Improving the performance of electric vehicle chargers

A green paper seeking input on ways to improve the energy performance of electric vehicle chargers

EECA TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

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Contents

Submission process

The Energy Efficiency and Conservation Authority (EECA) seeks your feedback on the issues raised in this green paper. All relevant material made in submissions will be considered. You are welcome to provide additional information by directing feedback and enquiries to STAR@eeca.govt.nz.

Submissions on this green paper close on **05 September 2022**.

EECA will provide advice to the Minister of Energy and Resources following the consultation period. A summary of submissions and analysis will be sent to all submitters and posted on the EECA website.

Official Information Act requirements

Under the Official Information Act 1982 (OIA), information held by EECA is to be made available to requestors unless there are grounds for withholding it. The grounds for withholding information are outlined in the OIA.

If you are making a submission, you may wish to indicate any grounds for withholding information included in your submission. Reasons for withholding information could include information that is commercially sensitive or personal (such as names or contact details). An automatic confidentiality disclaimer from your IT system will not be considered as grounds for withholding information.

EECA will consider your preference when determining whether to release information. Any decision to withhold information requested under the OIA may be reviewed by the Ombudsman.

Purpose

This green paper seeks your views on ways to improve the energy performance of private electric vehicle (EV) chargers. This will inform our ongoing thinking on the issues and our role, if any, in addressing them.

Modern technology has the potential to improve energy outcomes in New Zealand. An increasing number of energy-using products are 'smart', or demand response capable – that is, they engage with the electricity system and respond to market signals by changing when and how they use electricity. These products are commonly referred to as controllable distributed energy resources (DER). Harnessing controllable DER will mean lower electricity bills at the household level, and at a system level, the impact can be even more significant[1].

Flexibility services, such as demand response, have a key role to play in the energy transition. It can help to manage intermittent renewable supply and manage peak demand, both of which are essential to the success of delivering energy security and affordability alongside decarbonisation.

Smart and energy-efficient electric vehicle (EV) charging holds the greatest potential to reduce peak electricity demand in New Zealand[2]. This is because we expect to see significant growth in electricity demand from EV charging, and most of the generation required to meet this growth in demand has not yet been installed. We stand the best chance of realising this potential if we start planning for an expected increase in EVs and EV chargers now, when we can influence the types of devices installed.

Note that this green paper does not contain specific proposals – rather, it seeks further information from industry and other interested stakeholders about the opportunities, barriers, and potential role for EECA in this space. If we decide to pursue any of the potential measures set out in this green paper, we will undertake further consultation on specific proposals.

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1 Unlocking the potential of DER was a core focus of the Electricity Authority's July 2021 discussion paper *Updating the Regulatory Settings for Distribution Networks*.

2 Concept Consulting (2021) *Shifting gear: How New Zealand can accelerate the uptake of low emission vehicles*, Report 2: Consumer electricity supply arrangements, September 2021

Context

EECA was established as a Crown entity under the Energy Efficiency and Conservation Act 2000 (the EEC Act) to encourage, promote and support energy efficiency, energy conservation and the use of renewable sources of energy. As part of its work, EECA regulates a range of energy-using products through three mechanisms:

- Minimum Energy Performance Standards (MEPS) which ensure appliances and products meet minimum levels of energy performance to be sold in New Zealand,
- Mandatory Energy Performance Labelling (MEPL) which ensures some appliances (e.g whiteware and TVs) must display an energy rating label to be legally sold in New Zealand, and
- Vehicle Emissions and Energy Economy Labelling which ensures all light vehicles display a fuel economy label when offered for sale by a registered motor vehicle trader.

EECA also provides information and financial incentives to encourage smart energy choices. Together, EECA's levers work to:

- address information gaps for consumers in purchasing energy efficiency products,
- remove inefficient products from the market,
- reduce appliance and product operating costs, and
- contribute towards reducing New Zealand's energy consumption and associated greenhouse gas emissions.

In 2021, MBIE sought submissions on proposals to enhance the regulatory regime for energy-efficient products and services. This covered a suite of changes to EECA's regime (e.g. the EEC Act and associated Regulations) to ensure it remains fit for purpose.

This package of proposals included clarifying that EECA's energy performance standards and labelling can include requirements related to demand response capability ('smartness') as an enabling first step[3]. The majority of submitters supported this proposal.

EECA understands that Cabinet will consider the package of proposals in late 2022. EECA will support the Minister of Energy and Resources and MBIE to implement any changes through the legislative process in 2022/23. Any move by EECA to regulate EV chargers for demand response capability would be subject to this proposal being adopted and implemented in our legislation. This green paper is an opportunity to commence investigation into the matter now to ensure we are well placed to regulate following Cabinet approval.

These proposals are complementary to the Electricity Authority's *Future security and resilience* workstream, which is focusing on ensuring a stable, secure and resilient electricity system given its role in New Zealand's transition to a low emissions economy. In 2021 the EA consulted on the future challenges and opportunities for the electricity network, which highlighted the benefit of demand response on the wider electricity system (discussed further in this paper).

[3] https://www.mbie.govt.nz/have-your-say/energy-efficient-products-and-services

Scope

Charger types

This green paper considers EV chargers that consumers will purchase and install in their homes.

82% of time spent charging occurs within residential homes[4][5]. With the projected uptake of EVs and the increasing number of people charging at home, it is important that the energy performance of private chargers is optimised, and that as much of this electricity demand as possible is controllable. This will help to ensure EV owners get the most out of their chargers, lower their electricity costs and manage the impacts of widespread EV charging on the wider electricity network.

The majority of home charging is done with a three-pin plug rather than with a wall charger. In 2019 78% of chargers sold were cables plugging into a three-pin plug. These plugs are relatively slow at charging and can present safety and accessibility issues, particularly within older homes[6]. However, there is little incentive for those who currently use the three-pin plug (often supplied with the vehicle) to shift to other charging methods.

EECA recognises that EV charging also occurs outside of residential homes, including private places of business and at public EV charging stations also known as journey or destination charging.

Performance factors

There are three key performance factors EECA has identified to maximise the benefits of these products while managing demand on the network. This includes:

a. Energy efficiency: using less energy to perform the same task or achieve the same result,

b. Interoperability: ensuring connected devices can operate on any electricity network and also communicate with other appliances and devices installed in the home, and

c. Connectivity of EV chargers: including functions to enable signals to be sent to, and received from an external party

EECA recognises that there are other issues associated with the performance of EV chargers, such as autonomous operation, integration with management systems, electrical safety, cyber security, data privacy and billing provisions. EECA will continue to engage with the relevant government agencies to ensure the approach to these areas supports the whole-of-government effort to facilitate increased EV uptake.

Vehicles

This green paper considers plug-in chargers for electric vehicles.

The type of vehicle being charged (whether it is a light or heavy vehicle) is not a key consideration. New Zealand's vehicle fleet is predominantly light passenger vehicles, the vast majority of private chargers (at least in the short to medium term) are expected to be used to charge these vehicles.

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4 EECA Charging Behaviour Survey, 2021

5 KPMG, 2019. *Electric Vehicle Charging Technology*. https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/EV-Charging-New Zealand.pdf

6 https://www.aa.co.nz/cars/motoring-blog/charging-an-ev-safely-at-home/

Although this green paper focuses on residential EV charging, some of the issues raised are also relevant for other energy loads in the home, particularly residential water heating. After EV charging, water heating offers the greatest potential to address peak electricity demand in New Zealand[7].

This paper seeks your feedback on a wide range of issues. Questions are included as prompts but do not feel limited by these. We encourage you to provide any information you think is relevant.

The importance of 'smart' and energy-efficient chargers

This section discusses some of the drivers for encouraging the uptake of 'smart' and energy-efficient private EV chargers in New Zealand.

New Zealand's electricity demand will increase substantially over time

New Zealand's electricity demand is expected to increase significantly, as the country phases out fossil fuels and increasingly moves to renewable electricity. The Climate Change Commission's demonstration path expects total electricity consumption to reach 60,600GWh from a current level 39,700GWh, an increase of 53%[8].

The number of EVs in New Zealand is set to increase and will pose a particular challenge for supply

EVs will play a key role in light and heavy transport, and global sales are increasing rapidly[9]. EV uptake forecasts from several New Zealand Government sources are included in Figure 1. Despite a wide range of estimates, there is a common theme of rapid EV uptake across all of them. We expect the majority of charging activity for these vehicles to continue to be residential.

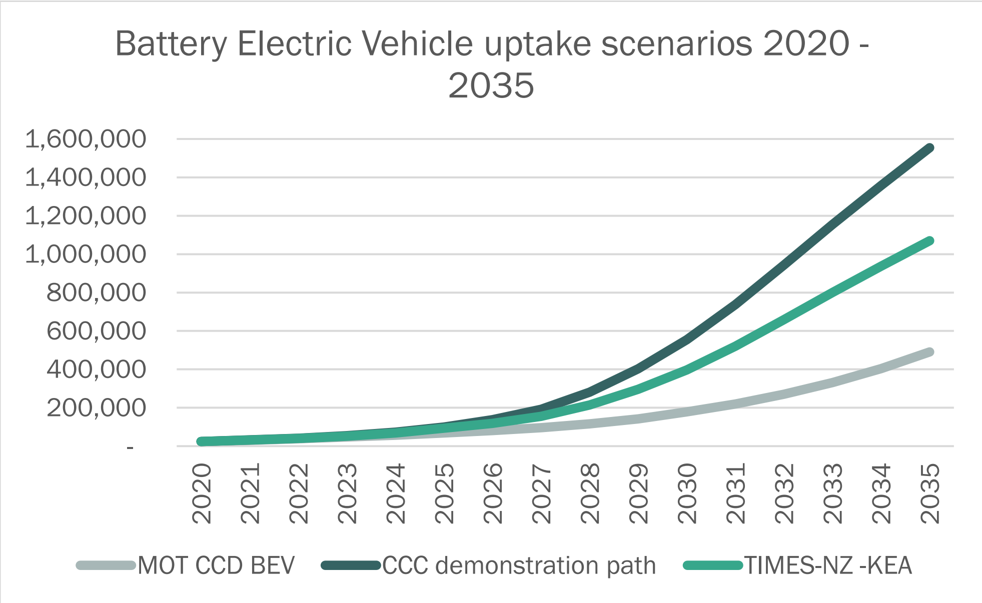

Figure 1 – Battery electric vehicle (BEV) uptake scenarios 2020-2035 (excludes plug-in hybrid electric vehicles)[10]

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7 Concept Consulting (2021) *Shifting gear: How New Zealand can accelerate the uptake of low emission vehicles*, Report 2: Consumer electricity supply arrangements, September 2021

8 Climate Change Commission (2021), Scenarios data-set

9 IEA (2021) *Global EV Outlook 2021: Accelerating ambitions despite the pandemic.*

10 Source references:

As the number of EVs and the rate of home charging increases, the energy that was once provided by liquid fuels must be provided by electricity. This will represent a significant increase in electricity demand, exacerbated by EV charging often occurring during periods of peak demand, the increasing capacity of EV batteries[11] and increasing EV charge rates[12].

Projections of EV uptake produced by the Climate Change Commission indicate that by 2050, uncontrolled EV charging could increase average household peak electricity demand by 40%. This peak-driven aspect would increase the average cost of supplying households by approximately $220/yr (incl. GST). This calculation considers the projected increases in network costs due to the significant programme of asset replacement and renewal that will be required over the next couple of decades. Multiplied by the projected 2.2m households in 2050, this gives a cost of approximately $430m per year (excl. GST). On a present value basis, given the pattern of EV uptake, this equates to $1.7bn of additional costs (excl. GST)[13].

Managing peak electricity demand will become increasingly difficult

Modelling by Vector estimates that EV uptake has the potential to double network capacity requirements by 2050 if unmanaged[14]. The increased demand for electricity, coupled with low storage and generation from intermittent energy sources, will make it increasingly difficult to manage stress on the electricity network.

The electricity network is designed to meet peak demand that occurs on cold winter evenings (between 5pm and 9pm) when households use more electricity. When demand is higher than expected, power cuts and reduced power quality are more likely to occur. Electricity distribution businesses (EDBs) would need to undertake significant network upgrades to supply the uncontrolled peak demand, leading to rising system costs (e.g. lines charges) for all connected consumers.

‘Smart’ and energy-efficient EV chargers can mitigate network impacts

A key way to optimise the effectiveness of the electricity system is to shift demand away from peak periods to align it with periods of low demand. If we can reduce peak demand by shifting some of it to off-peak periods (e.g. overnight), then a range of system-level benefits can be delivered including:

- Ministry of Transport Clean Car modelling results – Estimate based on current policies, including the Clean Car Standard and Clean Car Discount. Available: https://www.transport.govt.nz/assets/Uploads/CC-modelling-results-for-public-release-July-2021.xlsx
- Climate Change Commission Demonstration Path – Estimate based on the measures and actions that would deliver the Commission’s recommended emissions budgets. Available: https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/Inaia-tonu-nei-a-low-emissions-future-for-Aotearoa/Modelling-files/Scenarios-dataset-2021-final-advice.xlsx
- New Zealand Energy Scenarios TIMES-New Zealand Kea scenario – Estimate based on a scenario where climate change is prioritised as the most pressing issue (Based on EECA-BEC modelling). Available: https://www.eeca.govt.nz/insights/new-zealand-energy-scenarios-times-nz/

11 A first-generation Nissan Leaf has a battery capacity of 20kWh, whereas the latest model is 40kWh.

12 The amount of electricity transferred to the EV over time. Many wall-mounted EV chargers offer fast charging, with 46% of post-2017 Nissan Leaf owners owning a wall mounted charger compared to 30% of those who own an older Nissan Leaf (EECA Charging Behaviour Survey, 2021).

13 Concept Consulting (2021) *Shifting gear: How New Zealand can accelerate the uptake of low emission vehicles*, Report 2: Consumer electricity supply arrangements, September 2021

14 Vector presentation to EECA & MOT Officials, 2021

- greenhouse gas emissions reductions,
- deferred investment in new generation, infrastructure or network upgrades,
- reduced electricity costs for all connected consumers and lower transmission losses, and
- Improved electricity security and reliability

If EV uptake increases as expected, EECA's view is that it will be critical to ensure EV chargers are smart and energy-efficient. This will manage the impact of EV charging on the electricity network as:

- 'Smart' chargers will be able to shift charging load to off-peak periods (e.g. by reducing or stopping power flow into the vehicle until overnight). They may even be able to respond to real-time to signals from external parties such as a network operator or a load aggregator[15].

- Energy-efficient chargers will ensure as little electricity as possible is wasted when charging an EV, reducing overall energy demand per charger.

Over time, other developments, such as Vehicle to Grid (V2G) and vehicle to infrastructure (V2I), will provide other means for managing peak demand in New Zealand[16].

> *"The increasing use of EVs will either be part of the solution or contribute to the problem. We can avoid unnecessary future increases in peak demand if EV charging is managed to shift load. The network has the capacity to deal with mass off-peak EV charging, and load shifting can help avoid events like those of 9 August [...] while pricing signals that reach consumers are necessary, they are unlikely to be sufficient to avoid EVs increasing peak demand. Regulation is likely to be needed, but it needs to provide for flexibility given the uncertainty."*
>
> Independent Investigation into Electricity Supply Interruptions of 9 August 2021

There are tools in place to manage peak demand, but more opportunities could be utilised

New Zealand's current tool to manage peak demand is ripple control, which allows EDBs to switch off the electricity supply to approximately half of New Zealand's hot water cylinders during peak times. As New Zealand's demand for electricity grows, more rooftop solar photovoltaic technology (solar PV) and batteries are installed, and an increasing number of EVs are purchased, more sophisticated mechanisms will be required.

Fortunately, the increasing interoperability and connectivity of modern electronic goods offer a way to reduce stress on the electricity network. Through regulation and/or other mechanisms, EECA is looking to support the establishment of a population of EV chargers that can best respond to the challenges in the electricity sector. Given the long lead time for turnover of appliances, this no-regrets approach will ensure that there is sufficient demand response available at the time that it is needed. By ensuring EV charging is energy efficient, we can further boost its benefits. A population of smart and energy-efficient EV chargers would support greater EV uptake and the development of an effective demand response market in New Zealand.

[15] The Electricity Authority is currently considering the competition impacts of network operators directly controlling DER (including EV charging) through their work programme to update the regulatory settings for distribution networks.
[16] These functions allow electricity to flow into and out of the EV battery, allowing the EV to operate as an energy source at times when it is beneficial.

EECA's approach to managing EV charging in New Zealand

To optimise the uptake of EVs and EV charging, EECA is looking to strike a balance between:

- minimising energy emissions and encouraging EV uptake;
- alleviating the costs of decarbonisation on NZ households;
- reducing electricity disruptions for consumers;
- maximising energy and electricity system security, reliability and stability; and
- minimising network investment using demand management

EECA has developed the following principles to guide its engagement with residential EV charging:

- Manage EV charging in a way that provides net positive societal outcomes;
- Identify and address the impacts of EV uptake on the energy system early on (where practical);
- EV owners should receive the utility they require from their EVs and EV chargers;
- EV chargers should have a level of smartness and energy efficiency that is cost-effective and provides the greatest net benefit; and
- Improvements to the energy performance of EV chargers should encourage the development of a robust, fair and effective demand flexibility market

To achieve this, EECA will:

- intervene to the minimum extent necessary;
- work with other regulators to identify interagency gaps and overlaps to avoid duplication and unnecessary complexity;
- encourage market innovation and avoid path dependency; and
- ensure the costs and benefits of smart EV chargers are equally accredited to both electricity providers and consumers

Q1. What are your thoughts on EECA's suggested engagement principles for EV chargers?
What would you add or take away?
Is there anything you disagree with?

Potential characteristics of 'smart' EV chargers

EV chargers that have a common set of functions and means of communication, and that can be used by any potential operators of the device, are best placed to deliver maximum value to New Zealand.

This section outlines various aspects of the 'smart' charging system to help determine what a New Zealand 'smart' charger standard could encompass.

Basic functions

The ability to turn the charger on and off and adjust the charge rate of each EV charger would be valuable for managing stress on the network. For example, EV charging could be reduced during peak demand and increased at times of high renewable electricity supply (off-peak).

Default minimum charge mode

There is evidence that some vehicles do not restart charging if the charger is switched off before charging is complete[17]. To address this, an EV charger could be required to maintain a minimum level of current or power when it is connected to the vehicle.

Randomised delay function

If large numbers of EVs either charge or commence charging at the same time (for example in response to a price signal) the peak in demand may cause grid stability issues. 'Smart' chargers with a 'randomised delay function' could reduce this impact, by randomly spreading the onset of charging for a group of EV chargers over a specified period (e.g. 10 minutes).

Default off-peak charging mode

Another option is to require 'smart' chargers to have a 'default off-peak charging mode' where charging is delayed to off-peak times. The owner would retain the ability to manually override the default mode.

Default reduced charging at peak mode

A variation of the 'default off-peak charging mode' is a 'default reduced charging at peak mode'. Rather than delaying charging to off-peak, charging would occur during peak but at a slower rate. Again, the EV owner would be able to manually override this option.

V2G/V2I enablement

Vehicle-to-Grid (V2G) and Vehicle-to-Infrastructure (V2I) solutions will deliver substantial benefits, but this green paper does not propose any requirements in this area beyond a general requirement that 'smart charging' does not prevent the discharging of EVs. Part 6 of the Electricity Industry Participation Code 2010 (Code) regulates V2G and V2I-capable chargers. Any requirement for chargers that operate in this mode would need to comply with both the Code and the Electricity Safety Regulations.

[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817107/electric-vehicle-smart-charging.pdf

Q2.	**What are your thoughts on the proposed specifications for 'smart' chargers in New Zealand?**
	What do you see as most and least important?
	What functions would you add or exclude, if any, and why?
	What information could you supply to EECA to help inform our thinking about this issue?

Communications capability

In terms of the ability to communicate, it is EECA's view that 'open access' EV chargers would deliver the greatest benefit for New Zealand. The use of open communication protocols, such as OpenADR, allows all approved parties to access the EV charging process and promotes greater connectivity between appliances (e.g. EV chargers and home energy management systems)[18]. Open communication protocols allow chargers and electricity operators to communicate signals to each other, and are a key tool to help manage peak demand through delaying or increasing charging rates depending on grid load and energy availability[19]. EECA notes that any communication capability incorporated into EV chargers should ideally be compatible with other appliances, smart home management systems and demand flexibility suppliers.

Open access EV charging supports the development of an effective and dynamic demand response market in New Zealand. Allowing access to products (with owners' permission) means demand flexibility supplier can compete for business on an equal footing. This would encourage new players, businesses and products into the market to offer increasingly sophisticated and innovative services. The development of a demand response market could also seamlessly allow EV owners to switch their demand flexibility supplier for best gain, without the need for a visit to the premises.

EECA recognises that the electricity system is a critical asset and that open communications capabilities present risks to cyber security. Therefore, appropriate protections need to be included. Artificial intelligence (AI) and cognitive technologies are becoming increasingly commonplace, along with a range of internet-connected everyday devices. Targeting the transport capability of the population could be an attractive target to cyber terrorists. However, communications protocols (such as OpenADR) include provisions for cyber security that align with international standards.

Q3.	**Do you support EV charging being open access, and why/why not?**
	What information could you supply to EECA to help inform our thinking about this issue?
	Do you think that 'smart' chargers should address issues of cyber security?
	How would you suggest this is done?

Monitoring

For an effective demand response and flexibility system to operate, relevant parties must have sight of what is connected to the electricity network, where it is connected, and the impact the use of the appliance has on the wider electricity system. Knowing when to react and to what degree is critical information that electricity suppliers need to create a genuinely flexible system.

[18] The connection can be through Ethernet and/or 4G (or later) platforms, as well as being Wi-Fi capable to connect to household control systems.
[19] Open Charge Alliance (2021) *Using OpenADR with OCPP*, 2021

This section considers whether EV chargers should be required to transmit their location and energy data to approved parties e.g. a flexible demand service provider (FDSP), an EDB or grid operator. This would enable better planning to meet electricity demand, create a faster response, and ensure that financial reward (for making demand available) is maximised for flexible demand programme participants.

The development of Multiple Trader Relationships (MTRs) or Peer to Peer trading (P2P) would likely require each EV charger to contain its own electricity consumption and generation measurement, and on-demand remote reading capability. Placing these recommendations in a Standard (that is either widely trusted and/or regulated) would future-proof users' investment for potential electricity market development.

The required information must deliver the maximum benefit for New Zealand but with minimal risk, cost and inconvenience. EECA suggests monitoring for charger geographical location, installation date, maximum power rating, and live consumption data at a minimum. Any data provided would be at the explicit permission of the data owner for the purposes of demand response and flexibility and would be protected. However, we seek your input on whether there should be requirements and, if so, what information should be provided. The information could be anonymised to protect privacy. There would also be strong controls to ensure it is used only by approved agencies.

Q4. What are your thoughts on EV chargers having to transmit information on their location and use, and the suggested scope of information to be provided?

Who should be able to access this information?

In what form should it be transmitted?

What processes should be in place to safeguard the data?

Is there any other way this data might be captured?

Electricity consumption

To encourage a greater level of EV owner engagement, EV chargers could be required to capture the electricity consumed and/or exported during a charging event, and the length of time the charging occurred for. This information would be made available to the EV owner (e.g. through an app), helping them to secure the best value from smart charging (e.g. by providing this information to a flexible demand service provider, or directly comparing smart charging deals).

Q5. What are your thoughts on a requirement for EV chargers to monitor and record electricity consumed and/or exported during EV charging, and for this information to be made available to the EV owner?

What other information may be valuable to the EV owner?

What format should be used for this information if this requirement is adopted?

Mandated settings for power quality and control

To help support the resilience of networks and ensure grid stability, EV chargers could include mandated settings that automatically operate to protect both the customer’s electrical installation and the network it is connected to.

At a basic level, this could include a setting where the EV charger automatically turns off or down if frequency or voltage drops below a pre-set threshold and restores when the frequency or voltage recovers. This situation can also occur if other types of DER are connected to the same residential network (e.g. solar PV). These requirements for solar PV inverters are currently covered in the Australian and New Zealand joint Standard, AS/NZS 4777.2:2000 *Grid connection of energy systems via inverters – Part 2: Inverter requirements*.

Ensuring this power quality requirement is met could also allow more EV chargers to be hosted on an existing, low-voltage network reducing the likelihood of requiring network upgrades and investment.

EECA notes that settings can already be mandated by networks for distributed generation to increase the hosting capacity of networks, and this would operate in a similar, albeit opposite, manner. These requirements would apply to EV chargers also if they injected electricity back into the distribution network (e.g. through V2G).

Q6.	**What are your thoughts on requiring mandated power quality and control settings for EV chargers?**

Energy efficiency

The energy efficiency of private EV charging typically involves three components:

- The on-board charger in the EV –accepts AC electricity and converts it to DC electricity to store in the EV battery,
- An aftermarket (wall-mounted) charger (if present), and
- Charging cables – these are not chargers per se but control the flow of electricity to the EV.

On-board chargers

There is some evidence that the energy efficiency of onboard chargers can vary significantly. Danish research conducted in 2016 found energy losses of between 15-40% when charging three different vehicles[20]. This is much higher than the energy lost from high-quality power converters. As consumers have low awareness of charging losses, it is likely vehicle manufacturers do not prioritise the energy efficiency of onboard charging equipment. This leads to higher costs for EV owners and places an unnecessary load on the electricity network.

To date, research on the energy efficiency of onboard chargers has not been widely publicised. EECA is seeking more up-to-date research on this matter, to determine the importance of this issue for New Zealand and whether we might regulate in this area (e.g. require labelling).

Q7.	**What are your thoughts on regulating the energy efficiency of onboard EV chargers?** What information could you supply to EECA to inform this issue? What challenges, if any, do you see in regulating in this area?

[20] Kieldsen, A., Thingvad, A., Martinenas, S., & Sørensen, T. M. (2016) *Efficiency Test Method for Electric Vehicle Chargers* (In Proceedings of EVS29 - International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium)

Aftermarket (wall-mounted) chargers

Also called wall-mounted chargers, aftermarket chargers are becoming increasingly popular in New Zealand. They deliver faster charging rates than you get from a standard New Zealand electrical socket[21]. These chargers come with varying degrees of 'smartness', with some more sophisticated than others.

The vast majority of residential aftermarket EV chargers are alternating current (AC). AC chargers operate as a switch that opens to allow AC electricity into the EV, where the onboard charger converts it to direct current (DC) electricity.

Q8. What are your thoughts on labelling aftermarket AC EV chargers?

Charging cables

Many EVs are sold with a three-pin charging cable that can be used to connect the EV to an electricity supply. However, these cables are not designed for constant overnight use and can pose safety risks.

Although not chargers per se, some charging cables now come with a built-in device that enables 'smart' charging. We are seeking your view on whether these types of charging cables should be within scope of this paper. Cables without the ability to enable smart charging would be excluded.

Q9. What are your thoughts on whether charging cables which contain a 'smart' charging enabling device should be in scope for intervention?

Options to support 'smart' and energy-efficient chargers

The 'smart' charging market is in its early stages of development in New Zealand. The pace of innovation is quickening, and new products and business models are entering the market. In this environment, it is important that government right-sizes its effort to secure the greatest value from 'smart' charging without hindering innovation and market mechanisms.

This section considers mechanisms that might be applied to encourage EV chargers to be 'smart' and energy-efficient. It considers four key interventions of increasing stringency including doing nothing, providing information/education, offering incentives, or regulating. It seeks your views on what intervention, or combination of interventions, should be applied in New Zealand and why.

Option one: Do nothing

This section investigates the following trends that could emerge without government intervention.

Low uptake of 'smart' and energy-efficient chargers

EV owners may only consider a few factors (such as the upfront capital cost) when purchasing an EV charger, locking them out of the full value (including longer-term operational savings) they could

[21] Typically two to three times faster, given they use up to a 32A fuse, supporting charge rates over 7kW. Three phase chargers are also available which can deliver up to 22kW of power. In practice, the actual charge rate of an EV will often be less than the maximum possible. The battery management system in an EV adjusts the rate of charge to ensure ongoing battery health. Without these systems, EV batteries would fail prematurely and/or suffer an unnecessary reduction in capacity.

receive from a 'smart' EV charger. Purchasing decisions may be complicated by 'smart' charging being an emerging technology, which means there is a lack of awareness and/or uncertainty around the value of 'smart' charging.

At present, Open Charge Point Protocol (Version 1.6 and above) is currently the predominant global standard for 'smart' EV chargers. Global jurisdictions that are comparable to New Zealand's such as the United Kingdom (UK), European Union (EU), United States (US) and Australia have adopted EV charger Standards that align with this. However, despite the benefits of adopting 'smart' chargers, KPMG's research states that, without incentive to do otherwise, EV owners tend to opt for basic ('dumb') chargers[22].

New Zealand is unlikely to realise the full societal benefits of smart charging

The impacts of EV charging on the electricity network will go unmanaged. This means that EV charging will be controlled by the individual (e.g consumers will have control, and will charge when they like, with their preferred charger), and the network will be unable to reap the benefits of large-scale automated management. This will result in risks to electricity security, reliability, affordability and the environment.

As noted earlier, modelling by Vector estimates that EV uptake has the potential to double electricity network capacity requirements by 2050 if unmanaged.

Players in the 'smart' charger market may also be locked out of, or receive less value from their smart chargers, as firms use proprietary systems to prevent compatibility across products (to gain market power and establish themselves in the market). This could make the establishment of agreed technical standards very difficult.

In terms of energy efficiency, more information is needed to understand the type and scale of issues associated with the status quo. To fill this information gap, EECA is researching the energy efficiency of chargers currently available. Without visibility of this issue and its impact on users, manufacturers of chargers are unlikely to change their practices.

The market will correct itself

The functionality of aftermarket EV chargers and charging cables is improving, and there is increasing use of remote controllable plug-in timers. Home energy management systems (able to control a wide range of appliances) will become more common, and solar PV functionality is improving. These devices may deliver a natural improvement to EV charging functionality, without the need for any government involvement. Distribution prices are also becoming more cost-reflective. Cost reflective prices will send signals to consumers that may encourage behavioural changes to maximise savings. However, without some form of intervention, some EV owners can be expected to choose sub-optimal paths and the value of 'open access' communication would unlikely be realised.

Q10.	**What are your thoughts on the 'do nothing' option for EV chargers in New Zealand?** Do you think the market can adequately address this issue without the need for government intervention? What information could you provide to EECA to inform this issue?

[22] KPMG, 2019. *Electric Vehicle Charging Technology*. https://www.eeca.govt.nz/assets/EECA-Resources/Research-papers-guides/EV-Charging-New Zealand.pdf

Option Two: Information and education

There are a range of ways that information could be provided to the sector to encourage smart charging. These include:

- marketing campaigns,
- information on websites and best practice guides, and
- energy efficiency rating labelling.

EECA seeks your views on the likely effectiveness of these options, including whether they would create the degree of change needed and have an enduring effect.

Market research indicates that price, quality and brand are a key consideration in product purchase decisions[23]. Energy efficiency is a second-order issue but can be a deciding factor when consumers are considering products in-store that are otherwise similar. EECA is moving to require energy rating labels for products sold online, which will improve the overall effectiveness and outreach of rating labels. However, the use of labelling alone (without minimum energy performance standards) allows for the continued sale of poor performing devices. A key objective of information and education is to inform people of the potential benefits consumers reap from using a 'smart' charger (such as those mentioned earlier in the paper).

An energy rating label could be valuable for energy efficiency, but an endorsement label may be more appropriate for 'smartness', with only products that carry the minimum functionality and open communication protocols being eligible.

Q11. What are your thoughts on the likely effectiveness of information, education and labelling to improve the uptake of 'smart' EV chargers?
What information could you provide to support your position?

Option Three: Incentives

The electricity market is already providing incentives for 'smart' EV charging. In 2019 the Electricity Authority published the distribution pricing principles, to set clear expectations for efficient distribution prices, which include price signals for congested periods of networks[24]. Electricity retailers (including Meridian Energy and Mercury Energy) pass on this network pricing by offering dedicated EV plans where owners pay less for charging their EV outside of peak demand hours (e.g between 10pm and 6am). As flexibility markets develop, EV owners could be offered financial incentives on a per-event basis. A FDSP may pay EV owners to not charge their vehicles when there is high system utilisation, supply constraints and/or high prices. In the future, as solar PV densities increase in New Zealand, there may be value in charging EVs at times of high export to manage grid voltage issues.

Beyond time-of-use tariffs, there are currently no financial incentives to encourage the purchase of 'smart' chargers in New Zealand. Under the UK's Electric Vehicle Homecharge Scheme (EVHS), which provides financial support for private chargers, chargers must be 'smart' and meet technical

[23] Colmar Brunton / Kantar (2020) *Market Research: ERL program for household appliances*, a report for the Department of Industry, Science, Energy and Resources, Canberra, Australia. This report evaluated the effectiveness of product labelling for the Equipment Energy Efficiency (E3) programme, operated jointly by Australia and New Zealand.
[24] https://www.ea.govt.nz/operations/distribution/pricing/

specifications (announced in 2019)[25] to be approved for funding. The EVHS has been effective at moving the market towards smart EV charging in the last few years as verified in a recent impact assessment[26], which showed that smart chargers have increased to represent 70% to 100% of total private charger installations in the first quarter of 2020.

As discussed in this paper, EECA recognises that 'smart' charging largely benefits the electricity system, rather than the consumer. The benefits to consumers (such as the cost savings) may not be enough to encourage 'smart' charger uptake without incentives.

EECA seeks your thoughts on incentives as a means to encourage the uptake of 'smart' and energy-efficient EV chargers. We are particularly interested in whether they would bring about sufficient change for New Zealand and who might provide these incentives. We are keen to receive information on the effectiveness of this approach where it has been used internationally.

Q12. What are your thoughts on the use of incentives to encourage the uptake of 'smart' EV chargers?

What incentives do you think would be effective and who should provide these?

What other incentives might be valuable beyond financial incentives?

Option Four: Regulation

EECA is considering the costs and benefits of regulating the 'smartness' and energy efficiency of EV chargers through its MEPS regime. We seek your views on the relative merits and feasibility of regulation, compared to the other options discussed in this section.

The UK has offered subsidies for smart EV chargers since 2019 through the EVHS and has now moved to regulation. The Electric Vehicles (Smart Charge Points) Regulations 2021 were signed into law on 15 December 2021 and came into force on 30 June 2022[27]. This sets out minimum requirements for all chargers for use in homes and workplaces (where previously this was only a requirement for those seeking compensation through the EVHS). The key requirements include:

- data connectivity
- off-peak charging capabilities
- staggered charge times, and
- additional security.

Given the public and system-wide benefits of 'smart' charging, there is a strong case for the government to encourage the purchase of 'smart' chargers.

EECA seeks your thoughts on whether New Zealand should regulate in this area and/or link this approach to other mechanisms e.g. incentives. We are keen to get your thoughts on whether New Zealand should adopt a similar approach to that being employed in the UK.

[25] https://www.gov.uk/government/publications/electric-vehicle-homecharge-scheme-minimum-technical-specification
[26] The Electric Vehicles (Smart Charge Points) Regulations (publishing.service.gov.uk)
[27] The Electric Vehicles (Smart Charge Points) Regulations 2021 (legislation.gov.uk)

Q13.	**What are your thoughts on regulating the 'smartness' of EV chargers in New Zealand?** What do you think of New Zealand adopting the approach being undertaken in the UK? What information could you provide to support your position?

EECA already has voluntary guidance which could underpin regulation

EECA and Standards New Zealand (SNZ) have recently developed the publicly available specification (PAS) *SNZ PAS 6011:2021 Electric vehicle (EV) chargers for residential use*[28]. PAS are voluntary documents, designed to guide decision-making. SNZ PAS 6011:2021 includes an introduction to the topic for general readers, a checklist for the buyer, and a technical specification for energy performance.

EECA is considering using the PAS to underpin our engagement with EV chargers. The PAS has been through a robust development process, overseen by an expert advisory group. It represents the latest and best thinking in the area. As it was developed as a voluntary mechanism, some changes would be required if it were to be used for firmer interventions such as regulation (i.e only adopting a few key elements of the PAS).

Alternatively, a standard, such as the British Standard Institution (BSI) Standard that has been adopted in the UK, could be used. This has a wider ambit than just 'smartness' and energy efficiency, accommodating for aspects such as cyber security and safety.

The prescription of energy performance standards to improve energy efficiency outcomes is starting to be addressed by policy-makers around the globe. For example, the US Energy Star programme has set energy performance requirements for EV supply equipment for the US and Canada. The European Commission is also undertaking research and testing under real-use conditions. However, most countries are not explicitly addressing the energy performance of EV charging equipment in their policies[29], presenting an opportunity for New Zealand to lead the way.

Q14.	**What are your thoughts on using the PAS for residential EV chargers to underpin regulation/incentives?** What parts would you exclude or change? Does the PAS cover all the important issues? What other resources may be useful for New Zealand?

Alternatives to EECA involvement

EECA has regulated the energy performance of products and appliances for over twenty years, and has the legal mandate and necessary infrastructure to regulate the energy performance of EV chargers as energy-using products.

[28]*SNZ PAS 6011:2021 Electric vehicle (EV) chargers for residential use* https://www.standards.govt.nz/shop/snz-pas-60112021. A commercial EV charger PAS has also been developed: *Standards New Zealand PAS 6010:2021 Electric vehicle (EV) chargers for commercial applications* https://www.standards.govt.nz/shop/snz-pas-60102021.

[29] https://www.iea-4e.org/wpcontent/uploads/2021/01/EVSE_Scoping_Study_for_4E_EDNA_v18_15_12_2017c_-_FINAL.pdf

However, we are aware that a range of agencies have interests in this space, both within the public sector (i.e the Electricity Authority with their role in the wider electricity system) and private sector (i.e Electricity Distribution Businesses).

There may be alternative approaches to improving the performance of EV chargers in New Zealand that do not require EECA's involvement. We seek your views on what these could be.

Q15. In what other ways might the energy performance of EV charging in New Zealand be improved, that do not require EECA's involvement?

Next steps

We will provide updates on this green paper on our website: www.eeca.govt.nz. Following consultation, we will:

- consider the feedback received in submissions,
- discuss the feedback with other Regulators where feedback spans regulatory jurisdictions,
- post a summary of submissions on the EECA website and send this to all submitters,
- brief the Minister of Energy and Resources, and
- use the information received to inform our next steps.

We seek written feedback by 5 September 2022**.** Responses should be in electronic form, in either Microsoft Word or PDF format, and emailed to STAR@eeca.govt.nz.

Under the Official Information Act 1982 (OIA), information held by EECA is to be made available to requestors unless there are grounds for withholding it. The grounds for withholding information are outlined in the OIA.

If you are making a submission, you may wish to indicate any grounds for withholding information included in your submission. Reasons for withholding information could include information that is commercially sensitive or personal (such as names or contact details). An automatic confidentiality disclaimer from your IT system will not be considered as grounds for withholding information.

EECA will consider your preference when determining whether to release information. Any decision to withhold information requested under the OIA may be reviewed by the Ombudsman.

Glossary

AC	Alternating current
Act	Energy Efficiency and Conservation Act 2000
Charger	A device intended for charging a vehicle that is capable of being propelled by electrical power, or for discharging electricity stored in such a vehicle.
DER	Technologies used to generate, store, or manage energy are referred to as distributed energy resources (DER).
DC	Direct current
EDB	Electricity Distribution Business (lines company)
EECA	Energy Efficiency and Conservation Authority
EV	Electric vehicle
GHG	Greenhouse gas
kW	Kilowatt
kWh	Kilowatt hour
MEPS	Minimum Energy Performance Standards
MEPL	Mandatory Energy Performance Labelling
Minister	Minister of Energy and Resources
Product Regulations	Energy Efficiency (Energy Using Products) Regulations 2002
Vehicle Regulations	Energy Efficiency (Vehicle Fuel Economy Labelling) Regulations 2007
Solar PV	Solar photovoltaic
V2G	Vehicle to Grid
V2I	Vehicle to Infrastructure

Appendix One: Consultation Questions

1. What are your thoughts on EECA's suggested engagement principles for EV chargers?
    - What would you add or take away?
    - Is there anything you disagree with?
2. What are your thoughts on the proposed specifications for 'smart' chargers in New Zealand?
    - What do you see as most and least important?
    - What functions would you add or exclude, if any, why?
    - What information could you supply to EECA to help inform our thinking about this issue?
3. Do you support EV charging being open access and why/why not?
    - What information could you supply to EECA to help inform our thinking about this issue?
    - Do you think that 'smart' chargers should address issues of cyber security?
    - How would you suggest this is done?
4. What are your thoughts on EV chargers having to transmit information on their location and use, and the suggested scope of information to be provided?
    - Who should be able to access this information?
    - In what form should it be transmitted?
    - What processes should be in place to safeguard the data?
    - Is there any other way this data might be captured?
5. What are your thoughts on a requirement for EV chargers to monitor and record electricity consumed and/or exported during EV charging, and for this information to be made available to the EV owner?
    - What other information may be valuable to the EV owner?
    - What format should be used for this information if this requirement is adopted?
6. What are your thoughts on requiring mandated power quality and control settings for EV chargers?
7. What are your thoughts on regulating the energy efficiency of onboard EV chargers?
    - What information could you supply to EECA to inform this issue?
    - What challenges, if any, do you see in regulating in this area?
8. What are your thoughts on labelling aftermarket AC EV chargers?
9. What are your thoughts on whether charging cables which contain a 'smart' charging-enabling device should be in scope for intervention?
10. What are your thoughts on the 'do nothing' option for EV chargers in New Zealand?

- Do you think the market can adequately address this issue without the need for government intervention?
- What information could you provide to EECA to inform this issue?

11. What are your thoughts on the likely effectiveness of information, education and labelling to improve the uptake of 'smart' EV chargers?
    - What information could you provide to support your position?
12. What are your thoughts on the use of incentives to encourage the uptake of 'smart' EV chargers?
    - What incentives do you think would be effective and who should provide these?
    - What other incentives might be valuable beyond financial incentives?
13. What are your thoughts on regulating the 'smartness' of EV chargers in New Zealand?
    - What do you think of New Zealand adopting the approach being undertaken in the UK?
    - What information could you provide to support your position?
14. What are your thoughts on using the PAS for residential EV chargers to underpin regulation/ incentives?
    - What parts would you exclude or change?
    - Does the PAS cover all the important issues?
    - What other resources may be useful for New Zealand?
15. In what other ways might the energy performance of EV charging in New Zealand be improved, that do not require EECA's involvement?