Welsh Government

Electric Vehicle Charging Infrastructure Programme

Strategic Outline Business Case: Commercial, Financial and Management Cases

Final Arup report to the Welsh Government

February 2023

Llywodraeth Cymru
Welsh Government

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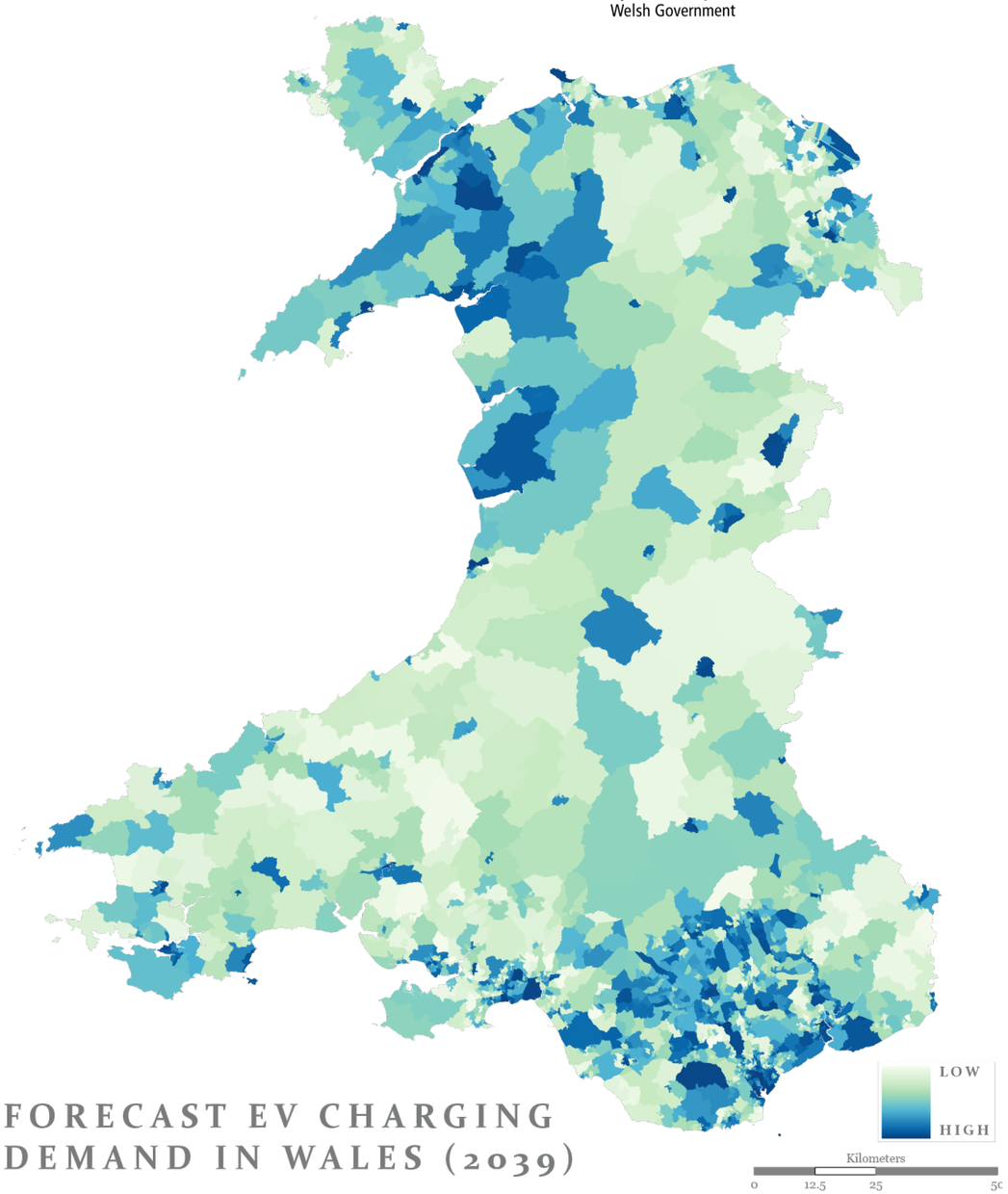

FORECAST EV CHARGING DEMAND IN WALES (2039)

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This report and the capital expenditure (CAPEX) estimate results included in the Financial Case (the Results) has been prepared by Arup specifically for and under the instructions and requirements of Welsh Government in connection with the Electric Vehicle Charging Infrastructure Strategy for Wales, under the Schedule 2b contract dated 28 February 2022.

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Glossary of terms

AIE	The European Association of Electrical Contractors
CE	Consumer Efficiency (demand scenario)
CP	Chargepoint
CPO	Charge point operator
DfT	Department for Transport
DNOs	Distribution Network Operators
ESG	Environmental, Social, and Governance
EVCI	Electric Vehicle Charging Infrastructure
EV	Electric Vehicle
GS	Government on-Street (demand scenario)
LA	Local Authority
LSOAs	Lower Super Output Areas
MSOAs	Middle Super Output Areas
OEM	Original Equipment Manufacturer
RD	Rapid Dominant (demand scenario)
SOBC	Strategic Outline Business Case
TfL	Transport for London
TfW	Transport for Wales
Tx	Transformation
ULEVs	Ultra Low Emission Vehicles
WelTAG	Welsh Transport Appraisal Guidance
WG	Welsh Government
WLGA	Welsh Local Government Association

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Introduction and context

Executive summary
Introduction

Purpose of this document

The purpose of this report is to explore how the Electric Vehicle Charging Infrastructure Strategy for Wales and accompanying Action Plan will be delivered in practice, to be referred to as the Electric Vehicle Charging Infrastructure Programme, as WG sets out to accelerate the roll-out of electric vehicle charging infrastructure across Wales. This report has been prepared for Welsh Government.

In 2021, Welsh Government launched the Electric Vehicle Charging Strategy for Wales (the Strategy), which sets out the vision for electric vehicle charging in Wales, outlining the current context, future charging needs, and how these can be met.

Welsh Government (WG) commissioned Arup to produce the three cases relevant to the deliverability of the Strategy to the Strategic Outline Business Case (SOBC) level, for the Electric Vehicle Charging Infrastructure (EVCI) Programme for Wales:

- **The commercial case** introduces key aspects of the charging market – including the EV charging value chain and a spectrum of potential business models. The case presents the results of a capability and capacity assessment of the public sector, capturing: existing and aspirational capability to deliver the Strategy, the roles to be played by different bodies in that delivery, barriers to strategy roll-out and interventions to overcome, and plans for engagement with the private sector.
- **The financial case** focuses on the total capital costs of the EV charging infrastructure roll-out required to meet future EV demand projections. The financial case presents a high-level estimate of the range of total capital cost of installing all on-route and destination charging infrastructure in Wales, agnostic of which body (whether public or private sector) is taking financial responsibility.
- **The management case** explores how the programme will be overseen, managed and delivered in the next phase, and subsequently. By defining and putting in the place the necessary management plans in place, such as programme management and risks management, this provides the reassurances the programme is achievable and that WG, Transport for Wales (TfW) and other delivery partners have the capacity to deliver the programme, which in this case, is the EV Charging Infrastructure for Wales Strategy.

The development of the three cases above are aligned with HM Treasury's Green Book and the Welsh Transport Appraisal Guidance (WelTAG).

Figure 1: Electric Vehicle Charging Infrastructure Strategy for Wales
Source: Welsh Government, 2021

Executive summary
The EV market today

Wales currently has fewer EVs, and fewer chargepoints than other parts of the UK

Wales currently has a relatively low level of EV uptake per capita, compared to other regions of the UK. Installed charging infrastructure is also low, especially for On-Route rapid and ultra-rapid charging, creating gaps in the minimum viable network of charging required for longer trips.

There are 1,310 public CPs installed in Wales, with eight battery electric vehicles (BEVs) or thirteen plug-in vehicles (BEVs, plug-in hybrids, other) per CP. 3.7% of public UK CPs are installed in Wales, where 2.2% of BEVs and 2.1% of all EVs are licensed.

Among UK regions, Wales ranks 10th in number of installed CPs, 2nd in CPs per licensed BEV, 3rd in CPs per licensed EV (BEVs and others), 6th in CPs per capita, and 10th in EVs per capita (out of 12 major UK regions). Lower levels of public changing infrastructure can have a dampening effect on EV uptake.

	# CPs	# BEVs /CP	# EVs /CP	# People /CP	# People /EV
Greater London	11,272	5	9	799	91
South East	4,606	24	40	2,001	50
Scotland	3,562	8	14	1,535	110
West Midlands	2,617	14	22	2,278	105
South West	2,438	30	46	2,321	50
East of England	2,303	17	35	2,722	77
North West	2,253	24	46	3,270	71
Yorkshire and the Humber	1,952	18	32	2,831	89
East Midlands	1,847	13	23	2,634	112
Wales	1,310	8	13	2,420	183
North East	1,069	8	12	2,508	203
Northern Ireland	352	17	29	5,385	184

KEY: Less infrastructure … More Infrastructure

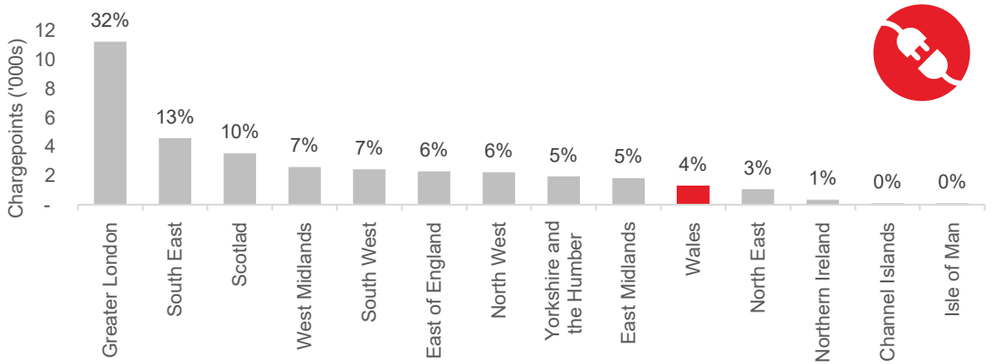

Figure 2: UK public chargepoints by region
Source: ZapMap August 2022

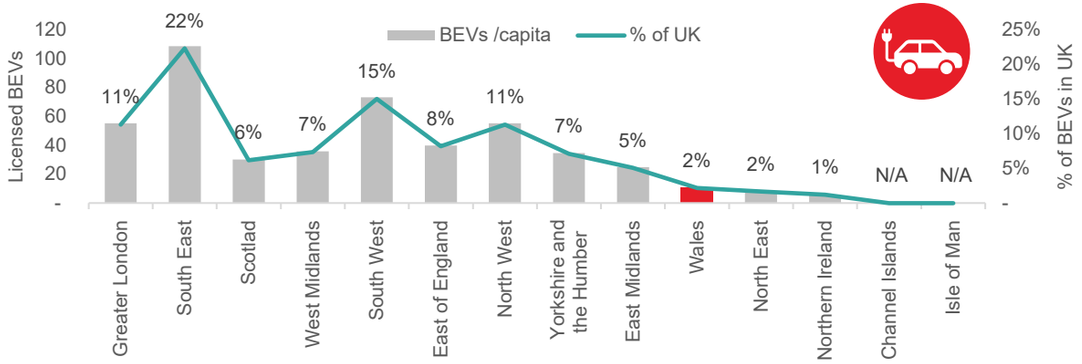

Figure 3: UK battery electric vehicles (BEVs) by region
Source: DfT, 2022

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Executive summary
The EV market: future development and challenges

The current pace of EV charging roll-out in Wales is too slow and government intervention is needed to achieve the aims of the Strategy

Based on Arup modelling, to fulfil demand, the projected number of fast chargers needed across Wales will reach around 34,000 chargers by 2030. As of August 2022, Wales currently has 1.2% of this total installed. Furthermore, around 4,000 rapid chargers are projected to be needed by 2030, with 1.7% of this total installed so far.

DfT statistics currently show the growth of the number of licensed EVs in Wales is outpacing the growth of publicly-available chargers by a factor of almost three. Between October 2019 and July 2022, the number of licensed EVs increased by 305%, yet the number of publicly-owned chargers increased by 125%.

Key strategy elements include encouraging transport decarbonisation, delivering at high standards, and equality of coverage and access.

Given the impending 2030 ban on new wholly diesel and petrol car sales, the pace of delivery will need to accelerate significantly if the WG is to deliver sufficient and equitable accessibility to a CP across Wales, as per the Strategy.

As such, continuing with current trends and levels of intervention is highly unlikely to be enough to deliver the charging infrastructure needed to meet current and future demand.

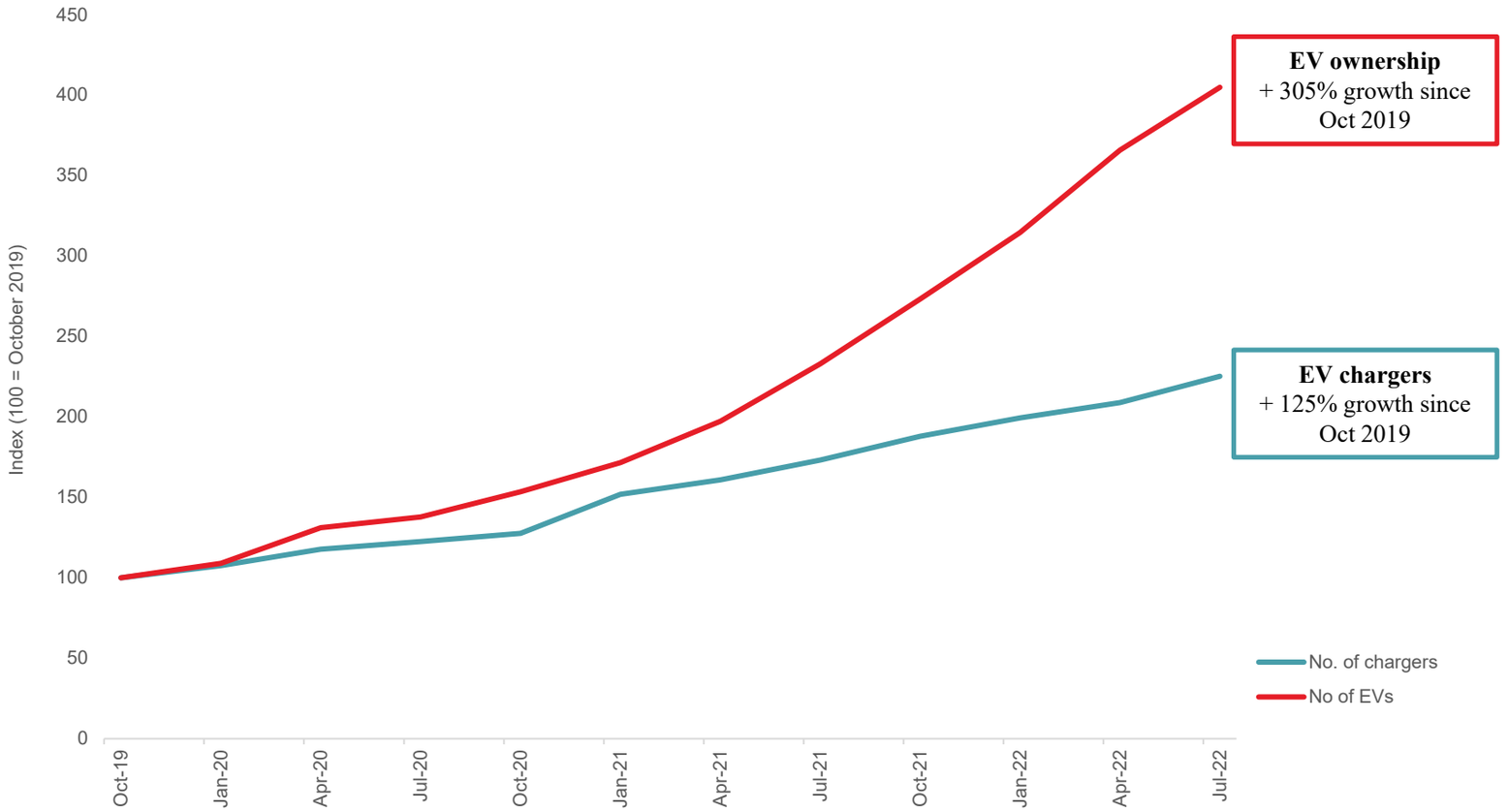

Figure 4: No. of EV chargers vs no. of licensed EVs in Wales (base index = 2019)
Source: DfT, as of October 2022

Key findings of the commercial, financial and management cases

Executive summary
Key findings of the Strategic Outline Business Case: commercial, financial and management cases

Commercial case [1/2]

Arup expects that the majority of charging will be delivered and funded by the private sector; however, where private sector roll-out would lead to opportunity gaps in the WG strategy, Arup recommends considering intervention through policy, selected subsidies, plans and developments. WG has a choice about the areas of the value chain in which to intervene, the role it will play and the funding or benefits funding it will provide – these should be considered on a case-by-case basis.

- Emerging recommendation
- Potential pathway
- Not recommended
- Not applicable

	Opportunity Type:	Key Take-Aways	Sites Developed on Private Land by Private CPOs	Sites Developed in PPP on Private Land	Sites Developed on Public Land by Private CPOs	Sites Developed in PPP on Public Land	Sites Developed on Public Land by Public Sector
*	Policy Intervention	The Welsh Government's main role across all opportunities lies in policy-based interventions that remove barriers, promote decarbonisation, and incentivise investment. These policy interventions can support both the private sector and other public sector bodies.	🟢	🟢	🟢	🟢	🟢
A	Subsidy / auction / franchise	Out of all Welsh public sector bodies, the Welsh Government has the most capacity – skill and resource – to financially intervene. This should be considered on a case-by case basis, with specific and targeted beneficiaries, with a special focus on closing equality gaps.	*Consider on a case-by-case basis where equality gaps emerge – all financial intervention should be targeted (specific sites, capex types, or areas) and balanced against other public needs.*			*Access to grants can help Local Authorities capture local opportunities.*	
A	Plan and lease / licence	On publicly-owned land that is well suited to EV charging, public sector delivery entities (TfW and Local Authorities) could plan sites and lease them out to private CPOs. The public sector could also offer planning support to private investors to help de-risk and incentivise.	*Planning support can be offered by the public sector to help de-risk private investment*		🟢	🟢	⚫
A	Develop and lease / licence	On publicly-owned land that is well suited to EV charging, public sector delivery entities (TfW and Local Authorities) could plan sites and develop sites, then lease them out to private CPOs. This option is more capital intensive, with not much public sector capability.	🔴	🔴	🟡	🟡	⚫
B	Low-control JV	In a low-control JV, public sector delivery entities could have a degree of control over charging outcomes at the site, without taking on the full investment risk (however, still facing demand risk). Operations should largely be outsourced to private CPOs.	🔴	🟡	⚫	🟢	⚫
B	High-control JV	In a high-control JV, a private sector partner would likely expect significant public sector investment, and the public sector would face demand risk. Operations should largely be outsourced to private CPOs, but the public sector could offer support (e.g., user experience).	🔴	🔴	⚫	🟡	⚫
C	Own and appoint operator	The private sector could retain full ownership of a charging site on suitable public land and outsourcing site operations to a private sector CPO. This would require significant capital investment and full exposure to demand risk.	🔴	🔴	⚫	🟡	🟢
C	Own and operate	Arup does not recommend this option to be deployed on a wide-scale basis, as it is in conflict with the Welsh Government's low appetite for operational risk. Select opportunities – especially in the On-Route network could be owned and operated by TfW.	🔴	🔴	⚫	🔴	🟡

Executive summary
Key findings of the Strategic Outline Business Case: commercial, financial and management cases

Commercial case [2/2]

Next steps should include socialising the EV charging strategy, engaging with the private sector and tailoring the approach to intervention.

Capability of the public sector

Public sector capability is strongest in planning, finance, power supply, and contract management activities. Significant gaps exist in public sector site design, CP installation and civils, operation, and maintenance capability.

Next Steps:

1. Roles across the Public Sector

Roles of the public sector should include:

- **Welsh Government** – oversight and socialisation of the EV charging strategy, setting standards, monitoring strategy progress, policy intervention, and financial intervention.
- **Transport for Wales** – delivering and monitoring the strategy at On-Route sites and rail station car parks, and providing delivery support to LAs and Welsh Government.
- **Local Authorities** – delivering and monitoring the strategy locally, at destinations and on-street, with support from TfW.

2. Engagement with the private sector

To understand the size and scope required public sector intervention, further engagement with the private sector is required. How much infrastructure will the public sector roll out? Where will this be located and who will it serve?

3. Prioritisation of Delivery

Arup recommends that two elements of the delivery strategy be prioritised first (before moving on to others): the **on-route network** and **destination /on-street charging in built-up areas**. These elements will have the most short-term benefit for users in Wales, providing a strong cross-national network and catering to users who have a greater need for public charging.

4. Approach to Intervention

There is no “one size fits all” business model or approach to public sector intervention. Different locations, modes, and sites will require different amounts and types of intervention. The table opposite outlines key take-aways from Arup’s emerging recommendations around business models to be employed on a targeted basis. Arup recommends that procurement take into account steps to mitigate identified barriers to strategy implementation – including flexible procurement, and larger opportunities and longer contractual terms that reflect the appetite of the private sector.

Executive summary
Key findings of the Strategic Outline Business Case: commercial, financial and management cases

Financial case

The financial case suggests a total capex cost of between £351 to £1,550m for On-Route and Destination charging by 2040. This analysis is agnostic of which body is taking financial responsibility.

Financial case modelling

The financial case presents a high-level estimate of the cost of installing all On-Route and Destination charging infrastructure in Wales, agnostic of what body is taking financial responsibility. The case includes on On-Route and Destination charging only. Capital costs include grid connection and substation costs, equipment supply and installation, planning, and civils. The range of results is wide because of uncertainties inherent to the development of the EV charging market – in terms of EV uptake, total demand, user behaviour, and both location and speed of charging

From the minimum to maximum range across all scenarios and sensitivities, capex reaches **£351 to 1,550 million by 2040**, with no growth after that point, with £114 to 689 million spent on On-Route charging and £236 to 861 million on Destination charging. By this point On-Route chargepoints number 1.1 to 6.5 thousand and Destination 6.4 to 61.8 thousand, with a total of **7.4 to 68.4 thousand**. Charging capacity reaches 141 to 1,165 MW, spread across 968 to 23,500 sites.

Legend:

- Central case results
- Range of min to max results (sensitivities applied to *Central Case* demand)
- Range of min to max results (sensitivities applied to all demand scenarios)

Next Steps

We recommend the following next steps:

1. **Refine the range of results:** consider location-specific costs, like grid connection; excluded costs, like land and opex; and evaluate LSOA-level demand and indicative costs.
2. **Engage with the private sector to understand plans:** form a view of private sector roll-out that will happen without intervention to identify gaps; collaborate with the private sector to align investment to the preferred network.
3. **Determine the phasing of roll-out:** prioritise intervention in the on-route network and public local charging in built up areas; evaluate the effects of roll-out phasing on public and private financial investment into public charging.
4. **Determine the size & scope of the funding envelope:** once the range of results, private sector engagement, and phasing have been considered, determine the size of the government funding envelope – how much is the public sector willing to invest? What non-financial actions could be taken to reduce the need for financial intervention? In what aspects of the public charging value chain is the government willing to invest?
5. **Explore options for financing:** once the public funding envelope has been determined, explore the means for financing and detailed commercial approach – this might include bundling sites and using Financial Transaction Reserve.

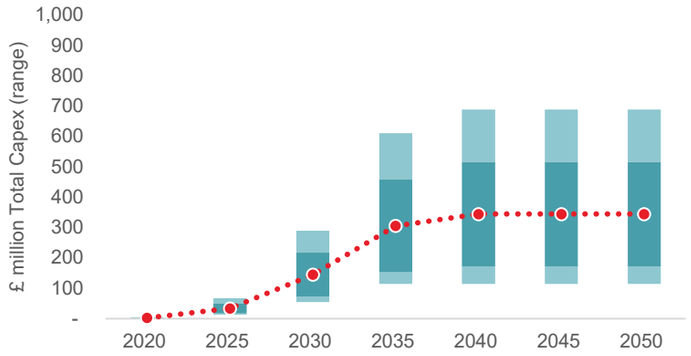

Figure 5: Total capex (£ million , range of results): on-route

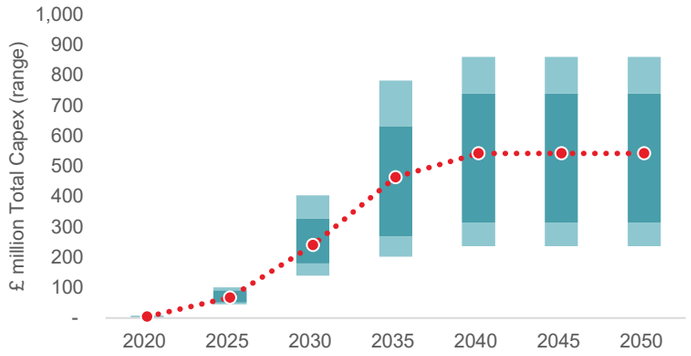

Figure 6: Total capex (£ million , range of results): destination

Executive summary
Key findings of the Strategic Outline Business Case: commercial, financial and management cases

Management case

The management case outlines the key considerations when delivering and managing the programme of interventions needed to facilitate and deliver the preferred network.

The scale and complexity of delivering the EVCI programme necessitates a strong and effective management structure which determines how WG and delivery partners will deliver and manage the EVCI programme. This is a significant step-up from the WG resources that are devoted today. Key findings includes:

- The **need for a PMO** to manage and deliver the EVCI programme is imperative to delivering the preferred network in line with policy objectives. Furthermore, portfolios and projects will need to be identified - Figure 7 sets out an illustrative example of a proposed EVCI portfolio structure.
- **Governance arrangements needs to be in place** to oversee and be clear on accountability for the programme, An assurance framework will need to be created to provide independent assurance that the programme is meeting the intended outcomes, and that programme risks and control issues are managed effectively.
- **Monitoring and Evaluation** is critical in understanding the progress of the EV charging roll-out, and whether policy objectives and KPIs are met.
- A programme **risk register and management plan** needs to be developed within the next six months, identifying key risks as early as possible and identify mitigation measures, minimising disruptive impact on the programme.
- A **communications and stakeholder engagement plan** should be developed jointly by WG and TfW, ensuring engagement and messaging is streamlined with the private sector and the public, avoiding duplication of efforts between different parties, as well as raising public awareness of progress and EV charging infrastructure in Wales.

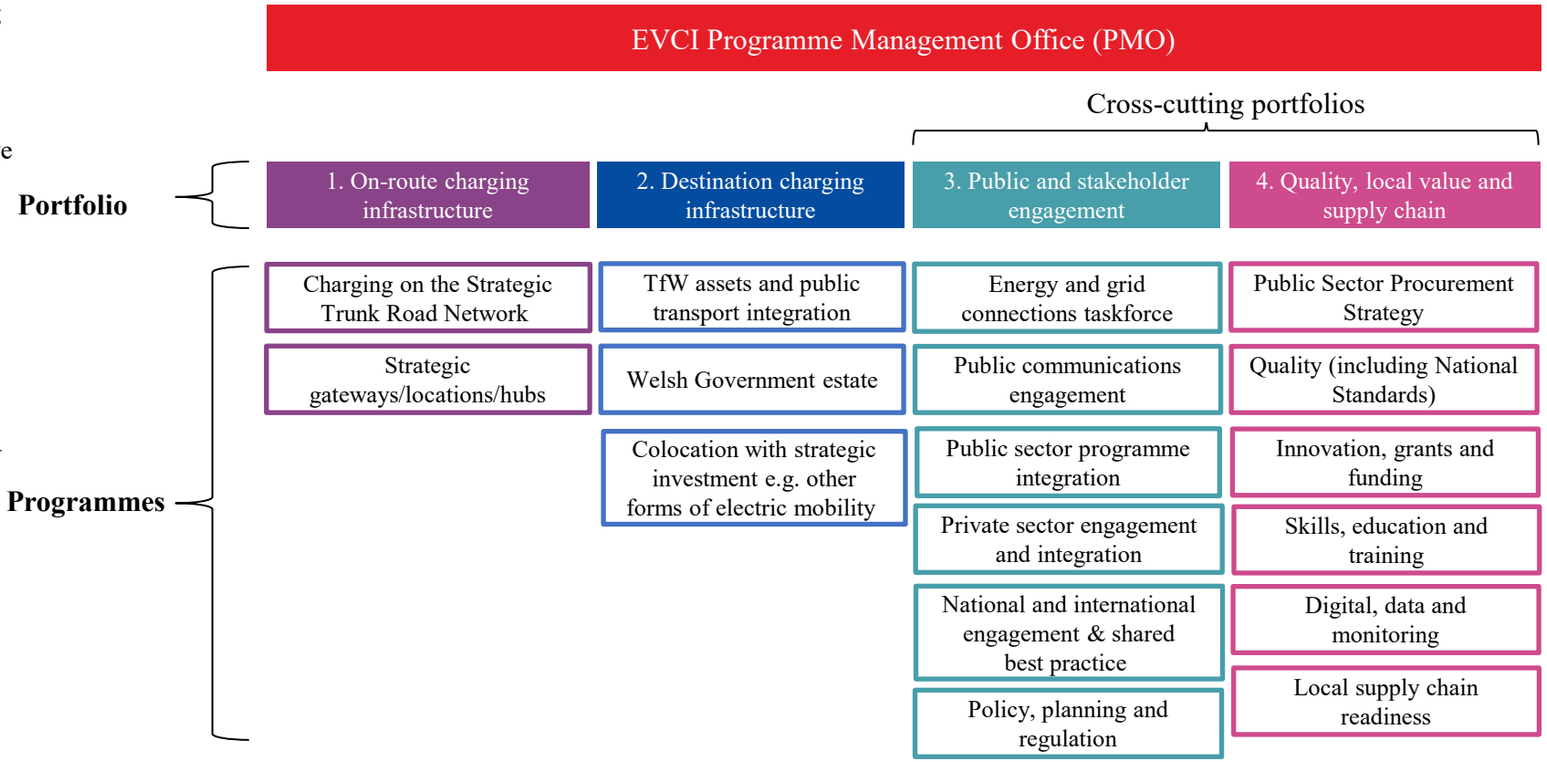

Figure 7: Illustrative example of the proposed EVCI portfolio structure

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Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

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Executive summary
Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

Next steps: priorities for Welsh Government and delivery partners

The findings of this report suggests that more work and development is needed to implement the EVCI programme in the next phase, harnessing the work done to date (e.g. National Standards, early market engagement). To achieve this, a programme-level roadmap has been developed, setting out actions across five key priorities for WG and delivery partners for the next 3-5 years, to deliver successful acceleration of EV charging infrastructure across Wales, and meet the defined KPIs set by the Strategy. The roles and responsibility of WG, TfW, local authorities and the private sector are summarised on the right.

Roadmap: 5 key priorities

1. Establish a PMO to govern delivery arrangements, set standards and monitor progress

2. Provide support and guidance to enable local authorities (and private sector) to deliver the preferred network

3. Engagement with the private sector to ensure we optimise the delivery of the preferred network and foster public-private sector collaboration

4. Develop the mechanisms, knowledge and tools to deliver the preferred network

5. Leverage the resource and mechanisms necessary to rapidly deliver the network in line with policy objectives

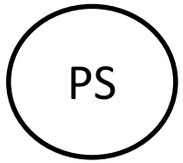
Role and responsibility

Delivering the preferred network within the required timescales will depend on the joint effort of the public and private sector, with the following key players:

Welsh Government – Strategic Oversight and Policy
Oversight of the EV Charging Infrastructure Strategy, setting standards, monitoring strategy progress, policy intervention and financial intervention.

Transport for Wales– Delivery Partner
Delivery and monitoring the strategy at the on-route network, providing delivery support to local authorities and Welsh Government.

Local Authorities – Delivery Partner
Delivery and monitoring the strategy locally, at destinations and on-street sites, with support from Transport for Wales.



Private Sector– Delivery of the Preferred Network
The private sector will largely install and operate the preferred network, public sector intervention is targeted where market failure has been identified (e.g. TfW delivering charge-points at commercially unviable on-route sites).

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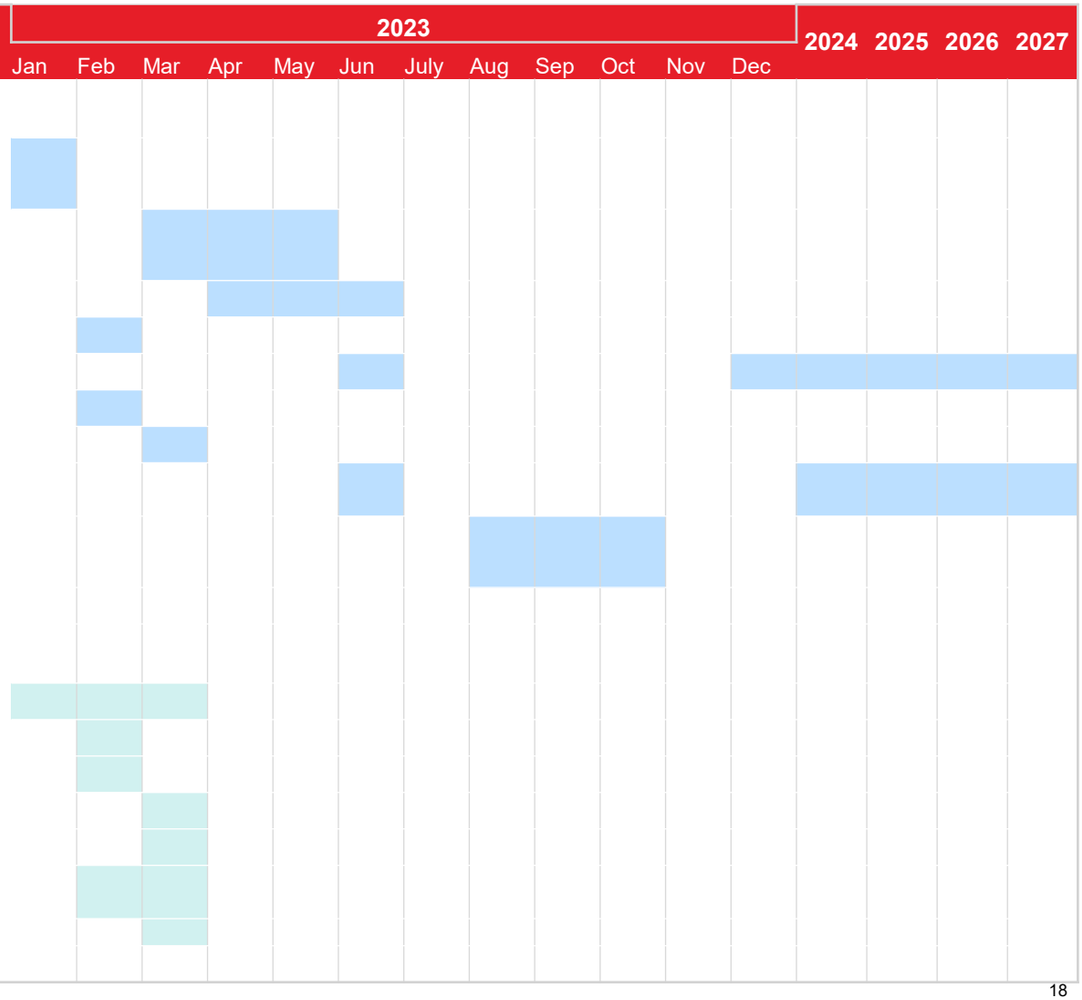
Executive summary

Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

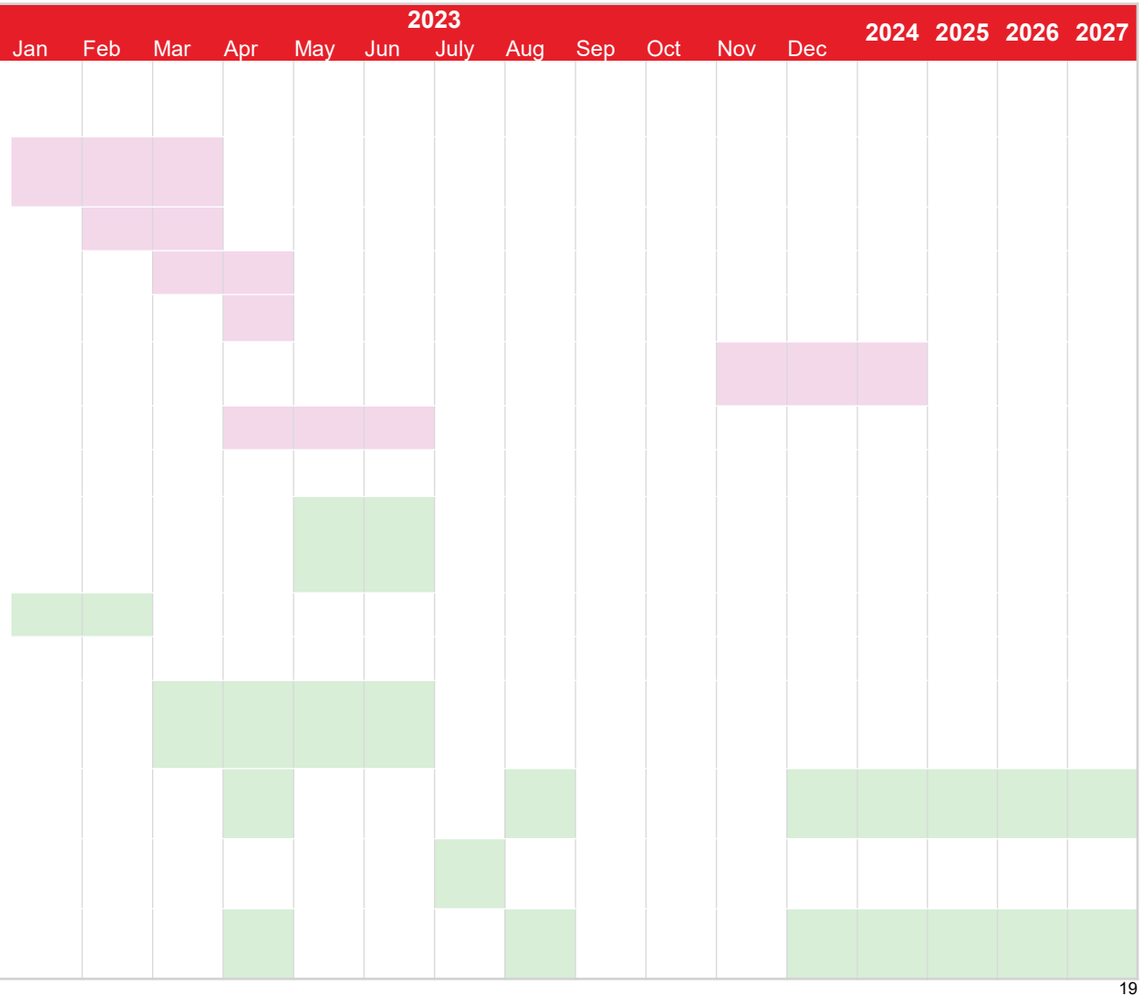
Tasks		Lead
1.	**Establish a PMO to govern delivery arrangements, set standards and monitor progress**	
1.1	Workshop to review all work done to date and identify key gaps and immediate next steps - what further consultancy support does WG need for policy strategy development?	WG, TfW
1.2	Establishment of a governance structure, including establishing a Transport Decarbonisation Governance framework which incorporates EV Charging Delivery.	WG
1.3	Set-up a Programme Management Office (PMO), with identified roles and responsibilities	TfW, WG
1.4	Develop a Performance management and accountability framework for WG/TfW delivery.	WG
1.5	Develop and regularly review and update the phased programme of interventions	TfW
1.6	Develop a programme-level risk register and management plan	TfW
1.7	Develop a communications and stakeholder engagement plan	WG, TfW
1.8	Review and revise the target number of CPs needed across Wales, as future demand projections evolve	TfW
1.9	Determine the funding requirement (budget) for the next 3-5 years - revisit and refine the range of cost results and identify funding sources by the public and private sector	WG
2.	**Providing support and guidance to enable local authorities (and private sector) to deliver the preferred network**	
2.1	Determine the scale of immediate funding and support local authorities require	WG, TfW
2.2	Publish National Standards	WG
2.3	Build on the capability exercise and continue to identify capacity and capability gaps	TfW
2.4	Develop a support function for local authorities	TfW
2.5	Facilitate funding for local authorities via ULEV	WG
2.6	Ensure all LAs have EV Charging strategy and ensure they are clear on roles for WG, TfW, Private sector and what we want from them.	WG
2.7	Engagement with CADW and National Trust to support delivery of CPs at heritage and tourist sites	WG



Executive summary

Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

Tasks		Lead
3.	**Engagement with the private sector to ensure we optimise the delivery of the preferred network and foster public-private sector collaboration**	
3.1	Market engagement with CPOs to understand the private sector's plans and priorities for future investment	TfW
3.2	Establish a cross interest public and private CP Task & Finish Group	WG
3.3	Develop engagement and comms capability with Private Sector.	TfW
3.4	Set target for PS delivery, and identify required public sector intervention to complement PS delivery	TfW
3.5	Create open access to Datamap Wales to allow private sector to utilise data for infrastructure roll-out	WG
3.6	Undertake a supply chain and opportunities review	WG
4.	**Developing the mechanisms, knowledge and tools to deliver the preferred network**	
4.1	WG to review and establish policy levers and remove barriers to EVCI installation and operations. This includes review of regulations to support the provision of home and workplace charging in new builds and refurbishments	WG
4.2	Develop funding and financing options, including FTR options	WG
4.3	Establish Commercial Procurement Framework - design and delivery	WG
4.4	Explore alternative procurement solutions, such as procuring a consortium of private sector partners to deliver the preferred network over the next 2-5 years. This could be structured as a Challenge Fund.	WG
4.5	Future proofing the grid network - regular engagement with DNOs to ensure current infrastructure can serve the preferred network	TfW
4.6	Develop and implement communications campaign (target audience: end users, the public), linked to Behaviour Change work, to raise awareness of EVs and CP rollout.	WG
4.7	Identify locations suitable for renewable generation and energy storage, assisting power provision for the charging network	WG



Executive summary

Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

Tasks		Lead	2023												2024	2025	2026	2027
			Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec				
5.	**Leverage the resource and mechanisms necessary to rapidly deliver the network in line with policy objectives**																	
5.1	Delivery of the on-route network, with TfW supporting where required (e.g. providing planning support and coordination or delivering CPs in commercially unviable sites)	Private Sector, TfW																
5.2	Delivery of destination and on-street charging in built-up areas, with local authorities supporting where required	Private sector, LAs																
5.3	Monitor progress of the EV charging infrastructure roll-out	WG																
5.4	Knowledge sharing and applying lessons learnt through regular public-private group engagement	WG, TfW																

1. Introduction

1. Introduction

1.1 Background

1.1.1 EV Charging Infrastructure Strategy for Wales

In 2021, Welsh Government launched the Electric Vehicle Charging Strategy for Wales (the Strategy), which sets out the vision for electric vehicle charging in Wales, outlining the current context, future charging needs, and how these can be met. The Strategy is accompanied by an Action Plan to track and manage delivery.

The Strategy represents the first step for Wales to take targeted action to deliver a vision for electric vehicle (EV) charging that meets the country's unique requirements. The strategy covers the period until 2030, and sets the vision for 2025, recognising the urgency of taking action now, particularly in response to recent legislation including the ban on sale of petrol and diesel cars and vans by the end of the decade. The Strategy's accompanying action plan commits the WG to nine actions:

1. Delivery of charging infrastructure through funding and collaboration
2. Optimisation of energy provision
3. Enhance rapid charging on the strategic trunk road network
4. Develop a Welsh Quality Standard for charging
5. Facilitating infrastructure delivery
6. Partnership and collaboration
7. Increase awareness of the needs of transport decarbonisation
8. Encourage investment and innovation
9. Maximise synergies between different charging needs

This document begins to explore the key considerations when implementing the above actions, whilst embedding the Five Ways of Working of the Well-being of Future Generations Act.

Figure 8: Electric Vehicle Charging Strategy for Wales
Source: Welsh Government, 2020

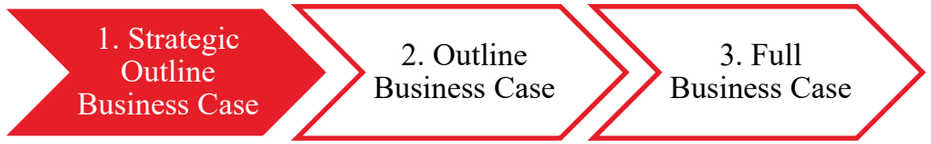
1. Introduction
1.1 Background

1.1.2 Purpose of this document

Arup was commissioned by Welsh Government (WG) to develop the Financial, Commercial and Management cases (the Deliverability cases) of the Strategic Outline Business Case (SOBC) for the Strategy. The purpose of this document is to enable WG and delivery partners including Transport for Wales (TfW) to employ effectively the tools and information already developed to create an effective programme of interventions to accelerate EV charging infrastructure roll-out in Wales.
This report is produced to the Strategic Outline Business case (SOBC) level, the scoping stage. At this stage the costs and affordability figures are indicative only.

1.1.2 Approach

The deliverability cases for the Strategy has been developed to SOBC stage.



This report has been written in accordance with Welsh Transport Appraisal Guidance (WelTAG) and HM Treasury's Green Book. This report focuses on the financial, commercial and management cases.

- **The commercial case** introduces key aspects of the charging market – including the EV charging value chain and a spectrum of potential business models. The case presents the results of a capability and capacity assessment of the public sector, capturing: existing and aspirational capability to deliver the Strategy, the roles to be played by different bodies in that delivery, barriers to strategy roll-out and interventions to overcome, and plans for engagement with the private sector.
- **The financial case** focuses on the total capital costs of the EV charging infrastructure roll-out required to meet future EV demand projections. The financial case presents a high-level estimate of the range of total capital cost of installing all on-route and destination charging infrastructure in Wales, agnostic of what body (the balance between public or the private sector) is taking financial responsibility.
- **The management case** explores how the programme will be overseen, managed and delivered. By defining and putting in place the necessary plans, such as programme management and risks management, this provides the reassurances the programme is achievable and that WG, TfW and other delivery partners have the capacity to deliver the programme.

Before delving into each of the three cases set out above, the next section summarises the need for government intervention in accelerating EV charging infrastructure roll-out, and subsequently driving the need to start developing a plan to deliver the Strategy.

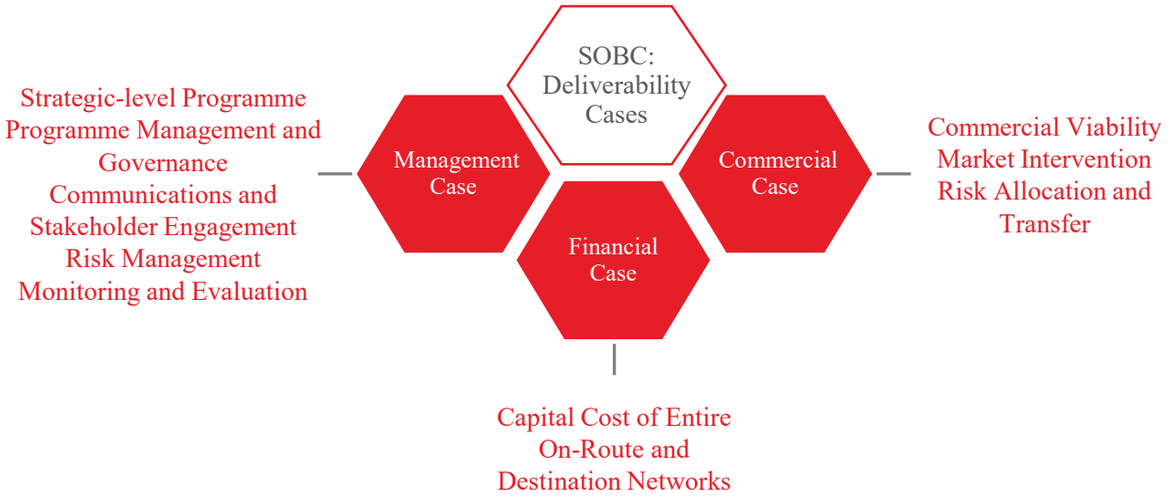


Figure 9: Deliverability cases model
Source: HM Treasury 2018

2. Strategic context

2.1 The EV market

2. Strategic context
2.1 The EV market

2.1.1 Market size and growth: UK charging market

The UK EV charging market has grown significantly over the past decade, with increasing demand from changes in consumer behaviour and policy decisions around the banning of ICE vehicles. Several large CPOs dominate the market, but significant further investment is expected.

The UK EV charging market is undergoing substantial growth. Installed UK public chargepoints (CPs) have increased at a cumulative average growth rate of 31% from 6,500 in 2016 to 33,300 in 2022, YTD.

CPs are rated to the speed of charging they provide. They can have multiple AC and/or DC connectors to accommodate vehicle requirements; e.g., a rapid CP might have two 50kW DC connectors and one 43kW AC connector.

The vast majority of public charging infrastructure currently provides slow and fast charging (rated at 3-22kW). However, growth in rapid and ultra-rapid CPs (36%) outpaces both the total market and slow / fast (30%).

Large participants present in the UK EV charging market include vehicle Original Equipment Manufacturers (OEM), chargepoint OEMs, utilities, oil majors, and CP operators (CPOs), often with any of these players operating as CPOs.

The largest CPO by market share is presently Ubitricity (owned by Shell), with 16% of installed UK public CPs, followed by PodPoint (13%, owned by EDF energy), and bp pulse (8%). Two thirds of UK public CPs are operated by 12 largest CPOs.

There are regional variations in the market, for example, ChargePlace Scotland does not operate in Wales or most of England. CPOs also specialise by charging type, location, and speed; e.g., PodPoint is the second largest network in the UK, but offers significantly less rapid charging than smaller CPOs, and no ultra-rapid charging.

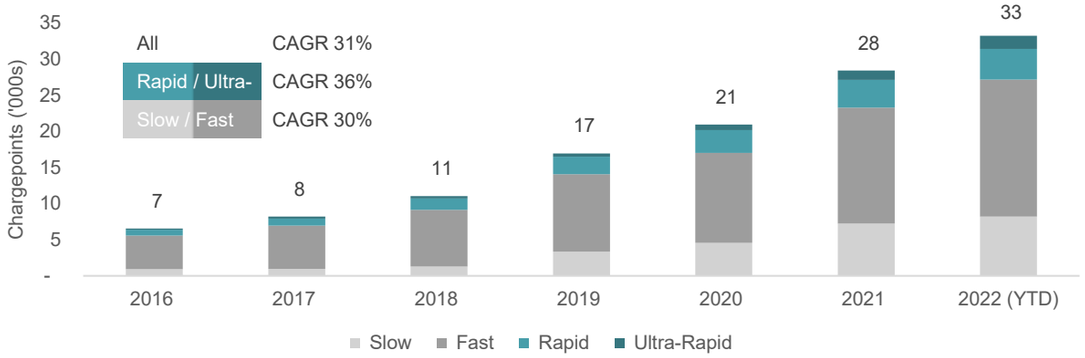


Figure 10: UK public chargepoints by rating
Source: ZapMap August 2022

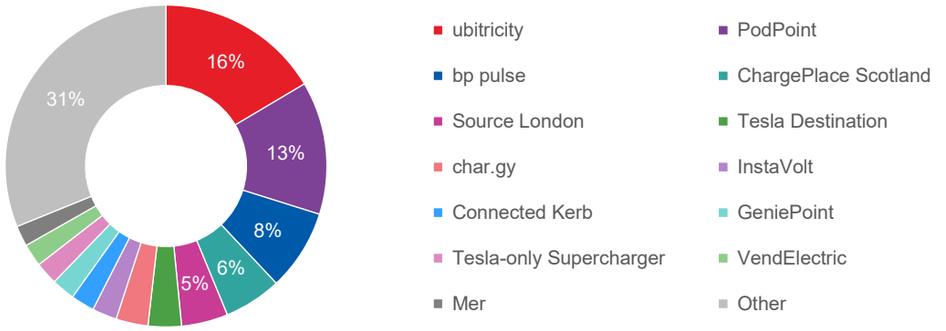


Figure 11: UK public charging networks by market share
Source: ZapMap September 2022

2. Strategic context
2.1 The EV market

2.1.2 Market size and growth: Welsh charging market

Wales has a relatively low level of EV uptake per capita, compared to other regions of the UK. Installed charging infrastructure is also low, especially for On-Route rapid and ultra-rapid charging, creating gaps in the minimum viable network of charging required for longer trips.

There are 1,310 public CPs installed in Wales, with eight battery electric vehicles (BEVs) or thirteen plug-in vehicles (BEVs, plug-in hybrids, other) per CP. 3.7% of public UK CPs are installed in Wales, where 2.2% of BEVs and 2.1% of all EVs are licensed.

Among UK regions, Wales ranks 10th in number of installed CPs, 2nd in CPs per licensed BEV, 3rd in CPs per licensed EV (BEVs and others), 6th in CPs per capita, and 10th in EVs per capita. Lower levels of public changing infrastructure can have a dampening effect on EV uptake.

	# CPs	# BEVs /CP	# EVs /CP	# People /CP	# People /EV
Greater London	11,272	5	9	799	91
South East	4,606	24	40	2,001	50
Scotland	3,562	8	14	1,535	110
West Midlands	2,617	14	22	2,278	105
South West	2,438	30	46	2,321	50
East of England	2,303	17	35	2,722	77
North West	2,253	24	46	3,270	71
Yorkshire and the Humber	1,952	18	32	2,831	89
East Midlands	1,847	13	23	2,634	112
Wales	1,310	8	13	2,420	183
North East	1,069	8	12	2,508	203
Northern Ireland	352	17	29	5,385	184

KEY: Less infrastructure … More Infrastructure

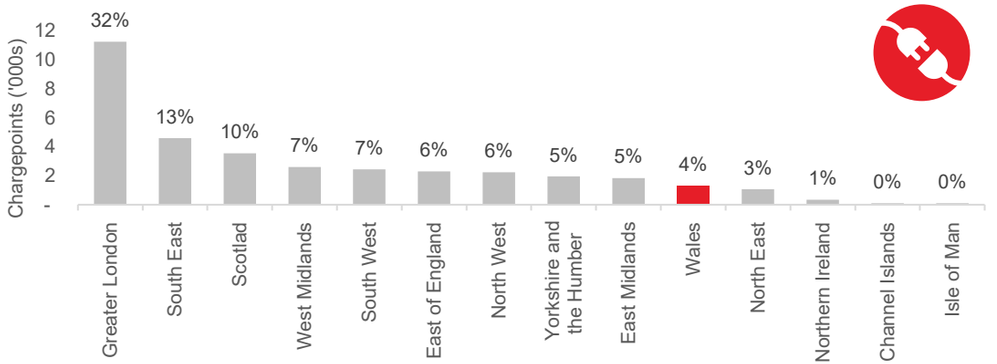


Figure 12: UK public chargepoints by region
Source: ZapMap August 2022

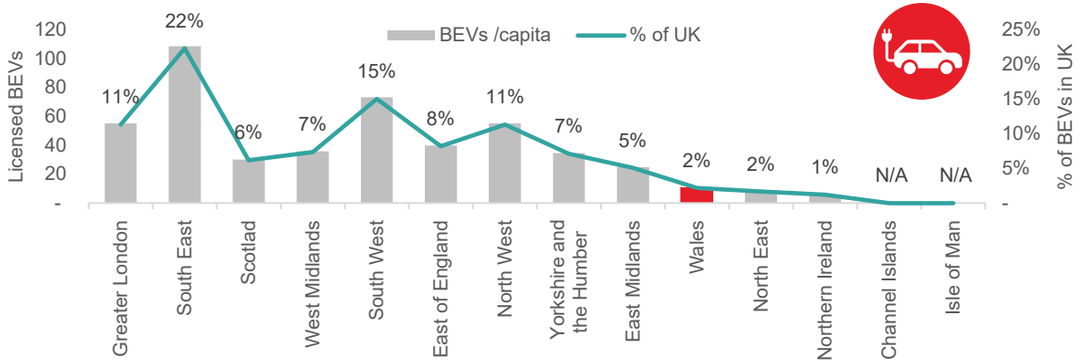


Figure 13: UK battery electric vehicles (BEVs) by region
Source: DfT, 2022

2. Strategic Context
2.2 The EV market

2.1.3 Market size and growth: future development

Although the number of installed CPs is still lower in Wales than in other UK regions, CPs have grown by 84% over the past two years. Significant further provision will be required to meet projected levels of EV uptake and demand, especially after the ICE ban and into the 2030s.

Since the Welsh Government published its Electric Vehicle Charging Strategy in March 2021, the installed charging infrastructure in Wales has already increased from 21 CPs per 100,000 capita (data in the Strategy is from June 2020) to 39 CPs per 100,000 capita – a change of around 666 CPs in June 2020 to 1,222 CPs in September 2022, or around 84% growth.

Further development is required for charging infrastructure to meet projected levels of EV uptake. The phase out of diesel and petrol vehicles will accelerate demand for EV charging infrastructure as these vehicles are banned from sale from 2030.

Current levels of EV uptake sit at approximately 2.1% of all vehicles registered and 2.4% of cars registered in the United Kingdom, as of the end of Q1 2022. EV uptake would be expected to be higher in areas with better access to charging infrastructure.

Published projections of charging demand range widely in pace of uptake and user behaviour around location and speed of charging.

As EV uptake increases, charging behaviour could further increase the need for public infrastructure. In 2018, 93% of EV owners had access to off-street parking – for the broader UK population this figure is around 67%, and lower in urban areas.

As EV uptake increases the proportion of EV owners with off-street parking is projected to decrease to meet the national average, while still maintaining variation between user types and regions. Because of lack of access to off-street parking and charging, this creates a shift in charging demand from the home, where charging is least expensive, to public infrastructure.

Note:

FES ST – *System Transformation*

FES CT – *Consumer Transformation*

FES LW – *Leading the Way*

FES SP – *Steady Progression*

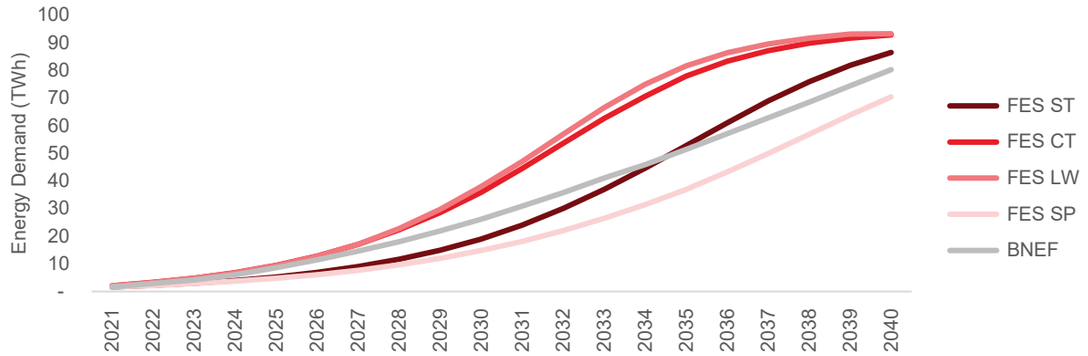


Figure 14: Projected EV charging energy demand: cars, vans, motorbikes
Sources: National Grid Future Energy Scenarios (FES) 2021 and BloombergNEF (BNEF) 2022

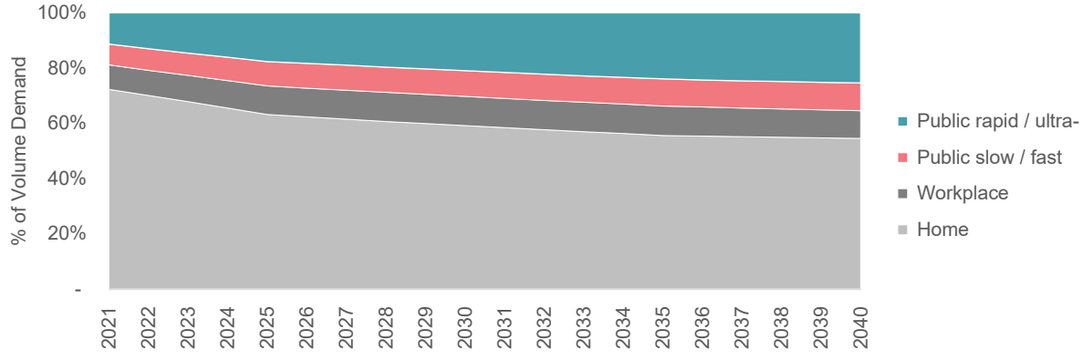


Figure 15: Projected UK EV charging demand (% of watt volume demand) by speed and location
Source: BloombergNEF (BNEF) 2022

2.2 The case for intervention

2. Strategic context
2.2 The case for intervention

2.2.1 Overview

Access to reliable EV charging infrastructure will bring benefits to consumers, businesses and wider society, from enabling EV adoption, ability to charge at a variety of locations, and potentially lower running costs. Although the private sector is taking the commercial opportunities to expand the provision of EV charging infrastructure, government intervention is needed in order to deliver a network of EV charging that enables consumers to confidently switch from combustion to Evs, quickly. This section summarises the key arguments for government intervention, and why the potential of the EV charging market cannot be maximised without government intervention:

- **Welsh Government's duty to act:** recent policy and strategic objectives set by the UK and Welsh Government, including achieving net zero by 2050 and sales of new diesel and petrol cars by 2030 incentivises WG to act where necessary.
- **Staying ahead of the EV demand curve**: EV car ownership growth is currently outstripping the growth of public EV chargepoints. Not acting to accelerate the roll-out of EV charging infrastructure risks reputational damage, particularly as Wales is at risk of also falling behind other countries in the pace of roll-out.
- **Enabling EV transition for all:** the Wellbeing of Future Generations Act (2015) mandates WG to ensure equitable access to EV charging infrastructure.
- **Re-imagining a decarbonised transport**: EV charging infrastructure presents a crucial opportunity in how we can transform the way people travel as we transition towards decarbonisation.

2.2.2 Welsh Government's duty to act

In 2019, WG declared a climate change emergency, recognising the pressing need to act and address the threat of climate change has to Wales' health, economy, infrastructure and the natural environment. WG identified that if Wales is to achieve Net Zero by 2050, the target set by the UK Government, the country would need to reimagine the way it moves around, and look towards transitioning to a decarbonised transport system. To achieve this, Wales will need to meet a 63% reduction by 2030 and 89% reduction by 2040 (WG, 2021c). Since the climate change emergency declaration, a number of policies and legislation have been introduced by the government to help this transition. To support this, there are plans to invest in public transport and active travel, to deliver an integrated, sustainable transport network in Wales. For private cars, the policies include the UK ban on sales of new wholly petrol and diesels by 2030, and by 2035, all new cars and vans will have to have zero emissions at the tailpipe. As such, facilitating the deployment of EVs is a key way of fulfilling the transport needs of Wales' businesses, residents and visitors, while tackling air pollution and reducing carbon emissions.

2. Strategic context
2.2 The case for intervention

2.2.3 The current pace of roll-out is too slow

Based on Arup modelling, the projected number of fast chargers needed across Wales reaches around 34,000 chargers by 2030. As of August 2022, Wales currently has l.2% of this total installed. Furthermore, around 4,000 rapid chargers are projected by 2030, with 1.7% of this total installed so far. The anticipated rapid growth in EVs means Wales cannot afford to wait until EV demand has matured to incentivise higher roll-out of EV charging infrastructure; it's critical we have the infrastructure in place before we reach critical mass of EVs.

DfT statistics currently show the growth of the number of licensed EVs in Wales is vastly outpacing the growth of publicly-available chargers, as shown in Figure 17. Between October 2019 and July 2022, the number of licensed EVs have increased by 305%, yet the number of publicly-owned chargers have increased by 125%. Hypothetically (note this is not the forecasted demand growth, but illustrative example), if the current growth rate in charger provision (31% per annum) is maintained until 2030, approximately 12,500 EV chargers will be provided, significantly less than the 34,000 fast chargers and 4,000 rapid chargers required.

As such, continuing with current trends and levels of intervention is unlikely to be enough to deliver the charging infrastructure needed to meet current and future demand.

Sites deemed commercially unviable, particularly in rural areas with a lower catchment area, may not benefit from private investment without government intervention. Given the impending 2030 ban on new wholly diesel and petrol car sales, the pace of delivery will need to accelerate if we are to deliver sufficient accessibility to a CP across Wales.

Government intervention in countries such as Norway and Scotland has successfully demonstrated effective acceleration in EV charging infrastructure roll-out, including Oslo City Council's EV Charging Infrastructure Programme, and project PACE. Further information on these case studies on can be found on the next page (pg. 32).

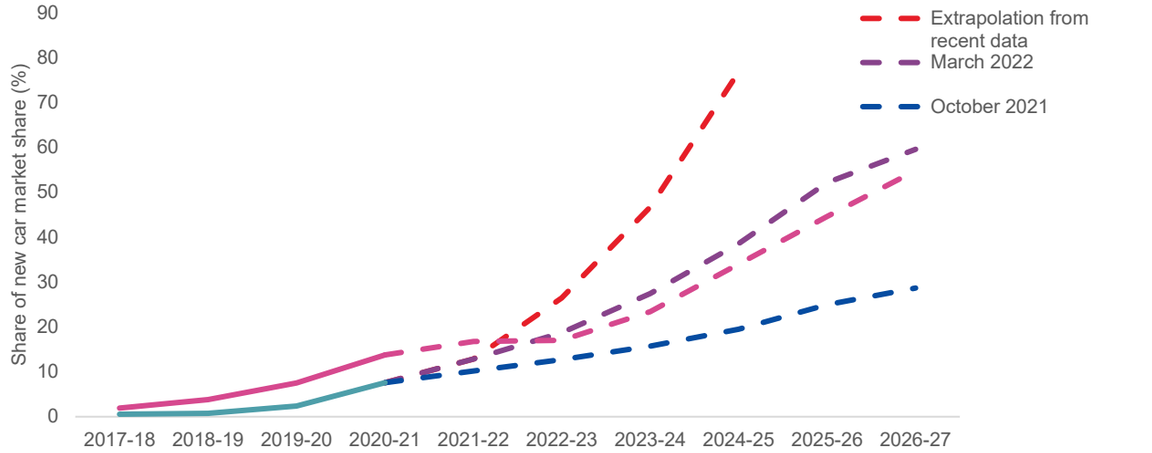


Figure 16: UK Electric vehicle new car market share, 2017/18 to 2026/27
Source: Office for Budget Responsibility, 2022

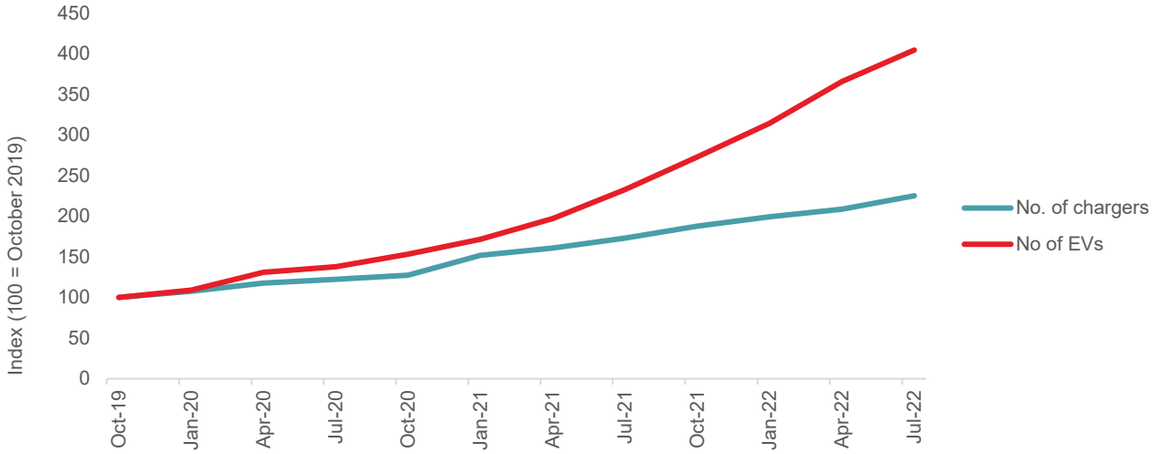


Figure 17: Comparison of the number of EV chargers vs number of licensed EVs in Wales (base index = October 2019)
Source: DfT, 2022

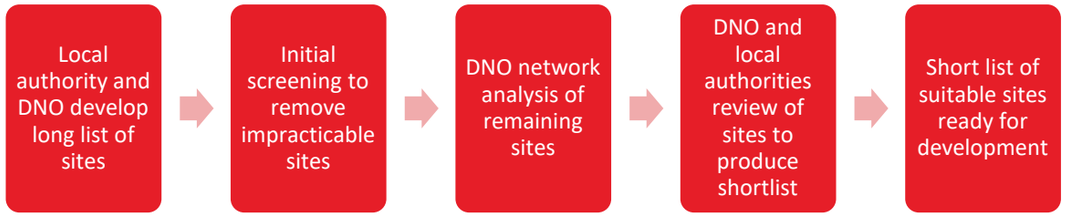
2. Strategic context
2.2 The case for intervention

Case study: Oslo, Norway

Year: 2008-ongoing
Responsible authority: City of Oslo, Agency for Urban Environment
Objectives: installation of a network of public charging points for EVs to encourage citizens to use this kind of vehicle and reduce GHG emissions, improve air quality, reduce noise etc.
The intervention: the City Council created an incentive to increase the number of private charging points by expanding the existing Climate and Energy Fund to support private charging points to be installed in shopping centres, apartment building and other public spaces. Furthermore, other interventions included tax incentives (e.g. no VAT on EVs), access to bus and taxi lanes, free parking, and free pass on toll roads. The charging stations were funded up to 60% (maximum 1,200 EUR per charging point).
Output: the city council achieved their original target of establishing 400 charging points between 2008-2011. They expanded this target by establishing an additional 100 new charging points in 2012, and a further 900 in total by 2014. Based on the maximum subsidy per charging point, up to 708,000 EUR may have been contributed by the public sector.
Outcomes/Impact: since the programme started in 2008, the number of registered EVs in Oslo increased from 2,000 in 2012 to 6,000 by May 2014. There has also been a 100% increase in the number of EVs passing through the Oslo central toll ring since 2012. The success to accelerating EVs in Oslo has mainly been attributed to the government's role in facilitating the infrastructure to influence consumer choices.

Case study source: planup.eu (retrieved November 2022), image source: electrive.com

Case study: Project PACE, Scotland



DNO-led process for site selection

Year: August 2019-April 2021
Responsible authority: Transport Scotland, local authorities, SP Energy Networks
Objectives: trial the approach of an electricity network provider to lead on the planning and installation of public EV chargepoints at a regional scale.
The intervention: using £5.3m of Scottish Government funding, alongside other funding including Green Economy Fund, project PACE involved a sophisticated site selection study, carried out by SP Energy Networks and local authorities, on both car parks and optimal sites across Lanarkshire. The project targeted areas and communities where the commercial market has not yet delivered and was unlikely to in the short to medium term.
Output: the project successfully delivered 167 EV chargers across 44 EV hubs in North and South Lanarkshire, increasing the number of public EV chargers for Lanarkshire communities by 200% and 14% for Scotland as a whole.
Outcomes/Impact: by choosing charging locations that make effective use of the existing electricity network, SP Energy Networks estimated potential savings of between £30,000 and £60,000 in grid connections for each new location, equating to £1.3m-£2.6m across all planned sites. The EV hubs have been extremely popular, with over 7,500 discrete users registered, and site ownership have since been transferred to local authorities.

Case study source: Transport Scotland, SP Energy Networks (retrieved November 2022)

2. Strategic context
2.2 The case for intervention

Wales risks falling behind other countries

While EV technology is relatively mature and uptake is growing in some countries, most notably in Norway, EV penetration remains low in Wales. Wales currently has one of the lower levels of EV ownership in the UK, and currently lags behind England and Scotland in terms of the number of chargers available, as well as EV ownership, as shown in Figure 19. As of October 2022, Wales had nearly 40 chargepoints per 100,000 population, falling below the UK average (52 chargepoints per 100,000 population) and their UK compactors England and Scotland.

Figure 18 illustrates the technology adoption life cycle as an indicator for market maturity based on ownership of battery electric cars (as explained in Appendix A), according to IEA. In 2020, at 7% of sales Wales was at the Innovator stage, whilst the UK as a whole entered the early adoption stage at the time. Global comparisons indicate that much of Europe is also at the early adoption stage, whilst Sweden, Iceland and Norway stand out as more mature markets. Norway has reached (and will soon exceed) the late majority stage of adoption, where a critical mass of the population would be comfortable adopting and using electric vehicles . In these countries, the range of policy initiatives deployed have significantly reduced the cost of EV ownership albeit cost-parity for the purchase of EVs has not yet been reached.

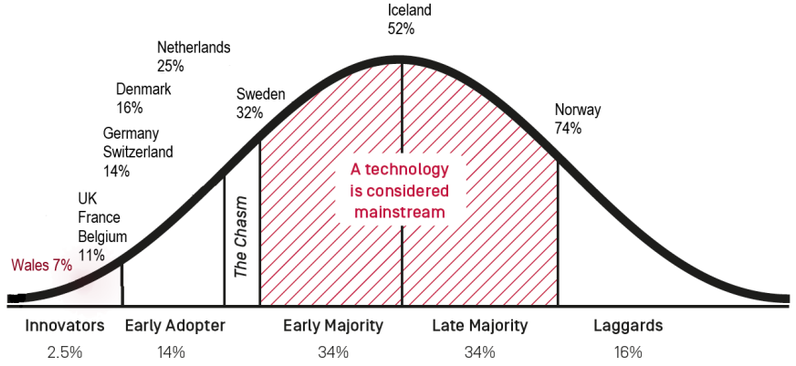


Figure 18: Sales of electric cars as a proportion of total car sales

Source: IEA Global EV data explorer
February 2023

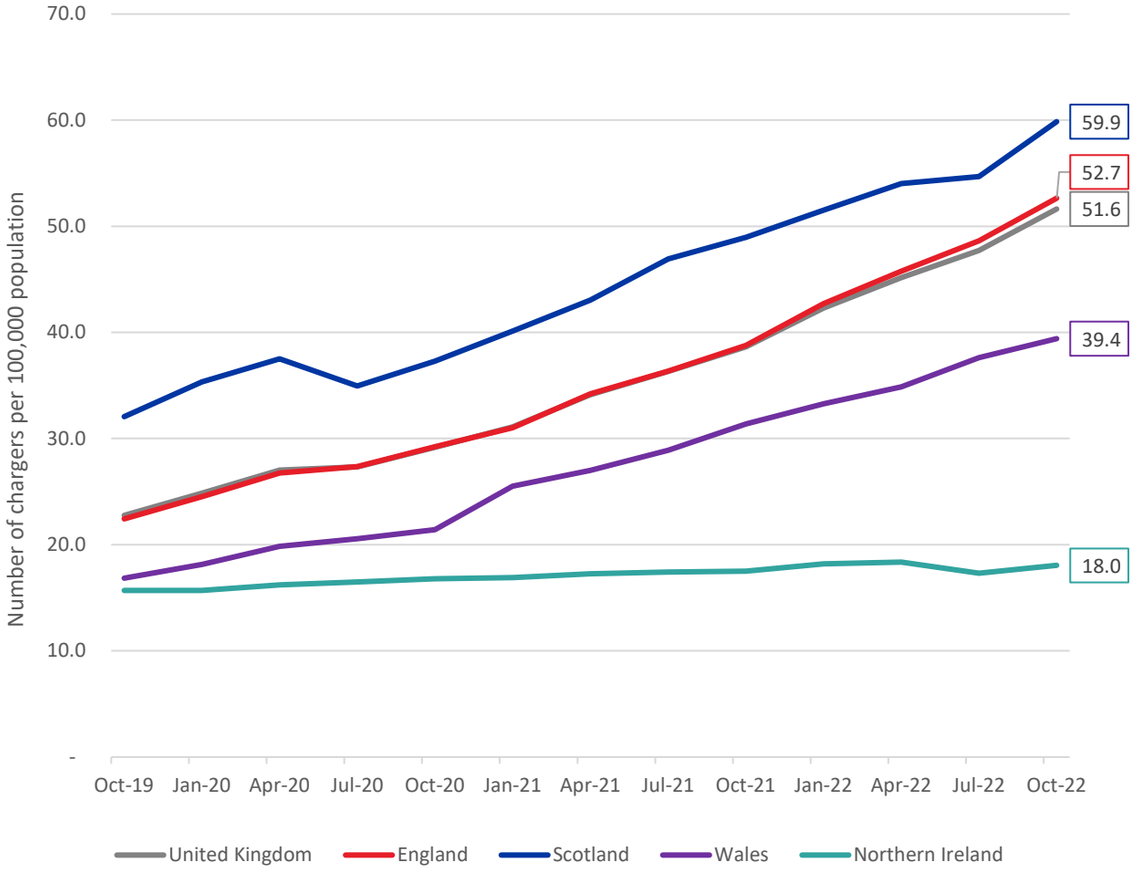


Figure 19: Number of chargers per 100,000 population

Source: DfT, October 2022

2. Strategic context
2.2 The case for intervention

2.2.4 Enabling EV transition for all

Wellbeing of Future Generations Act

Transforming the future of transport and mobility in Wales is fundamental to the achievement of the well-being goals defined by the Future Generations Act 2015. The Act requires all public sector bodies to account for the long-term impact of their decision-making and investment, and to ensure that future generations are not left worse-off than the current. WG must demonstrate leadership in developing new ways of sustainable travel and reduce the harmful impact of air pollution and carbon, leading to a more Resilient Wales, a Prosperous Wales, a Wales of Cohesive Communities, a More Equal Wales, and a Healthier Wales. By working closely with the private sector, WG, TfW and local authorities can influence and shape the provision of reliable, inclusive charging infrastructure which meets the pillars of the Act.

Disproportionate access to EV charging infrastructure

The government are in the optimal position to not only to establish sufficient provision of EV charging infrastructure available, but to also ensure all consumers have equal access to chargers, as well as the knowledge and access to public-available information relating to EVs, as reaffirmed within the Strategy.

Areas where it may be more challenging for private providers to make the case for EV chargers include locations with lower demand and/or potentially high infrastructure costs, such as rural areas and national parks. However, a reasonable network-wide coverage of all of Wales will be needed in order to provide public confidence in long-distance journeys. As Figure 20 illustrates, local authority areas around the north-west and the South Wales Valleys indicate relatively high gap in EV provision.

The same challenges may also apply to low income areas, which are often characterised by terraced housing and apartments. This lack of off-street parking (National Assembly for Wales, 2019) will have a greater reliance on on-street charging points (and at a higher tariff rate than households benefitting from home-charging).

A survey carried out by Ipsos Mori on behalf of National Highways suggests that older adults have a higher car dependence compared to other groups (National Highways, 2022). Furthermore, DfT's Great Britain Transport Statistics show that 64% of individuals with a long-term disability drove or were a passenger in a car, representing the highest share of travel mode used (DfT, 2021). Many others have temporary road reliance through carrying significant luggage, cargo, or children.

Opportunity to design and promote inclusive user experience

Creating a seamless and enjoyable user experience is also critical for all users. Charge point locations must meet standards for safety, accessibility and security, particularly for the most vulnerable users and those with accessibility needs. The current lack of standardisation leaves users confused by the memberships, payments, cards and apps, and hinders adoption. Incompatibility between vehicles and chargers further reduces the supply of charging infrastructure, an issue echoed by participants as part of the public consultation that was held to inform the development of the Strategy (WG, 2020). Survey participants also flagged issues at payment, including different payment platforms, membership schemes, lack of internet connection, and poor customer support services. In some of the more mature markets like Norway and China (Arup, 2020) these issues has been overcome by providing a single platform or standards. Both contribute to a more cohesive user experience. Consultation on the draft Strategy also highlighted the need for (but not limited to):

- The ability to pay using contactless payment methods.
- Standard and clear pricing.
- Appetite for new homes to have charging installed.
- Chargepoints in safe, secure locations with amenities.

Consultation also highlighted that the majority of the EV charging infrastructure installed to date is not designed with the needs of disabled users in mind, with issues including heavy cables and difficult connectors presenting problems for those with mobility and dexterity impairments.

Progress to develop guidance and influence planning policy has been made by WG and UK government to promote an integrated, accessible and collaborative approach to EV charging in Wales. For example, WG have developed the National Standards (due to be published in Spring 2023), designed for users, businesses, local authorities, CPOs and other stakeholders. WG will monitor the adoption of the National Standards to ensure a consistent approach to EV charging installation and operation. Furthermore, the Electric Vehicles – Accessible Charging Specification was mandated by the UK Government, in which *"requirements for the provision of accessible public chargepoints for electric-powered vehicles to all potential users, including disabled people and older people"*.

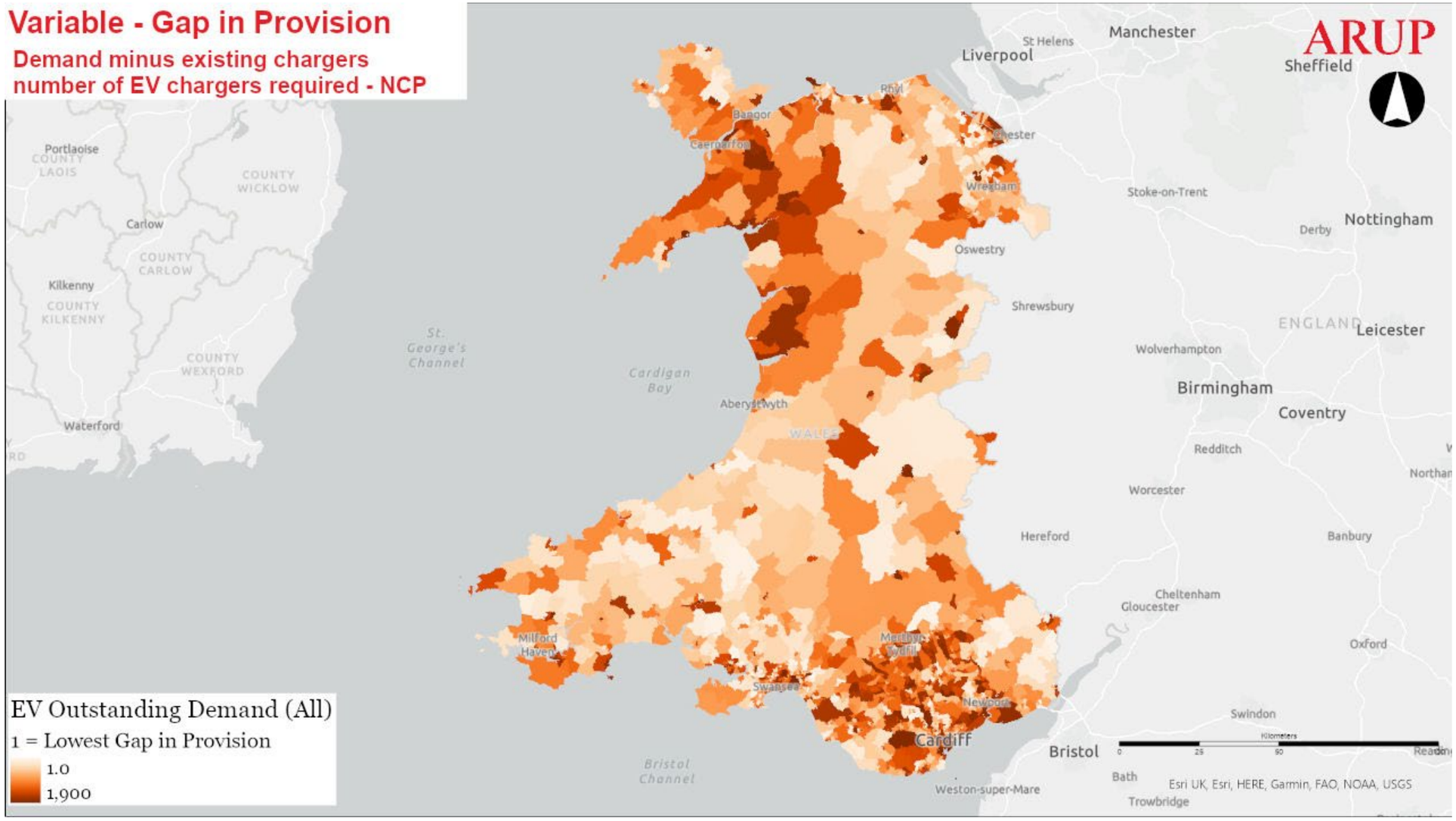


Figure 20: Gap in provision of public EV chargepoints
Source: DfT, 2022b and Arup Analysis

2. Strategic context
2.2 The case for intervention

2.2.5 Re-imagining a decarbonised transport system

More effective integration of journeys

Private vehicles will remain to be the primary choice of transport for many, particularly those travelling long-distance and for vulnerable groups. Yet, EVs can play a role in reducing traffic through better integration with public transport and micro-mobility, including cycling, and other modes of public transport. Commonly, more than one mode or service is required to complete a journey in rural areas. Ensuring reliability in transitioning between modes is essential, as a break in the chain could result in a person being stranded for a considerable amount of time. As conventional private vehicles are phased out, we cannot allow sub-standard EV charging infrastructure to be the source of the break in the chain. For urban environments, consultation responses to the Strategy noted the risk urbanised areas could become more populated with cars and traffic if chargepoints are to be located there. As public transport and active travel infrastructure provision tends to be higher compared to rural areas, better integration between EV charging infrastructure can enable more multi-modal trips, especially encouraging the 'last-mile' of a trip to be completed by public transport or micro-mobility if e.g. EV charging is provided at park-and-rides.

Furthermore, future proof of EV infrastructure is needed to allow for charging of public transport, active transport (e-micro mobility) and car share schemes. Whilst these areas are still in their infancy, planning for equitable access of these charging options should be considered and maintained.

Promoting innovation and advanced battery technologies

As EV technologies evolve, WG has a significant opportunity promote and where feasible, foster research and innovation to drive continuous improve across the industry. However, EV users, the wider society and businesses will not reap the benefits, which may range from lower running costs to improved user experience. The transport infrastructure must be adaptable to future advances in innovation, as emphasised by the Planning Policy Wales (2018). Existing and emerging innovations and trends that predicted to influence the future growth of the EV market includes:

- Improvements to battery performance is anticipated; the widespread availability of cars with ranges in excess of 400 miles could be expected within the next 10 years. With limited battery performance identified as one of the key barriers to EV adoption, significant improvements to EV mileage will ease range anxiety and boost EV uptake.
- Shared and autonomous mobility is on the rise, and will increase the progress towards electrification of transport.
- New smart grid solutions, including Vehicle-to-Grid (V2G) and battery storage based on second-hand batteries, can bring down the investment cost and operational cost for charging solutions, as well as alternative approach to co-locate renewables.
- New user-friendly innovations such as inductive (wireless) charging, high-performance chargers (with 5-8 times higher speeds), machine learning and artificial intelligence (AI), and user-friendly applications can increase the attractiveness of EVs.

Creating green job opportunities

Delivering the Strategy allows WG to demonstrate leadership in sustainable development, as demonstrated the Wellbeing of Future Generations Act, and capitalise on the opportunity for the EV industry to play a pivotal role in establishing a flourishing green economy, creating new job opportunities for local communities and boost sustainable economic growth.

According to the European Association of Electrical Contactors (AIE), the shift to EVs could create more than twice as many new jobs as the number that will be lost by the demise of internal combustion engine, based on 35% EV market share by 2030 in Europe (AIE, 2020). Most of the new jobs are expected to be downstream and are associated with the installation, operation and maintenance of charging points. The EV revolution creates an important opportunity for jobs in an entirely new value chain in the automotive and electric sectors, offering more green job opportunities for SMEs and local communities across the UK and Wales.

2. Strategic context
2.2 The case for intervention

2.2.6 Next steps – implementing the Strategy

The following three sections focuses on the three main components critical to the delivery of the Strategy, and sets out the emerging thinking and future considerations to inform a deliverability plan:

- Section 3: **Financial Case** – this case sets out the indicative (capital) cost of delivering the portfolio (i.e. across Wales) of chargepoints and supporting infrastructure required.
- Section 4: **Commercial Case** – this case sets out the emerging commercial and procurement considerations for the public sector, including current market conditions, key stakeholders and risks allocation.
- Section 5: **Management Case** – this case focuses on how the programme will be delivered, from programme management and governance to risk management.

3. Commercial case

3.1 Purpose of the commercial case

3. Commercial case
3.1 Purpose of the commercial case

3.1 Purpose of the commercial case

The commercial case explores the commercial arrangements of the Strategy. The commercial case introduces key aspects of the charging market – including the EV charging value chain and a spectrum of potential business models. The case presents the results of a capability assessment of the public sector, capturing existing and aspirational capability to deliver the Strategy, as well as the roles to be played by different bodies in that delivery, barriers to strategy roll-out and interventions to overcome, plans for engagement with the private sector, and emerging recommendations.

3.2 EV charging market background

3.2.1 Charging locations and modalities

This section provides an overview of different charging locations, modes, and associated user behaviour. Two modes are the focus of the commercial case: destination and on-route charging.

3.2.2 EV charging value chain

This section outlines indicative market player types, activities and roles involved in the EV charging market value chain, and where indicative market player types operate thereacross.

3.2.3 Business models

This section outlines a spectrum of business models with varying levels of complexity and control, introduces example business models for public sector entities intervening in the market, and evaluates these examples against the level of public intervention wielded across the value chain

3.2.4 Intervention in the market

This section presents a series of modes for financial and non-financial public sector intervention into the EV charging market – both to incentivise private sector investment or protect charging users.

3.2.5 Risk and de-risking

This section identifies risks of public sector market intervention as well as those faced by private-sector investors, and recommends mitigation tactics for both

3.3 Stakeholder engagement

This section covers active Arup collaboration with the public sector (the Welsh Government, Transport for Wales, and representative Local Authorities) to determine public sector capability and preferred roles, as well as recommendations for engagement with the private sector, further next steps, and conclusions.

3.3.1 Capability of the public sector

This section presents the results of a capability mapping exercise – carried out first individually by the Welsh Government, Transport for Wales, and Local Authorities, and then collaboratively, in a workshop hosted by Arup – to assess existing skills and resources within the public sector and identify gaps.

3.3.2 Roles across the public sector

This section identifies the role of the public sector in the EV charging market, and delegates responsibilities to different public sector bodies. Also identified are barriers to a successful strategy roll-out, captured via engagement with the public sector, with interventions by different public sector bodies to address these barriers.

3.3.3 Engagement with the private sector

This section outlines public sector plans for engagement with the private sector.

3.3.4 Conclusion

This section summarises emerging recommendations of the commercial case and provides next steps.

3.2 EV charging market background

3. Commercial case
3.2 EV charging market background

3.2.1 Charging locations and modalities [1/2]

EV charging takes place across a range of location modes – both private and public. Different business models and risk considerations exist for different location modes, by virtue of the infrastructure required, the customers served, the location of the assets, and the user behaviour.

Home Charging *(private)*

The majority of EV charging presently takes place at private dwellings, typically overnight at slow (3-5 kW) or fast (7-22 kW) CPs.

Home charging can be cheaper and more convenient for the consumer, but installation of the system can pose a hurdle – both financially and in terms of ease of access.

While around 90% of EV owners presently have access to off-street parking and charging, this is true for only 65-75% of the wider UK population, making home charging unsuitable or impossible for this group. This figure varies between geographies and user groups, with less access in urban areas.

Even with charging available at home, current vehicle ranges require additional charging for longer journeys, e.g., on-route charging. User behaviour can also lead home chargers to top up elsewhere (e.g., destination).

Workplace Charging *(private)*

Workplace charging takes place mainly in private employee or fleet car parks. Charging is typically slow or fast, as vehicles might dwell for extended periods.

There is less built charging capacity in workplaces than available publicly, and limitations on space could limit extensive growth. Some users who charge during their work commute do so at public CPs, including destination and on-route.

According to modelling assumptions from BNEF, Workplace charging presently makes up less than 10% of EV energy demand.

ZapMap's 2020 survey places respondents with access to workplace chargers in the UK at 16%, but notes that the effects of Covid-19 on office closures could be deflating this figure.

Hub Charging *(public)*

Hubs are dedicated sites, often serving multi-modal vehicle demand, sometimes with retail or industrial facilities on-site. Charging available at hubs is often rapid and ultra-rapid, with short dwell times.

Hubs are sometimes used by drivers charging on-route. They are distinct from street charging and destination charging in their location and charging-focused offering.

Hubs can be in remote or urban areas, but grid constraints (limiting the size of connection) and land availability can pose challenges, especially in the latter.

Many hubs have charging facilities dedicated to multiple user types, e.g., taxis, fleet vehicles, buses, private cars. It can be challenging to serve different vehicle modes at one hub if their technical charging needs are unique. This mode could be considered under other workstreams for bus decarbonisation.

3. Commercial case
3.2 EV charging market background

3.2.1 Charging locations and modalities [2/2]

Three location modes are the focus of the commercial case: residential on-street charging, destination charging, and on-route charging. Because of the differences in the assets and site types between the modes, there exist different considerations for each. On-Street charging is not included the Financial Case, later in the report.

On-Street Charging *(public)*

On-street charging is typically on the slower side of public charging, with vehicles often dwelling at the charger overnight. Slow and fast CPs are often incorporated into street-side lamp posts or are installed along the kerb.

Tariffs often range considerably, even within network. Reduced rates can be available for residents charging within their local area, for non-urban areas, and / or for network members.

Modelling from BloombergNEF indicates that the majority of public charging demand by energy takes place on slow (<7 kW) CPs; around 55% of public demand (or 9% of total demand, including home, work, public, and depot). This is projected to decline over time as demand for rapid charging increases with installed capacity.

Destination Charging *(public)*

Destination charging typically takes place at locations the user would otherwise already visit: retail centres, grocers, gyms, etc. The user charges at the destination car park while they visit.

In locations where dwell time is longer, e.g., overnight at hotels, slow charging may be used. Most destination CPs are fast, while some may be rapid, e.g., where dwell time is shorter.

PodPoint has projected that 7% of all charging will take place at destinations in a fully fledged EV market.

Public rapid and ultra-rapid charging – which includes hub, on-route, and some destination – makes up 45% of public charging demand by energy, as modelled by BloombergNEF.

On-Route Charging *(public)*

Drivers use on-route charging to top up their vehicle in order to complete their journey; typically at rapid and ultra-rapid chargers. Drivers travelling longer journeys are more likely to charge on-route.

One Arup modelling scenario suggests that 45% of the energy consumed on the motorways would recharged at motorway service areas (MSAs) by 2030. Users preferentially stop at MSAs if one is on-route.

On-route charging can decrease driver range anxiety, encouraging UV uptake among users requiring longer-distance transportation.

On-route charging is often multi-modal – serving vehicles with different charging requirements.

FOCUS OF THE COMMERCIAL CASE

FOCUS OF THE FINANCIAL CASE

3. Commercial case
3.2 EV charging market background

3.2.2 EV charging value chain: indicative market players

EV charging market players include pure CPOs, with business models focused around owning and operating charging networks and sites, as well as original equipment manufacturers and energy suppliers, for which charging might be a secondary or tertiary business, oil majors entering the EV charging market to diversify, and public sector bodies – providing, supporting, or encouraging private investment in – infrastructure.

Public Sector

FOCUS: providing public infrastructure, decarbonising transport, encouraging private-sector investment, protecting the consumer, supporting social equity

RISKS: reputational risk (e.g., from poorly managed infrastructure, greenwashing, high tariffs), discouraging private investment, uneven access to infrastructure, high cost of infrastructure (if intervening financially)

EXAMPLE(S): Welsh Government, TfW, LAs*

Chargepoint Original Equipment Manufacturer - OEM

FOCUS: original equipment manufacture of CPs with a secondary CPO role

REVENUE: fixed up-front payment from the sale of charging infrastructure and p/kWh charging revenue

RISKS: revenue exposure to charging volume demand is reduced by main business in the manufacture and supply of equipment and chargepoint installation

EXAMPLE(S): Swarco, Rolec

Vehicle OEM

FOCUS: original equipment manufacture of vehicles with a secondary CPO role

REVENUE: fixed up-front payment from vehicle sales and variable p/kWh or subscription charging revenue

RISKS: revenue exposure to charging volume demand is reduced by vehicle sales revenue/profit, which remains the main business of OEMs

EXAMPLE(S): Tesla, Ionity (owned by vehicle OEMs)**

Energy Supplier

FOCUS: securing new energy customers for home and network charging and retaining wider market share

REVENUE: variable p/kWh revenue from power sales and variable p/kWh charging revenue (with discount)

RISKS: power supply remains the core business; suppliers risk losing out home charging revenue from home and public tariffs to competing public networks

EXAMPLE(S): ESB, PodPoint (EDF)

Petrol Major

FOCUS: entering market to diversify away from carbon-intensive infrastructure/services

REVENUE: variable revenue from petrol sales and variable p/kWh charging revenue

RISKS: without decarbonising their businesses petrol majors will lose revenue security from petrol supply with EV uptake and fewer ICE vehicles

EXAMPLE(S): Shell Recharge, Ubitricity, BP Pulse

Pure CPO

FOCUS: operating and owning EV charging networks and sites, securing EV charging market share

REVENUE: p/kWh revenue from operating charging networks and sites

RISKS: Pure CPOs experience greater exposure to demand-related revenue risk without revenue stacking and providing ancillary charging services

EXAMPLE(S): Instavolt, Osprey, Connected Kerb, Iduna

* Local Authorities

** Consortium of BMW Group, Ford Motor Company, Hyundai Motor Group, Mercedes-Benz AG, and Volkswagen Group (with Audi and Porsche)

3. Commercial case
3.2 EV charging market background

3.2.2 EV charging value chain: activities and roles

On the previous slide, six indicative market players are outlined. These players provide an array of services across the EV charging value chain. These are aligned to six indicative market players on the following page.

- Policy levers
- Planning and finance
- Power supply
- Chargepoint assets
- Chargepoint O&M
- Ancillary services

Policy Intervention	Public sector bodies using policy levers to protect charging users, encourage private investment, or invest in charging infrastructure
Site Design / Planning	Design of charging sites, including number and capacity of CPs, location of site, site entrance and exit, number of bays; securing planning
Capital / Finance & Land	Capital costs of grid connection, CP supply and installation, and site set-up; provision or ownership of land
Power Supply	Supplying of power to the site or CP (e.g., PPA)
Chargepoint Supply	CP OEM (Original Equipment Manufacture) supply of CP, pillar (if ground-mounted), etc.
Chargepoint Installation	Installation of sub-terranean foundation, concrete base, underground ducts, manholes, circuit breaker, sub metering, cabling, CP and pillar
Chargepoint Operation	Back office, software, data (real-time information on availability and utilisation), insurance
Chargepoint Maintenance	Scheduled and unplanned maintenance (call-out), phone lines for call-out maintenance
Revenue Stacking	Partnerships with on-site retailers, other on-site revenue streams
Network Optimisation	Demand response and aggregation, battery storage to reduce costs, vehicle to grid, smart charging, battery storage for grid balancing
Customer Interface / CaaS	Subscription-based charging tariffs offering users the ability to charge within network, customer payment interface, site branding

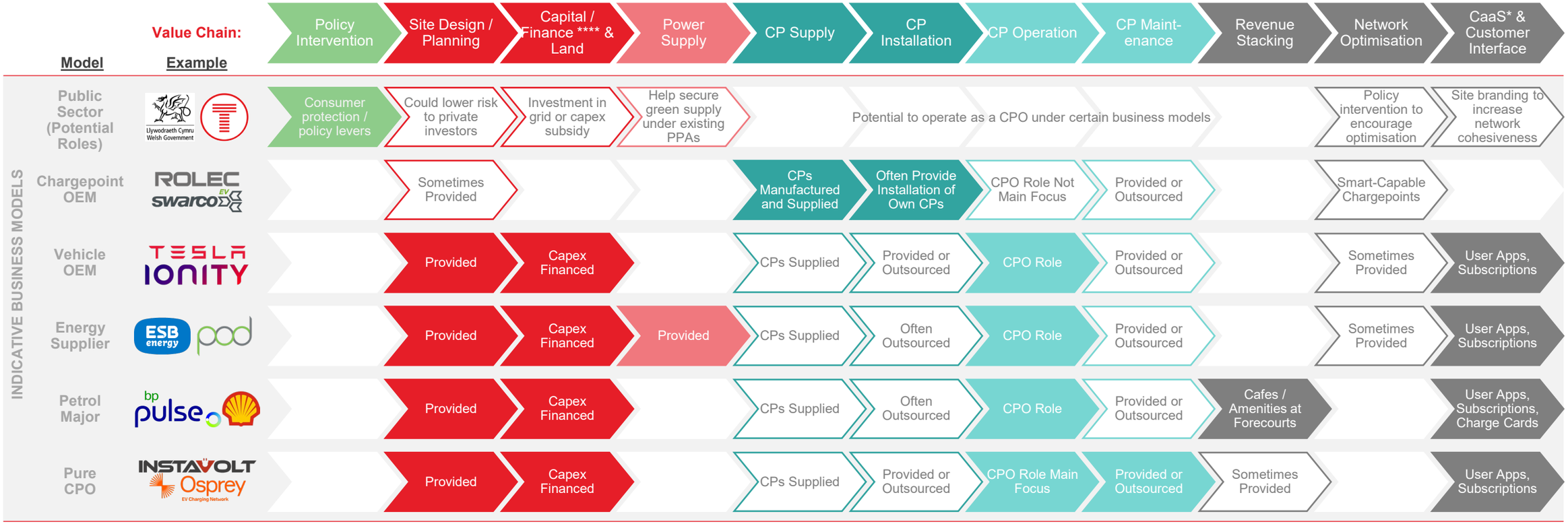
CaaS – Charging-as-a-Service

3. Commercial case
3.2 EV charging market background

Policy levers
Planning and finance
Power supply
Chargepoint assets
Chargepoint O&M
Ancillary services

3.2.2 EV charging value chain

Many participants offer ancillary services across the EV charging value chain – from site planning and design, capital and financing, power supply, chargepoint supply and installation, operation and maintenance, revenue stacking (retail, amenities, events, and vehicle sales), network optimisation (generation, power management, storage), customer interface, and charging-as-a-service.

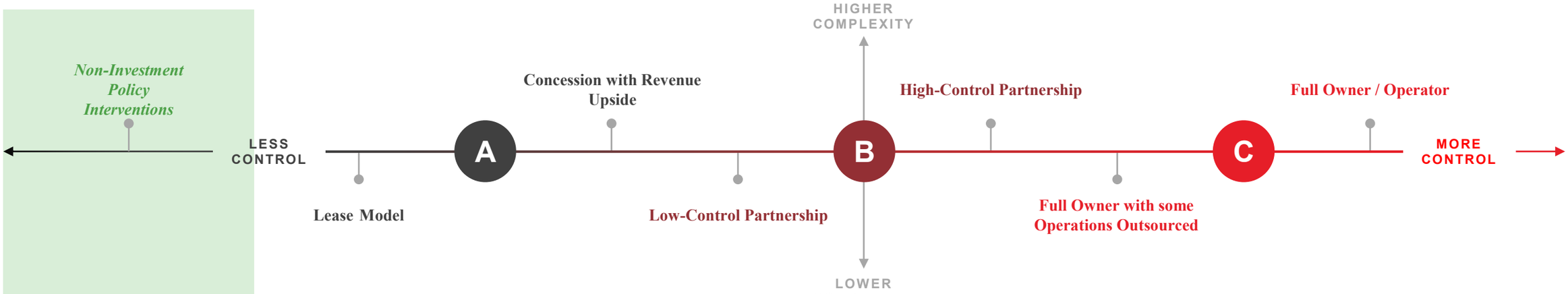


* CaaS – Charging-as-a-Service
** excl. Direct Sales
*** excl. Partner Networks
**** including grid investment

3. Commercial case
3.2 EV charging market background

3.2.3 Business models: control and complexity

Below, three high-level business models are mapped to a matrix of complexity (vertical axis) and control (horizontal axis). These high-level models will be explored to identify the area(s) within the matrix in which the public sector could operate.



** WG has access to levers (e.g., emission policy) that can act as non-investment interventions into the EV charging market*

A: Lease Model

WG, TfW, and/or the relevant Local Authority retains ownership of the charging site land and leases it/them out to an EVCP operator. With low complexity, this could be a simple lease, or, with higher risk and complexity, a concession with a revenue upside.

B: SPV / JV

WG, TfW, and/or the relevant Local Authority creates a partnership with at least one other party (e.g., an EVCP operator) to jointly own and operate the charging site(s). The public sector role – and thus complexity faced, risk, return, etc. – ranges from low-control to high-control partnership / SPV / JV.

C: Full Ownership

WG, TfW, and/or the relevant Local Authority provides a turnkey charging solution as the full owner and operator. Complexity and risk can be abated by outsourcing some or all O&M (operations and maintenance) etc. to a third-party vendor (e.g., Swarco).

3. Commercial case
3.2 EV charging market background

3.2.3 Business models: options available to WG [1/2]

There are a number of specific business models under which the public sector could operate in its role in the EV charging market. These models range in their level of intervention, investment, complexity, and control, and can be mapped to the higher-level models (A, B, and C) on the previous slide.

Business Model Group

- A Business Model A: Lease Model
- B Business Model B: Joint Venture (JV)
- C Business Model C: Turnkey Offering

	Business Model	
*	Policy Intervention	The Welsh Government has access to levers (e.g., emission policy) that can act as non-investment interventions into EV charging – these policy interventions can protect consumers, maintain minimum requirements for infrastructure, and encourage private investment into the market.
A	Subsidy / auction / franchise	The Welsh Government would make a subsidy available for, as an example, grid connection costs at a bundle of rural locations, and invite bids from the private sector to develop and operate these sites. Bundles could include a range of more and less financially viable sites. Policy interventions including providing planning support or demand data could decrease risk for private investors.
A	Plan and lease / licence	The Welsh Government, TfW, or a Local Authority would plan the sites / charging locations and then lease or license the land to a third-party (e.g., a private sector CPO) to finance, build, and operate without financial intervention or subsidy. Policy intervention via planning could set out minimum requirements per site or geographical area.
A	Develop and lease / licence	The Welsh Government, TfW, or a Local Authority would plan, contract, finance, and install infrastructure at the charging site(s) / location(s) and then lease or license the land to a third-party, to whom the charging business is offloaded in exchange for some kind of investment commitment – e.g., lifecycle / replacement costs, etc. – and pays a lease and / or a revenue upside to the public sector land owner. The public sector would offload most operational risk to the private sector, but face some from the revenue upside. Again planning could set out minimum requirements, and development would reduce risk for private investors.
B	Low-control JV	The Welsh Government, TfW, and / or a Local Authority would enter a JV with a third-party to carry out the works across the full extent of the value chain. In a low-control JV, the public sector would put in less investment and would therefore have lower levels of control over operations, tariffs, etc.
B	High-control JV	In a higher-control JV, the public sector would invest more in the charging site(s) / location(s) in exchange for more control over how the sites are designed and run.
C	Own and appoint operator	The Welsh Government, TfW, or a Local Authority would plan, contract, finance, and install infrastructure that they would maintain ownership of, while appointing a third party to operate and maintain for a fee. The public sector would retain all operational risk.
C	Own and operate	The Welsh Government, TfW, and / or a Local Authority would carry out the works across the full extent of the value chain, including operations and maintenance, and would be responsible for capital and operational costs. The public sector would retain all operational risk.

3. Commercial case
3.2 EV charging market background

3.2.3 Business models: options available to WG [2/2]

Below is illustrated possible areas of public sector intervention (see previous slide) across an adapted EV charging value chain. These are rated from low to high public sector intervention.

Level of public intervention
- High
- Medium
- Low

Business Model Group
- A Business Model A: Lease Model
- B Business Model B: Joint Venture
- C Business Model C: Turnkey Offering

	Business Model	Policy Intervention	Site Design / Planning	Civil Works	Finance	Power Supply	CP Supply / Installation	CP Operation	CP Maintenance	Contract Management
*	Policy Intervention	High	Low	Low	Low	Low	Low	Low	Low	Low
A	Subsidy / auction / franchise	High	Medium	Low	Medium	Low	Low	Low	Low	High
A	Plan and lease / licence	Medium	High	Low	Low	Low	Low	Low	Low	High
A	Develop and lease / licence	Medium	High	High	Medium	Low	Medium	Low	Low	High
B	Low-control JV	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	High
B	High-control JV	Medium	High	High	Medium	Medium	Medium	Medium	Medium	High
C	Own and appoint operator	Medium	High	High	High	High	High	Low	Low	High
C	Own and operate	Medium	High	High	High	High	High	High	High	Low

** WG has access to levers (e.g., emission policy) that can act as non-investment interventions into the EV charging market*

3. Commercial case
3.2 EV charging market background

3.2.4 Intervention in the market: investment-based interventions

Capital intervention in the EV Charging Market could lower the barrier to market entry for private CPOs, increasing infrastructure availability for consumers; however, subsidising this investment could come at a high cost to tax payers and incurs risk inherent to the market.

Capex Investment or Subsidy

Risk	*Capital costs depend on the number, size, design, and specification of charging sites or locations. Subsidising some or all capex areas could require a more specific costing exercise than the financial case.*
Planning & Design	Planning works could be carried out by the Welsh Government, TfW, or Local Authorities to encourage private investment from CPOs. This could also increase public planning control. Site design might be better left to the private sector, with it's greater capability (skills and resources) in this area.
Civil Works & Installation	Civil works could be subsidised at some charging sites or modalities. For example, the Welsh Government could employ a targeted on-route charging subsidy covering some civil costs to incentivise private CPO investment.
Charging Infrastructure	Subsidising CPs could create risk – many CPOs have contracts with specific OEMs. There is also a replacement capex associated with this infrastructure every 10 to 15 years. WG could, for example, subsidise some targeted charging infrastructure costs for on-street charging, incentivising private CPOs to tender for Local Authority contracts.
Grid	The Welsh Government could subsidise a portion of grid connection costs, or could create a fund covering connection costs (similar to the Rapid Charging Fund) at specific, less viable, or deprived sites.
Land	Land is a significant concern for CPOs, and can make up a large portion of the capital investment. The Welsh Government, TfW, and Local Authorities could provide CPOs access to land in a lease arrangement.

Opex Investment or Subsidy

Risk	*Subsidising operational costs, or taking responsibility for operations under a JV or turnkey business model, comes at a significantly higher risk than for capital costs. EV charging is a relatively new market that is still developing. Projections of future demand and the speed of EV uptake are uncertain, and create a revenue risk for operators.*
Energy Supply	One way that public sector bodies can reduce energy opex risk for CPO partners is via energy procurement. Public sector bodies with the ability to procure power at low costs (e.g., under a large supply agreement or PPA) could procure power and sell it on to the CP operator at cost. This could also ensure that power is sourced from renewable generation.
O&M	Operation and maintenance (O&M) of EV charging sites is a specialised capability that can usually be carried out at a lower cost by EV charging O&M contractors. Unless this is a capability area that the public sector is looking to build in house, O&M would continue to be contracted out, even in JV and turnkey business models.

3. Commercial case
3.2 EV charging market background

3.2.4 Intervention in the market: non-investment policy interventions

The Welsh Government can intervene in the EV Charging Market without direct investment – below are outlined some high-level interventions that could protect EV charging users and de-risk, incentivise, and encourage private investment.

Interventions to Protect Consumers

- Mandating **standards** (e.g., minimum infrastructure per site, green energy used for charging, "every LA / geographical area needs minimum of…", etc.) to incentivise proper investment from the private sector
- Local authorities could provide guidance on **tariffs** via price control bands:
  - Local standards are more flexible than national for tariffs
  - Under a concession with a local authority, a contract would set the charging tariffs; new tariffs would need to be approved with benchmarking
  - **Risk:** too low tariff controls could discourage private investment
  - **Risk:** CPOs might not agree to tariff control, especially during the current energy crisis; however, some might agree to increase their market share
  - **Case study:** tariff intervention is typically only achieved by a public sector body that has invested in the target charging infrastructure; North Lanarkshire Council invested in the roll-out of 122 chargepoints to ensure no tariff for a period of time to encourage EV uptake – in November 2022, the council announced plans to introduce a tariff from January 2023. A similar scheme was undertaken by Transport for Greater Manchester, which rolled out the BE.eV network with no tariff for the initial period – Be.EV now charges £0.46-0.59 /kWh.
- Policy intervention – working with Ofgem and / or local energy systems – to **encourage system flexibility** and **network optimisation** at charging sites

Cross-Workstream Interventions

- Identify synergies and integrate opportunities for other investment programmes (e.g., bus decarbonisation)

Interventions to Encourage Private Investment

- Provide **planning support**, **data heatmaps**, **location of public land**, etc. to private sector operators and investors. This could include both:
  - publishing heatmaps or other materials for operators looking to make investment decisions (co-benefit of more public planning control)
  - providing more detail with specific entities during negotiations for a concession (e.g., demand modelling, grid connection costs, etc. covering the site in question to limit the private sector investor risk).
- Provide access to **land** to private investors eager to meet roll-out goals – this could be used as an incentive for the private sector to obey **standards** (see left)
- **Package** sites in mixed-demand bundles to encourage private sector investment in less financially viable sites – this also **benefits consumers** in these areas
- Provide **guaranteed base demand** via government fleet charging and/or taxi and PHV charging via TfW – this could decrease demand risk for CPOs
- **Incentivise DNO investment** in the Welsh power grid to lower grid constraints; promote and provide justification for EV charging to be included in Local Energy Plans (LEPs) that allow DNOs to invest in the grid ahead of need (via Local Authorities, with support from the Welsh Government and Transport for Wales where needed)
- Remove unnecessary **legislative or policy-based barriers** to market entry (e.g., height of electrical upstand, which is no longer a barrier in England)
- Provide support meeting **Welsh Language requirements**

3. Commercial case
3.2 EV charging market background

3.2.5 Risk and de-risking: risk

There are a range of risks that could be faced by the public sector when intervening or investing in the EV Charging Market. The impact and applicability of these risks depend on both the type of policy intervention or business model selected by the public sector, and the mode of charging.

Major risks of public sector intervention

- **Capability risk** –created if the target and level of intervention and / or investment is not aligned with the capabilities of the public sector body/bodies intervening or investing
- **Revenue risk** – created if the public sector is entering a JV or Turnkey business model, where demand uncertainty creates revenue uncertainty; equally, poor sight design (e.g., entrance placement, signage) could lead to low driver awareness of site and lower than expected demand and EV charging revenue
- **Transport modelling** – might be required to get planning approved if the public sector is directly investing in large sites – risk of congestion from excessive footfall in dense urban area could risk planning rejection
- **ESG (Environmental, Social, Governance) risk** – created if all partners, contractors, and vendors do not meet the public sector's high ESG standards
- **Land use** – if the Welsh Government, TfW, or Local Authorities are providing land access under a lease or concession agreement, these should be tailored to suit future (post-charging) or alternative use of the site
- **Revenue stacking** – land use and connection subsidies should consider multiuse sites and supplementary revenue streams (e.g., battery storage, residential, etc.)
- **Tariff control risk** – tariffs that are too high take advantage of consumers, while tariffs that are too low discourage private investment in the market
- **Political risk** – zero carbon policy risks being accused as reason for price hikes that would potentially see EV charging as one of the drivers of increased fuel poverty; equally, there is a risk of public backlash to the public sector subsiding costs faced by private CP operators
- **Reputational risk** – if leasing out land or contracting out operations, or leaving operations to the responsibility of a partner, there is a reputational risk to the public sector if a Welsh Government or TfW-branded site is poorly operated
- **Social equity risk** – if the public sector is encouraging private investment in the market, there is a risk of rural, deprived, or less financially viable locations to be left behind, creating unequal access to charging infrastructure, and potentially leaving gaps in the minimum viable network for long trips
- **Inefficient governance** – contract variation or tariff control process risks delay from overly complex governance systems

Major risks faced by most CPOs

It is important to consider, not just the potential risk faced by the public sector in the Welsh Government EV Charging Strategy, but also to CPOs operating in the market. If the public sector can mitigate some of these risks, it could encourage private sector investment:

- Access to, and cost of, **land**
- Access to, and cost of, **grid connection**
- **Demand** uncertainty

3. Commercial case
3.2 EV charging market background

3.2.5 Risk and de-risking: risk mitigation

Mitigating potential risks can often involve both de-risking public sector intervention and investment in the market and providing de-risking solutions to the public sector to encourage its investment in the market.

De-Risking Public Sector Intervention and Investment

- **Capability risk** – critically assess public sector capability, including via the capability mapping exercise and Workshop; fill gaps with partnerships and/or private investment
- **Revenue risk** – use caution if investing in operational sections of the value chain that are tied to demand and revenue; guarantee base demand via fleet and taxi charging
- **Transport modelling** – consider public resources that could support traffic modelling; compile a pipeline of available publicly owned sites in less congestion-prone areas
- **ESG (Environmental, Social, Governance) risk** - Vet investors, partners, vendors; include ESG in contracts and eligibility for capex (incl. grid) subsidies
- **Land use** – consider existing, alternative, and future use of publicly owned land; survey possible charging sites / locations for environmental restrictions
- **Tariff control risk** – consider market benchmarks and energy supply costs when constructing tariff controls; maintain a balance between consumer protection and private sector investment incentivisation; look to case studies (e.g., Scotland)
- **Political risk** – engage with local authorities, private investors, and the public
- **Reputational risk** – lease to and contract with experienced CPOs / O&M vendors
- **Social equity risk** – see incentivisation strategies (right), consult heat maps
- **Inefficient governance risk** – Set up unique governance – e.g., contract variation process, tariff control process

De-Risking to Incentivise Private-Sector Investment

Many of the non-investment policy-based market interventions outlined three slides previous provide de-risking options to encourage private-sector investment in the EV charging market. These interventions and other risk mitigation strategies include:

- Provide CPOs with access to **land via a lease business model**, leasing out Government, TfW, or Local Authority-owned land
- Provide access to **demand heatmaps** to help CPOs mitigate their demand and revenue risk
- Guarantee a **base level of demand via public fleet** charging – this can also be provided at sites or CPs in areas of lower private demand, rural areas, or areas of deprivation using the heatmaps created under the EV Project Scoping workstream
- Under a lease business model, the public sector could incentivise the private sector to **maintain certain standards** (e.g., a minimum number or type of CPs per site or LSOA, use of green energy, etc.) via access to land or other capital subsidies
- Working with DNOs to **reinforce the Welsh power grid** and / or **expediate grid connection quotes** for CPOs looking to invest in charging infrastructure; promote and provide justification for EV charging to be included in **Local Energy Plans (LEPs)** that allow DNOs to invest in the grid ahead of need (via Local Authorities, with support from the Welsh Government and Transport for Wales where needed)

3.3 Stakeholder engagement

3. Commercial case
3.3 Stakeholder engagement

3.3.1 Capability of the public sector: capability mapping [1/4] - Welsh Government

Arup's workshops with the public sector and the Capability Mapping exercise are outlined in Appendix B.

The Welsh Government has strong capability in power supply, with experience bulk purchasing for public bodies and good relationships with DNOs. The Welsh Government does not see itself as the delivery entity of the charging strategy, with no plans to build capability in weak areas such as site design and operation; but has a role in removing planning barriers and financially intervening.

● High
● Medium
● Low

Llywodraeth Cymru Welsh Government	EV Charging Capability Areas										
	Land	**Planning**	**Contracting / Civils**	**Pricing/ Finance**	**Site Design**	**CP Installation & Construction**	**Power Supply & Metering**	**CP Operation**	**Customer Experience**	**CP Maintenance**	**Contract Management**
Needs / Capabilities	1. Land management 2. Legal	1. Planners- Development Management 2. Heritage Consultants 3. Environmental Consultants 4. Transport Planners	1. Procurement management 2. Structure of business 3. Legal	1. Market analysts 2. Finance and pricing management 3. Cost Management 4. Quantity Surveying 5. Funding	1. Architects 2. Landscape Design 3. Civils Engineers 4. Structural Engineers 5. Mechanical Electrical Engineers	1. Civils Contractors 2. Electrical Engineers	1. Independent Connection Provider (ICP) 2. Electrical Engineers 3. Meter Operators 4. Meter asset Managers 5. Power supply	1. Software Development Engineers 2. Customer Service Advisor 3. Markets and Comms	1. Market Analysts 2. Product managers 3. User experience specialists 4. Marcomms	1. Electrical Engineers 2. Software Engineers	1. Contract Managers 2. Legal
WG Assessment Karine Boucher *Welsh Government Project Director* Robin Beckmann *Head of Transport Environment and Decarbonisation* Dafydd Munro *Transport Decarbonisation Policy Manager*	● Land owned by the WG is often earmarked or reserved for specific projects ● Legal often is not available for specific projects like EV charging – outsourcing likely required ● Agencies within the Welsh Government have land management skills (i.e., Natural Resources Wales)	● Capacity to prepare a site, get planning permission, etc to go forward for investment is medium. ● Well placed to share materials (heatmaps, etc.) reduce planning risk. ● WG role in removing barriers; role to lead Planning Directorate.	● WG sees TfW as its delivery entity, and local authorities as delivery entities at a local level ● Procurement framework for contracting and civils, with call-off options, has some capacity to outsource these works	● Strong skills and resources in funding (incl. costing, market analysis, quant. surveying, etc.) ● WG requires independent advice to back up investment decisions, which cannot be provided internally.	● Skills exist in the WG, but a low ability to transfer these skills to the EV strategy, leading to low levels of resource. ● WG does not see itself as the delivery body, but has a policy role in ensuring TfW and LAs have skills and resources, and setting design standards.	● This is not a task currently carried out across the public sector, and the WG does not plan to build in-house capability in this area.	● WG experience purchasing power in bulk on behalf of public bodies. ● No experience requesting grid connection quotes. ● Relationship with DNOs from role in planning future power and grid needs. ● Well placed to affect policy and de-risk.	● WG does not have capability in software development ● WG has some capability in markets and comms and some general experience with customer service.	● WG has some capability in this area; including with market analysis. WG could play an organisational role in grouping or overseeing public sector entities to enable this role.	● WG has no experience and capability in this area – going forwards, this role is likely to be contracted out to expert providers.	● WG has the skills but little resources to carry out this role for EV projects. ● WG has strong skills on a government-wide level with contract management.

3. Commercial case
3.3 Stakeholder engagement

3.3.1 Capability of the public sector: capability mapping [2/4] - Transport for Wales

Arup's workshops with the public sector and the Capability Mapping exercise are outlined in Appendix B.

Transport for Wales possesses many of the skills practical to delivering EV charging, but in other markets – especially rail. TfW already has strong capability in general site design, and aspires to build capability in planning, EV site design, installation and construction, customer experience, and chargepoint maintenance. TfW also sees potential for a role in operation, and in on-route charging generally.

● High
● Medium
● Low

	EV Charging Capability Areas										
	Land	**Planning**	**Contracting / Civils**	**Pricing/ Finance**	**Site Design**	**CP Installation & Construction**	**Power Supply & Metering**	**CP Operation**	**Customer Experience**	**CP Maintenance**	**Contract Management**
Needs / Capabilities	1. Land management 2. Legal	1. Planners-Development Management 2. Heritage Consultants 3. Environmental Consultants 4. Transport Planners	1. Procurement management 2. Structure of business 3. Legal	1. Market analysts 2. Finance and pricing management 3. Cost Management 4. Quantity Surveying 5. Funding	1. Architects 2. Landscape Design 3. Civils Engineers 4. Structural Engineers 5. Mechanical Electrical Engineers	1. Civils Contractors 2. Electrical Engineers	1. Independent Connection Provider (ICP) 2. Electrical Engineers 3. Meter Operators 4. Meter asset Managers 5. Power supply	1. Software Development Engineers 2. Customer Service Advisor 3. Markets and Comms	1. Market Analysts 2. Product managers 3. User experience specialists 4. Marcomms	1. Electrical Engineers 2. Software Engineers	1. Contract Managers 2. Legal
TfW Assessment Steve Ward *Decarbonisation Programme Manager* Gordon Brown *EV Project Manager*	● Similar self-assessment of capability to that of the Welsh Government – TfW has some but limited resources for legal and management requirements surrounding the land it owns.	● Scope for WG / TfW to provide technical advice to de-risk planning – potentially TfW could provide traffic analysis to private investors. ● Planning skill exists but there us low levels of resource to provide this role for EV charging	● TfW has had little experience in performing these civil works, with more capability in outsourcing ● TfW has much experience with rail contracting and civils, but subcontracts to EV CPOs ● TfW is looking to build its skills and resources in this area	● TfW has experience with pricing management, which can be transferable, in non-EV projects ● TfW has little capability with Quantity Surveying, in-house market analysis, and funding. ● Benchmarked awareness of market costs.	● Site design skills are present at TfW, and resource is being built so that TfW can provide this role when called upon – this will require the support of WG.	● TfW has not historically performed this role ● TfW pans to build capability in this area, already having many skills and resources to perform this role in specific circumstances; however, CPOs often have existing contracts with CP installers.	● Familiar with requesting grid connections from DNOs and with ICPs, both via subcontract. ● Strong skills and capability in purchase of bulk power (e.g., for rail) – likely a transfer-able resource for EV roles.	● TfW does not have capability to perform this role in-house. CP operation is sub-contracted out to the CPO. Some skills in this area, including customer exp-erience are planned for development.	● TfW has skills in customer experience, incl. marketing and comms outside of the EV and decarbonisation spaces (e.g., in the rail team). ● TfW plans to grow these skills and resources for EV projects – including a service desk.	● TfW has no experience and capability in this area ● Going forwards, this could be an ambition area for TfW to build capability to provide in select cases - however, CPOs often have existing contracts with maintenance providers.	● TfW has the skills and resources to carry out this role for EV projects.

3. Commercial case
3.3 Stakeholder engagement

3.3.1 Capability of the public sector: capability mapping [3/4] - Local Authorities

Arup's workshops with the public sector and the Capability Mapping exercise are outlined in Appendix B.

Local Authorities have experience working with subcontractors to deliver EV charging on a local basis. The Welsh Government sees a role for Local Authorities as the delivery entities for destination and on-street charging, with coordination from TfW. Local Authorities have a good understanding of local land and aspire to more actively manage this asset to capture opportunities.

● High
● Medium
● Low

	EV Charging Capability Areas										
	Land	**Planning**	**Contracting / Civils**	**Pricing/ Finance**	**Site Design**	**CP Installation & Construction**	**Power Supply & Metering**	**CP Operation**	**Customer Experience**	**CP Maintenance**	**Contract Management**
Needs / Capabilities	1. Land management 2. Legal	1. Planners-Development Management 2. Heritage Consultants 3. Environmental Consultants 4. Transport Planners	1. Procurement management 2. Structure of business 3. Legal	1. Market analysts 2. Finance and pricing management 3. Cost Management 4. Quantity Surveying 5. Funding	1. Architects 2. Landscape Design 3. Civils Engineers 4. Structural Engineers 5. Mechanical Electrical Engineers	1. Civils Contractors 2. Electrical Engineers	1. Independent Connection Provider (ICP) 2. Electrical Engineers 3. Meter Operators 4. Meter asset Managers 5. Power supply	1. Software Development Engineers 2. Customer Service Advisor 3. Markets and Comms	1. Market Analysts 2. Product managers 3. User experience specialists 4. Marcomms	1. Electrical Engineers 2. Software Engineers	1. Contract Managers 2. Legal
LA Assessment Dylan Llewelyn Jones *Isle of Anglesey County Council (IoACC) Highways, Property, and Waste Service Officer* Ross Cudlipp *Newport City Council (NCC) Climate Change Service Manager*	● Strong knowledge of existing land ownership and legal status of land plots; LAs own ample land ● Historically, Newport City Council (NCC) has not retained its land assets for longer term opportunities ● Low legal capacity "in house"	● Many planning decisions happen at a LA level, rather than WG-level. ● Planning at Local Authority sites has been outsourced. ● Mid capability in obtaining permissions; low in actual planning ● WG interventions to remove barriers (e.g., electrical upstand height)	● LAs have experience subcontracting out civil works (e.g., IoACC) ● NCC has traditionally had a turnkey arrangement with CPOs handling all civil works – this has led to delays and quality compromises. Better civils management and standards are an LA aspiration.	● NCC has approved and monitored tariffs for concession agreements, and out-sources market analysis. ● LAs have limited ability to fund projects or participate in higher risk / higher reward models without grants, which can be difficult to access.	● NCC designed simple sites in collaboration with CPOs, but passes more complex sites over to their property JV company to treat design as they would for any other site. ● IoACC has some design skills but lacks resource – this role is largely outsourced.	● Historically, NCC has sub-contracted out CP installation; however, the LA has many skills required to perform this role in specific circumstances. Activities adjacent to CP installation, incl. installing feeder pillars, signage, street lighting, are regularly performed at LA instruction.	● Procurement experience with this skill area; however, this occurs via CCS. ● IoACC has experience screening grid connection quotes and advising on site selection on this basis. ● NCC provides guidance to 3rd parties applying for grid quotes.	● LAs have traditionally relied on CPOs to operate sites and provide back office and maintenance. Low capability in this area, both at NCC and IoACC.	● Similar to CP operation, this role is typically carried out by the CPO or a sub-contracted specialty provider.	● Local Authorities have so far delegated this role to CPOs, which have expert skills in providing CP maintenance.	● LAs have the skills but limited resources to carry out this role for EV projects.

3. Commercial case
3.3 Stakeholder engagement

3.3.1 Capability of the public sector: capability mapping [4/4] - aspirations, strengths, and significant gaps in capability

The capabilities of the public sector are strongest in planning, finance, power supply, and contract management, although capability differs between public sector bodies. Weakest capability areas relate to the design, construction, operation, and maintenance of charging sites, where private CPOs are area experts.

Aspiration
Strength
Significant gaps across capability

	EV Charging Capability Areas										
	Land	Planning	Contracting / Civils	Pricing/ Finance	Site Design	CP Installation & Construction	Power Supply & Metering	CP Operation	Customer Experience	CP Maintenance	Contract Management
WG	Aspirational role in managing awareness of location of public land	Can share materials (heatmaps, etc.) with private sector and remove barriers	Low skills and resources with no desire to build capability	Strong capability for funding and financial intervention	Low skills and resources with no desire to build capability	Low skills and resources with no desire to build capability	Strong capability for purchasing power and strong relationship with DNOs	Low skills and resources with no desire to build capability		Low skills and resources with no desire to build capability	Aspiration to coordinate on a high-level, supervisory basis
TfW		Aspiration to build capability to provide planning support	TfW is looking to build its skills and resources in this area		Aspiration to build capability to provide site design support	Aspiration to build capability to install and construct On-Route sites	Strong capability purchasing power and familiarity with connection quotes	Potential role in assisting LAs (e.g., when O&M contracts expire) - testing viability through 2023.	Aspiration to build capability to provide service desk support	Low skills and resources – unlikely to take on full role on wide-scale basis	Skills and resources in contract management and legal
LAs	Aspiration to more actively manage and retain owned land	Low skills and resources – typically outsourced	Skills in contracting Aspiration to more actively manage contractor work	Low capability to financially intervene Aspiration to access more grant funding			Capability for providing guidance to third parties applying for grid connections	Low skills and resources with no desire to build capability	Low skills and resources with no desire to build capability	Low skills and resources with no desire to build capability	
					Requires reliance on significant private sector expertise			Requires reliance on significant private sector expertise			

The above table draws on the previous three slides to identify significant areas of strength, capability gaps, and aspirations for growth in skills and resources.

Strengths exist in planning, contract management, finance, and especially power supply.

Significant weakness exists in the two grey areas outlined to the right; however, TfW has aspirations to build capability in some of these areas – to be applied on a targeted basis, likely in TfW's coordinating role of on-route charging network delivery.

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: how to deliver public strategy

The Welsh Government's strategic priorities include accelerants of EV uptake – like enabling and incentivising the private sector to invest in charging infrastructure, but also equality concerns – of access, coverage, pricing, language, and the avoidance of waste. Balancing actual charging needs with the goals of the Preferred Network requires the prioritisation of the delivery of charging in particular modes and areas.

Strategy Priorities

- Work towards delivering the Preferred Network
- Decarbonise road transport
- Accelerate EV uptake
- Identify alignment with public and private sector bodies
- Gain leverage from other public sector bodies
- Incentivise and enable private sector investment
- Fill investment gaps when equality issues are identified
- Create wide-spread coverage – a network to unlock decarbonised road transport
- Define equality as it pertains to the EV charging strategy
    - Equality of access
    - Equality of coverage
    - Equality of pricing
- Promote and facilitate the Welsh Language at EV charging sites
- Ensure speed of investment in the short term, prioritising by geographical area and mode
- Maximise return on infrastructure delivery with minimised public spending

Priority of Delivery

Two elements of the delivery strategy should be prioritised first:

- **Delivery of the on-route network strategy** (delivery entity: TfW) – the backbone of the high-speed cross-Wales network along strategic roads must be prioritised in order to decarbonise road transport and unlock long-distance EV travel within Wales. Wales presently has minimal on-route charging and is a gap in the wider UK network. On-route charging helps reduce user range anxiety and EV uptake could be accelerated if users know they'll have a convenient place to charge on longer journeys.
- **Delivery of destination and on-street charging strategy in built-up areas** (delivery entity: LAs, support from TfW):
    - Built up areas have less access to off-street parking (and thus, home charging), with a greater requirement for public charging, and the delivery of infrastructure in these areas should be prioritised in the shorter term.
    - Equality of coverage is a tenet of the wider strategy but built up areas present a more immediate need for charging requirement because of higher EV uptake.
    - EV users in rural areas have greater access to home charging and public charging would be provided in the shorter term on-route.
    - Actual need should be prioritised above per geography infrastructure coverage requirements.

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: roles and responsibilities

It is expected that the private sector will deliver the majority of EV charging infrastructure in Wales, with support from and gaps filled by the public sector. The main roles of the Welsh Government include strategic oversight, socialisation, standards, and monitoring; policy intervention; and financial intervention; with TfW delivering the strategy on-route and the Local Authorities at destinations and on-street.

Welsh Government – *Strategic, Policy, and Financial*

1. The Welsh Government does not see itself as the delivery entity for the Welsh EV Charging Strategy, but as its **oversight body**. This role includes:
    - Sharing strategy objectives with TfW and Local Authorities
    - Sharing supporting materials (demand heatmaps, etc.) with TfW and Local Authorities
    - Monitoring progress on EV uptake, infrastructure delivery, and equality goals
    - Engagement with the private sector to understand plans and needs, and align on key areas (by geography, charging mode, speed) of investment
2. Setting standards to be met in exchange for policy or financial support (e.g., number and speed of CPs per site, green energy use, accessibility, etc.)
    - With TfW, supporting private investors looking to fulfil Welsh Language requirements
3. The Welsh Government likewise includes a **policy role**, involving:
    - Removing policy barriers (e.g., planning restriction on height of electrical upstand)
    - Using policy levers to encourage investment
4. Lastly, the Welsh Government has a role in **financial intervention**, including:
    - Financially intervening in select circumstances – evaluated on a case-by-case basis – where, when left to its own devices, the private sector would leave an equality gap (via Financial Transaction Reserve, or, as a last resort, grant funding).
    - Subsiding specific aspects of select sites (e.g., grid connection costs at high-capacity on-rote sites in areas with poor grid infrastructure).

Transport for Wales – *Delivery Entity for On-Route Strategy*

The Welsh Government sees Transport for Wales as the main delivery entity for the EV Charging Strategy. Transport for Wales would have particular oversight of the cross-national high-speed network of **on-route charging**, unlocking long-distance EV transport in Wales. Roles include:

1. Engagement with the private sector
2. Monitoring **progress of the on-route network** delivery
3. Building **in-house capabilities**: service desk support – to be employed on a wide scale basis across on-route sites; planning support and CP installation / civils – to be employed on a wide scale basis across on-route sites
4. Working with **Local Authorities**: to coordinate larger local (destination and on-street) opportunities that cut across Authority borders, and to provide planning support and traffic modelling for local opportunities when needed
5. Monitoring and evaluating individual **equality gaps** when presented and recommending select cases to the Welsh Government for financial intervention

Local Authorities – *Delivery Entity for Destination and On-Street Strategy*

The Welsh Government sees Local Authorities as delivery entities for **local charging** – at destinations and on the street. This role includes:

1. Local **land management**
2. **Engagement** with local CPOs and other public sector bodies
3. Monitoring **progress of destination and on-street charging** delivery
4. **Sub-contracting** with private sector CPOs – with planning and contract management support from Transport for Wales, when required

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: barriers to successful roll-out (1/5)

During the workshop covering Roles across the public sector, a range of barriers to the successful roll-out of the preferred network, and to investment in EV infrastructure in general, were identified; these are identified in the leftmost column. The three rightmost columns outline potential interventions from public sector bodies [1/5].

Barrier	WG Intervention	TfW Intervention	LA Intervention
Cost of public sector intervention – challenges securing grant funding by Local Authorities limit business model choices when partnering with CPOs.	• **Targeted grant funding** – improve accessibility and awareness of grant funding that can be accessed for targeted cases. • Incorporate access to grants into an **Operational Board**, managing the delivery of the preferred network, overseen by a **Strategic Board**, ensuring delivery follows the wider government strategy.	TfW to assist and support local authorities in completing **grant applications**.	
Private sector appetite for investment – there is unclear investment appetite from the private sector due to low levels of engagement.	More **wide-spread engagement** with private sector to identify gaps specific to Wales. **One-on-one engagement** with private sector to understand roll-out plans and understand funding support requirements (some CPOs have a lot of funding already). Questions to pose to the private sector: • What can the public sector offer (e.g., mapping, info, finance)? • What does the private sector need to see to bring their investment to Wales? • What barriers might the public sector be putting up unintentionally? Engage with **Local Authorities** to understand their engagement with the private sector.		• Engage with **local connections** in the private sector (current contractors, CPOs operating within the Local Authority, etc.) to identify what the private sector needs from the local authority and how to improve investment access. • **Socialise understanding** of the private sector with TfW and the Welsh Government. • To assist TfW/WG in **private sector engagement** in addressing specific barriers to private sector delivery
Local Authority appetite for investment – there is uncertain internal buy-in or understanding as to why Local Authorities are intervening in the EV charging market, e.g., due to financial losses in the operational phase and potential for taxpayer supported opex.	• **Communicate strategy** – share Welsh Government strategy and preferred network with Local Authorities, including the amount of infrastructure projected within Local Authority areas over time.		• **Operational risk** – revenue risk makes operational investment more difficult; offload demand risk to the private sector CPO. • **Utilise land assets** – retain publicly owned land for long-term income opportunities and build from simple lease business models to concessions with revenue upside to maximise returns and motivate involvement.

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: barriers to successful roll-out (2/5)

During the workshop covering Roles across the public sector, a range of barriers to the successful roll-out of the preferred network, and to investment in EV infrastructure in general, were identified; these are identified in the leftmost column. The three rightmost columns outline potential interventions from public sector bodies [2/5].

Barrier	WG Intervention	TfW Intervention	LA Intervention
Consumer urgency – utilisation of existing CPs is relatively low; as a result, there is little urgency from consumers for public investment.	• Shape strategy around prioritisation of investment based on actual **regional requirement** just ahead of need. • Prioritise urban areas of **high EV-uptake** with **low access to off-street charging**, as well as the on-route network that will unlock cross-national travel. • **Monitor** location-specific access to infrastructure vs uptake of EVs.		
Inappropriate location and charging mode mix – misalignment of infrastructure to location (charging mode, rurality, etc.) can be wasteful and unsuited to user requirements; for example, car park slow and fast public charging is unsuited to a rural location without destinations nearby. Local Authority owned land can be at public offices or blocks of council flats unsuited to destination charging behaviour.	• **Prioritise infrastructure location strategy** – based on demand heatmaps reflecting preferred network. • **Socialise demand heatmaps** – with public delivery entities (TfW and Local Authorities) and private sector investors to identify key areas of investment for different charging modes.	• **Planning role for TfW** – in helping Local Authorities shape delivery of on-street and residential destination charging in collaboration with the private sector – aligning infrastructure location and modes to demand heatmaps and charging behaviour.	• Shape charging projects around **local needs** • Share **local charging behaviour** and **land resource** with the private sector, taking into account alignment of mode and location, to shape investment patterns. • In **tenders issued to private CPOs**, clearly communicate local charging needs and site types to align chargepoint quantities, speeds, and modes with site type and user behaviour
Small opportunities – for sites to work, most CPOs require an eight- to ten-year minimum agreement length, a minimum number of CPs per location (e.g., six per site), and a minimum number of sites available to tender; past agreements with Local Authorities have lasted five years, with one to two CPs per location.	• Increase the attractiveness of opportunities to the private sector by **creating larger programmes** across many sites – by region, location type, etc. • Create an **inter-Local Authority procurement system** with the support of the Welsh Government and TfW, especially in rural regions, increasing the scale of opportunity and providing larger investment targets for CPOs. • Refine the terms of opportunities with more market sounding. • **Length of lease** is a critical issue for private sector investment; however, public sector procurement rules tend towards leases being as short as possible. There is a large overhead both for public and private sector in agreeing lease heads of terms. A standardised lease template (e.g., that used by TfW) might help; TfW assistance could help fill gaps in local authority in-house legal capability.		

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: barriers to successful roll-out (3/5)

During the workshop covering Roles across the public sector, a range of barriers to the successful roll-out of the preferred network, and to investment in EV infrastructure in general, were identified; these are identified in the leftmost column. The three rightmost columns outline potential interventions from public sector bodies [3/5].

Barrier	WG Intervention	TfW Intervention	LA Intervention
Strategic and commercial misalignment– private sector business cases can be at odds with public sector strategy, with private CPOs investing only in those sites with strong commercial viability without consideration for the public sector's "preferred network", access equality, and affordable tariffs.	**Incentivise investment –** in less financially viable sites: • **Finance** – financial transaction reserve and / or WG grants to support targeted capital investment (e.g., a grid connection fund for select rural on-route sites). • **Bundling** – offer financially attractive investment opportunities in exchange for investing in a less financially viable (but strategically important) site, packaged as a bundle. **Intervene financially** – in targeted cases where the private sector leaves gaps in the preferred network and an equality issue is identified (see right, *equality intervention framework*).	• **De-risk** – alleviate some investor risk by providing supporting materials, including traffic modelling, planning, power purchasing, or customer service support. • **Equality intervention framework** – set up and implement an opportunity-specific framework, with strategic oversight from the Welsh Government, to review gaps in the preferred network and, is an equality (of access, coverage, etc.) gap is identified, recommend sites to the Welsh Government for financial transaction reserve financing or grant funding.	• **De-risk** – alleviate some investor risk by providing local planning support.
Quality underperformance – CPOs performing planning and infrastructure delivery without public intervention, guidance, or collaboration can have negative externalities when, for example, infrastructure is delivered behind schedule, sites are poorly managed, or quality expectations are unmet – this can have negative consequences for user experience and public sector reputation.	• Incorporate "**National Standards**", good practice guidance, and consistency of standards across Wales into EV charging strategy shared with TfW, Local Authorities, and the private sector.	• Set out **standards expectations** in procurement frameworks • Select **sites** considering environmental factors, future-proofing, and resilience • Carry out **monitoring** during execution of contracted works	• Set out **standards expectations** in procurement • Select **sites** considering environmental factors, future-proofing, and resilience • Carry out monitoring during execution of contracted works
	• Interventions into **addressing quality underperformance** will further be considered in collaboration with Arup's Programme and Project management team		

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: barriers to successful roll-out (4/5)

During the workshop covering Roles across the public sector, a range of barriers to the successful roll-out of the preferred network, and to investment in EV infrastructure in general, were identified; these are identified in the leftmost column. The three rightmost columns outline potential interventions from public sector bodies [4/5].

Barrier	WG Intervention	TfW Intervention	LA Intervention
Welsh market access – the private sector has had difficulty accessing Welsh market; CPOs operate at narrow margins and public sector expectations, such as the Welsh language requirement and planning requirements, can be a barrier.	Provide private sector CPOs with support to meet **Welsh language requirements** on a centralised scale.	TfW to explore opportunity to provide 'off the shelf' **bilingual customer support service**. TfW to develop standardised bilingual printed signage / information.	
	See "**private sector appetite for investment**" two slides previous – engage with the private sector to better understand access issues and if Wales is unintentionally putting up barriers to private sector investment.		
Parking and traffic management – it can be difficult to develop more charging bays at street side locations; equally, Local Authorities must manage traffic and the allocation of parking spots (at carparks, residential street) and ensure non-EV drivers too have access to parking.		• Roll-out of infrastructure should **consider spatial factors** – multi-connector EV CPs should be placed between bays to maximise access, land should be selected based on parking and charging behaviour, etc. • Roll-out of infrastructure should be **just ahead of need**. • Consider future-proofing (growth in CPs over time with EV uptake) in terms of grid connection capacities at larger car-park sites.	
		• Provide **traffic modelling** support to the private sector and Local Authorities.	
Limited local resources – Local Authorities face resource gaps and are responsible for a range of services outside of EV charging and decarbonisation; how can the Welsh Government and/or Transport for Wales support Local Authorities and fill capability gaps?	• Provide financial support to enable Local Authorities to each appoint an EV officer or appoint a centralised EV officer liaise with Local Authorities. • Take on the strategic governance role to guide TfW, allowing TfW to support Local Authority delivery.	• Provide support to Local Authorities in their role of enabling investment in (especially on-street and destination) charging infrastructure; for example, a helpdesk, traffic modelling, planning support, etc.	• Local Authorities have an important role in helping deliver on-street and residential destination charging. Use WG funding to appoint an EV officer at each Local Authority or liaise with centralised Welsh Government EV officer and seek support from TfW.
	• **Engage with LAs to understand wider capability** – both in in terms of current skills and resources and future plans to build skills and resources in targeted areas across the EV charging value chain. • In addressing strategy, engage with **national parks Local Authorities**.		

3. Commercial case
3.3 Stakeholder engagement

3.3.2 Roles across the public sector: barriers to successful roll-out (5/5)

During the workshop covering Roles across the public sector, a range of barriers to the successful roll-out of the preferred network, and to investment in EV infrastructure in general, were identified; these are identified in the leftmost column. The three rightmost columns outline potential interventions from public sector bodies [5/5].

Barrier	WG Intervention	TfW Intervention	LA Intervention
Home / public and regional tariff disparities – rising power costs have increased tariffs to approximately £1 /kWh for rapid charging and the gap between fast and rapid charging tariffs has decreased, creating greater costs for consumers. There is a disparity between home charging and public charging costs, as well as a regional disparity between tariffs.	Going forwards, there is likely to always be a price disparity between home (private) and public charging – this disparity mirrors that of costs faced by the "operator". At home, users face a small capital cost and then charge their vehicles via their home electricity tariff; however, public charging involves significantly higher capital costs and also involves costs of operating the charging site. That is to say, **at home, consumers are purchasing power – in public, they're purchasing a service**. Further, power costs at home are cheaper than in public by design of the power market – this is true not only in Wales, but across the UK. Subsidising public charging tariffs to remove the inequality for those without access to off-street parking and charging is impractical for a number of reasons: • Tariffs are set by CPOs – often with untransparent profit assumptions, capital costs of grid and infrastructure, and operating costs built into the margin between power supply cost and tariff. CPOs can change tariffs to meet their own business plan requirements – they do not move directly in line with the retail cost of power. • Subsidising tariffs would open the public sector to demand risk that is unlikely to go away over time (as the price disparity between public and home charging is unlikely to go away)		
	• Address inequality in inter-region tariff disparities via targeted grid connection capex support in specific sites, modalities, and locations (e.g., remote areas far from a distribution network point of connection).		
Policy / planning barriers – policies and regulations can make investment more difficult; for example, planning requirement surrounding height of electrical upstand and outlet remains in place in Wales, while England has removed this.	• Use policy levers to **address or remove barriers** to investment after engaging with the private sector; remove height regulation in planning like in England. • Promote the use of **dynamic procurement** to delivery entities, prioritising flexible, open market systems. • **Centralise** EV charging strategy under a single governance framework (i.e., a Strategic board to guide strategy, overseeing an Operational board to guide implementation).	Utilise **dynamic, open market, flexible procurement** to alleviate contracting barriers. Implement **lessons learned** from TfW work on the SRN: - change of Welsh permitted development rights; - strong ownership – single point of contact with ability to escalate quickly within local authority landowner, particularly on legal and leases; - noting the challenge of local authority planning processes; - ensuring CPO strongly incentivised to complete delivery in timely manner.	

3. Commercial case
3.3 Stakeholder engagement

3.3.3 The private sector: the role of the private sector

The private sector is likely to invest in Welsh EV charging infrastructure regardless of public intervention, as the sector profitability increases with EV uptake. However, the speed and location of this investment may not align to the Government's strategy. Before the public sector can intervene to realign objectives and outcomes, it must first engage with the private sector.

Private CPO site selection

- When CPOs are looking to invest in a site, cost typically has a higher weighting in the site selection process than does projected demand.
- Key risks for CPOs are land and grid – many are looking to acquire land and grid connections to build their planned CPs (see bottom right chart).
- Land and grid tend to have a major capex impact – CPOs are unlikely to develop a site where a grid connection would be very expensive without incentive. This could lead to inequity of coverage of charging infrastructure across Wales.
- One role for the public sector could be to close gaps in private sector investment: incentivising the private sector to invest in key locations, subsidising certain parts of investments, and/or developing a limited number of publicly or jointly owned sites.

Key Engagement Considerations

The Welsh Government and Transport for Wales are in the planning stage of engaging with the private sector to explore the following:

- What are the public sector expectations for private sector investment?
- What do private sector CPOs have planned for development in Wales (and by when)?
- Why has the private sector historically not engaged with the Welsh public sector or invested in Welsh charging infrastructure at a wide scale?

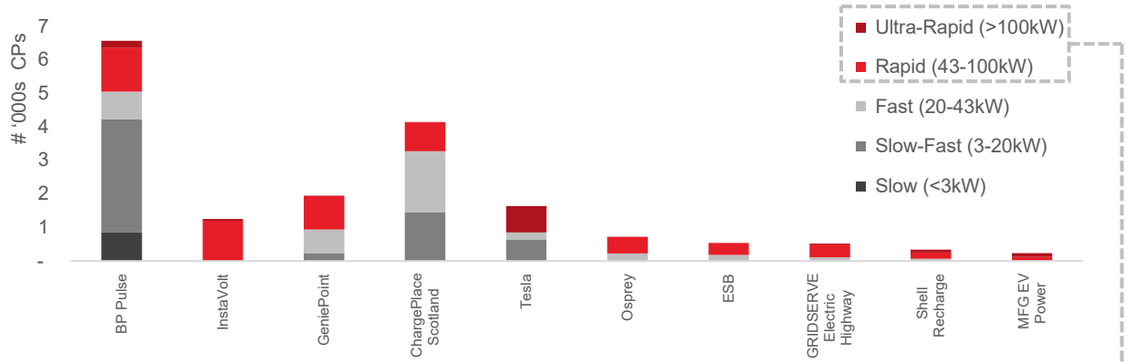


Figure 21: Existing chargepoints in the UK by speed and private-sector CPO ('000s of CPs)
Source: BloombergNEF 2022

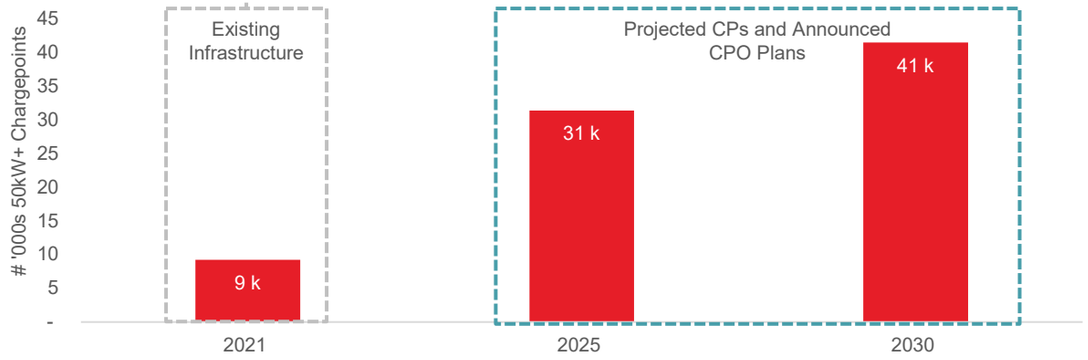


Figure 22: Existing and planned 50kW+ chargepoints to be delivered by private CPOs across the UK ('000s of CPs)
Sources: BloombergNEF 2022 and various Chargepoint Operator announced plans

3. Commercial case
3.3 Stakeholder engagement

3.3.3 The private sector: engagement with the private sector

The Welsh Government, Transport for Wales, and Local Authorities have begun engaging with the private sector to better understand its plans for infrastructure roll-out and what gaps might need to be filled by public sector intervention. Further and more targeted engagement is still needed.

Engagement So Far

Transport for Wales held a first private sector engagement session in November 2022. The session was attended by Transport for Wales, the Welsh Government, Local Authorities, and private sector players, and had the following aims:

- Allow the public sector to understand how to help the private sector unlock investment opportunities across Wales
- Share the Welsh Government approach to its EV programme
- Build a more cohesive and consistent offer from public sector
- Allow the private sector take advantage of Welsh Government support tools
- Engage with the private sector on key themes at a high level, and encourage further one-to-one dialogue between individual private sector players, the Welsh Government, and Transport for Wales.
- Opportunities for your engagement to be public, anonymous or confidential

The workshop was attended by 15 private sector companies – mainly CPOs, with some consultants and other market players. The private sector audience was receptive of the public sector's engagement and a constructive dialogue took place. Key emerging ideas included:

- the need to incorporate solar and battery into the deliverability strategy;
- the need to publish of Local Authorities' own delivery strategies for clarity;
- that CPOs see themselves as best placed to understand financials, and that CPO preference for many is for build-own-operate models, a desire to manage the process end-to-end; and
- that CPOs view contributing to and being consulted on procurement strategies as they are in development as very important.

The public sector intends to follow this introductory session up with one-to-one engagement with individual CPOs, specifically those catering to public car charging.

Guiding Questions for Future Private sector engagement

One-to-one engagement between the public sector (Welsh Government and Transport for Wales) and individual CPOs:

1. **How much charging infrastructure do private CPOs plan to deliver?**
    - Where and by when?
    - Serving what user groups?
    - At what speeds or using what technology?
    - *Internal consideration: how does this compare to the preferred network and the infrastructure costed in the financial case? Where are key gaps? Where do public sector assumptions differ from private sector?*
2. **What support is the private sector looking to the public sector to provide?**
    - Financial vs non-financial support mechanisms
    - Targeted intervention and regulation
    - Roles across the public sector
3. **What barriers to investment exist within the Welsh market?**
    - Interventions outlined in Barriers to Successful Roll-Out
    - What has caused there to be less investment in the Welsh than in the English EV charging market?
    - What, if any, government interventions have private chargepoint operators found useful in England that could be employed in Wales?
4. **What terms would the private sector be looking for in collaborative opportunities with the public sector?**
    - Type of procurement framework
    - Contract length
    - Site requirements (location, amount of infrastructure, amenities)
5. **What challenges to private CPOs face in rolling out charging infrastructure, generally?**
    - Connection costs and limited grid capacity headroom?
    - Availability or cost of land?
    - Demand from users?

3. Commercial case
3.3 Stakeholder engagement

3.3.4 Conclusion: emerging recommendations

A main take-away that emerged from Arup's work with the public sector in developing the commercial case was that there is no one-size-fits-all approach to market intervention. The degree and type of interventions that Arup would recommend the public sector make depend on the type of opportunity and owner of the site land.

- Emerging recommendation
- Potential pathway
- Not recommended
- Not applicable

	Opportunity Type:	Key Take-Aways	Sites Developed on Private Land by Private CPOs	Sites Developed in PPP on Private Land	Sites Developed on Public Land by Private CPOs	Sites Developed in PPP on Public Land	Sites Developed on Public Land by Public Sector
*	Policy Intervention	The Welsh Government's main role across all opportunities lies in policy-based interventions that remove barriers, promote decarbonisation, and incentivise investment. These policy interventions can support both the private sector and other public sector bodies.	●	●	●	●	●
A	Subsidy / auction / franchise	Out of all Welsh public sector bodies, the Welsh Government has the most capacity – skill and resource – to financially intervene. This should be considered on a case-by case basis, with specific and targeted beneficiaries, with a special focus on closing equality gaps.	*Consider on a case-by-case basis where equality gaps emerge – all financial intervention should be targeted (specific sites, capex types, or areas) and balanced against other public needs.*			*Access to grants can help Local Authorities capture local opportunities.*	
A	Plan and lease / licence	On publicly-owned land that is well suited to EV charging, public sector delivery entities (TfW and Local Authorities) could plan sites and lease them out to private CPOs. The public sector could also offer planning support to private investors to help de-risk and incentivise.	*Planning support can be offered by the public sector to help de-risk private investment*		●	●	●
A	Develop and lease / licence	On publicly-owned land that is well suited to EV charging, public sector delivery entities (TfW and Local Authorities) could plan sites and develop sites, then lease them out to private CPOs. This option is more capital intensive, with not much public sector capability.	●	●	●	●	●
B	Low-control JV	In a low-control JV, public sector delivery entities could have a degree of control over charging outcomes at the site, without taking on the full investment risk (however, still facing demand risk). Operations should largely be outsourced to private CPOs.	●	●	●	●	●
B	High-control JV	In a high-control JV, a private sector partner would likely expect significant public sector investment, and the public sector would face demand risk. Operations should largely be outsourced to private CPOs, but the public sector could offer support (e.g., user experience).	●	●	●	●	●
C	Own and appoint operator	The private sector could retain full ownership of a charging site on suitable public land and outsourcing site operations to a private sector CPO. This would require significant capital investment and full exposure to demand risk.	●	●	●	●	●
C	Own and operate	Arup does not recommend this option to be deployed on a wide-scale basis, as it is in conflict with the Welsh Government's low appetite for operational risk. Select opportunities – especially in the On-Route network could be owned and operated by TfW.	●	●	●	●	●

3. Commercial case
3.3 Stakeholder engagement

3.3.4 Conclusion: emerging recommendations and next steps

The majority of charging infrastructure is expected to be delivered by the private sector; to ensure that this aligns with the Government EV charging strategy, the Government must engage with the private sector and its public sector delivery entities, TfW and Local Authorities, firm up its prioritisation of delivery, and determine the size and scope of its funding envelope.

Priority of Delivery

Two elements of the delivery strategy should first prioritised first (before moving on to others); these are detailed in Section 3.3.2:

1. **Delivery of the on-route network** (delivery entity: TfW)
2. **Delivery of destination and on-street charging in built-up areas** (delivery entity: Local Authorities, support from TfW)

These elements will have the most short-term benefit for users in Wales, providing a strong cross-national network and catering to users who have a greater need for public charging.

Public Sector Roles

It is expected that the private sector will deliver the majority of EV charging infrastructure in Wales, with support from and gaps filled by the public sector. As detailed in Section 3.3.2, the main roles of the public sector include:

- **Welsh Government** – oversight and socialisation of the EV charging strategy, setting standards, monitoring strategy progress, policy intervention, and financial intervention
- **TfW** – delivering and monitoring the strategy at On-Route sites and rail station car parks, providing delivery support to LAs and Welsh Government
- **Local Authorities** – delivering and monitoring the strategy locally, at destinations and on-street, with support from TfW

Goals for Future Engagement

The private sector is expected to contribute the majority of the investment in Welsh charging infrastructure. To understand the size of the Government funding envelope and the scope of required intervention, engagement with the private sector is required. The below key considerations are detailed in Section 3.3.3:

1. How much charging infrastructure do private CPOs plan to deliver? Where, and by when?
2. What support is the private sector looking to the public sector to provide?
3. What barriers to investment exist within the Welsh market?
4. What terms would the private sector be looking for in collaborative opportunities with the public sector?
5. What challenges to private CPOs face in rolling out charging infrastructure, generally?

Approach to Intervention

Key to the commercial strategy is the underlying tenet that there can be no “one size fits all” approach to market intervention. The Welsh Government strategy sets out the need to balance actual charging needs with the goals of the preferred network, maximising return on infrastructure delivery while minimising public spending and allocating most risk to the private sector.

To approach market intervention to ensure the delivery of the strategy with one single business model or subsidy scheme would risk two negative externalities:

1. Intervention would not be aligned to actual need – creating unequal coverage and equality gaps in some areas, while in others supporting private investment that would have taken place regardless of public sector intervention, and
2. Intervention could not meet all, sometimes competing, strategy priorities (e.g., promoting EV uptake vs minimising public sector investment).

Equality gaps in private sector investment should be assessed on a case-by-case basis. Further, financial intervention should be targeted and limited, considering factors such as ownership of land, the costs that will be passed on to the consumer, and the actual charging need in the area – for example, the Government could subsidise grid connection capex at key on-route sites where grid capacity is limited or there is a great distance to the nearest point of connection.

The Government should take maximum advantage of the policy levers at its disposal and the capabilities of other public sector bodies, like TfW and Local Authorities, in delivering its strategy. Next steps include engaging with the private sector, socialising strategy with TfW and LAs, determining the size and scope of the funding envelope, and firming up the prioritisation of delivery.

4. Financial case

4.1 Purpose of the financial case

4. Financial case
4.1 Purpose of the financial case

4.1 Purpose of the financial case

The purpose of the financial case is to determine the cost of rolling out On-Route and Destination charging in Wales, and this section will focus on the total capital costs of the EV charging infrastructure roll-out required to meet future EV demand projections. The financial case presents a high-level estimate of the total capital cost of installing all on-route and destination charging infrastructure in Wales, agnostic of what body is taking financial responsibility.

The financial case presents a range of capital cost outcomes for three to four demand scenarios (three for on-route, four for destination) and eight sensitivities flexing site size and quantity, unit cost inputs, and the amount of demand met by supply. The financial case only focuses on public CPs at destination and on-route locations (see an explanation of charging modes and locations in the commercial case). Private charging at homes and workplaces, and public charging at hubs and on-street are not included.

4.2 Methodology

4.2.1 Approach to the costing exercise

This section provides a high-level outline of the capex calculation method, as well as the scenarios and sensitivities included in the modelling.

4.2.2 Demand modelling scenarios

This section outlines the demand modelling that fed into the capex estimate.

4.2.3 Sensitivities

This section expands on the inputs flexed in the capex estimate sensitivities.

4.2.4 Assumptions and limitations

This section sets out the assumptions and limitations of the capex estimate.

4.3 Central case results

4.3.1 Headline results

This section outlines the cumulative key results: number of CPs, number of sites, installed capacity, and total capex from 2020 to 2050, both for the central case and for the full range of demand cases and sensitivities applied to the central case demand.

4.3.2 Range of results

This section illustrates the central case results vs the range of minimum to maximum results from each demand case and all sensitivities applied to the central case.

4.3.3 Central case capex mix

This section illustrates the breakdown of capex by spending category.

4.4 Sensitivity testing

4.4.1 Extended range of results

This section illustrates the central case results vs the range of minimum to maximum results from each demand case and all sensitivities applied all demand cases.

4.4.2 Supply sensitivities

This section illustrates the results of scenarios and sensitivities affecting charging supply.

4.4.3 Capex sensitivities

This section illustrates the results of scenarios and sensitivities affecting capital costs.

4.5 Recommendations and next steps

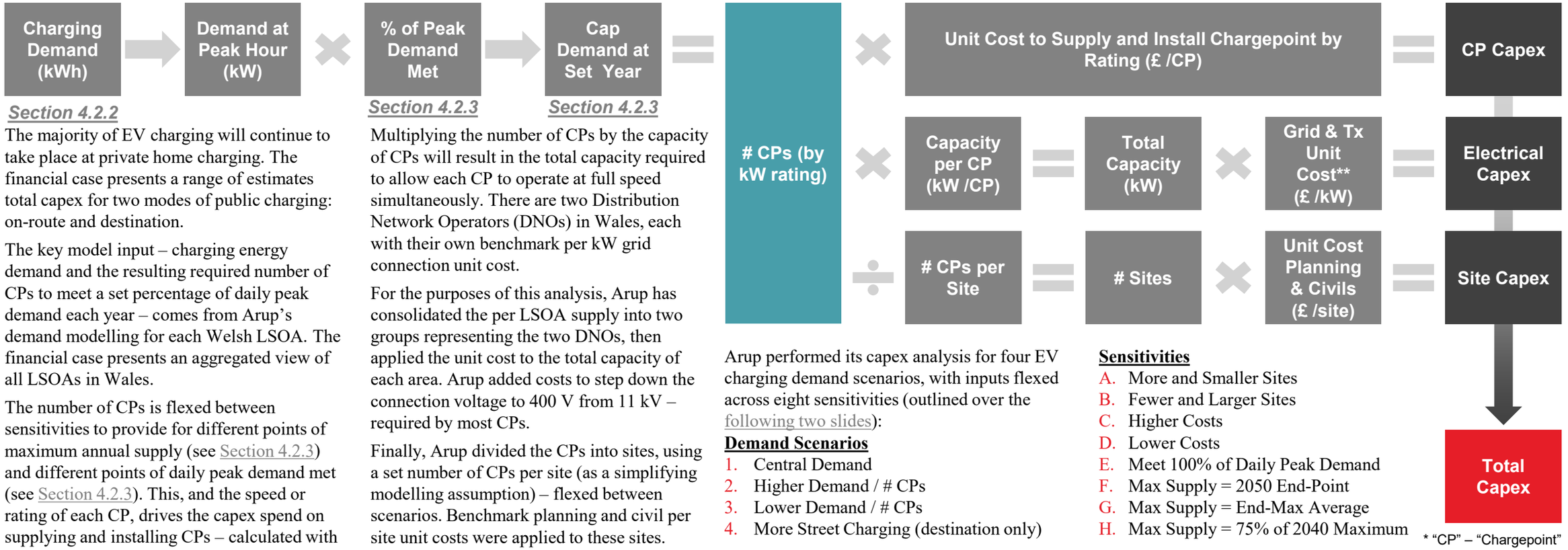
4.2 Methodology

4. Financial case
4.2 Methodology

** Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

4.2.1 Approach to the costing exercise

The financial case presents a high-level estimate of the capital cost of rolling out the full destination and on-route networks in Wales, across a range of scenarios and sensitivities. The capex analysis is split into three aspects: the cost to purchase and install CPs*, the cost to connect to the grid and perform necessary step-down transformation, and the cost of planning and performing the civil works to set up the site.



Section 4.2.2

The majority of EV charging will continue to take place at private home charging. The financial case presents a range of estimates total capex for two modes of public charging: on-route and destination.

The key model input – charging energy demand and the resulting required number of CPs to meet a set percentage of daily peak demand each year – comes from Arup's demand modelling for each Welsh LSOA. The financial case presents an aggregated view of all LSOAs in Wales.

The number of CPs is flexed between sensitivities to provide for different points of maximum annual supply (see Section 4.2.3) and different points of daily peak demand met (see Section 4.2.3). This, and the speed or rating of each CP, drives the capex spend on supplying and installing CPs – calculated with a per CP unit cost.

Section 4.2.3

Multiplying the number of CPs by the capacity of CPs will result in the total capacity required to allow each CP to operate at full speed simultaneously. There are two Distribution Network Operators (DNOs) in Wales, each with their own benchmark per kW grid connection unit cost.

For the purposes of this analysis, Arup has consolidated the per LSOA supply into two groups representing the two DNOs, then applied the unit cost to the total capacity of each area. Arup added costs to step down the connection voltage to 400 V from 11 kV – required by most CPs.

Finally, Arup divided the CPs into sites, using a set number of CPs per site (as a simplifying modelling assumption) – flexed between scenarios. Benchmark planning and civil per site unit costs were applied to these sites.

Section 4.2.3

Arup performed its capex analysis for four EV charging demand scenarios, with inputs flexed across eight sensitivities (outlined over the following two slides):

Demand Scenarios

1. Central Demand
2. Higher Demand / # CPs
3. Lower Demand / # CPs
4. More Street Charging (destination only)

Sensitivities

A. More and Smaller Sites
B. Fewer and Larger Sites
C. Higher Costs
D. Lower Costs
E. Meet 100% of Daily Peak Demand
F. Max Supply = 2050 End-Point
G. Max Supply = End-Max Average
H. Max Supply = 75% of 2040 Maximum

* "CP" – "Chargepoint"

4. Financial case
4.2 Methodology

***** NOTE:** Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

CE – "Consumer Efficiency" demand scenario
RD – "Rapid Dominant" demand scenario
GS – "Government On-Street" demand scenario

4.2.1 Approach to the costing exercise: capex model scenarios [1/2]

As outlined on the previous slide, Arup used three main scenarios (with an additional fourth Destination scenario) of charging demand and subsequent supply to be costed. Four sensitivities flex site size and unit costs:

	Central Case	Higher Demand	Lower Demand	More Street Charging *	Sensitivities A-D: A – More and Smaller Sites	B – Fewer and Larger Sites	C – Higher Costs	D – Lower Costs
Demand Scenario	Central projection of required charging infrastructure ("10%" On-Route; "Base" Destination demand)	Higher projection of required charging infrastructure ("15%" On-Route; "CE" Destination demand)	Lower projection of required charging infrastructure ("5%" On-Route; "RD" Destination demand)	Alternative projection of required charging infrastructure with more on-street charging ("GS" Destination demand)	Central	Central	Central	Central
Supply for what maximum annual point?	Charging infrastructure is supplied to meet the maximum point in 2040 and then does not change	Central	Central	Central	Central	Central	Central	Central
Meet what % of daily peak demand?	75%	Central	Central	Central	Central	Central	Central	Central
Site Size (CPs /site)	On-Route: 10 Destination: 6	Central	Central	Central	On-Route: 6 Destination: 2	On-Route: 14 Destination: 12	Central	Central
CP Cost	100% of Unit Cost**	Central	Central	Central	Central	Central	125% of Unit Cost**	75% of Unit Cost**
Site Cost	100% of Unit Cost**	Central	Central	Central	80% (On-Route) and 66.7% (Destination) of Unit Cost**	120% (On-Route) and 150% of Unit Cost**	125% of Unit Cost**	75% of Unit Cost**
Grid Connection	SPEN: £168 /kW *** WPD: £315 /kW ***	Central	Central	Central	Central	150% of Unit Cost**	125% of Unit Cost**	75% of Unit Cost**
SEE NOTE ABOVE	1	2	3	4				

Demand Scenarios 1-4

* Scenario for Destination charging only – does not apply to On-Route
** Unit costs detailed in Appendix C.2 and sources in Appendix C.4

4. Financial case
4.2 Methodology

***** NOTE:** Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

CE – "Consumer Efficiency" demand scenario
RD – "Rapid Dominant" demand scenario
GS – "Government On-Street" demand scenario

4.2.1 Approach to the costing exercise: capex model scenarios [2/2]

Four further sensitivities flex the amount of demand being met by supply – both on an annual basis and in terms of daily peak demand. These are expanded upon in section 4.2.3.

	Central Case	Higher Demand	Lower Demand	Government On-Street*	Sensitivities E-H: Meet 100% of Daily Peak Demand (E)	Sensitivities E-H: Maximum Supply = 2050 End-Point (F)	Sensitivities E-H: Maximum Supply = End-Max Average (G)	Sensitivities E-H: Maximum Supply = 75% of 2040 Maximum (H)
Demand Scenario	Central projection of required charging infrastructure ("10%" On-Route; "Base" Destination demand)	Higher projection of required charging infrastructure ("15%" On-Route; "CE" Destination demand)	Lower projection of required charging infrastructure ("5%" On-Route; "RD" Destination demand)	Alternative projection of required charging infrastructure with more on-street charging ("GS" Destination demand)	Central	Central	Central	Central
Supply for what maximum annual point?	Charging infrastructure is supplied to meet the maximum point in 2040 and then does not change	Central	Central	Central	Central	Charging infrastructure is supplied to meet the end point in 2050 (supply less than max) and then does not change	Charging infrastructure is supplied to meet the average point between the 2040 maximum and the 2050 end point (supply less than max) and then does not change	Charging infrastructure is supplied to meet 75% of the maximum in 2040 (supply less than max) and then does not change
Meet what % of daily peak demand?	75%	Central	Central	Central	100%	Central	Central	Central
Site Size (CPs /site)	On-Route: 10 Destination: 6	Central	Central	Central	Central	Central	Central	Central
CP Cost	100% of Unit Cost**	Central	Central	Central	Central	Central	Central	Central
Site Cost	100% of Unit Cost**	Central	Central	Central	Central	Central	Central	Central
Grid Connection	SPEN: £168 /kW *** WPD: £315 /kW ***	Central	Central	Central	Central	Central	Central	Central
SEE NOTE ABOVE	1	2	3	4				

Demand Scenarios 1-4

* Scenario for Destination charging only – does not apply to On-Route
** Unit costs detailed in Appendix C.2 and sources in Appendix C.4

4. Financial case
4.2 Methodology

4.2.2 Demand modelling scenarios: on-route

On-Route

The demand modelling workstream produced three on-route and four destination scenarios, driven by the Leading the Way EV uptake from National Grid's Future Energy Scenarios (FES), 2021. The CP supply that is costed in Arup's financial case analysis is equal to the number of CPs required to meet a set percentage of the peak hour of daily demand in each year, under each scenario.

Both the On-Route and Destination demand models are underpinned by National Grid's Leading the Way EV uptake assumptions from the 2020 FES, in line with the demand case used in the *Electric Vehicle Charging Strategy for Wales* (2021). Both models output CPs requited to meet 100% of peak daily demand each year per Welsh LSOA; this is later flexed in the capex analysis to better represent commercial practices in the EV charging market. Demand model outputs will be shared with the Welsh Government in Arup's **Preferred Network WebMap** tool.

Arup's On-Route demand model outputs demand and required number of CPs per Welsh LSOA to meet demand under three scenarios, representing different proportions of vehicle mileage charging On-Route. The On-Route model is based on a dataset of vehicle miles travelled in Wales. In the central case, On-Route charging serves the demand of 10% of vehicle miles travelled. In the higher demand scenario, this proportion is increased to 15%, and in the lower demand scenario, decreased to 5%.

On-Route Demand Scenarios:

1	Central Case Scenario	10%	10% of all vehicle miles are covered by On-Route charging
2	Higher Demand Scenario	15%	15% of all vehicle miles are covered by On-Route charging
3	Lower Demand Scenario	5%	5% of all vehicle miles are covered by On-Route charging
4	More Street Charging	*N/A*	*Does not apply to On-Route Charging*

4.2.2 Demand modelling scenarios: destination [1/2]

Destination

Like the On-route Model, Arup's Destination demand model outputs demand and required number of CPs to meet that demand by LSOA – this demand is aggregated into a total Wales capex in the financial case analysis. The Destination Model contains under four scenarios and includes Home, On-Street, and Destination and Workplace charging, based on a dataset of vehicle trips into each Welsh LSOA.

The modelling conflates Destination and Workplace charging. Because the latter is typically not public, Arup removes a portion of capacity under each demand case, assuming that 6% of Destination and Workplace charging takes place at private workplaces (informed by Arup analysis of BloombergNEF and DfT vehicle trip data). A description of each of the four Destination demand scenarios is outlined on the following slide, along with a breakdown of charging infrastructure and capacity by location and speed.

See appendix C.3 for additional information on the demand modelling that fed into the capex analysis.

Destination Demand Scenarios:

1	Central Case Scenario	Base	Base (current charging behaviour mix)
2	Higher Demand Scenario	CE	Consumer Efficiency
3	Lower Demand Scenario	RD	Rapid Dominant
4	More Street Charging	*GS*	Government On-Street (GS)

4. Financial case
4.2 Methodology

Destination

4.2.2 Demand modelling scenarios: destination [2/2]

The four Destination scenarios have their own assumptions of charging that takes place at Destinations or Workplaces, and their own mix of charging speeds*. As outlined on the previous slide, Workplace charging is later removed. Base is the central scenario, CE has more charging and slower at destinations, RD has faster charging, and GS has more street charging, with less and slower charging at destinations.

	Scenario	% Destination	Speed % by CPs	Speed % by Capacity	Description
1	**Base:**	6% of CPs 29% of kW	70% Fast 15% Rapid 15% Ultra-	27% Fast 24% Rapid 49% Ultra-	A baseline set of assumptions established using market and behaviour observations to date, continued forward with trends to forecast EV energy and charge point quantity.
2	**Consumer Efficiency (CE):**	17% of CPs 34% of kW	95% Fast 5% Rapid	82% Fast 18% Rapid	A scenario where consumers are more environmentally conscious. EV drivers choose to have a vehicle with a battery suitable for every day short distance use and do not purchase the largest range EV on the market.
3	**Rapid Dominant (RD):**	4% of CPs 28% of kW	50% Fast 30% Rapid 20% Ultra-	17% Fast 33% Rapid 50% Ultra-	In this scenario EV drivers are expected to follow the behaviour patterns observed in ICE vehicle refuelling, therefore there is a greater need for Rapid and above chargepoints to reduce consumer dwell times.
4	**Government On-Street (GS):**	6% of CPs 17% of kW	90% Fast 8% Rapid 2% Ultra-	65% Fast 23% Rapid 12% Ultra-	In this scenario it is assumed that a Government incentive or scheme is in place and widely adopted enabling drivers who have no off-street parking the ability to charge close to home via public residential charging.

* Charging speeds: Fast = 7 to < 43 kW | Rapid = 43 to < 100 kW | Ultra-rapid = 100 kW +

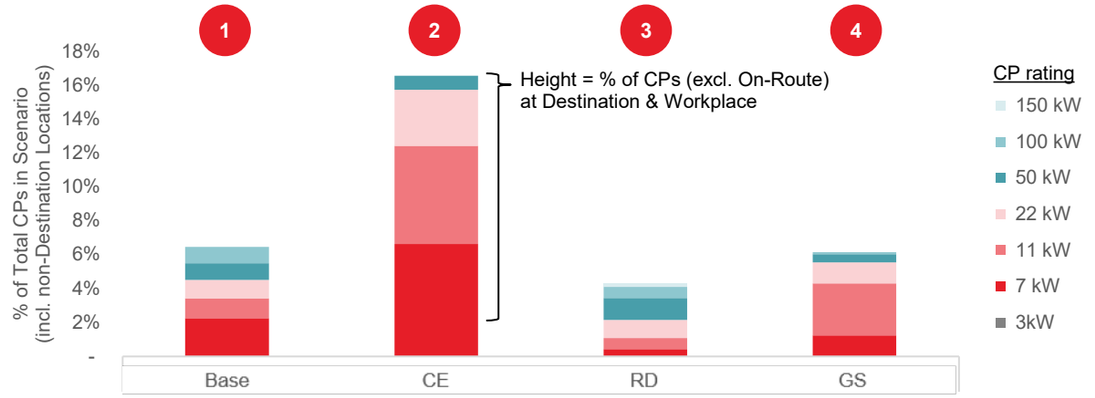


Figure 23: destination Charging Infra. (# CPs), by Scenario and Speed: 2040 (incl. workplace – *later removed*)
Source: Arup Analysis

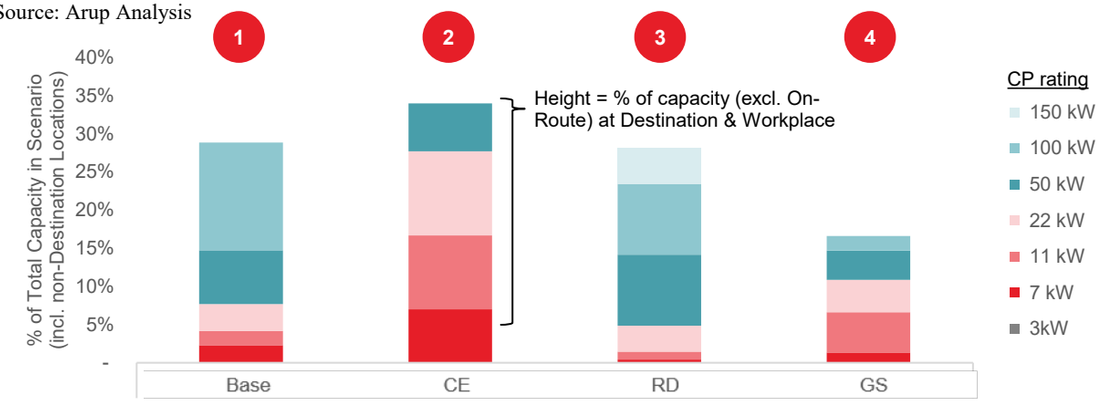


Figure 24: destination Charging Capacity (kW), by Scenario and Speed: 2040 (incl. workplace – *later removed*)
Source: Arup Analysis

4. Financial case
4.2 Methodology

4.2.3 Sensitivities [1/3]: maximum annual supply

The market could supply charging infrastructure to meet different points in projected demand. Arup's capex analysis assumes that chargepoints will be supplied to meet the maximum annual point in 2040 and 75% of daily peak demand via infrastructure roll-out. Three sensitivities outline the size and pace of roll-out to meet lower points of supply; a fourth reflects meeting 100% of daily peak demand (see next slide).

The EV uptake curve used in the demand modelling feeding into the financial case capex analysis is National Grid's 2021 Future Energy Scenarios "Leading the Way". This curve peaks around 2040, with fewer electric vehicles after this point, driven by a modal shift away from road transportation. Once charging infrastructure is installed, it is not cost effective to remove it when utilisation declines. Charging machines only have an asset live of 10 to 15 years, however, supplying these machines involves longer-term sunk costs, like that of connecting to power grid, and of first-time installation works, and of planning and civil works required at the charging site.

With that in mind, the capex model assumes that once chargepoints are installed, they will remain in place, with like-for-like replacement until the end of the modelling period. Because the end-point required supply to meet demand is lower than the peak in 2040, charging infrastructure can be installed to meet a range of outcomes – meeting the peak in 2040, meeting the end-point in 2050, or some point in between. The dotted black lines opposite represent the supply to meet 100% of the peak hour of daily demand via infrastructure roll-out each year – supply can be provided for less than this amount, as is outlined on the following slide. **This is not to say that demand would be left unmet in the sensitivities represented by the lower lines** – there are ways of meeting this demand via more dynamic charging solutions instead of installing extra chargepoints to meet the daily or annual peak.

Shape of Demanded Infrastructure:

- ••••• Demanded quantity of CPs (Base demand)

Shape of Installed Infrastructure (once installed, not removed):

- Meet 100% of daily peak demand (sensitivity E)
- **Maximum supply = 100% of maximum point in 2040 (central case)**
- Maximum supply = end-point in 2050 (sensitivity F)
- Maximum supply = average between max point in 2040 and end-point in 2050 (sensitivity G)
- Maximum supply = 75% of maximum point in 2040 (sensitivity H)

Meet 75% of Daily Peak Demand

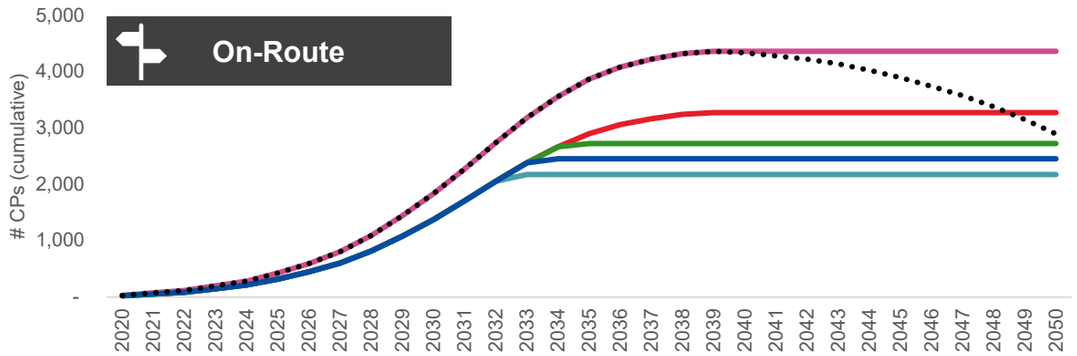


Figure 25: Sensitivities around central case scenario on-route demand (10% on-route) - # CPs
Source: Arup Analysis

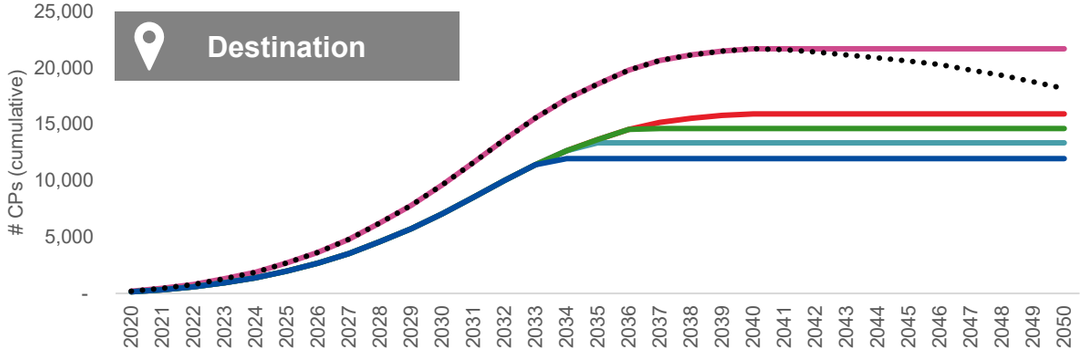


Figure 26: Sensitivities around central case scenario destination demand (base) - # CPs
Source: Arup Analysis

4. Financial case
4.2 Methodology

4.2.3 Sensitivities [2/3]: peak daily supply

The capex analysis assumes that CP infrastructure is supplied to meet 75% of the peak hour of daily demand each year by supplying charging infrastructure, with charging events distributed further out across the day. Sensitivity analysis explores another option of supplying CPs to meet 100% of the daily peak via supplying charging infrastructure (see opposite).

The demand modelling feeding into the capex analysis projects the number and capacity of chargepoints required to meet the daily demand in the peak hour each year (see charts opposite).

Commercial practices in the EV charging market do not typically result in charging supply meeting charging infrastructure. Supplying chargepoints to meet the peak hour of demand would lead to under-utilisation across the rest of the day, and would be capital intensive. Likewise, CPOs often limit the speed of chargepoints at their sites to maximise availability with limited grid connection capacity. Arup has assumed supply would meet 75% of daily peak demand in the central case. **This is not to say that 25% of demand would be unmet**, but demand would be shifted to off-peak times via dynamic or smart charging solutions.

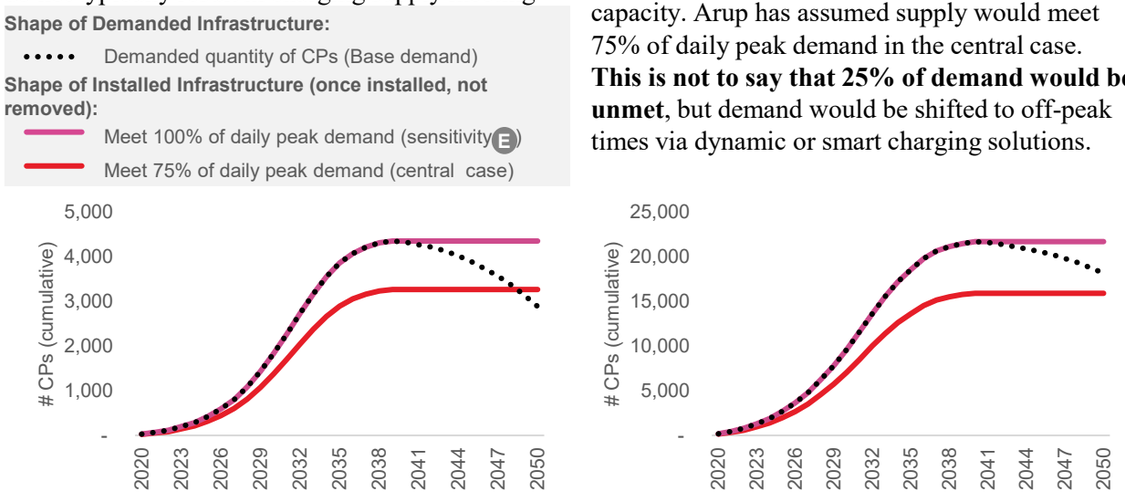


Figure 27: On-route peak daily demand scenarios

Figure 28: Destination peak daily demand scenarios

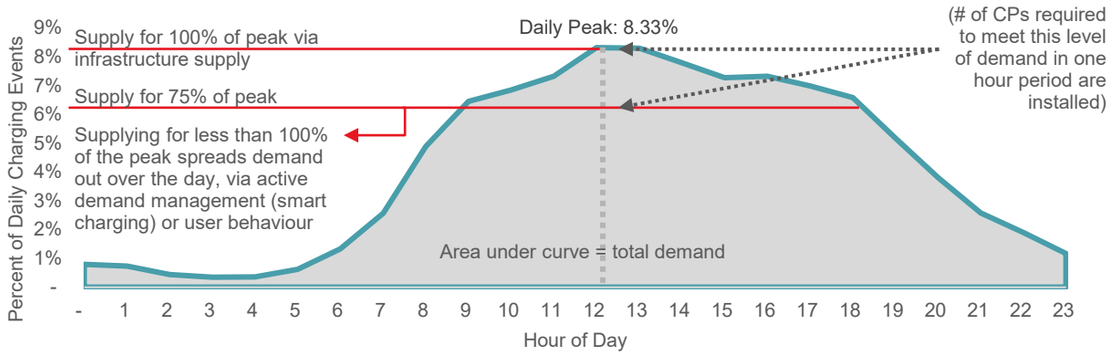


Figure 29: On-route model daily demand profile

Source: Department for Transport

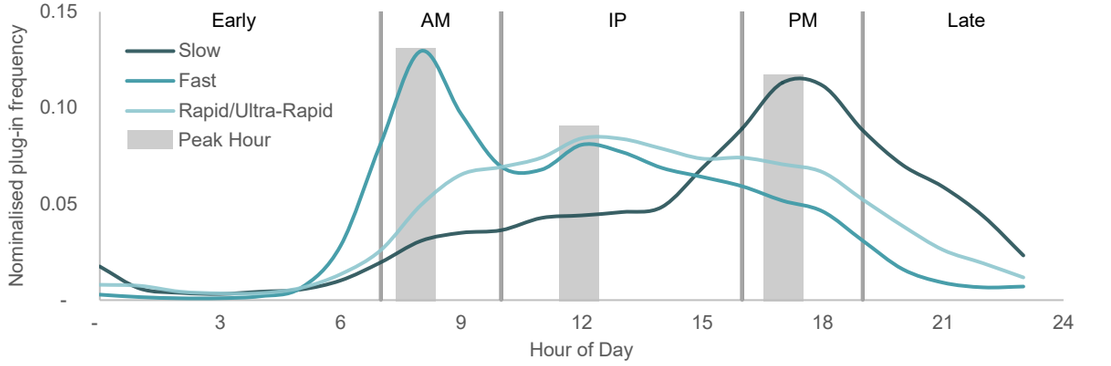


Figure 30: Destination model

4. Financial case
4.2 Methodology

4.2.3 Sensitivities [3/3]: costs

Sensitivities A and B include considerations of the effect of site size on grid connection and site planning and civils capex. Grid costs can increase by a margin once the size of the connection reaches a higher voltage level or vary in remote areas and those of grid constrain. Likewise site size can affect the planning and civil costs faced. Sensitivities C and D flex all unit costs up and down by 25%, respectively.

Grid Connection Cost

Arup's analysis uses a per kilowatt unit cost for each of two DNOs in Wales. This cost was supplied by SPEN and WPD and is applied to the assumed capacity of the site. Under sensitivities A and B, site size (number of CPs per site) is flexed, leading to more smaller capacity sites, or fewer larger capacity sites, respectively.

Grid connection cost does not necessarily have a linear relationship with site capacity. Many factors affect this cost – including available capacity headroom (i.e., network constrain) at, distance to (i.e., remoteness), and voltage of the nearest upstream point of grid connection.

However, the capacity of a site can cause a jump in grid connection cost once certain voltage thresholds are reached. To represent this, Arup has assumed that larger sites (under sensitivity B) will face a 50% uplift on the grid connection unit cost.

Site Planning and Civils

The capex analysis uses a per site unit cost for site planning and civil works capex. These unit costs are taken from Arup benchmarks and knowledge of the EV charging market.

Arup assumes that some portion of these unit costs will scale with site size, while some portion will be faced regardless of site size, as a baseline. For the purpose of this analysis, Arup has assumed that half of each unit cost is baseline and half scales with site size – represented by the number of CPs per site.

For on-route sites, this means unit costs decrease or increase by 20% for smaller and larger sites, respectively. For destination sites, the unit cost decreases by a third for smaller sites and increases by half for larger. Differences are caused by the number of CPs assumed for different site types under each sensitivity.

Cost Sensitivities

Sensitivities C and D flex all unit costs up and down by 25%, respectively. All unit cost assumptions – in the central case and across sensitivities – are outlined in Appendix C.2.

*** NOTE:** Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

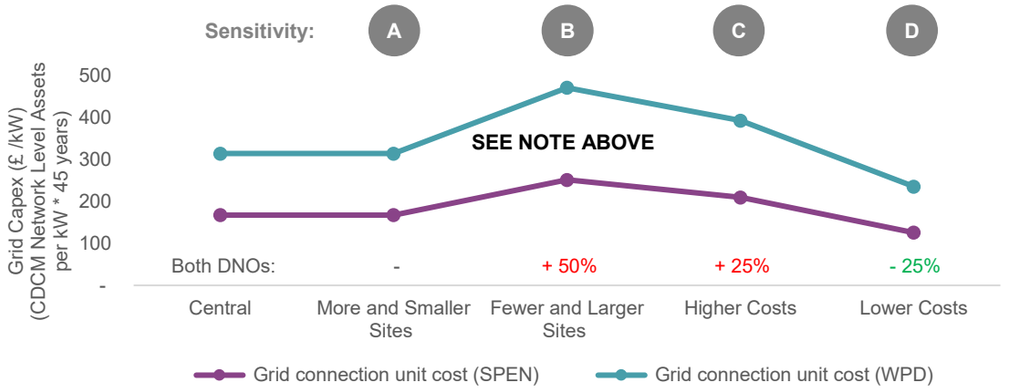


Figure 31: Grid capex unit costs: central case scenario and sensitivities A, B, C, and D *

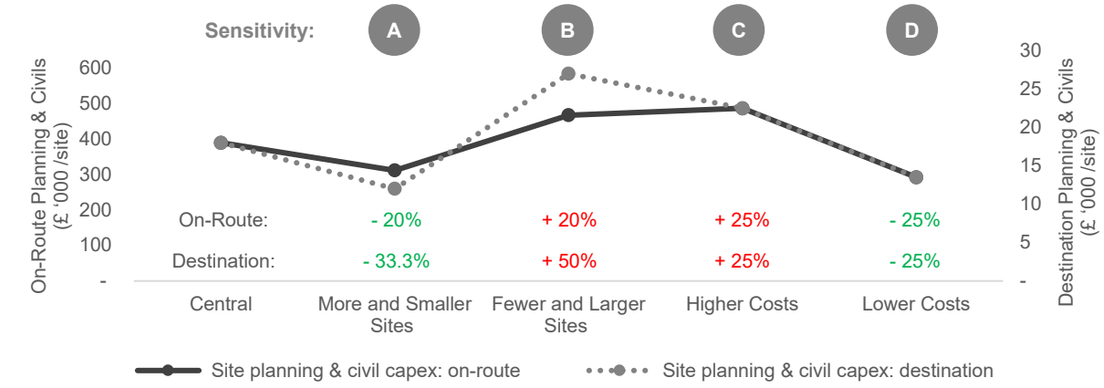


Figure 32: Site planning and civils capex unit costs: central case scenario and sensitivities A, B, C, and D

4. Financial case
4.2 Methodology

4.2.4 Assumptions and limitations[1/2]: demand modelling

Assumptions and limitations include those inherent to the demand modelling that fed into the capex estimate analysis, as well as those made in the analysis process. One scenario of EV uptake – FES Leading the Way an optimistic and fast-paced uptake – is assumed for all scenarios. The analysis based on constant costs and excludes land costs, lifecycle / replacement costs, operational costs, inflation, tax, and depreciation.

Some assumptions and limitations are inherent to Arup's demand modelling that fed into the capex estimate:

- **Home charging** – it is assumed that all EV drivers with access to off-street parking (driveways) will charge at home rather than destination or public residential charging.
- **Daily demand profiles** – used to identify the peak hour of demand are informed by DfT data on plug-in frequencies.
- **EV uptake** – is informed by National Grid's Leading the Way (LtW) scenario from its 2021 Future Energy Scenarios (FES).
- **Source data** – The destination model covers demand from cars based on data from the DfT National Trip End Model (NTEM). The on-route model is based on DfT traffic counts. DfT traffic count data is used to estimate average daily miles travelled for each LSOA.
- **Vehicle efficiency** – is assumed at 5km /kWh (based on BloombergNEF), and changes with temperature, informed by Met Office data and Geotab analysis.
- **Charging speed / rating** – All On-Route charging is assumed as 50kW, as opposed to a mix of rapid and ultra-rapid speeds, to be conservate and maximise access to charging while limiting the size of grid connections. The number of Destination chargepoints on the network are proportioned out to 7 respective charger ratings (3,7, 11, 22, 50, 100, 150 kW). Proportions applied were informed by DfT, OpenChargeMap.org, and a PhD study by Newcastle University.
- **Mileage** – The Destination model assumes that vehicle mileage decreases at a compounded annual interest rate of 1.82% from the base year (2019) – and of 0.68% for number of trips – informed by historical DfT data.
- **Rurality** – Lower mileage is assumed in urban areas and higher in rural. The split of mileage in urban and rural areas is informed by the National Travel Survey data (NTS9904).
- **Battery size** – Vehicle battery size in the Destination model is 60kW in 2020, increasing by 5kW every two years in the base scenario to 135kW in 2050.
- **Charging behaviour** – Arup assumes users that need to charge do so to refuel the energy consumed from the mileage driven every trip (top-up charging). In the On-Route model, frequency of plugin times are informed by DfT 2017 Charge Point analysis.
- **Location** – 2011 LSOA and Local Authority boundaries are taken from DataMap Wales.

4. Financial case
4.2 Methodology

* Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

4.2.4 Assumptions and limitations [2/2]: capex analysis

Assumptions and limitations include those inherent to the demand modelling that fed into the capex estimate analysis, as well as those made in the analysis process. One scenario of EV uptake – FES Leading the Way an optimistic and fast-paced uptake – is assumed for all scenarios. The analysis based on constant costs and excludes land costs, lifecycle / replacement costs, operational costs, inflation, tax, and depreciation.

In undertaking the capex estimate analysis, there are further assumptions and limitations:

- **Exclusions** - the analysis includes only capital costs of CP supply and installation, grid connection and site substation / step-down transformation, and site planning and civils. CP replacement, land costs, and operational costs are excluded, as is inflation, tax, and depreciation. It would not be useful to estimate land acquisition capex until site locations are identified. The total cost of rolling out the on-route and destination networks could be higher than Arup's estimates when taking into account the excluded capex items; including the operational costs would significantly increase the estimate.
- **Unit costs** – all costs are constant – not changing over time – and are based on unit costs per CP, kW of capacity, or site. Some adjustments are made to grid connection unit costs for larger sites and planning and civil works costs for smaller and larger sites (outlined on the previous slide) to address limitations of using unit costs (e.g., linearly scaling costs). Using benchmark unit costs can distort the total cost estimate, which would in reality differ by location, site size, etc.
- **Grid connection costs*** – as outlined above, a unit cost is used to estimate distribution network connection capex as a simplifying modelling assumption. In reality, grid connection costs vary by the capacity of connection (and voltage level of connection) and by location (including both rurality, or distance from the closest point of network connection, and grid constraint, or available capacity headroom). Grid connection capex will very significantly by site and location and is difficult to estimate, especially without exact site locations identified. Simplifying grid connection capex as a unit cost provides a very rough benchmark of potential cost. This cost item should be refined once sites are identified, using quotes from the DNOs. See note above.
- **Site size** – under each scenario, it is assumed that sites within each charging mode (On-Route and Destination) are same size. Site size is flexed under two sensitivities (A and B) to adjust for this limitation.
- **Rounding** – the demand modelling outputs an unrounded non-whole number of CPs required to meet each year's demand. The capex analysis rounds this number up, so that a whole number of CPs is installed each year; however, per site number of CPs is fractional and unrounded. This limitation does not significantly affect the Wales-wide capex estimate, as presented in the financial case, but would affect analysis on a site-by-site and LSOA-by-LSOA basis.
- **Amount of demand** – the pace of EV uptake, technological improvements, and user charging behaviour are all uncertain. Arup analyses a range of demand scenarios (1, 2, 3, and 4, with 4 for Destination only) to account for this limitation. However, all scenarios assume FES LtW EV uptake, which is the most optimistic case. Further sensitivity testing should be performed around different EV uptake cases, which would lead to different cost profiles.
- **Demand met by supply** – there is uncertainty about how much demand will be met by market supply – both in terms of the maximum point of annual supply (outlined in 4.2.3) and the amount of peak daily demand supplied for (also outlined in 4.2.3). In the central case, Arup has assumed that CPs will be installed to meet 75% of daily peak demand in the maximum year (2040) by infrastructure roll-out alone. Sensitivities E, F, G, and H provide a range of other outcomes to account for this limitation. The roll-out of infrastructure will in reality depend on the competitive market and commercial assumptions made by private CPOs, as well as on particular interventions made by the public sector.
- **Existing CPs** – the CPs rolled out in the capex analysis include those already existing within Wales. Existing chargepoints have not been removed due to lack of location-specific data – this presents the conservative view of total capex. This limitation could be addressed by carrying out a survey of the speed and quantity of all public Destination and On-Route chargepoints within each Welsh LSOA. The total capex estimate could potentially be lower than presented by Arup if the existing chargepoints were removed, with a lower cost profile for the first few years of roll-out.

4.3 Main scenario results

4. Financial case
4.3 Main scenario results

4.3.1 Headline results [1/2]: central case

Central case capex reaches £887 million by 2040, with no growth after that point, with £345 million spent on On-Route charging and £543 million on Destination charging. By this point On-Route CPs number nearly 3,300, Destination CPs number nearly 16,000, with a total of more than 19,200. Total charging capacity reaches more than 650,000 kW, spread across nearly 3,000 sites.

Total Modelling Period

In the central case, Destination and On-Route CP supply peaks at a cumulative **19,200 CPs** in 2040, with no capital investment after that point. Total capacity reaches over 650,000 kW across almost 3,000 sites. Cumulative capital investment over the entire modelling period reaches **£887 million** in 2040.

Short-Medium-Term Milestones

As of November 2022, there are over 1,300 public CPs in Wales – across all public charging modes.

2025

By **2025**, around **2,300** (destination and on-route) **CPs** – 300 On-Route and 2,000 Destination would be installed in Wales, across more than 350 sites. Total charging capacity would have reached over 75,000 kW, with **£100 million of capex** invested – around a third spent On-Route and two thirds Destination.

2030

By **2030**, almost **8,500** (destination and on-route) **CPs** would be operational in Wales – more than 1,300 On-Route and 7,000 Destination, across more than 1,300 sites. Total capacity would have reached 286,000 kW, with **£386 million of capex** invested - £145 million On-Route and £241 million Destination.

CUMULATIVE		2020	2025	2030	2035	2040	2045	2050
Total								
Number of Chargepoints	*# CPs*	158	2,298	8,443	16,542	19,211	19,211	19,211
Number of Sites	*# sites*	25	362	1,315	2,564	2,984	2,984	2,984
Total Capacity	*kW*	5,310	76,685	285,622	563,437	652,424	652,424	652,424
Total Capex	***£ million***	**6.97**	**100.92**	**385.51**	**769.80**	**887.13**	**887.13**	**887.13**
On-Route								
Number of Chargepoints	*# CPs*	22	318	1,376	2,900	3,272	3,272	3,272
Number of Sites	*# sites*	2	32	138	290	327	327	327
Total Capacity	*kW*	1,088	15,900	68,813	145,013	163,575	163,575	163,575
Total Capex	***£ million***	**2.29**	**33.48**	**144.90**	**305.35**	**344.44**	**344.44**	**344.44**
Destination								
Number of Chargepoints	*# CPs*	137	1,980	7,067	13,641	15,939	15,939	15,939
Number of Sites	*# sites*	23	330	1,178	2,274	2,657	2,657	2,657
Total Capacity	*kW*	4,223	60,785	216,810	418,425	488,849	488,849	488,849
Total Capex	***£ million***	**4.68**	**67.44**	**240.62**	**464.44**	**542.70**	**542.70**	**542.70**

Table 1: Central case scenario: headline results (cumulative)
Source: Arup Analysis

4. Financial case
4.3 Main scenario results

4.3.1 Headline results [2/2]: range of scenarios

Across the full range of Arup's four demand scenarios and eight sensitivities, total capex across the entire timeline varies by £768 million, reflecting the variability of the speed of roll-out, amount of demand and supply, and cost of delivery. EV charging is a developing market with high levels of uncertainty, which is considered in the range of scenarios and sensitivities in Arup's modelling.

The table opposite outlines the full range of results from any of four demand scenarios (three for on-route) and any of eight sensitivities applied to the central case scenario.

The minimum and maximum of each range represents the minimum and maximum output from any scenario or sensitivity. Because different inputs are flexed in each scenario and sensitivity, the minimum or maximum point of one metric (e.g., number of CPs) might come from a scenario and / or sensitivity different to that of another metric (e.g., number of sites).

For example, the minimum point in all On-Route metrics is the Lower Demand scenario result. However, the minimum number of Destination CPs results from the Lower Demand scenario, the minimum number of sites from the Fewer and Larger sites sensitivity, and both the total capacity and total capex from the Government On-Street demand scenario.

The maximum number of On-Route CPs results from the Higher Demand scenario, the number of sites from the More and Smaller Sites sensitivity, and both the capacity and capex from the Higher Demand scenario. The maximum number of Destination CPs results from the Higher Demand scenario, the number of sites from the More and Smaller Sites sensitivity, and both the capacity and capex from the Sensitivity that supplies for 100% of daily peak demand.

CUMULATIVE		**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Total								
Number of Chargepoints	*# CPs ('000s)*	0.1 to 0.42	1.38 to 5.82	5.54 to 23.42	10.83 to 45.65	11.95 to 50.31	11.95 to 50.31	11.95 to 50.31
Number of Sites	*# sites*	13 to 72	181 to 1,043	658 to 3,789	1,282 to 7,366	1,492 to 8,515	1,492 to 8,515	1,492 to 8,515
Total Capacity	*MW*	5 to 7	63 to 107	214 to 399	333 to 788	386 to 911	386 to 911	386 to 911
Total Capex	***£ million***	**5 to 10**	**67 to 142**	**253 to 545**	**423 to 1,091**	**488 to 1,256**	**488 to 1,256**	**488 to 1,256**
On-Route								
Number of Chargepoints	*# CPs ('000s)*	0.01 to 0.03	0.16 to 0.48	0.69 to 2.06	1.45 to 4.35	1.64 to 4.91	1.64 to 4.91	1.64 to 4.91
Number of Sites	*# sites*	1 to 4	16 to 53	69 to 229	145 to 483	164 to 545	164 to 545	164 to 545
Total Capacity	*MW*	1 to 2	8 to 24	34 to 103	73 to 218	82 to 245	82 to 245	82 to 245
Total Capex	***£ million***	**1 to 3**	**17 to 50**	**72 to 217**	**153 to 458**	**172 to 517**	**172 to 517**	**172 to 517**
Destination								
Number of Chargepoints	*# CPs ('000s)*	0.09 to 0.39	1.22 to 5.35	4.85 to 21.35	9.38 to 41.3	10.31 to 45.4	10.31 to 45.4	10.31 to 45.4
Number of Sites	*# sites*	11 to 68	165 to 990	589 to 3,559	1,137 to 6,883	1,328 to 7,970	1,328 to 7,970	1,328 to 7,970
Total Capacity	*MW*	4 to 6	55 to 83	179 to 295	261 to 570	304 to 666	304 to 666	304 to 666
Total Capex	***£ million***	**4 to 6**	**51 to 92**	**180 to 328**	**270 to 633**	**315 to 739**	**315 to 739**	**315 to 739**

Table 2: Range of scenarios & sensitivities (applied to central demand): headline results (cumulative)
Source: Arup Analysis

4. Financial case
4.3 Main scenario results

On-Route

4.3.2 Range of results [1/2]: on-route

The central case provides a good representation of the central point in all outputs resulting from each of the three demand scenarios and the eight sensitivities applied to the central case. This is because all chargepoints are the same speed (50 kW) and cost.

The opposite charts outline:

1. the central case scenario, and
2. a range of potential outcomes based on the minimum and maximum results of:
    a. all demand scenarios (5%, 10%, and 15% On-Route), and
    b. all sensitivities applied to central case scenario demand.

Sensitivities include:

- More and Smaller Sites
- Fewer and Larger Sites
- Higher Costs (+25% to all unit costs)
- Lower Costs (-25% to all unit costs)
- Supply for 100% of daily peak demand
- Maximum supply = 2050 end-point
- Maximum supply = average of max and end-point
- Maximum supply = 75% of 2040 max point

Legend:

Central Case (1.)

Range of minimum to maximum result (2.)

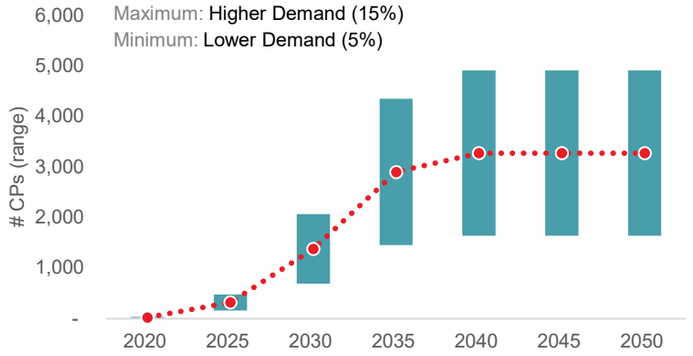


Figure 33: Total chargepoints
Source: Arup Analysis

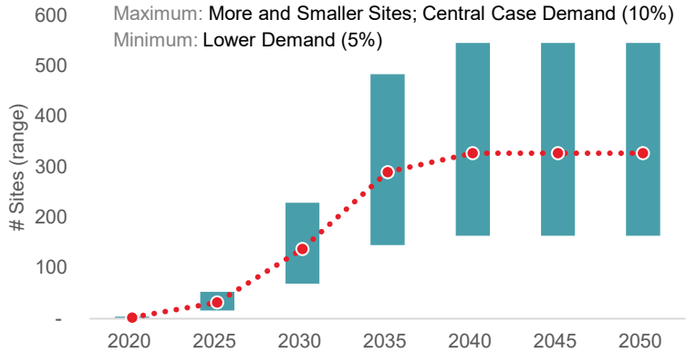


Figure 34: Number of sites
Source: Arup Analysis

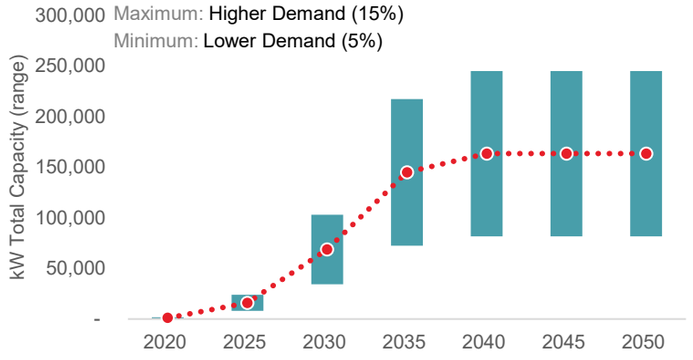


Figure 35: Total capacity
Source: Arup Analysis

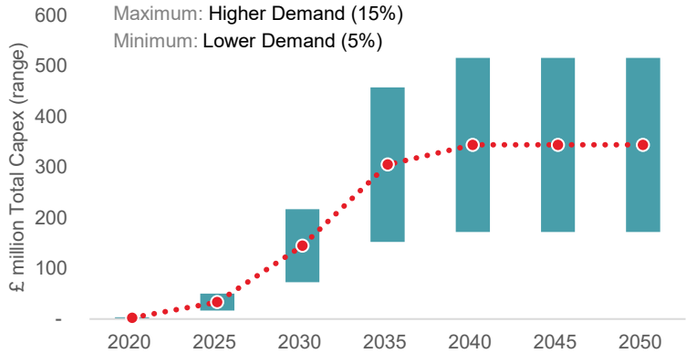


Figure 36: Total capex
Source: Arup Analysis

4. Financial case
4.3 Central case results

Destination

4.3.2 Range of results [2/2]: destination

The central case represents a relatively low number of CPs and sites, but average capacity and CPs; this is because the mix of charging speeds differs between scenarios (e.g., CE has many more chargepoints than Base, but of a lower average rating).

The opposite charts outline:

1. the central case scenario, and
2. a range of potential outcomes based on the minimum and maximum results of:
    a. all demand scenarios (Base, CE, RD, and GS), and
    b. all sensitivities applied to central case scenario demand.

Sensitivities include:

- More and Smaller Sites
- Fewer and Larger Sites
- Higher Costs (+25% to all unit costs)
- Lower Costs (-25% to all unit costs)
- Supply for 100% of daily peak demand
- Maximum supply = 2050 end-point
- Maximum supply = average of max and end-point
- Maximum supply = 75% of 2040 max point

Legend:

Central Case (1.)

Range of minimum to maximum result (2.)

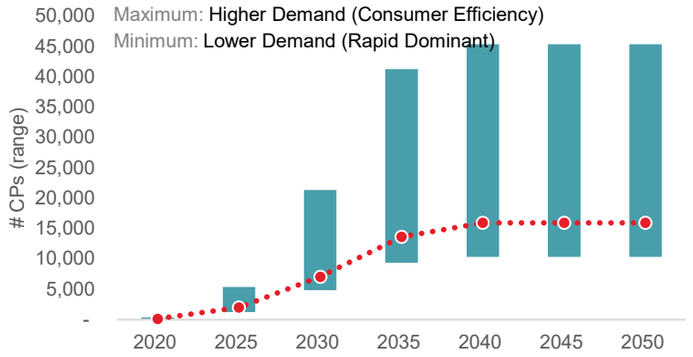


Figure 37: Total chargepoints
Source: Arup Analysis

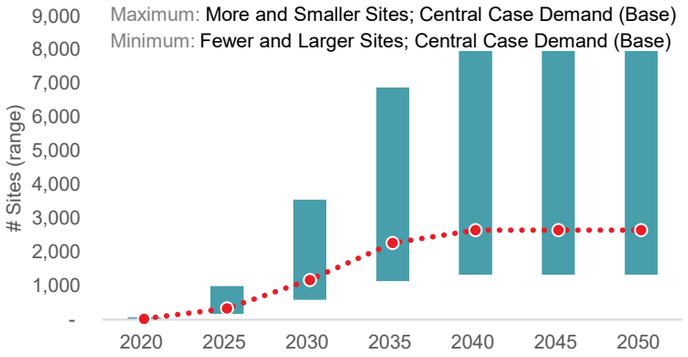


Figure 38: Number of sites
Source: Arup Analysis

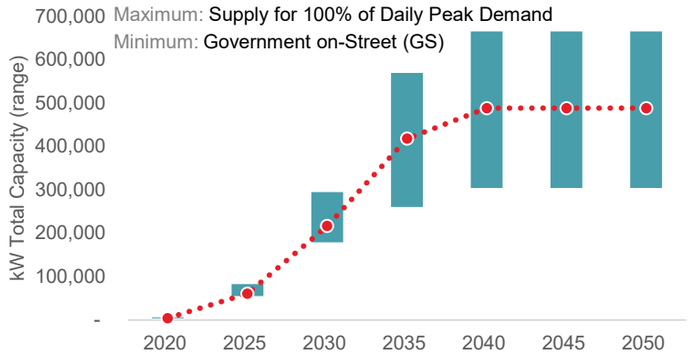


Figure 39: Total capacity
Source: Arup Analysis

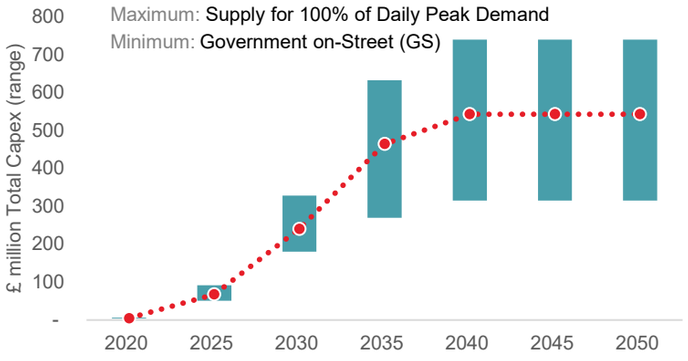


Figure 40: Total capex
Source: Arup Analysis

4. Financial case
4.3 Central case results

* Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models

Average capex: £1.8 million per site x 327 sites

On-Route

4.3.3 Central case capex mix [1/2]: on-route

Under the central case, annual On-Route charging capex would reach a peak of £37 million in 2032. Total capex reaches £344 million by 2040, when the network reaches maximum supply. The largest item of spend is site planning and civil works, followed by the supply of CPs.

Arup has assumed a significantly higher unit cost for setting up On-Route sites (incl. planning and civil works) than for Destination. This is in line with market benchmarks for sites of a similar size and with similar amenities. These sites might include amenities like restrooms, cafés, etc. There might be battery storage and on-site renewable generation, like solar canopies built into the sites.

It is Arup's understanding that On-Route sites will be larger – both in size and as a civil undertaking – and will require more design and planning consideration.

The On-Route charging network is expected to be smaller than local Destination networks; however, the CPs (per unit) tend to be more expensive, as all are rated 50kW. In practice, grid connection costs will vary depending on location (e.g., distance from substation, network constraints), while in the modelling, a per kW unit cost is used.

Installation also tends to be more expensive per unit for DC (direct current; rapid / ultra-rapid) than for AC (alternating current; <= fast) CPs. CP supply and installation capex peaks at £17 million, totalling £164 million by 204.

	Peak Annual Capex (£ million)	Cumulative Capex (£ million)	Percent of Total Capex (%)
CP Supply capex	12.2	114.5	33%
CP Installation capex	5.2	49.1	14%
Grid Connection capex *	4.8	45.1	13%
Transformation / Substation capex	0.9	8.2	2%
Site Planning & Civil Works capex	13.6	127.6	37%
Total capex	**36.8**	**344.4**	**100%**

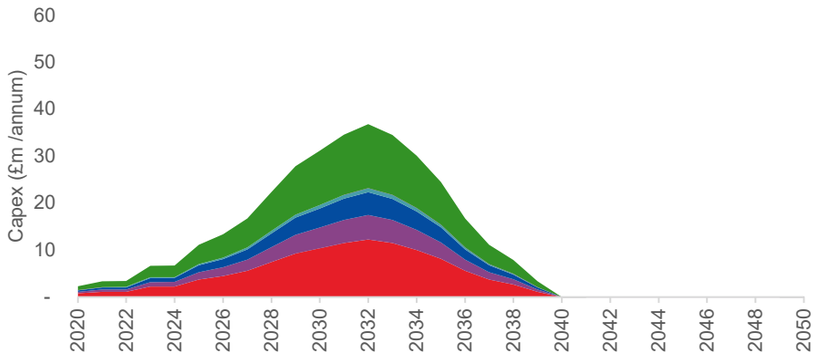


Figure 41: Annual capex (£ million)
Source: Arup Analysis

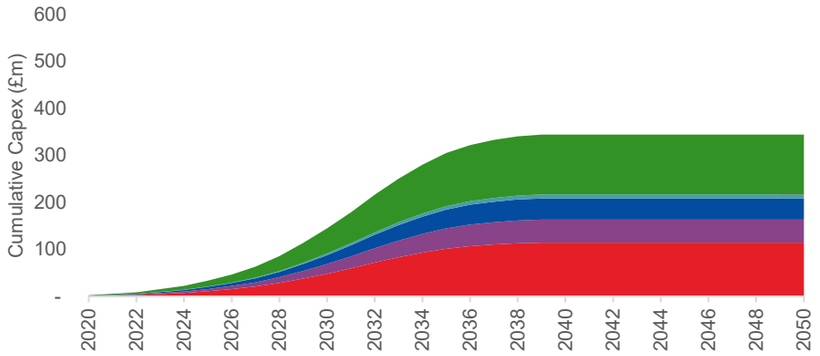


Figure 42: Cumulative capex (£ million)
Source: Arup Analysis

Grid Connection Cost & the RCF

In the central case, the total cost of connecting all sites to the grid (distribution network) is £45 million by 2040.

The UK government announced the £950 million Rapid Charging Fund (RCF) to finance grid connection costs at motorway service areas (key location for on-route charging) in England.

Taking a proportional approach by Welsh and English population size, the grid connection cost used in the financial case modelling is aligned with that in the analysis carried out for the English RCF.

4. Financial case
4.3 Central case results

* Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models

Average capex: £121,500 per site x 2,657 sites

Destination

4.3.3 Central case capex mix [2/2]: destination

Under the central case, annual Destination charging capex would reach a peak of £23 million in 2032. Total capex reaches £543 million by 2040, when the network reaches maximum supply. The largest item of spend is the supply of CPs, followed by grid connection costs.

Arup's demand analysis projects a higher CP requirement at Destination sites than On-Route, leading to significantly higher total capex required to roll-out the Destination network.

On the other hand, Arup assumes lower planning and civil costs per Destination site than per On-Route. In the central case, Arup assumes that an average Destination site of six CPs will cost £18,000 to plan and carry out all civil works (outside of grid connection, substation / transformation, and CP installation).

As an effect, CP supply and installation capex make up a greater proportion of total capex than (62% of Destination vs. 47% of On-Route Capex).

CP supply and installation capex reach a combined annual maximum of £32 million in 2032, and a total of £333 million by 2040.

The second highest area of capex spend at Destination sites is grid connection costs, which reach an annual maximum of £13 million by 2032 and a total of £138 million by 2040.

	Peak Annual Capex (£ million)	*Cumulative Capex (£ million)*	*Percent of Total Capex (%)*
CP Supply capex	22.5	236.6	44%
CP Installation capex	9.1	96.3	18%
Grid Connection capex *	13.0	137.5	25%
Transformation / Substation capex	2.3	24.5	5%
Site Planning & Civil Works capex	4.5	47.8	9%
Total capex	51.5	542.7	100%

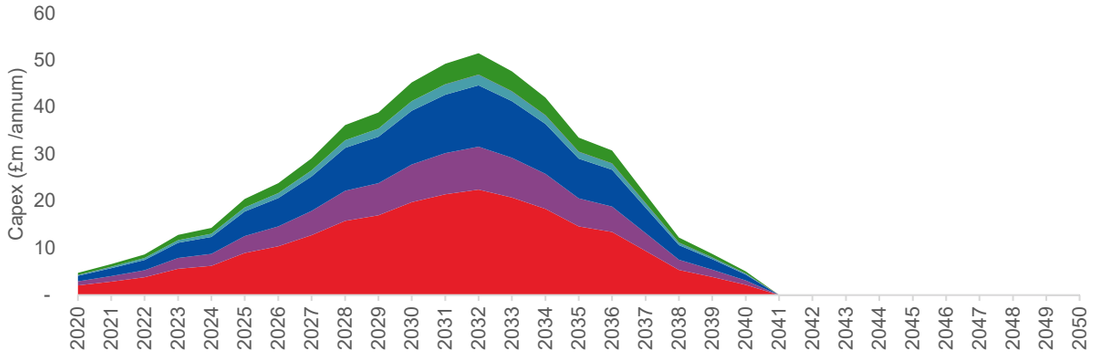


Figure 43: Annual capex (£ million)
Source: Arup Analysis

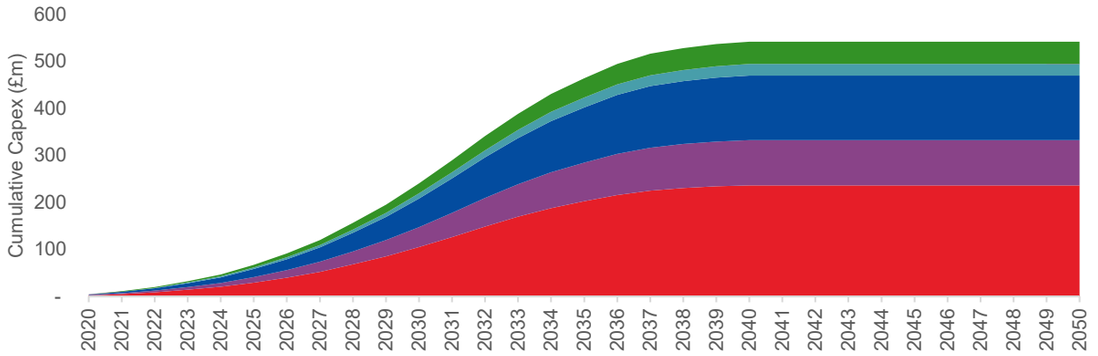


Figure 44: Cumulative capex (£ million)
Source: Arup Analysis

4.4 Sensitivity testing

4. Financial case
4.4 Sensitivity testing

On-Route

4.4.1 Extended range of results [1/2]: on-route

Applying all sensitivities too the lower and higher demand scenarios widens the range of outcomes for all metrics. The range is widened further on the high end because Sensitivity E increases supplied infrastructure by 25%.

The opposite charts outline:

1. the central case scenario, and
2. a range of potential outcomes based on the minimum and maximum results of:
    a. all demand scenarios (5%, 10%, and 15% On-Route),
    b. all sensitivities applied to central case scenario demand,
    c. and sensitivities **applied to all demand scenarios**.

Sensitivities include:

A. More and Smaller Sites
B. Fewer and Larger Sites
C. Higher Costs (+25% to all unit costs)
D. Lower Costs (-25% to all unit costs)
E. Supply for 100% of daily peak demand
F. Maximum supply = 2050 end-point
G. Maximum supply = average of max and end-point
H. Maximum supply = 75% of 2040 max point

Legend:

Range of min to max (2.a. & 2.b.) — Central Case (1.)
Range when sensitivities applied to non-central demand cases (2.c.)

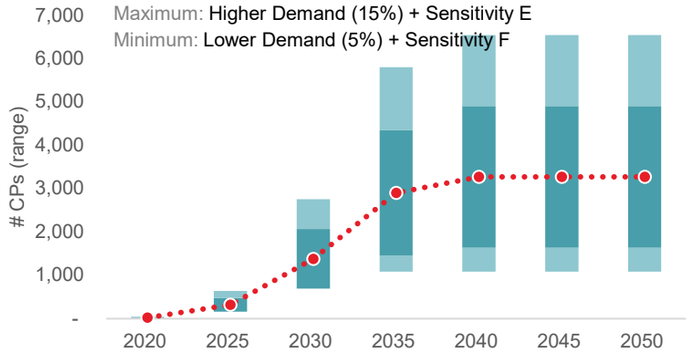


Figure 45: Total chargepoints
Source: Arup Analysis

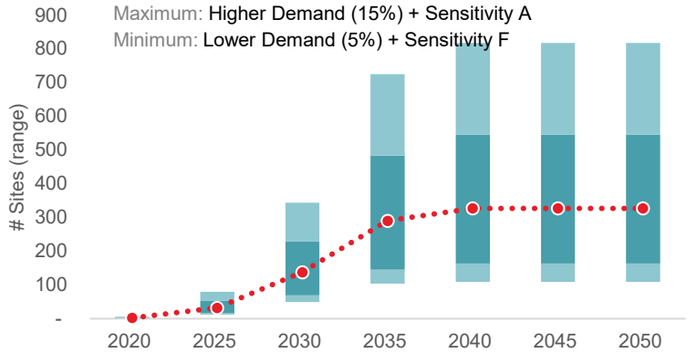


Figure 46: Number of sites
Source: Arup Analysis

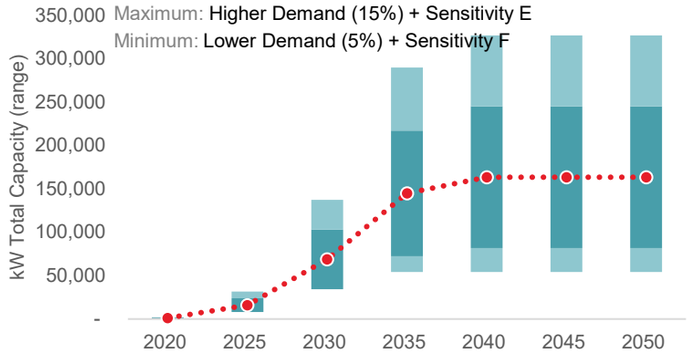


Figure 47: Total capacity
Source: Arup Analysis

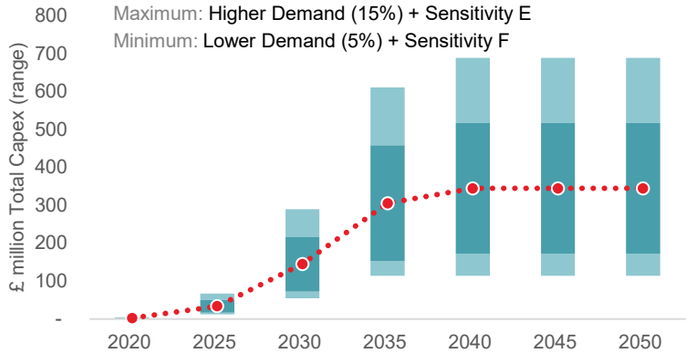


Figure 48: Total capex
Source: Arup Analysis

4. Financial case
4.4 Sensitivity testing

Destination

4.4.1 Extended range of results [2/2]: destination

As with On-Route, applying the sensitivities to the non-Central demand cases widens the range of results. Because more variables change between scenarios in the Destination demand model than in the On-Route, there is a wider range of results for all metrics*.

The opposite charts outline:

1. the central case scenario, and
2. a range of potential outcomes based on the minimum and maximum results of:
    a. all demand scenarios (Base, CE, RD, and GS),
    b. all sensitivities applied to central case scenario demand,
    c. and all sensitivities **applied to all demand scenarios**.

Sensitivities include:

A. More and Smaller Sites
B. Fewer and Larger Sites
C. Higher Costs (+25% to all unit costs)
D. Lower Costs (-25% to all unit costs)
E. Supply for 100% of daily peak demand
F. Maximum supply = 2050 end-point
G. Maximum supply = average of max and end-point
H. Maximum supply = 75% of 2040 max point

Legend:

Range of min to max (2.a. & 2.b.) Central Case (1.)
Range when sensitivities applied to non-central demand cases (2.c.)

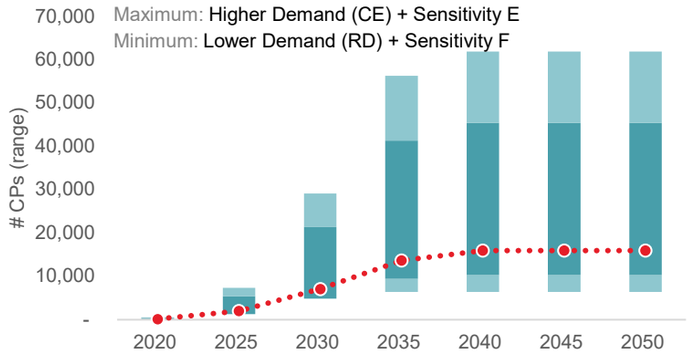


Figure 49: Total chargepoints
Source: Arup Analysis

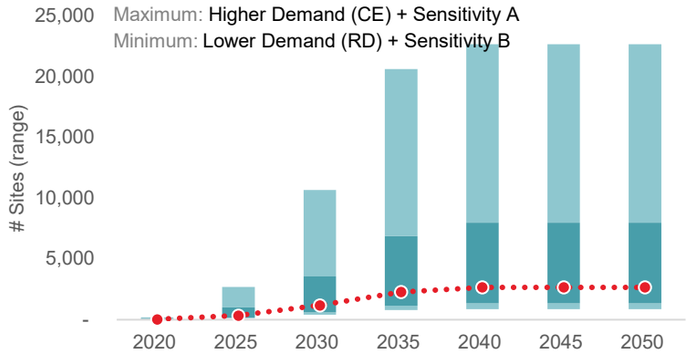


Figure 50: Number of sites
Source: Arup Analysis

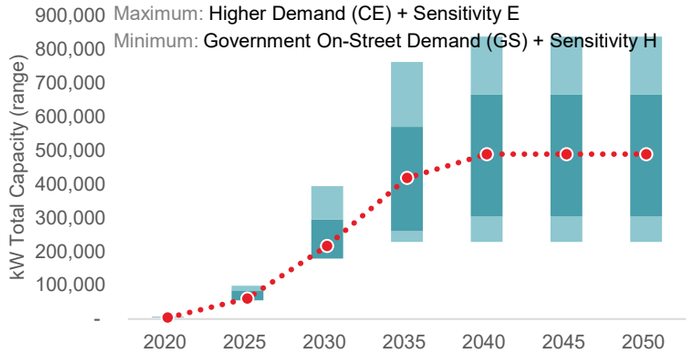


Figure 51: Total capacity
Source: Arup Analysis

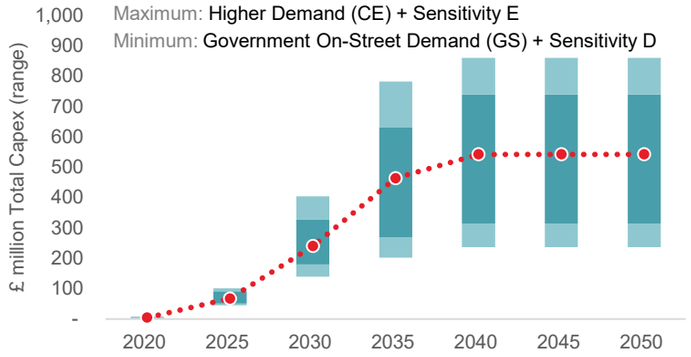


Figure 52: Total capex
Source: Arup Analysis

* i.e., the Destination demand model flexes assumptions of user behaviour, charging speed, and amount of charging at Destination sites between scenarios, while the On-Route demand model flexes only the amount of charging that takes place at On-Route sites, keeping all other assumptions equal.

4. Financial case
4.4 Sensitivity testing

On-Route

4.4.2 Supply sensitivities [1/2]: on-route

Installed CPs range from 1,600 to 5,000 by 2040 between scenarios. Total capacity ranges from 82 MW to 245 MW. The large range of results reflects the uncertainty inherent to the EV charging market development, the pace and scope of infrastructure roll-out, and the amount of charging that will take place on-route.

The charts opposite illustrate each of three scenarios of demand and each of four sensitivities affecting supply, applied to central case demand. The assumptions behind the demand scenarios and sensitivities are outlined in Section 4.2 and Appendix C.

There is an even range between each demand scenario because the percentage of charging that takes place On-Route changes from 5% to 10% to 15%. Sensitivities provide alternative outcomes where demand does not change, but the point of demand that is supplied for – either per year or per day – does.

The shape of outputs is the same between number of chargepoints and installed capacity because all On-Route chargepoints assumed to be rated 50 kW, unlike Destination, where speeds vary.

Main Scenarios

- Central Case (scenario 1)
- Higher Demand (scenario 2)
- Lower Demand (scenario 3)
- *Government On-Street – applies to Destination only*

Sensitivities (applied to the Central Case Scenario

- Supply for 100% of daily peak demand (sensitivity E)
- Maximum supply = 2050 end-point (sensitivity F)
- Maximum supply = average of max and end-point (sensitivity G)
- Maximum supply = 75% of 2040 max point (sensitivity H)

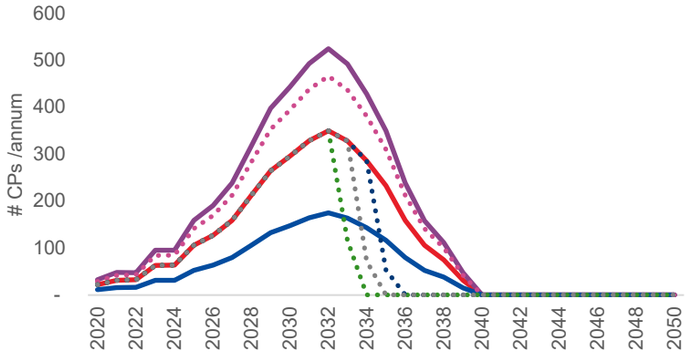


Figure 53: Chargepoint roll-out
Source: Arup Analysis

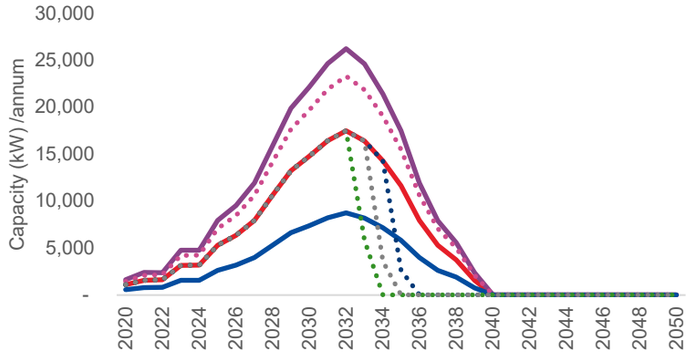


Figure 54: Capacity roll-out
Source: Arup Analysis

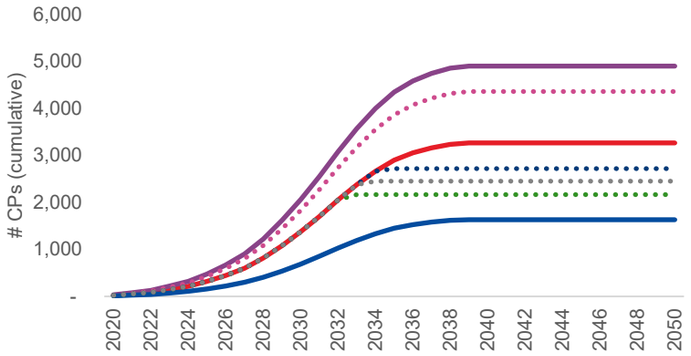


Figure 55: Cumulative chargepoints
Source: Arup Analysis

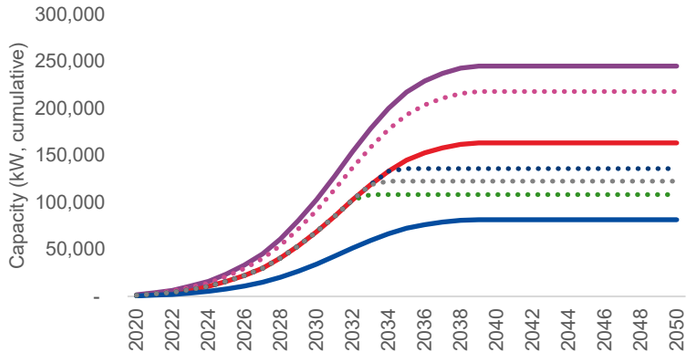


Figure 56: Cumulative capacity
Source: Arup Analysis

4. Financial case
4.4 Sensitivity testing

Destination

4.4.2 Supply sensitivities [2/2]: destination

Installed chargepoints range from 10,000 to 45,000 by 2040 between scenarios. Total capacity ranges from 300 MW to 700MW. The broad range of results represents uncertainty in the developing market, the pace and scope of infrastructure roll-out, user charging behaviour, the speed of charging, and the amount of demand at Destination sites.

The charts opposite illustrate each of four scenarios of demand and each of four sensitivities affecting supply, applied to central case demand. The assumptions behind the demand scenarios and sensitivities are outlined in Section 4.2 and Appendix C.

As can be seen in the charts opposite, number of chargepoints ranges more widely in the Destination scenarios than in the On-Route ones. This is because many assumptions change between scenarios in the Destination demand model, while in the On-Route model, only the percentage of charging that takes place On-Route is flexed.

Government On-Street provides an alternative view with more on-street charging – Destination chargepoints are rolled out more quickly in the short term but installed capacity is ultimately lower.

Main Scenarios

- Central Case (scenario 1)
- Higher Demand (scenario 2)
- Lower Demand (scenario 3)
- Government On-Street (scenario 4)

Sensitivities (applied to the Central Case Scenario

- Supply for 100% of daily peak demand (sensitivity E)
- Maximum supply = 2050 end-point (sensitivity F)
- Maximum supply = average of max and end-point (sensitivity G)
- Maximum supply = 75% of 2040 max point (sensitivity H)

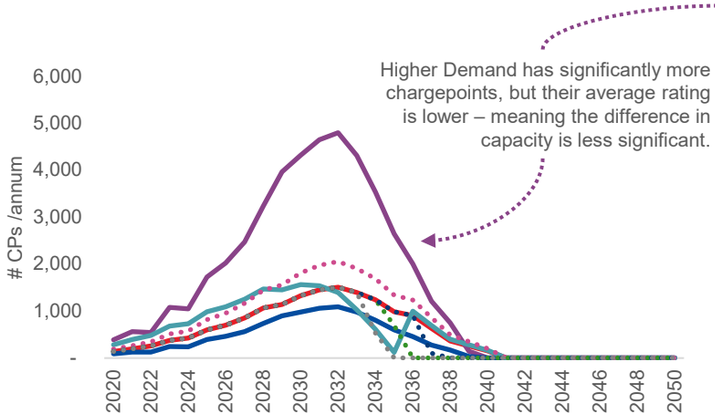


Figure 57: Chargepoint roll-out
Source: Arup Analysis

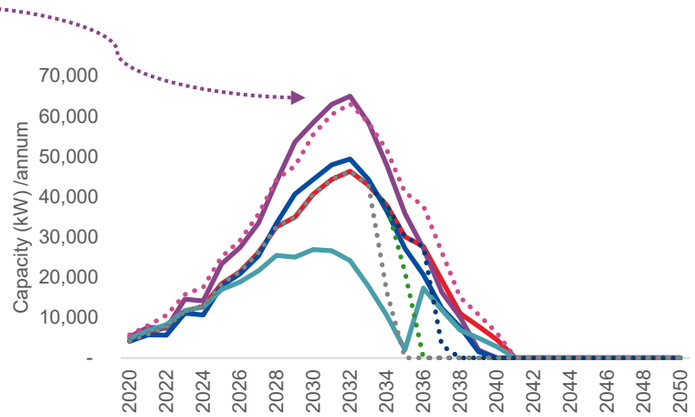


Figure 58: Capacity roll-out
Source: Arup Analysis

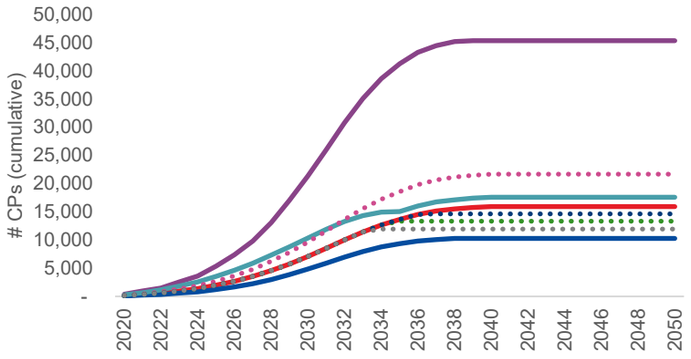


Figure 59: Cumulative chargepoints
Source: Arup Analysis

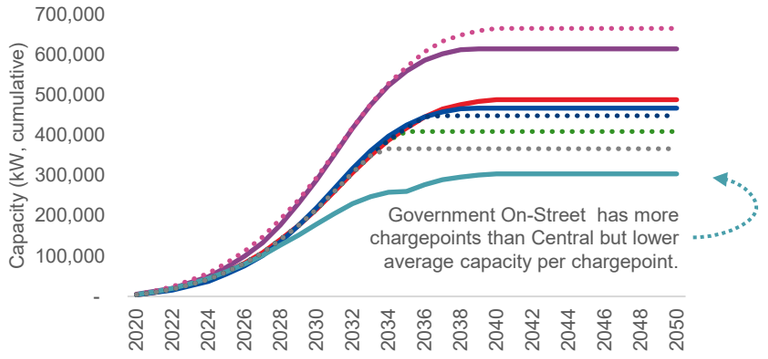


Figure 60: Cumulative capacity
Source: Arup Analysis

ARUP

4. Financial case
4.4 Sensitivity testing

On-Route

4.4.3 Capex sensitivities [1/2]: on-route

Total capex ranges between £172 million and £517 million by 2040 between the minimum *Lower Demand* scenario, and the maximum *Higher Demand* scenario.

The charts opposite illustrate each of three scenarios of demand and each of eight sensitivities affecting capex, applied to *Central Case* demand. The assumptions behind the demand scenarios and sensitivities are outlined in Section 4.2 and Appendix C.

When the sensitivities are applied to the *Central Case* demand, the minimum capex results from the *Lower Demand* scenario and the maximum from the *Higher Demand*. However, if the sensitivities are applied to the other scenarios (not illustrated in opposite charts), the minimum capex is £114 million – resulting from the *Maximum supply = 2050 end-point* sensitivity applied to the *Lower Demand* scenario – and the maximum is £689 million – resulting from the *Supply for 100% of daily peak demand* sensitivity applied to the *Higher Demand* scenario.

Main Scenarios

- Central Case (scenario 1)
- Higher Demand (scenario 2)
- Lower Demand (scenario 3)
- *More Street – applies to Destination only*

Sensitivities (applied to the Central Case Scenario

- More and smaller sites (sensitivity A)
- Fewer and larger sites (sensitivity B)
- 25% higher unit costs (sensitivity C)
- 25% lower unit costs (sensitivity D)
- Supply for 100% of daily peak demand (sensitivity E)
- Maximum supply = 2050 end-point (sensitivity F)
- Maximum supply = average of max and end-point (sensitivity G)
- Maximum supply = 75% of 2040 max point (sensitivity H)

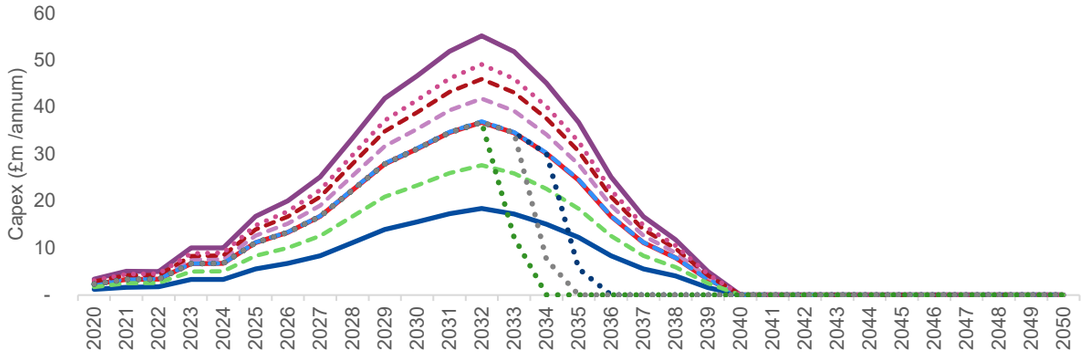


Figure 61: Annual capex (£ million)
Source: Arup Analysis

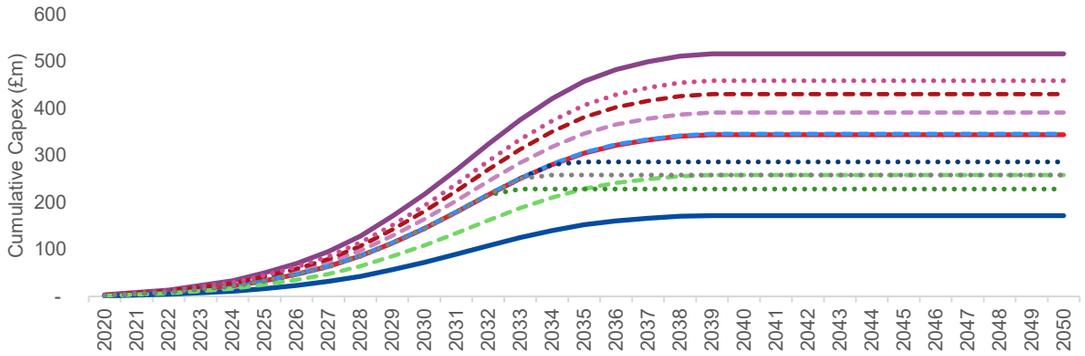


Figure 62: Cumulative capex (£ million)
Source: Arup Analysis

4. Financial case
4.4 Sensitivity testing

Destination

4.4.3 Capex sensitivities [2/2]: destination

Total capex ranges between £315 million and £739 million by 2040 between the minimum *Government On-Street* scenario, and the maximum *Supply for 100% of Daily Peak Demand* sensitivity.

The charts opposite illustrate each of four scenarios of demand and each of eight sensitivities affecting capex, applied to *Central Case* demand. The assumptions behind the demand scenarios and sensitivities are outlined in Section 4.2 and Appendix C.

When the sensitivities are applied to the *Central Case* demand, the minimum capex results from the *Government On-Street* scenario and the maximum from the *Supply for 100% of daily peak demand* sensitivity. If the sensitivities are applied to the other scenarios (not illustrated in opposite charts), the minimum capex is £236 million – resulting from the *25% lower unit costs* sensitivity applied to the *Government On-Street* scenario – and the maximum is £861 million – resulting from the *Supply for 100% of daily peak demand* sensitivity applied to the *Higher Demand* scenario.

Main Scenarios

- Central Case (scenario 1)
- Higher Demand (scenario 2)
- Lower Demand (scenario 3)
- Government On-Street (scenario 4)

Sensitivities (applied to the Central Case Scenario

- More and smaller sites (sensitivity A)
- Fewer and larger sites (sensitivity B)
- 25% higher unit costs (sensitivity C)
- 25% lower unit costs (sensitivity D)
- Supply for 100% of daily peak demand (sensitivity E)
- Maximum supply = 2050 end-point (sensitivity F)
- Maximum supply = average of max and end-point (sensitivity G)
- Maximum supply = 75% of 2040 max point (sensitivity H)

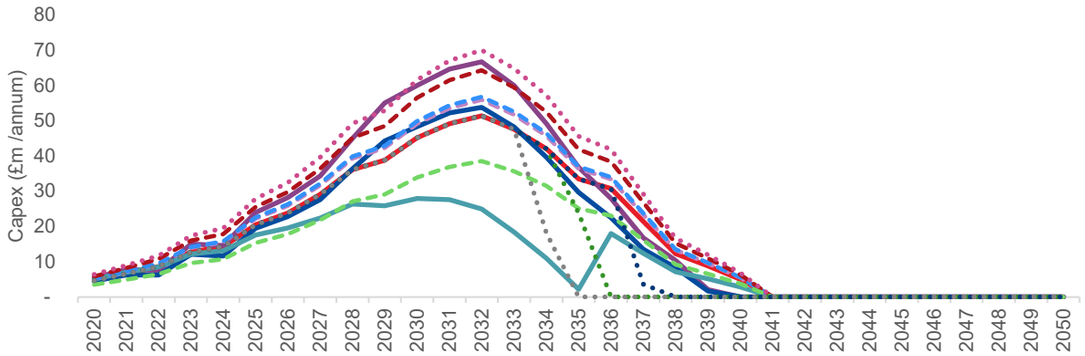


Figure 63: Annual capex (£ million)
Source: Arup Analysis

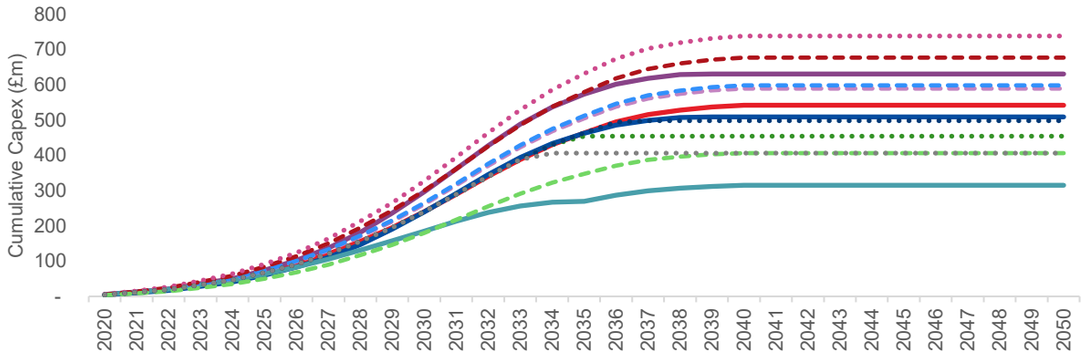


Figure 64: Cumulative capex (£ million)
Source: Arup Analysis

4.5 Recommendations and next steps

4. Financial case

4.5 Market recommendations and next steps

4.5.1 Recommendations and next steps

Next steps include refining the range of results, engaging with the private sector, determining the phasing of roll-out, determining the size and scope of the Government funding envelope, and exploring options for financing.

The financial case sets out the total capital cost of delivering the entire On-Route network and all public destination charging in Wales, under a range of demand scenarios, and flexed across a range of supply and cost sensitivities. Next steps for the Government include refining the range of results, understanding private sector plans, determining the phasing of roll-out, determining the size and scope of the funding envelope, and exploring options for financing.

1. Refine the range of results

The financial case includes a range of results for the capital cost of rolling out all public Welsh On-Route and Destination charging. It excludes all other public charging – including on-street and hub charging. Also excluded are capital costs like land and life-cycle replacement, all operational costs, tax, and inflation. The Welsh Government can refine the results of the financial case to include or exclude cost items and take into account its own assumptions of, for example, site size, charging speed, etc. At the same time, the broad range of results captures the uncertainty inherent to the development of the EV charging market, which will be of interest to the private sector. The financial case presents its capex estimates on a Wales-wide basis; Arup recommends that further analysis be performed on a more granular LSOA level to target funding regionally or prioritise certain geographies.

2. Engage with the private sector to understand plans

The private sector is expected to provide the majority of the investment required to deliver EV charging in Wales; however, the public sector currently has little insight into specific private sector plans. Some engagement has already taken place, but the Welsh Government needs to understand how much charging the private sector will deliver, where, and by when.

3. Determine the phasing of roll-out

The phasing of infrastructure roll-out will have a direct impact on annual capex, and could affect total capex. In the commercial case, Arup recommends that the Welsh Government prioritise its strategic focus the On-Route network first, alongside local charging in built-up areas. However, the financial case only considers the total demand each year, without policy intervention around phasing. Phasing will ultimately be decided by the private sector, but the public sector can affect phasing via engagement with the private sector and both policy and financial intervention. This should be further explored in determining the amount of public sector investment required.

4. Determine the size and scope of the Government funding envelope

Once the public sector has refined its assumptions, engaged with the private sector to develop a better understanding of the latter's plans, and determined the phasing of roll-out, it should then determine the size – how much public sector investment is required and available for EV charging – and scope – where should this finding be delivered and in support of what – of its funding envelope.

5. Explore options for financing

The Welsh Government should allocate most risk to the private sector, avoiding taking on excessive demand risk in its investment in the charging market. The Welsh Government should explore financing options that align with its strategy, such as Financial Transaction Reserve and bundling sites together for private investment, off-loading less financially viable sites to the private sector.

5. Management case

5.1 Purpose of the management case

5. Management case
5.1 Purpose of the management case

5.1 Purpose and structure of the management case

The purpose of this management case is to communicate how the programme will be overseen, managed and delivered. By defining and putting in the place the necessary management plans in place, such as programme management and risks management, this provides the reassurances the programme is achievable and that WG, TfW and other delivery partners have the capacity to deliver the programme, which in this case, is the EVCI programme.

5.2 Programme and governance arrangements

5.2.1 Governance arrangements

This section explores who will be overseeing the programme, outlining the current and potential future governance arrangements.

5.2.2 Programme arrangements

This section explores who will be managing the programme, outlining the current and potential future programme management and governance arrangements.

5.2.3 Programme roles and responsibilities

This section explores the type of and responsibilities the programme may consider employing, including both PMO and specialist-related roles.

5.2.4 Use of specialist advisors and third-party suppliers

This section outlines the current role of third party suppliers, and future potential workstreams / roles WG may consider outsourcing.

5.3 Communications and stakeholder management

5.3.1 Approach to communication and stakeholder management

This short section provides an overview of the approach to communication and stakeholder management.

5.3.2 Public sector engagement

This short section provides an overview of considerations to be made when engaging with the public sector, particularly local authorities.

5.3.3 Private sector engagement

This short section provides an overview of considerations to be made when engaging with the private sector.

5.3.4 Public engagement

This short section provides an overview of considerations to be made when engaging with the public, including public consultation.

5. Management case

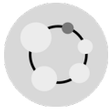
5.1 Purpose of the Management Case

5.4 Risk management

5.4.1 Approach to risk management

This section outlines the key considerations and recommendations when developing a risk management plan, as well as the development of a risk register.

5.5 Monitoring and evaluation



5.5.1 Developing a monitoring and evaluation framework

This section outlines the key considerations and recommendations when developing a Monitoring and Evaluation Framework.

5.6 Programme

5.6.1 Programme plan

This section outlines the current work to date, as well as the long-term illustrative programme from 2022 to 2030.

5.7 Recommendation and next steps

5.7.1 Immediate actions

This short section summarises the key, prioritised actions to be taken by WG and TfW in the short-term.

5.7.2 Monitoring and review

This short section reiterates the need to monitor and review progress when setting up the programme.

5.2 Programme management and governance arrangements

5. Management case
5.2 Programme management and governance arrangements

5.2.1 Governance arrangements

Delivering the EVCI Programme necessitates a governance structure which can be adaptable and responsive over time. Going forward, plans to determine the governance structure of the wider programme are due to take place in early Spring 2023, led by WG. We recommend the following governance groups to be considered and implemented, and accompanying example of what the governance structure could look like, as illustrated in Figure 65:

- **EVCI Programme board** comprises of a number of senior stakeholders, as well as the programme manager, and is often chaired by the programme sponsor. The primary remit of this board will be to oversee the delivery of the programme, key decision-making, determine the direction of the programme, whilst providing visible and sustained support for the programme manager. The programme board is ultimately accountable for the success of failure of the programme. In this case, the EVCI Programme board may involve both senior representatives from WG and TfW. Alternatively, as per the governance arrangements illustrated in the Irish example (pg. 99), Welsh Government could take accountability for establishing the PMO. After the programme has been established, accountability is shifted to TfW and other stakeholders as appropriate over time.

- **EVCI Assurance Board** should be set up if the programme board opts to assign the assurance tasks to a separate delegation. Given the anticipated complexity and scale of delivering the strategy, which cross-cuts numerous departments and public sector bodies, an assurance board is highly appropriate, offering an added layer of objectivity to decision-making and comfort to the direction set by the programme board.

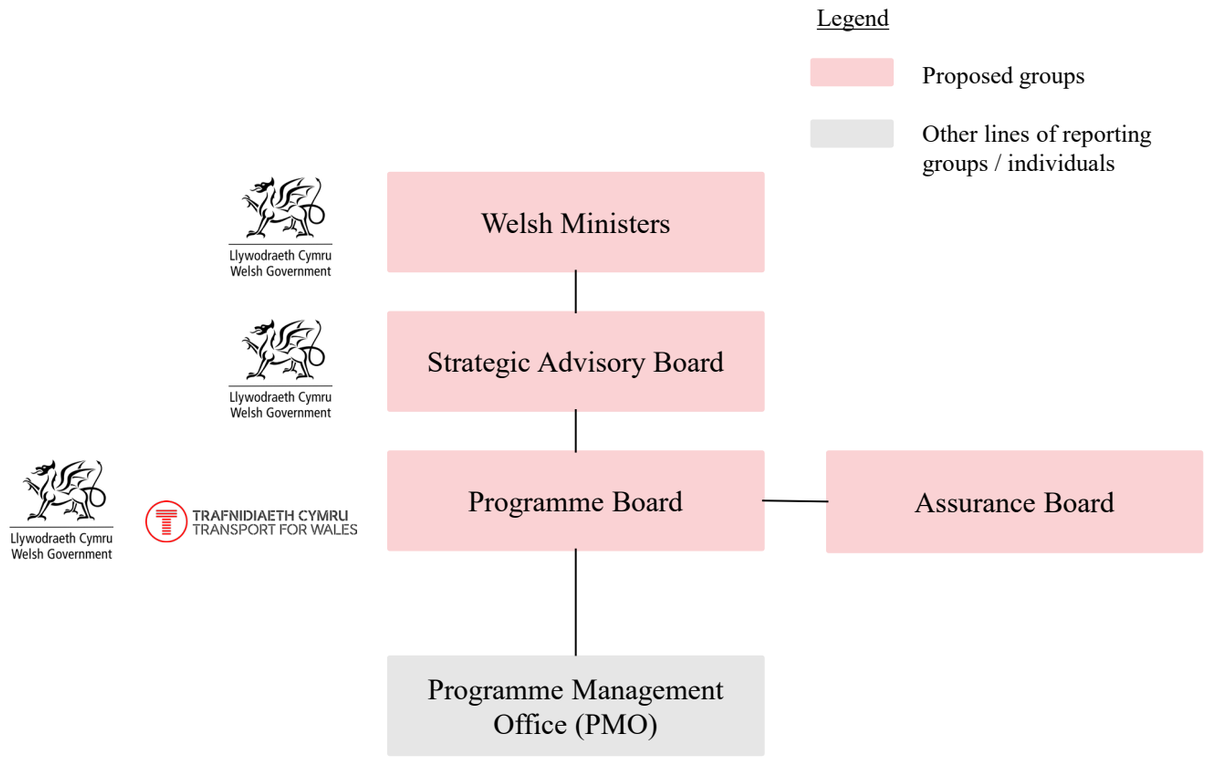


Figure 65: Illustrative example of the proposed governance structure

5. Management case
5.3 Programme management and governance arrangements

- **EVCI Strategic Advisory Board** will focus on overseeing the strategic direction of the programme, chaired by a WG representative, and comprises of senior leaders from WG and TfW. This board will be accountable for the programme achieving the targets set by the Strategy, and implementation aligns with current policies, other complementary strategies and legislation. Members of the Strategic Advisory Board may include those overseeing the delivery of other complementary strategies, including the Llwybr Newydd: the Wales Transport Strategy, as well as local authority representatives e.g. Welsh Local Government Association.

5.2.2 Programme arrangements

Similar to the governance arrangements, the EVCI Programme structure has yet to be defined, as well as the portfolios (i.e. group of related programmes) and specific programmes (i.e., group of projects / workstreams) to deliver the EVCI Strategy. The following early projects have been established.

- **Rapid Charging on the Strategic Trunk Road Network (SRN) -** TfW have started to deliver rapid charging on the SRN to facilitate long distance journeys in electric vehicles across Wales. Phase 1 of the programme is currently being delivered. Future phases will look at expanding the provision of charging at the the location identified during Phase 1 and/or installing charging at additional locations in order to keep pace with rapidly rising demand.
- **EV Charging Infrastructure Procurement Strategy Group (PSG):** the objective of this group is to agree the procurement strategy for the proposed Electric Vehicle Charging Infrastructure (EVCI) national procurement framework. Chaired by the WGCD procurement team representative, key activities of this group also includes identifying market characteristics to inform the development of the market engagement strategy. The PSG is supported by the **EV Charging Infrastructure Procurement Technical Group (PTG):** the objective of the PTG is to agree the service requirements, lotting structure, WBFG goals, call-off mechanism and all other associated key elements of the Invitation to Tender for the national procurement framework. The PTG members mainly consist of technical and procurement representatives from across the public sector. Chaired by the WGCD procurement team representative, key activities of this group includes developing the market engagement strategy, developing and signing off pricing mechanism and finalising the Contract Management Strategy.

Figure 66 outlines an example of the EVCI programme structure, in which we recommend three main portfolios to be established, reporting directly to the EVCI PMO:

1. **On-route charging** – this portfolio would be responsible for accelerating the roll-out of rapid/ultra-rapid charging infrastructure at key locations to facilitate long distance travel. Programmes listed in this portfolio overleaf are where WG/TfW may take a lead delivery role using the levers available (e.g. publicly owned land).

2. **Destination charging** – this portfolio would be responsible for accelerating the roll-out of charging at destinations. Programmes listed in this portfolio overleaf are where WG/TfW may take a lead delivery role using the levers available (e.g. publicly owned land).

3. **Public and stakeholder engagement** – this portfolio is a key enabler and is cross-cutting across the four portfolios, enabling communications and working together across the public and private sector, and engaging end users to create a favourable environment for delivery.

4. **Quality, local value and supply chain** – this portfolio is a key enabler and is cross-cutting across the four portfolios, focusing on qaulity procurement and readiness for capturing local value from charging infrastructure delivery.

5. Management case

5.3 Programme management and governance arrangements

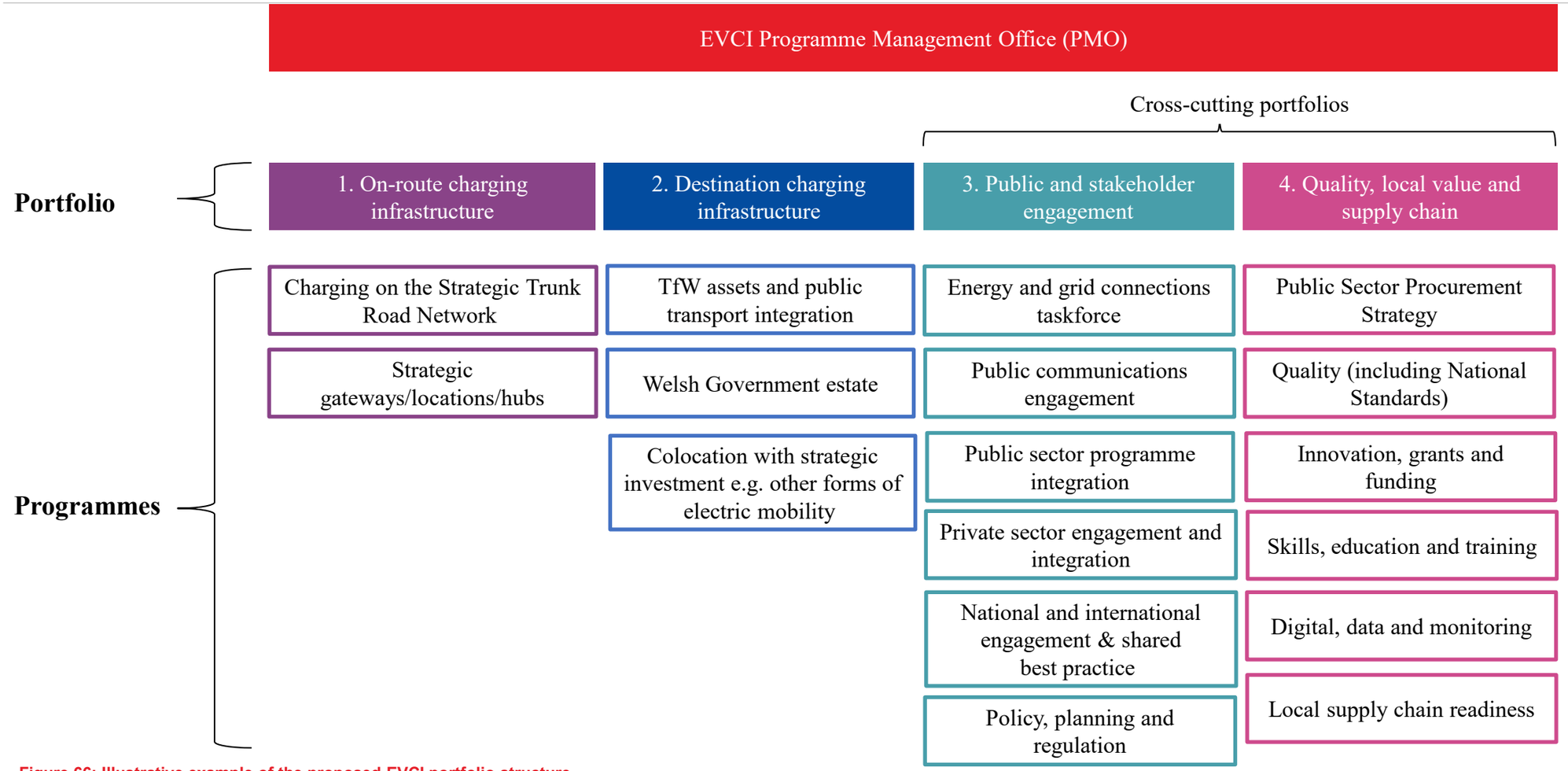


Figure 66: Illustrative example of the proposed EVCI portfolio structure

5. Management case
5.3 Programme management and governance arrangements

5.2.3 Programme roles and responsibilities

Below we set out the key considerations and recommendations to establishing programme roles and responsibilities.

Similar to the organisation structure of the recently established Zero Emission Vehicle Ireland office (see page 109), we recommend a dedicated centralised, PMO team to be formed who has direct responsibility and accountability for delivering the EVCI Programme. We envisage the centralised team to mainly operate using resources from TfW and WG and their advisors, albeit drawing on the appropriate skills from other cross-cutting departments within WG, alongside additional capability and capacity from advisors. Note, the remit of this proposed team would focus mainly on provision of EV charging infrastructure, therefore excludes measures which directly supports and enables EV purchases of consumers (e.g. EV purchase grants), as responsibility for the latter remains with the UK Government.

The core team members may comprise of the following cross-cutting roles (but not limited to):

- **Programme Manager / Team Leader** – the programme manager will manage the day-to-day operations of the programme, and reports directly to the programme board.
- **Communications and Stakeholder Engagement Lead** – responsible for developing the stakeholder engagement management plan, as well as overseeing engagement activities between the public sector (WG, TfW, Local Authorities etc.) and the private sector. Furthermore, they will oversee the communication activities to the public, from raising public awareness of EV charging infrastructure across Wales to providing regular progress updates of the team's activities and future initiatives.
- **Commercial and Finance Lead –** this role, which may be combined into one or split out into a separate commercial and finance role, would be responsible for the management of funding and financing of the programme, as well as the commercial and procurement delivery. TfW have indicated they have contract management skills and resourcing already to carry out this role for EV projects.
- **Programme coordination support** – we would expect a number of supporting roles will be needed to help manage the programme.

5.2.4 Use of specialist advisors and third-party suppliers

To develop the programme, several specialist advisors have been sought and engaged with. This is due to the specialist nature of the requirements and subsequent lack of capability in-house, as well as limited capacity in-house. These advisors include:

- Procurement advice, including development of the procurement framework for contracting and civils work.
- Modelling (including demand, preferred network modelling), technical advice, business case production.

Going forward, we anticipate WG, TfW and local authorities to continue to outsource capabilities at least within the short-term to help plug internal resourcing gaps. As identified through the capability mapping exercise, detailed in section 3.3, the likely advisors the WG, TfW and local authorities are likely to outsource includes (but not limited to):

- Programme establishment, leadership, governance and management
- Specialist legal counsel applicable to EV charging infrastructure.
- Financial and investment advisors offering support and independent assurance on public investment decisions (which cannot be performed internally).
- Planning, specialist technical advice and project business case production (if capability unavailable internally).
- Charge point operation and maintenance is expected to continue to be outsourced to CPOs.

Additionally, it is expected that support will need to be provided by specific teams within the local authorities (e.g. gaining powers and consent, engagement with CPOs); these requirements will be further defined once individual projects and/or sites have been identified.

Consideration should be given to the skills and employment necessary to provide the functions that sit within the private sector, as well as those necessary for the public sector outlined above, where opportunities for a collaborative skills and resourcing programme can provide training, skills and local employment to maximise the benefits for Wales.

5. Management case

5.3 Programme management and governance arrangements

Case study: Zero Emissions Vehicle Ireland (ZEVI)

ZEVI is a new dedicated office in the Department of Transport responsible for supporting consumers, the public sector and businesses to transition to zero emission vehicles. Similar to WG, ZEVI has ambitious goals to accelerate the transition to EVs, targeting 175,000 EVs on Irish roads by 2025. This will be furthered by incoming statutory European targets for the scale of charging provision required. ZEVI aims to deliver its objectives through incentivising vehicle uptake and developing national EV charging infrastructure. The role of ZEVI varies from strategic and policy oversight, infrastructure (e.g. funding support for delivery), grants for EV purchases, as well as engagement and partnership with the public and private sector.

The organisational chart (Figure 67) illustrates the current governance and programme structure of ZEVI, working with key agencies including Sustainable Energy Authority of Ireland (SEAI), Transport Infrastructure Ireland (TII), National Transport Authority (NTA) and ESB Group. The programme team, led by the ZEVI leader, is structured by four main functions:

- **Strategy and Policy** – responsible for developing the EV strategy and policy
- **Infrastructure** – responsible for funding & support for charging infrastructure delivery
- **Vehicles** – which provides grants for the purchase of EVs, as well as other financial (and non-financial) incentives to encourage direct EV uptake
- **Engagement** – responsible for engagement and partnership with the public, the wider public sector and the private sector.

The small team, comprising of in-house and external consultants, are continuing to grow, and looking to recruit more staff as they solidify the ZEVI programme plan and capability mapping over the next 1-2 years.

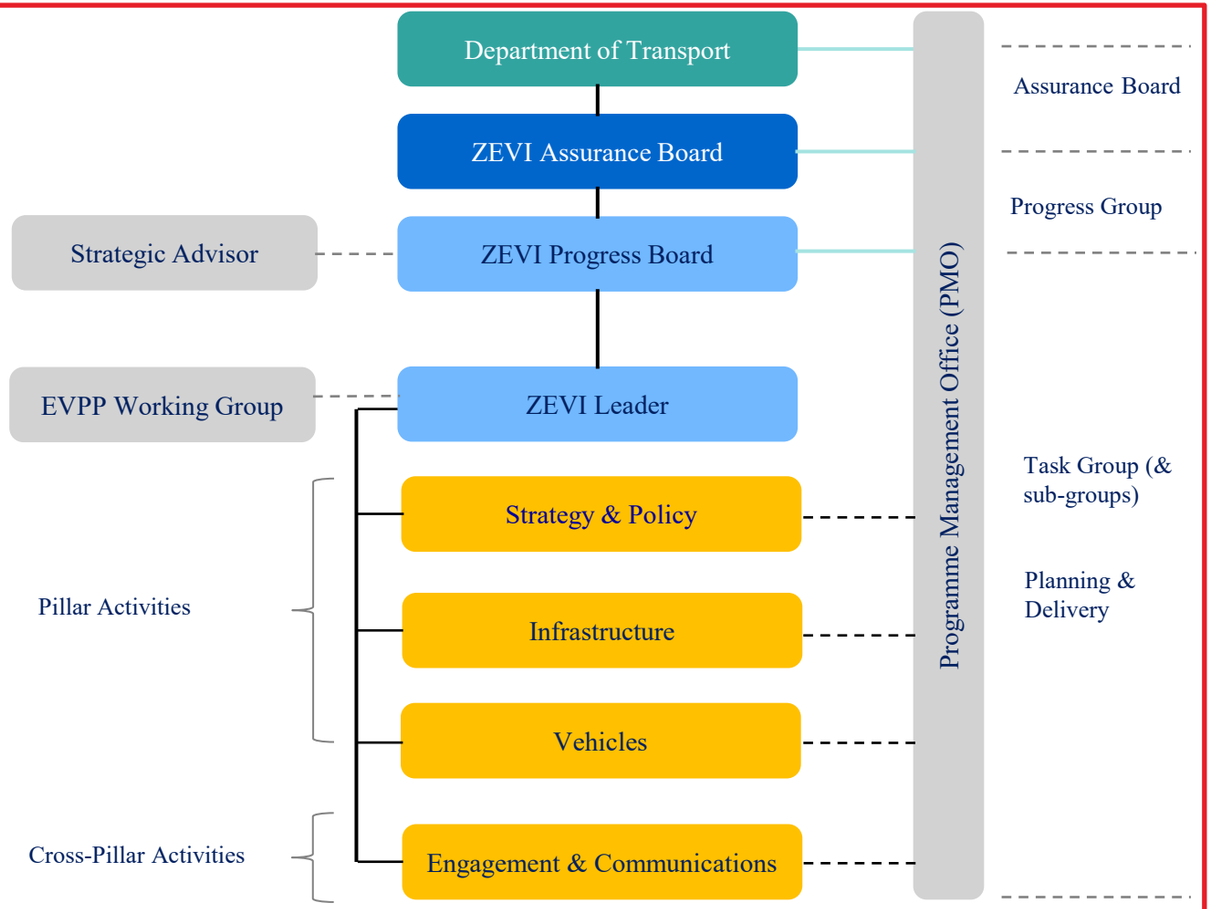


Figure 67: ZEVI organisational structure
Source: TII, 2022

5.3 Communication and stakeholder management

5. Management case
5.3 Communication and stakeholder management

5.3.1 Approach to communication and stakeholder management

The accelerated roll-out of EV charging infrastructure across Wales will require cross-collaboration and buy-in from a wide range from stakeholders, from CPOs to residents. We encourage the PMO to develop a programme-level communication and stakeholder management plan. As such, the supporting communications, engagement and consultation activities will operate at different levels of complexity and interaction with local authorities and other public sector bodies, the private sector, as well as the public. Table 3 presents the main stakeholders to engage with as part of the delivery of the programme. Note this is not an exhaustive list, and a stakeholder mapping exercise is recommended as the starting point to developing the communication and management plan.

5.3.2 Public sector engagement

Local authorities will play an integral role in the delivery of the infrastructure, with the nature of public charging determined at the local authority level and delivered in line with the Strategy. However, it is unclear how advanced all local authorities in understanding and acting on requirements for charging. One of the barriers to the successful roll-out of the preferred network, identified by WG, TfW and local authorities, includes local authority appetite for investment. There is uncertain internal buy-in or understanding as to why Local Authorities are intervening in the EV charging market, for example, due to financial losses in the operational phase and potential taxpayer supported operating costs. WG and TfW can address this barrier by sharing the different work packages (as illustrated under Figure 66) with the local authorities, e.g. the preferred network and the level of infrastructure projected within each local authority areas over time.

Other public sector bodies engagement WG (and TfW) will benefit from includes DNOs, who (grid capacity and connection cost-related matters), Ofgem (regulatory matters) and elected MPs (political buy-in).

Who	Role	Involve / inform / consult
Elected local representatives	The implementation of the Strategy requires political buy-in, which can determine the level of support and funding directed to EVs.	Inform
Welsh Local Government Association	Acting as the lead representatives for all local authorities, the WGLA can provide a collected view and status of the current and future needs of local authorities.	Inform/consult
Welsh Public Sector Bodies	Working with local authorities, National Trust, NHS and other public sector bodies will be crucial to ensure they have the tools, resources and capabilities to deliver EV chargepoints infrastructure.	Involve
Distribution Network Operators (e.g. National Grid)	Need to work with DNOs to understand and address grid capacity issues, and facilitate fast and efficient connections of EV charging infrastructure to the grid.	Consult / Involve
Ofgem	Opportunity to engage with Ofgem to ensure regulatory barriers are minimised and ensure the electricity network is ready for the transition to EVs.	Consult
Charge point operators	Close collaboration with CPOs to understand their current and future investment, and where the public sector bodies are best placed to support/intervene.	Consult / Involve
Operators of Motorway Service Areas	Plan and deliver the accelerated roll-out of EV charging infrastructure, particularly rapid chargers, across the SRN.	Consult / Involve
Fleet operators and businesses	Raise public awareness of future EV charging infrastructure roll-out for businesses dependent on on-route and destination charging, as well as future public consultation required for specific projects.	Inform / Consult
Residents	Raise public awareness of future EV charging infrastructure roll-out for residents dependent on on-route and destination charging, as well as future public consultation required for specific projects.	Inform / Consult

Table 3: Welsh EVCI Key Stakeholders

5. Management case
5.3 Communication and stakeholder management

5.3.3 Private sector engagement

Extensive engagement with the private sector is critical to gauge investment appetite, and in-turn identify the gaps in investment where the public sector may need to intervene. Both market and one-to-one engagement will take place, led by the programme, to understand the CPO's roll-out plans and understand funding requirements. Through these initial engagement exercises, questions to pose to the private sector includes:

- What can the public sector offer (e.g. mapping, information, finance)?
- What does the private sector need to see to bring their investment to Wales?
- What barriers might the public sector be putting up unintentionally?

The Action Plan includes establishment of a CPO working group, involving private, public, not-for-profit and community organisations. The working group will support coordination in determining suitable locations for EV charging infrastructure. This group will also provide an advisory function in support of developing and soft testing quality standards and other emerging initiatives within the sector, as well as sharing lessons learnt and barriers to investment. It's recommended the working group includes representatives from groups/individuals representing protected characteristic groups, helping to capture a wide range of views and needs as possible.

5.3.3 Public engagement

In addition to engaging with stakeholders, a clear plan will be developed to engage and communicate with the public, especially as one of the Strategy's core objectives is to raise public awareness of EV charging infrastructure across Wales. A local needs assessment (identifying local EV requirements) should also be done in consultation with local businesses and local community groups. This should include representatives from protected characteristic groups. Work will be required with the public and private sector to:

- Keep the public updated with progress and implementation of the Strategy
- improve coherence in messaging and cross-sectoral collaboration in the context of carbonisation
- Provide independent consumer advice to support the transition to EVs, supporting private vehicle owners, public sector shared and community mobility providers and businesses; and
- Engage with the wider public to encourage sustainable behaviours.

We recommend the WG, in partnership with the private and public sector, to develop a communications strategy which provides consistent, transparent and accessible information to consumers and the wider public. The communication strategy should consider who their target audience is, mechanisms of communication (e.g. in-person town halls, social media, Welsh EV-dedicated website), as well as the type of information to disseminate. For ZEVI, social media channels have been set up, including twitter, which provides live updates and latest press releases relating to the ZEVI programme. Any information / awareness campaigns to the public about chargepoints and EVs should be provided in accessible formats and distributed appropriately and equally to all communities. This may require different approaches applied to different locations.

5. Management case
5.3 Communication and stakeholder management

Case study: 'Switched on Scotland: A roadmap to widespread adoption of plug-in vehicles, 2016-ongoing', Transport Scotland

As part of the roadmap to widespread adoption of plug in vehicles, Transport Scotland created a number of cross-sector stakeholder groups as part of their own action plan:

- A **multi-stakeholder group on fleets** was formed to review the challenges and opportunities for wider adoption, and prepare necessary guidance and advice for public and private sector organisations.
- A **multi-stakeholder group on EV recharging** was formed to review the challenges and opportunities and prepare necessary guidance and advice for public and privates sector organisations. E-cosse events were held on the future of EV charging infrastructure and on rapid chargers, including a workshop to discuss drivers and guidance on procurement and installation of chargepoints with representatives of CPOs.
- A **multi-stakeholder group on energy systems** was formed to understand the impact and opportunities of increased EV adoption on Scotland's energy system. The output of this group was a report published in July 2016, which covers policy, electricity distribution and smart grids, demand management, energy storage and supporting high renewable grids.

Transport Scotland's ongoing engagement activities also includes work with energy suppliers to encourage the deployment of tariffs and technologies to manage recharging behaviours, as well as maximise the emission reduction benefits of Scotland.
In terms of marketing campaigns, the Scottish Government launched a market campaign in 2016, 'EVs are Go', around the launch of the roadmap to raise awareness. The campaign included a launch event with strong media attendance resulting in 12 pieces of news coverage, local media released in key areas; and targeted consumer and trade news releases resulting in five further articles.

For further details of Transport Scotland's stakeholder and community engagement activities supporting 'Switched on Scotland' roadmap, please visit this webpage.

5.4 Risk management

5. Management case
5.4 Risk management

5.4.1 Approach to risk management

Identifying, monitoring and mitigating programme-level risks is fundamental to the successful implementation of the Strategy, hence a transparent, robust risk management process needs to be in place. As of November 2022, a programme-level risk register has not been drawn up – this will be one of the critical, prioritised tasks recommended to take place over the next six months.

The programme-level risks register will be managed by the PMO, and if required a portfolio and/or project-level risk register will be developed once projects have been initiated. We encourage the PMO to facilitate and lead a risk workshop with WG/TfW and other relevant public sector bodies to identify all short, medium and long-term programme risks. The risk register should be peer reviewed to ensure there are no obvious omissions and appropriate assessments. Each risk should also be assigned an owner, as well as identified mitigation measures.

Once developed, the programme-level risk register should be reviewed by the Project Board each period or month to ensure risks are being identified and mitigated to make a qualitative assessment of the effect on the programme risk exposure. We envisage the programme (and project) risks will be assessed on both qualitative and quantitative basis, in which the quantitative risks may be modelled utilising Monte Carlo Simulation to provide a Quantified Risk Assessment (QRA) of risk exposure on the programme (and projects), and a measure of the capital risk allowance.

A process to escalate risks should also be defined in the event an individual does not have appropriate level of authority to manage a risk. A single risk or group of risks may need to be escalated to a higher level if the risk(s):

- exceed an agreed threshold / defined tolerance;
- cannot be controlled / managed within the current level;
- remain very high even after mitigations are implemented;
- will impact on more than one function / across a programme; or
- are cross-cutting in nature and require further collaboration.

Once the governance structure has been formed by WG, the hierarchy of risk escalation will become much clearer.

In addition to risks, management process should be in place to flag issues which will have an adverse effect on the programme's ability to meet its objectives within the planned cost and timescales. This is the result of either an existing risk materialising or a new issue not previously identified being raised. The estimated impact of the issue should be reviewed and updated regularly until the issue has been resolved to reflect the latest information available.

Table 4 sets out some of the key risks identified relating to the programme itself, as opposed to risks associated with specific sites and projects. Please note, the high-level, illustrative example that would require further refinement as part of the programme.

5. Management case
5.4 Risk management

Type of risk	Description	Potential Impact	Action Owner
Financial	Inability to raise funding needed to deliver the programme.	Insufficient funding may lead to delayed investment / project initiations and subsequently delay roll-out of charging infrastructure, reducing likelihood of meeting KPIs.	Strategic Advisory Board
Financial	Inability to attractive and/or incentivise private sector investment.	Barriers to EV uptake and range anxiety remains high due to insufficient scale of infrastructure provided.	Programme Board
Financial/Market	High inflationary pressures, exacerbated by global geo-political instability, may lead to insufficient funding and private sector investment.	Delay or cancellation of EV charging infrastructure provision, EV charging provision fails to keep pace with EV charging demand	Programme Board
Market	Supply chain pressure and/or disruption may lead to insufficient capacity within the market install EV charging infrastructure.	Delay or cancellation of EV charging infrastructure provision, EV charging provision fails to keep pace with EV charging demand	PMO
Programme management and Delivery	Insufficient funding and/or poor labour market conditions to attract and employ in-house, or contract resources with the appropriate skillset and capabilities, particularly within local government.	Delay or cancellation of EV charging infrastructure provision, EV charging provision fails to keep pace with EV charging demand	PMO
Programme management	The need for overarching programme allocation of roles and responsibilities	Potential delays, inefficiencies and/or missed opportunities in delivery.	Programme Board
Programme management / delivery	Insufficient capacity within WG and/or TfW to oversee and delivery of the programme.	Delays to decision-making, sign-offs etc, leading to delay in implementation. This leads to major risk EV charging provisions falls behind demand. There is also reputational risk if government perceived ineffective in improving public confidence and infrastructure can meet demand.	Programme Board
Programme management / delivery	Lack of visibility/oversight on local authorities' activities re. EV charging infrastructure. Conversely, local authorities are not aware of their role in ensuring sufficient EV charging infrastructure are installed.	Delays in EV charging infrastructure provision, duplication of efforts leading in inefficiencies in delivery.	Programme Board or PMO
Governance	Lack of clarity on cross-departmental governance for buy-into key decisions.	Delay and insufficient endorsement to decision-making	Strategic Advisory Board
Political	Change in the political landscape undermines access to funding/policy support at a UK and Wales level	Portfolio viability, reputational risks to government – poor perception government is failing to meet their policy objectives.	Strategic Advisory Board

Table 4: Key programme-level risks

5.6 Monitoring and evaluation

5. Management case
5.6 Monitoring and evaluation

5.6.1 Developing a monitoring and evaluation framework

Monitoring the progress of EV charging infrastructure provision is a critical task to ensure the programme is on course to achieve the objectives and KPIs set by the Strategy, as well as ensure sufficient charging infrastructure is being provided to meet future EV demand. As of November 2022, a monitoring and evaluation (M&E) plan has yet to be developed, therefore we outline a number of considerations below when developing the M&E plan. An illustrative of a M&E framework is presented in Appendix D.

1. Defining the metrics and KPIs

In order to monitor and evaluate whether the delivery of the Strategy has been successful or not, a set of metrics and accompanying KPIs need to be identified to help determine the success, and monitor progress. The Strategy and the Action Plan has already developed both quantitative and qualitative KPIs for each of the nine actions, as set out in the latter document. Since the Strategy (and Action Plan) launch in 2021, the EV market has evolved rapidly since, which may invoke the need to review the current Action Plan and determine whether the KPIs need to be updated.

2. Alignment with existing M&E frameworks

It's important to understand whether the metrics defined by the Strategy are currently being monitored. For example, for the Welsh Transport Strategy, TfW are monitoring a number of metrics relevant to the EVCI Strategy, as presented in Figure 68. This includes tracking the number of public chargepoints across Wales, and the number of registered ULEVs. The M&E framework for the Wales Transport Strategy can be found and accessible to the public online. Other (current and future) M&E frameworks to consider includes the Wellbeing of Future Generations Act and UK's Taking Charge: the EV Infrastructure Strategy. The forthcoming European regulations, whilst not applicable within Wales, will provide further comparative metrics and tools for benchmarking.

3. Method of monitoring

Currently, a number of open-access applications, e.g. Zap Map, maintains a live database of the publicly available chargepoints across Wales by location types and connector types. TfW are currently monitoring the roll-out of publicly available chargepoints in Wales based on DfT's Vehicle Licensing Statistics (which also relies on Zap Map data). For the purpose of monitoring the EV charging strategy itself, the Programme Management Office may consider expanding this coverage to monitor EV charge point roll-out by local authority. Furthermore, WG have commissioned work to develop EV demand and energy forecast modelling from now until 2050, informing the preferred network mapping tool which maps chargepoints provision across a number of scenario variables. The scenario variables ranges from gap in provisions, Welsh Index of Multiple Deprivation (IMD), rurality and substation capacity. Different mix of weightings to the four variables are then adopted to model the following three scenarios:

1. Demand-led - indicates areas considered commercially viable to private sector.
2. Rurality-led - indicates areas likely considered commercially unviable to private sector.
3. Grid infrastructure-led – high and/or complex grid connection upgrades/installation indicates areas facing major barriers to private investment.

There is an opportunity to update the preferred network periodically (e.g. at stage gate reviews of the programme) to monitor progress against, and provides a clearer indication of the impact of the public sector's targeted intervention (e.g. prioritising investment towards rural areas). The preferred network maps can be used to allow WG to prioritise activities and investment towards areas less likely to be served/prioritised by the private sector.

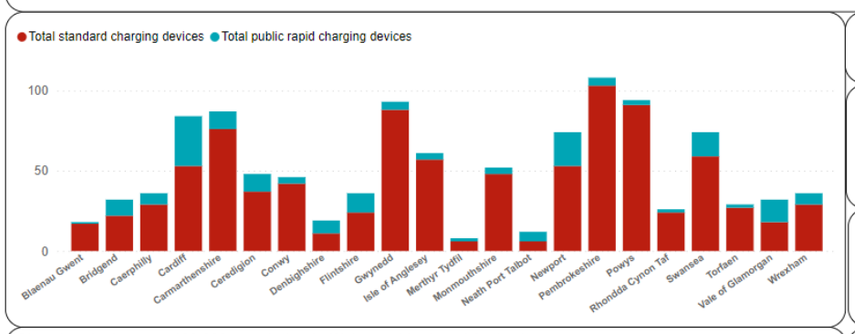
In addition to the M&E framework, putting in place the appropriate assurance framework is essential. This provides continuous and rigorous assurance on organisational stewardship, risks and unforeseen changes are managed effectively, and that public sector funding has been utilised to delivery best value for money and achieves the intended outcomes. Some of the pre-requisites for successful creation of an assurance framework (HM Treasury, 2012) includes, but not limited to,:

- Support and direction from the Accounting Officer and ownership for the framework at a board level
- Clarity on what you need to achieve
- Simplicity – avoid trying to cover too much in a single assurance map
- Build the framework first within a management boundary, beginning with the high level strategic and key process risks

S10 Number of publicly available electric vehicle charging points

Information:

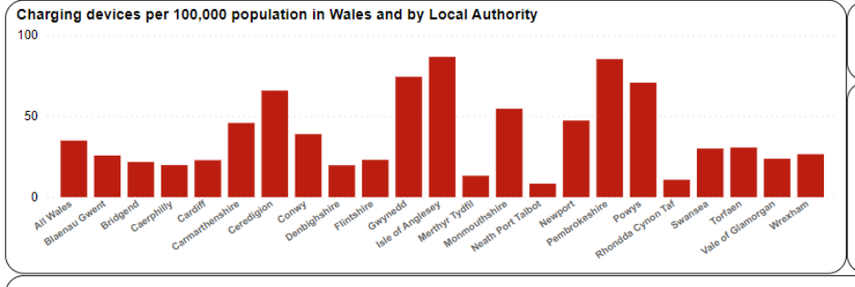
Number of publicly available electric vehicle charging devices in Wales.



All Wales

1,105
Total public charging devices

185
Total public rapid charging devices



All Wales

35
Charging devices per 100,000 population

Data Overview:

As at April 2022 there were **1,105** publicly available charging devices for electric vehicles across Wales. **185** of those have been classed as rapid charging devices. Across Wales there are approximately **35** electric charging devices per 100,000 population.

Note: Population estimates used to calculate the 'per 100,000' figures are based on 2020 mid-year ONS estimates.

Contact email: environment.stats@dft.gov.uk

Last Update: April 2022

Designation: Experimental Statistics

External links

Electric vehicle charging device statistics: April 2022 - GOV.UK (www.gov.uk)

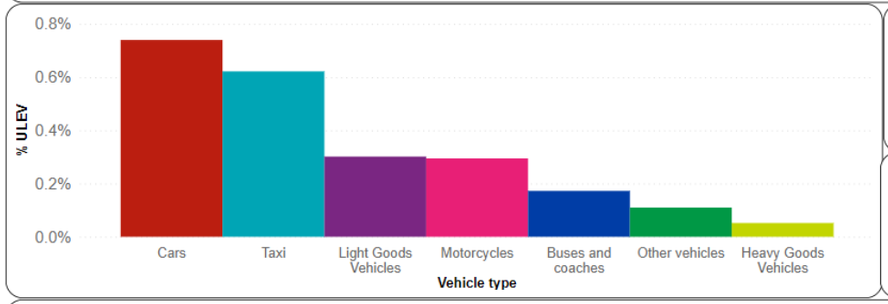
M2 % vehicles that are ultra-low or zero emission

Information:
Proportion of TfW Rail Services rolling stock and road vehicle fleet registered in Wales that are ultra-low or zero emission.

Ultra low emission vehicles (ULEVs) are vehicles that are reported to emit less than 75g of carbon dioxide (CO2) from the tailpipe for every kilometre travelled. In practice, the term typically refers to battery electric, plug-in hybrid electric and fuel cell electric vehicles.

The Department for Transport publishes numbers of all licensed vehicles by different type (excluding taxis and private hire vehicles) on a quarterly basis. DfT also published the numbers of licensed vehicles for each type on a quarterly basis (including taxis and private hire vehicles). Stats Wales publishes the levels of licensed taxis and private hire vehicles in Wales on an annual basis. For taxis and private hire vehicles the latest available figures from both data sources have been used.

Transport for Wales publishes information about all of its current fleet of trains on its website. This includes information on the fuel type used by each different class of train and the number of each class in operation.



Number of road vehicles that are ultra-low emission Q3 2021

12,887

% road vehicles that are ultra-low emission Q3 2021

0.64%

Data Overview:

Cars have the highest number (11,796) of ULEVs and also the highest percentage share (0.74%) compared to other road vehicle types.

There are 57 licensed ULEV taxis/private hire vehicles, which represents 0.62% of the current taxi/private hire fleet in Wales.

Transport for Wales currently has five Class 230 trains that operate using diesel and battery bi-mode fuel. The rest of the operational fleet currently use diesel as their fuel source.

Contact email: vehicles.stats@dft.gov.uk (for road vehicle fleet & ULEV)
stats.transport@gov.wales (for licensed taxis/private hire vehicles)
WTSMonitoring@tfw.wales (for rail fleet)

Last Update: Road Vehicle Totals (excluding taxis) and ULEV levels: January 2022
Licensed taxi/private hire vehicles: April 2022
TfW rail fleet: April 2022

Designation: Road Vehicle Fleet - National Statistics
Licensed taxi/private hire vehicles: No Statistical Designation
TfW rail fleet - No Statistical Designation

External links

All vehicles dataset- Department for Transport (gov.uk)

Licenced taxis and private hire vehicles by local authority and survey year (gov.wales)

Train accessibility | TfW

Figure 68: Wales Transport Strategy monitoring and evaluation dashboard
Source: TfW, 2022

5.7 Programme plan

5. Management case
5.2 Programme plan

5.2.1 Programme plan

Since the launch of the Strategy in 2021, WG and TfW have overseen a number of work packages designed to help transition toward delivery phase of the Strategy. As of November 2022, these work packages includes:

- Ongoing market engagement carried out by TfW with the private sector, including CPOs.
- Developing a preferred network mapping exercise to help visualise the areas across Wales which may need WG and TfW intervention, e.g. sites considered commercially unviable.
- Developing a National Standards for EV charging infrastructure.
- Forming a EV infrastructure procurement framework.

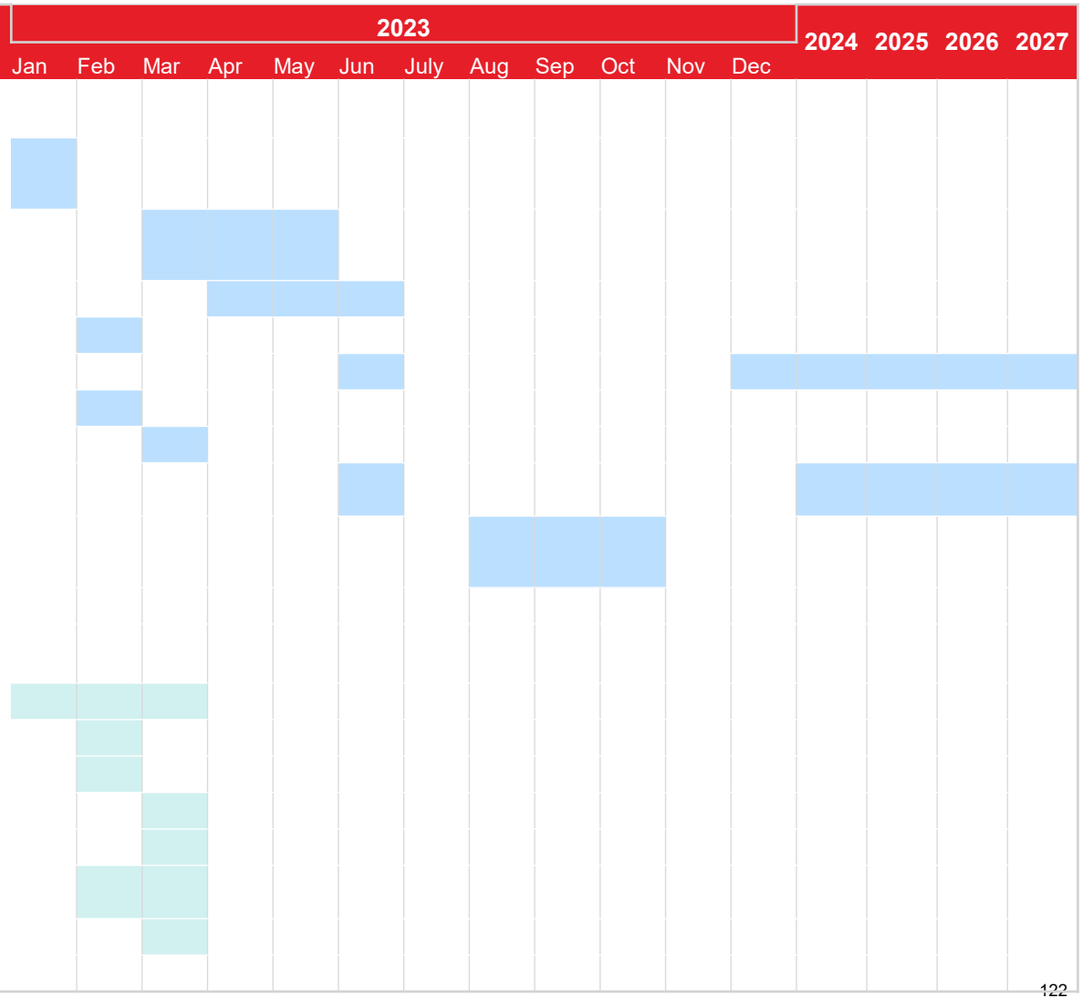
Meeting the 2025 target set by the Strategy necessitates immediate mobilisation and WG, alongside TfW, will need to develop a programme plan, at minimum for the next 1-2 years, identifying the activities, engagement etc. to implement the Strategy. There are three main activities WG and TfW will need to focus on within the next 6-12 months.

1. **Stakeholder engagement** – continued engagement with the market, including CPOs and DNOs, will be pivotal in the next 6 months to help WG and TfW understand the direction of the private sector investment and activities, as well as identify areas where public sector intervention will likely to be needed. Furthermore, as recommended by the Action Plan, a
2. **Identify a programme of interventions** – work has already begun to identify the level of intervention and associated risks the public sector are willing to take on through the red lines assessment (as set out under the commercial case). Once market engagement has taken place, WG, TfW and local authorities must continue this work to develop a programme of interventions, which in turn determines the business models to be potentially adopted.
3. **Developing a deliverability strategy** – this report marks the first step in setting out *how* the Strategy will be implemented. It is highly recommended a detailed deliverability plan should be developed which sets the direction of implementation, and address key gaps, including programme risks, funding and financing requirements, and monitoring and evaluation framework.

Pages 122-124 sets out the key tasks to be completed/take place within the next 3-5 years.

5. Management case
5.2 Programme plan

Tasks		Lead
1.	**Establish a PMO to govern delivery arrangements, set standards and monitor progress**	
1.1	Workshop to review all work done to date and identify key gaps and immediate next steps - what further consultancy support does WG need for policy strategy development?	WG, TfW
1.2	Establishment of a governance structure, including establishing a Transport Decarbonisation Governance framework which incorporates EV Charging Delivery.	WG
1.3	Set-up a Programme Management Office (PMO), with identified roles and responsibilities	TfW, WG
1.4	Develop a Performance management and accountability framework for WG/TfW delivery.	WG
1.5	Develop and regularly review and update the phased programme of interventions	TfW
1.6	Develop a programme-level risk register and management plan	TfW
1.7	Develop a communications and stakeholder engagement plan	WG, TfW
1.8	Review and revise the target number of CPs needed across Wales, as future demand projections evolve	TfW
1.9	Determine the funding requirement (budget) for the next 3-5 years - revisit and refine the range of cost results and identify funding sources by the public and private sector	WG
2.	**Providing support and guidance to enable local authorities (and private sector) to deliver the preferred network**	
2.1	Determine the scale of immediate funding and support local authorities require	WG, TfW
2.2	Publish National Standards	WG
2.3	Build on the capability exercise and continue to identify capacity and capability gaps	TfW
2.4	Develop a support function for local authorities	TfW
2.5	Facilitate funding for local authorities via ULEV	WG
2.6	Ensure all LAs have EV Charging strategy and ensure they are clear on roles for WG, TfW, Private sector and what we want from them.	WG
2.7	Engagement with CADW and National Trust to support delivery of CPs at heritage and tourist sites	WG



5. Management case
5.2 Programme plan

Tasks		Lead	2023 Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	2024	2025	2026	2027
3.	**Engagement with the private sector to ensure we optimise the delivery of the preferred network and foster public-private sector collaboration**																	
3.1	Market engagement with CPOs to understand the private sector's plans and priorities for future investment	TfW																
3.2	Establish a cross interest public and private CP Task & Finish Group	WG																
3.3	Develop engagement and comms capability with Private Sector.	TfW																
3.4	Set target for PS delivery, and identify required public sector intervention to complement PS delivery	TfW																
3.5	Create open access to Datamap Wales to allow private sector to utilise data for infrastructure roll-out	WG																
3.6	Undertake a supply chain and opportunities review	WG																
4.	**Developing the mechanisms, knowledge and tools to deliver the preferred network**																	
4.1	WG to review and establish policy levers and remove barriers to EVCI installation and operations. This includes review of regulations to support the provision of home and workplace charging in new builds and refurbishments	WG																
4.2	Develop funding and financing options, including FTR options	WG																
4.3	Establish Commercial Procurement Framework - design and delivery	WG																
4.4	Explore alternative procurement solutions, such as procuring a consortium of private sector partners to deliver the preferred network over the next 2-5 years. This could be structured as a Challenge Fund.	WG																
4.5	Future proofing the grid network - regular engagement with DNOs to ensure current infrastructure can serve the preferred network	TfW																
4.6	Develop and implement communications campaign (target audience: end users, the public), linked to Behaviour Change work, to raise awareness of EVs and CP rollout.	WG																
4.7	Identify locations suitable for renewable generation and energy storage, assisting power provision for the charging network	WG																

5. Management case
5.2 Programme plan

Tasks		Lead	2023												2024	2025	2026	2027
			Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec				
5.	**Leverage the resource and mechanisms necessary to rapidly deliver the network in line with policy objectives**																	
5.1	Delivery of the on-route network, with TfW supporting where required (e.g. providing planning support and coordination or delivering CPs in commercially unviable sites)	Private Sector, TfW																
5.2	Delivery of destination and on-street charging in built-up areas, with local authorities supporting where required	Private sector, LAs																
5.3	Monitor progress of the EV charging infrastructure roll-out	WG																
5.4	Knowledge sharing and applying lessons learnt through regular public-private group engagement	WG, TfW																

5.7 Recommendations and next steps

5. Management case
5.7 Recommendations and next steps

5.7.1 Immediate actions
WG and TfW have the opportunity to lead by example and help build a reliable, efficient EV charging network in Wales, transforming the way residents and visitors travel. Achieving this goal requires a strong, effective programme management and governance who will be responsible and accountable for the acceleration of EV charging infrastructure roll-out. Taking into consideration the scale of intervention required (based on the findings of the financial case and commercial case), TfW and WG will need to assess the minimum level of resourcing required to deliver the preferred network.

This report lays the foundation of the key components to delivering the Strategy and Action Plan. WG, alongside TfW, will need to build on this report to establish a PMO to govern delivery arrangements, set standards and monitor progress. Immediate tasks for the next six months includes:

- Establishment of a PMO, defining programme roles and responsibilities, and considerations which entity the PMO will initially sit within (WG or TfW).
- Market engagement with CPOs, via both focus groups and one-to-one consultation, to help identify the likely public sector interventions.
- Form a public-private sector working group.
- Establish a governance structure, defining lines of reporting and Terms of Reference for each governance groups.
- Address capability and capacity gaps in-house, as well as external third parties.
- Develop a detailed programme plan at minimum for the next 1-2 years, setting out the critical path, key tasks and activities, as well as funding requirements and key milestones.
- Create a programme-level risk register and management plan.

5.7.2 Monitoring and review
We encourage progress to be monitored and evaluated frequently in the short term to meet the aims of the Strategy and Action Plan. This will ensure it remains relevant in this rapidly developing market, and WG, alongside TfW and local authorities, are in prime position to respond and adapt quickly to any challenges and opportunities the evolving EV market may bring.

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

6.1 Overview

6.1.1 Next steps: priorities for Welsh Government and delivery partners

The findings of this report suggests that more work and development is needed to implement the EVCI programme in the next phase, harnessing the work done to date (e.g. National Standards, early market engagement). To achieve this, a programme-level roadmap has been developed, setting out actions across five key priorities for WG and delivery partners for the next 3-5 years, to deliver successful acceleration of EV charging infrastructure across Wales, and meet the defined KPIs set by the Strategy. The roles and responsibility of WG, TfW, local authorities and the private sector are summarised on the right.

6.1.2 Roadmap: 5 key priorities

1. Establish a PMO to govern delivery arrangements, set standards and monitor progress

2. Provide support and guidance to enable local authorities (and private sector) to deliver the preferred network

3. Engagement with the private sector to ensure we optimise the delivery of the preferred network and foster public-private sector collaboration

4. Develop the mechanisms, knowledge and tools to deliver the preferred network

5. Leverage the resource and mechanisms necessary to rapidly deliver the network in line with policy objectives

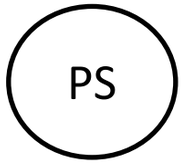
6.1.3 Role and responsibility

Delivering the preferred network within the required timescales will depend on the joint effort of the public and private sector, with the following key players:

Welsh Government – Strategic Oversight and Policy
Oversight of the EV Charging Infrastructure Strategy, setting standards, monitoring strategy progress, policy intervention and financial intervention.

Transport for Wales– Delivery Partner
Delivery and monitoring the strategy at the on-route network, providing delivery support to local authorities and Welsh Government.

Local Authorities – Delivery Partner
Delivery and monitoring the strategy locally, at destinations and on-street sites, with support from Transport for Wales.



Private Sector– Delivery of the Preferred Network
The private sector will largely install and operate the preferred network, public sector intervention is targeted where market failure has been identified (e.g. TfW delivering charge-points at commercially unviable on-route sites).

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales

6.2 Detailed roadmap by priorities

1. Establish a PMO to govern delivery arrangements, set standards and monitor progress

Objective

The establishment of a Programme Management Office (PMO) is recommended. The PMO will be responsible for the EV Charging Infrastructure Programme meeting the policy objectives. A PMO has proven critical for other countries for coordination and leadership (e.g. Ireland, Scotland), a model which can be replicated for Wales. Setting governance arrangements in place will also prove pivotal to provide oversight and leadership.

Benefits

The PMO model ensures consistency and efficiency of resourcing and maximisation of knowledge and skillset gained across the programme, avoiding delays in delivering the preferred network. A centralised oversight and management of EV charging infrastructure can create synergies and cross-collaboration between the public sector and private sector, to the benefit of different charging needs and consumers, from rural communities to public sector fleet.

Responsibilities

- WG to provide strategic oversight, including the establishment of the governance arrangements, as well as determine and administer direct funding.
- TfW to lead the set-up of the PMO (with WG support), and to develop the programme of interventions. TfW will also be responsible for overseeing and manage programme-level risks.

Task	Lead
1.1 Workshop to review all work done to date and identify key gaps and immediate next steps	WG, TfW
1.2 Establishment of a governance structure, including establishing a Transport Decarbonisation Governance framework which incorporates EV Charging Delivery.	WG
1.3 Set-up a Programme Management Office (PMO), with identified roles and responsibilities	TfW
1.4 Develop a Performance management and accountability framework for WG/TfW delivery.	WG
1.5 Develop and regularly review and update the phased programme of interventions	TfW
1.6 Develop a programme-level risk register and management plan	TfW
1.7 Develop a communications and stakeholder engagement plan	WG, TfW
1.8 Review and revise the target number of CPs needed across Wales, as future demand projections evolve	TfW
1.9 Determine the funding requirement (budget) for the next 3-5 years - revisit and refine the range of cost results and identify funding sources by the public and private sector	WG

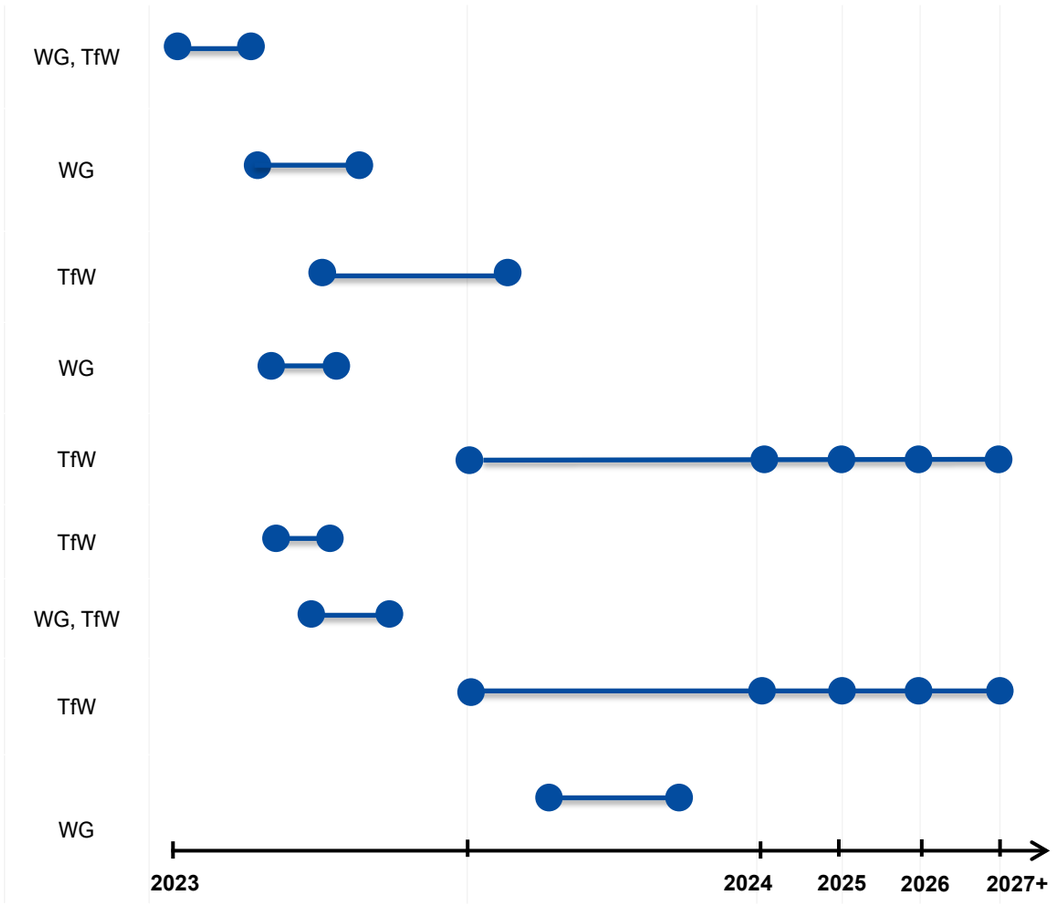


Figure 69: EVCI programme – priority 1 activities
Source: WG, TfW, Arup

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales
6.2 Detailed roadmap by priorities

2. Provide support and guidance to enable local authorities and private sector to deliver the preferred network

Objective
WG and TfW will work with local authorities to provide the support, tools and guidance needed deliver destination and on-street charging infrastructure, requiring collaboration between local authorities and private sector, and ensuring local authorities are clear on their role and responsibility. This includes the set-up of a support function, as well as facilitating funding for local authorities.

Benefits
This action provides clarity on the expectations of local authorities' role in the delivery of the preferred network. By providing local authorities access to the resources and funding needed, public charging needs can be met. Opportunities for synergies are also created, promoting a consistent approach to delivery and efficiency.

Responsibilities
- WG to oversee the development and dissemination of guidance and strategies, as well as administer funding to local authorities for EV charging infrastructure delivery. WG have already developed the National Standards, due for publication in early 2023.
- WG to engage with national bodies and trusts to coordinate nation-wide EV charging infrastructure e.g. CADW and the National Trust.
- WG to work with WG Business & Regions and International Trade to develop close relationship with key private sector organisations.
- WG to promote cross-government joined-up working to maximise resources and chance of successful delivery.
- TfW to work directly with local authorities to address capability and capacity gaps, as well as develop a support function for local authorities.

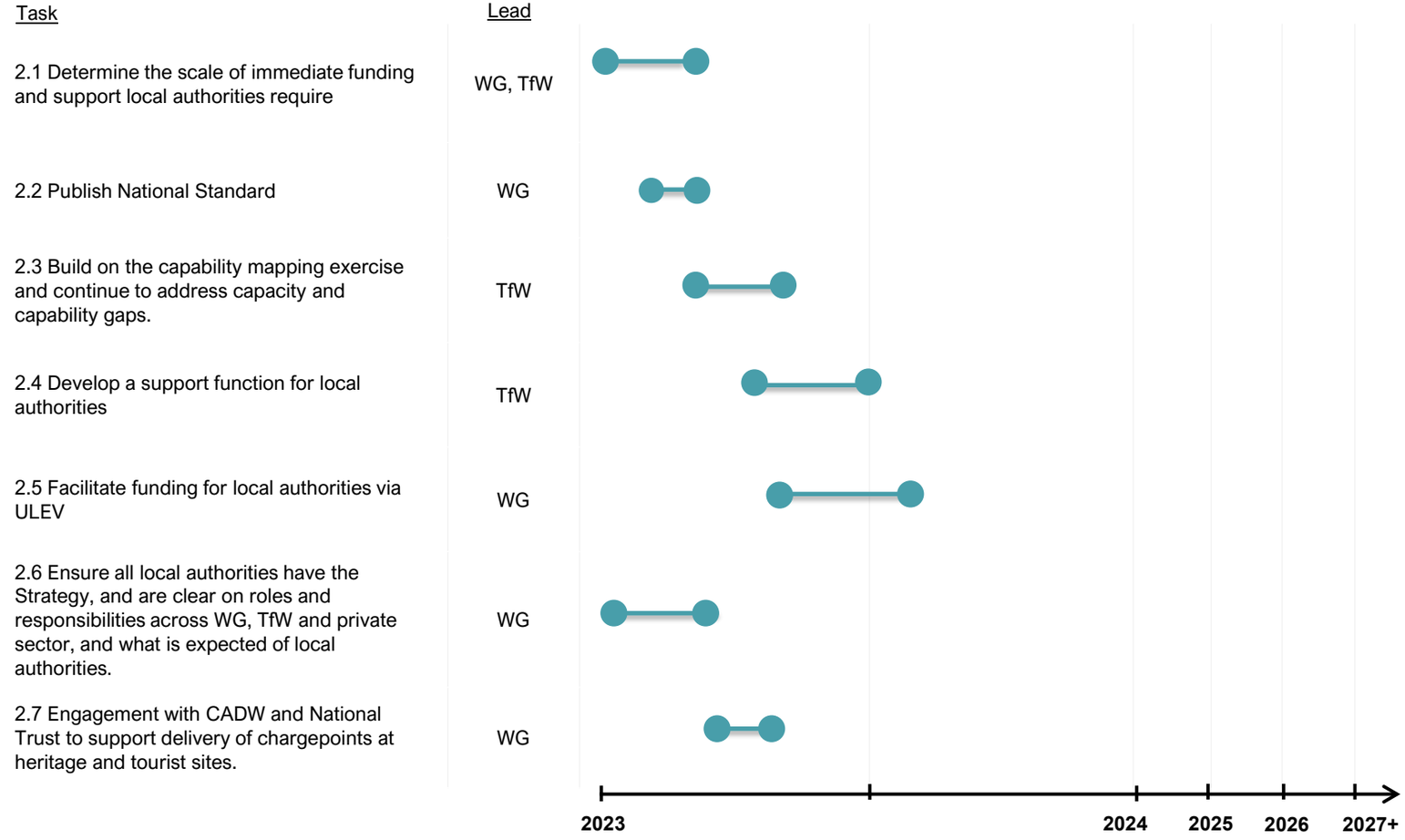


Figure 70: EVCI programme – priority 2 activities
Source: WG, TfW, Arup

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales
6.2 Detailed roadmap by priorities

3. Engage with the private sector to ensure delivery of the preferred network

Objective

Ongoing engagement and collaboration with the private sector is required. As recommended by the Strategy Action Plan, a public-private sector charge point working group will be created, enabling the communication and knowledge sharing between stakeholders in a rapidly evolving sector in Wales.

Benefits

The public-private sector charging point working group will support cross-sector coordination across infrastructure investment programmes. Understanding the private sectors' priorities for investment and charge point installation will allow the public sector to intervene where required to maximise equitable access to high quality EV charging for all, as well as avoid duplication of efforts. Incentives for the private sector may also be developed to encourage accelerated roll-out of the preferred network. Cross-sector knowledge sharing and lessons learned can help identify solutions to maximise network coverage across Wales.

Responsibilities

- WG to establish and manage the cross public-private charge point working group.
- TfW to primarily lead engagement activities with the private sector, with the support of WG.

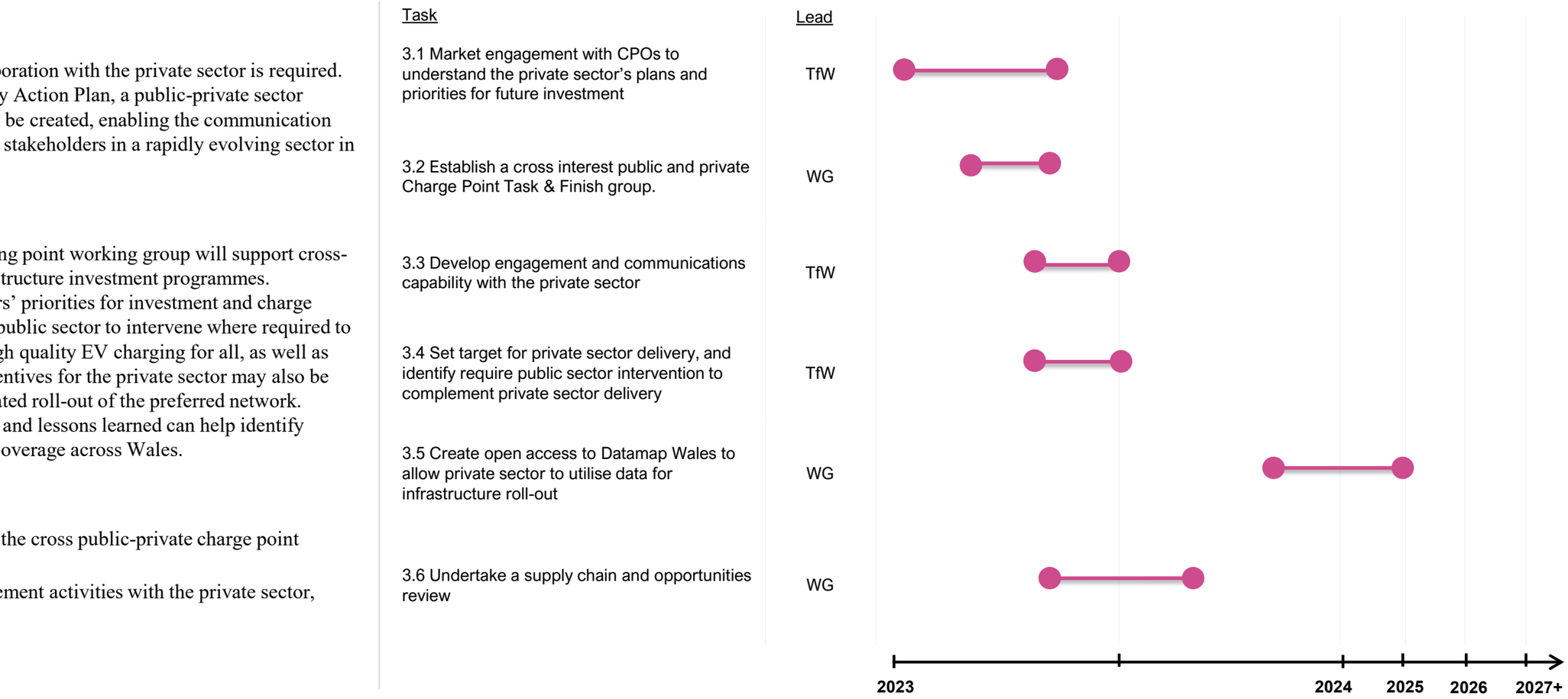


Figure 71: EVCI programme – priority 3 activities
Source: WG, TfW, Arup

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales
6.2 Detailed roadmap by priorities

4. Develop the mechanisms, knowledge and tools to deliver the preferred network

Objective

To develop the support that enables the delivery partners (TfW, local authorities and the private sector) to implement EV charging infrastructure across Wales include review of regulation and policy, developing funding and financing mechanisms, futureproofing the grid network and raising public awareness. Furthermore, suitable locations for renewable generation coupled with energy storage will be sought to assist in providing and futureproofing power for the preferred network.

Benefits

This action will encourage a consistent approach to the delivery of charging-ready infrastructure. WG will utilise its policy and planning levers to address any barriers to the implementation of EV charging infrastructure, and support acceleration of roll-out.

Responsibilities

- WG to review government policy and regulations to support EV charging.
- WG to work in partnership with private and public sector to raise awareness of the needs of EV charging infrastructure across Wales.
- TfW to lead engagement with DNOs to ensure current and future grid capacity is sufficient for the preferred network.

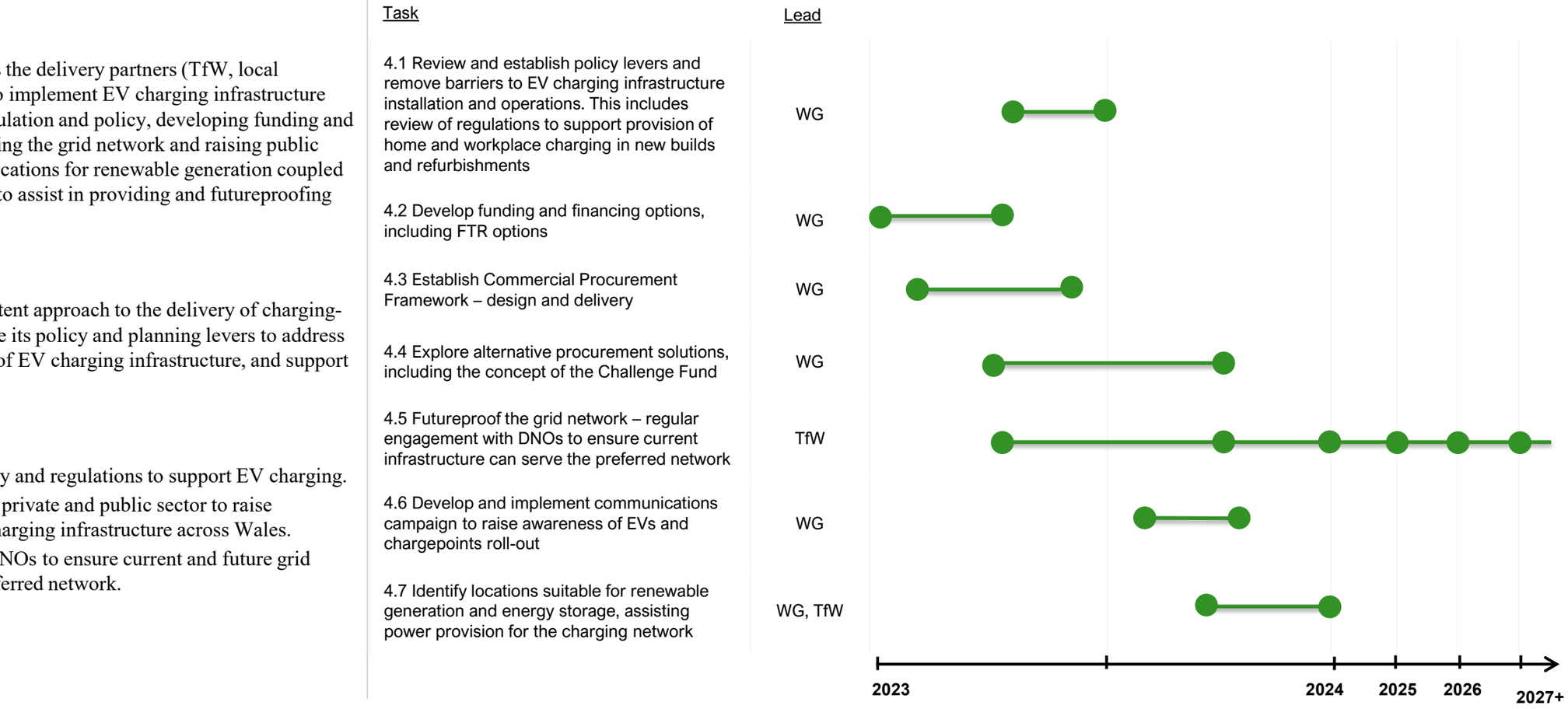


Figure 72: EVCI programme – priority 4 activities
Source: WG, TfW, Arup

6. Roadmap for accelerating the roll-out of EV charging infrastructure in Wales
6.2 Detailed roadmap by priorities

5. Leverage the resource and mechanisms to deliver the preferred network

Objective

WG and partners would leverage the support developed (from priority 1-4) to deliver the preferred network in line with policy objectives. Where feasible, the private sector will continue to lead the implementation and operations of the EV chargepoints across Wales, with the expectation TfW and local authorities to address charging infrastructure gaps, e.g. deliver chargepoints rural sites deemed commercially unviable.

Benefits

Increasing sufficient coverage of EV chargepoints, particularly ultra rapid/rapid chargers across the strategic road network, will ease range anxiety and boost public confidence long-distance travel is feasible, and encourage the switch from diesel/petrol vehicles to EVs. The role and influence of the public sector aims to mitigate disproportionate access to high quality (and inclusive) EV chargepoints, and all different charging needs are addressed.

Responsibilities

- The private sector to primarily lead and deliver the preferred network, particularly for home charging and off-street parking.
- TfW to deliver on-route chargepoints across sites not served by the private sector.
- Local authorities to deliver destination and on-street chargepoints across sites not served by the private sector.

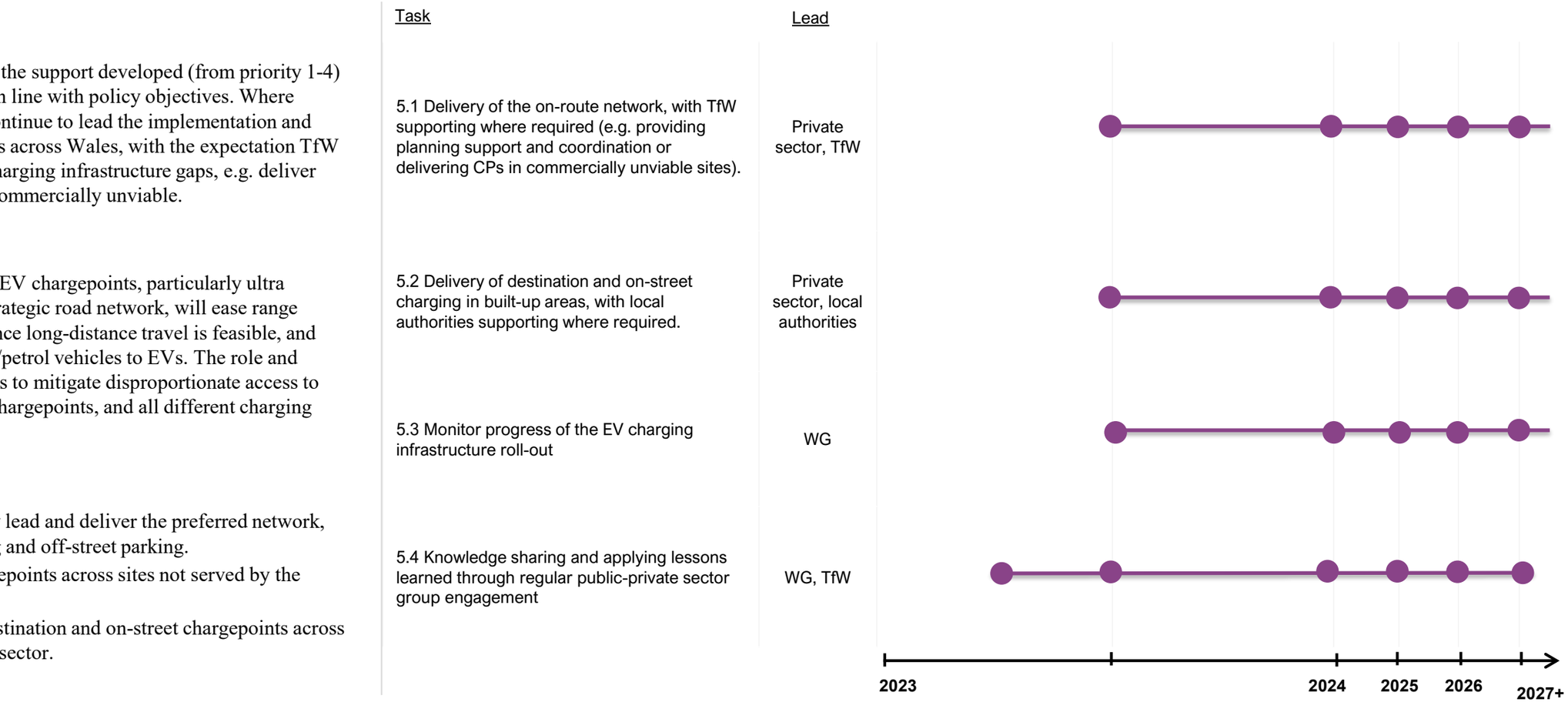


Figure 73: EVCI programme – priority 5 activities
Source: WG, TfW, Arup

Appendix A

The Technology Adoption Life Cycle

A.1
The technology adoption life cycle

Overview

The technology adoption life cycle was developed by Everett Rogers, and includes five categories: Innovators, Early Adopters, Early Majority, Late Majority and Laggards.22 The model was later modified by Geoffrey Moore to include "The Chasm", which accounts for discontinuous innovation between the first two adopter groups and the vertical markets.23 It is often used to describe the maturity of a technology within the market. The process of adoption can be illustrated over time by a normal distribution curve.

Innovator

Typically, a technology is first used by the Innovators, making up roughly 2.5% of the total population. Innovators sometimes seek technologies before they are formally marketed to the general public. They are willing to take risks, are usually the youngest in age and have the highest social class with great financial lucidity. They tend to be very social and have close contact to scientific sources and interaction with other Innovators. Their risk tolerance allows them to adopt technologies that may ultimately fail and their financial resources help absorb these failures.

Early adopters

Early Adopters are the second fastest category of individuals who adopt an innovation, making up roughly 13.5% of the total population. Similar to Innovators, they buy into a new product concept early in its life cycle but unlike Innovators, they are not only looking for an improvement but for a revolutionary breakthrough. They are willing to take high risks trying to find that breakthrough, they are the least price-sensitive of the whole population but are highly demanding. Early adopters rely on their own instinct and vision rather than references in making buying decisions. They are willing to serve as highly visible references to other adopter groups. Since early adopters are good at setting the trend and alerting the rest of the population, they are the most important segment to win over.

The chasm

Moore defines the Chasm as the space between Innovators (what he calls Visionaries) and the beginning of the mainstream market, the Early Majority (or in his words, the Pragmatists). This gap exists because the early purchasing groups have different buying criteria to the rest of the customer bases. The concept behind the Chasm is that a technology needs to evolve to incorporate people's experience to make it viable, scalable and able to fulfil the need of a mainstream audience. An example of an organisation that successfully crossed the chasm is AirBnB. They started out as a local rental marketplace with a focus on occasional events when demand for accommodation was high. They had gained a small customer base with individuals who were looking for temporary, lower cost lodging but their business model was not appealing to larger, more mainstream audiences. They expanded their reach to local rental at large, regardless of events in the area, which made it easier for landlords to connect with guests from all over the world.

Early majority

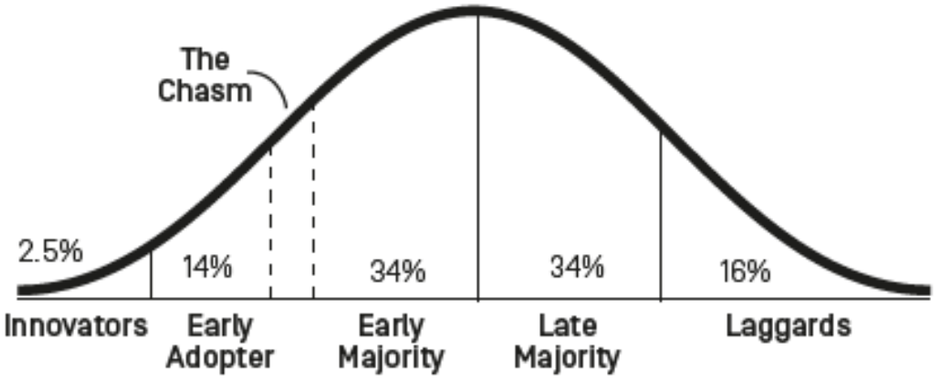
The Early Majority are the first customer segment in mass market adoption. They make up 34% of the population and hence are funda¬mental to the success or failure of a technology. They are open to new ideas but they adopt an innovation after a varying degree of time longer than the previous two groups, to ensure that the technology is not a passing fad. Early Majority are usually above average social class and income individuals, who are exposed to the opinions of Early Adopters.

Late majority / laggards

Following behind are the Late Majority (34% of population) and the Laggards (16% of population) who believe more in tradition than in progress. Both groups are not comfortable with their ability to handle a new technology. They have a strong belief that disruptive innova¬tions rarely fulfil their promises and almost always bring unexpected consequences. They are the hardest consumer groups to win over and require the market to be evolved and proven before they reluctantly commit to buying into a new technology.

A.1
The Technology Adoption Life Cycle

The **technology adoption life cycle** is a sociological model that describes the adoption or acceptance of a new technology according to five chronological demographics.



The technology adoption life cycle

Appendix B

Commercial case workshops

B.1
Public sector workshops

Engagement with the public sector

Arup's engagement with the Welsh Government, Transport for Wales, and representative Local Authorities have driven two key aspects of the commercial case: 1) where skills and resources currently exist (and where they might exist in the future), and 2) where and how the public sector would intervene to ensure the charging strategy is delivered in Wales.

Arup held a series of workshops with the Welsh Government, Transport for Wales, and representatives from Local Authorities. Workshop attendees are outlined opposite.

These workshops were formed of two main exercises:

1. **Capability Mapping:** This exercise informs the type of intervention that the Welsh Government, Transport for Wales, and Local Authorities are capable of carrying out, and where gaps might need to be filled. Understanding the capability within the public sector sets the boundaries of what action the public sector is *able* to take in the EV charging space, and to identify what roles will need to be outsourced. This activity also informs the division of roles within the public sector, between the Government, Transport for Wales, and Local Authorities.
2. **Role Across the Public Sector (Red Lines exercise):** This exercise informs the priorities of the strategy, wherein the public sector would ideally invest or intervene across charging modes, where there is room for compromise or negotiation, and where there are red lines. Arup used the outputs of this exercise to identify barriers to the delivery of the charging strategy and potential interventions to overcome these barriers, thus outlining the role of the public sector.

Public sector engagement Workshop Attendees

Welsh Government	Transport for Wales	Local Authorities	Arup	
Karine Boucher Welsh Government *Senior Commercial Manager – Business Solutions, Economic Infrastructure*	**Steve Ward** Transport for Wales *Decarbonisation Programme Manager*	**Dylan Llewelyn Jones** Isle of Anglesey County Council *Senior Engineer – Strategic & Sustainable Transport: Highways, Property & Waste*	**Matthew Dillon** Arup Project Director *Business Case and Financial Modelling*	**Wendy Cheung** Arup Project Manager *Business Case and Financial Modelling*
Robin Beckmann Welsh Government *Head of Transport Environment and Climate Change Economic Infrastructure*	**Gordon Brown** Transport for Wales *EV Project Manager*	**Ross Cudlipp** Newport City Council *Climate Change Service Manager*	**Helen Westhead** Arup Programme Director: *Welsh Government EV Charging Strategy*	**Niamh Hodkinson** Arup Consultant *Business Case and Financial Modelling*
Dafydd Munro Welsh Government *Transport Decarbonisation Policy Manager*	**Rachel Lewis** Transport for Wales *EV Project Manager*		**Teddy Spasova** Arup Expert Advisor *Business Case and Financial Modelling*	**Ben Adey-Johnson** Arup Senior Consultant *Isle of Anglesey EV Charging Strategy*

ARUP

B.2
Capability mapping workshop

Capability of the public sector: capability mapping

One workshop focused on identifying the "capability" (existing skills and available resources) of public sector bodies to perform a range of roles across the EV charging value chain. Representatives from the Welsh Government, Transport for Wales, and Local Authorities individually considered the exercise prior to a collaborative session hosted by Arup.

	EV Charging Capability Areas										
	Land	**Planning**	**Contracting / Civils**	**Pricing/ Finance**	**Site Design**	**CP Installation & Construction**	**Power Supply & Metering**	**CP Operation**	**Customer Experience**	**CP Maintenance**	**Contract Management**
Needs / Capabilities	1. Land management 2. Legal	1. Planners-Development Management 2. Heritage Consultants 3. Environmental Consultants 4. Transport Planners	1. Procurement management 2. Structure of business 3. Legal	1. Market analysts 2. Finance and pricing management 3. Cost Management 4. Quantity Surveying 5. Funding	1. Architects 2. Landscape Design 3. Civils Engineers 4. Structural Engineers 5. Mechanical Electrical Engineers	1. Civils Contractors 2. Electrical Engineers	1. Independent Connection Provider (ICP) 2. Electrical Engineers 3. Meter Operators 4. Meter asset Managers 5. Power supply	1. Software Development Engineers 2. Customer Service Advisor 3. Markets and Comms	1. Market Analysts 2. Product managers 3. User experience specialists 4. Marcomms	1. Electrical Engineers 2. Software Engineers	1. Contract Managers 2. Legal
Assessment	●	●	●	●	●	●	●	●	●	●	●

Each public sector representative evaluated their perspective of the levels of skill and resource that existed within their public sector body and team to carry out the roles outlined in each column of the above table.

In many cases, skills existed in other teams within the public sector bodies, but resource was not available within the EV charging or road decarbonisation spaces.

The evaluation was performed using a traffic light system – a green indicator for strong skills and resources, an amber indicator for existing skills but under-resourced (or vice versa), and a red indicator for no skills or resources, or for roles not seen as appropriate to any particular public sector body.

After individual analysis was carried out, Arup hosted a collaborative workshop, where public sector representatives shared their individual views and came to consensus on capability within the different public sector bodies. The ratings and considerations identified during this exercise are outlined in Section 3.3.

- ● **High** *Strong skills and resources available*
- ● **Medium** *Skills but little/no resource; some skills and resources; etc.*
- ● **Low** *Little to no skills and resources; not seen as appropriate role*

Appendix C

Financial case: cost development methodology

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C.1
Financial case supply assumptions

Supply assumptions

The table below summarises the capax analysis assumptions made around the supply of infrastructure. The Arup demand modelling scenarios (1) are outlined previously, in section 4.2, as are the sensitivities around the maximum annual and daily point of supply (2 and 3). The capex analysis assumes that there are 10 50 kW chargepoints per on-route site in the central scenario, flexing between 6 and 14 CPs per site in the "more and smaller sites" and "fewer and larger sites" sensitivities, respectively. At destination sites, the analysis assumes a site size of 6 CPs of varying speeds (mix of speeds outlined in section 4.2), flexing between 2 and 12 CPs per site in the aforementioned sensitivities.

				Central	Maximum # CPs	Minimum # CPs	More Street	More and Smaller Sites	Fewer and Larger Sites	Supply 100% of Daily Peak	Max = End Point Supply	Max = Average b/t Max and End	Max = 75% Max Point Supply
1	***Arup Demand modelling scenarios***												
	Supply scenario (on-route)	*scenario*	*Arup Demand Modelling*	10%	15%	5%	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*
	Supply scenario (destination)	*scenario*	*Arup Demand Modelling*	Base	CE	RD	GS	CENTRAL	CENTRAL	CENTRAL	CENTRAL	CENTRAL	CENTRAL
2	***Max # CPs***												
	Max # CPs scenario (on-route)	*scenario*	*Supply maximum point*	MAX	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	END	AVERAGE	MAX
	Max # CPs scenario (destination)	*scenario*	*Supply maximum point*	MAX	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	END	AVERAGE	MAX
	Scale for % of maximum supply (on-route)	*%*	*% of CPs*	100%	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	100%	100%	75%
	Scale for % of maximum supply (destination)	*%*	*% of CPs*	100%	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	100%	100%	75%
3	***Scale for peak supply***												
	Meet x% of peak hour demand (on-route)	*%*	*% of capacity*	75%	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	100%	*CENTRAL*	*CENTRAL*	*CENTRAL*
	Meet x% of peak hour demand (destination)	*%*	*% of capacity*	75%	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*	100%	*CENTRAL*	*CENTRAL*	*CENTRAL*
4	***CPs per site scenario***												
	CPs per site scenario (on-route)	*# CPs /site*	*Representative site size*	10	*CENTRAL*	*CENTRAL*	*CENTRAL*	6	14	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*
	CPs per site scenario (destination)	*# CPs /site*	*Representative site size*	6	*CENTRAL*	*CENTRAL*	*CENTRAL*	2	12	*CENTRAL*	*CENTRAL*	*CENTRAL*	*CENTRAL*

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C.2
Financial case cost assumptions [1/2]

Unit cost assumptions [1/2]: chargepoint capex

Unit costs are also flexed between sensitivities – sensitivities A, B, C, and D all affect the unit costs of different costs. In Sensitivities C and D, all unit costs are increased or decreased by 25%, respectively – as can be seen below in chargepoint supply and installation unit costs.

Sensitivity A and B

In Sensitivities A and B, chargepoint costs remain the same as in the central case. Inputs on the following slide are flexed in these sensitivities.

Sensitivity C

In Sensitivity C, all unit costs for the supply and installation of each chargepoint is increased by 25%.

Sensitivity D

In Sensitivity D, all unit costs for the supply and installation of each chargepoint is decreased by 25%.

Data Sources

- Chargepoint supply and installation costs – Arup benchmarks from market knowledge

Sensitivity:			A	B	C	D
		Central	More and Smaller Sites	Fewer and Larger Sites	25% Higher Costs	25% Lower Costs
Chargepoint Capex						
Chargepoint supply cost						
Chargepoint supply cost: fast (7 kW)	£/CP	1,700	CENTRAL	CENTRAL	2,125	1,275
Chargepoint supply cost: fast (11 kW)	£/CP	2,000	CENTRAL	CENTRAL	2,500	1,500
Chargepoint supply cost: fast (22 kW)	£/CP	2,300	CENTRAL	CENTRAL	2,875	1,725
Chargepoint supply cost: rapid (50 kW)	£/CP	35,000	CENTRAL	CENTRAL	43,750	26,250
Chargepoint supply cost: ultra-rapid (100 kW)	£/CP	55,000	CENTRAL	CENTRAL	68,750	41,250
Chargepoint supply cost: ultra-rapid (150 kW)	£/CP	60,000	CENTRAL	CENTRAL	75,000	45,000
Chargepoint installation cost						
Chargepoint installation cost: fast (7 kW)	£/CP	2,265	CENTRAL	CENTRAL	2,831	1,699
Chargepoint installation cost: fast (11 kW)	£/CP	2,265	CENTRAL	CENTRAL	2,831	1,699
Chargepoint installation cost: fast (22 kW)	£/CP	2,265	CENTRAL	CENTRAL	2,831	1,699
Chargepoint installation cost: rapid (50 kW)	£/CP	15,000	CENTRAL	CENTRAL	18,750	11,250
Chargepoint installation cost: ultra-rapid (100 kW)	£/CP	15,000	CENTRAL	CENTRAL	18,750	11,250
Chargepoint installation cost: ultra-rapid (150 kW)	£/CP	15,000	CENTRAL	CENTRAL	18,750	11,250

Chargepoint Capex Assumptions

C.2
Financial case cost assumptions [2/2]

* Grid connection unit costs are based on "Network level assets per kW (simultaneous peak) per year" multiplied by a period of 45 years, as published in SPEN and WPD's Common Distribution Charging Methodology (CDCM) models – in reality grid connection costs are determined on a site-specific basis and may vary considerably.

Unit cost assumptions [2/2]: electrical and site capex

Unit costs are also flexed between sensitivities – sensitivities A, B, C, and D all affect the unit costs of different costs.

Sensitivity A

In Sensitivity A, grid connection and substation / step-down transformation unit costs remain the same as in the central case. Site planning and civil works unit costs decrease by 20% for On-Route sites and by a third for Destination sites (mechanism outlined in section 4.2).

Sensitivity B

In Sensitivity B, grid connection costs increase by 50%, to represent the cost difference of a higher-voltage connection, while substation / step-down transformation unit costs remain the same as in the central case. Site planning and civil works unit costs increase by 20% for On-Route sites and by half for Destination sites (mechanism outlined in section 4.2).

Sensitivity C and D

In Sensitivity C, all electrical and site unit costs increase by 25%.

In Sensitivity D, all electrical and site unit costs decrease by 25%.

Data Sources

- Grid connection cost: SPEN and WPD CDCM charging models
- Site substation cost (step-down Tx): Arup electrical engineering and EV charging market knowledge and benchmarks
- Site capex (planning and civils): Arup EV charging market knowledge and benchmarks

		Sensitivity:	A	B	C	D
		Central	More and Smaller Sites	Fewer and Larger Sites	25% Higher Costs	25% Lower Costs
Electrical Capex						
Grid connection unit cost						
Grid connection unit cost (SPEN) *	£/kW	168	CENTRAL	252	210	126
Grid connection unit cost (WPD) *	£/kW	315	CENTRAL	473	394	236
Substation / transformation unit cost						
Site substation cost (step-down Tx to 400 V)	£/MVA	47,609	CENTRAL	CENTRAL	59,511	35,707
Site Capex						
Site planning & civil capex: on-route						
Planning & permitting	£/site	40,375	32,300	48,450	50,469	30,281
Civil works	£/site	376,230	300,984	451,476	470,288	282,173
Site planning & civil capex: on-route						
Site set-up	£/site	3,396	2,264	5,094	4,245	2,547
Technical design	£/site	2,000	1,333	3,000	2,500	1,500
Supply & install meter	£/site	415	277	623	519	311
Traffic regulation order	£/site	1,854	1,236	2,781	2,318	1,391
Site permits	£/site	234	156	351	293	176
Signage & road marking	£/site	1,600	1,067	2,400	2,000	1,200
Planning application & discharge	£/site	8,500	5,667	12,750	10,625	6,375

Electrical and Site Capex Assumptions

C.3
Financial case demand inputs

Demand modelling

Two demand models feed into the financial case analysis: an On-Route Demand Model and a Destination Demand Model. These models were produced by Arup outside of the SOBC workstream.

Demand Model Information

High Level Assumptions

- **EV Uptake:** National Grid's Leading the Way scenario from its 2020 Future Energy Scenarios is used to inform EV uptake in both the On-Route and Destination demand models. This decision was made in line with the EV uptake scenario used in the Welsh Government's 2021 EV charging strategy:
  - Electric Vehicle Charging Strategy for Wales (https://www.gov.wales/sites/default/files/publications/2021-03/electric-vehicle-charging-strategy-wales.pdf).
  - This EV uptake scenario is also highlighted as the preferred option (Option 3) in Arup's April 2022 optioneering report for the Welsh Government, EV Charging Strategy for Wales: Draft Options Appraisal Report.

Publication of Demand Models

- **Model results:** draft results have been shared with the Welsh Government as an output of the Preferred Network Webmap.

Use of Demand Model Data

The output of each demand model – produced by Arup outside of the business case workstream – is volumetric energy charging demand (kWh) and required number of chargepoints to meet 100% of peak demand per year, per LSOA, per site type, for three on-route and four destination scenarios.

In the financial case, Arup has grouped this LSOA-specific data by distribution network area and applied some sensitivities. As a commercial decision, Arup has limited the amount of peak hour charging demand (to be met by roll-out of additional chargepoints alone) to 75% in the central case, in line with common practices in the EV charging market. This reasoning is outlined in section 4.2.3.

Arup uses the results of the demand model to inform several views of public charging energy demand each year across Wales. The costs resulting from this demand and necessary infrastructure are representative of these levels of demand.

The demand scenarios presented in Arup's financial case analysis originate from the scenarios constructed in the demand models. The sensitivities presented in Arup's financial case analysis sit on top of the demand model outputs. These are constructed specifically for this report and flex both demand and cost-related inputs.

Arup's analysis in the financial case is subject to the assumptions and limitations of the demand model results that fed into it. These are covered in section 4.2.4.

The results of the demand models that feed into the financial case analysis are also subject to the disclaimer on slide 3 of this report.

C.4
Financial case input sources

Data Sources

Below are outlined the sources of key data points feeding into the financial case capex analysis. "Technical standard" refers to a widely-accepted market standard. "Arup Demand Modelling" is the product of another Arup workstream, outside of the SOBC (see next slide). "Commercial Assumption" refers to a commercially-driven decision, at the discretion of the infrastructure developer. "Market Benchmarks" are informed by Arup's knowledge of and experience in the UK EV charging market.

Item	Unit	Source
Chargepoint rating: slow (3 kW)	*kW*	Technical standard
Chargepoint rating: fast (7 kW)	*kW*	Technical standard
Chargepoint rating: fast (11 kW)	*kW*	Technical standard
Chargepoint rating: fast (22 kW)	*kW*	Technical standard
Chargepoint rating: rapid (50 kW)	*kW*	Technical standard
Chargepoint rating: ultra-rapid (100 kW)	*kW*	Technical standard
Chargepoint rating: ultra-rapid (150 kW)	*kW*	Technical standard
Supply scenario (on-route)	*scenario*	Arup Demand Modelling
Supply scenario (destination)	*scenario*	Arup Demand Modelling
Max # CPs scenario (on-route)	*scenario*	Commercial Assumption
Max # CPs scenario (destination)	*scenario*	Commercial Assumption
Scale for % of maximum supply (on-route)	*%*	Commercial Assumption
Scale for % of maximum supply (destination)	*%*	Commercial Assumption
Meet x% of peak hour demand (on-route)	*%*	Commercial Assumption
Meet x% of peak hour demand (destination)	*%*	Commercial Assumption
CPs per site scenario (on-route)	*scenario*	Commercial Assumption
CPs per site scenario (destination)	*scenario*	Commercial Assumption
Chargepoint supply cost: fast (7 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint supply cost: fast (11 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint supply cost: fast (22 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint supply cost: rapid (50 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint supply cost: ultra-rapid (100 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint supply cost: ultra-rapid (150 kW)	*£ /CP*	Arup Market Benchmark

Item	Unit	Source
Chargepoint installation cost: fast (7 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint installation cost: fast (11 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint installation cost: fast (22 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint installation cost: rapid (50 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint installation cost: ultra-rapid (100 kW)	*£ /CP*	Arup Market Benchmark
Chargepoint installation cost: ultra-rapid (150 kW)	*£ /CP*	Arup Market Benchmark
Grid connection unit cost (SPEN)	*£ /kW*	SPEN CDCM model: Network level assets for HV/LV; assumes 45 year lifetime
Grid connection unit cost (WPD)	*£ /kW*	WPD CDCM model: Network level assets for HV/LV; assumes 45 year lifetime
Site substation cost (additional step-down Tx to 400 V)	*£ /MVA*	Arup Market Benchmark
Planning & permitting	*£ /site*	Arup Market Benchmark
Civil works	*£ /site*	Arup Market Benchmark
Site set-up	*£ /site*	Arup Market Benchmark
Technical design	*£ /site*	Arup Market Benchmark
Supply & install meter	*£ /site*	Arup Market Benchmark
Traffic regulation order	*£ /site*	Arup Market Benchmark
Site permits	*£ /site*	Arup Market Benchmark
Signage & road marking	*£ /site*	Arup Market Benchmark
Planning application & discharge	*£ /site*	Arup Market Benchmark

Appendix D

Monitoring and Evaluation framework template

D.1
Monitoring and evaluation framework template (illustrative example)

Strategy Action	Indicator	KPI	Data si	Data source	Frequency of monitoring	Owner
The corresponding action(s) this metric relates to		The measurable value that demonstrates how effectively the programme is in achieving the objectives.	Quantitative/ qualitative	How will the measure be measured? What data sources will be used, and how will data be collected?	How often will it be measured?	Who will be primarily responsible for measuring?
E.g. 1. Delivery of charging infrastructure through funding and collaboration	*Number of public chargepoints per electric vehicles owned.*	*Provision of one public charge point for every 7-11 EVs on the road by 2025. As adoption increases these numbers rise proportionately to approximately 25 vehicles per charge point. This KPI will be reviewed and refined as set out on page x.*	*Quantitative*	• *Public chargepoints - live EV charge point database (e.g. Zap Map or National Chargepoint Registry (NCR)* • *EV ownership – DfT/TfW*	• *Public chargepoints – every 3 months* • *EV ownership – annually*	*TfW (on-route charging), Local Authority (destination charging)*
…	…	…	…	…	…	…
…	…	…	…	…	…	…

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