Dublin Local Authority Electric Vehicle Charging Strategy

Enabling the transition to Electric Vehicles for the Dublin region

Full report

A report for Fingal County Council, Dublin City Council, Dun Laoghaire Rathdown County Council & South Dublin County Council

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Executive Summary

Background and objectives

In 2019, Ireland's Climate Action Plan (CAP) targeted 100% electric vehicle (EV) sales with approx. 1 million EVs planned to be on the road by 2030. In 2021 a revised Climate Action Plan was published reiterating this ambition and in 2022 the Electric Vehicle (EV) Charging Infrastructure Strategy advises on a pathway for delivery of electric vehicle charge point infrastructure to support the delivery of the CAPs EV targets. The Dublin region represents 25% of Ireland's car fleet and so has a significant role to play in the decarbonisation of the country's transport system.

The four Dublin region Local Authorities (LAs) understand the need for a coordinated approach to deploying EV charging infrastructure in order to support and accelerate this transition. Climate Change Action Plans for the LAs also recognise their role in facilitating this infrastructure provision.

This report contains the 2022-2030 EV charging strategy that has been developed for the Dublin LAs. The objective of this study was to assess what infrastructure should be deployed and where, the number of charging points needed, the level of investment that will be required over the next 10 years, and to explore the roles the Councils could play in the infrastructure roll out.

Types of EV charging considered

The figure below summarises different types of EV charging and highlights those which the LAs can play a role in delivering, which are the focus of this strategy.

Type	Home charging	Neighbourhood charging	Residential charging hub	En-route charging	Destination charging	Workplace charging
Use case	Charging at home (driveway, garage, shared car park) typically overnight	Charging near to the driver's house, typically overnight	Charging in the driver's local area. In rapid case, similar to petrol refuelling	Charging along major routes or main roads in urban areas. Quick turnaround	Charging in car parks at the end journey. "Top up" charging	Charging while parked at workplace. Not strictly public charging
Key user groups	Residents with off-street parking	Residents without off-street parking	Residents without off-street parking, taxis, car clubs	All residents	All residents	Employees (particularly those without off-street parking)
Typical site	Driveway, garage, apartment block car park	In local area, near residents' home	Along urban roads public car park, forecourts etc.	Service station, forecourt, sites near main roads	Supermarkets, shopping centres etc.	Employee car park
Charging speed	Slow (3-7kW)	Slow to fast (3-22kW)	Varies but more likely rapid to ultra rapid (50-150kW)	Rapid to ultra rapid (50-350kW)	Slow to rapid (3-50kW), occasionally higher	Slow, 7kW
Led by	Resident	Council	Council or private sector	Council or private sector	Council or private sector	Private sector (unless Council site)

Not a focus of the strategy

Council led & key focus of strategy

Council may play a role hence a focus of strategy

Figure 1: Summary of EV charging types

Projected EV uptake in Dublin region

Two EV uptake scenarios were assessed: **CAP Ambition** which aligns with the 2030 CAP targets and **Medium** which is judged to be a more realistic trajectory. In the **Medium scenario**, for 2030 the region's EV stock is projected to comprise **120k cars, 12.5k vans, 2.5k taxis and 3k 2-wheelers.**

It is important to highlight that the majority of EVs will have access to off-street parking (driveways, garages etc.), so will be able to charge at home and not rely on the public charging considered in this report.

It is estimated that of the 138k EVs projected to be registered in the Dublin region in 2030, ca. 104k will have access to home charging and will only use public EV charge points (EVCPs) as a supplementary source of charging, while **ca. 34k will rely on public charging.**

Volume of EV charge points required

Based on the EV stock modelling outputs produced in this study and described above, a detailed assessment of EVCP volumes required to support the EV uptake was completed. The infrastructure required to meet the residential charging needs of drivers without access to home charging considered two approaches

- **Rapid hubs** – all residential charging demand met with rapid EVCPs, reflecting a future where vehicle recharging is similar to today's vehicle refuelling model
- **Mixed Technology** – rapid charging is deployed to meet residential demand in areas ranking in the top 50% for 'rapid hub suitability', slow-fast neighbourhood charging used in remaining areas

Figure 2 shows the 2025 and 2030 EVCP requirements based on these two deployment approaches at a LA level and a regional level. The CAP Ambition case is shown for comparison.

Neighbourhood charge points
Rapid hub charging points

		2025 EVCP requirement			2030 EVCP requirement		
		Residential	En-route	Destination	Residential	En-route	Destination
Rapid hubs	Dublin City	65	19	280	247	55	1,065
	South Dublin	23	13	149	85	38	560
	Fingal	23	14	157	86	41	589
	DLR	23	11	135	85	33	509
	Total in Medium scenario	**133**	**57**	**722**	**504**	**166**	**2,723**
	Total in CAP Ambition scenario for comparison	206	92	1,126	802	265	4,363
Mixed technology	Dublin City	329 + 47	19	243	1,280 + 176	55	918
	South Dublin	176 + 12	13	129	685 + 47	38	481
	Fingal	169 + 13	14	110	658 + 49	41	514
	DLR	219 + 10	11	110	850 + 38	33	411
	Total in Medium scenario	**893 + 82**	**57**	**592**	**3,474 + 310**	**166**	**2,324**
	Total in CAP Ambition scenario for comparison	1,402 + 127	92	1,001	5,545 + 494	265	3,724

Figure 2: Summary of EVCP requirement in each LA across different deployment approaches

In the **Mixed Technology approach**, by 2030 3,474 slow-fast neighbourhood EVCPs and 310 rapid EVCPs would be required to meet residential charging demand associated with EVs that lack off-street parking. This would equate to ca. 50 x 6-charger rapid hubs for example. Residential deployment is where the LAs are likely to play a more significant role.

The Dublin region is also shown to need 166 en-route and 2,324 destination EVCPs respectively, which will likely be realised through a more significant share of private sector led deployment (forecourts, supermarkets, multi-storey car parks etc.).

The **Rapid hubs approach** offers a more efficient way of meeting demand and requires less infrastructure to be installed – 504 residential EVCPs needed by 2030 vs almost 4,000 (3,784) in the Mixed Technology approach. However, there are siting challenges that must be considered for rapid hub deployment.

Local Authority role in charging infrastructure deployment

There are several ways in which the four Dublin LAs could facilitate EV charging deployment. ***It is not envisaged that the LAs would be responsible for any significant installation, operation or maintenance of EVCPs.*** The roles the Councils could play vary in terms of risk, public funding requirement, resource requirement, complexity, responsibiliy, and Council control over aspects such as pricing and siting.

The figure below compares example business models for fast & rapid charging that could be explored by the LAs. It may be that a mix of business models is necessary, depending on the type of technology, location, and state of the market. *Note: it is expected that "Council" costs would be covered by public funding.*

Based on experience in other cities, the concession model is effective in achieving city or region wide deployment requiring large volumes, and offers flexibility in terms of the contractual arrangements around ownership, revenue shares etc. Combining this with a "Dublin region EV charging procurement framework" could be an attractive way of delivering some of the region's network.

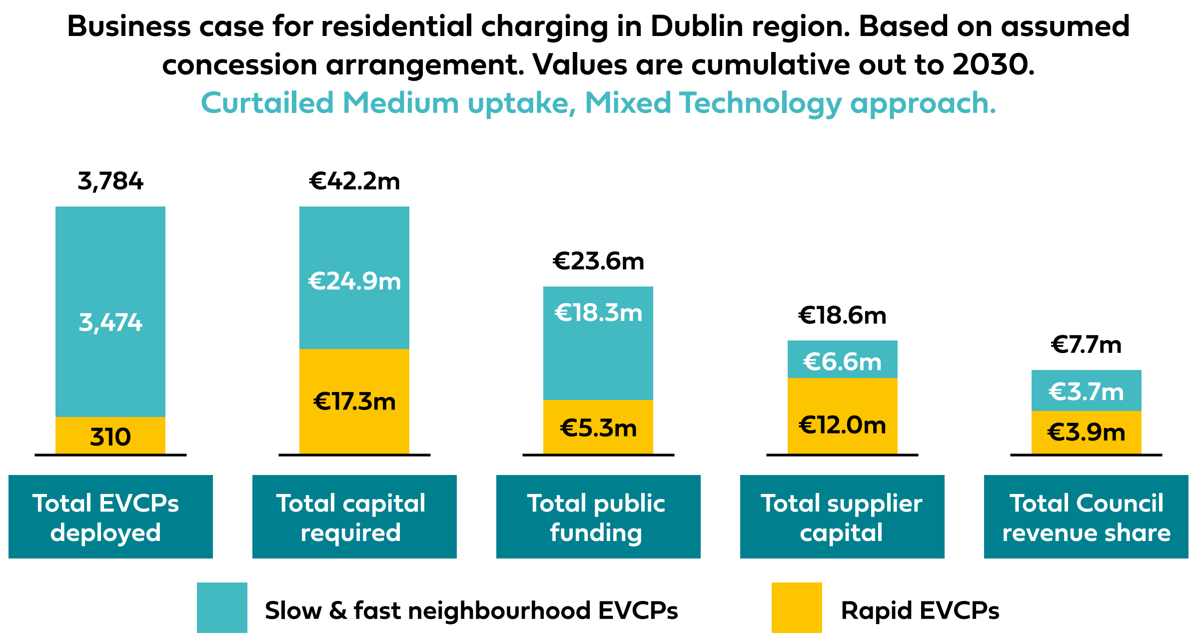
	CAPEX			OPEX				
Example rapid charging business models	**Hardware**	**Install**	**Ground & Grid**	**Back office**	**Electricity**	**Maintenance**	**Council revenue approach**	**Contract length**
Private sector match funding	Typically split Council (or Gov) 75% and supplier 25%			Supplier	Supplier	Supplier	Varies	Varies
Concession A	Council	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	5-10 years
Concession B	Supplier	Council	Council	Supplier	Supplier	Supplier	Share to Council + min. payment	
Concession C	Supplier	Supplier	Council	Supplier	Supplier	Supplier	Share to Council	
Lease model	Supplier	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	15-25 years

Figure 3: Comparison of different fast & rapid charging business models

Investment required for EV charging infrastructure

The high-level business case associated with deploying **residential charging** across Dublin region was assessed based on an assumed concession agreement (list of assumptions provided in the full report).

This provides an indicative view of the level of investment required out to 2030 and the potential public funding needed. The results are shown below. *Note this assumed Council-led deployment delivers all residential charging, but in reality, a share of this may be realised by the private sector as EV uptake grows and the business case improves.*



Note: based on assumed concession contracts for slow, fast & rapid charging derived through business case analysis for each technology. Business model amended post-2025 to reflect improved market conditions - public funding reduced, and revenue share introduced for slow and fast charging. Revenue share always set at 10%. **Results are indicative.**

Figure 4: Summary of 2021-2030 business case for residential charging in the Dublin region

The analysis highlights the challenging business case associated with public EVCP infrastructure and explains why deployment typically requires public funding support. This is the result of low EV uptake to date and in turn low utilisation of EVCPs. The business case of rapid charging is more attractive than slow and fast charging, but still tends to need some public funding. There must be a balance between return on investment aims and the need to transition to EVs and achieve net-zero carbon.

Geographic deployment strategy & recommended approach

Comprehensive geospatial analysis was carried out in order to identify priority areas for EVCP deployment throughout the region. This used a range of relevant data sets including off-street parking provision (derived through EE modelling), traffic flow, public amenities, taxi ranks, and car clubs. The recommended deployment approach is shown in Figure 5.

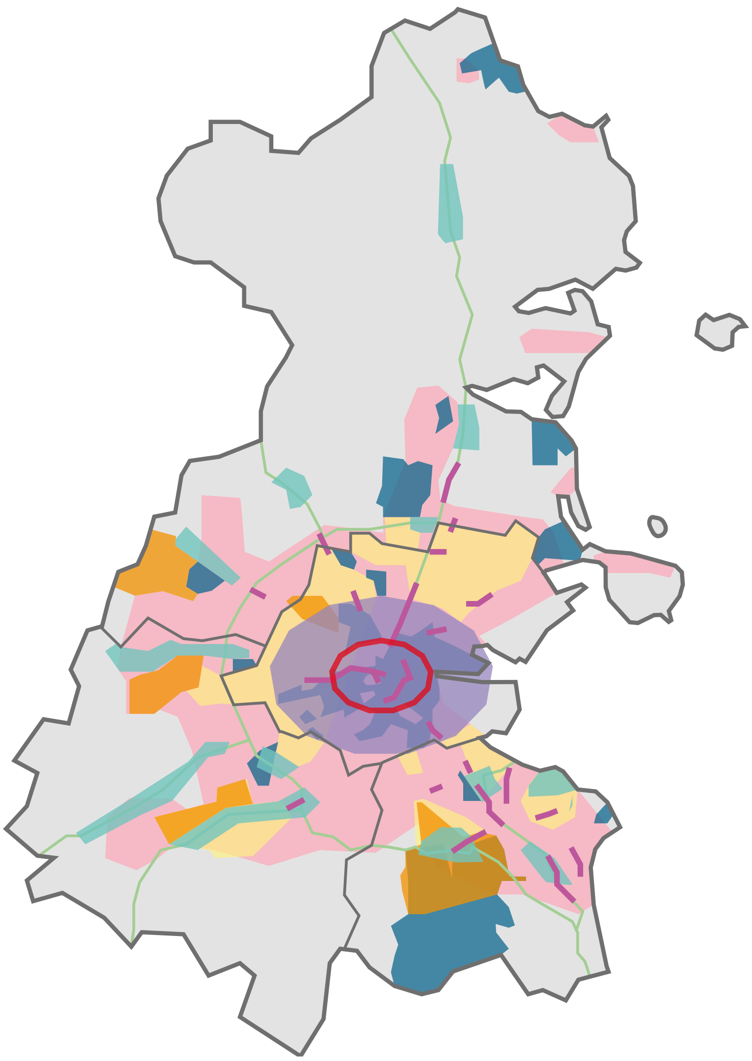
The deployment approach presented is based on the following key principles:

- **Rapid (hub) charging is the preferred model** and should always be the first-choice solution
- **Slow-fast neighbourhood EVCPs should only be used as a second-choice option** where there is a definite need, but rapid charging is not possible. This is partly due to their potential for inhibiting modal shift by making residents less likely to move away from private cars. This is in line with public realm and long stay parking policies.
- **Charging infrastructure siting should be demand-led** and where possible aim to aggregate demand across user groups, with a particular focus on vehicle types that align with longer term modal shift ambitions such as e-taxis and car clubs
- **EVCP deployment should leverage a range of location types** in order to develop a comprehensive charging network in a timely manner, including private car parks, en-route forecourts, and "low hanging fruit" opportunities such as Council-owned car parks
- **Charging infrastructure should align with wider mobility schemes in the region** (e.g. BusConnects and associated Park & Ride plans) such that it supports rather than hinders modal shift and the decaronisation of Dublin region's transport system

The Department of Transport's Electric Vehicle Charging Infrastructure Strategy 2022-2025 considers neighbourhood EVCPs to be the main solution for those without access to private home charging. Due to the nature of the Dublin region (considerable space constraint in places) and Dublin's aim to encourage a shift away from private car use in the city centre, the Dublin LA strategy considers a different priority. Namely, rapid (hub) charging will be prioritised over slow-fast neighbourhood chargers.

Overarching recommended deployment approach for Dublin region to 2030

Showing the areas recommended for priority / targeted deployment and indicating what types of charging are most suited to different parts of the region. Areas with overlapping layers likely to present more promising deployment opportunities.



Definition	Key user groups
Rapid hub charging for multiple user groups within Canal Cordon	Residents without private parking, taxis, car clubs, commuters
High public charging reliance - rapid hub charging recommended	Residents without private parking, taxis, car clubs, commuters
High absolute public charging demand	Residents without private parking
Priority areas for rapid en-route charging assessment	Residents without private parking, taxis, car clubs, commuters
Rapid hub deployment potential to be investigated	Residents without private parking, taxis, car clubs, commuters
Destination charging opportunities	Residents without private parking
Medium public charging reliance	Residents without private parking
Rapid en-route charging along major roads and arterial routes	Taxis, car clubs, commuters
Potential rapid en-route charging forecourts site opportunities	Taxis, car clubs, commuters
Not a priority deployment area - analysis shows high share of residents have access to off-street parking hence would be able to charge at home	

Figure 5: Overview of the recommended EV charging deployment approach

Strategy delivery & next steps

A deployment roadmap has been developed and is in Figure 6 at the end of the Executive Summary. This details key recommended activities that will enable the delivery of EV infrastructure in the Dublin region. Engagement has taken place with a total of 25 stakeholders over a number of key sectors including: charge point operators, landowners, car OEMs, fleet operators, public funding bodies and other governmental organisations. This engagement has allowed refinement in the strategy delivery covering both procurement approach and technology choice.

The strategy accounts for potential risks that may impact EV charging between now and 2030. Some of the most significant are listed below, along with how this is mitigated within the strategy proposed.

- **Limited public sites for rapid charging** – strategy highlights fuel station forecourts that could make attractive hub sites as well as private cars parks that could be leveraged
- **Lower than expected public funding support** – focus is on demand-led deployment of rapid EVCPs (where possible), ensuring the best value for money possible
- **COVID-19 impacts such as constrained car market and reduced commuting** – strategy keeps vehicle stock constant for 2 years to consider reduced turnover. Priority areas chosen based on multiple user groups, limiting the impact of a reduction of commuter charging

Table 1 outlines some of the key short-term next step recommendations included in the strategy split into 5 key themes: procurement & Council role, site identification and deployment, integration with national & local strategy, communications and actions to aid private sector deployment. A full list of recommendations is found in the full report.

Table 1: Selection of key next step recommendations (see longer list in the report)

Category	Next step recommendation
Procurement & Council role	The 4 LAs should agree on the role they wish to play in the deployment of infrastructure. Key part of this will be agreeing on preferred business models. It is recommended that LAs, where they consider it to be necessary and appropriate, consider offering LA sites and/or grant funding to charge point operators to support residential deployment.
Procurement & Council role	Allocate resource to set up a procurement framework for charging infrastructure that all 4 LAs can use. It is estimated that at least 1FTE will be required alongside support from each of the LAs.
Procurement & Council role	Decide the chosen technology split for each LA, and if the framework should be separated into a rapid hub charging and slow-fast neighbourhood charging framework.
Site identification and deployment	Each LA need to decide if they have LA owned sites that they are willing to offer and develop a short list
Site identification and deployment	Councils should use the first 6 months to start assessing low hanging fruit deployment opportunities in high priority areas.
Site identification and deployment	Engage with ESB Networks as early as possible regarding grid constraint issues and opportunities throughout the Dublin region, and establish effective communication channels to be used throughout the deployment.
Site identification and deployment	The Councils should develop a system for collecting, tracking, and mapping resident EVCP requests.
Integration with national & local strategy	The LAs should assess if planned EVCP deployment can make use of DoT funding schemes; ongoing consultations and dialogue with Department will be needed to secure appropriate funding
Integration with national & local strategy	Engage with Council representatives for all relevant mobility and development schemes in early-stage planning work, as well as colleagues in relevant departments (Planning, Roads, Housing etc.)
Communications	Continued communications need to take place between key stakeholders for example with fleets in order to anticipate demand
Communications	Develop a FAQ page for residents and site owners/suppliers
Aid private sector deployment	Due to the long timeframes involved in LA procurement approach, in the short term, LAs must aid private sector deployment through removing national and local deployment barriers due to LA regulations and processes
Aid private sector deployment	The Dublin LAs should use their position to lobby for changes in EV policy and incentives and national level regulations to ensure an accessible and equitable charging landscape

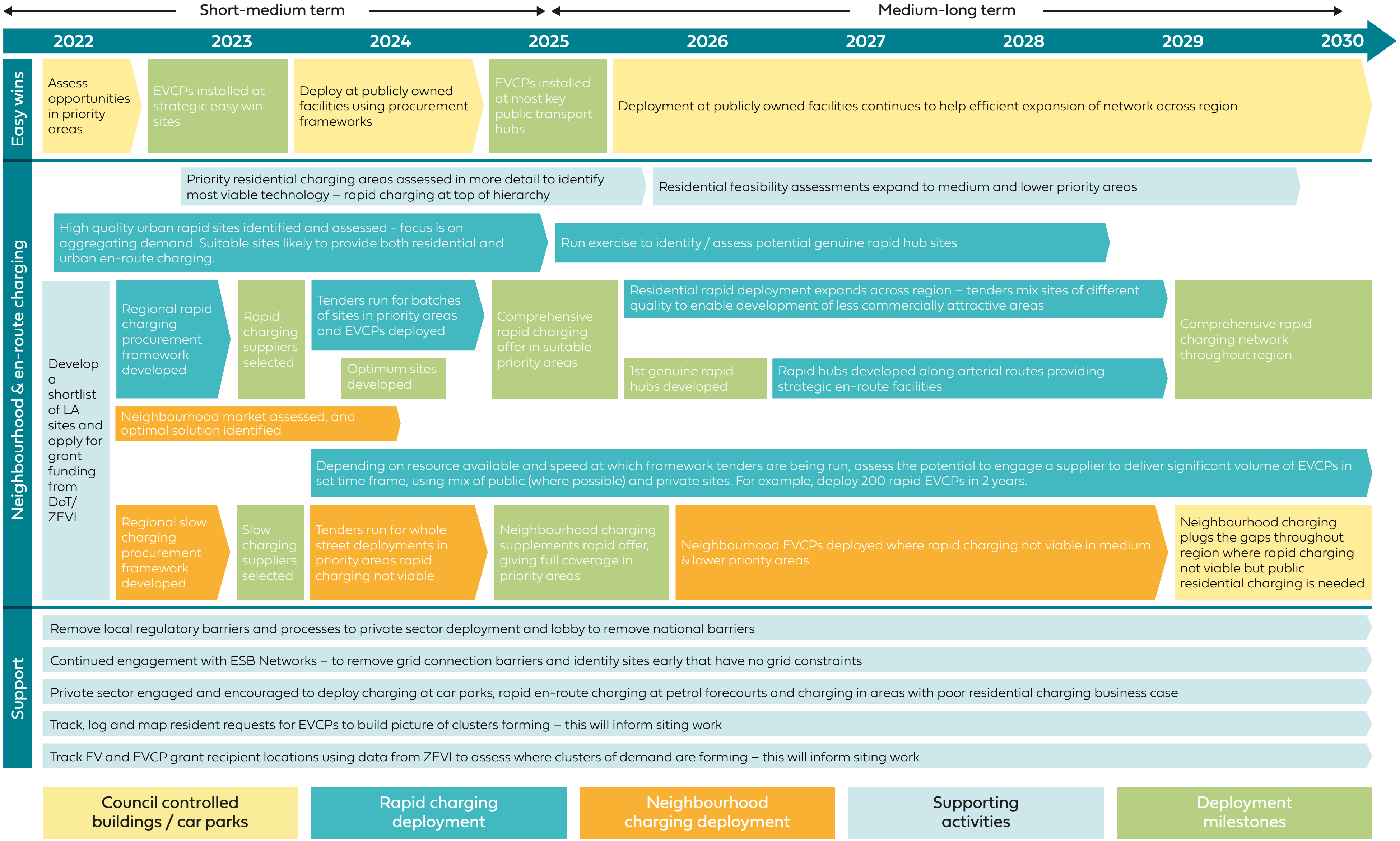


Figure 6: Summary of proposed charging network deployment and delivery roadmap. DoT= Department of Transport, EVCP = Electric Vehicle Charging Point and ZEVI= Zero Emission Vehicles Ireland

About this strategy

This short report is the executive summary of the strategy report – the full report is available online, on the website of the Dublin Local Authorities.

The work was funded by the four Local Authorities (Fingal County Council, Dublin City Council, South Dublin County Council and Dun Laoghaire Rathdown County Council), Smart Dublin and Dublin Climate Action Regional Office. These parties made up the Steering Committee and appointed Element Energy to deliver the work. The modelling work started in 2020, and a large consultation exercise was undertaken in 2021.

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Acronyms

2WL	Two wheelers
AC	Alternating current
B2B	Business to business
B2C	Business to customer
BEV	Battery electric vehicle
CAP	Climate action plan
CPO	Charging point operator
CSO	Central Statistics Office
DCC	Dublin City Council
DCR	Dublin City Region
DLR	Dún Laoghaire–Rathdown
DNO	Distribution Network Operator
DUoS	Distribution Use of System
ED	Electoral division
EVCP	Electric vehicle charge point
FCC	Fingal County Council
FCEV	Fuel cell electric vehicle
HEV	Hybrid electric vehicle
ICE	Internal combustion engine
IEVOA	Irish electric vehicle owners association
kW and kWh	Kilowatt and Kilowatt-hour
LA	Local authority
O&M	Operation & maintenance
OEM	Original equipment manufacturer
PAYG	Pay as you go
PHEV	Plug-in hybrid electric vehicle
RFID	Radio-frequency identification
SCATS	Sydney Coordinated Adaptive Traffic System
SDCC	South Dublin County Council
SEAI	Sustainable Energy Authority of Ireland
SOC	State of charge

1 Introduction

1.1 Background

In 2019, the Republic of Ireland's Climate Action Plan (CAP) set the target of having 950,000 electric vehicles (EVs) on the road by 2030, and for EVs to make up 100% of car and van sales by this point.

In June 2020, the Green Party, Fianna Fáil and Fine Gael formed a coalition government, and have since published a programme for government which includes a range of commitments as part of a proposed Green New Deal.

In October 2020 the government published the Draft Climate Action and Low Carbon Development Bill, which commits to achieving an average 7% annual reduction in overall greenhouse gas emissions from 2021 to 2030 and achieving net zero carbon by 2050. Furthermore, in alignment with the CAP targets mentioned above, the programme for government commits to legislating a ban on the registration of new fossil-fuelled cars and vans from 2030.

Following this in 2022 a second CAP was published reiterating the ambition of the 2019 CAP. alongside the Department of Transport published their Electric Vehicle Charging Infrastructure Strategy for 2022-2025. The Charging Infrastructure Strategy lays out a pathway for the delivery of EV charge point infrastructure to support the delivery of the Climate Action plans targets and to ensure that EV charge point provision remains ahead of demand.

The Dublin region represents around 25% of Ireland's car fleet and therefore has a significant role to play in the decarbonisation of the country's transport system. The four Dublin region Local Authorities (Fingal County Council, Dublin City Council, Dun Laoghaire Rathdown County Council & South Dublin County Council) have identified the need for an electric vehicle (EV) charging network to support the required shift to EVs. The Climate Change Action Plans for the four Dublin LAs also recognise the need for the electrification of their own vehicle fleet and their role in facilitating EV charging infrastructure for the wider community.

A Steering Group comprising the four LAs, the Dublin Climate Action Regional Office (CARO) and Smart Dublin has been set up. Fingal County Council, on behalf of the Steering Group, ran a market sounding exercise to understand the ability of the market to deliver the EV charging network needed.

The conclusion was that there is the need for a strategic overview of the Dublin region, detailing the infrastructure requirements and suitable deployment approach.

1.2 Objectives

This report contains the EV charging strategy that has been developed for the Dublin Local Authorities. The aim of the strategy is to outline how the four Dublin region LAs can deliver a comprehensive public EV charging network over the next 10 years.

The strategy aims to show where deployment should be targeted, based on detailed geospatial analysis of the region, and recommends what type of charging infrastructure should be used to ensure the network meets the needs of all residents.

In depth modelling of the future EV stock is used to assess the annual volume of EV charge points (EVCPs) that will be required out to 2030. This is the basis of a business case assessment which estimates the investment needed to realise a region-wide charging network, and in turn the public funding requirement.

1.3 Scope and approach

This strategy considers the charging needs of Dublin region's cars, vans, taxis and 2-wheelers (mopeds and motorcycles). The EVCP requirement is assessed based on the stock of these vehicles that is registered in the region. It is analysed between 2021-2030.

The method for developing the strategy involved modelling stock turnover and applying EV uptake scenarios to project the EV stock out to 2030, using this to estimate the annual charging energy demand at Electoral Division (ED) level and from this forecasting the EVCP deployment required to meet this.

To assess where the charging infrastructure should be targeted, and what type of charging is most suitable in different parts of the region, geospatial analysis of a range of key datasets was completed. This includes off-street parking provision (derived through dedicated modelling), traffic flow, car parks and vehicle user groups (taxi drivers and car club vehicles).

The recommended approach to procurement and deployment of the network is informed by a comprehensive review of best practice in other cities (London, Dundee, Oslo, Amsterdam, Nottingham etc.). This also fed into the proposed technology-specific business models, which were used to estimate the annual cash flows associated with the required EVCP deployment (total investment, public funding, Council revenue).

It should be noted that electric buses and Heavy Goods Vehicles (HGVs) are outside the scope of this work. The electric bus market is more mature than electric trucks but still in the relatively early stages. The European electric bus market to date has been dominated by depot charging, with little en-route "opportunity charging" deployed so far. This is expected to remain the case in the next few years and as such between now and 2030 there is unlikely to be any significant "public" bus charging demand. Electric trucks are still in the very early stages (e.g. demonstration trials) and there is expected to be little public urban charging demand from this fleet in the period considered in this strategy. Hydrogen fuel cell technology will also play a role in the zero-emission heavy duty vehicle markets in the coming years, in addition to battery electric powertrains.

1.4 Structure of the report

The recommended deployment approach, which brings together the mapping analysis mentioned above, is presented in section 2. This also includes an overview of the different charging types and technologies considered in the strategy.

Section 3 provides an overview of the projected EV uptake and stock evolution out to 2030, followed by the EVCP forecasting outputs. This shows the charging infrastructure requirement for each LA, split by charging type. The business case for the EVCP volumes required is analysed in section 4.

Finally, section 5 summarises the recommended strategy delivery activities. This includes a deployment roadmap, risk assessment and proposed next steps. The appendices are found in section 6.

2 Charging network deployment approach

This section provides an overview of the types of charging and technologies which make up the strategy. It then sets out the geographic and timing aspects of the recommended deployment approach. The results of comprehensive geospatial analysis are used to highlight areas expected to have a high public charging demand and/or dependency, and to assess the suitability of different charging solutions throughout the Dublin region. Combining these outputs shows where deployment should be targeted out to 2030 and what types of charging should be prioritised, in order to develop an overarching timeline, split into short-, medium- and long-term deployment activities.

2.1 Types of EV charging

The charging market can be split into four main charging types, each defined by the nature of their locations. These are residential charging (home and public), en-route charging, destination charging and workplace charging. A comprehensive network should provide a suitable combination of these charging types, deployed at strategically selected sites, in order to meet the needs of the full range of EV user groups (residents, company cars, taxis, car clubs etc.). Figure 1 gives an overview of the different charging types. Note that public residential charging has been split into slow-fast neighbourhood and hub charging, which are the two key approaches available for this market segment. For the purpose of this strategy, **rapid** hub charging is the preferred option - see section 2.3 for more details.

Type	Home charging	Neighbourhood charging	Residential charging hub	En-route charging	Destination charging	Workplace charging
Use case	Charging at home (driveway, garage, shared car park) typically overnight	Charging near to the driver's house, typically overnight	Charging in the driver's local area. In rapid case, similar to petrol refuelling	Charging along major routes or main roads in urban areas. Quick turnaround	Charging in car parks at the end journey. "Top up" charging	Charging while parked at workplace. Not strictly public charging
Key user groups	Residents with off-street parking	Residents without off-street parking	Residents without off-street parking, taxis, car clubs	All residents	All residents	Employees (particularly those without off-street parking)
Typical site	Driveway, garage, apartment block car park	In local area, near residents' home	Along urban roads public car park, forecourts etc.	Service station, forecourt, sites near main roads	Supermarkets, shopping centres etc.	Employee car park
Charging speed	Slow (3-7kW)	Slow to fast (3-22kW)	Varies but more likely rapid to ultra rapid (50-150kW)	Rapid to ultra rapid (50-350kW)	Slow to rapid (3-50kW), occasionally higher	Slow, 7kW
Led by	Resident	Council	Council or private sector	Council or private sector	Council or private sector	Private sector (unless Council site)

Not a focus of the strategy	Council led & key focus of strategy	Council may play a role hence a focus of strategy

Figure 1: **Summary of EV charging types**

It should be noted, as indicated in the figure above, that workplace charging is not included in the strategy deployment approach. This market segment will play an important role in meeting Dublin region's charging demand, particularly for resident's without off-street parking (e.g. driveway or garage), but will need to be led by the private sector and as such is not a priority for this study.

In reality, when charging infrastructure is deployed it can often straddle multiple charging types. For example, a rapid charging hub may be installed in a public car park situated in a residential area. This would fit into both the residential hub and destination charging categories. Moreover, a key consideration when developing the deployment approach is aggregating demand across user groups thereby maximising charge point utilisation. This again may result in EVCPs aligning with multiple charging types, such as a rapid charger on a main city centre road – demand would likely come from local residents as well as taxis, car clubs etc. hence fitting into both rapid residential and en-route charging.

2.2 EV charging technologies

EV charging technologies have developed significantly over the last decade since the first generation of charge points were installed. Figure 2 provides a summary of the technology developments for different types of charging, by comparing the early market trends with more recent and emerging trends.

	Trend	Technology offer	Customer offer	Technology readiness
Residential neighbourhood charging	Original / early market trends	• Traditional standalone EVCPs • Typically 7kW (Ireland mainly 22kW)	• Typically pay per use (based on time or kWh) with membership options • Apps and RFID cards required • Initially free to use in Ireland, but charges recently introduced	
	Recent / emerging market trends	• Several novel solutions being tested - lamppost, bollard, pop up charger etc. • Charging speeds range from 3-22kW • Aiming to reduce street clutter and improve scalability • Smart charging and load management enabled solutions are being trialed	• Typically pay per use (based on time or kWh) • Apps and RFID cards required with membership schemes • PAYG capability now more common	• Various stages of development - depends on technology • Lamppost chargers are now 'off the shelf' products (000's deployed in UK) • Pop up chargers at trial stage, several others approaching trial
Rapid charging	Original / early market trends	• Standalone 50kW rapid EVCPs • Typically deployed en-route or in urban areas to target key user groups (taxis, commuters) • Residents not generally a priority user group.	• Typically pay per use based on kWh delivered • Memberships available with apps and RFID cards	
	Recent / emerging market trends	• 50kW - 150kW is standard offer and 350kW is becoming more common at some enroute sites • Genuine hubs (ca. 6+ EVCPs) are being deployed • Mix of hubs at car parks (e.g. London), dedicated urban developments (e.g. Dundee) and dedicated en-route developments (e.g. Fastned) • Dedicated developments can offer on-site solar PV, and upcoming designs incorporate on-site retail and ca. 20+ chargers (e.g. Gridserve hub)	• Typically pay per use based on kWh delivered • Memberships available with apps and RFID cards • PAYG offers interoperability • Plug & Charge being trialled by small number of CPOs (Tesla has always offered Plug & Charge – enabled by ownership of the whole EV value chain which alleviates data sharing issues)	• 150-350kW now becoming relatively mature technology, particularly with big players such as Ionity targeting them
Destination charging	Original / early market trends	• Traditional standalone EVCPs • Slow and fast chargers (3-22 kW)	• Typically free EV charging offered as a way of attracting customers (site owner has B2B arrangement with CPO – monthly fee for O&M)	
	Recent / emerging market trends	• **Scalable hubs:** mainly 7-22kW EVCPs deployed in hubs with smart charging and load management (enabling savings on grid costs, more chargers for a given connection capacity) • **Rapid charging:** some companies planning to install rapid EVCPs in car parks due to demand from customers (e.g. players in supermarket and fast food sectors)	• Shifting towards a pay per use model, as EV uptake increases and businesses can't justify offering free charging • Developing more sophisticated offers that link with wider customer experience (e.g. loyalty card integration)	• Scalable hubs are a mature commercial offering, but the innovative customer offers are in development stage

Figure 2: Overview of technology trends in different EV charging market segments

A key trend in EV charging is the shift to more coordinated, hub-based deployment. This is seen across charging types, e.g. dedicated rapid charging hubs, scalable car park solutions and neighbourhood charging clusters. These solutions often utilise load management, where multiple EVCPs share a single grid connection and communicate through inbuilt smart capability, allowing their charging to be coordinated. In turn the chargers are able to manage their individual and total charging load within the limits of a fixed power supply.

This kind of deployment approach offers several benefits such as allowing more chargers to be installed for a given grid connection than would normally be the case (each EVCP can reduce its power as required to prevent the available supply being overloaded), avoiding expensive grid upgrade costs if limited capacity is available, and providing a cost effective and scalable way of expanding charging infrastructure.

2.3 Slow- fast neighbourhood charging vs rapid hubs

There are two main deployment approaches that can be used to meet residential charging demand: **slow- fast neighbourhood charging and rapid hub charging**. These two charging types are explained in Figure 3. At a high level, neighbourhood charging provides residents with slow overnight charging near to their house (similar to home charging) whereas rapid hub charging provides residents with quick charging at a centralised location in their local area (similar to conventional petrol / diesel refuelling).

Deciding on the most suitable public residential charging approach for a given area is crucial to delivering a user friendly, cost-effective, and future proofed network. There are strengths and weaknesses associated with both technology options and these are summarised in Figure 3.

The key takeaway from the technology comparison, and the view taken in this strategy, is that rapid hub charging is the optimal residential charging solution for Dublin due to the nature of the area and significant space constraints. A summary of the main reasons is provided below:

- Rapid hub charging is more compatible with shifting residents away from privately owned cars – slow-fast neighbourhood charging near drivers' houses would make this more challenging
- Rapid hub charging is compatible with the operational requirements of sustainable vehicle models such as electric taxis and car clubs which align with modal shift ambition, public realm and long stay parking policies
- Rapid hub deployment offers a more cost-effective approach, with lower capital investment required per EV served (see section 4.4)
- Rapid charging has a more attractive business case and is typically less dependent on public capital funding support (slow charging business case currently very challenging)
- Fewer EVCP devices need to be installed in a rapid hub approach, and it avoids large volumes of infrastructure being deployed along residential streets / pavements
- Rapid charging is a more mature and commercial technology option – the slow-fast neighbourhood charging market is still in development stage with several solutions involved in trial deployments

It should be noted that "rapid charging hubs" can take many forms. These range from dedicated / standalone rapid hub developments (see Figure 4 below) which use land for the sole purpose of EV charging, hubs comprising multiple rapid (sometimes mixed with fast) EVCPs in a destination car park (e.g. supermarket), and more recently large developments with ca. 30 rapid and ultra-rapid EVCPs co-located with amenities (e.g. café, shops) at service station style sites (e.g. Gridserve).

The number of EVCPs per hub is variable and depends on demand, space available, access etc. In the UK, car park rapid charging hubs now often have ca. 6 EVCPs. The assumption for this strategy is that in the short-medium term, rapid hubs would not necessarily be developments of this size, but instead there would be a smaller number of chargers (2-4 for example) installed at strategic car park and neighbourhood charging locations. In the mid-long term, as the market develops, demand grows and the business case improves, larger hubs are expected to be deployed and these may start to be located at dedicated sites, as is seen in more mature markets.

The Department of Transport's Electric Vehicle Charging Infrastructure Strategy 2022-2025 considers neighbourhood EVCPs to be the main solution for those without access to private home charging. Due to the nature of the Dublin region (considerable space constraint in places) and Dublin's aim to encourage a shift away from private car use in the city centre, the Dublin LA strategy considers a different priority. Namely, rapid (hub) charging will be prioritised over slow-fast neighbourhood chargers.

	Slow-fast neighbourhood charging	Rapid hub residential charging
Strengths	• Charging is convenient as EVCP is close to driver's house • Charging typically occurs overnight which may present the opportunity to offer attractive tariffs • Load management, enabled by smart charging, could result in grid cost savings (e.g. lower power connection needed, avoid grid reinforcement work) • Significant volume of EVCPs with predictable usage patterns presents opportunities to access grid services and associated revenue streams • Optimal new technology likely to emerge in the next few years – this should minimise siting issues as EVCPs can be deployed at scale on residential roads	• Avoids street clutter along residential roads and addresses space constraints in urban areas, particularly if private land used • Serves multiple user groups (residents, taxis, car clubs, commuters etc.) and enables the aggregation of demand • Attractive business case for high quality sites with good utilisation meaning private sector can take on a share of the risk and Council may receive a revenue share (as per UK contracts) • Siting can be based on user groups aligned with necessary mobility trends away from private car ownership (taxis, car clubs) thereby future proofing deployment as much as possible • More cost-effective and cost-efficient deployment method (cheaper per EV served than neighbourhood charging) • Mature and improving technology offering • Quick turnaround time for drivers and familiar refuelling model • Rapid chargers can be deployed in 1s and 2s in high quality neighbourhood locations while work to identify and develop genuine hub sites is ongoing
Weaknesses	• Very challenging business case particularly in early years when utilisation is low – currently 100% of lamppost EVCP capital costs are funded • Lamppost chargers are not a genuinely scalable technology, and it will likely be several years until the eventual "winning" neighbourhood solution emerges • Supports the private car ownership model and may contradict efforts to encourage modal shift • Less cost-effective approach than rapid charging (in terms of cost per EV served) • Requires a significant amount of civils works • Creates street clutter and uses valuable urban space • Potential for dispute between residents regarding EVCPs outside houses	• Siting work for genuine hub developments can be lengthy process and requires resources • Unlikely to be significant number of public land sites suitable for hub development – must meet many criteria • Private land developments (e.g. multi-storey car parks, customer car parks, forecourts) offer a backup to publicly owned sites but not under Council's control • Some areas will not be suited to rapid charging in early years due to low demand making business case unviable • Charging tariff more expensive than for neighbourhood residential • Capital cost per hub is significant (although more cost effective overall in long term) • Genuine off-street hubs would likely require planning permission

Figure 3: Comparison of the strengths and weaknesses associated with the slow-fast neighbourhood charging and rapid hub residential charging approaches

It should be noted that impact on the battery is often mentioned as a potential downside to rapid charging. This is not the case though and is explored further in appendix 6.6.

Conclusion for the Dublin region deployment approach: Based on the comparison of residential charging approaches above, the conclusion is that for the Dublin region EV charging strategy, **rapid charging should be the preferred technology deployed where technically and commercially viable**. Slow-fast neighbourhood charging should sit second in the technology hierarchy and seen as a "last resort".

Slow-fast neighbourhood charging should only be deployed if:

1. there is a genuine need for charging, but rapid charging is not a viable option (commercially and/or practically)
2. neighbourhood charging is suitable considering the area, street type and other mobility / e-mobility schemes

Figure 4: Standalone rapid charging hub (source: EVClicks)

As mentioned above, one of the key reasons rapid hub charging should be targeted (in suitable locations) is that it can be delivered in a way that is consistent with a move away from private car ownership, and caters for more sustainable car uses such as car clubs and e-taxis. Neighbourhood charging on the other hand can make resident less likely to give up their private cars. This shift towards more sustainable transport models, in combination with a significant reduction in total vehicle kilometres, will be crucial to achieving climate change goals such as the 2050 net zero target set out in Ireland's Climate Action Plan. Conversely, deploying widespread neighbourhood charging infrastructure near to resident's homes would likely encourage the idea of owning private cars and act to slow down necessary changes.

In recent years, lamppost chargers (EVCPs retrofitted onto street lighting columns) have become a popular neighbourhood charging solution in certain markets, particularly in the UK, due to their low cost compared to other technologies and ease of installation (where suitable). There are several innovative on-street charging solutions at various stages of development which are expected to become strong competitors to lamppost chargers in the next few years. In Ireland, the lamppost technology is only at trial level (free recharging) due the metering barriers[1].

If lamppost charging is an option investigated by Dublin Councils in areas where rapid charging is not viable (commercially or practically), there are several potential technical constraints around the suitability of lampposts which must be considered, some of which are outlined below:

- **Lamppost type and condition** – some lighting columns may be heritage devices and hence not suitable for retrofitting (as is the case for many DCC lampposts)
- **Lamppost position on pavement** – if lampposts are set back from the pavement it is not suitable for a cable to be laid across the walkway, and installing a channel so that the electronics can run under the pavement to the road is expensive

[1] Currently the required meter in Ireland is too large to fit within the lamppost column making deployment within the lamppost unfeasible. It will be necessary to agree a metering system with the DNO that does not require a large metering box.

- **Column width** – if lampposts do not have an internal diameter of around 140mm, a charging device may not fit inside the columns and would have to be "bolted on", which is not optimal due to increased risk of damage

2.4 Assessing rapid charging suitability

As explained in the section above, rapid charging is a solution which can offer significant benefits compared to slow-fast neighbourhood charging. However, a crucial aspect of delivering rapid charging effectively is identifying high quality sites that will provide high enough utilisation for the business case to at least be acceptable. If the deployment of rapid EVCPs is not strategic and demand-led, this will result in poor usage and return on investment. If there is a particular desire to deploy rapid chargers in areas that are less commercially viable, one way to enable this is to include these in tenders with a batch of more attractive sites.

There are several factors which act as good early indicators that an area will be suitable for installing rapid charge points. A non-exhaustive list of these is presented below:

Table 1: Summary of metrics which indicate rapid charging suitability

Metric	Explanation
Traffic flow in surrounding area	Routes with high traffic flows will develop higher en-route charging demand as EV uptake grows, due to the overall throughput of vehicles
Number of amenities in surrounding area	Amenities such as cafes and shops will attract drivers to rapid EVCPs. EE analysis of real-world charging data shows that a high volume of nearby amenities drives rapid charge point utilisation
Taxi ranks in surrounding area	Taxis are expected to be a key future EV user groups, particularly as they align with modal shift ambition. Taxi ranks indicate areas with high taxi operation and in turn future electric taxi charging demand
Car club locations	Car clubs will be a key future EV user groups, particularly as they are part of the move away from private car ownership. Official car club locations indicate areas with high shared car operation and in turn future car club charging demand
Modelled trip counts in surrounding area	Transport models estimate geographic spread of origin / destination trips split by purpose (leisure, work etc.). These indicate the level of vehicle operation in different areas and therefore potential charging demand.
EV uptake in surrounding area	The number of EVs relative to total vehicles indicates areas where people have been more likely to buy an EV to date
Off-street parking availability in surrounding area	Areas with a low availability of off-street parking will be more reliant on public charging infrastructure, as fewer residents can charge at home, which means demand will be higher
Grid capacity	Sites which require expensive grid reinforcements may be unviable due to the business case implications – see "access to power" discussion later in this section for further discussion on this metric
Potential sites for rapid hubs	Areas with a higher volume of potential public and private sites are more likely to be attractive for rapid hub deployment. This includes private / public car parks, forecourts, undeveloped public land sites etc.

Based on the data available, a number of the variables presented above were tested across the Dublin region as part of a geospatial analysis exercise. This generated a **"Rapid Hub Index"** score for each Electoral Division (ED) which indicates the relative suitability of different areas for the deployment of rapid charging. The test method is outlined below.

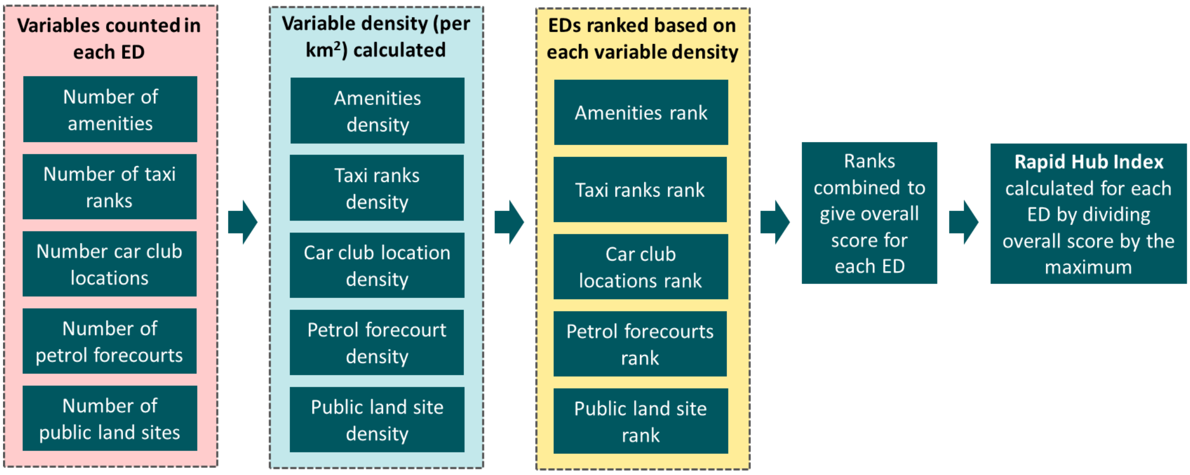


Figure 5: Overview of Rapid Hub Index analysis method

The results from the Rapid Hub Index analysis are presented in Figure 6 below.

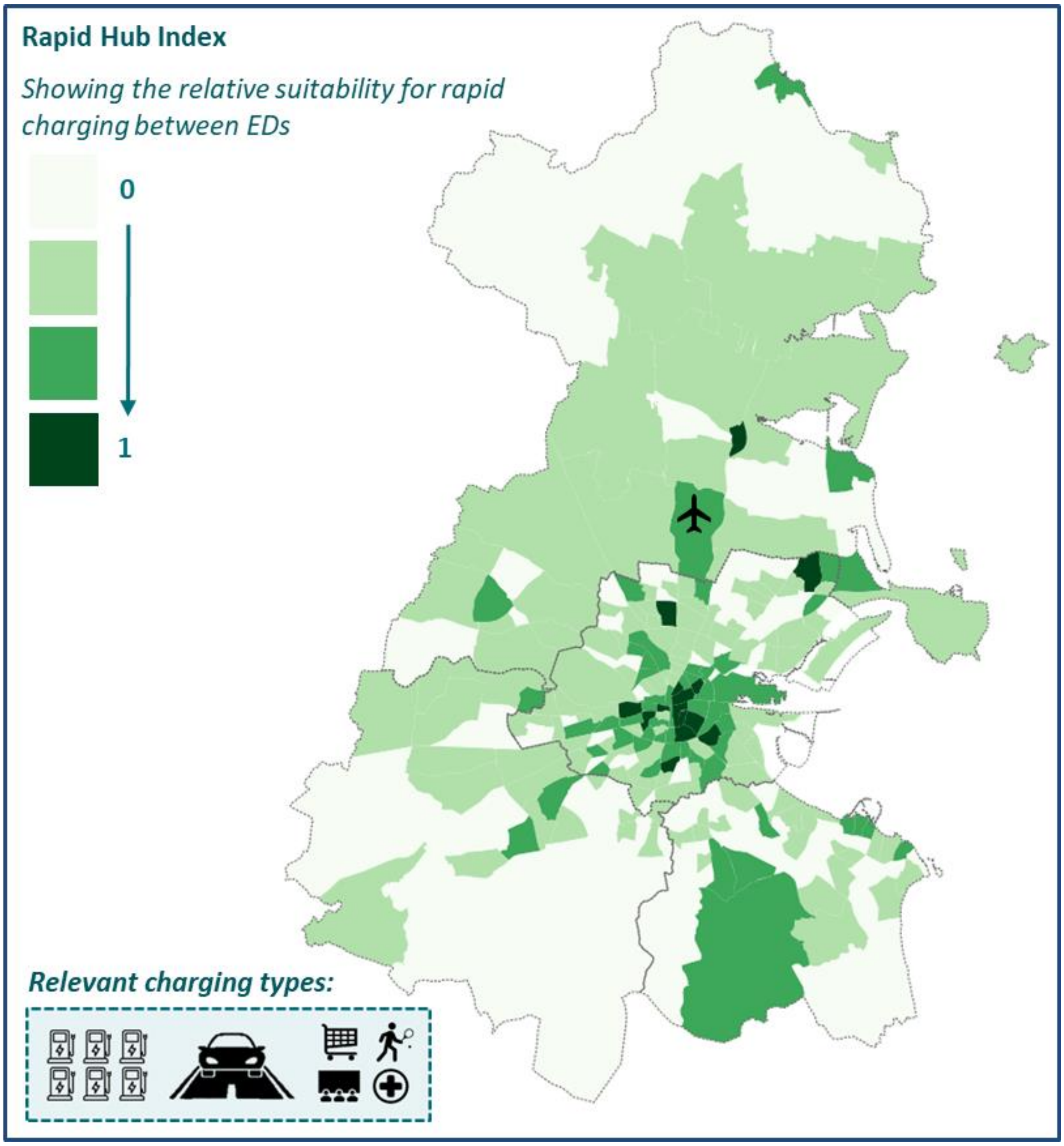


Figure 6: Map showing the rapid charging suitability throughout the Dublin region

As would be expected the areas most suited to rapid charging are clustered in Dublin city and many sit within the Canal Cordon. The main driver for this is the high volume of car club locations and taxi ranks in and around the city centre. This indicates the potential for rapid EVCPs to aggregate demand across different user groups and maximise utilisation. These urban areas also score highly on the availability of amenities which are shown to be useful for attracting drivers to chargers.

The inner Dublin City areas score less well on public land availability and petrol forecourts compared to the surrounding urban areas in South Dublin, DLR and Fingal. This would be expected given the competition for space towards the centre of major cities.

The effect of this may be that while the areas in central Dublin appear attractive for rapid charging deployment in terms of potential demand, identifying sites would likely be more challenging and require effective leveraging of private land (e.g. privately owned and operated car parks). Conversely, areas with good rapid charging suitability outside the DCC boundary may have lower potential charging demand (in the short-medium term) but be easier to deploy in.

Access to power

One of the most important factors that needs to be assessed for a potential rapid charging site is the grid capacity available. The cost of grid connections / upgrades can be a dealbreaker for rapid charging deployment, making installations at some sites prohibitively expensive thereby making the business case unviable. ESB Networks should therefore be engaged as early as possible in the site assessment process to provide information on capacity available, cost of connection etc.

One challenge of EV charging deployment which is common across markets is visibility of grid constraints. As part of this study, ESB were engaged regarding a number of aspects including the grid situation in the Dublin region. Unfortunately, grid capacity data is only collected and visible at primary substation level, which is not sufficiently granular for identifying areas or sites where grid connections / costs are unlikely to be an issue. Data at secondary substation level[2] would be useful but not sufficient either for a full-pre-costing as the point of connection location can be elsewhere, and cable laying costs can be increased greatly by site specific characteristics (e.g. need for crossing a road) . This reflects the situation in the UK, where DNOs maintain primary substation data but not higher resolution information.

Broader considerations around land use

When identifying and assessing sites for rapid charging deployment, it will be important to consider competing land uses and prioritisation of land. For example, a brownfield site may be in an area shown to have strong future EV charging demand, however there may be other uses for that site which the Council in question considers a more effective / appropriate use of the land, such as housing or other mobility schemes (e-bikes, e-scooters etc.). This will have to be discussed and assessed on a case by case basis. As described in section 2.11 there may be possibilities to combine EV charging with other mobility-related land uses to maximise the value and benefits offered by a developments – an example could be e-mobility hubs (e.g. EV charging, shared bike, shared e-scooters co-located at one site), or an EV charging hub co-located with other amenities such as shops and cafes.

2.5 Residential charging strategy

Sections 2.3 and 2.4 explained the different technological approaches to providing residents with public charging and identified areas most suited to the rapid charging option. However, it is also important to identify where the charging infrastructure should be targeted.

[2] Data on spare capacity at this level is not routinely collected as monitoring equipment for secondary stations is very expensive

This section considers the need for public residential charging throughout the Dublin region in order to highlight priority areas for deployment.

2.5.1 Residents without home charging

One of the key challenges associated with the transition to EVs is providing charging for residents without access to home charging, i.e. those without garages, driveways or car parks in shared accommodation[3]. These households will be reliant on public charging infrastructure (as well as workplace charging in some cases). In order to achieve climate change targets over the coming decade and beyond, it will be crucial to make owning and using an EV a viable option for this demographic.

To ensure that residents who will depend on public charging are properly factored into the strategy, a comprehensive analysis of off-street parking availability was carried out.

Correlations between population density and off-street parking provision for each dwelling type (detached house, semi-detached house, terrace house, flat) were extracted from EE's England Off-Street Parking Model (see appendix 6.5 for model diagram). These were combined with housing stock and population data at ED level to determine the proportion of households without off-street parking throughout the Dublin region.

Typically, households without access to off-street parking are less likely to own a car. To account for this, the relationship between the share of households without off-street parking and cars without off-street parking was taken from the England Off-Street Parking Model and used to determine the share of cars that would be reliant on public charging in each ED.

It should be noted that the outputs from the exercise should not be considered completely accurate. EE's original model has proven to show good agreement with actual off-street availability but there are obvious drawbacks to applying the results to the Dublin region.

However, the aim of the analysis is not to find out the exact off-street parking provision in each ED, but rather to indicate how different areas compare to each other. This allows places with a particular lack of off-street parking to be highlighted and identified as somewhere that is likely to have a relatively high reliance on public charging in the future.

Figure 7 shows the estimated split of drivers into each LA based on their access to parking, and Figure 8 shows the share of cars without off-street parking at an ED level. The graph indicates that a higher share of drivers in Dublin City are expected to park on-street which is consistent with the high proportion of apartment block households in this LA. However, a key finding from the off-street parking analysis is that a large majority of drivers have access to off-street parking, would be able to charge at home, and therefore would be less reliant on public charging infrastructure.

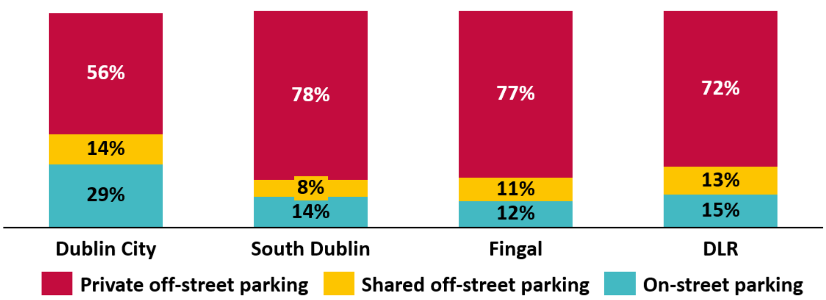


Figure 7: Estimated split of drivers in each LA based on their access to parking

[3] Note that the ability to do home charging in an apartment block is dependent on the landlord installing EVCPs for the residents to use and therefore is by no means guaranteed

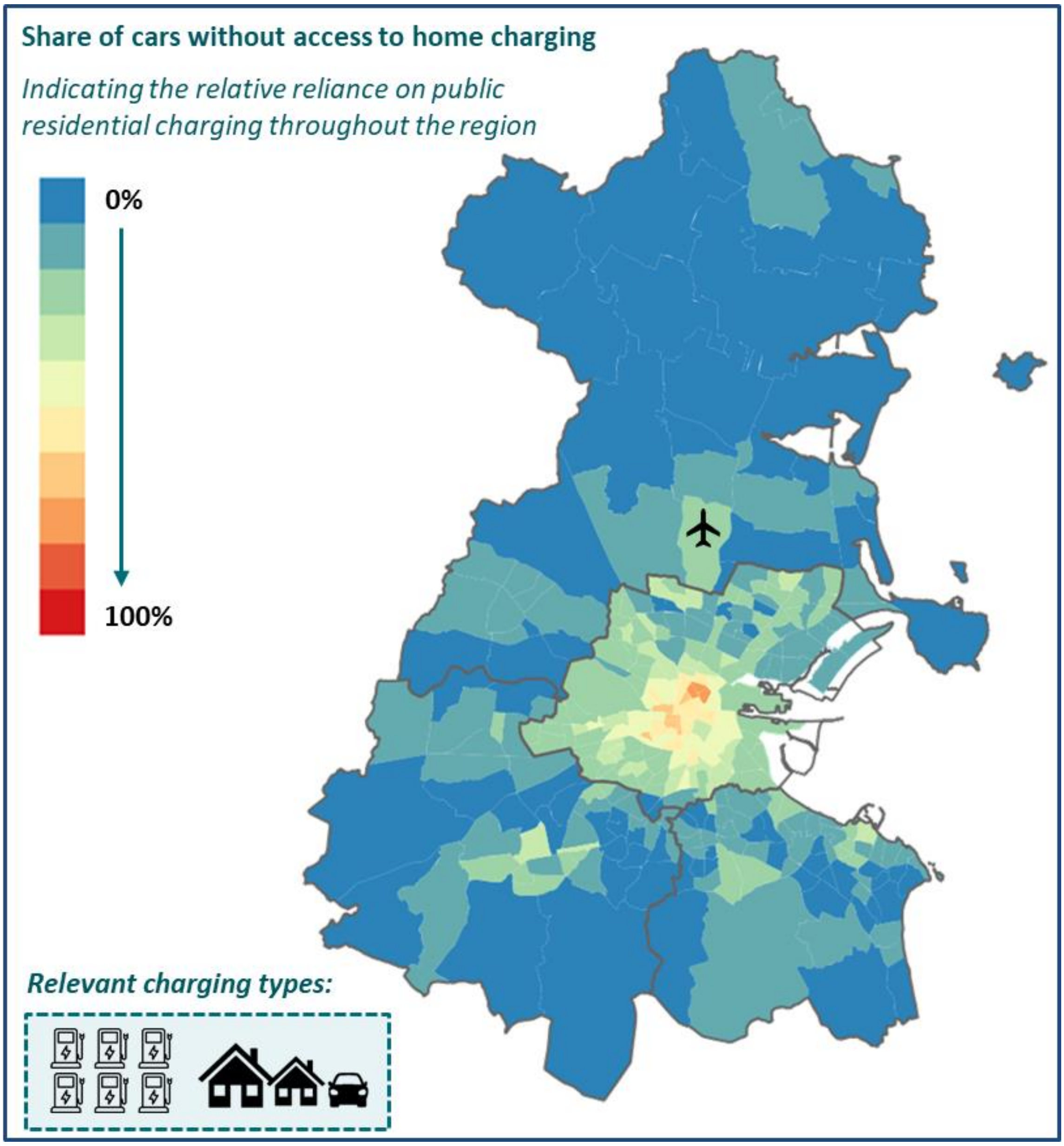


Figure 8: Map showing the share of cars without off-street parking at ED level. Red indicates the highest share of cars parked on-street and thus the highest reliance on public charging

Figure 8 shows that the areas with the highest proportion of vehicles parked on-street are clustered towards the centre of Dublin City. This would be expected due to the housing stock composition in this part of the region. Apartments, which are typically less likely to have private parking, comprise a greater share of Dublin City's housing stock than the other 3 LAs. On average, EDs in Dublin City are made up of 68% houses and 32% apartments. In South Dublin, Fingal and DLR the apartment share is 12%, 17% and 19% respectively.

In addition to the central cluster, there are areas surrounding DCC which have relatively low levels of off-street parking (ca. 20-40% of cars without private parking), such as near to the harbour in DLR and Tallaght in South Dublin.

The case of Fingal and South Dublin

The map above indicates that large parts of Fingal and South Dublin have a very high availability of off-street parking. As a result, the vast majority of drivers in these areas will be able to charge EVs at home and will not be reliant on local public charging infrastructure. These areas tend to be rural and also have a low absolute number of households and cars.

However, it is important to note that there may exist areas in a LA where the housing stock does not fit the typical trends relating household type, number of cars per household, population density, and off-street parking. In these cases, the analysis may not accurately reflect the availability of off-street parking. One potential example of this raised during strategy development are estates in Fingal (e.g. Swords, Lusk) which may be expected to have off-street parking but in fact do not. It should also be noted that a shift in Ireland highlighted during strategy development is from private off-street parking to shared parking spaces in newer estates.

2.5.2 Clusters of EVs without access to home charging

As well as identifying areas in which a large share of households do not have off-street parking, it is also important to consider which parts of Dublin region have particularly large vehicle populations, and in turn projected future EV numbers. This is to account for the fact that some residential areas may have a low percentage of cars parked on-street, but due to the size of the local fleet, have a high projected absolute number of EVs without private parking. In order to identify areas that fall into this category the EV uptake results (explained in Section 3.1) are assessed. Figure 9 shows the predicted number of EVs without off-street parking in 2025 in each ED.

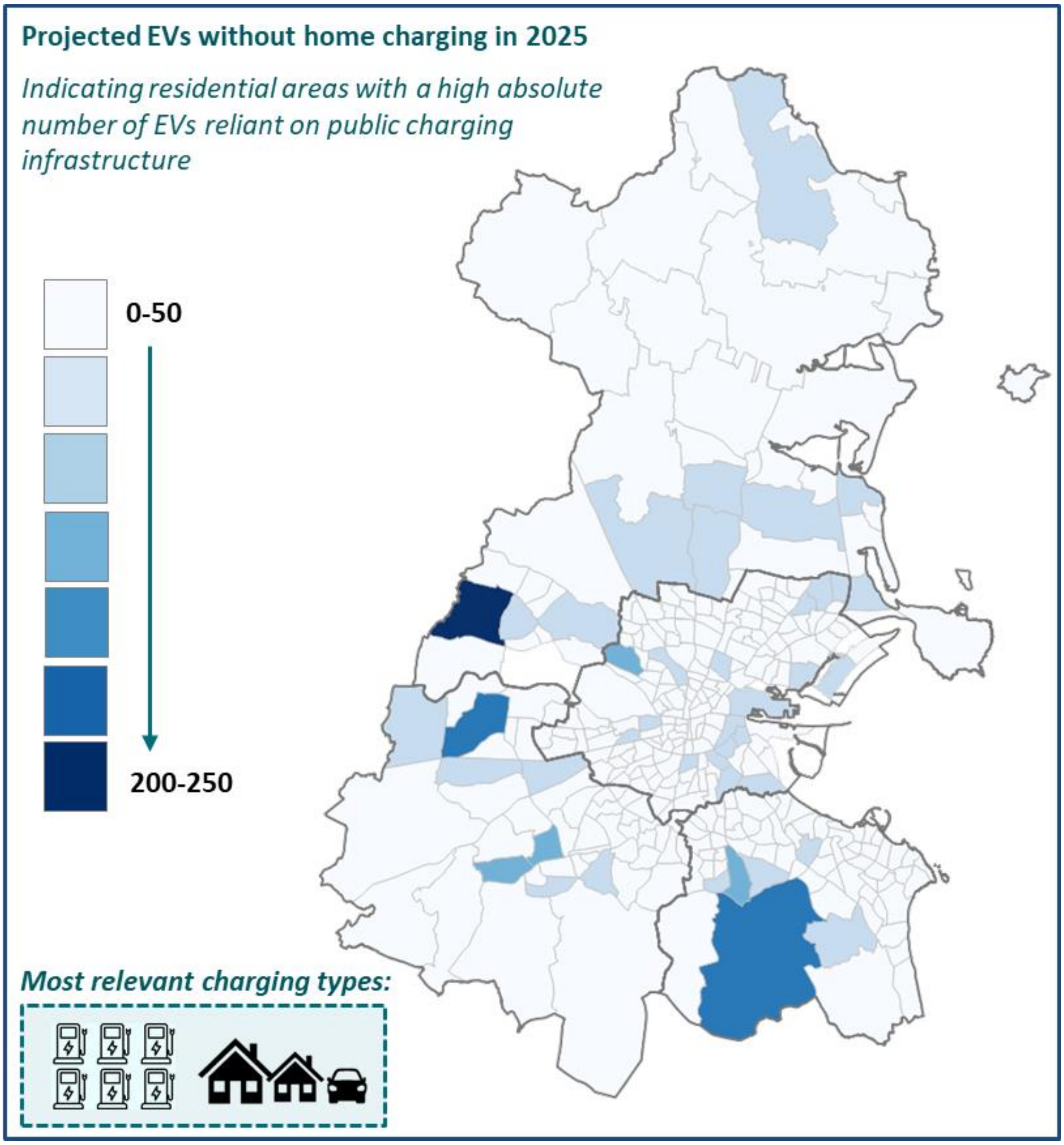


Figure 9: Projected number of EVs without access to home charging at ED level - Curtailed Medium

The map reveals a small number of residential areas that are expected to have particularly high volumes of EVs without off-street parking compared to the average. Blanchardstown in Fingal is in the ED with the highest predicted number of on-street EVs by 2025. This area has a private car fleet of ca. 16,000 vehicles based on the latest Census data, which is significantly higher than the ED average of ca. 2,000 for the Dublin region.

Other areas in EDs with significant projected on-street EV fleets are Glencullen in DLR and Lucan in South Dublin. Despite typically having a higher proportion of vehicles parked on-street, EDs in Dublin City tend to have smaller vehicle numbers and as a result fewer predicted EVs without off-street parking in absolute terms (an exception is Ashtown in West Dublin City).

It is important to note that this analysis is obviously impacted by the characteristics of each ED and its presentation at ED level. Appendix 6.1 6.1 contains the same analysis but presented as EVs without access to off-street parking per km^2. This allows for more like-for-like comparison between areas but is not included in the main deployment strategy because of limitations in the geographic component of the EV uptake analysis. SEAI data on current EV distribution could not be obtained and used in the modelling, so EVs are distributed based on the spread of *total vehicle stock* between EDs. This means the EVs without access to off-street parking per km^2 analysis is unlikely to accurately reflect hotspots of early EV adopters and patterns in uptake.

2.5.3 Target areas for deployment

In order to build a picture of which areas should be targetted for residential charging deployment, the findings from the above analyses are combined: rapid hub suitability, off-street parking availability, future on-street EV fleets.

The priority areas from each are highlighted and overlaid in Figure 10. It shows that many of the areas most suited to rapid charging also have either high / medium public charging reliance, or a significant future public charging demand. As would be expected, the majority of Dublin City is shown to be appropriate for targeting residential charging, in addition to particular clusters of urban areas Fingal, DLR and South Dublin.

It should be noted that while the analyses completed show the areas highlighted above to be good candidates for priority deployment, it will be important to consider other indicators of public charging need when deciding where to investigate further. This includes resident requests for public charge points and the geographic distribution of EV uptake.

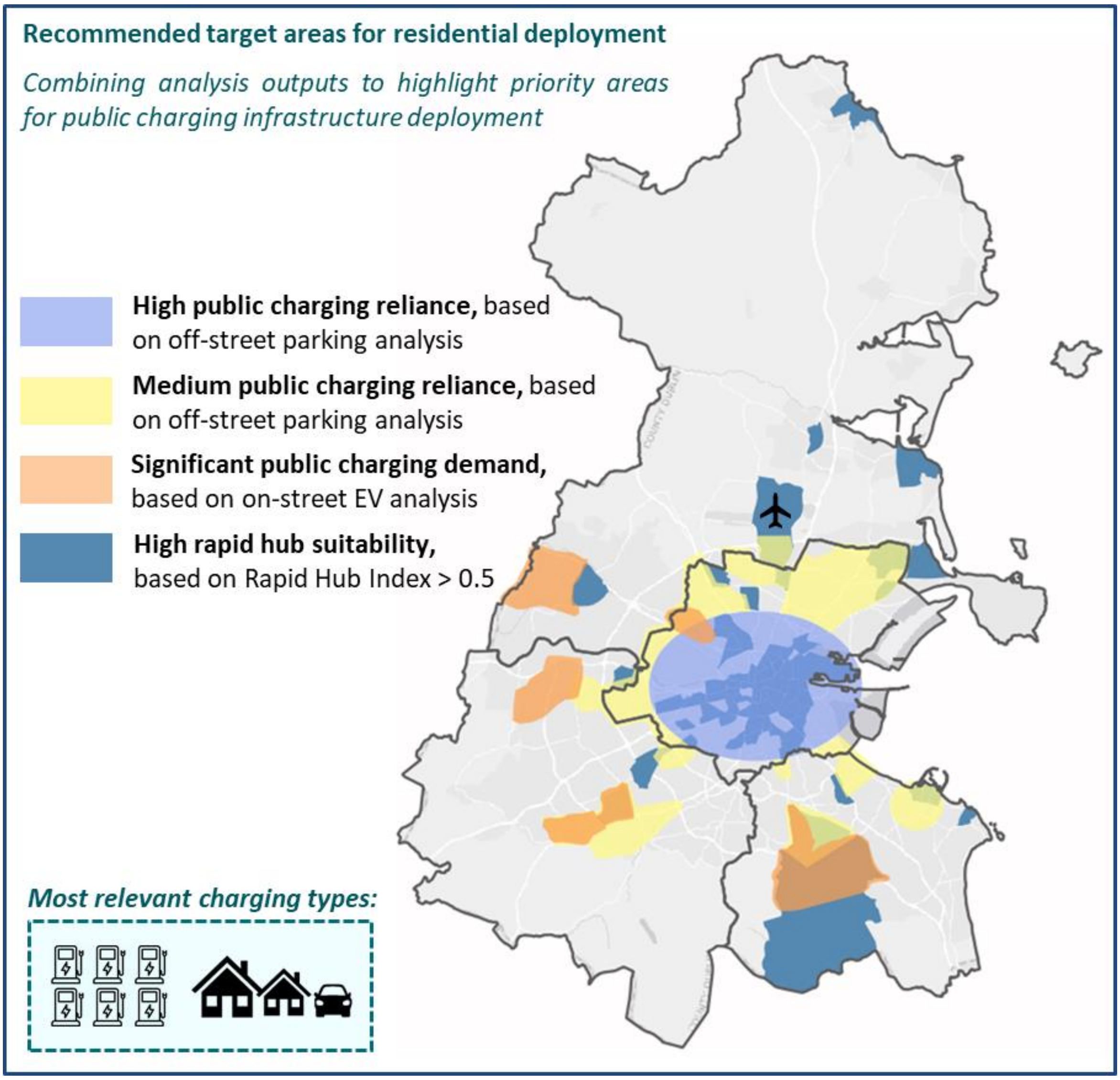


Figure 10: Map highlighting recommended target areas for residential charging deployment

2.6 Destination charging deployment

Slow destination charging can provide a useful source of “top up” charging and is particularly important for drivers who are unable to install an EVCP at home. The shift towards rapid destination charging will make these facilities increasingly attractive to EV owners as it allows them to become a primary source of charging.

The distribution of relevant car parks throughout the Dublin region has been analysed in order to highlight areas that appear most promising for destination charging. Figure 11 shows the results and compares the spread of potential sites to the target residential charging deployment areas identified in section 2.5.3.

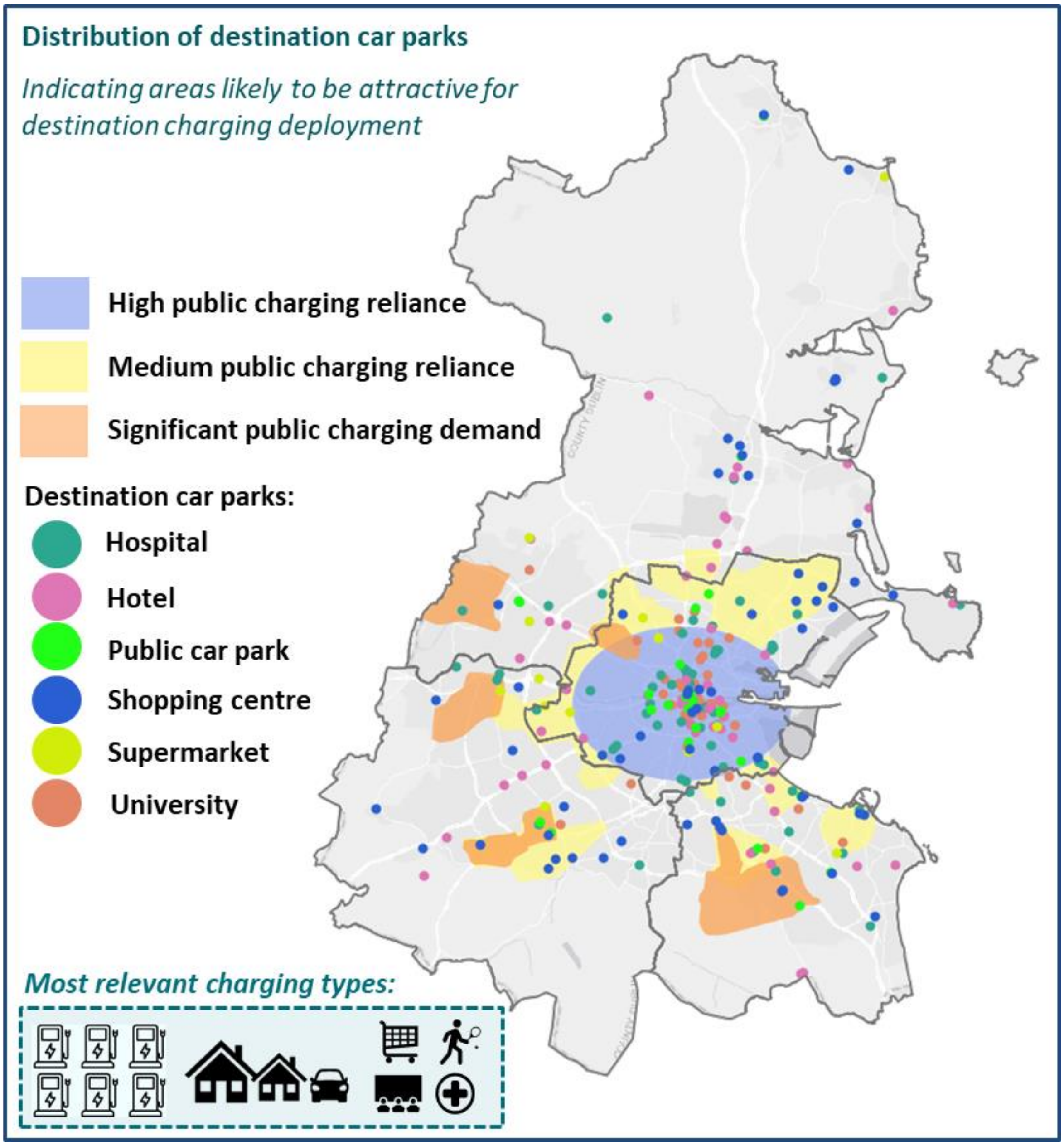


Figure 11: Distribution of destination car park sites throughout Dublin region[4]

The destination car park data is based on the OpenStreetMap database and comprises public car parks, supermarkets, shopping centres, hotels, hospitals and universities. It is important to note that the dataset is unlikely to be exhaustive but is nonetheless helpful in understanding the spread of relevant car parks across the four LAs.

Figure 11 shows that a significant share of the potential destination charging sites are aligned with areas that have been identified as suitable targets for residential charging. EVCPs installed at these locations could provide a crucial source of charging for local residents that lack home charging. In addition, the publicly owned car parks in these areas could represent “easy-win” installation opportunities due to being controlled by the Council. This can enable faster and more efficient deployment of chargers compared to on-street developments for example, where traffic regulations, consultations, pavement civils etc. can complicate the process.

[4] Nature of shopping centres may vary, e.g. large shopping centres, smaller clusters of shops etc.

The map above shows a large cluster of car parks towards the centre of Dublin City and particularly within the Canal Cordon. This area has significant space constraints which would make deployment of slow-fast neighbourhood charge points or the development of dedicated rapid charging hubs challenging compared to other parts of the region. As such, ensuring that car parks in this area are leveraged effectively will be an important aspect of building a comprehensive charging network. This will require the private sector to be active in installing EVCPs (e.g. at shopping centres, supermarkets etc.).

2.7 En-route charging deployment

There are two key types of en-route charging which have been considered in this strategy:

1. Charging along major roads and arterial routes – for enabling long journeys and travel between cities / regions.
2. Charging in urban areas with high traffic flow – for providing rapid top up charging for vehicles based / operating in city environments (e.g. taxis, residents in apartment blocks, car clubs)

Petrol forecourts represent one of the most promising location types for en-route charging due to their strategic positions along major roads, and those located at service stations are often preferable as a result of the space available. The distribution of forecourts was analysed and clusters of sites along the major road network identified. This is shown in Figure 12.

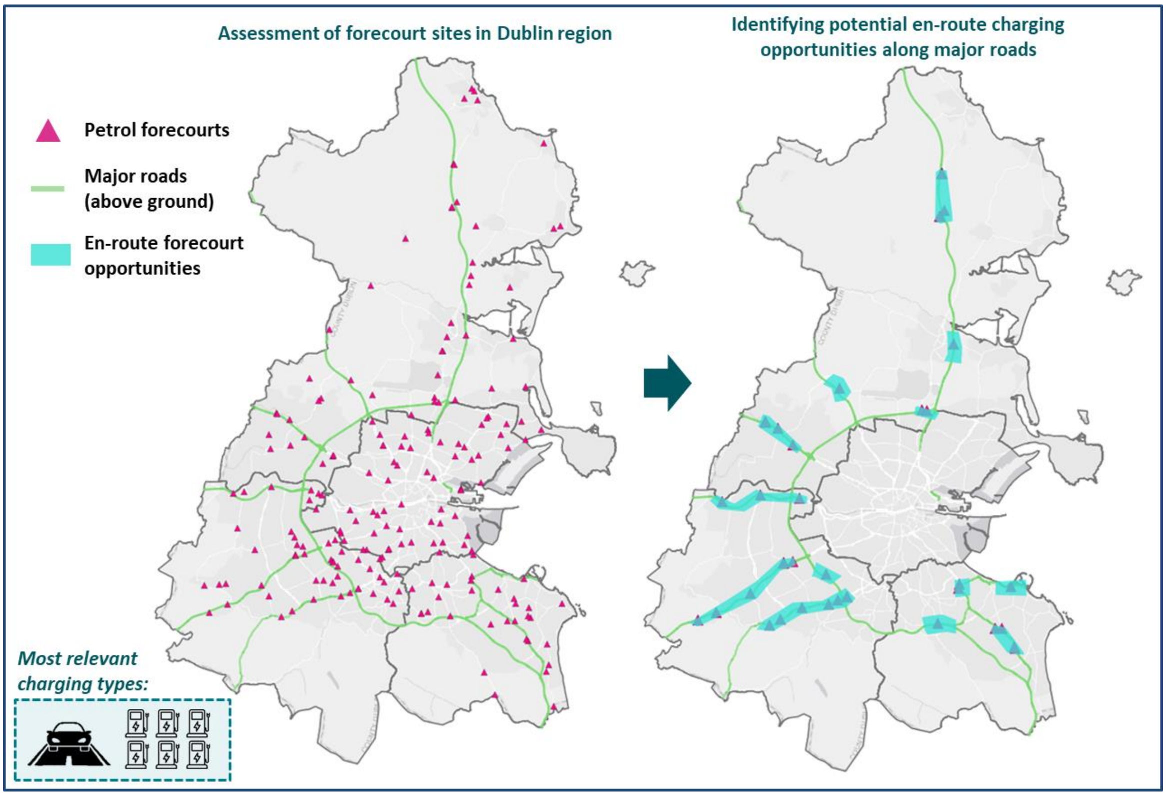


Figure 12: Map showing potential en-route charging opportunities along major roads

The petrol forecourts highlighted on the right-hand map are within 250m of a major road. These represent sites that would likely be suited to rapid EVCP hub deployment due to their proximity to high traffic volumes. Some of the sites already have EV charging infrastructure present, however given the projected increase in EV uptake, expansion of these charging facilities will be appropriate in the coming years.

In order to assess en-route charging opportunities in urban areas, detailed traffic flow data was analysed. The most comprehensive dataset available was from DCC's SCATS traffic management system. This comprised hourly traffic count data for Jan-Feb 2020 from ca. 12,400 detectors across 836 sites. Average daily traffic flow was calculated for each detector and then combined to give the total for each site. This was divided by the maximum from the dataset to give a standardised traffic flow score. Figure 13 shows the spread of SCATS sites and indicates their traffic flow as a percentage of the maximum (left), and then extracts the sites with high traffic flow (defined as 50% of the maximum and above) that may indicate particularly attractive locations for urban en-route charging (right).

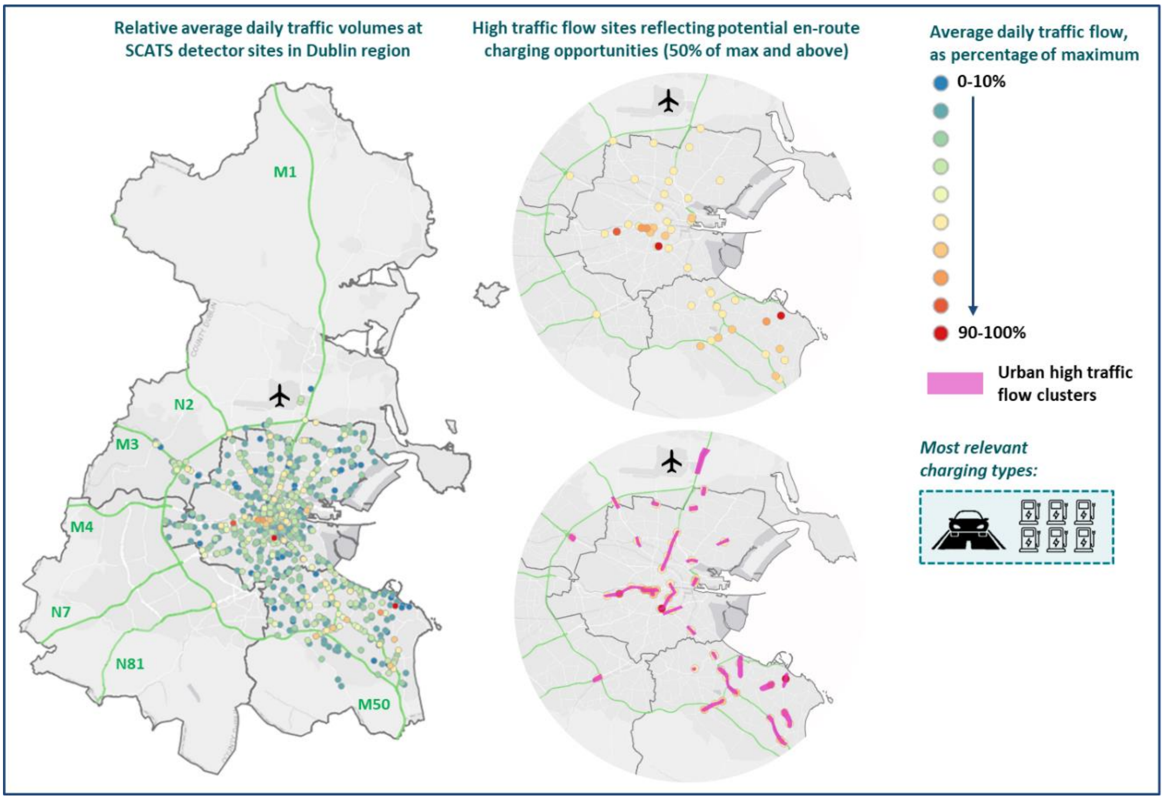


Figure 13: Assessment of potential urban rapid en-route charging opportunities

It should be noted that the maximum traffic volume identified was at a site next to the airport. The volume was such that it skewed results and was therefore removed for the standardisation process. It has however been recommended as a potentially attractive en-route charging opportunity.

The pink areas in Figure 13 represent stretches of road with significant traffic volumes. This indicates that a high demand for EV charging is likely to develop along these road segments as EV uptake grows in the coming years. As a result, these would be sensible areas in which to prioritise EVCP site identification.

Evidence from other cities such as London shows that rapid EVCPs located at strategic sites on busy urban roads can achieve impressive utilisation, even with current EV uptake levels. When assessing potential sites in the areas highlighted above, it will be important to also consider additional factors that indicate significant future demand and commercial viability, as per the list in section 2.4 (e.g. grid costs, taxi ranks, car clubs, amenities).

2.8 Aggregating demand across user groups

A crucial consideration for deploying rapid charging infrastructure, particularly while EV uptake is in its early stages, is aggregating demand across user groups. This will ensure utilisation is maximised and that there is a suitable return on the investment.

Taxis and car clubs are shown to be key EV user groups. They are both compatible with necessary transport trends away from private car ownership and towards shared car usage. Moreover, as high milage vehicles the fuel cost savings associated with EVs compared to diesel / petrol equivalents can deliver significant total cost of ownership (TCO) savings over the vehicle lifetime, making them suited to early electrification.

The sections above identified areas likely to have high future charging needs based on resident's access to private parking, projected EV uptake and traffic flow. By comparing these with the distribution of taxi ranks and designated car club locations throughout Dublin region, it is possible to start identifying areas that may develop EV charging demand from multiple user types. This analysis is shown in Figure 14.

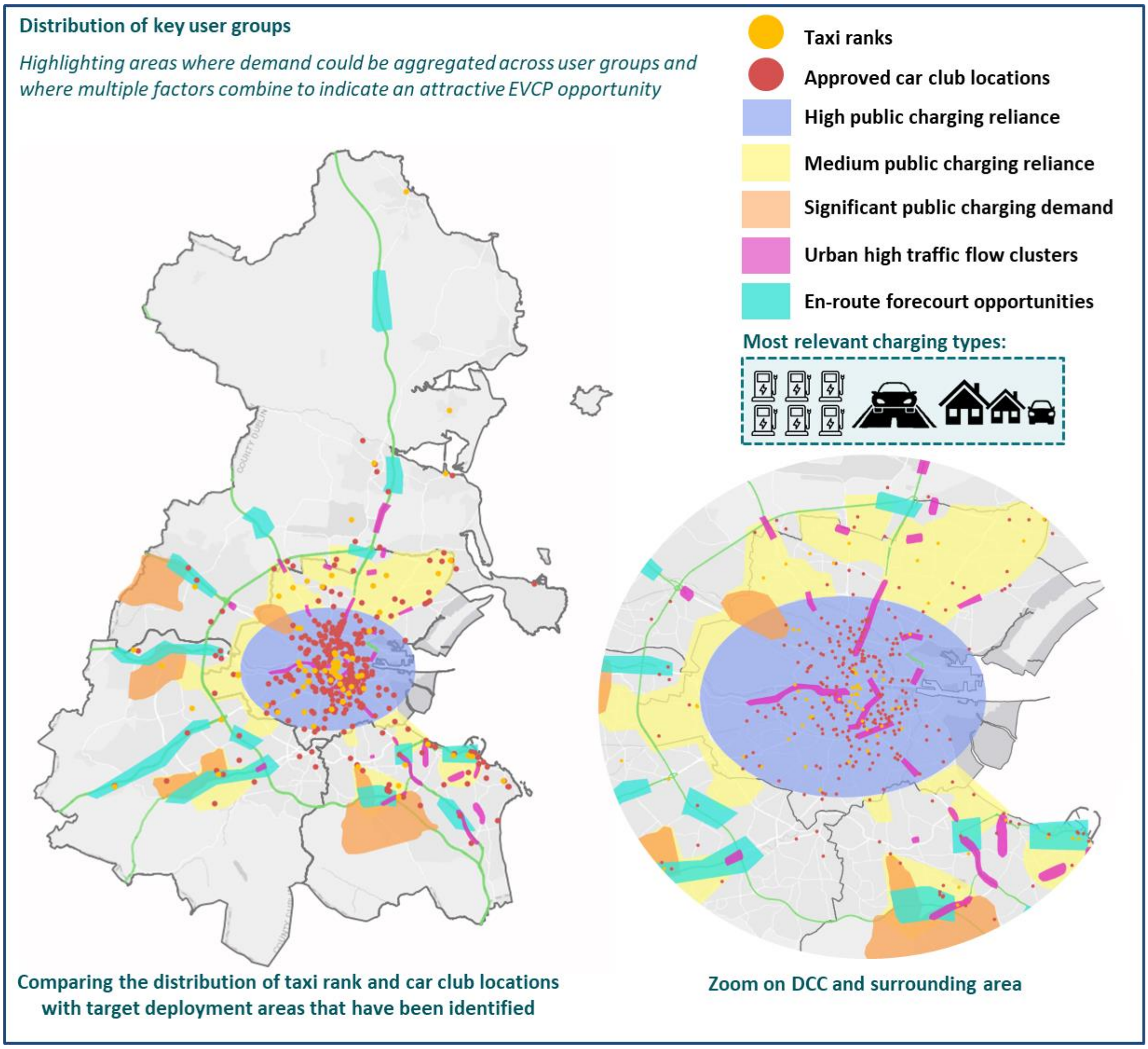


Figure 14: Map comparing the distribution of taxis and car clubs with target deployment areas to assess where demand can be aggregated across user groups (Taxi ranks based on OpenStreetMap, car clubs based on Go Gar data)

The map above shows that in general, taxi ranks and car club locations are within priority deployment areas. Unsurprisingly, there is a high concentration of sites towards the centre of Dublin City, where there is expected to be high public charging reliance due to low private parking availability. Furthermore, many clusters of the taxi ranks and car club locations in this area are near to the urban high traffic flow sites. The combination of these factors points to significant future charging demand and makes these regions suitable for early EVCP site identification work.

Figure 14 also shows clusters of taxi ranks and car club sites in DLR (surrounding the harbour and running up the coast from it) which overlap with high traffic flow areas, medium charging reliance areas and also en-route forecourt opportunities. This suggests that EVCPs deployed at these petrol forecourt sites would be well placed to aggregate demand and it may therefore be an attractive proposition for the private sector.

An emphasis on taxi-focussed EV charging has already been observed in Ireland, with the Department for Transport, Tourism & Sport (DTTAS) planning to invest ca. €1.5m to install taxi-dedicated EV chargers at key transport hubs. This is due to include strategic locations such as airports and major train stations. This is a promising example of deploying EV charging infrastructure in line with the needs of key user groups.

2.9 Overarching deployment approach

The findings from the sections above are combined and the priority / target deployment areas overlaid in order to generate an overarching recommended deployment approach for Dublin region, which is shown in Figure 15.

This figure shows that in the short- to mid-term, residential deployment should be focussed in the areas with the highest reliance on public charging and the most significant public charging demand (based on projected on-street EVs). A key part of this in the early stages should be assessing destination charging opportunities with a particular focus on publicly owned sites that offer “easy wins”. These may provide a way of relatively quickly installing EVCPs in areas with the most pressing need. See section 2.4 for a series of suitable metrics to consider in such an assessment.

Moreover, the short- to mid-term period should be used to further investigate the potential for rapid hub deployment in the areas shown to be most suitable by the Rapid Hub Index. It would be sensible to target this work in the areas which also contain urban high traffic flow clusters (purple areas). Many of these lie in the highest priority residential charging areas and strategically located rapid EVCPs could serve residents without off-street parking as well as other motorists using these key urban roads.

Beyond 2025 it is recommended that the residential charging deployment expands to the areas classified as having medium public charging reliance. This will ensure that as EV uptake grows, the residents lacking private parking continue to be provided with charging infrastructure.

It is recommended that the mid-long term period should also be used to develop the en-route charging provision along major roads and arterial routes, with a push where possible to encourage the private sector to install rapid EVCP hubs at petrol forecourts.

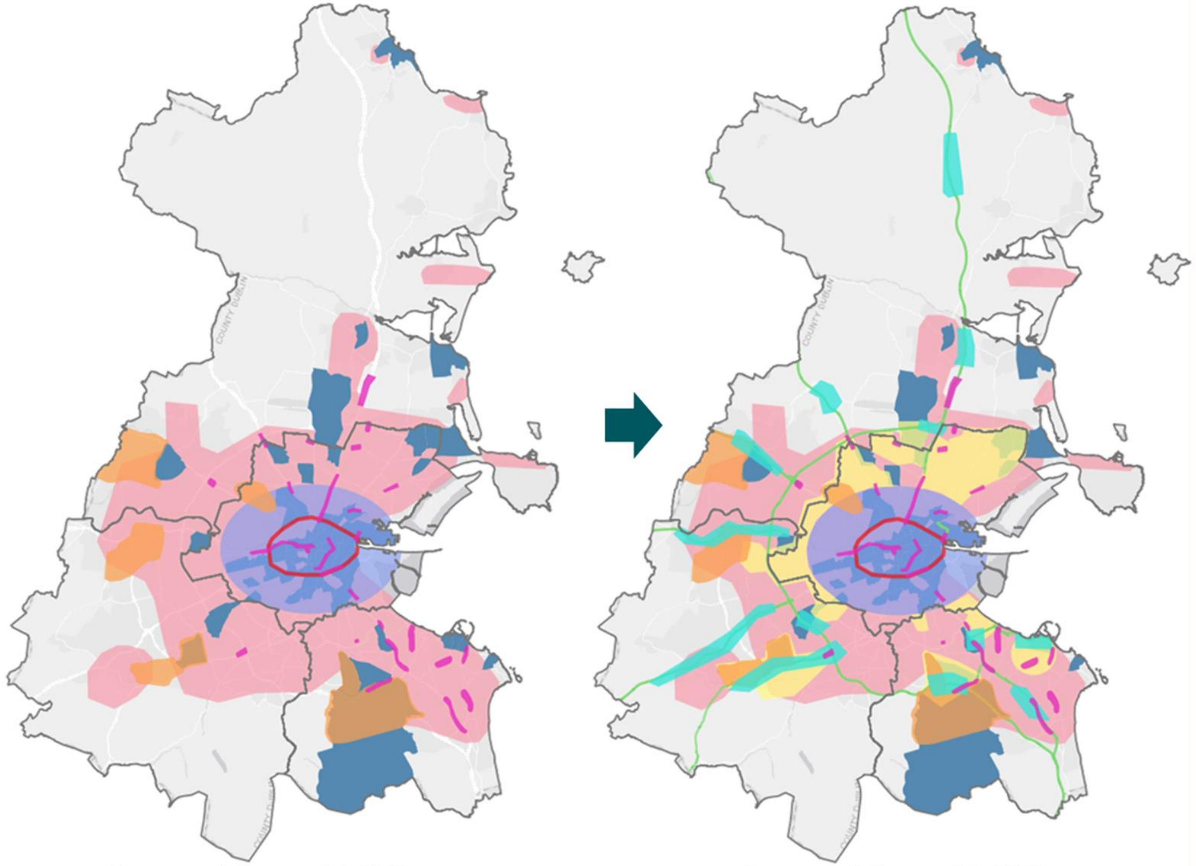
Throughout the period to 2030 it will be important to continually assess the “low hanging fruit” opportunities presented by public land. This includes both car parks attached to public buildings and greenfield / brownfield publicly owned parcels of land which may be suitable for rapid hub development.

An early stage assessment of public land availability is presented in the next section. Furthermore, a detailed deployment approach timeline is found in the Section 5 - EV charging strategy delivery.

Note that the deployment strategy map specific to each LA is provided in Appendix 6.2.

Overarching recommended deployment approach for Dublin region to 2030

Showing the areas recommended for priority / targeted deployment and indicating what types of charging are most suited to different parts of the region. Split into short-mid term deployment (to 2025) and mid-long term deployment (to 2030)



Definition	Key user groups
Rapid hub charging for multiple user groups within Canal Cordon	Residents without private parking, taxis, car clubs, commuters
High public charging reliance – rapid hub charging recommended	Residents without private parking, taxis, car clubs, commuters
High absolute public charging demand	Residents without private parking
Priority areas for rapid en-route charging assessment	Residents without private parking, taxis, car clubs, commuters
Rapid hub deployment potential to be investigated	Residents without private parking, taxis, car clubs, commuters
Destination charging opportunities	Residents without private parking
Medium public charging reliance	Residents without private parking
Rapid en-route charging along major roads and arterial routes	Taxis, car clubs, commuters
Potential rapid en-route charging forecourts site opportunities	Taxis, car clubs, commuters
Not a priority deployment area – analysis shows high share of residents have access to off-street parking hence would be able to charge at home	

Figure 15: Overarching recommended deployment approach for the Dublin region

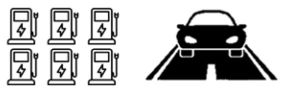
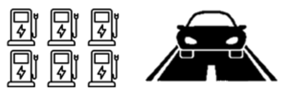
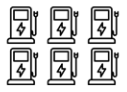
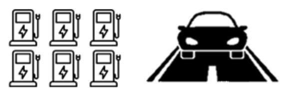
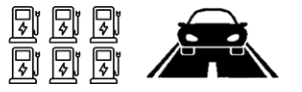
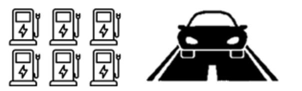
Definition	Explanation	Key user groups	Most relevant charging types
Rapid hub charging for multiple user groups within Canal Cordon	The city centre has very limited space and significant competition for the space that is available. It is well suited to rapid hub deployment (see Rapid Hub Index results) and there is a high volume of car parks (private + public) that could be leveraged.	Residents without private parking, taxis, car clubs, commuters	
High public charging reliance – rapid hub charging recommended	Clusters with the highest proportion of residents without access to off-street parking (20%-80%) and generally good suitability for rapid hubs. There are also multiple additional user groups (taxis + car clubs) for demand aggregation.	Residents without private parking, taxis, car clubs, commuters	
High absolute public charging demand	Residential areas with particularly large car fleets and as such high estimated charging demand. A systematic approach should be used to decide on the residential charging technology for each area (neighbourhood charging or rapid hubs).	Residents without private parking	
Priority areas for rapid en-route feasibility assessment	Clusters of sites with particularly high traffic flow (at least 50% of the maximum measured). These represent priority sites to investigate for urban rapid en-route charging deployment – alignment with other target areas should be considered.	Residents without private parking, taxis, car clubs, commuters	
Rapid hub deployment potential to be investigated	Areas that score well in the Rapid Hub Index test (0.5 and above) and are expected to have good rapid charging suitability. Some are in areas of high public charging reliance, making them good candidates for early-stage assessments.	Residents without private parking, taxis, car clubs, commuters	
Destination charging opportunities	Clusters of destination car parks which will potentially make suitable sites for both slow / fast and rapid charging. There may be good opportunities for easy win deployments in the short term, to help meet needs of residents.	Residents without private parking	
Medium public charging reliance	Relatively high proportion of residents without access to home charging (20%-40%). Contains a mix of areas with high and low rapid hub suitability. A systematic approach should be used to decide on residential charging technology for each area.	Residents without private parking	
Rapid en-route charging along major roads and arterial routes	These major roads have generally high traffic flow and are suited to rapid en-route charging. Site availability along these routes should be assessed, including private (see below) and public land.	Taxis, car clubs, commuters	
Potential rapid en-route forecourts site opportunities	Clusters of service stations and petrol station forecourts along major roads and arterial routes which could present high quality rapid charging sites.	Taxis, car clubs, commuters	

Figure 16: Explanation of overarching deployment approach

2.10 Initial assessment of public land opportunities

As mentioned in the section above, the strategic and timely rollout of charging infrastructure will benefit from the effective use of car parks over which public bodies have control or influence. This allows the Council to have more control of deployment, can avoid the landlord / management company negotiations involved with private site developments and avoids some of the complications associated with on-street EVCP installation (pavement civils, traffic orders, road closures).

Figure 17 provides an initial view of the availability and distribution of car parks linked to public body operations. This comprises train and tram (Luas) stations, and buildings (with car parks) that fall into four official categories: transportation & storage, education, health & social care, and arts, entertainment & recreation[5]. It should be noted that not all train and tram stations will have car parks however close inspection of the dataset shows that a large majority do. Moreover, some of the sites shown may not be controlled by public bodies.

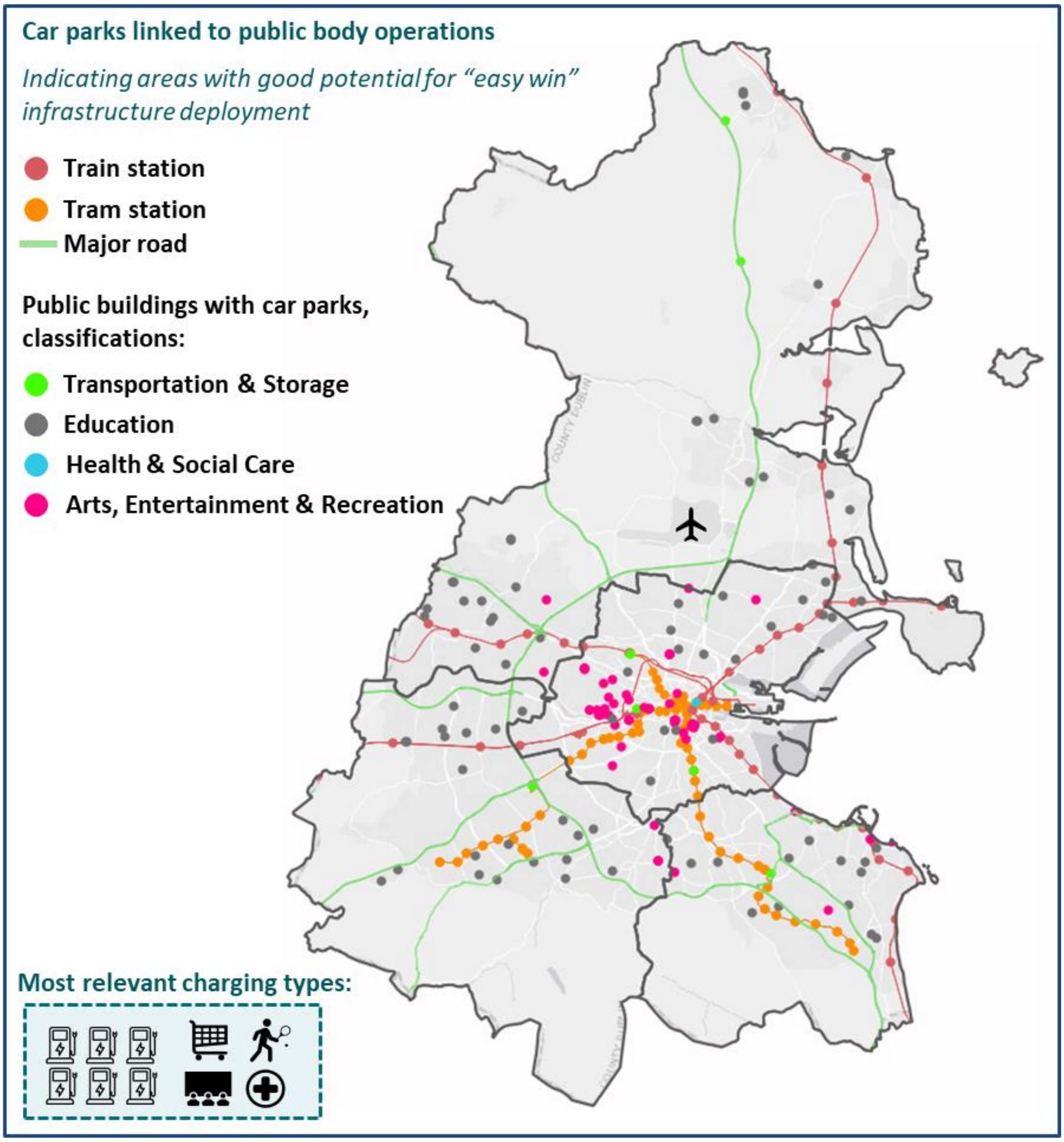


Figure 17: Map showing car parks linked to public bodies that may represent suitable easy win deployment opportunities

[5] Train and tram stations based on OpenStreetMap database. Public building data from the State Property Register for County Dublin

The map above shows a significant volume of publicly owned car parks in residential areas throughout Dublin. The dataset presented is not exhaustive, and as such there will be additional car parks to those presented. While not all of the sites shown will be appropriate for EVCP deployment, strategic assessment of these opportunities to determine which would be most suited to development would be a valuable exercise.

In particular, public transport stations can be attractive for EVCP installation, partly due the typical dwell time of the vehicles and the alignment with commuter / visitor journey habits. In London, train stations are now also being used for rapid hub deployment (e.g. Engenie hub in Stratford). Figure 17 shows a high density of train and tram stations in some urban areas of Dublin region. It would be worth investigating these in the context of rapid charging hubs.

In the mid-long term, as EV uptake becomes more widespread and demand increases, dedicated rapid charging hubs are likely to be an important component of a comprehensive charging network. Rapid hubs are a key aspect of the approach taken in Dundee and London for example, and offer a number of key benefits which are discussed in Section 2.3. Hubs can be located in existing car parks, or as is being investigated in London, built on Council owned brownfield or greenfield land.

The latter approach is more challenging, as it involves identifying suitable parcels of land that meet a range of criteria (grid, accessibility, size, charging demand etc.) and a full site development which has cost and time implications. However, if suitable sites can be located and approved for rapid charging hubs, then these can be a commercially viable option which offer significant charging provision.

As an initial site availability exercise, land classified as “undefined” in the County Dublin State Property Register has been assessed. Inspection of this dataset found that the majority of these sites appear to currently be undeveloped. The spread of these sites is shown in Figure 18, in addition to petrol forecourts, which may also represent potential hub opportunities in the future.

It should be noted that the public land dataset presented may not be exhaustive. In addition, the points shown are not presented as recommended sites for rapid hub deployment, but rather an initial set of options that may be worth investigating further. The main purpose of the map is to demonstrate that there appears to be a reasonable spread of potentially undeveloped publicly owned land sites throughout large parts of the region.

As would be expected, there are limited public land sites in the space constrained Dublin City. However, almost 10 sites were identified in the LA. Further assessment of these would be needed to determine the potential for development.

The map also indicates a significant volume of public land sites in more rural areas of Fingal, some of which lie close to the major road network. These could represent opportunities for en-route rapid charging hubs. However, their proximity to forecourts and service stations could make development of these public site less desirable. The dataset shows fewer public land sites in DLR and South Dublin, although there appears to be a number of forecourt sites in their residential areas. As such, leveraging private land may be a more suitable focus of the rapid hub strategy for these LAs.

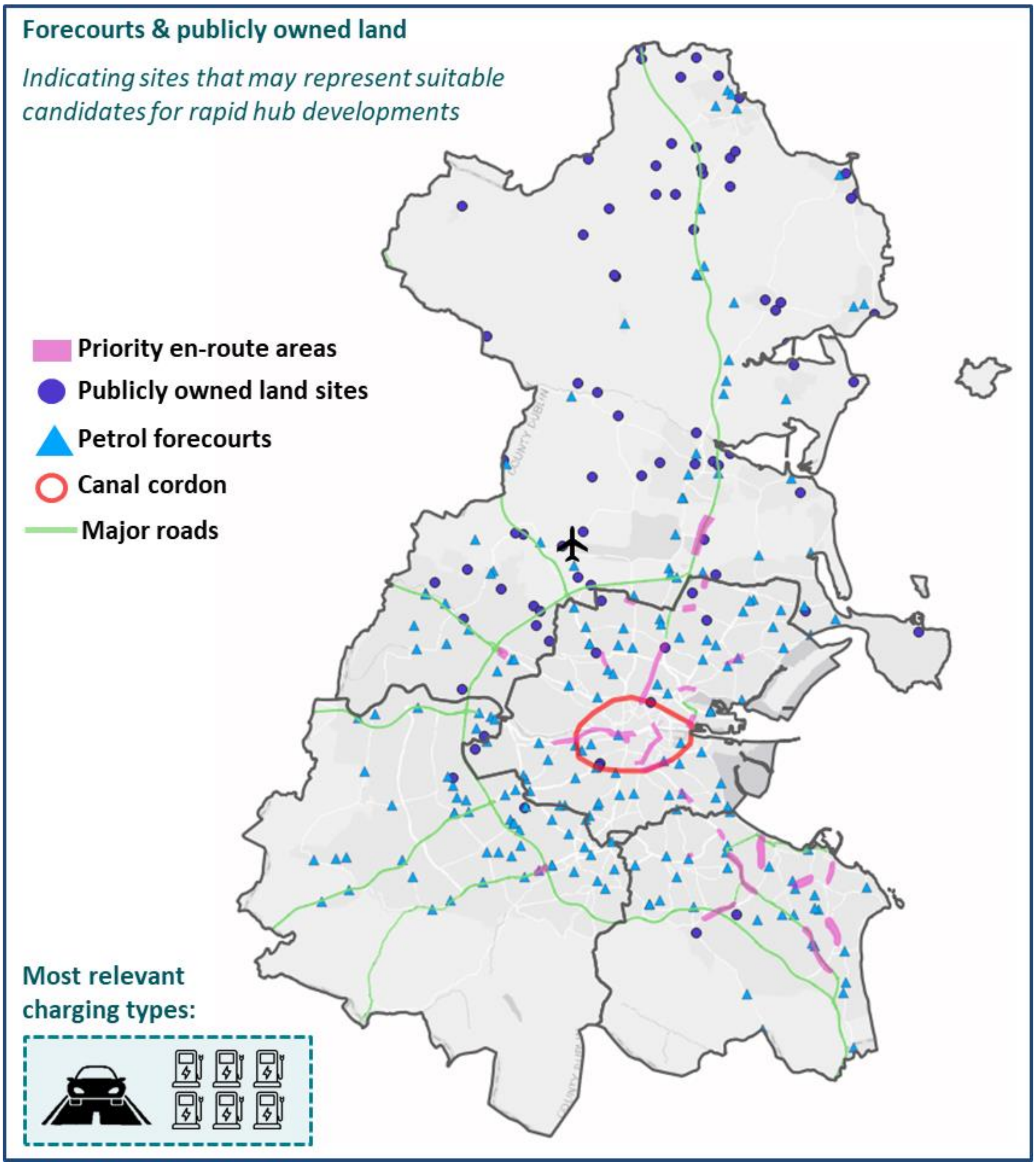


Figure 18: Map showing petrol forecourts and publicly owned land sites, which may suit investigation for rapid hub deployment

2.11 Alignment with wider mobility trends and ambitions

The siting of charging infrastructure in the Dublin region and overall deployment approach should align with and complement wider modal shift plans. This includes the transition away from private cars to more sustainable methods such as shared cars, active travel (cycling and walking), public transport and e-scooters, etc. It also includes delivery and logistics operations switching to decarbonised last mile delivery solutions such as cargo bikes and e-cargo bikes where adequate, a general move to more pedestrianised urban spaces, and upcoming public transport developments such as Bus Connect.

One way that the proposed EV charging strategy aligns with these aims is the prioritisation of rapid charging, as opposed to slow-fast neighbourhood charging. If residents are provided with slow charge points near their homes for overnight charging, it is expected this would make them less likely to give up their private car and switch to other means of travel. Rapid charging on the other hand offers a quick “Charge & Go” model which is suited to more sustainable types of EV usage such as taxis and car clubs.

Figure 19: Car park rapid charging hub (Source: EVClicks)

It is recommended that EV charging deployment is coordinated in a way that considers the rollout of other e-mobility technologies such as e-scooters and e-bikes. One way this could be done is the development of “e-mobility hubs”, where EVs can be charged, and e-scooters / e-bikes rented. It should be noted that privately owned e-scooters and e-bikes would be charged at the owner’s home (removable batteries charged inside), while the charging requirements of publicly accessible e-scooters and e-bikes was outside the scope of this study. The option of co-locating rapid charging with the Park & Ride facilities proposed as part of the Bus Connect scheme should also be investigated.

EV charging rollout should also align with wider public realm developments, such as car park closures and general reductions in parking spaces. This is particularly relevant in Dublin City where the Council has made a significant effort in recent years to reduce the number people commuting into the city by car, while driving up usage of the tram and train services. A key part of this strategy has been restricting the availability of parking. The share of journeys travelling into DCC’s canal cordon by car has reduced from ca. 40% in 2010 to ca. 27% in 2019, while the public transport share has increased by around 8% to 53% and walking and cycling combined have increase from ca. 12% to ca. 17%[6]. It is imperative that charging infrastructure is deployed in a way that supports this modal shift rather than hinders it. This is why, for example, it is recommended that EVCPs are located based on the premise of aggregating demand across user groups such as taxis and car clubs, and within the Canal Cordon it is explicitly recommended that slow-fast neighbourhood charging is avoided.

It should be noted that the EV and EVCP stock modelling shown in the next section reflects the need for alignment with modal shift by factoring a reduction in private vehicle ownership trends into the modelling. This is explained in more detail in section 3.1.2.

[6] NTA, Canal Cordon Report, 2019

3 Public charging infrastructure requirement

This section assesses the volume of EVCPs required to drive and support EV uptake in the Dublin region out to 2030. The forecasted number of charge points required annually, combined with the geographic deployment component covered earlier, will provide a comprehensive view of what infrastructure is needed, how much, and where.

When viewing the EV charging infrastructure requirement in this section and associated business case in the following section, it is important to consider the following definitions:

- **EV charger or device =** a standalone charging unit, which may have more than one charging connector / EVCP

- **EVCP** = an individual charge point connector plus associated parking bay. A device with 2 EVCPs could charge 2 cars simultaneously.

For the purposes of this strategy, it is assumed that:

- **Lamppost chargers** have 1 connector and comprise 1 EVCP
- **Slow EV chargers** have 2 connectors and comprise 2 EVCPs
- **Fast EV chargers** have 2 connectors and comprise 2 EVCPs
- **Rapid EV chargers** have different connector types but comprise 1 EVCP

It is crucial to consider that different types of EVCPs will serve a different number of EVs. Based on the detailed EV and EVCP stock modelling presented in this section, if only **slow** neighbourhood **EVCPs** were deployed to meet residential demand there would be **ca. 4 EVs per EVCP**, whereas if only **rapid hub EVCPs** were deployed to meet residential demand there would be **ca. 70 EVs per EVCP**[7].

3.1 Projected EV uptake & charging demand

In order to determine the charging infrastructure requirement, it is first necessary to find out how many EVs it will need to support, and to then assess the charging demand associated with this fleet. The following subsections outline this process and present the results for Dublin region.

3.1.1 Summary of scope & modelling approach

This strategy is designed to account for the charging needs of electric cars, taxis, vans and two-wheelers (mopeds and motorcycles) in the Dublin region out to 2030. The diagram in Figure 20 outlines the key stock modelling and energy demand forecasting steps that were taken.

The methodology takes the current vehicle stock breakdown in Dublin regions as a starting point, models the turnover of stock each year and applies EV sales assumptions (explained in more detail next) to determine the annual stock composition. For each year, the charging energy demand is derived for the calculated EV fleet (broken down by segment and EV powertrain) based on energy consumption projections and age-dependent mileage assumptions.

[7] 70 EV per EVCP relates only to the residential charging case and EVs without off-street parking. By 2030, the overall EV per rapid EVCP across charging segments is higher at ca. 200.

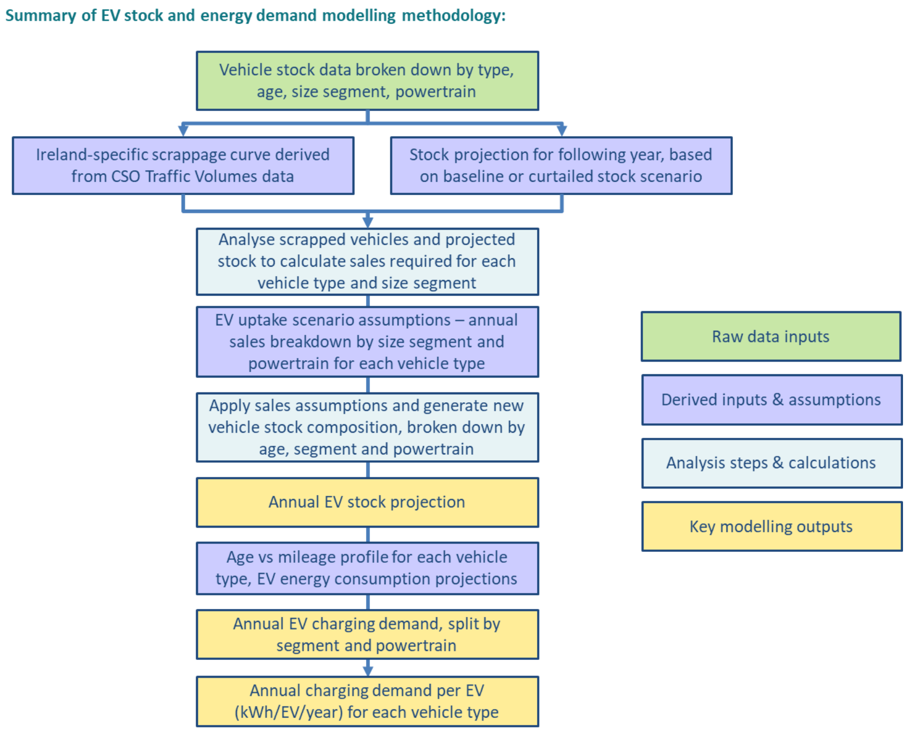


Figure 20: Summary of EV stock and energy demand modelling methodology

3.1.2 Vehicle stock projection scenarios

A crucial part of the stock modelling process shown above is calculating the annual new vehicle sales. This is done based on the volume of vehicles scrapped in a year, and the target total stock size for the following year. In the development of this strategy, two stock size projections were modelled: Baseline and Curtailed.

Historically the number of vehicles registered in the Dublin has grown with population. However, in order to achieve the level and pace of decarbonisation required to meet net zero targets, a reduction in car ownership and usage is required in combination with the transition to EVs. As a result, the link between population growth and vehicle stock size must be broken in order to facilitate this modal shift. This is reflected in the Curtailed stock scenario.

To develop the stock projections, the correlation for each vehicle type between population and registered vehicles in the Dublin was analysed based on 2013-2018 CSO data, and future stock numbers assessed based on CSO population growth projections (average case used). The two stock projection scenarios are summarised below and resultant vehicle stock numbers out to 2030 shown in Figure 21.

Note that the taxi stock in Dublin was shown to level off between 2017-2018 and has been left constant out to 2030. Furthermore, to incorporate the impacts of COVID-19, stock size is held constant in 2021 and 2022 to reflect a reduction in sales. The longer term and exact impacts of COVID-19 on the car market are difficult to predict, however the approach taken ensures that short-term effects are considered.

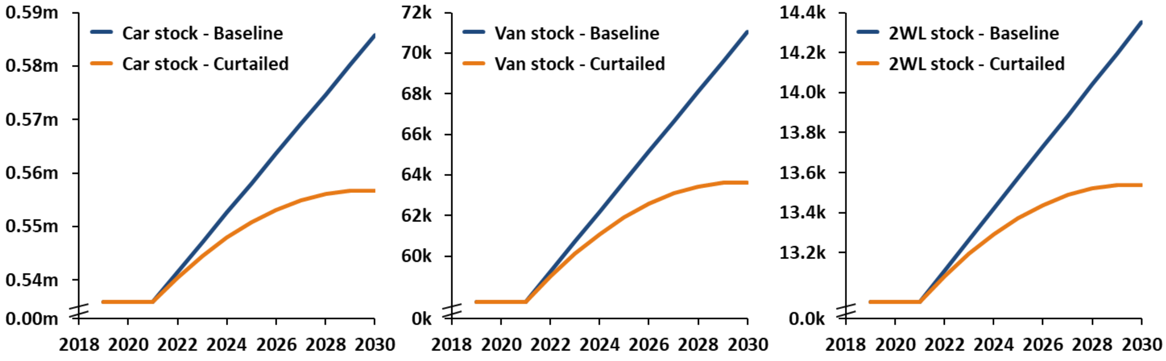


Figure 21: Vehicle stock projection scenarios for cars, vans, and 2-wheelers

- **Baseline stock projection:** business as usual case, stock increases according to correlation between stock size and population observed between 2013-2018 for each vehicle type, and the CSO population growth estimate out to 2030

- **Curtailed stock projection:** the link between population growth and vehicle stock is gradually broken, reflecting a reduction in private vehicle ownership trends (cars, 2-wheelers), with a shift towards public transport, shared vehicles, cycling and walking. The pre-COVID 2020 annual percentage stock increase is reduced year on year, until in 2030 there is no annual increase in vehicle stock

In the Curtailed stock scenario, the 2030 stock is reduced by ca. 5%, 11% and 6% compared to the Baseline case for cars, vans, and 2-wheelers respectively. This reflects a relatively moderate change, however given that there are no official stock reduction targets in ROI is viewed to be a suitable level of modal shift to include in this study. The Curtailed stock projection scenario is the central case used in this report, due to the importance of modal shift away from private cars.

3.1.3 EV uptake scenarios

A key aspect of the EV stock projections is developing and applying suitable uptake scenarios. These comprise an assumed percentage of annual sales which will be made up by EVs for each vehicle type and segment, split by BEV and PHEV (where appropriate).

For this strategy piece, two EV uptake scenarios were investigated: CAP Ambition & Medium. At a high level, the basis of CAP Ambition is that it achieves Dublin region's estimated share of the Climate Action Plan target of Ireland having 950,000 EVs on the road by 2030. This scenario represents a challenging growth in sales out to 2030 but may be achievable with significant Government backing, private investment, and public engagement. The Medium scenario is designed to be a more conservative, but one which would still be ambitious. It is broadly based on the sales growth seen in some world leading countries (Norway, Sweden, Iceland).

The Medium scenario will be the central uptake case presented in this strategy, but results associated with the CAP Ambition scenario will also be included to provide an upper bound view of EV market growth and EV charging infrastructure requirements.

Figure 22 shows the EV uptake scenarios for each vehicle type (taxis are assumed to be the same as cars). Note that the uptake scenarios show sales percentages for total EVs, comprising BEVs and PHEVs. A detailed breakdown of the assumed sales shares by powertrain for each vehicle is found in Appendix 6.3 .

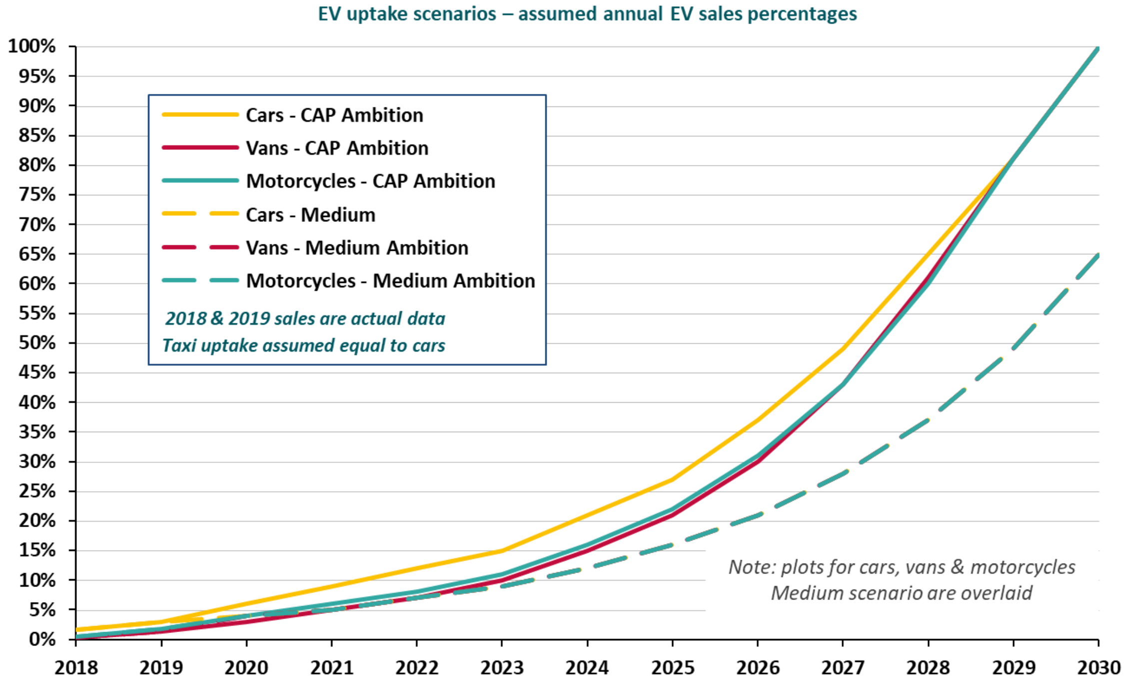


Figure 22: EV uptake scenarios - assumed annual EV sales percentages

The following table provides further explanation of the underlying uptake assumptions as well as the market share and EV stock associated with each scenario in 2025 and 2030.

Table 2: EV uptake scenarios

EV uptake scenario	Vehicle type	Market share 2025	Market share 2030	EV stock 2025	EV stock 2030	Scenario explanation
CAP Ambition (Curtailed)	Cars	27%	100%	53k	196k	• 100% of sales in 2030 are EVs, in line with the CAP target • Dublin County accounts for ca. 25% of Ireland's vehicle stock[1] - based on this it was assumed the region's share of the CAP 2030 EV target is ca. 241k • When split based on current stock breakdown, this relates to 218k electric cars + taxis, and 23k electric vans • The CAP Ambition scenario meets both stock targets, when Baseline stock growth is assumed. Under the Curtailed case shown opposite, where a reduction in private car use is assumed, the 2030 EV stock is slightly lower (as expected) • Vans / motorcycle sales lag cars to reflect less mature markets and lower public awareness – their gap in market vs cars gradually closes out to 2030
	Vans	21%	100%	3k	18k	
	Taxis	27%	100%	1k	4k	
	2WL	22%	100%	1k	4k	
Medium (Curtailed)	Cars	16%	65%	34k	120k	• EV sales do not reach the 100% CAP target by 2030, but do achieve strong market growth in the period considered • EV car sales grow based on trends seen in leading countries (Norway, Sweden, Iceland) when they were at similar stage to Ireland is now (ca. 3% sales) • Vans and motorcycles sales share remains in line with cars out to 2030 – assumed achievable due to the lower absolute sales vs CAP Ambition, meaning that supply constraints have less of an impact
	Vans	16%	65%	3k	12k	
	Taxis	16%	65%	0.5k	2k	
	2WL	16%	65%	1k	3k	

It should be noted that in the modelling, sales do not reach exactly 100% in CAP Ambition. This is because the stock model assumes that the lower bound targets for hydrogen fuel cell electric vehicle deployment, based on Hydrogen Mobility Ireland, are achieved between now and 2030. As a result, in 2030 plug-in cars actually make up 98% of sales, but for simplicity this will be referred to as 100% EV sales in this strategy document.

3.1.4 EV stock projections

Dublin region EV stock projections are calculated based on the methodology outlined in Figure 20, the Curtailed stock projection described in Section 3.1.2 and the uptake assumptions detailed in the section above. These are presented for both the Medium and CAP Ambition case below.

EV stock growth – Curtailed Medium uptake scenario

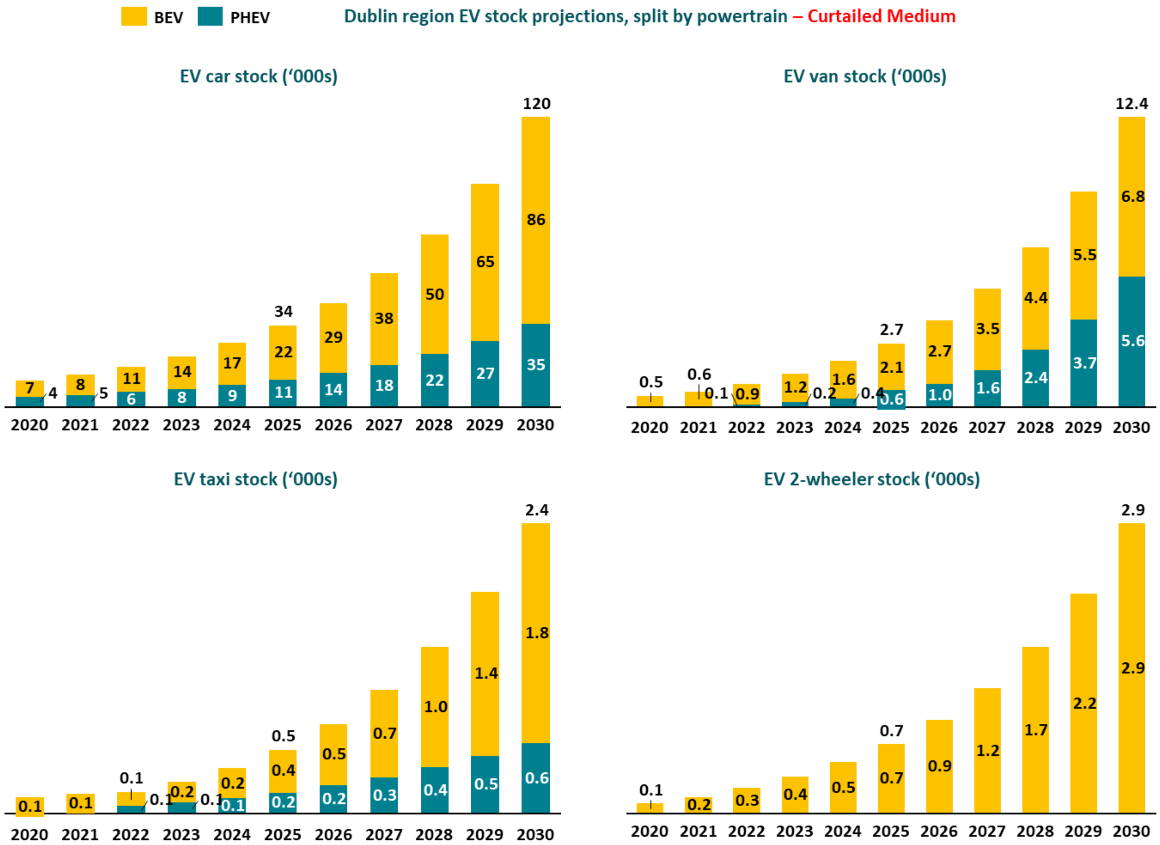


Figure 23: Dublin region EV stock projection split by vehicle type, based on Curtailed Medium uptake scenario

It is important to highlight that of the 138k EVs projected to be registered in the Dublin region in 2030, modelling suggests that ca. 104k will have access to home charging and will only use public EVCPs as a supplementary source of charging, **while ca. 34k will rely on public charging.**

Figure 24 shows how the overall Dublin region stock composition is projected to evolve based on the EV uptake presented above.

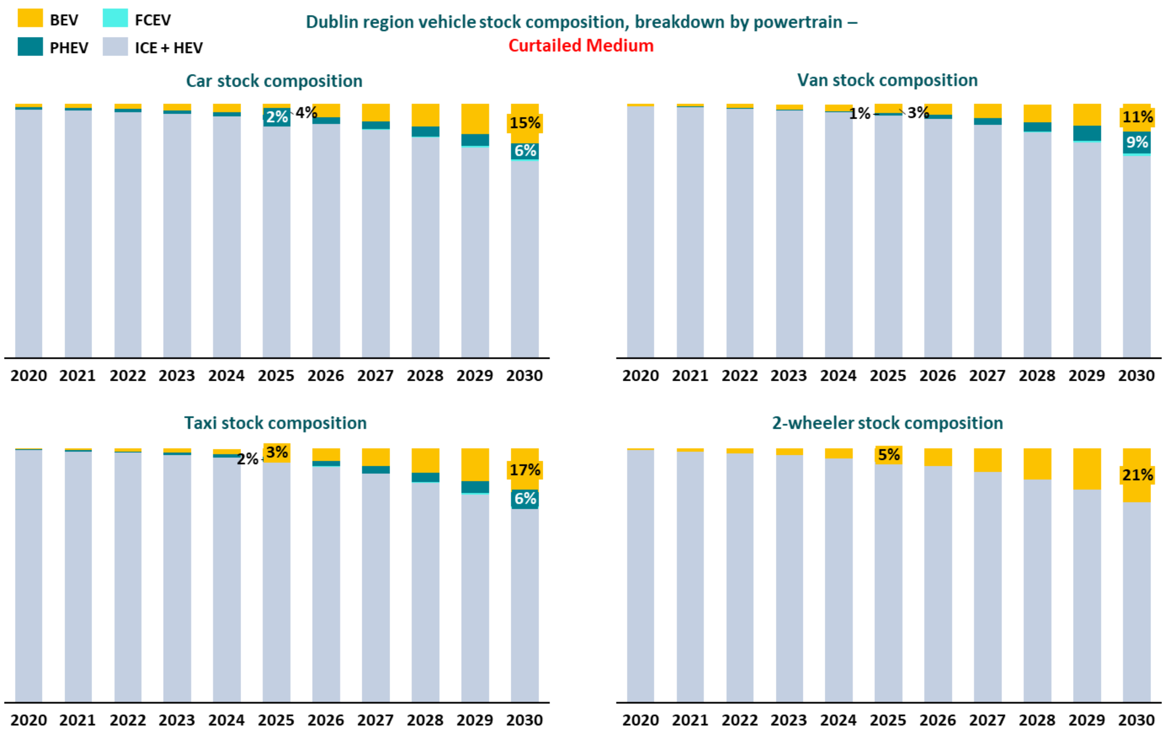


Figure 24: Dublin region stock composition split by vehicle type, based on Curtailed Medium uptake scenario

Figure 24 highlights the challenge associated with transitioning to a zero-emission vehicle fleet. Despite reaching 65% zero emission vehicle sales by the end of the decade, the stock modelling shows that under the Curtailed Medium scenario, ca. 21% of the region's car stock would be EVs by 2030 and of this ca. 15% would be fully electric.

The key issue is the internal combustion engine (ICE) and hybrid vehicles bought up to 2030 which will then likely be in circulation for in excess of 10 years beyond this. One option for accelerating the switch of these vehicles to EVs would be a comprehensive scrappage scheme.

EV stock growth – Curtailed CAP Ambition uptake scenario

Figure 25 shows that in the most ambitious EV sales scenario, there would be ca. 76k more plug-in electric cars on the road in Dublin region by 2030 compared to in the Medium uptake case. There are some challenges associated with this level and pace of uptake, including supply constraints and a range of common barriers that consumers are shown to be influenced by, such as range anxiety, upfront cost, perceived lack of charging infrastructure and lack of familiarity with the technology.
These CAP Ambition results are useful in reflecting a "best case" outcome that is in line with Government ambition. They reflect a future in which the EV market and consumer attitudes towards EVs develop faster than anticipated (as of 2020).

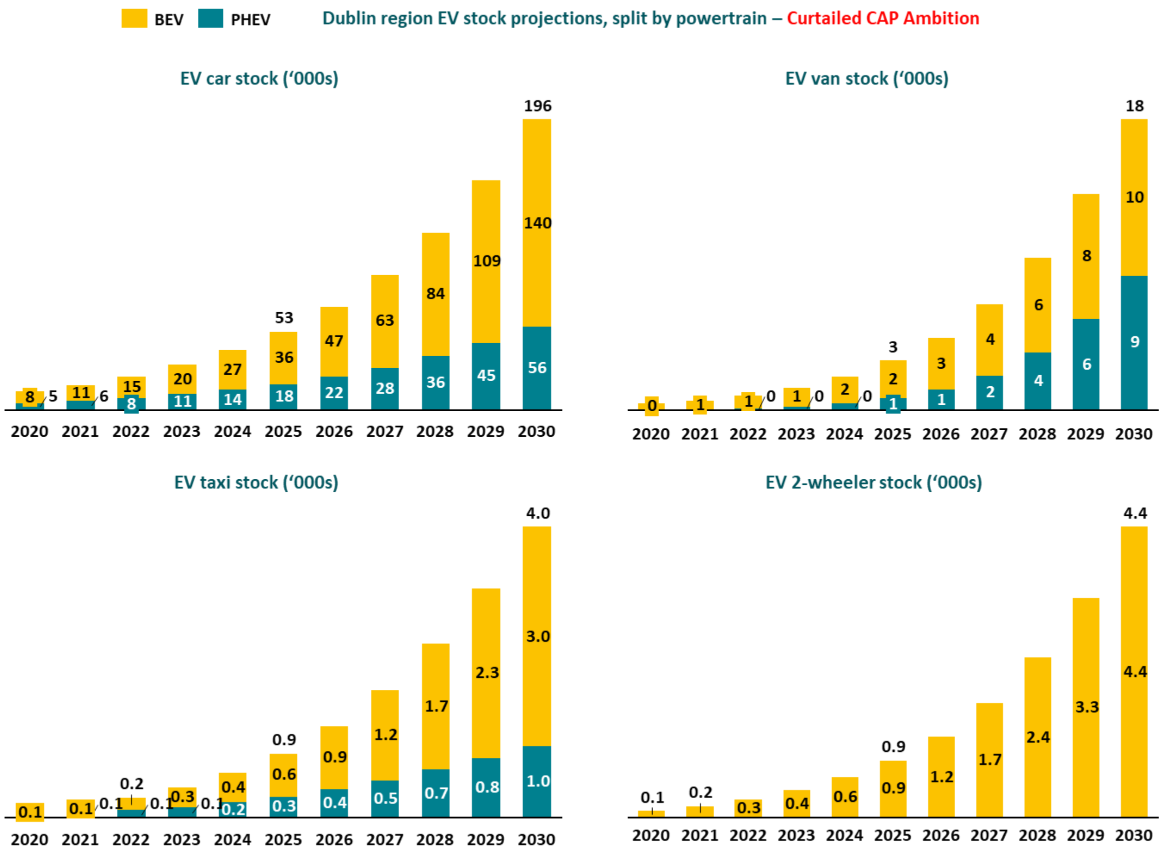


Figure 25: Dublin region EV stock projection split by vehicle type, based on Curtailed CAP Ambition uptake scenario

Figure 25 shows that in the most ambitious EV sales scenario, there would be ca. 76k more plug-in electric cars on the road in Dublin region by 2030 compared to in the Medium uptake case. There are significant challenges associated with this level and pace of uptake, including supply constraints and a range of common barriers that consumers are shown to be influenced by, such as range anxiety, upfront cost, perceived lack of charging infrastructure and lack of familiarity with the technology.

Despite the Medium uptake scenario likely representing a more realistic future, these CAP Ambition results are useful in reflecting a "best case" outcome that is in line with Government ambition. They reflect a future in which the EV market and consumer attitudes towards EVs develop faster than anticipated.

Figure 26 shows how the overall Dublin region stock composition is projected to evolve based on the EV uptake presented above.

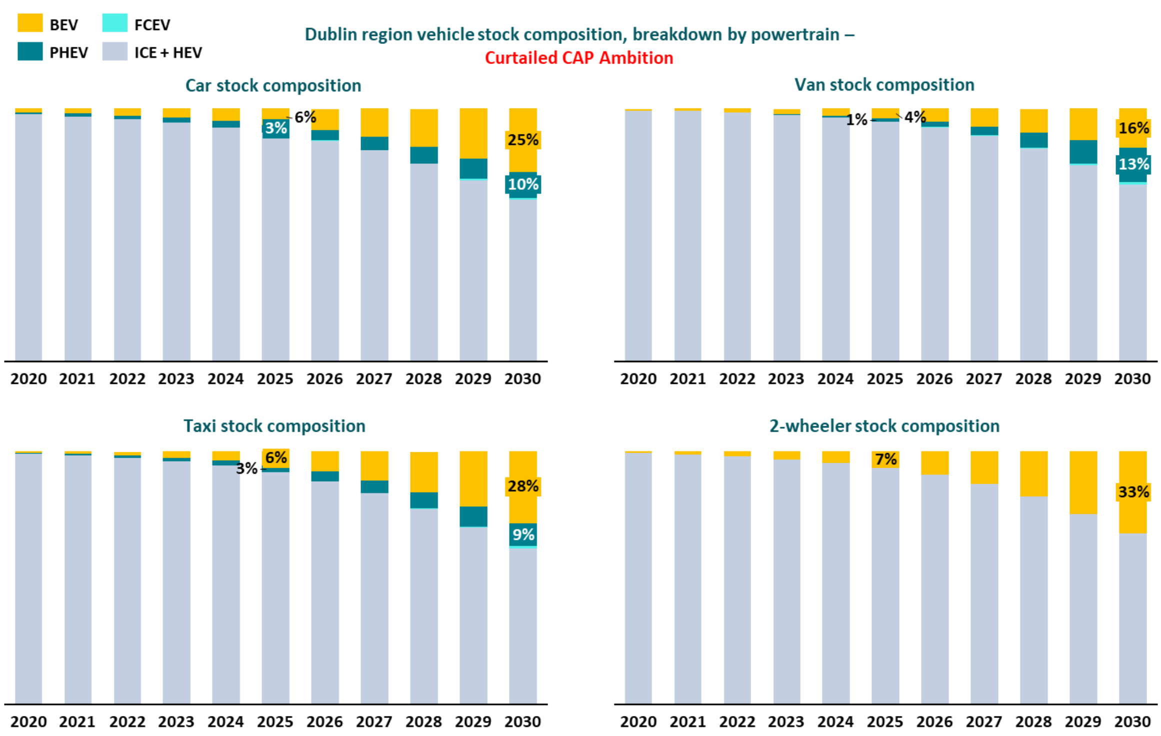


Figure 26: Dublin region stock composition split by vehicle type, based on Curtailed CAP Ambition uptake scenario

The graphs above show that even in the most ambitious scenario in which 100% of cars, vans, motorcycles and taxis sold in 2030 are plug-in electric, the resultant EV stock represents less than 40% of total vehicles for all vehicle types. The results show that 6% of cars in the Dublin region would be fully electric in by 2025, increasing to a quarter by 2030. Again, this emphasises the lag between EV sales and resultant EV stock which is a key challenge in decarbonising road transport in a timely way.

The EV stock and total stock graphs shown in this section are for the entire Dublin region. When calculating EVCP requirements, the projected EV uptake is split between the region's EDs according to the current distribution of cars, based on the latest Census data. A more sophisticated methodology was planned, in which initially EV sales are split according to their current geographical distribution, and then out to 2030 the distribution becomes increasingly even. However, the required dataset which infers the current spread of EVs could not be obtained within the project timeframe. It is recommended that this data is sourced by the Dublin region LAs as it will be an important tool in assessing current EV hotspots and indicating where EV uptake is most likely in the shorter term.

3.1.5 EV charging demand projections

Based on the annual EV stock breakdown (vehicle type, age, powertrain, size segment), Ireland-specific age vs mileage trends, and projections of EV consumption, the total charging energy demand for each vehicle type is calculated. The results of this analysis are shown in Figure 27.

It should be noted that the graph shows total energy demand rather than public charging demand. As will be explored in the next section, the majority of charging for a significant share of the EV fleet will be completed at home and so would not need to be delivered through publicly accessible infrastructure.

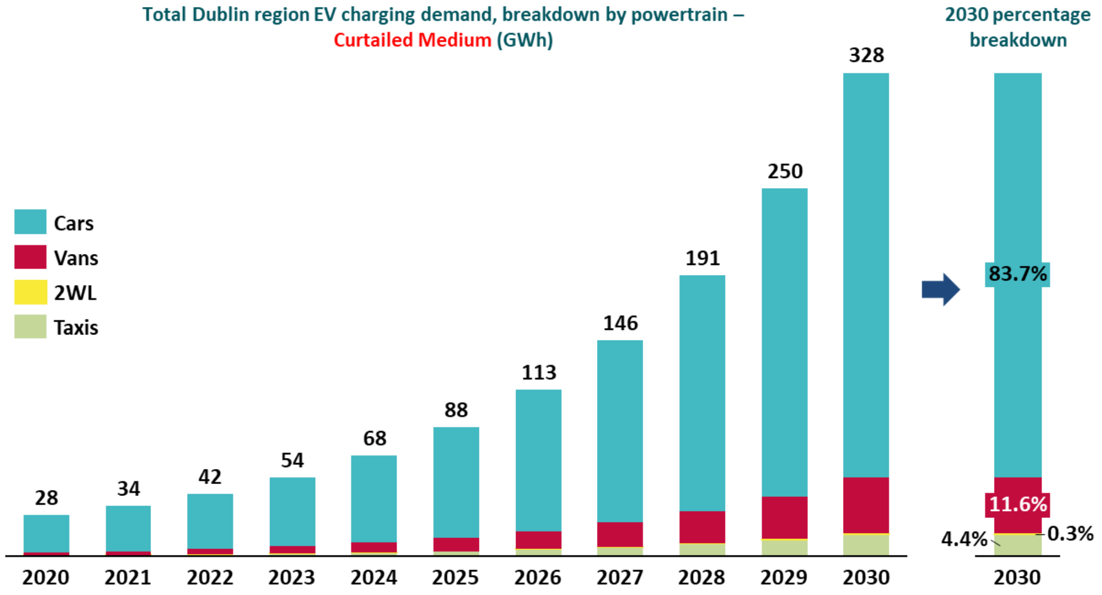


Figure 27: Dublin region total EV charging energy demand out to 2030 – Curtailed Medium

As would be expected the charging demand is dominated by cars, comprising 84% of the 2030 energy requirement. For reference, in 2018 Ireland's total electricity demand was ca. 27,000 GWh, based on which the 2030 EV demand represents ca. 1% of the country's electricity use.

As a comparison, in the Curtailed CAP Ambition uptake scenario, the total EV charging demand in 2025 and 2030 is expected to be ca. 135 and 543 GWh respectively. This represents a 2030 energy demand ca. 65% higher than that shown above, and roughly 2% of the Republic of Ireland's total annual electricity usage.

3.2 Charging behaviour

In order to assess the EVCP requirement, the amount of charging that will be done in public sites must be calculated. This requires splitting the total charging energy demand from section 3.1.5 into the four key charging types: residential (home or public), destination, work, en-route.

There is limited data available on how EVs distribute their charging across the different charger types. The charging scenarios used are therefore based on reliable and reputable studies which analyse and estimate the charging split based on what data is available. The assumptions are validated by EE's extensive experience working in the EV charging space and engaging with key user groups.

The charging breakdowns used in the modelling work are summarised for BEVs and PHEVs in Figure 28. Note that the small 2-wheeler segment, which contains moped-style vehicle, typically have detachable batteries that can be charged in the driver's home. As a result, only motorcycles (large segment) are considered in the EVCP forecasting work.

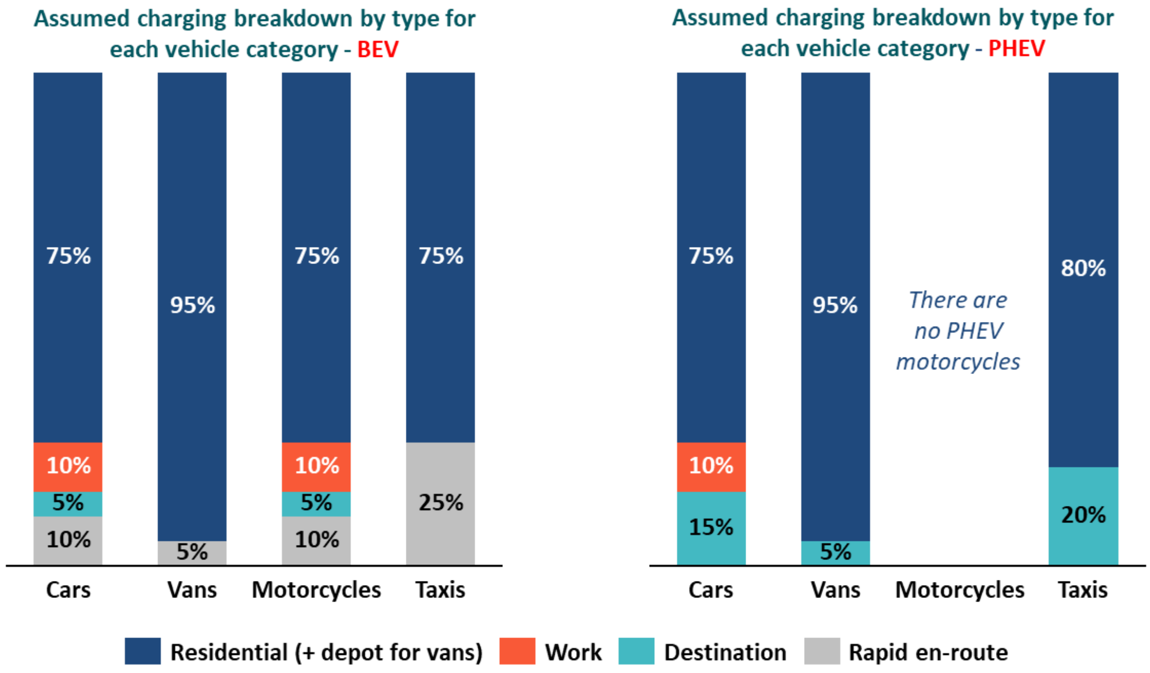


Figure 28: Charging breakdown by type for each vehicle category

The charging split for cars is predominantly based on EE's EV Charging Behaviour Study, completed for National Grid in the UK in 2019. Within this the Destination and Work charging is based on analysis of the Electric Nation survey data, while the BEV rapid share is based on real world data from the My Electric Avenue trial. It is assumed that PHEVs cannot rapid charge due to their battery size. Residential charging is then the total demand minus other 3 charging types giving 75%. This is in line with the fact that the majority of charging is typically done at home (where possible). It is assumed that motorcycles have the same charging behaviour as cars.

Due to typical shift patterns and operational requirements, vans tend to charge once and overnight. It is assumed the vast majority of charging is done either in the residential setting (home or public) or at a depot. A small share of rapid (BEV) or destination (PHEV) is included to account for days on which the van's battery cannot facilitate range requirement.

The assumed taxi charging behaviour is based on the 2019 London EV Infrastructure Delivery Plan. Operational requirements of taxis mean they charge whenever off-shift hence majority is done at residential EVCPs (home or public). Taxis typically have over double the mileage of private cars so will require additional charging. Rapid EVCPs are the best fit operationally as it allows drivers to be moving again as quickly as possible, hence this makes up remaining demand for BEVs. As PHEVs typically cannot use rapid chargers, it is assumed slow / fast destination chargers make up the remaining demand.

3.3 Projected EVCP requirement

Outputs from the EV stock and energy demand modelling are combined with the charging behaviour scenarios explained in the section above and fed into the EVCP modelling process to generate the volume of EVCPs required out to 2030. This methodology is outlined, and the results presented in the following sections.

When viewing the outputs in this section it is important to consider the underlying assumptions used. For example the projected growth in EV uptake is ambitious, and while it is assumed that the majority of charging is completed at home (where possible), improvements in battery capacity could lead to home charging making up an even bigger share. Moreover, there is significant uncertainty around the role work charging will play in the future. This study assumes a conservative share of charging is done at work but if employers take an active role then this could be much higher, which would lead to a reduced need for public charging provision. As a result of these factors, the EVCP volumes presented in this section should be viewed as an upper bound requirement.

3.3.1 Summary of approach

Figure 29 outlines the modelling methodology used to estimate the annual EVCP requirement at ED level. It is important to note that two distinct approaches have been employed. For destination and en-route charging, the total daily charging demand is found for each ED, based on the stock / energy demand projections and charging splits, and then assumed utilisation projections are used to derive the number of EVCPs required to meet the demand.

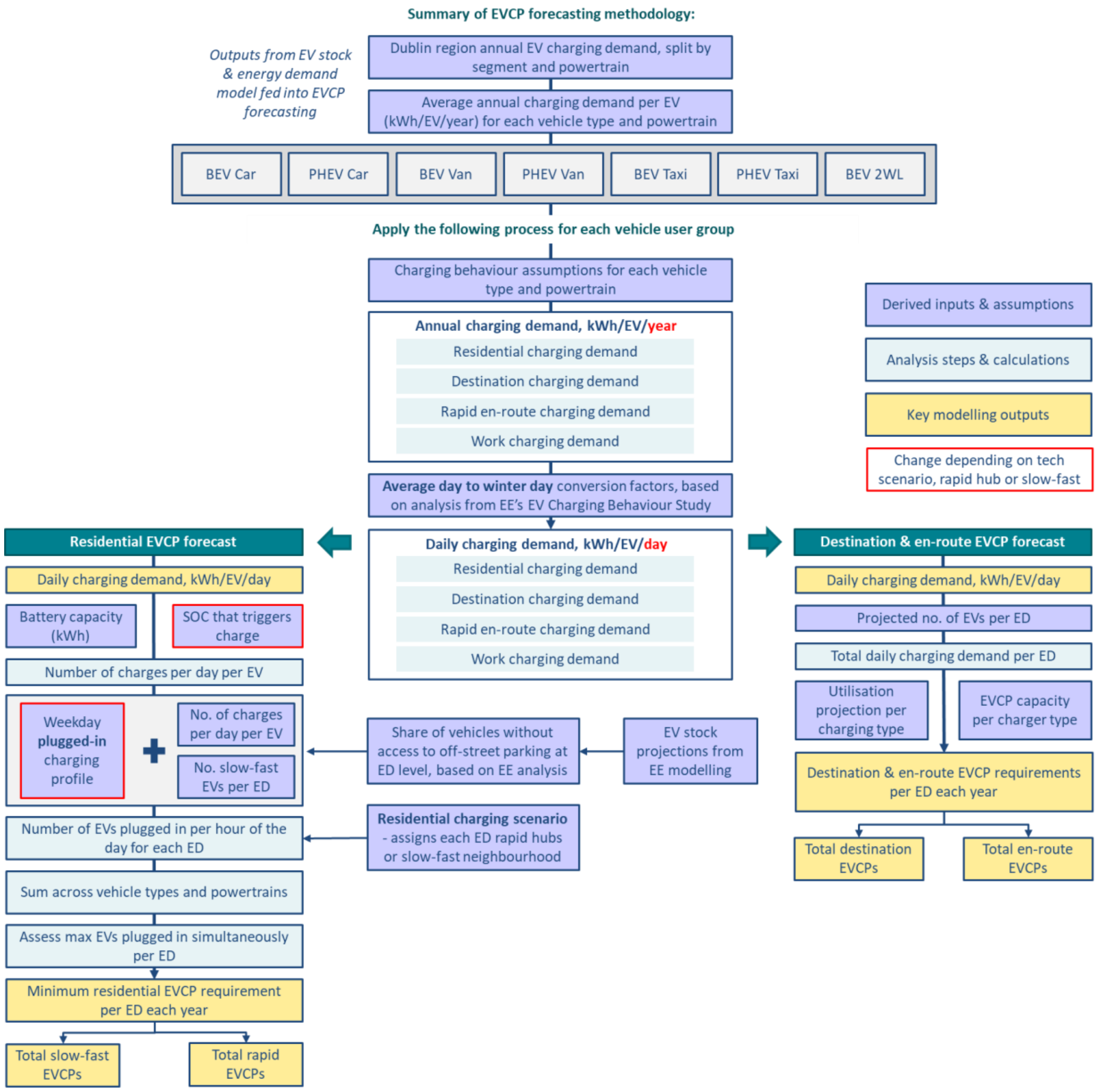


Figure 29: Summary of EVCP forecasting methodology

Residential EVCP volumes are derived in a more sophisticated way to reflect the importance of this charging type and the significant role Councils have in delivering it. The method uses charging profiles specific to each vehicle type in order to assess the number of EVs that would need to be charging simultaneously in each hour of a typical winter day. The maximum plugged-in at one time infers the minimum number of EVCPs required to cope with the worst-case charging demand. This process is done at ED level, and based on the technology scenario (rapid or slow-fast neighbourhood) selected for a given ED. The technology scenarios and EVCP outputs are shown in the next section.

3.3.2 Residential charging scenarios

The residential EVCP requirement is determined according to the technology scenario, which defines whether a rapid hub or slow-fast neighbourhood charging approach is taken in each ED. Table 3 provides an overview of each technology scenario. Note that due to the pros and cons of using slow-fast neighbourhood and rapid charging to meet residential demand explained in section 2.3, there is no “slow-fast neighbourhood charging only” scenario as this would be a non-optimal deployment approach representing poor value for money and may reinforce the idea of residents owning private cars, thereby working against modal shift ambitions.

Table 3: Summary of the residential charging technology scenarios

Technology scenario	Explanation
Rapid hubs	All public residential charging demand is met by rapid EVCPs. It is envisaged that in short-medium term this would likely to 1 or 2 chargers installed together, and in the medium-long term “proper” hubs would be developed (e.g. 6+ EVCPs)
Mixed Technology (primary scenario)	The top performing 50% of EDs in the Rapid Hub Index test are assigned rapid hub charging, and the remaining EDs are assigned slow-fast neighbourhood charging. This reflects the most realistic and optimal approach, as the technology is selected based on the specific characteristics of an area

3.3.3 Volume of EVCPs required in each LA

Detailed EVCP requirement outputs are presented at LA level in the following sub sections. The volumes are based on the Mixed Technology residential charging scenario and the Curtailed Medium EV uptake case. For context, as of the start of 2022 there were ~500 EVCP deployed across all the Dublin LAs.

It should be noted that in order to ensure the proposed deployment not only supports EV uptake but also drives and accelerates it, the *annual EVCP volumes derived using the method in Figure* 29 *are shifted to the preceding year*. Moreover, the approach assumes that 50% of residents with shared parking (e.g. apartment blocks, estates) are provided an EVCP by the landlord / management company, and so 50% will rely on public charging. This represents a source of uncertainty in the modelling but is deemed a reasonable assumption given the policy recommendations around charging in shared residential car parks and the upcoming SEAI grant focusing on this user groups. Furthermore, there is a growing number of 7-22kW hub solutions aimed at car parks (including residential) on the market, and suppliers are starting to deliver apartment block charging projects in which a significant volume of EVCPs are installed at once (e.g. Pod Point in London, EO Charging in Edinburgh).

When viewing the results below, it is important to note that the graphs show the total EVCP requirement to meet the projected public charging demand. It is not suggesting this requirement must all be realised through Council-led deployment. As seen in other markets, the private sector is expected to play a significant role, and each Council’s preferred approach and involvement is still to be assessed and decided upon.

Dublin City EVCP requirements

The EVCP forecasting shows that, based on the Medium EV uptake projection and a Mixed Technology approach, Dublin City would need ca. 330 slow-fast neighbourhood EVCPs and ca. 50 rapid EVCPs by 2025 to meet the residential demand. This increases to ca. 1,280 and 175 by 2030.

Dublin City has the highest EVCP requirement off all the Dublin region LAs, which is expected due to it having the largest vehicle fleet (ca. 54k more cars than South Dublin, next biggest, based on Censes 2016 data), and a higher estimated share of vehicles without access to private parking / charging.

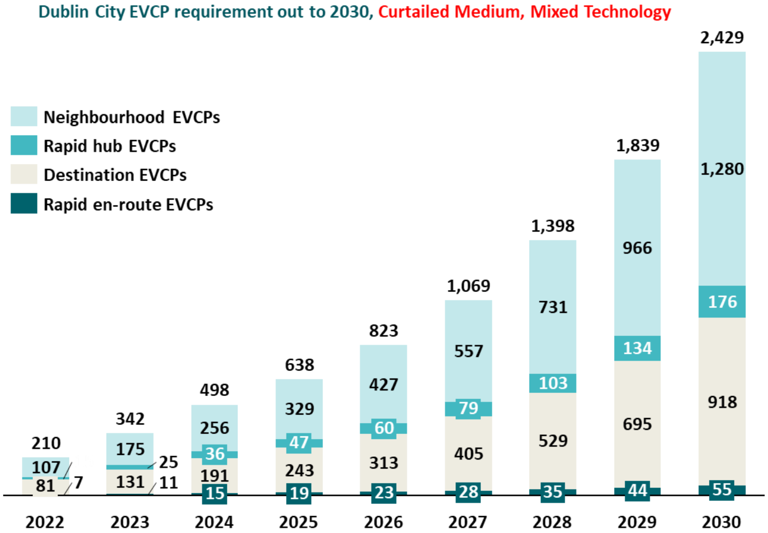


Figure 30: Dublin City EVCP requirement to 2030, Baseline CAP Ambition, Mixed Technology

South Dublin EVCP requirements

Analysis shows that in order to meet the 2030 residential charging demand, based on the Curtailed Medium uptake scenario and a Mixed Technology approach, ca. 685 slow-fast neighbourhood EVCPs and ca. 50 rapid hub EVCPs would be required in South Dublin. The residential charger requirement is lower than for Dublin City due to a smaller vehicle stock and a higher share of vehicles with access to off-street parking. This means that overall, fewer drivers will rely on public infrastructure as their primary source of charging.

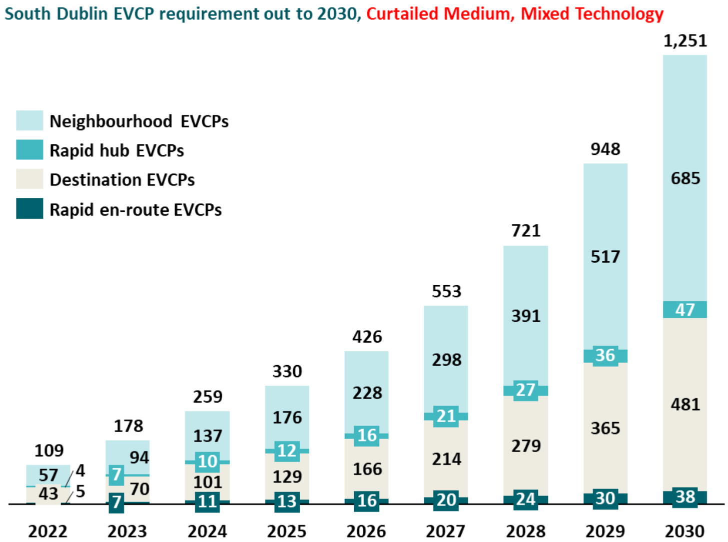


Figure 31: South Dublin EVCP requirement to 2030, Baseline CAP Ambition, Mixed Technology

Fingal EVCP requirements

The EVCP requirements for Fingal are broadly similar to South Dublin. This is largely due to having comparable vehicle fleets (ca. 125k cars in South Dublin vs 123k in Fingal, based on 2016 Census) and off-street parking provision (driven by similar housing stock breakdowns). By 2030, analysis shows that Fingal would require up to ca. 660 slow-fast neighbourhood EVCPs and ca. 50 rapid hub EVCPs, in order to support EV uptake.

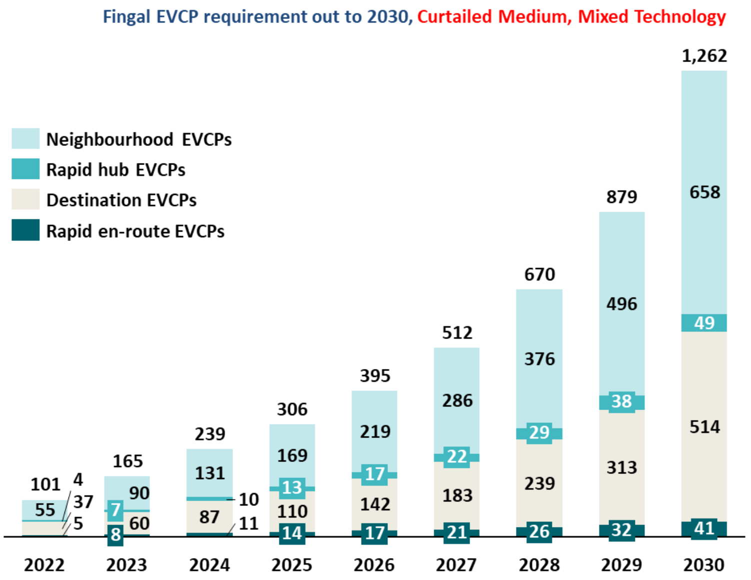


Figure 32: Fingal EVCP requirement to 2030, Baseline CAP Ambition, Mixed Technology

DLR EVCP requirements

The forecasting shows that to achieve 100% EV sales by 2030, in line with Baseline CAP Ambition, DLR is expected to need slightly more EVCPs than South Dublin and Fingal. DLR has a smaller vehicle fleet than these LAs (ca. 104k compared to ca. 125k and 123k in S. Dublin and Fingal respectively, based on 2016 Census), but the off-street parking analysis shows that a lower share of DLR drivers have access to private parking / charging.

The EVCP modelling shows that by 2030, DLR would require ca. 1,400 slow-fast neighbourhood EVCPs and ca. 65 rapid hub chargers, in order to support EV uptake in line with the CAP targets.

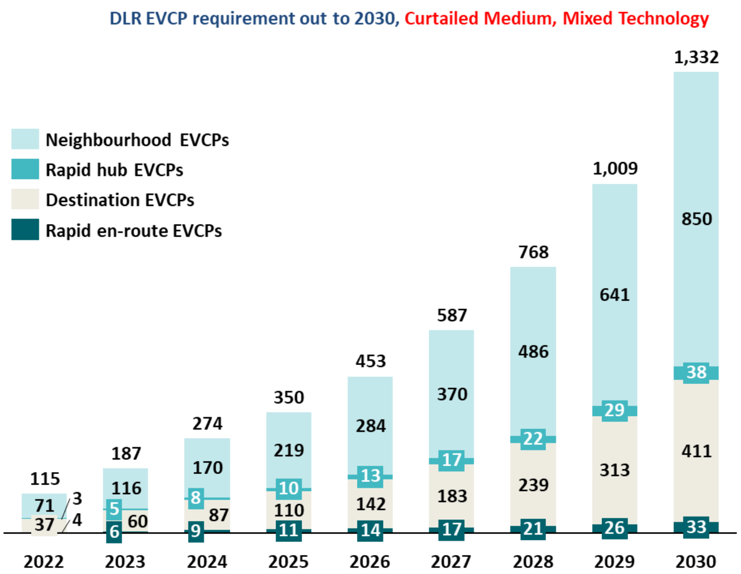


Figure 33: DLR EVCP requirement to 2030, Baseline CAP Ambition, Mixed Technology

3.3.4 Summary of EVCP requirement

The figure below provides a summary of the EVCP forecasting across each of the technology scenarios. It highlights the EVCP requirement in 2025 and 2030 in the four LAs, split by charging type. Moreover, it shows how the volume of chargers needed changes under the CAP Ambition uptake scenario (based on Mixed Technology).

Neighbourhood charge points
Rapid hub charging points

		2025 charge point requirement			2030 charge point requirement		
		Residential	En-route	Destination	Residential	En-route	Destination
Rapid hubs	Dublin City	65	19	280	247	55	1,065
	South Dublin	23	13	149	85	38	560
	Fingal	23	14	157	86	41	589
	DLR	23	11	135	85	33	509
	Total in Medium scenario	**133**	**57**	**722**	**504**	**166**	**2,723**
	Total in CAP Ambition scenario for comparison	206	92	1,126	802	265	4,363
Mixed technology	Dublin City	329 + 47	19	243	1,280 + 176	55	918
	South Dublin	176 + 12	13	129	685 + 47	38	481
	Fingal	169 + 13	14	110	658 + 49	41	514
	DLR	219 + 10	11	110	850 + 38	33	411
	Total in Medium scenario	**893 + 82**	**57**	**592**	**3,474 + 310**	**166**	**2,324**
	Total in CAP Ambition scenario for comparison	1,402 + 127	92	1,001	5,545 + 494	265	3,724

Figure 34: Summary of EVCP requirement in each LA across different technology scenarios

The analysis shows that the entire Dublin region public residential charging demand in 2030 could be met by ca. 500 rapid EVCPs, or a mix of around 3,500 slow-fast neighbourhood EVCPs and 310 rapid EVCPs. In the most ambitious EV uptake scenario, a mix of ca. 5,550 slow-fast neighbourhood EVCPs and ca. 500 rapid EVCPs would be needed. Based on an assumed 6 rapid EVCPs per hub, the Rapid Hubs and Mixed Technology approaches would require ca. 80 and 50 rapid charging hubs deploying by 2030 respectively.

In the Mixed Technology scenario, the Dublin region would need just over 2,700 destination charge points and almost 170 rapid en-route EVCPs. These market segments in particular are likely to have significant private sector involvement, with CPOs deploying charging infrastructure at service stations, forecourts, supermarkets, shopping centres etc.

The figure above highlights the difference in infrastructure requirements between deployment approaches. The rapid only scenario needs fewer devices to be installed compared to a scenario in which slow-fast neighbourhood EVCPs chargers are also installed to meet residential demand. This is because rapid devices employ a quick "Charge & Go" model so that one device can serve many EVs. There are challenges in siting rapid EVCPs and the cost *per device* is higher, however compared to installing slow-fast neighbourhood charge points, it offers a significantly more cost-effective way of meeting charging demand and would minimise the volume of infrastructure that needs installing across Dublin region.

3.3.5 Sensitivity analysis – EVCP requirement in high uptake scenario

This section provides a comparison of the Dublin region EVCP requirement in the Medium and CAP Ambition EV uptake scenarios. The annual infrastructure needs under each scenario are shown in Figure 35. As would be expected, the volume of charge points that is needed to support a transition in line with the 2030 100% EV sales target is shown to be considerably higher than in the Medium uptake scenario.

Analysis shows that by 2030, the Dublin region would need ca. 4,000 additional devices in total (across charging types) in order to reach 100% EV sales, compared to the 65% EV sales reached in the Medium uptake scenario. In terms of the residential charging infrastructure, which Councils may be more likely to be involved in delivering, by 2025 an additional 45 rapid EVCPs and ca. 500 slow-fast neighbourhood EVCPs would be needed in the more ambitious EV uptake future. By 2030, this is shown to increase to an additional 184 rapid EVCPs and ca. 2,070 slow-fast neighbourhood EVCPs.

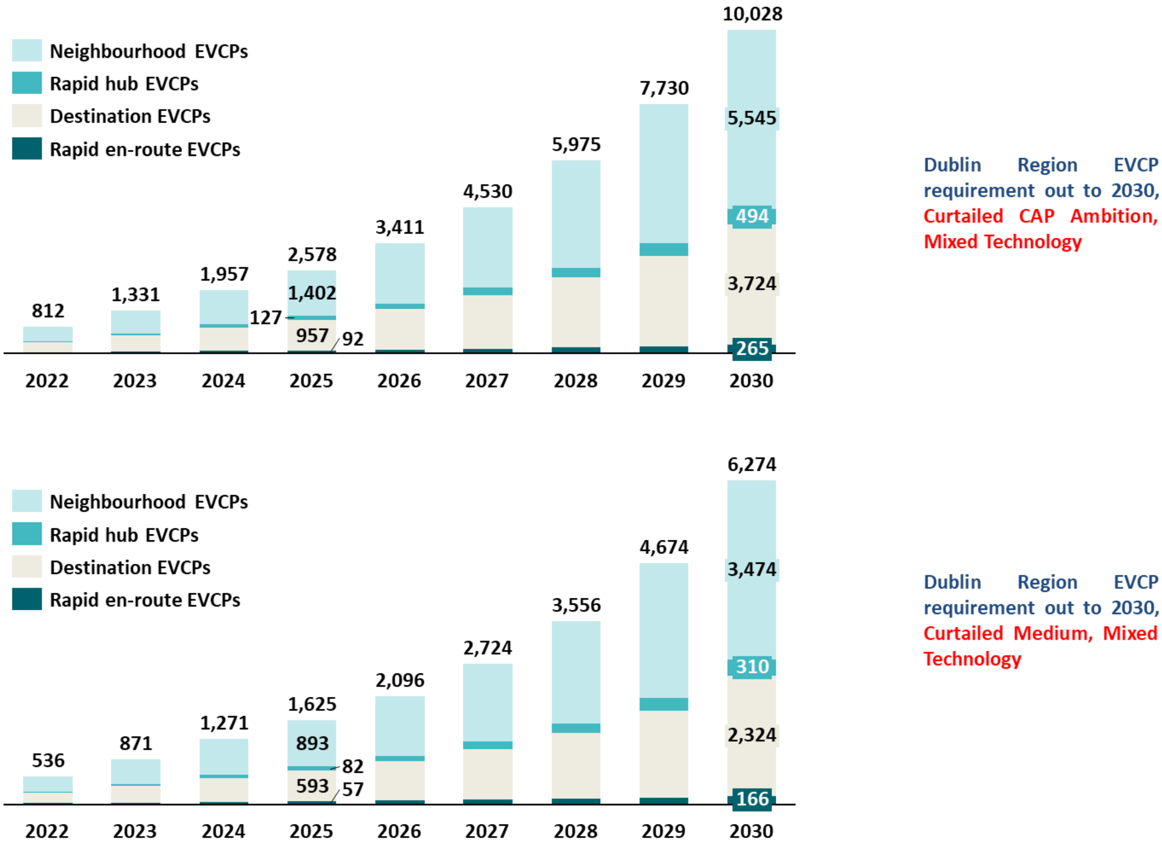


Figure 35: Comparison of EVCP requirements in the Medium and CAP Ambition uptake scenarios, based on Mixed Technology approach

4 Public charging infrastructure business case

This section investigates the cost associated with deploying a public charging network in Dublin region, as well as the most suitable business models to enable delivery based on the business case of different technologies. The business case analysis focuses on residential (rapid and slow-fast neighbourhood) charging, as the other charging types will be largely led by the private sector.

The underlying cash flow assumptions (CAPEX, OPEX, charging tariffs etc.) are presented in Appendix 6.4 .

Reminder: when viewing the EV charging business case in this following section, it is important to consider the following definitions:

- **EV charger or device =** a standalone charging unit, which may have more than one charging connector / EVCP

- **EVCP** = an individual charge point connector plus associated parking bay. A device with 2 EVCPs could charge 2 cars simultaneously.

For the purposes of this strategy, it is assumed that:

- **Lamppost chargers** have 1 connector and comprise 1 EVCP
- **Slow EV chargers** have 2 connectors and comprise 2 EVCPs
- **Fast EV chargers** have 2 connectors and comprise 2 EVCPs
- **Rapid EV chargers** have different connector types but comprise 1 EVCP

4.1 Business models available for EV charging infrastructure

There are several business models that Councils can use to enable EV charging deployment. These differ in terms of the role played by the Council, which party is responsible for ownership and operation of infrastructure and the risk taken on by different parties. Business models are often suited to particular technologies, for example lease agreements in which a supplier may take on all capital and operational risk, is currently targeted at rapid charging due to the more attractive business case it offers. Slow charging on the other hand offers a more challenging business case hence business models that include significant public funding are typically the preferred options. Some of the key business models available are summarised below:

- **Own & Operate:** Council plan, own and operate the network and are responsible for maintenance. They retain all revenue and pay for hardware / software support in order to run the network. Council choose where EVCPs are installed and sets tariffs. *Note that this is now generally not a preferred approach for LAs due to significant capital and personnel requirements, in addition to the risk involved.*

- **External Operator:** Essentially Own & Operate but engage a 3rd party CPO contractor to provide a full O&M service, alleviating the Council of this responsibility.

- **Private sector match funding:** Specific case that uses government grant schemes to deploy EVCPs. This funding is used to pay for a share of the capital (in UK typically 75% for example), then the CPO (or in some case the Council) funds remaining 25%, and the two parties negotiate arrangements around ownership of network. CPO will take on full O&M responsibilities.

- **Concession agreement:** These vary from Council to Council. Supplier and Council agree a split of capital costs, ownership and risks. Supplier typically takes on full O&M responsibility.

Council will receive a revenue share. Typically used to deploy relatively high EVCP volumes, often based on a pre-agreed number of devices.

- **Lease arrangement:** Supplier funds, owns, operates and maintains the EVCPs. This service is leased to the Council based on a long-term agreement. Council may be able to negotiate the ownership of below-ground infrastructure. Suppliers will target attractive locations.

It is important to highlight that in almost all business models available, the Council would not be expected to take on responsibility of installing and operating / maintaining the charging infrastructure.

The tables below provide a summary of the typical split of upfront and ongoing costs for the business models listed above, as well as indicative lease lengths and revenue share arrangements. These are split into slow charging and fast-rapid charging. Note that these are based largely on the UK market to date, however, are considered to be transferrable to other markets such as ROI.

Note: it is envisaged that "Council" costs would typically be met by government funding.

	CAPEX			OPEX				
Example fast & rapid charging business models	Hardware	Install	Ground & Grid	Back office	Electricity	Maintenance	Revenue	Contract length
Own & Operate	Council	Council	Council	Council	Council	Council	All to Council	-
External Operator	Council	Council	Council	Supplier	Council	Supplier	Majority to Council	-
Private sector match funding	Typically split Council (or Gov) 75% and supplier 25%			Supplier	Supplier	Supplier	Varies	Varies
Concession A	Council	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	5-10 years
Concession B	Supplier	Council	Council	Supplier	Supplier	Supplier	Share to Council + min. payment	
Concession C	Supplier	Supplier	Council	Supplier	Supplier	Supplier	Share to Council	
Lease model (rapid)	Supplier	Supplier	Supplier	Supplier	Supplier	Supplier	Share to Council	15-25 years

Figure 36: Indicative cost breakdowns for typical fast & rapid charging business models

Note that in the Own & Operate model, it is assumed the Council would invest in hardware and software support. In the Lease model, the cost split can sometimes be flexible, e.g. Council retains ownership of ground and grid works and electricity (everything behind the EVCP). The different concession arrangements shown represent different contractual agreements developed in major UK cities, and reflect different Council approaches and market conditions.

	CAPEX			OPEX				
Slow charging business models	Hardware	Installation	Ground & Grid	Back office	Electricity	Maintenance	Revenue	Contract length
Own & Operate	Council	Council	Council	Council	Council	Council	All to Council	-
Service Contract	Council	Council	Council	Supplier	Council	Supplier	All to Council, pay supplier service fee	1-5 years
Concession contract	Council	Council	Council	Supplier	Supplier	Supplier	Share to Council	5-10 years
Private sector match funding	Typically Council (or Gov) 75% and supplier 25%			Supplier	Supplier	Supplier	Varies	Varies

Figure 37: Indicative cost breakdown for typical slow charging business models

The most suitable business model for a Council to employ depends on factors such as their ambitions, technology choice, resource, appetite for risk and the overall role they want to play.

The figure below provides a high-level assessment and comparison of the different business models, in the context of installing fast and rapid charging infrastructure (22kW and above). Each business model is assessed based on a series of metrics according to how attractive it would be to the Council. It is important to note that this may differ between Councils because of their particular aims. However, the assessment shown is based around the following case:

- Utilisation is relatively low due to early stages of EV uptake
- Council has limited resource available for EVCP deployment
- Capital available to Council is limited by public funding that can be won

Increasingly attractive to Council

Assessment metric	Own & Operate	External Operator	Private sector match funding	Concession	Lease
Capital required					
Asset ownership risk					
Risk of poor value for public investment in a low usage scenario					
O&M responsibility					
Potential returns for Council					*Assuming good sites and contract terms*
Length of land lease					
Control of EVCP siting			*Depends on the agreement and volume of EVCPs being installed under contract*		
Control of tariff pricing					
Technical complexity for Council					
Contractual complexity					
Dependency on supplier business case					
Range of charging speeds available					

Figure 38: High level assessment and comparison of different EV charging business models

In order to establish what business model(s) will be used in the Dublin region to facilitate the rollout of EV charging, further discussions and engagement will be required. This includes internal communication at the Councils and engagement with the private sector to understand their view on a mutually beneficial approach.

For the purposes of this strategy and the business case assessment for the Dublin region out to 2030 (shown in section 4.4), a concession framework approach is considered. This is explained further in section 4.3.

4.2 Business case on a charge point basis

This section evaluates the commercial viability of the different charging technologies on an individual charger basis. In doing so, it helps to explain how the business models described in section 4.1 are compatible with different types of charging. Moreover, the analysis that follows is the basis for the business model assumptions used to assess the Dublin region business case out to 2030 in the following sections.

The cash flows shown are designed to represent the "average" or "typical" charger. However, the business case for all charge points is different and is dependent on the specifics of a deployment, e.g. location, local demand, hardware chosen, ground works required, grid capacity etc. All of these variables can have a significant impact on the commercial viability of a given charge point.

One of the most uncertain factors affecting the EV charger business case is utilisation. This is the product of a range of location-based factors. The utilisation projections used are based on EE's experience analysing real-world charging data in a range of cities and have been validated by discussion with industry players. The assumptions align with the fact that most chargers in markets such as Ireland would currently struggle to achieve a utilisation above 10%, and that the maximum utilisation observed at EVCPs with optimal locations and multiple user groups is around 20-25%. The annual utilisation assumptions are shown below[8].

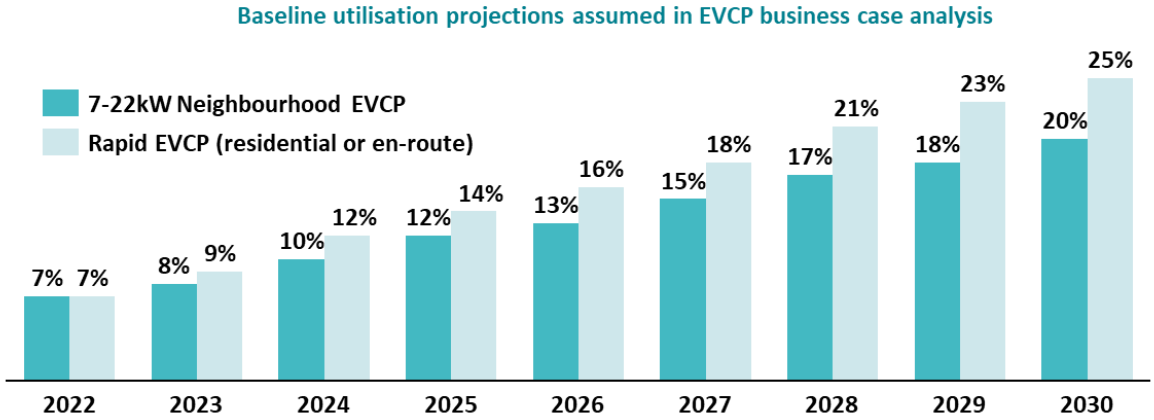


Figure 39: Utilisation projection assumed in business case analysis

4.2.1 Slow-fast neighbourhood EVCPs

The business case for slow and fast neighbourhood chargers is particularly challenging. This is because of low utilisation, caused by current levels of EV uptake, in combination with significant relative costs, much of which is due to civils works. As a result of these issues, slow-fast neighbourhood chargers generally require significant capital funding. It should be noted that there are exceptions to this situation, for example Norway which has the highest EV penetration globally and very cheap electricity, resulting in an attractive business case even for slow neighbourhood charge points.

The figure below compares the cash flows (non-discounted) for a single 7kW lamppost EVCP[9], and a 7kW and 22kW standard bollard charger. It is based on a 2021 deployment and considers the case without funding and with 100% and 75% funding for 7kW and 22kW chargers respectively.

[8] Utilisation here is defined by the energy actually delivered as a percentage of the theoretical maximum energy that could be delivered, based on 24/7 availability

[9] In reality lamppost chargers typically supply ca. 5kW to EVs. However, they are often capable of 7kW and in some cases can supply this. 7kW is used in modelling for simplicity and to reflect future on-street solution capability when the cash flows out to 2030 are assessed later in this section.

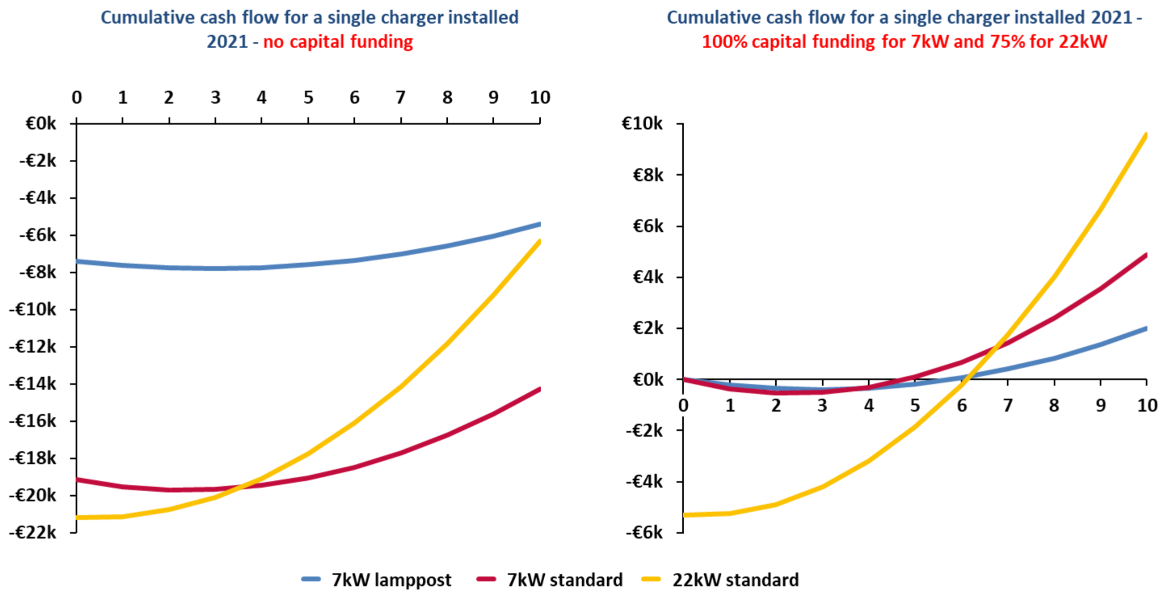


Figure 40: Cumulative cash flow for single charger (7-22kW) installed 2021[10]

Figure 40 shows that without funding support, the business case for slow charge points is currently not viable. This is driven by low utilisation, particularly in the early years, which means the revenue is not sufficient to pay off the initial outlay. Under the conditions tested, none of the 7-22kW technologies pay back within 10 years.

When 100% of the CAPEX is funded, the lamppost and standard chargers are shown to break even around year 6 and 5 respectively. The lamppost charger reaches cumulative cash flow of ca. €2k in year 10 while the standard device reaches ca. €4k, both reflecting reasonable business cases. A 75% funded 22k charger is shown to also payback in ca. 6 years and due to the faster charging speed enabling more electricity to be delivered, is able to reach a cumulative cash flow of around €10k.

As the 22kW and 7kW devices have comparable capital costs, but the 22kW charger offers a better business case and requires less capital funding to make it financially viable, this strategy recommends fast (22kW) chargers for slow-fast neighbourhood residential charging in the Dublin region business case assessment (shown in section 4.4).

Standard slow (7kW) chargers are not included, which is in line with a broader shift away from this technology. Lamppost chargers are included, due to being a low-cost option allowing relatively simple deployment but should only be installed where lampposts are suitable for retrofit (see section 2.3 for an overview of the barriers to lamppost deployment).

It is important to highlight that, as explained in section 2.3, slow deployment is not the preferred solution and it is recommended when an area / location is proposed for deployment, rapid charging is the chosen solution whenever possible. Moreover, if slow charging is the only viable option for a certain location, upcoming innovative alternatives to lamppost (low profile devices) should be considered as these are expected to offer a more scalable and clutter-free option.

The figure below is equivalent to the graphs shown above but for a 2025 installation.

[10] Note that EVCP costs are based on recent Dublin-specific costs and are higher than those seen in GB cities where larger scale deployment has occurred. As such, costs should be viewed as an upper bound.

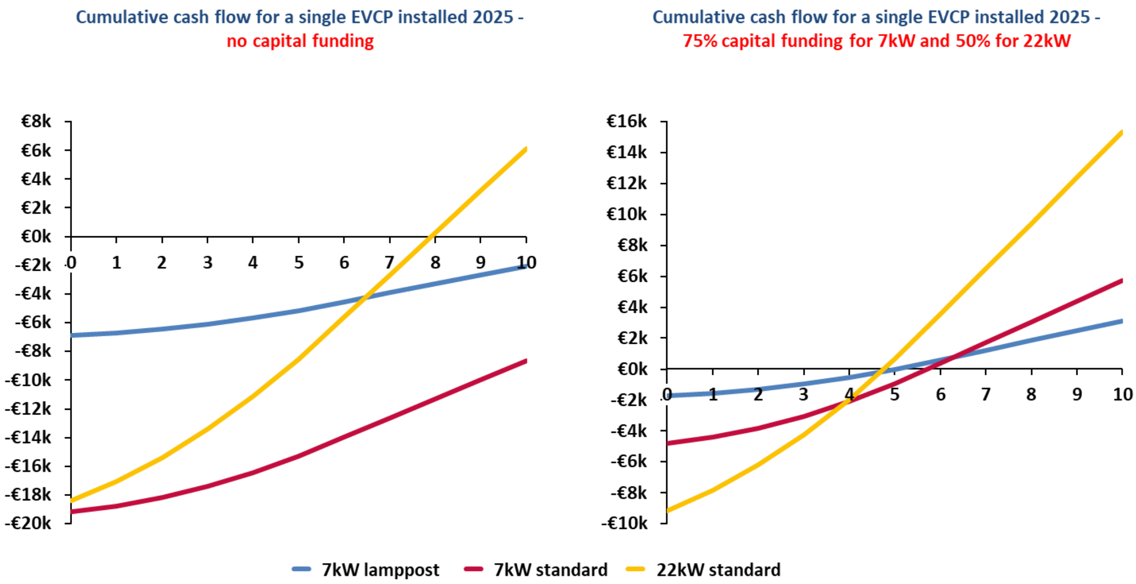


Figure 41: Cumulative cash flow for single charger (7-22kW) installed 2025

The analysis presented in Figure 41 shows that in 2025, despite the projected increase in utilisation, the business case for 7-22kW chargers is still very challenging without funding support.

75% capital funding is shown to provide a reasonable business case for 7kW lamppost and standard chargers, with payback period of ca. 5-6 years. 22kW charger would again need a lower share of the upfront costs met through public funding in order to be financially viable, with 50% funding resulting in a payback of ca. 5 years and a 10-year non-discounted cumulative cash flow of ca. €16k.

The 2021 and 2025 business cases for 7-22kW EV chargers explain why these technologies are typically only deployed with funding support.

4.2.2 50-150kW rapid EVCPs

Rapid EV chargers represent a more attractive business opportunity than slow-fast chargers when deployed in attractive locations. The costs associated with rapid chargers (hardware, civils, grid) are more expensive than for the less powerful charging technologies, however due to the nature of their operation, rapid devices can deliver a significant amount of electricity in a given period resulting in high revenue.

The figure below compares the cumulative (non-discounted) cash flow for a single 50kW and 150kW rapid EV charger, with no capital funding support and then 50% funding. It should be noted that the power assumed to be drawn from these devices is limited to 35kW in 2021 due to current EV model capabilities. This is assumed to then increase over time as EV charging capabilities improve (see Appendix 6.4 for details).

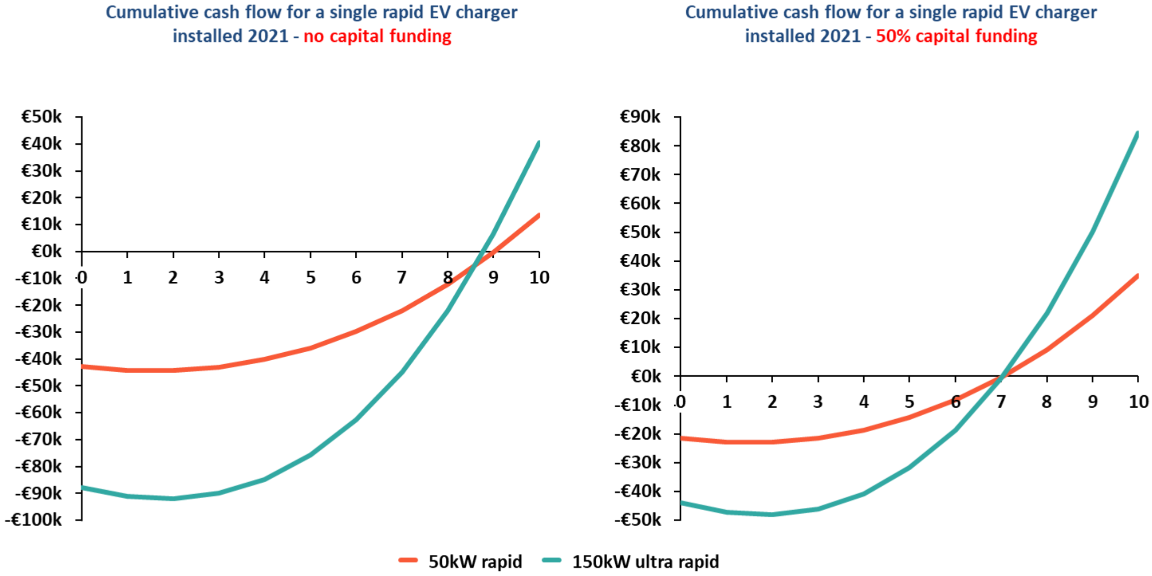


Figure 42: Cumulative cash flow for a rapid EV charger (50kW & 150kW) installed 2021

Figure 42 shows that based on the cash flow analysis completed, rapid EV chargers deployed in 2021 could achieve a payback within 10 years when no funding support is received. When 50% CAPEX funding is assumed, the payback for a 2021 installation is shifted forward to around 7 years for both 50kW and 150kW chargers respectively. The cash flows above highlight the more promising business case offered by rapid charging devices and help to explain why currently these are often deployed with a relatively even mix of private and public sector capital.

The figure below presents the case of rapid EV chargers deployed in 2025.

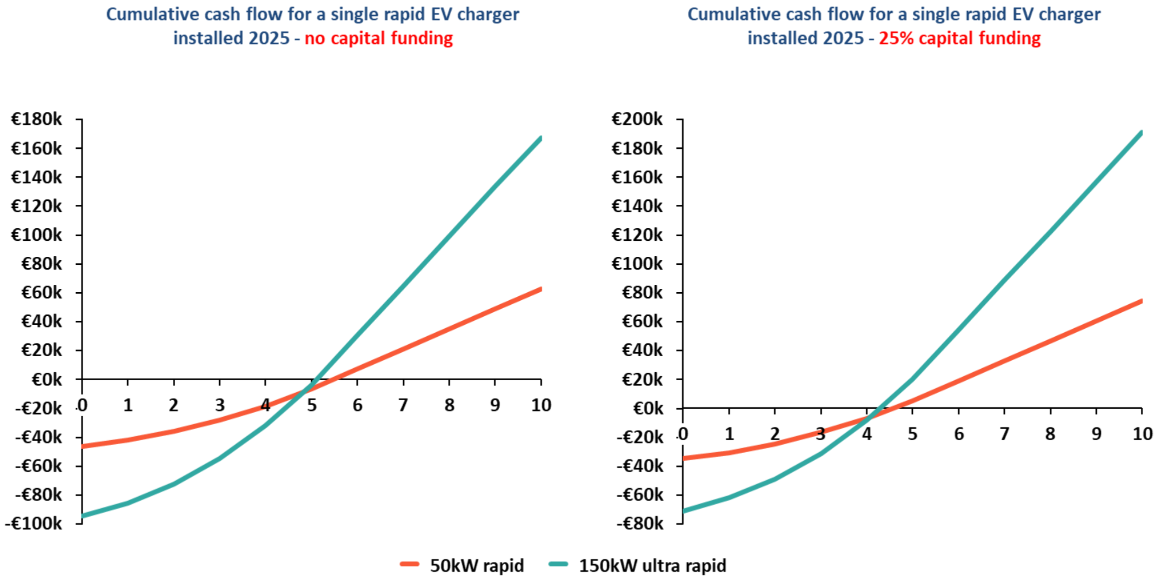


Figure 43: Cumulative cash flow for a rapid EV charger (50kW & 150kW) installed 2025

Figure 43 shows that as a result of the improved utilisation expected by 2025, the business case for a rapid residential EVCP deployed in Dublin region may be viable without funding support. With 25% of the CAPEX covered by public funding, the 50kW and 150kW devices are both expected to payback around a year earlier and represent a relatively attractive business opportunity.

4.3 Assumed business model for assessing future deployment

A key aspect of developing a comprehensive EV charging network and maximising the impact of investment is deploying infrastructure using appropriate business models and contractual arrangements. The business model chosen must reflect the attractiveness of the business case associated with a specific technology, how this evolves with EV uptake, and in the case of Council-led deployment, the role said Council would like to play.

As stated in section 4.1, for the purposes of analysing the business case of residential charging in the Dublin region, a concession framework approach has been modelled. This is due to it being an increasingly popular business model for the deployment of region- and city-wide charging networks requiring large volumes of installations, and offers a way of balancing capital risk, revenue, and Council influence over siting, tariffs etc. Moreover, this approach is flexible and could be tailored to the needs of the Dublin region local authorities. It also puts the responsibility of installing, operating, and maintaining the charging infrastructure on the supplier.

These business model assumptions, based on a concession approach and the EV charger business case analysis shown in the section above, are explained in the tables below[11].

Table 4: Assumed business models for 50kW+ chargers

	Upfront costs			Ongoing costs			
Rapid concession arrangement	Hardware	Installation	Ground & Grid	Back office	Electricity	Maintenance	Revenue share to Council
2021-2025	50% funding, 50% supplier			Supplier pays			10%
2026-2030	25% funding, 75% supplier			Supplier pays			10%

Table 5: Assumed business models for 22kW chargers

	Upfront costs			Ongoing costs			
Fast neighbourhood concession arrangement	Hardware	Installation	Ground & Grid	Back office	Electricity	Maintenance	Revenue share to Council
2021-2025	75% funding, 25% supplier			Supplier pays			0%
2026-2030	50% funding, 50% supplier			Supplier pays			10%

Table 6: Assumed business models for 7kW chargers

	Upfront costs			Ongoing costs			
Slow neighbourhood concession arrangement	Hardware	Installation	Ground & Grid	Back office	Electricity	Maintenance	Revenue share to Council
2021-2025	100% funding			Supplier pays			0%
2026-2030	75% funding, 25% supplier			Supplier pays			10%

The business model structures presented above reflect concession models often used in the UK. The capital expenditure is split between the supplier and the Council (via public funding), with the supplier's share increasing with the attractiveness of the business case. Ongoing costs are covered by the supplier, and a suitable revenue share is provided to the Council. It is assumed that for rapid chargers, the Council funding is used to cover the Ground & Grid costs (ensuring the Council retains

[11] It is assumed that the 2026-2030 arrangement is applied to EVCPs installed in that period, not existing EVCPs that were installed earlier.

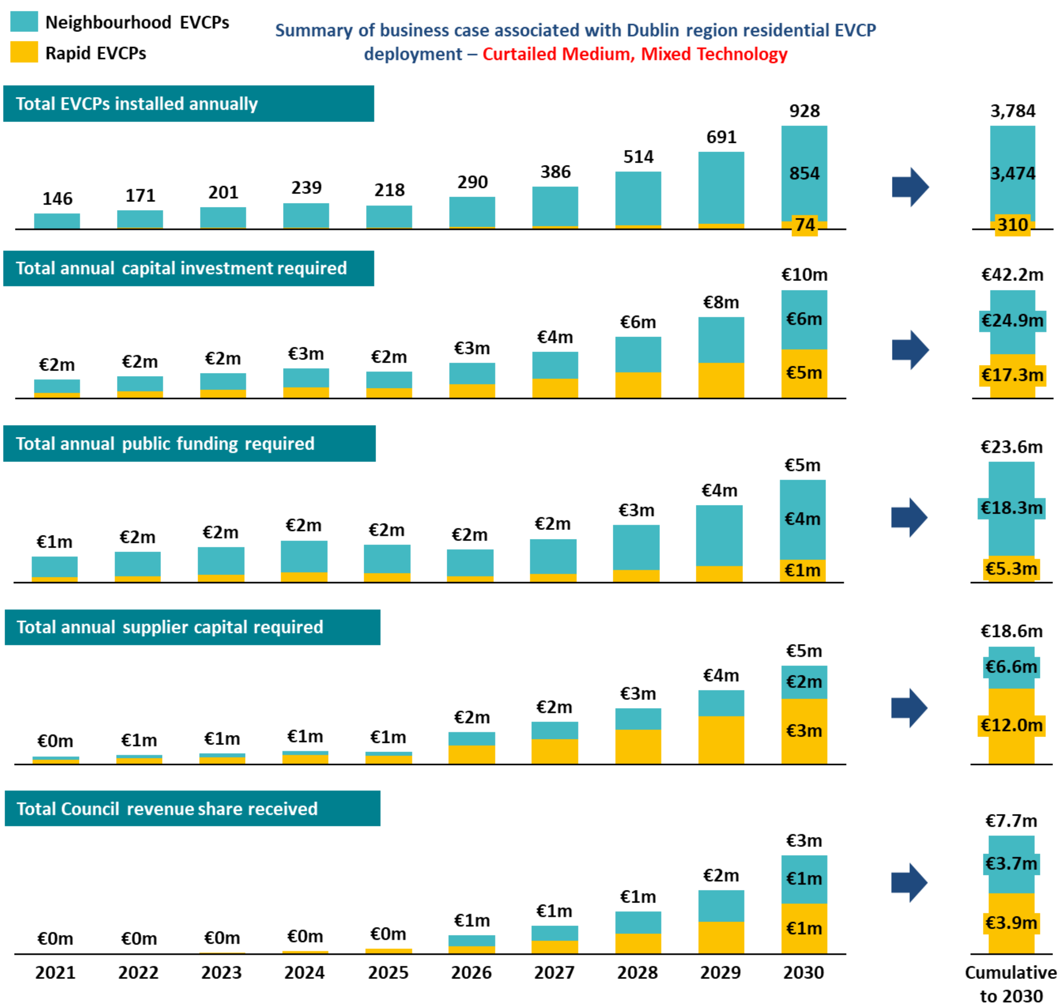
ownership of all "underground" infrastructure) while the supplier capital is targeted at hardware and installation.

4.4 Business case for the Dublin Local Authorities

The high-level business case associated with deploying **residential charging infrastructure** in the Dublin region was analysed based on the assumed business models explained in section 4.3 and the EVCP requirement presented in section 3.3.3. The following figure present the results for the Curtailed Medium uptake scenario and Mixed Technology approach.

When viewing the business case, it is important to remember that this is based on the concession framework assumptions detailed above and may not reflect the approach ultimately taken by the four Local Authorities. The results should therefore be viewed as indicative numbers for one potential strategy.

The actual business case will depend on the business model chosen by the four Dublin region Council's, and indeed the role they elect to play in deploying charging infrastructure. For example, if a more "hands off" approach was chosen to enable some of the rapid charging deployment, such as the lease model described in section 4.1, it could be that for certain sites all of the capital costs and associated risk are taken on by the private sector.



Note: revenue share based on entire installed EVCP stock for given year. Revenue would continue to be received beyond period shown.

Figure 44: Summary of business case associated with Dublin region residential charging deployment, based on Curtailed Medium uptake and Mixed Technology scenario

Figure 44 shows that between 2021-2030, a total cumulative investment of ca. €42 million would be needed to deliver the residential charging infrastructure required to support Dublin region's EV fleet. Based on the assumed concession contract business models, ca. €24 million of this investment would need to be made up of public funding support, leaving ca. €19 million to be provided by the private sector.

The analysis suggests this investment would yield a total of ca. €8 million revenue to the Councils over by 2030. It should be noted that revenue from the installed EVCPs would continue to be received beyond this date but is not captured in the graphs above. The disparity between the projected capital funding support required and revenue received highlights the expected challenging nature of EVCP business cases over the next decade. This helps to explain why robust government policy and funding support is needed in order to drive the deployment of charging infrastructure and in turn the transition to EVs.

The figure below provides a comparison of the total capital expenditure requirements based on the different uptake scenarios, and for both the Mixed Technology and Rapid Hubs deployment approach scenarios. It is important to note that as per the analysis above, it is not expected that the Councils would meet all of the CAPEX requirements.

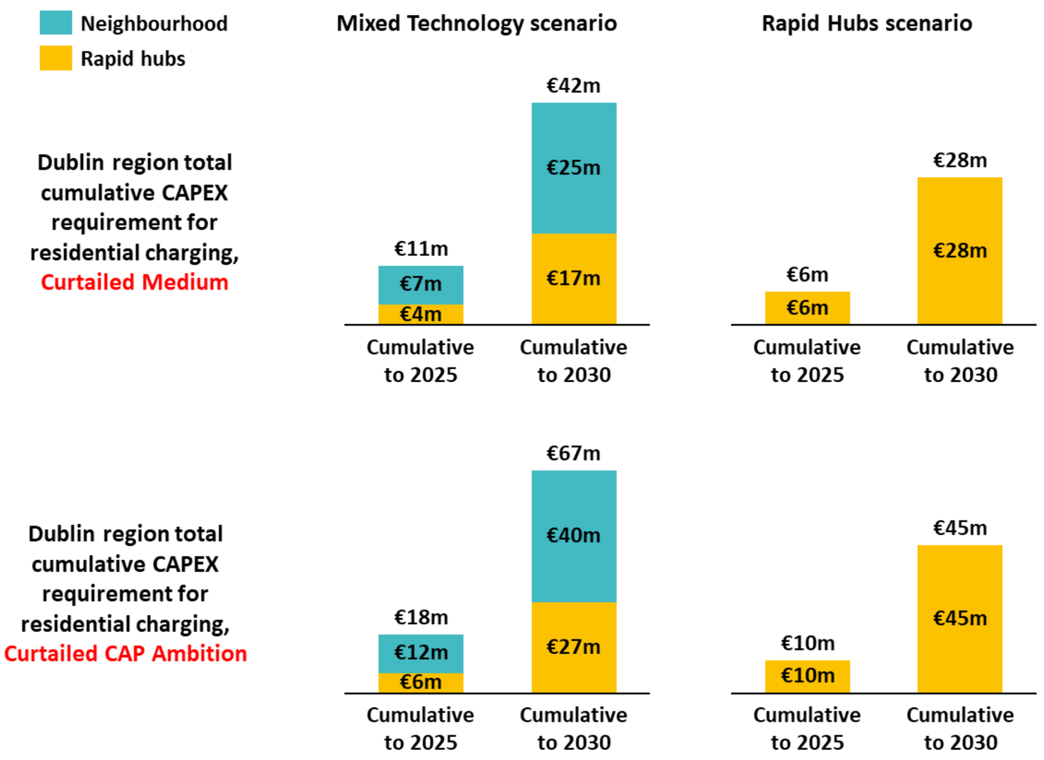


Figure 45: Comparison of total capital requirements for Dublin region residential charging infrastructure under different uptake and technology scenarios

Figure 45 shows that in the most ambitious EV uptake case considered, in which 100% of cars, vans, taxis and 2-wheelers sold in 2030 are plug-in electric, the cumulative capital investment needed for Dublin region's residential charging infrastructure is ca. 60% higher than in the Medium uptake case.

The comparison provided above highlights the value for money benefits of deploying rapid charging. In the Curtailed Medium scenario, total CAPEX required out to 2030 is ca. €14 million lower if rapid charging is used exclusively, instead of a mix of rapid charging and slow-fast neighbourhood. As discussed in section 2.3, rapid charging deployment is not always practically possible or commercially viable, however the results shown above reinforce the recommendation that rapid charging should be the priority technology wherever possible.

The table below provides an overview of the deployment assumptions on which the above cash flows are based.

Table 7: Overview of deployment assumptions used for Dublin region cash flows

Charging type	2021 situation	2030 situation
Slow-fast neighbourhood EVCPs	• Deployment comprises equal shares of 7kW lamppost EVCPs and 22kW standard EVCPs • Each EVCP has its own grid connection	• 80% of installations comprise scalable, hub-based 7kW technologies (assumed 7 chargers share grid connection) • Remainder of deployment is 22kW standard EVCPs (assumed 2 chargers share grid connection) • Coordinated approach to installation results in civils savings
Rapid EVCPs	• 1 charger installed per site, in an ad-hoc approach • 1 grid connection per charger • All EVCPs are 50kW	• Dedicated hubs of 6 chargers are developed, split evenly between 50kW and 150kW • There is an even mix of greenfield and brownfield sites being developed • Full site development works needed, e.g. site preparation, civils, access roads, site works etc.

Note that the assumption for 22kW EVCPs is that by 2030 they will be deployed in groups of 2. Ideally, larger hubs would be installed to ensure a more efficient and cost-effective network deployment.

However, the current grid capacity cost structure means that when the connection exceeds 50 kVA, the installation moves from Distribution Use of System (DuOS) group DG5 to DG6. In turn, the DuOS standing charge per annum increases from €95.7 to €893.1, and the capacity charge per annum increases from zero to €33.33 per kVA.

These increased grid charges are prohibitively expensive and make hubs of three or more 22kW EVCPs sharing a single grid connection unviable. It is recommended that LAs request a review of this pricing regime, supported by industry, in order to address this cost barrier.

5 EV charging strategy delivery

This section summarises recommended delivery activities for the proposed strategy. A timeline out to 2030 is outlined for the deployment, the key risks are assessed and then a series of recommendations are presented.

5.1 Deployment roadmap

The next figure sets out the recommended deployment roadmap out to 2030. This is split into three main categories: easy win deployment, residential & en-route charging, and supporting work.

It should be noted that while the following figures present high level, indicative timelines for the delivery of the charging network, in reality the different LAs will proceed at different rates according to their local context, funding available, resources etc.

In addition to the activities that directly support the installation of public charging infrastructure and are included in Figure 46, there is policy related work that will help to facilitate charging provision in the long term. For example, the LA development plans contain guidelines for new apartment block developments. This includes car parking bays per flat, which can be used to encourage a shift away from private car ownership, and most include charge point requirements (i.e. EVCPs per flat).

Dublin City also updated their development plan to require that all new parking for new (or extensions to) housing, apartments and places of employment that provide car parking shall be electric charge enabled (i.e. ducting in place).

A consistent approach to the planning and legislative requirements for electric vehicles will assist the private and public sector in the deployment EVCP infrastructure. It is recommended that updated County and City development plans guidance is provided as soon as possible to the Local Authority sector to include the topic of EVCPs. A number of recommendations from the Government's Low Emission Vehicle Task force report are relevant in this regard, namely:

- Update Development Plan Guidelines with reference to updated LEV policies to support the roll out of Low Emission Vehicle infrastructure through Planning Authority functional areas.
- Issue guidance to planning authorities to ensure a consistent and future proofed approach to the rollout of EV charging infrastructure through planning decisions.
- Present draft regulations to the Houses of the Oireachtas for approval to future proof existing provisions in the Planning and Development Regulations 2001, exempting specified EV charging infrastructure from the requirement to obtain planning permission.
- Publish requirements of the Energy Performance of Buildings Directive EU/2018/844 for public consultation in Q4 2019 and take account of submissions received in the transposition of requirements for charging infrastructure of the Directive to ensure the requirements consider the future demand for EV infrastructure.

It would also be beneficial for the LAs to review the government's approach to the EU Directive on the deployment of alternative fuels infrastructure (2014/94/EU). This contains a framework of measures for the early deployment of alternative fuel infrastructure in the EU to minimise the dependence on fossil fuels and requires each MS to develop their own national policy frameworks. It should be noted that a new version of the Directive has been proposed in Summer 2021 under the Fit for 55 package[12].

[12] https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

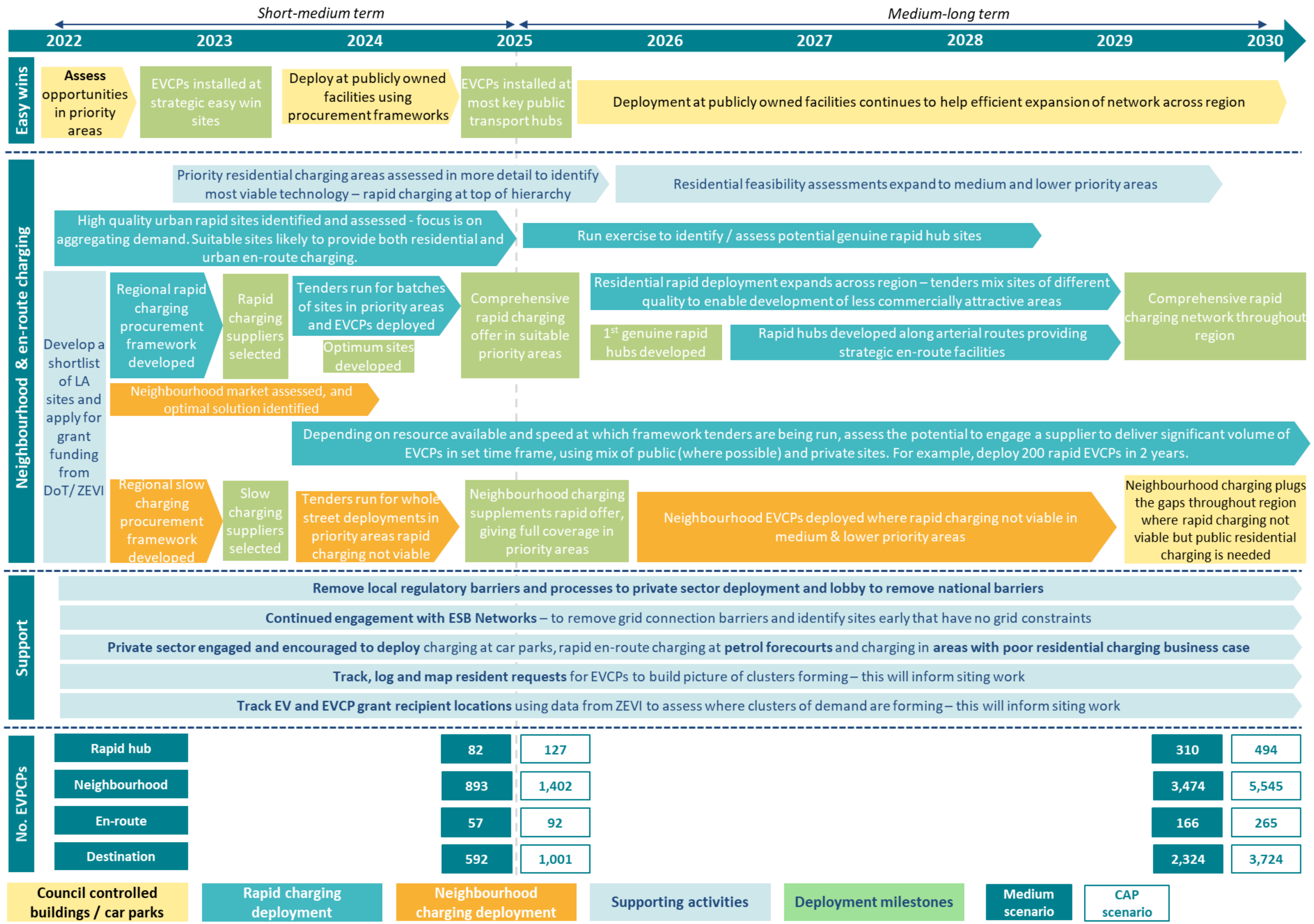


Figure 46: Indicative deployment roadmap for the Dublin Local Authority EV charging strategy

5.2 Risk assessment

There is a range of potential risks associated with developing a regional EV charging network. The following table summarises some key risks that may impact the Dublin region strategy and splits them into 4 main categories: EVCP & EV market, deployment, mobility trends & COVID, policy & funding. The table also details how the strategy has taken each risk into account and has therefore embedded mitigating actions.

There are a number of uncertainties, from charging technologies development speed to the uptake rate of EVs. The deployment plan and risk register should therefore be reviewed every two years to compare the projected EV stock with the actual and adjust the EVCP deployment target accordingly.

		Impact		
	Overall risk	Low	Medium	High
Likelihood	Low	Low	Low	Medium
	Medium	Low	Medium	High
	High	Medium	High	High

Risk no.	Category	Risk in the 2021-2030 timeframe	Key impacts of risk	How strategy accounts for risk	Likelihood	Impact	Overall risk
1	EVCP & EV market	**Scalable neighbourhood solution is slow to emerge** meaning neighbourhood charging remains expensive / challenging to rollout. Could be impacted by COVID delaying technology trials	• Significant neighbourhood deployment delayed • Neighbourhood deployment expensive where it is still installed • Wide scale neighbourhood deployment not possible	• Considers both neighbourhood and rapid hub approaches to residential charging, and recommends rapid EVCPs deployed where possible • Options for destination / rapid en-route charging highlighted, which would provide charging for those in areas waiting for neighbourhood residential deployment			
2	EVCP & EV market	**EV uptake is slower** than expected	• Reduced charging demand • Higher investment may be needed to stimulate market (depending on reason for slow uptake)	• Uptake accounts for short term slow down due to COVID • Aggregating demand across user groups maximises EV uptake that does take place			
3	EVCP & EV market	**Plug-in hybrids sell better than expected** compared to fully electric vehicles	• Reduced rapid EVCP need	• Strategy considers multiple charging technology futures, including all neighbourhood, all rapid, and mixed technology			
4	EVCP & EV market	**Plug & Charge technology is slow to develop** and does not become a standard solution by 2030	• PAYG must be offered for longer than planned	• Technology roadmap advises ensuring PAYG offered until Plug & Charge available			
5	Deployment	There is only a **small volume of suitable publicly owned sites** for rapid hub development	• More neighbourhood rapid deployment will be needed • Increasingly reliant on private site rapid hubs	• Strategy highlights forecourts that would make attractive hub sites as well as private car parks that could be leveraged			
6	Deployment	There is resistance to using Kerbside space for EV charging	• Limits residential charging deployment potential	• It is expected that in next few years, low profile chargers that are submerged in pavement when not in use will become market leader – limited space impact			
7	Deployment	DUoS grid cost structure is not reviewed and updated, meaning deploying hubs of 3 or more 22kW EVCPs remains commercially unviable	• Limits deployment of fast 22kW chargers • Less diverse charging network	• Strategy favours rapid charging where it is viable • Neighbourhood deployment assumed to shift to smart enabled charging hubs that will require lower grid connection per charger			

Risk no.	Category	Risk in the 2021-2030 timeframe	Key impacts of risk	How strategy accounts for risk	Likelihood	Impact	Overall risk
8	Mobility trends & COVID	**Urban areas start to become pedestrianised** as part of a wider shift to sustainable forms of transport, and in order to reduce air pollution in the city	• Stranded assets • Wasted investment	• Deployment considers most sustainable user groups to future proof (e.g. taxi, car clubs) where possible • Rapid hubs recommended for areas most likely to be pedestrianised (lower cost per EV served)			
9	Mobility trends & COVID	There is a **shift away from private car ownership** as part of a wider shift to a more sustainable transport system	• Reduced charging demand • Underutilised / stranded assets • Worse return on investment	• Short-medium term deployment focussed on areas with multiple user groups, not just private cars			
10	Mobility trends & COVID	Some **public car parks start to be closed** in city centre, to aid the trend away from private car use and as a knock-on effect of COVID	• Stranded assets • Wasted investment	• Recommended that private sector encouraged to deploy rapid charging on their sites in city centre • Identifies forecourt sites that could be leveraged			
11	Mobility trends & COVID	There is **less commuting** as a whole as more people choose to work from home, and within this there is a **reduction in car commuting**	• Reduced charging demand in city centres • Underutilised assets	• Multiple user groups available for city centre EVCPS, not just commuters			
12	Mobility trends & COVID	There is **decrease in commuting by train, tram and bus** due to COVID-19, leading to an **increase in car commuting** as people switch modes	• Increased charging demand • More EVCP investment needed	• Residential deployment to be targeted at priority areas in early years • Includes scenario which considers very ambitious uptake (CAP Ambition)			
13	Mobility trends & COVID	The **car market continues to be constrained** due to COVID-19 for years to come, as further lockdown periods are imposed	• Reduced charging demand while market constrained • Slower investment needed	• Stock size held constant in first 2 years of strategy to reflect limited turnover			
14	Policy & funding	There is **less public funding available for EV infrastructure than expected** over the coming decade	• Lower EVCP volumes possible • Funding must be more targeted – high quality sites, multiple user groups etc.	• Key focus of strategy is on deploying well utilised rapid hubs, which represent best value for money • Coordinated hub approach is the goal for both neighbourhood + rapid, which helps reduce costs			

Figure 47: Risk assessment

5.3 Next step recommendations

A series of priority actions have been drafted that should ideally be completed over the next 3-6 months. These fall into 5 categories and are described below in the table below.

Table 8: Summary of next step recommendations

Category	Next step recommendation
Procurement & Council role	The 4 LAs should agree on the role they wish to play in the deployment of infrastructure. Key part of this will be agreeing on preferred business models. It is recommended that LAs, where they consider it to be necessary and appropriate, consider offering LA sites and/or grant funding to charge point operators to support residential deployment.
	Allocate resource to procurement process to set up a procurement framework for charging infrastructure that all 4 LAs can use. It is estimated that at least 1FTE will be required alongside support from each of the LAs.
	Decide the chosen technology split for each LA, and if the framework should be separated into a rapid hub charging and slow-fast neighbourhood charging framework.
Site identification and deployment	Decide on the long-term role each LA wishes to play in site identification. For example, they could be heavily involved in preparing batches of publicly owned sites for suppliers to bid for or could rely more on suppliers leading site identification and acquiring privately owned sites. Each LA also needs to decide if they have LA owned sites that they are willing to offer and develop a short list.
	It is recommended that Councils should use the first 6 months to start assessing low hanging fruit opportunities in high priority areas (see section 2.9). This will include publicly owned dedicated car parks and public buildings that have car parks on site.
	Further the analysis of areas recommended for short term deployment, i.e. those with low levels of off-street parking, high traffic flow, taxi ranks, car club vehicles etc. This may involve grid assessments and analysing resident requests for charging infrastructure.
	The 4 LAs should engage with ESB Networks as early as possible. It will be an important stakeholder and effective collaboration will ensure more efficient network development. For example, identifying in the early stages in which areas the grid capacity is particularly constrained could save time when identifying and assessing sites.
	The Councils should develop a system for collecting, tracking, and mapping resident requests. This could be a simple online form capturing contact details and address, or a more sophisticated online map tool which residents can add to. This will save time in the long run as it streamlines the process and avoids requests arriving through multiple channels in a way which is difficult to track. Clusters of requests can be identified to inform EV charging siting. Various best practice examples of resident EVCP request systems from boroughs in London can be found here.
Integration with national & local strategy	Based on the findings of this strategy, the four LAs should assess if planned EVCP deployment can make use of DoT funding schemes. They need to ensure they have ongoing consultations and dialogue with Department of Transport in order to secure appropriate funding.

	Begin the necessary communications within the Councils. Many departments will need to align in order to deliver the required charging infrastructure (Planning, Highways, Transport, Housing etc.) and so it is recommended the relevant people are identified and engaged as soon as possible. Including council representatives for all relevant mobility and development schemes in early-stage planning work.
Communications	Ensure effective communication of the region's infrastructure requirements and plans in order to give confidence in the future EV landscape and foster private investment. This includes discussions with forecourt owners / operators, car park operators and businesses, as well as the EV charging providers who would lead deployment on their sites. In particular, engagement with fleet operators in order to anticipate their EV uptake targets and anticipate the amount and distribution of future demand.
	Set up effective communications with Dublin region residents so that they are aware of plans and gain confidence in purchasing an EV. This should include communication to residents in Council-owned houses about the process for installing an EV, i.e. request for EV charger should be dealt with as a standard request for upgrade to property similar to normal maintenance or improvement enquiries. Resident would need to fund EVCP installation which can be supported by the relevant SEAI grant.
	Develop a FAQ page for residents and site owners/suppliers
Aid private sector deployment	Due to the long timeframes involved in setting up and deploying infrastructure through an LA procurement approach, in the short term, LAs must aid private sector deployment. This should be done by through removing national and local deployment barriers due to LA regulations and processes such as making planning permission applications more efficient,
	The Dublin LAs should use their position to lobby for changes in EV policy and incentives and national level regulations to ensure an accessible and equitable charging landscape

6 Appendix

6.1 Assessment of projected EVs without home charging per km²

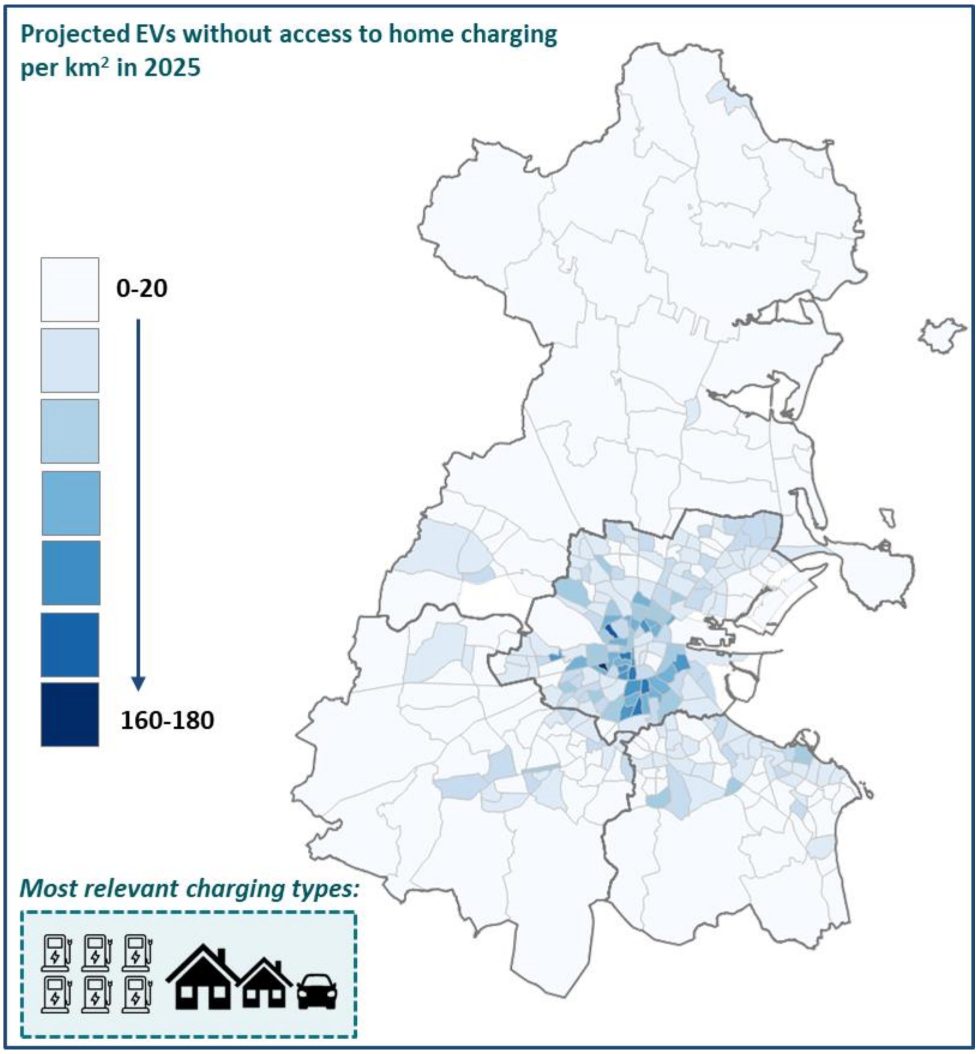


Figure 48: Projected number of EVs without home charging per km2 in 2025

Note: analysis limited by an assumed even distribution of EV uptake based on current spread of total vehicle stock between EDs. Current EV location data could not be obtained to inform geographic EV uptake modelling based on actual trends uptake trends, e.g. areas with early adopters.

6.2 Deployment approach map for each LA

This appendix contains the deployment approach maps specific to each Council. These are zoomed in versions of the map found in section 2.9.

Dublin City Council

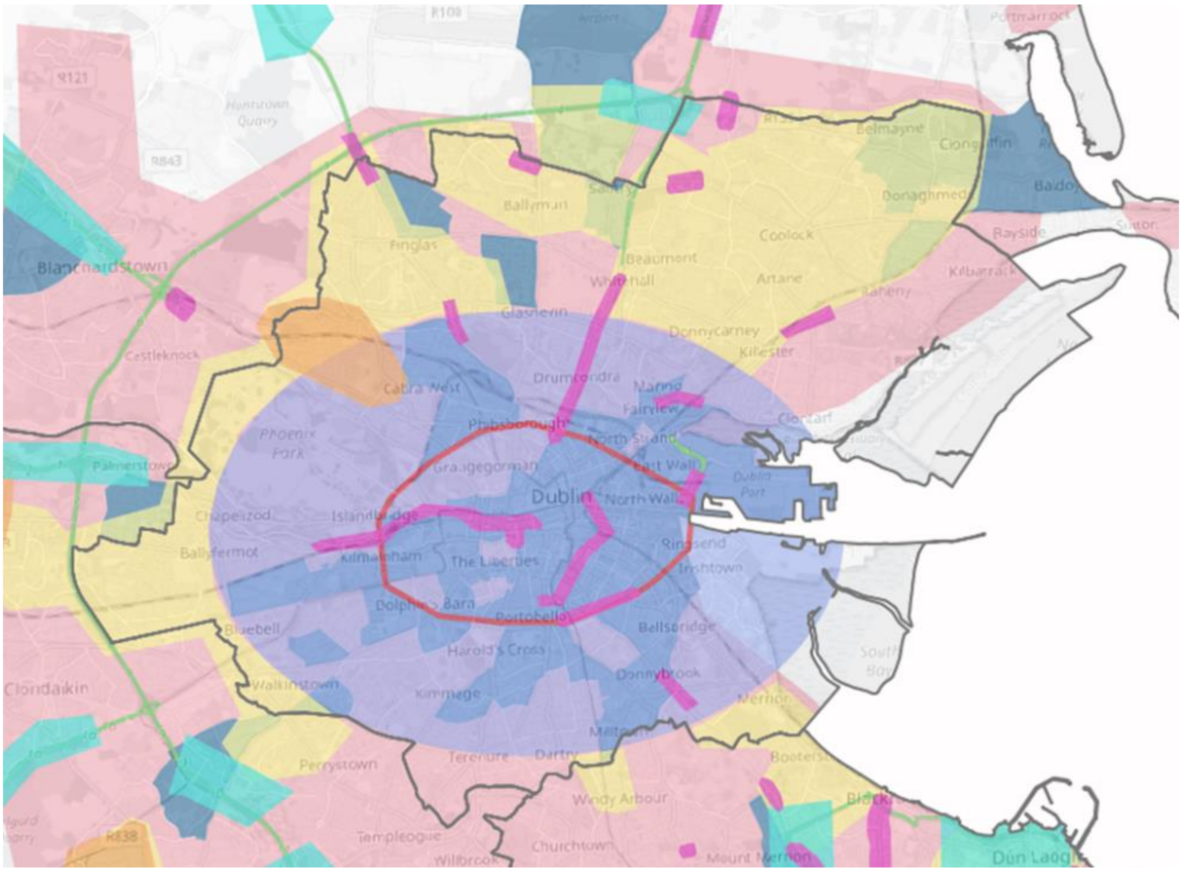


Figure 49: Dublin City deployment approach map

Fingal County Council

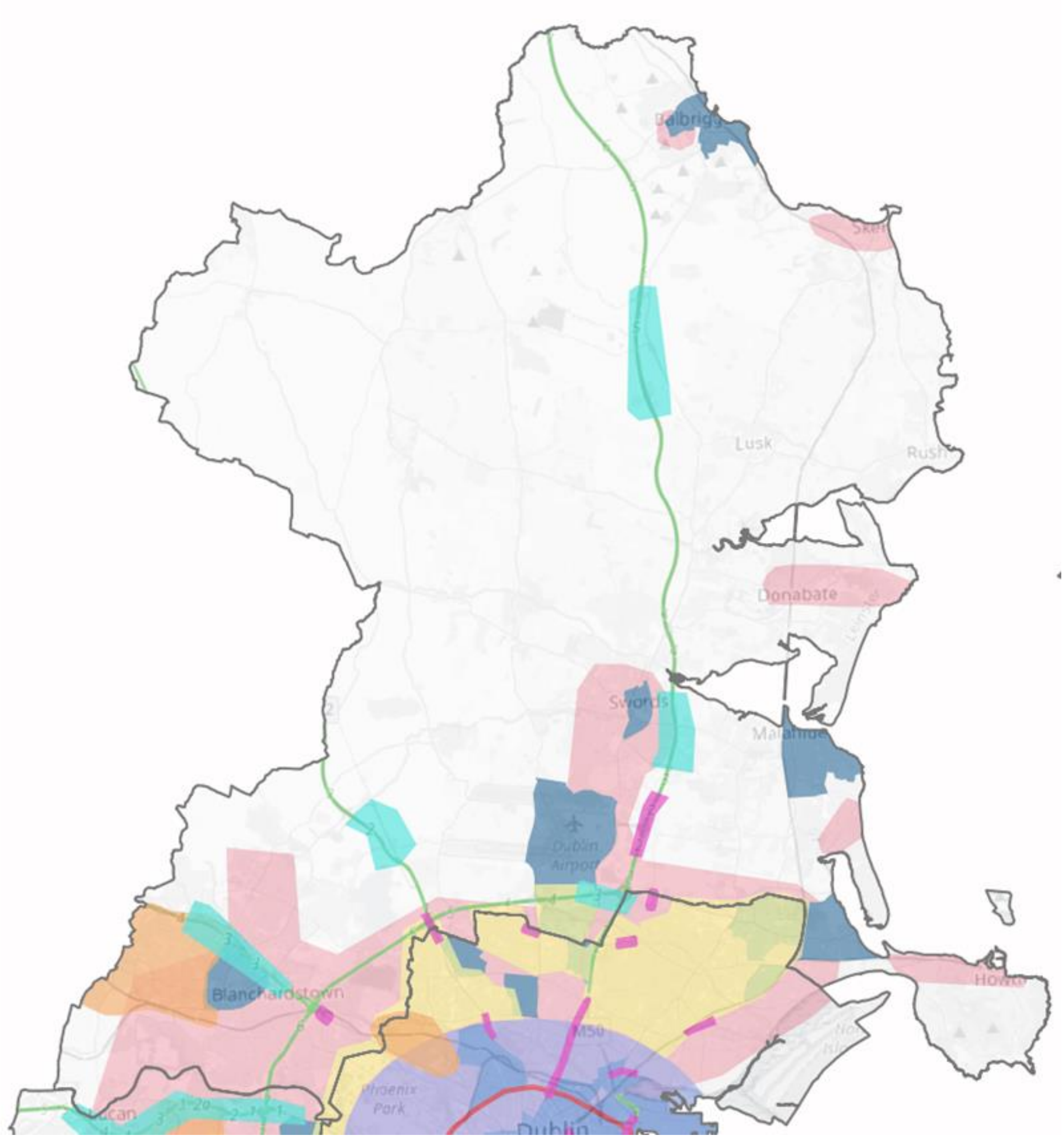


Figure 50: Fingal deployment approach map

South Dublin County Council

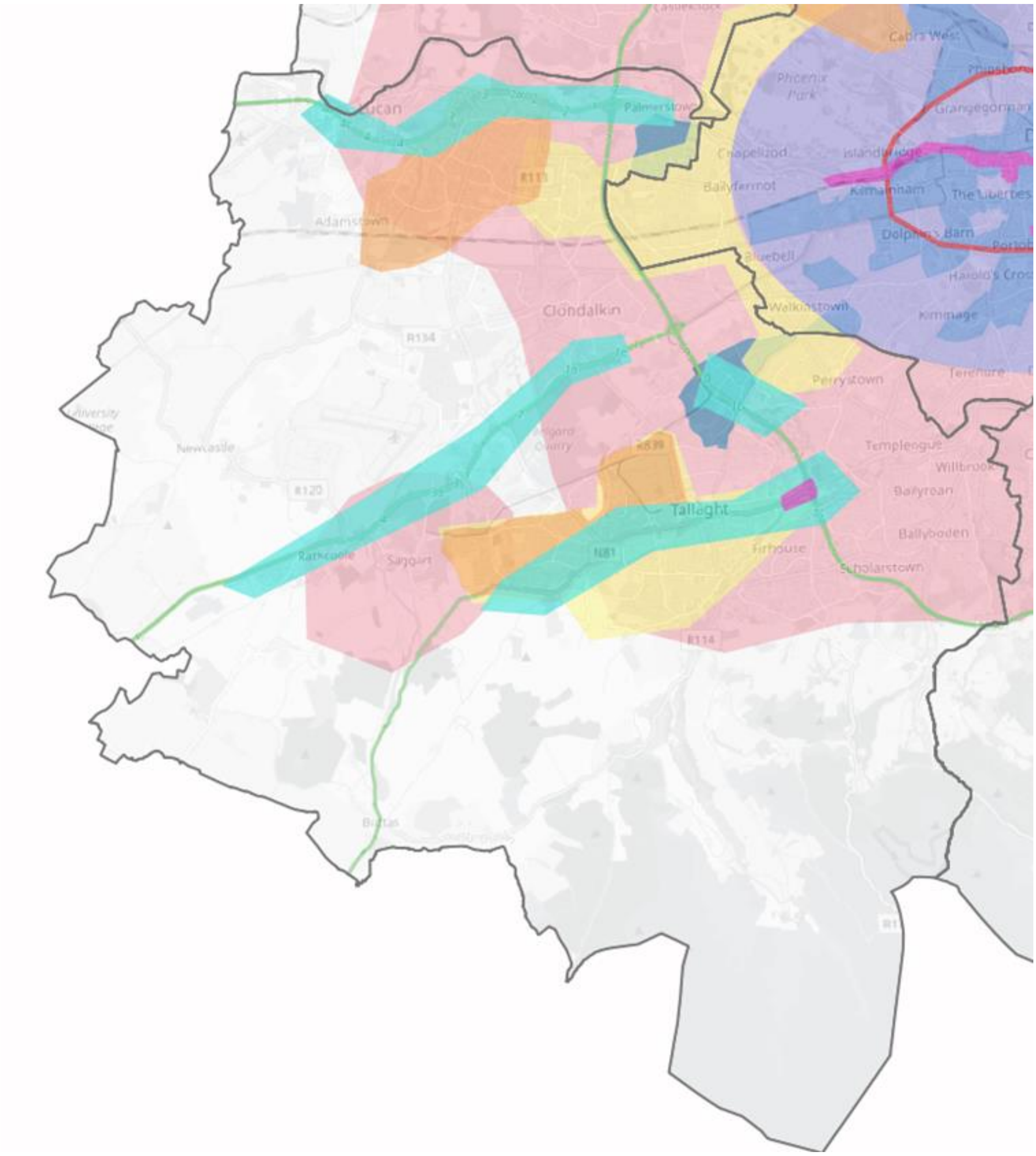


Figure 51: South Dublin deployment approach map

DLR County Council

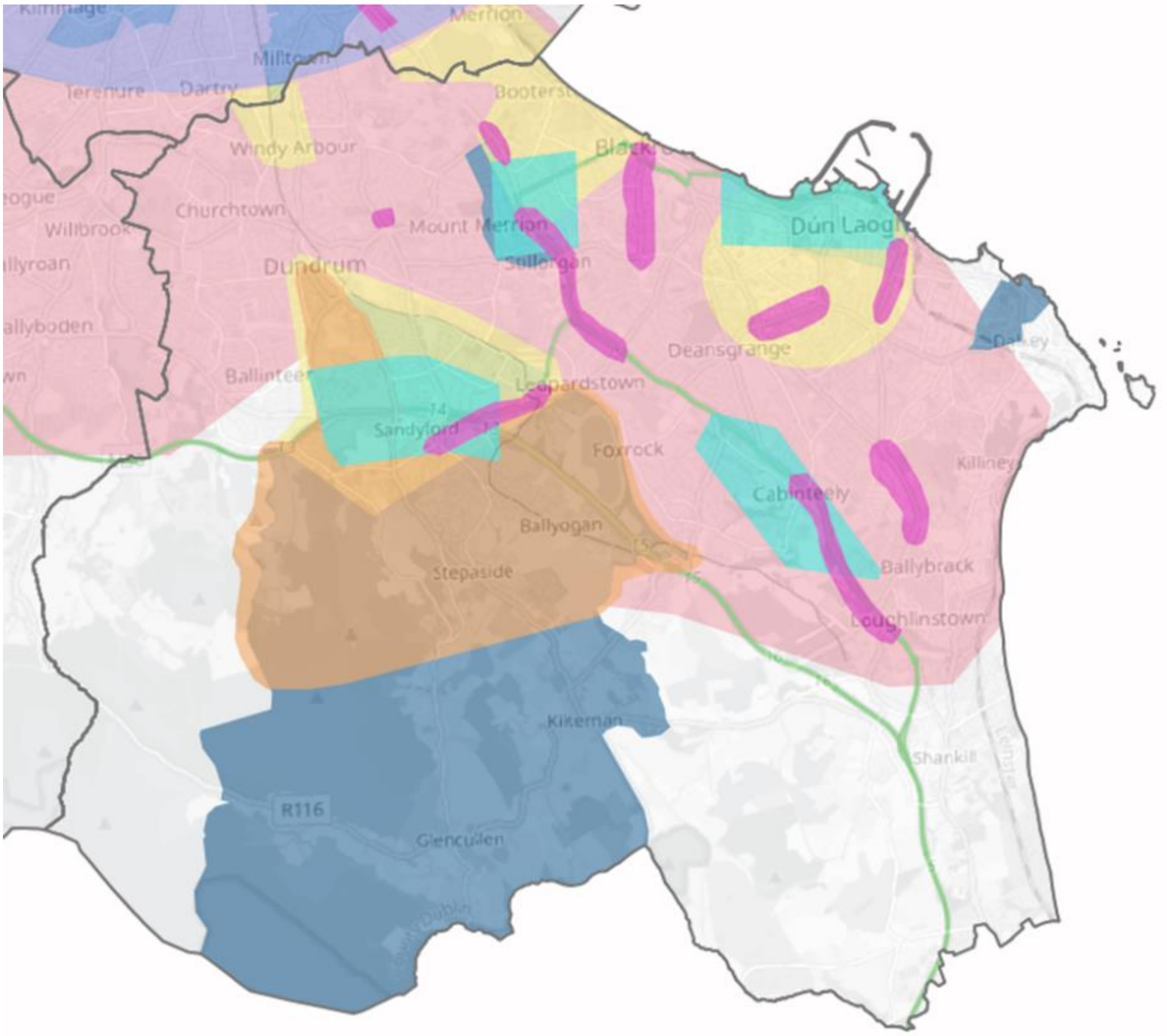


Figure 52: DLR deployment approach map

6.3 EV sales powertrain assumptions

The following graphs show the assumed split of annual EV sales by powertrain. These transition from the current powertrain split in the actual Dublin region stock in 2019 to the assumed future market situation in 2030.

Figure 53: Assumed split of annual car EV sales by powertrain

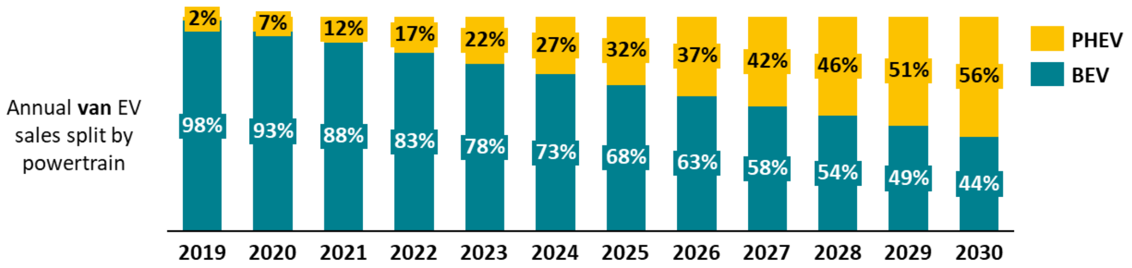


Figure 54: Assumed split of annual van EV sales by powertrain

6.4 Cashflow modelling assumptions

This appendix summarises the key cash flow modelling inputs.

2021 cash flow inputs	*Lamppost*	Standard	Standard	Standard
Hub size (no. devices)	*1*	*1*	*1*	*1*
EVCP kW	*7*	*22*	*50*	*150*
Hub kW	*7*	*44*	*50*	*150*
Cost per EVCP	Slow	Fast	Rapid	Ultra Rapid
Hardware	2,250 €	5,000 €	22,500 €	50,000 €
Install	3,400 €	13,400 €	16,500 €	30,000 €
Connection	1,750 €	2,760 €	3,820 €	7,780 €
Total	**7,400 €**	**21,160 €**	**42,820 €**	**87,780 €**
Annual maintenance	68 €	342 €	798 €	798 €
Annual operation	342 €	484 €	484 €	484 €
Annual hub standing charge	96 €	96 €	893 €	893 €
Annual EVCP standing charge	96 €	96 €	893 €	893 €
Annual hub capacity charge	0 €	0 €	1,667 €	5,000 €
Annual EVCP capacity charge	0 €	0 €	1,667 €	5,000 €
PAYG Tariff	0.26 €	0.27 €	0.33 €	0.42 €
Price of electricity	0.17 €	0.17 €	0.17 €	0.17 €

Figure 55: Summary of cash flow inputs for 2021 deployments

2030 cash flow inputs	Neighbourhood solution	Bollard	Bollard	Bollard
Hub size	*7*	*1*	*6*	*6*
EVCP kW	*7*	*22*	*50*	*150*
Hub kW	*49*	*44*	*300*	*900*
Cost per EVCP	Slow	Fast	Rapid	Ultra Rapid
Hardware	2,250 €	5,000 €	22,500 €	50,000 €
Install	3,400 €	8,000 €	16,500 €	30,000 €
Connection	546 €	1,910 €	1,555 €	2,538 €
Total	**6,196 €**	**14,910 €**	**40,555 €**	**82,538 €**
Annual maintenance	68 €	342 €	798 €	798 €
Annual operation	342 €	484 €	484 €	484 €
Annual hub standing charge	96 €	96 €	893 €	1,574 €
Annual EVCP standing charge	14 €	48 €	149 €	262 €
Annual hub capacity charge	0 €	0 €	9,999 €	10,359 €
Annual EVCP capacity charge	0 €	0 €	1,667 €	1,727 €
PAYG Tariff	0.26 €	0.27 €	0.33 €	0.42 €
Price of electricity	0.14 €	0.14 €	0.14 €	0.14 €

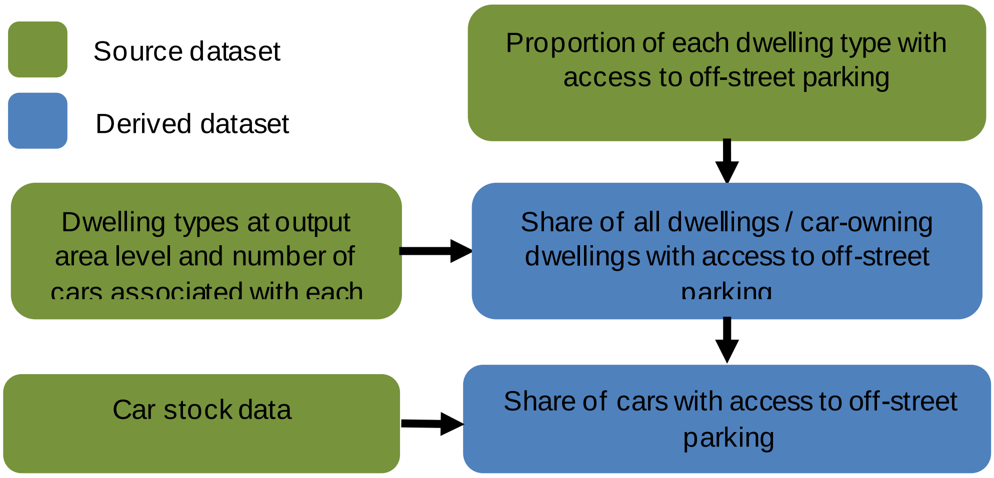
Figure 56: Summary of cash flow inputs for 2030 deployments

22kW devices have 2 x 22kW connectors, hence why the single charger hub is 44kW.

Note: in reality the hub kW (or kVA) connection would likely bsee less than the sum of the individual charger power capacities, due to the power actually drawn by EVs rarely being equal to the max power available for 22kW+ EVCPs and the low likelihood of all chargers starting a session at the same time (the power draw decreases during a charging session). However, for simplicity the grid connection costs are based on the EVCP kW capacity and number of EVCPs.

6.5 Off-street parking model diagram

The diagram below is for the Element Energy England Off-Street Parking Model. The main sources for the data are the RAC Foundation research on parking[13] and NOMIS datasets. Some local authority level surveys are also used to calibrate and sense check the model.



6.6 Discussion around the impact of rapid charging on EV batteries

Broadly, battery degradation can be separated into 1) calendar degradation - related to the age of the battery and 2) cycle degradation - related to the number of charge-discharge cycles the battery has experienced.

Predicting the actual degradation of a lithium-ion battery is difficult, as it's influenced by a number of factors, including[1]:

- Temperature (**strong** impact on both calendar and cycling ageing – degradation increases with temperature)
- State of charge (**medium** impact on calendar ageing – degradation increases when stored at high state of charge)
- Time (**high** impact on calendar ageing – degradation increases with time)
- Current throughput (**high** impact on cycling ageing – degradation increases with current throughput)
- Depth of Discharge window (**strong** impact on cycling ageing – degradation is higher for cycling within a large depth of discharge window)
- Rate of (dis)charge (**some** impact on cycling ageing – increases with the rate of (dis)charge)
- Cathode chemistry (**strong** impact on cycling ageing)

The impact of charging at 50kW instead of 3-22kW has been found to be very small. More importantly, vehicle manufacturers equip the EV with battery and charging management systems that ensure the charging rate received can be handled safely by the battery and in a way that minimises the impact on life. The actual charging rate when a BEV is plugged to a 50kW (or higher) point is actually decreasing at the state of charge increases. Secondly, EVs are limited in the max charging rate they will accept, again to ensure the battery is safe and not overly degraded. An important metric is the kW/kWh ratio (C rate) – the higher the C rate the harder it is for the battery. For instance, charging a 50kWh battery at 50kW (C rate =1) is fine, whereas charging a 12kWh battery at 50kW (C rate =4) is too demanding for the lithium-ion batteries commonly used in cars. This is why most PHEVs cannot charge at 50kW, and why many BEVs cannot handle 100+kW.

[13] Bates & Leibling, Spaced Out – Perspectives on parking policy, 2012

A report for:
Fingal County Council, Dublin City Council,
Dun Laoghaire Rathdown County Council
& South Dublin County Council

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