The Schumacher Institute

Is Bristol Prepared for its Electric Car Revolution?

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Executive Summary

Bristol aims to achieve 100% ultra-low-emission-vehicle (ULEV) coverage by 2050. With an estimated 200,000 cars and an already fragile transport ecosystem, how will Bristol approach this growth without burdening the city's infrastructure? Bristol's busy urban streets make home-charging difficult and a Baringa survey suggests up to 50% of the population will not switch without this option. On-the-move charging facilities are also scarce with one electric car charger for every 7,000 Bristolians. With electricity demand doubling in the next 30 years and an out-dated electrical grid, Bristol faces significant obstacles. This paper explores solutions to these challenges by observing capacity case studies from Norway, California and the Netherlands. This paper will also explore innovative experiments from lamp-post charging in Brighton, on-the-kerb charging in South London and wireless road charging in Sweden. Some solutions will work for Bristol and some will not, however, finding a balance and understanding the upcoming challenges is essential for a successful transition to an electric future. This paper concludes that there are many obstacles with considerable complexity. While achieving an electric transition will provide Bristol with many benefits, rushing its delivery will only lessen its success.

Introduction

Bristol has big ambitions. By 2027, the city aspires for 50% of all public vehicles to be ultra-low-emission-vehicles (ULEV). By 2041, 50% of all cars, and by 2048, all vehicles on Bristol's roads will be ultra-low emissions (BOCP, 2019). But what are the challenges that Bristol will face? This article will highlight capacity concerns and the actions the city can take to facilitate this revolution. This paper will explore smart city case studies, innovative technology, and economic principles to better understand the road-map ahead. By embracing example cities, such as Oslo, Bristol can remodel a future to blueprint the UK. Finally, this paper will assess the likelihood of Bristol reaching 100% ULEV prevalence, and more importantly, if this goal is even desirable.

Vehicle Capacity

Region (Population)	# of Vehicles Per Electric Charge Point
Rotterdam (635,389)	2 - 4
San Francisco (833,305)	5 - 7
Bristol (459,300)	7 - 8
Oslo (673,469)	24 - 26

Source – ICCT (2018), Zap-Map (2019)

An ICCT report states that there is no universal benchmark of charger-to-car ratio due to obvious variants in population density and demographics (ICCT 2018). However, it is insightful to observe other similar sized cities and their focus on ULEV capacity building. Rotterdam in the Netherlands and San Francisco in California have some of the highest charger prevalence. Without easy home-charging facilities, it is often necessary to support the city with a large volume of charge points. Oslo, however, can sustain over 38,000 ULEV cars with around 1,500 chargers. A European Commission report detailed that through smart deployment in urban traffic areas and by placing charge points in already built areas, gas stations or rest areas, Oslo's investment was reduced and this enabled a greater capacity (JRC, 2017). Nevertheless, residents do complain about waiting for chargers (NEVA – cited in Zaptec, 2019). This would suggest Oslo is at the upper-end of the charger-to-car ratio. The ICCT finding would also suggest the upper-limit is around 1:30, as no city in the top 25 ULEV cities has a higher ratio.

Bristol currently has 81 charge points - approximately 1 for every 7-8 electric vehicles (Zap-Map, 2019). However, if they want to maintain this ratio to 2050, there will need to be considerable investment. By 2050, Bristol aim for 100% of all cars to be ULEV and there is currently approximately 190,000 cars in Bristol (BCC, 2019). With no increased uptake in cars, and the full switch of 190,000, Bristol would need over 23,000 charge points. Even to match the upper-limit for charger-per-vehicle ratio of 1:30, Bristol would need over 6,000 charge points. A considerable increase from the current 81. However, demand will not necessity grow as fast as we think - innovations will help drastically. Car range is growing so vehicles will have to charge less often. Charging on the move is also in trials. In Sweden, a mile-long motorway stretch has been laid with a wireless charging conductor (Olavarría, 2018). If costs fall enough, solutions such as these would not require stopping at all. Nevertheless, Bristol still needs to provide adequate home-charging possibilities.

There has been a range of solutions to home-charging – some more promising than others. There is considerable public data pronouncing that for electric cars to be a viable solution, home-charging has to be available. In a Baringa study 46% of participants said they would not consider buying an electric car without home-charging facilities. But how do you supply home charging in densely populated public spaces? Some solutions to street-parking charging has been trialled in similar-sized councils, such as street-lamp charging in Brighton, and 'kerb' charging in South London. Both are smart innovations but research suggests these charge points to be, at best, slow charge points. A standard Nissan Leaf would take between 6-13 hours to charge (Motoring Research, 2019).

In addition, although feasible on a supply viewpoint, literature has suggested that these solutions may cause more problems than its worth. Public parking, especially in Bristol, tends to sprawl, so the introduction of street-charging would almost certainly have to require parking bays. A public study (JMP, 2016) found when you interfere with public parking arrangements, such as introducing parking bays, capacity is reduced. As Bristol's streets do not tend to support public parking, or at least they were not built for it, formalising parking arrangements with pre-designed bays would cause a greater stress on city transport. Although street-charging solutions may be possible, the city would simply have to do more to increase capacity, especially in city centre. One possible solution is the introduction of exclusive electric car parking lots in desirable city centre locations, as seen in Oslo, San Francisco and Amsterdam. Not only would this supplement ULEV vehicle owners demand for parking chargers, but it would offer an advantage to switching, volume can be tracked, and new lots can be opened when necessary. Nevertheless, the council would have to tread carefully as to avoid upsetting a city with an already fragile transport ecosystem.

Electrical Capacity and Sourcing

It is not just vehicle capacity which is an issue – electrical capacity is also worrying. In the instance of 100% electric transport, UK energy demand will be double it is now (Catapult, 2018). In addition, on a more local scale, Green Alliance warned one car charge uses the same amount of electricity as the average house does in 3 days. The think tank warned that as little as six cars charging, positioned closely to each other, could cause a 'brownout' in an area (a sudden drop in local electrical voltage). Electric car uptake is not predictable either. By chance, an entire street could take up electric cars, and on which, the regional grid will not be able to cope and 'brownouts' appear. The solution to this would be a regional grid upgrade but specific regional ULEV uptake is very difficult to forecast and pro-active upgrades would thus be difficult. This suggests that charging has to be conducted more intelligently. 'Smart-charging' shows promise, such as controlling charging to run irregularly through the night to minimise peak times. However, any negative experiences or car charge 'curfews' could deter consumers and undermine the ambitions to decarbonise the car industry. It is the responsibility of the local councils, and relevant governments, to facilitate the increased electrical demand without impacting or discouraging the adoption of electric vehicles.

Providing the electrical capacity is one issue, but sourcing this energy is another. If Bristol's vision is to decarbonise the city, then they have to be responsible with the sourcing of this additional energy. As of 2018, 79% of Bristol's energy comes from renewables, which is considerably higher than the UK grid average of 32% (Bristol Energy, 2018). Nevertheless, higher ULEV take-up would still lead to a higher use of non-renewables. If Bristol want to facilitate a clean revolution they will continue to invest in non-renewables as to avoid an increased demand for non-renewables. Unpreparedness could lead to energy shortages, on which, non-renewable sources would have to be consulted to fill the gaps. It is the responsibility of the council and relevant governments to ensure that Bristol's increased electricity demand can be absorbed by an increased uptake of renewable energy sources.

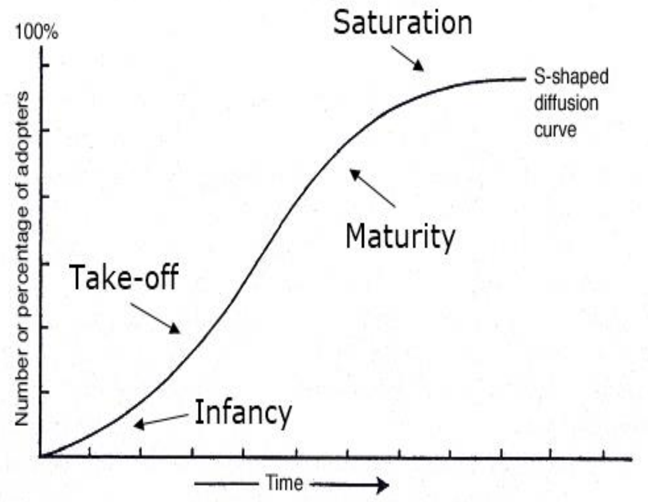
The electric vehicle movement is a large portion of the environment subsection of the One City Plan and rightly so. However, Bristol has to take care as to avoid opening themselves up to a new set of global trends and challenges. Oil is a major source of world conflict and has often dragged western powers into the Middle-East. However, a switch to renewables will not be conflict-free and will present its own set of challenges to the countries which are blessed, or potentially cursed, with the relevant resources. The UK, as we are now, produce around 60% of the oil that we use (ONS, 2017). Although supply is dwindling, is it wise to switch reliance to resources we cannot produce ourselves? Over 50% of the world's lithium supply comes from the 'Lithium Triangle', which covers Argentina, Bolivia and Chile (Martin, 2018). Cobalt is another key element in electric car batteries where 50% of production comes from the Democratic Republic of Congo alone (NRC, 2018). It is unlikely the UK will ever produce commercial supplies of Lithium or Cobalt domestically. Therefore, without domestic natural resources, the UK is dependable and as a result, vulnerable. It is unclear how much of this will be felt by the consumer, and to what extent this may damage, or halt, the electric car industry. This uncertainty could cause some future problems if Bristol is to be entirely dependent on this industry for car-travel. Relationships have to be created with these resource-rich countries to facilitate a steady and uneventful rise to ULEV market adoption.

Public Perception

When understanding the challenges for the electric car industry it is often seldom to remember that the industry is relatively new. Whereas the electric car concept has been around since the 1970's, mainstream production only started in 2010. As with every new innovation and the movement to market saturation, the product needs time to settle. As the automakers switch production, and the ULEV's become more affordable to the masses, uptake will accelerate.

Take for example, the infamous technological innovation ‘S curve’. The electric car industry would currently be in the first of four stages; infancy. Market competition is fierce, capacity is being built, and most of the resources is being spent of research and development. Then would come take-off where charger prevalence is satisfactory, decreasing costs has allowed a mass-produced electric car, and the market is accepting the product. The UK is not there yet – a 2018 Baringa study found only 30% of brits would even consider buying an electric car. `

Technological Innovation ‘S-Curve’



Source – Visual interpretation of Davis (1997), Bayus (1998) and Byun (2016)

However, it is not wise to just expect, with time, that the industry will reach this position of take-off. They may be on the right track, but a balance has to be tipped with public opinion for up-take to excel. A zap-map survey suggests a few social concepts which are withholding this breakthrough.

Zap-map Statistics 2018	‘’Strongly Agree’’
The cost of buying an electric car is too high	**55%**
Not being able to travel far enough with one charge to reach the next charging point	**54%**
There is not a public charging point near my home	**53%**
You have to charge the car too often	**38%**
It takes too long to recharge the battery	**33%**

Firstly, price equity is the most prevalent issue facing customers. More than half (55%) of people believe the high cost of an electric car is the main factor deterring purchase. At the moment, the most popular electric car costs £31,000 (Nissan Leaf), whilst the most popular conventional vehicle costs only £15,995 (Ford Focus) (Ford, 2019; Nissan, 2019). However, battery costs have fallen 50% in the last three years and will continue to do so (Statista, 2019). Considering electric car batteries make up around half of the electric vehicle cost (Bloomberg NEF, 2019), costs should continue to fall. Secondly, car range is another important factor off-putting customers. This should also continue to fall with mean vehicle range increasing by a factor of four since 2010 (Mcdonald, 2018). However, and perhaps most importantly, there is a considerable amount of misinformation surrounding the electric car. In a study commissioned by Volkswagen, 20% of participants believed an electric car slows down whilst battery decreases and when asked how long it takes to charge the average electric car, the average answer was just under eight hours. Both responses show a lack of education upon electric cars, and this does contribute to a slower take-up. Although electric vehicle cost and range may improve there still seems to be a way to go to educating the consumer base and improvements here could very well be a catalyst for the accelerating growth the industry seeks.

Conclusion

This paper demonstrates that there is no silver bullet. Most solutions tend to involve a degree of risk and uncertainty about them. At the moment, there is clear under-capacity across many spheres; charging, parking, electrical capacity and electrical sourcing. These areas are not quick fixes and they certainly are not cheap. The target of 2050 is smart. Too much change too quickly could do more harm than good and could hold the industry back by decades. On the other hand, ULEV growth will continue to accelerate. The technological s-curve suggests that the electric car industry is on the brink of a take-off and capacity should be prepared to absorb this demand. However, this won't happen automatically. Costs and range need to improve but their also seems to be a lack of information surrounding the market. Improvements in this department could prove decisive to the speed of the revolution.

This paper has presented many obstacles and challenges facing of the electric car industry without asking perhaps the most important question; is this future desirable? Although environmentally friendly, it would not be desirable to immediately overthrow fragile traffic infrastructure, burn out the electricity grid or facilitate higher demand with fossil-fuel energy. An electric future seems an inevitability but great care has to be taken not to rush towards it. It would thus be wise to prepare the sources of energy. Domestically, in the renewability of the electricity, but also, internationally, where resources, such as Lithium and Cobalt, could cause more problems than expected. Ultimately, it will get easier. Innovative experiments are happening worldwide and this will change the dynamic. The council and wider government should prepare for an electric future, but do so with patience, as rushing towards it may actually slow it down.

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