Report

Roland Berger

LONDON / GREAT BRITAIN

Charging Ahead 3: Who Wins?

THE RACE TO ELECTRIFY OUR EVERY MOVE

Roland Berger

MANAGEMENT SUMMARY

When RB started forecasting EV growth around twenty years ago, it was uncertain and controversial — a bit like climate change. Drivers equated engine size with quality, and Euro-diesels were getting almost as carbon-efficient as the coal-hungry grid. We imagined that this might change, and so revised our forecasts, upwards, and often.

Today, expectation of the switch to BEVs is unanimous, even boring. But the approach to EV chargers and charging remains much less clear.

EV charging remains most convenient, and an order of magnitude cheaper, when at home; the large majority of Brits have off-street parking, a fact lost on Londoners. And yet public charging is clearly rising as owner cohorts change and travel further afield, and use cases demand more reliability, convenience, and entertainment. EV charging is thus not just a substitute for petrol stations, but also a recasting of the electricity retail market, and of hospitality and leisure on the move.

This document, with its "Top 20", is RB London's attempt at identifying the winners and losers emerging from the UK EV charging industry. At best, we will be largely right, at worst, we hope we will stimulate debate.

FAST FACTS & CONTENTS

<5%

the estimated average utilisation of the ~6,000 DC public EV chargers in the UK today

>2,000%

the forecast increase in the number of miles driven annually by EVs between 2021 and 2030 in the UK

1 / Buzz

It is probably now beyond debate that battery electric vehicles (BEVs) have won the race to drive the decarbonisation of road transport. Policy decisions led, industry followed (some parts faster than others), and the ease of plugging in just one more car meant the consumer closed the debate.

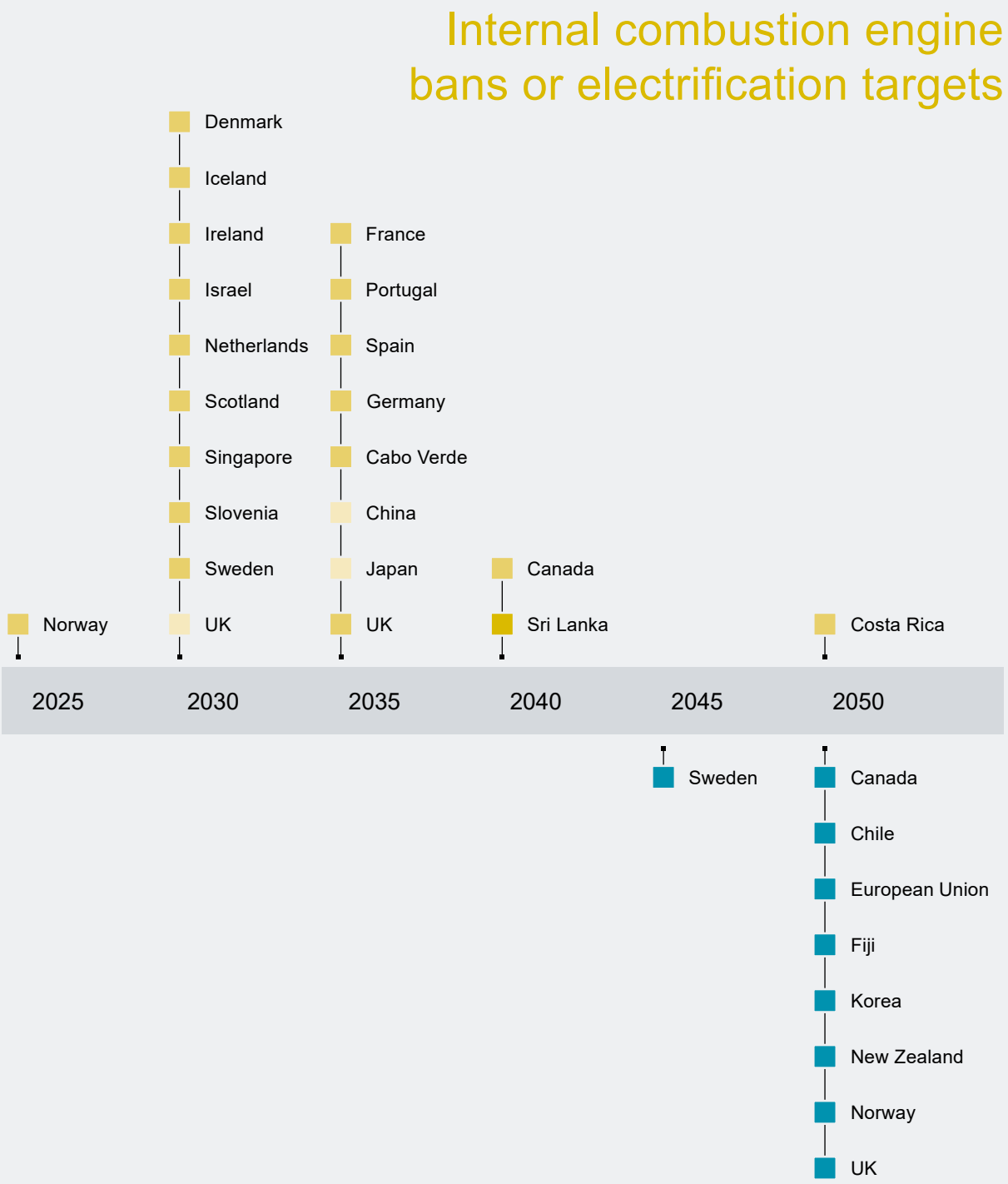
The greatest risk to the continued electrification of the vehicle parc is arguably now geopolitics — with demand for batteries growing exponentially, materials such as nickel and rare earth elements have become the 'crude oil of the 21st century' and the new object of affection for world leaders seeking control of natural resources — perhaps exemplified most recently by Russia's "special military operation" in Ukraine. Extracting, refining, and producing battery cells from these materials to meet projected 2030 lithium-ion battery demand of 2,500 GWh from automotive OEMs alone now represents the greatest challenge to the goals of policymakers and industry alike. → A

If these significant supply chain risks can be overcome, over the next 2–3 decades the global vehicle parc is set to undergo its most significant transformation since the advent of the automotive industry. The IEA expects BEVs to comprise 5–8% of global vehicle stock by 2030, yet in jurisdictions which have developed a clear vision and targets for electric mobility, this figure is expected to be significantly higher: China, Japan, the EU, the UK, and parts of the US, amongst others, have set accelerated trajectories with significant BEV sale volumes through the next decade and phasing out of internal combustion engines.

The UK has emerged as a frontrunner in terms of electric mobility ambitions, with an internal combustion engine sale ban for cars and vans in 2030, and all new cars and vans sold needing to be fully zero-emission at the tailpipe by 2035. By modelling the vehicle parc, retirements, and new vehicle sales (factoring OEMs' production plans, expected demand, and UK incentive structures), RB has forecast BEV penetration in the UK PC and LCV parc: from a base of less than 1% in 2020, we expect every 1 in 5 vehicles to be a BEV by 2030 and 1 in 2 by 2035 — forecasts that are closely aligned to those made by the SMMT (trade association for the UK motor industry). By 2050, only 1 in 20 of the 40+ million vehicles in the country will not be a BEV but perhaps a fuel cell vehicle, or an ICE vehicle with a stubborn enthusiast owner. → B

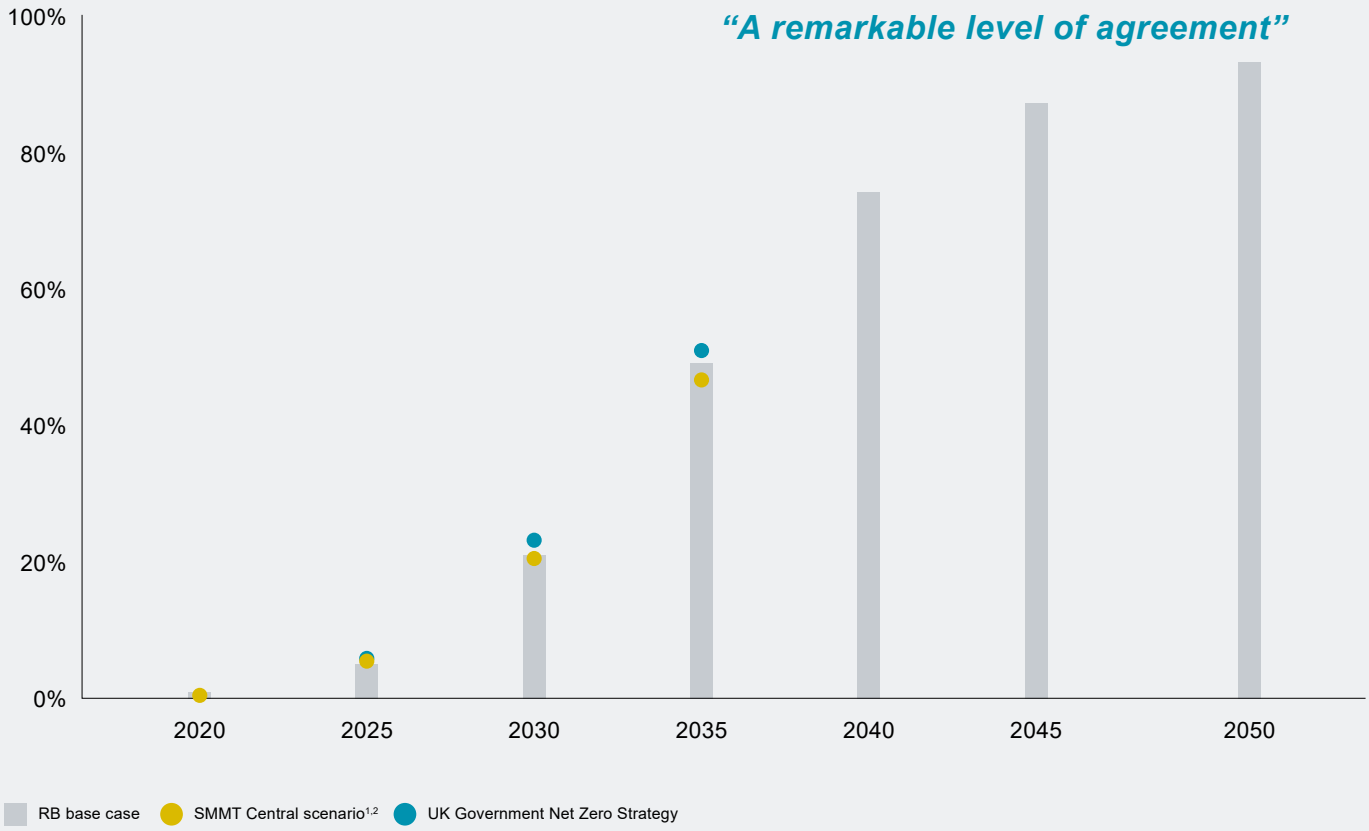
Even heavy goods vehicles, once seen as a 'safe haven' for liquid fuels, are starting to pivot away from a future of hydrogen or synthetic fuels as the once-insurmountable payload barriers to electrification are slowly chipped away. Whilst supply chains and infrastructure are not ready for a large-scale roll-out of either technology, estimates from bodies such as ACEA, IEA and EC indicate that in 2030, up to 5% (364,000) of the EU's heavy-duty fleet will be battery electric, an order of magnitude higher than fuel cell-powered vehicles. As we write, heavy goods vehicle OEMs are launching joint ventures with competitors and infrastructure players to de-risk development of vehicles and charging networks.

A / As of June 2022 vehicle electrification targets



Source: IEA, Roland Berger

B / BEV share development in PCs and LCVs in the UK parc, RB vs. other forecasts, 2020-2050 [%]



1 Society of Motor Manufacturers and Traders; 2 Based on passenger cars only

Source: SMMT New Car Market and Parc Outlook (2021), National Grid Future Energy Scenarios (2021), Roland Berger

For example, Daimler Trucks is partnering with:

- Volvo Trucks and Traton Group: to install high-performance public charging networks for long-haul BEV trucks across Europe
- EVBox and ENGIE: to provide central depot charging for Mercedes truck fleets in Europe
- NextEra Energy Resources and BlackRock: in a USD 650 million JV to develop, install, and operate US-wide charging network for BEV and fuel cell trucks

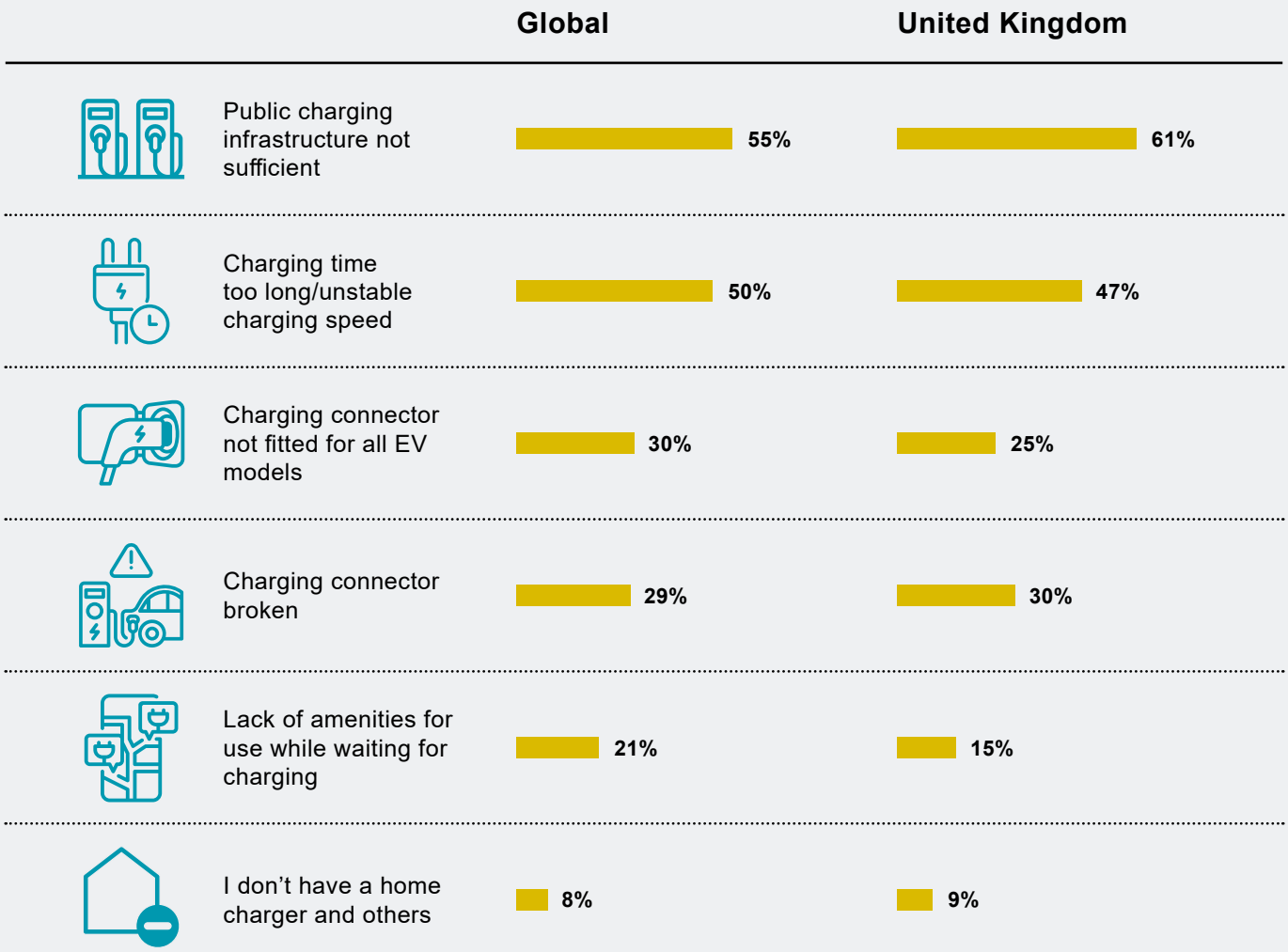
All in all, it has become clear that BEV uptake is set to grow exponentially as the main tool in our armoury to decarbonise road transport, and that we need to electrify the infrastructure around us to keep up. In the UK alone, 40 million BEVs on the road by 2050 would likely require 80–100 TWh annually (for reference, total electricity UK consumption across all use case applications in 2019 was just north of 300 TWh, a figure that has been steadily declining since 2005).

Generation and transmission infrastructure are expected to cope with this additional demand (pending the appropriate investment and notwithstanding

the challenge in delivering all of the UK's electricity from clean sources by 2035), but the key challenge lies in ensuring sufficient distribution and charge point infrastructure, typically characterised by:

- Low availability of EVCI especially outside of urban and high-traffic areas, cited as the primary concern across 10,000+ EV users in a global survey by Roland Berger → C
- EV charging infrastructure that does exist being relatively inaccessible:
  - Difficult to use for the uninitiated with only 41% of UK rapid and high-powered charging points accepting contactless payments [DfT, 2021]
  - Not universally compatible with a wide range of chargers and connectors across different vehicle models, e.g., CCS vs. CHAdeMO, Tesla vs. other →

C / Based on your overall charging experience, which of the following are least satisfactory to you? (multiple choices) [% selecting answer]



Source: RB EV Charging index #2

Not all charging is made equal: Use cases

EV chargers are classified as 'private' (e.g., in domestic off-street and on-street parking locations or workplace off-street parking locations) or 'public' (at a range of venues, such as fuel forecourts, motorway service areas, public car parks, and many other locations). Each of these 'use cases' tends to be associated with different charger types to match user needs (such as how long a vehicle will be parked and thus the typical duration of a charging session — or "dwell time") in that use case, and available power supply at the location. → D

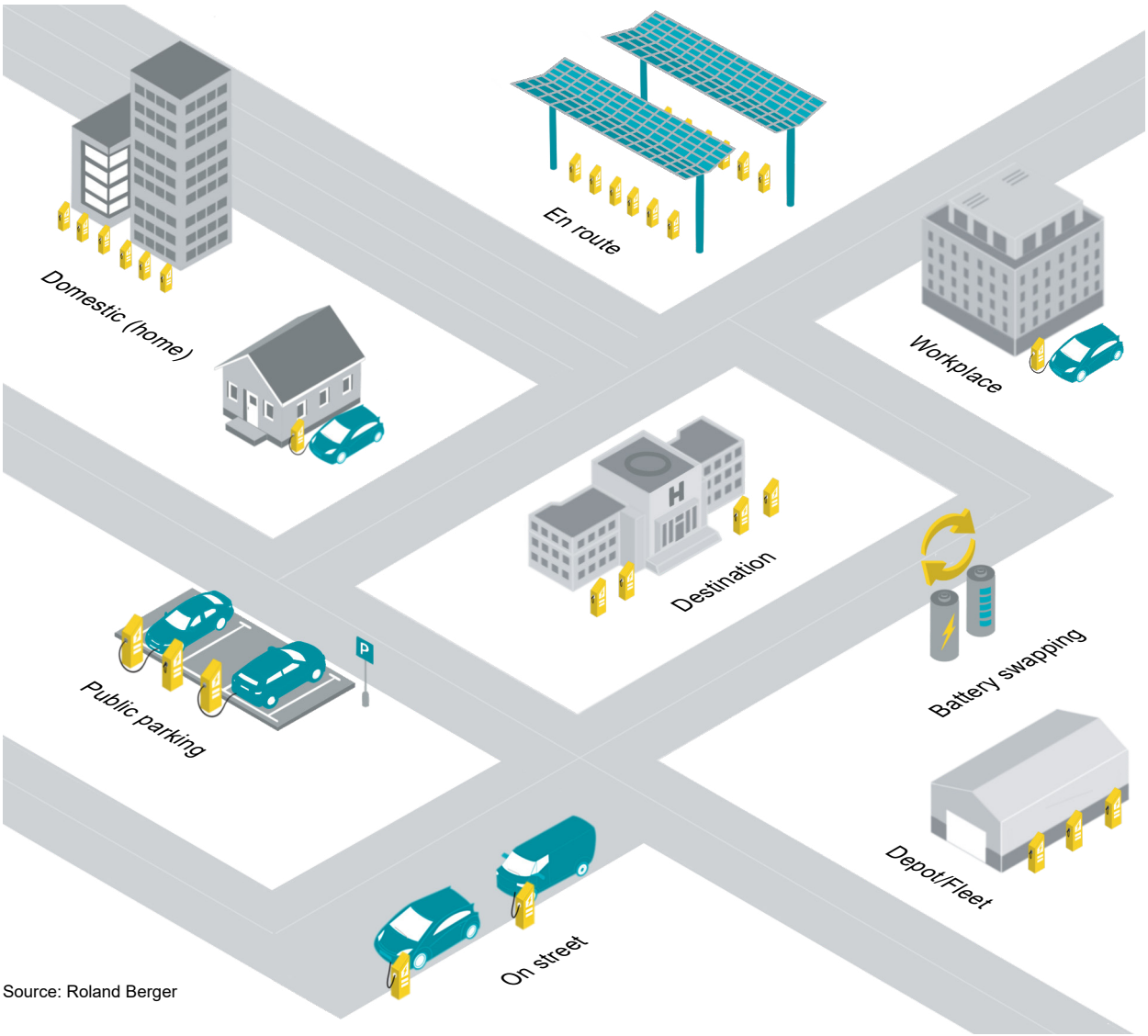
The main difference between charger types lies in their power rating — a 'slow' 3.6 kW charger will take a full day to charge the 75 kWh battery of a Tesla Model Y, while a 150 kW 'ultra-rapid' charger will achieve the same feat in less than an hour and take the battery from 20% to 80% charge in just 20 minutes. These intersection points of use case and charger power are fundamental in defining the EV charging market landscape, particularly in public charging: supply must anticipate demand in the right places in order for the charging network to function effectively and continue to attract users.

D / EV charging use cases

		Typical charging power [kW]	Definition	Typical charging time for 100 miles range[1] [mins]
Public	**En route**	50–350	High-power, fast charging offered as part of a forecourt-type model (MSA, forecourt, dedicated EV hub, etc.)	**25–30**
	Destination	7–150	Semi-public charging offered on-site by retail, leisure or similar locations, allowing charging whilst user performs other activities	**50–60**
	Public parking	7–50	Public charging networks outside of residential areas (on street, public car parks, etc.), in a non-forecourt-type model	**60–70**
	On street	3–11	Public charging networks in residential areas catering to overnight charging demand for residents without home charging access	**160–180**
Private	**Depot/Fleet**	3–50	Private charging for commercial fleets at a central depot location	**60–70**
	Workplace	7–22	Private charging offered by workplaces to employees, typically providing day-time charging for commuting vehicles	**130–150**
	Domestic (home)	3–7	Private charging attached to off-street parking at EV owner's residence, typically providing overnight charging	**200–240**

1 Assumes four miles/kWh efficiency; charging power by segment informed by current (2021) average power of chargers at charging use cases

Source: T&E, Element Energy, Zap-Map, Roland Berger



Source: Roland Berger

→ – Not open access as many chargers require membership/signup with charging clubs and eMSPs

– Unreliable with chargers out of use, not delivering stated power or charging a higher price than stated — reliability was identified as the most important consideration when selecting a public charger by 65% of surveyed EV users in the UK [ZapMap, 2020]

In the UK, 90% of EV drivers currently use public charging networks, though half do so only once a month or less [ZapMap]. As BEVs continue to penetrate the vehicle parc in drivers who lack access to private charging (as of 2020, 84% of UK BEV users had a home charger [ZapMap] but only two-thirds of dwellings in the country have off-street parking), the importance of public charging will only increase.

As such, government bodies, policymakers, infrastructure providers, automotive OEMs, and countless other parties have started to respond with targets, commitments, and funding for EVCI. Let there be no doubt: there is a wall of money being thrown at EV charging! → E

E / Selected public and private EVCI funding packages

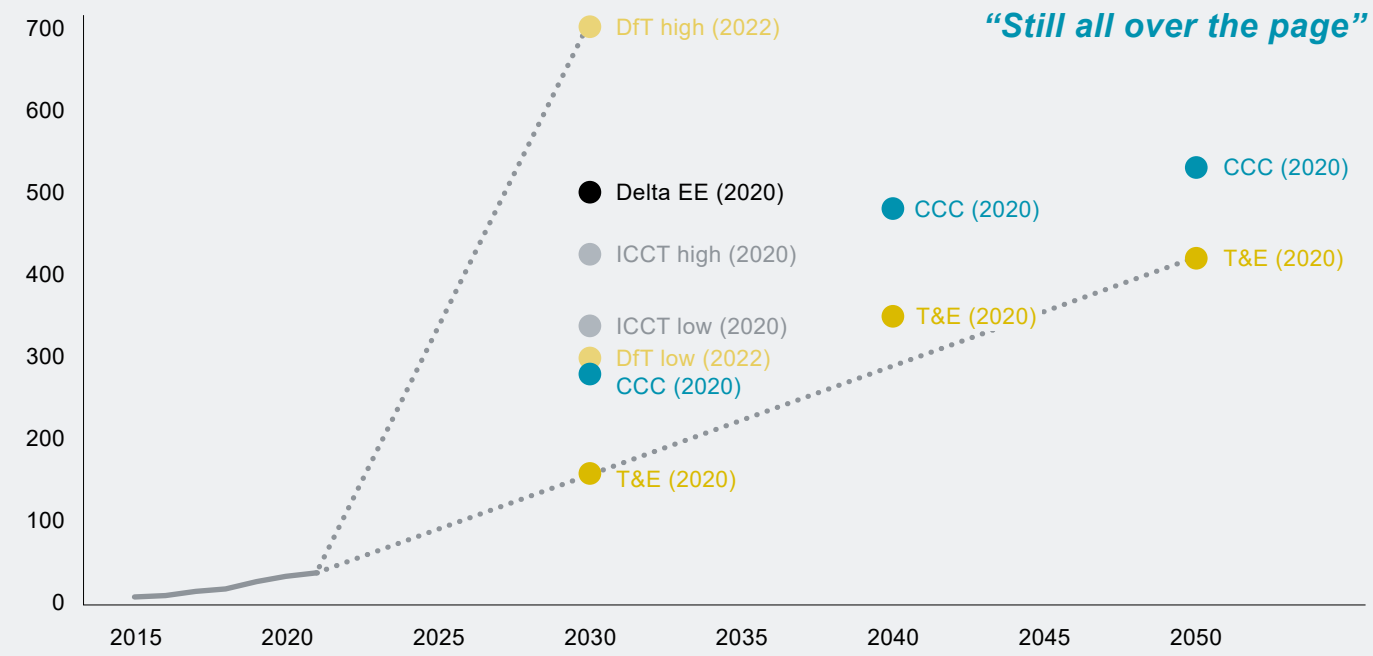
	Value [GBP bn]	Investor (date)	Initiative
UK	0.5	UK Gov. (2016–2022)	OLEV charger grants for homes and businesses to install private chargers, tapering down from GBP 450, and discontinued to homes in 2022
	1.6	UK Gov. (2022)	Electric Vehicle Infrastructure Strategy supporting the installation of 300,000 public electric vehicle (EV) charge-points by 2030
	0.95	UK Gov. (2020/21)	Rapid charging fund (RCF) supporting installation of 6,000 high-powered, open-access charge-points across England's motorways and major A roads
	1.0	BP (2022)	10-year investment to support the rollout of ultra-fast charging points and triple the current number of charging points in its UK network
USA	c. 4.0	US DOT and DOE (2022)	National Electric Vehicle Infrastructure (NEVI) Formula Program creating a network of EV charging stations along designated Alternative Fuel Corridors
Germany	c. 4.6	DE Gov. (2021)	Funding of EV charging infrastructure until 2024
France	c. 0.1	FR Gov. (2021)	Funding of fast-charging stations (>150 kW)

Source: Roland Berger

2 / Gold rush?

The roll-out of EVCS/EVCI in the UK has taken a somewhat patchwork approach to date. Government has provided support and incentives on national and local levels to encourage charger deployment, but outside the remit of the Strategic Road Network, motorways and significant A roads has generally veered away from stipulating how many chargers should be installed and where. It has recently set a target of 300,000 public chargers in the UK by the end of the decade, but by its own estimates, acknowledges that by 2030 there could be more than double that number. Such breathless estimates beg the question: how will the utilisation for these public chargers, and thus their economics, hold up? At current costs and prices, we are seeing acceptable investment returns in geographies with more than 25 vehicles per public charge point; the UK target above equates to 37 cars/charger, in line with informal targets from the most mature market in Norway, and higher than in markets with fewer home chargers like China. There will be pain for investment ahead of the curve. → F

F / UK Government and industry forecasts for total UK public EV charger deployment, 2015-2050 ['000 public chargers]



Source: Roland Berger

The lack of a centralised view on how many chargers of what type are needed, for which use cases, and where, means it will be left to market forces to determine who will win and lose (and has created opportunities for advisors such as ourselves). The theoretical ubiquity of EV charging and accessibility of technology means that the competitive landscape has quickly become crowded, with a broad range of stakeholders dipping their oars into a profit pool that promises much but is currently very shallow indeed. Charge point operators, fuel forecourt operators, motorway service area operators, oil companies, energy and utilities companies, retailers, real estate operators, FMs, infrastructure investors, e-Mobility Service Providers (EMSPs), automotive OEMs, and others, are all vying for their roles in the value chain. In some areas (for example, digital platforms enabling EV drivers to locate charge points), many small companies are developing solutions that ultimately will, we think, be best served by 1–2 companies at scale. Installation of chargers is often more a 'land grab' than a route to a short-term return on investment, and in some cases, EV charging is purely a means to a different end: in Tesco and Volkswagen's partnership to install free-to-use (slow) EV chargers at 500 Tesco stores across the UK, neither party cares about making money from EV charging — Tesco wants happy shoppers and Volkswagen vehicle sales.

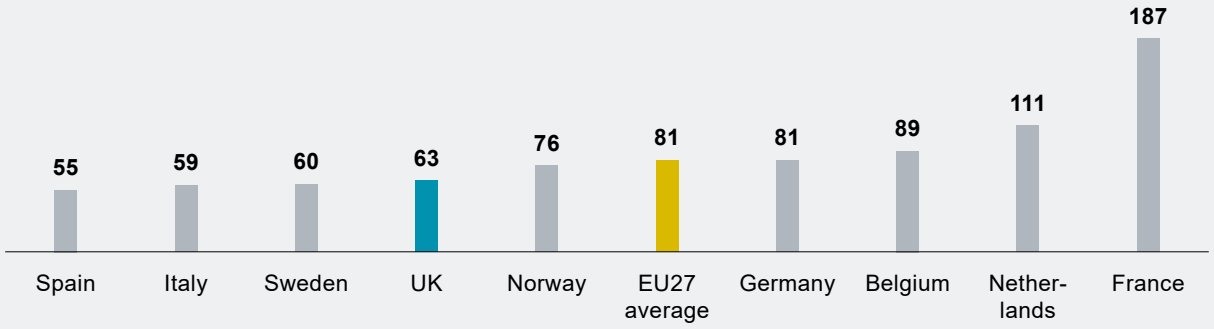
The UK roll-out has been charger-heavy: relative to the number of BEVs in the parc, we are relatively well endowed with charge points. As of 2021, the UK

had one rapid (≥ 50 kW) DC public charger for every 63 light vehicle BEVs, a statistic that puts it ahead of the EU27 average. → G

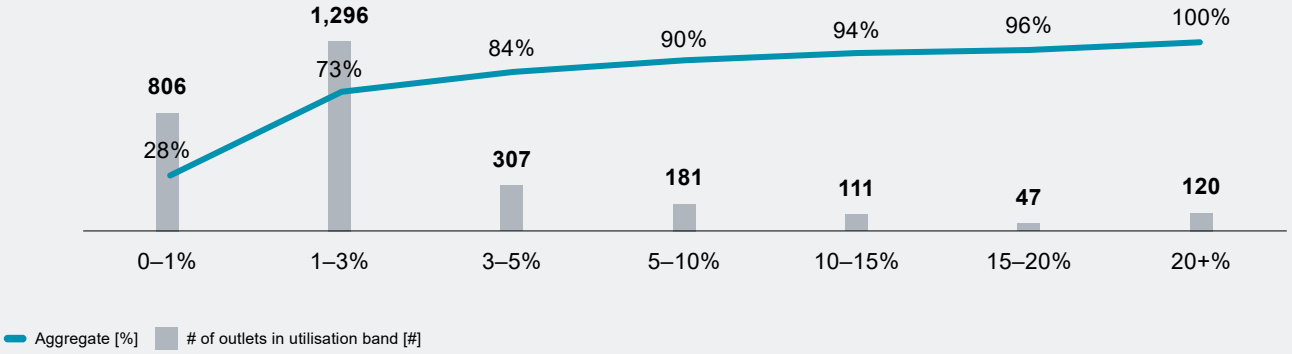
However, not all chargers are made equal: use case, location, power, and a range of other factors (reliability, availability, compatibility, etc.) influence how well an asset is utilised and thus its return on investment. In the UK in 2020, 3 in 4 DC public chargers had utilisation rates of less than 3%, with very few achieving levels that would be deemed economically viable in the long run (at least without cross-selling of adjacent products and services, such as food and drink). Only 6% of chargers had utilisation of at least 15%, which experience from Norway tells us is 'par' for acceptable return on investments from DC public chargers. While the 2020 UK utilisation figures were likely impacted by COVID-19, even 2 years on, the picture is unlikely to be much different as growth in the number of BEVs in the UK parc has not outpaced growth in EVCI. → H

The unrelenting flow of investment into EV charging — some of it quite irrational — is only serving to up the stakes in the race to electrify our every move. Unchecked, it will lead to an overshoot in the number of economically feasible chargers in certain use cases and locations; investment cases will not be met, with obvious consequences for EV charging networks and their users.

G / BEVs (light vehicles) per rapid (>50 kW) public charger by country (EAFO), 2021 [#]



H / UK DC public charge point utilisation (Roland Berger/Charging Radar) — London, 2020



Source: Roland Berger

3/ Recutting and revolution

Many EV charger forecasts produced to date by different parties in relative isolation are effectively evolutionary models that view EVCS as a substitute for oil as a transport fuel. However, EVCS is not about substitution of the petrol market. It represents a fundamental recutting of the petrol, electricity network, leisure and retail markets; a revolution with potential to transform, for example, retail patterns and electricity grid operations, and to impact HMG's fiscal approach. → I

The fact that EV chargers can in theory be installed anywhere, added to the fact that charging 'dwell times' of at least 20 minutes will be common for many years to come, makes EV charging a perfect match for another activity of similar duration — buying a coffee, eating at a quick-service restaurant, or doing the grocery shopping for example. The constraint on charging times is observably

I / How charger location affects business models

	Road-side charging	En route charging	Destination charging	Shared home or work charging	Battery swapping
Type of charger	• All charger types possible • Slow for overnight or longer duration parking • Fast hubs in cities	• Fast or ultrafast chargers	• All types possible, depending on dwell time at destination	• Primarily slow single phase AC charging	• No plug-in of the vehicle • Batteries can be charged on or off site
Motivations for installation	• Complement or replace home charging • Diminish coverage gaps • Address a wider set of use cases	• Long-range journeys • Tourism	• Attracting business to destination • Additional revenue from users • Tourism	• Revenue and employment generation • Efficient use of existing infrastructure • Least cost	• Reducing charge times • Allowing swaps at off-grid locations • Quicker battery maintenance
Grid connection	• Limits the power available, but can be enhanced by on-site storage or grid upgrades				• Not obligatory at swap site
Grid services	• Possible, especially for longer dwell times	• Zero, since emphasis is on charging speed	• Limited, depending on dwell times	• Increasingly prevalent	• Possible at the charging site
Ownership models	• Owner-operator • External operator	• Concession	• Leasing	• Owner operates charge point	• Usually owner-operated
Business model examples	• Sweden's utility charging roads	• France's tendering process for highway charging infrastructure	• Turnkey charging as a service for businesses	• Community charging via sharing apps	• Car makers include swappable battery in EV design and build/ operate swapping stations

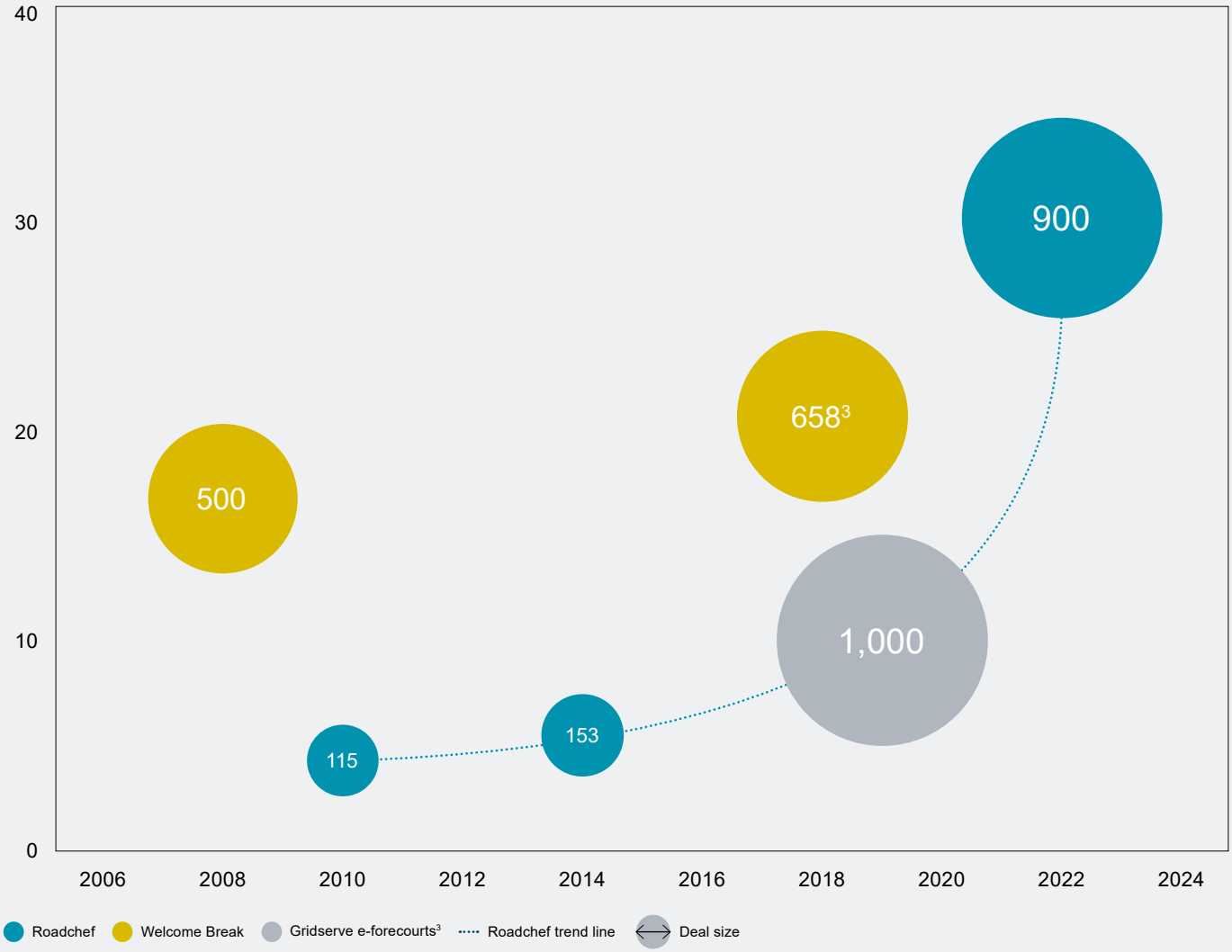
Source: IEA, Roland Berger

behaviour, not physics. In recognition of this, some fuel forecourts are already being repurposed as local one-stop-shops for EV charging, coffee, and groceries — moving firmly from 'petrol station with a shop' to 'places to charge up while you shop'. Overall, we think retail freeholders will be amongst the winners of the EV charging boom in the UK.

The importance of the freeholder in public charging use cases is exemplified by the meteoric increase in valuation of motorway service area (MSA) operators. This not only reflects the crucial role MSAs will play in supplying range and amenities to EV users on longer journeys on the motorway network, but points to freeholders owning the profit pool in EVCS itself as well as value in quality of earnings from adjacent business models.[2] → J

2) Such as quick service retail and grocery offerings

J / MSA operator valuations indicating the increasing importance of freeholders owning the profit pool, 2006-2022 [GBP m]



3 Gridserve's 100 planned sites valued at GBP 1 bn in 2019

Source: Roland Berger

Other market participants set to win include DSOs and their supply chains (due to increased growth in demand for electricity), including EVCI installers (given the large volume of chargers to be installed and ongoing revenue opportunities from operations and maintenance).

Other losers will likely include Big Oil (not only is their 100% share of the road transport fuel market being divided amongst a wide range of competitors, but their fuel forecourts without retail/cafes or close proximity to attractions will not be easily converted to attractive EV charging propositions), traditional virtual power plant operators, induction/catenary charging, and vehicle-to-grid providers.

Valuation will be an art form in this environment. Despite the explosive growth outlook for their equipment, publicly-listed EVCI OEMs have lost value since the 'bull run' of late 2020 and early 2021, on average 50% down from recent highs, with many that IPO'd or merged with SPACs below their initial offering prices. Ultimately this reflects the recognition by the market that not everyone can win. → K

We dare to assess how the (UK) EV charging investment landscape is developing and who is positioned to win and lose.

K / Valuations (daily close prices) of selected EVCI OEMs [02/05/2022 = 100]

Source: TradingView, Nasdaq, CBOE, LSE, Company information, Roland Berger

EV Charging Investment Top 20

Non-movers, risers, and fallers — Q3 2022

1 HPC[4] WIRED CHARGERS >100 KVA

- The charger of choice for en route and destination public chargers, especially with dynamic load management
- Fast enough for all production cars envisaged until solid state batteries are introduced post 2030
- Standardising, scaling, and consolidating fast

2 HOME/WORK CHARGERS

- Cheap and convenient
- Falling back from 80% market share in early adopter markets as EVs penetrate cohorts without off-street parking, but still the dominant solution
- Increasing potential to address Energy Services and stability markets through aggregation of demand side management

3 CPOs[5]

- Still best positioned to execute in this nascent market
- Very full valuations, and plenty of growth ahead, but potential to get squeezed out by equipment providers, EMSPs, and landowners in the longer term as the industry matures

4 PUBLIC CHARGING

- Growing vs. private in every country as cohorts without off-street parking at home buy EVs

5 MSAs[6]

- Especially good price inelastic locations with a perfect 20–25 minute retail offer, government support for grid connections, and potential for upside from BEV trucks in longer term

6 REAL ESTATE OWNERS/ OPERATORS (SHOPS, RESTAURANTS, ETC.)

- Until solid state batteries emerge c. 2030, public charging will remain a 20–25 minute experience
- Retail/leisure venues will be advantaged, with customers drawn in by EMSPs
- Maturity of hardware and 98% availability SLAs will put negotiating power in hands of freeholders of attractive locations vs. CPOs

7 EMSPs[7]

- Apps have potential to be natural monopolies, and to extend in the long-term to, e.g., vehicle handshaking and dynamic pricing power

8 DSOs[8] AND SUPPLY CHAIN

- Much more growth in demand for electricity, reversing a decade of OECD stagnation

9 SMART ELECTRICITY RETAIL

- Where 80% of home chargers are presently sold through automotive OEM channels, future winners will combine with smart meters, EV chargers, and Energy Efficiency hardware with tariffs tapping grid stability profit pools, accelerated by energy security concerns

10 EVCI INSTALLERS

- At prices ranging from GBP 500 per domestic charger to GBP 10,000 per HPC hub, plus operations and maintenance, the UK market opportunity over the next 10–15 years is north of GBP 1 billion

▲ Risers ● Neutral ▼ Fallers

4 HPC: High Performance Charger; 5 CPO: Charge Point Operator; 6 MSA: Motoring Service Area; 7 EMSP: e-mobility Service Provider; 8 DSO: Distribution System Operator; 9 VPP: Virtual Power Plant; 10 V2G: Vehicle to Grid

Source: Roland Berger

11 PETROL FORECOURTS WITH RETAIL/CAFES AND/OR CLOSE PROXIMITY TO ATTRACTIONS

- Parallel EV charging and hydrocarbons a good long-term proposition: Convenient locations, high barriers to exit, and good additional gross margin potential given 25 minute dwell times

12 ADVISORS

- The only constituency to have had high margin work to date!
- Sector starting to be better understood as it matures

13 LONG DWELL TIME CAR PARKS

- Public car parks with long dwell times (including on-street rail stations, hotels, stately houses, etc.) can install low cost interruptible AC chargers, allowing them to charge more for value-added parking

14 ADVERTISING PROVIDERS

- Lots of opportunities, albeit becoming a little less attractive after early adopters as demographics homogenise and novelty wears off

15 50 KVA CHARGERS

- Neither fast enough to replace fuel pumps in on route use cases, nor cheap enough to challenge AC chargers in long dwell time use cases — risk of being squeezed out as EV fleet charging speed increases

16 PETROL FORECOURTS WITHOUT RETAIL/CAFES OR CLOSE PROXIMITY TO ATTRACTIONS

- Increasingly unattractive venues to spend 25 minutes relative to a well-located location

17 BATTERY SWAPPING

- Seen as obsolete for some time, but surprisingly facing a resurgence in China where there are relatively few home chargers and urban density is high

18 INDUCTION CHARGING/ CATENARY SYSTEM

- Technically possible, but overtaken by batteries

19 VPPs[9]

- Traditional VPPs operating, e.g., batteries or aggregating generators will see pricing undermined by the increasing ubiquity of private interruptible AC chargers

20 V2G[10]

- Attractive to automotive OEMs and for VPPs but unlikely to be needed by the grid vs. demand side management
- Lots of noisy inverters are hard to accommodate and not cost effective
- Jeopardises residual value of cars

4/ Winners and losers

In such a nascent market where the only certainty is uncertainty, how are we to know how the future will unfold in the UK? We have no crystal ball, but more mature markets such as Norway and the Netherlands have served as something of a laboratory for EVCS, and continue to generate powerful insights as to where, when, and how people charge. → L

In reading across the results of these early experiments to other markets, we must of course apply a hefty pinch of salt and convert the findings into the local currency — of characteristics that describe those markets. We can draw some parallels between the UK and Norway, which is generally considered to be 3–5 years ahead of the UK in its EV roadmap and where BEVs already represent 1 in 6

L / Comparisons to other geographies and how they are similar to/different from the UK

Insights on Norway and other markets

	EV maturity EV penetration, 2021 [%]	EV charging infrastructure Charger distribution [% of chargers]	 Charge delivery [Est. % kWh delivered]	Comparison to UK
UK	1.1% **2%** 1.1%	11% **100%** 89%	43% **100%** 57%	-
Norway	15.1% **21%** 6.0%	4% **100%** 96%	31% **100%** 69%	Mass market adoption has penetrated cohorts beyond the affluent early adopter group, EVs are here to stay
Netherlands	2.8% **4%** 1.6%	28% **100%** 72%	43% **100%** 57%	Govt. support led to many 22 kVA public chargers: sophisticated user experience, but becoming obsolete vs. DC due to slow charging
France	1.4% **2%** 0.9%	9% **100%** 91%	64% **100%** 36%	Different regulatory approach and interaction with state utilities, but outcome closely comparable to UK to date
Spain	0.4% **1%** 0.3%	30% **100%** 70%	64% **100%** 36%	Low EV adoption to date, and very low access to offstreet home parking so high focus on public charging

BEVs PHEVs Public Private

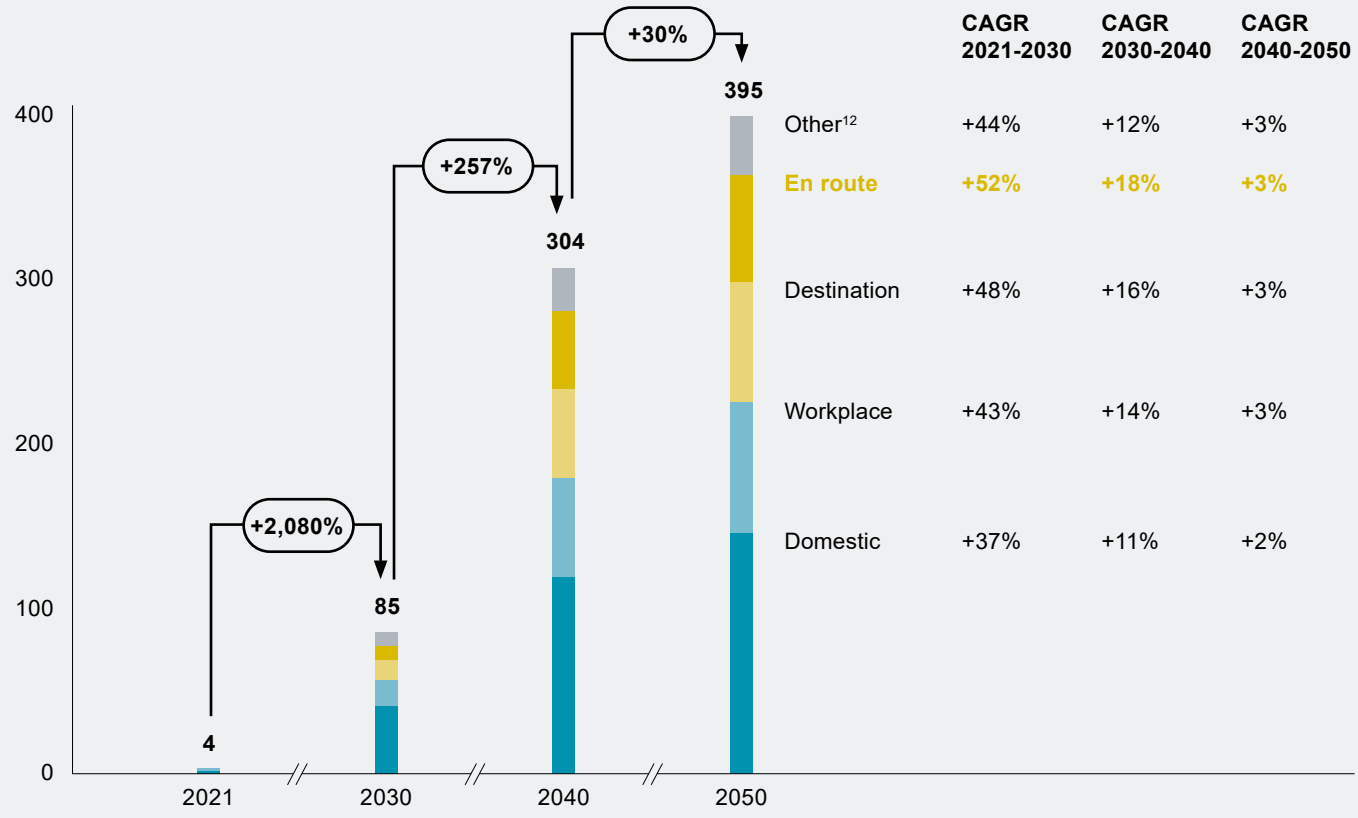
Source: Roland Berger

passenger cars and xEVs 98% of new sales as of March 2022. A strong majority of drivers in both the UK and Norway have access to home off-street parking, and there are similarities in use case. Brits can thus watch with interest as Norway's public rapid charging share of total charging rises from 9% to 12% and on towards 15% as BEVs penetrate mass market cohorts. However Brits would also do well to remember that Norway has an extraordinary tax system, only one major city, and achingly cold winters, and as such is just not the same. The lessons from the Netherlands, with its extensive but increasingly obsolete 22 kVA charger network or Italy with its distribution network constraints and paucity of domestic parking require comparable context. Roland Berger is proud of the findings of its international EV charging radar, covering 27 countries in its second edition at time of writing, but applies humility when drawing international comparisons.

Based on observations from such 'test case' markets and our analysis of the factors defining UK charging demand,[11] we expect that in the longer term, charging will be split between slower charging at home or work, and rapid charging en route and in some destinations — not dissimilar from today's 'petrol station' type use case — with a spectrum of smaller niche use cases besides. In our view: → M

11) including vehicle parc forecasts, EV penetration by user cohort, road traffic forecasts, vehicle ownership, residential stock, charger power and vehicle charging speeds

M / Forecast electric miles supplied by charging use case, 2021-2050 [bn miles]



	CAGR 2021-2030	CAGR 2030-2040	CAGR 2040-2050
Other[12]	+44%	+12%	+3%
En route	+52%	+18%	+3%
Destination	+48%	+16%	+3%
Workplace	+43%	+14%	+3%
Domestic	+37%	+11%	+2%

12 Public parking, on street, fleet/depot

Source: Department for Transport, Office for National Statistics, RAC, Fleet200, Element Energy, Roland Berger

HPC/ULTRA-RAPID CHARGING WILL:

- Be mainly for en route charging use cases, with some attractive urban destinations cannibalising the local filling station market
- Offer higher margin potential for EVCS providers, landowners/lessees and EVCI OEMs (but how they share profits is still to be determined)
- Have a lucrative installation, maintenance, and upgrade cycle

SLOWER PUBLIC CHARGING WILL:

- Retrench to long duration parking environments, i.e., 'car parks' where charging speed is irrelevant vs. dwell time, and where the cost of grid reinforcement is prohibitive, or else to reassuring and convenient "top up" use cases
- Become commoditised fast, with providers needing to focus on low thru-life cost

PRIVATE (DOMESTIC/WORKPLACE) CHARGING WILL:

- Continue to lead the market overall, since the home and work chargers are cheaper and more convenient and can also access grid stability markets
- Provide a lucrative installation opportunity and upgrade cycle

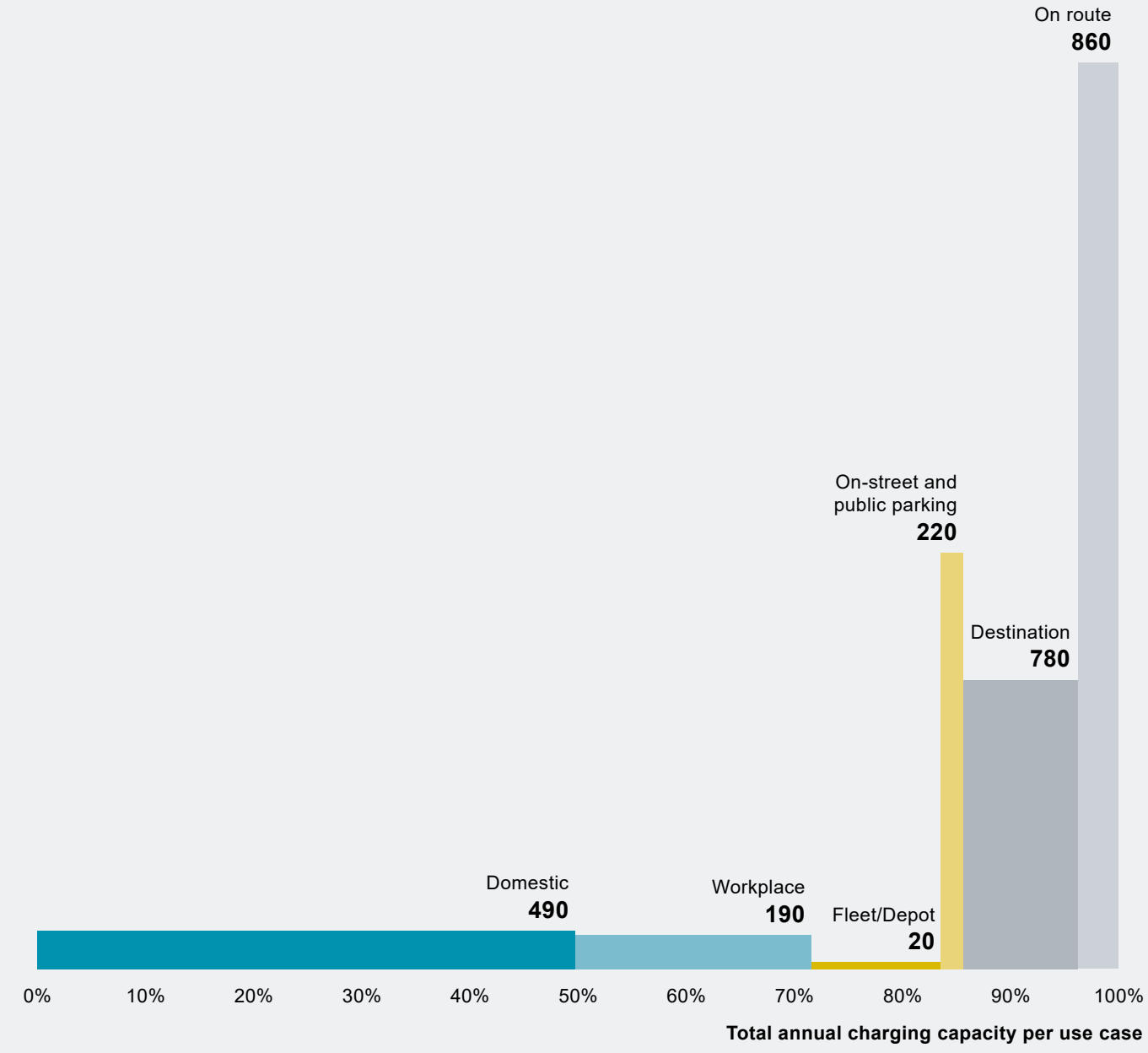
The profit pool related to the grid stability market will be a particular battleground. Shedding aggregated populations of interruptible domestic EV chargers to balance the grid will become a material and commonplace solution, competing with stand-by generators and virtual power plants. On the other hand, the ubiquity of such power electronics on the system, and with its signal noise and inertia challenges, will try the patience of system operators and perhaps prevent the advent of V2G or similarly futuristic solutions altogether.

Accordingly, with manufacturing excluded, the direct downstream EV charging value/profit pool will be heavily weighted toward public rapid charging use cases, which will represent more than 70% of EVCS value in 2030, despite private chargers outnumbering public chargers by 30–40 to 1. The logic for this is that the typical public charger will of course be able to dispense charge at a rate an order of magnitude higher than its private cousin, thus will command accordingly a price per unit of electricity several times higher than slow charging at home or the workplace, and given its accessibility to all road users, will be more highly utilised than private chargers. → N

Of course, this is only what our crystal ball is telling us, and remains to be proven out in practice; some relatively straightforward interventions could perturb the system and create an entirely different future. The UK Government will surely look to fill the GBP 35 billion annual gap in vehicle excise duty (which is not currently levied on BEVs) and fuel duty (there is currently no equivalent for EV charging) that would result from a transition to electric vehicles. Combined with steady increases to benefit-in-kind tax liabilities on EVs, these measures could curb enthusiasm for the EV revolution and temper growth in overall charging energy demand in the next 15–20 years. Taxing public charging will pressurise prices and margins as EVCS providers either swallow some of the cost (as has already happened with VAT) and/or increase prices to put an even larger differential

between rapid public charging and slow private charging. Many other issues — the roll-out of (ultra-)rapid public chargers (and the readiness of the grid to enable it), the ability of vehicle batteries to take on charge more quickly, how EVCS providers develop compelling user propositions, charging behaviours, the prevalence of peer to peer charging — all have the potential to reshape the trajectory of the market and leave us and our fellow advisors with egg on our faces. We eagerly await being proven right or wrong.

N / Forecast UK EVCS value pool by use case, 2030 [GBP m]



Source: Roland Berger

CONCLUSION

When we started writing about UK EVCS, only five short years ago, home chargers were often Heath Robinson affairs and the as-yet-unused 50 kVA public chargers emerging in some exotic locations were the epitome of cool. Today's BEVs drive past these same 50 kVA chargers entreating their apps for something more suitable.

There is still no clear evolutionary winner in place, but we are now in the period where fortunes are being made and lost; players with many and varied business models regularly transact with enterprise values in the hundreds of millions, befitting the billions of profit pool foreseen within the decade. We hope that this document can help you in navigating this world.

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Further Reading

CHARGING AHEAD WITH ELECTRIC VEHICLES
➔ **rb.digital/Charging_Ahead_1**

CHARGING AHEAD 2: LOCATION, LOCATION, LOCATION
➔ **rb.digital/Charging_Ahead_2**

EV CHARGING INDEX
➔ **rb.digital/EV_Charging_Index**

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