Vector Limited
110 Carlton Gore Road
PO Box 99882
Newmarket
Auckland 1149
+64 9 978 7788 / vector.co.nz

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Electricity Authority

By Email: connection.feedback@ea.govt.nz

Maximising benefits from local generation

Vector welcomes the opportunity to comment on the Electricity Authority's consultation paper *Maximising Benefits from Local Electricity Generation*. No part of this submission is confidential, and we are happy for it to be published.

We support the Authority's objectives to enable greater participation in distributed generation (DG) while maintaining network safety and reliability. Our submission focuses on ensuring equitable access to hosting capacity, improving consumer outcomes, and future-proofing the regulatory framework to accommodate evolving technologies. The current proposal imposes a clear first-mover advantage to early adopters of solar that either (i) denies later adopters or (ii) imposes significant network upgrading costs on electricity consumers.

Flexible Export Limits will be more equitable than Static Export Limits

DG such as rooftop solar panels are one of several types of evolving consumer devices that have the potential to export onto EDBs' networks. Distributed batteries and discharging from EV batteries will also become more popular in coming years, as demonstrated in overseas experience.

The proposal to raise export limits to 10kVA for small-scale DG is a positive step toward enabling more of these technologies. However, Vector strongly recommends that the Authority adopt *flexible* export limits—enabled through dynamic operating envelopes and smart inverters able to receive signals from EDBs—rather than using static limits. Flexible exports provide significant long-term benefits. They allow hosting capacity to be allocated fairly among all consumers by adapting to changing circumstances over time, avoiding inequitable outcomes with static limits where early adopters monopolize capacity. They also enable more DG connections without compromising network safety and reliability. Further, they help manage extreme periods with coincident high generation and low load, creating an opportunity to improve utilisation of existing network headroom.

International experience clearly supports this approach. South Australia's implementation of dynamic operating envelopes for flexible connections, presented in detail in Appendix B, demonstrates how flexible exports can reduce curtailment, improve network utilization, and deliver better outcomes for consumers. Flexible exports represent an equal short term opportunity but with a more sustainable and equitable solution for the future.

Our view is supported by the Australian Energy Regulator (AER), who stated in their 2022 consultation on flexible exports[1], that:

> *As the uptake of consumer energy resources continues, the use of static limits is likely to eventually see newer solar connections receive lower export limits as networks become increasingly congested. This can limit consumers' ability to obtain financial benefits for exporting excess energy back into the grid as well as the benefits to the broader system from their exports*.

As to the advantages of flexible exports, the AER stated[2]:

> *Flexible export limits can provide the opportunity for consumers to achieve greater value from their consumer energy resource investments (such as solar panels and batteries), through potentially higher levels of export onto the grid.*

Critically, at no stage did SAPN propose or attempt to increase default export rates from 5 kVA to 10 kVA. Historically, SAPN, alongside most other distributors in Australia, applied a flat static export limit of around 5 kW per phase for small embedded generators (with Ausgrid a notable exception). As rooftop solar penetration increased and local networks became more constrained, SAPN foreshadowed or applied lower static limits (around 1.5 kW) for new connections in many areas, particularly where customers did not opt into flexible exports. The significant increase in export capacity – up to 10 kW per phase for many customers – was achieved through flexible, dynamic export limits, not by permanently increasing static export caps. The Authority's proposal therefore puts it out of step with international precedent, in this regard.

A static 10kW export limit remains for the life of the inverter

Static export limits will lock in the settings used at the time of installation for the life of the inverter, which is often 15 years. Flexible connections could even enable even greater export limits than 10 kW in the future - potentially up to the consumer's main fuse size (which is ~14 kVA for most households) provided the network could accommodate it. Constraints are most likely to occur when export levels are high across the network (e.g. the middle of a sunny day, when load is low).

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[1] See Australian Energy Regulator (2022). *Flexible export limits – issues paper. Available online at https://www.aer.gov.au/documents/aer-flexible-export-limits-issues-paper-october-2022*

[2] See https://www.aer.gov.au/news/articles/communications/aer-releases-final-response-flexible-export-limits

In a paradigm where everyone receives static limits, a consumer seeking a new DG connection in a constrained area might receive a static 0 kW export limit, which would remain for the life of their inverter, because the existing DG customers in their area effectively reserved their 10kW export limit for the life of their system. With flexible exports, the available capacity can be shared dynamically as adoption increases. That same customer seeking a new DG connection would be offered the same 10kW export limits as their neighbours when everyone receives flexible limits, because each customer has agreed at the time of installation and enabled their smart inverter to be controlled by the distributor to share the available capacity equitably if there are periods with physical limitations on the network.

Flexible export limits considerably improve long-term societal outcomes (affordability, decarbonisation, fairness and equity) compared to fixed limits. The benefits are:

- **Fair access to available network capacity regardless of when a DG connection is made**; those with the financial ability to buy DG sooner are not receiving preferential access
- **Sustains adoption over the long term with clear expectations;** flexible export limits enable the monitoring of curtailment as a service metric to inform system growth decisions
- **Enabling more connections during periods of rapid growth of DG;** high electricity prices can cause rapid growth of DG connections. Growing network infrastructure in response to the rapid growth of DG requires time and flexible export limits can simplify approvals of new connection requests during these growth periods.
- **Reduces risk of cross-subsidies to those that export;** Based on the experience in Australia, we do not believe the EA's stated position that EDBs will not have to invest to release congestion caused by solar export is sustainable. The lion's share of the benefits of this investment would be for those exporting more from their solar, rather than distribution-connected consumers benefiting from lower energy prices. However, due to restrictions in Part 6, EDBs are currently unable to recover the costs of export congestion-relieving investment from DG owners, ex post, therefore it would be recovered from load customers.

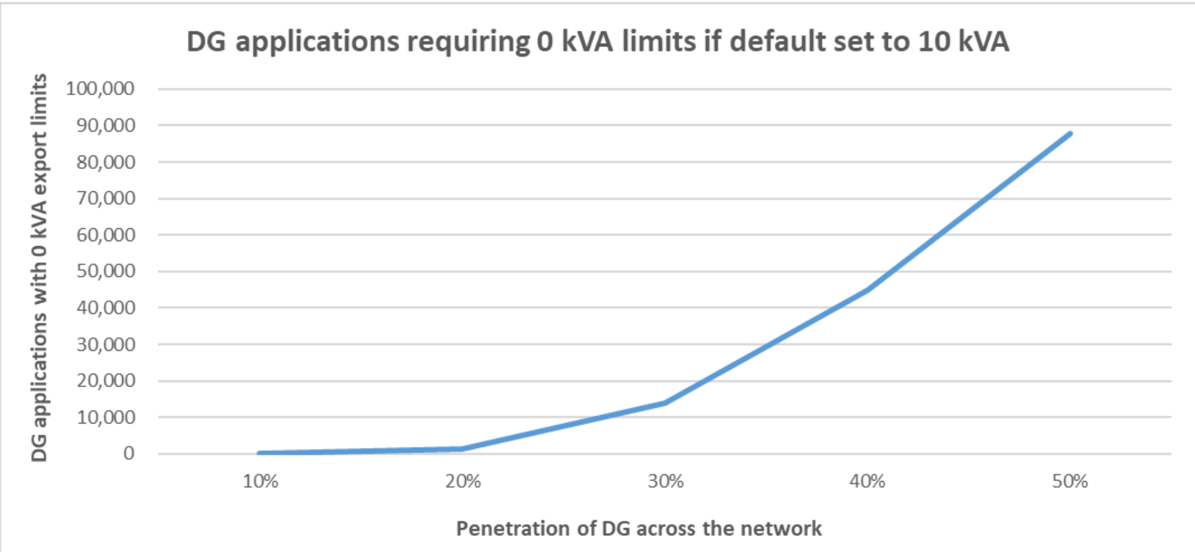
Security of Supply and Solar Contribution

The Security of Supply Assessment 2025 highlights an important distinction: solar generation contributes meaningfully to the energy margin but very little to the capacity margin. This means that while solar improves overall energy availability, it does little to reduce peak demand risk as solar does not generate during typical peak demand periods. Consequently, the vast majority of DG connection is solar which does not defer or eliminate investment in network upgrades required to maintain capacity and reliability during peak periods. Benefits will be limited to energy cost savings. Policy decisions should reflect this reality to avoid overstating the impact of solar on network investment requirements.

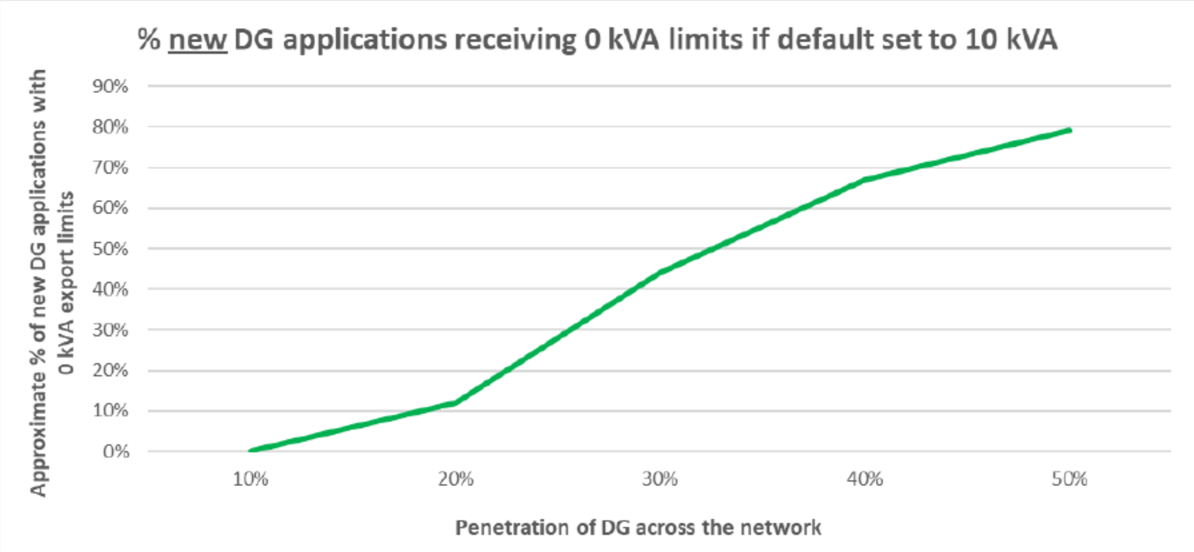
Equitable Hosting Capacity Allocation

Hosting capacity on distribution networks is inherently limited and should be allocated fairly across all consumers. Static limits risk locking in inequitable outcomes, particularly for later adopters. Under the Authority's proposals, EDBs will be required to allocate 10 kW static limits to any customer connecting while headroom is available, and 0 kW to every customer who follows. Flexible export arrangements, by contrast, allow dynamic allocation based on real-time network conditions, ensuring that all consumers have an opportunity to participate in distributed generation regardless of when they made their DG connection and without disadvantaging others. Later adopters can be treated the same as early adopters, and, as noted above, more export can be enabled, more often.

The graph below models how the number of DG applications facing curtailment on the Vector network would rise sharply as DG penetration increases under a default, static 10kVA export limit. At low penetration levels (10–20%), curtailment is minimal, but as penetration reaches 30% and beyond, the number of curtailed DG applications (assessed on a static, conservative basis) accelerates dramatically. This is despite the fact that, for the vast majority of the time, there would at least be *some* network headroom available for exports from these installations. This trend highlights the limitations of static export settings and underscores the need for flexible export arrangements to avoid widespread curtailment and ensure fair access for all consumers as DG uptake grows.



Another way of representing this data is shown in the chart below. This says that, for example, by the time there is a 30% penetration on the network of DG with a 10 kVA export limit, approximately 44% of all new applicants from that point on would receive an export limit of 0 kVA. At 40% penetration, two thirds of new applicants would receive an export limit of 0 kVA. As noted below, with such significant limitation of new DG connections, we do not think this will be a sustainable solution.



Rather than reaching the level of constraint on new DG connections estimated in those two charts, the table below models the escalating level of new and additional investment in the Vector network that would be required to avoid any curtailment of DG exports under different uptake scenarios (i.e. every new DG connection is able to export at either 5, 7 or 10 kVA). This investment would be necessary to ensure equity and fair access for all DG applicants, allowing every customer to connect and export without restrictions as solar penetration increases.

Estimated Investment for Equal DG Export Limits					
Fixed Export limit	10% uptake	20% uptake	30% uptake	40% uptake	50% uptake
5kW	-	$3m	$34m	$226m	$677m
7kW	$1m	$21m	$282m	$1,066m	$2,109m
10kW	$3m	$226m	$1,348m	$2,846m	$4,022m

Inverter standards address voltage but do not stop thermal limits being breached

Inverter standard AS/NZS 4777.2:2020 focuses on voltage and frequency performance requirements for grid-connected inverters. These standards define how inverters respond to grid conditions (e.g., Volt-Var and Volt-Watt modes) to maintain power quality and grid stability, especially under high penetration of DERs. However, they are designed to mitigate risks to power quality (e.g. voltage), but cannot protect against network assets ratings (thermal limits) being exceeded. This has significant potential risks to assets such as transformers, lines, cables and terminations.

Voltage management: Inverters can dynamically adjust reactive and active power to control voltage rise on low-voltage networks. This is why the standard mandates response modes like Volt-

Var and Volt-Watt, and sustained operation limits for voltage variations. They are focussed on correcting issues at the location of the DG and its inverter.

Thermal constraints: Thermal limits relate to current and loading on network assets (e.g., transformers, cables). These are physical capacity issues driven by aggregate power flows, not instantaneous voltage. Inverters in consumers' homes cannot "see" transformer temperature or feeder thermal headroom – they only measure local voltage and frequency. In contrast, managing thermal constraints requires external coordination, such as dynamic export limits or flexible connection arrangements, often controlled by the EDBs via signals or curtailment systems. This is why Australian networks combine smart inverter settings with external control schemes for thermal headroom.

The Authority has significantly underplayed the risk to network assets, and consequently public safety, in its proposed Code amendment. As noted above, flexible connections are essential to enabling greater export limits on EDBs' networks.

Implementation Timeline

For the avoidance of doubt, Vector does not support the Authority's proposal. Our strong preference is for the adoption of flexible export arrangements where inverters are connected to distribution management systems as the most effective way to deliver equitable outcomes and optimize network capacity. Our responses to the specific questions posed should be read within that context.

We recommend implementing flexible export settings that are proven to work in Australia. Monitoring performance of these settings will provide insights for future reviews of technical requirements, interoperability standards, and consumer acceptance. The Authority should aim for a full rollout of dynamic operating envelopes, incorporating real-time monitoring, cybersecurity measures, and robust data-sharing protocols.

While initial implementation costs for flexible exports will be higher due to system upgrades and integration of advanced control systems, the long-term benefits—including improved network utilization, increased export, reduced curtailment, equitable access, and future-proofing against increasing DG penetration—far outweigh these costs.

Conclusion

Vector believes that flexible export arrangements offer the most effective and future-focused solution for integrating distributed generation. They provide fairness, optimize network capacity, and align with international best practice.

Vector recommends that the Authority reconsider its current proposal for static export limits and instead work collaboratively with industry and consult further to design and implement flexible export arrangements. Vector is happy to discuss this submission with the Authority.

Kind regards

[redacted]

James Tipping
GM Market Strategy / Regulation

Appendix A: Responses to consultation questions

Questions	Comments
Q1. What are your views on the proposal to set a default 10kW export limit for Part 1A applications?	We support efficient export limits that benefit DG investors, networks, and consumers, but Vector is concerned the proposal overlooks long-term effects in favour of short-term gains by mandating static instead of flexible export limits and risk increasing costs for all electricity consumers. Export limits should be mandated in kVA (not kW).
Q2. What are your views on the Code clarifying that a distributor cannot limit the nameplate capacity of a Part 1A application, unless the capacity exceeds 10kW?	We agree, and already do this
Q3. There are requirements for distributors in Proposal A1. Which of these do you support, or not support, and why?	Assuming this concerns clause 5.28, we support the new requirements' intent. However, the Code only permits the ELAM to consider connected DG and current applicants, preventing a forward-looking approach, which conflicts with the intent of the proposed requirements.
Q4. What are your views on the proposal for industry to develop an export limits assessment methodology?	We agree
Q5. What would you do differently in Proposal A1, if anything?	The Australian experience indicates that dynamic export limits can provide more consumer benefits overall compared to static export limits. Although dynamic export limits may require additional development and implementation time and cost up front, it will be beneficial for the Authority to assess these options thoroughly before making changes that may erode potential long-term outcomes.
Q6. What concerns, if any, do you have about requiring the 2024, rather than 2016, version of the inverter installation standard for Part 1A applications?	None

Q7. Do you support amending the New Zealand volt-watt and volt-var settings to match the Australian values for Part 1A applications - why or why not – what do you think are the implications?	We agree in principle but recommend an independent review of the Australian settings is done to confirm its suitability as New Zealand's default settings
Q8. What would you do differently in Proposal A2, if anything?	None
Q9. Do you have any concerns about the Authority citing the Australian disconnection settings for inverters when high voltage is sustained?	No
Q10. Do you have any concerns about the Authority requiring the latest version of the inverter performance standard for Part 1A applications?	No
Q11. What are your views on the proposal that where distributors set bespoke export limits for Part 2 applications, they must do so using the industry developed assessment methodology?	We agree
Q12. What are your views on the several requirements that must be adhered to regarding the distributors' documentation (see paragraph 5.96) relating to setting export limits under Part 2?	Acceptable If the network's assessment is undertaken by a specialist third party (eg. power system engineering consultancy), relevant distributor requirements should be waived.
Q13. Do you agree it is fair and appropriate that where distributors set export limits for Part 2 applications, applicants can dispute the limit? If so, what sort of process should that entail?	Applicants should only be able to dispute export limits set by distributors when it can be clearly demonstrated that the distributor has failed to comply with the BELAM.
Q14. What would you do differently in Proposal B, if anything?	We support Proposal B as it is outlined in the consultation paper. However, there are some inconsistencies in the proposed Code amendments that we do not support.

Q15. What are your thoughts on requiring the inverter performance standard (AS/NZS 4777.2:2020 incorporating Amendments 1 and 2) for low voltage DG applications in New Zealand?	Supported
Q16. Do you consider the transitional arrangements workable regarding requirements and timeframes? If not, what arrangements would you prefer?	The proposed transitional arrangements are practical but require a backstop if ELAM and BELAM are delayed. Additionally, the Code amendments should explicitly include transitional arrangements for ELAM/BELAM for clarity.
Q17. What are your views on the objective of the proposed amendments?	While we fully endorse the intended objective, we believe that the proposed amendments for static export limits are primarily focused on short-term outcomes and do not deliver the most benefit possible for DG investors, networks, or consumers over the long term.
Q18. Do you agree the benefits of the proposed amendments outweigh their costs? If not, why not?	The cost-benefit analysis is too broad and does not provide enough detail that should be required for material Code amendments. The high-level calculation of the benefits appear overstated, and in the absence of any cost estimates, it is not possible to determine whether the benefits outweigh their costs.
Q19. What are your views on the Authority's estimate of costs of lost benefits from a 5kW export limit?	The Authority's calculation of total annual revenue loss is based on the premise that distributed generation (DG) installations exceeding 5kVA will spill all surplus generation above the 5kVA export limit. This assumption is unlikely, as a portion of the excess generation is likely to be consumed on-site, diverted to appliances like hot-water cylinders, or stored in onsite batteries for later use. Consequently, the estimated figure of $4.23 million is overstated and likely significantly less. It is reasonable to expect that someone would not invest in DG systems exceeding the export limit without an intended use for the excess generation. The Authority should also take into account the potential costs associated with future electricity spillage that may occur if network hosting capacity is allocated using static limits instead of dynamic limits. The level of spill would be greatly reduced (and aggregate level of export

	increased), improving the Authority's CBA, under a paradigm of flexible exports rather than static limits.
Q20. Are there costs or benefits to any parties (eg, distributors, DG owners, consumers, other industry stakeholders) not identified that need to be considered?	We recommend that the Authority conduct a comprehensive cost-benefit analysis and comparison of static versus dynamic export limits. Based on such an analysis, we anticipate that going ahead with static export limits will be anything but a no-regret decision.
Q21. Do you agree the proposed Code amendments are preferable to the other options? If you disagree, please explain your preferred option in terms consistent with the Authority's main statutory objective in section 15 of the Electricity Industry Act 2010	No. The alternative options do not include flexible export limits. Although the development and implementation of flexible export limits will require additional time, we consider them to be significantly more advantageous in the medium to long term.
Q22. Do you agree the Authority's proposed amendments comply with section 32(1) of the Act?	We disagree. The implementation of static limits is likely to favour early adopters only while providing only limited increases in generation capacity. In contrast, adopting flexible limits would better serve all consumers in the long term and optimise the potential for increased generation.
Q23. Do you have any comments on the drafting of the proposed amendment?	We recommend revising the proposed amendment to adopt flexible export arrangements developed with industry and stakeholders.

Appendix B: South Australia Power Networks – Flexible Exports Journey

Context, problem definition and early responses

South Australia has become one of the most solar-intensive power systems in the world. By the early 2020s, there were well over 300,000 rooftop PV installations in the state, with rooftop solar meeting a significant share of annual electricity use. The state has just passed a key milestone, with panels now on the rooves of over half of all dwellings. On mild, sunny days, solar meets all of South Australia's underlying electricity demand, with periods where rooftop PV output exceeds total underlying demand and pushes operational demand towards or below zero.

By contrast, New Zealand's solar deployment is still at an early stage. While there are tens of thousands of systems nationally, rooftop solar contributes a relatively small share of annual electricity consumption. This difference in scale makes South Australia a useful "early warning" case study for the technical and consumer issues New Zealand will face if rooftop solar grows rapidly.

This appendix sets out the journey South Australia has been on over the past two decades, arriving at the point of confidence they now have that flexible connections will enable them to manage even greater levels of solar generation than they experience currently. Importantly, the solution is now being implemented as business-as-usual not just in South Australia, but in other states across Australia, indicating the widespread view that it is the long-term, sustainable approach for managing and maximising solar exports for the ultimate benefit of consumers.

1. Technical challenges as rooftop solar grew

From the late 2000s to mid-2010s, rooftop solar in South Australia grew steadily, supported by falling PV costs and state feed-in policies. As uptake accelerated, SA Power Networks (SAPN) and the Australian Energy Market Operator (AEMO) progressively observed several emerging challenges:

- Voltage rise and power quality issues on low-voltage feeders as large numbers of PV systems exported simultaneously on mild, sunny days.
- Reverse power flows through distribution transformers and into higher-voltage parts of the network that had been designed for one-way flows from the transmission grid to customers.
- Minimum operational demand risks, where high PV output during mild spring days pushed operational demand towards thresholds needed to maintain system security, particularly inertia and fault-level requirements when the South Australian system is islanded.
- Thermal and voltage constraints at local transformers and zone substations as hosting capacity was consumed by early adopters.

AEMO's minimum operational demand work for South Australia, along with successive South Australian electricity reports, documented these trends and highlighted that, without new tools, distribution network service providers (DNSPs, the Australian equivalent of New Zealand's EDBs) would increasingly rely on blunt measures such as static export limits, zero-export connections or emergency disconnection to protect the wider system.

From a consumer perspective, the emerging problem looked like this: early adopters often secured relatively generous fixed export limits (for example, 5 kW per phase), while, as local hosting capacity filled up, later customers faced progressively tighter limits – including zero-export – despite investing in the same technology. Customers were not necessarily aware that their export rights were effectively locked in based on conditions at connection, and could not easily improve as the system evolved.

SAPN's recent sustainability and innovation reporting describes this as a key equity and efficiency concern: static export limits were increasingly consuming available capacity and limiting future customers' ability to participate in solar generation, while unnecessarily wasting potential renewable generation on the best solar days.

2. Initial responses: static export limits and their impacts

Like other Australian DNSPs, SAPN's first responses to high rooftop solar penetrations were conventional:

- Fixed export limits – automatic approval for exports at standard values such as 1.5 or 5 kW per phase for small embedded generators, regardless of local network conditions.

- Zero or near-zero export in constrained areas – network studies showed that in parts of the network, continued application of standard fixed limits would breach voltage or thermal limits; SAPN and other DNSPs therefore foreshadowed or applied zero or reduced export limits for new customers in those areas.

- Traditional augmentation and voltage management – upgrades to transformers and conductors, installation of voltage regulators and capacitor banks, and tighter voltage settings. These options improved hosting capacity but involved significant capital expenditure and would ultimately be reflected in network tariffs paid by all customers.

These static arrangements had three notable consumer impacts.

First, static limits are set for worst-case conditions (sunny, mild days with low load), but apply 100% of the time. This reduces both customer value and the volume of low-cost renewable energy supplied to the market. The result is more frequent curtailment on the best solar days and higher reliance on conventional generation overall.

Second, there is an inequity between customers. In constrained areas, new customers can be prevented from exporting at all, while earlier customers export freely. This raises fairness and "first-come-first-served" concerns and can create a perception that networks are closing the gate to later adopters, even when they share the same decarbonisation aspirations as early movers.

Third, minimum demand and system security risks prompted emergency backstop measures that can curtail large volumes of distributed PV at short notice. Without more granular tools, such measures may affect many customers simultaneously, regardless of local network conditions, with limited ability to target interventions where they are actually needed.

It is against this backdrop that SAPN began exploring more dynamic ways of managing distributed energy resource (DER) exports, culminating in the globally-leading development of flexible exports and dynamic operating envelopes.

Regulatory enabling environment and the development of flexible exports

3. Regulatory and policy frameworks enabling SAPN's response

Several regulatory and policy developments created the conditions for SAPN's flexible exports approach.

The Australian Energy Market Commission (AEMC) decision on DER access, pricing and incentives recognised export services as a core regulated service provided by DNSPs. It removed the blanket prohibition on export charges and required the Australian Energy Regulator (AER) to develop export tariff guidelines and reporting on DNSP export performance. The AER's subsequent work on flexible export limits highlights reduced curtailment, more efficient use of existing network hosting capacity, and deferral of costly augmentation as key benefits of dynamic operating envelopes.

The South Australian Government mandated that new small embedded generation connections intending to export must use certified "dynamic export-capable" equipment, with export limits remotely updateable via standardised interfaces. This regulatory step addressed a key barrier: ensuring that new inverters and control devices could participate in a flexible exports regime at scale, rather than leaving DNSPs to navigate fragmented vendor-specific solutions.

The Australian Renewable Energy Agency (ARENA) funded the *Flexible Exports for Solar PV* Trial (2020–2023), providing material support to a project led by SAPN with other partners. A core outcome was development of the CSIP-AUS profile – an Australian adaptation of the IEEE 2030.5 smart inverter communications standard – which has since been adopted as national guidance and used to underpin flexible exports roll-outs in multiple National Electricity Market (NEM) jurisdictions.

Together, these reforms moved export management from an ad-hoc, static exercise to a regulated, standards-based service with clear consumer protections and performance expectations. This sequence of reforms provides an important precedent for New Zealand's regulatory design.

4. SAPN's technical evolution towards flexible exports

4.1 Core concept: flexible exports vs static limits

SAPN's customer-facing materials describe flexible exports as smart solar technology that allows customers to export up to 10 kW per phase using an internet-connected inverter, compared with fixed export limits of around 1.5 kW or 0 kW per phase depending on location.

Fixed (static) exports are analogous to a normal light switch: either "on" at a constant, conservative export limit all the time, or "off" with zero export.

Flexible exports are more like a light-switch dimmer: the export limit is automatically turned up or down based on real-time or forecast network conditions, giving customers full export capacity most of the time and reducing it only during rare periods of local congestion.

From a consumer viewpoint, the key difference is that flexible exports preserve high export potential while still protecting the network, avoiding the permanent loss of value associated with static low or zero limits.

4.2 Interim measures and enabling systems

Before flexible exports moved into business-as-usual, SAPN incrementally developed a set of enabling capabilities:

- Enhanced network monitoring and visibility, including LV monitoring and use of SCADA and data analytics to better understand local voltage and thermal constraints.

- Targeted augmentation and voltage management, focusing investment in the most constrained feeders while recognising that physical augmentation alone would not be sufficient or efficient as PV uptake continued to grow.

- Pilot work on dynamic operating envelopes, where early trials of localised export limits informed the design of envelopes used in the ARENA project, allowing export capacity to vary between defined minimum and maximum bands at each site.

4.3 Flexible Exports for Solar PV Trial – milestones and technology partners

Key milestones in the ARENA-funded trial included:

- project planning commencing in 2020
- field trials launching in September 2021, initially targeting several hundred new and existing customers in constrained areas of South Australia and Victoria who would otherwise face zero or very low exports
- trial operations through to 2023, including recruitment, commissioning of CSIP-AUS-capable inverters and gateways, and collection of performance data

- subsequent transition of the solution into business-as-usual, aligned with the South Australian Government's dynamic export requirements for new systems.

SAPN's key technology partners included SwitchDin, which developed the CSIP-AUS-compliant utility server (the "brain" that sends export limits to inverters) and gateway devices, and inverter manufacturers that implemented CSIP-AUS integration into their product ranges. The trial also involved AusNet as a second DNSP trial partner, demonstrating portability of the solution across networks.

In practice, SAPN's dynamic operating envelope system calculates time-varying export limits for each eligible connection (within a band, for example 1.5–10 kW per phase) based on local network models and real-time or forecast conditions. SAPN publishes these limits to a utility server via a common interface, and communicates them to inverters or gateways using the CSIP-AUS profile over IEEE 2030.5. This architecture is inherently extendible – the same signalling can support future DER such as batteries, electric vehicle chargers and controllable loads.

Implementation outcomes, comparative analysis and lessons for New Zealand

5. Implementation and consumer outcomes

5.1 Roll-out and customer uptake

Following the trial phase, SAPN began offering flexible exports as a standard connection option, rolling out on a suburb-by-suburb basis with an expectation of broad availability across the state. The South Australian Government's dynamic export requirements mean all new exporting systems must be flexible-exports capable, greatly improving the availability of compatible equipment and reducing friction for customers and installers.

Trial and early roll-out data indicate a marked shift in uptake: during the trial, a material share of eligible customers chose flexible exports; as dynamic-capable equipment became the default offering and the process became familiar to installers, the majority of new customers in business-as-usual roll-out areas selected flexible exports over fixed limits.

This behaviour suggests that when the option is well-explained and technically straightforward, consumers strongly prefer a dynamic limit that preserves export potential over a conservative static cap.

5.2 Quantitative consumer benefits

Key learnings for participating customers include high export availability, with flexible exports devices receiving their maximum export limit (for example, up to 10 kW or the system capacity) for the great majority of the time. Exports are reduced only during rare periods of local congestion. In areas where customers would otherwise face zero or very low export limits, flexible exports enabled substantial additional exported energy over the trial period compared with static limits.

From a consumer perspective, these outcomes translate into higher feed-in earnings and better system payback, especially for customers who would otherwise be limited to low or zero export caps, and greater ability to size PV and batteries to their site, knowing that exports will be allowed most of the time rather than hard-capped at a low value. Importantly, fairness is improved, as more customers can connect and export within shared hosting capacity, instead of later adopters being locked into zero-export arrangements.

Customer research summarised in SAPN's public reporting indicates that participants generally understood and accepted the rationale for flexible exports, preferred it to fixed zero or low export options, and would recommend it to others – particularly when the offering and installation requirements were clearly explained upfront. SAPN's public information emphasises that most customers can expect to export more under flexible exports than under fixed limits, and provides eligibility checkers and examples to help customers understand likely performance in their area.

5.3 Limitations and challenges addressed

The trial and early roll-out also identified several challenges. Equipment compatibility and installer processes initially constrained uptake and required additional installer training. This has been largely addressed through regulation and broader manufacturer support.

Internet dependence was recognised as a key factor; where connectivity is lost, exports default to a conservative fixed limit until communications are restored, protecting both the network and consumers. Expectation management was also important: SAPN is explicit that the advertised maximum export limit is a ceiling, not a guarantee, and that actual exports may be lower in some locations or as more customers connect. Historical eligibility data is presented as indicative rather than binding.

These design choices – fallback limits, transparency on performance, and mandated technical capability – are directly relevant to any New Zealand implementation.

5.4 Flexible exports in other Australian states

Experience in other Australian jurisdictions indicates that flexible exports and dynamic operating envelopes are increasingly viewed as the preferred long-term approach to managing and maximising rooftop solar exports, rather than raising static export limits.

In Victoria, AusNet's *Solar Flexible Exports Trial* (2021–2023) adopted the same core model as SAPN, using CSIP-AUS to vary export limits up to 5 kW for customers who would otherwise face zero or near-zero export caps. AusNet reports that customers "successfully exported many megawatts" of rooftop solar during the trial and that flexible exports "provides an alternative" to low or zero static export limits, allowing more customers to export while maintaining network security.

AusNet has now implemented flexible connections for eligible constrained customers and intends to expand availability to other eligible customers over time.

Other Victorian distributors are moving in a similar direction. CitiPower, Powercor and United Energy have trialled dynamic operating envelopes and flexible exports under an ARENA-funded Flexible Services Trial. Their second lessons-learnt report highlights strong customer engagement once flexible exports were deployed, and notes that dynamic export limits are important for unlocking additional customer exports while managing inverter compatibility and customer communication challenges. These Victorian projects indicate that SAPN's approach is portable across different networks and can be integrated with broader low-voltage DER management systems.

In New South Wales and Queensland, DNSPs are also developing DOE and flexible export capabilities. Ausgrid's "Project Edith" is trialling DOEs and related tools such as dynamic pricing to make more network capacity available by flexibly managing local constraints.

Energex and Ergon in Queensland have developed dynamic connection standards as part of a transition from passive to dynamic DER connections, and describe "dynamic connections" using five-minute DOE or flexible export limit signals to instruct solar PV systems to maximise export within available network capacity. In submissions to the AER, Energex and Ergon explicitly support developing a considered flexible export limits framework grounded in principles of fairness, maximisation of renewable energy and customer expectations, and emphasise the need for plain-English information so customers can make informed decisions about opting in.

At a national level, the AER's *Flexible Export Limits – Issues Paper* and associated DOE policy work confirm that DOEs and flexible export limits are being investigated and rolled out by DNSPs across all NEM states as a primary means of increasing the efficient utilisation of shared hosting capacity. The AER notes that static limits will increasingly lead to lower export offers for new customers in congested areas, limiting both consumer financial benefits and system-wide renewable energy value, whereas flexible export limits can provide consumers with "greater value" from their solar and battery investments through higher levels of export.

Industry submissions generally support this direction, with stakeholders such as the Australian Energy Council accepting that the primary use case for flexible export limits – provision of export services that better reflect network conditions – has been established, even while calling for robust governance and capacity-allocation principles.

Taken together, these developments show that SAPN's flexible exports approach is not an isolated experiment but part of a broader, coordinated move across Australian DNSPs and regulators towards dynamic export management. Flexible exports and DOEs are increasingly treated as the most efficient and scalable method of preserving and enhancing customer export opportunities under high DER uptake, compared with simply tightening static export limits.

6. Comparative analysis: flexible exports vs static limits

Static limits are sized to worst-case conditions, so they leave substantial "headroom" unused most of the year and do not adapt as network conditions change.

In contrast, flexible exports and dynamic operating envelopes allow DNSPs to safely use more of the existing network, more of the time, by increasing export limits whenever constraints are not binding. Trial data from SAPN's experience shows that customers can receive their maximum export limit for the overwhelming majority of the time, compared with permanent static caps of 1.5–5 kW or zero export in constrained areas.

For New Zealand consumers, this means that a flexible export framework can materially increase the amount of solar energy exported to the grid and improve the return on investment for rooftop solar, while maintaining network security and fairness between customers. The approach also defers costly network augmentations that would otherwise be required to support higher static limits, benefiting all consumers through lower long-term costs.

7. Transferable lessons for New Zealand

Taken chronologically, SAPN's journey offers several lessons relevant to the Electricity Authority's consideration of export arrangements:

1. Acting early, before zero-export becomes widespread, avoids entrenched inequities and customer dissatisfaction
2. Treating export as a core regulated service of the EDB, with clear consumer protections, aligns incentives for networks and regulators.
3. Mandating technical capability for dynamic operation once a flexible regime is adopted is essential to scale.
4. Prioritising consumer outcomes in design and communication helps secure acceptance of dynamic limits.
5. Leveraging common standards and shared platforms reduces implementation cost and supports interoperability.
6. Designing for integration with future DER and markets ensures that today's flexible export arrangements are future-proofed for electric vehicles, batteries and flexible loads.

Overall, SAPN's experience demonstrates that flexible exports can maintain network security, unlock substantial additional hosting capacity and exported energy, and deliver better, fairer outcomes for consumers than static export limits, particularly in high-PV systems. The South Australian case therefore provides a strong, evidence-based precedent for favouring flexible exports over simply increasing static limits as rooftop solar grows in New Zealand.