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EV Connect

Customer Benefits and Secure Networks through Industry Collaboration

Stakeholder Consultation Document

EV Connect is a 2019 LEVCF EECA Project
Co-funded with Wellington Electricity & GreenSync

Initial project findings are presented for industry consultation to support a road map for managing EV charging congestion on residential distribution networks

Industry participants will discuss consultation questions at a workshop held on 20 October 2020 in Wellington

Consultation Document 1.0
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GreenSync

Executive Summary

This industry consultation document opens the conversation on engaging consumers so we can deliver more energy through existing network structures. The purpose of doing this is to support EV adoption while maintaining network security, and as a result provide benefits across the electricity supply chain. If we approach this with workable solutions we can supply a high level of service at a reduced cost to consumers. To achieve this – we think – will require coordination and collaboration across the electricity supply chain.

In this context, we have looked internationally for comparisons with New Zealand's EV uptake and supporting policy. Also, the PV uptake experience in Australia serves as a warning to reinforce the need to front foot changes which are being led at the consumer level.

The New Zealand Government has set a CO2 emissions reduction target as part of its Carbon Zero legislation. Contributing to this reduction target is the plan for electrification of transport fleets. As EV uptake increases, electricity networks will be required to manage the increase in demand.

Without a planned approach, networks may struggle to absorb this increase in coincident demand and maintain supply security, reliability and quality.

If left unmanaged, accommodating an increase in peak demand could require significant network reinforcement to provide the additional peak demand capacity required. Unfortunately this would also result in cross subsidies between EV and non-EV customers. Either outcome would damage market confidence for EV adoption and delay the government's achievement of a reduction in CO2 emission levels.

We are not alone in thinking about this – as a company or as an industry. Nor are we alone in taking iterative, progressive and innovate steps. However, more work is required and given that the energy system is complex and multi-layered, there is no silver bullet. We need to ensure the development of efficient, fair and equitable tools and techniques that work together to address both the economic and technical challenges of solving this problem.

We believe that a system that allows consumers and the wider industry to unlock value and utility will ultimately be the best long-term solution to manage the increase in EVs. Being a utility, we are agnostic to the technology chosen by consumers. With funding from EECA, through the Low Emission Vehicle Contestable Fund, we have commenced the EV Connect project that uses a trial to help inform our thinking and this document. The EV Connect trial is scalable across many vendors and has allowed us to collaborate with other players in the electricity supply chain to work on offering customers the option to have their EV charger dynamically controlled.

This document provides perspectives and commentary on the key technical, market and funding areas that need to change to allow these benefits to be realised. We also wish to seek stakeholder feedback on this consultation document for shaping the EV Connect project outcomes.

Stakeholder feedback will contribute to a roadmap aimed at articulating the steps to take now to educate and inform the community so that the industry will be ready to support Government's initiatives for a high level of EV penetration.

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Contents

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1 Introduction

The world's energy systems are changing at a rapid pace as consumer owned devices and distributed energy resources are poised to play an increasingly significant role in energy markets and general life.

The 20th Century centrally oriented frameworks in which the electricity system was designed may no longer be suitable. This change is set against a new landscape of governments looking for more sustainable outcomes and reduction in negative environmental effects. Significantly, this necessitates a deeper understanding, engagement and collaboration by all stakeholders to recognise that key functions, within the power system, need to be managed differently.

One change that is occurring is the electrification of our transport fleets. Electric vehicles (EVs) are being purchased by New Zealanders in growing numbers. The adoption of EVs for government or private fleet and commercial purposes is likely to be further accelerated through the New Zealand Government's decarbonisation plans.

Wellington Electricity considers there is a high likelihood that EVs and associated charging infrastructure at both residential and commercial scale will play a significant role in the nation's transition to zero net emissions by 2050.[1]

We are concerned about the increased network load that this transition will bring to network reliability, security and the quality of supply if this change is not well managed. Equally we are excited about the way this load could be coordinated, and the benefits that collaboration on this issue could deliver across the entire electricity supply chain, especially for end customers.

As part of this, Wellington Electricity and EECA co-funded a project, EV Connect, where we have identified some key areas that need to change to allow these benefits to be realised and delivered. The purpose of this consultation document is to articulate the key challenges, outline options that could address those challenges and seek wider stakeholder feedback to support the necessary progress on these matters.

Stakeholder feedback will contribute to a roadmap aimed at articulating the steps to take now to educate and inform the community so that the industry will be ready to support Government's initiatives for a high level of EV penetration.

[1] Our position on the transition to net zero emissions by 2050 is broadly consistent with recent publications from the Productivity Commission, ICCC and Transpower's Te Mauri Hiko.

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1.1 About the Document

This consultation document outlines the drivers for change and lessons from international experience (the good, bad and interesting). We zoom in on the EV context in New Zealand and for Wellington Electricity more specifically – both what's coming in terms of EVs and what that might mean for different parts of our network and industry stakeholders.

We shine a spotlight on the key technical (practical) trial we undertook as part of this project as a way of introducing context for the subsequent document sections and consultation questions. We highlight what networks can do to support EVs, and a number of areas where we will need to work with partners and stakeholders to amend current business models to enable realisation of further benefits to customers and deliver better outcomes overall. The role of industry regulation, funding arrangements and broader policy over what networks may do is canvassed. Additionally, we discuss what is required in terms of new protocols or standards and how they might be more efficiently adopted.

Questions are included throughout and summarised at the end to seek stakeholder input and engagement as we develop the final output from this project: The EV Connect Roadmap.

- ⇒ **Feedback is sought by 6th November 2020.**
- ⇒ **Comments can be sent to EV_Connect@Welectricity.co.nz**

2 Imperative for Change

The changes that will occur to the New Zealand energy system due to a high level of EV uptake (and other distributed energy resource (DER) products) will have profound implications for our electricity distribution networks. Combined with the electrification of process heat and the future removal of domestic gas which could be replaced by electricity.

EV uptake will challenge traditional assumptions about how, when and where consumers use electricity. Increasing levels of EV uptake will mean lines companies like us (Wellington Electricity) will need to do three key things:

- Adapt the methods we use to plan and operate our electricity networks – including pricing/tariff structures
- Allow for the uncertainty of increased load, energy storage; and
- Allow for where and when this load and storage will connect.

With the move to customer centric devices for home energy generation, storage and substitution for grid-supplied electricity, new relationships and engagement is required between customers, retailers and distributors. These will be multi-faceted. Using an EV example, a customer that electrifies their transport is making a sustainable choice but also buying storage and generation capability which if coordinated, can unlock further commercial opportunities for participants across the electricity sector. The key is collaborating this value stack across retailers, aggregators, distributers, transmitters and generators.

We are not alone in thinking about this – as a company or as an industry. Nor are we alone in taking iterative and progressive steps. There are many lessons and insights visible beyond our borders from technology and market perspectives. We have outlined some of these examples below.

2.1 International EV Context

Electric vehicles are growing in number globally but were just 2.6% of total 2019 global vehicle sales.[2] In certain markets however, this rate of growth is far higher. In 2019, the top 15 markets for EVs included Norway (#1), the Netherlands (#3), China (#7), the UK (#10), New Zealand (#11) and Japan (#14).[3]

Drivers for EV growth in the top markets include national targets for vehicle emissions limits[4] and set timeframes for the sale of internal combustion engine (ICE) vehicles to be phased out.[5] In a number of markets, small changes to taxation arrangements also play a strong role in driving the transition to EVs. Consumer choices and the availability of vehicles from which to choose – are also important factors in accelerating the growth in EVs.

WE* is particularly interested in the linkages that are beginning to occur in key advanced energy markets in relation to EV charging infrastructure and interactions between electricity networks, EV chargers, customer connections and customers themselves. For the purpose of this consultation document, we have highlighted Norway, the UK and the Netherlands.

[2] IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles
[3] IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles chart: Electric car market share in selected countries, 2019.
[4] See for example: https://carpart.com.au/blog/car-part-world-news/14-countries-banning-fossil-fuel-vehicles-norway-leads-in-2025
[5] These nations include Norway, Israel, UK, Iceland, Singapore, Sweden, Slovenia, Sri Lanka and Ireland as reported here: https://carpart.com.au/blog/car-part-world-news/14-countries-banning-fossil-fuel-vehicles-norway-leads-in-2025

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Table 1: Features of Leading EV & Advanced Energy Market Nations

	Norway	The Netherlands	United Kingdom	New Zealand
EV market status	• 56% of new car market (2019)[6]	• 15% of new car market (2019)[7]	• 4% of new car market (2019)[8], ~8% YTD (2020)[9]	• 2.82% of new car market (2019)[10]
Charging infrastructure	• +10,000 public charging stations[11] • +700 fast charge stations (2,900 fast charge points)	• +50,000 public and semi-public charging stations[12] • +1,300 fast chargers (2019)	• +19,000 public charging devices across +12,000 sites[13] • +3,000 rapid chargers (25-99 kW)	• 209 DC rapid charge points (144 North Island; 65 South Island)[14] • 400+ charge points on PlugShare[15]
Per km of road	• 39,500 km of paved roads • Roughly 1 public charge point/4 km[16]	• 126,500 km of paved roads • Roughly 1 public charge point/2.5 km[17]	• 396,700 km of paved roads • Roughly 1 public charge point/20.9 km[18]	• 94,000 km of paved roads • Roughly 1 public charge point/154 km[19]
Point of sale requirements	• Existing registration requirements apply	• Existing registration requirements apply	• Existing registration and annual 'roadworthy' testing policies apply	• Existing registration and warrant of fitness 'roadworthy' tests apply
Relevant policies/ regulations	• Ensure 100% zero emissions new vehicles by 2025. • Energy side – Grid to vehicles (VG1) – Vehicle to Grid (V2G) • Transport – lower tax rates and usage incentives for EV sales • End of life -	• Ban sales of petrol/diesel cars by 2030	• Ban sales of petrol/diesel cars by 2035 • Transport incentives and tax rates (EV incentive of £3,000 and road tax exemptions <£40k EVs), no congestion charge[20] • Company car tax incentives from 0% (2020), 1% ('21), 2% ('22)[21] • Home charge unit grants (~ £350)	• EV Programme (2016) set out targets/initiatives to: - reach 64,000 EVs by 2021 - raise awareness - set up EECA fund for EV projects

2.2 Postcard from Australia

Australia has faced a major change and challenge to their electricity system from another largely consumer led change – solar PV. While government policies and incentives have played a role in encouraging uptake over two decades, as technology costs came down and incentives were reduced, consumers still took up solar in huge numbers.

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6 IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles chart: Electric car market share in selected countries, 2019. Note this statistic includes battery electric vehicles and plug-in hybrid electric vehicles (BEV, PHEV)
7 [ibid] IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles chart: Electric car market share in selected countries, 2019. Note this statistic includes battery electric vehicles and plug-in hybrid electric vehicles (BEV, PHEV)
8 [ibid] IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles chart: Electric car market share in selected countries, 2019. Note this statistic includes battery electric vehicles and plug-in hybrid electric vehicles (BEV, PHEV)
9 https://www.zap-map.com/statistics/
10 [ibid] IEA (2020), Electric Vehicles, IEA, Paris https://www.iea.org/reports/electric-vehicles chart: Electric car market share in selected countries, 2019. Note this statistic includes battery electric vehicles and plug-in hybrid electric vehicles (BEV, PHEV)
11 https://elbil.no/english/norwegian-ev-policy/
12 https://wallbox.com/en_catalog/netherlands-ev-incentives and https://www.emobilitysimplified.com/2019/12/netherlands-highest-density-ev-charging-infrastructure.html
13 https://www.zap-map.com/statistics/
14 https://www.leadingthecharge.org.nz/charging-sites
15 https://www.plugshare.com/
16 https://www.statista.com/statistics/450003/norway-length-of-road-network-by-road-type/
17 https://www.statista.com/statistics/449936/netherlands-length-of-road-network-by-road-type/
18 https://www.gov.uk/government/statistical-data-sets/road-length-statistics-rdl#table-rdl0201
19 https://www.nzta.govt.nz/roads-and-rail/research-and-data/state-highway-frequently-asked-questions/
20 https://www.motoringresearch.com/car-news/electric-car-buyers-guide/
21 https://www.wired.co.uk/article/electric-cars-uk-buying-guide & also https://www.rac.co.uk/drive/advice/know-how/electric-cars/

Australia now has over 2.5 million rooftop PV systems installed – equating to a generating capacity of 11.8 GW.[22] On average, 20% of households have a solar PV system. In some locations this is closer to 40 or 50%.[23] By 2040 around 45% of generation is expected to exist behind the meter.[24]

The system impacts and challenges from solar PV for some has only become widely understood in the last three years. During this time, substantial effort was put into the Open Energy Networks (OpEN) initiative - a collaborative exercise to identify the most appropriate governance and architecture model to manage and coordinate distributed energy resources.[25] Almost in parallel, Australia's Energy Security Board began a project to review, assess and identify what the energy market(s) need to have in place by 2025 - largely (but not exclusively) focussed on the 'fitness' to support high numbers of DER and renewables. At the time of writing this report, Australia's OpEN project is not active, while the ESB's Post 2025 project is 'mid-flight'.

Underneath these helicopter-view initiatives, work is going on within and among distribution businesses and industry/market stakeholders on a range of initiatives aimed directly at DER visibility, integration, coordination and market participation. They include:

- DER data registry (static information only) implementation in the eastern states in 2020 and Western Australia in 2021[26]
- Access, pricing and incentive arrangements for distributed energy resources[27]
- Connection agreements to enable 'dynamic DER management', 'flexible export'[28] or application of dynamic limits'[29]
- Communications protocols for distributed energy resources[30]
- Device standards and requirements for communications and/or control capabilities[31]
- Virtual power plant operations, data provision and communications structures between VPP operators, distribution networks[32] and the Market Operator[33]

The initiatives are somewhat aligned, but not tied to a clear policy goal or vision. And, while these discussions and initiatives continue, solar PV connections and uptake just keeps rolling on. The situation has been deemed critical in South Australia this year[34] and is predicted to become so in Western Australia in the near-term.[35] With "critical" status being reached, more radical and interventionist options are being implemented.[36]

22 https://reneweconomy.com.au/rooftop-solars-stunning-surge-to-new-records-as-australia-installs-reach-2-5-million-55528/
23 https://www.energynetworks.com.au/news/energy-insider/solar-saturation-sooner-than-we-thought/
24 http://www.energynetworks.com.au/projects/electricity-network-transformation-roadmap/
25 See for example the ENA's 2020 OpEN Position Paper for a full overview and summary of current status. https://www.energynetworks.com.au/resources/reports/2020-reports-and-publications/open-energy-networks-project-energy-networks-australia-position-paper/
26 https://aemo.com.au/energy-systems/electricity/der-register
27 https://www.aemc.gov.au/rule-changes/access-pricing-and-incentive-arrangements-distributed-energy-resources
28 SA Power Networks AER Regulatory Proposal submission (Dec 2019). LV Management Strategy Business Case
29 GreenSync (2019). Application and deployment of Dynamic Connection Agreements – discussion paper
30 There is a coordination piece being led by the ESB - http://www.coagenergycouncil.gov.au/publications/governance-distributed-energy-resources-technical-standards-consultation and a more technical level initiative led by AEMO https://aemo.com.au/consultations/industry-forums-and-working-groups/list-of-industry-forums-and-working-groups/deip-sdiwg
31 See for example https://www.solar.vic.gov.au/sites/default/files/2020-08/Notice-to-Market-published-17-April-2020.pdf p32-33 and https://www.energymining.sa.gov.au/energy_and_technical_regulation/energy_resources_and_supply/regulatory_changes_for_smarter_homes
32 See for example https://arena.gov.au/projects/advanced-vpp-grid-integration/
33 https://aemo.com.au/en/initiatives/major-programs/nem-distributed-energy-resources-der-program/pilots-and-trials/virtual-power-plant-vpp-demonstrations
34 See for example: https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/sa_advisory/2020/minimum-operational-demand-thresholds-in-south-australia-review.pdf?la=en
35 https://aemo.com.au/-/media/files/electricity/wem/planning_and_forecasting/esoo/2020/2020-wholesale-electricity-market-electricity-statement-of-opportunities.pdf?la=en
36 https://www.abc.net.au/news/2020-05-20/concerns-over-plan-to-switch-off-household-solar-panels/12267162

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Table 2: Solar PV Postcard – South Australia and Western Australia

	South Australia	Western Australia[37]
Grid context	• Connected to the national grid, but notionally has a 'skinny' grid at the end of the National Electricity Market (NEM) - the east-coast interconnected network	• South-Western Interconnected System (SWIS) managed as an integrated, small grid. • Rest of regional WA has isolated grids managed by vertically integrated state-owned utility.
Residential solar PV	• 32% (2018), approx. #, rate of installs per week	• 27% (2018), approx. #, rate of installs per week
Connection agreement options	• Flexible export in exchange for control capability via API comms link to fleet operator • 5kW export limit (site) or zero export if zone is considered 'too congested'	• Considering dynamic connection agreement structure including ability to control DER and apply dynamic operating limits.
Grid risk timeframe	• SA region assessed as likely to reach operational demand of zero within 1-3 years.[38]	• WA 'WEM' region has set 3 records in the last 12 months for the lowest operational demand[39] and is predicted to see ongoing declines from 2020-25.[40]
Device requirements/new standards	• Communications capabilities (IOT enabled) • Dynamic export enabled • Minimum 2 element smart meter required	• Consultation process underway at time of writing
Tariffs	• New solar sponge tariff • ToU structures	• Consultation process underway at time of writing
Other data requirements	• [Nationally required] DER registry data submission requirements (as of March 2020)[41] • Consumer Data Right – energy – provides rights over premises/device owner on their data – to share with 3rd parties (retailers) or access for own purposes.[42]	• [Nationally required] DER data registry submission requirements (coming 2021) for devices installed in the SWIS region.[43] • Consumer Data Right – energy – provides rights over premises/device owner on their data – to share with 3rd parties (retailers) or access for own purposes.[44]

The implications and potential insights we can take from our neighbour's experience with this distributed energy resource example with solar PV are threefold:

- *An emerging trend can become a critical concern within a 'normal' regulatory cycle (5 years).*
- *Change should be seen as an opportunity to evolve and work with that change, not try to 'hold back the tide', 'ignore' or treat as 'the competition'*
- *Planning for and creating necessary changes to support or even accelerate a change is probably better than needing to respond when things reach breaking point.*

[37] WA Government. 2020. Issues Paper – DER Roadmap: Distributed Energy Resources Orchestration Roles and Responsibilities
[38] https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/sa_advisory/2020/minimum-operational-demand-thresholds-in-south-australia-review.pdf?la=en
[39] https://aemo.com.au/newsroom/news-updates/min-op-demand-records
[40] https://aemo.com.au/en/newsroom/media-release/wa-esoo-2020
[41] https://aemo.com.au/energy-systems/electricity/der-register
[42] https://aemo.com.au/initiatives/major-programs/consumer-data-right-cdr
[43] https://aemo.com.au/energy-systems/electricity/der-register
[44] https://aemo.com.au/initiatives/major-programs/consumer-data-right-cdr

2.3 New Zealand's EV Context

Central Government has a target of reaching approximately 64,000 EVs on New Zealand roads by the end of 2021.[45] At the end of July 2020 the total number of registered EVs on New Zealand roads was 21,586.

It is estimated that there will be between 5,000 and 9,000 battery electric vehicles in the Wellington region by mid-2021, and between 15,000 and 28,000 (3.9 -6.7% of all vehicles) will be EVs by mid-2024. Around 30% of these will be plug-in hybrids (PHEVs) and 70% fully battery electric (BEVs). The estimated number of public DC fast chargers required to support Wellington's EV fleet is between 50 ~ 90 in 2021 and 150 ~ 280 in 2024. Up to ten times these numbers of public AC chargers (mostly at destinations for shopping, tourism and hospitality) may also be desirable – an additional 1,500-2,800 charging points.[46]

2.3.1 Where and when for EV network challenges?

There have been numerous studies completed by industry and academics, both domestically and internationally on the level of EV penetration and consequential impacts on networks.[47]

The time frames in which EV uptake will cause a network issue is dependent on a number of factors such as clustering, location, type of EV/EV charger, user behaviour, network construction types, size of spare capacities, whether we are considering vehicle to grid (V2G) as well as grid sourced charging capacity (VG1).

Different parts of the network and different asset classes may experience more specific challenges:

1. In urban areas, particularly in Wellington, some residential EVs may use more public chargers due to their lack of access to private chargers / garage. The network will see a large step change in the load from off-street public chargers. Beyond a certain point this will cause network imbalance and the distribution substation may be constrained, affecting supply quality. If this occurs, TOU tariffs may be less attractive and – perversely – drive up the need for electricity distribution businesses (EDBs) to implement a network expansion project. This outcome would place extra costs across all consumers, creating a cross subsidy.
2. In urban to rural areas, where people need to travel slightly further, a growth in clusters of EVs will cause LV feeders to overload. Charging to replenish for the next day's journey, if unreliable, will potentially limit interest in EV ownership and could increase range anxiety.
3. In rural areas with lower customer density and much longer and thinner 'lines', people normally travel further in any case. The impact on the network in areas like this from increased EV charging could see overloading on the network or voltage issues within the home. This could be solved through education on demand side scheduling to avoid voltage and capacity constraints.

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[45] https://www.transport.govt.nz/multi-modal/climatechange/electric-vehicles/
[46] http://www.gwrc.govt.nz/assets/Climate-change/Wellington-Region-Electric-Vehicle-Support-Strategy-DRAFT-v1.5.7.pdf
[47] Studies we refer to here include Miller and Lemon 2019: Electric Vehicle Charger Hosting Capacity, EEA 2019. These studies identified that "where and when" impacts will occur depends on "where" the network location is, where and what the chargers are, and the characteristics of the network (topology, transformer size, cable type, number of connections, etc) and localised consumption patterns. Generally, the studies concluded that there is a 'threshold' beyond which the network will begin to experience impacts from EVs and suggested this is 'likely to be reached' within the next five or more years.

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2.4 Wellington Electricity

When considering what we can do and what we should do to minimise any cost impacts from responding to the changes from EVs, we take the view that we will need ourselves to make a number of changes in order to accommodate customer choices.

Network reinforcement is the traditional response option to manage the increased demand associated with EV charging activity during peak. While it does remain ***an*** option, network reinforcement is costly, time-consuming and would drive up total costs across the asset base, affecting all customers – regardless of whether they own an EV. This last point raises the need for equitable solutions when change is occurring.

There are other smarter options, such as managed charging, to proactively ready the network for the congestion and associated power quality issues that may occur where large numbers and high rates of charging is happening.

If the industry can collaborate on workable approaches to support development of managed charging in appropriate locations, there is the potential to avoid or delay reinforcement and still accommodate the increase in consumer demand equitably. This doesn't mean that no reinforcement will be required, but that networks will be able to target this and have more time to properly assess where and when reinforcement is most needed, consequently saving customers money on the 'supply charge'.

Change like this doesn't happen overnight, so getting our first steps as right as possible (on a least-regrets basis) and working closely with the wider industry and the regulatory authorities is important. To help explain what we have learnt throughout the last year in working with our partners on this project, we've included a focus – in the next section – on our EV Connect trial. This was established specifically to help us understand smarter and more agile options that might help us to support and enable managed charging in our network.

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2.5 WE* Project Spotlight – EV Connect Technology Demonstration

Networks and other market participants face challenges in being able to communicate with and coordinate actions with customer owned devices. Where possible, there are benefits to enabling this communications structure to set the foundations for future network management and for customers, or their agents, to access new value streams.

We believe that a system that allows consumers and the wider industry to unlock value and utility will ultimately be the best long-term solution to manage the increase in EVs.

The approach that we took here was to identify a technology solution that allowed for many and multiple vendors to participate. Equally we wanted a solution that would address coordination and communications for us from an early pilot stage through to demonstration and (we hope) wider participation and engagement with retailers and customers.

This project has highlighted options we could implement to provide incentive and reward structures for EV owners to engage with something new. Such options include Dynamic Connection Agreements (DCAs) - which enable visibility, consent for EV management at specific times - combined with network support contracting and opening up the option of access to additional value streams by participating in energy services via aggregators/virtual power plants.

Wellington Electricity worked with GreenSync to demonstrate and test the capability of their decentralised energy exchange (deX) platform and applications for distribution networks to coordinate and manage third party EV chargers.

The first trial involved supporting a third-party EV charging technology to complete an integration with the deX API. Once in place, these chargers were registered and instantly visible to WE* in the deX application. With inbuilt DCAs functionality, deX records permissions from the device owner and provides the technical capacity to impose limits on the devices – individually and as a group. WE* was able to direct the EV chargers to change their activities for a specified period of time and see this happening in real time. Post-event telemetry was also provided to WE* as the service requester.

A second trial is now underway using the deX platform, supporting the integration of a second EV charging technology using a specific communications protocol, OCPP. This second trial will include collaboration with Genesis Energy to further develop DCAs and show the interactions and benefits available for the customer, network and retailer from increased coordination and management.
To support this second trial, we are working with our project partners to develop draft DCAs that will be available to device owners on an opt-in basis. These agreements and consents will enable WE* to gain visibility and capacity to manage those assets in peak times and providers like Genesis to be able to coordinate those assets for wholesale, demand response or other services.

Further collaboration is welcome to progress this type of approach and develop tariff/incentive structures to encourage customer engagement.

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2.6 Section 2 Stakeholder Questions

International Insights

- What policy choices or other advanced EV markets would be appropriate or valuable in New Zealand?

Postcard from Australia

- Do you agree that the issues that Australia has experienced with solar PV are concomitant to emerging EV uptake in New Zealand?
- Would you agree that some of the actions Australia has taken recently would be relevant to New Zealand policy and regulatory discussions with regard to EV uptake?

New Zealand EV Context

- Given the rapid changes occurring in technology – which can go from 'emerging to critical' in one regulatory cycle – what is needed to allow more agile, flexible responses by lines companies?
- How do we as an industry move from 'talking about what changes should be made', to making those changes? Given regional diversity and non-uniform approaches across New Zealand, what additional steps or challenges do we need to overcome?

Wellington Electricity Approach and Technology Trial

- We intuitively believe customers will be better off with a tariff and manage option – what incentive and tariff arrangements would you like to see develop?
- Should retailers be required to pass on a new tariff to their customers, even if it's opt-in?
- What other ways could be considered to shift EV charging to maintain stable network operating conditions?

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3 What Networks can do to Support Expansion of EVs

3.1 Network Options to Address Low Voltage (LV) Visibility

Visibility is regularly identified as the central barrier to better network management on the low voltage network and interaction (let alone integration) with distributed energy resources (DER), including EVs at the consumer connection level.

Historically, low voltage networks have been difficult to visualise and were designed on an install and forget basis such was the homogeneous nature of network connections, which has suited a predictable load growth and traditional one-way power flows. Lines companies in New Zealand have normally only installed monitoring on primary equipment i.e. assets rated at 33kV and 11kV.

There were some expectations that Smart Meters would enable access to more network detail, however these have largely remained electricity consumption devices due to flat kWh pricing structures with little real time capability and simple communication structures for daily remote reading of consumption registers.

To accommodate the growing uptake of EVs and other DER whilst still remaining efficient will require lines companies to treat their LV distribution network as a set of flexible assets. To do this requires additional capacity to accommodate interaction and engagement with assets that are owned by others (EVs/other DER for example) and LV network systems and assets. This is very different to the traditional approach to asset management, operation and planning.

Emerging or evolved markets for DER participation will require the LV network owner to have increasing interaction with third party providers such as aggregators. Getting to this step will require lines companies to improve visibility of their LV networks. Improved visibility of the LV network will provide information about where uptake and growth are occurring. Improved visibility will also allow lines companies to better understand the power quality issues and network constraints which may be exacerbated by EVs and other DER. Equally, in time, these issues or constraints may be solved and supported by EVs and other DER where collaboration is developed.

The first step for lines companies to consider is the need to improve their understanding of their LV network hosting capacity and constraints.[48] For Wellington Electricity this could mean:

- Mapping 15,000 LV feeders and 4,500 distribution transformers into a set of standard LV templates. Simulations could then be applied to assess the first point of breach and saturation level. The key benefit if this is that it will identify where constraints are expected in the future and inform priorities by focusing on networks with the lowest hosting capacity

- Defining available solutions and the preferred solutions (e.g. new assets with larger capacity, consumer level voltage regulator or procure network support)

[48] https://www.ena.org.nz/dmsdocument/483

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Aligned to the ENA Network Transformation Roadmap[49] Wellington Electricity's view is that lines companies need to roll out LV monitoring systems with data management systems and provision of AMI data to assist with network management. This will improve the quality and type of monitored data over time and ensure there is more granular knowledge of each LV network. There are several options for achieving this:

1. At the distribution substation and LV feeder level, providing real-time and planning data the options are:
    - Install lines company-owned remote monitoring devices on the LV side of distribution transformers
    - Contract existing metering system providers to install smart meters i.e. rent them
2. At the LV ICP level, the options to provide planning data are:
    - Procure directly from metering system provider and set up cloud-based storage and analytic tools
    - Modify existing Electricity Information Exchange Protocol (EIEP) requirements by enabling EIEP3 so retailers have the obligation to provide the data. This may also require an upgrade to the central ICP data management system, Gentrack
    - Smart devices having dual role of providing profile data to the cloud for network performance at LV feeder points and data sharing agreements with grid-tied inverters.

We also note that LV monitoring – which can be provided by smart meters - can also provide safety benefits at the ICP such as the early identification of hazards such as faulty neutrals.

3.2 Dynamic Operations

The industry already knows and understands congestion mechanisms to ensure the lights stay on, albeit at a transmission level. For example, Grid Warning and Grid Emergency Notices allow Transpower to signal EDBs to take action to curtail demand so the transmission grid remains stable. Similar constraint notices are made by the System Operator for generation support or support from reserves.

Automated systems are also in place to protect and recover from system frequency excursions which rely on coordinating generation and distribution system load so that the transmission grid remains available, avoiding a blackout and lengthy system restart.

We see an increasing need to allow and enable orchestration to maintain a stable supply system at the distribution level similar to the sort of elements in place at the transmission level.

We do have some ability to control the distribution system dynamically, today: We are able to use ripple control systems to manage night storage heating and electric hot water storage. This capacity can support the network, transmission demand curtailment and/or market services.

[49] https://www.ena.org.nz/dmsdocument/483

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There is a clear hierarchy specifying what is the highest value use for these existing dynamic system controls:

1. Keep the lights on for customers
2. Secure the distribution network supply quality
3. Reduce the transmission peak demand
4. Other market services

Customers who provide the network company ripple control of their hot water device receive reduced line charges. The reduced rate is offered because networks are able to be operated more efficiently by dynamically optimising hot water storage demand on the system.

Looking ahead to EV management, the same principles apply around benefits of shifting demand, however there are now, through technology and communication advances, some more eloquent ways of doing this.

3.3 Network Policies and Standards

Network quality standards are well established and mandated through regulation. Upper and lower voltage limits (230V ±6% at the point of supply) are managed through the Electricity Safety Regulations. Similarly, harmonic limits are managed through Electricity Code of Practice 36 (ECP36). It's the line companies' responsibility to operate their networks within these limits. Past standards have set the present design ratings of NZ networks.

In the case of distributed generation there is regulatory support to assist the lines company with staying within these limits. For example, requiring compliance with the inverter standard AS/NZS - 4777. Additionally, the electricity industry participation code mandates that distributed generation connection applications must be approved by the lines company before installation can occur.

It is the lines company's responsibility to have their own internal policy and process to deal with these applications i.e. a system that assesses hosting capacity, inverter settings and protection requirements based on the connection's size and surrounding network conditions. To ensure consistency across lines companies this system should be aligned to the EEA Interim guide for connections of small-scale generation.[50]

In the case of EVs, or more specifically, EV chargers, it seems a reasonable step to expect that the lines company would be notified of a connection request for a very large charger. However, even if the connection location has available capacity, there is no specific requirement for these devices to assist the lines company in staying within voltage, harmonic and network design limits, at an individual or cumulative level.

[50] https://www.eea.co.nz/tools/products/details.aspx?SECT=publications&ITEM=2917

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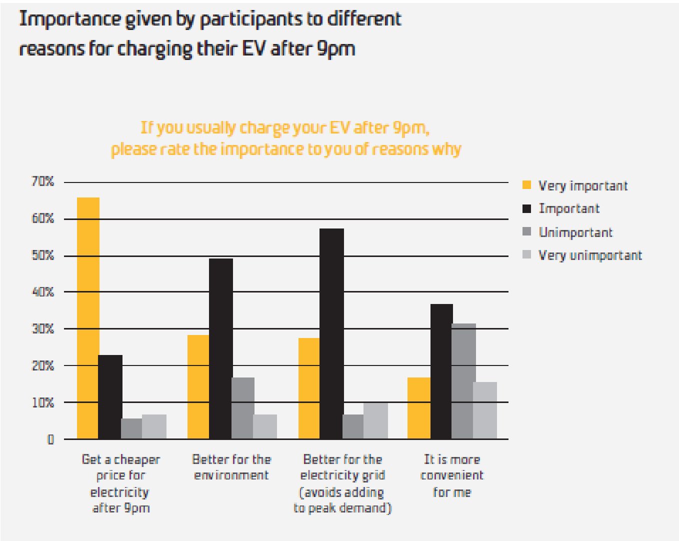
3.4 Network Tariff Changes/Incentives

A significant portion of the EV charging load will occur when EV owners return home from work coinciding with the residential evening peak usage period. Adding high rates of EV charging to the busiest network period of the day, could be problematic for the network, causing quality issues or even loss of supply in extreme circumstances.

As discussed in Section 2 of this document, at high rates of EV penetration if we do nothing to prepare and change, we will simply see resulting network congestion. To help alleviate this, lines companies are now trialling – or in some cases implementing – stronger congestion price signals with adoption of time of use tariffs (ToU).

ToU tariffs apply different price points for different time periods and provide a simple form of cost reflective price signal. Customers pay a higher charge at a period when the network incurs higher congestion which incentivises customers to shift consumption to lower priced periods. A recent trial we undertook with 100 EV owners in Wellington showed that there was strong motivation to shift EV charging because it was better for the environment and electricity grid, see figure 1 below.

Figure 1: Importance given to participant to different reasons for charging their EV after 9pm



While there is the potential to create a new network peak as customers all simultaneously begin charging their EVs as soon as the low-price period as available, this can be managed with further engagement and innovation.

Aligned to the ENA Transformation Roadmap,[51] we consider that tariffs and incentives will continue to develop further to include short and long run pricing to consider locational and dynamic situations as we look to coordinate DER for system-support. We support the work that the Distribution Network Pricing Group is doing to develop cost-reflective pricing.

[51] https://www.ena.org.nz/dmsdocument/483

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3.5 Section 3 Stakeholder Questions

Low Voltage Visibility

- Do you agree that LV monitoring is a prerequisite for ongoing power quality management as customers make investments that create a more dynamic network?
- Are the above options for improving LV monitoring right? What would you add or change?
- What would a collaborative approach to LV monitoring look like?
- Are there other approaches that could be considered for improving visibility – are there any device based approaches that would help?

Dynamic Operations

- Will customers, or retailers or aggregators see a different hierarchy of needs in relation to the performance of the distribution network?
- Do you agree that evolving technology and advanced communications provide more 'eloquent' ways of managing the performance of the distribution network?

Network Policies and Standards

- Do you agree that it would be sensible to implement a regulatory support framework and / or device requirement for EV charging technologies similar to the existing approach for distributed generation?
- Should the central vehicle registry (NZTA), or another entity, be enabled/tasked with capturing and sharing data with the electricity registry of EV ICP locations?
- How will privacy be coordinated as an enabler rather than a barrier?

Network Tariffs

- TOU tariffs are easier to explain when retailers engage with their customers, however more sophisticated signals can be generated through demand signals. Do you foresee TOU being a significant price incentive for charging behaviour or are capacity or demand signals required?
- Do TOU tariffs provide sufficient equity for all customers so cross-subsidies by non-EV owners are avoided?
- If tariffs are insufficient to drive behaviour, ie fuel/electricity makes the lines charge differential too small to influence behaviour, what other congestion reduction steps could be taken?

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4 What can be done in Partnership with Others?

Customer investment in EVs and other distributed energy resources is bringing forward a conversation about distribution network availability also providing market access for customers. In order to do this, the distribution system will need to be operated both in the physical sense but also in the market sense which is quite a different dimension.

As an industry, we need to establish foundational elements that set up both physical and market access. One pathway, potentially, is through progressing, standardising and adopting a consistent approach to Dynamic Connection Agreements (DCAs).

4.1 Dynamic Connection Agreements

With the potential for EV registration information being captured digitally, and an incentive and tariff structure that is attractive to customers (covered earlier in this document), a new approach to expanding current Connection Agreements is required. Today, any customer wanting to connect a distributed energy generating resource to the network needs to apply for approval from the lines company; this historically used to occur on networks when Power Boards had "defined loads" which required further agreement before they were approved for connection.. Such agreements allow the lines company to ensure compliance with guidelines and standards that define basic electrical settings in order to avoid deterioration of supply quality to other consumers connected to the distribution network[52] .

Dynamic Connection Agreements (DCAs) change the style of the traditionally passive connection to the distribution network to allow variability required for larger devices. DCAs provide a mechanism through which dynamic limits (thresholds) can be implemented within the LV network for a period of time, then allow reversion back to a higher or unlimited operational state. [53]

The essential elements of a DCA are:

1. Customer consent - explicit agreement via the dynamic connection agreement, which increases customer access to the network in exchange for provision of services.
2. Provision of specified services, must include:
   - Telemetry data from the device to the network; and
   - Reducing device output in response to EDB specified limits, to maintain the network within specified operational limits.

Combined with a smart approach to asset registration, and in combination with tariffs/incentives, DCAs can establish a streamlined pathway for customer permitted support from and management of EVs/EV charging. DCAs are also helpful, we think, in supporting the provision of EV charger service contracting into existing markets such as the Demand Response program or wholesale services more generally.

Wellington Electricity – as part of this project – is working on establishing and implementing processes and policies to support DCAs being applied in our network. We think there is merit in building a stronger collaboration around these agreements so they can be developed and adopted nationally, supporting consistency for customers, retailers, OEM vendors and regulatory authorities.

[52] GreenSync (2019). Application and deployment of Dynamic Connection Agreements (DCAs) for distributed energy resources.

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4.2 EVs / EV Charging Assets Registration Information

As mentioned in Section 3.1 we believe there is significant merit in making sure that EDBs are provided with information regarding registration of EV connections and charger types by EV owners. We should be smart about the steps we take to improve visibility, coordination and support for the network and from the network to ensure customers' assets and service quality levels are delivered well into the future.

We want to stress that we are not, today, concerned with existing small connection EV chargers that barely add to a customers' load. We do expect, however, that over time smarter, faster and larger charging units will become more and more ubiquitous for EV owners. Indeed, this is already the case for public and semi-public charging units.

Provision of information about these assets, going forward, would allow the Central Government, vehicle industry and electricity stakeholders to have a clearer picture of both the status of EV and EV charger uptake and use and provide a pathway to see how these assets behave in a managed charging context. Importantly, for lines companies, registration of charging points would allow them to enforce network standards. Additionally, this would also allow lines companies to better forecast future loading issues and plan their asset management and investment activities accordingly.

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4.3 Section 4 Stakeholder Questions

Dynamic Connection Agreements

- Are market participants in support of dynamic agreements with customers so actions can be taken to stabilise the distribution grid?
- Do you agree that development of DCAs is appropriate to EVs/EV chargers? Should there be a size/threshold minimum for their application? Should they be extended to other types of devices?
- Are there other or alternative approaches that should be considered?
- Are there other policies, incentives or mandates needed to proceed with DCAs?

EV Registry

- Do you agree that a national EV registry is worth considering? Should this be applied more widely (ie. not just EVs)? Why should such information be provided?
- If a Registry was established, what would you like to see underpinning it? (Incentive structures; regulatory requirements; Connection agreements / tariff + connection agreement incentive arrangements provided by EDBs; or something else)
- If such a Registry was established, who could/should supply this information to the EDB?
- If such a Registry was established, what data would be required, how and who would determine it? How would it be shared?

5 Standard Protocols for EVs in NZ?

EV charging technology is developing rapidly. Early on charging infrastructure enabled EVs to be charged at a place of work or home, using 2-4 kW supplies which meant a fairly slow recharge. Today, charging in public and semi-public locations are becoming more commonly fast (7-22 kW), rapid (25-99 kW) or ultra-rapid (+100 kW).

Coming to terms with what is required from the lines company perspective is vitally important to ensure that the safe and reliable operation of the grid is maintained for all of our customers.

For WE* (or other lines companies) to manage third party EV chargers, we need to be clear about the emerging and 'de facto' approaches taken on communications protocols and standards for interfaces and communications between devices and systems.[54]

To be clear, a protocol is a means of communication over a computer network. A standard documents an agreed norm. Protocols that operate over the Internet are sometimes referred to as Application Programming Interfaces (APIs). Open standards are freely available for people to reference and implement, without charge or constraint. Some protocols are standardised; some aren't. The overlap between protocols and standards is often referred to as protocol standards.[55]

5.1 EV Charging Protocols and Standards

To coordinate the operation of EV chargers, standard communication protocols are a key piece of the puzzle for electricity infrastructure management. There are two main options here:

1. VG1 – managed EV charging
2. V2G – leveraging the EV as a storage system

While there are a number of protocols that can be used for communication with EVs/EV charging devices, [56] Open Charge Point Protocol (OCPP) is becoming the 'de facto' standard for VG1 in many global locations including Europe and the UK.[57] Led by the Open Charge Alliance, this protocol is evolving alongside technologies and expansions and extensions are being developed. Extensions to OCPP for V2G capabilities can be done, but are not yet 'standardised'.[58]

By 2017, OCPP was described by Drive Electric NZ as having "become standard throughout the world" for EVs and had been adopted by New Zealand's biggest EV charging provider (Chargenet).[59] OCPP allows charging stations and management systems from different vendors to communicate with each-other,[60] relying on cloud-to-cloud communications.

[54] SEPA (2020). Guidelines for Selecting a Communications Protocol for Vehicle-Grid Integration
[55] GreenSync (2019). Navigating DER Standards and Frameworks
[56] SEPA (2020). Guidelines for Selecting a Communications Protocol for Vehicle-Grid Integration
[57] https://evreporter.com/ocpp-and-ev-charging/
[58] https://www.v2g-evse.com/2020/04/14/ocpp-2-0-1-released/
[59] DriveElectric https://driveelectric.org.nz/whitepaper/charging-ahead/
[60] DriveElectric https://driveelectric.org.nz/whitepaper/charging-ahead/

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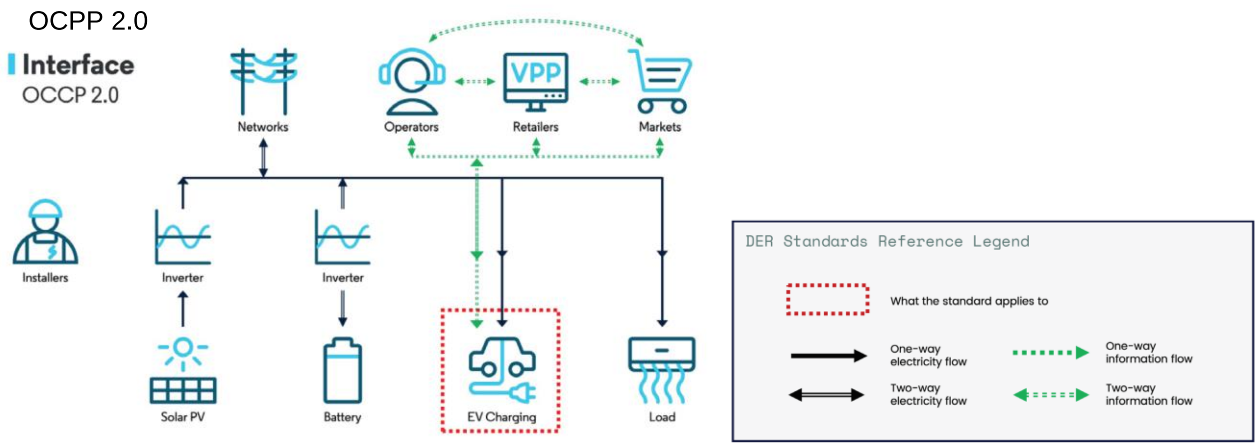
Figure 2: OCPP 2.0 Schematic to explain the flow of electricity and communications between EVs/EV chargers and energy market participants



This *interoperability* capability in OCPP is vitally important for WE* in thinking through our approach to EV charging connections and coordination options. We are vendor agnostic on the charging equipment. We must be able to accept and manage interactions from as broad a range of charging technology as possible to support consumer/customer choice and product options. Those products must, of course, also meet safety and operational requirements of the network and regulators.

Figure 3: deX API and 'bridging' communications schematic

Our technology partner in this EV Connect project – GreenSync – was chosen in part because their deX platform is designed to handle and engage with multiple technology types[61] and can build 'bridges' to industry adopted protocols and standards (see Figure 3 above).[62] In essence, the deX technology enables us to receive 'translated' communications from the EV charging management platform, to send communications to those systems and importantly it also provides a system of record.

We are exploring how best to establish common approaches so that as many vendors are able to communicate with us – and vice versa – and to ensure we can accept/approve a wide range of charger equipment within our connection/dynamic connection agreements.

[61] GreenSync's deX platform can accommodate communications protocols with other technology types (eg. Solar PV, Battery Energy Storage Systems, Heatpumps, …etc), enable communication and coordination of them via a common pathway.
[62] GreenSync (2019). Navigating DER Standards and Frameworks

5.2 Section 5 Stakeholder Questions

EV Charging Protocols/Standards

- Do you agree that a standard like OCPP is the most appropriate protocol to encourage as we progress to interacting / setting up interfaces with EV charging equipment? Why/why not?
- To progress implementation/ adoption, what steps are appropriate for a network business, or others?

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6 Preserving Structures while Maintaining Standards

To build on foundational elements for physical access, and support ongoing uptake of EVs, distribution network availability should also provide market access for customers. The distribution system will need to be operated both in the physical sense but also in the market sense. This will drive an increasing need to enable orchestration to maintain a stable supply system at the distribution level. Similar operating structures to those applying in the transmission system are likely to be needed. So too, the clear hierarchy specifying what is the highest value use.

Customers enabled through their DER choices to access energy markets directly may be more interested in distribution congestion to the extent that it interacts with options to derive value. Creating wider flexibility for customers to seek recompense for their energy behaviours either consuming or generating or both is important, conceptually.

The dynamic nature of these relationships requires an understanding that to keep the system stable, it will need to be operated dynamically. At the extreme end of this is South Australia where the distribution network there is now allowed to interrupt domestic solar to maintain distribution network security under critical conditions.[63]

Through our experience with this EV Connect project, to date, it is clear to us that improved flexibility and access for multiple-parties and to multiple markets for services from DER could deliver value to customers and other market participants. A first step along this path, importantly, is agreement with customers of devices to make their appliance available or not available. Over time, more interaction and familiarity will drive ubiquity. However, even to move forward a little bit, there are market structure, framework and regulatory funding issues to consider and address – collaboratively.

6.1 Market Structures

The New Zealand Electricity Market, and the associated market participants, operate under the Electricity Industry Participation Code 2010 (The Code)[64]. The market is well regulated and generally well understood by participants. It serves New Zealand well for delivering electricity through an asset hierarchy which has transactions at the wholesale and retail levels for customer purchases. In this traditional method of supply, generators produce electricity from primary sources. The electricity flows through the transmission grid and into distribution networks. The retailers purchase electricity from generators, at spot or contracted market prices, and pay for distribution and transmission charges. These costs are passed onto customers in a single monthly bill.[65]

As the uptake of EVs and other DER increases it is likely that customers, or their agents, will want to interact with the electricity market. The traditional market structure provides little in the way of a framework or support for effectively managing a high uptake of EVs or other DER.
Whilst the ability to scale is a barrier; this (presently) unregulated approach has seen the development of innovative emerging markets. One example of this is the Transpower demand response (DR) scheme. The DR allows customers to respond to a price signal and reduce their electricity demand in exchange for payment.

[63] South Australia's LV network operator is also allowed further investment for 120 substations to provide capacity for the 1500MW of solar injection into the distribution network
[64] https://www.ea.govt.nz/code-and-compliance/the-code/
[65] https://www.ea.govt.nz/about-us/media-and-publications/electricity-new-zealand/

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Transpower and the Electricity Authority have agreed an operational protocol that explains how Transpower will operate the DR scheme and ensure the wholesale electricity market is not adversely affected.[66] However, the protocol provides no consideration of distribution networks or other industry players, despite the obvious aspect of changes in physical power flows having a physical implication for the operation of the distribution system.

With no framework to ensure appropriate coordination across the electricity supply chain embedded into the DR scheme, growing participation in it has the potential to reduce the security of supply to the customer, negatively affect supply quality for end consumers and potentially damage customer owned equipment and damage distribution network assets. Additionally, there is the potential for lines companies to have their code obligations put at risk i.e. AUFLS.

It's our view that the industry needs to collaborate and develop a framework that will coordinate DER dispatch and establish the foundations and rules for a clear hierarchy of needs-based access to services and support from customer-owned assets. With time and experience the number of support and incentive programmes will increase beyond traditional wholesale market support into network support, system support, PPA firming and other services. This will allow all industry sections to have visibility and coordinate benefits i.e. retail, distribution, transmission and generation.

6.2 Regulatory Framework and Funding Arrangements

WE* is a regulated monopoly under Part 4 of the Commerce Commission's DPP3 Price/Quality path. The current regulatory allowances are largely calculated based on traditional infrastructure-based network solutions which don't cover networks for investment risk of developing the flexibility to adapt to the challenges and opportunities of new and emerging technology.

Some good progress has been seen in the most recent default price-quality path (DPP) allowance reset with the introduction of the innovation fund, growth reopeners and equalising the capex and opex IRIS incentive rates. However, this may not be sufficient to match the rate of change in customer adoption of new technology, so we need to engage with policy and regulatory bodies to join in with our development of new solutions. We are keen to open up a conversation about whether further regulatory funding flexibility needs to be provided to enable both sufficient future funding and non-capex solutions to meet the requirements of the future state of the energy system.

As EV and wider DER uptake grows, investment to reinforce the LV network could be deferred if flexibility around new DER services is well coordinated, provided the tools for this can be provided (including monitoring and management). Some costs for these tools are likely to occur behind the meter, so setting operability standards for devices which allow managed access to the network and secondary markets has to be considered in relation to device capability and comms requirements.

Industry has a key role to play in this as customers buying flexible DER can be enabled to play an increasing, interactive role in supporting the network and in accessing markets for services from their DER.

The present DPP and CPP investment rules appear not nuanced enough to consider flexibility arrangements. Non-business-as-usual, single issue investments are not anticipated by the current regulatory arrangements with one exception; the 54Q provisions which explicitly target energy efficiency and incentivise investments to deliver such outcomes.

[66] https://www.transpower.co.nz/keeping-you-connected/demand-response/demand-response-documents

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We see a need for flexibility in the regulatory framework opex allowance forecasts. Currently these are based on historical spend. Given the rapid pace of technology change, there should be a mechanism to consider funding for the additional opex drivers expected as a result of increased DER uptake. More flexibility in the step change mechanism or a reopener to capture verifiable new operating costs may help solve this.

Although the latest DPP reset has aligned the opex and capex IRIS incentives rates, there are still limitations of the IRIS which restrict innovation. Currently there are no offsetting IRIS rewards for long-term capex savings to offset penalties from short-term opex overspend. This issue could be solved by introducing the ability to include opex new costs in allowances (which would avoid the IRIS penalty) and remove customer growth from the IRIS calculation (avoiding penalties for customer driven investments).

These are the key issues which WE* believe need to be addressed within the regulatory framework and funding arrangements to encourage and enable innovative responses to the challenges and opportunities posed by increased DER uptake.

6.3 Market Evolution

As noted above, our view that the industry needs to collaborate and develop a framework that will coordinate DER dispatch and establish the foundations and rules for services from customer-owned assets while preserving LV network quality and stability. We are some way off that being the case, but there is an emerging and growing trend in advanced energy markets that is well aligned with this direction.

In their recent Whakamana i Te Mauri Hiko report, Transpower emphasised the importance of collaboration and coordination at a policy, regulatory, market, industry and customer level in order to shift, more quickly, to taking steps to drive electrification of the economy.[67] Clearly EVs and transport are key elements of this transition.

Indeed, most countries with advanced energy market structures and high volumes of renewables and/or EVs are likely to be seeing their utilities – and regulatory authorities – considering how best to evolve frameworks, regulations, rules to drive new business models while ensuring reliable, safe, sustainable operation of the system. There is often a focus on larger generation sources, but as Australia has demonstrated to us, there is a need to incorporate and embrace changes being led at the consumer level.

The UK industry has been progressing from the traditional Distribution Network Operator model to a Distribution System Operator (DSO) and Distribution Market Operator (DMO) approach – devolved at a regional level.[68] As noted earlier, Australian distribution businesses are moving (in some cases rapidly) to implement processes, device requirements, operational access and protocols to enable coordination and control of DER. There are a number of early moves to establish and coordinate state-wide virtual power plant capabilities through DER.[69] Australia's Western Energy Market (which operates the market around Perth and the South-West of Western Australia) is, with the support of the WA Government, moving very deliberately to establish DSO and DMO foundations and to embed early requirements for DER that will underpin increasing interaction with networks, utilities and market service opportunities.[70]

[67] Transpower (2020). Whakamana i Te Mauri Hiko – Empowering our Energy Future.
[68] See for example: https://www.ofgem.gov.uk/system/files/docs/2019/07/ofgem-beis_joint_open_letter_to_the_ena_open_networks_project.pdf
[69] Eg. South Australia and New South Wales.
[70] https://www.wa.gov.au/organisation/energy-policy-wa/energy-transformation-strategy

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While it is useful to look West, we would prefer New Zealand developed a nationally coordinated, collaborative approach that avoids development of divergent pathways and that accelerated progress along that path. While we agree with much of the ENA's 2019 Transformation Roadmap,[71] we believe there is a need for progress and collaboration to be led, nationally. In particular, pathways to service contracting – especially in relation to EV charging infrastructure – could provide the impetus for a wide range of stakeholders to engage and develop an approach that leverages what we've got and iterates to ensure benefits are more widely shared. For this to get started we are keen to open up the conversation on how deep and how fast our market should evolve.

[71] NZ ENA Network Transformation Roadmap

6.4 Section 6 Stakeholder Questions

Market Structures

- Do you agree that there is risk and duplication with the current unregulated approach to DER market development?
- Would you like to see the industry develop a coordinated approach to DER market development?
- Should the responsibility for managing distribution quality remain with distribution companies or are there other natural operators who can provide this service and what would this look like particularly from other consumer protection laws (consumer guarantee act)?
- How will the competing benefits of separate market participants be managed to preserve customer supply quality?
- The trade-off with regulatory flexibility is regulatory certainty. Are you comfortable giving up price path certainty to allow a network's allowance to reflect new costs?
- What changes do you think are most beneficial to provide the flexibility to enable innovation? Are NZ retailers interested in/willing to using DER, whether aggregated by them or aggregators, to respond to nodal spot prices (i.e. the combination of energy market and transmission congestion signals)? Is this sufficient to incorporate distribution prices into the nodal price signal, and move towards DER response to manage congestion in distribution networks?

Regulatory Framework and Funding Arrangements

- Is the 54Q application path the mechanism to develop as part of DER becoming part of the DPP?
- Should DER be part of a reopener and show maintaining an existing network which has further LV visibility and management investment to ensure quality continues where DER penetration has reached a certain level
- Will customers require subsidies for smart enabled DER devices so we can maintain management of quality standards at the LV distribution level. Ie every EV which needs 3kW or 4kW or above charging is given an enabled charging device by the car dealer?

Market Evolution

- Thinking ahead, are we better to prepare for orchestration of DER or be faced with a regulatory intervention like South Australia and have powers to turn off DER to avoid system instability?
- Is the industry aligned, as yet, on the path and timeframe required to move? How would you suggest this is addressed/enabled most effectively?
- How far are we willing to move in order to progress and accommodate rapid adoption of EVs?
- How deeply should that effect the move to distribution operating models – the DSO/DMO? How and who is best placed to take on what role?

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7 Stakeholder Questions

Section	Ref	Topic	Questions
2		**Imperative for Change**	
	2.1	**International EV Context**	• What policy choices other advanced EV markets would be appropriate or valuable in New Zealand?
	2.2	**Postcard from Australia**	• Do you agree that the issues that Australia has experienced with solar PV are concomitant to emerging EV uptake in New Zealand? • Would you agree that some of the actions Australia has taken recently would be relevant to New Zealand policy and regulatory discussions with regard to EV uptake?
	2.3	**New Zealand's EV Context**	• Given the rapid changes occurring in technology – which can go from 'emerging to critical' in one regulatory cycle – what is needed to allow more agile, flexible responses by lines companies? • How do we as an industry move from 'talking about what changes should be made', to making those changes? Given regional diversity and non-uniform approaches across New Zealand, what additional steps or challenges do we need to overcome?
	2.4	**Wellington Electricity**	• We intuitively believe customers will be better off with a tariff and manage option – what incentive and tariff arrangements would you like to see develop? • Should retailers be required to pass on a new tariff to their customers, even if it's opt-in? • What other ways could be considered to shift EV charging to maintain stable network operating conditions?

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Section	Ref	Topic	Question
3		**What Networks can do to Support Expansion of EVs**	
	3.1	**Network Options to Address Low Voltage Visibility**	• Do you agree that LV monitoring is a prerequisite for ongoing power quality management as customers make investments that create a more dynamic network? • Are the above options for improving LV monitoring are right? What would you add or change? • What would a collaborative approach to LV monitoring look like? • Are there other approaches that could be considered for improving visibility – are there any device based approaches that would help?
	3.2	**Dynamic Operations**	• Will customers, or retailers or aggregators see a different hierarchy of needs in relation to the performance of the distribution network? • Do you agree that evolving technology and advanced communications provide more 'eloquent' ways of managing the performance of the distribution network?
	3.3	**Network Policies and Standards**	• Do you agree that it would be sensible to implement a regulatory support framework and / or device requirement for EV charging technologies similar to the existing approach for distributed generation? • Should the central vehicle registry (NZTA), or another entity, be enabled/tasked with capturing and sharing data with the electricity registry of EV ICP locations? • How will privacy be coordinated as an enabler rather than a barrier?
	3.4	**Network Tariff Charges/Incentives**	• TOU tariffs are easier to explain when retailers engage with their customers, however more sophisticated signals can be generated through demand signals. Do you foresee TOU being a significant price incentive for charging behaviour or are capacity or demand signals required? • Do TOU tariffs provide sufficient equity for all customers so cross-subsidies by non-EV owners are avoided? • If tariffs are insufficient to drive behaviour, ie fuel/electricity makes the lines charge differential too small to influence behaviour, what other congestion reduction steps could be taken?

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Section	Ref	Topic	Question
4		**What can be done in Partnership with Others?**	
	4.1	**Dynamic Connection Agreements**	• Are market participants in support of dynamic agreements with customers so actions can be taken to stabilise the distribution grid? • Do you agree that development of DCAs is appropriate to EVs/EV chargers? Should there be a size/threshold minimum for their application? Should they be extended to other types of devices? • Are there other or alternative approaches that should be considered? • Are there other policies, incentives or mandates needed to proceed with DCAs?
	4.2	**EVs/EV Charging Assets Registration Information**	• Do you agree that a national EV registry is worth considering? Should this be applied more widely (ie. not just EVs)? Why should such information be provided? • If a Registry was established, what would you like to see underpinning it? (Incentive structures; regulatory requirements; Connection agreements / tariff + connection agreement incentive arrangements provided by EDBs; or something else) • If such a Registry was established, who could/should supply this information to the EDB? • If such a Registry was established, what data would be required, how and who would determine it? How would it be shared?
5		**Standard Protocols for EVs in NZ?**	
	5.1	**EV Charging Protocols/Standards**	• Do you agree that a standard like OCPP is the most appropriate protocol to encourage as we progress to interacting / setting up interfaces with EV charging equipment? Why/why not? • To progress implementation/ adoption, what steps are appropriate for a network business, or others?

Section	Ref	Topic	Question
6		**Preserving Structures while Maintaining Standards**	
	6.1	**Market Structures**	• Do you agree that there is risk and duplication with the current unregulated approach to DER market development? • Would you like to see the industry develop a coordinated approach to DER market development? • Should the responsibility for managing distribution quality remain with distribution companies or are there other natural operators who can provide this service and what would this look like particularly from other consumer protection laws (consumer guarantee act)? • How will the competing benefits of separate market participants be managed to preserve customer supply quality? • The trade-off with regulatory flexibility is regulatory certainty. Are you comfortable giving up price path certainty to allow a networks allowances to reflect new costs? • What changes do you think are most beneficial to provide the flexibility to enable innovation? Are NZ retailers interested in/willing to using DER, whether aggregated by them or aggregators, to respond to nodal spot prices (i.e. the combination of energy market and transmission congestion signals)? Is this sufficient to incorporate distribution prices into the nodal price signal, and move towards DER response to manage congestion in distribution networks?
	6.2	**Regulatory Framework and Funding Arrangements**	• Is the 54Q application path the mechanism to develop as part of DER becoming part of the DPP? • Should DER be part of a reopener and show maintaining an existing network which has further LV visibility and management investment to ensure quality continues where DER penetration has reached a certain level • Will customers require subsidies for smart enabled DER devices so we can maintain management of quality standards at the LV distribution level. Ie every EV which needs 3kW or 4kW or above charging is given an enabled charging device by the car dealer?

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Section	Ref	Topic	Question
6		**Preserving Structures while Maintaining Standards**	
	6.3	**Market Evolution**	• Thinking ahead, are we better to prepare for orchestration of DER or be faced with a regulatory intervention like South Australia and have powers to turn off DER to avoid system instability? • Is the industry aligned, as yet, on the path and timeframe required to move? How would you suggest this is addressed/enabled most effectively? • How far are we willing to move in order to progress and accommodate rapid adoption of EVs? • How deeply should that effect the move to distribution operating models – the DSO/DMO? How and who is best placed to take on what role?

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8 Glossary

Term	Meaning
54Q	Section 54Q of the Commerce Act which requires the Commerce Commissions "to promote/encourage lines companies to invest in energy efficiency and demand side management…"
AC	Alternating Current
DR/ DR Scheme	Demand Response / DR Scheme
AEMO	Australian Energy Market Operator
API	Application Programming Interface
AUFLS	Automatic Under-Frequency Load Shedding
BEV	Battery electric vehicle
Capex	Capital expenditure
CPP	Customised Price-Quality Path
DC	Direct Current
DCA/DCAs	Dynamic Connection Agreement(s)
DER	distributed energy resource(s)
DMO	Distribution Market Operator
DPP	Default Price-Quality Path
DPP3	Default Price-Quality Path applying to the regulatory period 2020-25
DSO	Distribution System Operator
EDB	Electricity Distribution Business
EECA	Energy Efficiency and Conservation Authority
EIEP	Electricity Information Exchange Protocol
EIEP3	Electricity Information Exchange Protocol "3" applying from 2019
ESB	Energy Security Board (Australia)
EV/EVs	Electric vehicle(s)
ICE	Internal combustion engine
ICP	Installation Control Point
IRIS	Incremental Rolling Incentive Scheme
LV	Low voltage
NZTA	New Zealand Transport Agency
OCPP	Open charge point protocol
OEM	Original equipment manufacturer
Opex	Operational expenditure
PHEV	Plug-in hybrid electric vehicles
PPA	Power purchase agreement
TOU	Time of Use
V2G	Vehicle to grid communications protocol
VG1	Grid-sourced charging communications protocol
VPP	Virtual power plant

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