Shifting gear

How New Zealand can accelerate the uptake of low emission vehicles

Report 3: Electric vehicle charging infrastructure

20 December 2021

About this report

This is the third of three reports about policies to support the rapid transition away from combustion engine vehicles required to meet New Zealand's environmental and economic objectives.

It is an independent report from Concept Consulting in association with Retyna, supported by the following organisations who have provided funding or data:

> *AA New Zealand, ChargeNet, Contact Energy, Drive Electric, Fuso New Zealand, Genesis Energy, Imported Motor Vehicle Industry Association, Mercury Energy, Meridian Energy, Motor Industry Association of New Zealand, Orion, Powerco, Transpower, Trustpower, Unison Networks, Wellington Electricity*

We would like to thank the many individuals who have provided valuable input into our work. However, this report represents our analysis and views (and any errors within it are our own) and should not be construed as representing the views of any of the supporting organisations.

About Concept Consulting Group Ltd (www.concept.co.nz)

We have been providing useful, high-quality advice and analysis for more than 20 years. Our roots are in the electricity sector and our practice has grown from there. We have developed deep expertise across the wider energy sector, and in environmental and resource economics. We have also translated our skills to assignments in telecommunications and water infrastructure.

Our directors have all held senior executive roles in the energy sector, and our team has a breadth of policy, regulatory, economic analysis, strategy, modelling, forecasting, and reporting expertise. Our clients include large users, suppliers, regulators, and governments. Our practical experience and range of skills means we can tackle difficult problems and provide advice you can use.

About Retyna (www.retyna.co.nz)

Retyna is a specialist consultancy focusing on electric vehicles and renewable energy for transport. Retyna's Managing Director, Elizabeth Yeoman, was previously the General Manager Transport at EECA and led the set up and delivery of EECA's EV programme. She has worked in the renewable energy and transport fields for over 25 years in both the private and public sectors. Elizabeth recently became a director of ChargeNet.

Contents

Executive Summary

In 2017, the government set a goal of achieving nationwide coverage of fast charging stations for light electric vehicles (EVs) and set up co-funding arrangements administered by the Energy Efficiency and Conservation Authority (EECA).[1] This programme has been a success – it has helped overcome range anxiety for early adopters and there are now very few parts of the state highway network with more than 75 km travel distance between charging facilities.

This report, which is the third in a series of three looking at EV polices, examines three questions:

1. Is there an ongoing role for public funding of publicly accessible charging infrastructure?
2. How should such funding be structured?
3. What else should be done to support efficient charging infrastructure?

Is there an ongoing role for public funding?

While most EV charging will be overnight at home (or workplaces) there is a vital role for public charging to increase the utility of EVs by enabling longer journeys and improving access for those unable to charge vehicles at home. The case for public investment in charging infrastructure is at its strongest when:

- the fast-charger market is not mature
- EV purchase sentiment is fragile, and
- there are public benefits from supporting EV uptake.

In our view, all these factors still hold true and will do for several years.

The public fast charger market is now dominated by ChargeNet, with proprietary Tesla chargers in second place. There are more players involved in destination chargers[2] and private facilities, but the market certainly hasn't reached a state where there are multiple providers vying to deploy the full suite of public charging station types. This is because public fast charging stations are not yet commercially viable as a standalone service.

EV purchase sentiment also remains relatively fragile. EVs are not the mainstream option, but their position is rapidly improving thanks to the growing range of vehicles available, including at ever lower price points, reinforced by the introduction of purchase incentive policies. For now, although the lifetime cost of EVs is reaching parity with internal combustion engine (ICE) vehicles due to EVs' much lower fuel and maintenance costs, their higher upfront cost and novelty means potential purchasers can be put off by perceptions that charging facilities will not be available or will be congested. This is particularly the case for households without access to at-home charging.

In time, sentiment will become more robust – EVs will be the first choice for many buyers due to their falling costs, growing variety and transition from niche to mainstream. As EV momentum grows, buyers should become less easily put off by concerns about charger congestion – provided there are indeed sufficient chargers to meet demand. A transition from demand 'pull' to 'push' should also translate into more viable unsupported investment in charging infrastructure in time.

---

[1] See Waka Kotahi vision, including minimum requirements, at https://www.nzta.govt.nz/planning-and-investment/planning/transport-planning/planning-for-electric-vehicles/national-guidance-for-public-electric-vehicle-charging-infrastructure/enabling-a-nationwide-network-of-public-charging-infrastructure/

[2] Destination chargers are lower cost, but slower-speed, chargers located at places where people will anyway be spending a longer dwell period – eg, shopping centres, recreational facilities, and the like.

In the meantime, we think there is a strong public benefit from supporting charger investment. This is because EVs have a payoff now – from lower lifetime costs and avoided carbon emissions. There is an asymmetry between the potential cost of too much support versus the potential cost of too little support:

- the risk from too much support is that useful charger capacity is added too early and is underutilised. However, with a growing EV fleet, the risk of early investment leading to stranded assets is relatively low
- the risk from not enough support is that public EV charging infrastructure becomes congested, resulting in poor user experience and slowing overall uptake of EVs. This would likely result in more ICE vehicles entering the New Zealand fleet, with higher lifetime costs and carbon emissions.

In other words, the risk of investing in charging infrastructure early is significantly lower than the risk of investing in this infrastructure too late.

To test this balance, we have used the ENZ model that we developed for the Climate Change Commission. This includes an EV demand forecasting tool, and a high-level assessment of the amount of charger investment needed to support the EV fleet.

We estimated that, even if EV buying sentiment were to become so strong as to transition from 'pull' to 'push' by 2025, there would be a net benefit of close to $100m from continuing public funding support until that time. Under the more realistic scenario of a 2030 transition to a self-sustaining market, the net benefit is close to $1.4bn and the benefit to cost ratio improves for 3.5 to 17.

The analysis above considers public chargers for light passenger vehicles (LPVs) only. Two other areas with commensurately strong cases for public funding are:

1. heavy trucks – the largest trucks, with a tare weight of 20 tonnes or more, are small by number but travel long distances and have high emissions per km. Even the highest capacity (300kW) public fast chargers built in New Zealand to date cannot meet the needs of these vehicles, so there is a strong chicken-and-egg dynamic. This dynamic is exacerbated by public investment in hydrogen fuelling infrastructure, which contributes to doubts about battery-electric heavy transport. Since battery-electric is at least as likely to become the preferred solution for these vehicles, it would be prudent not to bet on hydrogen only
2. metro service vehicles – these include taxis, rideshare, delivery vans and light trucks. These vehicles travel long within-region daily distances, so have a relatively high energy use and public chargers targeting private passenger vehicles are not a good fit. Public investment in dedicated facilities for metro service vehicles – whether kerbside or at convenient rest sites – can have an outsize emission reduction payoff.

In addition, there may be value in further investment where lack of at home charging is a material barrier to uptake (or becomes a source of hardship).

How should public funding be structured?

The low emission vehicle contestable fund (LECVF) has operated using funding rounds, with funding priorities signalled in advance for each round and applications evaluated and funding awarded twice per year. This has delivered basic coverage of 50 kW sites, plus some higher-power sites in later rounds. While the approach has been largely successful and fit-for-purpose to date, it is time to reshape funding into two tracks:

1. accelerator fund (for near-commercial sites) – without public funding, we would expect existing sites to congest until demand becomes strong enough to bring forward more density (charging stations per vehicle). This is usually a desirable investment dynamic but, in this case, could deliver a level of congestion that would harm EV uptake sentiment. This fund should aim to harness

bottom-up commercial drivers of investment while delivering lower levels of congestion – by making a fixed contribution readily available to support any new public fast charging facilities.

2. public-good fund – in contrast to the accelerator fund, there is still a place for a more top-down centrally coordinated approach to funding investment that is more commercially challenging. This includes challenging LPV fast chargers (eg, sites with especially high costs or volatile demand profiles), facilities for households without access to at-home charging, and facilities targeting heavy trucks and metro service vehicles. This fund would continue to operate by inviting applications, but with more specific central direction.

Demand for fast charging facilities is inherently uncertain – including due to lack of experience with how user behaviour and commercial solutions will evolve as the market matures – but we have developed a high-level model of investment for the next few years to test the adequacy of funding arrangements. We estimate the accelerator fund targeting densification of near-commercial LPV fast chargers is likely to consume approximately 25% of the new Low Emission Transport Fund (LETF) each year for the next three years.

However, the LETF is also intended to cover other funding requirements, including those we class in the public-good bracket, such as higher-cost LPV sites, truck charging, metro service vehicle charging, communities with significant numbers of households who don't have access to at-home charging, and electrification of public transport (buses, trains, ferries, and planes). We have not modelled these uses, but it is likely that when these are included, the current proposed level of funding in the LETF will not be sufficient.

We note that, with basic coverage in place, spatial distribution (eg, the current target is to have a charger at least every 75km on the state highway network) is diminishing as a driver for investment:

- for the accelerator fund, investors will be driven by demand. The aim should be to increase density within communities where there is the prospect of congestion, or to tap new opportunities to attract drivers
- for the public-good fund, considerations such as cost of supply, the nature of demand (including the extent of access to at-home charging in a community), and the likelihood of commercial investment will be important.

The funds should be designed to support competition in the market for fast charging services. We think competition is viable, with relatively limited barriers to entry and a cost structure that would enable multiple suppliers to achieve competitive pricing levels. Competition is a critical enabler for investment transitioning to a self-supporting state and should drive experimentation and evolution of commercial models and service offerings. This is particularly important for a new service with a wide scope for differentiation. Without sufficient competition, there will be incentives on the dominant charger providers to only invest to a level that results in too much charger congestion than would be optimal.

Features that could be implemented to promote competition include:

- funding share limits – place limits on the share of funding any single provider can access in any period, and across periods
- concentration criterion – include market concentration as an evaluation criterion for the public-good fund
- exclude electricity distribution businesses (EDBs) from accelerator fund – participation by upstream monopoly suppliers can dampen competition
- limit scope of EDB participation in public-good fund – EDBs could provide site, electrical connection, and telecommunications infrastructures, but other parts of the service (such as the charging appliance and billing system) should be contestable.

For households without at home charging, we note that building more fast chargers may not be the best solution for supporting uptake or expanding access to EVs as a low-cost transport option. Additional funding targets could include:

- destination charging – destination charging is a partial substitute that may not normally warrant public funding support, but may be under-provided in some neighbourhoods with low levels of access to at-home charging
- vehicle share, or transport as a service – car ownership is not always the only (or best) option and EVs may be well suited to community solutions that provide shared access to a vehicle with on-site charging facilities
- part-contributions to electrification of off-street or kerbside parking spaces.

What else should be done?

Securing a suitable electricity supply is a major part of the challenge and cost of establishing a public fast charging facility. Providers report that EDBs vary considerably in their approach to providing network access – including in terms of timeframes, charges, and assistance determining hosting capacity.

There will be an extended period, through to around 2030, where fast charger availability will need to scale up rapidly to meet demand from the growing fleet of EVs. This will require many new sites, and the addition of more or higher-power appliances to existing sites. To prevent network access becoming a material barrier to rapid growth, we recommend that a network access regime should be developed like the regime for distributed generation. This would cover fees, processing timeframes, default contract terms, dispute resolution and pricing (including capital contributions).

A regulated access regime would have the dual benefit of standardising arrangements across the country and establishing settings that are favourable to fast charging infrastructure – for example, with prices at the lower end of the subsidy-free range and with a commercially attractive structure (in terms of the balance between up-front and ongoing charges, and between fixed and variable components).

Continued public funding provides a good opportunity to continue to gather information on the cost of supplying charging services, and demand patterns. This should include information aimed at informing ongoing operation of the funds (such as setting the contribution rate for the accelerator fund) and information that is useful to EV owners and potential investors in charging infrastructure. For the latter, government should continue to operate and enhance the EV Roam database.

It could also be prudent to build supportive polices into building and tenancy laws. This involves a mix of bringing regulation arrangements up to date with technology change and ensuring future proofing in the face of a rapid shift to electric transport:

- buildings – consider requirements to future proof buildings to be 'EV ready' by ensuring switchboard capacity and conduit (or prewiring) for electrification of carpark spaces
- tenancies – as with fibre internet access, ensure landlords support the ability of tenants to electrify parking spaces.

1 Introduction

This is the third of three reports into policies for accelerating uptake of low emission vehicles.

Our first report at the start of this year focussed on policies to support electric vehicle (EV) purchases – we estimated that our core recommendations for fleet emission standards, a feebate scheme, and several complementary policies, would generate around $15 billion of benefits to 2050. Most of the policy recommendations we covered have subsequently moved into implementation.

$15bn of benefits from EV **uptake** policies

Our second report focussed on electricity tariffs for at base charging. The convenience and low cost of charging EVs is a key advantage. Most charging operations will occur at home, using infrastructure that is already in place, and has the potential to take advantage of low-cost off-peak electricity supply. Our second report identified the type of electricity tariffs and associated market arrangements that would enable us to take advantage of the unique opportunity to accommodate EVs while reducing household and business energy costs and improving convenience.

More EVs, **lower cost** of energy supply

However, not all charging operations will use existing infrastructure, so supplementary investment in new facilities will be needed – especially in public fast chargers. Significant public funding has already been directed to charging infrastructure. With basic coverage now in place, it's time to reset funding arrangements for the next phase of development. This is the subject of this, our third, report.

It is time to **reset** funding arrangements

2 Context

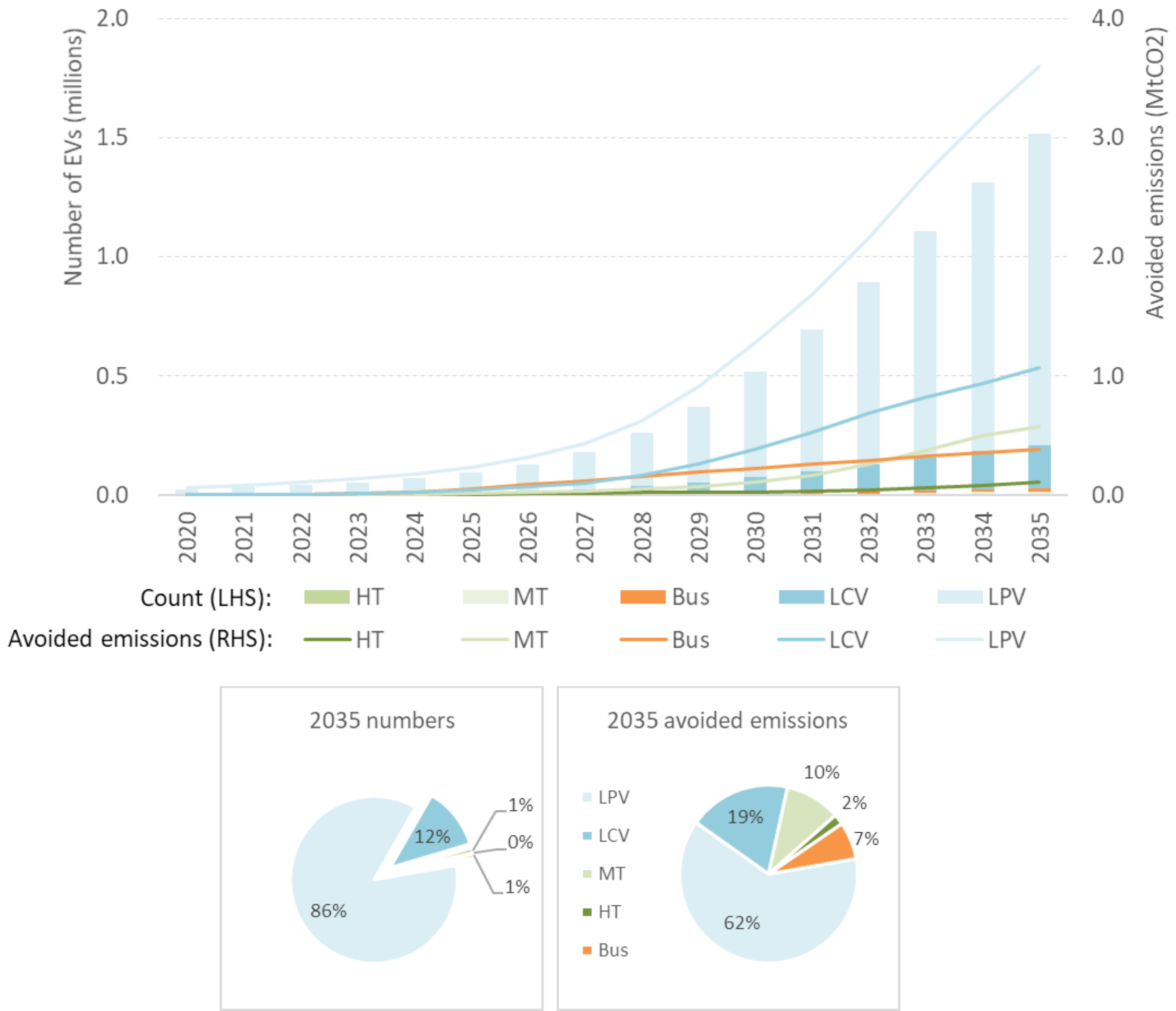
2.1 Transport will electrify rapidly

In our first report we forecast that, with well-designed and cost-effective policy support, New Zealand will experience rapid growth of EVs over the coming 30 years. This conclusion is consistent with subsequent projections from the Climate Change Commission whose analysis showed that rapid EV uptake would not only be cost-effective – even without a cost of carbon – but necessary for New Zealand to achieve its goal of achieving net-zero emissions in long-lived greenhouse gases by 2050.

Figure 1 shows forecast growth to 2035 in EV numbers and associated avoided emissions, and the status in 2035. Throughout this report we categorise vehicles as:

- LPV – light passenger vehicles – passenger cars and SUVs with a tare (ie, unladen weight) of up to 3.5 tonnes
- LCV – light commercial vehicles – utes and vans with a tare of up to 3.5 tonnes
- Bus – buses with a gross vehicle mass of more than 3.5 tonnes
- MT – medium truck, being trucks with a tare of 3.5 to 20 tonnes
- HT – heavy truck, being trucks with a tare of more than 20 tonnes.

Figure 1: With policy support, EV numbers are forecast to grow rapidly



Source: Concept analysis, consistent with Climate Change Commission demonstration path.

As shown by Figure 1:

- LPVs dominate in terms of vehicles numbers and avoided emissions
- the LCV fleet is much smaller, but makes a material contribution to avoided emissions due to the comparatively high fuel consumption per vehicle
- the MT fleet is small by number, but significant by 2035 in terms of avoided emissions
- the bus fleet is similarly small by number, but electrification should be rapid and significant in terms of avoided emissions
- HT has the smallest fleet and is comparatively difficult to electrify in these early years but offers the greatest avoided emissions per vehicle.

2.2 Away-from-base charging

This transition to EVs will not only change the type of ‘fuel’ we use to power our vehicles, but it will also bring a profound change in where and how people refuel their vehicles:

- because EVs offer the convenience of charging at the vehicle owner's home or business premises, relatively low-speed (and very low-cost) overnight charging will meet the needs of most vehicles most of the time. Arrangements to facilitate such 'at-base' charging were addressed in our second report
- however, at-base charging will need to be supplemented by some away-from-base charging. That is the subject of this report.

Unlike petroleum-fuelled vehicles, there are many different situations where away-from-base charging is required or could be delivered. We found it useful to group away-from-base charging situations as follows:

A. public fast charging for light vehicles – primarily used to extend range for longer journeys

B. high-capacity charging to provide range extension for trucks and coaches

C. metro – dedicated facilities for high-use service vehicles such as taxis, ride-share, delivery vans and light trucks

D. destination charging for light vehicles – facilities where the principal purpose is to visit the destination (eg, shop or leisure facility) with charging offered as an additional service

E. charging for households without access to an at-home powered car park.

Depot charging (eg, for buses) is out of scope for this report as it is an at-base charging requirement. However, we note that:

- electrification of public transport will be a significant contributor to capacity demands for urban distribution networks. After years of relatively stable growth, some networks will have limited capacity headroom and will need to invest to accommodate this new demand
- the need to plan, fund and deliver growth investments could be a significant source of friction and delay for ambitions to electrify public transport. This will require some patience, collaboration and supportive arrangements for revenue recovery and capital contributions
- otherwise, there appear to be several large fleet operators successfully leading the way in electrifying depots and carparks, and this early work is helping foster an ecosystem of people and firms with experience in how best to plan, deliver and manage charging facilities.

2.3 Suppliers and service layers

There are a range of potential fast charging suppliers, with examples of each having some involvement or interest already in New Zealand.

Figure 2: Fast charging services have a range of potential suppliers.

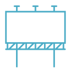
Supplier	Description	Comment
Independent	Standalone charge point operator.	ChargeNet is an independent operator with NZ's largest public fast charging network.
E-mobility	Providers of transport-as-a-service.	There are a range of businesses aiming to provide an alternative to car ownership, and charging could be part of the service.

Supplier	Description	Comment
EV suppliers	Manufacturers or distributors of electric vehicles.	May invest to differentiate their product (eg, Tesla) or to support EV sales volumes.
Fuel retailers	Existing operators of liquid fuel stations.	May invest to leverage existing brand and sites, and transport sector know-how.
Electricity retailers	Existing electricity retailers.	May invest to leverage (or enhance) their brand, increase customer loyalty, and leverage existing billing infrastructure and electricity know-how.
Electricity distributors	Owners of local electricity networks.	May extend services into a downstream market to leverage electricity know-how, promote network usage or support local community.

Fast charging can be thought of as having separate service layers, with the possibility of different suppliers for each layer.

Figure 3: Fast charging can be divided into service layers.

Layer	Description	Comment
Site	Paved area in a suitable location with road access and other facilities (eg, lighting and stormwater).	May be dedicated site or part of another parking facility. May be on road reserve, or private land.
Electricity connection	Electrical connection from local network to the site.	Can be a material component of up-front cost, particularly if network reinforcement or long cable run required.
Appliance	Charging device(s).	Can be largest up-front cost component and major contributor to customer experience.
Communications	Connection to telecommunications network.	Supports billing and remote monitoring or management.
Servicing	Inspection and maintenance of site and appliances.	Coverage and capacity cam materially impact reliability and general condition.
Energy	Supply of electricity.	Major operating cost component.
Billing	System for managing access and payment.	Major contributor to customer experience.

Layer	Description	Comment
Wayfinding 	System for ensuring customers can locate the facility.	Can include information on capability and location, and operating information (eg, 'fault' and 'in use').
Promotion 	Marketing the facility (or network).	Objectives likely to shift from awareness to sales growth and provider positioning as market matures.
Amenities 	On-site facilities for use while waiting.	Could range from simple bathroom facilities, to more elaborate 'club lounge' facilities.
Attendant 	On-site assistance with charging, or ancillary on-site services.	Optional component. May become useful as the market matures for managing congestion or providing premium experience.

3 Public funding to date

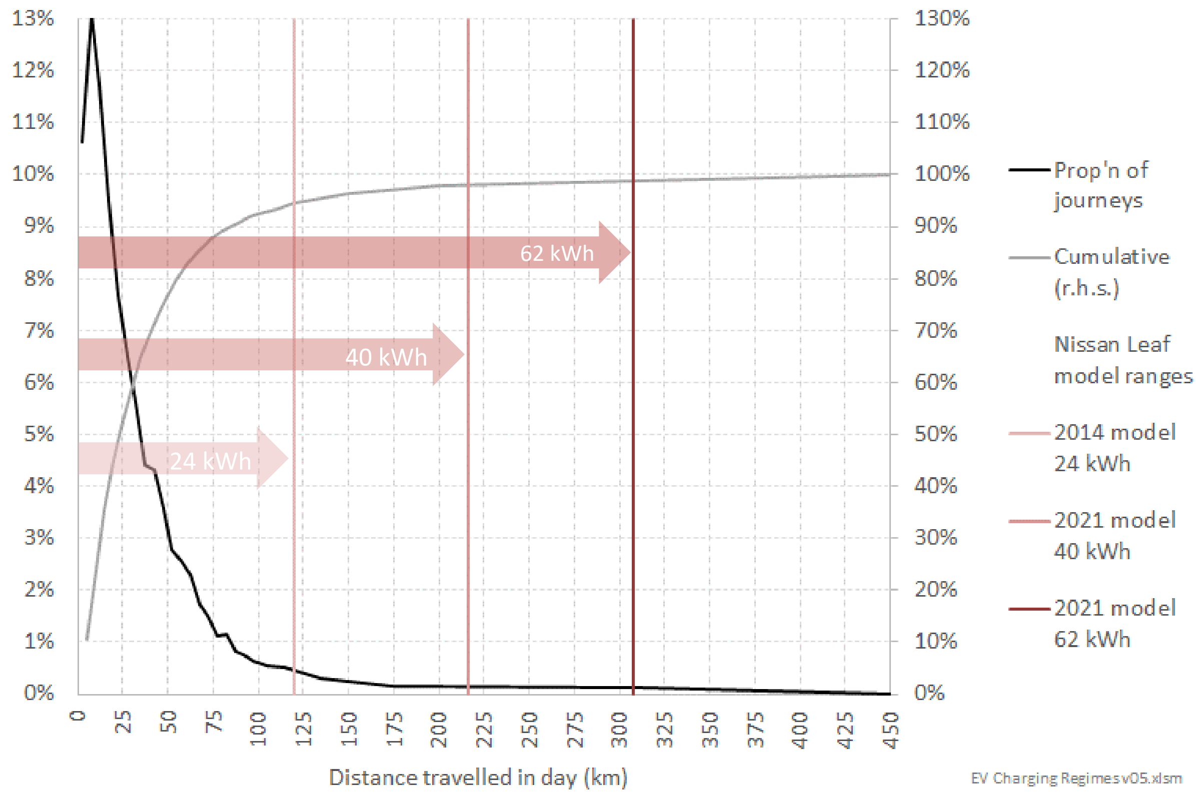
3.1 Early focus has been on LPV fast chargers

Much of the early focus on EV charging infrastructure has centred on public fast chargers for light passenger vehicles. These are sites with one or more high-capacity charging points that are open for public use, usually with some form of billing system and often close to amenities for drivers to use while charging.

In this section, we focus on use of public fast charging to extend the range of light EVs. Early EVs had a much shorter range than internal combustion engines (ICEs), so having a basic network of public fast charging points has been important for enabling longer journeys and overcoming 'range anxiety' amongst early adopters.

Figure 4 below illustrates that, while most journeys are well within the range of even modest EVs, long journeys (including multi-day trips, or days with many smaller trips) require access to away-from-base facilities. This may be en-route between towns (to extend a journey mid-way), at a destination town (to recharge for the return journey or onward travel), within a region (to support cross-town or cross-region trips) or near home (to support multiple return-to-base trips).

Figure 4: Even modestly rated EVs can cover most journeys.



Note: Data supplied by Ministry of Transport, based on Household Travel Survey (2011 to 2014). Nissan Leaf ranges based on stated values, derated by 80%.

'Fast' chargers, also known as 'Level 3' chargers,[3] use dedicated appliances to supply a direct current (DC) charge at peak power of 22 kW or more, with 50 kW being the most common rating in New Zealand. However, as high-end EVs are emerging with larger battery capacities and the capability to charge at much higher rates, higher capacity chargers are starting to be installed with capacities of up to 300 kW.

As Table 1 illustrates, these faster rates will reduce the time to add range.

Table 1: Range added (km) from by charging time at various kW charger ratings

Power	Charging Time		
	5 minutes	20 minutes	40 minutes
50 kW	18 km	71 km	142 km
175 kW	63 km	250 km	500 km
300 kW	117 km	469 km	938 km

Note: Charging times based on data reported at https://blog.evbox.com/level-3-charging-speed and (conservatively) assume vehicle efficiency of 6.25 km per kWh.

Fast chargers do not add range as quickly as refuelling a petrol or diesel vehicle. So, while public fast chargers are somewhat analogous to petrol stations in the role they play, they differ in important respects, including:

- supplementary – unlike petrol stations, public fast chargers will not be the main way most people refuel their vehicle. Many EV owners very rarely need to visit a public fast charger – only on rare days of taking much longer journeys than normal. Slow chargers, whether at base or away-from-base at destinations, take advantage of natural vehicle downtime to provide more convenient and low-cost refuelling
- dwell time – EV charging sessions are typically longer than liquid refuelling sessions, so on-site or nearby facilities can be an attractive feature
- scale and siting – charging sites are smaller and less obtrusive than petrol stations, so there is greater siting flexibility. However, variations in electrical connection costs are a major driver of suitability for higher power sites.

Most fast charge stations are open to any vehicle, with connectors that can accommodate most New Zealand EVs, and billing arrangements that are easy to access. This open infrastructure is supplemented by proprietary networks – the largest of which (in New Zealand and globally) is the Tesla supercharger network. Proprietary networks add value for the parent brand, but also help relieve congestion at open sites.

3.2 Basic coverage is largely in place

Most fast charger investment to date has been supported by EECA's low emission vehicles contestable fund (LEVCF). Of the $40 million LEVCF funding to date, approximately thirty percent ($12 million) has gone toward supporting approximately 400 public fast charging sites.[4]

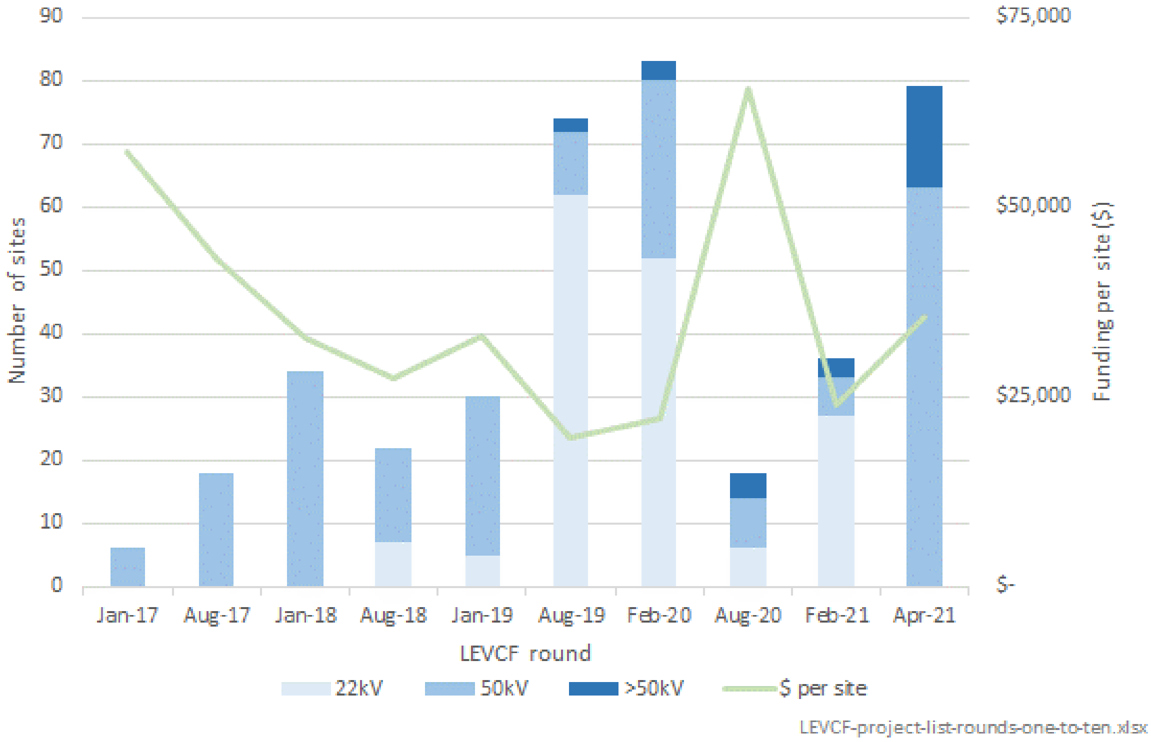
---

[3] Level 1 and 2 chargers supply AC power to the vehicle which is then converted to DC using the vehicle's onboard AC/DC converter. Level 3 chargers supply DC power directly to the vehicle via an AC/DC converter within the charging station.

[4] Based on review of LECVF public information for rounds one to 10. Count is of public charging sites (not appliances or charging points) with peak power of 22kW or more.

As illustrated in Figure 5, in recent funding rounds, an increasing proportion of funding is going to higher capacity (175 or 300kW) sites.

Figure 5: Public funding is shifting toward higher power sites (which also provide more charging points per site).

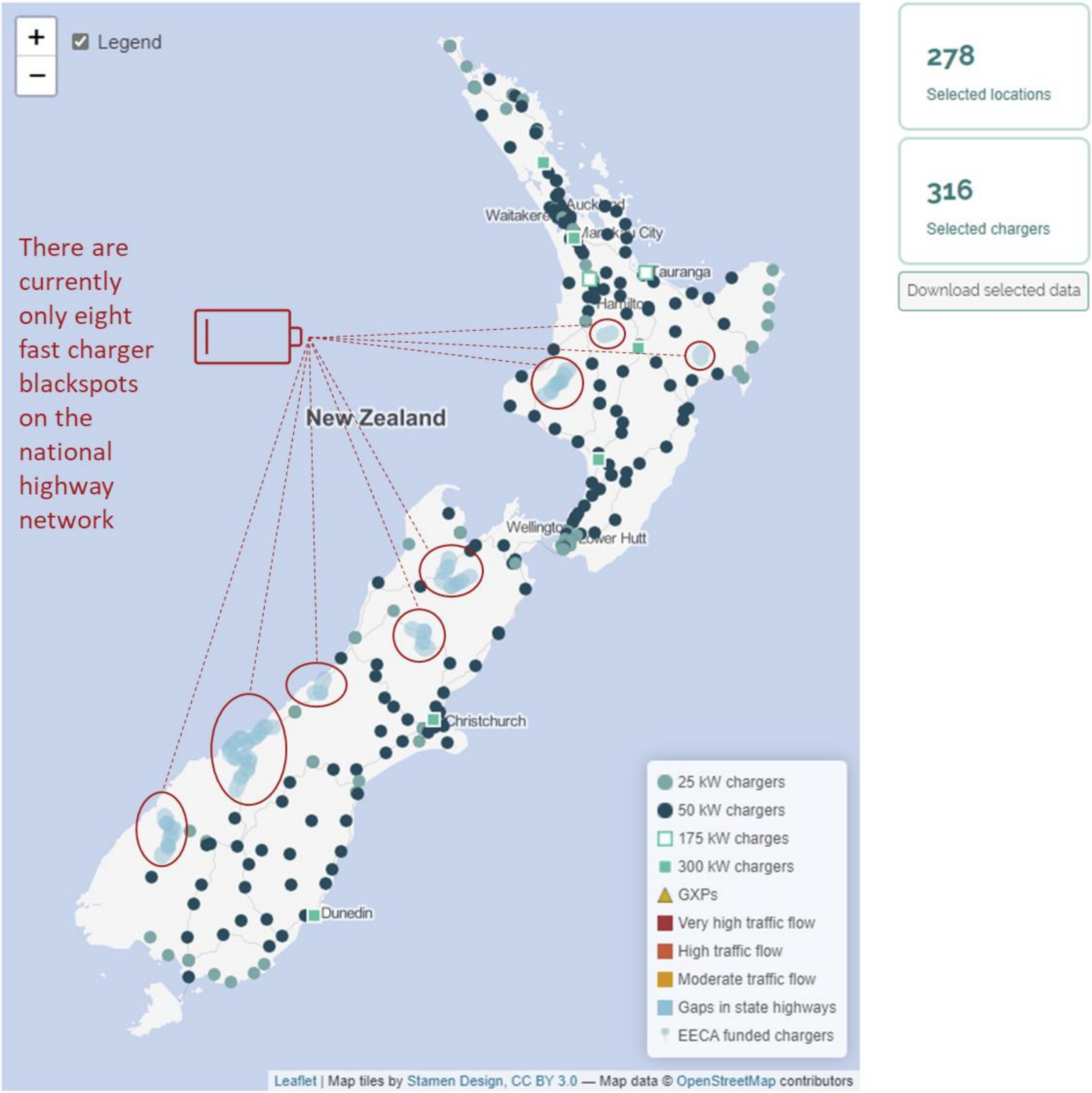


Notes: Chart based on analysis of publicly available information on the funding rounds.

Public funding has played an essential role in successful early roll-out of fast chargers for the state highway network. A key focus of this initial roll-out was achieving *coverage* – having at least one charger within a 75 km radius of any part of the state highway network. This 75 km was based on the needs of early-generation EVs with smaller batteries (eg, the 24kWh Nissan Leaf shown in Figure 4).

As shown in Figure 6, there are now only a few parts of the state highway network further than 75 km from a public fast charger (all in very remote areas), which means coverage is sufficient for early-generation EVs to travel almost nationwide. This position will improve further as longer-range EVs enter the NZ fleet, however the prevalence of second-hand EVs imports means the needs of early generation EVs will remain relevant for many years.

Figure 6: There are only six fast charging blackspots on New Zealand state highways



Note: Map sourced from EECA on 15 November 2021. https://www.eeca.govt.nz/insights/new-zealand-public-ev-charger-map/

Developing this early basic coverage had a good case for public funding because it overcomes an initial hurdle to EV uptake – reducing range anxiety in people considering purchasing an EV – and was unlikely to emerge without public funding during this early low-demand stage of market development. Solely private-funded investment was unlikely to occur to a sufficient level due to:

- the chicken-and-egg situation of parties not wanting to invest in chargers until there was a large enough market for their chargers, but consumers not wanting to purchase EVs until there were sufficient public chargers available
- the dynamic that building for coverage delivers low density (EVs per charger) and hence low utilisation, which makes achieving full cost recovery unlikely for most stations and for some time.

This initial round of investment has helped build some operator capability and raised public awareness of EVs. With basic coverage in place, the next phases of fast charger investment will increasingly deliver:

- density – charging sites will congest as volumes grow so there will be demand for more charging sites, and more points per site
- resilience – basic coverage does not provide fallback options when a charger is out of operation
- extended coverage – basic state highway coverage may leave regional coverage gaps
- premium coverage – there will be demand for sites with high power or superior amenities
- market development – evolution in suppliers, services, pricing, and demand.

4 Future of public funding

4.1 There is an ongoing role for public funding

If public funding were stopped now, we would expect to see an initial slowdown in the rate of investment, adjustments to pricing and other attempts to manage congestion by spreading usage across the day or week, followed by resumption of investment as more heavily utilised sites become profitable enough to support expansion.

Ordinarily, this would be a healthy dynamic for infrastructure investment. Some level of congestion is usually efficient and over time would help to stimulate investment where it is needed, attract competitors, spur innovation, and establish a balance between fast chargers and other services that can meet some of the same underlying demand (such as destination charging, or valet charging services). These dynamics are particularly attractive for a service where so much is unknown about how supply and demand will evolve – eg, what mix of charger types, pricing arrangements and supporting services will provide the best outcomes.

Fast charging for light passenger vehicles is also well suited to decentralised, demand-led investment because entry to the market is relatively low-cost and will become attractive as overall demand grows. While there are some fixed costs per supplier, they will not be insurmountable as demand grows. Similarly, there are fixed costs to establishing each site, but each site also has capacity and catchment limits such that competition between sites will be feasible as demand grows. Finally, there is considerable scope for differentiation in service offering, including for such things as siting and amenities, charging facilities, billing, and congestion management.

However, there are several factors that argue in favour of continuing funding into the next phase:

- the risk of stimulating over-investment is low. As illustrated in Figure 1, the demand for fast charging capacity should grow rapidly in coming years such that any oversupply should be rapidly absorbed provided it is reasonably located. If funding remains a part-contribution to upfront costs, investors will bear residual demand risk and remain incentivised to find the best locations and service proposition
- the risk of slowing EV uptake remains high. As per our first report and the Climate Change Commission's economic analysis, the potential benefit from rapid EV uptake is large. Uptake is being driven by EVs becoming more attractive as prices fall, new models arrive, and buyer sentiment improves. However, sentiment remains fragile at this early stage and would likely be soured by worsening fast charger congestion
- the market remains immature. There are few operators, and only one with nationwide scale. This heightens the risk of a lengthy period of stalled investment and service deterioration during any transition to self-sustaining investment
- deliverability risks may arise as demand continues to ramp up. As the number of EVs on New Zealand roads surges in coming years, the number of charging points needing to be installed each year will ramp up rapidly. This presents a risk of congestion flaring if there is not enough capacity and momentum in the supply chain.

In summary, there is a significant asymmetry in outcomes between under-investment and over-investment in fast chargers:

- over-investment should soon be absorbed by growing EV uptake – ie, the consequence is capital being invested in charging infrastructure a few years too early (but ultimately proving useful)
- in contrast, under-investment will frustrate EV uptake causing individuals to choose ICE vehicles rather than EVs – ie, the consequence is irreversible costly investment in the wrong capital assets.

To test this balance, have used the ENZ model that we developed for the Climate Change Commission (CCC). This includes an EV demand forecasting tool, and a high-level assessment of the amount of charger investment needed to support the EV fleet.

We tested the asymmetry with scenarios for when investment transitions to a fully self-sustaining footing – ie, when strong EV purchase sentiment drives uptake and spurs sufficient fully commercial investment in charging facilities.

Using the pattern of EV uptake in the CCC's Demonstration Path as a base projection, we ran the model with a two-year delay (relative to this base uptake) occurring up to a transition year, after which uptake reverts to the Demonstration Path.

The present value out to 2050 of all vehicle costs (capital purchase and maintenance, petroleum fuel, electricity, and emissions) for this delayed pattern of uptake was compared with the present value of vehicle costs for the Demonstration Path. This gives the cost of uptake being delayed by two years up until to the transition year.

We compared this with the cost of bringing forward charger investments by two years (again up to the transition year) compared to the charger investment pattern in the Demonstration Path.

We repeated this analysis for three scenarios for when the market transitions to being self-sustaining: 2025, 2030, and 2035. Results are shown in the Table 2.

Table 2: Public funding is beneficial while uptake sentiment remains fragile

	Transition Year		
	2025	**2030**	**2035**
Cost of early charger investment ($m NPV)[1]	39	86	97
Benefit of preventing EV uptake being delayed ($m NPV)[2]	134	1,471	2,686
Net benefit ($m NPV)	95	1,365	2,590
Benefit:Cost Ratio	3.5	17	28

Notes:

1. Charger costs, including public funding contribution.
2. Benefits are from reduced non-charger costs, which include vehicle purchase and maintenance, fuel production and delivery (petroleum or electricity) and carbon emissions. We have not included human health benefits from reduced tailpipe emissions.

Even if EV buying sentiment were to become so strong as to remove the case for any further public support for LPV charging infrastructure as early as 2025, we estimate a net benefit of $95m from continued public funding support until that time. We note that 2025 is very optimistic and is used here to stress test the asymmetry analysis rather than as a prediction of when funding could be withdrawn. We suspect that 2030 is a more realistic estimate of the time when investment in LPV public chargers could become fully self-sustaining.

The analysis above considers fast chargers for LPVs only. Two other areas with commensurately strong cases for public funding are:

1. heavy trucks – the largest trucks, with a tare weight of 20 tonnes or more, are few in number but travel long distances and have high emissions per km. Even the highest power (300kW) public fast chargers built in New Zealand to date cannot meet the needs of these vehicles, so there is a strong chicken-and-egg dynamic. This dynamic is exacerbated by public investment in hydrogen fuelling infrastructure, which contributes to doubts about battery-electric heavy transport. Since

battery-electric is at least as likely to become the preferred solution for these vehicles, it would be prudent not to bet on hydrogen only

2. metro service vehicles – these include taxis, rideshare, delivery vans and light trucks. These vehicles travel long within-region daily distances, so have a relatively high fuel burn and public chargers targeting private passenger vehicles are not a good fit. Public investment in dedicated facilities for metro service vehicles – whether kerbside or at convenient rest sites – could have an outsize emission reduction payoff.[5]

In addition, there is likely to be merit in contributing to community chargers that support uptake for households without access to at home charging.

We address all three cases in section 4.4.

4.2 Has enough funding been allocated?

For context, we have developed a high-level indication of how EV growth may translate into LPV fast charger demand and investment over the coming five years. This is a more detailed assessment than the ENZ modelling described above, though still high-level in part because demand for infrastructure is inherently uncertain for many reasons, including:

- inherent demand – fast chargers have partial substitutes, including in the form of at-base charging and destination charging. Fast charger demand will be influenced by the availability of these substitutes. Also, private vehicle travel has substitutes, so the link between forecast vehicle numbers and distance travelled is also uncertain
- user preferences – as with any new technology, user behaviour is uncertain at this early stage of uptake. EV users today are early adopters, and their behaviour may not be indicative of mainstream consumers or late adopters. Also, behaviours and preferences are likely to evolve over time as charging becomes normalised and people find new ways to build charging into their journeys and routines
- commercial models – as volumes increase, there will be considerable value to be gained from improving the utilisation of each EV charging station. We should expect to see innovation in pricing, facility design and other aspects of the fast charger offering aimed at spreading demand to improve utilisation
- capacity mix – the number of chargers needed to adequately meet any given level of demand depends on the capacity of the chargers – eg, a smaller number of 150 kW chargers may be able to meet the same level of demand as a larger number of 50 kW chargers (depending on vehicle capabilities) and lower power destination chargers can provide a partial substitute for other public fast chargers.

Given these uncertainties, we don't think accurate forecasting is possible, but have applied simplifying assumptions to provide a basic indication of the demand for public funding:

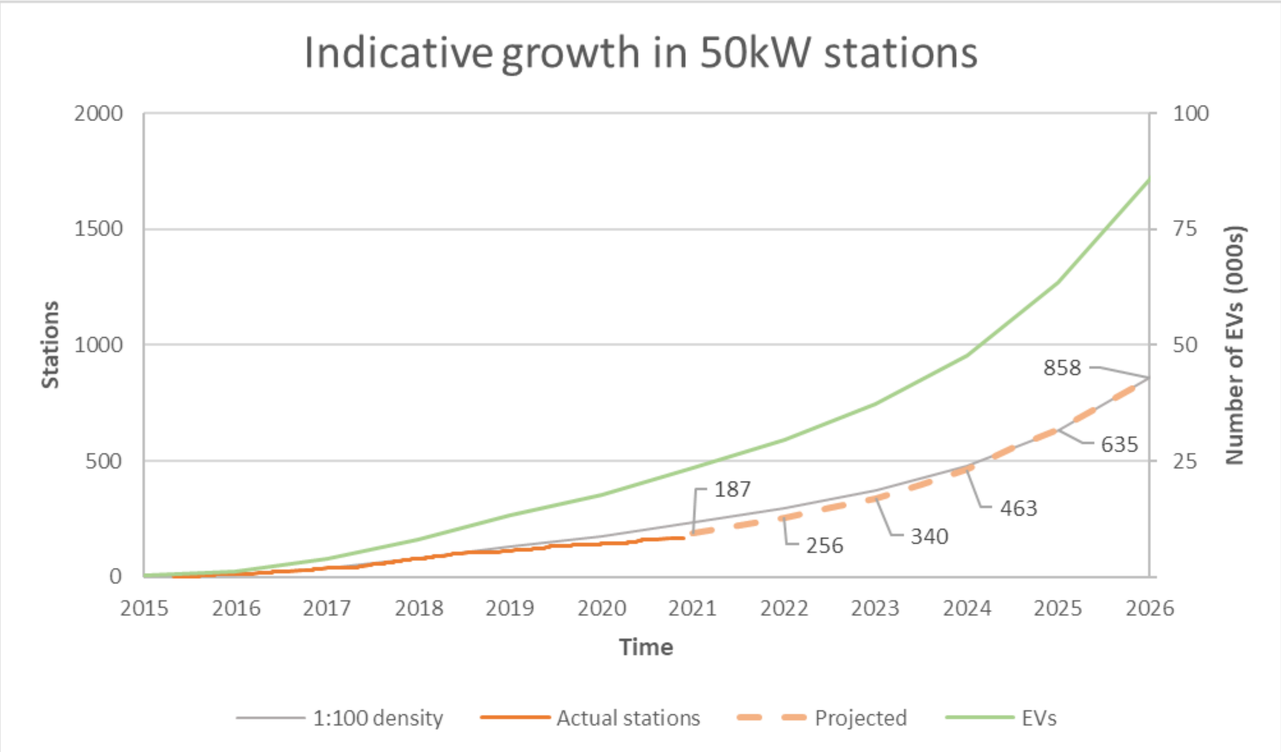
1. a target rate of one public 50 kW charging station per 100 EVs. We assume each station can (when enabled and with carparking provided) provide two charging points. This provides a reasonable baseline for our purposes, though international guidelines range from 50 to 300 EVs per charger. Factors that argue in favour of higher density (fewer EVs per charger) include low availability of at-home (or destination) charging and early market development, while more mature markets may need lower densities due to demand diversity and the ability for demand to "overflow" from one station or site to another

[5] These vehicles are also a leading source of particulate emissions in areas with high populations. As such, there is an air pollution and human health payoff to electrification of metro service vehicles.

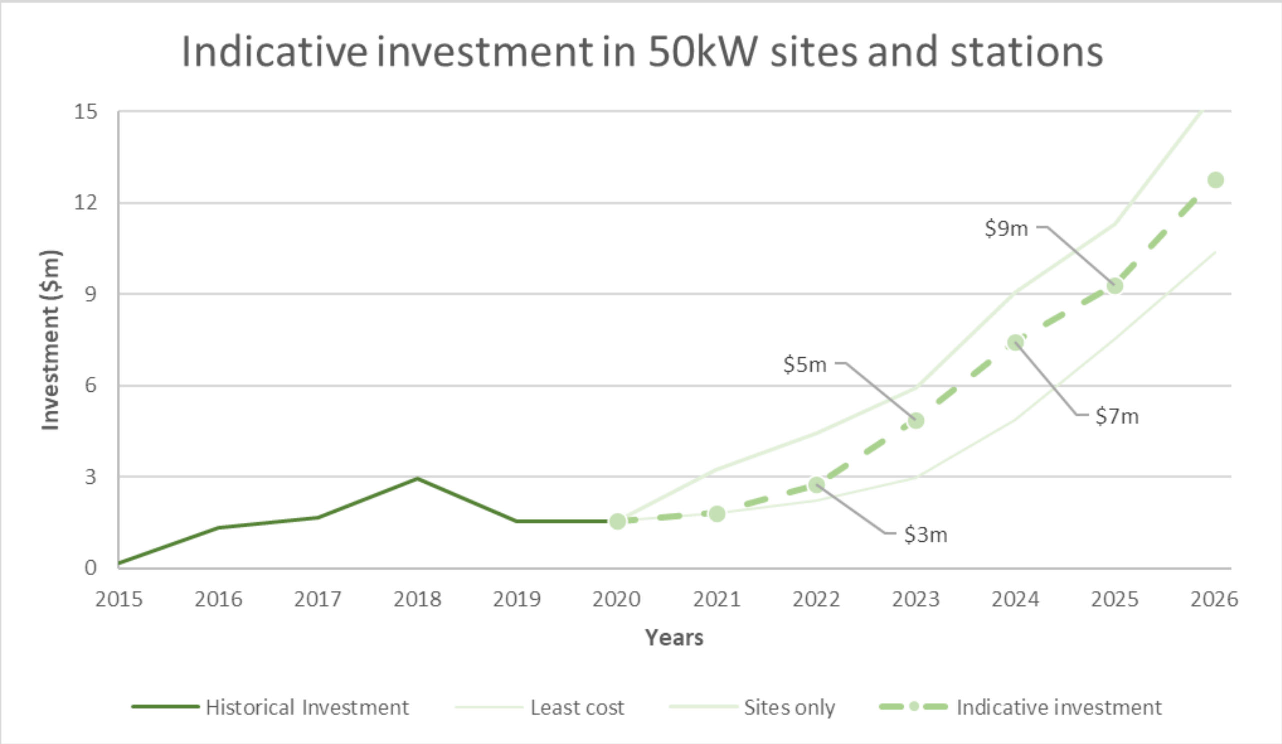
2. expansion can be met through a mix of new sites and expanding existing sites. We assume each established site can scale from two to six charging points
3. the cost of a new site with two charging points is $60,000 based on the average cost from LECV round three.[6] We assume an incremental cost of $30,000 per two additional points at an established site[7]
4. the starting point is 140 EVs per 50 kW station. We assume a transition from this density toward the target density over the period from 2022 to 2025
5. for simplicity we model the starting state as two points per site. We assume investment will be balanced between establishing new sites and adding points to existing sites – ie, it doesn't follow a least cost path, which would favour reinforcing existing sites wherever possible. Nor does it follow an expensive 'sites only' path.
6. demand is met through 50 kW sites only[8]
7. charging is provided to meet demand from light passenger vehicles only. As discussed elsewhere, there is the potential for significant demand from light commercial vehicles to add to demand for this charging infrastructure.

The following charts show our forecast in terms charging stations, and total investment required each year.

Figure 7: Demand for fast charging is set to grow rapidly, demanding increasing investment.



[6] Round 3 of the LEVCF, which ran in January 2018, contributed $33k per site for 34 50kV sites. We have assumed a contribution rate of 50% for these projects, which is the maximum rate for the LEVCF (hence our assumption is conservative).
[7] Based on discussions with charging providers.
[8] This means we are ignoring more expensive high-power sites that would increase total cost, and less-expensive low-power sites that could complement 50 kW sites and reduce total costs.



The analysis indicates that the rate of investment could readily grow by around $2m each year between 2022 and 2025, from around $3m in 2022 to around $9m in 2025. The following table compares this rate of investment to the scale of the existing LEVCF funding, and the larger Low Emission Transport Fund (LETF) announced as a replacement in Budget 2021.[9]

Table 3: Funding only appears sufficient to meet growing need for LPV fast-charging

	2022	**2023**	**2024**
Indicative fast charger investment	$3m	$5m	$7m
LEVCF funding with current settings[1]		$2.9m pa	
Maximum contribution with current settings	97%	58%	41%
LETF fund[2]	$6.8m	$9.5m	$12.6m
Indicative contribution level[3]	50%	45%	40%
Portion of LETF fund	22%	24%	22%

Notes:

1. We have used the FY22 LEVCF fund size of $7.5m p.a. and assumed the share of the fund directed to fast chargers is 39%, which is the average across the last four funding rounds.
2. The Low Emission Transport Fund was announced in Budget 2021 as a replacement for the LEVCF. It is larger, but also has a wider scope.
3. This is an indicative transition path down from current (50% contribution) rate as investment becomes closer to being standalone profitable.

[9] See https://budget.govt.nz/budget/pdfs/estimates/v1/est21-v1-buscin.pdf (p63).

While not definitive given the inherent uncertainties, this analysis indicates that LETF fund should remain sufficient to support ongoing investment in LPV fast charging for the next few years.

However, the analysis above only covers mass densification of LPV fast chargers and not higher cost-per-site investment, or investment that may require a greater public funding contribution – for example trucks, metro service vehicles, chargers for communities with poor access to at-home charging, or electrification of significant public transport (buses, trains, ferries, and planes). We have not modelled these aspects. It is likely that when these are included, the current proposed level of funding in the LETF will not be sufficient.

4.3 Two distinct funding tasks are emerging

From the analysis above, we are moving into a phase of investment for LPV fast chargers where the priority will shift from building basic coverage to increasing density – providing more charging points per site and more sites in or near areas with existing basic coverage. Most investment will flow into providing density that is becoming closer to being commercially viable.

However, there will also be an ongoing need to support investment in 'public good' facilities:

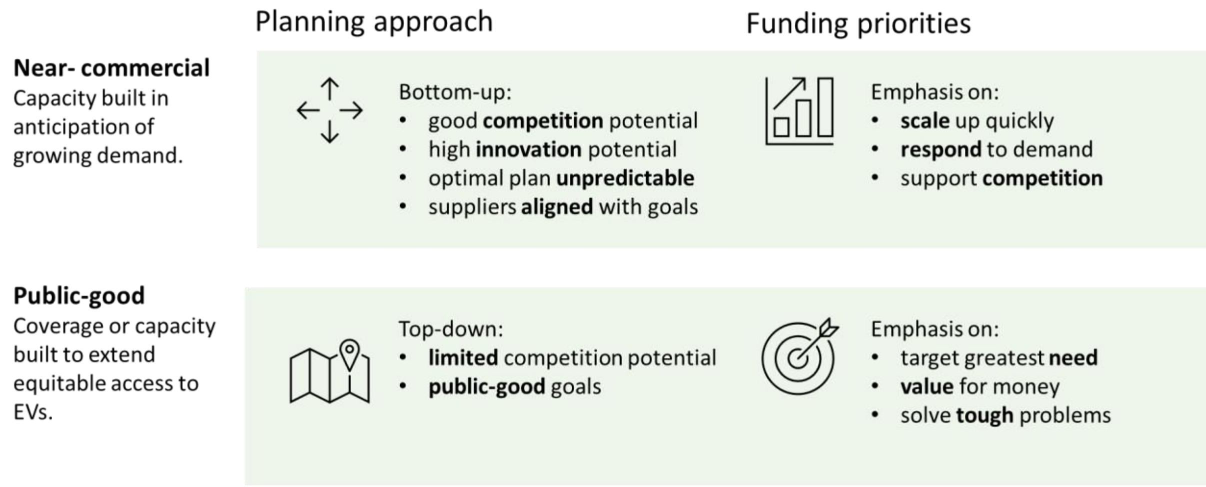
- areas where basic coverage hasn't yet been achieved
- areas where increasing density is inherently unlikely to become standalone commercially viable, such as locations with poor profitability potential due to:
  - high costs and/or low traffic volumes – for example, on remote routes with poor power or telecommunications infrastructures. This is analogous to mobile phone coverage blackspot areas on the state highway network that would not be developed commercially, but provide benefits in terms of safety and improving uptake sentiment
  - challenging demand characteristics – for example, hotspots that have a seasonal surge of demand. These may become commercially viable eventually but while the market is developing, they have limited potential for competitive supply and relatively high potential to harm EV uptake sentiment
- vehicle types with high decarbonisation potential that could benefit from early assistance:
  - high power facilities for heavy (>20 tonne) trucks
  - facilities for metro service vehicles (eg, taxis, delivery vans and light trucks)
- situations where lack of at home charging is a barrier to uptake, or a driver of hardship.

This suggests that two separate streams of funding priorities are emerging:

1. accelerator fund – supporting rapid scaling up of **near-commercial** fast-charging infrastructure to stay ahead of burgeoning demand. For this stream, it should be possible to foster competition between suppliers who are well placed to direct the rollout of infrastructure in response to demand
2. public-good fund – ensuring adequate provision of **public good** infrastructure that won't be delivered through the near-commercial stream. This stream would benefit from a more centrally coordinated approach that prioritises investment based on government policy objectives.

The two streams are illustrated in the diagram below.

Figure 8: Two distinct sets of funding priorities are emerging



A more top-down approach is desirable for the public-good stream. This should be targeted at infrastructure that has little prospect of emerging through the bottom-up stream, and that delivers on wider policy objectives relating to promoting EV uptake, ensuring traveller safety, or supporting social wellbeing.

A bottom-up approach is desirable for the near-commercial stream because there is limited prospect that a central planner could deliver an optimal rollout plan – there is simply too much uncertainty about technology and demand, too much scope for innovation and too much on-the-ground information to assimilate centrally.

In addition, there is limited scope for harm from a bottom-up competition-driven approach. Each site is relatively modest compared to the overall scale of investment required, so there is ample scope for productive trial-and-error and for competitive market entry and exit. Also, if funding remains a part-contribution to upfront costs, investors bear residual demand risk and remain incentivised to find the best locations and service propositions.

The accelerator fund should be designed to support rapid investment, by setting fixed contributions that are quick and easy for any providers to access (with pro-competitive limitations discussed in section 4.5) as they rollout charge points that meet predefined acceptance criteria. The fund could set contribution rates for a range of deliverables – eg, new sites, and new points at existing sites – and charger types – eg, fast chargers and destination chargers, and various capacities.

Both streams of funding should also be complemented by ongoing investment in centralised information systems. EV Roam, and EECA's charger map are a good start. Ongoing investment could focus on expanding the information captured and made available, and using this both to support wayfinding services for EV users and to inform:

- contribution levels for the accelerator fund

- monitoring charger performance – public funding should come with 'strings attached' in terms of the reliability of public charging facilities,[10] and
- priorities for the public-good funding steam.

We note that, with basic coverage in place, spatial distribution becomes a less dominant input to planning for public good investment. It will be increasingly important to develop planning focussed on finding investment needs that won't be met by commercial investment. Increasingly overseas, density metrics (measured as chargers per head of population within a given community area) are being used to evaluate charger investment adequacy. Often these density metrics are factored by considerations of the proportion of households within this community area that have access to at-home charging.

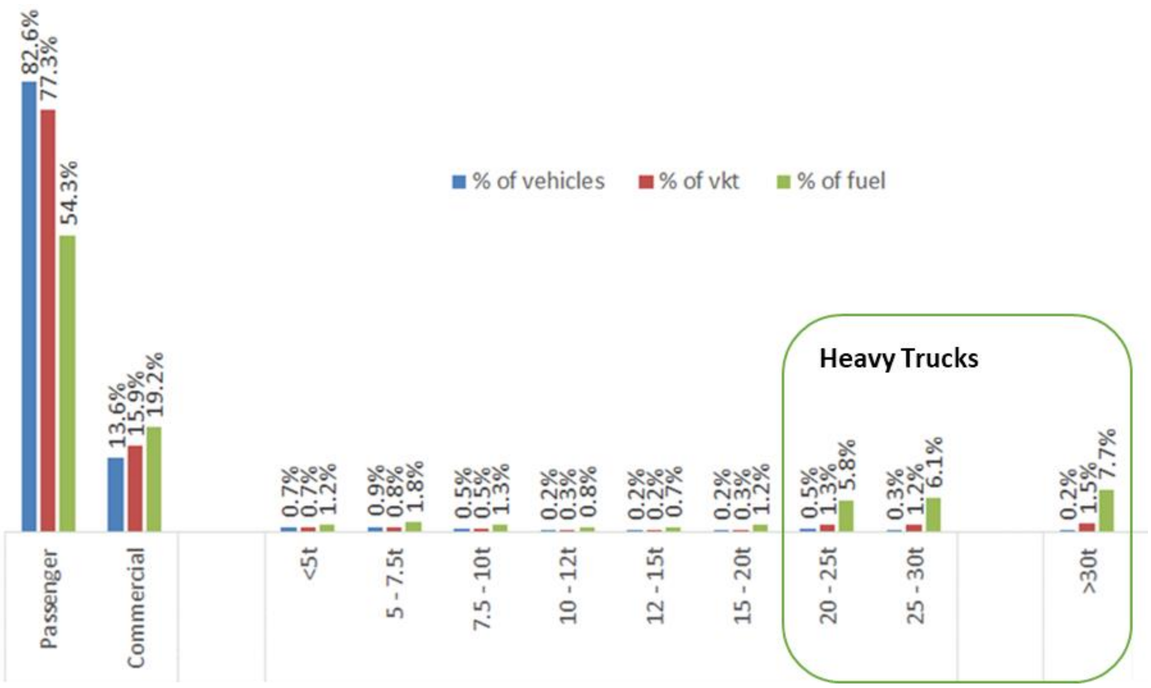
4.4 Specific additional areas requiring public-good funding

4.4.1 Heavy transport

The heaviest trucks, with a tare weight of more than 20 tonnes,[11] warrant particular attention because the fleet is relatively small but produces a disproportionate share of emissions and cannot realistically rely on fast chargers built for other vehicles.

Heavy trucks make up around 1% of all road vehicles, and just under 30% of the truck fleet. However, because they are heavy and travel long distances, their fuel consumption share is around 20% of all vehicles and 75% of the truck fleet.

Figure 9: Vehicles over 20t account for a large share of fuel use[12]



[10] Poor reliability of public charging infrastructure is a notable pain point for UK EV owners. https://www.rac.co.uk/drive/news/motoring-news/revealed-uks-top-ranking-electric-vehicle-charging-networks/

[11] The Ministry of Transport classifies trucks with a tare weight of 3.5 tonnes or more as 'heavy'. In this report we describe >20 tonnes as heavy (and 3.5-20 as 'medium').

[12] Based on 2015 data.

Due to their long travel distances, heavy trucks will need away-from-base charging facilities. While 300 kW chargers being rolled out for cars can also serve medium trucks (with appropriate parking spaces), heavy trucks realistically require megawatt-scale chargers. With megawatt facilities, a truck driver can add enough range during each compulsory rest break to reach the next rest break (in practice, the 5.5-hour maximum uninterrupted travel time limit translates to around 400 km).[13]

There are several considerations that support the view that public funding of megawatt chargers will be required to ensure efficient uptake of battery electric heavy trucks:

1. Range anxiety is likely to be greater for owners of heavy vehicles than for light vehicles.

   Range anxiety is overcome for many light EV owning households by having an ICE vehicle as their second car (or renting an ICE when required). This resolves any challenge around infrequent long-distance journeys (eg, the family holiday). Having a 'second truck' is clearly not a feasible option for commercial heavy truck operators. This is particularly relevant for New Zealand where a high proportion of trucks are owned by individual owner-operators.

   This is likely to exacerbate the chicken-and-egg of private investment for heavy truck charging being unlikely to emerge until heavy EVs emerge, but heavy EVs not emerging until away-from-base charging is available

2. There is uncertainty about which clean fuel option will be most cost-effective for heavy trucks.

   While there is a near-universal consensus that EVs will be the most cost-effective option for light vehicles and medium trucks (with almost all international automotive manufacturers heading down this route), there is some residual debate as to whether the heavy weight of batteries and longer refuelling times may make EVs less cost-effective compared to green hydrogen-fuelled vehicles (fuel cell EVs, or FCEVs) for the heaviest trucks.

[13] Travel distances in NZ are not long enough to replicate the US and Australian practice of using two drivers to enable continuous journeys.

Although our modelling suggests heavy EVs will be much more cost-effective than FCEVs for heavy trucks, and we note an increasing number of heavy truck manufacturers are coming to the same conclusion[14], we acknowledge this debate is not yet settled in New Zealand or overseas.

This uncertainty, coupled with government investment in support of hydrogen infrastructure, creates a further deterrent to investment

3. The number of vehicles in the heavy fleet is much smaller (1% of all vehicles) than the light and medium fleets.

   This means the number of away-from-base heavy truck charging sites required will be materially less than will be required for light and medium vehicles.

   Our modelling indicates that once coverage is achieved for heavy truck chargers, this will also largely satisfy the overall capacity requirements for this sector. This contrasts with the roll-out of fast charging units for light vehicles where there is an initial phase of coverage, followed by a more significant phase of steadily increasing density – in part through adding charging points to existing sites

4. Only a small number of sites will be needed, but each will be comparatively expensive.

   Sites for recharging heavy trucks will require relatively high-capacity grid connections, and more space for parking and manoeuvring than sites for light vehicles. An efficiently sized site is likely to operate at a loss for some time and would be difficult for a private investor to finance.

   The relatively small number of sites required to service the heavy truck fleet also means ownership is likely to be concentrated, with limited prospect of investors competing to supply heavy vehicle charging services – at least at the site infrastructure layer.

   Together, these factors point to the benefits of a more centrally planned approach, with a focus on finding locations that are optimal in terms of the roading network, grid capacity, land use and journey patterns

[14] For example, see this statement earlier this year from the heavy truck manufacturer Scania:

> *"Scania's aim is to be the leader in the shift towards a sustainable transport system. Battery electric vehicles will be the main tool to drive this shift and to enable decarbonised transport solutions with better transport economy to customers.*
>
> *The rapid development of electric solutions for heavy duty vehicles includes the fast advancement of battery technology in respect of energy storage capacity per kg. Charging time, charging cycles and economics per kg are improving rapidly. This means these solutions will become more cost effective, primarily in repetitive and predictable applications. They will gradually overtake Scania's industry-leading fossil and biofuel powered solutions in most transport applications.*
>
> *Scania has invested in hydrogen technologies and is currently the only heavy-duty vehicle manufacturer with vehicles in operations with customers. The engineers have gained valuable insights from these early tests and efforts will continue. However, going forward the use of hydrogen for such applications will be limited since three times as much renewable electricity is needed to power a hydrogen truck compared to a battery electric truck. A great deal of energy is namely lost in the production, distribution, and conversion back to electricity.*
>
> *Repair and maintenance also need to be considered. The cost for a hydrogen vehicle will be higher than for a battery electric vehicle as its systems are more complex, such as an extensive air- and cooling system. Furthermore, hydrogen is a volatile gas which requires more maintenance to ensure safety."*
>
> https://www.scania.com/group/en/home/newsroom/news/2021/Scanias-commitment-to-battery-electric-vehicles.html

5. As indicated in Figure 1, the rate of uptake of heavy EVs is likely to be slower than the rate of uptake of light EVs.

   This is because it will take longer for the economics of heavy EVs to surpass that of heavy ICE vehicles. That said, as heavy EVs are starting to become available, there is growing interest from heavy fleet operators – partly on the grounds they could earn a 'green premium' from transitioning their operations away from fossil-based transport more rapidly than the underlying transport economics may suggest.

Range anxiety means we are unlikely to see material uptake of heavy EVs until there is sufficient away-from base charging infrastructure. However, scale factors mean away-from-base chargers are likely to be loss making for many years.

In combination, it seems extremely unlikely there will be sufficient private investment to support adequate roll-out of heavy vehicle fast chargers. As such, and given the emissions reduction potential of heavy trucks, we think there is a strong case for public investment in heavy truck away-from-base charging infrastructure.

Public investment in charging facilities for heavy vehicles would complement investment in hydrogen facilities and support the government's COP26 commitment to target 100% zero emission new truck and bus sales by 2040 (and 30% by 2030).[15]

Solely investing in hydrogen facilities for heavy trucks creates a significant risk of frustrating the cost-effective decarbonisation of this sector as OEMs increasingly start to roll-out BEV heavy trucks for sale. For example:

- over 20 Fuso eCanter electric trucks are operating in New Zealand now, and other members of the Daimler group are readying heavy EV trucks for production internationally.[16] Mass production of eCanter trucks will enter New Zealand in 2024, with heavier eActros trucks here from 2024/25. Daimler plan to have ceased production of diesel trucks by 2039
- Nikola is currently piloting its Tre battery-electric heavy truck in Los Angeles, and plans a similar trial with the Hamburg Port Authority[17]
- heavy truck manufacturer Scania expects 50% of its total vehicle sales will be electric by 2030, and they plan to launch a long-distance heavy truck within a few years
- Tesla and Geely both claim that they will have heavy EV trucks in production by 2024[18]
- BYD offers a heavy electric truck overseas.[19]

With continued improvements in battery technology, particularly significant ongoing improvements in energy density and speed to re-charge, the economics of EVs for heavy trucks are arguably improving at a faster rate than for light vehicles. In particular, the fact that heavy trucks have much higher utilisation factors (hours driven per day) means the higher upfront-capital-versus-lower-ongoing-fuel-cost dynamic is more compelling for this category of vehicle.

There have also been international developments in high-capacity charging, with a soon-to-be-released megawatt charging system (MCS). This is set to become the international standard for MW-scale charging, with connectors rated up to 4.5 MW.

---

[15] https://globaldrivetozero.org/mou/
[16] https://freightliner.com/electric-trucks/
[17] https://nikolamotor.com/press_releases/nikola-delivers-first-nikola-tre-battery-electric-trucks-to-total-transportation-services-inc-143
[18] https://www.inverse.com/innovation/tesla-semi-price-specs
[19] https://en.byd.com/truck/class-8-day-cab/

4.4.2 Metro service vehicles

A significant portion of vehicle travel in large urban centres comes from metro service vehicles such as couriers, delivery vans, taxis, rideshare vehicles and light trucks. Even though EV ranges are increasing, the daily distances travelled by these vehicles are such that within-day charging is valuable. Also, many of the drivers of such vehicles will live in areas with low levels of access to at home charging.

As an indication of the importance of metro service vehicles, Transport for London estimate that 80% of the energy supplied via public chargers would be for taxis and rideshare vehicles. While New Zealand cities are not directly comparable (with higher private vehicle ownership but lower public transport use) this is illustrative of the importance of this type of transport.

While metro service vehicles can use the same charging technology as for privately-owned LPVs and could be a useful source of revenue for public charging providers, their distinct needs mean relying on LPV-focussed public charging infrastructure is unlikely to be sufficient. Light service vehicles need charging that is compatible with maximising their uptime – for example, with high power or located to make use of existing idle time. The unique needs of metro service vehicle operators can also conflict with privately-owned LPVs, with some public charging operators prohibiting use of their facilities by service vehicles.

The high usage of service vehicles means that providing charging services should become profitable for private investors, so public funding should focus on the infrastructure layers – sites, and electrical connection – with appliances and other service layers made contestable. There are two main models for meeting metro service vehicle needs:

1. kerbside – including at taxi ranks or loading zones, or in other dedicated parking zones
2. sites – dedicated sites in locations and with facilities that allow metro service vehicle operators to build charging into their workday.

In both cases, any central government support should be coordinated with local authorities who own or control access to relevant road space or land and are otherwise involved in spatial and transport planning.

4.4.3 Households without at-home charging

In addition to the funding priorities identified above (accelerating funding of LPV fast chargers, establishing heavy truck sites and supporting metro service vehicles) there is likely to be value in directing some public-good funding to other means of supporting uptake by households unable to charge at home. Examples of living situations without at-home charging can include:

- urban areas where off-street parking is uncommon – this includes some older suburbs, plus newer developments where planning rules are encouraging active transport and housing densification by relaxing requirements to provide parking
- developments with shared, communal, or remote parking – including apartment buildings, housing complexes with a shared parking zone, and properties with detached unpowered parking spaces that may be remote from the property
- flats – for example, where a house is occupied by several independent flats or flatmates such that the number of vehicles is beyond the capacity of any off-street parking.

There are a range of potential solutions for providing charging facilities that would enable these households to purchase EVs:

- kerbside – where residents park on the street, a direct solution is to fit kerbside parking facilities. However, this tends to be expensive on a per-vehicle basis and raises questions around controlling access to the charging facilities while not granting privileged access to road space that could be used for general parking or to relieve congestion. This may become part of the solution in time, with the funding challenge overcome when there is enough pent-up demand. In the meantime, there could be value in ongoing experimentation and potentially part-funding in future if viable models for deploying infrastructure and managing access are developed

- electrify off-street parking spaces – where there are existing dedicated or communal parking facilities, these can be electrified without raising the same access control and road use issues as kerbside facilities. As cost is a barrier in these situations, part-contribution arrangements could unlock EV uptake
- destination charging – some cities have found that destination charging is a better bang-for-buck solution for now. For example, charging facilities at parks and libraries can serve reasonably sized catchments and provide an acceptable substitute for at home facilities. Destination charging is already occurring on a commercial basis, with multiple proponents vying to provide services.[20] However, there may be cases where public support would help expand availability and use of the destination charging to unlock more EV uptake
- transport as a service – there is ongoing experimentation with transport as a service, including EV carshare provision in social housing settings.[21]

For funding directed at these types of solutions we suggest three types of evaluation criteria are used together:

1. electrification potential – cost per directly avoided emissions, including consideration of the likely counterfactual if funding isn't provided
2. market development – whether investment may have value as a pilot or demonstration that will indirectly stimulate avoided emissions
3. hardship – as EVs increasingly become the lowest-cost option there is a risk of exacerbating hardship for households who are locked out of EVs due to a lack of at home charging facilities (or suitable transport as a service options).

We note that destination charging may span the accelerator and public-good funds. The best approach may be to start with a low contribution rate for destination charging through the accelerator fund, then promote the public good goals with a contribution rate top-up for investments that would deliver additional benefits consistent with the evaluation criteria above.

4.5 Funding should promote competition

There is ample scope for competition to emerge in the market for fast charging services – including because:

- there are many potential suppliers (as shown in Figure 2)
- competition can operate locally, so the hurdle for entry is relatively low
- service layers are separable, which further reduces the hurdle for entry
- new entrants can readily access relevant know-how
- there is wide scope for differentiation and innovation

[20] See, for example, programmes by Meridian Energy (https://www.meridianenergy.co.nz/business/pricing-and-plans/electric-vehicles-for-business#EV%20form) and the Wellington and Hutt City Councils (https://wellington.govt.nz/news-and-events/news-and-information/our-wellington/2021/07/ev-fast-chargers) .

[21] See Zilch and Ōtautahi Community Housing Trust e-vehicle scheme https://www.ocht.org.nz/our-e-vehicle-services/ocht-zilch-ev-scheme/

- economies of scale operate most strongly at a site infrastructure level, with scope for multiple efficiently scaled suppliers for other service layers (eg, billing, marketing, servicing).

However, at this early stage there are only two sizeable competitors:

- ChargeNet – pioneering independent operator with nationwide network of open access charging points. Also supplies back-end control software and billing services to others
- Tesla – pioneering electric vehicle manufacturer with vertical integration into the market for charging. Proprietary service tied to Tesla vehicles, with plans to open up access.[22]

This position reflects the small size of the market, plus the outcome of the contestable fund as it has operated to date. As demand grows, so does the scope for profitable entry by other suppliers. Supporting competition should be a key objective as the funding arrangements evolve because this will:

- provide choice for the growing base of EV owners
- exert competitive pressure on costs, quality, innovation, and pricing, and
- improve the workability of a bottom-up funding model.

Fund design features that could support competition include:

- funding share limits – for the near-commercial funding steam, there should be limits on the share of total funding that any supplier can access each cycle and across cycles. These would mitigate the risk of funding supporting excessive concentration as the market grows
- market concentration criterion – for the public-good funding stream, market concentration could be an evaluation criterion
- limiting participation by EDBs – full participation by upstream monopolies can dampen competition in downstream markets.

At this early stage of market development, several electricity distribution businesses (EDBs) have built fast charging sites. This has provided a helpful contribution during the basic coverage phase. However, further participation by EDBs carries a risk of dampening competition. In particular:

- free sites – Some EDBs have installed chargers that are free to use. At the extreme, EDB sites with free charging supress the ability for other charging providers to set prices at their sites that would cover the costs of supply and support ongoing investment. This significantly constrains entry by other parties. During the early phase of market development free sites can have an outsize influence across a wide area. This dampening effect that has been experienced to date should ebb away as the market grows, provided free sites do not scale up alongside commercial supply
- non-commercial pricing – more generally, other market participants may worry that EDBs will continue to suppress prices below cost as the market matures. This adds to the risk profile for investment in charging infrastructure, and economic regulation of EDBs only partially addresses this issue. Only 17 of 28 EDBs are subject to price-quality regulation. For these firms, the Commerce Commission has invested considerable effort tuning and clarifying cost, revenue, and disclosure rules over recent years.[23] However, the Commerce Commission (understandably)

---

[22] See https://www.reuters.com/business/autos-transportation/tesla-plans-open-up-its-charging-network-other-evs-later-this-year-2021-07-20/

[23] See for example, the clarification on vehicles charger in the appendix to a May 2018 *Open letter on intention to gather information relating to emerging technologies*, https://comcom.govt.nz/__data/assets/pdf_file/0023/90581/Open-letter-Our-intention-to-gather-information-relating-to-emerging-technologies-9-May-2018.pdf .

centres its considerations on the efficient supply of regulated services, rather than on competition in related markets. This leaves scope for non-commercial pricing to persist as the charging market scales, and

- playing field incentives – if an EDB were to actively pursue a sizeable share of the growing EV charging market, other suppliers would be likely to worry about whether the EDB would provide a level playing field between its business and independent businesses. This would be a concern because electricity distribution network access is a major (and often the most challenging) input to the supply of charging services.[24]

Given this context, it would make sense to exclude EDBs from accessing the near-commercial funding stream. For the public good funding stream, EDBs could have a valuable role to play as platform providers. For example, for sites with high connection costs:

- EDBs could be funded to provide the infrastructure layers – this could include the site, electrical connection, and telecommunication infrastructure
- open access arrangements could be used to preserve contestability for other services layers.

This arrangement may support EDB participation where it is most valuable, while mitigating the risk of adverse impacts on competition.

At this stage we don't think further measures are required to limit EDB participation in favour of supporting competition, however it may be important for the Commerce Commission to monitor this over time.

5 Complementary measures

5.1 Electricity network access

Above, we have recommended a redesign of the public funding arrangements to support acceleration of near-commercial fast charging facilities and deepening of competition amongst suppliers. To complement this, we think it would be beneficial for the Electricity Authority to develop a tailored set of distribution network access arrangements for fast chargers.

From discussions with a range of parties who have invested in charging infrastructure we have heard that:

- there is considerable variation across electricity distributors in terms of the process and the commercial arrangements for gaining network access – ranging from very accommodating, to very challenging
- it can be time consuming, expensive, and frustrating to discover whether electricity network capacity will be an impediment, and to determine what network upgrades or connection costs may be required
- sizeable upfront capital contribution requirements further deter early investment in charging infrastructure, and
- arrangements for ongoing charges also vary considerably.

---

[24] Similar concerns with respect to electricity retailing prompted the Electricity Industry Reform Act 1998, which prohibited common ownership of EDB and electricity retail activities.

We think the asymmetry in cost between early and late investment in fast charging infrastructure means it would be worthwhile extending the distribution network access regime that currently applies only to distributed generation to encompass public and private EV charging facilities.

The distributed generation access regime is set out in Part 6 of the Electricity Industry Participation Code (EIPC) and covers:

- maximum application fees
- maximum processing times, and other constraints on the application and approval process
- default contract terms, include dispute resolution, and
- high-level pricing requirements.

The regulated access regime has the dual benefit of harmonising arrangements across New Zealand and establishing terms that are relatively favourable to rapid and affordable growth.

For the high-level pricing requirements, it's important that these are consistent with the Electricity Authority's distribution pricing principles.[25] The pricing principles ensure prices are subsidy-free and designed to guide efficient network usage and development.

Within the distribution pricing principles there is wide scope to design price structures that would be more or less favourable to fast charging. The access arrangement could require pricing structures that are at the favourable end, with requirements such as:

- dedicated consumer group(s) for public fast charger sites, with subsidy-free analysis at a consumer group level. This means distributors would set prices that permit a degree of averaging (or subsidy) between charging sites
- cost allocation at the low end of the subsidy-free range – this would mean fast charging providers as a group would not pay more than avoidable costs (that is, they would not contribute to shared or common network costs, but prices wouldn't be set at a level that is so low that it would adversely affect the price that other consumers pay to cover shared or common network costs)
- low capital contributions, with an ability to spread contributions over time
- usage charges that are cost reflective but structured in a way that suits pass through and rewards demand management (eg, through load balancing across appliances or use of on-site batteries to buffer demand).

5.2 Other measures

As a relatively new sphere of activity, there will be numerous changes that could and should be made to regulatory arrangements and other spheres of public management to facilitate efficient uptake of EVs. We haven't tried to canvass all such matters in this report, but note two areas that may warrant early attention:

1. future proofing buildings and property developments – for buildings and developments that include carparking spaces, it may be worth introducing "EV ready" requirements now.

   Charging facilities are sure to become a must-have within the next decade, and retrofitting can be costly if developers haven't built in the ability to easily add charging appliances.

[25] See Electricity Authority (2019) *More efficient distribution network pricing – principles and practice: decision paper* at https://www.ea.govt.nz/assets/dms-assets/25/25436Distribution-pricing-More-efficient-distribution-prices-Principles-and-practice.pdf

Futureproofing requirements could extend to the sizing for electrical connections and switchboards, and provision of conduit and space for future charging appliances

2. tenant rights – for rented buildings, landlord willingness to allow chargers to be installed could be a barrier to EV uptake. It may be worthwhile introducing a requirement that landlords cannot unreasonably deny a request to install an EV charger (which in many cases may simply be a standard electrical socket).

   This could mimic the approach taken in section 45B of the Residential Tenancies Act to facilitate fibre connections. We recognise this would not remove financial barriers to installing a charger, but it could improve the success rate for any public funding aimed at resolving the financial challenge.