Independent, not-for-profit, low emission vehicle and energy for transport experts

PROJECT

REPORT

Cardiff Metro Infrastructure Review

Programme Support Phase 1

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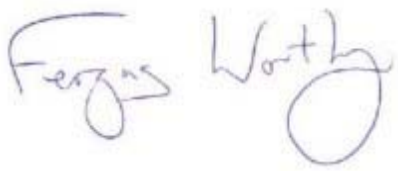

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Document Revisions

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1	Initial draft for customer review	16/12/2018
2	Final draft for review	22/01/2019

Contents

Table of abbreviations

PiVs	Plug-in Vehicles
CO_2	Carbon Dioxide
DNO	Distribution Network Operator
DfT	Department for Transport
EV	Electric Vehicle
V2G	Vehicle-to-grid
OLEV	Office for Low Emission Vehicles
ULEB	Ultra-low emission buses
WPD	Western Power Distribution

1 Executive summary

Cardiff Capital Region commissioned Cenex to assess the potential impact of zero emission capable vehicles on the recharging infrastructure and energy requirements at 11 metro sites located across South East Wales.

This report presents:

- Forecast uptake of plug-in vehicles, including cars, buses and taxis.
- Estimated charging infrastructure requirements to support these vehicles.
- Preliminary assessment of potential for a plug-in car club scheme.
- Infrastructure considerations, including onsite renewables, energy storage, capital costs, operating models, and policy and planning requirements.
- Details of relevant local and national policies, developments and funding opportunities including consideration to local renewable energy developments.

Cardiff Capital Region specified 11 locations to be in the scope of this project: East Cardiff Bus Corridor, the Newport to Cardiff bus corridor, Barry Docks Interchange, Caerphilly Transport Hub, Ebbw Vale Abertillery Spur, Merthyr Tydfil Bus Station, Pentrebach Station and Park & Ride, Pontypool and New Inn Park & Ride, Porth Interchange, Pyle Park & Ride and the Severn Tunnel Junction Park & Ride.

1.1 Infrastructure and plug-in vehicle forecasts

Cenex estimated the base number of metro car parking spaces requiring charging infrastructure for customers by establishing a ratio of plug-in vehicles (PiVs) to conventional vehicles and then calculating the peak power requirements and associated installation costs. Cenex also undertook a higher-level estimation of the future demand from plug-in taxis, car clubs, buses and the potential for the metro sites to host a limited number of rapid chargers for wider community use (non-rail service users) with PiVs – these high level estimates should be subject to further study before infrastructure purchase decisions are made.

Table 1 displays the resultant estimates for each site to support expected demand in 2025 under a high PiV adoption scenario. The report also details expected infrastructure requirements to 2030. Providing enough chargepoint infrastructure is one of the key factors that will determine whether this scenario is achieved, so it is advisable to set a high target initially. It is recommended that infrastructure to support PiV demand for 2025 is installed, along with providing passive chargepoint provision[1], which involves providing cabling to parking bays and carrying out any network upgrades to support 2030 demand so that chargepoints can easily be added later.

The provision of charging infrastructure across all sites to meet the anticipated 2025 demand for standard charging (7kW) of rail users' PiVs is estimated at £191k. To future proof the installations for an increased demand, the addition of passive infrastructure to support anticipated 2030 needs would cost an additional £110k. When infrastructure provision to supply other PiVs (taxi, car club, bus and public rapid chargers, the estimated costs for provision rises to £3,135k.

[1] Passive chargepoint provision involves installing the necessary underlying infrastructure (including capacity in the connection to the local electricity distribution network and electricity distribution board, as well as cabling to bays) to enable simple installation and activation of a charge point at a future date.

	2025 Base provision for metro rail customers			2025 Potential provision for other services (car club, taxi, public rapid charge point, passive bus)					
Metro site	**7kW charge outlets**	**Peak power requirement (kW)**	**Estimated cost**	**22kW fast chargers for car clubs**	**50kW rapid chargers for taxi**	**50kW rapid chargers for public use**	**50kW passive provision for bus use**	**2025 Total peak power requirement (kW)**	**2025 Total estimated cost**
Bridgend	2	14	£14.6k	1	1	2	2	286	£252k
Vale of Glamorgan	2	14	£14.6k	1	1	2	5	436	£347k
Cardiff	6	42	£29.8k	2	5	5	14	586	£433k
Rhondda Cynon Taf	2	14	£14.6k	1	2	0	2	286	£252k
Merthyr Tydfil	2	14	£14.6k	1	1	2	14	586	£443k
Pentrebach	2	14	£14,6k	1	0	1	3	236	£220k
Caerphilly	3	28	£22.2k	1	3	1	6	550	£418k
Blaenau Gwent	2	14	£14.6k	1	1	1	2	186	£189k
Torfaen	2	14	£14.6k	1	0	1	1	136	£157k
Monmouthshire	3	28	£22.2k	1	1	0	2	222	£203k
Newport	2	14	£14.6k	1	2	2	0	236	£221k
Total	**28**	**210**	**£191k**	**12**	**17**	**17**	**51**	**3,746**	**£3,135k**

Table 1. Infrastructure estimates required to achieve 2025 PiV adoption, by target location.

1.2 Car clubs

We interviewed two car club representatives for this research. Car clubs provide a cost-effective and flexible alternative to owning a car, and can help alleviate parking congestion, pollution and transport poverty. The feasibility of a car club typically depends on three conditions: a relatively affluent, young local population; high population density; and a location near major public transport routes or key destinations. Based on these factors we estimated the potential success of electric cars clubs at each metro site. We recommended providing 22kW chargepoints for car clubs, as they strike a balance between providing a fast charge to top up vehicles between bookings, while hardware and installation costs are lower than for 50kW rapid chargers.

1.3 Renewables, energy storage and smart charging

Clean, smart and integrated technology can transform the metro sites' electrical and recharging network into a modern low emission and profitable energy system. Individually or combined renewables, energy storage and smart charging of vehicles can be integrated into the electrical network upgrades. Solar PV installations are characterised by long payback periods but can enable local authorities to meet CO_2 reduction targets and access low cost borrowing and grant funding. The greater economic benefit of adding PV is available when off-setting grid electricity costs and reducing any capacity upgrade costs (and providing a zero-carbon energy supply).

1.4 Supporting national and local policy and funding

There are several Welsh Government strategies that strongly support the development of PiV infrastructure, most notably, the recent strategy to support implementation of Environment Act targets for decarbonisation; 'Achieving our low carbon pathway to 2030' on which consultation has recently closed. The document details proposed actions to 2030 including; develop a charging network that encourages early take-up of electric vehicles (EVs). It also echoes a target set out in the Economic Action Plan (2017) to reduce the carbon footprint of taxis and buses to zero within 10 years. The National Assembly has also recently (2018) consulted on

EV charging infrastructure in Wales to which there have been several useful responses, notably, Western Power.

Policy at the local authority level is less advanced except for Caerphilly and Cardiff City Council which have adopted an electric vehicle strategy and action plan (2018) and low emission transport strategy (2018) respectively.

The options for Local Welsh funding to deliver PiV infrastructure would be to incorporate the PiV infrastructure as part of the development costs and therefore access the various infrastructure and regeneration sources being used to develop the metro sites. There is a limited direct £2m fund being administered by Welsh Government for the development of PiV infrastructure on key strategic routes and the Welsh public sector also has access to national OLEV funding both directly or in partnership with private sector stakeholders such as the bus providers.

1.5 Recommendations and conclusions

This study provides a review of potential electric vehicle infrastructure requirements and provisions across 11metro sites setting out the potential power requirements, infrastructure numbers, and potential supporting technologies such as renewables, energy storage and smart charging. Recommendations are provided below to enable the progression of the infrastructure upgrades at each of the metro sites. Cenex can also provide further support in all the following areas.

Car park infrastructure (7kW): It is recommended that the 2025 infrastructure provision is installed in full, with passive infrastructure provision provided for the anticipated use in 2030.

Other charging services (22kW – 50kW): A high-level estimate has been provided for infrastructure provision for other types of charge point users (car club, taxi, public rapids and bus) representing the scale of the provision. These services should be subject to a specific study before further consideration.

Refine chargepoint costs and select service model: The costs provided for chargepoint hardware, installation and Distribution Network Operator (DNO) services are best estimates based on our experience of working with other local authorities. Cost should be further refined through establishing connection costs with the DNO, undertaking a detailed siting study to allow a tender specification for chargepoint infrastructure. This report sets out the various operating models available, with some benefits and drawbacks of each. The next step is to draw up a joint procurement and contracting framework and carry out market research into the hardware options and network services available.

Renewable energy and energy storage: The report discusses the use of renewable (both on-site and linking to off-site) energy developments, battery storage and smart charging. Further exploration of the benefits of these technologies should be undertaken, especially where they allow avoided network upgrade costs, which will provide a strong business case.

Co-ordinated approach: A working group attended by representatives of each of the 10 local authorities (and external actors where necessary) should be set-up to co-ordinate PiV actions plans, funding plans, bids, infrastructure procurement strategies and frameworks.

2 Introduction

2.1 Background

The Environment (Wales) Act places a duty on Welsh Ministers to ensure that in 2050 net carbon dioxide (CO_2) emissions are at least 80% lower than the baseline set in legislation. This will be achieved through interim targets for 2020, 2030 and 2040 and five yearly carbon budgets up to 2050. Decarbonising transport by investing in zero emission capable public transport and chargepoint infrastructure for fleets and private car owners will be essential to help achieve these targets. Improved access to a connected, affordable, low carbon multi-modal transport network can help regenerate South East Wales and attract inward investment in the local economy.

2.2 Scope and approach

Cardiff Capital Region commissioned Cenex to assess the potential impact of zero emission capable vehicles on the recharging infrastructure and energy requirements at 11 metro sites.

This report presents:

- Forecast uptake of plug-in vehicles, including cars, buses and taxis.
- Estimated charging infrastructure requirements to support these vehicles.
- Preliminary assessment of potential for a plug-in car club scheme.
- Infrastructure considerations, including onsite renewables, energy storage, capital costs, operating models, and policy and planning requirements
- Details of relevant local and national policies, developments and funding opportunities

Cardiff Capital Region specified 11 locations to be in the scope of this project: East Cardiff Bus Corridor, the Newport to Cardiff bus corridor, Barry Docks Interchange, Caerphilly Transport Hub, Ebbw Vale Abertillery Spur, Merthyr Tydfil Bus Station, Pentrebach Station and Park & Ride, Pontypool and New Inn Park & Ride, Porth Interchange, Pyle Park & Ride and the Severn Tunnel Junction Park & Ride.

The scope was specifically limited to considering the infrastructure requirements at these Metro sites. Cenex was not asked to look at the more general patterns of plug-in vehicle uptake and charging infrastructure requirements across the region. For many vehicle types, particularly buses and taxis, a strategic, regional approach should be taken. This would involve considering how the fleet will change across a wider geographical area, and then determining potential chargepoint locations. This work could be undertaken as a follow-on to this study, subject to further discussions with the Cardiff Capital Region.

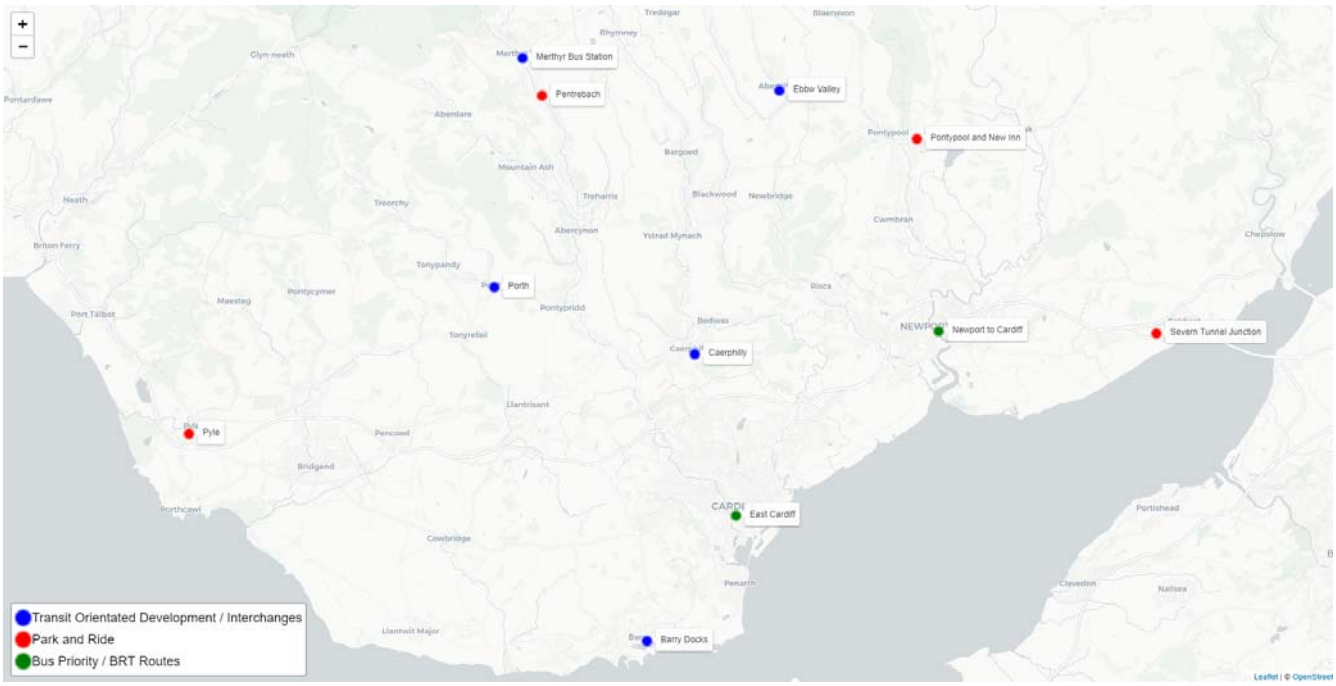


Figure 1. Map of sites in scope of this report.

3 Vehicles and infrastructure scenario development

This section explains how we estimated chargepoint numbers for private cars, car clubs, taxis and buses. It then includes 11 single page overviews of each site, showing key characteristics of the local area, development opportunities and constraints, forecasts for PiV uptake and chargepoint requirements, and preliminary car club suitability assessment.

We have a higher level of confidence around estimates provided for 7kW chargepoints for metro site users parking their private cars as these are based on a robust dataset and well understood assumptions. Estimates for rapid chargepoints for private cars, car clubs, taxis, and buses, are provided with a lower degree of confidence as they rely on more complex methodologies and less certain assumptions.

3.1 Infrastructure for rail customers' privately-owned cars

3.1.1 Proportion of PiVs in each local authority

To understand how many rail users may wish to charge EVs at each metro site, we first need to establish the proportion of PiVs in the local areas. A brief summary of the methodology is provided here and is provided in full in Appendix **Error! Reference source not found.**

We developed three scenarios for the uptake of privately-owned plug-in cars in each local authority area through to 2030. These scenarios are summarised below.

1. Business as usual: uptake of PiVs continues to be slow. Figures were estimated by extrapolation from the number of PiVs currently registered in the relevant local authority for each site[2].
2. Medium: PiV uptake accelerates in line with the 'low' scenario in the Department for Transport (DfT)'s *Road to Zero*[3] strategy, i.e. at least 30% of new car sales will be PiVs in 2030.

[2] DfT table VEH0130/1

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

3. High: PiV uptake accelerates in line with the 'high' scenario in *Road to Zero*, i.e. at least 70% of new car sales will be PiVs in 2030.

The proportion of PiVs in each local authority is not equal and is weighted by the current relative performance of uptake between authorities and the UK overall.

We believe the high scenario described above is achievable, given appropriate national and local support, and should be used as the basis for chargepoint network planning. There are several reasons for this assertion:

- Access to enough chargepoint infrastructure, of the right type and rate, at the right locations, is one of the most significant factors influencing plug-in vehicle uptake. If chargepoint provision is not planned based on the high scenario, plug-in vehicle uptake will always be constrained. The only way to achieve this high forecast is by making enough infrastructure available.
- If vehicle uptake falls behind forecasts, local authorities can focus on providing passive chargepoint provision, which involves providing cabling to parking bays and carrying out any network upgrades[Error! Bookmark not defined.]. This will deliver a better and more cost-effective outcome than providing enough chargepoints for a low or medium scenario and then carrying out additional network upgrades later.
- Even with the high scenario applied, forecast numbers are low in many instances and, based on our experience, would appear to be achievable targets.
- The baseline of current plug-in vehicle ownership is low, partly reflecting limited support for purchase and use. Our choice of the high scenario assumes that the Welsh Government will enact policies to deliver on its ambitions for decarbonising road transport.

For the reasons outlined above, we use our high scenario for plug-in car uptake to calculate infrastructure requirements and estimate costs throughout this report.

Uptake figures in this scenario for each local authority are shown in Table 2.

	2020		2025		2030	
	PiVs (% of all cars)	**All cars**	**PiVs (% of all cars)**	**All cars**	**PiVs (% of all cars)**	**All cars**
Bridgend	626 (0.8%)	77,617	3,841 (4.6%)	83,841	12,878 (14.3%)	90,065
Vale of Glamorgan	547 (0.8%)	70,012	3,357 (4.4%)	75,626	11,254 (13.9%)	81,240
Cardiff	994 (0.7%)	148,746	6,096 (3.8%)	160,674	20,437 (11.8%)	172,601
Rhondda Cynon Taf	367 (0.3%)	116,508	2,255 (1.8%)	125,851	7,559 (5.6%)	135,193
Merthyr Tydfil	68 (0.2%)	27,750	418 (1.4%)	29,975	1,400 (4.3%)	32,200
Caerphilly	248 (0.3%)	90,343	1,520 (1.6%)	97,588	5,095 (4.9%)	104,832
Blaenau Gwent	63 (0.2%)	34,333	384 (1.0%)	37,086	1,288 (3.2%)	39,839
Torfaen	180 (0.4%)	48,521	1,102 (2.1%)	52,412	3,695 (6.6%)	56,303
Monmouthshire	506 (0.9%)	56,779	3,107 (5.1%)	61,332	10,414 (15.8%)	65,885
Newport	397 (0.5%)	75,056	2,438 (3.0)	81,075	8,175 (9.4%)	87,093

Table 2. Cumulative forecast of plug-in car uptake in each local authority in 2020, 2025 and 2030 in the high uptake scenario (based on PiVs accounting for 70% of new car sales)

3.1.2 Infrastructure for rail customers' privately-owned cars

The ratio of PiVs to conventional vehicles in each local authority, established in the table above, was used to estimate the number of PiVs using the metro sites car parks, with appropriate adjustments as detailed below:

1. **Off-street parking:** PiV owners with off-street parking will primarily charge their vehicles at home as costs will be lower. Therefore, adjustments were made based on the estimated proportion of local households with off-street parking:
    a. High availability of off-street parking: 20% of PiV customers standard rate charging events will take place at the Metro site.
    b. Medium availability of off-street parking: 50% of PiV customers standard rate charging events will take place at the Metro site.
    c. Low availability of off-street parking: 80% of PiV customers standard rate charging events will take place at the Metro site.
2. **Technology selection:** PiV registrations will be 50% plug-in hybrid (PHEV) and 50% pure battery electric vehicle (BEV). This split is modified from the Committee on Climate Change's central scenario[4] which estimates 70% PHEV and 30% BEV. However, more recent evidence suggests PHEVs are not plugged in, reducing their benefits, and UK Government subsidies for them have been reduced. The relative proportion of BEV sales is therefore expected to increase.

[4] This split may change due to the introduction of the World Harmonised Light Vehicle Test Procedure (WLTP), recent changes to OLEV's Plug-in Car Grant, and improvements to BEV technology.

3. **Charging events:** PHEVs will need to recharge every day, and BEVs will be recharged on average twice weekly[5]. BEV battery capacities are expected to continue increasing, so their requirement for frequent charging events will reduce.
4. **Parking spaces:** the planned number of parking spaces, as provided by Cardiff Capital Region, was multiplied by the proportion of cars expected to be PiVs (derived from the assumptions above) to estimate the number of chargepoints required at each site.

Cars which are parked for more than a couple of hours, for example for shopping and commuting trips, can be charged using a 7kW (standard rate) unit. The assumptions above allow us to calculate with reasonable confidence the number of 7kW chargepoints required at each site.

3.1.1 Infrastructure metro sites rapid charging customers

The metro sites may also act as a charging hub for the general PiV users, and could encourage the use of PiVs, especially in areas with low availability of off-street parking. Rapid (50kW) chargepoints, able to charge vehicle in 30 to 60 mins could also be provided where needed for use by the local community. These chargepoints will be used by residents who visit the Metro site primarily in order to recharge their vehicle. Accurately forecasting the number of rapid chargepoints required for this use case is not possible at this time as it will require a more detailed study of the availability of other rapid chargepoints in the area, for example at a fuel forecourt or supermarket.

For the purposes of this high-level report, we estimated rapid chargepoint requirements based on the following assumptions:

1. **Off-street parking:**
    a. High availability of off-street parking: 0% of potential rapid charging events will take place at the Metro site.
    b. Medium availability of off-street parking: 50% of potential rapid charging events will take place at the Metro site.
    c. Low availability of off-street parking: 100% of rapid charging events will take place at the Metro site.
2. **Vehicle type.** Only BEVs (rather than PHEVs) will use rapid chargepoints.
3. **Charging frequency.** Vehicles will require an average of two rapid charges per week in 2020, and one per week in 2025 and 2030. This reflects expected increases in battery capacity. Rapid chargers will be able to deliver up to 12 charging events per day.
4. **Capping parking bay reallocation.** The designated spaces for public rapid charging bays have been capped at each site due to the uncertainty of future rapid charge provision in the wider area (e.g. supermarkets, petrol forecourts, public car parks etc.) and the fact that rapid chargers provisioned for the general public reduce the capacity of the car park for public transport users. The local authority should ensure that rapid chargepoint provision is capped so that the car park can serve its primary function and protect parking revenue. Ultimately this cap will need to be set individually for each site. For this report, we set an arbitrary limit of two per cent of car park spaces to be reassigned for rapid charging.

3.1.2 Car clubs

Car clubs provide a cost-effective and flexible alternative to owning a car, and can help alleviate parking congestion, pollution and transport poverty. Car clubs are typically provided

[5] Based on an average PHEV electric-only range of 20 miles, average BEV range of 250 miles, and national average daily mileage of 23 miles per day. We also assume BEV drivers will keep batteries topped up rather than running them almost to empty and then fully recharging.

by a private sector operator, although they can be run in-house by a local authority. Operating models vary, but typically users will pay a monthly or annual subscription plus a fee per hour of vehicle rental.

The feasibility of a car club depends on the characteristics and demographics of the local area. Typically, three conditions are required for a viable car club scheme: a relatively affluent, young local population; high population density; and a location near major public transport routes or key destinations. The relative importance of these factors varies for different car club operators; for example, some place little importance on the socio-economic group of the local area.

The most successful schemes have demand from public or private sector organisations during the day and residential demand during evenings and weekends. Many car clubs rely on an anchor client, often a local authority or other large public sector employer, to supply much of the weekday demand. New housing developments will often generate residential demand and improve viability.

We interviewed two car club representatives for this research: Keith Kelly, Head of Projects and Partnerships from Enterprise Car Club and Russell Fenner**,** Head of Innovation from E-Car Club. Enterprise primarily provide petrol and diesel vehicles but are increasingly offering plug-in hybrid and pure battery electric cars. E-Car Club only offers plug-in vehicles. We used qualitative data from these interviews, together with our experience and understanding of car clubs from undertaking other work in this sector, to make a preliminary assessment of the suitability of each site for a plug-in car club. Sites were categorised as high, medium or low, defined as follows:

- High: relatively high population density, relative medium or highly affluent population[6], and large residential, commercial or mixed development planned in the area
- Medium: lower population density and affluence and smaller developments planned
- Low**:** low population density and affluence and no significant developments planned

We recommend providing 22kW chargepoints for car clubs, as they strike a balance between providing a fast charge to top up vehicles between bookings, while hardware and installation costs are lower than for 50kW rapid chargers. (See Section 4.1.1 for more on the benefits and drawbacks of different charging speeds). The car club industry interviewees also proposed providing 22kW units.

It is beyond the scope of this review to undertake a detailed appraisal for the potential for car clubs at each site, using the criteria outlined here. Primarily this is because such review would need to be area-based, with the metro sites used as potential host locations, rather than working upwards on a site-specific basis. Based on discussions with Cardiff Capital Region, and our understanding of the car club market, we would recommend provisional deployment of at least one chargepoint at each site to support a car club vehicle. East Cardiff, which we expect would have the type of characteristics to support car club use, should consider making additional infrastructure available.

These recommendations are shown on the one-page overview for each site. We emphasise that further work would be required to refine these estimates, considering the factors discussed above. Car club operators would be able to undertake a more detailed demand assessment, or an independent assessment could be provided by Cenex.

[6] Affluence estimated using the Welsh Index of Multiple Deprivation

3.1.3 Buses

For this report we assessed each site to determine whether any of the proposed developments include a new or substantially rebuilt bus interchange. Where such developments are taking place, the local authority should mandate passive chargepoint provision, which involves installing the necessary underlying infrastructure (including capacity in the connection to the local electricity distribution network and electricity distribution board, as well as cabling to bays) to enable simple installation and activation of a charge point at a future date.

We recommend that all new bays at sites undergoing redevelopment are provided with passive charging capability to support charging at 50kW. It is possible that buses will be able to accept charging at faster rates; use of smart charging and energy storage (explained in Section 5) can be used to facilitate this without requiring an over-specified grid connection. Refer to the one-page overviews for each site for the number of passive bays needed at each site.

From an operational perspective it is not practical to provide charging infrastructure at all sites. Those where buses are stationary for at least 15 minutes, i.e. park & ride and layover sites should have passive infrastructure installed. At other sites, such as East Cardiff, vehicles are only stationary for a couple of minutes, and therefore it would not be practical to provide chargepoints. Bus operators should primarily use overnight charging at depots. For certain routes, opportunity charging may be required if the distance exceeds the vehicle's range. Technologies such as pantograph (overhead) and inductive charging are in development, and it may be useful to trial these, subject to funding. Further discussion of these technologies is in Section 4.

Providing passive capacity now allows a potential revenue stream from bus operators in the future as they look to incorporate plug-in buses. This will increase the bus operator's choice of plug-in technology and alleviate the need for buses to return to base for charging, increasing operating efficiency and reducing the power demand on bus depots as electrification increases.

Cardiff, Caerphilly and Newport Local Authorities have recently submitted low carbon bus bids to the Office for Low Emission Vehicles (OLEV) in partnership with the local private bus providers.

3.1.4 Taxis

DfT figures[7] show that the current provision of taxis and private hire vehicles licenced in each local authority is as shown in Table 3:

[7] TAXI 0105 https://www.gov.uk/government/statistical-data-sets/taxi01-taxis-private-hire-vehilces-and-their-drivers

	Taxi and private hire vehicles
Bridgend	460
Vale of Glamorgan	288
Cardiff	2,162
Rhondda Cynon Taf	462
Merthyr Tydfil	174
Caerphilly	427
Blaenau Gwent	157
Torfaen	201
Monmouthshire	212
Newport	885

Table 3. ***Current provision of taxi and private hire vehicles in each local authority.***

Local authorities are responsible for taxi licensing and are therefore able to mandate the uptake of PiVs by amending local policies. Cardiff Council already has a six-year age limit in place for saloon Hackney taxis and private hire vehicles, which means any policy changes would alter the fleet composition relatively quickly. However, others have much less restrictive age limit policies. We have therefore made two assumptions to inform development of a 'high' scenario for plug-in taxi uptake which attempts to balance the different policy baselines of the various local authorities:

- All local authorities adopt a ten year age limit policy for Hackney and private hire vehicles.
- All 10 local authorities implement a policy which requires newly licensed Hackney and private hire vehicles to be plug-in (PHEV or BEV) from January 2022.

These assumptions are made to show what would be required in order to achieve a 'high' scenario of plug-in vehicle uptake. We are not assessing their feasibility as part of this report. Further work would be required to appraise them and propose policy levers to support their implementation, such as in-service financial support for drivers or tools and guidance to help with the transition to plug-in vehicles.

Aside from a small number of exemptions such as limousines and classic cars, the policies detailed above would transition approximately 30% of the taxi fleet to plug-in by the start of 2025 and around 80**%** by the start of 2030, as shown in Table 4. Note that these outcomes fall short of the Welsh Government's ambition (announced in 2017) to move buses and taxis to zero-carbon alternatives within 10 years.

	Plug-in taxi and private hire vehicles	
	2025	**2030**
Bridgend	138	368
Vale of Glamorgan	86	230
Cardiff	649	1730
Rhondda Cynon Taf	139	370
Merthyr Tydfil	52	139
Caerphilly	128	342
Blaenau Gwent	47	126
Torfaen	60	161
Monmouthshire	64	170
Newport	266	708

Table 4. Forecast uptake of plug-in taxi and private hire vehicles in each local authority.

In order to estimate chargepoint requirements at each site we would need detailed information on taxis in each area, including number of trips to and from each site, dwell time, and total daily mileage. Sourcing this data was outside the scope of this report. However, we were able to make a high-level assessment of likely charging needs, using the following assumptions:

- 30% of taxis being plug-in by 2025, and 80% by 2030, as discussed above
- 20% of taxis in each local authority will frequent the specific Metro site and require access to rapid charging. This assumes that each local authority will have five rapid charging hubs available for taxis, which we estimate would be enough to give good geographical coverage. Further work is needed to refine this estimate; as with the car clubs this work needs to be undertaken on an area-led, rather than site-specific basis.
- One rapid chargepoint is needed per 25 plug-in taxis in the fleet. This is the ratio calculated by Cenex for Kent County Council following in-depth analysis of their taxi parc.

Results are shown on the one-page overviews for each site.

3.2 Infrastructure requirements and costs

The following pages present the results of our analysis for all 11 sites for 2025 and 2030, for the high uptake scenario[8]. The first page is a template provided to define key terms and explain how results were calculated or estimated. Each page includes the following:

- **Site characteristics:** type, catchment areas, estimated catchment population, catchment affluence, off-street parking availability, planned parking spaces, development opportunities and potential constraints.
- **Graph**: forecast cumulative plug-in car uptake in the relevant local authority.
- **High confidence results:** a table showing the results in which we have a high degree of confidence, i.e. number of 7kW chargepoints required at each site and costs (including installation and DNO costs).
- **Low confidence results:** a table showing the results in which we have a lower degree of confidence: number of rapid chargepoints required for cars, car clubs and taxis; passive chargepoint requirement for buses; peak power requirements; and total costs

[8] Sensitivity analysis, plus figures for 2020, can be found in Appendix B.

for 7kW and rapid chargepoints (including installation and DNO costs). This also includes total power provision and estimated costs of all infrastructure provision.

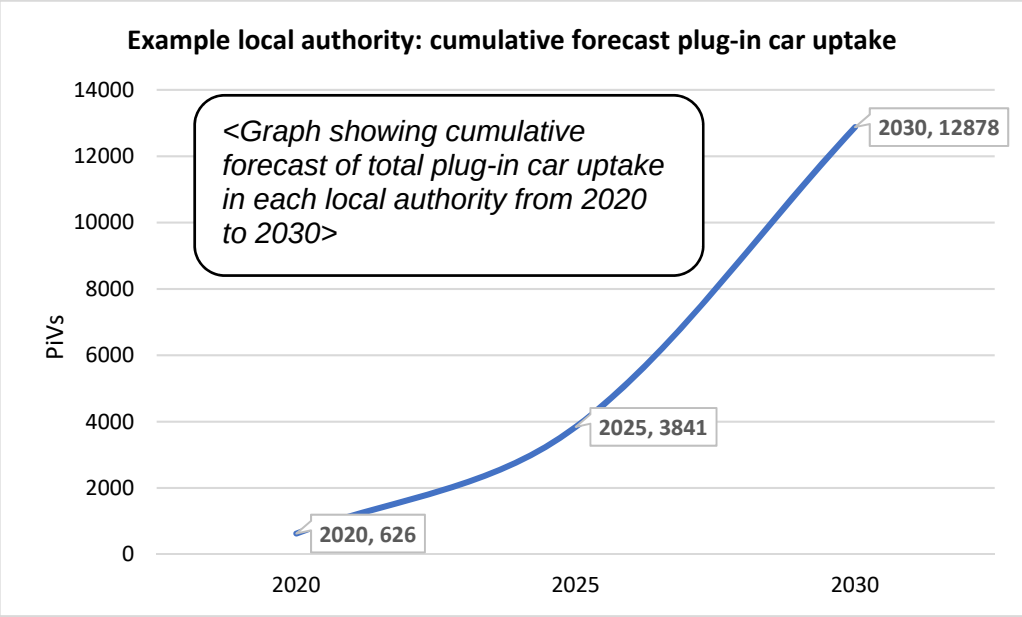
DNO costs are the most significant cost element for medium and high capacity installations. A low capacity installation, up to 70kVA, would typically cost around £3,000. A medium capacity installation, between 70 and 1,000 kVA, may incur costs in the region of £75,000. A high capacity installation, above 1,000 kVA, could incur costs of around £200,000. Since only two rapid chargers at one site would require a medium capacity installation, it is clear that DNO costs across the region will be substantial.

Please note the following when interpreting the results:

- Chargepoint forecasts for metro rail customers requiring standard charging (7kW) have been provided with a high level of confidence.
- Lower confidence estimations of the future demand from plug-in taxis, car clubs, buses and the potential for the metro sites to host rapid chargers for wider community use (non-rail service users) with PiVs have also been provided – these should be subject to further study before infrastructure purchase decisions are made. Cost and infrastructure provision are provided in 2 scenarios:
    - 2025 scenario includes all installation costs relating to infrastructure to support 2025 PiV usage estimations.
    - 2025 & 2030P scenario includes all 2025 infrastructure costs plus the provision of passive (P) infrastructure to support expected infrastructure requirements for 2030 PiV usage estimations.
- Costs for chargepoint hardware and installation are industry averages: individual site surveys and quotes will be required to obtain accurate prices. See Section 5 for more information.
- Costs for DNO services are ’worst typical case’. They assume that peak power cannot be offset by Smart Charging or energy storage, and they assume the highest end of the cost range for typical network connections and upgrades. See Section 5 for more information on infrastructure cost factors.
- Summary cost tables breaking down costing assumptions at each site are provided in Appendix B.

Site: *<Example>* **Local authority:** *<Example>* **Type**: *<Type of site, e.g. park and ride or bus priority route>*

Catchment areas: *<Names of local towns or areas which provide demand for transport services at this site>*	**Planned parking spaces:** *<Provided by Cardiff Capital Region, or plans that are in the public domain>*
Catchment affluence: <Categorised using the Welsh Index of Multiple Deprivation as low (below 700), medium or high (above 1,000)>	**Off-street parking availability:** *<Estimated availability of off-street parking, taken from Google Earth, and categorised as high, medium or low. This was used to help estimate demand for charging as explained in Section 3.2.1>*
Opportunities: *<Qualitative assessment of local considerations e.g. planned developments that could impact demand or changes to local public transport services>*	
Constraints: *<Qualitative assessment of any constraints that may impact plans for plug-in vehicles, such as potential land ownership or planning permission issues>*	

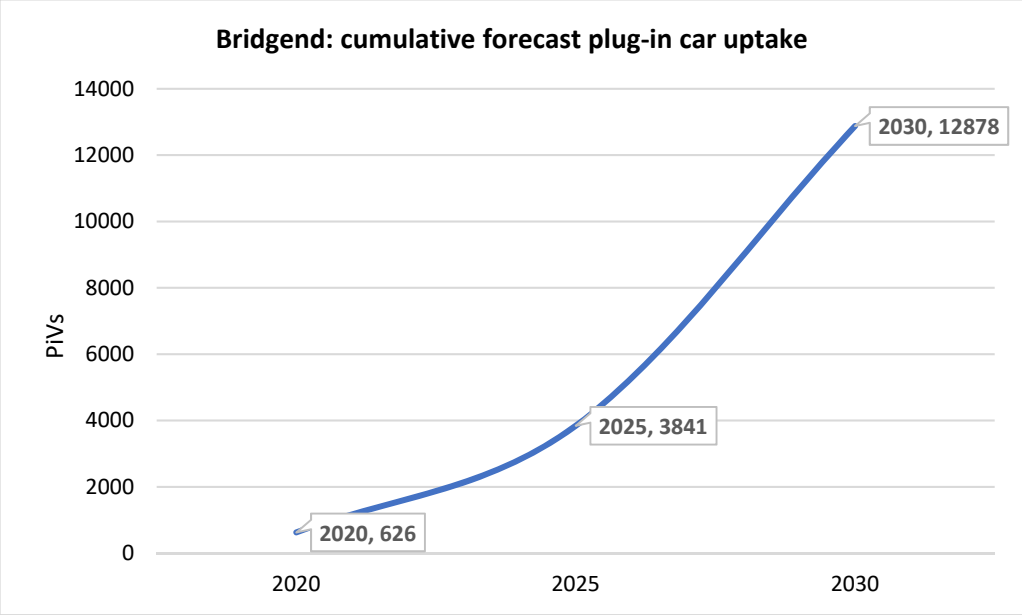


Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	*<Forecast 7kW chargepoints for rail users' private cars. Numbers are for total outlets, but costs assume double head units will be installed. Costs include installation and DNO services 2030 provision is for passive (P) installations only.>*	
Cost of 7kW chargepoints		
7kW peak power requirement	<Peak power requirement for rail user private car provision>	

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	*<Forecast fast and rapid chargepoint requirements for all vehicles, peak power requirement (total amount of power needed to serve all chargepoints), and total estimated costs including installation and DNO services. 2030 provision is for passive (P) installations only >*	
50kW chargepoints (taxis)		
22kW chargepoints (car clubs)		
Passive 50kW provision (buses)		
Peak power requirement (kW)		
Total costs (7kW, 22kW and 50kW including passive)		

Site: Pyle **Local authority:** Bridgend **Type**: Park and ride

Catchment areas: Pyle, Porthcawl, Kenfig Hill, Cefn Cribwr and Cornelly	**Planned parking spaces:** 75
Catchment affluence: Medium	**Off-street parking availability:** Medium
Opportunities: The demand for park and ride (P&R) spaces at Pyle station is increasing in line with station usage data: journeys increased 35% between 2011/12 an 2016/17. The expanded integrated transport hub will serve Pyle and its catchment area, improve links to Village Farm Industrial Estate and provide P&R facilities for commuting to Swansea and Cardiff. The station's proximity to Porthcawl provides access to the Metro network for current residents and those that will be attracted by the regeneration of the town. The 23-space car park operates over capacity; at least 75 additional spaces should be considered as part of any future development, subject to an updated business case. The proposal will also include Active Travel connections and consider including EV charging points and cycle parking facilities where appropriate.	
Constraints: Ownership of land extending from the current car park to the West alongside the train station should be investigated. As with all sites, availability of Western Power Grid Connection and cost of any required reinforcement will need to be determined via a budget estimate request and subsequent application.	



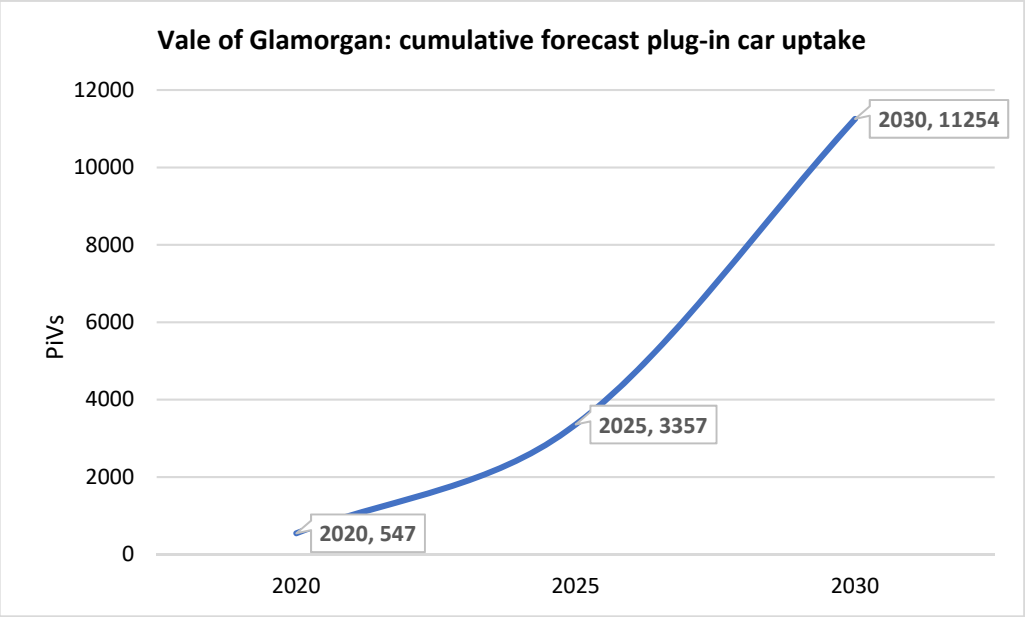
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£16,300
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	2	2 & 2P
50kW chargepoints (taxis)	1	1 & 3P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	2	2 & 2P
Peak power requirement (kW)	286	500
Total costs (7kW, 22kW and 50kW including passive)	**£252,100**	**£259,000**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Barry Docks **Local authority:** The Vale of Glamorgan **Type:** Transit Orientated Development / Interchange

Catchment areas: Barry, Barry Waterfront, Cardiff Airport	**Planned parking spaces:** 100
Catchment affluence: Medium	**Off-street parking availability:** Medium
Opportunities: A proposed bus interchange would include four or five bus bays, provision for taxis and possibly a 60 space extension to the existing P&R which is at capacity. The new rail franchise includes additional line capacity and all P&R sites within Barry are at or over capacity. Phase 2 of the Barry Waterfront development will include over 1,500 new houses, a school and retail units. Additional regeneration is planned to include a mixed use provision between two locations identified along the rail corridor and a Targeted Regeneration Investment (TRI) bid has been submitted for this provision. A North–South Barry bus provision to link with the railway could reduce the congestion on the Port Road / Culverhouse Cross corridor and the Dinas Powys corridor. EV chargepoints will be included in any future proposal implemented.	
Constraints: A feasibility study is required to identify the most suitable location and to also assess suitability of the land adjacent to the railway and park & ride site, which would be the most obvious strategic location. Local Transport Fund is being allocated to carry out this work in 2018/19.	



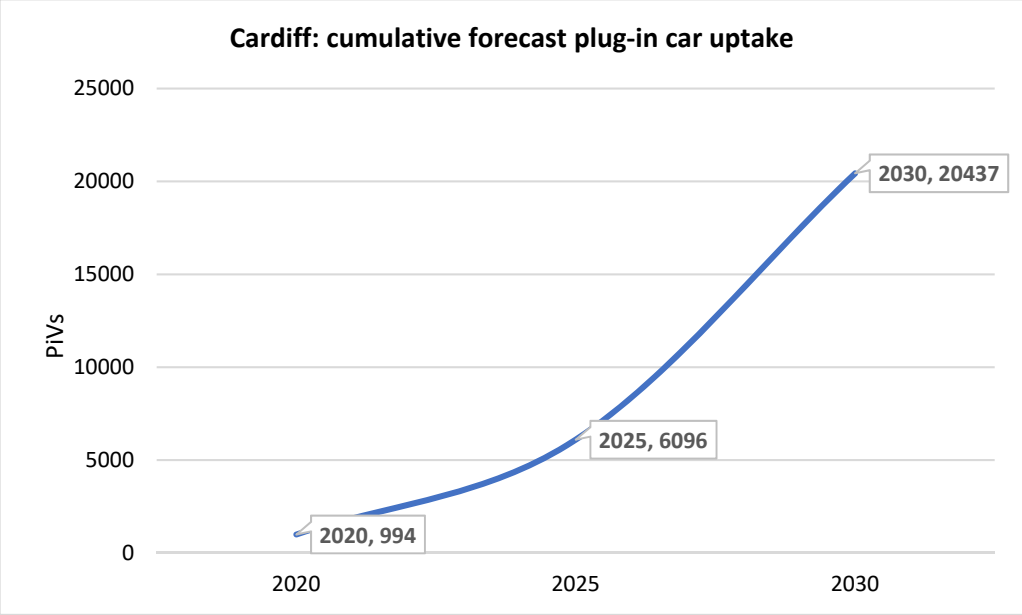
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 4P
Cost of 7kW chargepoints	£14,600	£18,000
Peak power requirement (kW)	14	42

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	2	2 & 0P
50kW chargepoints (taxis)	1	1 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	5	5 & 0P
Peak power requirement (kW)	436	514
Total costs (7kW, 22kW and 50kW including passive)	**£347,350**	**£352,050**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: East Cardiff **Local authority:** Cardiff **Type:** Bus priority route

Catchment areas: Cardiff	**Planned parking spaces:** 269
Catchment affluence: High	**Off-street parking availability:** Low
Opportunities: Planning permission has been granted for a new transport interchange opposite Cardiff Central station. This is part of a larger mixed use scheme providing retail, offices and flats. The nearest large development is 7,000 houses at Radyr on the outskirts of North East Cardiff. The City Centre East project will incorporate a series of sustainable and active travel packages that will enable improved bus connections in Cardiff City Centre, improved active travel infrastructure and pedestrian safety improvements. The infrastructure improvements will benefit local and regional transport through providing improved sustainable connections to key transport hubs, employment zones and visitor destinations. Improvements include new bus priority measures to connect local and regional buses through the east and south of the city to the Enterprise Zone, Queen Street Station, Retail Quarter (St David's Shopping Centre), Central Square, The Transport Interchange, Central Quay, and Cardiff Bay; bus priority measures that will allow buses to service the Transport Interchange on major event days; installation of Central Cycle Superhighway Section that will connect and link all 4 superhighways to the city centre; pedestrian crossing and public realm improvements on/to Dumfries Place, Station Terrace, Queen St Station, Stuttgart Strasse; 20mph Zone and traffic calming measures; air quality improvements (outside Queen Street Station); cycle parking and Next Bike; and EV chargepoint infrastructure.	
Constraints: The willingness of the developer to integrate zero emission infrastructure into the scheme could be a constraint, although Section 106 could be used to help mitigate this. Electricity capacity is likely to be a constraint, given the scale of chargepoint infrastructure required.	



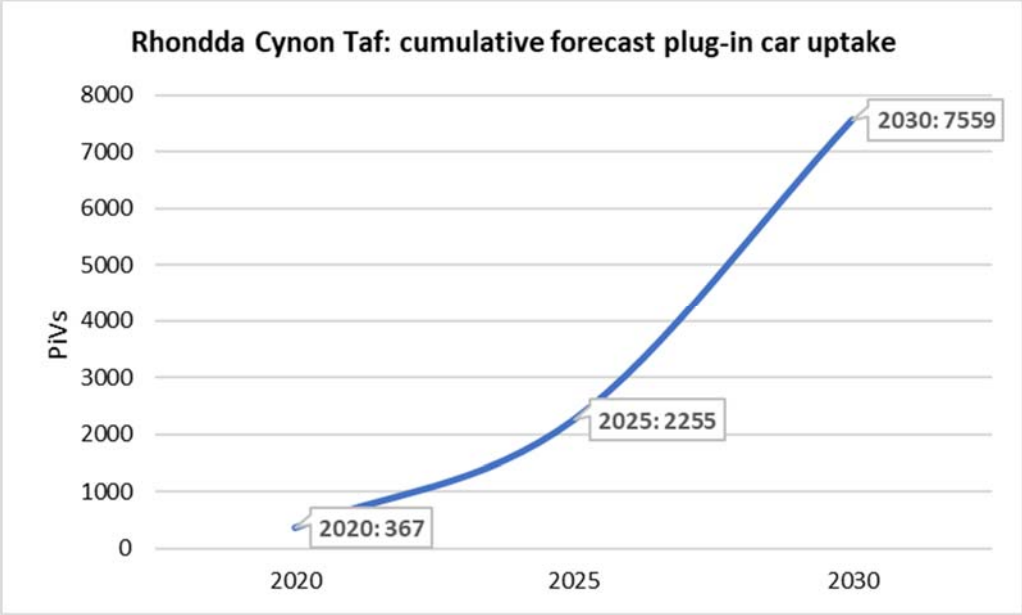
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	6	6 & 14P
Cost of 7kW chargepoints	£29,800	£113,700
Peak power requirement (kW)	42	140

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	5	5 & 0P
50kW chargepoints (taxis)	5	5 & 9P
22kW chargepoints (car clubs)	2	2 & 0P
Passive 50kW provision (buses)	14	14 & 0P
Peak power requirement (kW)	586	1127
Total costs (7kW, 22kW and 50kW including passive)	**£432,800**	**£581,400**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Porth **Local authority:** Rhondda Cynon Taff **Type:** Transit Orientated Development / Interchange

Catchment areas: Porth, Rhondda Fach, Trebanog, Tonyrefail, Gilfach Goch	**Planned parking spaces:** 150
Catchment affluence: Low	**Off-street parking availability:** Medium
Opportunities: A modern transport hub and station quarter is proposed to present a transformational change for Porth and improve connectivity in the Town Centre. The strategy identifies the Alec Jones Day Centre site for a new Transport Hub, – including a seven bay bus interchange, taxi rank, cycle stores, park and ride and train station links. The current interchange between bus and rail services is poor. The vision is to transform Porth into a prosperous and attractive town, with improved connectivity to and from surrounding areas, anchored by a Transport Hub and a regenerated "Station Quarter". Electric chargepoints will be included within any future proposal implemented.	
Constraints: There is no rail link to many of the communities surrounding Porth, such as the Rhondda Fach, Trebanog, Tonyrefail and Gilfach Goch, and interchange at Porth is vital to allow commutable journeys, particularly to Pontypridd and Cardiff, to be made by public transport. The current on-street set up has three main bus stops 450 metres apart and removed from the railway station, thus preventing a seamless transition between the two modes.	



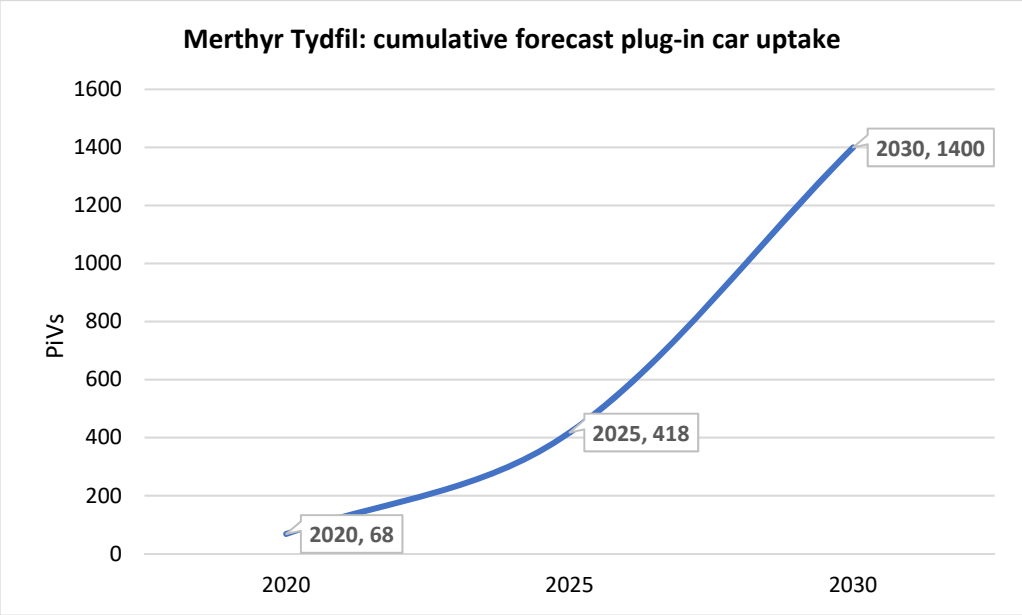
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£16,300
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	0	0 & 1P
50kW chargepoints (taxis)	2	2 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	2	2 & 0P
Peak power requirement (kW)	286	450
Total costs (7kW, 22kW and 50kW including passive)	**£252,100**	**£257,700**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Merthyr Bus Station **Local authority:** Merthyr Tydfil **Type:** Transit Orientated Development / Interchange

Catchment areas: Merthyr Tydfil, including Dowlais and Treharris	**Planned parking spaces:** 76 (+33 at the rail station)
Catchment affluence: Low	**Off-street parking availability:** Low
Opportunities: Merthyr Bus Station is a fully developed project comprising a new 14 bay bus interchange and link between bus and rail. Project managers are reconsidering renewable energy provision to support zero emission capable buses (and possibly taxis) at the station. Large developments in the area include Goat Mill Road mixed use and plans for a large leisure facility at Rhydycar West.	
Constraints: If local renewable energy provision is not included in the scheme, electricity demand could exceed local grid capacity and therefore power could be a constraint here.	



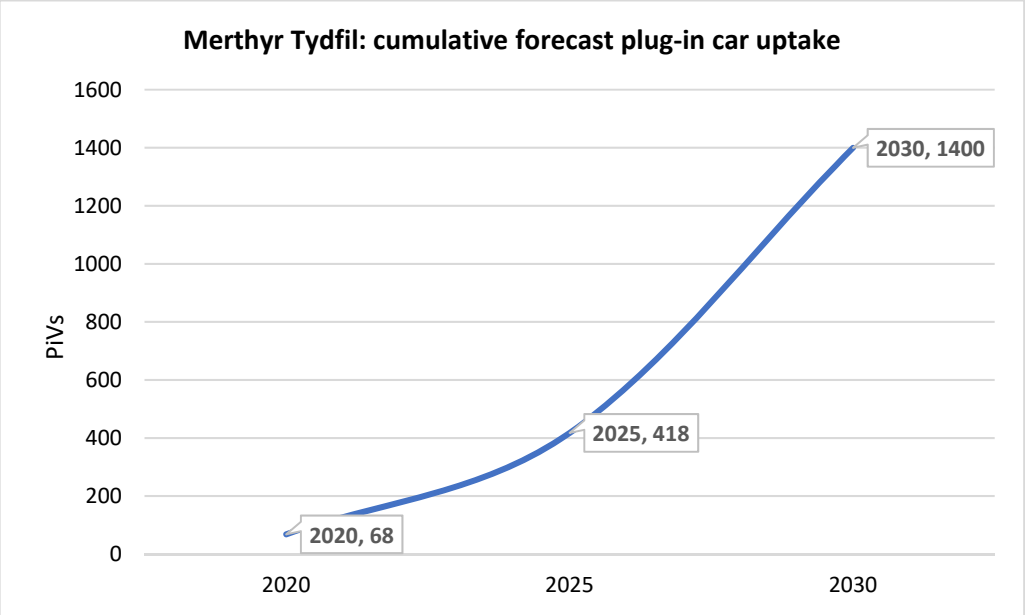
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£16,300
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	2	2 & 0P
50kW chargepoints (taxis)	1	1 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	14	14 & 0P
Peak power requirement (kW)	586	686
Total costs (7kW, 22kW and 50kW including passive)	**£442,600**	**£446,900**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Pentrebach **Local authority:** Merthyr Tydfil **Type:** Park & ride

Catchment areas: Merthyr Tydfil, including Dowlais and Treharris	**Planned parking spaces:**
Catchment affluence:	**Off-street parking availability:**
Opportunities: A brownfield site that has been largely vacant for nearly 10 years is being regenerated. The South Wales Metro, with high frequency light rail connections, will catalyse development of a sustainable, mixed use neighbourhood with excellent links to the local area and Merthyr Tydfil Town Centre. The redevelopment can maximise opportunities from planned transport infrastructure investment, i.e. increases in service capacity, Pentrebach station and park and ride improvements and a potential future new metro station. It would provide approximately 20% of the identified housing requirement over the LDP Plan period, new employment and local retail provision and offer opportunities for improved green infrastructure along the River Taf corridor. The Hoover Strategic Regeneration Area is a major mixed-use development comprising 440 new homes, local convenience retail provision of 409m^2, new employment development on 6.5 hectares of land, Pentrebach Station Park and Ride, a new footbridge to Abercanaid, and safeguarded land for a new Metro station. The Council has worked with Welsh Government and Transport for Wales to prepare a draft Framework Masterplan (June 2018) for the area. This has been informed by providing a layout that indicates densities of between 30 to 45 dwellings per hectare. It identified 6.5 hectares of vacant and underused land for new employment use at the Willows/Abercanaid Industrial Estate and reflects sustainable placemaking principles and the Hoover Factory site legacy.	
Constraints: No significant constraints identified	



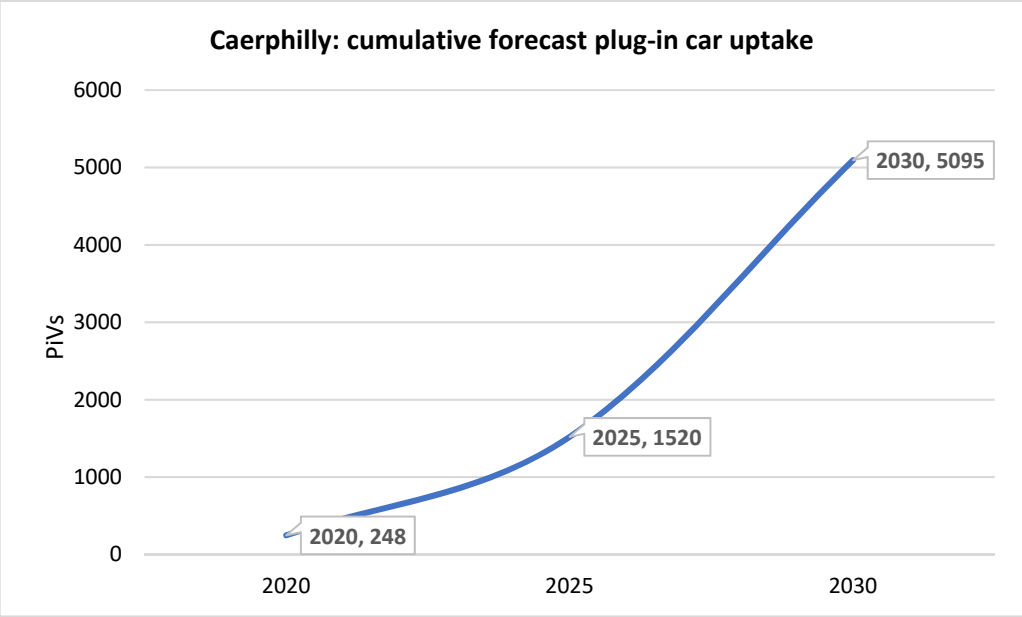
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£17,200
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	1	1 & 1P
50kW chargepoints (taxis)	0	0 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	3	3 & 0P
Peak power requirement (kW)	236	350
Total costs (7kW, 22kW and 50kW including passive)	**£220,350**	**£224,650**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Caerphilly **Local authority:** Caerphilly **Type**: Transit Orientated Development / Interchange

Catchment areas: Caerphilly, Bedwas, Trethomas, Machen and Abertridwr (Aber Valley)	**Planned parking spaces:** 280
Catchment affluence: Medium	**Off-street parking availability:** Medium
Opportunities: Caerphilly is an interchange where the frequency of bus and rail services promotes natural integration. Caerphilly is developing a brief to implement a seamless interchange between rail and bus. High quality passenger facilities will be provided, including electronic information, increased capacity with 280 park and ride spaces, and electric vehicle chargepoints for buses and private cars. A bid has been submitted to OLEV for electric buses with the local commercial operator and the results of the bid are due imminently. If successful, the town would benefit from fully electric buses, including charging infrastructure at the commercial operator's depot. A town centre clean air zone will be created, affecting buses and taxis; the project will include wider goals such as tying into business development and a green hub for technology.	
Constraints: No significant constraints were identified.	



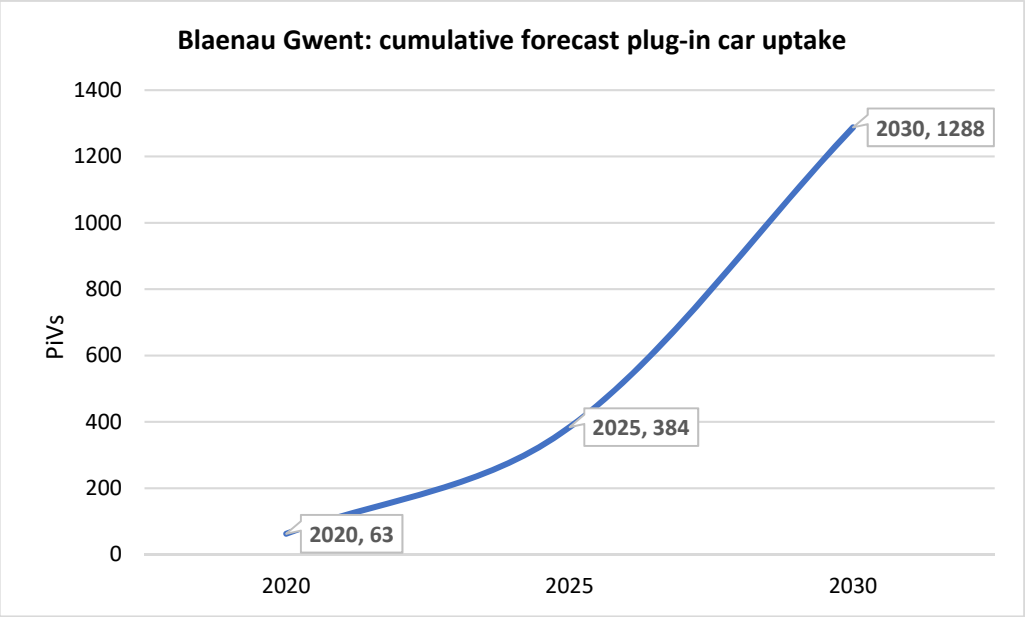
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	4	4 & 4P
Cost of 7kW chargepoints	£22,200	£25,600
Peak power requirement (kW)	28	56

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	1	1 & 3P
50kW chargepoints (taxis)	3	3 & 3P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	6	6 & 0P
Peak power requirement (kW)	550	828
Total costs (7kW, 22kW and 50kW including passive)	**£418,450**	**£428,350**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Ebbw Valley/Abertillery **Local authority:** Blaenau Gwent **Type**: Transit Orientated Development / Interchange

Catchment areas: Abertillery, Cwmtillery, Blaina, Nantyglo and Six Bells	**Off-street parking availability:** 100
Catchment affluence: Low	**Off-street parking availability:** Low
Opportunities: The current Ebbw Valley Railway service is one train per hour. The Transport Minister made a commitment for a second train service per hour to Newport to be introduced by 2021. The Abertillery Spur option will create a link from Abertillery to Ebbw Valley at Aberbeeg. Previous proposals regarding Heavy Rail to Abertillery are being reviewed with a range of options being considered, e.g. light rail or guided bus. Electric vehicle chargepoints will be included within any future proposals implemented. Trains from Llanhilleth take around 48 minutes to Cardiff Central (with onward connections to Bristol and London Paddington).	
Constraints: Currently, the proposed site is a Tesco including a fuel forecourt.	



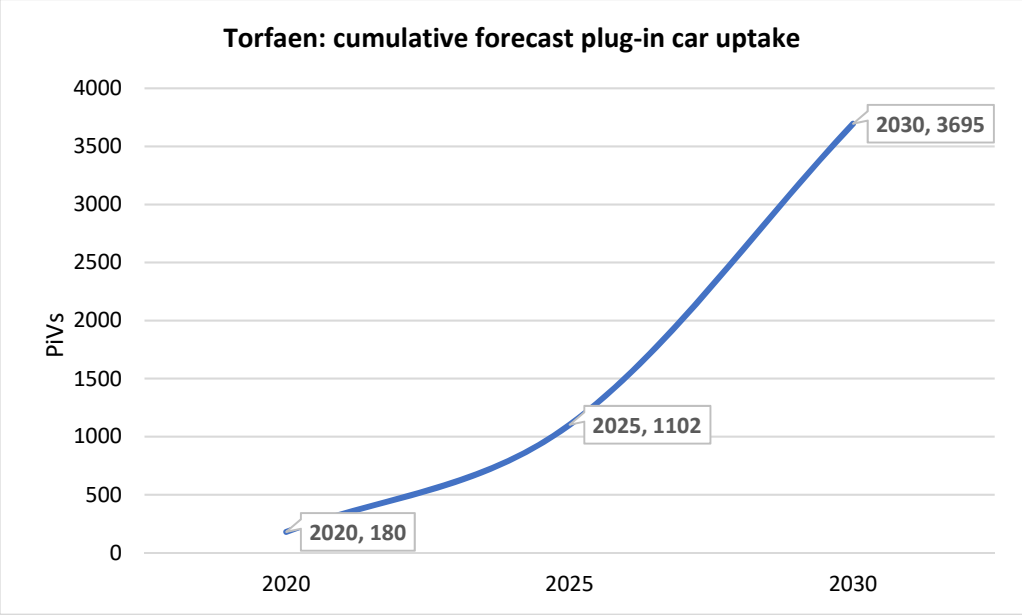
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£16,300
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	1	1 & 1P
50kW chargepoints (taxis)	1	1 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	2	2
Peak power requirement (kW)	186	400
Total costs (7kW, 22kW and 50kW including passive)	**£188,600**	**£195,500**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Pontypool/New Inn **Local authority:** Torfaen **Type:** Park and ride

Catchment areas: Blaenavon, Abersychan, Pontypool (including Trevethin), New Inn, Little Mill and Usk	**Planned parking spaces:** 200
Catchment affluence: Low	**Off-street parking availability:** Medium
Opportunities: The scheme is for provision of a Park & Ride facility with a minimum of 200 spaces including electric vehicle chargepoints on the South Side of A4042 at Pontypool and New Inn Rail Station, which has DDA compliant platform access and improved station facilities including cycling facilities. The aim is to develop the station as a key regional travel hub. The station is a potential interchange point for passengers from the 'Eastern Valley' (including Blaenavon, Abersychan, Pontypool, New Inn), Usk and the West of Monmouthshire. The station has good connections to the North of England, e.g. Crewe and Manchester. The station will support the proposed Mamhilad development with a current allocation of 1,800 dwellings and up to 12,000 houses planned at Llanfrechfra. The station has already benefited from WG investment for physical improvements and design and development works for the current park and ride served off the A4042(T), with associated accessibility improvements. The former project consisted of the improvement of parking, pedestrian and cycling facilities and included the provision of a bus stop and turning area to accommodate any future interchange facilities. Active Travel improvements have been undertaken to better connect the station to the surrounding area and facilities.	
Constraints: No significant constraints identified.	



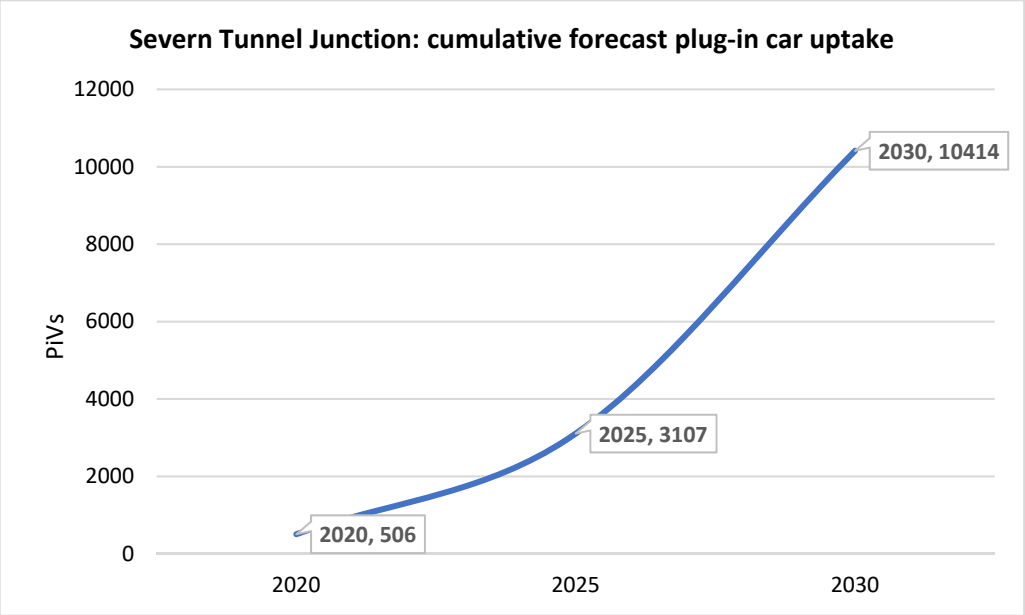
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 4P
Cost of 7kW chargepoints	£14,600	£18,000
Peak power requirement (kW)	14	42

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	1	1 & 2P
50kW chargepoints (taxis)	0	0 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	1	1
Peak power requirement (kW)	136	414
Total costs (7kW, 22kW and 50kW including passive)	**£156,850**	**£166,750**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Severn Tunnel Junction **Local authority:** Monmouthshire **Type:** Park and ride

Catchment areas: Rogiet, Caldicot, Magor & Undy, Shirenewton, Chepstow and Caerwent	**Planned parking spaces:** 314
Catchment affluence: High	**Off-street parking availability:** High
Opportunities: The scheme includes a proposal for 200 additional parking spaces. The existing car park will be repurposed to provide 40 additional bike and ride spaces, safer walking and cycling access, a revamped bus-rail interchange and plug-in vehicle chargepoints. The Severnside development near Chepstow will include 13,000 new homes; developments are also planned for Crick and Caldicot.	
Constraints: There are possible land issues, but no details have been made available.	



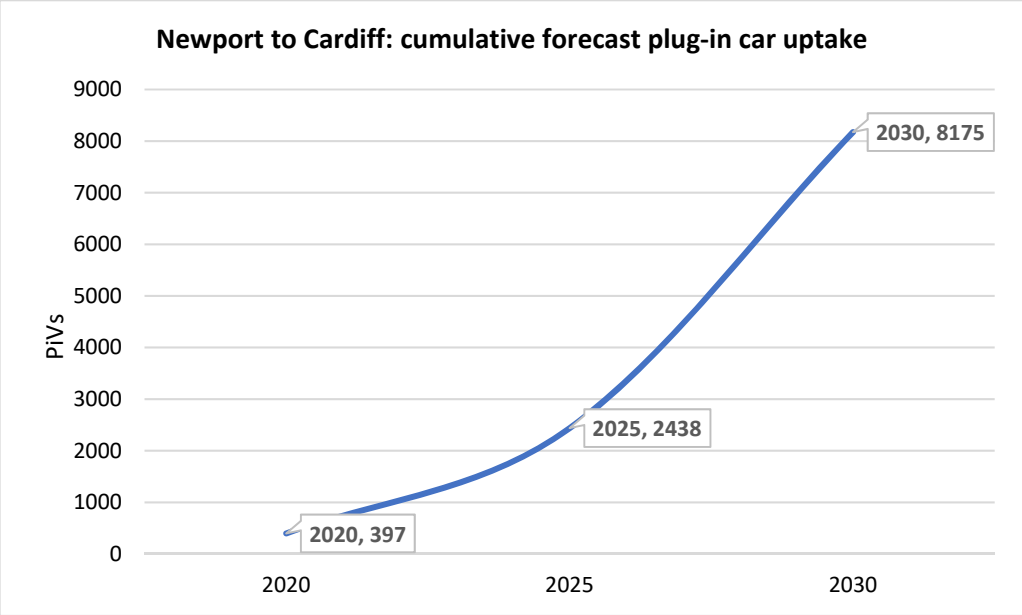
Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	4	4 & 4P
Cost of 7kW chargepoints	£22,200	£25,600
Peak power requirement (kW)	28	56

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	0	0 & 0P
50kW chargepoints (taxis)	1	1 & 1P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	2	2
Peak power requirement (kW)	222	350
Total costs (7kW, 22kW and 50kW including passive)	**£202,950**	**£208,950**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

Site: Newport to Cardiff **Local authority:** Newport **Type:** Bus priority corridor

Catchment areas: Newport and Cardiff	**Planned parking spaces:** 100
Catchment affluence: Medium	**Off-street parking availability:** Medium
Opportunities: The Newport to Cardiff Bus Corridor links several significant trip attractors in the Cardiff Capital Region. A large scale mixed use development is planned between St Mellons and Duffryn, to include a new railway station. Residential developments include Glan Llyn (4,000 houses) and Llanwern (1,100 houses). The new International Convention Centre Wales is being developed at Celtic Manor. With a total cost of £83.7m including car parking and external landscaping, ICC Wales will be capable of accommodating up to 5,000 delegates with a total floor space exceeding 26,000 square metres. Services on this corridor currently suffer from extended journey times (around one hour for a 15 mile journey). The scheme would provide new bus priority measures from Newport to Cardiff along the M4 and A48 corridors, including consistent, high-quality roadside infrastructure to promote and facilitate increased bus use. This will improve journey times and reliability. The scheme will also provide the foundation to introduce a Park and Ride facility to the East of Newport, including charging for electric vehicles.	
Constraints: Land ownership along the route and current traffic flows and congestion could potentially be constraints: further work is required to understand these issues.	



Metro customer user private car provision		
High confidence results	**2025**	**2025 & 2030P**
7kW chargepoints (cars)	2	2 & 2P
Cost of 7kW chargepoints	£14,600	£16,300
Peak power requirement (kW)	14	28

All infrastructure provision		
Low confidence results	**2025**	**2025 & 2030P**
50kW chargepoints (private cars)	2	2 & 0P
50kW chargepoints (taxis)	2	2 & 4P
22kW chargepoints (car clubs)	1	1 & 0P
Passive 50kW provision (buses)	0	0
Peak power requirement (kW)	236	450
Total costs (7kW, 22kW and 50kW including passive)	**£220,950**	**£227,250**

The infrastructure estimates and associated costs must be subject to further study before investment decisions are made. Site specific installation and connection costs have not been determined.

3.1 Site attribute summary

Target Location	Type	Catchment areas	Catchment affluence	Off-street parking availability	Planned parking spaces	Bus Interchange
Bridgend	Park & Ride	Pyle, Porthcawl, Kenfig Hill, Cefn Cribwr & Cornelly.	Medium	Medium	75	Yes
Vale of Glamorgan	Transit Oriented Development /Interchange	Barry, Barry waterfront, Cardiff Airport	Low	Low	100	Yes
Cardiff	Bus priority route	Cardiff	Medium	Low	269	Yes
Rhondda Cynon Taf	Transit Oriented Development /Interchange	Porth, Rhondda Fach, Trebanog, Tonyrefail, Gilfach Goch	Low	Medium	150	Yes
Merthyr Tydfil	Transit Oriented Development /Interchange	Merthyr Tydfil, including Dowlais and Treharris	Low	Low	76(+73 rail station)	Yes
Merthyr Tydfil (Pentrebach)	Park & Ride	Merthyr Tydfil, including Dowlais and Treharris	Low	Low	100	Yes
Caerphilly	Transit Oriented Development /Interchange	Caerphilly, Bedwas, Trethomas, Machen and Abertridwr (Aber Valley)	Medium	Low	280	Yes
Blaenau Gwent	Transit Oriented Development /Interchange	Abertillery, Cwmtillery, Blaina, Nantyglo and Six Bells	Low	Low	100	Yes
Torfaen	Park & Ride	Blaenavon, Abersychan, Pontypool (including Trevethin), New Inn, Little Mill and Usk	Low	Medium	200	Yes
Monmouthshire	Park & Ride	Rogiet, Caldicot, Magor & Undy, Shirenewton, Chepstow and Caerwent	High	High	314	Yes
Newport	Bus Priority Corridor	Newport & Cardiff	Medium	Medium	100	Yes

Table 5. Summary of target location catchments & proposed infrastructure.

3.2 Site infrastructure and power requirements summary

	2025 Base provision for metro rail customers			2025 Potential provision for other services (car club, taxi, public rapid charge point, passive bus)					
Metro site	**7kW charge outlets**	**Peak power requirement (kW)**	**Estimated cost**	**22kW fast chargers for car clubs**	**50kW rapid chargers for taxi**	**50kW rapid chargers for public use**	**50kW passive provision for bus use**	**2025 Total peak power requirement (kW)**	**2025 Total estimated cost**
Bridgend	2	14	£14.6k	1	1	2	2	286	£252k
Vale of Glamorgan	2	14	£14.6k	1	1	2	5	436	£347k
Cardiff	6	42	£29.8k	2	5	5	14	586	£433k
Rhondda Cynon Taf	2	14	£14.6k	1	2	0	2	286	£252k
Merthyr Tydfil	2	14	£14.6k	1	1	2	14	586	£443k
Pentrebach	2	14	£14,6k	1	0	1	3	236	£220k
Caerphilly	3	28	£22.2k	1	3	1	6	550	£418k
Blaenau Gwent	2	14	£14.6k	1	1	1	2	186	£189k
Torfaen	2	14	£14.6k	1	0	1	1	136	£157k
Monmouthshire	3	28	£22.2k	1	1	0	2	222	£203k
Newport	2	14	£14.6k	1	2	2	0	236	£221k
Total	**28**	**210**	**£191k**	**12**	**17**	**17**	**51**	**3,746**	**£3,135k**

Table 6. 2025 Installed infrastructure & charge points values and costs.

	2025 & 2030P Base provision for metro rail customers			2025 & 2030P Potential provision for other services (car club, taxi, public rapid charge point, passive bus)					
Local authority metro site	**7kW charge posts**	**Peak power requirement**	**Estimated cost**	**22kW fast chargers for car clubs**	**50kW rapid chargers for taxi**	**50kW rapid chargers for public use**	**50kW passive provision for bus use**	**2025 Total peak power requirement**	**2025 Total estimated cost**
Bridgend	2 & 2P	28	£16.3k	1 & 0P	1 & 3P	2 & 2P	2 & 2P	500	£259k
Vale of Glamorgan	2 & 4P	42	£18.0k	1 & 0P	1 & 1P	2 & 0P	5 & 0P	514	£352k
Cardiff	6 & 14P	140	£113.9k	2 & 0P	5 & 9P	5 & 0P	14 & 0P	1127	£581k
Rhondda Cynon Taf	2 & 2P	28	£16.3k	1 & 0P	2 & 1P	0 & 1P	2 & 0P	450	£258k
Merthyr Tydfil	2 & 2P	14	£14.6k	1 & 0P	1 & 1P	2 & 0P	14 & 0P	686	£445k
Pentrebach	2 & 2P	28	£17.2k	1 & 0P	0 & 1P	1 & 1P	3 & 0P	343	£225k
Caerphilly	4 & 4P	56	£25.6k	1 & 0P	3 & 3P	1 & 3P	6 & 0P	828	£428k
Blaenau Gwent	2 & 2P	28	£16.3k	1 & 0P	1 & 1P	1 & 1P	2 & 0P	400	£196k
Torfaen	2 & 4P	42	£18.0k	1 & 0P	0 & 1P	1 & 2P	1 & 0P	364	£167k
Monmouthshire	4 & 4P	56	£25.6k	1 & 0P	1 & 1P	0 & 0P	2 & 0P	350	£209k
Newport	2 & 2P	28	£16.3k	1 & 0P	2 & 4P	2 & 0P	0 & 0P	450	£227k
Total	**30 & 42P**	**504**	**£299.6k**	**11 & 0P**	**17 & 26P**	**17 & 10P**	**51 & 2P**	**5,999**	**£3.348k**

Table 7. 2025 infrastructure & charge points + 2030 passive (P) infrastructure values & costs.

4 Chargepoint installation and operation

Installing and operating chargepoint infrastructure is complex and has multiple risks that need to be considered and managed. This section explains some of the issues to be aware of and makes recommendations for setting up a cost-effective, reliable network. More information on funding options is provided in section 6.

4.1 Introduction to electric vehicle charging

4.1.1 Charging speeds

Chargepoints are specified by the power (kW) they produce and therefore the speed at which they can charge a vehicle.

- Slow charging (up to 3kW) is supplied via a three pin socket. Charging can take 10 to 12 hours or more and is less safe than using a dedicated outlet. However, it can be used if no other charging points are available.
- Standard charging (3.5 to 7kW) can supply a typical electric vehicle (EV) battery (15 to 60 kWh) with a full charge in two to eight hours from a 3.6kW unit or three to four hours from a 7KW unit.
- Fast Charging (above 7 and below 25kW) typically provides an 80% charge in three to five hours from a 7kW unit and one to two hours from a 22kW unit.
- Rapid charging is typically supplied at either 43kW (AC units) or 50kW (DC units). This can supply most EVs with an 80% charge in around half an hour, depending on battery capacity. We have recommended the installation of 50kW rapid chargers.
- Ultra-rapid charging refers to even higher rates of charging, such as the 120kW Tesla Supercharger units. Higher rates are in trials for use with buses. As vehicle battery sizes increase, and to overcome barriers to widespread EV adoption, automotive manufacturers are keen to support wider deployment of ultra-rapid charging units. Any passive charging provision provided at the metro site should also enable larger cables to be run through ducting to allow for higher capacity cables should ultra-rapid charging become prevalent for buses in the future.

The table below shows indicative costs of standard chargers, excluding installation costs.

Chargepoint Type	Cost Range
Type 2 3.6kW Wall Mounted	£300-£500
Type 2 Wall Mounted 7kW	£750-1,500
Dual Type 2 Wall Mounted 7 kW	£1,700-2,700
Dual Ground Mounted 7kW	£1,700-5,000
Dual Type 2 Wall Mounted 22kW	£1,800-4,000
Dual Type 2 Ground Mounted 22kW	£3,000-5,000
Triple outlet 25kW Ground Mounted	£12,000 - £18,000
Dual Outlet 43-50 kW, Type 2 and CHAdeMO	£15,00-26,000
Triple outlet 43-50kW, Type 2, CHAdeMO and CCS	£16,000-30,000

Table 8: Indicative costs of standard chargers, excluding installation costs.

4.1.2 Mounting and siting

Chargepoints can be wall or floor mounted, depending on availability of space and ventilation. Air flow to charging equipment is critical to prevent overheating and ensure safe and effective

working of the power electronics, although this is generally only an issue for rapid chargepoints. The chargepoint should be sited to avoid obstructing walkways, passages, fire escapes or any other high footfall areas. Wireless or inductive charging systems can overcome some of the issues associated with charging via a cable, but are currently only available for slow charging, and are more costly than conventional chargepoints.

4.1.3 Charging connectors

In the UK, slow and standard charging (3kW and 7kW) is supplied by either a Type 1 AC or a Type 2 AC connector. Electric vehicles will be supplied with the appropriate lead for connecting to these chargepoints, which are typically installed at residential or workplace sites, and kerbside public chargepoints.

Fast and rapid charging (20kW and above) can be supplied by either alternating current (AC) or direct current (DC). AC rapid charging is always supplied via a Type 2 connector. DC rapid charging has two connector types, depending on the vehicle:

- Japanese vehicle manufacturers such as Nissan and Mitsubishi use the CHAdeMO connector.
- European vehicle manufacturers use the Combined Charging System (CCS)

Rapid chargepoints have tethered cables for both DC protocols, and often for AC Type 2 as well, so it is not necessary to carry a cable in the vehicle. AC charging requires an on-board charger on the vehicle to convert the current to DC; therefore, DC is more suitable for very fast charging rates.

4.1.4 Alternative charging options

The use of cable charging at bus stations may not be appropriate in all cases. This could be because buses don't have enough dwell time to plug-in, there isn't enough space for charging hardware, or due to electricity supply constraints. There are two dynamic charging technologies being developed which could help overcome this limitation: overhead catenary cables with pantographs, and wireless inductive charging.

Pantograph charging involves power being supplied to the vehicle from an overhead catenary cable. Several trials are underway around the UK, primarily involving Volvo, which is working with Kent County Council and Merseytravel to demonstrate this technology. In addition, we understand that the Newport bus bid proposes opportunity charging during layover time at the end of the route to minimise impact on journey time. Power would be supplied by a pantograph that deploys automatically. Theoretically, this technology has the potential to allow electrification of longer bus routes that exceed current EV bus ranges. It could also allow smaller battery packs to be specified on the vehicle, reducing weight and costs. Currently this technology is expensive, so deployment is only possible as part of a funded trial.

Wireless inductive charging works by power being transmitted from a primary coil buried in the road and being picked up by a secondary coil on the vehicle. This allows charging to take place at locations where the vehicle will stop at a predictable place for a short period of time, such as a bus stop. This technology is also at demonstration stage; Arriva has trialled eight Wrightbus StreetLite electric buses with inductive charging in Milton Keynes. Inductive charging allows substantial theoretical rates of power transfer – up to 200kW – but transfer losses are higher than for wired charging.

4.2 Cost and ownership

4.2.1 Hardware costs

A chargepoint's power rating has a near exponential impact on the cost of the hardware. It is therefore crucial to select the appropriate power rating for each location and scenario,

considering expected dwell time[9] for each vehicle type and the distance travelled between charges. Examples of how to determine the charger power rating required are given below:

- **Example 1**: a commuter owns an electric car and wants to charge it at a rail station then take the train to their office. The vehicle will be on charge for eight hours while the employee is at work. A 7kW charge point would supply c.50kWh during that time. This is the equivalent of 200 miles range in a typical EV and exceeds the battery capacity of many cars. Therefore, a 7kW charge point is enough and it may be worth considering 3kW.
- **Example 2**: A car club operating from a metro site wishes to switch to electric vehicles. Cars will be returned to the metro site between rentals. The car club operator has calculated that the vehicle needs to have a maximum 100 mile range for customers to have confidence that it will meet their requirements. A 22kW charger would support this duty cycle, assuming vehicles can stay at the metro site for an hour to recharge between bookings. A 50kW charger would halve this downtime, increasing vehicle productivity, and allowing more vehicles to be charged from a single point. The organisation will need to assess the costs of the upgraded hardware against the forecast increased revenue.

4.2.2 Installation costs

Chargepoint installation costs vary significantly depending on the site, the hardware, and the ownership model. Detailed site surveys are required in order to provide accurate quotes. As this was outside the scope of this report, we have used indicative costs and provide information on what you need to consider below. This is broken down by the five key stakeholder groups you are likely to encounter: DNOs, energy suppliers, landlords, internal partners, and chargepoint installers.

1. **Distribution Network Operators**. DNOs are responsible for ensuring that the local electrical network has the capacity and reliability to meet demand. Increases in demand by a customer can require the DNO to carry out network upgrades. Costs are passed to the end customer and vary significantly depending on the characteristics of the network and the additional demand required. Upgrades can take six months or more and be very costly, so it is vital to engage with the DNO as early as possible to agree a timescale and secure funding. There are steps you can take to reduce costs associated with the DNO:
    - Investigate ‘timed-profile connections’, which have set times when demand must be below a certain level but permit higher demand at other times. This would minimise the DNO upgrade work required to meet demand.
    - A large site may be supplied by more than one substation, so the DNO may be able to provide the capacity at a cheaper cost elsewhere on the estate.
    - Consult local organisations who may also need extra capacity, with a view to spreading costs.
    - Consider smart charging or vehicle-to-grid (V2G) services (see Section 4.3.2).

    Figure 2 illustrates example costs and timescales.

[9] The amount of time an electric vehicle will remain stationary at a charge point.

Small (up to 70kVA)	Medium (200kVA – 1,000kVA)	Large (above 1,000kVA)
Number of charge points		
1-3 Fast or 1 Rapid	10-50 Fast, 4-20 Rapid or 1-6 Ultra-Rapid	50+ Fast, 20+ Rapid or 6+ Ultra-Rapid
Approximate Connection Time		
8-12 Weeks	8-12 Weeks	6 Months +
Approximate Connection Cost		
£1,000 - £3,000	£4,500 - £75,000	£60,000 - £2 million
Other Consideration Affecting Cost		
• Street work costs	• Street work costs • Legal costs for easement and wayleaves	• Street work costs • Legal costs for easement and wayleaves • Planning Permission • Space for a Substation

Figure 2. Example costs and timescales of small, medium and large-scale projects.

2. **Energy suppliers**. Installations may require a new electrical supply point and meter point administration number (MPAN). This must be provided by the relevant energy supplier. This is a free service; however, the customer and energy supplier need to agree a tariff for the supply point or add it to an existing tariff. Engage with the energy supplier early in the installation process to avoid delays to the timescale.
3. **Landlords**. Landlords' permission should be sought for any charge point installations prior to starting work. This may require updates to legal agreements which can incur costs and will take anywhere from a few weeks to a year.
4. **Internal partners**. Effective engagement with internal stakeholders is an essential part of a successful installation. The health and safety team must be consulted as the installation contractor will be subject to their rules and processes, so these must be set out during the procurement process. Ensure you have considered the management sign-off needed and the timescales involved.
5. **Chargepoint installers**. Determine the location and power of chargers required before engaging an installer. This will streamline the procurement process by ensuring tenders meet requirements. Source quotes from at least three suppliers as services offered and prices can vary significantly. Installation consists of the purchase of the charge point and the associated enabling activities. The charge point hardware typically accounts for up to 50% of the total budget, although costs and this split can vary significantly. Factors to consider include:
    - Costs for excavations and cabling increase with distance between the electrical supply (distribution board, MPAN, transformer and/or substation) and the chargepoint site. These are generally the most expensive aspects of an installation and should therefore be minimised, for example by selecting an appropriate parking bay for the chargepoint.
    - Different ground types can have a significant impact on the cost of underground cabling; the cost of excavating a road is more than double that of turf or soil.
    - Demarcation of parking bays with paint, protective barriers and signage must be considered prior to engaging an installer.

Examples of typical costs[10] for installations are illustrated in Figure 3, with details of typical component costs shown in Table 8.

[10] Prices exclude chargers and are based on 5-10m travel from supply to charge position.

Figure 3. Typical installation costs (excluding chargers).

Installation Component	Typical Costs
Excavations	**Turf:** up to £120 per meter, **Pavement**: up to £200 per meter, **Road:** up to £250 per meter
Earthing	£300 - 500 per pit
Electrical Cabling	£40 - 50 per meter
Signage	£75 – 100 per sign
Road Markings	£75 - 150 per bay
Protective Barriers	£200 – 300 per bay

Table 8. Typical installation cost breakdown per component.

4.2.3 Ownership and operating models

Choosing the right ownership model is important to ensure the financial viability of a chargepoint infrastructure project. There is a trade-off to consider as increased financial returns typically come with increased risk. There are three categories of ownership model, each with its own benefits and drawbacks:

1. Own and operate: the local authority installs and operates the chargepoints themselves. They have full responsibility for the network including maintenance and back-office systems.
    - **Benefits**: this approach offers the highest potential returns as there are limited third party costs and all revenue goes to the local authority.
    - **Drawbacks**: requires substantial upfront capital to procure and install the network. Local authorities may not have the necessary expertise to install and operate a chargepoint network.
    - **Example**: Somerset County Council.
2. Third party operator: the local authority installs the network and procures a contractor for operations and maintenance.
    - **Benefits**: outsources the expertise needed to run a network
    - **Drawbacks**: requires substantial upfront capital and reduces revenue compared to the own and operate model, making it harder to recover the initial investment.
    - **Example**: Plymouth City Council.
3. Concessionaire model or lease ownership: a third-party operator funds the hardware and installation costs and runs the network. The authority should take responsibility for ensuring that sites have sufficient electricity supply and are suitable for installation.
    - **Benefits**: upfront costs are reduced, making it a good option for local authorities facing budgetary challenges, and risk is similarly reduced. It is flexible: for example, the supplier can rent equipment to the local authority and split the profits. It is also relatively easy to transition to a new supplier once the first lease agreement expires.

- **Drawbacks**: the authority's share of revenue is reduced and would be zero in a concessionaire model. If the authority doesn't ensure that sites have enough electrical capacity, network operators may target sites where installation costs are low, leading to low utilisation rates.
- **Examples**: Transport for London (concessionaire); Nottingham City Council (lease ownership)

Private sector funding can be sought to offset the costs of the outright ownership and third-party operator models. Mid Devon District Council used this approach for its chargepoint network, allowing infrastructure to be rolled out without the authority facing substantial upfront costs. However, this option lacks flexibility, as sites can be tied up for long lease periods.

Cenex would generally recommend a concessionaire or lease ownership model, as the capital investment and risk involved in the other options are too high for many local authorities. A detailed network feasibility study was not in the scope of this project: however, Cenex has completed such studies for other authorities and would be pleased to submit a proposal to Cardiff Capital Region.

Whichever approach is taken, it is important to consider service level agreements (SLAs) and key performance indicators (KPIs) for network reliability. These should cover proactive and reactive maintenance, and phone or online customer support.

A standard framework should be established for the Welsh public sector to support procurement and installation of infrastructure.

4.3 Planning considerations

It is not always necessary to secure planning consent for chargepoints – they can often be installed under permitted development rights, as detailed in Statutory Instrument 2056. Planning permission will generally be required if the chargepoint:

- Is wall mounted at an off-street location and exceeds 0.2 cubic metres
- Is ground mounted at an on-street location and the height exceeds 1.6 metres
- Faces onto and within two metres of the highway
- Is within a site designated as a scheduled monument or within the curtilage (open space surrounding) of a listed building

Usually only rapid charge points (20kW or above) exceed the height and volume criteria detailed above. At the time of writing, planning regulations are undergoing revision to make streamline the process for installing chargepoints, including allowing rapid chargepoints to exceed the 1.6 metre restriction.

If you are unsure whether you need planning permission, check with the local authority planning department. You will need to supply details of the equipment and a map of the location. Ordinance Survey maps may be available from the Council or you may have site plans if the installation is on your estate.

5 Renewables, energy storage and smart charging

Clean, smart and integrated technology can transform the metro sites' electrical and recharging network into a modern low emission and profitable energy system. Individually or combined renewables, energy storage and smart charging of vehicles can be integrated into any electrical network upgrade.

The following subsections give a very high-level overview of the benefits and barriers of integrating clean technology into the metro-site. Each of these must be assessed in more detail and on a site-specific basis to determine the costs and benefits.

5.1 Renewables and energy storage

5.1.1 On-site renewables

Description Generating renewable energy on-site can reduce peak demand for grid electricity, reducing total CO_2 emissions and saving money. Solar PV panels can be installed on a solar car port or on nearby land. Wind generation requires far less space than a comparable solar PV system. Cardiff is a good location for generating electricity from wind as the average annual wind speed exceeds 4m/s. It can be challenging to secure planning permission, particularly in urban areas.

Economics Capital and installation costs vary greatly depending on the size of the system. Potential costs of a solar installation are shown in Table 9. Solar PV installations are characterised by long payback periods but can assist enable local authorities to meet CO_2 reduction targets and access low cost borrowing and grant funding. The greater economic benefit of adding PV is off-setting grid electricity costs and reducing any capacity upgrade costs (and providing a zero carbon energy supply). Therefore, for maximum economic benefit PV arrays should be sized to allow a high level of avoided electricity purchase.

PV Array Size	CAPEX[11]	Balance of system	Development fees	OEPX
7kWp	£5,390.00	£2,198.00	£6,160.00	£1,512.00
10kWp	£7,700.00	£3,140.00	£8,800.00	£2,160.00
15kWp	£11,550.00	£4,710.00	£13,200.00	£3,240.00
20kWp	£15,400.00	£6,280.00	£17,600.00	£4,320.00

Table 9. Potential costs and benefits of a solar PV array

Opportunity Whilst the income from the sale of electricity does not make a compelling case for installation, offsetting electricity purchased from the grid for site use and vehicle charging may form an attractive business case. Clearly electricity generation and demand do not always match, therefore energy storage could be used to store wrong time renewable generation.

5.1.1 Off-site renewables

Local renewable developments being established by the private and public sector have been identified in relation to the 11 sites. Further feasibility work should be undertaken to understand the potential for integration of renewable electricity supply from these schemes to the metro but there are potentially significant mutual benefits to utilising energy from these schemes in the metro development.

A summary of the known developments in relation to each site is given below.

[11] Pricing taken from Solar Trade Association[11] £/kW installed, as such is an approximation.

	Local Authority Area	Related Hub	Planned (& Existing) renewable energy schemes nearby
1	Blaenau Gwent	Ebbw Valley Line/Abertillery Spur and Interchange	Planned Caerphilly 2MW Trinant Solar PV in close proximity to Llanhilleth. Torfaen local authority site 'The British' is in close proximity to Abertillery; 8MW wind and solar option on the table.
2	Caerphilly	Caerphilly	Nothing known of near-by (but their might be renewable developments in and around Caerphilly we're unaware of to be further explored).
3	RCT	Porth	RCT Local Authority are reviewing a wind development at Lewis Merthyr (4MW wind adjacent to Porth) and Wattstown (6MW wind 1.7 miles away)
4	Vale of Glamorgan	Barry Docks	Existing private 5MW solar farm on Barry Docks (ABP development) ABP have previously expressed interest in adding value to their scheme which is currently supplying electricity directly to the grid.
5	Merthyr	Merthyr Bus Station	Merthyr CBC could incorporate solar into the bus station roof and Capita have now been asked to review, further exploration of the potential for hydro on the adjacent river taff should be explored.
6	Bridgend	Pyle	Private renewables nearby; Private solar farm around 1.5miles away (to the North West of Pyle). A full asset review hasn't been undertaken with Bridgend Local Authority to identify options for renewable developments.
7	Monmouthshire	Severn Tunnel Junction	Monmouthshire Local Authority own Crick solar farm (5MW) 4 miles from STJ.
8	Torfaen	Pontypool and New Inn	A private solar farm is located opposite the Mamhilad development site. Torfaen local authority don't have any sites in proximity identified as having potential for renewables.
9	Newport	Newport to Cardiff	Newport County Borough Council have a ~ 2.5MW 'East of Ebbw' solar PV project which is likley to progress. Cardiff Local Authority have 5MW solar progressing at Lamby Way (Cardiff) Newport also have Duffryn Solar opportunity (West Newport) and docksway opportunities. Llanmartain (Newport East) is identified as a potential solar site, and an existing solar farm has been privately developed in Langstone. Private developments: The recently consented 50MW Gwent Farmers Community Solar Scheme and the proposed 50MW Wentlooge solar and wind project. These have a combined capacity of 100MW and when combined with batteries, which are proposed for both schemes, could make an important contribution to the Metro.
10	Cardiff	East Cardiff	Lamby way 5MW solar scheme is currently being developed.

5.2 Energy storage

Description Renewable generation is unpredictable and often happens when vehicles aren't available for charging. Therefore, it can be used in conjunction with a battery energy storage system to maximise income. This allows energy to be stored during off-peak times and then fed into vehicles as required. This has several potential benefits for the metro sites:

- Provide load management services by charging when electricity demand is low and discharging to offset demand at peak times.
- Increase self-sufficiency through reduced reliance on the grid.
- Revenue can be produced by providing network flexibility to aggregators which manage supply and demand.

Further feasibility work needs to be undertaken to cost out the benefits of renewable installations and energy storage at each of the site.

5.3 Smart charging and V2G

Charging large numbers of vehicles at the same time can have a significant impact on site and local electricity network supply, particularly at peak times. Smart charging and V2G can help manage this demand and offset the need for costly network upgrades.

5.3.1 Smart charging

Description Smart charging is the ability for electric vehicle supply equipment to control the timing of charging and the power output level in response to a user-defined input or signal. At the most basic level, this allows charging to be scheduled for times when grid demand is lower. Dynamic demand shifting can also be used to provide energy services including time of use tariff optimisation, peak demand shaving, network constraint management and simple renewable electricity generation optimisation.

Economics Network upgrade costs for multiple charge points can run to tens of thousands making network connection unviable. Smart charging capability is an embedded functionality in all modern charge points. The functionality will be dependent upon the capability of the charge point management system. But the charge across a group of charge points can be limited so that at times of low EV demand chargepoints operate at full power but at times of high EV demand charge rates to all the points is limited. This allows the avoidance of network upgrade costs in some cases.

Opportunity At a rail site carpark, it is likely that users will leave vehicles to charge for a long amount of time. Therefore, smart charging can reduce the power rating of the chargers to allow the installation of many charge points but allow charging times to be increased to avoid costly network upgrades.

5.3.2 V2G

Description V2G is a system whereby vehicles can provide bi-directional flows of energy when connected to electric vehicles supply equipment. Energy can be discharged from the EV to meet on-site demand or to export electricity to the network.

Economics This allows the energy stored in an EV to be traded in electricity markets to generate income from the vehicle whilst it is not in use. Because the electricity can be dispatched when the grid needs it most, it can be sold at a profit. V2G is not yet fully developed or commercially viable, current V2G charging units cost around £10k, with prices expected to fall by around 70% over the next 2-3 years. The revenue models available to EV owners through V2G activity is also not well proven.

Opportunity The development of V2G equipment and business models is an active and well-funded area of R&D at the moment. Long stay car parks, such as rail, multi-story, airport could form part of the power stations of the future using EV batteries. There is a potential opportunity for Cardiff and the metro sites to bid for innovation funding to showcase new technology from the sites.

6 Policy and funding

There is a complex national and local policy landscape which could affect, and ideally help support the uptake of PiVs and provision of chargepoint infrastructure. There are also various funding opportunities that Cardiff Council and the other local authorities may wish to investigate. The sections below summarise key supporting policy and known potential funding opportunities.

6.1.1 UK policy

- Air quality plan for nitrogen dioxide. The UK Government's most recent air quality plan, published in 2017, states that the UK will end the sale of new conventional petrol and diesel cars and vans by 2040. The Road to Zero (see below) provides more detail on how this will be achieved.
- Road to Zero. Published in July 2018, Road to Zero sets out the UK Government's ambition for at least half of new cars to be ultra-low emission by 2030. Specific proposals and measures include:
    - All new homes and offices to have chargepoints installed, subject to consultation in 2019.
    - A £400 million charging infrastructure investment fund to help new and existing companies that produce and install charge points.
    - Up to £500 for electric vehicle owners to put in a charge point in their home through the Electric Vehicle Homecharge Scheme.
    - The continuation of the plug-in car and van grants until at least 2020.
    - The launch of an electric vehicle energy taskforce to bring together the energy and automotive industries to plan for the increase in demand on energy infrastructure that will result from a rise in the use of EVs.
    - New powers through the Automated and Electric Vehicles Bill to ensure chargepoints are easily accessed and used across the UK, available at motorway service areas and large fuel retailers.

  The full document is available on the UK Government website[12].

6.1.2 Welsh policy

- Clean Air Zone Framework for Wales. The Clean Air Zone Framework for Wales provides guidance to local authorities who are considering options to address local air quality issues. The framework, which was consulted on in 2018, is available online[13].
- Achieving our Low Carbon Pathway to 2030. At the time of writing, the consultation on this strategy had just closed. Proposed actions to 2030 include developing a chargepoint network to encourage early take-up of plug-in vehicles and exploring the merits of measures such as access to bus lanes and free municipal parking. If the strategy is translated into policy, it will provide national support for Cardiff Capital Region's plans.
- National Assembly consultation on EV charging in Wales, 2018. Western Power Distribution's response stated that the South Wales distribution network has enough capacity to connect additional electric vehicle chargers without the need for intervention

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

[13] https://beta.gov.wales/sites/default/files/consultations/2018-04/180424-clean-air-zone-framework-en.pdf

or reinforcement. There will however be some occasions where clusters of connections, for example at some of the sites in scope of this report, exceed available capacity and therefore the network would need to be reinforced.

- Local Air Quality Management (LAQM) requires local authorities to undertake regular air quality assessments against common standards and objectives. Where standards and objectives are unlikely to be met, authorities must designate air quality management areas (AQMAs) and implement remedial action plans. AQMAs have been identified in multiple areas in scope of this report: Caerphilly town centre, Cardiff (four areas including city centre and key arterial roads), Newport (including George Street near the new bus route) and Rhondda Cynon Taf (Cymmer, adjacent to Porth).
- Prosperity for All: Welsh Government Economic Action Plan 2017. This plan sets out what the Welsh Government is seeking to achieve including building a connected infrastructure that supports growth and investment.

  "Our roads, railways, ports, airports, energy infrastructure and digital networks form the arteries that enable our economy to function. Fit for purpose and resilient energy networks will be essential for accommodating the future growth expected in EVs as well as to respond to wider changes in the energy system. We will decarbonise our transport networks and improve the air quality of the communities they serve. To support this, we will introduce a range of measures whose aim is that all taxis and buses in Wales will have a zero-carbon footprint within 10 years". This is echoed in the strategy 'Achieving our low carbon pathway to 2030'.
- Improving Public Transport is a White Paper which was released for consultation in December 2018. The purpose is to set out the Welsh Government's proposals for improving the legislative framework in Wales for how local bus services are planned and delivered, together with reform of the licensing regime for taxis and private hire vehicles. The paper sets out a recommendation for establishing Joint Transport Authorities (JTAs) to establish a distinct regional approach linked to the national context. It reiterates the Welsh Government's aim for all taxis to have a zero carbon footprint within 10 years.
- South East Wales Regional Transport Strategy: we understand that Cardiff Capital Region has been tasked with preparing a regional Transport plan which presents the opportunity to identify and deliver regional charging infrastructure.
- Planning Policy Wales (PPW) is the Welsh Government's national land use planning policy and was first published in 2002. It's the first point of call for Welsh planning policy and is supported by a suite of Technical Advice Notes (TANs) and other guidance. PPW is being updated to align with the Well Being of Future Generations (Wales) Act 2015 and includes policy changes including thresholds for the provision for electric vehicle charging infrastructure.
- The National Development Framework (NDF) will set out a 20 year land use framework for the whole of Wales and will direct the development plans that sit below it – Strategic Development Plans (SDPs) and Local Development Plans (LDPs). It will also support decisions on large scale infrastructure projects through the Developments of National Significance (DNS) process. The final NDF is due to be published in early 2020, following an extensive consultation period which will include scrutiny by the Assembly and will replace the current Wales spatial plan. The NDF will:
    - Set out where nationally important growth and infrastructure is needed and how the planning system - nationally, regionally and locally - can deliver it.
    - Provide direction for Strategic and Local Development Plans and support the determination of Developments of National Significance.

- Sit alongside Planning Policy Wales, which sets out the Welsh Government's planning policies and will continue to provide the context for land use planning.
- Support national economic, transport, environmental, housing, energy and cultural strategies and ensure they can be delivered through the planning system

6.1.3 Local authority policy

Our review found a lack of local policies and strategy documents which specifically relate to the uptake of plug-in vehicles and associated infrastructure. Local policies should explicitly set out how they contribute to national policy ambitions, such as the intention to decarbonise taxis and buses within 10 years. All policies should be updated once the Welsh Government finalises its *Achieving our Low Carbon Pathway* strategy, with clear targets set and measures planned for plug-in vehicle and chargepoint infrastructure deployment.

The white paper currently out for consultation on improving public transport will support a better and more informed regional delivery approach addressing capacity, skills and knowledge challenges, but timeframes need to be expediated to align with delivery of the metro hubs. There's also potentially scope to utilise S106 agreements to support the delivery of some of the infrastructure.

We identified just two documents (out of around 20 reviewed) that specifically mention plug-in vehicles:

- Caerphilly's *Electric Vehicle Strategy and Action Plan* (2018) includes a vision for the introduction of EV infrastructure across Caerphilly to maximise the economic, social and environmental benefits and opportunities of plug-in vehicles.
- Cardiff City Council's *Low Emission Transport: a strategy for cleaner, greener transportation fuels* (2018) sets targets for a pathway to zero emission transport including fleet, infrastructure, renewable technologies, procurement, local partners and supporting innovation.

6.1.4 National and local funding

There are multiple funding sources which Cardiff Capital Region should investigate further. It should develop a coherent funding strategy for each of the 11 sites, with synergies identified and an exploitation plan in place.

- **Plug-in car and van grants:** government grants administered by OLEV to support the uptake of plug-in vehicles. Grants are applied at the point of purchase so there is no need to apply. Refer to the OLEV website[14] for the latest grant values and eligible vehicles.
- **Electric Vehicle Homecharge and Workplace Charging Schemes**: government grants administered by OLEV to support the wider use of electric and hybrid vehicles. Refer to the OLEV website[15] for the latest grant values and eligibility criteria.
- **Ultra-Low Emission Bus Scheme**: an OLEV and DfT fund to support the purchase of new buses. The £48m scheme is available to local authorities and bus operators in England and Wales to help purchase Ultra Low Emission Buses (ULEBs) and supporting infrastructure between 2018-2021.
    - Grants can be provided for up to 75% of the cost difference between a ULEB and a Euro VI diesel equivalent model. All pure electric buses will technically qualify for this scheme, though manufacturers need to test the vehicle on the UK Bus

[14] https://www.gov.uk/plug-in-car-van-grants

[15] https://www.gov.uk/government/collections/government-grants-for-low-emission-vehicles

Cycle and submit the results to the Low Carbon Vehicle Partnership to gain certification.

  - Successful grant applicants can also apply for up to 75% of the cost of installing electric charge point infrastructure.

- **City Deal Capital Finance**: a £30m City Deal and Welsh Government fund to 2021 for delivery of these initial 11 schemes. Provisionally £3m has been allocated to each development but this will be managed on a portfolio basis.
- **Local Transport Fund**: £26m available annually for 2018-19, 2019-20 and 2020-2021 from the Welsh Government via the local transport fund. Funding is generally limited to £1.5m per scheme.
- **Targeted Regeneration Funding**: a £100m fund with £44m allocated to SE Wales. Projects must secure 30% match funding. Cardiff Capital Region City Deal has been asked to prepare a regional development plan that could support an application to this funding pot for mutual transport and regeneration schemes.
- **Wales Infrastructure Investment Plan**: Funding allocated for delivery of the Cardiff interchange
- **Building for the Future**: a £120m EU-funded programme which runs to 2023 and which aims to regenerate town centres by investing in under-utilised land or buildings.
- **Transport for Wales**: Within funding to upgrade the rail network, 1,500 additional park and ride spaces have been allocated; this could be a source of funding for the park and ride facilities planned as part of the metro upgrades.
- **Local Authority Capital Reserves**: Rhondda Cynon Taf County Borough Council is contributing capital reserves towards the Porth interchange. Similarly, Caerphilly has committed £8m to an all-electric public transport network.
- **Welsh Government fund for EV charging infrastructure**: the £2million funding will help create a publicly accessible national network of rapid charging points by 2020, focusing on locations on or near strategic Welsh road networks. The Transport Secretary Ken Skates has asked officials to explore the feasibility of funding chargepoints at park and ride facilities and taxi ranks, to be operated via a national concession model.
- **Bus Operator Contributions**: For example, Stagecoach is supporting Caerphilly's town centre electrification ambitions.
- **OLEV**: funding bids have been submitted for electric buses and associated infrastructure by Cardiff, Newport and Caerphilly.
- **InnovateUK**: Abercynon Park and Ride and Maesteg are applying for funding to procure and install chargepoints.
- **Welsh Government Invest to Save**: This is a fund to support deployment of low carbon technology across the public sector and is based on criteria of an 8 year payback and carbon savings of £200/tonne carbon saved over the life of the project. Typically, the fund is used for energy efficiency measures and is administered by SALIX, however, the fund can be used in conjunction with other funding if a project payback exceeds 8 years but still meets the carbon criteria.
- **Public Works Loan Board**: The public sector has unique access to low cost finance via the PWLB. This funding stream is being utilised by Local Authorities to take forward several large-scale renewable energy developments across South East Wales and might be considered as a funding option for an own and operate infrastructure model.

- **Section 106 agreements** between local authorities and developers can be attached to planning permission to make a development proposal acceptable in planning terms that would not otherwise be acceptable. Section 106 funding from private sector development could be channelled towards delivery of infrastructure. With the right planning conditions in place, Section 106 agreements can also be used to require charging infrastructure in new developments, PiV-only parking bays and taxi ranks.

7 Recommendations and conclusions

This study provides a review of potential electric vehicle infrastructure requirements and provisions across the 11 metro sites setting out the ball park power requirements, infrastructure numbers, and potential supporting technologies such as renewables, energy storage and smart charging. Recommendations are provided below to enable the progression of the infrastructure upgrades at each of the metro sites in a co-ordinated manner.

7.1 Recommendations

7.1.1 Set up a cross-authority working group

The first step should be to set up a working group attended by representatives of each of the 10 local authorities. This should be attended by environmental or sustainability officers and transport planners or project managers responsible for each site. Currently there is a risk that efforts to increase plug-in vehicle uptake is not coordinated across the 10 authorities; it is therefore possible that some of these may compete with others for funding and resources. There are multiple benefits to closer collaboration, including improving the strategic case to support funding bids, pooling resources, and sharing best practice.

The working group should develop a regional plug-in vehicle and infrastructure strategy with a focus on the 11 metro sites for the period 2020 to 2030. This should include a detailed roadmap for plug-in vehicle uptake and plans for implementing or facilitating provision of chargepoint infrastructure. Some local authorities have already published strategies, such as Caerphilly County Borough Council's Electric Vehicle Strategy and Action Plan, and we would recommend drawing from these to produce the regional document. The working group should consider setting up sub-groups for specific vehicle types (cars, buses, taxis and car clubs).

7.1.2 Develop a regional strategy

Undertake a strategic appraisal of the fuels and technologies that Cardiff Capital Region should consider for all vehicle types, with indicative analysis and discussion of environmental performance, cost and implementation timelines. The proposed low emission vehicle strategy would complement existing strategies and policies to promote uptake and use of plug-in vehicles in South East Wales. The objectives should be to improve air quality, reduce carbon dioxide emissions, and encourage regional economic development. It would also form an evidence base that can be used to support local, national and European funding bids.

The strategy should be broader in scope than this Infrastructure Review, encompassing more vehicle types (such as vans and HGVs) and more fuel types, including gas and hydrogen. The primary outputs will be a low emission vehicle and fuels road transport strategy and recommendations on the implementation steps, timelines and benefits of the strategy.

This strategy should seek to develop scenarios for low emission vehicle uptake: low (business as usual), medium (in line with best practice), and high (exemplar region), and equivalent scenarios for likely recharging and refuelling requirements. It may then be possible to assess the potential impact on local economic growth, investment and employment.

7.1.3 Coordinate funding bids

The areas could benefit from the coordinated development of a funding plan for each of the metro sites in partnership with the local stakeholders, and coordination of funding applications. Some bids have already been submitted; for example, Caerphilly County Borough Council, Newport CBC and Cardiff City Council have submitted OLEV bids in conjunction with local bus operators. We are not aware of the extent to which these submissions were aligned, but it is likely that bids would be strengthened by referring to a coherent and strategic regional approach to plug-in vehicle uptake. Section 6 of this report identified several additional funding streams from which the 11 sites could potentially benefit. The working group should discuss the best way of securing funding and maximising its use.

7.1.4 Refine chargepoint cost estimates

The costs provided in Section 4 for chargepoint hardware, installation and DNO services are best estimates based on our experience of working with other local authorities. However, hardware costs vary for different chargepoint types and manufacturers, and installation and DNO costs are highly site specific. Cardiff Council, working with the other nine local authorities, should obtain quotes to refine these estimates.

The first step is to contact the local DNO, Western Power Distribution (WPD). It is vital to engage with the DNO as early as possible and work closely with them throughout the journey from initial strategy to chargepoint operation. For larger installations, DNO services will be the most expensive and time consuming part of the process.

Apply to WPD for an initial budget estimate, providing details of the location and the required power. An indicative location for installation will need to be supplied for each site. The DNO will use the cumulative maximum capacity of all the chargepoints to determine the total load and estimate costs for upgrades and connection. Any capacity identified is not reserved until a formal quotation is supplied. This should be requested once the type and number of chargepoints has been finalised and a provisional date set for network operation to start.

7.1.5 Select and implement a chargepoint operating model

Section 4.2.3 of this report sets out the various operating models available, with some benefits and drawbacks of each. Cardiff Capital Region should review these with respect to their own objectives and budgets and select the most appropriate approach. We recommend developing a bespoke cost tool to compare the various models and produce a cash flow based on inputted values. Scenarios and sensitivity analysis could then be used to show payback and risk under the different ownership models and to understand if scale plays a part in the appropriate ownership models.

The next step is to draw up a procurement strategy and contracting framework carry out market research into the hardware options and network services available. Cenex has substantial experience and industry contacts and can advise on this step.

The working group should support development of a procurement framework across all 11 local authorities which could be managed centrally by Cardiff Capital Region with engagement from National Procurement Service to support this approach. This approach has been successfully implemented by Nottingham City Council in conjunction with 15 other local authorities. Cenex may be able to facilitate sharing of best practice and lessons learned from this innovative scheme. Additionally, there is an opportunity to up-skill locally for the installation and management of charge point infrastructure as supported by the Valley's Task Force Regional skills partnerships.

7.1.1 Renewable and energy storage

Section 5 discussed the use of renewable (both on-site and linking to off-site) energy developments, battery storage and smart charging. Further exploration of the benefits of these technologies should be undertaken. The economic case for the technology will be greater where upgrade constraints exist and a higher level of PiV charging is expected. Following DNO feedback a more detailed feasibility study can be undertaken, looking at the most appropriate sites for technology integrations. The available mechanisms (physical or contractual) which can link into the planned public sector renewable energy developments should also be further explored.

7.1.2 Assess car club feasibility

The car club suitability assessments provided in Section 3.1.2 are based on incomplete information and should be treated as indicative at this stage. We recommend Cardiff Capital Region undertake feasibility studies to address these knowledge gaps. Cenex has developed a

bespoke car club feasibility methodology based on the Public Transport Accessibility Levels approach. Enterprise Car Club and E-Car Club both have bespoke software to help estimate demand and viability. Cenex would be pleased to make the relevant introductions and help Cardiff Capital Region scope and undertake a feasibility study, to include:

- An assessment of the local demographics and likely impact on car club feasibility.
- A preliminary cost model of a car club scheme.
- Quantification of the environmental benefits in terms of pollutant and CO_2 emissions.
- A bespoke assessment of the various car club operating models, with recommendations for the most appropriate for each site.
- Strategies to improve car club utilisation rates and therefore viability

7.1.3 Assess bus infrastructure requirements

Requirements for charging infrastructure for buses should be assessed on a regional, or at least route-specific basis, rather than working upwards from individual sites. This will involve reviewing available technology, determining which routes are good candidates for electrification, and deciding on an appropriate combination of at depot, wired rapid, and other opportunity charging technologies.

Feasibility work will be required to determine what charging requirements are appropriate at each site. The two main points to consider are route length and dwell time at each site, to estimate whether charging is required and feasible. A more detailed study, looking at bus provision and talking to bus operators, can then be undertaken to estimate the number and type of chargepoints required. This can in turn feed into bids to OLEV and the Welsh Government to support deployment of vehicles and infrastructure.

Where passive charging has been recommended, local authorities should consider this as part of ongoing or planned site developments. Providing electricity capacity and carrying out major cabling and groundworks will be more cost effective and less disruptive if carried out as part of a new development, rather than as a retrofit project in the future.

7.1.4 Refine taxi forecasts

Plug-in taxi uptake and infrastructure requirements need to be considered on a regional basis (rather than at individual metro site level). We recommend developing a taxi strategy for South East Wales, encompassing the 10 local authorities in scope of this original report. This would involve collating data to better understand the current taxi fleet and vehicle movements, estimating the potential for plug-in vehicle uptake, determining the level of chargepoint infrastructure required, and making recommendations for supporting policies and incentives.

A feasibility study should include the following:

- Fleet benchmarking and technology review.
- Driver survey and cost modelling.
- Licensing policy review.
- Infrastructure requirements review.

7.2 Conclusions

This report provides estimates for plug-in car uptake and demand for charging infrastructure at each site, and Cenex has a good degree of confidence in these figures. High level assessments of the potential for plug-in taxi, bus and car club fleets have also been put forward, with recommendations for refining these estimates.

The South East Wales region has a good opportunity to tackle multiple challenges including congestion, pollution and transport poverty, while also stimulating economic growth. A coordinated strategic approach, closer ways of working, and joint funding bids will be key to helping this region achieve its policy goals.

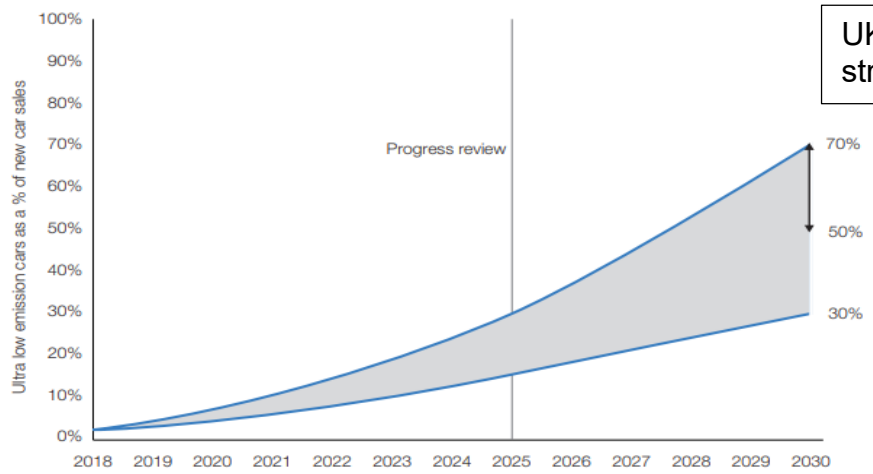
The local authorities involved should consider how to lead by example by focusing on their own transport needs and impacts. For example, reducing grey fleet use by switching to an electric pool car fleet can help create demand for charging infrastructure. Finally, we encourage Cardiff Capital Region to ensure it strikes the right balance between supporting plug-in vehicle uptake by private car owners and encouraging a shift to public transport and active travel. The additional benefits from improved public health and reduced congestion must be considered as part of the policy mix.

A. Appendix A: Methodologies

Establishing the number of PiVs in each local authority area

1. Establish the total number of cars registered in the UK, Wales, and at each Metro site local authorities per quarter since 2014 (from DfT- veh0105)
2. Establish the total number of PiV cars registered in the UK, Wales, and at each Metro site local authorities per quarter since 2014 (from DfT- veh0130/1)
3. Establish number of annual new vehicle registrations each year base on historic trends (from DfT – veh0150)
4. Establish PiV uptake scenarios to 2030
    a. Low – exponential increase based on PiV historic vehicle registration trends
    b. Medium – apply Road-to-Zero projections of % of new registrations being PiVs to 2030, which equates to 30% in 2030
    c. High – apply Road-to-Zero projections of % of new registrations being PiVs to 2030, which equates to 70% in 2030

Figure 1: Illustrative ultra low emission car uptake trajectory as a percentage of new car sales



UK Gov. Road to Zero strategy PiV (cars) projections

5. Using the High scenario (for the purpose of this study), calculate the % PiVs per year as % of UK cars.
6. Apply weighting to PiVs by each local authority (established in No.1 above), so that the same proportion of current UK PiVs is applied to future vehicle projections.

B. Appendix B: Cost tables

		Local Authority:	Bridgend		The Vale of Glamorgan		Cardiff		Rhondda Cynon Taf		Merthyr Tydfil		Merthy Tydfil		Caerphilly		Blaenau Gwent		Torfaen		Monmouthshire		Newport	
		Site:	Pyle		Barry Docks		East Cardiff		Porth		Merthyr bus station		Pentrebach		Caerphilly		Ebbw Valley/ Abertillery		Pontypool/New Inn		Severn Tunnel Junction		Newport to Cardiff	
Charge point type	**Cost per unit**		**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**
Dual ground mounted (7kW)	£5,000	per charger	1	£5,000	1	£5,000	3	£15,000	1	£5,000	1	£5,000	1	£5,000	2	£10,000	1	£5,000	1	£5,000	2	£10,000	1	£5,000
Rapids (50kW) for cars	£30,000	per charger	2	£60,000	2	£60,000	5	£150,000	2	£60,000	1	£30,000	1	£30,000	3	£90,000	1	£30,000	1	£30,000	0	£0	2	£60,000
Fast (22kW) for car clubs	£5,000	per charger	1	£5,000	1	£5,000	2	£10,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	2	£10,000	1	£5,000
Rapids (50kW) for taxis	£30,000	per charger	1	£30,000	1	£30,000	5	£150,000	1	£30,000	0	£0	0	£0	1	£30,000	0	£0	0	£0	1	£30,000	2	£60,000
Passive bays (50kW) for buses	£30,000	per charger	2	£60,000	5	£150,000	0	£0	2	£60,000	10	£300,000	3	£90,000	6	£180,000	2	£60,000	1	£30,000	2	£60,000	0	£0
Installation (inc. rapids)																								
Excavations	£200	per meter	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000
Earthing	£400	per earth pit	8	£3,200	11	£4,400	18	£7,200	8	£3,200	14	£5,600	7	£2,800	15	£6,000	6	£2,400	5	£2,000	9	£3,600	7	£2,800
Electrical cabling	£45	per meter	140	£6,300	200	£9,000	300	£13,500	140	£6,300	260	£11,700	120	£5,400	260	£11,700	100	£4,500	80	£3,600	140	£6,300	120	£5,400
Signage	£75	per sign	8	£600	11	£825	18	£1,350	8	£600	14	£1,050	7	£525	15	£1,125	6	£450	5	£375	9	£675	7	£525
Road markings	£125	per bay	8	£1,000	11	£1,375	18	£2,250	8	£1,000	14	£1,750	7	£875	15	£1,875	6	£750	5	£625	9	£1,125	7	£875
Protective barriers	£250	per bay	8	£2,000	11	£2,750	18	£4,500	8	£2,000	14	£3,500	7	£1,750	15	£3,750	6	£1,500	5	£1,250	9	£2,250	7	£1,750
DNO costs inc. rapids and passive	**Min**	**Max**																						
Small (up to 70KVA)	£1,000	£3,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Medium (up to 1000kVA)	£4,500	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000
High (above 1000kVA)	£60,000	£200,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Costs for 7kW for cars only		**Hardware costs:**		*£5,000*		*£5,000*		*£15,000*		*£5,000*		*£5,000*		*£5,000*		*£10,000*		*£5,000*		*£5,000*		*£10,000*		*£5,000*
		Installation costs:		*£6,600*		*£6,600*		*£11,800*		*£6,600*		*£6,600*		*£6,600*		*£9,200*		*£6,600*		*£6,600*		*£9,200*		*£6,600*
		DNO costs:		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*
		TOTAL COST:		**£14,600**		**£14,600**		**£29,800**		**£14,600**		**£14,600**		**£14,600**		**£22,200**		**£14,600**		**£14,600**		**£22,200**		**£14,600**
Costs for 7kW for cars, 22kW for car clubs, 50kW for taxis and 50kW passive for buses		**Hardware costs:**		*£160,000*		*£250,000*		*£325,000*		*£160,000*		*£340,000*		*£130,000*		*£315,000*		*£100,000*		*£70,000*		*£110,000*		*£130,000*
		Installation costs:		*£17,100*		*£22,350*		*£32,800*		*£17,100*		*£27,600*		*£15,350*		*£28,450*		*£13,600*		*£11,850*		*£17,950*		*£15,350*
		DNO costs:		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*
		TOTAL COST:		**£252,100**		**£347,350**		**£432,800**		**£252,100**		**£442,600**		**£220,350**		**£418,450**		**£188,600**		**£156,850**		**£202,950**		**£220,350**
Peak power requirement (kW) inc. buses				286		436		586		286		586		236		550		186		136		222		236
Power requirement for 7kW only				14		14		42		14		14		14		28		14		14		28		14

Table 10. 2025 costs per targeted area of charge points and infrastructure.

Charge point type	Cost per unit		No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost	No. units	Cost
Dual ground mounted (7kW)	£5,000	per charger	2	£5,000	3	£5,000	10	£15,000	2	£5,000	2	£5,000	2	£5,000	4	£10,000	2	£5,000	3	£5,000	4	£10,000	2	£5,000
Rapids (50kW) for cars	£30,000	per charger	2	£60,000	2	£60,000	5	£150,000	3	£60,000	2	£30,000	2	£30,000	6	£90,000	2	£30,000	4	£30,000	0	£0	2	£60,000
Fast (22kW) for car clubs	£5,000	per charger	1	£5,000	1	£5,000	2	£10,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	2	£10,000	1	£5,000
Rapids (50kW) for taxis	£30,000	per charger	3	£30,000	2	£30,000	14	£150,000	3	£30,000	1	£0	1	£0	3	£30,000	1	£0	1	£0	1	£30,000	6	£60,000
Active bays (50kW) for buses	£30,000	per charger	2	£60,000	5	£150,000	0	£0	2	£60,000	10	£300,000	3	£90,000	6	£180,000	2	£60,000	1	£30,000	2	£60,000	0	£0
Passive bays (50kW) for buses)	£0	per charger	2	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	2	£0	1	£0	2	£0	0	£0
Installation (inc. rapids)																								
Excavations	£200	per meter	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000
Earthing	£400	per earth pit	14	£5,600	16	£6,400	41	£16,400	13	£5,200	18	£7,200	11	£4,400	24	£9,600	12	£4,800	14	£5,600	15	£6,000	13	£5,200
Electrical cabling	£45	per meter	240	£10,800	260	£11,700	620	£27,900	220	£9,900	320	£14,400	180	£8,100	400	£18,000	200	£9,000	220	£9,900	220	£9,900	220	£9,900
Signage	£75	per sign	14	£600	16	£825	41	£1,350	13	£600	18	£1,050	11	£525	24	£1,125	12	£450	14	£375	15	£675	13	£525
Road markings	£125	per bay	14	£1,000	16	£1,375	41	£2,250	13	£1,000	18	£1,750	11	£875	24	£1,875	12	£750	14	£625	15	£1,125	13	£875
Protective barriers	£250	per bay	14	£2,000	16	£2,750	41	£4,500	13	£2,000	18	£3,500	11	£1,750	24	£3,750	12	£1,500	14	£1,250	15	£2,250	13	£1,750
DNO costs inc. rapids and passive	**Min**	**Max**																						
Small (up to 70KVA)	£1,000	£3,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Medium (up to 1000kVA)	£4,500	£75,000	1	£75,000	1	£75,000	0	£0	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000
High (above 1000kVA)	£60,000	£200,000	0	£0	0	£0	1	£200,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Costs for 7kW for cars only		**Hardware costs:**		*£5,000*		*£5,000*		*£15,000*		*£5,000*		*£5,000*		*£5,000*		*£10,000*		*£5,000*		*£5,000*		*£10,000*		*£5,000*
		Installation costs:		*£8,300*		*£10,000*		*£23,700*		*£8,300*		*£8,300*		*£9,200*		*£12,600*		*£8,300*		*£10,000*		*£12,600*		*£8,300*
		DNO costs:		*£3,000*		*£3,000*		*£75,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*
		TOTAL COST:		**£16,300**		**£18,000**		**£113,700**		**£16,300**		**£16,300**		**£17,200**		**£25,600**		**£16,300**		**£18,000**		**£25,600**		**£16,300**
Costs for 7kW for cars, 22kW for car clubs, 50kW for taxis and buses, plus additional passive for buses		**Hardware costs:**		*£160,000*		*£250,000*		*£325,000*		*£160,000*		*£340,000*		*£130,000*		*£315,000*		*£100,000*		*£70,000*		*£110,000*		*£130,000*
		Installation costs:		*£24,000*		*£27,050*		*£56,400*		*£22,700*		*£31,900*		*£19,650*		*£38,350*		*£20,500*		*£21,750*		*£23,950*		*£22,250*
		DNO costs:		*£75,000*		*£75,000*		*£200,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*
		TOTAL COST:		**£259,000**		**£352,050**		**£581,400**		**£257,700**		**£446,900**		**£224,650**		**£428,350**		**£195,500**		**£166,750**		**£208,950**		**£227,250**
Peak power requirement (kW) inc. active and passive for buses				500		514		1134		450		700		350		828		400		414		350		450
Power requirement for 7kW only				28		42		140		28		28		28		56		28		42		56		28

Table 11. 2025 costs per targeted area of charge points and infrastructure. Also includes additional passive costs for 2030 chargepoints. The additional values (+nP) represent the additional passive infrastructure prepared for each charge point as expressed in additional installation costs (earthing, cabling).

	Local Authority:		Bridgend		The Vale of Glamorgan		Cardiff		Rhondda Cynon Taf		Merthyr Tydfil		Merthy Tydfil		Caerphilly		Blaenau Gwent		Torfaen		Monmouthshire		Newport	
	Site:		Pyle		Barry Docks		East Cardiff		Porth		Merthyr bus station		Pentrebach		Caerphilly		Ebbw Valley/ Abertillery		Pontypool/New Inn		Severn Tunnel Junction		Newport to Cardiff	
Charge point type	**Cost per unit**		**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**	**No. units**	**Cost**
Dual ground mounted (7kW)	£5,000	per charger	2	£10,000	3	£15,000	10	£50,000	2	£10,000	2	£10,000	2	£10,000	4	£20,000	1.5	£7,500	3	£15,000	4	£20,000	2	£10,000
Rapids (50kW) for cars	£30,000	per charger	2	£60,000	2	£60,000	5	£150,000	3	£90,000	2	£60,000	2	£60,000	6	£180,000	2	£60,000	4	£120,000	0	£0	2	£60,000
Fast (22kW) for car clubs	£5,000	per charger	1	£5,000	1	£5,000	2	£10,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	1	£5,000	2	£10,000	1	£5,000
Rapids (50kW) for taxis	£30,000	per charger	3	£90,000	2	£60,000	14	£420,000	3	£90,000	1	£30,000	1	£30,000	3	£90,000	1	£30,000	1	£30,000	1	£30,000	6	£180,000
Active bays (50kW) for buses	£30,000	per charger	2	£60,000	5	£150,000	0	£0	2	£60,000	10	£300,000	3	£90,000	6	£180,000	2	£60,000	1	£30,000	2	£60,000	0	£0
Passive bays (50kW) for buses)	£0	per charger	2	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	2	£0	1	£0	2	£0	0	£0
Installation (inc. rapids)																								
Excavations	£200	per meter	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000	20	£4,000
Earthing	£400	per earth pit	14	£5,600	16	£6,400	41	£16,400	13	£5,200	18	£7,200	11	£4,400	24	£9,600	11	£4,400	14	£5,600	15	£6,000	13	£5,200
Electrical cabling	£45	per meter	240	£10,800	260	£11,700	620	£27,900	220	£9,900	320	£14,400	180	£8,100	400	£18,000	190	£8,550	220	£9,900	220	£9,900	220	£9,900
Signage	£75	per sign	14	£1,050	16	£1,200	41	£3,075	13	£975	18	£1,350	11	£825	24	£1,800	11	£825	14	£1,050	15	£1,125	13	£975
Road markings	£125	per bay	14	£1,750	16	£2,000	41	£5,125	13	£1,625	18	£2,250	11	£1,375	24	£3,000	11	£1,375	14	£1,750	15	£1,875	13	£1,625
Protective barriers	£250	per bay	14	£3,500	16	£4,000	41	£10,250	13	£3,250	18	£4,500	11	£2,750	24	£6,000	11	£2,750	14	£3,500	15	£3,750	13	£3,250
DNO costs inc. rapids and passive	**Min**	**Max**																						
Small (up to 70KVA)	£1,000	£3,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Medium (up to 1000kVA)	£4,500	£75,000	1	£75,000	1	£75,000	0	£0	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000	1	£75,000
High (above 1000kVA)	£60,000	£200,000	0	£0	0	£0	1	£200,000	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0	0	£0
Costs for 7kW for cars only		**Hardware costs:**		*£10,000*		*£15,000*		*£50,000*		*£10,000*		*£10,000*		*£10,000*		*£20,000*		*£7,500*		*£15,000*		*£20,000*		*£10,000*
		Installation costs:		*£9,200*		*£11,800*		*£30,000*		*£9,200*		*£9,200*		*£9,200*		*£14,400*		*£7,900*		*£11,800*		*£14,400*		*£9,200*
		DNO costs:		*£3,000*		*£3,000*		*£75,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*		*£3,000*
		TOTAL COST:		**£22,200**		**£29,800**		**£155,000**		**£22,200**		**£22,200**		**£22,200**		**£37,400**		**£18,400**		**£29,800**		**£37,400**		**£22,200**
Costs for 7kW for cars, 22kW for car clubs, 50kW for taxis and buses, plus additional passive for buses		**Hardware costs:**		*£225,000*		*£290,000*		*£630,000*		*£255,000*		*£405,000*		*£195,000*		*£475,000*		*£162,500*		*£200,000*		*£120,000*		*£255,000*
		Installation costs:		*£26,700*		*£29,300*		*£66,750*		*£24,950*		*£33,700*		*£21,450*		*£42,400*		*£21,900*		*£25,800*		*£26,650*		*£24,950*
		DNO costs:		*£75,000*		*£75,000*		*£200,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*		*£75,000*
		TOTAL COST:		**£326,700**		**£394,300**		**£896,750**		**£354,950**		**£513,700**		**£291,450**		**£592,400**		**£259,400**		**£300,800**		**£221,650**		**£354,950**
Peak power requirement (kW) inc. active and passive for buses				500		514		1134		450		700		350		828		393		414		350		450
Power requirement for 7kW only				28		42		140		28		28		28		56		21		42		56		28

Table 12. 2030 cost per targeted area of charge points & infrastructure.

C. Appendix C: Local policy and funding

1. Welsh Government Policy & Strategy

Document Reference	Purpose	Reference to supporting zero emissions transport
Welsh Transport Appraisal (WelTAG) guidance used to assess applications to the Local Transport Capital Grants 2018-19	WelTAG should be used in the development and appraisal of transport proposals promoted or funded by Welsh Government	WFGA guidance provided to support project appraisal, also requirement to reference active travel plan and the environment act re carbon emissions. No specific mention of ZE capability. Essentially a 5 case business model.
Environment (Wales) Act 2016 PART 2 Climate Change	The purpose of Part 2 is to require Welsh Ministers to meet targets for reducing emissions of greenhouse gases from Wales. The achievement of this aim is set out in 'Achieving our Low Carbon Pathway to 2030' Strategy document.	Emissions of GHG from sources in Wales. Hopefully Welsh Government Transport Policy Leads can provide more detail on how the transport emission reductions set out in the strategy will be supported by policy.
Achieving our Low Carbon Pathway to 2030 (2018) consultation has recently closed.	This strategy sets out target for achieving decarbonisation and covers Transport. The report makes recommendations for decarbonisation including provision of infrastructure. In relation to Transport, 14% of Welsh emissions are from transport (significantly less than the UK average at 33%)	Proposed actions to 2030 include; Develop a charging network that encourages early take-up of electric vehicles (EVs) and explore the merits of other measures, including access to bus lanes and free municipal parking; Reduce the carbon footprint of taxis and buses to zero within 10 years to achieve the aim in the Economic Action Plan (from 2017);

Prosperity for All: Welsh Government Economic Action Plan	Includes ambition to 'Drive sustainable growth and combat climate change' and 'Deliver Modern and Connected Infrastructure'.	The document sets out what Welsh Government is seeking to achieve including; We will build a connected infrastructure that supports growth and investment. Our roads, railways, ports, airports, energy infrastructure and digital networks form the arteries that enable our economy to function. Fit for purpose and resilient energy networks will be essential for accommodating the future growth expected in take up of electric vehicles as well as respond to wider changes in the energy system. W*e will decarbonise our transport networks and improve the air quality of the communities they serve. To support this, we will introduce a range of measures whose aim is that all taxis and buses in Wales will have a zero carbon footprint within 10 years.*
Well Being of Future Generations Act (2015)	The Well-being of Future Generations (Wales) Act 2015 sets the framework for the Welsh Government's approach to sustainability and how this will improve the social, economic, environmental and cultural well-being of Wales. The aim of the Act and its local interpretation will be to create an environment that is sustainable both now and into the future.	The WFGA Commissioner recently released a report challenging the proposed £1.4bn investment in the proposed M4 relief road, planned to ease congestion on the M4 at Newport tunnels. The report 'Transport Fit for Future Generations' sets out proposals for an alternative sustainable transport strategy. We set out 3 case study ideas of public transport schemes to complement the South Wales Metro at a cost of approximately £460m. This could be complemented by additional active travel measures (in the 3 local authorities) at a cost of £118m. The total cost of our package would be approximately £578m, delivering an integrated system of public transport and active travel infrastructure to complement the planned Metro phases 2 and 3, at a fraction of the proposed £1.4bn investment on the Black Route.
National Assembly has consulted on EV charging in Wales (2018)	To understand the gaps in EV infrastructure and progress against the recommendations in the low carbon vehicle report (Sept 2015)	Useful responses so far including WPD with estimates of EV uptake in South Wales for reference. http://www.senedd.assembly.wales/mgIssueHistoryHome.aspx?IId=22874
Low carbon vehicle report (Sept 2015)	The Group's remit is to provide the Minister with advice and recommendations on the development of the LCV sector in Wales to maximise the sector's opportunities for growth and jobs and to support social and environmental benefits.	Includes recommendations on improving infrastructure (that haven't been delivered). https://gov.wales/docs/det/publications/160322-lcv-steering-group-report.pdf

Active Travel (Wales) Act 2013	With the Active Travel (Wales) Act 2013, we have set Wales on a path to help transform our country into an ‘active travel nation’. Focuses on increasing walking and cycling as modes of transport and requires consideration within LDP's of active travel options.	Link to accessing the transport hubs and a more integrated transport system. https://beta.gov.wales/sites/default/files/publications/2017-09/active-travel-action-plan.pdf
National Transport Finance Plan 2017 Update	Sets out in detail how WG propose to deliver the outcomes set out in the Wales Transport Strategy from 2015 and beyond. The Plan includes all transport interventions financed by the Welsh Government. No mention of ZE transport.	References air quality management areas and 'Measures to reduce our energy consumption such as low energy lighting and innovative techniques to manage the network will be rolled out where specific business cases allow'
Integrated Transport in Wales report 2013	Focus on integration of transport to facilitate an end to end journey	Relevant to the ZE as the hubs should cater for the integration of all transport solutions (focus in the report on public transport bus and rail links)
The Wales Transport Strategy (2008)	References climate change and environmental benefits but seems out of date now.	
The Air Quality Standards (Wales) Regulations 2010:	These regulations bring into the law in Wales the limits set out in European Union Directives on Air Quality. The regulations require that Welsh Ministers divide Wales into air quality zones.	Requires action to improve air quality standards.
Air Quality Strategy 2007	The UK Government and Devolved Administrations have to produce a national ambient air quality strategy containing objectives and standards for improving air quality.	

Local Air Quality Management (LAQM)	Local Authorities must carry out regular reviews and assessments of air quality in their area against standards and objectives. Where these standards and objectives are unlikely to be met authorities must: designate air quality management areas (AQMAs); and prepare and implement remedial action plans.	With the scope of the Metro, Air Quality Management Areas have been identified in; Caerphilly town centre, Cardiff (x 4 areas including city centre and key arterial roads), Newport (x14 but George street nearest to the route of the new bus route), RCT (x14 nearest is Cymmer, adjacent to Porth) https://airquality.gov.wales/laqm/air-quality-management-areas
Our Valleys, Our Future delivery plan	The Valley's Task Force is an arm's length body to Welsh Government (it's not a separate organisation) that is made up of Valley's stakeholders that inform Welsh Government policy and will work with existing programmes and partners to deliver objectives. Its delivery plan includes 7 strategic sites, some of which include the Metro sites (Merthyr and Caerphilly).	P.29 list of key milestones NB Regional skills partnerships - opportunity to up-skill local people re installation of EV and infrastructure associated with the hub upgrades. https://gov.wales/docs/dsjlg/publications/comm/171107-our-valleys-our-future-delivery-planv3-en.pdf
Wales Infrastructure Investment Plan – Project Pipeline Update 2018	Include allocated funding £738m for delivery South Wales Integrated Transport – Metro (This include funding for the newly established Transport for Wales).	

2. Local Policy and Strategy

Local Authority Area & Related Hub	Any adopted Strategies or work to date?	Planning policy requirements to support delivery of Zero Emission Transport and Infrastructure
Blaenau Gwent: Ebbw Valley Line/Abertillery Spur and Interchange	South East Wales Valleys Local Transport Plan (Jan 2015)	**Objectives of the local transport plan;** No. 8 To achieve a modal shift towards more sustainable forms of transport for moving people and freight. 9. To reduce significantly carbon emissions from transport. Lists out issues, opportunities and interventions across the SE region - key schemes. No mention of zero emissions. **NB: These plans are expected to be updated every 3-5 years**.
	BG LDP 2012 - 2021	No mention or consideration to ZE in the current plan
Caerphilly: Caerphilly Town Centre	South East Wales Valleys Local Transport Plan (Jan 2015)	As above
	Electric Vehicle Strategy and Action Plan (Sept 2018)	Vision: Introduce an electric vehicle infrastructure across Caerphilly county borough, to maximise the economic, social and environmental benefits and opportunities that the electric vehicle agenda will provide.
RCT: Porth	South East Wales Valleys Local Transport Plan (Jan 2015)	As above
	RCT LDP (2006 - March 2021)	No mention or consideration to ZE in the current plan
	Porth Town Centre Strategy	Sets out ambition to develop Porth as a strategic transport hub. No mention of ZE transport or infrastructure.
Merthyr: Merthyr Bus Station	South East Wales Valleys Local Transport Plan (Jan 2015)	As above
Torfaen: Pontypool and New Inn	South East Wales Valleys Local Transport Plan (Jan 2015)	As above

Vale of Glamorgan: Barry Docks	Local Transport Plan 2015-2030	This Local Transport Plan (LTP) seeks to identify the sustainable transport measures required to ensure the Vale of Glamorgan Council adheres to current requirements and good practices to allow for a sustainable transport environment for the period 2015 to 2020 as well as looking forward to 2030. No mention of ZE (although includes air quality and active travel)
Bridgend: Pyle	Local Transport Plan 2015-2031	However, the Local Development Plan does not contain all the transport measures that address local transport issues in the County Borough. Instead, it addresses transport schemes that are of a strategic nature and which are necessitated by land-use developments' Also no mention of ZE in the plan.
Monmouthshire: Severn Tunnel Junction	Monmouthshire local transport plan	No mention of ZE in the plan. **NB all plans set out the same objectives around** "To achieve a modal shift towards more sustainable forms of transport for moving people and freight. 9. To reduce significantly carbon emissions from transport" but the focus is on active travel rather than a shift towards ZE.
Newport: Newport to Cardiff	Newport City Council Local Transport plan (2015-2020)	No mention of ZE in the plan although recognition of changing working patterns (for example)
Cardiff: East Cardiff	Cardiff Transport Strategy 2017	Our transport strategy is underpinned by two main plans – **the Local Development Plan (LDP**) and **Local Transport Plan (LTP)** – which are also the main tools for securing the transport improvements needed to help Cardiff grow and become a truly liveable city. Focus is on moving around the city sustainably (walking, cycling and public transport) rather than ZE. 'Investigate green buses' is the most related statement.
	Local Transport plan 2015-2020	No mention of ZE
	Low Emission Transport: A Strategy for Cleaner, Greener Transportation Fuels. Approved April 2018	Sets out targets for facilitating and speeding up a pathway to zero emission transport including fleet, infrastructure, renewable technologies, procurement, local partners, city growth (an ensuring new infrastructure is fit for purpose) and supporting innovation.

3. Potential Funding Opportunities by Local Authority

	Local Authority Area	Related Hub	Funding Options											
			City Deal Capital Finance (£3m per scheme)	**Local Transport Fund** (Usually capped at around £1.5m per scheme)	**Targeted Regeneration Funding** (£100m 70% fund)	**Building for the Future (EU funded)** running to 2023 (£120m) **Town Centre Regen**	**Infrastructure Investment Plan**	**Transport for Wales P&R**	**£2m WG Electric Vehicle Fund**	**OLEV**	**SALIX**	**PWLB**	**Own Capital Reserves**	**Innovate UK**
1	Blaenau Gwent	Ebbw Valley Line/Abertillery Spur and Interchange	✓	✓	✓	✓		✓	To be determined	✓	To be determined	✓	Unknown	To be determined
2	Caerphilly	Caerphilly	✓	✓	✓	✓		✓		✓		✓	Unknown	
3	RCT	Porth	✓	✓	✓	✓		✓		✓		✓	✓	
4	Vale of Glamorgan	Barry Docks	✓	✓	✓	✓		✓		✓		✓	Unknown	
5	Merthyr	Merthyr Bus Station	✓	✓	✓	✓	✓ (?)			✓		✓	No	
6	Bridgend	Pyle	✓	✓	✓	✓		✓		✓		✓	Unknown	
7	Monmouthshire	Severn Tunnel Junction	✓	✓				✓		✓		✓	Unknown	
8	Torfaen	Pontypool and New Inn	✓	✓				✓		✓		✓	Unknown	
9	Newport	Newport to Cardiff	✓	✓						✓		✓	Unknown	
10	Cardiff	East Cardiff	✓	✓			✓			✓		✓	Unknown	

Independent, not-for-profit, low carbon vehicle technology experts

Research

Programme Development

Consultancy

Low Carbon Vehicle Event

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