Integrating hosting capacity into small-scale distributed generation connections

Consultation paper

Submissions close: **5pm on 3 December 2019**

3 May 2019

Market Services

Executive summary

Household consumers are increasingly becoming interested in installing small distributed generation units in or on their homes. These typically use rooftop solar photovoltaic (solar PV) panels and, sometimes, storage battery systems. These systems provide consumers with a degree of self-supply from renewable energy sources.

Although New Zealand currently has very low levels of such distributed generation, other countries, such as Australia, have achieved much higher levels and have experienced technical network problems associated with connecting more distributed generation. The problems are usually associated with high local voltage, overloads of network equipment (both terms are referred to as congestion), and the management of grid-level system frequency.

The amount of new distributed generation or consumption (eg, to charge electric vehicles) that can be connected to the electricity network without diminishing the reliability or voltage quality for other network users is referred to as the 'hosting capacity' of the network.

New Zealand distributors studied network hosting capacity and developed a draft technical guide they considered would help to address power quality and congestion issues before they become big problems. To be fully effective, the draft guide requires amendment of aspects of Part 6 of the Code, which deals with connection of distributed generation to networks. Coordinated through the Electricity Engineers' Association (EEA), distributors requested that the Authority amend Part 6 to add eligibility criteria for applicants looking to connect distributed generation not exceeding 10 kW in capacity, using the streamlined Part 1A process for applying to connect.

Given the increasing levels of interest in the new technology options available to consumers, the Authority decided to publish an issues paper to gather information and broader views from distributors and broader stakeholders. The Authority considered the 19 submissions received and has decided to propose an amendment to Part 6 of the Code.

This paper consults on the Authority's proposal to amend Part 6 of the Code, to efficiently enhance the hosting capacity of electricity networks, at both the local network and grid levels.

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What this consultation paper is about

1.1 The purpose of this paper is to consult with interested parties on the Authority's proposal to amend Part 6 of the Electricity Industry Participation Code (Code) to change the eligibility criteria for distributed generation connection applications that seek to use the Part 1A process for applying to connect.

1.2 The proposed amendments will better align Part 6 with the Authority's statutory objective by enhancing the hosting capacity of distributors' networks while maintaining reliable supply to all consumers.

1.3 The proposed amendment would change the eligibility criteria for connection applications by distributed generation that only seek to use the more streamlined Part 1A process. The proposed changes do not affect the Part 1 and Part 2 application processes.

1.4 The change would require connection applications made under Part 1A to:

(a) use an inverter that is capable of implementing specific power quality modes. The advanced power quality modes are included in the inverter standard AS/NZS 4777.2:2015, but only as optional modes. Connection applications for distributed generation that are ineligible for consideration under the Part 1A process are still able to be considered under the alternative Part 1 connection process

(b) comply with maximum export power criteria specified by the distributor in its congestion management policy.

1.5 The topics presented in this paper contribute to the Authority's Open Networks project by ensuring appropriate standards are implemented that facilitate efficient, secure and reliable access to networks.

1.6 Section 39(1)(c) of the Act requires the Authority to consult on any proposed amendment to the Code and corresponding regulatory statement. Section 39(2) provides that the regulatory statement must include a statement of the objectives of the proposed amendment, an evaluation of the costs and benefits of the proposed amendment, and an evaluation of alternative means of achieving the objectives of the proposed amendment. The regulatory statement is set out in section 3 of this paper.

How to make a submission

1.7 The Authority's preference is to receive submissions in electronic format (Microsoft Word) in the format shown in Appendix B. Submissions in electronic form should be emailed to Part6hosting.submissions@ea.govt.nz with "Consultation Paper—Integrating hosting capacity into small-scale distributed generation connections" in the subject line.

1.8 If you cannot send your submission electronically, post one hard copy to either of the addresses below, or fax it to 04 460 8879.

Postal address	Physical address
Submissions Electricity Authority PO Box 10041 Wellington 6143	Submissions Electricity Authority Level 7, Harbour Tower 2 Hunter Street Wellington

1.9 Please note the Authority wants to publish all submissions it receives. If you consider that we should not publish any part of your submission, please

(a) Indicate which part should not be published

(b) Explain why you consider we should not publish that part

(c) Provide a version of your submission that we can publish (if we agree not to publish your full submission).

1.10 If you indicate there is part of your submission that should not be published, we will discuss with you before deciding whether to not publish that part of your submission.

1.11 However, please note that all submissions we receive, including any parts that we do not publish, can be requested under the Official Information Act 1982. This means we would be required to release material that we did not publish unless good reason existed under the Official Information Act to withhold it. We would normally consult with you before releasing any material that you said should not be published.

When to make a submission

1.12 Please deliver your submissions by **5pm** on Tuesday **3 December 2019**.

1.13 The Authority will acknowledge receipt of all submissions electronically. Please contact the Submissions' Administrator if you do not receive electronic acknowledgement of your submission within two business days.

2 Issue the Authority would like to address

Background relevant to the issue is available in papers on the Authority's website

2.1 Distributed generation is generation connected directly or indirectly to a distributor's local network.[1] Part 6 of the Code regulates how distributed generation connects to a local network.[2]

2.2 Distributed generation includes small-scale generation systems such as rooftop solar photovoltaic (solar PV) installations, in-home battery installations, small wind turbines, and micro-hydro schemes. Small-scale systems have capacities up to 10 kilowatts (kW). These small-scale systems typically provide renewable energy sources for households and small businesses. Larger distributed generation installations may have capacities from 10 kW up to several tens of megawatts (MW).

2.3 Comprehensive background relevant to the hosting capacity of low voltage networks and the connection of small-scale distributed generation was provided in the issues paper *Integrating hosting capacity into Part 6 of the Code on low voltage networks*, available at: https://www.ea.govt.nz/development/work-programme/operational-efficiencies/market-enhancement-omnibus/consultations/

2.4 The Authority published the issues paper in September 2018 and has considered the 19 submissions it received. The Authority subsequently published a decisions paper that summarised the key themes received in submissions and notified interested parties of its intention to consult on a proposal to amend Part 6 of the Code at https://www.ea.govt.nz/dmsdocument/25504-decisions-paper-enhancing-hosting-capability-into-part-6-of-the-code-pdf-170-kb.

The existing arrangements

2.5 A distributed generator is a person who owns or operates any form of electricity generation that is connected, or is intended to be connected, within a consumer installation, for example their home or business premises. The consumer installation is itself connected to the local electricity network. In this configuration, excess electricity from the distributed generation will flow into the network if the level of generation output exceeds the level of consumption by the appliances within the consumer installation.

2.6 Part 6 provides regulated processes that distributed generators and distributors must use if a distributed generator wishes to connect distributed generation or to change the capacity of an existing distributed generation installation.

2.7 The connection processes in Part 6 are separated into two capacity bands:[3]

(a) 10 kW or less

(b) above 10 kW.

2.8 Applications to connect distributed generation of 10 kW or less have two alternative connection application processes for which an applicant may be eligible:

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1 The relevant definitions are contained in Part 1 of the Code, available at https://www.ea.govt.nz/code-and-compliance/the-code/

2 Part 6 is available at https://www.ea.govt.nz/code-and-compliance/the-code/

3 See Schedule 6.1 – Process for obtaining approval

(a) Part 1

(b) Part 1A

2.9 The Part 1 process was originally included to provide a connection application and approval process that could assess any distributed generation technology, whether inverter-connected or otherwise. It provides timeframes suitable for a comprehensive case by case review of the effect of the proposed technology on the network by the distributor. The Authority introduced the Part 1A process to streamline the connection application and approval process for the more straightforward connection applications.

2.10 Part 1A provides a simplified application and approval process that an applicant may use if the proposed distributed generation complies with prescribed eligibility criteria. The eligibility criteria are specified in clause 1D of Schedule 6.1, as follows:[4]

> ***1D When application may be made under Part 1A***
>
> *A **distributed generator** may elect to apply to a **distributor** under Part 1A instead of Part 1 if the **distributed generation** to which the application relates—*
>
> *(a) is designed and installed in accordance with AS 4777.1; and*
>
> *(b) incorporates an inverter that has been tested and issued a Declaration of Conformity with AS/NZS 4777.2 by a laboratory with accreditation issued or recognised by International Accreditation New Zealand; and*
>
> *(c) has protection settings that meet the **distributor's connection and operation standards**.*

2.11 The Part 1A process reflects common distributed generation design practice for installations that include an inverter that complies with standards, if the inverter has settings applied that comply with the settings prescribed in the distributor's connection and operation standards.[5] The settings control important operational parameters related to the safe, secure and reliable operation of the inverter when connected to a consumer installation that is connected to a local network.

2.12 The Part 1 process may be used if an application is ineligible for consideration under Part 1A. Part 1 thereby allows for consideration of applications that include a wider range of distributed generation equipment than might be processed under Part 1A.

Issues with the existing arrangements

2.13 The Authority has formed the view that issues exist with the eligibility criteria for the Part 1A process and that relatively straightforward improvements are available by amending Part 6.

2.14 The Authority has formed its view after:

(a) describing relevant background and the basis of its concerns in the issues paper developed and published as described in paragraph 2.4

(b) considering feedback on the issues paper submitted by interested parties.

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4 Part 6 as at 1 November 2018.

5 An inverter is an electronic interface device that transforms the direct current (DC) output from generation plant (most frequently this is an array of solar PV panels) into alternating current (AC) output at a voltage and frequency that conforms with the voltage and frequency of the connected AC consumer installation or network.

2.15 The Authority published a decision paper notifying interested parties of its intention to consult on a Code amendment proposal and provided its rationale for reaching that decision.

2.16 In summary, the Authority considers there are three issues:

(a) Issue 1: clause 1D(a) of Schedule 6.1 references a superseded standard, raising uncertainty about which version should apply

(b) Issue 2: distributors and consumers are missing a low cost, high return opportunity to maximise (future proof) low voltage network hosting capacity.

(c) Issue 3: the Part 1A process could better address connection applications to parts of the network subject to export congestion

2.17 We expand on the background and cause of these issues in the next three sections.

Issue 1 – Part 6 references an outdated standard

2.18 First published in 2002, the technical standard AS 4777.1 was updated in 2005. This standard specifies requirements relevant to grid connection of energy systems via inverters. This standard's stated objective is to *provide guidance for installers of inverter energy systems intended for the injection of electric power through an electrical installation to the electricity distribution network*. The standard specifies good inverter installation practices that should deliver safe, secure and reliable inverter installations.

2.19 AS 4777.1 was reviewed and updated in 2016 and made a joint Australian and New Zealand standard at that time. Its full title is now AS/NZS 4777.1:2016 *Grid connection of energy systems via inverters – Part 1: Installation requirements.*

2.20 The eligibility criteria for the Part 1A connection application process provide incentives for distributed generation system designers/installers to adopt design and installation practices that reflect good electricity industry practice by adopting the practices set out in the latest relevant standards. Like Australia, New Zealand has anchored good design and installation practices on the AS/NZS 4777 suite of standards.

2.21 The Authority proposes to provide regulatory certainty by updating the reference in clause 1D(a), replacing *AS 4777.1* with *AS/NZS 4777.1:2016*. Updating the standard reference will be of interest to distributed generation designers and installers, distributors and consumers considering investment in distributed generation.

2.22 Note that the outdated standard AS 4777.1:2005 is also currently referenced in section 60(2)(f) of the Electricity (Safety) Regulations 2010 (the ESRs). The Authority has previously referred the issue to MBIE and understands MBIE intends to update the reference to the latest standard in due course. The Authority considers it creates no conflict with the ESRs by moving now to update the standard reference in the Code because the reference is only used in Part 6 as an eligibility criterion for the streamlined Part 1A connection application process.

Issue 2 – distributors and consumers are missing an opportunity to efficiently maximise the hosting capacity of low voltage networks

2.23 Relevant to electricity distribution networks, the term 'hosting capacity' means *the amount of new generation or consumption that can be connected to a network without diminishing the reliability or voltage quality for other network users*.[6]

2.24 In our current context:

(a) *generation* refers to any network-connected source of electricity, for example, a rooftop solar PV installation providing a generation source or a storage battery that is capable of discharging stored energy into the network.

(b) *consumption* relates to any appliance that consumes or stores electricity and is focused with increasing frequency on the relatively high rates of consumption that occur with electric vehicle battery chargers

(c) *reliability* includes the reliable performance of the whole network, including local networks and the national grid

(d) *voltage quality* relates to maintaining both the 50 Hz voltage, and harmonic voltages,[7] within statutory limits – and is broadly synonymous with the term 'power quality'.

2.25 Distributors manage significant investments in the low voltage network assets that provide distribution services to more than 2.1 million electricity consumers in New Zealand. Driven by the anticipated uptake of new technologies by consumers, cost-effective options that unlock additional hosting capacity in distribution networks are in consumers' long-term interests. This is because such options would allow more consumers and distributed generators to connect new technologies to existing networks than would otherwise have been possible without additional investments in costly network assets.

2.26 Network power flows will change from their historical patterns as consumers seek to connect more distributed energy sources and high capacity electric vehicle chargers to their homes and businesses. If these new technologies operate in an unconstrained manner, this will lead to:

(a) higher consumption peaks – and hence higher current flows and lower local voltages – during winter evenings, possibly causing excessively low voltages on the local network

(b) reverse power flows and higher local voltages during summer weekdays, possibly causing excessively high voltages.

2.27 Reference to international experience indicates that consumer investment in distributed generation technologies can occur rapidly. These changed electricity generation and consumption patterns will lead to network congestion as the remaining hosting capacity of the network becomes fully utilised.

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6 There are several references available for this broadly accepted definition that use equivalent but slightly different words. See, for example, Bollen and Rönnberg, *Hosting Capacity of the Power Grid for Renewable Electricity Production and New Large Consumption Equipment* at https://www.mdpi.com/1996-1073/10/9/1325/pdf-vor.

7 Harmonics are AC voltage waveform components comprised of frequency multiples of 50 Hz voltages superimposed on the primary 50 Hz waveform. Excessive levels of harmonics in networks lead to poor power quality and can cause problems in electrical appliances.

2.28 The Authority recently discussed with distributors the impact of emerging technologies on their networks. While they generally expect that problems will emerge over the next five to ten years, distributors anticipate:

(a) emerging clusters of new technology adoption in some areas, giving rise to local congestion issues

(b) a more rapid uptake of some new technologies, particularly of electric vehicle ownership, once adoption reaches a tipping point.

2.29 The Authority considers that distributors are best placed to:

(a) monitor and analyse their network utilisation and develop strategies to provide the hosting capacity required to connect the new technologies consumers increasingly seek to deploy

(b) operate their networks efficiently, managing supply security and reliability in the face of technology advancement and changing customer expectations

(c) carry out timely and innovative investments in the electricity system.

2.30 Cost effective options are available now that can unlock latent hosting capacity in existing networks. A new distributed generation installation that incorporates a suitably capable inverter can help to maintain – or even improve – network reliability and voltage quality, and thereby enhance existing network hosting capacity.[8]

2.31 To achieve this outcome, the inverter must be capable of enabling two advanced power quality operational modes that are included in the latest inverter standard, but only as *optional modes*. The two advanced power quality modes are called (a) *volt-var mode* and (b) *volt-watt mode*, collectively referred to as *volt response modes*.[9] Enabled with suitable settings applied, these modes provide beneficial local voltage regulation that act to curb excessively low and high local voltage conditions.

2.32 As currently drafted, the eligibility criteria for the Part 1A connection application process require that the inverter proposed as part of the distributed generation installation complies with the *mandatory* requirements of AS/NZS 4777.2:2015. Therefore, an otherwise standards-compliant inverter, eligible to use the Part 1A process, would not *necessarily* be capable of enabling the desired (but only optional) volt response modes.

2.33 By amending the eligibility criteria for the Part 1A application process, the Authority proposes to improve the incentive to use inverters capable of implementing the volt response modes.

2.34 The Part 1 application process will continue to allow sufficient time for distributors to perform manual assessments, and provide the ability to enforce any mitigation measures arising from manual assessment. As a result, network access and reliability will be improved.

2.35 While distributors could specify suitable requirements in their connection and operation standards, under the current Code requirements, eligibility for the Part 1A connection application process requires only compliance with the mandatory aspects of AS/NZS 4777.2. The issues are that AS/NZS 4777.2:2015

[8] Note that unlike requirements for connecting distributed generation, under current legislation, the Authority cannot regulate connection requirements relevant to electric vehicle chargers.

[9] The volt response modes provide local voltage regulation by varying the reactive power generated or consumed and by curtailing inverter power output at excessively high voltages.

(a) includes the two volt response modes as optional capabilities only

(b) does not include any criterion for limiting export power for an installation.

2.36 While adoption of currently optional operational inverter modes is expected to become mandatory as the standards develop over time, distributors are seeking to clarify the requirements now. This is discussed further in the next section.

Issue 3 – the Part 1A process could better address connection applications to parts of the network subject to export congestion

2.37 A consumer installation to which distributed generation is connected will export energy back into the network if the instantaneous power generated by the distributed generation exceeds the instantaneous power consumed by the appliances.[10] For example, if the distributed generation is generating 3 kW of power and the appliances (loads) within the consumer installation are consuming in aggregate 2 kW, the export power from the consumer installation to the network is 1 kW.

2.38 Export congestion means:[11]

> *a situation in which a **distribution network** is unable to accept **electricity** exported from **distributed generation** because the injection of an additional unit of **electricity** into the **distribution network** would—*
>
> *(a) directly cause a component in the **network** to operate beyond the component's rated maximum capacity; or*
>
> *(b) give rise to an unacceptably high level of voltage at the **point of connection** between the **distribution network** and the **distributed generation***

2.39 As hosting capacity becomes increasingly scarce on particular parts of the network, distributors are required to identify and publish a list of all locations on their network that are subject to export congestion, or that are expected to become subject to export congestion within the next 12 months. The requirement is as follows:[12]

> *6.3(2) Each **distributor** must make publicly available, free of charge, from its office and Internet site,—*
>
> *…*
>
> *(d) a statement of the circumstances in which **distributed generation** will be, or may be, curtailed or interrupted from time to time in order to ensure that the **distributor's** other **connection and operation standards** are met; and*
>
> *(da) a list of all locations on its **distribution network** that the **distributor**—*
>
> *(i) knows to be subject to **export congestion**; or*
>
> *(ii) expects to become subject to **export congestion** within the next 12 months;*
>
> *…*

2.40 The current Part 1A connection application process provides that a distributor may advise the applicant distributed generator that the distributed generation may be subject

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10 For simplicity, this assumes there is no battery storage connected to the consumer installation. In any instant, an active storage battery will either source ("generate") or consume energy.

11 See definition in Part 1 of the Code.

12 Clause 6.3(2)(d) and (da)

to export congestion as set out in the distributor's congestion management policy.[13] If this occurs:

"*… the **distributor** must take reasonable steps to work with the **distributed generator** to assess whether solutions exist to mitigate the **export congestion**.*"

2.41 One means of mitigating export congestion is for the distributor to impose a limit on the maximum level of power that an applicant's proposed distributed generation may export into a congested part of the network (the *maximum export power*). This would have the effect of sharing the increasingly scarce hosting capacity of an identified part of the network amongst current and future applicants' distributed generation.

2.42 The problem is that it is not clear that a distributor may legally impose a maximum export power limit on proposed distributed generation as a means of mitigating congestion.

2.43 The proposal is to make it clear that, for parts of the network included in the list published in accordance with clause 6.3(2)(da), the distributor has the right to specify maximum export power in its connection and operation standards. Connection applications that seek to use the Part 1A process must comply with any maximum export power limit previously specified by the distributor in its published congestion management policy.

Why the Authority is addressing these issues now

The EEA requested the Authority to consider a Code amendment request

2.44 The Electricity Engineers' Association's (EEA) role includes developing and publishing good practice guides for its members (ie, distributors and Transpower). The guides disseminate good industry practice, which provides significant value to distributors and thereby to consumers in terms of supply reliability and asset management efficiency.

2.45 Relevant to hosting capacity on low voltage networks, the EEA developed a draft guide that includes methodologies that can be used to assess the hosting capacity of individual networks and to implement good industry practice that seeks to enhance hosting capacity in cost-effective ways.

2.46 The EEA requested that the Authority amend the Code to allow individual distributors to require that inverters included in a Part 1A connection application include the optional volt response modes described in the last section.

2.47 The EEA also requested that the Code amendment should clarify that distributors may set limits on the maximum power that may be exported from a consumer installation to a local network experiencing export congestion – or expected to experience export congestion in the near future.

Submissions on the issues paper supported the Authority's assessment of the issue and the proposed solution

2.48 Feedback on the issues paper generally agreed the Authority had correctly identified issues with the current Code provisions in Part 6 and supported the Authority proceeding to amend the Code to remedy these.

[13] Clause 9D of Schedule 6.1

Reference to international experience supports the direction of using increasingly capable inverters to enhance network hosting capacity

2.49 As compared with consumers in other decarbonising economies, New Zealand consumers are at an early stage of distributed generation adoption. New Zealand is thereby well-placed to learn from international experience.

2.50 International development of inverter standards drives manufacturers to design and sell increasingly capable inverters, specifically by adding capabilities that enhance network hosting capacity.

2.51 From feedback received on the issues paper, the Authority understands that many inverters sold locally are capable of implementing the advanced power quality modes, and cost little or no more than 'old 2005 standard' inverters. New Zealand is thereby well placed to act as a selective technology follower, benefiting from increasingly capable products supplied into international renewable energy markets.

2.52 As will be seen in the next section, adoption of advanced inverter capabilities as eligibility does not preclude the use of '2005 standard' inverters but require only that such connection applications use the Part 1 process.

Q1. Do you agree the issues identified by the Authority? If not, why not?

Q2. Do you agree with the proposals identified by the Authority? If not, why not?

3 Regulatory Statement for the proposed amendment

Objectives of the proposed amendment

3.1 The proposed Code amendment seeks to enhance the hosting capacity of electricity networks at both local and grid levels in a cost-effective manner.

3.2 Increasing network hosting capacity is in the long-term interests of consumers because it provides options for more consumers to choose to invest in network-connected distributed energy resources, maintaining reliable supply at minimum cost.

Q3. Do you agree with the objectives of the proposed amendment? If not, why not?

The proposed amendment

3.3 The proposed Code amendment remedies two issues in Part 6 related to the eligibility criteria for the Part 1A distributed generation connection application process in clause 1D of Schedule 6.1

3.4 First, the proposed amendment replaces the reference to a superseded standard in clause 1D(a) with the current standard.

3.5 Second, the proposed amendment adds new eligibility criteria to the existing criteria for the Part 1A process. The new criteria:

(a) make mandatory two advanced power quality modes that are included in the inverter standard AS/NZS 4777.2:2015 as optional modes only. The two modes are the volt-watt response mode and the volt-var response mode.

(b) introduce a maximum export power limit for consumer installations to which new or upgraded distributed generation is to be connected – applications must comply with the limit specified by the distributor.

3.6 Distributed generation connection applications that do not meet the expanded eligibility criteria for the Part 1A process remain able to use the Part 1 process.

3.7 The proposed amendment thereby incentivises inclusion of inverters that comply with the latest standard, including the optional modes described, because the Part 1A process provides connection applicants with a significantly simpler process that has shorter timeframes and greater certainty.

3.8 Appendix A provides a draft of the proposed Code amendment.

The benefits of the proposed amendment benefits are expected to outweigh the costs

3.9 We have simplified our evaluation of benefits and costs on the basis that a potentially large benefit stream is significantly greater than the minimal costs that might accrue if the proposal is ultimately adopted.

3.10 We expect consumer benefits to accrue from the following source. The desire to use the simpler, faster and less costly Part 1A connection application process should incentivise applicants to use an inverter that is capable of implementing the two specified optional power quality response modes in addition to the mandatory capabilities set out in AS/NZS 4777.2:2015. Whether and how the volt response modes are ultimately used should appropriately be addressed in the distributor's connection and operation standards.

3.11 Including inverters that are capable of implementing the volt response modes in distributed generation installations will unlock latent hosting capacity from low voltage networks. The volt response modes provide additional voltage regulation of the local network so as to assist with retaining the voltage with the statutory limits. This will allow more distributed generation to be connected than would otherwise have been possible, deferring potentially costly network upgrades.

3.12 Volt-var mode enables each distributed generation installation to provide, within limits, its own voltage regulation. Volt-watt mode provides a second layer of overvoltage management by curtailing inverter power output if local voltages exceed a pre-set threshold, effectively rationing scarce hosting capacity in extreme operating conditions.

3.13 Given the level of investment in network equipment by distributors, network upgrade deferral, even if for just one year, could be expected to deliver benefits in the order of millions of dollars annually across the low voltage networks that connect to in excess of 2.1 million ICPs nationwide.

3.14 Relative to the expected order of magnitude of the benefits, we consider the costs of the proposal should be minimal. Inverters deployed in New Zealand broadly conform with the latest international standards, in our case with the Australia-driven standard that we have jointly adopted. We benefit significantly from having a comparatively very low level of demand for inverters that conform with the latest standards from international suppliers selling into much larger territories (in our case, into Australia).

3.15 Some applications that would have been eligible for the Part 1A process would no longer be eligible for consideration under that process. However, such applications are not automatically precluded from connection because they can still be assessed and approved under the Part 1 process.

3.16 The Part 1 process provides more time to consider a connection proposal and enables the distributor to carry out a more detailed assessment of the proposed distributed generation connection in the context of the available hosting capacity of the relevant network. Reflecting this, applications made under the Part 1 process can, at the distributor's discretion, require a higher application fee (*up to* $200 versus *up to* $100 for an application made under Part 1A).

3.17 Information provided in submissions on the issues paper, discussed earlier, indicates that inverters eligible for the Part 1A process are readily available in New Zealand at little or no additional cost. Costs can only be considered to accrue while residual 'old standard' inverter stocks remain.

3.18 The Authority is confident that significant net benefits will accrue to consumers from the proposed Code amendment. At the very least, the proposal represents a no-regrets approach.

Q4. Do you agree the benefits of the proposed amendment outweigh its costs? If you don't agree, please explain your reasons.

The Authority has identified two other means for addressing the objectives

3.19 The Authority has identified two other means of addressing the objectives:

a) Option 1: wait for future revisions of relevant international standards to eventually impact the AS/NZS 4777 standards suite, providing the hosting capacity benefits sought

b) Option 2: rely on distributors to include relevant provisions in their connection and operation standards and seek to enforce compliance with those standards to require the advanced power quality modes they have requested and impose the maximum export power limits.

1.1.2 Option 1 anticipates that the source international standards from which the AS/NZS 4777 suite is derived and adapted for local conditions, will eventually be revised to provide more advanced power quality modes on a mandatory basis. We have time before hosting capacity becomes a day to day issue so this raises the question of why we should move now.

1.1.3 Option 2 suggests that distributors can already require the advanced power quality modes by specifying their requirements in their published connection and operation standards. This option also relies on distributors being able to practically enforce maximum export power limits for Part 1A connection applications.

The proposed amendment is preferred to other options

3.20 The Authority has evaluated the other means for addressing the objectives and prefers the proposal.

3.21 Option 1 is not preferred because technical standards revisions involve highly consultative processes amongst experts that take many years to ratify and eventually trickle down into our local standards. New Zealand wholesalers source inverter stocks from suppliers that service a very large global market for increasingly capable products.

3.22 Inverters supplied into New Zealand now are, at the hardware level, capable of performing the advanced power quality modes sought. Software settings can enable the required features. Anchoring inverter performance expectations through the connection application process eligibility criteria is likely to increase standardisation across New Zealand distribution networks.

3.23 Option 2 is not preferred because there is, in some cases, doubt about what distributors may reasonably include in their connection and operation standards and congestion management policies. National standardisation is also desirable in the solar PV installation industry that is becoming serviced by national service providers.

3.24 The current eligibility criteria for access to the Part 1A connection application process allow inverters that do comply with the mandatory requirements of AS/NZS 4777.2:2015 but not with the optional capabilities. The proposal would provide greater regulatory certainty by unambiguously specifying the otherwise optional volt response modes in the eligibility criteria.

Q5. Do you agree the proposed amendment is preferable to the other options? If you disagree, please explain your preferred option in terms consistent with the Authority's statutory objective in section 15 of the Electricity Industry Act 2010.

The proposed amendment complies with section 32(1) of the Act

3.25 The Authority's objective under section 15 of the Act is to promote competition in, reliable supply by, and efficient operation of, the electricity industry for the long-term benefit of consumers.

3.26 Section 32(1) of the Act says that the Code may contain any provisions that are consistent with the Authority's objective and is necessary or desirable to promote one or all of the following:

Table 1: How proposal complies with section 32(1) of the Act

(a) competition in the electricity industry;	The proposed amendment will promote competition by providing more consumers with access to electricity supply alternatives, placing downward pressure on energy prices.
(b) the reliable supply of electricity to consumers;	The proposed amendment will promote reliable supply to consumers by unlocking latent hosting capacity in the networks to which consumer connect. Hosting capacity means the amount of new production or consumption that can be connected to the network without diminishing the reliability or voltage quality for other customers.
(c) the efficient operation of the electricity industry;	The proposed amendment will promote the efficient operation of the electricity industry by a) increasing the utilisation of existing network assets b) incentivising more standardisation of the network interface equipment used in distributed generation installations.
(d) the performance by the Authority of its functions;	The proposed amendment will not materially affect the performance of the Authority.
(e) any other matter specifically referred to in this Act as a matter for inclusion in the Code.	The proposed amendment will not materially affect any other matter specifically referred to in the Act for inclusion in the Code.

Q6. Do you agree the Authority's proposed amendment complies with section 32(1) of the Act? If you don't agree, please explain your reasons.

The Authority has given regard to the Code amendment principles

3.27 When considering amendments to the Code, the Authority is required by its Consultation Charter to have regard to the following Code amendment principles, to the extent that the Authority considers that they are applicable. [14] Table 2 (below) describes the Authority's regard for the Code amendment principles in the preparation of the proposal.

Table 2: Regard for Code amendment principles

Principle	Comment
1. Lawful	The proposal is lawful, and is consistent with the statutory objective (see section 3) and with the empowering provisions of the Act.
2. Provides clearly identified efficiency gains or addresses market or regulatory failure	The efficiency gains are set out in the evaluation of the costs and benefits (section 3). The efficiency gains accrue from cost-effectively enhancing network hosting capacity and improving regulatory certainty.
3. Net benefits are quantified	The extent to which the Authority has been able to estimate the efficiency gains is set out in the evaluation of the costs and benefits (section 3).
4. Preference for small-scale 'trial and error' options	Not applicable
5. Preference for greater competition	Not applicable
6. Preference for market solutions	Not applicable
7. Preference for flexibility to allow innovation	Not applicable
8. Preference for non-prescriptive options	Not applicable
9. Risk reporting	Not applicable

[14] The consultation charter is one of the Authority's foundation document and is available at:: http://www.ea.govt.nz/about-us/documents-publications/foundation-documents/

Appendix A Proposed amendment

A.1 Part 1 Preliminary provisions

congestion management policy means the policies, clauses, or conditions referred to in clause 6.3(2)(d)

connection and operation standards, in relation to a **distributor** or **distributed generation**,—

(a) means requirements, as amended from time to time by the **distributor**, that—

(i) are set out in written policies and standards of the **distributor**; and

(ii) relate to connecting **distributed generation** to a **distribution network** or to a **consumer installation** that is connected to a **distribution network**, and the operation of the **distribution network**, including requirements relating to the planning, design, construction, testing, inspection, and operation of **distributed generation** that is, or is proposed to be, connected; and

(iii) are made publicly available in accordance with clause 6.3; and

(iv) reflect, or are consistent with, **reasonable and prudent operating practice**; and

(b) includes the following, as amended from time to time by the **distributor**:

(i) the **distributor's congestion management policy**, as referred to in clause 6.3(2)(d); and

(ii) the **distributor's** emergency response policies; and

(iii) the **distributor's** safety standards; and

(c) may include the **distributor's** policies for specifying available **maximum export power** amongst categories of **network** users, a **maximum export power** threshold for applications under Part 1A of Schedule 6.1, and the methodology used to determine that threshold.

maximum export power means the maximum **active power** exported into the **local network** or **embedded network** at an **ICP** of a **distributed generator**, and is equal to—

(a) the **nameplate capacity** of the **distributed generation** minus the minimum load at the **point of connection**; or

(b) the power export limit imposed by an active export control device.

Part 6 Connection of distributed generation

6.3 Distributors must make information publicly available

(1) The purpose of this clause is to require each **distributor** to make certain information publicly available to enable the approval of **distributed generation** under Schedule 6.1.

(2) Each **distributor** must make publicly available, free of charge, from its office and Internet site,—

(a) forms for applications under Schedule 6.1; and

(b) the **distributor's connection and operation standards**; and

(c) a copy of the **regulated terms**, together with an explanation of how the **regulated terms** will apply if—

(i) approval is granted under Schedule 6.1; and

(ii) the **distributor** and the **distributed generator** do not enter into a connection contract; and

(d) a statement of the circumstances in which **distributed generation** will be, or may be, curtailed or interrupted from time to time in order to ensure that the **distributor's** other **connection and operation standards** are met; and

(da) a list of all locations on its **distribution network** that the **distributor**—

(i) knows to be subject to **export congestion**; or

(ii) expects to become subject to **export congestion** within the next 12 months; and

(db) for locations at which it has set a **maximum export power** threshold for applications under Part 1A of Schedule 6.1, the **maximum export power** threshold and the methodology used to determine it; and

(e) a list of any fees that the **distributor** charges under Schedule 6.1, which must not exceed the relevant maximum fees prescribed in Schedule 6.5; and

(f) a list of the makes and models of inverters that the **distributor** has approved for connection to its **distribution network**; and

(g) the **distributor's** contact information for any enquiries relating to the connection of **distributed generation** to its **distribution network**.

Part 6 Schedule 6.1

1D When application may be made under Part 1A

A **distributed generator** may elect to apply to a **distributor** under Part 1A instead of Part 1 if the **distributed generation** to which the application relates—

(a) is designed and installed in accordance with AS/NZS 4777.1:2016 and

(b) incorporates an inverter that—

(i) has been tested and issued a Declaration of Conformity with AS/NZS 4777.2:2015 by a laboratory with accreditation issued or recognised by International Accreditation New Zealand; and

(ii) has the following volt response modes:

(A) volt-watt response mode; and

(B) volt-var response mode; and

(iii) has protection and volt response mode settings that meet the **distributor's connection and operation standards**; and

(c) has an export power limit at the **ICP** of the **distributed generator** that meets the **maximum export power**, if any, specified by the **distributor** in its **connection and operation standards**.

9B Application for distributed generation of 10 kW or less in total in specified circumstances

(1) ……

(2) An application must include the following:

(a) the name, contact, and address details of the **distributed generator** and, if applicable, the **distributed generator's** agent:

(b) a brief description of the physical location at the address at which the **distributed generation** is or will be connected:

(c) any application fee specified by the **distributor** in accordance with clause 6.3(2)(e):

(d) details of the make and model of the inverter:

(e) confirmation as to whether the inverter—

(i) is included on the **distributor's** list of approved inverters made publicly available under clause 6.3(2)(f); or

(ii) conforms with the protection settings and volt response mode settings specified in the **distributor's connection and operation standards**:

(ea) confirmation that the **distributed generation** has a **maximum export power** limit that meets the **maximum export power** threshold, if any, specified by the **distributor** in its **connection and operation standards**:

(f) if the inverter is not included on the **distributor's** list of approved inverters, a copy of the AS/NZS 4777.2:2015 Declaration of Conformity certificate for the inverter:

(g) details of—

(i) the **nameplate capacity** of the **distributed generation**; and

(ii) the fuel type of the **distributed generation** (for example, solar, wind, or liquid fuel); and

(iii) the **maximum export power** of the **distributed generation**.

Q7. Do you agree with the drafting of the proposed amendment? If not, why not?

Appendix B Format for submissions

Submitter	

Question		Comment
Q1.	Do you agree the issues identified by the Authority? If not, why not?	
Q2.	Do you agree with the proposals identified by the Authority? If not, why not?	
Q3.	Do you agree with the objectives of the proposed amendment? If not, why not?	
Q4.	Do you agree the benefits of the proposed amendment outweigh its costs? If you don't agree, please explain your reasons.	
Q5.	Do you agree the proposed amendment is preferable to the other options? If you disagree, please explain your preferred option in terms consistent with the Authority's statutory objective in section 15 of the Electricity Industry Act 2010.	
Q6.	Do you agree the Authority's proposed amendment complies with section 32(1) of the Act? If you don't agree, please explain your reasons.	
Q7.	Do you agree with the drafting of the proposed amendment? If not, why not?	
Clause	X.X	

Glossary of abbreviations and terms

Authority	Electricity Authority
Act	Electricity Industry Act 2010
Code	Electricity Industry Participation Code 2010
EEA	Electricity Engineers' Association
solar PV	Solar photovoltaic
kW, MW	kilowatt, megawatt