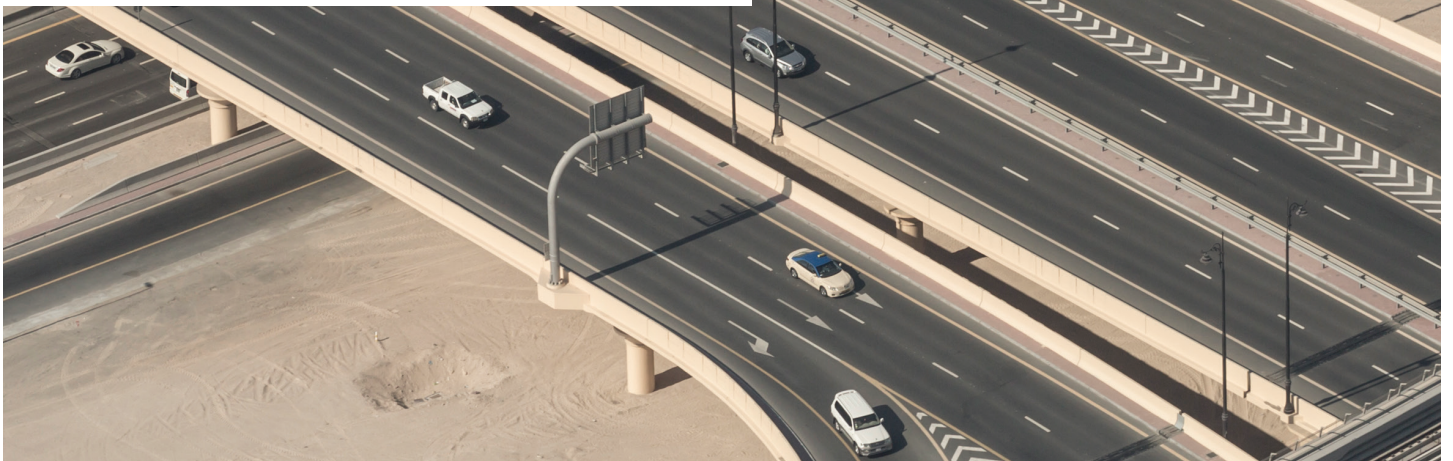
As for public charging infrastructure in the UK this too has been evolving quickly, but not at the same rate as the EV stock. The importance of having this infrastructure in place cannot be over-emphasised. In the UK, infrastructure is growing at 44% CAGR with a focus on slow chargers and with over 12,000 total charging points in 2016, as depicted in Figure 2.



So what were the key findings of our research?

We interviewed over 1,000 respondents who were vehicle users, covering internal combustion engines (ICE) and EVs, across the UK. Based on our PwC proprietary research findings we identified a number of ‘pinch points’ with regard to charging infrastructure. These are summarised in the following pages.

1. Home charging infrastructure – the need for residential power grid reinforcement and / or the deployment of smart technologies
2. Public charging infrastructure – the need to support EV adoption rates in cities
3. BEV sales – the need to improve sales through lower vehicle prices and availability of public charging
4. BEV sales – the need to educate the public on home charging and the economic benefits of EVs



1. Home charging infrastructure – the need for residential power grid reinforcement and / or the deployment of smart technologies

What our data said



Irrespective of vehicle type, the **majority of drivers in the UK have off-street parking at home**



Homeowners are the largest share of vehicle drivers

78% of them have access to off-street parking⁵



Moreover, while BEV drivers plug in to charge throughout the day at different locations, the **most common group**

35% charge at home (off-street) and typically between 5pm – 8pm

The pinch point

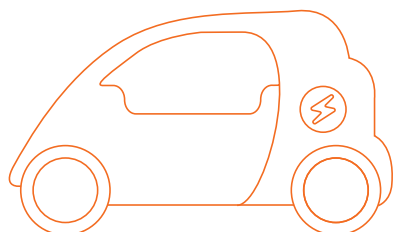
If home charging is to become the norm across the length and breadth of the UK, one big thing will be needed: a step-change in the capacity of residential power grids so they can handle expected peaks in electricity demand.

Our research shows that people who currently own BEVs show a clear tendency to plug their vehicles in a three hour window at the end of the day (see findings, left). Assuming that habit continues, then we will need more residential grid reinforcement to cope, or alternative solutions to smooth peak demand.

While there is a high level of access across UK vehicle drivers to off-street parking – making home charging convenient – any failure to reinforce power grids for residential charging generally could act as a brake on EV adoption rates.

As EV users are likely to rely heavily on home charging, with its inevitable impact on the residential distribution load, charging in the workplace will also need to be expanded.

Finally, as more and more EV drivers charge their vehicles at home, it will be important to use commercial incentives, such as differential pricing, and demand-side response technology and vehicle-to-grid (V2G) services to smooth electricity consumption.



⁵ Our survey targeted only vehicle drivers across the UK, as opposed to the general public. Moreover, we segmented vehicle drivers by residential status, ranging from homeowners to council tenants.

2. Public charging infrastructure – the need to support EV adoption rates in cities

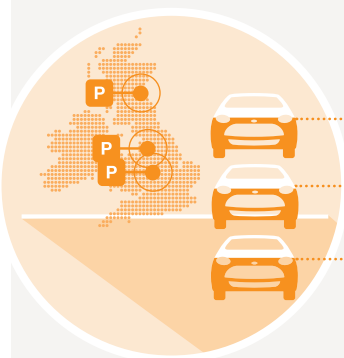
What our data said



Availability of off-street parking is lower in cities, particularly in London



In London, only **48%** of vehicle drivers have off-street parking compared to the UK average of 72%



Other major UK cities have similar challenges, where levels of vehicle drivers with access to off-street parking range from

61% in Edinburgh

61% in Cardiff

65% in Manchester

The pinch point

Cities will be key to driving EV adoption rates, as air quality issues will underpin policies to promote EVs. Moreover, urban use patterns are well suited to the (current) lower range of EVs versus ICE and hybrid powertrains.

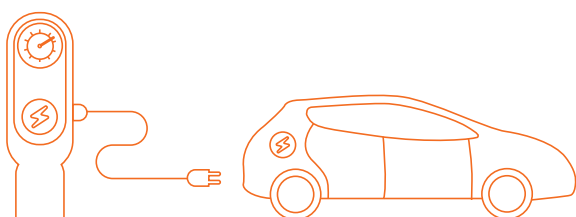
Yet EV adoption rates in cities could be held back due to an inadequate public charging infrastructure.

While homeowners across the UK typically have access to off-street parking, that's not the case when it comes to cities. In London only 48% of off-street vehicle drivers have access to parking, compared with a national average of 72%.

This means that public charging points are going to be critical in cities.

According to the International Energy Agency, “early EV market developments show that the availability of chargers emerged as one of the key factors for contributing to the market penetration of EVs.”⁶ Hence, it is critically important that public charging infrastructure is in place in major cities across the UK to stimulate EV growth.

Collecting data on charger usage, both public and private, has a role to play here. Not only can data help utilities better manage power flows across the grid, but these data can also help inform EV infrastructure operators on where further investments in public charging need to be made.



⁶ IEA Global EV Outlook 2017

3. BEV sales – the need to improve sales through lower vehicle prices and availability of public charging

What our data said

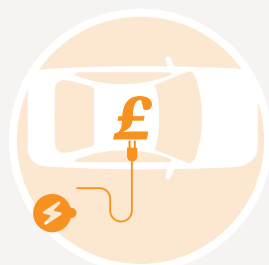


Of those ICE vehicle drivers surveyed,
60% said they had not considered
a BEV when they last chose a vehicle



As for the reason why they had not
considered a BEV, the number one
ranked reason was initial price

32%
with the availability of charging
22% a close second



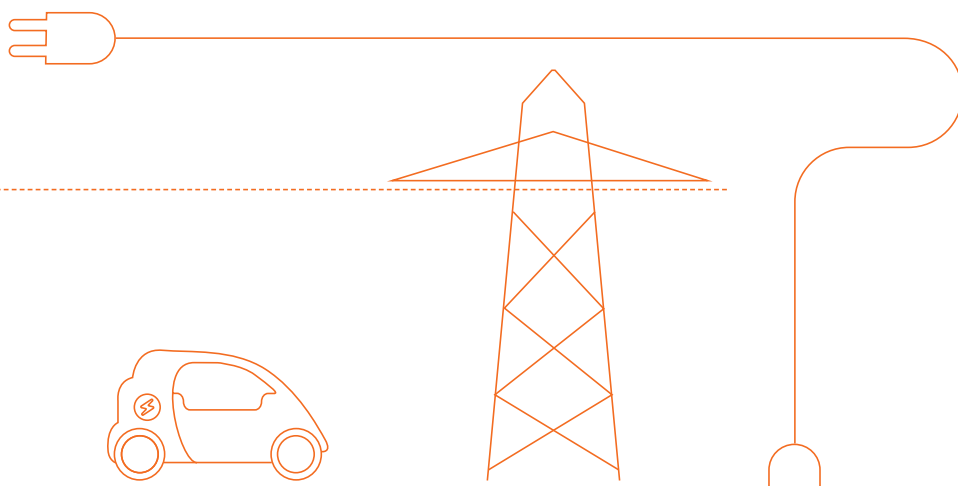
But on the whole
51% of respondents ranked
'initial price' and 'availability of charging'
separately as their number one or number
two reason why they had not considered
acquiring a BEV

The pinch point

Concerns about the initial price and
the availability of charging remain the
most important reasons discouraging
ICE vehicle drivers from acquiring
a BEV.

While the range of BEVs on sale is
broadening, prices need to come
down further if they are to appeal to a
bigger audience of ICE vehicle drivers.
Further falls in battery costs will be
extremely important.

Our research suggests that the
crossover point in terms of Total
Cost of Ownership (TCO) will favour
BEV over ICE by 2025 for most
driving patterns.⁷



⁷ Strategy& – *Fast and Furious*: Why making money in the roboconomy is getting harder, 2017

4. BEV sales – the need to educate the public on home charging and the economic benefits of EVs



Among ICE vehicle drivers, tellingly the highest level of response to our question ‘Who installs charging at home?’ was

Don’t know’ with **22%**
People are, quite simply, not sure who to turn to



Other responses about ‘Who installs charging at home?’ were lower than **22%** and ranged across a host of other market participants



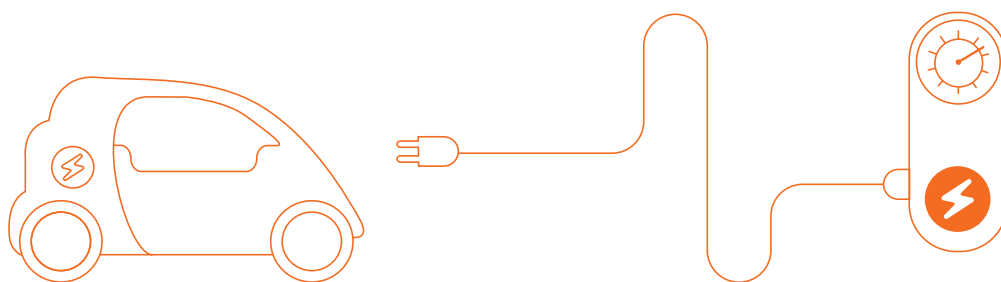
As for the running costs of BEVs, among ICE vehicle drivers, only **11%** responded that they would be comfortable evaluating the total cost of BEVs

The pinch point

If EV adoption rates are to accelerate, there needs to be more focus on educating potential buyers about their charging options and the economic benefits of EVs.

In our survey, ICE vehicles drivers generally did not know who actually installs charging infrastructure at home. There needs to be greater clarity around who is responsible for the provision of home charging infrastructure if more drivers are to switch.

Equally, no one is effectively educating the public on the economic benefits of EVs. As illustrated in our survey results, only a small number of ICE vehicle drivers (11%) felt comfortable evaluating the total cost of BEVs. To date, much effort has been focused on selling the environmental benefits of EVs and not enough on the compelling economics of driving an EV, most notably the significantly reduced running costs.



So what should government and industry do next?

Future adoption rates of EVs in the UK will be highly contingent on the evolution of the charging infrastructure, both public and private.

As highlighted in our research, there are several fundamental issues to address, from reinforcement of the residential grid and deployment of smart technologies, to the scaling up of workplace and public charging. There is an analogy worth making with the evolution of mobile phone networks. The revolution we have witnessed in the usage of smart phones would not have been possible if the mobile networks had not scaled up coverage and improved connection speeds. This in turn fostered competition and innovation across the sector. The EV revolution is likely to follow a similar path. Once EV infrastructure networks are upgraded this will pave the way for the private sector to innovate and create new products and services.

This is the type of challenge that one cannot expect market forces to address on their own – this is a classic case of a “public good” where markets require government help to get to the right answer. After all, there are a number of potential issues that may require some form of government intervention. For example, as demand for public charging infrastructure grows, who will pay for this increased investment? As fuel duty revenues wither away, how will the tax regime evolve vis-à-vis EVs?

What is required therefore, is a strategic road map to be developed by government and industry. This road map will clarify the type of charging infrastructure the country requires and where key investments need to be made across the power networks (transmission and distribution). It will also set a target roll out timetable and establish the commercial and regulatory framework. Moreover, aside from funding, there will need to be a strong educational element so that the benefits of EVs (environmental and economic) are made clearer to the public. Getting all of this right is important. EV infrastructure will enable the UK to take a leading role in new automotive technology developments, as well as pioneer the transition to a low carbon economy.

However, there will be risks. Given the disruptive impact of technology, it is not difficult to envisage a scenario where advances in inductive and dynamic EV charging make current technology and infrastructure investments rapidly redundant. Equally, as already referenced, how will the £25bn in fuel duty evolve over time? In sum, it is therefore critical to bring government and industry together to agree the way forward and plan a sustainable and comprehensive approach. Failure to do this might not only mean the ‘lights go out’ but the wheels could come off as well.



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*We would like to acknowledge the
valuable contributions made to this
report by Danny Clink and
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Design Services 31089 (04/18).