Electric Vehicle Charging market study: final report

Appendices

Appendix A: En-route Charging

Introduction

1. This appendix sets out evidence and analysis relevant to en-route electric vehicle (EV) charging. It provides background information on this segment, evidence relating to current competition and the key issues identified in en-route charging as set out in chapter 4.

Background

What is en-route charging?

2. En-route charging refers to EV charging by consumers on longer journeys (eg along motorways at MSAs or other major A-roads). It involves high-powered rapid/ultra-rapid charging speeds, relative to other charging segments, since drivers prefer not to be delayed en-route; a rapid charging session takes 20 minutes to an hour depending on battery capacity and its starting state of charge (with scope for improved technology to speed up charging over the next decade).[1]

3. Key routes for en-route charging include roads on the Strategic Road Network (SRN) in England (which includes all motorways and trunk A roads, and is managed by Highways England), and trunk roads and motorways managed by national governments in Scotland, Wales and Northern Ireland. Many A roads throughout the UK, which are managed by Local Authorities (LAs), are also likely to be relevant for en-route charging.

Why is en-route charging important?

4. The UK Government has identified extensive public charging infrastructure across the motorway network and major A roads as a key part of the transition to EVs.[2] The Governments of Wales, Scotland and Northern Ireland have similarly identified the importance of rapid charging, especially for long distance journeys.[3]

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[1] Zap-Map, EV Charging connectors - Electric car charging speeds, retrieved 24 May 2021. Zap-Map's 2020 EV Charging survey found that the median public rapid chargepoint user charged for 31 to 40 minutes. Zap-Map EV Charging Survey, Key Findings 2020.
[2] Government vision for the rapid chargepoint network in England, 14 May 2020.
[3] Electric Vehicle (EV) charging strategy for Wales, Consultation Document, 2 December 2020. The Governments of Scotland and Northern Ireland have funded free public rapid charging networks.

5. One study forecasts that in England in 2030 approximately 17% of the energy consumed by EVs will be from en-route charging. MSAs will be key locations for en-route charging; one estimate forecasts that 56% of all en-route charging will be delivered at MSAs.[4]

6. Several respondents to the CMA's invitation to comment referred to the role which en-route charging can play in addressing 'range anxiety', and therefore encourage EV adoption. For example:

   (a) RAC Motoring submitted rapid charging 'will also help to reduce so-called 'range anxiety' which is recognised as being a barrier to EV take-up.'

   (b) The Association of Convenience Stores submitted 'to solve the issues with 'range anxiety' facing the market, there will need to be a good provision of rapid charging across the UK'.

   (c) Fastned submitted 'provision of EV chargers on MSAs is essential to further the transition to e-mobility in the UK, because it will dramatically reduce range anxiety (fear of not being able to reach a long distance destination due to lack of charging opportunities on the way), which is continually cited as a key barrier for consumers to switch to e-mobility.'

   (d) Many individual respondents referred to range anxiety. One noted that range anxiety is a 'real thing, especially whilst driving on motorways'; another submitted that 'it is actually 'charging anxiety' that is the biggest issue for EV owners travelling distances longer than 170 miles in the UK.'

Competition in en-route charging

7. In choosing between chargepoints, evidence shows that EV drivers value factors including location, reliability and ease of use,.[5] A key current issue for consumers is the lack of available chargepoints.[6] This issue is especially acute in en-route charging, which often takes place away from drivers' regular charging locations. This was reflected in responses to the CMA's invitation to comment. For example, E.ON submitted that it is:

> the lack of predictability in price, service and geographic availability of charging points that often makes long journeys challenging. Whilst many early adopters have adapted to such

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[4] The estimate is driven by a range of assumptions about battery size, vehicle efficiency, access to home charging, charging behaviour thresholds as well as movement patterns from the Regional Transport Models.
[5] Other than location, these factors are used by Zap-Map to measure consumer satisfaction (Zap-Map, 'Revealed: UK's top ranking electric vehicle networks', retrieved 7 July 2021). See Appendix D for further evidence on the features consumers value.
[6] See Appendix D, paragraph 3.

challenges with a pioneering spirit (often building in a plan B and plan C for longer journeys in case of charger unavailability/malfunction), this must change urgently as we move to mass adoption of EVs.

Shares of supply

8. Electric Highway, BP and Chargeplace Scotland are the largest providers of rapid and ultra-rapid en-route charging in the UK. However, while BP's chargepoints are deployed at a wide range of locations, the Electric Highway and Chargeplace Scotland have had more targeted chargepoint deployment strategies – ie most of the Electric Highway's chargepoints are located at MSAs, and Chargeplace Scotland is only active within Scotland.

Table 1: Shares of supply of rapid and ultra-rapid en-route charging within 0.5 miles of motorway or principal A road in Britain (February 2021)

Chargepoint operator	Rapid and ultra-rapid chargepoints	Share of rapid and ultra-rapid chargepoints
Electric Highway	270	25.6%
bp pulse	206	19.5%
ChargePlace Scotland	148	14.0%
InstaVolt	143	13.5%
ESB Energy	61	5.8%
GeniePoint/Engie	55	5.2%
Ionity	50	4.7%
Shell	41	3.9%
Other	82	7.8%
Total open-network chargepoints	1,056	100%
Tesla	446	29.7%
Total including Tesla	1,502	100%

Source: CMA analysis of Zap-Map data 26 February 2021.

9. As described below in paragraphs 37-43, EV charging at MSAs is far more concentrated than the overall en-route segment.

Chargepoint operators

The Electric Highway

10. The Electric Highway is one of the largest providers of en-route charging in the UK, with revenues of £754,000 (year to April 2020) (prior to Gridserve's acquisition in 2021).[7]

11. Founded by Ecotricity, a renewable energy company, the Electric Highway was the first chargepoint operator to install chargepoints at scale at MSAs. It

[7] The Electric Highway, Full accounts made up to 30 April 2020.

entered [✂] in partnership with Welcome Break and rapidly grew its network; [✂] it had chargepoints at around 90% of MSAs in Britain.

12. The Electric Highway has a network of 293 chargepoints at service stations on the motorway and A roads, plus at IKEA stores, and at handful of ports and airports and other strategic locations; it is present at nearly all MSAs. Almost all of its chargepoints were 50kW chargepoints.[8] As described below (paragraph 54 onwards), through its agreements with three MSA operators, the Electric Highway has the exclusive right (save for Tesla and in one case Ionity) to install chargepoints at the main retail sites of around two-thirds of MSAs.

13. Between March and June 2021, Gridserve (an international sustainable energy and EV charging business) acquired the Electric Highway. As part of the first stage of this acquisition in March 2021, the Electric Highway announced plans to replace all its existing chargepoints with new technology, doubling these chargepoint' capacity, and to add a further six to 12 350 kW chargepoints at some of these sites.[9] Gridserve has also announced plans to develop more than 100 'Electric Forecourts' with chargepoints at sites off the motorway.[10]

BP

14. BP is a multinational energy business with a revenue of $184 billion (year to December 2020) and a wide range of activities.[11] BP established its presence in EV charging in the UK via its acquisition of Chargemaster in 2018.[12] BP's network is now branded as bp pulse. Chargemaster made revenues of £18 million (year to December 2019).[13]

15. Chargemaster launched its public charging network in 2011, and by its acquisition in 2018 had already become the largest open charging network in the UK.[14] As bp pulse it has continued to grow, including at BP forecourts, and is currently the largest open rapid charging network in the UK.[15]

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[8] Under Ecotricity's ownership the chargepoints were mostly 50kW rapid chargepoints, but under GRIDSERVE these are now in the process of being upgraded to new chargepoints, higher than 50kW of power, up to 350kW.
[9] Ecotricity and GRIDSERVE announce new partnership to power up the Electric Highway, Ecotricity, 11 March 2021, retrieved 25 May 2021.
[10] GRIDSERVE launches the 'GRIDSERVE Electric Highway' to revolutionise EV charging across the UK, and eliminate charging anxiety, Gridserve, June 30 2021.
[11] Annual Results 2020, BP. Retrieved 25 February 2021.
[12] BP buys UK's largest car charging firm Chargemaster, BBC News, 28 June 2018.
[13] Chargemaster Limited, Full accounts made up to 31 December 2019.
[14] BP buys UK's largest car charging firm Chargemaster, BBC News, 28 June 2018.
[15] CMA analysis of Zap-Map data.

16. A number of BP forecourts are located very close to MSAs but are not covered by the Electric Highway's exclusivity agreements with MSAs. BP has installed a total of 22 chargepoints at 5 of these sites in the UK, which should shortly become available to the public.

InstaVolt

17. InstaVolt is a chargepoint operator which entered the market in 2017, backed by Zouk Capital, a private equity firm. It has since been a major beneficiary of the UK Government's Charging Infrastructure Investment Fund. It had a revenue of £363,000 (year to March 2020).[16]

18. InstaVolt operates rapid and ultra-rapid chargepoints (50kW and above). While many of InstaVolt's sites are suitable for en-route charging, it has developed much of its network in partnership with retailers such as KFC, Starbucks, Costa and Burger King (we discuss destination charging in chapter 6).[17]

Tesla

19. Tesla is an EV manufacturer with a revenue of $31.5 billion (year to December 2020).[18] It has constructed a network of rapid chargepoints which currently can only be used by Tesla cars, branded as its Tesla Supercharger network. As non-Tesla EV drivers cannot use its chargepoints, Tesla is not in direct competition with other chargepoint operators.

20. Tesla has rapidly grown its Supercharger network, which is the largest en-route ultra-rapid charging network in the UK today. However, unlike other chargepoint operators, Tesla has concentrated its chargepoints at a relatively small number of locations; [✂]. As set out in further detail below, we note that Tesla has been carved out of the Electric Highway's exclusive contracts with MSAs.

Publicly owned providers

21. Chargeplace Scotland is a network of chargepoints funded by the Scottish Government. Chargepoints on this network are owned and controlled by hosts (typically LAs) who are able to set tariffs; many chargepoints are free to use. It was formerly operated by Charge Your Car (a BP subsidiary), but from July 2021 has been operated by SWARCO (a chargepoint operator which also

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[16] InstaVolt Limited, Annual Report and Financial Statements, Year Ended 31 March 2020.
[17] InstaVolt Limited, Annual Report and Financial Statements, Year Ended 31 March 2020.
[18] Tesla, Inc., Annual Report on Form 10-K for the year ended December 31, 2020.

operates many other publicly owned chargepoints). Chargeplace Scotland is the largest public charging network in Scotland, and many of its rapid chargepoints are likely to be suitable for en-route charging.

22. ecarNI provides free public charging in Northern Ireland, including 17 rapid chargepoints.[19] It was set up by the Government of Northern Ireland in 2011, and is operated by ESB.[20]

Investment in en-route charging

23. Chargepoint operators deploying en-route charging pay an upfront cost to install rapid/ultra-rapid chargepoints, which they recoup over time. In response to the CMA's invitation to comment, Motor Fuel Group submitted that the 'current pre-tax pay-back periods for high powered (150kW) EV charging hubs is c.8 years'. Other stakeholders provided models using similar assumptions to the CMA with payback periods of between six and eight years, on the basis of installing chargepoints ahead of demand. As EV ownership increases, and therefore chargepoint utilisation increases, the profitability of investment in rapid charging is expected to increase; according to one model provided by a chargepoint operator, the payback period for a bank of newly installed chargepoints could fall to as little as three years.

24. Few private chargepoint operators provide en-route charging in Scotland and Northern Ireland. In its response to the CMA's invitation to comment, bp pulse suggested that this is a consequence of 'public investment in infrastructure with free charging for consumers for a longer period. Whilst this led to a baseline level of infrastructure, it has delayed private sector investment in public charging (whilst the majority of charge points remained free)'. Other chargepoint operators also commented that free public charging has made installing new chargepoints less commercially attractive in Scotland.

Competition off the motorway

25. We found that there are over 20 chargepoint operators providing en-route public charging in the UK, many of which provided plans to the CMA demonstrating their ambitions to rapidly expand their chargepoint networks.

26. Chargepoint operators told the CMA that, in addition to chargepoints deployed at petrol forecourts and dedicated charging hubs, many destinations such as

[19] Based on CMA analysis of Zap-Map data, 26 February 2021.
[20] In addition to operating free chargepoints in Northern Ireland, ESB also operates paid chargepoints in England.

supermarkets and retail parks are commercially attractive sites for rapid chargepoints and will be suitable for many en-route drivers.

27. Off the motorway in areas where chargepoints are commercially viable, we consider that EV drivers are likely to be able to switch easily between chargepoint operators located at different sites. Most stakeholders have not raised concerns about the ability of chargepoint operators to find suitable sites for chargepoints off-motorways.

28. However, in the short-term at least, there are likely to be gaps in rapid chargepoint availability in rural areas, given the lower density of passing traffic, which decreases the commercial attractiveness of rural chargepoints. Several submissions raised concerns that chargepoint operators will be slower to deploy chargepoints in rural areas:

    (a) The British Holiday & Home Parks Association expressed concern about 'the infrastructure needed to enable people to travel to their end destination which, for domestic tourism, is likely to be in a rural or coastal location', and submitted that 'there is less incentive for EV charging providers to install the infrastructure needed in more remote regions of the UK – areas where many holiday and residential parks are located' and that more remote areas of the UK may be 'left behind'.

    (b) The Camping and Caravanning Club submitted that there are a 'very low number of publicly accessible charging points in rural locations', and that there is a 'lack of electrical grid network capacity in rural locations being able to cope with the increased demands'.

29. This is consistent with the evidence the CMA has received on chargepoint operators' expansion plans.

Competition on motorways

30. In contrast to en-route charging off the motorway, the evidence set out below demonstrates that there is currently very limited competition on the motorway.

Concerns about poor reliability and limited provision

31. Many respondents to the CMA's invitation to comment (ITC) submitted concerns about a poor level of service in charging at motorways in the absence of competition:

    (a) Fastned submitted that the lack of competition has resulted in 'poor quality and availability of charging infrastructure on Motorway Service Areas (MSAs)'.

(b) The Electric Vehicle Association England submitted that 'Motorway and A-road service stations are also a concern. Competition on those is currently limited or absent and if the current EV charging suppliers and fossil fuel companies are not challenged by wider competition this will lead to a negative impact on pricing, reliability and the general service experience'.

(c) An individual respondent submitted that 'On the motorway services, I am not one to name and shame normally, but Ecotricity have had a devastating impact on most first time buyers and magazine journalists first impressions of public charging through unreliability, difficulty of payment and poor customer service.'

(d) Another individual respondent submitted that 'More public money and grants should be available to companies providing reliable services, companies like InstaVolt and Osprey should be having money thrown at them to provide reliable services - companies such as Ecotricity/Electric Highway should not.'

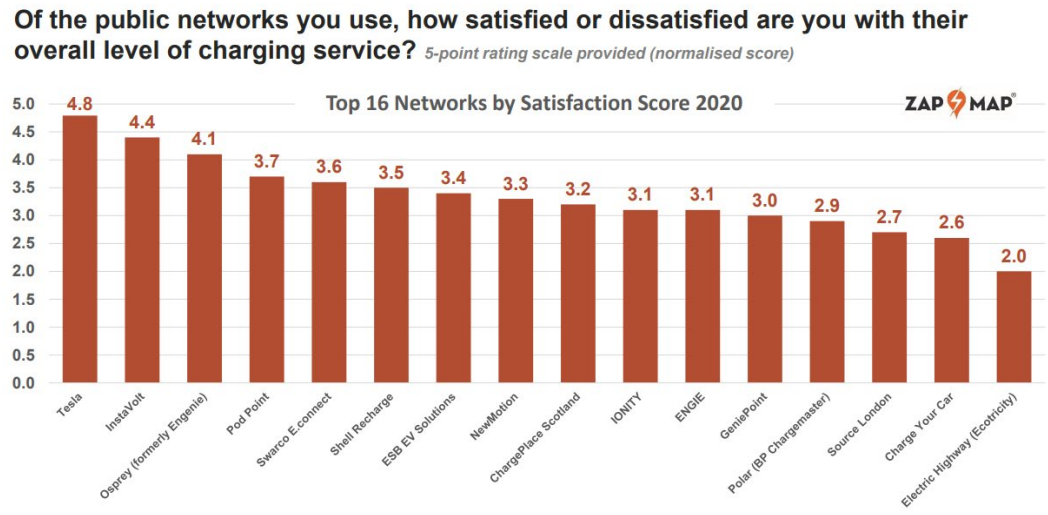
(e) An individual respondent submitted that 'The greatest issue when choosing a charging network is reliability and knowing you will be able to top up simply when you arrive. I will actively avoid using motorway services and Ecotricity for this reason.'

(f) An individual respondent submitted that 'The Motorway facilities seem to be monopolised by Ecotricity whose chargers are now getting old and have reliability issues.'

(g) An individual respondent submitted that 'The ecotricity network is unreliable, they have old charging units, the app doesn't always work or unlock the charge.'

32. The Electric Highway had the lowest customer satisfaction score in Zap-Map's 2020 survey of customer satisfaction at the top 16 chargepoint operators.

Figure 1: EV drivers' satisfaction-levels with chargepoint networks



Source: Zap-Map.

33. Several respondents to the ITC suggested that the Electric Highway's poor level of service and poor reliability is a consequence of underinvestment:

(a) One individual respondent submitted that:

> In my experience Ecotricity provide a poor offering, with only two chargers installed at MSA's. These chargers are very unreliable and Ecotricity are poor/slow at repairing them. They are therefore often out of service and let EV drivers down. Anecdotally a lot of EV drivers avoid using them due to their unreliability – so again you get the downward spiral of them not being used. Additionally, the Chargers are now out of date and slow. The[y] are mostly only 50kW chargers and the type of Charger is not a very good model, so usually isn't capable of producing 50kW of output. Ecotricity are always offering 'jam tomorrow', with better reliability, new chargers, and faster We chargers – but it hasn't happened.

(b) Another individual respondent submitted that 'The Ecotricity chargers are now some of the oldest charging hardware in the UK. They can only charge at 50Kw whereas many of the newer charging networks have chargers that can manage 100Kw or more. This age contributes to the lack of reliability but the lower power also increases the charge time and therefore the journey time for EV's.'

34. Following its acquisition of the Electric Highway, Gridserve has announced that it is upgrading the Electric Highway's chargepoints.[21]

Key issue: Limited electricity network capacity

35. At many MSAs, grid capacity is limiting the speed at which en-route chargepoints can be deployed. This is reflected in MSAs' internal strategy documents. For example, one MSA operator's strategy paper stated that it had 'no spare capacity' for new charging hubs at almost all of its sites. An operator told the CMA that 'at the moment capacity is not constrained by power, but with the 2030 ban [on the sale of petrol cars] it is going to become so pretty quickly'.

36. Many chargepoint operators told the CMA that one of the main challenges they encounter in growing their en-route charging networks is the cost of connecting new chargepoints to the electricity network. While network connection can be a barrier to chargepoint installation across many segments, chargepoint operators told the CMA that this challenge is especially acute in en-route for two reasons:

    (a) En-route charging has a particularly high peak power demand. En-route EV chargepoints are rapid (50kWh and above) chargepoints, to minimise the duration for which charging interrupts drivers' journeys. For example, one chargepoint operator told the CMA that at MSAs 'you need to put in a large number of high-powered chargers' and a large substation, which is 'a genuine technical issue'.

    (b) En-route charging locations (such as MSAs) are often located in rural locations, which are especially expensive to upgrade. For example, one chargepoint operator submitted that grid connections 'can be prohibitively expensive particularly in remote areas where are substantial groundworks (digging) to take place between the EV chargepoints and the point of connection'.

Limited competition on motorways

37. The supply of en-route rapid charging on the motorway is very highly concentrated. As shown in Table 2, the Electric Highway is by far the largest provider of rapid en-route EV charging on the motorway.

[21] GRIDSERVE launches the 'GRIDSERVE Electric Highway' to revolutionise EV charging across the UK, and eliminate charging anxiety, 30 June 2021.

Table 2: Shares of supply of open-network rapid and ultra-rapid EV chargepoints in Britain, within 0.5 miles of the motorway (February 2021)

Chargepoint operators	Share of supply (%)
The Electric Highway	58.8
InstaVolt	10.2
bp pulse	9.6
Ionity	9.2
ChargePlace Scotland	3.4
GeniePoint	2.4
Shell Recharge	2.4
Other	3.2
Total	100

Source: Zap-Map.
Note: These figures are based on an initial dataset produced by Zap-Map to scope the CMA's work. There were some adjustments to the chargepoint classification between segments in later datasets and thus these figures are likely to include some minor errors. Tesla is excluded as it does not provide open-network charging; if included it would have a 43.5% share of supply.

38. Looking at MSAs in particular, the Electric Highway's position is even stronger with a share of 80%, or 83% excluding chargepoints at petrol forecourts (Table 3).

Table 3: Shares of supply of open-network rapid and ultra-rapid chargepoints at MSAs in Britain (June 2021)

Chargepoint operator	Including chargepoints at petrol forecourts (%)	Excluding chargepoints at petrol forecourts (%)
Electric Highway	80	83
Ionity	15	12
InstaVolt	5	5

Source: CMA, data for June 1 2021.
Note: Excludes Tesla chargepoints, which are not open-network.

39. Many respondents to the ITC expressed concern about the state of competition on motorways:

(a) The Association for Renewable Energy and Clean Technology submitted that its 'leading area of concern for the market is around the potential for monopoly of the public charging at existing motorway service area (MSA) sites.'

(b) BP submitted that 'only a handful of sites offer a choice of providers due to exclusivity arrangements in place' at motorway service areas.

(c) Fastned submitted that 'lack of competition' at MSAs is a key risk.

(d) Individual responses noted that the 'only other [non-Tesla] network available on the motorways is Ecotricity', that 'we need to relook into the current company who seem to have the monopoly on motorway service stations', that 'there must be an element of competition especially at motorway services', that 'there is a monopoly of EV charging provision here in England Motorway Service Stations', that 'one operator, Ecotricity,

has a monopoly for chargers on Motorway Service Areas', that 'Ecotricity have some form of Monopoly agreement with the MSA operators', that 'Motorway facilities seem to be monopolised by Ecotricity', and that 'there is no competition for EV charging at motorway services across 90% of the motorways in the UK'.

40. We considered the extent of competitive constraints on the Electric Highway from nearby chargepoints that are not located at MSAs. There is evidence to suggest that this constraint is weak in general and that EV drivers may be even less willing and able than drivers of petrol/diesel vehicles[22] to switch to alternatives away from the motorway:

(a) Chargepoint operators told the CMA that few sites along the motorway, other than MSAs, are suitable for the installation of chargepoints. For example, one chargepoint operator told the CMA that for 'the majority of the strategic road network, MSAs are by far the highest value locations where customers will look to stop and charge. This severely limits the opportunity to deploy outside of MSAs.' Another chargepoint operator submitted that 'off-highway locations are important in the overall story of serving the e-mobility transition, but ultimately serve a different customer group from the MSAs.' However, another chargepoint operator noted that some retail parks located close to the motorway may be suitable for en-route charging.

(b) EVs typically have smaller ranges than petrol/diesel vehicles, currently, and therefore must stop more frequently. Zouk Capital submitted that 'The comparatively shorter range of an EV versus an ICE vehicle will place a higher demand' on MSAs. One individual respondent described motorway service EV charging as 'utterly essential', unlike for drivers of ICE vehicles, given EVs' range constraints.

(c) EVs take longer to refuel than petrol/diesel vehicles, and therefore EV drivers may prefer the amenities of a MSA (restaurants, toilets etc) more strongly than petrol/diesel vehicle drivers. One individual respondent submitted that 'when charging, you want access to toilet facilities and perhaps somewhere to get a drink, have a snack, and take a break for 20-30 minutes, preferably away from the car. Motorway service stations are better equipped for this, but local petrol stations are not.'

41. At a minority of MSA sites the petrol forecourt is operated by a fuel supplier, which could install chargepoints. However, a chargepoint operator told the CMA that such sites are often unsuitable for the installation of chargepoints

[22] Also referred to as vehicles with 'internal combustion engines' (ICE).

due to their size and the inaccessibility of the MSA's amenities. This is consistent with one operator's internal documents which notes that forecourts are 'not of particular concern [✂] as the footprint of petrol forecourts is limited, making inclusion of HPC charge points adjacent to petrol pumps difficult, and customers are not expected to choose to charge at a forecourt given the alternative of the main MSA retail area'.

42. MSA operators did not raise concerns about the Electric Highway's competitive position or service provision, although one MSA told the CMA that the Electric Highway's chargepoints had become 'outdated'. Two MSA operators told the CMA that utilisation at their sites was still low. One MSA operator told the CMA that 'given the low demand, Ecotricity is doing everything in line with the contract.... Ecotricity has an obligation to keep their equipment in good working order and they are doing this.'

43. However, several stakeholders raised concerns about the incentives of MSAs in the context of en-route charging. For example, The Association for Renewable Energy and Clean Technology submitted that 'MSAs lack the incentive to run competitive tender processes that lead to positive outcomes for EV drivers.'

Cost of network upgrades

44. A recent study on the feasibility of EV charging at MSAs in England estimated that future proofing the network connections to meet long-term EV charging demand could cost over £10 million per MSA at the most expensive sites.[23]

45. The cost of connecting MSAs is highly variable. Connection costs at some MSA sites are relatively cheap and can be met by commercial operators. However, many MSA sites are located away from the existing electrical distribution network, which substantially increases the cost of upgrading their connection. At such sites, large scale roll-out of chargepoints is more commercially challenging (especially in the near-term, when chargepoint utilisation will be lower). Chargepoint operators and MSAs told the CMA that the private sector would be unlikely to fund the more expensive network upgrades, especially where demand was not likely to quickly become high enough to produce a commercial return on chargepoints installed using the additional network capacity.

46. The high cost of en-route network connections create a barrier to entry and expansion by chargepoint operators. If left unaddressed, there is a risk that

[23] Subject to a range of assumptions about travel patterns, battery sizes, grid constraints, etc.

this will lead to a shortage in charging capacity at high volume en-route sites in the short term, if network upgrades fall behind EV uptake.[24]

47. High network upgrade costs will act as a barrier to entry in three ways:

(a) Existing sites with chargepoints will be less able to expand to compete more effectively with each other. For example, MSAs currently have few chargepoints, and as utilisation rises the availability of chargepoints at each site is likely to decrease as more will be in use at a time. Capacity constrained sites will not competitively constrain other sites, as EV drivers will not be able to switch to using them (unless they are willing to wait longer).

(b) Chargepoint operators which create new charging sites (such as FastNed) will expand less rapidly to compete with existing sites.

(c) High network upgrade costs can prevent competition within sites, by increasing the cost of entry. Indeed, this can be used strategically by chargepoint operators to defend an incumbent position. By buying network connection rights an incumbent chargepoint operator can raise the cost for its rivals to enter, as they will have to pay additional costs to reinforce the network to support their new grid connection. [✂] This can hinder competition by making it more difficult for the site owner to switch to a different chargepoint operator.

Network upgrade funding

48. Although EV ownership is rapidly increasing, and the Government's 2030 ban on the sale of new petrol/diesel cars and light vans has increased investors' confidence in the direction of travel, the rate at which demand will increase in future remains uncertain, and this complicates the commercial investment case at marginal sites (since investors require higher rates of return where they bear additional risk).

49. The UK Government plans to invest £950 million (the 'Rapid Charging Fund') in future proofing grid capacity along motorways and key A roads in England to prepare for 100% uptake of EVs ahead of need.[25] In particular, it 'will fund a portion of costs at strategic sites across the strategic road network where upgrading connections to meet future demand for high powered chargepoints is prohibitively expensive and uncommercial'.[26]

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[24] In general, lack of sufficient provision is a key issue, as described in Annex D.
[25] HM Treasury, National Infrastructure Strategy, November 2020.
[26] UK Government, Government vision for the rapid chargepoint network in England, May 2020.

50. The Devolved Administrations are also developing policies to support en-route charging, although there is no equivalent of the Rapid Charging Fund. For example, Transport for Wales is leading a £2 million project consisting of proposed concession agreements to facilitate the installation of rapid charging and key points in Wales' transport network.[27] Transport Scotland has already deployed a network of rapid chargepoints, operated by Chargeplace Scotland,[28] and has the most rapid chargepoints per capita of any region in the UK.[29] While Northern Ireland has its own network of 17 publicly-owned rapid chargepoints, it has the fewest rapid chargepoints per capita of any region in the UK,[30] and one stakeholder noted that the 'charging network in Northern Ireland has been contracting dramatically in recent years, instead of growing, discouraging the uptake of EVs.'[31]

51. In addition, Ofgem has announced investments for network upgrades needed for 1,800 new ultra-rapid chargepoints at MSAs and key trunk road locations.[32] This funding comes as part of the RIIO ED1 price control, and funded selected investment projects proposed by distribution network operators which would support near-term network utilisation and would be deliverable within the remaining period of the RIIO-ED1 price control (ie before April 2023).[33] Relative to the RCF, this funding is focused on meeting the short-term need for grid upgrades.

52. The above public funding will help to address the barrier to entry that network upgrade costs represent, and in doing so provides an important opportunity to open up competition.

Key issue: Long-term exclusive supply arrangements

53. As described above, the Electric Highway has a high share of supply and a very strong position in competition on the motorway. Its position is reinforced by lengthy exclusive agreements with MSA operators, which are a further barrier to entry by other chargepoint operators.

[27] Welsh Government, Electric Vehicle (EV) charging strategy for Wales, December 2020.
[28] Transport Scotland, Switched on Scotland: A roadmap to widespread adoption of plug in vehicles, 2016.
[29] UK Government, Electric vehicle charging device statistics: April 2021, 11 May 2021.
[30] UK Government, Electric vehicle charging device statistics: April 2021, 11 May 2021.
[31] Northern Ireland Electric Vehicle Owners, response to invitation to comment.
[32] https://www.ofgem.gov.uk/publications-and-updates/ofgem-delivers-300-million-down-payment-rewire-britain
[33] Ofgem, Decision on the RIIO-ED1 Green Recovery Scheme, 24 May 2021.

The Electric Highway's exclusive agreements

54. The Electric Highway has exclusive agreements with three MSA operators (MOTO, Roadchef and Extra).[34] Under these arrangements, save for Tesla and in one case Ionity, only the Electric Highway can install and operate EV charging equipment at the MSA operators' main retail sites, subject to carve-outs.

55. The Electric Highway has had relationships with three MSA operators [✂]:

    (a) [✂]

    (b) [✂]

    (c) [✂][35]

56. The Electric Highway is not the only chargepoint operator at every MSA. For example, Tesla is carved-out from the arrangements with some MSAs and has chargepoints at many MSAs.[36] However, these are a 'closed network' only available for use by Tesla drivers and therefore do not compete with the Electric Highway.[37]

57. While petrol stations at MSAs are outside the scope of the exclusivity, and have some potential to install chargepoints, as evidenced above in paragraph 41, these sites have limited space, are in a less desirable location for accessing MSAs' amenities and have constraints in locating chargepoints next to petrol pumps.

58. Many chargepoint operators listed the Electric Highway's exclusive agreements as one of the most significant barriers to installing en-route EV chargepoints. Examples of submissions include:

    (a) 'MSAs have signed exclusive arrangements with another EVC provider which prevent others from installing EV charge posts in the amenities areas... …[✂] is not able to provide service on motorways due to Ecotricity exclusivity. Without fair and open competition allowing multiple EVC operators access to these critical locations, we believe the consumer offer will suffer in terms of reliability, suitability and competitive pricing.'

    (b) 'There is significant unserved demand for EV charging on the motorways, but a monopoly seems to exist with one EV operator across the MSAs

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[34] Listed in order of size. [✂]
[35] [✂]
[36] Tesla has 222 rapid chargepoints at MSAs in the UK.
[37] [✂]

meaning that other chargepoint operators [✂] cannot install chargers at those locations. That operator has a reputation for poor reliability and under-investment in hardware, thus creating dissatisfaction with drivers who are active on social media calling for other networks to invest'.

(c) 'While [✂] has not had sight of confidential contracts, some of the MSA operators have indicated they are not able to enter into agreements with [✂] due to the exclusive nature of the agreements with Ecotricity.'

(d) Electric Highway's exclusive agreements 'prevent open competition between alternative providers, where competition would see only those chargepoint operators with the best reliability and pricing offers be successful, as customers would vote with their feet. If the MSA operators were forced to run competitive tenders for multi-brand EV charging sites, awarding contracts with strict reliability and service SLAs, then drivers could be confident in buying and driving an EV for long journeys on the UK Strategic Road Network.'

(e) 'A major roadblock for the development of the sector, and for the transition to e-mobility more broadly, is the situation on the MSAs…The cumulative effect of the majority of MSAs granting exclusive rights to a single operator has been to eliminate all effective competition.'

Need for exclusive agreements and viability of within-site competition

59. The Electric Highway argued that its exclusivity is justified in order to protect its investments' economic viability, submitting that:

(a) The EV charging market is nascent and installing chargepoints requires large scale capital investment, especially where a network upgrade is required. It is a risky investment, given the highly uncertain nature of the market: investors do not know when demand for EV charging will increase, whether en-route charging will be heavily used, and whether competitors will enter.

(b) Multiple competing operators at MSAs 'would have the net result of requiring even longer agreements to be negotiated to ensure [return on investment] could be delivered'.

60. We consider that chargepoints located at the same site would compete more closely than the same chargepoints located further apart ie between-site competition, for the reasons set out at paragraph 40 above.

61. There are some existing cases of multiple chargepoint operators competing at or in proximity to the same MSA, today:

(a) InstaVolt has, since January 2021, deployed 15 chargepoints across two Welcome Break sites, alongside the Electric Highway's chargepoints.

(b) Ionity operates chargepoints alongside the Electric Highway at Extra MSAs, albeit that these are higher powered 350kwh chargepoints provided at a higher price.

(c) BP has, since January 2021, installed chargepoints at five of its forecourts adjacent to MSAs.

62. Some chargepoint operators told us that exclusivity is sometimes required in order to invest in installing EV chargepoints: one chargepoint operator stated that 'exclusivity is a necessary tool to encourage investment'; and another chargepoint operator stated that 'they would be less likely to invest in an MSA site where there was direct competition from other operators on the site, as this would likely reduce the opportunity to build a sustainable business case'.

63. However, other respondents told us that they saw less need for exclusivity at MSAs. In response to the CMA's invitation to comment, bp pulse stated that exclusivity may be required to recoup investment costs, but that it was 'unclear whether that is the case for MSAs (excluding forecourts). Another stakeholder told us that there are minimal economies of scale, and that multiple chargepoint operators at a site is therefore a 'commercially attractive proposition.'

64. The CMA notes that given the scale of charging which is expected to take place at MSAs, multiple chargepoint operators could operate within an MSA. [✂].

65. Five chargepoint operators told us that they would be willing to compete within-site at most or all MSAs, in principle. They noted that the business case would become attractive at more sites with the planned Government funding for network connections as part of the RCF.

Appendix B: On-street charging

Introduction

1. On-street chargepoints refer to chargepoints that consumers can use while parking outside or near their home, often overnight, using slow charging. On-street chargepoints are set up on the kerbside (eg installed in lampposts or bollards) and may also include car parks where residents typically park their cars on a regular basis. We refer to charging at these locations as on-street unless otherwise stated.

2. This appendix summarises relevant evidence on the development of on-street charging in the UK. It sets out the key evidence relating to the importance of on-street charging for supporting the take-up of EVs; current competition in on-street; and key issues in relation to barriers to investment from commercial challenges, difficulties faced by LAs in supporting on-street, and the risks to effective competition.

Background

Importance of on-street residential charging for supporting the take-up of EVs

3. This section sets out evidence from driver surveys, qualitative consumer research and chargepoint operator business documents to understand consumer needs and preferences for local charging.

4. The average car is parked at home for about 80% of the time, parked elsewhere for about 16.5% of the time, and only actually used for the remaining 3.5%, with the average journey being about 20 minutes.[38] Given how much time a car is parked close to the home, this is a key location for EV charging.

5. Most early EV adopters have access to home charging. A 2020 Zap-Map survey of EV drivers found that 98% of respondents had access to private off-street parking with only 1% relying on on-street parking.[39] This is illustrative of the importance of having charging options close to home, including on-street charging, for EV take-up.

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[38] RAC foundation, Spaced out - Perspectives on Parking Policy, July 2012.
[39] 83% reported having access to a dedicated home chargepoint. Zap-Map EV Charging Survey 2020, page 6. Survey conducted in November 2020. Survey results based on 1,747 respondents drawn from Zap-Map's 15,400+ opt-in online survey panel of EV owners and users.

6. Looking at the attitudes of drivers who have not yet adopted EVs, many drivers are hesitant about buying EVs if they cannot see charging options at home or close to home, highlighting the importance of on-street charging to widespread EV take-up.

   (a) An October 2020 AA survey of drivers found that one in seven drivers would not consider buying an EV on their next purchase because of a lack of off-street parking / home charging.[40]

   (b) A literature review[41] covering over 50 EV charging studies of existing EV drivers, new vehicle buyers and the general public across a number of countries (including the UK) found that home and on-street charging is the most important piece of infrastructure in convincing consumers to purchase a EV and is the most frequently used charging location.[42]

   (c) One chargepoint operator's EV consumer research (covering six European countries including the UK) found that most consumers envisage they will predominantly charge overnight at home and if they 'can't see overnight charging options [they are] likely to park [the] idea of getting an EV, intentions become more theoretical'. The research concludes that the ability to charge overnight/at home is often a crucial prospect for market development with associated cost and convenience benefits.

7. Consumer research also suggests that future EV drivers would not expect to charge an EV car in the same way as they would fuel a petrol or diesel car.

   (a) EV focus group research commissioned by a chargepoint operator[43] found that respondents thought rapid charging hubs would be used rarely or for emergency occasions which they would mainly use on longer journeys (which not many take). When they thought through the time involved for rapid charging, '20 minutes [is] an awkward time – too long

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[40] The AA Yonder Driver Poll is run across a panel of members, who are not necessarily fully representative of the general driving population. The survey was run from 13 to 19th October 2020 and was completed by 16,201 respondents. The survey found 50% of drivers (8,135 respondents) would not consider buying an EV on their next purchase, with lack of off-street parking / home charging reported as a barrier by 30% of these.

[41] Hardman et al, A review of consumer preferences of and interactions with electric vehicle charging infrastructure, Transportation Research Part D, 62 (2018), pages 508-523. This is a review of studies published from 2011 to 2017 including national household travel surveys, questionnaire surveys on EVs (to a range of respondents such as the general public, new vehicle buyers in general, consumers who own or who have trialled use of EVs) also evidence from interviews, modelling, GPS data from vehicles, and data from electric vehicle charging equipment

[42] Bailey et al., 2015; Dunckley and Tal, 2016; Franke and Krems, 2013; Nicholas and Tal, 2017; Plötz and Funke, 2017.

[43] 26 consumer group discussions across 6 countries including the UK were held between 29 October to 14 November 2018. These groups contained EV intenders and EV current drivers, with EV intenders defined as those in a position to buy an EV in the next five years, including those aware of EVs, those initially researching EVs and those thinking/planning for EV use.

not to notice, too short to really use. Petrol stations at least as they look now [are] not particularly pleasant places to be'.

(b) A March 2019 AA survey of drivers[44] found most (62%) respondents who have not yet bought an EV but would consider doing so reported that an advantage of EVs is that they can be charged while users are not waiting around eg overnight at home or in a car park.[45]

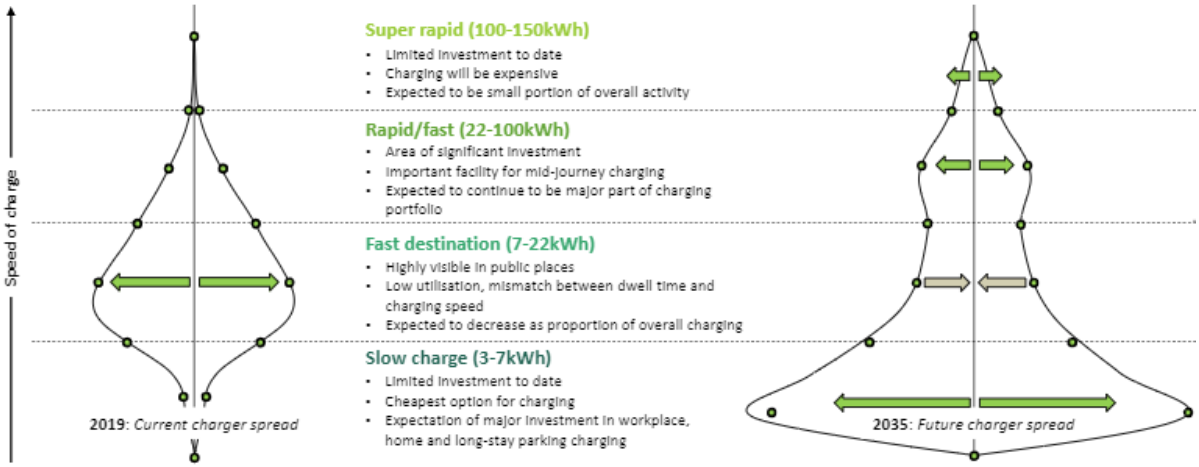
8. We also reviewed evidence from business plans and internal evidence submitted by chargepoint operators which was largely consistent with the consumer research in highlighting the importance of on-street charging to EV take-up. Evidence submitted by chargepoint operators included:

(a) One chargepoint operator submitted an internal business document that concludes 'on-street charging infrastructure for residents without off-street parking is essential to enable mass market adoption of EVs' as it offers 'the most convenient solution for EV users'. The convenience of low power charging is described as being 'the car is charged while it is parked and the customer leaves every morning with a full charge' whereas for DC high power charging, EV drivers need to drive to a specific place and wait while charging. The document concludes that low power charging wherever the vehicle is parked 'is and will remain the main charging solution for electric vehicles, covering 80-90% of energy needs of a vehicle.'

(b) Figure 1 sets out one chargepoint operator's illustration of the potential future requirement for different charging speeds 2019 compared with 2035. This shows in its view there will need to be substantial increase in low powered charging provision.

[44] The AA Populus Driver Poll is run across a panel of members, who are not necessarily fully representative of the general driving population. The survey was run from 12 to 18th March 2019 and was completed by 20,778 respondents. Results also show that the majority (71%) don't expect charging an EV to be as quick and convenient as for petrol/diesel cars.
[45] Potential EV 'considerers' exclude the minority of respondents whose current car is/will be fully electric (2% of respondents) and those who would never buy an EV (14% of respondents).

Figure 1: Current vs future EV charging requirements



Source: Chargepoint operator. [✂]

(c) An online survey by one chargepoint operator with 500 respondents[46] looked at what persuaded existing EV drivers to take-up EVs, and what put others off. It found that the majority (67%) of existing EV driver respondents would not have bought an EV if they did not have access to overnight charging at home. It also found that, out of the respondents who do not own EVs, 40% do not have somewhere to park and charge it overnight and that this was a barrier to them purchasing an EV.

(d) A chargepoint operator submitted third-party commissioned research [✂] which found that having a chargepoint at or near a consumer's home (65% of respondents) is more important than having them near or at their workplace (57% of respondents). This was based on a survey of 9,000 drivers in eight countries including the UK.[47]

9. Fast and rapid charging hubs may be another option (especially where it is difficult to locate on-street residential chargepoints) but this can take up more of a consumers' time (travel to hub, waiting for the car to charge) and is typically more expensive (see Appendix E).[48]

[46] 212 existing EV drivers and 288 'interested in EVs'.
[47] [✂].
[48] Consumer research commissioned by a chargepoint operator found that EV 'intenders' considered they would tend to use fast charging at stations in rare/emergency occasions

Competition in on-street charging

Key players

10. Chargepoint operators bid for contracts with LAs, which currently act as gatekeepers who grant access to on-street sites (see chapter 5). There are two broad types of chargepoint operator active in on-street charging:

    (a) Chargepoint operators that provide above the ground physical chargepoints with or without operation. These can include lamppost chargepoints which deliver between 3-7kWh charging and standalone charging units or bollards which deliver up to 22kWh charging. The main players include: bp pulse (formerly BP Chargemaster), Char.gy, Electric Blue, Source London and Ubitricity. In Northern Ireland the main provider of fast and slow chargepoints is EcarNI. In Scotland, LAs provide or contract out installation and maintenance but use a single back-office provided by Swarco under the Chargeplace Scotland brand.

    (b) Operators or vendors that provide long-life below the ground infrastructure (cabling) such as Connected Kerb and Liberty Charge. The chargepoint operator or another operator can connect a chargepoint onto this below ground infrastructure.[49]

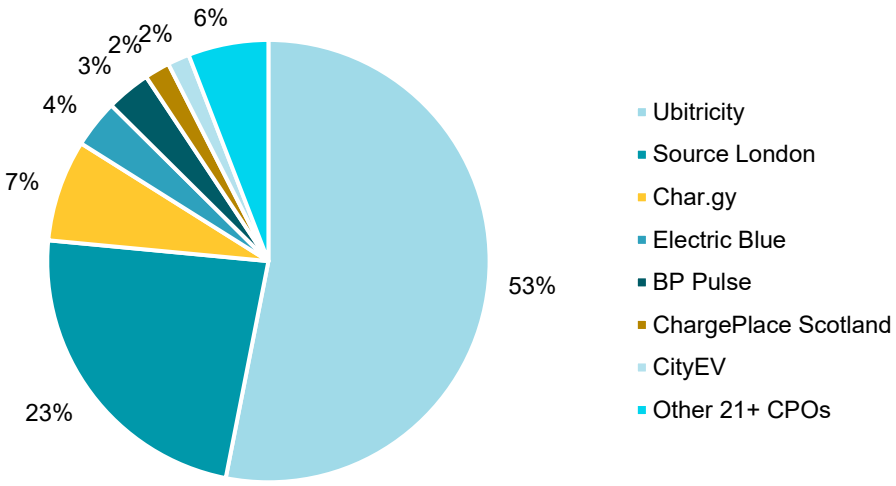
Shares of supply

11. Figure 2 shows the shares of supply on February 2021 for the number of UK on-street chargepoints. These statistics are presented for descriptive purposes and should not be interpreted as a geographic market assessment.

12. Ubitricity has the largest share of supply of 53% in on-street charging. Other chargepoint operators include Source London, Char.gy, Electric Blue, bp pulse, ChargePlace Scotland, with shares of supply ranging from 23-2%.

[49] Connected Kerb at present provides both chargepoint and below ground infrastructure on its projects. Other operators could theoretically connect their chargepoints to Connected Kerb underground infrastructure due to the interoperability of its system.

Figure 2: Shares of supply for on-street charging



Source: CMA analysis of Zap-Map data, 26 February 2021.
These statistics are presented for descriptive purposes and should not be interpreted as a geographic market assessment.

Entry and expansion

13. There has been some entry in the on-street segment, for example by ubitricity and Char.gy adding chargepoints to lampposts as an alternative to using dedicated bollards. There has also been some expansion into on-street charging from firms that started in the provision of taxi/fleet charging for LAs such as Electric Blue. Recently we have seen entrants from complementary sectors such as Liberty Charge, part of Liberty Global which owns Virgin Media.

14. The entry of new firms may have led to greater competition in tenders run by LAs to award contracts for the provision of on-street charging. However, when new entrants have won such tenders, this has mainly been to serve areas where there is a lack of on-street charging provision rather than to increase competition between on-street chargepoint operators serving the same households.

15. There has also been acquisitions of on-street chargepoint operators by operators active in rapid charging. Specifically, Source London was acquired by Total in September 2020 and ubitricity by Shell in February 2021.

Key issues

16. In the following sections we set out evidence relating to the key issues affecting the roll-out of on-street chargepoints.

17. There are two overarching concerns in the supply of on-street charging:

(a) lack of investment leading to limited and patchy EV roll-out and reduced consumer appetite and confidence in taking up EVs; and

(b) risk of ineffective competition in the longer-term leading to poor consumer outcomes for sufficient, low cost and convenient local charging options

18. A number of issues are leading to these concerns and this section sets out the evidence on each of these in turn:

(a) barriers to investment and chargepoint operator contracting needs in on-street charging.

(b) difficulties faced by LAs in supporting on-street roll-out.

(c) evidence on risks to effective competition.

Barriers to investment – commercial challenges and contracting needs

19. Chargepoint operators face a number of challenges developing viable on-street commercial models which are needed to build a sustainable EV charging network in the long-term that meets EV drivers' needs.

20. In this nascent segment there are not yet established business models or approaches for supporting large scale delivery of on-street charging, though operators told us they are ready to roll-out on-street charging on a greater scale should the right contracting and concession approaches be deployed by contracting bodies such as LAs and other relevant authorities.[50] However, this is a significant undertaking which requires a combination of contracting models that support business incentives to invest, financing solutions, motivated and resourced LAs, and strategic planning with distribution network operators (DNOs).[51]

Low utilisation when deploying ahead of EV demand

21. The single largest issue for private investment is the low utilisation of installed chargepoints, as it is typically necessary to deploy ahead of local EV uptake and demand.[52] This has meant that the business case for the installation of large numbers of on-street chargepoints has to date been poor. For example:

(a) One on-street chargepoint operator told us that at this stage on-street chargepoints are generally not commercially viable without support. It

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[50] For example, in Northern Ireland, responsibility for infrastructure sits with the Department for Infrastructure.
[51] See for example EDF/Podpoint submission Response: EDF and Pod Point (publishing.service.gov.uk)
[52] As set out earlier, drivers without access to off-street parking are likely to need to see on-street charging close to home before they will take up EVs.

stated that the usage patterns combined with a low price to use the amenity means on-street chargepoints cannot pay for their investment and running costs purely from utilisation revenue. It estimates that to breakeven it would need an average of [✂] utilisation across its network of chargepoints. At present its average utilisation across its entire network is [✂]. It considers [✂] would require a ratio for on-street of [✂] to one chargepoint (alternatively this could be achieved through a [✂] ratio with a high usage EV driver such as a taxi or a [✂] ratio for low mileage recreational EV users).

(b) Another on-street chargepoint operator provided financial modelling that indicates payback is achieved after around seven to nine years (depending on the speed of growth of the market). It also submitted that each chargepoint would need to service one to four vehicles, with two or more vehicles or a high usage user such as a taxi driver required to break even. Data on revenue per chargepoint shows it is loss-making on most chargepoints.

(c) Similarly, the business case for on-street chargepoints was not obvious to LAs. Oxford City Council thought that on-street chargepoints were not an attractive business model for a chargepoint operator given the cost of installation and annual maintenance against a potential initial revenue of only around £500 per chargepoint per year (<£1.50 a day) and chargepoints unlikely to grow beyond 10% utilisation.

22. In light of low utilisation, many operators told us that grant funding for LAs procuring on-street charging is very important.[53] See paragraphs 47-52 on the grant funding available, in particular for capital costs of on-street chargepoints.

Contract lengths

23. Long payback periods as a result of low utilisation has meant that operators have looked for long contracts to justify investment. For example:

(a) One chargepoint operator told us that it required scale and contracts in excess of 15 years to provide the required return.

[53] One chargepoint operator submitted that LAs are dependent on grants, so therefore it is also dependent on these grants.

(b) Another operator told us that while contracts can be two or three years, if they are 10 years or more its financial model means that it is able to contribute to the funding of the chargepoint.

24. While chargepoint operators have sought long term contracts, the availability of these have varied across LAs. For example:

(a) Milton Keynes's contract [✂] (covering a variety of slow and fast charging) has a [✂] year term. Milton Keynes [City] Council stated that longer contract lengths are attractive as they get certainty of having a viable network.

(b) Oxford City Council told us that since concession contracts for on-street are really only available in areas with high utilisation, the best areas for charging in the cities are being operated by chargepoint operators on very long contracts. Oxford City Council told us that it had extended its initial on-street contracts under the Go Ultra Low Cities scheme for lamppost chargepoints by another year.[54]

(c) In London, contract terms under recent tenders have generally between five to eight years depending on the purchasing framework used.

(d) Nottingham City Council's contract with bp pulse is an initial term of [✂].

The role of scale and density

25. We have been told by a number of operators that scale and density are important.

26. Some chargepoint operators told us that the nature of costs that they face also encourages density of provision. For example:

(a) A chargepoint operator told us that the upfront cost of digging up streets to install below the ground infrastructure is a factor encouraging it to deploy dense networks at scale. It told us that 50% or more of its costs goes into digging the streets. To future proof its sites for future demand (and reduce digging costs over time), it tends to install between five-10 chargepoints on each residential street which involves installing five-10 node boxes below ground and with five-six active chargepoints. By way of an example, [✂]. It does not favour alternative lower density strategies, for example providing one to two parking spaces per location is a less attractive business proposition, as the lack of scale makes them

[54] [✂]

expensive to pay for and maintain and means that as demand rises, the street will have to be re-dug repeatedly.

(b) Another chargepoint operator submitted that service and maintenance are its biggest costs and it is cheaper to maintain a dense charging network over a smaller area to minimise time travelling to chargepoints.

27. Scale helps alleviate some of the commercial challenges in terms of dealing with procurement, choices of site location and liaising with lots of LAs. Related to this:

(a) Some chargepoint operators said that consistency in frameworks and procurement requirements across LAs would help reduce their costs in liaising with lots of LAs (see later section).

(b) A chargepoint operator noted that scale is important for accessing lower cost capital funding from infrastructure financers. It also gave us an example of how it is 'bundling' projects together in order to increase the overall size as this would help it achieve lower cost infrastructure financing.

28. Scale may also address coverage issues while balancing the need to support business incentives to invest. Oxford City Council acknowledged that operators will naturally tend to pursue the most attractive areas with highest likely utilisation rates and so other areas with lower initial likely utilisation would have poorer coverage. It considered that a solution to help increase commercial incentives may be to issue contracts at scale, with requirements for installation to include some provision in areas with lower utilisation.

Exclusivity

29. Some chargepoint operators told us that some form of exclusivity may be necessary to enable them to recoup their investment in the immediate term, although this may be less necessary longer-term in some densely populated areas as EV demand increases.

(a) One chargepoint operator asks for no rival chargepoint operators to be within 250 metres of its chargepoints (although it stated it would agree to having [✂] chargepoints from other operators on the same street).

(b) Another chargepoint operator told us that its standard exclusivity term was [✂] years.

(c) Oxford City Council told us that for on-street, it had not entered into exclusivity clauses, although it had heard of long contracts elsewhere of 15 years with exclusivity clauses.

Variation in procurement process across LAs

30. Some chargepoint operators told us that LAs each run their own procurement differently and this raises costs for chargepoint operators in engaging with these tenders. For example, a chargepoint operator submitted that one of the main barriers to installing on-street chargepoints is that framework agreements are fragmented across the country, requiring operators to work with several frameworks and LAs per installation.

Difficulties faced by LAs in supporting on-street roll-out

31. LAs face a number of challenges for supporting on-street roll-out. This section sets out evidence on the nature of the challenges.

Lack of clear LA role and mixed appetite among LAs

32. Many stakeholders told us that chargepoint provision (including in terms of scale and coverage) is constrained by a lack of clarity in, and support for, the role LAs play in enabling EV roll-out.

33. For example, London Councils, Transport for London (TfL), the GLA and the Local Government Technical Advisers Group (LGTAG) submitted that the role of LAs for local EV charging roll-out is not closely defined.

> Whilst there are strong messages from central government to extend charging opportunities, there is no obligation or duty on authorities to do so in the same way as there is in respect to general asset maintenance of the highway…There is no obligation even to provide an outline strategy for how charging facilities will be developed in future, along the lines of that pioneered for Local Cycling and Walking Implementation Plans for example.

34. The submission also stated that the provision of comprehensive national guidance[55] for LAs on how best to develop an EV chargepoint implementation

[55] LGTAG suggested that improvement in the consistency of approach across LAs through provision of common guidance setting out how to develop an EVCP Implementation Plan could be a relatively low cost way in assisting the creation of a consistent market, potentially increasing attractiveness for private sector investment.

plan would be a good place to start in helping to remove barriers to market development from public sector actors.

35. Stakeholders told us there are bottlenecks for on-street roll-out arising in some cases from lack of appetite by local leadership to set direction on these issues and competing considerations of the needs of different street users. For example:

    (a) A chargepoint operator told us that LAs fear that deploying chargepoints will create street clutter and that LAs have to balance this with for example disability access on pavements.

    (b) Nottingham City Council told us that it avoided on-street charging due to concerns around street clutter, as well as potential concerns around seeming to allocate parking bays to specific users (EV owners) where on-street parking is naturally limited, or creating a postcode type lottery where one street got chargepoints but another didn't.[56]

No clear team and lack of capability within LAs

36. Several chargepoint operators and other stakeholders told us that there was sometimes no clear team with LAs responsible for EV charging and on-street charging delivery and this can make it more difficult for chargepoint operators. For example, the Local Government Association told us that responsibilities for EVs varies across LAs (it could sit in transport, climate change, parking etc) and without a formal place for it to sit, the ability to share knowledge and oversee effective roll out becomes difficult – ultimately no-one has clear responsibility for EVs and this also makes it hard for operators to establish who is responsible and who they should engage with.

37. LAs and chargepoint operators told us that lack of expertise within LAs constrains on-street delivery and consequently that more support to enable LAs to fulfil this role would be beneficial. For example:

    (a) A chargepoint operator told us that EV knowledge / capability varies a lot across LAs, directly affecting their ability to articulate their EV requirements to the market and develop economically viable propositions that operators want to bid for. It recommended that national government policy focus should shift to funding the education of all LAs on how best to deploy charging points within the EV market.

[56] In a related point, Oxford City Council told us that as part of on-street technologies they are testing they were looking at installing gullies to allow cables to go under the pavement from the car to users' homes.

(b) Nottingham City Council told us that there is a vast difference between LAs as to the amount of expertise on EV charging and that LAs can struggle to apply successfully for grant funding schemes. It would be useful for LAs that are starting in this area to have broader support to fulfil all the necessary stages involved including operational, connection and planning considerations.

Lack of central support

38. Some stakeholders told us that LAs could be better supported by greater central support and direction. For example, Liberty Charge told us that 'LA capabilities and process complexities are the key barrier for on-street charging […] and this needs to be addressed through much greater policy direction from government'. It also flagged the need for cross-agency co-ordination alongside financial assistance for resource and expertise at LA level, as well as other enabling mechanisms to fast track deployment.

Lack of planning and coordination

39. A number of stakeholders told us of the need for, and benefits of, improved local area EV charging planning. For example, Engie recommended that more focus should be given to forecasting infrastructure requirements at both a national and local level. It said that investment decisions would be enhanced with local area energy planning by the public sector and by the provision of data to help coordinate and support the efficient rollout of EV charging infrastructure.

40. The evidence also illustrates the need to develop a better understanding of future electricity network demand and upgrades. For example, the NAO found that there is currently no single data set for planning purposes to show which residential areas will pose the most serious challenges to installing chargepoints or where additional network infrastructure will be needed.[57] Oxford City Council told us currently LAs are investing in 'sweet spots' (ie where network infrastructure is already there and installation is cheap) rather than adopting a strategic approach.[58]

41. London City Councils, together with TfL and GLA, has been particularly active at planning on-street delivery. An EV Taskforce was set up in 2018, comprised of public sector and chargepoint operator representatives, which

[57] Reducing carbon emissions from cars (nao.org.uk) paragraph 2.22
[58] NCC also told us that in rural areas a lack of power supply can make it difficult to find a suitable site for chargepoints, while in urban areas there can be issues with the cabling underground that makes certain sites unsuitable.

set direction in terms of modelling the number and mix of chargepoints needed, along with initiatives to facilitate smoother installation. These include a pan-London coordination body and a tool to identify energy network constraints and areas where new charging capacity will be cheaper and easier. Further analysis by the ICCT,[59] building on the work of the EV Taskforce, looked at borough level infrastructure needs.

42. The evidence also indicates that there are bottlenecks in coordination and information flow between LAs, DNOs and chargepoint operators which can constrain on-street roll-out.

43. Many chargepoint operators said there were challenges in engaging with DNOs – for example it can be a slow process to obtain quotes, understand costs and get the necessary connections, with variations in approach between DNOs. There was recognition that DNOs could play a greater role in helping chargepoint roll-out e.g. through strategic planning – but they are not currently sufficiently incentivised (see chapter 3).

44. Nottingham City Council told us engagement with DNOs is a bottleneck with, in its view, the inconsistent interpretation of regulations across DNOs meaning that different information is provided for different costs (although this is better than previously, it still presents challenges).

Lack of demand-led approach

45. The evidence indicates that there has been a lack of a demand led-approach in developing on-street charging with LAs tending to focus on 'quick wins' rather than planning for on-street provision more broadly.

46. For example, Nottingham City Council told us that almost all its chargepoints are installed in council-owned car parks with no kerbside on-street chargepoint provision. This approach was decided early on because this was seen as the best way to get chargepoints installed relatively quickly given funding constraints and concerns about the needs of different street users.

47. This contrasts with the demand-led approach taken by some London boroughs, where planning of new chargepoint installations is informed by data collected from residents without off-street parking via an online chargepoint request form.[60]

[59] Fulfilling electric vehicle charging infrastructure needs in Greater London and its boroughs (theicct.org), 2020
[60] See also London case study in chapter 5.

Difficulties relating to government funding schemes

48. The main UK Government funding scheme aimed at on-street residential charging is the On-street Residential Charging Scheme (ORCS), launched in 2017. This scheme is available for LAs throughout the UK.[61] Chapter 5 sets out more details on the level of funding and the patchy uptake by LAs. Evidence indicates there are some funding bottlenecks for LAs.

49. ORCS partially funds capital expenditure (it provides funding of up to 75% of the capital costs of procuring and installing the chargepoint and an associated dedicated parking bay where applicable). The remaining 25% has to be raised privately or funded by the LA. In most cases this funding element has been provided by the LA, but the scale in which they can do so is limited. In particular:

    (a) One chargepoint operator told us that it has become apparent over the past two years that in most instances LAs do not have either the capital available to deploy at the scale required to drive the transition to EV, nor the risk appetite to invest ahead of the EV adoption / demand curve.

    (b) London Councils told us that in the last couple of years it has been difficult for LAs to provide the capital funding independently. It stated that for most London Boroughs, a key source of capital funding has been Local Implementation Plan funding through TFL.

    (c) Milton Keynes Council told us that currently it does not have the financial capacity to fund 25% of a new EV project.

50. Grant funding is also not generally available to help cover LA resource costs, thereby reducing the ability and appetite of LAs to proactively lead roll-out. To access ORCS funding, a LA needs to put together a scheme plan and then apply for funding of that plan. This requires LAs to use their own funding and resources or incur external consultancy fees (these costs are not covered by any scheme). In addition, post-implementation, LAs need to manage the chargepoint operator and the contract. In relation to this:

    (a) A chargepoint operator stated that providing EV chargepoints for residents is a new obligation for councils and that council budgets have been especially stretched by Covid-19 response programmes on top of austerity-related cuts in funding from central government.

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[61] Other major schemes that have included on-street residential charging is GULC which had a £85 million fund (2017- 2020) that had the aim to create a cohort of eight exemplar cities or regions that would lead the way in promoting electric vehicles, tackling air quality, and reducing carbon emissions. The Go Ultra Low Cities were Oxford, Milton Keynes, Nottingham, York, Dundee, London, the West of England, and the North East.

(b) Milton Keynes council told us that one of the biggest challenges for LAs is the ongoing issue of maintaining and keeping the charging networks operational.

51. Some LAs have been able to fund part of their resource costs via contractual arrangements with the chosen chargepoint operator, but development of these arrangements happens after the LA has incurred what can be significant resource costs to get to the tender phase.[62]

52. Another issue is that annual funding rounds for schemes and the need to implement a scheme within the funding year has led to a stop-start approach to installing chargepoints. Nottingham City Council told us that it approached the problem by setting out a total procurement value of £23 million, not just the initial £2 million required because they knew that there were various government funding schemes that they might be able to access over time.

53. Furthermore, some chargepoint operators told us that the focus on grant funded capex creates the risk that LAs will not explore different types of contract that can support commercially viable business models, for example:

(a) through longer term contracts that allow operators to recoup private sector investment;

(b) business models based on installing 'dormant' infrastructure upon which additional 'active' chargepoints can be more easily and cheaply expanded as and when sufficient demand increases. One chargepoint operator told us that current funding schemes tend to exclude these models as they pay out per active chargepoint; and

(c) using complementary activities such as the repairing of roads as an opportunity to also install chargepoints. Milton Keynes told us that this was an approach they considered and sought OZEV funding for – therefore more flexibility in funding would support this.

54. More broadly, some chargepoint operators told us that LAs may wait to initiate tenders until receiving grant funding; but grant funding may not strictly be necessary in all cases to support commercially viable concession contracts (for example, if LAs provide sufficient tenure to the chargepoint operator).

[62] One LA told us that it obtained through the tender process a guaranteed minimum payment of £[✂ pa for [✂] years from a chargepoint operator. This effectively pays for a single member of staff to be the liaison across the 20 local authority areas that are part of the scheme to help establish the network.

Risks to effective competition

55. There are a number of risks to competition in the on-street segment and we set out further evidence on this below.

Ultra-local competition for EV drivers

56. Demand for on-street charging is likely to be highly localised, so strong competition for drivers among chargepoint operators ('within-market' competition) in this segment may be difficult to achieve. Evidence from on-street chargepoint operators indicates that EV drivers value convenience and proximity to home. For example:

    (a) One chargepoint operator told us that on-street residential is 'hyper-local' with each chargepoint likely servicing one-to four vehicles; and

    (b) Another operator told us that for their regular charging needs, drivers want to charge as close to home as possible, wherever they park normally. It uses a 30-50 metre radius as the distance an on-street parker will tend to walk from their home to a chargepoint.

    (c) Qualitative consumer research[63] commissioned by one operator found that location is important for those relying on on-street parking, with the distance to the next chargepoint seen as main obstacle for those without access to home charging and chargepoints outside the home preferred to those 'close to home'. On-street chargepoints further from home or destination charging tends to be used for 'serendipitous top-ups' or emergency charging when there is no other option.

57. Alongside this, EV drivers tend to engage in habitual charging with familiar chargers used over other options. For example, one on-street chargepoint operator has found that its customers tend to have up to three preferred chargepoints and should these not be not available, they will wait until the next day to use them rather than seeking other options.

Local Authority role in tenders and setting prices

58. The evidence also highlights that some LAs favour working with a single chargepoint operator for on-street charging[64] on LA-owned sites and are not actively thinking about competition.[65] A number of stakeholders told us that it

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[63] Based on 26 consumer group discussions across the six countries.
[64] For example, Nottingham City Council issued a contract on LA-owned sites to a single chargepoint operator. Dundee City Council appointed Swarco.
[65] London is one of the few examples where more than one operator is present locally, though in the examples we have seen this tended to be on adjacent streets rather than on the same street.

takes time and resource for LAs to prepare procurement and concessions, reducing the frequency in which LAs engage with market. For example:

(a) Nottingham City Council told us that [✂] it has had operators enquiring about installing chargepoints in the area (for example recently an operator relatively new to the market contacted them wanting to install around 100 chargepoints). However, Nottingham City Council reported practical challenges for resourcing because engagement with other operators implies a resource cost for LAs in terms of running the procurement process. Even if operators bring their own resource there are costs for the LAs in terms of having the relevant conversations, so Nottingham City Council needed to think whether just to focus on the existing network or potential new opportunities.

(b) A chargepoint operator told us that it about has recently seen unsuitable frameworks (procured a long time ago and without most market participants included) being used to quickly procure a stopgap solutions to community requests for charging, rather than investing thorough procurement processes.

59. Many stakeholders told us there are complexities for LAs in engaging with the sector and difficulties in assessing value. For example,

(a) [✂] told us that a number of operators have recently offered fully funded chargepoints including for slow charging with much longer contract terms (around 20 years), but the lack of LA resource to assess these opportunities and determine whether they are good value for money is a barrier.

(b) A chargepoint operator told us that customers like LAs often have a limited knowledge of the EV market and are looking for a 'trusted advisor' to guide them through the process of EV charging and help them understand the available financing options. On the prospects of introducing staggered contracts with different operators locally, this would not be a favourable model because LAs often seek a single solution and want to build a relationship with a specific supplier within a specific segment of the market.

(c) The Local Government Association said procurement can be difficult as the offers or approaches they get from different chargepoint operators are often made on a very different basis, making it difficult for councils to compare and assess which is ultimately best. On top of this, each LA has varying fleet profiles and traffic networks which contributes to the difficulty in comparing offers.

60. Evidence from chargepoint operators indicates that in many cases LAs play an important role in setting prices,[66] rather than using the competitive tendering process to determine prices. In particular, LAs are generally setting on-street charging prices largely by reference to the prices that other LAs set, rather than using the competitive tender process to determine prices.

[66] Charging prices may be set by an LA under a concession agreement when an LA awards a site for on-street charging to a chargepoint operator. Alternatively, an LA can own the chargepoint and set this charging price directly. For example, one operator told us that although it provides guidance, it is the LA that decides the PAYG price for charging (currently [✂] pence/kWh across most locations). Another operator told us that although it sets the price of chargepoints on the majority of its network, it does not do so for third-party owned chargepoints which have their own common back office system.

Appendix C: Home and workplace charging

Introduction

1. This appendix sets out relevant evidence and analysis on home and workplace EV charging. It provides background information on these segments, evidence relating to current competition and the supply and demand-side issues identified in home and workplace charging as set out in chapter 6. We did not find any key issues relating specifically to competition in destination charging (as discussed in chapter 6) therefore we have not covered it further in this appendix.

Home charging

Background

2. It is estimated that around 80% of EV charging is done at home and it is expected that home charging will remain a key part of the sector going forward.[67] For those that have access to a garage, driveway or other off-street parking, it can also be a highly convenient and cost-effective charging option (see Appendix E for an assessment of the price differential between different charging segments).

3. Smart charging, which allows charging to be modulated and scheduled during off-peak periods when demand on the electricity system is low, benefits consumers through cheaper electricity tariffs and also allows better balancing of the electricity system. Shifting EV charging demand to off-peak times will minimise network congestion, reduce the need for network upgrades and maximise the use of clean, renewable electricity.[68]

4. The UK Government has supported the development of the home charging segment in the four nations through the provision of UK-wide grants via the Electric Vehicle Homecharge Scheme (EVHS) (formerly the Domestic Recharging Scheme, DRS). These grants go towards the cost of installing a home chargepoint. In Scotland, an additional grant of up to £250 is available,

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[67] DfT, Electric Vehicle Charging in Residential and Non-Residential Buildings, page 6, July 2019. A 2020 Zap-Map survey showed that 83% of respondents (EV drivers) had access to EV charging at home. A document provided by one chargepoint operator projects a shift from home charging towards workplace and public charging over the years to 2025, but with strong demand for home charging remaining. It projects the share of charging that takes place in the home to decline from 75% in 2020 to 60% in 2025 (although it also notes that this will depend on the quality of public networks).
[68] DfT, Electric Vehicle Smart Charging, paragraphs 1.4-1.6.

with a further £100 available for those in the most remote parts of Scotland.[69] Since July 2019, eligible chargepoints for the EVHS have been required to be capable of smart charging.[70]

5. Through the EVHS, and its predecessor the DRS, UK Government has provided over £100 million in grant funding and supported the installation of nearly 180,000 home chargepoints.[71] The National Audit Office (NAO) estimates that 9% of total UK Government spending on supporting EV infrastructure has been spent on the EVHS and DRS.[72]

6. Since the inception of the EVHS in 2014, grants have declined from £900 in 2014 to £350 in 2020 and to date. In February 2021, UK Government announced changes to the existing EVHS and an intention to re-focus the scheme on leaseholders and those in rented accommodation, which it confirmed in its recently published 2035 Delivery Plan[73] These proposed changes are detailed in paragraphs 31 to 32.

7. The UK Government is supporting the home charging segment and encouraging the adoption of smart charging in other ways in addition to providing grant funding:

   (a) Following consultation, the UK Government recently announced plans to require all home and workplace chargepoints installed in the UK to be smart.

   (b) It is currently consulting on proposals to alter building regulations for new residential buildings to include requirements for EV chargepoint installations.

8. As set out in the main report (see chapter 2) the supply of electricity to homes (and, therefore, to home chargepoints) is regulated by Ofgem in Great Britain and Uregni in Northern Ireland, however chargepoints are not in themselves regulated.[74] Ofgem is also responsible for consumer protection in energy supply and sets rules on the communication of information to consumers by energy suppliers among other aspects.[75]

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[69] This grant funding is made available to Scottish residents through the Energy Saving Trust. Energy Saving Trust: Domestic charge point funding.
[70] DfT, Electric Vehicle Smart Charging, paragraph 1.7,July 2019.
[71] As of April 2021. Electric vehicle charging device grant scheme statistics: April 2021.
[72] NAO, Reducing Carbon Emissions from Cars, paragraph 2.18, February 2021.
[73] The EVHS historically has only been eligible for residents at the property where the home chargepoint is installed, which has prevented owners of rented properties or freeholders of leasehold properties from applying.
[74] Ofgem, What you need to know about selling electricity to electric vehicles users, page 3, October 2019.
[75] See Ofgem, Guides to Supply Licences for further information.

Competition in home charging

9. In this section, we set out estimated shares of supply (based on EVHS data provided by OZEV)[76], provide a brief overview of the key players currently active in the supply of home chargepoints in the UK and consider entry in the home charging segment.

Shares of supply

10. Table 1 sets out the top 20 chargepoint operators in home charging, based on EVHS approved chargepoints to March 2021.

Table 1 EVHS funded chargepoints installed per year by top 20 manufacturers[77]

Row Labels	2014	2015	2016	2017	2018	2019	2020	Total	% of Total
POD Point	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
bp pulse	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Rolec Services Ltd	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EO Charging	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
myenergi	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Schneider Electric	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Andersen	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Ohme Technologies	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Indra Renewable Technologies Ltd	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Wallbox Chargers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Atess	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Keba	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
NewMotion	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Growatt	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
APT Controls	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Alfen B.V	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EVBox	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Chargepoint Services	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
eHome	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Easee	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

[76] There is no requirement to register a privately funded chargepoint so data on the number of chargepoints installed in homes is likely to be an under-estimate. The available data is based on chargepoints installed through the EVHS.
[77] We understand that there may be some errors and inconsistencies arising from how information was entered in the database.

Unknown	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: OZEV.

11. The data in Table 1 suggests that the home charging segment to date has been characterised by high levels of concentration, with the top three manufacturers - Pod Point, bp pulse and Rolec - supplying a significant majority of the segment since 2014 [70-80%] ([✂]%) in 2020).

12. However, while these figures remain high, the data also shows that there is a long tail of providers in home charging, with new suppliers entering frequently in recent years. It also indicates that newer entrants may be able to compete with the more established players. Some of those companies outside of the three biggest providers have been growing in recent years[78] and the success of new entrants is a positive sign for competition going forward.

Chargepoint operators

13. As can be seen from Table 1, there are a number of companies currently active in the supply of home chargepoints in the UK. For the purposes of our study, we refer to each of these companies as chargepoint operators (though we note that some of these firms only sell home chargepoints and do not provide public charging networks). We provide here brief descriptions of the top five players, according to EVHS data, as well as selected others.

- **Pod Point**: UK-based manufacturer and installer of chargepoints, focused on home and destination charging. EDF acquired a majority stake in Pod Point in 2020. Generated revenue of approximately £[✂] million from the supply of UK home chargepoints in 2019.

- **bp pulse (formerly BP Chargemaster)**: acquired by BP in 2018. Active in home, fleet and public charging. Generated approximately £[✂] million in revenue from the supply of UK home chargepoints in 2019.

- **Rolec**: UK-based, Rolec manufactures and installs chargepoints, with a focus on home and fleet charging. Estimated revenues from the sale of home chargepoints of approximately £[✂] million in 2019.

- **EO Charging**: UK-based company founded in 2015. Manufacturer of EV chargepoints for home, fleet and destination charging.

[78] For example, EO Charging, myenergi, Anderson, Ohme Technologies, Wallbox and NewMotion.

- **myenergi**: Manufactures a range of devices for home energy management (including smart chargepoints). [✂].

- **NewMotion/Shell**: NewMotion operates the largest EV charging network in Europe. It was acquired by Shell in 2017. Supplies home chargepoints in addition to operating its public network. Estimated revenues in the home charging segment of £[✂] million in 2019.

- **Tesla**: manufactures home chargepoints for Tesla cars in addition to operating its Supercharger network.[79]

Entry and competitive outlook

14. Documents and submissions from chargepoint operators indicate that current providers anticipate entry from other providers and strong competition in future in home charging. A number also recognised a need to innovate to remain successful, for example:

    (a) One chargepoint operator noted in an April 2020 strategy document, the risk from new entrants, particularly entry by retail energy providers. In a December 2020 financial review, the same chargepoint operator stated that 'competition and price pressure will be very strong – as [home charging] remains the entry point' and that it expects gross margins to decline steadily in the years to 2030. Its financial review document showed that it anticipates:

        (i) greater competitive challenge from new and recent entrants than from one of the main current providers.

        (ii) high competitive challenge from two currently much smaller suppliers.

        (iii) high potential competitive threat from a potential entrant.

        (iv) medium competitive challenge from two further smaller suppliers due to the advanced features of their respective units.

    (b) Another chargepoint operator's competitor analysis indicated that newer entrants had brought to market wider and more innovative feature sets than those of the larger suppliers. The chargepoint operator told us that 'there are a great number of existing and potential competitors in this field'

[79] Tesla's home chargepoints do not qualify for EVHS grant funding. The list of chargepoints eligible for the EVHS can be found at EVHS: approved chargepoint model list.

and that this pressure meant it 'must continue to innovate in terms of its product, service and offering'.

15. We received fewer documents from newer entrants, however these documents similarly suggest positive signs for competition in home charging. For example:

(a) One chargepoint operator submitted that [✂] had an ambition to make the company the market leader in the UK. Internal documents [✂] show that it had commissioned consumer research to help it understand the emerging EV sector and how it might grow its presence in EV infrastructure, including in home charging.

(b) The strategic plan of one chargepoint operator describes an intention to make its offering in home charging more mainstream, including by scaling up its operational capacity.

16. As well as chargepoint operators, many other stakeholders told us that they considered the home charging segment to be competitive. For example:

(a) Energy UK noted that '[in] home and off-street charging, there is a significant amount of competition and this segment is the most established'.

(b) E.ON told us that 'there are good levels of competition in a number of market segments including home'.

(c) Northern Ireland Energy Networks stated that 'the market place for off-street home charging is becoming well established … offering different features across a wide price range'.

(d) The Society of Motor Manufacturers and Traders said that competition in home charging is expected to intensify as the rollout of chargepoints is expanded and that the segment is 'likely to see a number of new market entrants with bundled offerings'.

17. Several submissions also noted that the investment required to enter home charging was not significant compared to other segments.[80] This was supported by internal documents from one chargepoint operator which stated that entry in home charging required 'small capex' and that home charging was 'very scalable' for entrants.

[80] EDF, Motor Fuel Group [✂] responses to CMA Invitation to Comment.

18. We sent further detailed questions to a range of chargepoint operators currently active in home charging, including a number of smaller operators. All respondents to our questionnaire considered the segment to be characterised by low barriers to entry and expansion. Responses received from new suppliers as well as established players consistently considered this to be the case, with respondents citing the number of recent entrants as evidence of low barriers. An internal document from one chargepoint operator identified a risk to its home charging business as 'barriers to entry are low, and cheaper products could put pressure on price and erode margin'.

Key issues

19. We have identified four issues in home charging:

(a) The role of vehicle manufacturers and car dealerships in providing information and advice to consumers.

(b) Lack of open standards for controls and data.

(c) The potential effect of proposed changes to the EVHS.

(d) The potential risks from increased bundling.

The role of vehicle manufacturers and dealerships

20. Evidence from a number of different sources has highlighted the importance of vehicle manufacturers and car dealerships to consumer decision-making in home charging:

(a) Several respondents to our ITC noted that vehicle manufacturers and dealerships were often relied on by consumers to provide information on home chargepoints.[81]

(b) A research document prepared for one stakeholder found that 'home charger choice and install [is] steered by car deal/dealer' and that consumers' own research into chargers tended to be 'cursory and quick'. It found that consumers were 'not weighing up the options in much detail' and had little mental capacity to take on real research into chargers after making the decision to switch from an ICE vehicle to an EV.

(c) Research commissioned by a chargepoint operator found that dealerships 'are well placed as a conduit for ancillary sales' and 'may well be first port

[81] See ITC responses from E.ON, EDF and Pod Point, Rightcharge, Electric Highway Company, and Iduna.

of call for less self-motivated third wave consumers'. It noted that dealerships 'clearly have had [a] key influence on how individual markets have developed'.

(d) Estimates provided by chargepoint operators for the proportion of home chargepoint sales that are made via vehicle manufacturers and dealerships ranged from 21% to 42%. Research provided by one chargepoint operator found that sales via vehicle manufacturers and dealerships were the 'main route to market', with 45% of sales in major European countries estimated to be made this way.

21. Similarly, work carried out by Ofgem has highlighted that car dealerships are an important touchpoint and source of information for consumers.

22. However, there is evidence of issues with the role that vehicle manufacturers and dealerships play. Respondents to the ITC raised concerns that vehicle manufacturers and car dealerships were themselves frequently not well informed.[82]

23. We have also seen evidence that, through 'preferred partner' arrangements with chargepoint operators, vehicle manufacturers and dealerships can recommend certain chargepoints and incentives can be offered to sales staff where referrals convert to sales. This can mean that consumers are not fully informed of the choices available:

(a) One chargepoint operator told us that discounts for qualifying customers (ie those referred by the vehicle manufacturer or dealership) ranged from [✂]off the recommended retail price.

(b) Another chargepoint operator provided a list of discounts that it offered to customers and to vehicle manufacturers,[83] ranging from [✂] off the price of a home chargepoint. We also found instances of chargepoint operators offering vouchers to sales staff as incentives for successful referrals.

(c) Another chargepoint operator provided a recent agreement with a vehicle manufacturer which similarly included the payment of referral fees per completed sale.

(d) One chargepoint operator, which told us that it does not sell its products via this channel, told us that vehicle manufacturers and dealerships were not incentivised to provide proper signposting for EV adopters and that

[82] See for example ITC responses from E.ON, Rightcharge, Electric Highway Company, and Iduna.
[83] Where vehicle manufacturers offer customers a home chargepoint for free at the time of EV purchase and bears the cost itself, the vehicle manufacturers then benefits from the discount offered by the chargepoint operator.

vehicle manufacturers represented a potential barrier to market access where they referred new EV adopters to their 'preferred partners'.

(e) A number of ITC submissions similarly noted that dealerships can make recommendations based on partnerships with chargepoint operators, and that this hindered consumers' ability to make informed purchases.

Open standards for controls and data

24. We received a number of submissions relating to different types of home chargepoint 'interoperability', in particular:

(a) compatibility between the home chargepoint, different energy suppliers and different energy tariffs (and the need for the home chargepoint to retain smart functionality upon switching);

(b) open standards for controls and data which enables compatibility of home chargepoint interface systems with third parties; and

(c) compatibility between the home chargepoint and the proprietary operating system of different chargepoint operators (ie so different operating systems could be used with different home chargepoints, as well as the chargepoint kit being compatible with EVs and energy tariffs - 'full interoperability').

25. As regards compatibility with energy suppliers and energy tariffs, all chargepoint operators that responded to our home charging questionnaire recognised the need for this type of interoperability. Operators consistently told us that their chargepoints were interoperable with any energy supplier or tariff. Some stakeholders told us that difficulties had arisen in the early development of smart metering and that, in some instances, smart functionality had been lost following a change in energy supplier. These stakeholders told us that the same problems must be avoided in EV home charging. We note recent announcements by UK Government that it will require smart home chargepoints to be designed so they do not lose smart functionality when people switch supplier.

26. In regards to the second type of interoperability, some stakeholders highlighted the risks of closed standards for home chargepoint controls and data for competition, innovation and consumer outcomes. For example:

(a) Centrica told us that closed software systems in home chargepoints do not allow hardware to be managed by other providers and therefore risk consumers being locked in to one chargepoint operator. Centrica stated that it supported the adoption of open data standards in EV charging and

that, by allowing consumers to request data stored by chargepoint operators and allowing third parties to use this data, third parties would be able to offer new propositions to consumers.

(b) Calisen submitted that there was a need for interoperable communications standards in the home charging segment and that this would allow consumers to shop around, rather than being tied to a particular solution.

27. Several chargepoint operators raised concerns around requirements for full interoperability between chargepoint hardware and the proprietary operating systems of other providers. Chargepoint operators generally considered this kind of interoperability to be inappropriate particularly at this early stage of the sector. For example:

(a) One chargepoint operator told us that there was no clear need for full technical interoperability between hardware and software offerings of different providers.

(b) One chargepoint operator told us that full technical interoperability could disincentivise investment and innovation in the segment.

(c) Another chargepoint operator told us that the technical standards being developed by the BSI (which include requirements around interoperability) should not be mandated. It said that while there is a need for elements of interoperability, the implementation of mandatory standards would add complexity and cost and that 'full interoperability' was inappropriate at this stage in the sector.

28. In our view, interoperability requirements should focus on the need for open data standards, rather than necessarily requiring software systems of different providers to be interchangeable and compatible with all chargepoint hardware. As has been seen in other markets, open data can bring significant benefits for consumers.

29. In retail banking, for example, common and open application programming interfaces (APIs)[84] facilitate the secure sharing of banking transaction data (known as 'Open Banking' - see Box). With the permission of the consumer, Open Banking allows this data to be shared with trusted third party providers which are then able to use this data to provide innovative add-on services for consumers (eg budgeting apps).

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[84] Open Banking was introduced following the CMA's market investigation into retail banking. See CMA, Retail banking market investigation final report, August 2016.

Box X: Open Banking

Following a market investigation into competition in UK retail banking market, the CMA implemented a remedy requiring banks to implement 'Open Banking.'

Open Banking allows customers to share their current account data through secure, standardised and open Application Programming Interfaces (APIs) with trusted third-parties without having to disclose their online credentials to them. This has a number of benefits, including allowing consumers and businesses to use digital comparison tools to obtain bespoke advice on the best current account for them and facilitating apps which allow people to look at all of their accounts in one place. Opening up access to this dataset also enables the sector to develop new approaches for consumers, helping them engage with their banking decisions.

Today, over 3 million people and businesses are using Open Banking. As of December 2020, there were 109 firms offering Open Banking enabled live products and services, reflecting 76% growth from December 2019. There has been 450% growth in APIs (2019-20).

For more information see: Home - The open banking Impact Report 2021

30. In the case of home chargepoints, the ability of third parties to control the chargepoint and access chargepoint usage data (with permission from the user) could similarly encourage the development of innovative, flexible solutions for home charging and energy management by third parties. While the home charging segment remains at a relatively early stage in its development, there is an opportunity to embed open standards in home charging infrastructure and to ensure that consumer access to these types of services is not restricted in the future.

Changes to the EVHS

31. In February 2021, the Department for Transport (DfT) announced that the EVHS would be opened up to leaseholders and those in rented accommodation.[85] The existing scheme, which currently provides up to £350 towards the cost of installing a home chargepoint, will end for owner occupiers of single unit occupancy housing (such as detached, semi-detached or terraced housing) from 31 March 2022. From this date, the scheme will focus on supporting rental and leasehold properties only. It will allow non-resident property owners and managing companies of rental or multiunit occupancy buildings to apply on behalf of their tenants or leaseholders for home

[85] Support for small businesses, landlords and leaseholders: government charges up the electric vehicle revolution with £50 million boost. See also: Transitioning to zero emission cars and vans: 2035 delivery plan (publishing.service.gov.uk).

chargepoint installations. As of 2018, over four million dwellings in England were estimated to be leasehold (around 20% of housing).[86]

32. An additional fund will also be made available to help with the cost of ducting for people in multi-unit occupancy buildings (such as blocks of flats). The fund will provide landowners and/or managing companies up to 75% of the cost of installation of cabling (and any associated connections and communications) required for qualifying chargepoints.[87]

33. Two chargepoint operators raised concerns about the potential effect of these changes:

(a) One chargepoint operator told us that the price to owner-occupiers of OZEV-compliant chargepoints would increase and that chargepoints which were not eligible for the EVHS grant would become more competitive. It stated that it had observed safety issues with some non-OZEV compliant devices and that increased prices risked more EV drivers relying on three-pin plugs as a means of charging.[88]

(b) Another chargepoint operator told us that it was critical that a minimum level of product quality and functionality is retained when funding from the EVHS is removed for owner-occupiers. It told us that this was needed to ensure that devices are of a standard which can fulfil the aims within the Government's Smart Systems and Flexibility Plan[89] (ie that devices are capable of delivering flexibility to the broader energy network), particularly as EV adoption accelerates. It added that defining and enforcing product standards would be more challenging without the EVHS and that 'unregistered, non-smart, lower cost installation' devices may be seen as an alternative by some consumers. It considered there to be a risk that cheap and low quality products would become more prevalent in the sector following the removal of the EVHS subsidy.

34. The proposed changes to the EVHS result in the loss of a financial incentive for owner-occupiers to install an OZEV-compliant home chargepoint. OZEV analysis indicates that the average cost to the customer when using the

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[86] Estimating the number of leasehold dwellings in England, 2017-18, Ministry for Housing, Communities and Local Government. Published 26 September 2019.
[87] Support for small businesses, landlords and leaseholders: government charges up the electric vehicle revolution with £50 million boost.
[88] Some consumers charge their EVs using a standard three-pin socket rather than a dedicated EV chargepoint, which can raise safety concerns as well as being slower and more costly for the consumer (compared to smart charging).
[89] Upgrading our Energy System, Smart Systems Flexibility Plan, published July 2017.

EVHS scheme has been around £570.[90] Without EVHS grant funding, OZEV's analysis shows that the average cost to the customer over the years that EVHS funding has been available would have been around £1,100. We note that UK Government recently confirmed that it intends to continue funding the EVHS until at least 2024/25.

35. It is difficult to anticipate the effect that these changes may have on the home charging segment, though we note that private sector investment appears to be developing relatively well. However, as set out in the main report (chapter 6), given the benefits of smart charging, it will be critical to ensure the continued take-up of smart chargepoints (as opposed to 'dumb' chargepoints available for purchase that do not have the same functionality to enable cost savings for consumers and benefits for the electricity network).

36. We therefore support UK Government's plans to require home chargepoints to be smart. It also plans to mandate smart home chargepoints to meet a minimum set of requirements in 2021 (eg on safety and other technical requirements).[91] Government plans a phased intervention and aims to consult on an appropriate regulatory approach for organisations performing a 'load controlling' role in 2022 as part of wider policy developments for smart devices (including for smart home chargepoints).

37. We also note that, as part of its Road to Zero strategy,[92] the UK Government has formed the Electric Vehicle Energy Taskforce (EVET), a cross-industry body which is focused on smart charging and planning for future EV uptake.[93] The EVET has made a number of proposals to the UK Government, including that Government undertakes a promotional campaign to promote the benefits of smart charging and funds an independent advisory and information service on smart charging and EVs.[94]

Bundling

38. Bundling refers to selling different items ie products and services together as a package – in this case selling a home chargepoint along with other products such as an EV, electricity tariff or public charging subscription. While currently

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[90] Based on data up to May 2020. This amount includes the cost of the EV chargepoint, any ancillary equipment, labour and any VAT charged, less the grant rate available to the customer. See OZEV analysis of the EVHS scheme, available in response to a written parliamentary question tabled in December 2020.
[91] Electric vehicle smart charging: final outcome (publishing.service.gov.uk)
[92] DfT, The Road to Zero, July 2018.
[93] DfT, The Road to Zero, page 101, July 2018. The EVET brings together government and the energy and automotive industries.
[94] EVET, Energising Our Electric Vehicle Transition, pages 57-59, January 2020.

bundling is not very common, we have seen evidence which indicates that it may become more common over time, for example:

(a) Our review of chargepoint operators' internal documents indicates that various bundling strategies are being examined by providers.[95] This includes bundling of home chargepoints with public network access as well as with home energy tariffs. Chargepoint bundling with initial EV purchase/leasing is already common for some chargepoint operators[96] and other forms of bundling (eg with public charging) are increasingly being made available to consumers.[97]

(b) Almost all chargepoint operators that responded to our home charging questionnaire told us that they were assessing different forms of bundling, though planning and testing were at an early stage.

(c) Documents provided by one chargepoint operator show that it assessed the highest future competitive threats to come from those chargepoint operators which were able to offer a home chargepoint bundled with an energy tariff.

(d) Some chargepoint operators considered that bundling with other products and services (eg energy tariffs and public charging) may increase following the removal of the EVHS grant for owner-occupiers.[98] They considered bundling to be a possible means of reducing the increased cost that would otherwise be borne by these consumers.

(e) Citizens Advice told us that bundling could simplify the transition to EVs.

39. While bundling may offer consumers some benefits (eg in terms of simplicity), there may also be some risks. A number of stakeholders raised concerns about the potential effects of bundling, for example:

(a) Citizens Advice added that it wasn't clear whether bundled services with multiple suppliers would mean less freedom for consumers when making decisions about their energy needs in the long-term.

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[95] One chargepoint operator assesses consumer feedback on various bundle package ideas. Another chargepoint operator's documents identify an opportunity in home charging by 'bundl[ing] offer with retail energy or home energy management systems' and the creation of bundled offers as a means of mitigating possible risks to its market position.
[96] Paragraphs 38 and 39.
[97] See, for example, the partnership between Octopus Energy and EO Charging, Ecotricity and Rolec's 'Fully Charged Bundle', the partnership between Scottish Power, Wallbox and Arnold Clark and OVO's 'EV Everywhere' bundle provided with bp pulse. Discounted smart chargepoints are also available to OVO members.
[98] See above for an explanation of Government's proposed changes to the EVHS.

(b) E.ON told us that bundling of cars and chargepoints with energy tariffs can make it 'incredibly difficult' for consumers to make comparisons and that unbundling energy tariffs would help prevent consumers being locked in to uncompetitive prices. E.ON considered that bundling of chargepoints and tariffs could create barriers to competition and that this practice may allow larger suppliers to secure market share through heavily subsidising chargepoints.

(c) The Data Communications Company told us that bundling may be initially convenient for consumers but may constrain their ability to switch in future.

40. We also note that while the supply of electricity to home chargepoints is regulated by Ofgem and Uregni (as explained in paragraph 8), not all aspects of the operation of EV chargepoints is currently regulated. Bundling of home chargepoints with public charging provision may create complex interdependencies between service providers which, in turn, increases the potential for gaps in consumer protection and unsatisfactory redress procedures. We note that the EVET has recommended that Government and Ofgem undertake a full review of consumer protections for EV drivers.[99]

Workplace charging

Background

41. It is estimated that 68% of UK workers travel to work by car. [100] Of those who drive to work, 70% report that they park in workplace car parks.[101] Typically, vehicles will then remain stationary for the working day. This presents a convenient opportunity for EV charging, with minimal disruption or change to the behaviour of drivers. Where vehicles remain stationary for long periods of the day, consumers will also be able to take advantage of lower cost, slower chargers and smart charging. In this way, workplace charging may present a viable alternative to home or on-street charging for some EV drivers.[102]

42. Since 2016, OZEV has offered grants to businesses to help with the cost of installing EV chargepoints. In the same year, a survey carried out by Zap-Map found that 75% of EV drivers did not have access to workplace charging.[103]

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[99] EVET, Engaging EV Users in Smart Charging and Energy Services, page 8, October 2020.
[100] Transport Statistics Great Britain 2020, page 3.
[101] National Travel Survey: 2019.
[102] A document provided by one chargepoint operator projected that workplace charging would increase in importance over the years to 2025, but that it would represent a lower share of charging activity than home and public charging. It projected that 15% of charging would be done at work by 2025.
[103] Zap-Map, Zap-Map survey reveals workplace EV charging gap, October, 2016.

Since then, UK Government has funded 13,586 socket installations at over 4,000 businesses.[104]

43. Through the Workplace Charging Scheme (WCS), UK Government provides up to 75%, or £350, of the purchase and installation cost of each socket, up to 40 charging sockets per workplace.[105]

44. The NAO estimates that Government had spent around £4 million on the scheme to March 2020.[106] In February 2021, Government announced that the WCS would be opened up to small to medium enterprises (SMEs) and the charity sector.[107]

45. In addition to the WCS grant scheme, Government is consulting on other policy measures aimed at increasing workplace charging provision. As part of its consultation on changes to building regulations, Government has proposed requirements for new non-residential buildings and those undergoing major renovation (including workplaces) to have one EV chargepoint for one in five car parking spaces.[108]

Competition in workplace charging

46. In this section, we set out estimated shares of supply and consider the outlook for entry and competition in the workplace charging segment.

Shares of supply

47. OZEV provided data which showed the number of WCS funded sockets installed per year for the top 20 manufacturers of approved chargepoints. This data is set out in Table 2. The top providers in workplace charging are also active in home charging, with brief descriptions of these companies provided in paragraph 13.

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[104] As of April 2021. Electric vehicle charging device grant scheme statistics: April 2021.
[105] OZEV, Workplace Charging Scheme: guidance for applicants, chargepoint installers and manufacturers. For the WCS, the number of sockets installed are counted as one grant may cover more than one chargepoint. Since the inception of the WCS in 2016, the number of sockets eligible for funding has increased from 20 in 2016 to 40 in 2020. The grant cap was increased from £300 in 2016 to £500 in 2018, before reducing to £350 in 2020.
[106] NAO, Reducing Carbon Emissions from Cars, paragraph 2.23, February 2021.
[107] Support for small businesses, landlords and leaseholders: government charges up the electric vehicle revolution with £50 million boost, gov.uk website.
[108] OZEV and DfT, Electric vehicle chargepoints in residential and non-residential building consultation. The requirement would apply to all new non-residential buildings and every non-residential building undergoing major renovation with more than 10 car parking spaces.

Table 2 WCS funded sockets installed per year by top 20 manufacturers[109]

Manufacturer	2016	2017	2018	2019	2020	Total	% of Total
Rolec Services Ltd	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
POD Point	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EO Charging	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Alfen ICU	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
NewMotion	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
myenergi	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
bp pulse	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
ATESS	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EVBox	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Easee	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Chargepoint Inc	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Swarco UK Limited	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Growatt	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Schneider Electric	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Andersen	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Wallbox Chargers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Garo	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
CityEV Limited	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Delta Electronics	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Sevadis	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: OZEV.

48. The data in Table 2 suggests a similar picture to that for the home charging segment. That is, workplace charging appears to be currently highly concentrated, with the top four manufacturers accounting for over 70% of WCS funded sockets since 2016. While this is the case, there is a long tail of providers in workplace charging, with new suppliers entering frequently in recent years.

Entry and competitive outlook

49. The data in Table 2 shows that many new entrants have entered the workplace charging segment in recent years and that new entrants have been able to compete successfully with more established providers.

[109] We understand that there may be some errors and inconsistencies arising from how information was entered in the database.

50. In this context, we note that no respondents to our ITC raised concerns about competition in workplace charging and a number told us that the segment was highly competitive.

(a) In their joint submission, EDF and Pod Point told us that 'workplace charging is a vibrant, developing market, with increasing numbers of companies seeking to provide EV charging options for their workforce, company fleets and visitors'.

(b) Energy UK and a chargepoint operator told us that the workplace charging segment was similarly established and competitive as was the case in home charging and SMMT told us that 'competition in the workplace segment is expected to intensify'.

(c) One stakeholder told us that 'workplace charging infrastructure is relatively low cost and high utilisation and, as such, is being deployed at speed and delivered by a highly competitive supply landscape'.

51. As was the case with the home charging segment, almost all respondents to our workplace questionnaire told us that barriers to entry and expansion are low and internal documents provided by sector participants support this view.

52. For example, in an internal strategy document, one chargepoint operator noted that 'the market for workplace is becoming increasingly competitive from smaller installation companies' and its financial forecasts assumed a reduction in gross margins 'due to pressure from increasing competition'. A separate document provided by the same chargepoint operator identified a threat that international providers could enter the UK market for workplace charging, indicating low barriers to entry.

53. Similarly, a strategy document provided by another supplier indicated its intention to grow its presence in workplace charging and stated that new market entrants were expected to emerge in this segment. Again, this indicates that barriers are seen to be low and that new providers are incentivised to enter the workplace charging segment.

54. The evidence as regards competition in the workplace charging segment indicates a similar outlook as for home charging. Although some providers currently hold strong positions in the segment, there appear to be low barriers to entry.

Key issues

55. Respondents to our ITC and responses to our questionnaires generally discussed the home and workplace charging segments together and

considered competition to be working well in both segments. The combination of a clear business case for private investment (as cashflows can be more accurately predicted for home and workplace charging than for other parts of the EV charging sector) and government support appears to have led to the development of a healthy marketplace for workplace charging.

56. Where respondents anticipated that issues might arise for consumers in the future, these concerns were the same as those identified in home charging. Concerns focussed on ease of switching and interoperability, with some respondents considering that any potential issues might apply to a greater degree for workplace customers than for home chargepoint users (as a result of greater numbers of chargepoints being deployed at workplaces and, consequently, greater investment required to change hardware). However, no respondents raised concerns that were unique to the workplace charging segment.

Appendix D: Problems people face using public charging

Introduction

1. As set out in chapter 7, we found that people are facing problems in public charging. This appendix provides additional relevant evidence we received from stakeholders (including chargepoint operators) through written responses to our ITC, information requests and calls, submissions from the public to our ITC, and consumer research. It also sets out our analysis of Zap-Map data – further detail of this data, including caveats and methodology, is in Appendix E.

2. This appendix sets out: the evidence on problems people are facing in public charging; evidence on emerging developments in the sector; and the regulations currently in place and relevant work by others.

Problems people are facing

Not enough chargepoints in the right places

3. Various consumer surveys have highlighted concerns about chargepoint provision, particularly in rural or remote areas, on-street and on motorways. Similar points were raised in stakeholder and consumer submissions – lack of provision was the most commonly mentioned issue by consumers who responded to our ITC.[110]

Concerns about reliability

4. Evidence from stakeholders and consumer research highlights that reliability is a key current concern for EV drivers. Further evidence includes:

   (a) A 2021 EVA England survey which found that:

   - 62% of 1,025 respondents disagreed or strongly disagreed that public chargepoints are typically in good working order. Only 14% of respondents felt they found chargepoints in good working order.

   - The most common reliability issue to drivers was that a chargepoint was out of order. This was followed by the chargepoint could not be easily activated or that the chargepoint would not connect with the vehicle.

[110] For example, consumer ITC submissions 13, 19, 25 and 31 and SMMT submission. All submissions are published on the case page.

- 55% of respondents disagreed that there is clear and easy instruction on how to access assistance when issues arise. Only 15% felt there is clear instruction.

(b) Reliability was the most mentioned issue in the consumer[111] and stakeholder responses[112] to our ITC after sufficient provision. Some stakeholders - including chargepoint operators – and consumers noted that there was a need for better maintenance, with some particularly highlighting en-route chargepoints as frequently being out of service or faulty.[113] For example:

> [T]here is some specific concern over the reliability and downtime of charging infrastructure in key locations - in particular en-route charger reliability is critical for confidence in longer journeys. [EDF Energy and Pod Point]

> Charging on the motorway network is decisively the worst customer experience of all charging networks in the UK. This is the clearest indicator of a significant market failure on the 130 or so locations that, it can easily be argued, are the most commercially attractive in the country. [Fastned]

5. Chapter 7 sets out our analysis of Zap-Map data on reliability which shows that at any given time, 1 in 25 chargepoints may be inactive, and in particular 1 in 10 rapid en-route chargepoints may be inactive, compared to 1 out of 100 slow chargepoints.

Causes of unreliability

6. Chargepoint operators told us that there are a variety of causes of poor reliability, the main one being communication errors (see Figure 1). Other reasons include older chargepoint technology, vehicle development technology, driver error, or errors with the connectors. When communication errors occur, some chargepoints can be used by consumers without payment (this is sometimes referred to as a 'free vend'). In particular, EVA Scotland said:

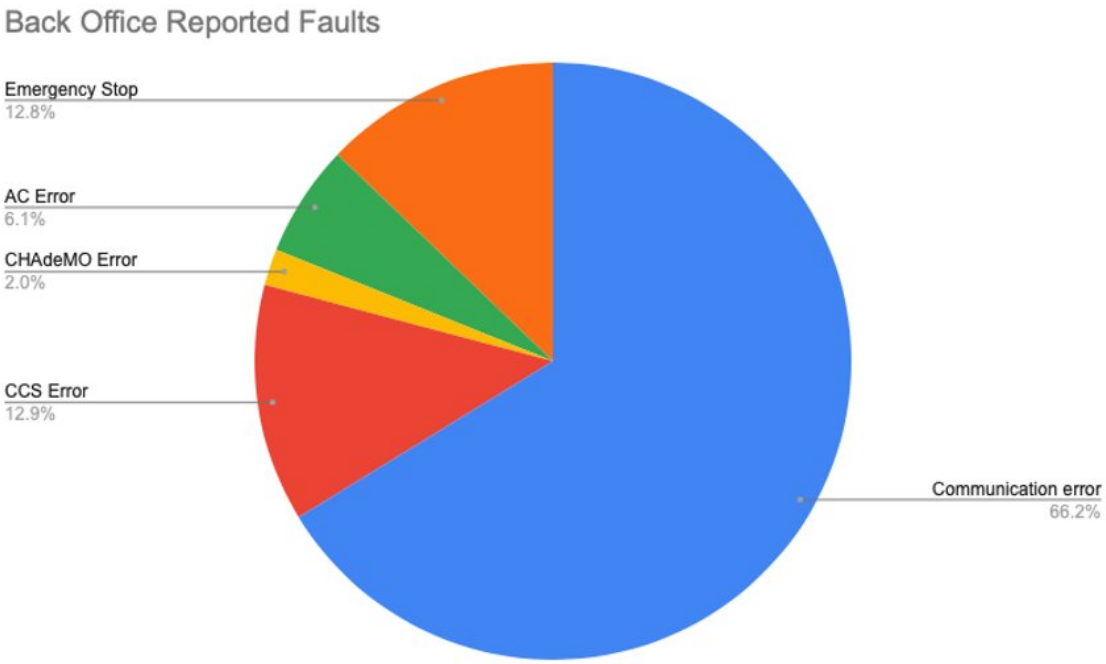
> Communication between charger and the back office can be an issue in remote locations, and implementation of a whitelist and a cached vend when communications are down is the way to

[111] All consumer ITC submissions are published on the case page. For example, see responses 9 and 26.
[112] For example: ENGIE (GeniePoint), EDF Energy and Pod Point, Zap-Map, SMMT, Tesla Owners Club UK, RAC Motoring Services, Energy UK, LV= GI, TfGM, EVA Scotland.
[113] For example: EDF Energy and Pod Point, Zouk Capital LLP, Fastned

resolve this issue for chargers using an app or RFID card. When communications are restored, the cached transactions can be forwarded to the CPNO [chargepoint network operator].

7. Some chargepoint operators mentioned that CCS connectors are more unreliable than CHAdeMO connectors[114] (see also Figure 1). Some stakeholders also raised other specific concerns relating to consumers struggling to use specific chargepoints. For example, one stakeholder mentioned that some technical problems may occur with the software functionalities of the EV, leading to it not communicating with some chargepoints.

Figure 1: Back office reported faults[115]



Source: Chargepoint operator [✂].

Submissions on measures to tackle problems with reliability

8. We received submissions from stakeholders supporting a minimum reliability standard, for example:

   (a) SMMT suggested that the Government must regulate for minimum reliability standards and the regulatory body should be tasked with monitoring for compliance and enforcing regulatory standards. These

[114] As set out in chapter 2, EVs can use different connectors. For example, CCS and CHAdeMO can be used for DC rapid charging.
[115] AC error refers to an error involving the AC connector.

standards should include penalties for repeated non-compliance. To be on par with the reliability rate commonly seen in the Netherlands, SMMT suggested that the mandated minimum reliability rate should be 99%.

(b) REA suggested that baseline expectations for reliability should be set in place by central Government and/or in LA tenders.

(c) Of four submissions to OZEV's consumer experience consultation that we have seen, three stakeholders were in favour of reliability standards to be set, and one chargepoint operator was in favour of a 99% reliability measure. A fourth chargepoint operator however thought that 99% reliability would not be possible due to networks not having direct control over all aspects of their reliability performance.

Difficulties finding chargepoints

9. We have seen evidence that there is limited information for consumers to identify available, working chargepoints. Many stakeholders and consumers submitted that consumers would benefit from greater aggregated information on chargepoints, and highlighted evidence that consumers have a preference for a convenient cross-network data source, in particular information on: location, live availability, connector types, chargepoint power, price, payment/access methods.[116] For example:

(a) A 2021 EVA England survey found that 94% of 1,025 respondents had experienced concern at some time or another about finding a public chargepoint when in need of a charge and away from their normal charging destination. Additionally, 98% of respondents believed that having access to real-time data ahead of a charging event would save them time. Survey comments also suggested that such information could usefully include the working order of a chargepoint, the availability of a chargepoint, time until charging completes and peak usage times.

(b) Relevant points raised by stakeholders in their submissions include:

> Finding out information on the whereabouts and availability of public charging infrastructure is a challenge today. Chargepoint operators are already working to improve this issue by providing this information to Zap-Map, which is the go-to choice at present, however there are few alternatives to Zap-Map. [Energy UK]

[116] For example: Citizen's Advice, SMMT, Energy UK, EVA Scotland, ENGIE (GeniePoint), EDF and Pod Point, DDC, E.ON UK, RAC Motoring Services, Association of Convenience Stores, Centrica.

> Comparison websites/apps are already available [...] Such tools however do not tend to show: live charger availability information; historical reliability and usage data; customer service detail. Such websites/apps support advanced planning of routes, however viewing dynamic data on nearby chargers via car navigation systems, configured with user preferences on charger type, price etc..., would help [consumers] make more informed choices. [ENGIE (GeniePoint)]

(c) Some consumers said they currently struggle to find the information they need to plan for charging on their journeys,[117] for example:

> One thing that would really help is a centralized system for collecting real-time data from chargers, showing if they are working and if they are in use. This information should be available in-car, via a variety of apps (e.g. integration with mapping and satellite navigation tools) and via a website. A consumer should be able to plan a journey in their choice of mapping application, e.g. Google Maps, with recommended stops and expected costs displayed. [Individual response 3].

10. Some stakeholders noted that having live data on chargepoint status would also be helpful in light of poor reliability (and that a lack of information compounded reliability issues).[118] For example:

> We believe the following would be beneficial to support consumer interaction: […] Data showing real-time 'out of service' charging points to reduce the chances of consumers being unable to charge and to be able to fully plan their journeys. It would also be helpful to understand which charge points by operator is most reliable, which would help drive up operating standards in the sector. [RAC Motoring Services].

Submissions on measures to make it easier to find chargepoints

11. Many stakeholders including chargepoint operators told us that open data standards, such as the Open Charge Point Interface protocol (OCPI), would enable new, cross-network comparison websites and data aggregators to

[117] For example, consumer ITC submissions 3, 39 and 48. All submissions are published on the case page.
[118] For example: E.ON UK, RAC Motoring Services, ENGIE (GeniePoint).

enter the sector. This would make it easier for people to find working chargepoints.[119] For example:

(a) Of four submissions to OZEV's consumer experience consultation that we have seen, all four stakeholders (three of which are chargepoint operators) thought that OCPI should be the standard provision for public chargepoint data across chargepoint operator's systems. However, two of the chargepoint operators raised potential challenges around the adoption of this standard, such as around upfront development and firmware/software changes, as well as ongoing issues to do with the version of the standard.

(b) Relevant points raised by stakeholders in submissions include:

> The government must at the earliest opportunity mandate interoperability between all charging networks via a common open protocol like OCPI. There should be financial penalties issued to the CPO [chargepoint operator] operating any station that is not interoperable with other networks. [ChargePoint]

> The EV market is likely to benefit from the provision of high-quality aggregated data platforms based on open data standards such as the Open Charge Point Interface (OCPI), a standard that is emerging as a global standard for Mobility Service Providers (MSPs) to enable efficient peer-to-peer and MSP to CPO [chargepoint operator] communications. [Zap-Map]

12. People may use their EV sat-nav to find their nearest chargepoints.[120] We have seen evidence that some EV sat-navs only display chargepoints for charging networks which the EV manufacturer has an agreement with, rather than all public chargepoints. There is some evidence of this becoming more common, such as BP integrating with Volkswagen EVs. This may lead to people not being aware of the full range of public chargepoints. Having open data standards (such as OCPI) would be beneficial in this respect, for example BVRLA stated that greater information sharing between vehicle manufacturers and satnav providers would help consumers by enabling access to information on chargepoints.

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[119] For example: ChargePoint, Paua, Zap-Map, DDC, SMMT, LV= GI, Association of Convenience Stores, Centrica, London Councils, Citizen's Advice. As set out in chapter 7 in the main report, there are a small number of third parties using open data standards - notably by Zap-Map and Open Charge - but this does not cover all of the sector and live information is less comprehensive.

[120] For example, 17% of 1,025 respondents to EVA England's 2021 survey said this way their primary method of finding a chargepoint.

Difficulties paying for charging

Ease of payment

13. There is variation in the payment methods that consumers can use to pay for a charge covering both pay-as-you-go (PAYG)[121] and subscriptions, with chargepoint operators offering any combination of apps, RFID cards, QR codes, web links, text-based options and others.

14. Having a choice of payment options can be beneficial for consumers to reflect different needs and preferences. However, the evidence indicates that consumers can be frustrated with having to use multiple different payment methods (eg apps or RFID cards) for different networks.[122] For example:

    (a) A Shell 2021 EV driver survey found that the UK had the joint lowest percentage of EV drivers (60%) out of France (60%), Germany (78%), Belgium (80%) and the Netherlands (88%) who said that their main charging card gives them access to the charging they need.

    (b) A 2021 EVA England survey found that 94% of 1,025 respondents said they would welcome the ability to use what they deemed as the easiest access method across all public chargepoints.

    (c) Ofgem conducted qualitative interviews with consumers[123] – some respondents expressed frustrations about having to use multiple different apps or RFID cards to access chargepoints. For example:

    > 'There's a ridiculous amount of apps and networks and cards.'
    >
    > 'I'd say I have 10-15 apps on my phone for that, and RFID cards for some of these.'

15. Some chargepoint operators submitted that needing multiple payment methods was a legacy problem that has largely been resolved, while some other operators believed that there will be consolidation and standardisation of payment methods in future.[124] However others indicated that having a

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[121] Pay-as-you-go refers to when pricing is on a usage basis and does not include any ongoing payment. See paragraph 17 on why some PAYG options are more complex to use than others.
[122] For example: BVRLA, Zouk Capital, Zap-Map, SMMT, LV= GI, EVA England, Centrica, Tesla Owners Club UK, E.ON UK, London Councils. All consumer ITC submissions are published on the case page, for example see responses 4 and 17. Has-to-be gmbh thought that payment and access methods may also limit which chargepoints a user can use.
[123] The Ofgem qualitative research into consumer experiences of public charging and home charging involved 29 interviews in England, Wales and Scotland from September to October 2020 with a mix of EV drivers.
[124] For example, one chargepoint operator's internal document stated: 'Contactless payment will become the industry norm'.

multitude of payment options for different networks, such as apps, contactless, RFID cards was likely to continue.

16. We received evidence on other issues relating to payment methods. Some stakeholders pointed out that the use of apps and QR codes would not be ideal in all cases as mobile connectivity is not guaranteed across the country, and so rural or remote areas in particular may need alternative payment options.[125] See also paragraph 30 and chapter 7 on consumers without bank accounts.

17. Some stakeholders and consumers have submitted that despite AFIR[126] requiring all public chargepoints to have 'ad hoc' payment options (ie the ability to pay without having to enter a pre-existing contract or being subject to any ongoing financial commitments to the chargepoint operator), consumers still sometimes need to sign up with a chargepoint operator network to use their chargepoints,[127] or to 'top up' their account.[128]

Contactless

18. Contactless bank account payment is a PAYG option which can be used across different charging networks (ie is 'cross-network'). Developments in technology mean that other cross-network payment options – such as roaming – may become more common in future, which we consider in paragraphs 32-38.

19. In 2020, the Government stated that all new rapid chargepoints must provide contactless card payment. However, as Table 1 shows, across the sector only 9% of all public chargepoints offer contactless, and half of rapid and ultra-rapid chargepoints offer contactless.

[125] For example: BVRLA.
[126] See paragraph 50 for further information on the AFIR 2017 regulations and what they cover. There is guidance available for the regulations.
[127] For example see individual responses 11 and 39. All ITC submissions are published on the case page.
[128] For example: SMMT.

Table 1: Summary table of contactless access

Contactless – segments	Number of chargepoint operators	Percentage of chargepoint operators in segment
Public charging (all)	20	43%
On-street [1]	2	8.7%
En-route [2]	9	45%
Contactless – charger power	Percentage of chargepoints [3]	
All chargepoints	8.9%	
Rapid and ultra-rapid	50%	

Source: CMA calculations based on data provided by Zap-Map, 26 February 2021. Data includes the top 47 chargepoint operators and so is not fully comprehensive, and in particular excludes very small networks, including some council chargers. Tesla has been excluded from our analysis due to it not being a public network.
[1] There are 23 operators active in the on-street segment, according to CMA analysis of data provided by Zap-Map.
[2] There are 20 operators active in the en-route segment, according to CMA analysis of data provided by Zap-Map.
[3] Zap-Map state this number might be an under-estimate, see appendix E for more detail.

20. As well as survey evidence set out in chapter 7 in the main report, consumers and stakeholders submitted that there is a strong preference for contactless payment at public chargepoints. For example:

(a) Most of the chargepoint operators we spoke to were supportive of contactless for rapid and ultra-rapid chargepoints, though some preferred alternatives such as roaming (see paragraphs 32-38). Many stakeholders who responded to our ITC thought that offering contactless charging on all public chargepoints, and not just new rapid chargepoints, would be beneficial for the consumer experience.[129]

(b) Almost all consumers who responded to our ITC who mentioned payment methods preferred a single PAYG option, with contactless being mentioned by some consumers as the most attractive option, for example:[130]

> [T]here are multiple mobile apps and multiple companies to deal with, I currently have 5 different apps... all I want to do is use contactless to pay. [Individual response 5]

21. We note that some chargepoint operators highlighted that offering contactless payment is not always feasible, particularly for slow and fast AC chargepoints, for example because the chargepoint doesn't have space for a card reader or the costs may be prohibitive.[131] Examples of the costs highlighted by chargepoint operators include:

[129] For example: Tesla Owners Club UK, BVRLA, Zouk Capital, RAC Motoring Services, LV= GI, EVA England, SMMT, TfGM.
[130] For example, consumer ITC submissions 5 and 23. All submissions are published on the case page.
[131] For example: EDF Energy and Pod Point, TfGM.

- A chargepoint operator highlighted that contactless has a high upfront capital cost, which may be around £800-£1,000 per AC chargepoint (in addition to the total cost of an AC unit of around £2,000).

- Another chargepoint operator also mentioned that card readers would more than double the annual fixed costs for any given slow/fast chargepoint (ie from £200 to £500 per annum), which the chargepoint operator stated would not be financially viable.

- Another chargepoint operator mentioned that retrofitting contactless on old kit would cost around £2,000 per chargepoint.

- One chargepoint operator in its response to OZEV's consumer experience consultation noted that:

> The cost of a contactless payment terminal is approximately £1000 per charge post. A single site visit to fit would cost approximately £250. Per transaction, the cost is £0.35. The cost per transaction depends on the volume of transactions and is a sum of fixed and variable costs for payment processing and terminal maintenance, the figure provided is an estimate.

Unclear and complex pricing

Variation in price structures adds complexity

22. There are currently around 160 different pricing models available in the UK.[132] As shown in Table 2, most chargepoint operators set a variable price for charging based on energy usage, ie pence per kWh, though some providers also price based on time or a flat rate per session. In addition to this variable price, chargepoint operators may also include flat connection fees or overstay charges.[133] There are also some alternative models including free membership,[134] subscriptions and roaming which affect pricing and comparability (we consider the latter two further below).

[132] Based on Zap-Map pricing report, 26 February 2021. Includes every discrete pricing model for each chargepoint operator under each access method and charger power segmentation if applicable. Does not account for operators which have different pricings per location.
[133] Overstay charges are sometimes levied to disincentivise consumers from leaving their EVs plugged in once they've completed a charge. For example, see evidence in paragraph 25c below.
[134] 'Free membership' refers to instances where the consumer receives discounted variable pricing in exchange for registering their details with a provider.

Table 2: Summary table of pricing

Pricing structure		Number of chargepoint	Percentage of total chargepoint operators [1]
Standardised pricing [2]		26	55%
Variable unit pricing	p/kWh	41	87%
	p/hour	7	15%
	p/min	2	4%
	per session	2	4%
	Other [3]	5	11%
Flat pricing	Connection fees	15	32%
	Minimum payments	6	13%
	Overstay charges	6	13%

Source: CMA calculations based on data provided by Zap-Map, 26 February 2021. Pricing data includes the top 47 chargepoint operators and so is not fully comprehensive, and in particular excludes very small networks, including some council chargers. Tesla has been excluded from our analysis due to it not being a public network.
[1] The numbers indicated by our analysis do not sum to 100% as some chargepoint operators offer multiple pricing structures. For example, newer chargepoints may be priced in p/kWh while older models are priced in p/hour.
[2] Standardised pricing refers to when the chargepoint operator has the same pricing for either all their chargepoints, or groups of their chargepoints based on charger power (ie slow/fast versus rapid/ultra-rapid pricing).
[3] Other variable pricing includes per: 10kWh, 2 hours, 2 or 4 hours, 4 hours, per hour + p/kWh

23. Pricing itself typically varies based on chargepoint operator, chargepoint speed (ie slow/fast vs rapid/ultra-rapid charging) and payment method.[135] Some chargepoint operators told us that they set pricing to be reflective of operating and/or investment costs, while others choose a rate in line with other competing networks. For further information on price differentials to consumers and how chargepoint operators set pricing, see Appendix E.

24. Over half of chargepoint operators have a standardised pricing structure across their network, ie either a single unit rate, or a tier-tariff structure based on charger power. The main reason given by operators for this was to help the consumer experience by simplifying the market. For example, one operator told us that having a single unit pricing was useful for transparency.

25. These different pricing structures and charging models (eg in p/kWh and p/min among others), as well as the presence of subscription models, occasional minimum pricing, maximum charging periods, connection fees, and overstay charges can be confusing for consumers. Evidence suggests it is difficult to compare prices across charging networks and for consumers to find the best deals.[136] There is a clear preference for a standardised p/kWh pricing metric to be used across different payment options, for all public chargepoints.[137] For example:

[135] Based on Zap-Map pricing report, 26 February 2021. For further discussion on price differentials, see Appendix E.
[136] For example: E.ON UK, BVRLA, Zap-Map, SMMT, Tesla Owners Club UK, Ombudsman Services, RAC Motoring Services, Energy UK, EVA England, Centrica, Connected Kerb, ENGIE (GeniePoint), DCC, London Councils, BHHPA, EVA Scotland, ChargePoint.
[137] For example: RAC Motoring Services, LV=GI, EVA Scotland, TfGM, SMMT, Paua, ChargePoint.

(a) In a January 2021 AA survey,[138] 82% of 17,032 respondents thought that having standardised p/kWh pricing would make it a great deal or quite a bit easier to use public chargepoints.

(b) A 2021 EVA England survey found that 94% of 1,025 respondents that their preferred metric for paying for a charge is p/kWh.

(c) Internal documents from chargepoint operators have referenced the complexity of pricing for consumers in their commissioned consumer research. For example:

> Pricing complicates EV life. Owners instantly gain a sense of the price of a kWh in a way that's never happened with electricity. This is the only way of judging whether a charge is good value or not. […] Connection charges always resented and not well understood or anticipated.

(d) Relevant points raised by consumers in submissions include:

> Charging tariffs are mind numbingly complex and difficult to compute [Individual response 19]

(e) Similarly, Ofgem conducted some qualitative interviews which found that[139] that some participants thought pricing wasn't clear. For example, one respondent said:

> 'It's really complicated to work out the pricing structures on the public ones [chargepoints].'

Transparency of pricing

26. As well as complex pricing, evidence indicates that pricing can be unclear as there is limited upfront information available on pricing. For example:

(a) Some stakeholders thought that there was a lack of information available on pricing currently, leading to little or no price transparency,[140] which was echoed by some people who responded to our ITC who said that there was a need for greater price transparency and/or less complex pricing.

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[138] The AA Yonder Driver Poll is run across a panel of members, who are not necessarily fully representative of the general driving population. This survey was run from 12 to 20 January 2021 and was completed by 17,373 respondents, of which 890 had either owned or driven a plug-in electric vehicle.
[139] The Ofgem qualitative research into consumer experiences of public charging and home charging involved 29 interviews in England, Wales and Scotland from September to October 2020 with a mix of EV drivers.
[140] For example: BVRLA, E.ON UK, SMMT, EVA England, Ombudsman Services.

Some stakeholders thought having more visible pricing, for example on totem poles as with petrol/diesel, would be beneficial.[141]

(b) In a January 2021 AA survey,[142] 53% of applicable respondents agreed that the pricing of public chargepoints is unclear and confusing.

(c) Internal documents from chargepoint operators referenced research which had found a lack of price transparency, for example:

> In order to access charge points (UK and Germany) or get good deals, the participants used various charge cards from different providers. However, when the participants were comparing providers, it wasn't clear to them whether they only pay for the energy, or whether an additional transaction or subscription fees is needed.
>
> Non-transparent rates cause annoyance and confusion. The participants were annoyed by the inconsistency and disparity of charging rates. Across all markets new EV drivers compared the experience to refuelling and found the price information difficult to digest at first. […] The participants with lower EV maturity were puzzled with the different rates and struggled to understand why some of the chargers were more expensive than others, leading them to question what they were getting.
>
> Key need from payment systems are […] transparency; not knowing how much they pay for each transaction can be a bit of a bugbear.

Most chargepoints are interoperable but some remaining issues

27. We have seen evidence that closed charging networks which can only be used by a single brand of car (such as the Tesla Supercharger network), hinder the consumer experience.[143] For example:

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[141] For example: RAC Motoring Services, BVRLA.
[142] The AA Yonder Driver Poll is run across a panel of members, who are not necessarily fully representative of the general driving population. This survey was run from 12-20 January 2021 and was completed by 17,373 respondents, of which 890 had either owned or driven a plug-in electric vehicle. All questions relating to EVs were answered by those the latter base. The respondents who had owned or driven a plug-in EV but had not used public charging (ie because they used exclusively home or workplace charging) were placed in the 'non-applicable' category
[143] For example: ENGIE (GeniePoint), LV= GI, E.ON UK.

(a) In a December 2019 AA survey,[144] when asked to imagine that the respondent owned an EV, 87% of 17,633 respondents thought that being able to easily use any availably public EV chargepoint is an important factor in deciding whether or not drivers will buy an EV. In addition, 86% of respondents agreed that all chargepoints on public land should be accessible to all EV drivers.

(b) Some consumers who responded to the ITC raised concerns around Tesla's closed network, for example:

> I object to seeing a nearly empty row of Tesla chargers that only Tesla can use. I get that they got a jump on the market by getting in early but it's definitely anti-competitive. To make another petrol station comparison you don't see pumps reserved for Fords at the Shell garage. [Individual response number 17]

28. Some stakeholders told us there has historically been an issue with DC charging due to EV manufacturers using different connectors, with the CHAdeMO connector being used pre-dominantly in Asian-manufactured EVs and CCS being used in European-manufactured EVs. Having multiple potential connectors for EVs and finding an appropriate chargepoint with the correct connector can be confusing and frustrating for consumers. However, we have also heard from some stakeholders that the sector appears to be moving towards CCS as the standard,[145] as for example the EU has mandated that DC chargepoints need to provide at least CCS connectors. The sector has similarly moved to 'Type 2' connectors as standard for AC charging, following standardisation in the above EU regulations.

Additional challenges for some groups

29. There is evidence that some groups of consumers may face additional challenges in public EV charging, such as drivers with physical disabilities due to accessibility issues, consumers with poor numeracy and those without bank accounts. For example:

(a) A Zap-Map and Motability survey of 2,200 EV drivers found that one-third of disabled people surveyed had difficulties locating a suitable charger that could meet their needs, with one in seven noting their very specific challenges with the weight of charging cables. The survey also revealed that some users experienced difficulties with the force required to attach

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[144] The AA Populus Driver Poll is run across a panel of members, who are not necessarily fully representative of the general driving population. This survey was run from 10 – 17 December 2019 and was completed by 17,643 respondents, of which 17,633 drive. This question was asked of the latter base.
[145] For example: bp pulse, ecar NI.

the connector, the lack of dropped kerbs around charge points, and unsuitable parking arrangements.

(b) The Research Institute for Disabled Consumers conducted a consumer panel survey of 702 respondents, including a large number of older people and those living with a physical impairment which affects their mobility or dexterity. The survey found that:

- 61% of disabled people would consider buying an EV only if charging was made more accessible (25% would agree to consider getting an EV now).
- 54% of respondents felt that lifting the charge cable from the boot and having to then close it would either be difficult or very difficult to do
- 66% of respondents felt that space or trip hazards/ barriers around the car and charger would either be difficult or very difficult to navigate

(c) A 2021 EVA England survey found that 76% of 46 disabled drivers indicated that they often or sometimes felt concern over finding a public chargepoint away from their normal charging location.

30. Chapter 7 sets out additional evidence on challenges for other groups, including on those in remote/rural areas, people without bank accounts[146] and/or smartphones, as well as other safety concerns.[147]

Emerging developments

31. While there remain many uncertainties around how the sector will evolve over time as more people shift to EVs and the sector grows, there are some emerging developments in the sector. In particular, these relate to new payment methods (roaming and plug-and-charge), subscriptions and bundling. While these developments have many potential benefits to people, there is a risk these make charging more confusing and undermine trust in the sector.

[146] For example, see stakeholder submissions: RAC Motoring Services, TfGM, MFG. We note that in a recent report Which? called for a RFID card that could be topped up by cash, in the same way that people top up cards for utilities, which would also be beneficial for those without bank accounts.
[147] For example, see stakeholder submissions: BVRLA, Centrica, Citizen's Advice, EVA Scotland, London Councils, Tesla Owners Club UK.

New payment methods – roaming and plug-and-charge

32. Roaming is a cross-network payment method that allows people to pay for charging via a single app or card. Roaming can be provided through bi-lateral roaming agreements between chargepoint operators, or by e-Mobility Service Providers (eMSPs), who are software-based aggregators of chargepoints. Historically, roaming has been more prevalent in continental Europe than in the UK, though some sector-led roaming options are starting to emerge, such as Zap-Pay and the Electric Juice Network, as well as being offered by chargepoint operators.

33. We have received mixed evidence on the need for roaming. Some stakeholders told us that roaming isn't needed as contactless offers an adequate cross-network payment option.[148] However, others submitted that roaming would be beneficial for consumers as it could make paying for charging simpler and allow consumers to access chargepoints across different networks.[149] For example:

    (a) During our stakeholder roundtables, there were mixed views on roaming with some noting that there appears to be consumer appetite (and it is used in some other countries) for roaming and that it may resolve some of the issues around payment methods faster than the retrofitting of contactless payments – however others noted that contactless payment potentially alleviates some of the issues.

    (b) A chargepoint operator in response to OZEV's consumer experience consultation said it thought Government should intervene now to actively encourage roaming. Four stakeholders who responded to this consultation all favoured a sector-led approach for implementing roaming (rather than QR codes, a Government established interoperable platform, or requiring operators to open their networks to third parties).

34. A few stakeholders also noted that roaming could increase competition, for example by enabling smaller chargepoint operators and eMSPs to better compete and accelerate growth by increasing access to consumers via roaming with larger networks, or by offering competitive rates when bidding to become partners of choice on certain platforms.[150]

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[148] For example: BVRLA, Zouk Capital, London Councils.
[149] For example: LV= GI, EVA England, E.ON UK, BVRLA, TfGM, Citizen's Advice, EVA Scotland, ChargePoint.
[150] For example, SSMT.

35. We note that roaming may be a good alternative where contactless can be less viable (eg slow/fast destination charging, as set out above).[151] We also understand that roaming is particularly beneficial for fleets who require receipts and records of usage (which roaming provides but PAYG does not), though these are out of scope for our study.

36. However, evidence indicates that there are a number of potential risks with roaming. We analysed publicly available information on roaming prices in continental Europe.[152] This analysis found that while roaming agreements may occasionally lead to cheaper prices for consumers,[153] the majority of roaming agreements we looked at led to higher mark-ups for consumers than the chargepoint operator's direct access method. The mark-up was lower in the Netherlands (eg around 1 cent/kWh or 0.06-0.36 €/session more expensive), but notably higher in Germany and France (eg from 5-19 cent/kWh or 0.73-2.5 €/session more expensive). This is supported by evidence which highlighted that roaming may increase costs for chargepoint operators. In particular, one chargepoint operator submitted in its response to OZEV's consumer experience consultation that:

> 10,000€ access fee per eMSP. […] Some of the hubs make use of an access fee either in combination or with a transaction fee. These transaction fees may range from 0.40€ to 0.50€ per charge. Admin/developer time to onboard an eMSP could be £1,500-£2,000 if going smoothly but likely to be higher.

37. In addition to general mark-ups, our analysis found that the roaming provider may also change the pricing structure, for example by adding a new fixed fee component, or altering the variable pricing unit. This can further complicate pricing for consumers and reduce comparability. Some chargepoint operators and stakeholders also mentioned that eMSPs are not beneficial for transparency of pricing, as they add a mark-up.

38. We also note that other developments in technology are likely to impact the payment experience in future. For example, some stakeholders including

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[151] Contactless and roaming may be less important in on-street public charging where people are likely to use the same chargepoints and charging networks. Over time, roaming may potentially offer some additional benefits to contactless eg if people with off-street parking can 'port' their home EV tariff to use at public chargepoints, and/or if people can use their subscriptions at different chargepoints – which might become more important in future if subscriptions become more common. However we note that currently roaming does not offer these options.
[152] We considered prices for Germany, France and the Netherlands where roaming is more common than contactless.
[153] For example potentially from around 3 cent/kWh, 30 cent/5 mins or 0.40 €/session cheaper in France and Germany.

chargepoint operators said that plug-and-charge technology[154] may become more prevalent, which could benefit consumers as there would be no need for multiple apps/RFID cards.[155] However, we note that this technology would require interoperability of software (see paragraphs 11-12 for related suggested measures). For example:

> Chargers can identify cars when plugged in (like the Tesla network) which could remove the need for any cards at all and allow fees to be charged straight to the cars account. [Northern Ireland Electric Vehicle Owners]

Subscriptions

39. While all chargepoint operators offer a PAYG option, subscription models are currently offered by 12 chargepoint operators (ie around one in four), including some large providers.[156] Generally, subscriptions are offered on a monthly basis, though there are also some yearly subscriptions available in the sector.[157]

40. Evidence suggests that PAYG, which is currently the primary payment method for many consumers, is likely to continue to be important. For example:

    (a) One chargepoint operator made 97% of its revenues in 2019 and 2020 from PAYG users, which it expects to remain broadly the same in future (forecast 80% revenues from PAYG users in 2030).

    (b) Another chargepoint operator told us that 32% of its users were subscribers.

    (c) Another chargepoint operator derived [✂]% of its revenues in 2020 from subscription-related fees, and the remaining [✂]% from selling electrons to all users. This chargepoint operator told us that 80% of its usage comes from subscribers.

41. However, evidence from some chargepoint operators through calls and internal documents show that they are planning to introduce subscription models in future or expand their existing subscription offer. This may make

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[154] Plug-and-charge technology allows the consumer's EV to identify and authorise itself to a chargepoint once plugged in, starting a charge automatically. The consumer will then be billed for the charge after the fact. This requires the chargepoint and EV to have compatible hardware and software. This technology is made possible through the ISO-15118 standard and can be used for both wired AC/DC charging, and wireless charging.
[155] For example: Paua, Tesla Owners Club UK, Association for Renewable Energy and Clean Technology, NIEVO, ENGIE (GeniePoint).
[156] CMA analysis based on data provided by Zap-Map, 26 February 2021.
[157] Based on Zap-Map pricing report, 26 February 2021.

subscriptions more commonplace and may be an attempt to increase market share by capturing both infrequent customers through their PAYG offering and converting some of these users to subscribers. For example:

(a) One chargepoint operator's internal document stated:

> We are now seeing that 35% of our revenue is through the Account offering [non-membership] and we expect that the subscription offering will grow to 15% of revenue by the end of 2021. With the remaining 50% coming through our contactless PAYG offering…

(b) Another chargepoint operator's internal document stated:

> In scenarios where demand is matched with market supply, [✂] can leverage volume-based (B2B) or subscription (B2C) models to command market share; […] An arrangement could be used to reward loyal [✂] customers with discounts, at the same time guarantee their monthly visit to [✂]; […] Customers can cancel anytime, so they avoid commitment and don't find the offer 'tricky'

42. Many chargepoint operators we spoke to mentioned that subscription models may be beneficial for high-mileage drivers in particular as they can offer cost savings through having cheaper variable pricing. Subscriptions may also be appealing for consumers who frequently use the same chargepoints, such as for on-street charging or for charging at certain destinations in the local area. For example, some chargepoint operators' internal documents have stated:

> Consumers using [✂] [subscription] are competitively advantaged versus [✂] [PAYG] once they have used the network for 80kWh of charge each month (equivalent to around 3 charges per month).
>
> [Membership] [b]enefit for users doing more than 10 full charges per month

43. Subscriptions can also be an important revenue stream for chargepoint operators. For example, one chargepoint operator we spoke to said that subscription models were important to attract private investment as it provides more certain returns and a fixed income from the monthly subscription fees.

44. However, as set out in chapter 7, as we have found in other markets, subscriptions can increase the risk that consumers get locked in to poor deals. Some stakeholders also raised potential drawbacks of subscription

models, such as the risk of further complicating the sector for consumers and making pricing even harder to compare. For example:

(a) Some chargepoint operators we spoke to did not offer subscriptions as they believed it was important that consumers are able to easily compare tariffs or believed in the importance of consumers being able to easily use any chargepoint. One chargepoint operator and Tesla Owners Club UK thought that subscription models may be indicative of chargepoint operators trying to tether consumers to their network.

(b) While there is limited consumer evidence on attitudes to subscriptions in the sector currently, Baringa found that 52% of respondents would prefer ad-hoc payment options, while 23% prefer subscription models for unlimited charging.

(c) Some consumers have expressed frustrations with subscriptions and comparability already in the sector. For example:

> Operators is also something of a mess and seems like the 'Wild West'. They all have their own subscription services, payment cards, Apps, tariffs, geographic areas – so it is impossible to know in advance for a long journey which Operator(s) you should join / be a member of (you can end up with 10+ payment cards, memberships and Apps). This wouldn't be acceptable for traditional petrol stations and isn't acceptable for EV charging. [Individual response 38]

45. We also note that while there is some evidence from chargepoint operators that PAYG and subscriptions may be currently priced competitively, there is some indication this may change in future. For example:

(a) One chargepoint operator's suggested pricing changes '[c]reate clear distinction between the cost and value of differing charging speeds; and [✂] membership versus Contactless'; and [✂].

(b) Another chargepoint operator's internal documents stated:

> One-off Visitors are relatively price-insensitive, supporting a PAYG price increase as a way to make more revenue from this large segment of first-time or one-off users. Pricing, however, becomes an increasingly important driving factor the greater the kWh volume of the customer

Bundling

46. There are some early examples of products and services being bundled together across different charging segments, including in home charging (see Appendix C). For example, some home energy suppliers may offer free or discounted public charging on a given network when you switch to them. We note that some chargepoint operators thought bundling may become more commonplace in future.

47. Bundling can offer better value, or help simplify a complex sector.[158] However, some stakeholders who responded to our ITC submitted that bundling can make direct comparisons complicated as it makes pricing less transparent and therefore makes it harder for people to identify the best deal.[159] For example:

(a) Relevant points raised by stakeholders in submissions include:

> The bundling of charging posts and tariffs could increasingly result in a significant barrier to competition. […] This would mask the true cost of both charging infrastructure and energy provision and potentially result in a worse outcome for the consumer because they cannot access meaningful market comparisons. This might, for example, lead to 'charge point only' providers being squeezed out of the market despite offering a competitively priced charge point product. [E.ON UK]

> OS is keen to better understand we are keen to understand such packages [ie bundling] because of the potential complexity for consumers in achieving good deals that are right for them. [Ombudsman Services]

(b) E.ON UK also noted that bundling may lead to consumer lock-ins:

> We believe that there is a genuine risk that some companies could establish customer lock in through bundling if there is insufficient regulatory oversight. Existing legislative powers may be sufficient to address this, but they will need to be actively and rapidly deployed to prevent the bundling model (and the potential

[158] As set out in the CC3 (Revised) Guidelines for market investigations, tying and bundling are common commercial practices, frequently having no anticompetitive consequences (and in fact may be benefitting consumers by enabling firms to provide better products or offerings in cost-effective ways), but with the potential sometimes to foreclose markets and harm consumers.
[159] For example: Ombudsman Services, E.ON UK.

for heavy cross subsidisation) leading to an erosion of competition in the market.

(c) Bundling and vertical integration can also sometimes be used as a way of leveraging market power or presence from one market to another,[160] for example, one chargepoint operator's internal document stated:

> [To mitigate risks to market positioning] Create bundled-offer to capture additional share of wallet [✂].

Regulations and ongoing relevant work

48. This section sets out the regulations currently in place and ongoing work by the Government and other bodies in relation to consumer interaction with public charging.

Regulations

49. There are two key pieces of UK-wide legislation relating to the sector, the AFIR and the AEVA.[161]

50. AFIR applies to public chargepoints and covers technical specification and consumer experience standards.[162] Under AFIR chargepoint operators have to allow for 'ad-hoc' payment ie the ability to pay for a one-off charging sessions.[163] Chargepoint operators can choose their own preferred option for meeting this requirement and most do so through a smartphone app, contactless card payment, RFID card or a QR code provided at the chargepoint, which then directs consumers to a payment platform.

51. AEVA enables the Government to introduce regulations to improve the consumer charging experience, this includes being able to:

(a) require a common payment method at all public chargepoints;

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[160] As set out in the CC3 (Revised) Guidelines for market investigations, a firm with significant market power in the tying (or bundling) market can harm customers through tying (or bundling) by foreclosing the tied market and, indirectly, the tying (or bundling) market. Incumbent firms tying or bundling products together may also raise barriers to entry and expansion, raising the costs for an entrant producing only one of the complementary goods.
[161] See chapter 2 for further detail on these two pieces of legislation.
[162] This includes chargepoints for public use otherwise located on private land. It excludes home chargepoints (which includes residential care homes, resident car parks), off-street chargepoints for local residents, workplace car parks, proprietary networks aimed at exclusive use by one car manufacturer, car dealership forecourts, and chargepoints reserved for a company's fleet vehicles.
[163] AFIR defines ad-hoc access as 'the ability for any person to recharge an electric vehicle without entering into a pre-existing contract with an electricity supplier to, or infrastructure operator of, that recharging point'.

(b) introduce requirements on chargepoint operators to make available static and dynamic information on public chargepoints, and prescribe when, how, to whom and in what format information is made available;

(c) introduce availability and performance standards for public chargepoints; and

(d) introduce connector standards to ensure physical interoperability between EVs and public chargepoints.

Ongoing relevant work

52. As set out in this appendix, we have identified a number of challenges to consumer interaction with public charging. The Government is considering how to address some of these challenges. It recently consulted on ways to improve the consumer experience of using public EV chargepoints and plans to introduce regulations later this year. The consultation, which covered all publicly available chargepoints in the UK, asked for views on the following proposals:

(a) making it easy to pay – a minimum standard for payment across all chargepoints (which does not rely on the use of a smartphone), convergence towards fewer apps to access chargepoints across the UK and roaming;

(b) opening up chargepoint data – a data standard that chargepoint operators need to meet when making public chargepoint data openly available, including mandating 'must-have' data types ie location, power-rating and pricing;

(c) using a single payment metric – standardisation to a pence-per kilowatt hour (kWh) basis to enable simpler pricing frameworks for consumers; and

(d) insuring a reliable charging network – a minimum 99% availability standard across a chargepoint operator's entire fleet of chargepoints.

53. In June 2021, DfT announced it will be partnering with Motability to develop accessibility standards across the UK to allow disabled drivers to easily identify which chargepoint models are suitable for their needs.

54. In January 2020 the EV Energy Taskforce (EVET) published its report Energising our electric vehicle transition setting out proposals for the efficient integration of EVs with the energy system. In October 2020 EVET published a further report outlining its recommendations to ensure its proposals were put

into action. These recommendations included having a roaming solution in place by the end of 2021 and making public chargepoint data (including location, type, status, capacity, price and availability) consistent and openly available for EV drivers by 2021.

55. We note that after the summer Ofgem will set out its high-level priorities to ensure that regulation can play a key role in enabling the transition to EVs at pace and ensuring that consumers benefit from the shift.

Appendix E: Data and analysis overview

Introduction

1. This appendix includes information on the chargepoint data we commissioned from Zap-Map, which we have used to inform our analysis. It then sets out our analysis of the price differential to consumers between and across segments based on this Zap-Map data, as well as information from chargepoint operators.

Zap-Map data

2. This section sets out the data we have commissioned from Zap-Map. Zap-Map is a third-party aggregator of information on chargepoints and charging networks. It produces a live map showing the location and information on chargepoints (around 95% coverage), including live availability for some chargepoints.

3. Zap-Map provided us with three main reports to inform our assessment: the core report, the pricing report, and the reliability report. The purpose of this data was to fill evidential gaps where no comprehensive publicly accessible data was available.

Core report

4. The core report contains information on the number of slow, fast, rapid and ultra-rapid chargepoints for each network by each segment, as of 26 February 2021. This report was used in our shares of supply calculations and other statistics in chapters 2, 5, 6 and 7, and Appendices A and D. Zap-Map used the data it receives from networks and its internal database to inform this report.

5. Zap-Map provided the data based on number of chargepoints (ie devices), rather than at the connector level. Some chargepoints may have multiple connectors, but many may only be used by one EV at any given time (only up to 10% of multiple connector devices can be used by multiple EVs simultaneously), therefore we have used chargepoint device-level data. Where there are multiple connectors, the device has been categorised according to the highest power rating of a connector on a device. The power ratings of the chargepoints are defined as shown in Table 1 below.

Table 1: Chargepoint power rating classification

Slow	≤6kW
Fast	6kW to 22kW
Rapid	22 to 50kW
Ultra-rapid	>50kW

Source: Zap-Map. We note this classification is consistent with the classification set out in chapter 2 of the main report.

6. Following discussions with Zap-Map, there were approximately 2,500 chargepoints which were excluded from the report Zap-Map provided us. This was predominantly to exclude some chargepoints which aren't fully publicly available, for example:

   (a) Dealerships: these are only quasi-public as most are only open to their own brand models and are typically only accessible when the dealership provides access with a dealership card.

   (b) Workplace chargepoints: these are not generally publicly accessible.

   (c) Taxi and Uber only: these are not accessible to consumers.

7. We asked Zap-Map to provide the data on number of chargepoints for each network according to the segments we were considering, namely on-street, en-route and destination chargepoints. The segments we agreed on for the core report were:

   (a) On-street: This segment includes kerbside chargepoints with the power rating 'slow' and 'fast' only. The chargepoints were classified using Zap-Map's internal 'On-street' tag.

   (b) En-route: This segment includes chargepoints with the power rating 'rapid' and 'ultra-rapid' only. Chargepoints were classified as 'en-route' if they were within 0.5 miles from a motorway junction or 0.5 miles from an A road (trunk) 'as the crow flies'.[164]

   (c) Other: This segment includes all chargepoints not captured under the on-street and en-route segments and is predominantly made up of 'destination' chargepoints.

   (d) Zap-Map also provided a separate report including information on Destination chargepoints. These chargepoints include all power ratings and were classified using Zap-Map's internal 'Hotel', 'Leisure', 'Supermarkets', 'Retail Car Parks' and 'Restaurants' tags.

[164] Zap-Map also provided a version of the report which only included en-route chargepoints within 0.5 miles of a motorway, which we have used in Appendix A.

8. We note that for some chargepoints it was difficult to establish whether they were fully publicly available, so the numbers indicated may slightly overestimate the amount of public chargepoints.

Pricing report

9. The pricing report contains information on pricing and access method for the top 47 charging networks[165] by number of chargepoints (which covers the vast majority of public chargepoints), including information on access fee, connection fee, minimum and maximum usage price, usage unit, minimum and maximum payment and overstay charge by network, power and access method (eg app/RFID card). This report was used to inform our pricing and payments analysis referenced in Chapter 7, Appendix D and later in this Appendix. Zap-Map used desk research and its knowledge of the sector to inform this report.

10. For the scheme types:

- 'Subscription' has been used only where there is some form of ongoing payment required to access the chargepoint, whether this is an annual payment for the RFID card or a monthly subscription.
- 'Pay-as-you-go (PAYG)' has been used when the pricing is on a usage basis and does not include any ongoing payment.
- 'Free membership' has been used where the network offers free or discounted charging in exchange for the driver registering their details (but with no subscription payment).

Reliability report

11. The reliability report contains a summary of the number of active and inactive chargepoints by segment taken at a snapshot of time on 26 February 2021. Chargepoints that are either fully or partially out of service (ie when at least one connector is out of service) have been labelled as 'inactive'.

12. This report was used to inform our analysis of reliability referenced in chapter 7, Appendices A and D.

[165] Zap-Map also provided pricing information on Tesla Destination and Tesla Supercharger networks, but these have been excluded from our analysis due to Tesla not being a publicly accessible network.

13. The Zap-Map data came from a combination of data directly from the networks Zap-Map has a partnership with, and user status updates on the Zap-Map live map.

14. Zap-Map noted to us that as the data was made partially with user updates, it may overestimate the number of chargepoints which are inactive, as users tend to report issues but may not update the device back to 'available'. Zap-Map also noted that the usage of rapid chargepoints is higher than any other power rating, so there will be more user updates to these chargepoints.

Price differential in home and public charging

15. This section sets out the CMA's analysis of price differentials, namely the differences in pricing between segments, and the evidence we have received from stakeholders and consumers. First, we set out what the price differential to consumers is in home and public charging, and any concerns raised around this. Second, we examine what is underlying these price differentials, explain what costs chargepoint operators incur and how pricing is set.

Variation in pricing

16. This section sets out the variation in pricing structures for consumers when charging their EVs, and the concerns stakeholders and consumers have raised around this.

17. To inform this analysis we used the Zap-Map data referenced in this Appendix and also collected views from a variety of stakeholders and chargepoint operators through written responses to our ITC, information requests and calls, and views from consumers who responded to our ITC and through publicly available consumer research.

18. Pricing typically varies mainly by chargepoint operator, charger power and access/payment method, though some operators also have non-standardised pricing which varies by location.[166] In particular, rapid and ultra-rapid pricing is generally more expensive than slower on-street charging. Some chargepoints may also be free to use, and Scotland and Northern Ireland in particular currently offer mostly free charging on their public networks.

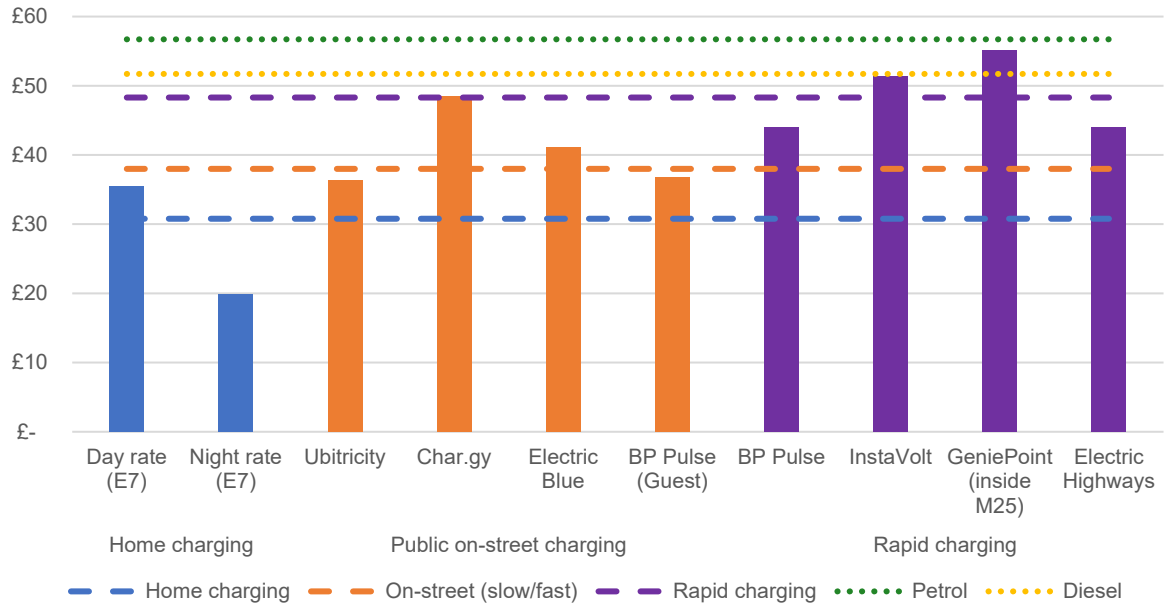
19. Contactless or guest payment is typically the most expensive way of accessing and paying for a charge, while using the chargepoint operator's app

[166] Appendix D on the consumer interaction with public charging sets out some further information on pricing, including on the transparency and comparability of pricing.

or RFID card may offer cheaper variable pricing. Subscription models typically offer cheaper variable pricing, but with an additional fixed monthly fee.

20. Figure 1 and Table 2 summarise the total monthly cost for a typical consumer (see details in notes to Table 2) using home charging, public on-street charging, rapid charging and by fuelling an internal combustion engine vehicle using petrol or diesel.[167] We have found that there is a sizable price differential between off-street home charging and public charging, including on-street and rapid chargers which may be en-route and at destinations.

Figure 1: Total monthly cost in home, public on-street, rapid charging, and petrol/diesel



Note: Dotted lines indicate weighted averages for public on-street and rapid charging, standard electricity average price for home charging, and average diesel/petrol prices.
Source: CMA analysis of Zap-Map data, 26 February 2021. Chart is based on Table 1 and includes only PAYG options and excludes ultra-rapid charging.

[167] Appendix A and B set out the evidence on the en-route segment and on-street segment respectively, and their importance to consumers.

Table 2: Price differential in home charging, on-street, rapid charging and petrol/diesel

[1] [2] [3]	Provider name	Charger power (kW)	Cost (p/kWh or p/litre)	Connection fee [one-off] (£)	Cost per charge (£) [3]	Total monthly cost (£)
Home charging [6]	Day rate (E7) [4]	3	20.6		4.9	35.5
	Night rate (E7) [4]	3	9.9		2.4	19.9
	Average (Standard) [5]	3	17.4		4.2	30.8
On-street charging [7]	Ubitricity	5	24	0.19	6.0	36.4
	Char.gy	7	33		7.9	48.5
	Electric Blue	3	28		6.7	41.1
	bp pulse (Guest)	3	25		6.0	36.7
	Weighted average					38.0
Rapid charging [8]	bp pulse	50	30		7.2	44.0
	InstaVolt	50	35		8.4	51.4
	GeniePoint (inside M25)	50	30	1.8	9.0	55.1
	Electric Highways	50	30		7.2	44.0
	Weighted average					48.3
Petrol and diesel	Petrol [9]		113.2		47.5	56.7
	Diesel [10]		118		49.6	51.7

Source: CMA analysis of Zap-Map data, 26 February 2021. Table includes only PAYG options. Table excludes ultra-rapid chargers due to large variability in the charger power, large variations in pricing and a limited number of providers.
[1] The average mileage per car has been assumed to be 7400 miles in line with data from DfT for England in 2019.
[2] We have assumed the consumer is driving a Nissan Leaf EV with a 40kWh battery capacity and a range of 168 miles.
[3] We have assumed the consumer is charging their EV from 20% to 80% each time.
[4] The average economy 7 variable day unit rate a consumer paid in the UK in 2020 was 21p/kWh, and the variable night unit price was 10p/kWh (VAT inclusive)
[5] The average variable unit energy price is based on standard electricity in 2020 in the UK (VAT inclusive)
[6] We have assumed the consumer buys a home chargepoint for £445 and assumed the chargepoint will last for 7 years. We have subsequently incorporated this cost and spread it evenly across the 7 years.
[7] Top 4 providers in on-street according to Zap-Map data. Source London has been excluded due to including parking in its pricing. Weighted average has been calculated based on the number of chargepoints of these 4 providers, as stated in the Zap-Map core report.
[8] Top 4 providers for rapid chargepoints according to Zap-Map data. ChargePlace Scotland has been excluded due to offering free charging. Weighted average has been calculated based on the number of chargepoints of these 4 providers, as stated in the Zap-Map core report.
[9] We have assumed the consumer is driving a Ford Fiesta (petrol) with a fuel capacity of 42 litres and 517 miles per tank. We have used the average unleaded petrol price in December 2020.
[10] We have assumed the consumer is driving a Ford Fiesta (diesel) with a fuel capacity of 42 litres and 591 miles per tank. We have used the average diesel price in December 2020.

21. Figure 1 and Table 2 show that for the average consumer, charging an EV at home is typically the cheapest option, around £31 per month on a standard rate and even less expensive at £20 per month if the consumer is able to take advantage of smart charging and use a low cost night rate. On-street charging is £38 per month on average, which is approximately 20% more expensive than home charging on a standard rate and this difference is even greater when compared to home charging at off-peak rates.

22. Rapid charging is typically the most expensive form of charging at £48 per month on average – around 60% more expensive than home charging[168] on a standard rate and around 30% more expensive than on-street charging.[169]

[168] Drivers could save over £100 a year by using an on-street charger rather than rapid charging.
[169] Note that ultra-rapid charging can also be more expensive than on-street and rapid charging. We have not included ultra-rapid pricing in our analysis due to large variability in the charger power, large variations in pricing and a limited number of providers.

Fuelling a diesel or petrol car is the most expensive option overall (ie around £52 and £57 per month respectively).

23. Some consumers and stakeholders have raised concerns around the potentially stark differences in pricing in public charging discussed above.[170] In addition, some have mentioned operators such as Source London and Ionity (for non-members) as being particularly expensive. In particular:

(a) E.ON UK said:

> At time of writing the highest unleaded petrol price in the UK (London) is £1.15/litre whilst the lowest (Northern Ireland) is £1.10/litre (excluding motorway services). In an average sized saloon car (c50 litres) this equates to a difference in the cost of a full tank of full of up to £2.50. The price difference between an average domestic electricity tariff and a public rapid charger can be as high as 55p/kWh or an extra £33 for a 'full tank' (assuming a 60kW battery capacity). New ultra-rapid chargers and larger car batteries have the potential to make this variability even more pronounced going forward. New EV drivers, especially those without domestic charging capability will find this significant price range difficult to comprehend.

(b) Relevant points raised by consumers who responded to the ITC include:

> Secondly, the prices seem very high, typically 35p/kWh, much higher than the 10-20p/kWh rates payable for home charging. [Individual response 17]

> I understand Ionity charge up to 69p per KWh for charging at their sites. This is simply usury and shouldn't be allowed. [Individual response number 38]

> Also, Ionity chargers cost 69p/kwh (normal rate is 30-35p/kwh). I would never use their chargers at this price unless I was absolutely desperate. [Individual response 7]

24. Some respondents also raised concerns around the price differential between home charging and public charging in particular, highlighting that this is an equity issue and may be potentially hindering the switch to EVs. In particular:

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[170] For example: BVRLA, E.ON UK, DCC, Tesla Owners Club UK.

(a) Some stakeholders have raised concerns,[171] for example:

> The affordability of on-street residential charging should be reviewed to ensure EV users are not effectively 'penalised' for not having a private driveway or garage. […] Affordability of public charging could also be a barrier to EV uptake for less affluent consumers. It would be highly unfortunate, as well as detrimental to social equity, if less affluent consumers who do not have off-street charging at home and own lower priced or used earlier generation EVs have few other options but to pay considerably more to use certain public charging networks. For some less affluent consumers, the cost of taking up multiple network memberships could be a barrier to EV uptake, while others are put off by some rather steep pay-as-you-charge rates. [SMMT]

(b) Relevant points raised by consumers who responded to the ITC include:

> The cost of charging in public should be no more than 2p to 5p more [than home charging]. This will encourage more EV ownership and take up of the EV method of travel without range anxiety. [Individual response number 15]

> In order to avoid creating divisions between those who can charge cheaply at home and those who are forced to pay high prices it will be essential to provide on-street charging at rates similar to home electricity. [Individual response 3]

Reasons for the variation in pricing

25. As set out above, the price paid by the consumer tends to be higher for on-street (low powered) charging than for home charging, and higher still for rapid (up to 50kWh) charging. This section looks at the reasons for the difference in pricing and whether through competition we can expect the differential, especially between home and on-street, to decrease. This is important as the pricing of alternatives to home charging may have a significant effect on the speed of uptake of EVs for those without access to home charging.

26. We first compare the factors underlying the price of home charging compared with on-street charging, before looking at the difference between on-street

[171] For example: E.ON UK, DCC, SMMT.

and rapid charging. Finally, we examine the effect we expect competition to have on these prices.

Home compared to on-street charging

27. To understand the prices charged for home and on-street we need to look at costs and pricing constraints.

28. Home charging usually occurs through a chargepoint connected directly to the home's electricity supply.[172] There is currently no distinction between general home use electricity and that used for EV charging, therefore the price paid for home EV charging is the general electricity tariff of the home, namely the domestic retail price.

29. In simple terms the domestic retail price is made up of the wholesale electricity cost to the supplier and the fixed and variable costs of supply. To this the supplier adds a profit margin and VAT is then charged at 5%.

30. There are a number of other factors which affect the actual price paid by the domestic consumer. These include: the electricity price cap[173]; the type of tariff the domestic user is on; the size of the electricity supplier's customer base and network utilisation rates;[174] and the level of competition in retail electricity market. Furthermore, in setting the domestic retail price the electricity supplier does not need to take into account the need to recoup any of the EV charging equipment and its installation as these costs are borne by the EV owner.

31. We reviewed the financial modelling of on-street chargepoint operators to understand the costs they incurred in providing EV charging. The cost base for on-street charging is made up of:

    (a) The retail electricity price charged by the electricity provider to a business. While this may be less than the domestic retail price as a result of the quantity of electricity purchased by the chargepoint operator it will still be based on the costs of the electricity supplier set out in paragraph 29. The level of business discount to the domestic rate is heavily dependent on the volume of electricity a chargepoint operator purchases, which in turn is dependent on its customer base and network utilisation. On-street

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[172] Home changing can be done through three-pin plug rather than chargepoint, although this is much slower and not recommended by EV manufacturers or electricity suppliers.
[173] The energy price cap limits the rates a supplier can charge for their default tariffs. These include the standing charge and price for each kWh of electricity and gas
[174] The level of a supplier's customer base and network utilisation will have a direct effect on the allocation of fixed costs through the supplier's tariffs. The higher the customer base and network utilisation the lower the amount of fixed costs per consumer.

operators have told us that they currently do not buy sufficient volume to get significant discounts on their electricity prices. This therefore means that at present, they are buying electricity at roughly the same rate as domestic users on a general tariff.[175]

(b) An element of capital expenditure for the chargepoint. A slow/fast public chargepoint's capital cost (hardware and installation including connection to electricity network) are generally between £1,000 and £10,000 including installation.[176] Most on-street chargepoints though are currently part funded by government grants, the main one being ORCS which provides up to 75% of the capital cost. The remaining capital cost needs to be funded by either the LA or the operator.

(c) The fixed costs of the chargepoint operator. These include service and maintenance costs of the chargepoints, insurance, customer support eg call centers and apps, data charges and any interest costs.[177]

(d) Variable costs would include for example: transaction fees payable on each charging transaction and rent (if based on a variable such as usage rather than a fixed fee)[178]

32. A profit margin would be added to these costs and VAT charged at 20%. We note that some stakeholders (including operators) raised concerns around the difference in VAT costs incurred by on-street in comparison with home chargers (20% as opposed to 5%).[179]

33. The price paid for on-street charging is often set by LAs. As a result, the charging price is heavily influenced by the price expectation or requirements of the LA. This price may be lower than a commercial price an operator would set to recoup its costs and make a profit as LAs may place greater emphasis on encouraging a switch to EV usage than providing a return on the investment.

34. We note though that chargepoint operators also have an interest in encouraging EV take-up and levelling the costs of charging between users. A chargepoint operator told us that it was trying to get pricing as close to the

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[175] Operators have told us that they are not able to access off-peak rates which domestic users can.
[176] Costs vary depending on the power of the unit and whether it can make use of current street furniture eg lamppost or needs a dedicated new structure eg bollard or standalone charging unit. The guidance for ORCS 2021/22 financial year has a maximum fund per chargepoint of £13,000 although it expects this to be the case only where connection costs are high. It anticipates in most cases funding per chargepoint will be below £7,500 ie below a hardware and installation cost of £10,000. On-Street Residential Chargepoint Scheme guidance for local authorities - GOV.UK (www.gov.uk)
[177] Some of these costs will be variable over the longer-term.
[178] One chargepoint operator for example generally pays transaction charges of 2.8% of revenue and a rent per charge post to the LA of 5% revenue share.
[179] For example: ChargePoint, EDF and Pod Point, Zouk Capital.

domestic electricity price as it believes that those without off-street should pay a similar amount.

35. To make a return on investment with the costs base and pricing constraints set out above an operator needs its network to be used by EV owners to charge. The higher the usage (utilisation) the more likely the operator is to make a return. This is illustrated in Figure 2 taken from a chargepoint operator's financial modelling. Under these assumptions the operator would lose £[✂] per chargepoint per month with no usage of that chargepoint. It would require [✂]kWh of usage to breakeven. This is equivalent of [✂] hours charging per month,[180] which would provide around [✂] driving miles per month or [✂] miles per year.[181] Given the average mileage of a private car is around 7,200 miles per annum[182] it suggests that to make a profit per on-street chargepoint each chargepoint must be used by one average car driver for all its charging per annum.

[180] [✂]
[181] [✂]
[182] Department of Transport statistics on vehicle mileage for private cars for 2019. Annual vehicle miles for business cars was 18,400 Vehicle mileage and occupancy - GOV.UK (www.gov.uk)

Figure 2: Example of the effect of utilisation on profitability of a chargepoint

Electricity Trading Margin	£				
Price per kWh (as PAYG)	[✂]				
Cost per kWh	[✂]				
Profit per kWh	[✂]				
kWh charged per month	[✂]	[✂]	[✂]	[✂]	[✂]
£					
Electricity revenue	[✂]	[✂]	[✂]	[✂]	[✂]
Electricity cost	[✂]	[✂]	[✂]	[✂]	[✂]
Electricity income	[✂]	[✂]	[✂]	[✂]	[✂]
Fixed Servicing Costs	[✂]	[✂]	[✂]	[✂]	[✂]
Variable costs					
Bank fees	[✂]	[✂]	[✂]	[✂]	[✂]
Location Rent	[✂]	[✂]	[✂]	[✂]	[✂]
Total Variable Costs	[✂]	[✂]	[✂]	[✂]	[✂]
Income per charge point per month	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Chargepoint operator. [✂]

36. Currently, on-street charging is not profitable for operators. [✂]. One chargepoint operator told us that at this stage on-street chargepoints are generally not commercially viable without support. It submitted that the average utilisation across its entire network is currently [✂]. It estimates that breakeven would be an average of [✂] utilisation.

37. The key factors behind the higher prices of on-street charging compared to home charging are therefore:

    (a) The additional costs an on-street operator needs to recoup for providing the chargepoint and its services

    (b) The inability at the present time for an on-street operator to access lower business tariffs for electricity due to current low utilisation.

    (c) The ability of domestic users to access low tariffs for eg off-peak tariffs which are currently unavailable for on-street charging.

    (d) VAT charged at 20% for on-street electricity compared to 5% on domestic.

Rapid charging compared to on-street and home charging

38. The nature of costs incurred by an operator providing rapid EV charging (which, as already noted, predominantly takes place at destination and en-route chargepoints) will be broadly similar to that of an on-street operator described in paragraph 31. The key difference is the size of the capital costs.

39. A rapid public chargepoint costs upwards of £25,000 for hardware and installation (compared to £1,000 to £10,000 for a slow/fast public chargepoint as set out at paragraph 31(b)). This cost though can increase significantly if the site needs additional work to become suitable eg new power connections (network upgrades) and additional site preparation. Network upgrades may be more necessary as a result of the higher power requirement of the chargepoint, especially if more than one is being installed in a location.

40. Some rapid chargepoints have been installed through LA tenders and as such were partly grant funded. London for example received £13 million in funding from Go Ultra Low Cities scheme to put into: residential charging; car clubs[183]; rapid EV charging and its Neighbourhoods of the Future project.[184] With these chargepoints the LA, as with on-street, had an input into prices charged and locations.

41. The remaining rapid chargepoints have been funded by the chargepoint operators in full. Pricing on these chargepoints is set by the operator or the landlord on which the chargepoint is sited.

42. In setting the price an operator needs to take account of its costs base. One chargepoint operator [✂]. Other operators also noted that

Effect of competition and demand on prices over time

43. In a competitive market it is expected that prices fall to a competitive level. This does not necessarily mean that prices for home, on-street and rapid will be the same or similar. As set out above the costs associated with each of the different methods of EV charging are different with higher costs associated with more rapid charging. Competition can help drive down prices closer to costs but differences in costs would still be reflected in these competitive prices.

[183] Car clubs are short-term car rental services that allow members access to locally parked cars and pay by the minute, hour or day.
[184] The project supported the delivery of local, innovative projects to prioritise and encourage the uptake of ULEVs. Go Ultra Low City Scheme | London Councils

44. Both fixed and variable costs may fall over time as the number of EV drivers grows and there is a resulting growth in networks and utilisation:

(a) **Electricity cost:** A larger number of chargepoints and higher utilisation of a network should enable operators to negotiate better rates with electricity suppliers. Technology improvements could also allow on-street chargers access to off-peak charging rates similar to home users and take advantage of V2G charging, reducing the overall cost to the consumer.

(b) **Fixed costs: (variable element over time)**: Economies of density could lead to improvements in efficiency of chargepoint maintenance and servicing eg reduce travel time between sites. Increased number of consumers could lower average customer servicing cost and overall insurance costs. In addition, as operators gain more experience in this area, servicing could become more efficient.

(c) **Variable costs:** Increasing in scale could lead to the operator being able to negotiate better transaction rates and income sharing/rent with landlords.

45. However, all the financial models provided to us by chargepoint operators indicate that utilisation is the key element. Currently the market is still developing and as such most operators are seeing utilisation below the level required for profitability across their networks - although some sites are profitable.

46. As the sector develops there may also be factors that increase costs. These include the reduction of grants which will mean that operators will most likely need to cover the capital costs of chargepoint installation. In addition, we note that both on-street and rapid charging prices are not always set by the market due to the tender process and that this may mean that current prices do not reflect the long-term competitive price. The competitive price may be higher (or lower) without LA/landlord intervention.

Glossary

AEVA	Automated and Electric Vehicles Act 2018
AFIR	Alternative Fuel Infrastructure Regulations 2017
Alternating Current (AC)	Type of electricity supplied from the national electricity network to UK homes and businesses. Can be used by all speeds of EV chargepoint. EVs have 'on-board chargers' to convert AC electricity to DC electricity, which is used to charge the EV battery.
Battery Electric Vehicle (BEV)	An all-electric vehicle that uses an on-board lithium ion battery as the sole power source.
Bundling	Selling different items ie products and services, together as a package.
Chargepoint	Device that is connected to the electricity network and supplies the electricity used to charge an electric vehicle – can have multiple connection points and charge at different speeds based on the chargepoint's power output.
Charging hubs	Several chargepoints sited together that can be slow/fast/rapid/ultra-rapid or a combination of charging speeds.
Chargepoint operator	Commercial entity that provides chargepoints for electric vehicles – can be involved in the sale, installation, operation and service of chargepoints (or any combination of these).
Department for Business, Energy & Industrial Strategy (BEIS)	UK Government department responsible for business, energy and industrial strategy policy including the overall responsibility in Government for achieving net zero.
Department for the Economy	One of nine Departments of the Northern Ireland Executive, responsible for economic policy in Northern Ireland including energy, among other areas.
Department for Infrastructure	One of nine Departments of the Northern Ireland Executive, responsible among other areas for transport strategy and sustainable transport policy in Northern Ireland
Department for Transport (DfT)	UK Government department responsible for transport policy.
Destination charging	Charging in car parks at places which consumers have travelled to eg supermarkets, shopping centres, cinemas, restaurants and tourist attractions. Chargepoints are typically fast or rapid (slow or ultra-rapid are less prevalent).
Devolved Administrations	Governments of each of Scotland, Wales and Northern Ireland.
Direct Current (DC)	Type of electricity supplied from the national electricity network to charge a battery. Rapid and ultra-rapid chargepoints provide DC electricity directly to the battery.
Distribution Network Operator (DNO)	Licensed companies which manage the local electricity infrastructure that runs to homes, businesses and industrial users. Regulated by Ofgem.
Electricity system	The electricity system covers everything relating to the provision of electricity, including assets relating to generation, transmission and distribution. The electricity network both transmits and distributes

	electricity. Chargepoints need to be connected to the electricity network.
eMobility Service Provider (eMSP)	E-mobility Service Providers (eMSPs) are third-party software-based aggregators of chargepoints. eMSPs typically do not own or operate chargepoints but contract with individual chargepoint operators so that drivers can access and pay for all of the chargepoints with which the eMSP is contracted. A chargepoint operator may also perform the role of an eMSP.
En-route charging	Charging along motorways at motorway service areas (MSAs) or at service stations on A roads and trunk roads, for drivers to top up generally when travelling on longer journeys. Chargepoints are rapid and ultra-rapid. Can also include rapid charging hubs.
Electric Vehicle (EV)	Electric vehicles comprise both plug-in hybrids and all-electric passenger vehicles (cars and light vans).
Electric Vehicle Homecharge Scheme (EVHS)	A UK-wide Government funded grant scheme that provides part funding for up to 75% of the installation cost of home chargepoints.
Electric Vehicle Energy Taskforce (EVET)	EVET was convened by OZEV and brings stakeholders from the energy and automotive sectors together to make suggestions to government and industry to enable the mass take up of EVs.
Fast charging	Chargepoints with power output of 7-22 kilowatts
Highways England	Operates and maintains England's motorways and major A roads.
Home charging	Charging in a driveway or garage for those with off-street parking. A slow or fast chargepoint is installed and connected to the home electricity supply.
Interoperability	The ability of a product or systems to work together with other products/systems – in EV charging this includes the ability for all models and brands of EV to use any chargepoint.
Kilowatt hour (kWh)	Measure of EV battery charging capacity using kilowatts (kW) (measure of electric power - 1kW = 1000 Watts)
Local Authority (LA)	LAs are elected bodies responsible for a range of local public services. LAs include district, borough, city and county councils.
Motorway Service Area (MSA)	Facility along a motorway where drivers can refuel/recharge, rest, eat and drink, shop or stay in an on-site overnight hotel. They are run by MSA operators.
Net Zero	A target of zero overall greenhouse gas emissions across an economy or for a company. The UK Government has committed to Net Zero emissions across the UK by 2050.
Office for Zero Emission Vehicles (OZEV)	Part of DfT and BEIS - responsible for supporting the transition to zero emission vehicles.
Office of Gas and Electricity Markets (Ofgem)	Ofgem is the GB energy regulator, responsible for regulating the supply, transmission and distribution of electricity, including obtaining new electricity network connections for chargepoints.
Open Charge Point Interface (OCPI)	An international standard that enables chargepoint operators to standardise their data collection and storage.
On-street charging	Charging which largely comprises chargepoints set up on the kerbside (eg installed in lampposts or bollards) or in car parks regularly used by local residents. These chargepoints are slow or fast and can be used overnight – similar to home charging.

On-Street Residential Chargepoint Scheme (ORCS)	A UK-wide Government funded grant scheme available to Local Authorities that can be used to fund up to 75% of the cost of installing EV chargepoints.
Pay-as-you-go (PAYG)	An ad-hoc method for accessing and paying for a charge at a public chargepoint without entering into a pre-existing contract with the chargepoint operator. This may include contactless, apps, QR codes or paying online.
Pence per kilowatt hour (p/kWh)	A measurement of the price of electricity per kilowatt hour.
Plug-in Hybrid Electric Vehicle (PHEV)	A vehicle powered by an internal combustion engine (ICE) running on petrol or diesel, along with a small lithium ion battery. The battery can be charged at an EV chargepoint.
Public charging	A chargepoint that can be used by members of the general public - broadly includes en-route, on-street and destination charging.
Rapid charging	Chargepoints with power output of 43-50 kilowatts.
Rapid charging fund (RCF)	£950 million Government fund for upgrades to the electricity network to help meet future demand for chargepoints on motorway service areas and key A road locations in England where the costs of chargepoint installation are prohibitively expensive and uncommercial.
RFID card	Radio-frequency identification chargepoint travel card, through which users can access and pay for charging at public chargepoints
Roaming	A cross-network payment method that allows people to pay for charging via a single app or card. Roaming can be provided through bilateral roaming agreements between chargepoint operators, or by eMSPs.
Slow charging	Chargepoints with power output of up to 6 kilowatts.
Smart charging	Smart charging allows EV charging to be intelligently controlled, so the charging occurs when the electricity network has surplus capacity or there is less demand (such as overnight) and electricity is cheaper. Can currently be used in home or workplace charging.
Strategic Road Network (SRN)	All motorways and trunk A roads in England, managed by Highways England.
Transport Scotland	The national transport agency for Scottish Government.
Transport Wales	The national transport agency for Welsh Government.
Ultra-rapid charging	Chargepoints with power output of over 50 kilowatts, usually 100 kilowatts or more.
Uregni	The utility regulator in Northern Ireland, covering electricity and other utilities.
Vehicle to grid (V2G)	Vehicle to grid technology enables batteries to store and discharge energy back to the electricity network.
Workplace charging	Charging in workplace car parks generally for use by employees. Chargepoints are typically slow or fast and can be used as an alternative to charging at home.
Workplace Charging Scheme (WCS)	A UK-wide Government funded grant scheme for businesses supplying workplace charging. As at April 2021 the grants covers up to £14,000 (£350 per chargepoint) (conditions apply).