EV Charging:
What the remarketing sector needs to know

Vehicle Remarketing Association

Dr Euan McTurk
Plug Life Consulting
Vehicle Remarketing Association

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Contents

Introduction

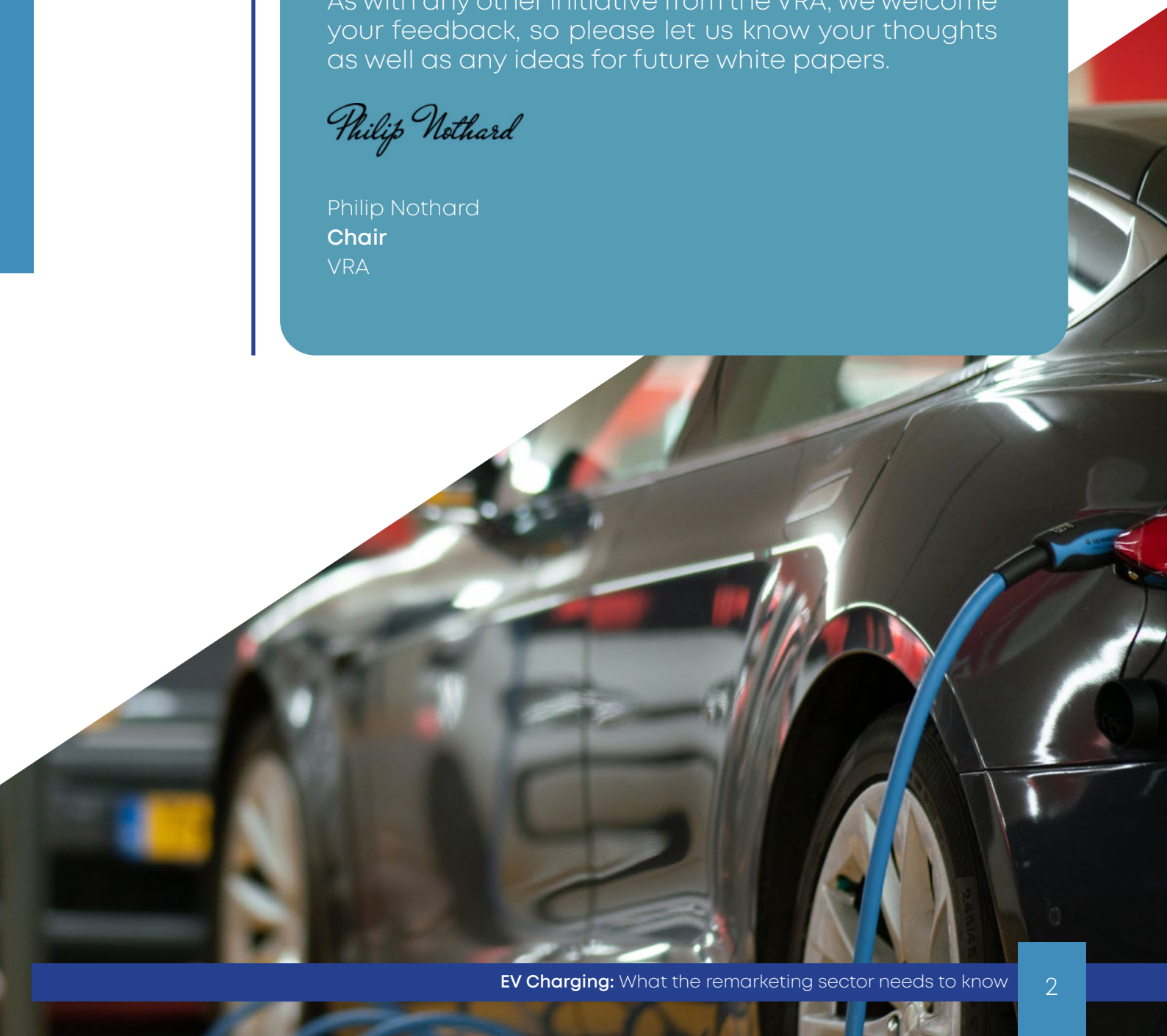
Welcome to the first in a series of new white papers on electric vehicles written especially for Vehicle Remarketing Association members by Dr Euan McTurk of Plug Life Consulting.

Each is designed to provide an essential briefing on a key aspect of the used EV sector, with this edition looking in-depth at the subject of charging - covering everything from what car and van buyers need to know, through to installing the right charging facilities for your premises. It's full of interesting information that we are sure you will find useful.

As with any other initiative from the VRA, we welcome your feedback, so please let us know your thoughts as well as any ideas for future white papers.

Philip Nothard

Philip Nothard
Chair
VRA



What is the current situation regarding the public recharging infrastructure?

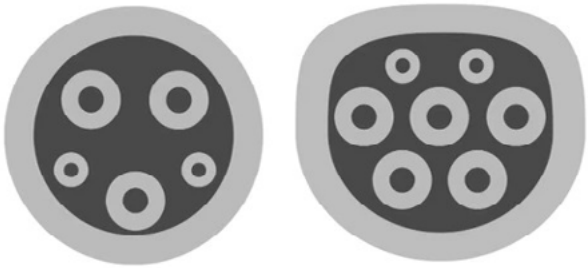
The electric vehicle public charging network is growing rapidly in the UK. According to Zap-Map, as of March 2023, there were 40,496 public charge points and rapid chargers in the UK, of which 1,827 were installed in that month alone. The UK has a target of 300,000 public charge points by 2030.

Of those 40,496 public charge points, 19% are DC rapid chargers, which are basically like petrol pumps for EVs – you stay with or near your vehicle, take what you need and move on immediately. Their typical power ranges from 50 to 350 kW, with faster charger and EV combinations providing an 80% top-up within the average dwell time at a UK motorway service station. The vast majority of the remaining chargers - 81% - are AC, which are designed for you to drive up, plug in, do what you were planning to do at the time (work, shop, sleep, etc) and return a few hours later to a fully charged vehicle, or at least one with considerably more charge than it had before. AC charge points have power of between 7-22 kW, which will typically add between 20-70 miles of range per hour, depending on the vehicle.

Public charging tariffs vary depending on the charging network. RAC Charge Watch reports that the average rapid charging tariff across the UK in March 2023 was 70.46 p/kWh for chargers that have a maximum power of less than 100 kW and 73p/kWh for chargers that have a power of greater than 100 kW. AC charge points range from being free to use in some - but increasingly rare - places to around 44-49p/kWh at Tesco supermarkets, and 65 p/kWh for peak time tariffs on some on-street charge points. While tariffs are currently at record highs, downward trends in wholesale electricity prices should soon translate to cheaper electricity for charging networks and lower tariffs for drivers. If your home or depot has solar panels or other onsite renewables, you can charge an electric vehicle for "free," or a few pence per kWh if including the cost of the solar panels in the first place."

What is the current situation with home and business-based charging?

Almost all home charge points are AC units and it is exceptionally rare to find a home charge point that has a maximum power of over 7kW. There are several reasons for this. Most UK homes are on a single-phase power supply with a 60-100 amp master fuse, so a 7kW, 32 amp charge point is the most that a typical home will comfortably support. This is more than enough to fully charge the longest-range electric cars at home overnight, although it is unlikely that the driver would return home on 0% and genuinely need a 100% charge for the next day anyway. Since an AC charge point provides AC electricity to the vehicle which then converts it to DC using its onboard charger, while a DC charger converts AC electricity to DC and then supplies it to the vehicle, AC charge points are considerably cheaper to buy than DC chargers.



Type 1 Type 2

The maximum achievable power on an AC charge point is the lesser of the maximum power of the vehicle's onboard charger and the charge point's power supply. Most EVs have a 7kW onboard charger, so are limited to being able to charge at 7kW using AC. Some EVs have 11 or 22kW onboard chargers, so can draw 11 or 22 kW from 22 kW public AC charge points, but will be limited to 7kW on a typical 7kW home charge point.

Almost all EVs today have a Type 2 socket, but some earlier EVs, like the 24 and 30kWh Nissan LEAF and the Nissan e-NV200, have a Type 1 socket. Therefore, if a premises has vehicles with a mixture of Type 1 and Type 2 sockets, a socketed Type 2 charge point (which effectively allows you to bring your own charging cable) is strongly advised, rather than a tethered Type 1 or 2 cable that would be incompatible with some EVs. Some EV drivers like to have a tethered home charge point as it means that they can leave their public charging cable in the boot while others prefer socketed charge points for universal compatibility and their more discreet appearance.

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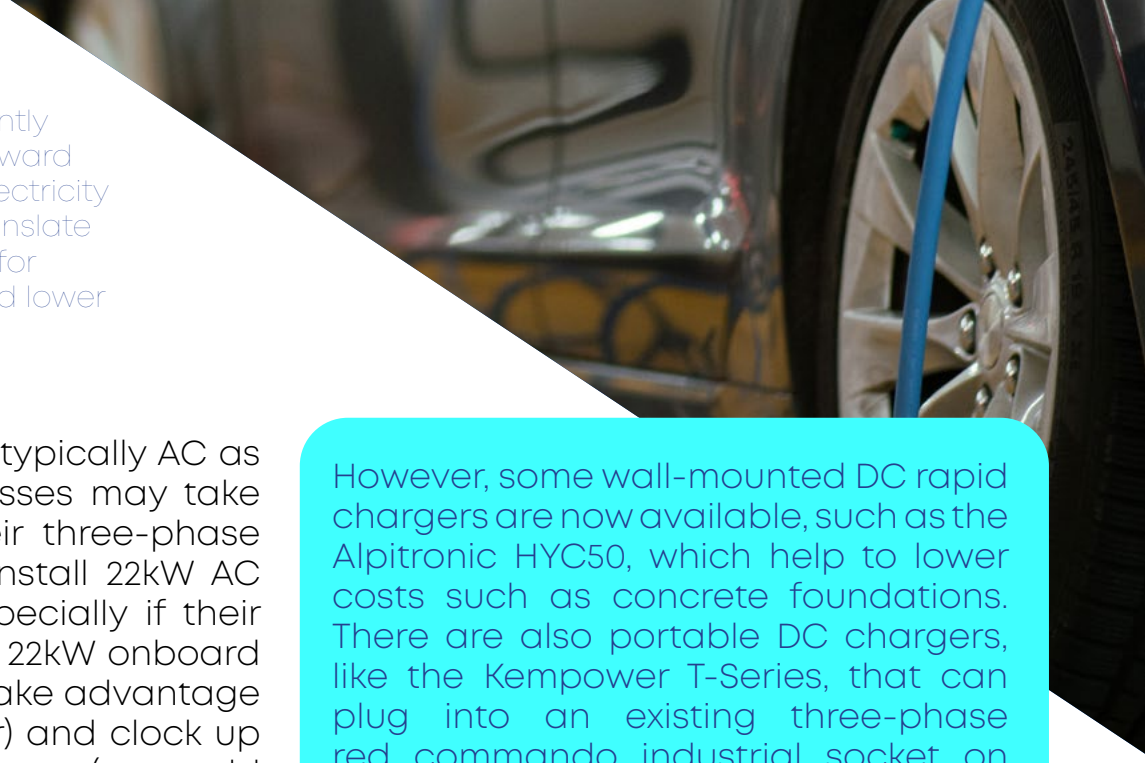


Depot charging is typically AC as well. Some businesses may take advantage of their three-phase power supply to install 22kW AC charge points, especially if their vehicles have 11 or 22kW onboard chargers (so can take advantage of the extra power) and clock up considerable mileage (so could benefit from faster turnaround times on a charge point). Dynamic load managed charge points allow a large number of charging sockets to be installed on a limited grid supply, without having to pay for a grid upgrade. A master unit then juggles the available power between all vehicles on charge, ramping the power to each socket up and down accordingly. This setup works for many large scale users, with only those requiring the highest mileage and quickest turnaround requirements needing more power to be charged in time for their next shift.

For vehicles that need to be back on the road in minutes rather than hours, and for large vehicles like refuse trucks that have a battery so big that even 22 kW AC couldn't charge them fully in time for their next shift, DC rapid chargers are required. These are mostly ground-mounted units, and are considerably more expensive to buy than AC charging infrastructure.

However, some wall-mounted DC rapid chargers are now available, such as the Alpitronic HYC50, which help to lower costs such as concrete foundations. There are also portable DC chargers, like the Kempower T-Series, that can plug into an existing three-phase red commando industrial socket on your premises, meaning that they are completely plug-and-play and require no civils, cable run or new grid connection. Most EVs now use the CCS rapid charging socket although some, such as the Nissan LEAF and e-NV200, use use the CHAdeMO rapid charging socket. Most public rapid chargers have both a CHAdeMO and a CCS cable, although CCS-only rapid chargers are starting to become common as well, especially on the Ionity network. My explanation of EV plug types and charging speeds is available here:

https://youtu.be/yCjtiCFTFbk

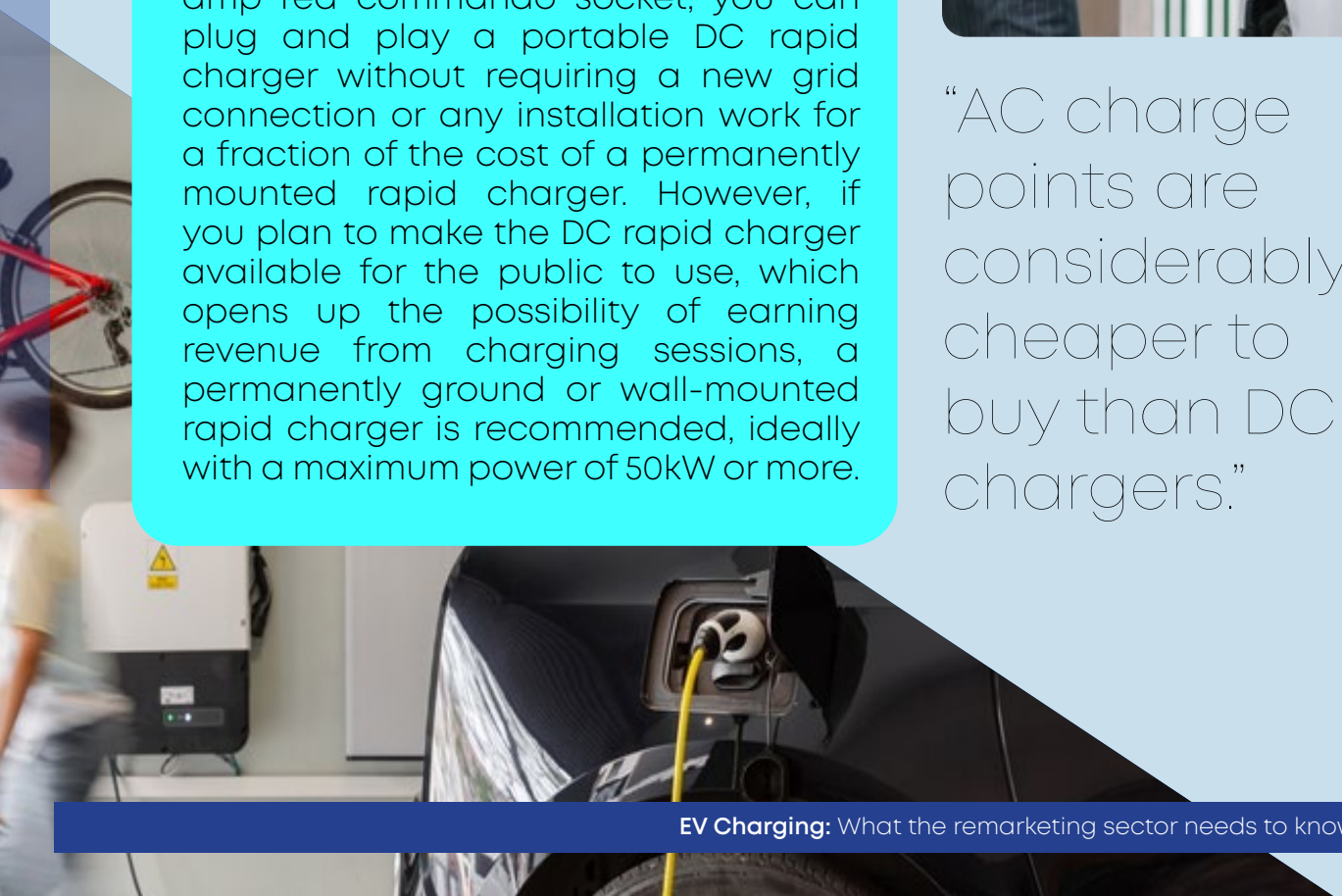
CCS1

CHAdeMo

What kinds of charging facilities might remarketing companies need?

For vehicle dealers with three-phase power supplies, a DC rapid charger plus 7 or 22kW AC charge points are highly recommended. A row of AC charge points is relatively inexpensive to install, will charge your vehicles overnight, and also add meaningful range to other EVs during the day. Opting for dynamic load-managed AC charge points will allow you to add more sockets at a later date without having to upgrade your grid supply. Socketed Type 2 charge points should be chosen to ensure that you can charge any Type 1 vehicles in your inventory. A DC rapid charger will not only be useful for turning around vehicles in a hurry, but for diagnosing issues encountered when rapid charging. A DC rapid charger with a CHAdeMO and a CCS cable is recommended, especially if you regularly deal with Nissan EVs. If your premises have a three-phase 63 amp red commando socket, you can plug and play a portable DC rapid charger without requiring a new grid connection or any installation work for a fraction of the cost of a permanently mounted rapid charger. However, if you plan to make the DC rapid charger available for the public to use, which opens up the possibility of earning revenue from charging sessions, a permanently ground or wall-mounted rapid charger is recommended, ideally with a maximum power of 50kW or more.

"AC charge points are considerably cheaper to buy than DC chargers."



For sites with a limited grid supply, and for which the cost of grid connection upgrades is prohibitively expensive, then the installation of quantity of dynamic load-managed 7kW or 22kW charge points that your grid capacity allows will be beneficial. Each socket can charge a typical EV overnight, which can then be moved to allow another EV to charge during the day.

For vehicle remarketers, whose inventory may be on site for several days or weeks, charging time is of less concern, but for any businesses whose EVs requires a turnaround time of no more than a few hours, compare the maximum AC charging speed of the dynamic load-managed sockets when they are all in use, to the capacity of the vehicles' batteries and the typical amount of charge that they require. This will determine their charging times. For example, a dynamic load-managed charging hub with a maximum 30 kW power supply and 10 sockets will provide 3kW to each vehicle. If your vehicles typically have a 75kWh battery pack (and an 11kW onboard charger but with charging power limited to 3kW by the available power supply) and need to be charged from 30% to 80% State of Charge, this would take a maximum of 12.5 hours. If the charging socket can provide at least 11kW, the same charging session would take 3.5 hours, but for power-constrained sites, ask yourself before upgrading your grid supply whether you really need faster charging times for your operations?

"Dynamic load managed charge points allow a large number of charging sockets to be installed on a limited grid supply, without having to pay for a grid upgrade."

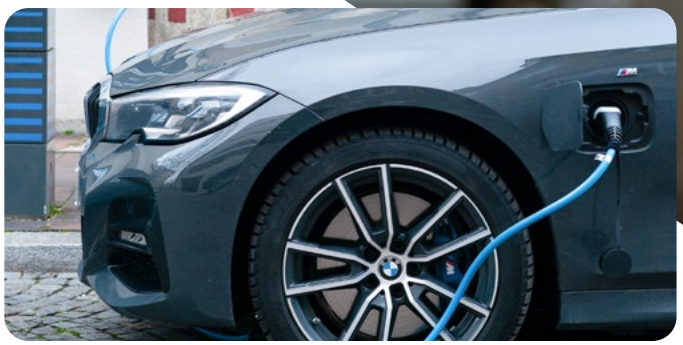
How should remarketing companies handle EV movements?

For best practice, do not leave EVs sitting at below 20% or above 80% State of Charge (SOC) for prolonged periods of time, such as several days or weeks. If the vehicle is to be stored for weeks on end, aim to charge it to between 50–80% SOC - while commonly-used lithium-ion batteries themselves have low rates of self-discharge, this target SOC range will help to ensure that any parasitic drain from even the most power-hungry auxiliary loads, such as car alarms, do not run the battery flat. Note that Sentry Mode found on Teslas is particularly power hungry, so either keep a periodic eye on the SOC of any newer Teslas in your stock or switch off Sentry Mode. Some EVs have apps that allow you to perform basic functions remotely including monitoring SOC. Others take this further by offering an API that allows vehicle SOC to be pulled and logged centrally, thus alerting staff to the need to plug a vehicle back in if its SOC drops too low.

Many - but sadly not all - EVs let the user set the maximum SOC to which the vehicle will charge, which can be used to set the 50-80% SOC limit and avoid charging the vehicle fully to 100% ahead of being stored for weeks on end. During the COVID pandemic, I created a Lockdown Battery Top-up Calculator that takes the SOC of vehicle at present, the target SOC, the battery capacity and the charge power, and tells you how long to leave your vehicle plugged in to reach your target SOC. This tool is equally applicable to long-term storage of EVs on remarketing premises, and can be found at:

https://www.pluglifetelevision.co.uk/lockdown-battery-top-up-calculator

For vehicles that are going out on extended test drives or being collected by customers, a full charge to 100% the previous night will ensure that it has full range available for the driver, something that will be greatly appreciated by your customers. Furthermore, this small gesture is generally regarded by EV drivers as the sign of a knowledgeable and trustworthy EV retailer.



What does the remarketing sector need to do to maximise take-up of second-hand EVs?

One misconception of EVs is that charging takes too long. There is a legacy mindset amongst some customers that they can be in and out of a petrol station in three minutes as opposed to taking hours to charge their car. However, the majority of customers can charge at home or their place of work of work, rather than having to go out of their way to a petrol station, queue to get to the pumps, then drive back again. It effectively takes seconds to charge an EV at home or work – drive up, plug in, go to work or sleep depending on the time of day, then come back and unplug your fully charged car when you next need it. Slower charging can sometimes be financially advantageous – charging your EV with a smart home charge point to use excess electricity if you have solar panels installed, or waiting until your off-peak electricity window starts before filling your car, can save hundreds of pounds per annum compared to a standard flat-rate electricity tariff, and thousands of pounds when measured against petrol or diesel.

Similarly, the merits of slower AC public charge points need to be emphasised by dealers. Yes, you can charge an EV in minutes at a high power DC rapid charger, but if there's an AC charge point at your destination, you can charge your vehicle using mere seconds of your time, as with the home/work charging described above, disappearing off to do what you were going to do at that destination and coming back when you're ready or when the time limit on the public charge point has expired. If your EV can take advantage of 11 or 22kW AC charge points, then you may find that you'll rarely need to touch a rapid charger. For example, I once drove from Edinburgh to Oban and back in my EV, using AC charge points for 30-60 minutes at a time at tourist destinations to grab some electrons while sight-seeing, and didn't need to touch a rapid charger once.

Even if you do need to use rapid chargers, these can often be incorporated around your day's plans anyway. You can plug into a rapid charger at a service station, go inside to have a bite to eat, then return to a vehicle that is charged and ready to go, without having to then join the queue for the petrol station. This convenience needs to be shouted from the (hopefully solar panel-covered) rooftops of dealers, and the legacy thinking that petrol stations and refuelling times are more convenient challenged accordingly.

What needs to be emphasised about charging when retailing EVs?

As stated above, dealers should emphasise the convenience of home and place of work charging to customers, explaining that the average new EV has a range of over 200 miles per charge, which can all be ready and waiting for you in the morning having charged overnight on cheap off-peak electricity. Even the oldest, shortest-range EVs can be exceptionally economical propositions, being more than capable of covering the average UK round-trip commute with plenty of charge to spare. If a driver can charge at home or work, they are likely to rarely need to use public chargers, although the rapidly expanding public charging network should make cross-country journeys easy when they do need them. You can direct EV drivers towards charge point finding apps like Zap-Map, journey planners like WattsUp, and local EV driver forums from the EV Groups Nexus to find charge points near them or their destination, find the best routes to drive, and get lots of friendly help and advice from experienced owners.

It is also important to make sure that new EV drivers know how to charge their vehicles to avoid them having frustrating experiences that are down to a lack of awareness. Clearly explain to them how to charge the vehicle in question, including the difference between Type 1/2 (AC charging) and CHAdeMO/CCS (DC charging) and the times that you would typically use these. Note the maximum power of the vehicle's onboard charger and explain that, when AC charging, it will not be able to charge any faster than this. Also explain that, on some triple-headed 50 kW rapid chargers, there may be a tethered Type 2 cable, but this will not rapid charge most cars - it exists purely for the original Renault Zoe, which was unique in having a 43 kW onboard charger which used rapid charging via Type 2, with no CHAdeMO or CCS socket for DC rapid charging.

For DC rapid charging, note the maximum charge power of the vehicle and explain this to the customer. For a more advanced explanation, which may be requested by more tech-savvy individuals, note that charge power will likely be reduced as the vehicle reaches a higher State of Charge (SOC), or if the battery is very cold.

The charging network Fastned has a helpful series of graphs that show the charge power versus SOC for different makes and models of EV at https://support.fastned.nl/hc/en-gb/sections/4428932764573-Vehicles

Retailers must also be upfront about whether or not the EV supports DC rapid charging - a small number of EV model variants have a Type 1 or 2 socket only, with a comparatively small onboard charger (typically 7 kW) that means the vehicle will always take hours to charge, rather than minutes. These include the Nissan LEAF Visia, entry-level Skoda CITIGOe, Mercedes B250e, and some 50kWh Renault Zoes in addition to all the 22 and 40 kWh Zoes.

It is also worth addressing a common misconception - Tesla has opened up some, but not all of its supercharging network to non-Tesla vehicles. Therefore, drivers should check the Tesla app and website to see if the supercharger that they plan to use is available to them. Also, only the CCS cable on superchargers will work on non-Teslas - the proprietary Type 2 supercharger cable may fit your vehicle's charging socket but it won't charge your car unless it's a Tesla Model S or X.

When retailing EVs to customers, make sure that the Type 2 public charging cable is included with the vehicle, and rated to at least the maximum power of its onboard charger. For example, don't throw in a replacement 7kW cable with a Renault Zoe that has a 22kW onboard charger - make sure that the cable is rated to 22 kW too. Do not be surprised if some customers haggle for the inclusion of the 3-pin "granny cable" – a useful backup if driving to a destination without proper EV charging infrastructure (such as your granny's house, hence the popular nickname).

"It is important to make sure that new EV drivers know how to charge their vehicles to avoid them having frustrating experiences that are down to a lack of awareness."

If your EV does not have a granny cable in the boot already, then it is worth including one upon request to seal the deal, as long as you stress that it is for backup use only and that a proper EV charge point should be installed at the customer's home or work to safely deal with the sustained high power of charging an EV.

Some customers will be appreciative of advice on competitive electricity tariffs and reliable home charge points. These are both increasingly well-served sectors, with Octopus being a pioneer of EV-friendly charging tariffs that offer discounted electricity at off-peak times, and a wide range of home charge points now available that have differing levels of features and price. Zaptec, Ohme, Indra and MyEnergi are just a few examples. Engaging with EV drivers will help to determine which brands are the most trusted and reliable before you make recommendations. Bundling a home charge point with the sale of an EV could not only help to secure the sale for the dealer but make the process of obtaining a home charge point cheaper for the customer.

Another option is the all-inclusive home charge point subscription service offered by Egg, which provides the Indra Smart Pro smart charge point, fully installed, complete with aftercare. If the customer cannot have a charge point installed at home or work, a subscription to – or credit for – a a public charge point roaming service like Bonnet or Octopus Electroverse, or Paua for business customers, could be offered instead.

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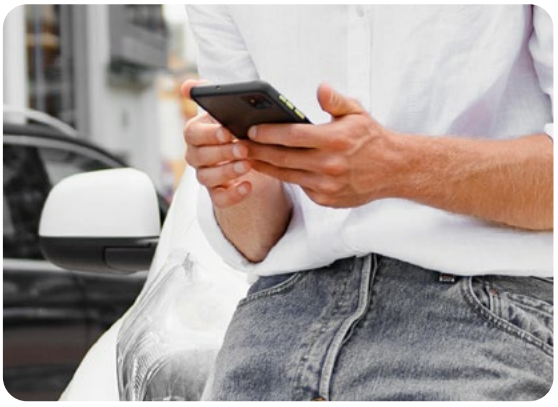


Nick Raimo's YouTube series of home charge point reviews may be of interest to some EV remarketers:

https://www.youtube.com/playlist?list=PL5PJg4d7Q2BKxdpaOFw6NK0oAThDyuSn0

Are there any more technically advanced aspects of charging that retailers should be aware of?

Another important piece of knowledge to have concerns high power chargers and their rated charging power. Some chargers say that they can charge "up to X kW," X is at least the same maximum rated charge power of the EV, but the charger may not be able to provide full charge power to the EV. As an example, if a charger is rated at "up to 150 kW", it may only have a maximum cable current of 250 amps. Since power = current x voltage, and most EVs have a 400V battery pack, then the maximum charge power that they shall receive is 250 x 400 = 100kW, even if the EV manufacturer claims that they can charge at 150 kW or more (which would entail a required cable current of at least 375 amps). 800V EVs like the Hyundai IONIQ 5 and Porsche Taycan do not have this issue and can receive full power from the charger. A full explanation is available at https://www.youtube.com/watch?v=9CeUgN0C2zs

Note that the inverse of the above has been observed at some Tesla superchargers that are open to vehicles from other brands. Tesla superchargers are unique in having comparatively low voltage but very high current, rather than higher voltage and lower current to reduce cable thickness. When 800V non-Teslas charge at superchargers, the maximum voltage of the supercharger is lower than their own system voltage.

Some EVs like the Hyundai IONIQ 5 can boost the voltage from the charger to the vehicle's battery and maintain a high charging power but others, like the Porsche Taycan, can only do this up to a few tens of kW, rather than the 270kW at which it would normally charge.

This has caused frustration for some Taycan owners. However, since most high-power chargers being installed today support in excess of 800V, this is a niche issue, so has been noted here as a reference for advanced troubleshooting rather than something that all dealers should know off by heart.

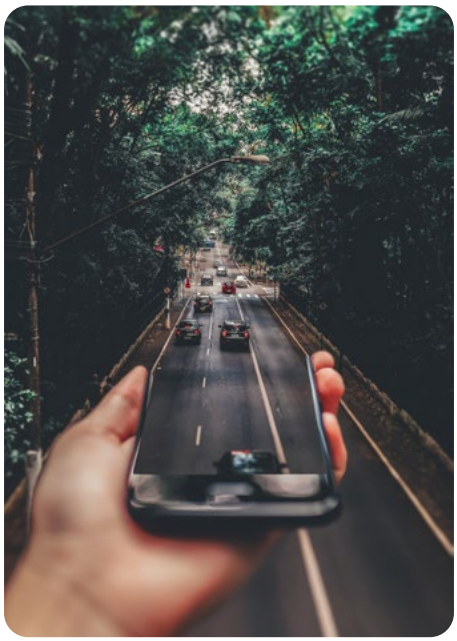
For retailers of HGVs and other large, niche vehicles with 800V battery packs, note that some of these vehicles cannot boost the charger voltage at all, and so will be unable to charge on DC rapid chargers that have a maximum output of less than 800V. This applies to most legacy 50kW rapid chargers installed in the UK and is an important consideration for the customer when specifying their depot charging infrastructure, which must support at least 800V for these vehicles.

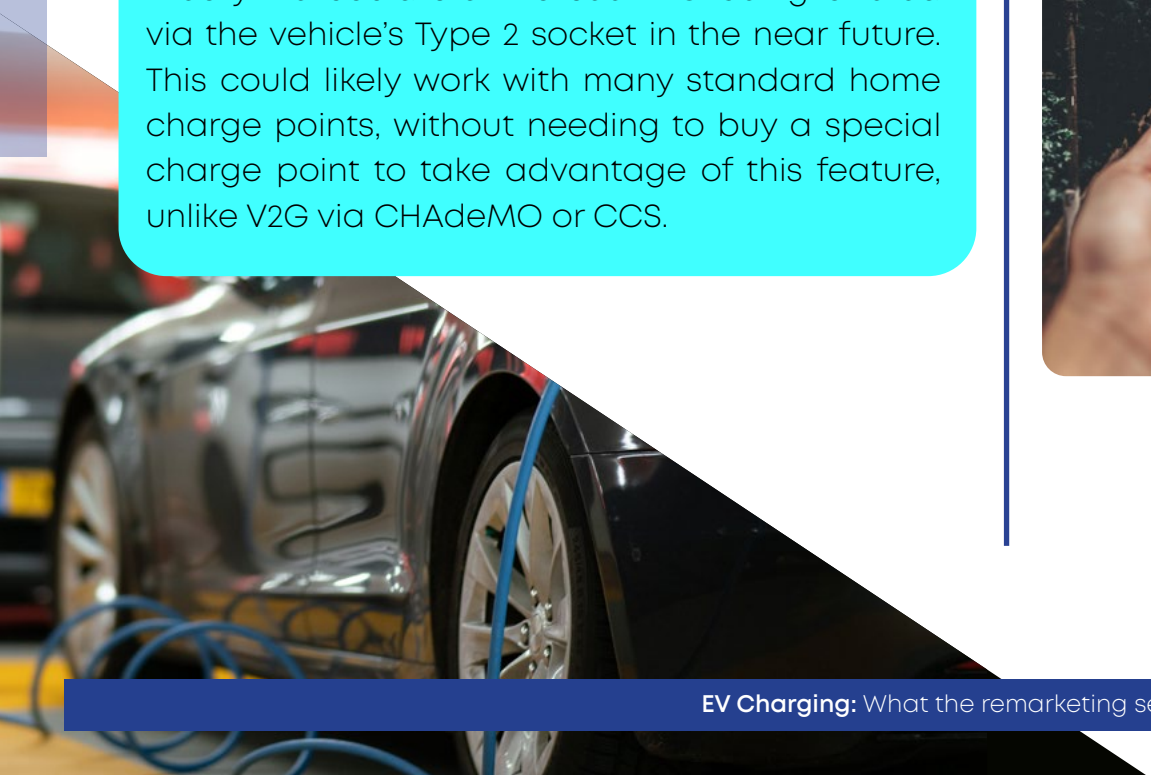
What future developments should we watch out for?

As CCS has won the charger format war, expect CCS-only rapid chargers to become increasingly common. CHAdeMO's loss is unfortunate in some ways, because it could support vehicle-to-grid (V2G) - that is, the ability to use your vehicle to power your home or premises, and help to balance the grid – from day one, while CCS did not have this feature originally and is still catching up. Incidentally, the Nissan LEAF and e-NV200's use of CHAdeMO, and support of V2G, with an appropriate charger, is a unique selling point in a market that has shifted to CCS. However, a standard to allow V2G to be performed using CCS has recently been agreed, so watch out for a wave of new EVs being able to power homes and businesses with the help of a special bidirectional CCS charger.

Vehicle-to-load (V2L) – the ability to power 3-pin devices ranging from power tools to kettles using a special charging socket adapter or onboard 3-pin sockets in the vehicle - is starting to become popular on EVs, including the Hyundai IONIQ 5, MG EV range, Honda e and Ford E-Transit. This entails the use of bidirectional onboard chargers, so in theory we could start to see V2G being offered via the vehicle's Type 2 socket in the near future. This could likely work with many standard home charge points, without needing to buy a special charge point to take advantage of this feature, unlike V2G via CHAdeMO or CCS.

"Charging speeds for EVs may continue to trend upwards, although this is unlikely to render any existing EVs, chargers or charging standards like CCS obsolete."





"Utility providers and public charging networks are starting to offer increasingly innovative tariffs to help to bring down the cost of charging."

Charging speeds for EVs may continue to trend upwards, although this is unlikely to render any existing EVs, chargers or charging standards like CCS obsolete. Also, inductive – or wireless - charging trials are underway around the world, but these will entail the installation of an induction coil on the vehicle and at present, no vehicle manufacturers are fitting these in the factory, and no one has agreed on a standard format like CCS yet. Therefore, inductive charging is unlikely to replace cable-based charging anytime soon.

Spurred on by record electricity prices, utility providers and public charging networks are starting to offer increasingly innovative tariffs to help to bring down the cost of charging. These include off-peak electricity tariffs for overnight charging on public charge points, when grid demand is low and excess renewable energy from wind turbines is high, as well as dynamic electricity tariffs that track the half-hourly wholesale electricity price and have even been known to pay EV drivers to charge their vehicles. Some of the most advanced smart charge points can read these dynamic tariffs and deliberately wait to charge the vehicle when it is cheapest - or most lucrative - to do so.

Overall, most of the charging developments on the horizon are highly unlikely to displace today's agreed standards of Type 2 AC and CCS DC charging, thus ensuring that EV remarketers will still have stock that is technologically relevant. Vehicle remarketers should focus on understanding how EV charging works, and offering customers the most accurate information about how and where to charge their EV, as well as ensuring that they are provided with the cables, charge points and public charging subscriptions to do so.

Vehicle Remarketing Association

The Vehicle Remarketing Association exists to promote networking and provide essential briefings for companies who work in the handling, selling, inspection, transportation and management of used vehicles.

We aim to help our members – who together process more than 1.5 million cars, vans and trucks every year – to forge new and productive links as well as share good practices to help them prosper in a rapidly changing and challenging environment.

The VRA creates a crucial environment where industry issues are addressed by the sector's leading experts in a collegiate and constructive manner. As a result of this successful approach, the Association has expanded by 25% since 2020.

The key objectives of the VRA are:

- To create better awareness of the activities of professional remarketing
- To raise standards and generate an accepted best practice across the industry for key disciplines like vehicle inspection
- To provide a much needed voice to represent the sector in the trade and consumer media on issues which affect remarketing suppliers and customers
- To provide an effective focal point through which major matters concerning those involved in remarketing can be addressed
- To raise the profile and professionalism of the industry to ensure recruiting good quality people becomes much easier
- To generate views and opinions of the industry for use in lobbying for the greater good of the remarketing sector
- To create a forum where members can network, exchange views, debate key topics and share best practice

For more information contact:

info@thevra.co.uk

www.thevra.co.uk