

# Electric Vehicle Charging Facilities

A summary and guide



**2021**

## Introduction

The Government has announced that all new cars and vans wholly powered by petrol and diesel will not be sold in the UK from 2030.

Bracknell Forest Council supports this shift towards cleaner-emission vehicles as part of the wider aim to tackle the causes of climate change, and we want to make that transition as smooth as possible for our residents and businesses.

To do so it is important that we carefully consider the social, financial and technical practicalities and implications of Electric Vehicle (EV) charging infrastructure. There are many stakeholders that will contribute towards the conversion to EV and we want to ensure that the Council's actions are supportive and co-ordinated wherever possible.

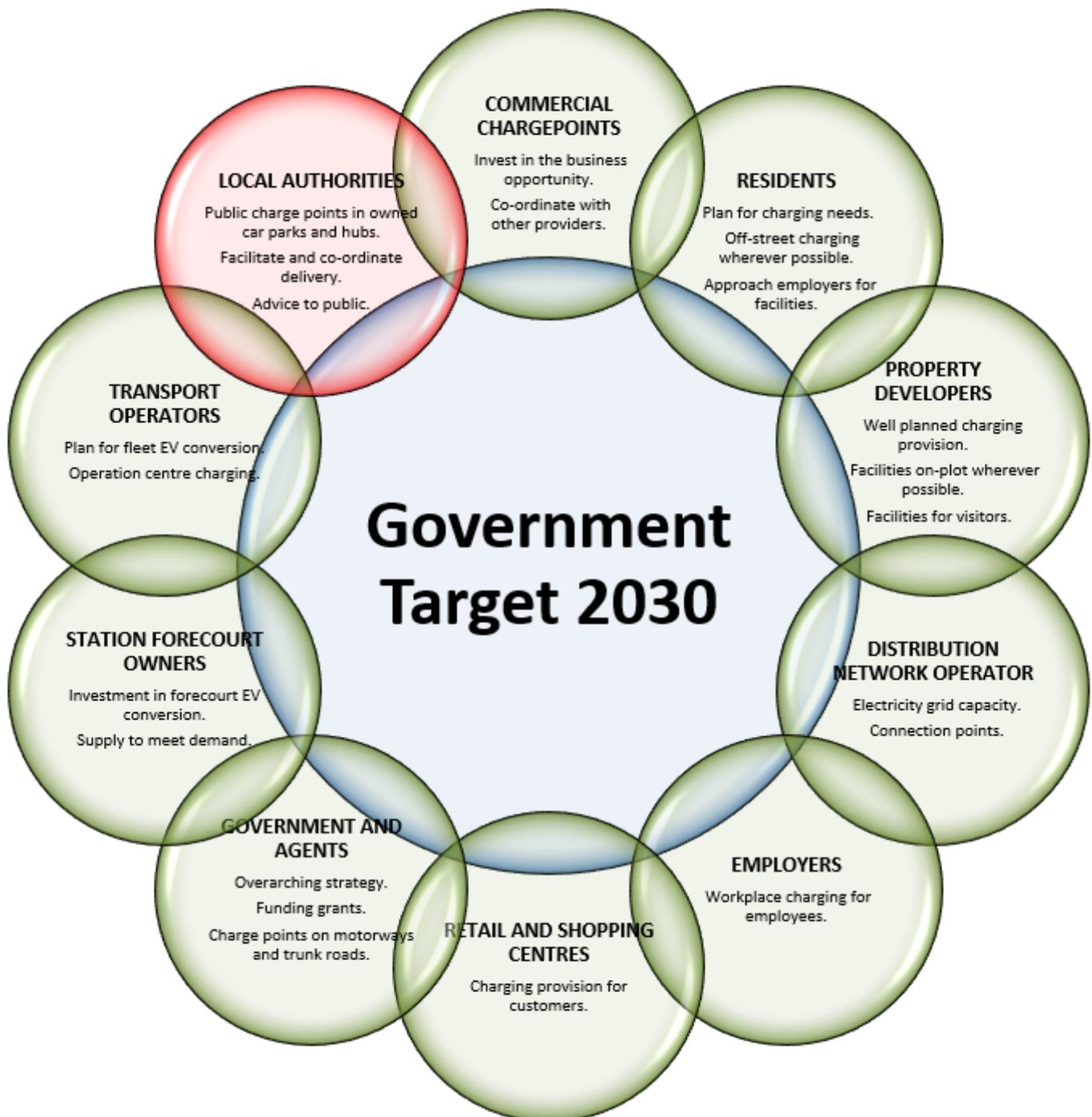
We must be clear on our role in the overall charging solution. Councils are not energy providers, nor do they provide petrol stations. As such, we are looking more closely at how we can work with the private sector to deliver the Borough's charging needs, whilst retaining our limited budgets for installing infrastructure in areas where we do have a responsibility and duty, such as public car parks, education and leisure destinations and other settings linked to services, health and social care.

The Council has been exploring and investigating EV charging solutions since 2015, when we installed our first public-use charge point in the High Street multi-storey car park (Bracknell). As with most technological advances in the last 30 years, developments in battery and charger technology have been rapid and we have already encountered challenges in what might be considered the early days of adoption. Whilst earlier installations had followed the latest trends and advances in technology at that time, clearly the pace of EV technology has accelerated since and the risk of technological obsolescence must also be a consideration in our plans for the future.

The rollout of charging infrastructure and the approach taken by Councils varies across the country and we recognise the need to provide clarity. As such, this document aims to provide a detailed overview of Bracknell Forest Council's approach, and how we aim to facilitate electric vehicle ownership and use in the Borough.

# The Overall Charging Solution

There are many stakeholders that will contribute towards the conversion to EV, as can be seen in the diagram below:



# Electric vehicles and charging: background and basics

Electric vehicles are sometimes known as Battery Electric Vehicles (BEVs), or as 'pure electric vehicles' in order to distinguish them from hybrid vehicles.

In 2011, there were only three EVs on the market with 70 to 80 miles range on a single charge. Since then, the number and variety of EVs has increased dramatically with significant improvements in range. The latest models are approaching 300 miles on a single charge with some even exceeding this. Speculation on future technological advances includes the potential for batteries to deliver a 600 mile range which could help simplify our future charging needs.

The range of an EV depends on a variety of factors including vehicle configuration, battery age and condition, driving style and environmental and climate conditions affecting its operation.

EVs generally have higher purchase costs than their petrol and diesel competitors due to the manufacturing costs associated with the batteries and electric motor. Although in contrast they are often cheaper to maintain, at least in the short-term, due to their comparative simplicity. As the EV market develops, battery costs and therefore vehicle prices will continue to drop and are expected to reach parity with conventional models in the next few years.

## Chargepoints and costs

There are currently four main types of EV chargepoint – slow, fast, rapid and ultra-rapid, summarised in **Table 1** below. This categorisation reflects the power outputs (with power measured in kiloWatts-kW) and therefore the charging speed available.

Each charger type has an associated set of connectors which are designed for low or high power use, and for either alternating current (AC) or direct current (DC) charging.

Installation costs can vary hugely and depend on the type of unit being used, the ease of grid connection and (for rapid chargepoints) the proximity to high voltage networks and/or necessary transformer upgrades. The costs below are rough estimates provided by the Energy Saving Trust.

**Table 1: EV Chargepoint Types**

	Slow (3-7kW)	Fast (7-22kW)	Rapid (Up to 50kW)	Ultra-Rapid (100 kW or more)
<b>Typical charge time</b>	6 to 12 hrs	2 to 4 hrs	20 mins to 1 hr	10 to 30 mins
<b>Vehicle range added in 15 mins</b>	3 to 6 miles	6 to 20 miles	35 to 40 miles	100+ miles
<b>Equipment cost per unit</b>	£500 to £1k	£2k to £4k (AC) £20k (DC)	£20k to £50k	£50k+
<b>Installation work and grid connection cost</b>	£250 to £10k	£1k to £25k	£5k to £100k	£20k to £1 million

Typically, slow chargepoints are found in locations where vehicles are left for longer periods. Fast units are found in car parks where dwell time is likely to be shorter whereas rapid units are found more at charging 'hubs' within car parks or on existing station forecourts where the user is likely to stay with their vehicle if only charging for a short period.

The Council sees rapid and ultra-rapid chargepoints as the practical and long-term solution for the majority of our charging needs - especially for those without off-street home charging facilities. These more powerful units will enable EV owners to charge quickly and, as technology improves, would take a similar timeframe to refilling a petrol/diesel vehicle. These would be supplemented by slower units within public and privately owned car parks and workplaces.

Further technical detail on chargepoints, available charging connector types and their main characteristics is provided in **ANNEX B**.

Below: **A 50kW Rapid chargepoint at Shell, Bagshot Road**



Below: **A 7Kw Fast chargepoint at Tesco, Martins Heron**



## Car Park chargepoints

At the time of writing, there are 35 public use chargepoints in Bracknell Forest, located within either Council or privately owned car parks. Their types and locations are summarised in Table 2 and 3 below.

**Table 2: Council car parks**

Location	Type	No. of sockets	Charging provider
High Street multi-storey car park, Bracknell	7kw	12	BP Pulse
Braccan Walk multi-storey car park, Bracknell	7kw	2	BP Pulse
The Avenue multi-storey car park	7kw	4	BP Pulse
Westmorland Park	22kw	2	PodPoint

**Table 3: Other car parks**

Location	Type	No. of sockets	Charging provider
Tesco, Warfield	7kw	4	PodPoint
Tesco, Martins Heron	7kw	4	PodPoint
Waitrose, Bracknell	7kw	2	BP Pulse
Shell, Bagshot Road	50kw	1	Shell Recharge
Lidl, Crowthorne	50kw	2	PodPoint

This list is constantly evolving, with new chargers being added to car parks on an almost monthly basis by the private sector.

There is ongoing work to increase EV charging bays within Council public car parks, with a bid submitted to the Office for Zero Emission Vehicles in June 2021 which seeks to provide multiple chargers in 11 communal car parks around the Borough. This may be supplemented by further chargers using parish-owned sites, whilst we will also continue to encourage (and where necessary assist) private car park owners to do the same.

## Charging hubs and station forecourts

We envisage a steady increase in the number of rapid and ultra-rapid chargepoints at existing filling station forecourts. As a greater share of the vehicles on our roads become EVs, this will become a natural business model shift as oil companies diversify into becoming broader energy providers, and we are already seeing this in the corporate re-branding of some globally recognised 'petrol station' operators.

Filling stations are ideally placed to facilitate rapid charging, given the similarity of process to filling a traditional combustion engine car, but also the facilities they (increasingly) offer or host on the premises for dwell time, such as coffee or sandwich outlets and convenience grocery shopping. Corporate partnerships such as these will help to facilitate the shift in how we will refuel our vehicles, but potentially also in how we use our time.

Within Bracknell Forest, Shell and BP operate the majority of filling stations and they are making commitments to significantly increase their charging infrastructure.

Shell aims to have 200 Shell Recharge points on their forecourts by the end of 2021, with plans to grow their EV charging network to over 5,000 EV charge points on forecourts and in new locations by 2025. <https://www.shell.co.uk/motorist/ev-charging.html>

BP has established BP Pulse as its electric offer and is aiming to add rapid 50kw and 150kw chargers to its forecourts, and other locations across the UK. BP Pulse claims to already have the UK's largest network of Rapid chargers, and this is backed by the existing BP Chargemaster network (with 12 of these chargers located in Bracknell already). <https://www.bppulse.co.uk/charging-on-the-go>

Conversely, supermarkets are also increasingly seeing the benefits of providing rapid chargepoints, as the average weekly shop can be achieved in roughly the same amount of time as it takes a rapid charger to completely refuel a car. Coffee companies are also investing in roadside sites with rapid chargers to provide a comfortable 'stop-off' point for EV users who can fill their cars in the time it takes to order and consume a cup of coffee.

There are also entirely new companies such as Gridserve who have opened 100% EV charging stations at sites in Braintree (Essex) and Norwich, and plan to open over 100 more by 2026 across the UK's strategic road network.

Forecourts will be further complemented by commercial charging 'hubs' where clusters of 4 or more rapid chargepoints are located together in car parks, usually on or close to major roads with facilities nearby. Much of Tesla's Supercharger network uses this model, and we are keen to facilitate further commercial rapid charging hubs on the strategic A322, A329 and A3095 corridors where practical.

On the wider strategic road network, including motorways and trunk roads managed by Highways England, speed and convenience of charging is paramount for those undertaking longer journeys. As such, service stations have been early adopters of rapid chargepoints, and consequently have been some of the first to see 150kw ultra-rapid chargers. It is likely that motorway service stations will see a significant increase in rapid chargepoints in the coming years.

Collectively, these charging opportunities will be complimented by the Council's local approach to install slower chargers in community and multi-storey car parks where travel patterns suit longer dwell times and where value for money can be achieved with public funds.

## **Workplace chargepoints**

Workplaces are ideal locations for employee and company owned EVs to be charged, whether during the day or overnight. As the uptake of electric company cars increases due to favourable benefit-in-kind tax relief and increasing EV availability, it will become more important for organisations to introduce chargepoints at workplaces.

In determining how many chargepoints to install, and what specification to use, employers will need to think about the size of their fleet now and in the near future, including private staff vehicles. A detailed analysis of vehicle mileages may also help, for example if an EV with 200 mile range vehicle is used on an average daily route of 40 miles, it will only need charging once per week. Employers should also consider who actually needs to charge as a proportion of their employees are likely to utilise homecharge units instead.

It may be easier and cheaper for employers to install slower chargepoints, i.e. 7kw capable of recharging a car in six to eight hours.

## **Workplace Chargepoint Grant**

The Department for Transport has funding available for employers to install up to 40 fast (7kw – 22kw) chargepoints, where it will contribute 75% of purchase and installation costs, up to £350 per socket. Find out more [here](#).

## **Residential charging**

### **Home chargepoints**

We recognise that in the short-term one of the most convenient ways to charge an EV will be at home. A chargepoint on a private driveway or within a garage reduces the complications of charging availability. The Department for Transport has funding available for homeowners to install a chargepoint, where it will contribute 75% of purchase and installation costs, up to £350 per socket. Find out more [here](#).

### **Street chargepoints**

A number of housing areas within Bracknell Forest, particularly those built in the 1950s and 60s, do not have on-plot parking. In these locations parking is often provided away from the property in private garage blocks that have become unsuitable for both the size and number of modern-day vehicles. Past surveys undertaken by the Council have found that many of these garages are used for general storage. Some older developments contain communal parking courts which generally provide spaces on a first-come-first-served basis, although some private courts have allocated bays.

Whilst more recent housing developments feature increasing levels of parking provision, with many including private on-plot parking as standard, the increasing levels in car ownership often place parking pressures on surrounding roads.

We continue to invest in the provision of additional parking bays within areas experiencing the greatest parking pressures, but this is limited to land within our control or through our partnership with third parties, e.g. Silva Homes. However, in many residential areas there simply isn't enough space to provide additional parking for all local residents' vehicles.

Adding formal EV chargepoints into residential streets could exacerbate existing parking pressures and potentially create wider divisions within communities. Over time, this could become less of an issue as EV ownership increases, but the prohibitive cost of providing this scale of personalised charging infrastructure would remain.

There are also physical practicalities associated with providing charge points in residential streets. In the majority of cases, limited footway and carriageway widths would make installing chargepoints impossible without significant impacts on the use and layout of the street. In particular, lamp column chargepoints would be impractical as columns are mostly located at the back of the footway within Bracknell Forest.

Collectively, these challenges reinforce the need for wider and more varied charging solutions for EV owners which remove the reliance on home charging.

### **Domestic on-street charging (cables)**

Charging a car from a home supply without off-street parking typically means trailing a cable from the property to the vehicle, which is likely to involve the crossing of a public space or public highway. Footways (or pavements as they are typically known) are part of the public highway, and the Council has a legal responsibility and duty to ensure that these are maintained and kept free from obstruction, including tripping hazards.

Cables across footways are not a new issue to the Council, and licences exist for street traders to run power cables for their business. However, these are issued with conditions that the cable will be suitably protected (i.e. with a quality, high visibility, low-rise rubber cable protector), but more importantly that they are manned while the cable is in place, allowing it to be moved if necessary for any reason. Given that the majority of domestic EV charging will probably take place overnight, cables will effectively be left unattended and out of sight of the vehicle owner, increasing the risk of an incident.

Nevertheless, we recognise that as EVs become the norm for residents, the need to charge from a property located next to the public highway will only increase, at least until the wider charging solutions become commonplace, e.g. station forecourts, charging hubs, workplace and destination chargepoints. As such, we have produced specific guidance to aid residents on the use of domestic charging cables and this is provided at **ANNEX A**.

## **New developments**

Overall parking requirements for new development are determined in accordance with the Council's Parking Standards Supplementary Planning Document (SPD) which aims to deliver effective parking solutions while taking account of other planning considerations. The current standards seek to provide for future EV chargepoints whilst addressing the current lower levels of demand.

For residential schemes with garages and/or driveways the provision is simpler as a 240V power supply can be adapted to the relevant charger by the developer or home owner as required. Parking spaces within private parking courts, however, require preparation through the installation of cable ducting and to facilitate their future connection to a charging unit as demand grows. This provision includes the necessary connection to the local electricity distribution network, as well as cabling to parking spaces.

As demand for home and destination chargepoints is set to increase, we are now reviewing the requirements for EV charging facilities within new developments to establish how best to ensure that current and future needs can be met.

## **Public chargepoint installation, ownership and management**

There are a number of approaches available for Councils looking to provide chargepoints in public places, with varying levels of control, cost and risk involved. First and foremost it is worth understanding that a typical chargepoint requires the following elements:

**Ownership:** the party who owns the physical charging equipment.

**Management:** the party responsible for the daily maintenance and interface with customers.

**Operation:** the party in charge of the 'back-office' systems and business process via which customers use the chargepoints.

For chargepoints installed on Council-owned land the authority could opt to control all, some, or none of the above. **Table 4** below outlines the different options available, detailing likely Council involvement and associated benefits/disbenefits.

Taking control of the whole chargepoint system provides the opportunity for the Council to specify charger types, set prices and maximise the opportunity to recover running costs - **Option 1** within the table below. This arrangement avoids the more complex and constraining

lease agreements with private chargepoint providers. However, it also comes at a significant set-up cost.

Some more complex chargepoint sites can require electricity grid connections which in some cases can cost hundreds of thousands of pounds if rapid units are installed. There is also the cost of in-house staff to manage and maintain the chargepoints.

As the EV market and demand grows, there is increasing interest in Council-owned sites from commercial chargepoint providers, particularly those close to major roads and well-populated areas. In these situations we are looking to secure a partnership arrangement that provides benefits for the Council in terms of cost recovery, whilst leaving installation and overall management to the chargepoint provider - essentially **Option 5**. We are also investigating using Government grant funding to purchase chargers with 25% Council match funding, which would create a scenario more like **Option 3**.

As the Council is not an energy provider, and has limited experience or resources as such, a flexible approach to chargepoint provision is considered sensible. Our contribution to the overall charging network will be complemented by wider investment from the private sector such as at station forecourts, retail destinations, leisure attractions and workplaces.

In summary, we will select the most appropriate chargepoint delivery model for each location to ensure practicality, maximise consistency and deliver the best value for money from public funds.

**Table 4: Models for the supply and operation of EV chargepoints**

	Owner	Manager	Operator	Considerations	Relative installation cost	Cost recovery	Level of Council control
1	Council	Council	Council	Provides flexibility and independence to the council regarding alterations on charging fees, installation/uninstallation of equipment, incentives to users etc. Requires a high level of investment and ongoing “in house” expertise.	££££	£	★★★★★
2	Council	Council	Supplier	The council purchase and maintain the chargepoints. The network is operated by a supplier with experience in EV, familiar to the users. Constraints in achieving a coordinated and consistent approach between all the EV chargepoints. Potential delays in maintenance due to additional coordination between council and supplier.	£££	££	★★★★★
3	Council	Supplier	Supplier	The equipment is purchased by the council but is maintained and operated by an external supplier. Single contact point for users facilitating the processes for maintenance and operation. Reduced influence from the council once installed and contract started.	££	£££	★★★
4	Council	Supplier	Council	The council purchase and operate the chargepoints but the maintenance is undertaken by an external supplier with expertise in this sector, familiar to the users. Council can operate an integrated network of EV chargers with flexibility in adjustments to charging fees, installation/uninstallation of equipment and incentives to users.	£££	£££	★★★★★
5	Supplier	Supplier	Supplier	Possible requirements to lease land to supplier for 10 – 20 years. Increasing potential for cost recovery as EV demand grows. Low financial risk for Council. Low influence from the Council.	£	£££	★★
6	Commercial provision			Chargepoints installed and operated by commercial suppliers on private land. Zero financial risk for council. Lowest influence from the council and unlikely to resolve charging needs in residential areas.	-	-	★

# Practical considerations for public chargepoints

## Market forces

Given the general capabilities of the local electrical network infrastructure and high cost of purchasing and installing rapid chargepoints, the majority of public chargepoints installed by Councils are likely to be 'fast' 7kw units, meaning a typical electric vehicle would need between 4 and 6 hours to fully charge.

The costs involved in upgrading electricity supplies and installing rapid chargers are less of a barrier for commercial chargepoint providers, but there must be an incentive for their investment. Commercial feasibility is generally determined by the proximity to major roads, populations, businesses, shops and services that can guarantee a level of usage to justify initial cost outlays.

The technology behind EV charging is moving forward very quickly and this presents a number of pitfalls when looking at chargepoint options. This could place Councils at significant risk of investing in technology that could quickly become obsolete, be incapable of fulfilling users' charging expectations and result in some chargepoints becoming unpopular and losing viability. It is important for Councils to secure flexible arrangements with chargepoint providers and operators, with agreements to upgrade chargepoints if necessary or to allow for relocation of under-used sites.

## Payment methods and understanding operator networks

As with any emerging technology, new charging providers enter the market almost every week and it can be difficult to keep up with the number of tariffs, payment methods and apps used. It is crucial that easy payment methods are available to improve EV driver experiences and provide choice.

Some chargepoint operators offer incentives for membership of their payment network, but this could mean an EV owner needing several apps or user cards simply to charge their vehicle. Fortunately, there is recognition from Government of the need for regulation and standardisation amongst providers and it now requires all new chargepoints to be fitted with contactless bank card payment capabilities.

## Bay-marking and enforcement

Experience from trials elsewhere in the country has shown that if an EV chargepoint is installed in an area where parking is already at a premium, it needs to be provided with a marked bay to avoid any vehicle simply parking in front of it and blocking its use by an EV. Conversely, marked bays also remove parking space from the street for non-EV users who may see this as disproportionate in some cases.

A marked bay requires a Traffic Regulation Order, which requires public funds to implement and requires subsequent enforcement, for example through the issuing of fines if used by a non-EV, or against an EV which isn't charging. These cases may be difficult to prove or determine, whilst Council enforcement teams already face competing priorities.



### **Maintenance, public safety and vandalism**

Whilst appropriate site surveys and risk assessments will be carried out prior to any chargepoint installation, ongoing maintenance and assurance of public safety of chargepoints is better suited to service industries than Councils. Vandalism is also a risk that we have learned from first-hand, when a chargepoint was severely damaged within the Braccan Walk car park within 48 hours of installation.

### **Public funds**

In order not to risk public funds and maintain value for money in our EV investment the Council must not unwittingly becoming an energy supplier or place itself in competition with chargepoint providers. It is our opinion that the private sector should be leading the way in delivering charging infrastructure and the investment of public funds should focus on providing the authority's contribution to the overall charging network.

## **In summary**

There is no certainty at present on where future EV owners will predominantly undertake their charging, but we recognise that demand for all charging types will increase rapidly as we head towards the Governments 2030 target. However, societal shifts in the ways we work, travel and manage our time are also likely to mean we travel less by car

Many residents with on-plot parking are likely to establish home chargepoints, whilst other charging choices will be based on factors such as supply and demand, quality, convenience and personal circumstances.

The pace of change in battery capacity and charging technology will mean that the available range of new cars increases whilst charging times reduce. This means charging a vehicle at a forecourt or rapid charging hubs needn't be an inconvenience any more than filling a petrol/diesel-engined car currently.

Market forces will increasingly dictate the locations, costs, numbers and standard of chargepoints delivered by the private sector. Equally, the increasingly competitive EV charging market will continue to drive early investment by key energy providers. This activity will supplement the chargepoints installed by the Council in partnership with providers and operators.

We clearly have a role to play in the overall charging solution, but much of this focus will come early on, and be focused towards providing practical, viable and affordable charging infrastructure of public benefit.

Our role is also as a facilitator and influencer in terms of private investment and infrastructure delivery on our transport network, whilst in parallel providing information to our residents, businesses and employers on emerging themes and Government funding opportunities.

## ANNEX A

### On-street domestic charging (cables): Guidance for residents

It should be stressed from the outset that much of this guidance relies on common sense and an awareness of personal and public safety, along with an acceptance that liability for the cable lies with the cable owner. **We would strongly advise Electric Vehicle (EV) owners to ensure that they have car or home insurance that provides public liability cover for the cable.**

It should also be noted that domestic cable street charging generally lends itself far better to traditional terraced streets - a housing style which is less common in Bracknell Forest. Given the design and layout of many of Bracknell Forest's residential areas which do not have off-street parking, running a cable from a property is simply not a practical, sensible or realistic solution from the outset.

For these residents, we re-affirm our suggestion and commitment to using chargers in public car parks, rapid units at existing forecourts and other destination charging opportunities.

The Council will not provide personal allocated bays for EV users in residential streets and so the space on the highway outside the property is not for the exclusive use of the EV owner. Therefore, any other residents or visitors could park outside the property meaning charging is not guaranteed and depends largely on the goodwill and understanding of neighbours.

**Refer to your vehicle's handbook and any instructions for the use of cables, including extension cables, and seek advice from a qualified electrician before charging an EV.**

#### Parking your vehicle for charging

It is the responsibility of the person charging the vehicle to adhere to any parking restrictions that may be in place and to not obstruct the footway or any accesses. The guidance is intended to help residents make informed decisions about how they can charge a vehicle in these locations. It is the responsibility of the person charging the vehicle to avoid putting themselves and others at risk when trailing a cable across a footway or an area people may cross.

Vehicles should be parked as close to the property as possible. Where a vehicle cannot be parked immediately outside the property, the cable should be run along the carriageway channel against the kerb. The recommended maximum distance from a point outside the property is 10 metres (approximately 2 car lengths).

The cable should not cross the carriageway therefore your vehicle should always be parked on the same side of the road as your property.

#### Charging your vehicle

Whenever you are charging your vehicle, you should always follow the guidance and recommendations in your manufacturer's handbook (this may differ depending on the vehicle).

Any extension lead that is required should be suitable for external use. You should read any instructions on the correct use provided with your extension lead.

Cables should be laid flat and never be extended from an upper storey to a vehicle, nor should they be hung from any street furniture including lamp columns or trees.

A cable should only be placed over the footway when the vehicle is charging and should always be removed when not in use.

**It is the resident's responsibility to ensure that the cable does not cause a danger or a nuisance to the public.**



Cable protectors should extend the full width of any footway and verge between the property and vehicle



Always use a cable protector if laying your charging cable across a footway or path.

### **Cable licensing**

Currently an EV charging cable does not require a licence. However, as policies are reviewed and updated this may change in the future.

**Where a location is not suitable the Council has existing powers under Section 162 of the Highways Act to seek to have the cable removed.**

A license is required for all other temporary placement of cabling on or over the Highway.

## ANNEX B

### Chargepoints and connectors: Technical information

The table below provides a summary of all available charging connector types and their main characteristics:

Connector type	Power Ratings	Features
<b>Type 1</b>	3-7kW AC	<ul style="list-style-type: none"><li>• 5-pins</li><li>• Standard US connector</li><li>• No locking mechanism</li><li>• Single phase only</li></ul>
<b>Type 2</b>	3-43kW AC	<ul style="list-style-type: none"><li>• 7-pins</li><li>• Is becoming the standard European electric car charging cable connector type</li><li>• Inbuilt locking mechanism</li><li>• Compatible with both single and three phase electricity supply</li><li>• Tesla has a 150kW DC and 250kW DC (Tesla Superchargers) version of type 2</li></ul>
<b>CHAdMO</b>	50kW DC	<ul style="list-style-type: none"><li>• Is compatible with Japanese vehicle manufacturers</li><li>• Common now in 89 countries in total including Australia, New Zealand, Japan, China, Singapore etc.</li><li>• Is the most common rapid connector type due to the popularity of the Nissan Leaf</li><li>• Bi-directional charger allowing Vehicle to Grid (V2G) energy flows</li></ul>
<b>CCS</b>	50kW - 350kW DC	<ul style="list-style-type: none"><li>• CCS socket is always combined with either a Type 2 or a Type 1 socket</li><li>• Common in Europe, SA, USA</li><li>• Likely to become the most popular DC standard</li><li>• Enables a higher power rating to support larger ultra-rapid chargers</li></ul>

#### Ultra-rapid chargers

Ultra-Rapid DC chargers provide power at 100kW or more. These are typically either 100kW, 150kW, or 350kW – though other maximum power ratings between these figures are possible. These are the next-generation of rapid chargepoint, able to keep recharging times down despite battery capacities increasing in newer EVs.

For those EVs capable of accepting 100kW or more charging times are kept down to 20-40 minutes for a typical charge, even for models with a large battery capacity. If an EV is only able to accept a maximum of 50kW DC, they can still use ultra-rapid chargepoints, as the power will be restricted to whatever the vehicle can deal with. As with 50kW rapid devices, cables are tethered to the unit, and provide charging via either CCS or CHAdMO connectors.

#### Rapid chargers

Rapid chargers are a fast way to charge an EV, often found at motorway services or locations close to main routes. Rapid devices supply high power DC or AC to recharge a car quickly.

All rapid devices have charging cables tethered to the unit, and rapid charging can only be used on vehicles with rapid-charging capability. These are the most common type of rapid EV chargers currently, having been the standard for the best part of a decade.

Rapid DC chargers provide power at 50kW – 75kW (125A) and use either the CHAdeMO or CCS charging standards. Both connectors typically charge an EV to 80% in 20 minutes to an hour depending on battery capacity and starting state of charge.

Rapid AC chargers provide power at 43kW (three-phase, 63A) and use the Type 2 charging standard. Rapid AC units are typically able to charge an EV to 80% in 20-40 minutes depending on the model's battery capacity and starting state of charge.

## **Fast chargers**

Fast chargers are typically rated at either 7kW, 11kW or 22kW (single-phase 32A, three-phase 16A and three-phase 32A 22kW). The vast majority of fast chargers provide AC charging.

Charging times vary on unit speed and the vehicle, but a 7kW charger will recharge a compatible EV with a 40kW battery in 4-6 hours, and a 22kW charger in 1-2 hours. Fast chargers tend to be found at destinations such as car parks, supermarkets, or leisure centres, where you are likely to be parked for an hour or more. They are much less costly to install than rapid chargers, and because they work on regular alternating current, they can be installed in most locations with a standard electricity supply.

Most fast chargers are 7kW and untethered, though some home and workplace-based units have cables attached. Charging rates when using a fast charger will depend on the car's on-board charger, with not all models able to accept 7kW or more. These models can still be plugged in to the charger but will only draw the maximum power accepted by the on-board charger. For example, a Nissan Leaf with a 3.3kW on-board charger will only draw a maximum of 3.3kW, even if the fast chargepoint is 7kW or 22kW. Internal AC chargers can be single-phase or three-phase (Zoe Chameleon). The three-phase option provides higher capacity and quicker charge times (close to rapid) when compared to single-phase.

## **Slow chargers**

Slow charging is carried out between 2.3kW and 6kW, though the most common slow chargers are rated at 3.6kW (16A). Charging on a three-pin plug will typically see the car draw 2.3kW (10A), while the majority of lamp-post chargers are rated at 5.5kW because of existing infrastructure but some can be 3kW.

Charging times vary depending on the charging unit and EV being charged, but a full charge on a 3kW unit will typically take 6-12 hours. Most slow charging units are untethered, meaning that a cable is required to connect the EV with the charger.

Slow charging is a very common method of charging electric vehicles, used by many owners to charge at home overnight. However, slow units are not necessarily restricted to home use, with workplace and public points also able to be found. Because of the longer charging times over fast units, slow public chargers are less common and tend to be older devices.

While slow charging can be carried out via a three-pin socket, because of the higher current demands of EVs and the longer amount of time spent charging, it is strongly recommended that those who need to charge regularly at home, or the workplace get a dedicated EV charging unit installed by an accredited installer.

The most common connector types are Type 1, Type 2, CHAdeMO and Combined Charging System (CCS).