Delivering electric vehicle charging infrastructure in the UK

This paper sets out the current state of play in the roll-out of electric vehicle (EV) charging infrastructure across the UK, including the policy drivers and challenges. It makes several recommendations and highlights areas for further consideration.

Recommendations

1. A review of the strategies and incentives for EV uptake and charging infrastructure in the UK is required to ensure appropriate alignment and the optimum use of available resources.

2. Ultra Low Emission Vehicles are only as 'clean' as the means of fuel generation. Stable and consistent policymaking are both critical for increasing renewable electricity and the storage technologies that will enable full system impact.

3. Government should work more closely with Distributed Network Operators to identify solutions to overcome slow delivery potentially holding up EV charging infrastructure roll-out. This should include exploring the potential for EV manufacturers themselves to provide greater supporting resource.

What's driving the shift to alternative fuel vehicles?

There are several policy drivers and mechanisms at work in driving a shift from traditional internal combustion engine vehicles to Ultra Low Emission Vehicles (ULEVs), of which EVs are one type, across the UK.

Climate change awareness and poor air quality, particularly in cities, has spurred cross-party policy alignment. Phasing out the sale of traditional combustion engines and incentivising ULEVs is a core strand of this work. This is underpinned by EU policy Directives specifying average emissions of new cars in 2021 must be 95g CO_2/km.[1]

Country	Deadline for phase-out of new combustion engine registrations	Charging point connections[2]	Total licenced vehicles in UK/% of total registrations	Total ULEVs Q1 2018[3]
England	2040	13149	32.2m/83%	140,314
Wales	2040	558	1.9m/5%	3,275
Scotland	2032	2563	3m/8%	8,404
Northern Ireland	n/a[4]	469	1.1m/3%	2,100

Table 1GB ULEV statistics by country

[1] https://beta.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/pages/12/
[2] https://www.zap-map.com/statistics/#region
[3] All vehicles. DfT statistics.
[4] The ongoing absence of a devolved government at Stormont has prevented a NI policy from being agreed.

Specific mechanisms to incentivise ULEV uptake, and deadlines for the phase out of new combustion engine registrations, varies across the UK. As shown in the table above, uptake of ULEVs is still relatively limited, but proportionally uptake of ULEVs – hybrids in particular – is growing quickly. The Society of Motor Manufacturers and Traders noted that hybrid and plug-in registrations are up more than a third, moving to a 5.8% share of new registrations, although pure EV sales have slowed recently.[5]

A recent report suggested that the number of EVs on the road could reach 20 million by 2030 (or 13 million by 2030 if a 2040 backstop is maintained).[6] The UK Government has committed to a 2040 target for phasing out the sale of internal combustion engine vehicles.[7] However, recent evidence to the Business, Energy and Industrial Strategy (BEIS) Select Committee suggested that a 2030 target is achievable with more concerted policy and milestones.[8]

Grants and loans

The UK Government administers a grant scheme for new EVs and hybrid vehicles. The grant funding available depends on the type of vehicle, with grants of up to 35% (to a maximum of £4,500) of the purchase cost available.[9] Industry has recognised the grant as a factor in the rise of EV and hybrid sales.

In its recently published *Road to Zero* document, the UK Government committed to:

> "*Continuing to offer grants for plug-in cars, vans, taxis and motorcycles until at least 2020. The plug-in car and van grants will be maintained at the current rates until at least October 2018. Consumer incentives in some form will continue to play a role beyond 2020*."[10]

Additionally, the UK Government committed £400m to a Charging Infrastructure Investment Fund until 2020.

In contrast, the Scottish Government operates a loan scheme via Transport Scotland[11] of up to £35,000 repayable over 6 years. Launched in 2011, the scheme initially saw low uptake, but in the last year of operation the scheme has been oversubscribed and future additional funding is being considered. It is worth noting that overall numbers of successful loan applications total around 500 since the scheme's inception. However, many new cars are acquired via long term hire schemes rather than outright purchase.[12]

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[5] https://www.smmt.co.uk/2018/06/uk-new-car-demand-warms-up-in-may-with-modest-3-4-rise/
[6] https://utilityweek.co.uk/smart-v2g-charging-halve-ev-integration-costs-2030/
[7] The UK Government has committed to "effectively zero" emissions from cars and vans by 2040.
[8] Business, Energy and Industrial Strategy Select Committee (2018) Oral evidence to *Electric vehicles: developing the market and infrastructure* inquiry, 22 May 2018. Available at: https://www.parliament.uk/business/committees/committees-a-z/commons-select/business-energy-industrial-strategy/inquiries/parliament-2017/electric-vehicles-17-19/
[9] https://www.gov.uk/plug-in-car-van-grants
[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724391/road-to-zero.pdf
[11] http://www.energysavingtrust.org.uk/scotland/grants-loans/electric-vehicle-loan
[12] https://www.scotsman.com/news/environment/growing-take-up-of-scottish-government-electric-vehicle-finance-scheme-1-4721864

These mechanisms are intended to create market stability and policy certainty for emergent technologies, as well as incentivise uptake by consumers by moving toward greater price-parity with current technologies.

Who is delivering the infrastructure investment?

EV charging infrastructure across the UK is delivered both by the public and private sector, with a range of grants and incentives in place to motivate uptake. Ultimately the consumer pays via taxes or direct charging.

Public

Currently, there is no duty on local authorities to provide electric charging points; it is up to them to decide based on local priorities whether to do so.[13] However, in its recently published National Infrastructure Assessment (NIA), the National Infrastructure Commission (NIC) recommended that government should place a requirement on local authorities to work with charge point providers to:

> "*allocate 5 per cent of their parking spaces (including on-street) by 2020 and 20 per cent by 2025 which may be converted to electric vehicle charge points*."[14]

Currently several grant schemes exist, but applications to the UK Government's £4.5m On-Street Residential Chargepoint Scheme have been limited, with only five local authorities securing funding in 2017.[15]

Low uptake has been attributed to a mixture of:

- Poor awareness
- Concern about long-term funding of infrastructure beyond capital for delivery during a period of ongoing austerity[16]
- Views that the private sector should ultimately be responsible for delivery

Scotland has taken a public-sector driven approach. Local Authorities host the majority of public charging sites and receive Scottish Government funding to enable roll-out.[17] Additionally, local authorities have been incentivised to move to EV fleets where appropriate. However, in Wales, only 31 charging points have been delivered publicly.

Local authorities face the challenge of balancing the requirements of supporting and enabling the roll-out of charging infrastructure with the requirements of other policy areas.

Concerns have been raised about:

- Ensuring that charging points do not impact upon active travel infrastructure;
- The potential for growth of private EVs to undermine other modal shift policies;

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[13] House of Commons Library (2018) Electric vehicles & infrastructure. Briefing paper CBP07480.
[14] https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf
[15] Although in recent evidence to the Business, Energy and Industrial Strategy Select Committee it was reported that there had been an increase in uptake during early 2018.
[16] https://www.businessgreen.com/bg/news-analysis/3024348/uk-councils-take-up-of-ev-charge-point-funding-extremely-disappointing
[17] http://www.cosla.gov.uk/sites/default/files/documents/17-10-23_item_07_electric_vehicles.pdf

- Charging points contributing to 'street clutter' that could impact upon those with visual and mobility impairments;
- A lack of real drive in the National Planning Framework to enable delivery and a failure to use existing powers to compel EV charging infrastructure in new developments.

Unsurprisingly, international EV uptake correlates strongly with the availability of public EV charging infrastructure, but that availability varies dramatically at a local level and there is no agreed benchmark for EV charging provision.[18] In the UK, analysis suggests there is no clear link between local/city EV strategies and uptake of EVs, and that other factors – such as income – may currently be more relevant.[19]

Recommendation: A review of the strategies and incentives for EV uptake and charging infrastructure in the UK is required to ensure appropriate alignment and the optimum use of available resources.

Private

The Workplace Charging Grant sought to incentivise businesses to install charging points at their sites, setting aside £7.5m for the purpose. However, uptake to date has been poor. Evidence to the BEIS Select Committee suggested that the maximum £300 per socket (up to 20) toward installation was an insufficient incentive when compared to the time required to progress the work.[20] However, in its *Road to Zero* strategy, the UK Government has committed to increasing this to £500 per socket.[21]

Research by the Energy Saving Trust has indicated that, in Scotland, grant funding of up to 100% for workplaces to install charging infrastructure was a key driver for business charging point installation, with 63% of the workplaces that were interviewed suggesting that they would not have installed charging infrastructure without the grant.

By contrast, the uptake of the UK Government's Electric Vehicle Homecharge Scheme has been strong. It provides a 75% grant contribution towards the cost of one chargepoint and its installation, up to a maximum of £500 per household/eligible vehicle.[22]

In Norway, the provision of the network has been delivered on a similar basis. Initial rounds of 100% funding (up to a set limit) helped to deliver a basic public infrastructure network, followed by funding for household sockets. Increasingly private operators are delivering

[18] https://www.theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf
[19] https://www.sciencedirect.com/science/article/pii/S0040162516305935
[20] http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/business-energy-and-industrial-strategy-committee/electric-vehicles-developing-the-market-and-infrastructure/oral/82664.html
[21] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724391/road-to-zero.pdf
[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710071/evhs-guidance-for-customers-v-2.2.pdf

charging infrastructure without government financial support as the market begins to reach maturity.[23] UK models are broadly in line with this approach, though less advanced.

Types of charging infrastructure

EV charging infrastructure is being delivered in a range of public and private locations across the country. This can be at people's homes, on local authority or public sector land including on-street, on private business sites, or business sites open to the public – like carparks or train stations. Homecharging systems make up the bulk of charging sites.

There are several types of charging infrastructure:

- slow (6 – 8hr)
- fast (3-4hr)
- rapid (~1hr)

Rapid charging points are the fastest growing group of chargers. Rapid charging points will be essential along motorways and will be a factor in reducing 'range fear' and encouraging public uptake. It has also been suggested that enforced charging breaks on long drives may be instrumental in improving road safety. National Grid is currently planning for superfast charging infrastructure along motorways which would feed directly off the grid. They anticipate 50 strategically sited super-chargers with 6-8min charge time. It is expected that this will cost £0.5bn-£1bn, with the cost to be met either by direct charging or split across stakeholders.[24]

Scottish Government announced as part of its Programme for Government in 2017 that the A9, which is currently undergoing dualling works, would be an 'electric highway' with regular charging points on the route to encourage uptake.[25]

However, a challenge to the delivery of charging infrastructure along motorways and trunk roads is landownership. Making use of appropriate publicly owned land to enable the delivery of charging infrastructure makes sense, however, the availability and appropriateness of sites does not always match with need.

In the urban context land availability and ownership is a problem. A recent survey highlighted that only 48% of Londoners and 61% of drivers in Edinburgh have access to off-street parking and therefore home charging.[26] On-street charging is a significant challenge. Preferred interventions – like lighting columns which double as charging points – are only suitable where the column is directly adjacent to the road. The UK Government has called for all new streetlights, where suitable, to also be charging points in areas where there is existing on-street parking.[27]

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[23] https://wpstatic.idium.no/elbil.no/2016/08/EVS30-Charging-infrastrucure-experiences-in-Norway-paper.pdf
[24] Financial Times (18 May 2018) *National Grid motorway charging infrastructure*.
[25] https://www.bbc.co.uk/news/uk-scotland-41551535
[26] https://www.pwc.co.uk/press-room/press-releases/uk-roadmap-vital-to-convert-ev-ambition-into-action-pwc-report.html
[27] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/724391/road-to-zero.pdf

Homecharging is widely seen as the biggest opportunity for increasing EV uptake, but risks large urban populations potentially lacking access to charging infrastructure if adequate public charging infrastructure can't be delivered.

UK charging systems are based on a park-and-charge model, but other approaches exist. In Sweden eRoadArlanda have deployed a stretch of road with charging rails underneath, allowing for in-use vehicle charging.[28] The cost has been projected at €1m per kilometre, 50 times lower than that required to construct an urban tram line. In Germany, overhead charging wires, like those used by trams, are being deployed on the autobahn.[29]

Electrified transport and energy systems

Transport, heating/cooling and electricity are the core components of our energy system. The move from internal combustion engines to EVs represents a significant change in the profile of demand. This has implications for both generation and transmission.

Generation

Questions have been raised about what a mass shift to electrified transport means for our electricity requirements. The Infrastructure Transitions Research Consortium (ITRC) modelling suggests that electrification of heat and transport, in an unconstrained model, could leader to a doubling of electricity consumption by 2050.[30]

In modelling for 9 million electric vehicles by 2030, National Grid has suggested that a straight transfer would require "roughly 8GW of new power generation".[31] However, it is generally anticipated that smart grid technology will enable 'smart charging' – smoothing out demand over the day – and on this basis National Grid suggest that 4GW of new generation might be required.

Recommendation: ULEVs are only as 'clean' as the means of fuel generation. Stable and consistent policymaking are both critical for increasing renewable electricity and the storage technologies that will enable full system impact.

Transmission

National Grid anticipates that smart grid and smart charging technologies, along with an 'evolution not revolution' approach, will help to manage requirements for additional transmission infrastructure investment.[32] However, a range of energy organisations have expressed concern. A third of respondents to the recent Energy Barometer survey took the view that a lack of capacity on the electricity grid to support additional demand is a major challenge.[33]

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[28] https://www.theguardian.com/environment/2018/apr/12/worlds-first-electrified-road-for-charging-vehicles-opens-in-sweden
[29] https://electrek.co/2017/08/11/electric-truck-charging-overhead-contact-charging-autobahn-germany/
[30] ICE (2016) *National Needs Assessment: A vision for UK infrastructure*. Pg. 82.
[31] Business, Energy and Industrial Strategy Select Committee. Oral evidence to *the Electric vehicles: developing the market and infrastructure* inquiry, 27 March 2018.
[32] http://fes.nationalgrid.com/media/1253/final-fes-2017-updated-interactive-pdf-44-amended.pdf
[33] Energy Institute (2018) *Energy Barometer 2018*

Distributed network operators (DNOs) and local connections are seen by some as a barrier to roll-out of EV charging infrastructure.[34] While DNOs do not necessarily prevent EV infrastructure roll-out, connections can take time to deliver and the existing local transmission infrastructure does not always support charging point delivery at reasonable cost. The costs to DNOs come not only from the infrastructure itself, but also the skills and training to support roll-out of low-voltage charging infrastructure.

Recommendation: Government should work more closely with DNOs to identify solutions to overcome slow delivery potentially holding up EV charging infrastructure roll-out. This should include exploring the potential for EV manufacturers themselves to provide greater supporting resource.

Vehicle to grid technology

There is some expectation that smart charging will enable vehicle-to-grid (V2G) technology. V2G allows electric vehicles to charge and discharge electricity to and from the grid allowing EVs to act as storage units. A recent report suggested that the annual cost of integrating EVs into the energy system could be cut by up to a half by 2030 through a combination of smart and V2G charging.[35]

However, recent evidence to the BEIS Committee highlighted several considerations:

- getting the right infrastructure in place initially is higher priority than V2G;
- the viability of V2G technology is still being explored, and;
- changes to business models and market requirements may impact upon V2G proposals. [36]

Other issues for consideration

Batteries

Improvements to battery technology have made increased time between charges feasible. However, batteries still have a five to ten year lifetime, with charge capacity deteriorating over time.[37] This implies additional costs of several battery replacements for customers over the lifetime of the vehicle.

In considering the full lifecycle of EV production and use, the carbon impacts at the point of production, and how batteries are recycled or reused when they can no longer be used to power EVs, should be considered. Sustainable sourcing of the raw materials – cobalt and lithium – may also be challenging, especially with limited returns from recycling.[38]

Issues like these require consideration if the move to EVs is to deliver the desired outcomes without unintended negative consequences.

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[34] https://www.pwc.co.uk/power-utilities/assets/electric-vehicle-charging-infrastructure.pdf
[35] Vivid Economics (2018) *Accelerating the EV transition – part 2; electricity systems impacts*. (Prepared on behalf of WWF).
[36] http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/business-energy-and-industrial-strategy-committee/electric-vehicles-developing-the-market-and-infrastructure/oral/80982.html
[37] House of Commons Library (2018) Electric vehicles & infrastructure. Briefing paper CBP07480.
[38] https://www.weforum.org/agenda/2017/11/battery-batteries-electric-cars-carbon-sustainable-power-energy/

Maintenance

The RAC Foundation highlighted in 2017 that, as of June 2017, 13% – one in eight – of charge points were out of action at any one time.[39] Public trust in the availability of existing charging infrastructure, beyond concerns of range anxiety and 'space blocking', is a factor in realising ULEV uptake. The RAC Foundation proposes a time-limit for repairs to address this problem.

Connected and autonomous vehicles

It can be anticipated that, given political commitments to phase-out the sale of internal combustion engines, that Connected and Autonomous Vehicles, when they are rolled-out on UK roads, will be ULEVs. The timelines for deployment remain uncertain. Depending on models of ownership (private/taxi/car club models) these vehicles may have different charging infrastructure requirements.

[39] https://www.racfoundation.org/research/environment/ultra-low-emission-vehicle-infrastructure-dermott