



Powering ahead!
**Making sense of
business models
in electric vehicle
charging**

October 2018

Contents

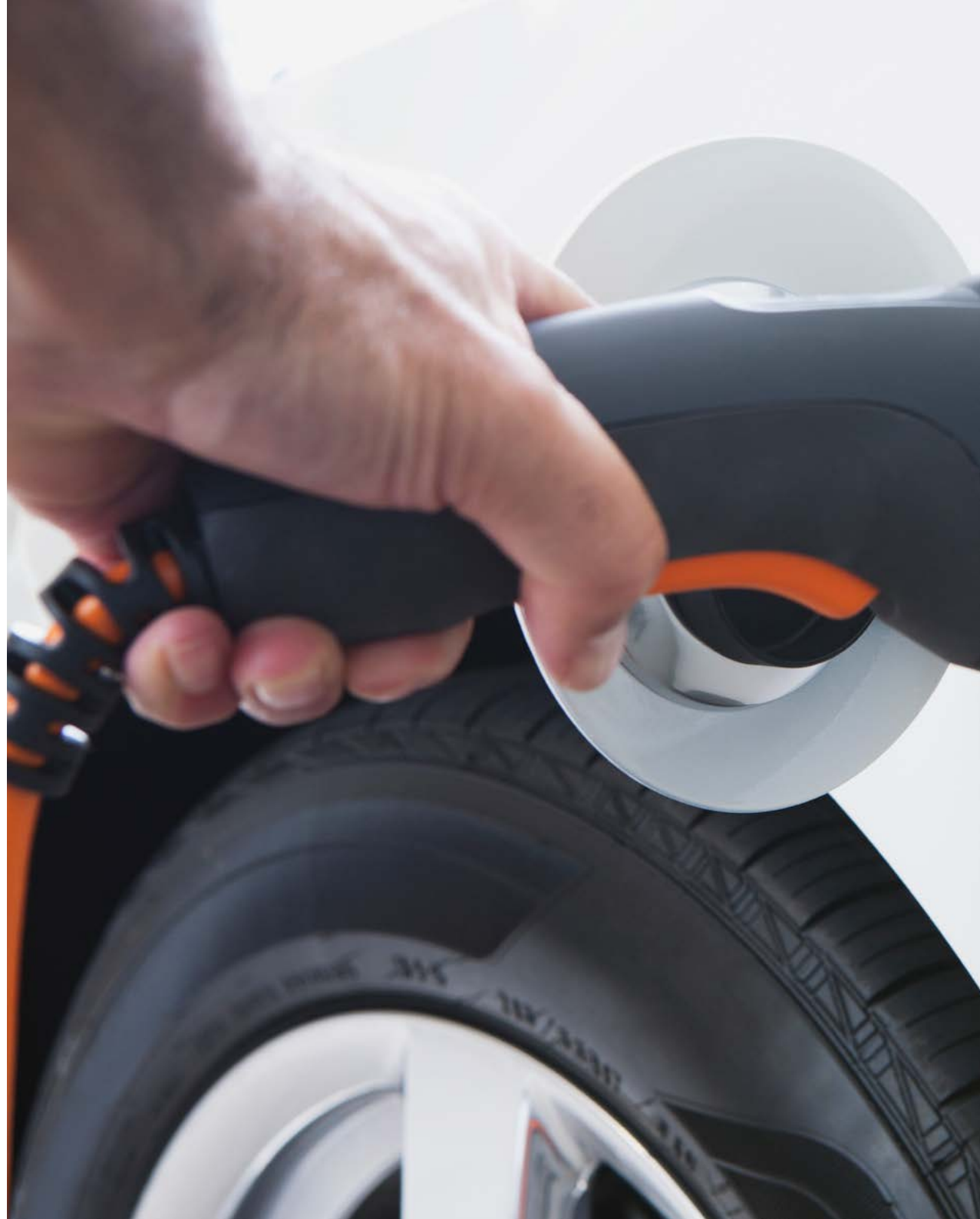
Acknowledgements	1
Foreword from Energy UK	2
Setting the scene	4
Our approach	5
Key findings	6
How the charging market stacks up	11
Where does charging take place and how does it work?	14
Bringing your business model to life	26
Deep dive on business models	28
What should you do next?	33

strategy&

Strategy& is PwC's global strategy consulting team. We help you transform your business by creating strategy that starts with your greatest strengths and builds in execution at every step.

We call this strategy that works, and it delivers immediate impact and lasting value for you. As part of the PwC network, we combine 100 years of strategy consulting experience with PwC's deep industry and functional capabilities.

PwC has more than 250,000 people in 158 countries committed to delivering quality in assurance, tax, and advisory services.





Acknowledgements

To research and fully understand the constantly evolving landscape that is the electric vehicle charging market, we had the good fortune to speak to a number of companies and individuals who are at the very heart of this transformation. We would like to thank everyone who contributed to the report for their insights and time.

Addison Lee – Andrew Wescott and Justin Patterson

Chargemaster – Tom Callow

Ecotricity – Mark Meyrick

EDF Energy – Roy Collins

ELEXON – Kevin Spencer

Elsden Consultants – Miles Elsdon

Energy UK – Sam Hollister

InstaVolt – Tim Payne

National Grid – Graeme Cooper and Thomas Maidonis

Ovo Energy – Tom Packenham

Pivot Power – Matt Allen

Pod Point – James McKemey

ScottishPower – Malcom Paterson

Tesla

Western Power Distribution – Ben Godfrey

Foreword from Energy UK



Lawrence Slade
Chief Executive

I am delighted to work with PwC to bring their insight to investigating the market dynamics of electric vehicle (EV) charging and how the private sector can help customers charge their vehicles when and how they prefer.

130,000+
electric vehicles on the roads

15,000+
public charge points installed across the UK

The EV revolution is already upon us. Battery life and other performance measures are rapidly improving at pace. There are now over 130,000 electric vehicles on the roads and 15,000 public charge points installed across the UK – not to mention rising numbers of privately-owned chargers being rolled out.

Over the past 10 years the UK has successfully reduced emissions from the power sector by 54%. Coal no longer plays a dominant role in how we produce electricity, but instead we now have over 20GW of wind capacity installed in the UK, with low carbon sources regularly producing over half of our daily power needs.

We know that to meet the UK's climate change targets, we must reduce transport emissions with the same ambition we have achieved in the power sector. Now, with a system increasingly powered by low carbon generation such as wind, solar and nuclear, filling up our cars with electricity – not petrol or diesel – is the cleanest choice to make. Given the rising portion of UK emissions and air quality concerns attributed to transport, it is clear that progress must continue – and quickly.

It is essential that charging infrastructure – sufficient access to charging points and their compatibility with energy networks – keeps pace with rapidly evolving technologies and business models in this sector. Having high performance EVs without the means to power them easily and conveniently, will stall a wide scale take-up.

The successful roll-out of low carbon transport will depend on putting the customer in the driving seat. Many motorists have long seen their cars as more than just vehicles, but in the case of EVs this will take on new dimensions given the potentially transformative role they can perform in storing and supplying electricity. Those capabilities mustn't overshadow the fact that EVs will be used as cars first and foremost and customer adoption rests on drivers retaining the choice and freedom they have had with their vehicles to date.

Managing the potential incremental energy demand that EV charging could put on the grid is crucial. I believe it is imperative that this is achieved through providing choice and incentivising certain behaviours for customers. Encouraging drivers to charge their cars in ways that minimise the impact on the grid must be done through engagement and rewards rather than by imposing restrictions from above.

Smart systems and reflective price signals are an important component in changing consumer habits and will play a central role in the entire energy system of the future. However, this will only succeed if we build and earn consumer confidence and trust. Enthusiastic and widespread EV take-up will come from the carrot rather than the stick.

We are working closely with government to ensure that the transition to low carbon transport is a success. The early signs from government are positive with a supportive policy framework in place and the release of the 'Road to Zero Strategy', coupled with the enactment of the Automated and Electric Vehicle Act.

As an industry, we're taking the lead by working with partners from across the energy, automotive and technology sectors to drive this transformation forward and enable the government to take the wheel with ambitious targets. This report, in collaboration with PwC, provides a fundamental building block to how the private sector will need to adapt and transform to meet the needs of all customers.

In light of the considerable benefits an ambitious EV uptake scenario offers, however, we believe that even more can be done.



Lawrence Slade
Chief Executive

Energy UK

Key recommendations for the government from Energy UK

- **Be more ambitious.** Government should increase ambition for the phase-out of new petrol and diesel vehicles by bringing forward the 2040 commitment to at least 2035. This is aligned with an increasing number of recommendations, including a parliamentary committee report in October 2018 which recommended that the UK bring forward the deadline to 2032. This will enable the UK to continue its ambition to be a leader in 21st century transport.
- **Ensure customers can charge when they want.** The UK is transitioning to an energy system that increasingly puts power in the hands of customers. Markets must be developed to provide solutions that balance customers' charging preferences and the needs of the network. Any centralised managed charging by network operators is at odds with this and risks hindering EV uptake.
- **Increase funding for local solutions.** This report highlights a number of market solutions coming forward. Customers need to feel empowered at the local level and there should, therefore, be a further round of 'Go-Ultra Low City' funding.
- **Target public funding in certain locations.** Though the majority of charging installations will be privately funded, there will likely be areas where there is no business case for the private sector to install infrastructure. These areas will require public funding to help reduce 'range anxiety' and encourage the take-up of EVs.
- **Continue direct support in the short term.** Government funding has been fundamental to the uptake of EVs. Government should continue to support the upfront costs of both EVs and charge points until at least 2020. Government should also provide clarity on the levels of support to be available post-2020 with timelines for reduction and removal. We expect EVs to become cost-competitive with internal combustion engine vehicles in the 2020s and therefore will no longer require such significant and direct support.

Setting the scene

Let's start with a story based on a real scenario. The CEO of an electric vehicle charging company recently took his young family from south London to Bristol

They had a modern electric car and arrived at a 'rapid charger' to top up their battery. The charger worked and delivered the power to their car reliably – but it took 45 minutes.

So there was no issue around 'range anxiety' (having enough of a charge to reach a destination) or service reliability. However, from an experience point of view, it was lacking. His children were two and four years old. The only food available was an unhealthy fast food retailer. There was nothing nearby to entertain his children, nor was there anything for he and his wife to do. No business lounge. No playground. No shopping centre. Forty-five minutes is a long time to kill with young kids and nothing to do. You might call this 'experience anxiety'.

This story illustrates the challenges facing a new and rapidly evolving charging market. Ensuring we have the right charging infrastructure in place will be critical to stimulating the rapid adoption of electric vehicles. However, for charge point operators (CPOs) to be successful, they need to understand their customers' needs and the dynamics of the different charging environments. Therefore, having the right business model in place, with the appropriate partnering and funding, are essential if charging companies are to succeed. The companies that understand their customers and their business will be the ultimate winners in a nascent and fragmented market that is on the tipping point of an EV revolution.



A photograph of a white electric car, likely a Tesla, with a man in a green polo shirt standing behind it. The car is in the foreground, and the man is slightly out of focus in the background. The background shows a building with a red roof.

Our approach

This report focuses on the charge point operators and the different business models and challenges we see emerging in EV charging

CPOs are the companies that install, maintain, operate or optimise EV charging infrastructure. We interviewed some of the leading operators in charging from larger to smaller players. We also spoke to other key stakeholders across the value chain such as electricity suppliers and transmission and distribution businesses.

In our previous report “**Charging ahead! The need to upscale UK electric vehicle charging infrastructure**”, we looked from the consumer’s perspective at the broad challenges facing EV charging in the UK.

This time, from the CPO’s view we have identified different strategies, approaches and business models. Our research has sought to distill the common strengths and key themes relevant to this array of players.

Key findings

Our research identified four emerging business models for charge point operators in the UK EV charging market



The 'Portfolio' player

This type of company operates across multiple charging segments, such as home, work and destination charging. Typically this player extracts revenue from several charging segments. Its operations may also span different parts of the EV charging value chain (from installation of charge points to maintenance of the network).



The 'Specialist' player

Companies in this category tend to focus on one charging segment, leveraging their technical capabilities and relationships with key stakeholders to generate revenue from that business. Some rapid charging operators are a good example of this.



The 'Network Optimiser' player

Companies in this group focus on building a future market position across multiple charging segments to capture alternative revenues on the back of traditional EV charging. These secondary revenues could be from helping manage the grid by exporting power from clusters of stationary EVs or by using smart technology to 'load shift' (facilitating the charging of EVs at periods of low demand).




The 'Energy Supplier' player

For these type of companies, typically an electricity supplier, EV charging is currently not a core part of the business. However, they are keen to build a position in EV charging, given increased adoption of EVs will boost national demand for electricity, which in turn will benefit the power companies. Future opportunities around managing power demand profiles, via smart charging for example, will increasingly appeal to energy suppliers.

Across the EV charging universe, some operators will fall neatly into one of these business models. Other operators may blend elements of several models. Given the rapid evolution of this market, it is likely other models will emerge. We believe there may be some market triggers that accelerate the evolution of business models. One such trigger may be the ending of government grants for EVs and chargers at some point in the future.¹ This may require automotive original equipment manufacturer (OEMs) to participate in the value chain more actively. Selling an EV in the future may need free charging hardware and installation as an incentive for consumers.

¹ In October 2018 the UK government announced it was going to reduce subsidies for purchasing greener cars (source: BBC news)

A woman with long brown hair, wearing a red top, is shown in profile, looking down at a black charging cable she is holding. She is standing next to a blue electric vehicle charging station. The background shows a modern building and a clear sky. The image is used as a background for the text boxes.

“We think about 60% of all energy will flow into cars at home and 30% will be at work. The remaining 10% splits between destination and en route charging.”

James McKemey, Pod Point

“VCharge is based on the concept of scale, allowing you to bid on larger grid services. This is most effectively delivered through multiple partnerships, such as with energy suppliers, OEMs and many other parties.”

Tom Pakenham, OVO Energy

When adopting these business models, operators will need to consider some guiding principles to be successful

‘Revenue stacking’ is crucial

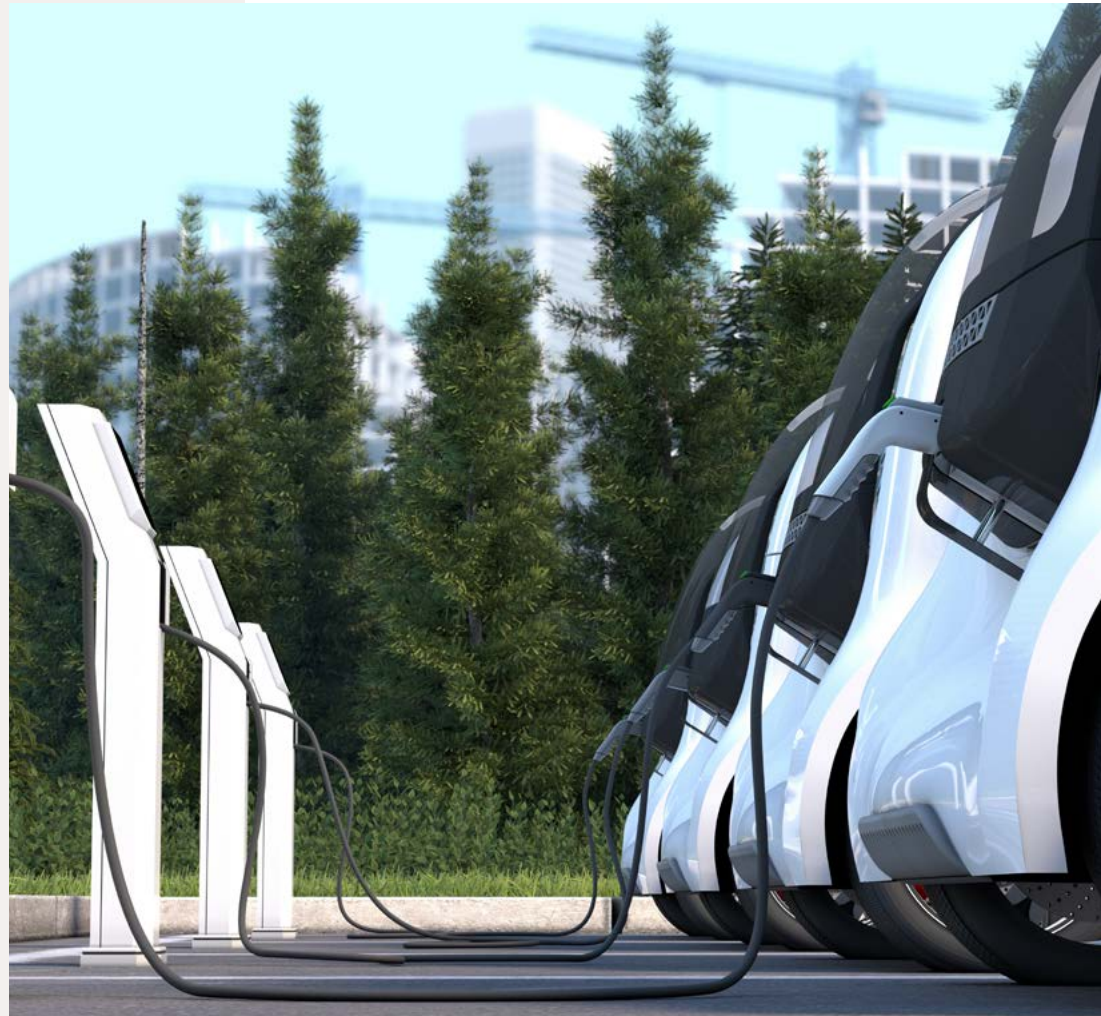
Operators need to consider generating multiple revenue streams to mitigate investment and utilisation risk. Moreover, as EV charging proliferates, increased competition will erode energy margins, emphasising the need to deliver additional services. Needless to say, revenue growth needs to be delivered with profitability.

Achieving network scale is critical

The more charge points an operator develops, the greater the potential to deliver multiple services, generate alternative revenue streams and create a ‘sticky customer’ value proposition. Network scale also unlocks efficiencies of scale from maintenance through to the cost of capital. Moreover, there is an argument that in the long term, those operators who have a national network are more likely to thrive.

Delivering a solution for ‘experience anxiety’

As illustrated in our opening anecdote, addressing ‘experience anxiety’ will be a key enabler to increasing utilisation and maximising revenue generation, as well as catalysing the broader adoption of EVs. The key here is to know your customers’ habits so you can address their needs across a variety of charging scenarios.



“We’re sceptical about the rapid charge business model where you install an expensive charging asset and look solely for pay-per-charge revenue to pay off the asset.”

James McKemey, Pod Point

Our research suggests the prospects for home and destination charging are positive

Given most home owners have access to off-street parking, as found in PwC's [Charging ahead!](#) report, home charging will be a relatively easy channel for charge point operators to develop as EV demand grows. Investment costs and regulatory complexity are low (compared to rapid charging for example). Looking ahead, home charging offers a large base of EV customers for charge point operators to achieve scale. This scale can help develop future revenue opportunities from bundled services to smart charging.

As for destination charging, the current prospects are positive. If charging assets are well located, a high level of footfall and guaranteed dwell time (how long an EV driver spends charging their vehicle) will support utilisation. This segment also lends itself nicely to developing additional revenue streams – such as targeted advertising. In the longer term, figuring out the destinations of the future will be key to sustaining this segment.

As for rapid charging and work place charging, their prospects appear more mixed.

Rapid charging is currently a challenging channel due to high investment costs and uncertain utilisation. Location is also relatively restrictive, as it needs to balance grid connection costs and ensure ease of access for customers and high levels of footfall. In the near future, if EV drivers become more comfortable with longer journeys, utilisation rates are likely to increase and the economics of rapid charging may become more attractive.

For work place charging, commercial buildings are increasingly required to demonstrate 'greener' credentials, thus supporting the rationale to deploy EV chargers in the work place. Outside of towns and cities, where commutes are typically longer, EV drivers will also build up the demand for infrastructure to 'top up' during the day. Moreover, EV charging for car fleets is likely to be another attractive proposition due to scale and utilisation. However, the ongoing trend of remote working and overall uncertainty of demand from workers for this (as it's only likely to gain traction as a work perk) may weaken the future prospects for this segment.

“We are building a rapid DC [direct current] network for now and into the future. From day one we were planning for charging at higher speeds than is available today. The business model is based on utilisation so securing the best locations is key. These early years are a land grab, and ultimately this becomes an alternative fuel play.”

Tim Payne, InstaVolt

“Fast forward five years, I don't think the regional network is a viable proposition. I think we will simply have strong, nationwide networks.”

Tom Callow, Chargemaster

A successful business model needs a robust go-to-market strategy based on partnerships and efficient financing

Partnerships

Leveraging the automotive original equipment manufacturer sales channel and developing an in-house installation capability will be key to the current and future prospects of operators. In-house installation capabilities are especially important to home charging, as automotive suppliers selling premium EVs will expect charging installers to deliver a high value service reflecting the brand of the vehicle.

Beyond the home charging channel, partnerships that are mutually beneficial for CPOs and infrastructure site hosts will also be crucial to securing locations across all other channels whether it be with supermarkets (destination charging), corporate offices (work place charging) or petrol retail outlets at motorway service areas (rapid charging).

Financing

While the EV charging market boasts attractive growth potential, the emerging nature of this sector may complicate lending opportunities.

As a result, operators will need to understand where EV charging sits on the technology maturity curve, as this will dictate the funding options available to companies looking to drive their growth ambitions. Debt financing offers significant potential to achieve scale. However, potential lenders will need to assess the risks associated with an immature technology and uncertain revenue outlooks.



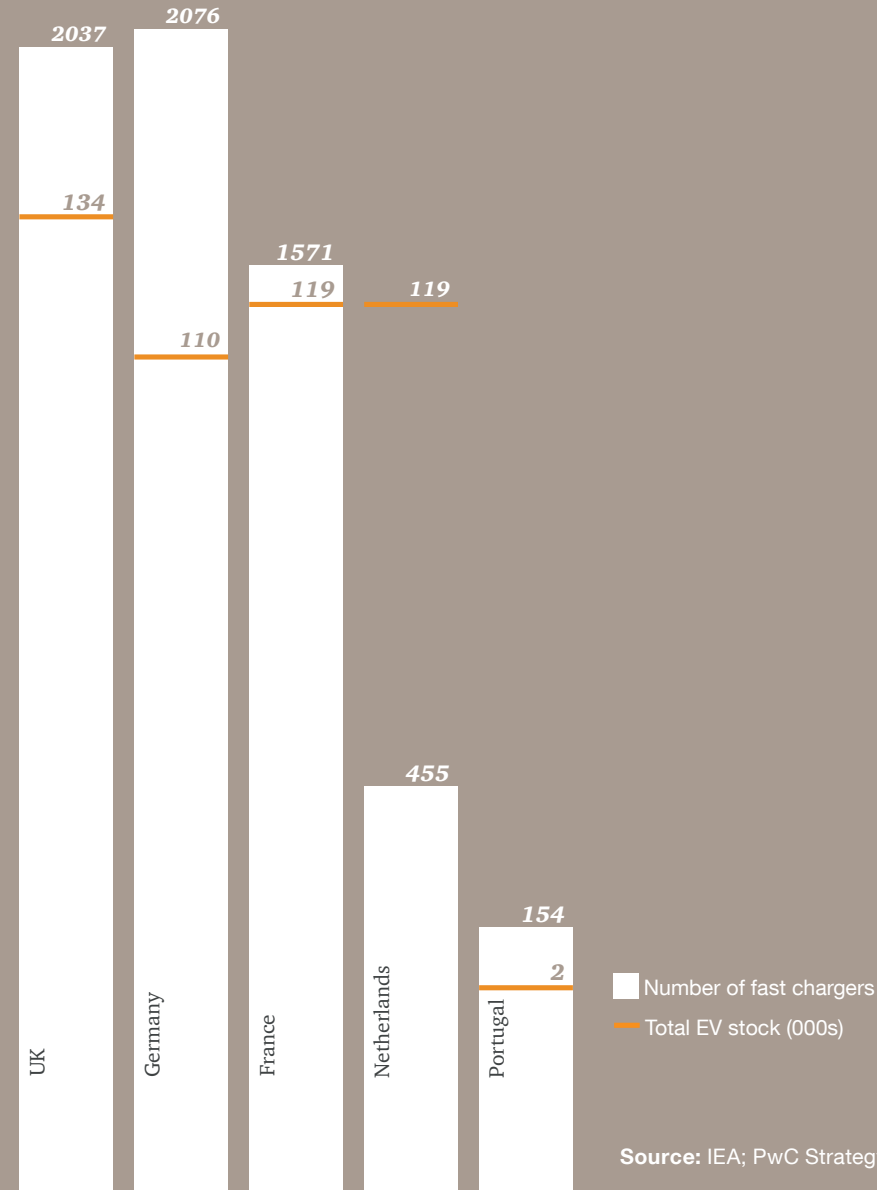
How the charging market stacks up

A leading market in Europe, but fragmented

The UK EV charging market is arguably one of the most advanced in Europe. What happens in this country may influence the evolution of EV charging in other geographies. As illustrated in Exhibit 1, the UK ranks alongside Germany with the highest number of publicly accessible fast chargers – an indicator of charging maturity. Moreover, the UK also has the largest EV stock (number of vehicles made up of plug-in hybrid EVs and pure battery EVs).

Exhibit 1: UK a leader in EV charging

Note: Norway has the highest level in EV stock but was excluded given that the size of the overall conventional car fleet in Norway is much smaller than in other larger European markets



UK demand for EVs is growing rapidly. In 2017 the EV stock totalled about 134,000. The increase from 2016 to 2017 alone was almost as much as the cumulative total up to 2015 (some 47,000 vehicles), as illustrated in Exhibit 2. The EV stock grew about by some 90% compound annual growth rate (CAGR) between 2011 and 2017, virtually doubling year-on-year with plug-in hybrid electric vehicles (PHEV) driving that growth trajectory.

Charging infrastructure is, naturally, expanding too. The number of publicly accessible charge points, spanning slow and fast chargers, is growing rapidly. In 2017 there were nearly 14,000 publicly accessible charge points across

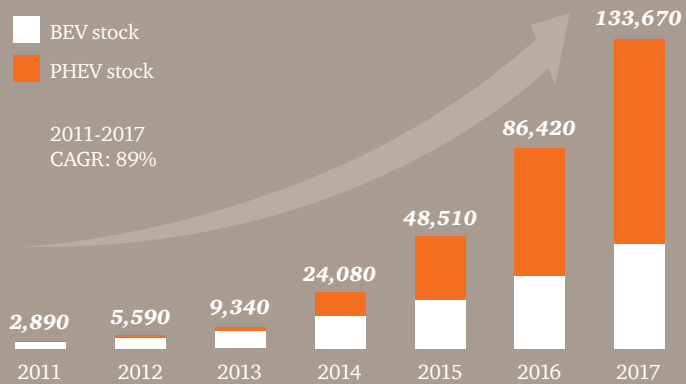
the UK. Between 2011 and 2017 the overall number of charge points grew at 44% compound annual growth rate (CAGR) mirroring the growth in EV stock, as illustrated in Exhibit 3. Interestingly slow chargers make up most of the publicly accessible infrastructure, despite the needs of EV drivers to have charging with a shorter dwell time.

Data on the total number of private charge points, typically at homes or work places of EV owners, is much harder to obtain. Using the International Energy Agency (IEA)'s assumption of a 1:1 ratio for private charge points to EVs, this would suggest a number as high as 134,000 in the UK.

The deployment of charge points to date has been strongest across Greater London/South East and Scotland. These three regions alone account for over half of all points, as detailed in Exhibit 4. The drivers behind this deployment in London and the South East is simply that more EVs are on the road in these regions. As for Scotland, a government-backed incentive scheme, 'Charge Place Scotland', has given charge point operators, installers and third party destinations the financial incentives to roll out infrastructure.

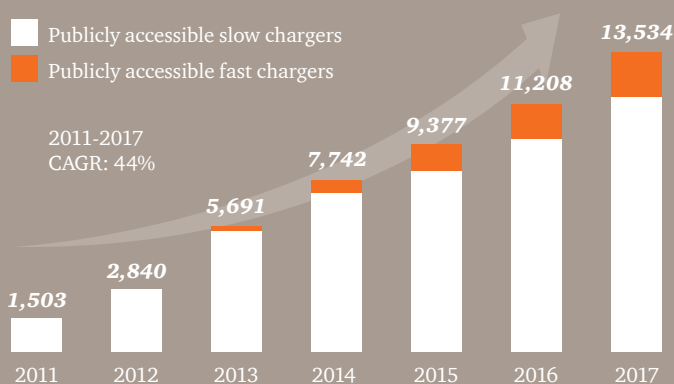
A supportive regulatory environment and general growth in demand for charging infrastructure has attracted many companies into the space. We have identified at least 60 CPOs or hardware players in the UK, ranging from electrical conglomerates through to start-up data focused enterprises.

Exhibit 2: Electric vehicle stock in the UK – total EV car stock



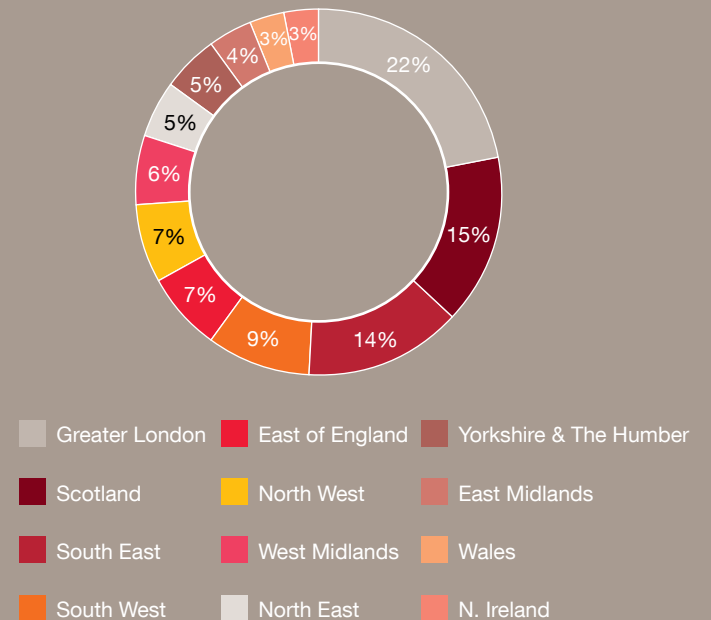
Source: IEA; PwC Strategy& research

Exhibit 3: Publicly accessible charge points in the UK – total public EV charge points



Source: IEA; PwC Strategy& research

Exhibit 4: Publicly accessible charge point distribution



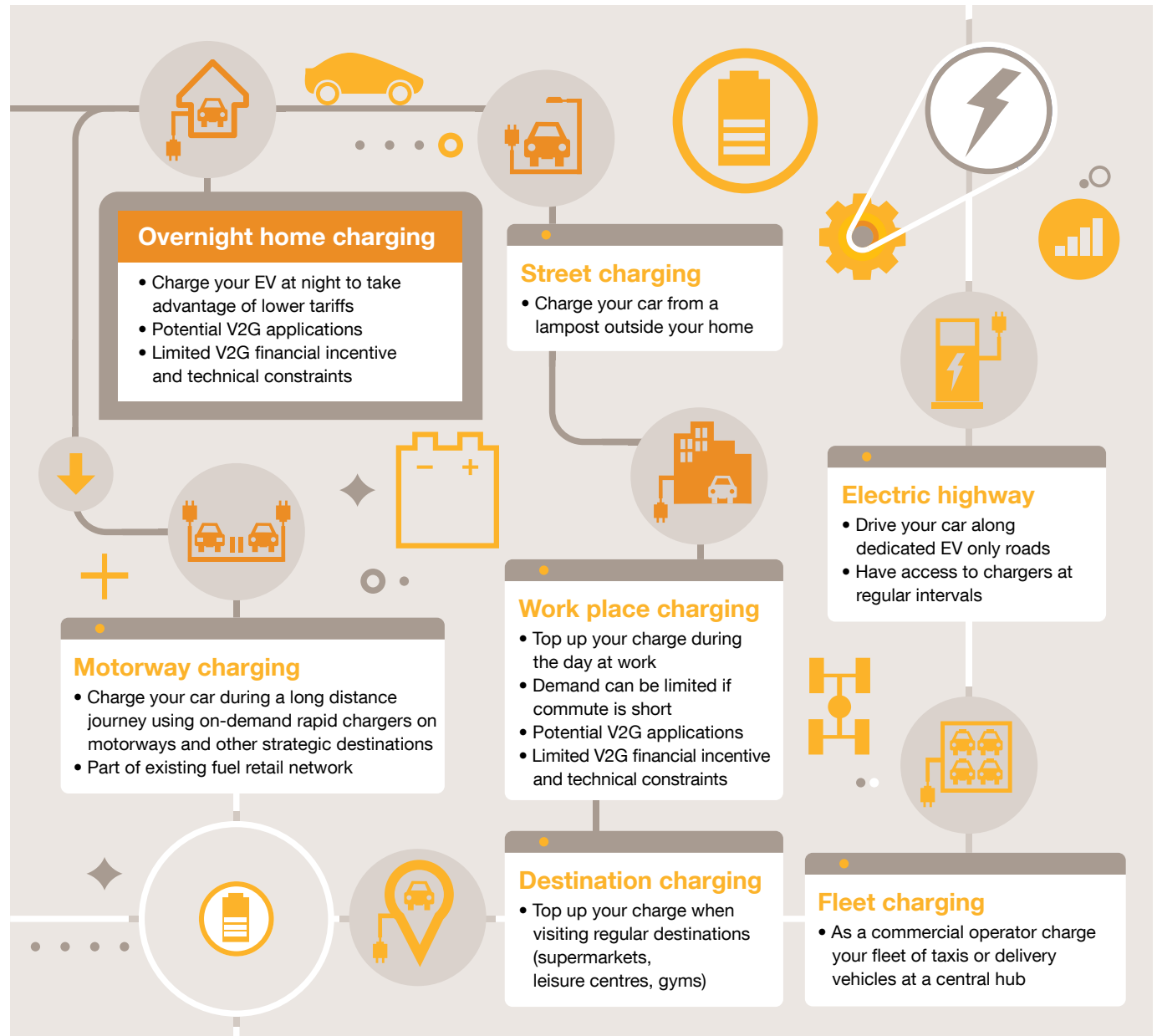
Source: Zap Map; PwC Strategy& research

Another aspect of the evolving ecosystem is how consumers are discovering different ways to interact with the infrastructure around them. We have identified the main behaviours that consumers tend to show when charging, as shown in Exhibit 5.

These patterns provide CPOs and other related market participants a variety of ways to play. While the EV charging market is fragmented, two players – Chargemaster and Pod Point – have built the most scale to date. They have established networks that span the value chain and across the UK, covering the public and private sector. With over 7,000 publicly accessible charge points between them, they are estimated to hold around half of the publicly accessible market.

Beyond the two largest players, a growing market will support many differentiated approaches. However, due to evolving consumer behaviour, various competing business models and ongoing consolidation (such as BP’s acquisition of Chargemaster in 2018), we believe the market is quickly reaching a tipping point. This then raises the question: **“Which business models are likely to be the most resilient as the market develops?”**

Exhibit 5: Evolving EV charging patterns







Source: PwC Strategy& research

Where does charging take place and how does it work?

Business models must consider unique operator and consumer perspectives by segment

Unsurprisingly, given the relative immaturity of this market, we see a diverse range of business models emerging. To help better understand the industry dynamics we have divided the EV charging market into four segments, as shown in Exhibit 6.

Exhibit 6: Overview of EV charging segments

Segment	Power (kW)	Comments
Home charging		
	AC 3 – 7	<ul style="list-style-type: none"> Home charging (which is the largest charging segment) is slower than rapid charging A Nissan Leaf with 30kWh battery with a 7kW charging point will take 5 – 6 hours to charge
Destination charging		
	AC 3 – 50	<ul style="list-style-type: none"> Charging at typical destinations you may travel to during the day These may include supermarkets, hotels or gyms
Rapid charging		
	AC 43	<ul style="list-style-type: none"> This is the only power level currently available in AC rapid charging
	DC 50 – 120	<ul style="list-style-type: none"> Currently only Tesla offers 120kW 'Superchargers'
	DC 150	<ul style="list-style-type: none"> In 2018 Pod Point announced it was introducing 150kW chargers across the country The new Jaguar I-Pace claims to be able to charge to 80% in just 45 minutes using 150kW charger, despite a relatively large 90kWh battery With the UK's current 50kW rapid chargers, it would need around 90 minutes
Work place charging		
	AC 7 – 22	<ul style="list-style-type: none"> Charge points at work are often similar speeds to those used in home charging

Note: AC is alternating current and DC is direct current

Source: Zap Map; company websites; PwC Strategy& research

Based on our interviews with various stakeholders, we identified a number of key criteria, such as ease of location and scalability, to assess each segment. These criteria are assessed through the lens of the EV driver and the CPO.

For the EV driver, we considered:

1. How easy and convenient, in terms of **location**, is it to charge in that segment?
2. How **price-sensitive** is the driver to charging in this segment?
3. What is the **customer experience** like when charging?





































For the CPO, we considered:

4. What is the potential for '**revenue stacking**' in the segment? In other words, what is the opportunity to generate alternative revenue streams apart from straight forward power or hardware sales?
5. Does the segment require significant **investment** (such as capital expenditure) to deliver through this channel?
6. Are there major **regulatory hurdles to overcome** to roll out infrastructure via this channel?
7. Is it **easy to scale up** using the channel?

Getting the right balance across these different criteria is important if business models are to be resilient. Clearly CPOs can choose to play in just one or multiple charging segments.

Using this framework and based on our interviews, we rated the criteria for each channel, marking each as a constraint (-) or an enabler (+), as illustrated in Exhibit 7.

Exhibit 7: Anatomy of success for EV charging segments

Charging segment	Key customer criteria			Key charge point operator criteria				Overall segment outlook	
	Ease of location	Price-sensitivity	Customer experience	Revenue stacking	Investment requirement	Regulatory complexity	Opportunity to scale		
Home charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +	-  +	Positive outlook Low cost model with potential to scale up customer base and bundle products
Destination charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +	-  +	Positive outlook Potential for alternative revenue streams. Contingent on future retail trends
Rapid charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +	-  +	Mixed prospects Remains high cost model, dependent on high utilisation
Work place charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +	-  +	Mixed prospects Strong 'green' policy incentives to adopt charging but unclear if work force will exploit









Source: PwC Strategy& research

All charging segments are analysed in detail but at a top level:

- home charging is promising due to the benefits of scale and the future potential to bundle products and provide power grid level services
- destination charging also offers significant potential due to revenue stacking such as advertising

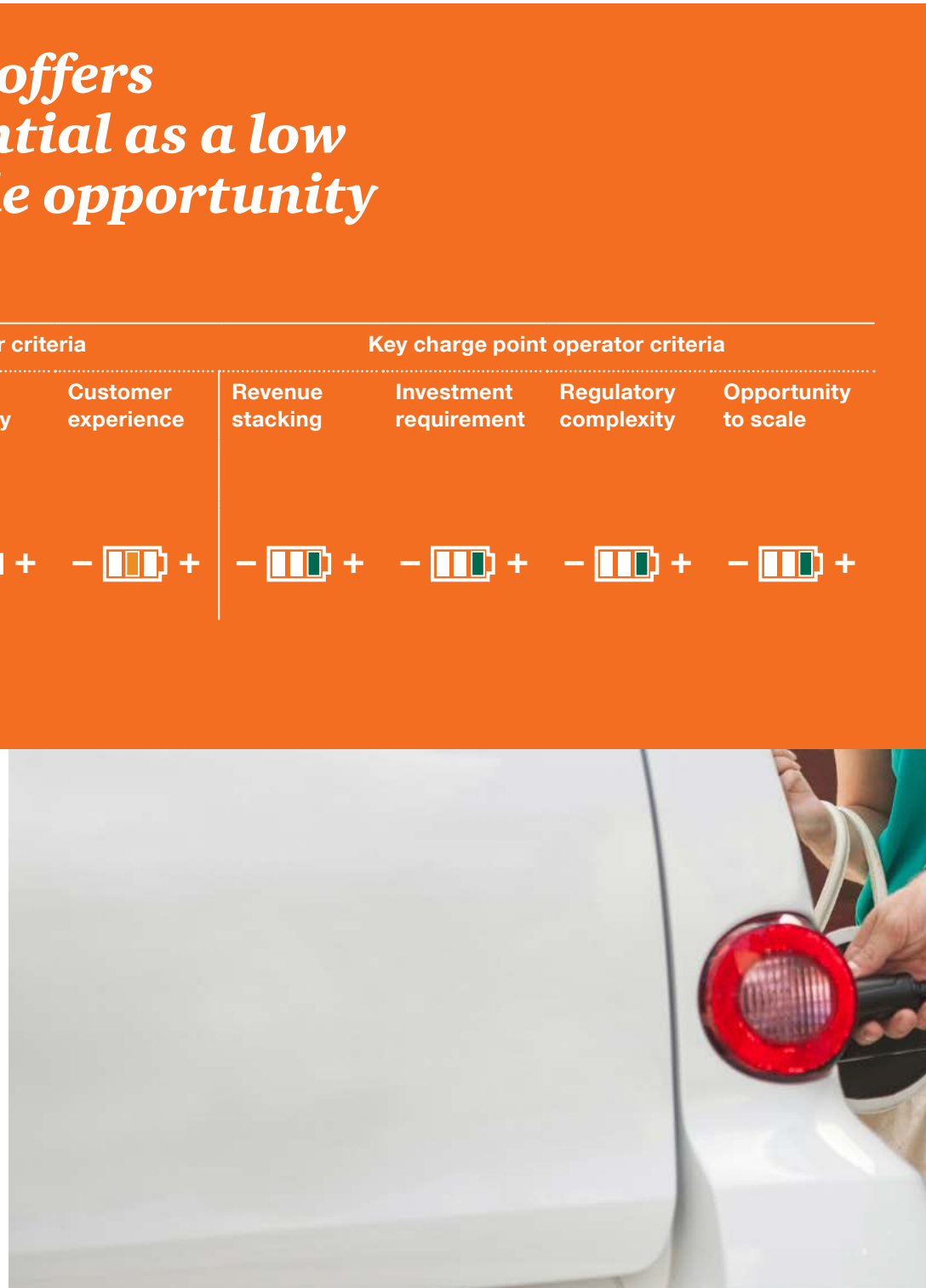
- rapid charging currently remains a high cost model, facing a number of challenges in terms of revenue opportunities, scale and regulatory complexity. However, as more EV drivers take to the road and get used to taking longer journeys, demand for rapid charging is likely to increase
- work charging offers potential opportunities via scale but it is still a niche play, as businesses are still in the early stages of engagement

Home charging offers promising potential as a low cost and scalable opportunity

Charging segment	Key customer criteria			Key charge point operator criteria			
	Ease of location	Price-sensitivity	Customer experience	Revenue stacking	Investment requirement	Regulatory complexity	Opportunity to scale
Home charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +

Source: PwC Strategy & research

In our report “[Charging ahead! The need to upscale UK electric vehicle charging infrastructure](#)”, we found 78% of homeowners have access to off-street parking – making home charging the most likely way to charge for EV drivers. It is for this reason we see home charging as a growth prospect. Moreover, for CPOs it is an effective way to build up a customer base for future alternative revenue models.



Opportunities and challenges in home charging

For EV owners, home charging offers a convenient and relatively easy way to charge a car without having to alter lifestyle habits. For CPOs, home charging offers significant growth potential, as well as revenue stacking opportunities

Partnerships with automotive OEMs will be key to ensuring a robust sales platform. For example, Jaguar has a partnership with Chargemaster and Pod Point to provide installation services for charging units with every Jaguar I-PACE (the new all-electric sports utility vehicle) sold. Equally, the need to have an in-house charging installation capability will be critical to deliver the customer experience and protect the brand of the automotive OEMs.

If CPOs can develop partnerships with other related third parties, such as solar panel installers, more bundled services can be explored to deliver a 'sticky customer' proposition. There is also an evolutionary curve of sophistication for drivers purchasing their first EV and charging at home. They quickly develop an awareness of the cost of charging, seek alternative power suppliers and become inquisitive about additional related hardware (such as solar panels). This will present opportunities to CPOs to develop secondary revenue streams. Grid flexibility services from load shifting or vehicle-to-grid (V2G) power discharge will also present future opportunities especially by partnering with energy suppliers.

Building up a large customer base through households will drive additional revenues. Moreover, in contrast to rapid charging, the investment requirements are relatively low with limited regulatory complexity.

Smart technology will be critical to changing customer home charging behaviours, to avoid unnecessary costs in grid management. In our earlier report 'Charging ahead!', we discovered that while battery electric vehicle (BEV) drivers plug in to charge throughout the day at different locations, the most common group, 35%, charge at home (off-street) and typically between 5pm – 8pm. These are clearly peak hours across the grid.

Therefore, a combination of market incentives ('time of use tariffs' – cheaper rates of electricity during the day when demand is lower) and smart technology will be needed to shift typical charging patterns to off-peak times.

In terms of constraints, for EV drivers there may be concerns about the speed of charging. As referenced already, a Nissan Leaf with a 30kWh battery with a 7kW charging point will take 5-6 hours to charge. Admittedly charging will happen in the evenings or overnight and so the length of time may be less of an issue.

Another future hurdle for the segment may be the outlook for government subsidies. Currently the UK government provides grants for the purchase of some EVs, as well as for home chargers. At some point this funding will end. It is unclear if consumers will be willing to pay the full price of a home charger once this subsidy ends. Automotive OEMs may then have a role to play. They may need to consider moving further down the value chain to ensure their EVs are sold by offering their own installation services and / or discounting the cost of the hardware.

Finally, a few thoughts about on-street charging. For the purposes of this report we have clustered this sub-segment under home charging as it is most likely EV owners will use street charging close to their home. Whether stand-alone charging units or street lamp chargers are involved, the provision of on-street charging is an important element of getting people used to charging and therefore accelerating adoption rates. Government at both the national and local level has focused efforts to date on promoting street charging.

From the CPO's perspective, street charging offers a low margin but dependable model. Operators can sell the hardware to local councils, as well as install and maintain the asset. Additionally, for the immediate future CPOs have the assurance of continued demand as councils in the main require an "infrastructure as a service" proposition to offset the lack of in-house capabilities.

However, as for the provision of free charging in some public infrastructure, this does raise an issue for the future. Free charging certainly helps encourage EV adoption rates. But there is a risk that some EV drivers may expect this to be an ongoing benefit and changing that mind set may prove challenging.

“Most of the public charging infrastructure installed to date has been with grant funding, and initially this was intended to encourage early adoption by offering free charging to EV drivers.

Now that electric vehicle adoption is increasing, commercial markets need to provide high quality and reliable infrastructure, and people need to get used to the idea of paying to charge their vehicles.

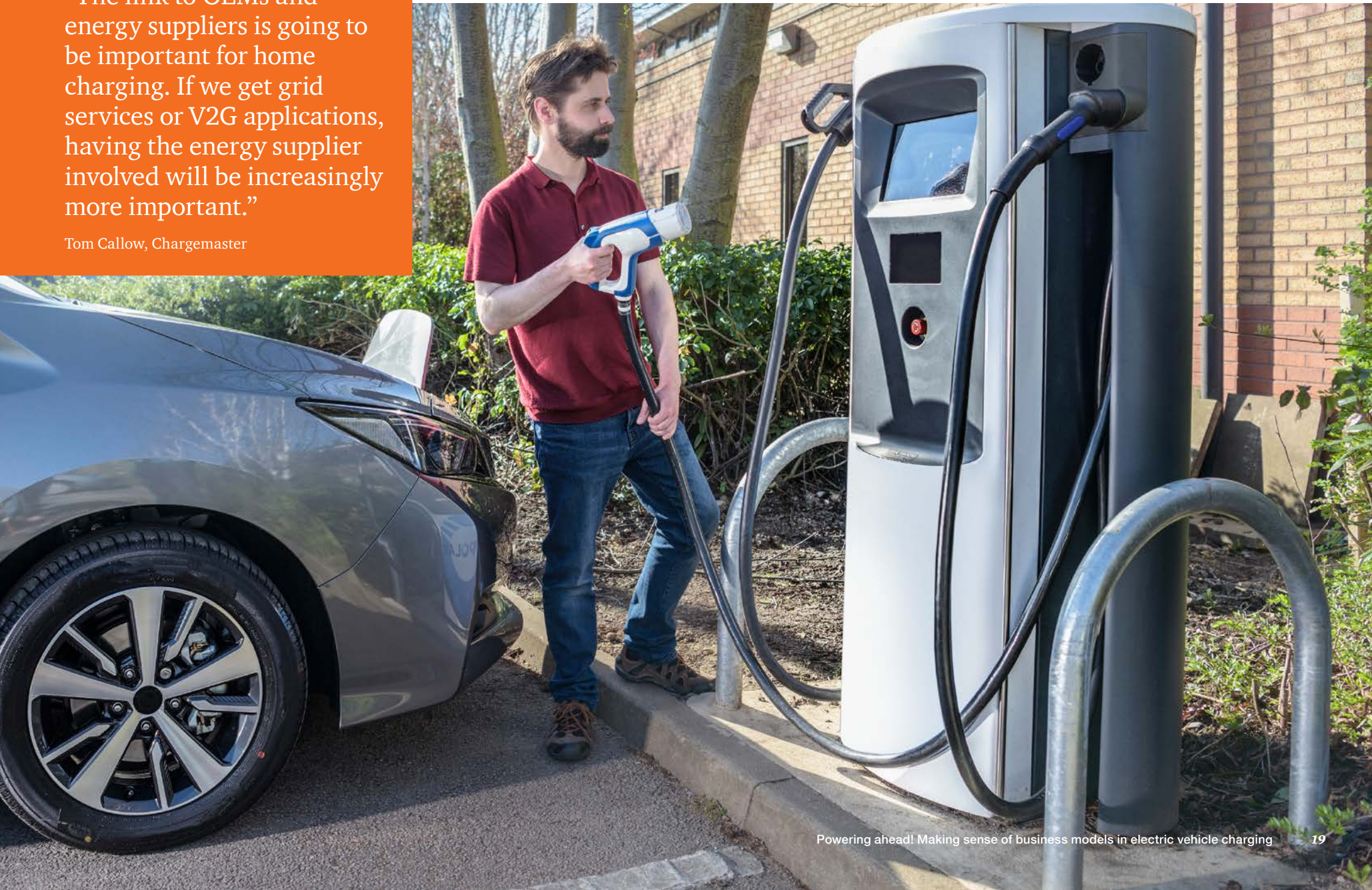
There is a large contingent of existing EV drivers who think charging their car should be free. We need to challenge that mind set.”

Tim Payne, InstaVolt











“The link to OEMs and energy suppliers is going to be important for home charging. If we get grid services or V2G applications, having the energy supplier involved will be increasingly more important.”

Tom Callow, Chargemaster



Destination charging offers a major opportunity to scale up and generate secondary revenue streams

Charging segment	Key customer criteria			Key charge point operator criteria			
	Ease of location	Price-sensitivity	Customer experience	Revenue stacking	Investment requirement	Regulatory complexity	Opportunity to scale
Destination charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +

Source: PwC Strategy& research

Destination charging covers charge points which are at regular destinations for EV drivers. This may include supermarkets for shopping, food outlets or gyms and leisure centres for sporting activities. All these destinations typically have high levels of footfall and prolonged dwell time (hence higher utilisation of the charging infrastructure). Destination charging is an emerging segment with high potential to exploit alternative revenue streams.



Opportunities and challenges in destination charging

In destination charging, the convenience of location for EV drivers is addressed, as they do not have to go out of their way for charging

For CPOs, destination charging offers a baseline revenue through the sale and installation of hardware. Moreover, if the retailer charges a fee for charging, the CPO can receive a percentage of that transaction fee. Equally, operators may be able to generate secondary revenue opportunities, such as from advertising or leasing agreements with site owners for the hardware.

One potential trend might be for supermarkets to offer free charging. By using the chargers as a loss leader, supermarkets can attract customers in the same way they discount fuel sales to generate more custom.

Speed of charging in this context becomes particularly important. Rapid charging would be too short (and expensive) for customers to linger. Slow charging may equally discourage customers from staying longer. Getting the right balance in charging speed will be important. Moreover, retailers can explore other options, such as charging a fixed price for charging, in exchange for a voucher where the charge is redeemed if the EV driver shops at the retail outlet.

Destination charging is likely to be a target segment for the network optimiser model. For example, car parks, especially those at airports, have the possibility of knowing exactly how many batteries they will have connected at any one time and available for ancillary services.









Working out which are the key destinations – now and in the future will be critical to the success of this channel. It is interesting to note Chargemaster's decision to install (with no upfront cost) a network of charge points at AA hotels, in the belief that EV drivers will seek out destinations that have charging points over those that do not.

A charging point also provides an additional draw for hotels as the EV market continues to develop. In fact, as the chief executive of Chargemaster David Martell noted, "We believe that within the next five years, all hotels will offer EV charging, just like they provide Wi-Fi today."²

Either way, the nature of destinations will change. Given the impact of online shopping for food for example, there may be far fewer supermarkets in 15 years' time. In which case CPOs will need to figure out other likely destinations of EV drivers.

² Chargemaster press release

Rapid charging remains a niche and high cost segment with limited revenue stacking opportunities and barriers to scale

Charging segment	Key customer criteria			Key charge point operator criteria			
	Ease of location	Price-sensitivity	Customer experience	Revenue stacking	Investment requirement	Regulatory complexity	Opportunity to scale
Rapid charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +

Source: PwC Strategy& research

Rapid charging has an important role to play in addressing potential concerns around ‘range anxiety’. For those EV drivers on long distance travel, it is critical to have strategically located rapid charge points such as at motorway service areas or hotels. From a customer perspective, the ability to charge quickly mid-way through a long journey is arguably an important part of the overall driving experience.



Opportunities and challenges in rapid charging

For charge point operators, rapid charging offers a premium pricing channel, where drivers may be willing to pay more to have peace of mind. In our research, price points for rapid charging ranged from 25-36p/kWh versus 10-15p/kWh for home charging (tariff dependent)

The location of rapid charge points is key to ensure drivers can access them easily. Moreover, they need to be in a geography where the distribution grid is resilient and capable of meeting the significant power needs entailed in rapid charging. Equally, CPOs need to ensure high utilisation of these assets to make this segment economic. Therefore, location and ease of access will be key to ensuring the overall economics of rapid charging are addressed.

In terms of constraints to future growth, rapid charging is expensive to set up. As a rule of thumb, a 7kW home charger costs about £1,000 to install a socket, whereas a 50kW charger is likely to cost upwards of £30,000 a connector. Moreover, as one goes beyond 50kW, the costs multiple as grid-related and site costs are factored in.

Given the potential strain on the grid presented by rapid charging, obtaining the consent and support of a regional distribution network operator (DNO) can be a lengthy and possibly a prohibitively expensive process. According to feedback from our interviews, some CPOs alluded to mixed levels of engagement by the different DNOs.

The application of advanced energy storage systems (such as batteries) to complement rapid charging could be essential to alleviate stress on the grid and lower scale-up costs. Energy storage will enable this segment to generate more opportunities to 'revenue stack', as ancillary services are sold to the grid (such as balancing and/or frequency response). However, even with the use of energy storage systems, rapid charging will always be location sensitive with respect to local grid resilience and convenience of charging for EV drivers.









“The EV charging market, and rapidly growing vision for the industry, still lacks clarity in some segments. What is clear, we will require rapid charging infrastructure, in strategic locations through the country, to complement home charging. But the balance currently lacks clarity.”

Matt Allen, Pivot Power

“Rapid charging is a captive market and very likely customers will be willing to pay a premium for the usage of that asset.”

James McKemey, Pod Point

Work place charging has some potential but it is unclear if demand will match expectations

Charging segment	Key customer criteria			Key charge point operator criteria			
	Ease of location	Price-sensitivity	Customer experience	Revenue stacking	Investment requirement	Regulatory complexity	Opportunity to scale
Work place charging 	-  +	-  +	-  +	-  +	-  +	-  +	-  +

Source: PwC Strategy& research

Work place charging is an evolving segment. With commercial buildings under obligation to be more energy efficient and 'green', interest in charging infrastructure at work is likely to grow. Like home charging, the size of the prize can be significant, as CPOs can leverage an increasingly growing and captive network of users to sell secondary services. Work charging can be positioned as a perk (a benefit in kind) for staff and usage can serve as an incentive to encourage other users to adopt EVs. However, demand for work place charging will be impacted by an increasing trend for remote working and different driving patterns in large cities.



Opportunities and challenges in work place charging

For EV drivers, work place charging offers the opportunity to top up during the day. This convenience will likely be more attractive to rural drivers, as around three quarters use a car to commute to work (according to an RAC survey) compared to 30% of those living in London³

Rural commuters also tend to travel around 35% more miles each year compared to those living in an urban environment.⁴ As urban drivers are more likely to use public transport and have shorter journeys with less need to top up during the day, demand for work place charging may be weaker.

For CPOs, having a large group of work place charging users will provide a captive network to sell secondary services such as advertising. Moreover, once this becomes a sophisticated offering, work place charging could act as a balancing mechanism for the grid. Having cars parked for some eight hours a day could help manage peak and off-peak periods, especially in heavy industrial and power intensive locations.

Equally, EV charging for commercial car fleets is an attractive opportunity due to scale and utilisation as already referenced.

In terms of challenges, EV drivers may not be willing to pay a tariff for charging, especially if they have preferential rates at home. Some work places may decide to offer free charging as a perk, in which case this is less of an issue.

As referenced already there may be differing levels of demand depending whether the work place is urban or non-urban. Equally, the ongoing trend of remote working may also impact the economics of work place charging.

³ Source: RAC's Car and Commute report

⁴ Source: Department for Transport Travel Survey 2016

Bringing your business model to life





Building partnerships will be essential to delivering this growth

In an emerging market, one of the challenges facing EV charging operators is having to scale up to achieve commercial viability.

Our research revealed partnerships were necessary depending on the charging channel being targeted, as highlighted in Exhibit 8. Partnerships are required to develop ‘revenue stacking’ opportunities or to gain access to new markets.

Figuring out the benefit to allow a site owner to use their land is critical and an important dimension to partnerships. CPOs typically do not own the land where charging assets are installed. Therefore, operators have to understand what is the benefit they offer site owners (such as a commission or rental income) that will allow their business model to work and be profitable. In some cases the site owner may not expect an income, treating charging as a free service (as in the case of Wi-Fi) to attract footfall.

Exhibit 8: Overview of partnership options for charge point operators

Key criteria	Charging segments			
	Home charging	Destination charging	Rapid charging	Work place charging
				
Critical now	<ul style="list-style-type: none"> • EV car manufacturers • Vehicle leasing providers 	<ul style="list-style-type: none"> • Parking spaces at commercial hubs (e.g. supermarkets, cinemas, gyms, retail parks, theme parks, airports) • Land owners 	<ul style="list-style-type: none"> • Motorway service areas • Universal card payment providers • Advertising agencies • Land owners 	<ul style="list-style-type: none"> • Commercial estate management companies • Land owners
Important tomorrow	<ul style="list-style-type: none"> • House builders • Councils 	<ul style="list-style-type: none"> • Advertising agencies 	<ul style="list-style-type: none"> • Premium EV car manufacturers (large battery models) 	<ul style="list-style-type: none"> • Vehicle leasing providers
Maybe in the long term	<ul style="list-style-type: none"> • Retail energy suppliers • Renewable energy hardware (solar PV, battery storage) 	<ul style="list-style-type: none"> • Owners of experience centres (e.g. escape rooms) 	<ul style="list-style-type: none"> • Distribution network operators 	<ul style="list-style-type: none"> • Advertising agencies • Specialist energy management companies

Source: PwC Strategy& research

Business model funding

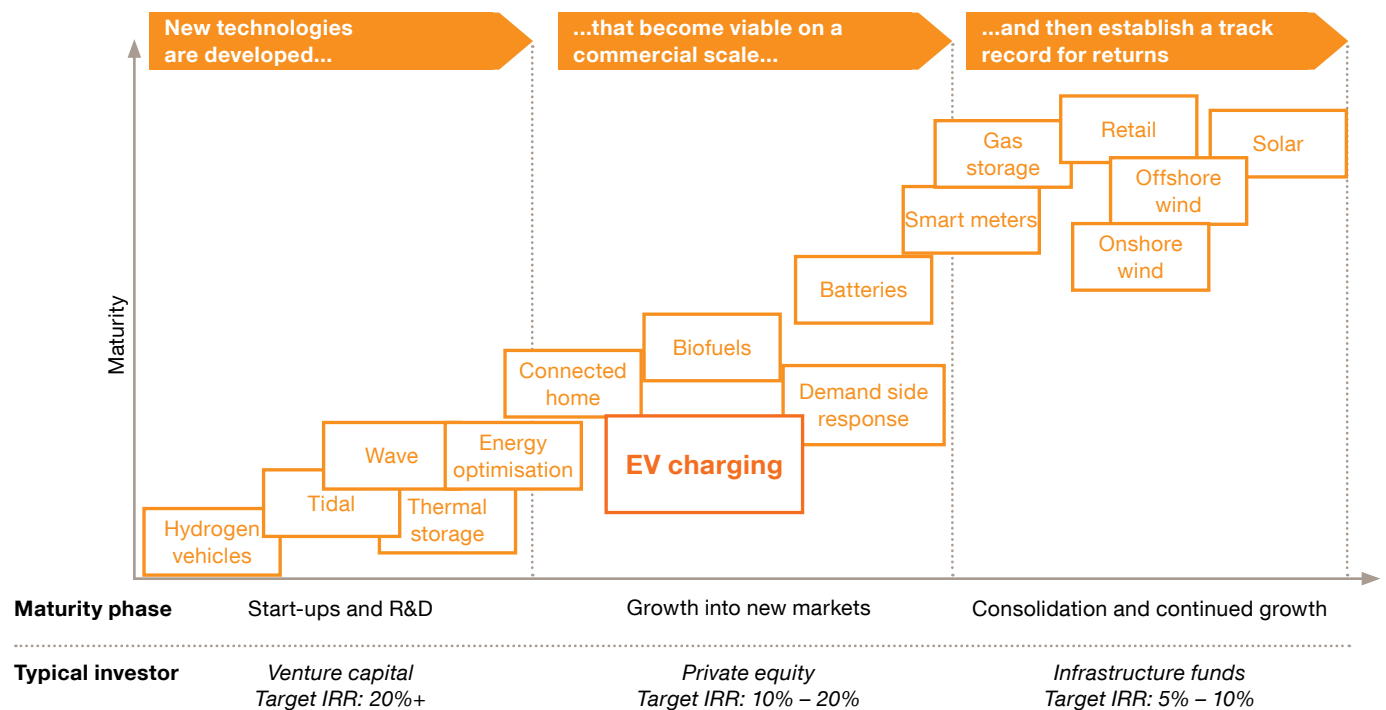
EV charging is competing with a number of other technologies, all of which are aiming to solve some of the most pressing energy problems of our time, most notably decarbonisation

From a financing perspective, EV charging is progressing up the funding maturity curve but remains a relatively new technology, see Exhibit 9.

Given EV charging has still some way to go before becoming a mature technology, there are some funding hurdles to overcome. Most CPOs are currently restricted to private equity and venture capital financing. As they grow in scale and develop a track record of financial growth, a broader pool of lending could be accessed.

As a result, any go-to-market funding strategy will need to demonstrate a solid and reliable revenue model. Moreover, if the revenue is 'stacked' and operations are diversified, this will further bolster the revenue model and act to lower the risk profile of the CPO. Building revenue on the back of a growing EV customer base will be critical and strategic partnerships are a key tool to help deliver this growth, as already referenced.

Exhibit 9: EV charging on the funding maturity curve



Source: PwC Strategy& research

Deep dive on business models

In our research, we identified several types of business models that are focused on different segments with differing strategies

Case Study 1: The “Portfolio” Player

Key Criteria

Home charging



Destination charging



Work place charging



Rapid charging



Business model characteristics

- Builds a network spanning the value chain and charging segments to diversify risk and maximise revenue stacking possibilities
- Across the segments, home charging remains the key one to build scale quickly
- Diversity of charge points by segment means operator better placed to address customer experience

Key charging segments

- Player builds across all segments, although volume of charge points concentrated in home segment
- Lesser focus on rapid charging due to higher costs and utilisation challenges

Route to market (partnerships, financing)

- Develops partnerships with leading EV automotive OEMs, as this is the key route to build scale through home charging
- Installation capabilities need to be in-house to protect OEM brand reputation and ensure customer experience in home charging
- Build partnerships focused on destinations with high footfall and long dwell time in destination charging
- Land owners critical partner to install charging assets

Key opportunities

- Access to differentiated revenue streams (maintenance contracts, bundled products, advertising etc.)
- Ability to attract low cost financing due to diversified revenue streams
- Flexibility to scale up and down by segment and according to market potential

Key Threats

- High investment cost implications due to diversified operations and need to monitor customer charging habits across different charging segments (major data analytics capabilities required)

Source: PwC Strategy& research

Case Study 2: The “Specialist” Player

Key Criteria

Destination charging



Work place charging



Rapid charging



Home charging



Business model characteristics

- Focuses on a core capability in a single charging segment

Key charging segments

- Greater potential to target for specialists given technological / partnering needs
- Home charging harder to penetrate as a specialist due to commoditisation

Route to market (partnerships, financing)

- Builds strategic relationships with partners focused on core capabilities
- Uses innovative funding model (no up front cost) to incentivise partners to adopt their charging solution
- High risk and high return funding model requiring Venture capital-like funding

Key opportunities

- Ability to exploit niche charging behaviours (with specialist approach) as market grows to carve out a leading role
- Can command a price premium for example in rapid charging

Key threats

- Financing costs higher compared to other models as dependent on market growth assumption
- High exposure to specific segments that may shrink or have limited growth potential over time
- Limited revenue stacking opportunities due to narrow focus

Case Study 3: The “Network Optimiser” Player

Key Criteria

Home charging



Work place charging



Destination charging



Rapid charging



Business model characteristics

- Focused on aggregating EV battery capacity and selling the services to the electricity distribution network operators
- Scale is important, as many cars will need to be aggregated to produce viable grid service revenues

Key charging segments

- Segments offer the scale and also a long dwell time (up to 8 hours)
- Destination charging car parks, especially at airports, could be potential target segment
- Rapid charging not likely to be a focus due to shorter dwell times

Route to market (partnerships, financing)

- Cultivates relationships with distribution network operators to evolve the market for aggregated storage services
- Partnerships with EV OEMs crucial for scale building
- High risk funding model due to future focused business model with financing restricted to venture capital options for some time

Key opportunities

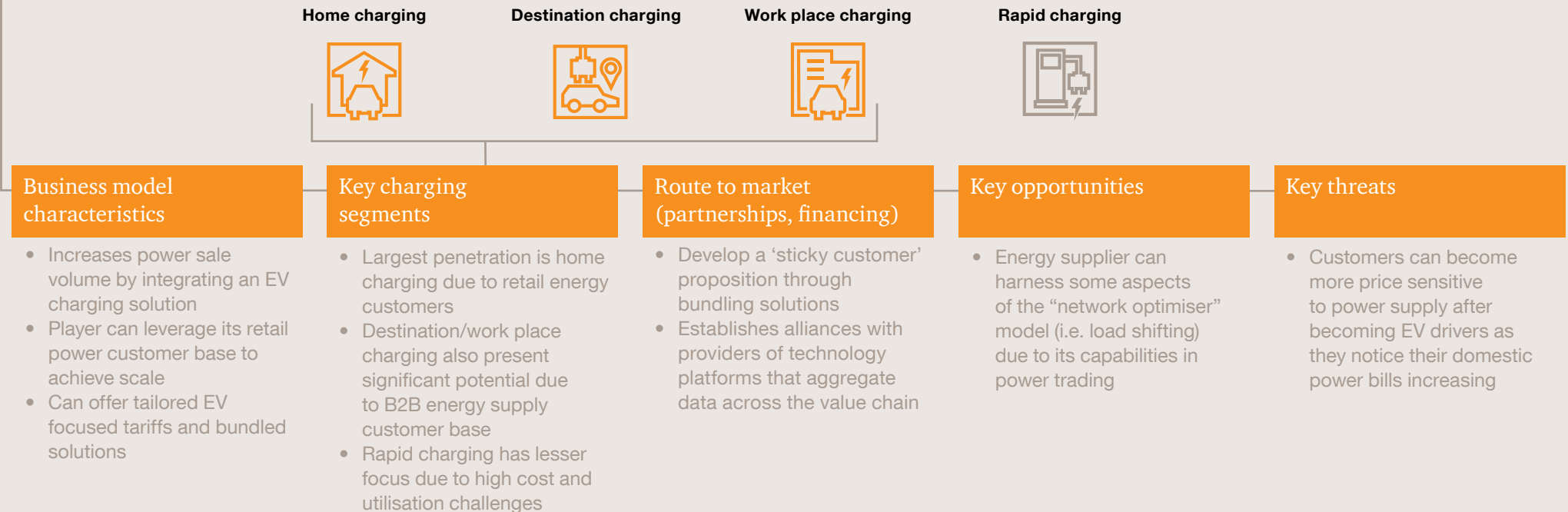
- Energy storage related services are likely to rise in value due to growing volume of intermittent power sources (i.e. renewables) in the power mix

Key threats

- EV drivers' charging habits may not evolve in a way to have storage available at the right time of the day

Case Study 4: The “Energy Supplier” Player

Key Criteria



“It’s the hardware and the data we’re interested in. This allows you to control the charge point’s activity and access smart charging benefits off the back of it.”

Mark Meyrick, Ecotricity

What should you do next?

We are still very much in the early stages of this EV revolution. Creating an environment that allows people to charge easily and where charging fits into their way of living will be fundamental to catalysing EV demand. It's not just about sticking charge points in the ground

From the customer perspective, it's about developing a holistic value proposition that meets the needs of the user and delivers an experience that encourages EV drivers to come back. From the perspective of the charging operator, it's about building a business with optionality and potential to scale up.

So whether you are an aspiring CPO, an investor looking to fund an operator or a business looking to partner with a charging company, here are a few key questions to consider:

- *Is there an optimal business model in place for long term success in the chosen charging segments?*
- *What revenue streams are planned for now and in the future?*

- *What capabilities are needed in-house and what other partners are needed to deliver revenue growth?*
- *How will technology and data analytics enable the business to provide 'smart' solutions?*
- *What are the funding plans for growth now and in the future?*

Getting answers to these questions will be critical to making sense of the options. With so many business models in the market, it can be difficult to figure out which ones are the likely winners. However, choosing the right strategy, capabilities and partnerships are essential if 'experience anxiety' is to be addressed. So perhaps, as in the opening anecdote, the next time that modern EV pulls into a rapid charger for 45 minutes the family gets a tailored meal delivered to them; there is a mobile business lounge for the parents to relax in and catch up with emails and make calls; and there is a retail centre to take the kids shopping, with play areas to let them run wild. Now wouldn't that be a much better experience when charging your EV!

“In a rapidly emerging market, business model innovation and evolution is very dynamic. Opportunities exist to innovate and collaborate. So many will succeed and others will fail – only time will tell.”

Graeme Cooper, National Grid

Authors & Contact Details



Steve Jennings

Partner, Energy & Utilities Industry

T: +44 (0)20 7212 1449

steven.m.jennings@pwc.com



Rich Parkin

Partner, Automotive Industry, Strategy&

T: +44 (0)7900 163731

rich.parkin@strategyand.pwc.com



Adrian Del Maestro

Director of Research

T: +44 (0) 7900163558

adrian.delmaestro@pwc.com

*We would like to acknowledge the
valuable contributions made to this
report by Tom Haddon*

www.pwc.co.uk

At PwC, our purpose is to build trust in society and solve important problems. We're a network of firms in 158 countries with more than 250,000 people who are committed to delivering quality in assurance, advisory and tax services. Find out more and tell us what matters to you by visiting us at www.pwc.com.

This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and, to the extent permitted by law, PwC does not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication or for any decision based on it.

© 2018 PwC. All rights reserved. "PwC" refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details.

Design Services 31565 (09/18).