Flexible Export Limits

Issues Paper

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Inquiries about this publication should be addressed to:

Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601
Tel: 1300 585 165

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Request for submissions

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Mark Feather
General Manager, Strategic Energy Policy and Energy Systems Innovation
Australian Energy Regulator
GPO Box 3131
Canberra ACT 2601

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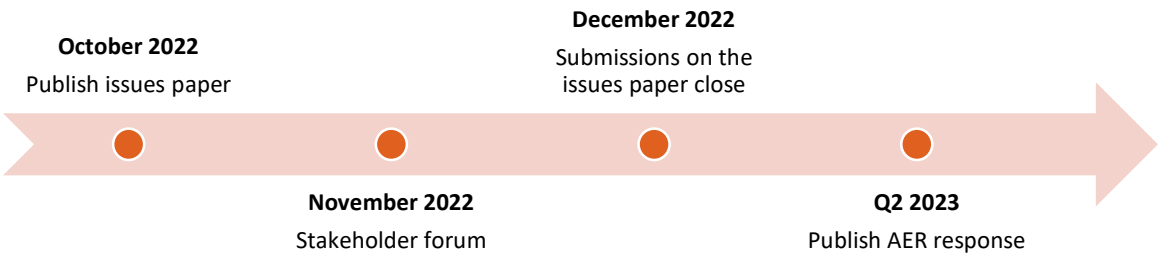
Review timeline and next steps



1 Introduction and background

1.1 Who we are

The Australian Energy Regulator (AER) aims to ensure energy consumers are better off, now and in the future. Consumers are at the heart of our work, and we focus on ensuring a secure, reliable, and affordable energy future for Australia. Energy is an essential service for Australian households and businesses, and a critical contributor to the long-term success of the Australian economy. As the economic regulator of energy networks in the National Electricity Market (NEM), we play an important role in the energy transition. Our primary role in regulating energy networks is to set the maximum revenue and prices that network businesses can recover from users of their networks. We aim to ensure consumers pay no more than necessary for safe and reliable energy, and we promote efficient supply and use of electricity.

As noted in the AER Strategic Plan 2020-25, we also use our expertise to inform debate about Australia's energy future and support the energy transition. To this end, we are supporting the work of the Energy Security Board (ESB) by leading the Dynamic Operating Envelopes (DOEs) workstream of their Post 2025 Consumer Energy Resources (CER) Implementation Plan.

1.2 About this issues paper

This paper is the first step of what is anticipated to be an iterative process with regards to DOEs (more specifically, flexible export limits, as referred to throughout this document), given the rapid pace of change in the consumer energy resources sector. The issues considered within this paper are not exhaustive nor intended to prevent further development of DOEs, given that we are aware that they will continue to evolve in the broader energy ecosystem. The regulatory landscape will continue to change and progress and as such, it is important that this work is not viewed as a final piece, but rather the commencement of on-going consideration of what is needed to facilitate the implementation of the functionality.

We are leading this project to develop policy direction and advice to the ESB in relation to DOEs and their implementation within the NEM. The implementation of DOEs has important implications for consumers and our role in relation to distribution network investment and pricing, consumer protection arrangements, governance of DOEs, and associated enforcement and compliance arrangements. This work builds on and was informed by the findings of the Distributed Energy Integration Program (DEIP) DOE outcomes report.[1]

Box 1: What are 'distributed' or 'consumer energy resources'?

The term 'consumer energy resources', also known as distributed energy resources, refers to usually smaller renewable generating units located at the consumers' side of the meter at homes or businesses. The term includes technologies such as rooftop solar, residential battery storage, home energy management systems, and in the coming years, electric vehicles. These technologies have introduced a dynamic two-way flow of electricity in our

[1] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022.

electricity networks. It is important to ensure these two-way flows of electricity do not breach the physical or operational limits of distribution networks.[2]

Box 2: What are dynamic operative envelopes?

DOEs manage the bi-directional energy flows into the NEM from customer energy resources.

An operating envelope is a technical term that refers to the physical limits of the network to facilitate both the import and export of electricity at a given premises (such as home or business). These limits are determined by a combination of the prevailing conditions, power flow, and the available capacity of the local network.

In the NEM, consumer energy resources within distribution networks are generally able to export excess energy from the premises to the connected network. To manage the emergence of these two-way energy flows and to ensure networks operate within defined technical limits, DNSPs impose static (or fixed) limits on exports. 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. Static limits are one approach that DNSPs can use to manage the capacity and congestion in their networks due to the export of consumer energy resources. Dynamic limits provide upper and lower bounds on the import or export of power in a given time interval for consumer energy resources.[3]

In this paper, we consider the issues associated with the introduction of DOEs by distribution network service providers (DNSPs) across the NEM and the potential implications for consumers. We also use the term 'trader' to refer to a party registered with AEMO in a wholesale electricity market and/or frequency control and ancillary services markets. In some cases, a consumer may consent to allowing traders to control their energy resources and participate in markets. More commonly however, these resources are operated by 'technology providers' (such as inverter Original Equipment Manufacturers (OEMs)) who are not registered participants in these markets.

This paper notes the implementation of DOEs will be led by DNSPs in the first instance and proposed expenditure would be assessed by us as part of DNSPs' revenue proposals. To effectively identify and map out the issues associated with DOEs, this paper considers the primary purpose of DOEs should be the efficient and increased utilisation of the shared hosting capacity on the distribution network.

[2] Australian National University, Dynamic operating envelopes: what are they and why are they so important? November 2020.

[3] Australian National University, Dynamic operating envelopes: what are they and why are they so important? November 2020.

We engaged FTI Consulting to assist in identifying key areas for attention to support the development of this issues paper. FTI undertook a gap analysis of potential issues relevant to the regulatory and governance framework associated with the implementation of DOEs in the NEM. The outcome of this work was captured in a report to us and used as an input to this work. FTI Consulting's report has been published alongside this paper.

We will follow this issues paper with an AER response in Q2 of 2023, which will provide recommendations as to what changes are needed to ensure good consumer outcomes associated with DOEs. This may include, but is not limited to, recommendations for rule change requests to the AEMC, expanded guidance for DNSPs, or development of new guidance material by the AER.

This issues paper commences our public consultation on the implementation of DOEs in the NEM, outlining:

- the transition in the energy sector being driven by increased uptake of consumer energy resources
- the current frameworks that apply to increasing consumer energy resource integration by DNSPs
- areas identified requiring immediate attention
- proposed options to address the issues identified
- future development opportunities, including areas where we identify that we can leverage existing workstreams or require future action.

We are seeking stakeholder feedback on the policy issues identified in this paper in the context of establishing foundational guard rails to support the implementation of flexible export limits, while balancing good consumer outcomes. To assist stakeholder responses, consultation questions are included throughout the paper, and a summary of stakeholder questions is available at Appendix 1.

While developing this issues paper, we have been supported by, and consulted with, representatives from the Australian Energy Market Commission (the AEMC), the Australian Energy Market Operator (the AEMO), the ESB, and industry stakeholders. Consumer impacts have been considered throughout this paper through relying on the Energy Consumers Australia work that formed a significant contribution to the DEIP DOE outcomes paper.[4]

To assist readers of this paper in considering the issues presented in the context of the regulatory framework, we have included detail about the relevant sections of the current framework at Appendix 2.

1.3 What are 'flexible export limits'? How do they relate to 'dynamic operating envelopes'?

In the NEM, the export of excess energy generated from consumer energy resources within distribution networks is managed through static (fixed) export limits. This is generally 5kW on

[4] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022.

a single phase but can be lower in highly congested networks.[5] Static limits must be conservative to keep generation within a network's hosting capacity and share that network's capacity across all consumers, particularly during periods of high congestion. Static limits are analogous to low-speed limits that apply at all times, regardless of the road conditions. As increasing volumes of consumer energy resources are connected in the future, consumers may face lower static export limits to avoid the increased risk of those limits being breached. This may result in a greater disparity of consumer outcomes, with some consumers potentially having higher export limits due to legacy arrangements, with newer connections only being offered low export limits in the same area of the network due to increased congestion. Indeed, some DNSPs are already setting increasingly conservative static limits.[6] Static limits are not guarantees of a fixed or maximum level of export, as one's ability to export is still subject to local system constraints.

Box 3: The evolving role of the consumer in the NEM

Throughout this paper we refer to 'consumer energy resources' in place of 'distributed energy resources' or 'DER' to reflect a recent change in the terminology used by the market bodies, which was spearheaded by Energy Consumers Australia.[7] This acknowledges the role of consumers has shifted from only consuming energy services, to one that is able to influence outcomes in the broader energy system. The consumer could have such influence through personal investments in technologies like rooftop solar, home battery storage and in the coming years, electric vehicles. This new role sees the consumer become both a user of energy and a generator to meet their own demand needs with the ability to export excess energy back to the grid. Individual consumers can benefit from using their own rooftop solar and/or storage to meet their energy demand more cheaply, rather than relying on supply from the wholesale market. They may also receive a financial reward for exporting their excess energy, for example through a discount to their energy bill.

Consumers as a whole are expected to benefit from the increasing uptake of two-way technologies (e.g. residential battery storage) at the distribution level as it promotes more efficient use of the existing network. Energy can be exported when it is needed to ensure the network continues operating within required system limits, avoiding the need to invest in additional infrastructure to avoid breaching these limits. Exported energy at the distribution level can also support meeting demand with more efficient supply. In this way, this workstream and the broader CER work program promotes the National Electricity

[5] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 5.

[6] The AEMC's recent Access, Pricing and Incentive arrangements for DER rule change recognises that *"in some parts of Australia, customers have been prevented from exporting electricity as their DNSP imposes a zero-export limit to all new connecting customers"*. In April 2021, SAPN announced that it would need to introduce reduced or zero export limits in some areas of Adelaide's southern suburbs. It was not the first DNSP to do this.

[7] Energy Consumers Australia, Death to DER? Why we need to change the language we use for the energy transition, May 2022.

Objective.[8] However, it is important that the regulatory framework that underpins these evolving technologies is developed in a way that promotes the interests of all consumers, both those that adopt these evolving technologies, and those who do not but still use the system.

DOEs offer a more flexible approach to managing exports from consumer energy resources, with the following benefits:

- Reduced curtailment of rooftop solar
- More efficient use of the existing shared network hosting capacity
- Delays to network augmentation resulting in reduced network costs
- Lower wholesale electricity prices due to increased supply from rooftop solar

The benefits of flexible export limits are discussed in section 1.3.2.

When networks are not constrained, consumers can export more from their resources at times and locations where there is "spare" unallocated capacity, rather than be restricted to (potentially lower) static limits.

The implementation of flexible export limits offers an alternative method to the use of static export limits. The term flexible export limit refers to the ability to *'vary export limits over time and location based on the available capacity of the local network…'*.[9] This will allow DNSPs to set the export limit for a given area of the network, allowing consumer energy resources to operate within the defined limits and assist in managing network congestion.

Being able to export more from locations that have spare capacity at particular times throughout the day means consumers may be able to earn more from their exports.

Box 4: Communicating the concept of flexible export limits to customers

If flexible export capability is to become an effective tool for managing local congestion and facilitating the development of more sophisticated services, it must first be understood and accepted by consumers. To achieve this, market bodies and energy industry stakeholders acknowledge that the term 'DOE' is unintelligible to the average consumer. To assist in building an understanding with consumers about this new capability, i.e., what it is and how it will affect them, a more meaningful label should be used when discussing DOEs as they apply to consumer energy resource. **Therefore, for the purposes of this issues paper, the term 'flexible export limits' will be used to refer to DOEs as they apply to consumer energy resources.**

[8] The National Electricity Objective as stated in the National Electricity Law is "to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

- price, quality, safety and reliability and security of supply of electricity
- the reliability, safety and security of the national electricity system."

[9] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 5.

DNSPs must invest in infrastructure and technology to implement flexible export limits. When assessing expenditure forecasts for DNSPs to invest in and implement flexible export limits, we consider that consumers should not be constrained by export limits unnecessarily, unless it is prudent and efficient to do so for consumers as a whole. Flexible export limits should also reduce the likelihood of new connections requiring low static limits (provided consumers sign up to a dynamic connection agreement[10] – which is necessary so that they actively consent, or actively withdraw consent, to their compatible devices participating in flexible export limits).[11]

We are focussing in this paper on flexible export limits as we anticipate DOEs will apply to export services when first implemented, which includes consumer energy resources such as rooftop solar, residential storage batteries, and potentially electric vehicles (EVs) (following the adoption of vehicle to grid capability). However, DOEs can also apply to 'imports' where consumers draw from the grid.

There is great potential for flexible export limits to support a variety of business models for traders to facilitate the integration of consumer energy resources into future markets for services. We also acknowledge that cases of flexible import limits may develop in the future with increased consumer energy resource integration (for example, managing EVs charging during peak demand periods). While it is possible that DOEs could also be used for active management of load at the choice of the consumer in the future, application of DOEs for this purpose warrants further consideration and consultation separately from this process. In our view, this would be best informed by the technical and social learnings through trials, as is occurring with flexible export limits.[12] The DEIP DOE outcomes report also reached a similar conclusion.[13] As such, the use of DOEs for active management of load at the choice of the consumer is outside the scope of this paper. This reflects and acknowledges that flexible management of devices represents a significant departure to what consumers are familiar with in terms of how they derive benefit from their energy resource.

In considering the potential role for flexible export limits in the NEM, we are seeking to ensure the associated governance frameworks are fit for purpose while also establishing the policy objectives and 'guard rails' for the implementation of flexible export limits in the NEM. This extends to ensuring regulatory frameworks and governance arrangements are fit for purpose to support outcomes that are in the best interests of consumers as a whole. This approach acknowledges that flexible export limits are currently being implemented by some DNSPs, and other DNSPs are at various stages of consideration or are planning for potential implementation.

A practical application of the concept of flexible export limits would see DNSPs vary the export of participating energy resources in response to the prevailing conditions of the local network. In practice, a DNSP would set and communicate the limit for connected consumer

[10] A connection agreement is an agreement between a customer and a distribution network service provider (DNSP) for the provision of electricity to the connection point

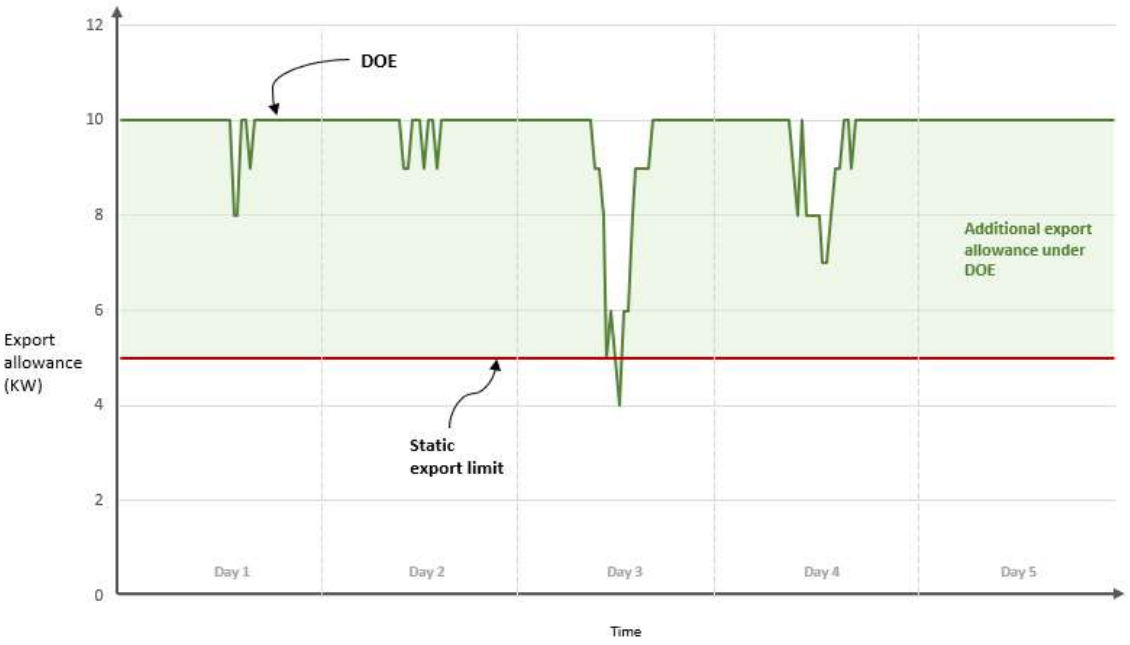
[11] See section 3.3.3 for more information on consumer participation

[12] DEIP, Dynamic Operating Envelopes Working Group Outcomes Report, ARENA, March 2022, p. 61.

[13] DEIP, Dynamic Operating Envelopes Working Group Outcomes Report, ARENA March 2022, p. 15.

energy resources in a given area of the network, with participating resources responding directly to the signal, or potentially having the signal passed through a technology provider cloud platform. For example, where the network has excess capacity, the export limit may be raised to 10kW, allowing sufficiently large systems to send additional generation into the grid and potentially earn additional revenue. Should the network become congested (e.g., due to low demand and ideal generation conditions), the export limit may be reduced to 4kW to manage the additional electricity flows in the area (see Figure 1 below).

Figure 1. Flexible export limit vs static export limit



Source: DEIP DOE Outcomes Report p. 19

To illustrate with an analogy, flexible export limits would operate in a manner similar to variable speed limits in school zones.[14] As illustrated above, a static limit would set a fixed single speed limit, irrespective of road conditions. However, a flexible limit would allow for a low-speed limit during busy periods (e.g., during school hours), ensuring the safety of road users and minimising the likelihood of an accident and road closures. Outside busy school periods, the speed limit would increase to support additional traffic flow. These flexible limits ultimately allow for faster travel subject to expected road conditions whilst also balancing safety and utility by increasing protection at times of greater risk to consumers.

Recent and current trials of flexible export limits have focused on rooftop solar exports, allowing participants to increase export capacity from a 5kW static limit up to 10kW.[15] In South Australia, as part of their flexible export limits trial, SA Power Networks are providing a new flexible export option for new CER connections as an alternative to a lower static export

[14] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 5.

[15] SAPN, Why Flexible Exports, 2022.

limit. Participants can choose from a flexible connection that can vary up to 10kW, or a fixed limit of 1.5kW.[16]

1.3.1 How do flexible export limits work?

Where DNSPs have developed the capability for flexible export limits, the DNSP will determine the maximum export limit for consumers in their network that have compatible devices and have entered into dynamic connection agreements with the DNSP. A calculation will be performed based on the hosting capacity of the network and the DNSP will communicate a signal to compatible devices in its network to specify an export limit. A distinction here is the limit will not actively control the device, rather, it will specify the parameters for operation that reflect the current network conditions. Controlling consumer devices is a separate concept to setting a technical limit for operation. Consumer energy resources, such as rooftop solar, will see their output vary depending on environmental conditions (e.g., due to cloud cover or rain), and local demand within the household.

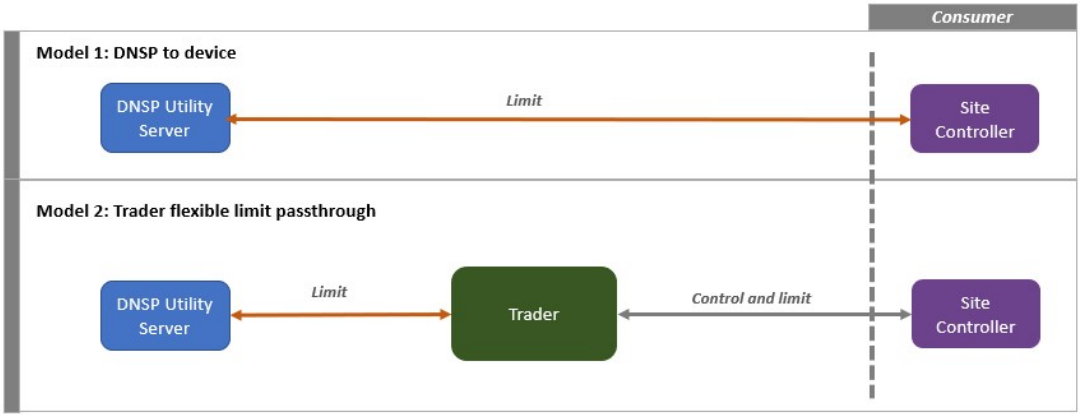
The setting of an export limit does not mean the energy resource will always export to that limit. An example of a scenario that illustrates control would be where a trader that operates consumer energy resources (such as rooftop solar combined with battery storage) on behalf of a consumer sends instructions for a specific amount of energy to be exported at a given time, with a high degree of accuracy (e.g., 3kW export due to aggregated participation in the wholesale market).

During the initial implementation of flexible export limits, we expect to observe two broad models of operation:

- a DNSP communicates the export limit to compatible consumer devices that subsequently manage their output to export within the communicated limit, and
- a third-party trader sees the DNSP limit and passes it through to consumer devices.

We note that many variations of these models may emerge in the coming years, and that there may be benefits in determining a preferred approach in line with the NEO.

Figure 2: Expected models for the operation of flexible export limits



[16] SAPN, Fixed v Flexible – A new solar connection option, 2022.

1.3.2 Benefits of flexible export limits

As noted in section 1.4 below, AEMO's 2022 Integrated System Plan (ISP) highlights rooftop solar in the NEM is projected to rise significantly by 2050.[17] AEMO's forecasts are prepared on the basis of the most efficient development of the system, i.e., it utilises a least-cost approach to expanding the system to support the energy transition.

The implementation of flexible export limits is one aspect of ensuring the forecast additional consumer energy resources entering the system is managed more efficiently, delivering benefits to NEM consumers that AEMO anticipates in its ISP. These potential benefits include additional exports from connections with compatible equipment (thereby allowing consumers to achieve additional value from their investments), and lower wholesale electricity costs for consumers more broadly. Unlocking additional available network capacity has the potential to defer the need for network upgrades and put downward pressure on wholesale electricity prices. However, there are costs associated with the implementation of flexible limits. For example, DNSPs will need to invest in information technology systems to facilitate the application of flexible export limits and improve accuracy of forecasting and monitoring.

In the future, it is expected that flexible export limits will be used to support not only the operation of rooftop solar, but also the efficient management of a variety of flexible resources such as residential battery storage systems (either dedicated storage or vehicle-to-grid electric vehicle battery discharging) and other smart technology. Consumers who choose to take advantage of these opportunities are likely to derive additional financial value from their energy resource investment through new offerings from electricity retailers and/or aggregators. New business models and retailer/aggregator offerings are expected to emerge as offerings mature (such as essential system services). AEMO's Flexible Trader Arrangements Rule change request is about to be considered by the AEMC to create a framework for secondary parties being able to manage a consumer's energy needs alongside their retailer. Where consumers sign up to these services, consumer energy resources could derive greater financial return from consumers' investment while also supporting the safe and efficient operation of the distribution network.

1.4 Background

The uptake of consumer energy resources, such as rooftop solar and batteries, across global energy markets is rapidly accelerating. Australia is leading this transition with the highest level in the world of rooftop solar penetration, with approximately three million households and small businesses across Australia owning rooftop solar as at the end of 2021.[18] Rooftop solar is connected to the energy systems via the distribution network. This is resulting in a trend towards a more decentralised energy market, which will continue as the NEM becomes increasingly two-sided, with consumers both exporting and importing electricity.

There are multiple benefits of increased uptake of consumer energy resources, such as carbon emissions reduction and the lowering of wholesale electricity prices, new sources of supply for frequency control and ancillary services (FCAS) markets and network and system

[17] AEMO, 2022 Integrated System Plan, AEMO, June 2022, p.10.

[18] Department of Climate Change, Energy, the Environment and Water, 'Australia achieves 3 million rooftop solar installations', November 2021.

support services. These benefits can then lead to lower power bills for consumers. However, there are risks to consumers as well. If the regulatory framework is not fit-for-purpose, consumers may not achieve the benefits outlined above or potentially be dissuaded from investing in their own energy resources. It is critical the consideration of these policy issues in the context of the regulatory framework promotes the long-term interests of consumers.

This rapid uptake of decentralised consumer energy resources is demonstrated by AEMO's 2022 ISP, which highlights that in the NEM today, approximately 30 per cent of detached homes collectively host approximately 15GW of rooftop solar. This is projected to rise by 65 per cent to 69GW by 2050.[19] Distributed rooftop solar now represents the largest generator in the NEM.[20] AEMO's 2022 Electricity Statement of Opportunities states that rooftop solar is expected to reach approximately 4 to 4.5 million homes by 2031-32.[21] Networks also face increased congestion on distribution networks, particularly in areas with high rooftop solar uptake. During the middle of the day, when rooftop solar generation is at its highest and demand is generally lower, the risk of the power flow exceeding voltage and thermal constraints is amplified.

The ISP notes that many of these rooftop systems are expected to be paired with battery energy storage. Provided these consumer energy resources are efficiently managed, the combined output has the potential to meet up to 20 per cent of the NEM's underlying demand over a year by 2030.[22]

About 50 per cent of consumer energy resources are expected to participate in the demand side of the NEM by 2030. Investment in such resources can provide consumers new levels of control over their energy usage. Currently most consumer energy resources, predominantly rooftop solar, are 'passive' in the sense that consumers do not have control over when energy is available for export. This makes it hard to balance supply and demand or manage local constraints. This also means consumers cannot readily provide energy to the network and be rewarded for turning their energy output up or down.

To address these challenges, the ESB provided final recommendations to Energy Ministers in July 2021 on the Post-2025 reforms. Energy Ministers have endorsed these recommendations and tasked the ESB with their delivery. The ESB continues to work with the AER, the AEMC and AEMO to progress the integration of energy resources into the power system.

As part of the Post 2025-reforms, the ESB has established the Consumer Energy Resources (CER) Implementation Plan.[23] These reforms will enable the building of a grid where consumers can participate as energy users, and simultaneously use assets to create value across the energy system for all consumers, even those without such assets. The CER Implementation Plan sets out the detailed technical and regulatory activities to be delivered over the next three years and sequences the work over three horizons.

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[19] AEMO, 2022 Integrated System Plan, AEMO, June 2022, p.10.

[20] AEMO, National Electricity Market Fact Sheet, AEMO, December 2021.

[21] AEMO, 2022 Electricity Statement of Opportunities, AEMO, August 2022, p. 28.

[22] AEMO, 2022 Integrated System Plan, AEMO, June 2022, p.10.

[23] ESB, Integration of distributed energy resources (DER) and flexible demand, ESB, 2022.

The ESB has identified that the move to a more decentralised energy system, with more consumers actively managing their own power, provides opportunities from consumer energy resources and the energy transition to develop a two-sided market. Benefits of such a market include lower overall system costs for all consumers, increased efficiency of existing network assets, and optimised utilisation of flexible loads and variable renewable energy.

The ESB's final advice to Energy Ministers noted the need to develop a system-wide standard to manage export limits at consumer energy resource connection points in the NEM.[24] Export limits for consumer energy resources are currently static in most of the NEM (outside technical trials), but the implementation of DOEs (flexible export limits) offers an alternative that can allow for a greater number of new consumer energy resource connections that will not be limited to low static export limits.

As part of the CER Implementation Plan, the ESB is working to make DOEs a long-term feature of the NEM consumer energy resources ecosystem.[25]

The trials being undertaken by various organisations (including Project EDGE and Project Edith) form part of Horizon One of the CER Implementation Plan. The regulatory and policy settings workstream for DOEs/flexible export limits being considered through this paper (as a first step in the process) forms part of Horizon Three. Both Edith and EDGE aim to explore the use of flexible export limits to allow customers to use more energy or export larger amounts of their rooftop solar at times when there is extra capacity on the network.

Project EDGE (Energy Demand and Generation Exchange) is a collaboration between AEMO, AusNet Services and Mondo with financial support from the Australian Renewable Energy Agency. EDGE is a trial that seeks to understand, test, and demonstrate a proof-of-concept marketplace that enables efficient and secure coordination of aggregated consumer energy resources to provide wholesale and local network services within the constraints of the distribution network.[26] One of the objectives of the trial is to demonstrate how consumer energy resources can participate in the future in wholesale markets, trade network services, and adhere to the local constraints of the network.

Replicated at scale across the NEM, the EDGE marketplace could enable consumers to access cheaper electricity, improve electricity network reliability, and allow consumers who have invested in renewable generation and storage to maximise the value of their investments.

Separately, Project Edith is a trial run by Ausgrid and Reposit Power to test tools for managing power flows on the distribution network, as well as how that can co-exist with market participation from consumer energy resources. Edith aims to showcase how the grid can facilitate technology and green energy solutions (like Virtual Power Plants (VPPs)) to participate in energy markets while staying within distribution network capacity limits. Project Edith is testing the extent to which dynamic pricing can be used to allocate distribution

[24] ESB, Post 2025 Market Design Final Advice to Energy Ministers – Part B, ESB, 2021, p. 75.

[25] This is consistent with the ESB's final advice to Energy Ministers in July 2021, which resulted in the ESB undertaking DOE work as part of its 'Horizon One' activities in 2022 under its DER implementation plan.

[26] ARENA, Project EDGE (Energy Demand and Generation Exchange), July 2022.

network capacity in a decentralised manner, and reward network support, such as voltage support.[27]

Edith is using two main tools to manage network hosting capacity, namely DOEs, which define the limits at each location, and Dynamic Network Prices (DNPs), which are dynamic real-time network charges that reflect the level of constraint at different locations in the network.

Both EDGE and Edith are examining how consumer energy resources can meet market services functions. This includes the provision of system-level market services such as participating in current wholesale energy, FCAS, or Reliability and Emergency Reserve Trader markets; and network services, where capacity is provided to local networks to defer or avoid the need for network upgrades.

As highlighted by the Project Edith outcomes report, as DNSPs enable more dynamic capabilities and services, they shift from operating a network that just provides electricity to consumers, to innovating services and enabling consumers and aggregators to participate in the wholesale and ancillary services markets and provide local network support.[28]

We are aware there are other use cases that build on flexible export capability, such as the emergency backstop to maintain system security for management of rooftop solar to address the emerging issue of minimum system load in all NEM regions, and retail / trader control within the flexible limit as set by the DNSP, and participation in markets for services. Due to the nascent nature of DOEs (and specifically flexible export limits), the market services are viewed as future development opportunities in the context of this paper. Initially, having flexible export limit functionality would enable DNSPs to better manage congestion on their low voltage networks and enable the backstop for system security reasons, enabling a 'dial down' rather than 'turn-off' approach where possible. These would be particularly effective tools for networks during mild seasons where rooftop solar output and subsequent export is high, but network demand is low. DOEs as a solution to manage minimum demand in future reduces the need for other emergency backstop measures, provided there is sufficient uptake of flexible export limits by consumers.

With DOEs, Project Edith envisions that DNSPs could facilitate more electric vehicle charging and faster charging by allowing for higher loads during off-peak times. This could improve the service of the network to consumers while putting downward pressure on network costs.[29]

1.5 What is meant by flexible load management or flexible imports?

While outside the scope of this paper, we recognise any discussion of flexible load management at a consumer's premise is in the formative stages and potentially controversial. This is because that there are risks to consumers associated with flexible load management that are not present for export limits. To be clear, where stakeholders see

[27] Ausgrid and Reposit, Project Edith – project outcomes report, July 2022, p. 13.

[28] Ausgrid and Reposit, Project Edith – project outcomes report, July 2022, p. 19.

[29] Ausgrid and Reposit, Project Edith – project outcomes report, July 2022, p. 12.

references in broader work to ‘variable import limits’, ‘flexible imports’ or ‘dynamic imports’, these collectively refer to the ability to remotely manage the use of specific flexible demand or load (flex load) type energy resources, at the choice of the consumer. Flex load is that which does not have to be used immediately and the consumer views as ‘flexible’ as to when the appliance is operated, such as the potential to use a pool pump or charge an EV in the day or night. One way to understand the concept would be to consider any demand not associated with flex load at a consumer residence as ‘primary load’ or the ‘essential’ load. This would include household usage of standard appliances, such as fridges, stoves, ovens, TVs, digital devices etc. Turning on the lights and watching a movie or series on a streaming service are considered primary load and there is no suggestion import limits would affect this type of energy usage.

An initial use case for flexible load management would be to assist DNSPs to manage the charging of EVs during peak demand periods (such as weekday evenings). To illustrate, some home EV chargers can draw up to around 7kW of electricity while charging.[30] During the evening peak, the combined total of potentially hundreds of thousands of EVs charging at this rate would put significant strain on capacity of distribution networks. By creating market frameworks and device level capabilities, the potential costs of this network strain can be mitigated by enabling consumers to smart charge EVs in a specific, predictable way during peak demand periods. Allowing for the more effective management of existing network hosting capacity in this scenario has the potential to avoid or delay the need for costly network upgrades. This would, in turn, avoid or delay costs that would otherwise need to be incurred and paid for by consumers through export fees.

In any discussion of flexible load management, it is imperative to note this **does not** refer to limiting consumer use of everyday home appliances covered under the broad umbrella of primary load. Over time, there is potential for more devices or appliances to be managed (e.g., pool pumps), but this would only occur with the consumer’s consent. Beyond requiring active consent, many other safeguards will be required to be put in place ahead of the implementation of flexible imports, to ensure primary load is not affected and consumers are protected.

[30] ESB, Electric Vehicle Smart Charging Issues Paper – for consultation, ESB, July 2022, p. 24.

2 AER approach to flexible export limits

2.1 Why this project is needed

The ESB's CER Implementation Plan sets out the necessary technical, market and regulatory reforms over a three-year horizon needed to deliver a more diverse and flexible power system capable of capturing the potential benefits that may emerge with the uptake of new technologies. The plan acknowledges that the consumer-driven growth in technologies such as rooftop solar and battery storage, combined with the rollout of new smart devices, requires coordination.

The priorities of the first horizon of the ESB's CER Implementation Plan include the introduction of DOEs (flexible export limits). The momentum for flexible export limits has grown in recent years, given the numerous trials underway in the NEM. We are leading this workstream for the ESB given our primary role as the economic regulator for network businesses, as the rollout of flexible export limits will be led by DNSPs in the first instance.

Flexible export limits have already been considered as part of recent network revenue determinations. DNSPs are already investing or seeking to invest in flexible export trials in the NEM. This issues paper is timely as while such investment was approved under the existing framework, as DNSPs move to explore broader implementation of flexible export limits, the ESB can ensure the existing regulatory frameworks for DNSPs provide effective guardrails to support further rollout in a manner that protects and promotes the long-term interests of consumers.

2.2 Objective of this issues paper

This issues paper seeks to identify the gaps in the existing regulatory framework that require immediate attention to support the efficient implementation of flexible export limits that is supported by consumers. The objective of this project is to ensure DNSPs consider and address consumer outcomes and experience when implementing flexible export limits to efficiently utilise the spare capacity available in their networks to manage congestion. To be clear, we do not seek to incentivise the implementation of flexible export limits sooner than would otherwise be prudent or efficient.

There are a variety of use cases associated with flexible export limits. For instance, the more granular management of consumer energy resources in the distribution system can be combined with the new markets for services sourced at the distribution level (e.g., voltage management) as well as increased participation in wholesale and frequency control ancillary services markets.[31] However, we consider the integration and participation of consumer energy resources as future development opportunities for flexible export limits, until several other workstreams that seek to resolve significant technical and coordination matters are complete. These workstreams include the ESB's work on Interoperability, the AEMC's CER technical standards review, the Flexible Trader Arrangements rule change and Scheduled

[31] According to ARENA, frequency control ancillary services a process used by AEMO to maintain the frequency of the system within the normal operating band around 50 cycles per second. Put simply, FCAS provides a fast injection of energy, or fast reduction of energy, to manage supply and demand. More information is available at ARENA's website.

Lite, as well as the AER's Consumer Protections for Future Energy Services review (formerly known as the Retailer Authorisation and Exemption review). The results of these workstreams will help us to better understand future use cases and make informed policy and governance decisions that are compatible with the technical capability of consumer energy resources.

Therefore, the objectives of this issues paper are to:

- Identify
  - the areas of the framework that require attention in the immediate term, and present options to resolve these perceived gaps
  - potential gaps that will be addressed through work already underway (or expected to be undertaken in the near future as part of existing reform or review processes)
  - matters that may require attention over the longer term, where no immediate action is needed.
- Seek stakeholder feedback on the gaps identified in the existing framework and the proposed options to address these matters. We are seeking feedback specifically on the following matters:
  - principles for capacity allocation, and whether to also establish a capacity allocation methodology
  - whether flexible export limits should be opt-in or opt-out, with a static export limit always offered
  - what specifications connection agreements offering flexible export services should include as a minimum
  - the approach to monitoring the calculation and application of flexible export limits.

2.3 Concurrent workstreams

As detailed in chapter 4, there are several concurrent processes underway that overlap with the ESB's DOE workstream which could raise questions as to the sequencing of this work (before the other workstreams are finished). However, we are of the view that commencing consultation with this paper on the first stage of implementation of flexible export limits is important, notwithstanding that some of these processes are expected to continue into 2023. The below table sets out the alignment of key consumer energy resource policy issues currently considered by the ESB in its Interoperability workstream, the AEMC under its consumer energy resources technical standards work, and by the AER in this paper:

Consultation paper	Summary
Review of CER technical standards consultation paper (AEMC)	This paper explores challenges associated with the implementation of inverter standards (AS4777.2), implications for compliance and enforcement arrangements and industry roles and responsibilities for broader CER technical standards including national and jurisdictional arrangements. This follows the Technical Standards

	for Distributed Energy Resources Rule Change process completed in March 2022.
Flexible Export Limits issues paper (AER)	This paper seeks stakeholder input on how consumers' interests can best be enhanced through the evolution of regulatory frameworks to support the implementation of Flexible Export Limits including opt in/opt out arrangements for consumers, conformance monitoring, approaches to compliance and rectification, and implications of flexible exports for market participants.
Interoperability for Consumer Energy Resources directions paper (ESB)	Following submissions on the ESB's Interoperability Issues Paper, this paper sets out the ESB's position on priorities and actions to promote greater interoperability of CER. This includes an implementation framework for CSIP-Aus to support a nationally consistent approach to flexible exports limits, and the future development of standards for behind-the-meter interoperability and interoperability for market participants. This paper will highlight roles and responsibility issues raised in the specific context of interoperability that will be investigated more fully through the AEMC CER Technical Standards Review process.

2.4 The consumer risk assessment tool

To consider the potential impacts on consumers, we will use the ESB's consumer risk assessment tool.[32] This tool was developed to ensure market bodies explicitly and consistently consider the benefits and risks to consumers when developing market reforms. This approach seeks to identify where additional consumer protections or other measures may be warranted, reflecting the potential for unintended negative consequences resulting from new products or services.

The consumer risk assessment tool sets out specific questions to consider when undertaking risk assessments as well as the following consumer protection principles:

- **access to energy** – recognising that energy is an essential service, customers should have access to at least one source of electricity
- **switching providers** – customers should be able to change retail providers when they [so] choose
- **access to information** – customer should have access to information that is sufficient, accurate, timely, and minimises complexity and confusion to allow them to make informed decision
- **vulnerable consumers** – the needs and circumstances of vulnerable consumers need to be explicitly considered

[32] ESB, Post-2025 Market Design Final Advice to Energy Ministers Part C – Appendix, ESB, July 2021, p. 26.

- **dispute resolution** – customers should have easy access to no cost dispute resolution mechanisms when things go wrong

The full consumer risk assessment tool is included at Appendix 3.[33]

We recognise that not all consumers are the same in terms of their energy needs and how new products and services are likely to appeal or provide benefits based on individual circumstances.[34]

[33] ESB, Post-2025 Market Design Final advice to Energy Ministers Part C – Appendix, ESB, July 2021, p. 26.

[34] ESB, Customer Insights Collaboration – DER Implementation Plan Customer Insights Collaboration Release One, Knowledge Share Report, ESB, June 2022

3 Immediate actions

3.1 Our approach

Given the limited experience outside technical trials of flexible export limits in the NEM context, we consider it is appropriate during this early developmental period to provide some flexibility to DNSPs in determining their approach to implementation. We consider a principles-based approach is appropriate, as this provides flexibility for DNSPs in terms of integrating the functionality with their existing capability, systems and infrastructure. A prescriptive approach also risks inefficient outcomes and potentially stifles innovation through the implementation process. That said, as more research is undertaken in this space, additional guidance may be required to ensure implementation of flexible export limits occurs in a manner that delivers the most beneficial outcomes for all consumers.

We note the finding of the DEIP DOE outcomes report that there is no need to mandate the implementation of flexible export limits at this stage as it would bring forward investment unnecessarily. As DNSPs are already at various stages of planning for flexible export limits, we consider the question of whether or when to implement should be left at the discretion of individual DNSPs. They are best placed to make the determination as to when/if it is necessary and efficient to manage congestion in their respective networks. Further, there is currently a lack of available devices on the market that can receive signals to adjust export limits, though availability is expected to improve in coming years. Mandating retroactive application for export service connections would also likely result in additional consumer costs.

We are of the view that while DNSPs can invest in the infrastructure required to implement flexible export limits, consumers need to enter into a dynamic connection agreement with a DNSP to enable the service, provided the consumer has installed compatible equipment. Otherwise, there is the risk that consumers will not seek the service and realise the potential benefits. Another way to view this is that the implementation of flexible export limits will be led by DNSPs, but the potential benefits can only be realised with the support of consumers. This has guided our approach to identifying the immediate actions outlined in section 3.3.

We welcome stakeholder feedback on the suitability of this approach to flexible export limits at this stage in their development and any issues that we may not have identified through this process.

It is expected at the early stages of adoption and implementation, flexible export limits will not apply to consumers with existing energy resources, but that these consumers could choose to opt-in to capture the benefits of the capability. This principle will also apply to new connections for consumers that choose to enter into a dynamic connection agreement. Moving forward, the ESB's Interoperability stream is considering flexible export limit capability should be mandated to come in-built into devices, but opt-in provisions to activating and using this capability for new connections with consumer energy resources will still apply. More information about this is provided at section 4.3.3.

3.2 Our analysis

This issues paper seeks to obtain feedback on our analysis of the various factors affecting the implementation of flexible export limits in distribution networks. As such, this issues paper

identifies the gaps and asks how we can enable efficient implementation of flexible export limits while ensuring appropriate consumer protections.

FTI Consulting (FTI) were engaged to undertake a gap analysis of DNSP roles in the implementation and operation of flexible export limits. FTI produced a series of recommendations about immediate actions that we can take to ensure appropriate 'guard-rails' and consumer protections around the implementation and operation of flexible export limits. We have used FTI's report as an input into this issues paper, including several gaps FTI identified, while deviating from their report in certain places to remove gaps or reassign them to different action statuses based off further analysis.

To effectively identify and map out the issues associated with flexible export limits, this paper considers the primary purpose at this stage of flexible export limits should be the efficient and increased utilisation of the shared hosting capacity on the distribution network to enable consumers to obtain the benefits of exporting their energy resources such as solar PV to the grid.

- ***Do stakeholders agree with the primary use case for the implementation of flexible export limits?***

3.3 Gaps requiring immediate action

3.3.1 Capacity Allocation Principles

Capacity allocation refers to the apportioning of available network hosting capacity between individual consumers. This capacity is based on the anticipated network conditions and expected power flow. The allocation dictates how much value consumers can potentially derive from their energy resources through defining how much each consumer can export from their energy resources. For example, where a consumer has installed a 9kW rooftop solar system capable of flexible exports, should they enter into a dynamic connection agreement, the approach taken to capacity allocation by the DNSP will dictate how much they are able to theoretically export. This will in turn determine how much value they receive from their system in lowering their electricity bills. However, there are trade-offs for the various approaches to capacity allocation, which are determined by the physical limitations of the system and the technical approach to allocating this spare network capacity.

The DEIP outcomes report found that a principles-based approach for capacity allocation is appropriate at the early stage of implementation, as DNSPs continue learning from trials, while they are given flexibility to develop their own approaches. This includes responding to local conditions and efficiently using their existing infrastructure.[35] While network hosting capacity can be efficiently utilised through unique allocations to each consumer's connection point, this could result in trade-offs with implementation costs, transparency, 'fairness' and social equity concerns. For example, two residential consumers on the same street could receive different export limits, with the consumer at the end of an urban feeder receiving a tighter export limit than the one closer to the distribution transformer.

[35] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 52.

The DEIP Working Group identified *'universal stakeholder support for the development of 'national allocation principles' to guide DOE design and implementation by DNSPs'*.[36] The application of such principles would help to ensure a nationally consistent approach and provide assurance to consumers that flexible export limits are being implemented equitably and transparently.

Preliminary positions

As referred to above, to provide guidance to DNSPs in developing capacity allocation approaches for DOEs, the DEIP Working Group developed the following export hosting capacity allocation principles (which have been adapted for flexible export limits):[37]

1. DNSPs are responsible for setting flexible export limits, with the calculation methodology used to determine the limits being transparent and subject to stakeholder consultation
2. Allocation should seek to maximise the use of network export hosting capacity while balancing customer expectations regarding transparency, cost and fairness
3. Capacity allocation can initially be based on net exports and measured at the customer's point of connection to the network
4. Capacity should be allocated to small customers irrespective of the size or type of customer technology (e.g., solar or batteries) at the customer premises
5. In the near term, flexible export limits should be offered on an opt-in basis with capacity reserved only to make good on legacy static limit connection agreements, with efficient incentives provided for customers to transition to flexible export limits over time.

The DEIP report notes that to define how these principles would be applied practically, more work is required,[38] including further stakeholder engagement. Industry will also need to understand that the implementation of flexible export limits will likely evolve.[39]

We recognise that there is currently no guidance for capacity allocation for static export limits. We are of the view that the approach used by DNSPs for capacity allocation for flexible export limits will likely be informed by their current approach for allocating capacity for static exports.

We note that initial trials are testing both advanced and simpler approaches to capacity allocation to make efficient use of existing network infrastructure. We expect that over time, technical innovation, trials and learnings from consumer consultations will lead to more sophisticated approaches by DNSPs, and for consideration by market bodies as to whether an approach or approaches emerge that best meet the NEO.

We are of the view that at this time, a principles-based approach should be adopted, to enable DNSPs to continue to innovate more advanced approaches in response to consumer feedback. Further, we are comfortable the above principles provide a sound foundation, for

[36] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 52.
[37] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 53.
[38] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 53.
[39] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 53.

now, to enable the development of capacity allocation methodologies during the early stages of the implementation of flexible export limits.

We note that in the future, as levels of consumer energy resources continue to increase, it is possible that more sophisticated approaches will be needed to manage capacity allocation. For example, as more rooftop solar connects and network capacity limits start to constrain exports, different approaches may be needed to the pricing and allocation of capacity. This may need to be a future focus area of work, particularly to the extent that aggregated consumer energy resources are used to help supplement the wholesale supply of electricity as well as providing system and network services in the energy transition.

The impacts upon consumers from capacity allocation and how it is undertaken have the potential to be significant. It is important that DNSPs are transparent in the application of the capacity allocation principles, and in their methodology (as detailed in section 3.3.2 below), to ensure consumers have the necessary information to make informed decisions about utilising flexible export capability. An understanding of the potential increased export availability may influence a consumers' investment in consumer energy resources (e.g., regarding the size of a rooftop solar system).

- ***Do stakeholders agree with the DEIP Working Group principles for capacity allocation? Why / why not?***
- ***Should these principles for capacity allocation be binding for DNSPs?***
- ***Should the application of capacity allocation principles by DNSPs be auditable to assure consumers of fairness?***
- ***Should principles for static export limits also be developed for use by DNSPs going forward?***
- ***Do stakeholders have a view as to whether existing AER guidance material is sufficient to communicate expectations regarding capacity allocation principles for flexible and/or static export limits?***

3.3.2 Capacity Allocation Methodology

The capacity allocation methodology is the approach utilised by a network business to calculate and allocate network capacity to consumers' energy resources. Determining and setting out the methodology for capacity allocation is key to the initial implementation of flexible export limits, as the dynamic limit can be calculated only where there is clear underlying reasoning.

DNSPs will be required at times to apply flexible export limits by allocating the network capacity available across consumers' premises, when total network capacity exceeds the volume of power that consumers seek to export onto the network. Network capacity must be allocated by accounting for both the response from consumers that have installed compatible devices and entered into dynamic connection agreements, as well as the expected exports from consumer energy resource that operate under static export limits.

To implement flexible export limits, DNSPs must first allocate available network capacity across consumers. The DEIP outcomes report highlighted that capacity allocation requires:

- Identification of DOE-capable connection points that can use available hosting capacity
- Allocation of available capacity to each connection point for a given time and location in accordance with defined capacity allocation principles (as per section 3.3.1) and methods.[40]

Network capacity can be calculated and allocated in a variety of ways, leading to a variety of different outcomes for consumers and the system. As such, transparency as to the methodology a DNSP develops is crucial.

The DEIP outcomes report identified that across the trials and demonstrations completed or underway, there are numerous calculation methodologies used.[41] The availability, accuracy and timeliness of data is one of the drivers of each DNSP's approach to calculation methodology. The most appropriate approach will change depending on a DNSP's specific circumstances, and the impacts on roles and responsibilities of participants in the consumer energy resource ecosystem such as traders and technology providers.

Preliminary positions

We have considered the potential requirement for guidance that clearly sets the expectations on DNSPs of how network capacity is to be allocated. Clear and transparent expectations around the methodology is important, to promote efficient and fair outcomes for all consumers.

We expect DNSPs are likely to take differing approaches with regards to the detailed technical approach. We expect that the capacity allocation methodology for flexible export limits should be documented in a DNSP's CER integration strategy as outlined in our DER Integration Expenditure guidance note.[42] This should also detail the consumer engagement undertaken to underpin the DNSP's approach.

The DEIP Working Group considered it would be unnecessary and difficult to achieve national harmonisation of a prescriptive methodology. We are of the view that at this time, a detailed capacity allocation methodology should not be prescribed, to enable DNSPs to be innovative in their approaches. A 'one size fits all' approach would likely stifle implementation of flexible export limits. DNSPs across the NEM vary in their approach to operating their networks and as such, they are best positioned to leverage their knowledge of their respective networks to develop the methodology through which capacity can be allocated. It is expected, that as more consumers install and utilise flexible export limits, DNSP allocation methodologies will be updated on a semi-regular basis to account for the additional flexible generation. Over time, as older, legacy rooftop solar systems are replaced when they reach the end of their useful life, they will likely be replaced with larger systems given the cost parity of the system being replaced. An increase in system size will require a new connection agreement, allowing for the option to utilise flexible export limits. These factors will necessitate revisions of the allocation methodology by the DNSP.

[40] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 22.

[41] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 29

[42] AER, DER Integration Expenditure guidance note, AER, June 2022.

Given our approach in this issues paper is to identify what areas of the framework require immediate action to allow for the policy foundations to be set to support the implementation of flexible export limits, we take the view that prescriptive approaches to capacity allocation are not necessary at this stage. However, as noted, more research is required given that as rooftop solar uptake increases, the risks of constraints and capacity issues in the future also increase. It is important this work is progressed expediently, as settling specific requirements will take time. As a high-level principles approach moves into detailed design and implementation, it will be important to have answered questions around the broader objectives of flexible export limits, when considering the trade-off of different approaches to capacity allocation amongst consumers.

As such, we believe that it is appropriate at this stage to take a principles-based approach to providing guidance through existing guidance material.

- ***Is the approach outlined above in allowing flexibility for DNSPs to develop their capacity allocation methodologies appropriate?***
- ***Do stakeholders agree that DNSPs should include their capacity allocation methodology in their CER integration strategy?***
- ***Should DNSPs be required to publish their capacity allocation methodologies, clearly outlining the trade-offs considered in setting their approach?***
- ***Should the AER have a role in approving DNSP capacity allocation methodologies? If so, what form should this mechanism take?***

3.3.3 Consumer participation (opt-in or opt-out)

Consumers require transparent and accessible information to decide if they want to participate in flexible export limits.[43] The DEIP outcomes report found that consumers should have the option to opt-in to flexible export limits by providing active and informed consent to participate (where flexible export limits are available). This consent can be sought when new consumer energy resources are connected, or when compatible hardware is used to upgrade consumers' existing energy resources.

Given the importance of consumer protections and consumer trust in relation to their energy resource operation, social licence is needed to obtain consumer buy-in of the flexible export limit concept. The DEIP outcomes report notes that without transparent information and a social licence, consumers may disengage and opt-out of flexible export limits. The implementation and operation of flexible export limits may not realise its full benefits if consumer trust and social licence is not secured.

Alternatively, if flexible export limits are made the default or standard connection offer, consumers would have the option to opt-out. Under an opt-out approach consumers could decide not to participate, even when they have invested in compatible energy resources.

[43] For clarity, we note again that neither static nor flexible export limits will guarantee export access. The amount that a consumer can export at any given time will depend on broader network conditions.

Consumer decisions depend on 'choice architecture',[44] that is, how information is presented to them. As a result, empowering and educating consumers is key. Since the benefits of flexible export limits increase with greater adoption, the question as to whether all eligible new connections should automatically be subject to such limits must be asked. An opt-in approach may result in fewer participants, and thus fewer benefits being realised. Research demonstrates that people tend to stay with the default option rather than actively opting-in.[45] Given the potential benefits to consumers that have invested in their own energy resources, as well as consumers that have not made the investment (by way of lower wholesale electricity prices), there is an argument for dynamic connection agreements being the default offered to new connections in areas where flexible exports are available.

The DEIP outcomes report highlights a social licence and consumer buy-in requires DNSPs and regulators to understand consumers' motivations and expectations of their energy resources. Mandating flexible export limits through opt-out may not be appropriate at this early implementation stage, given that consumers will likely be hesitant of arrangements that involve the perception of some external control of their devices. The DEIP outcomes report highlighted reasons for wariness including suspicion that the system cannot deliver sophisticated, trusted 'smart' grid technologies; that energy companies are not trusted to serve the public interest; privacy and data misuse, particularly using data for profit or surveillance; and the belief that control over the level of automation in the home should ultimately be in the hands of consumers.[46,47]

Under a DNSP-led approach, it will be up to DNSPs, retailers and installers to effectively communicate to consumers to determine whether dynamic connection agreements could be beneficial and appropriate for them. This is likely to occur through DNSPs informing and educating solar retailers on these emerging capabilities to ensure consumers are made aware of these options if/when they become available. As detailed in section 4.2.6, it is imperative to provide accessible information to consumers on the purpose of flexible export limits, and how they are being designed and managed over time. DEIP found that information, knowledge, and capability building are critical to mitigate power imbalances and potential consumer harm.[48]

Preliminary positions

There are several options to increase the likelihood of consumers entering dynamic connection agreements, including relevant information and education campaigns, as well as an active opt-in or opt-out process. We understand that DNSPs intend to continue to offer connection agreements for static export limits. However, we are of the view that where DNSPs choose to implement flexible export limit connections, they should also offer consumers the choice of a static export connection, even where that static limit may be lower

[44] Thaler, R. H., & Sunstein, C. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

[45] Environmental Defense Fund (EDF), To Opt-In or Opt-Out: What Works for Time-Variant Pricing, 2014, accessed August 2022.

[46] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA March 2022, p. 34..

[47] ESB, Customer Insights Collaboration – DER Implementation Plan Customer Insights Collaboration Release One, Knowledge Share Report, ESB, June 2022.

[48] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA March 2022, p. 34.

than the traditional static export limit. This could be achieved through changes to the terms and conditions of the DNSPs' connection agreement.[49]

- ***Do stakeholders agree with the expectation that over the near to medium term, consumers should continue to have the option of static export limits?***
- ***Should consumers be expected to opt-in or opt-out of flexible export limits (where available)?***
- ***Is it necessary for this expectation to be captured in the Model Standing Offer?***

3.3.4 Governance of traders and consumer energy resources

We anticipate that as battery uptake increases and energy services continue to emerge, third parties, such as traders, are going to have greater interaction with flexible export limits. In the instance of retailers or other traders, the ability to control and vary the output from consumer energy resources such as rooftop solar will provide another tool to assist them in managing their exposure to wholesale electricity markets (particularly negative wholesale prices driven by high renewable generation output). This adds further complexity from a compliance aspect as the party controlling consumer energy resources would have to adhere to any export limit set by the DNSP. It also could result in technical complexity if the same communication channels are being used for the limit and control where the consumer energy resource could receive coincident and possibly conflicting commands.

To ensure consumers are adequately protected in these scenarios and not held responsible for breaches of the export limit set by the DNSP, we are of the view that the roles and responsibilities associated with adherence to the flexible export limit for controlled consumer energy resource devices require review. There needs to be an understanding of the technical architecture to the hierarchy of command that ensures that devices manage control and flexible export limit signals appropriately with respect to network and system requirements. This hierarchy, as noted in the DEIP outcomes report, includes consumers being able to use their energy resources to buy and sell energy within the physical constraints of the local network.[50]

Preliminary positions

Consumer protection must also be considered throughout these developments. To that end, the Review of Consumer Protections for Future Energy Services (formerly known as the Retailer Authorisation and Exemption review) is underway as identified in section 4.1.1. This review may interact with the Interoperability workstream to set governance requirements for retailers, traders and aggregators, amongst other parties.

We note that traders are not currently critical to the implementation of flexible export limits. However, given that they are likely to be more involved in coordinating consumer energy resources in the future, we consider it is important to raise these issues and seek feedback

[49] The connection agreement is often in the form of a Model Standing Offer, which is approved by us.

[50] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 54.

on a potential framework that sets the expectations for trader performance in relation to consumer energy resources.

- ***Do stakeholders require further guidance with regards to the interactions of retailers and aggregators and flexible export limits outside of what is being explored through the existing workstreams?***

3.3.5 Connection agreement

Under the NER, the connection agreement governs the relationship between a DNSP and a consumer as it sets out the terms and conditions of network access and must be in place prior to the connection of consumer energy resources.

Currently, when a consumer installs energy resources, such as rooftop solar, they will enter into a connection agreement with a DNSP that outlines the conditions of operation and includes details of any applicable static export limit. We note that some DNSPs have updated their Model Standing Offers (MSOs) to enable flexible export limits for certain types of connections.[51] Where available, such as certain network areas in South Australia, consumers have the option to select a dynamic connection agreement when connecting consumer energy resources, provided they have installed compliant equipment. This gives effect to the flexible export capability.

Preliminary positions

We consider the current connection agreement framework is the most appropriate existing mechanism to set out the terms and conditions, as well as performance expectations for flexible export limits for both the consumer and DNSP. It therefore may be appropriate for DNSPs' connection agreements to be expanded or alternative governance arrangements to be explored, as outlined in section 3.3.6 below.

We are of the view that we should seek changes to the connection agreements to establish sufficient consumer protections that apply consistently across the NEM. We consider the following information should be set out and specified, both to inform consumers while also setting out rights and obligations:

- Operating parameters, such as the length of the interval, notification period and how often the limit will be changed, expectations of performance (e.g., 10kW export limit 95 per cent of the time)
- Conditions for the revision of the flexible export limit, including the options for the consumer to change to a static export limit (i.e., there is more than one connection agreement option available)
- Communication processes for changes to the flexible export limits
- Consumers' compliance obligations, including DNSPs' approaches to identifying non-compliant devices

[51] Aurecon, Flexible Exports for Solar PV – Lessons Learnt Report 2, SAPN, April 2021, p. 8.

- Related commercial implications, including direct compensation or rebates on network charges, if service levels are not achieved

We may consider standardisation of connection agreements at a future date once flexible export limits become more commonplace.

- ***Should DNSPs be required to set out expectations of flexible export limit operation within the connection agreement where there is no trader, or third party involved in the operation?***
- ***Do stakeholders agree with the rights and obligations outlined above?***

3.3.6 Governance arrangements for flexible export limits

The matter of identifying non-compliance with a set export limit will be the responsibility of the DNSP. There may be a variety of reasons for consumer energy resources to not conform with the set limit, including potential firmware issues with the device following an over-the-air update. We understand that consumers will generally not be actively, or even capable of, altering settings on their energy resources to ensure compliance with the flexible export limit and the process for responding to limits will be largely automated. Therefore, our expectation is that any action taken by a DNSP when contacting consumers after identifying a device that is non-conforming should account for this notion, as a consumer is unlikely to be aware their energy resources are not complying with an export limit.

We consider there are two broad scenarios that need to be considered for governance arrangements; one where the consumer has engaged a trader or technology provider that must adhere to and operate within the flexible export limit. The other scenario is where the consumer device responds to the flexible export limit set by the DNSP, but no other party is actively involved in controlling the device.

Where there is no trader involved in passing through the limit to the consumer device, the existing connection framework (subject to the matters discussed in section 3.3.5) may be sufficient. However, if a consumer has engaged a trader that will be responsible for adhering to the limit set by the DNSP, we consider the governance arrangement must move beyond the existing connection agreement framework.

Preliminary positions

To acknowledge the role of a trader in the tripartite relationship between them, the DNSP and consumer, a new governance framework is expected to be necessary. The existing connection agreement framework has been appropriate for outlining access arrangements and governing export limits where no trader or technology provider is involved but is not considered suitable for enforcement matters involving these parties. This would necessitate opening the agreement and adding a third party, who has no role in access arrangements, and who may change over time, resulting in a requirement for the agreement to be subsequently amended, even though matters relating to access are unaffected. Introducing another party to the existing agreement will also create additional complexity for the consumer.

In the future where a consumer enters an arrangement with a trader to control their energy resources, we expect the responsibility for complying with the flexible export limit will be the responsibility of the trader. We expect this may be reflected in agreements between the DNSP and the trader or the customer and the trader but will be outside of the connection agreement.

As consumers are unlikely to be able to manually adjust the settings of their energy resources to intentionally breach export limits set by DNSPs, we consider any issues with the performance of the consumers energy resources concerning flexible export limits should be identified by the party 'controlling' the device (e.g., trader) / DNSP, depending on the scenario. We consider the DNSP is responsible for identifying an issue with the consumer's device and bringing it to their attention, but should not be responsible for rectification, where a trader is not involved. However, where a trader is involved, it may be appropriate for them to take on the responsibility of rectification.

We are of the view that consumers should not be exposed to formal penalties for their device(s) not responding to a change in the flexible export limit. In an instance where the device falls out of communication with a trader/utility server, we understand the inverter should drop to a low static export limit, defined by a DNSP in its dynamic connection agreement. We also understand that CSIP-Aus allows for scheduling of export limits over multiple intervals.

- ***Do stakeholders have concerns about the approach to governance outlined above, particularly embedding elements of the rectification process in the connection agreement?***
- ***Is it appropriate for a technology provider/OEM be held responsible for devices that do not conform to the export limit set by the DNSP (i.e., where this is no active control)?***
- ***What is the appropriate governance arrangement for managing flexible export limits?***
- ***Is it necessary to develop a separate framework to manage governance where a trader or technology provider is involved in passing-through the flexible export limit (i.e., where there is active control)?***
- ***Do stakeholders agree with our view of that consumers should not face significant penalties for non-conformance of their energy resources for flexible export limits?***
- ***Do stakeholders believe there needs to be a standardised approach to enforcement for consumer energy resources under the control of a trader? For example:***
    - ***If notified by the DNSP of an issue with device conformance (where no trader is involved), it is appropriate for the responsibility of rectification to rest with the consumer?***
    - ***Where a trader is involved, should responsibility for rectification rest with the trader?***

- ***What should be the responsibilities of traders in ensuring consumer energy resources do not exceed any export limit set by the DNSP?***

3.3.7 Notification period for a dynamic limit

Following the implementation of flexible export limits, and as the understanding of the functionality grows, DNSPs may need to provide notice of their forecasts for export limits ahead of the point in time when the limit will need to be adjusted. This would enable market participants to effectively plan their offers for energy services across a portfolio of consumer energy resources, and AEMO to understand the level of supply and demand in the system. Two options could form the basis for the notice, either real-time forecasts or longer-term forecasts, or a combination of both. There is currently no guidance on how far in advance the limit must be communicated, meaning that there could be variation between states and networks as flexible export limits are implemented.

As the use of flexible export limits by DNSPs to manage congestion grows, this could see the level of generation in the system constrained, resulting in an increase in demand. This impacts AEMO's role in balancing supply and demand in the NEM. As a result, AEMO will need to be notified, as these constraints could be issued external to market based / traders bidding into the market. To ensure consistency of expected response across the fleet of consumer energy resources for both trader and network purposes, the forecasting technique will need to be consistently applied across all DNSPs. AEMO appears best placed to coordinate this functionality with requirements to consult in the approach with DNSPs, as these forecasts will need to interface with its existing forecasting systems and approaches. We understand the Scheduled Lite workstream is also investigating the development of this visibility. Moving forward, data exchange models will assist in a consistent forecasting approach.

We note that the DEIP outcomes report considered this and found that 24-hours advance notice is appropriate for communicating the updated limit. The report also supported improvements in longer range forecasting over time.

Given the opportunities for new business models and energy services to emerge over time through the transition, such as those observed via aggregators that utilise consumer energy resources to offer services to the wholesale and frequency control ancillary services markets, these commercial entities may also have to account for varying export limits throughout the day. To participate efficiently in these markets and maximise the value for the consumers whose devices they are controlling, parties will require accurate forecasts about the expected export limits.

Preliminary positions

We understand DNSPs will have preferred approaches to providing notice of their forecasts for export limits. We consider there is benefit in awaiting the outcome of the ESB's Interoperability workstream as it has the potential to deliver insights on guidance on these issues. However, we understand that if traders are to become more involved in coordinating consumer energy resources, they will need access to some form of forecast of what dynamic limits will be, with reasonable notice to optimise portfolios. We also note the work of the ESB

Data Strategy network transparency workstream, which is expected to consider related issues.

We also acknowledge that the outcomes from the Schedule Lite workstream may require this issue to be revisited in the future.

- ***Does the issue of a framework for providing forecast information on expected dynamic limits need to be considered in the short term?***
- ***Do stakeholders consider this will be sufficiently addressed through the Scheduled Lite workstream?***

3.3.8 Broad questions regarding immediate actions

- ***Do stakeholders agree with the areas identified above as requiring immediate attention?***
- ***Do stakeholders consider there are additional matters requiring immediate attention not covered here? If so, what are they, and what specific factors should we be considering?***

4 Leverage existing workstreams

4.1 Interlinkages with other consumer energy resource workstreams

Through this section of the issues paper, we seek to identify and map out relevant existing workstreams and guidelines that are being undertaken or have been completed by either us or other market bodies (including the ESB).

There are several workstreams underway under the CER Implementation Plan to achieve the following outcomes:

- Consumers have access to secure, reliability, affordable and sustainable energy no matter how they participate in the energy market
- Consumers can realise the value of their flexible demand and energy resources
- Fit-for-purpose protections frameworks improve the experience for all consumers.[52]

There are also various pieces of work currently underway to improve low-voltage network visibility for network management, including through the wider CER Implementation Plan, and several industry trials and research collaborations. As such, we are of the view that we can leverage the following workstreams where they are relevant to flexible export limits.

4.1.1 Review of Consumer Protections for Future Energy Services

We are undertaking a review of the retailer authorisation and exemption frameworks set out in the National Energy Customer Framework. The need for the review was outlined in the ESB's final advice to energy ministers in July 2021.[53]

The review aims to assess the adequacy of the current energy consumer protection framework in the context of a transitioning energy market and consider whether these frameworks remain fit for purpose for the post-2025 NEM. Broader consideration of consumer protections is outlined in section 4.2.6.

4.1.2 Interoperability workstream

Interoperability is the ability for different information technology systems, devices and software applications to enable two-way communication, use, and exchange of data accurately, effectively, and consistently.[54] In the context of consumer energy resources, this would refer to consumer assets (such as rooftop solar) being able to operate alongside each other and respond to signals from traders, or other parties, within the flexible limits communicated by DNSPs, irrespective of their different brands and technological characteristics. Standards for interoperability will specify the minimum device functionality in terms of a common communication protocol for adoption across the industry to provide access to additional revenue streams for compatible consumer energy resources such as through the existing wholesale electricity and frequency control markets, which can also support system security. This standardisation of device functionality will support the

[52] Energy Security Board, Attachment A – three-year horizon of DER Implementation Plan, ESB, July 2021.

[53] Energy Security Board, Finale advice to energy ministers Part B, ESB, July 2021.

[54] ARENA, DEIP Interoperability Steering Committee webpage, accessed July 2022.

implementation of flexible export limits, as OEMs will understand the expectations of devices sold in the Australian market.

The Interoperability workstream is considering the implementation of a common communications protocol for consumer energy resources to coordinate the operation of multiple devices. The workstream is focused on the adoption and implementation of CSIP-Aus, which is expected to be the communication protocol utilised by DNSPs and traders to communicate with consumer devices, including for the purposes of communicating flexible export limits.

4.1.3 AEMC's technical standards review

The AEMC has commenced the first of its planned annual reviews of CER technical standards in the NEM. The review aims to support the successful integration of consumer energy resources for the long-term benefit of consumers. The review will assess the NEM's 'state of play' implementing such technical standards and identify necessary next steps for market participants, market bodies, and other relevant parties. The review will identify existing activities in relation to technical standards for consumer energy resources, clarify the NEM's needs from new technical standards, and report on progress on adopting and implementing technical standards across the NEM. This will allow the AEMC to consider existing work to develop and implement technical standards for consumer energy resources to support the NEM's continued transition, by identifying potential gaps requiring further action.

The review intends to focus on compliance and enforcement of technical standards in the NEM. The AEMC will note the existing arrangements in place relating to compliance and enforcement issues of technical standards for consumer energy resources, specifically in relation to AS 4777.2 as referenced in the NER.

In addition, the review will note the needs and expected outcomes from the successful implementation of technical standards, particularly AS4777.2, from the perspective of NEM participants and consumers. The review is also expected to consider the roles and responsibilities of various parties associated with the implementation of technical standards for consumer energy resources in the NEM.

4.1.4 Cybersecurity

A future element of the CER Implementation Plan is expected to address the cybersecurity risks associated with interoperable connected energy resources in the NEM. Cybersecurity risks are not unique to interoperable devices, but it will be a key consideration as the number of interoperable devices in the NEM increases in the coming years. Cybersecurity arrangements for DOEs or flexible export limits are also being considered by the ESB via the Interoperability workstream.

Broader policy and regulatory framework related to cybersecurity are expected to be considered in a cybersecurity workstream under the CER Implementation Plan.

4.1.5 Flexible Trading Arrangements rule change

The Flexible Trader Arrangements rule change request developed by AEMO seeks to assist consumers unlock further value of their energy resources. The rule change aims to provide consumers with additional options for engaging with electricity products and services in the

context of the development of two-sided markets. Flexible trading has already been enabled via the AEMC's final rule and determination for the Integrating Energy Storage Systems rule change, which was also requested by AEMO. The FTA proposal seeks to remove barriers that might prevent customers, and in particular small customers, from accessing products and services from a party other than their traditional retailer. It also proposes more efficient models for separately recognising consumer energy resources for wholesale settlement, providing greater options for aggregation:

- Consumers to engage one retailer to supply electricity and potentially a second provider for the provision of another specific service, such as EV charging, battery services or wholesale services
- New electricity business models that result in expanded energy services and/or combined services.

The outcome of the FTA rule change could facilitate and promote innovation in the energy market through different business models emerging that coordinate and optimise specific devices through various metering and sub-metering arrangements. Given the potential interactions with flexible export limits, further work may be necessary in the future to consider the impact of the new metering arrangements once the rule change is finalised.

4.1.6 Customer Insights Collaboration

The ESB is undertaking a Customer Insights Collaboration (CIC) to enable an end-to-end view of customer issues associated with the integration of CER and flexible demand. The CIC process is testing assumptions and understandings about how customers may want to engage with a variety of service providers or products. The CIC will inform the development of standards to support effective switching and identify where risks or harms may emerge with new services becoming available.

Stakeholders are coming together in a series of collaborative, independently facilitated workshops, and draw on the best available evidence and analysis to generate insights to inform the delivery of reforms required under the CER Implementation Plan.

In the first workshop, "Release One", the Customer Insights Collaboration explored barriers and enablers to customer reward for flexible CER and energy use. The knowledge share report, and the supporting rapid evidence review by ACIL Allen found that customer participation in the market for flexibility services cannot be taken for granted, and that barriers around equity and inclusion, incentives, communications and trust, need to be overcome to unlock the value of flexibility.[55] Release Two is now underway, which is focussing on working with the CER Implementation Plan project teams, to apply the insights gathered in Release One.

4.1.7 Scheduled Lite

The Scheduled Lite mechanism is a voluntary initiative that aims to lower barriers and provide incentives for non-scheduled load and generation to participate in the NEM's scheduling process. This mechanism provides an opportunity for consumer energy resources

[55] ESB, Customer Insights Collaboration – DER Implementation Plan Customer Insights Collaboration Release One, Knowledge Share Report, ESB, June 2022.

and flexible demand to make valuable contributions to the security and reliability of the power system. The initiative will be applicable to both large energy users and small generators.

The ESB tasked AEMO with the development of a high-level design for a Scheduled Lite mechanism for the NEM. In June 2022, AEMO released a consultation paper on the draft design to seek feedback from stakeholders on any potential challenges to participating in the mechanism. The consultation paper included 'requirements' of DOEs to support its implementation:

- DOEs are available to traders so that they can manage their market bids
- DOEs are available for use in market systems where it is necessary to incorporate limits into short-term forecasts, security, or reliability processes
- Where there are multiple traders at a distribution connection point, a mechanism is required to coordinate, share and allocate limits between the traders.

AEMO will use the information gathered through the consultation process to inform a rule change request.

4.1.8 ESB Data Strategy

The ESB Data Strategy was developed as a critical foundation for the post-2025 market design to support the shift to a smarter, more modern energy system in a digitalised future, coordinating more complex technologies and services. It was agreed in late 2022 along with the wider plan. It includes a range of workstreams reforming frameworks and capabilities for data access and sharing, to create greater value for consumers, as well as coordination to address priority data gaps. Five priority gaps have been agreed, focused on supporting CER integration, one of which is to address Network Visibility for the Market.

Many of the existing ESB workstreams, including the focus of this paper and the ESB's Interoperability workstream, focus on the operational challenges facing networks and market operators, in their need to manage a secure system. The Data Strategy project aims to complement this work, by focusing on defining and delivering network data needed by the market to support optimisation of CER benefits and network resources. This includes data to support decision-makers optimising CER-related investments, for example: installers and homeowners managing future export risks, aggregators forecasting output, or investors optimising community batteries or public EV charging. It also includes data to support decision makers in planning, policy and research, seeking to manage risks in the market transition. Data released to the market may be highly relevant to effective delivery of flexible export limits, for example in engaging with stakeholders transparently around how they are calculated or why they may vary.

This project will be undertaken in several stages over the next 12 months. The first stage will focus on defining stakeholder data needs and use cases and will including bringing together insights across existing research projects and related reform processes. The second stage will review existing data and consider a range of different case studies and approaches, recognising that available data is highly variable across networks and diverse approaches may be needed. The final stage will consider options for ongoing delivery of the data and a pathway to resolve data gaps efficiently over time.

4.2 Gaps that can leverage existing workstreams

The following sections contain the gap analysis and actions we have identified that we can leverage existing work. We welcome stakeholder feedback on our analysis of the matters outlined below.

4.2.1 Communication protocol

DEIP released CSIP-Aus in 2021. While CSIP-Aus is intended to provide a national protocol to facilitate communication between DNSPs and devices to enable flexible export limits, it is not mandated yet. A flexible limit needs to be communicated by the DNSP to a device to facilitate compliance with the limit.

Communicating the dynamic limit is critical to the operation of flexible export limits, as should communication not occur, then the limit cannot be changed in response to external signals. However, we acknowledge that CSIP-Aus provides for a fallback operational profile where communications are lost with the host server issuing the instructions. If communications are lost, the device can default to a pre-set low static export, as determined by the DNSP.

A common standard for communicating dynamic limits would assist in ensuring interoperability across the NEM, whereby instructions issued by DNSPs to change limits are understood across consumer energy devices. Further, a common operating language ensures minimum costs are imposed upon parties required to comply with a dynamic limit, such as retailers, aggregators and OEMs. Adopting a single approach across the NEM could reduce costs through economies of scale and learning from experience. Were each DNSP to adopt their own protocol, they could face higher costs in implementing flexible export limits, which would ultimately be borne by consumers.

The application of CSIP-Aus is currently being considered under the ESB's Interoperability workstream. This workstream is expected to set a path to a common communication approach to enable interoperability of devices in the NEM. This will allow the effective coordination and operation of consumer energy resources in the NEM, including participation in energy markets – increasing the potential benefits for consumers from their energy resource investment.

4.2.2 Monitoring export limit performance and information provision

We publish reports and data on the performance of each network we regulate. We understand it could be useful to define or establish performance monitoring processes specific to DNSP functions regarding flexible export limits to provide transparency and accountability. Additionally, transparent and effective monitoring processes may encourage increased consumer uptake and build trust in flexible export capability. Effective monitoring can help ensure consumers see the benefit of a framework to allow flexible export limits by transparently checking the appropriateness of DNSPs' implementation and building greater consumer trust to participate.

There are several metrics associated with flexible export limits that could be monitored. These include the value of alleviated curtailments,[56] or network utilisation improvement compared to historical benchmarks.

DNSP performance is monitored through several existing mechanisms and processes, including the AER's annual performance reporting functions, such as the State of the Energy Market report,[57] and the annual Electricity Network Performance Report.[58]

From 2023, we will also report on distribution export service performance as part of our performance reporting.[59] Amongst other things, this reporting aims to provide transparency around whether DNSPs have overly restrictive export limits. This should improve our understanding of whether export curtailment is no higher than necessary and if consumers are benefitting from efficient outcomes. We are currently considering how to most effectively measure export service performance given current data limitations and sought stakeholder views via a consultation paper.[60]

Preliminary positions

In the AER's *Incentivising and measuring export service performance* consultation paper, we are considering the extension of our monitoring roles to include monitoring flexible export performance. For example, we have suggested mandating publishing information on the performance of each DNSP in providing flexible export services by updating our existing annual performance reporting functions.

Additionally, following the AEMC's access, pricing and incentive rule change, we are currently updating the annual reporting processes to include further oversight of export services. The rule change recognised exports as a core service offering of DNSPs. The monitoring of flexible export limits is captured by monitoring export services. The export service performance consultation paper already captures as a metric the number of customers on flexible export limits.

We would be supportive of DNSPs publishing any additional data they hold about their flexible export limits. Such information supports transparency and could allow third-party reconciliation between a DNSP's stated methodology and the resulting dynamic limits. It would also provide valuable information to interested market participants, such as consumers considering whether to opt-in to dynamic connection agreements, provided they have compatible energy resources.

Going forward, we are interested in stakeholder feedback about whether we should expand our existing monitoring and reporting processes for DNSPs to cover the calculation and application of flexible export limits, as well as data around trials undertaken. Once flexible

[56] See the AER's CECV methodology and associated explanatory statement.

[57] AER, State of the energy market reports, accessed August 2022.

[58] AER, Electricity Network Performance Report 2022, July 2022, accessed August 2022.

[59] AEMC, Access, pricing and incentive arrangements for distributed energy resources, Rule determination, 12 August 2021.

[60] AER, Consultation paper: Incentivising and measuring export service performance, August 2022.

export limits have been operating for some time, we will be interested in hearing feedback from stakeholders as to whether an enhanced monitoring framework is required.

- ***Are there any additional metrics that should be considered that have not been incorporated into the broader export services review?***
- ***Should the AER publish data on the performance of individual DNSPs in terms of their flexible export service for consumers?***

4.2.3 Device capability to respond to flexible export limits

Consumer devices must be compatible with the DNSPs' chosen communication protocol and capable of communicating the required necessary information so that flexible export limits can be used to manage congestion on the distribution network. This extends beyond consumer energy resources and in the future could include devices such as home/building/facility energy management systems. Currently, consumers are not required, nor is there guidance as to how, to install consumer energy resources that are compatible with certain communication protocols. While there is no single communication standard set to facilitate flexible export limits, if one were to be set, it could accelerate uptake that does comply with such a standard.

Compatible devices on the network are critical to enabling DNSPs to implement flexible export limits. The network benefits through having more consumers that have compatible devices and enter dynamic connection agreements that make use of the capability. As such, there is arguably a case for mandating to increase the take-up of compliant devices. This could include requiring consumers to purchase compliant equipment after a certain date. However, a mandate would also come at a cost to consumers, through requiring either an update to their energy resources before otherwise necessary, or the purchase of more expensive equipment.

We understand that consideration of implementation of CSIP-Aus in the NEM is being considered in the ESB's Interoperability workstream. The AEMC's review of CER technical standards will also examine issues associated with applying CSIP-Aus in the NEM. As such, we will leverage the outcomes of this existing work to avoid duplication.

- ***Regarding the governance of a potential CSIP-Aus requirement, do stakeholders consider there should be a mandate for devices to be CSIP-Aus compliant for new connections in the NEM?***
- ***Do stakeholders have views on how this mandate could be most effectively implemented?***

4.2.4 Interval length

Given that updates to the dynamic limit are critical to the operation of flexible export limits, determining the frequency of these updates is also important for implementation.

Flexible export limits require a time interval to be fixed for successful operation. These can be short or long intervals, and finding the right interval is an exercise in balancing efficiency, complexity, costs and device capabilities.

Theoretically, shorter interval length results in greater potential efficiency, as limits are frequently updated to reflect real-time conditions. On the other hand, longer intervals can offer simplicity, greater certainty to market participants and lower costs, but would likely result in less efficient allocation of network capacity.

The DEIP outcomes report recommended five-minute intervals are adopted or transitioned to over time. As highlighted by the DEIP report, five-minute intervals for variable exports align with the settlement frequency of the NEM, which transitioned to five-minute settlement of the wholesale market in 2021.

Given that networks have different approaches to operation, we do not believe that it is necessary to mandate a particular interval period. DNSPs are best placed to assess the frequency with which the export limit should be updated.

During the initial implementation of flexible export limits, we consider DNSPs are best placed to determine the interval length. However, we intend to indicate our expectation that DNSPs should transition towards five-minute intervals. If needed, we may undertake further work in future to assess the point at which DNSPs should complete the transition.

- ***Do stakeholders agree that DNSPs are best placed to determine the interval length of flexible export limit operation? If not, what guidance would stakeholders like to see on this issue?***

4.2.5 Demonstrating investment need

DNSPs will have to incur costs to implement and operate flexible export limits, depending on what arrangements or systems they already have in place. Expenditure may be required on additional systems, monitoring equipment or more, depending on how DNSPs choose to implement flexible export limits.

DNSPs must demonstrate any expenditure that they intend to recover under the regulatory framework aligns with the objectives outlined in the NER.[61] We have existing frameworks that provide DNSPs guidance on forecasting expenditure and further guidance regarding consumer energy resource-related spending, including the CECV methodology,[62] expenditure forecast assessment guidelines[63] and the DER integrated expenditure guidance note.[64]

[61] Objectives include meeting or managing the expected demand; complying with applicable regulation; maintaining the reliability, quality, and security of supply of standard control services; and maintaining the reliability of security and safety of the network.

[62] See Appendix 1; AER, Customer export curtailment value methodology, AER, June 2022.

[63] AER, Expenditure Forecast Assessment Guideline, AER, August 2022.

[64] AER, DER integrated expenditure guidance note, AER, June 2022.

The expenditure forecast assessment guideline describes the process, techniques and associated data requirements for our approach to setting efficient expenditure allowances for network businesses. Further to this high-level guidance, we have published several standalone guidance documents for expenditure relating to major investments, large-scale and continuous replacement programs and new technologies to manage electricity networks. The DER integration expenditure guidance note and the CECV methodology supplement these pieces of guidance by providing clarity and certainty to DNSPs and their customers about how to prepare expenditure proposals for investments related to consumer energy resource integration and how we will assess these proposals.

We are of the view that there is sufficient guidance for DNSPs to facilitate the development of their investment proposals within the existing regulatory framework. The documents outlined above provide sufficient clarity for DNSPs to demonstrate the need for, and to justify investments related to flexible export limits.

- ***Do you agree the AER has sufficient guidance on what information DNSPs are expected to provide to justify specific flexible export-related proposals?***
- ***Do DNSPs need more information than is currently available to demonstrate the investment need for flexible export limits?***

4.2.6 Consumer protections

We consider it important that consumer protection frameworks include specific references to flexible export limits (or DOEs) and contain mechanisms that identify or address any consumer protection issues regarding flexible export limits.

As referred to in section 4.1.1 above, we are progressing the Review of Consumer Protections for Future Energy Services. Under this review we are assessing the adequacy of the current energy consumer protection framework in the context of a transitioning energy market. The review will consider how consumers will interact with the flexible export limit framework and the potential risks this could create, particularly regarding different models that may emerge and how customers can understand and navigate this new avenue to interact with the energy system.

We see a key risk with the implementation of flexible export limits being consumers not making an informed choice to opt-in or opt-out where the capability is available to them, given the potential for increased benefits from a higher export limit, due to inconsistent messaging and information about the potential impacts of the decisions. A lack of appropriate communication of the impact and benefits to consumers may hamper their ability to make an informed choice whether to participate (where they have the capability). This could lead to sub-optimal or slower uptake of flexible exports and consumers miss out on the benefits outlined previously in section 1.3.2. Over time, if static limits are decreased, consumers risk not being able to access the additional benefits provided by more headroom with higher export limits.

Given that the Review of Consumer Protections for Future Energy Services is considering consumer protection requirements, including resulting from the implementation of flexible export limits, and the AEMC's review of CER technical standards in the NEM is also

considering consumer protections, we consider it appropriate to await the outcomes of these projects.

- ***Beyond the issues being canvassed in the Review of Consumer Protections for Future Energy Services and the AEMC's review of CER technical standards, are there any other specific consumer protection issues we should explore in the context of the implementation of flexible export limits?***

4.2.7 Data protection and privacy

The implementation and operation of flexible export limits will result in more data being created, made visible and transferred across networks. As a result, data protection and privacy are crucial. Both static data (relating to the physical characteristics of consumer energy resources and the local network) and operational (dynamic) data (relating to 'live' technical information such as power, voltage and frequency) are required to calculate, forecast and monitor the impact of flexible export limits.

DNSPs will likely require connection point data provided by consumer energy resources to facilitate the effective implementation of flexible export limits. [65] However, DNSPs are subject to ring-fencing provisions that limit their ability to share a customer's private information obtained through their provision of direct control services. [66] As a result, DNSPs generally cannot on-sell a customer's private data into competitive markets or share it with other providers without the customer's consent.

The existing ring-fencing framework prevents DNSPs from using ring-fenced information for a purpose other than the purpose for which the ring-fenced information was acquired or generated (i.e., for the provision of direct control services). [67] DNSPs are prevented from sharing ring-fenced information with their affiliates or using ring-fenced information to give a competitive advantage to their affiliates. We consider that we can leverage this existing framework to set expectations around consumer data protection.

- ***Are more data protection and privacy requirements needed for the implementation of flexible export limits beyond those already available in the current framework and what is being considered in the ESB Data Strategy?***
- ***What impact is there likely to be on metering service providers from the implementation of flexible export limits?***

4.2.8 Consumer understanding and interest

[65] See section 5.1.1 below which explores the location of the application of the export limit.

[66] Ring-fencing is regulation which supports competition in markets for electricity services and the efficiency of regulated network services provided to consumers on a monopoly basis. It does this by requiring regulated distribution and transmission businesses to separate parts of its business that provide regulated services from the parts of its business that provide unregulated services.

[67] Ring-fenced information is that acquired by a DNSP in connection with its provision of direct control services that is not already publicly available

We are of the view that the implementation of flexible export limits will be DNSP-led but the potential benefits will be realised by consumers. That is to say that consumers must have access to sufficient and fit-for-purpose information to enable them to make an informed decision whether to opt-in or opt-out where flexible export limits are available, to fulfill the potential of flexible export limits. This information, and how it is conveyed to consumers, will be critical to establishing acceptance and social licence of the service.

Critical to the uptake and acceptance of flexible export limits is consumers' understanding of what they are, the potential benefits, risks and how they affect their energy services. As outlined in section 4.3.3 on consumer participation (opt-in or opt-out), the DEIP outcomes report identified this as needing a 'social licence' for the choice between conservative export limits or flexible export limits, which is a more palatable option at this stage than mandatory rollout of flexible export limits.

There is a risk that flexible export limits could be perceived by consumers with new connections as an 'unfair burden' when existing connections received higher static export limits (where the alternative is a low static export limit). This could hinder investment in new consumer energy resources and flexible export limit uptake. This may be due to a perception by consumers that they have a right to export to the maximum level, even where their exports were curtailed at times under lower limits. However, consumers may not have been aware of previous curtailment. Another risk is that consumers are not adequately informed on the benefits of flexible export limits, and as a result do not understand the concept, leading to low uptake.

Under their NECF obligations, electricity retailers usually provide consumers with information about the electricity market, mostly in relation to retail electricity usage and billing. There are also government education campaigns to educate consumers about electricity and consumer energy resource products and associated services. While currently not required, it may be beneficial for us to set expectations about DNSP engagement with solar retailers/traders and consumers or other market participants to provide ongoing information to consumers or retailers about flexible export limits.

Learnings from the ARENA flexible export limits trials in South Australia and Victoria with SAPN and Ausnet respectively demonstrate that active education by DNSPs does lead to greater engagement from consumers. Further, the solar industry is crucial to consumer awareness, given the many touch points between them and retailers and installers. Therefore, the solar industry must be trained in how to provide accurate and up-to-date information about flexible export programs.

With the Ausnet trial, the main information sources that consumers sited for their awareness of the trial were direct outreach from AusNet, word of mouth, and the website. Very few customers were referred from their installer.[68] The ARENA report recognises that installers are a key group that needs to be engaged and upskilled to support the transition from passive to smart connected energy resources.

We are cognisant of the difficulties in explaining benefits and drawbacks of consumer energy resources and flexible export limits, particularly as consumers will be understandably hesitant

[68] ARENA, Flexible Exports for Solar PV – Lessons learnt report 4, ARENA, June 2022.

at the prospect of their export limits being 'turned down', notwithstanding that a static limit may also be curtailed at times. As such, we understand there may be a greater focus on this aspect instead of giving equal consideration to export limits being raised with the implementation of flexible exports. However, we understand these issues will be more broadly explored through the ESB's CIC.[69]

Consumer information is crucial to ensuring the successful roll out and acceptance of flexible export limits by consumers. The CIC work underway will assist to address this gap, as it seeks to provide insights into communication pathways and consumer requirements. We will thus leverage the existing work of the CIC for improved understanding of flexible export limits.

In particular, the CIC has sought to shed light on the most important barriers to households and businesses benefiting from flexible energy generation and energy use. The barriers identified are inclusion and equity; incentives and nudges; communication; and trust. Communication is the key barrier relevant here, with the CIC highlighting that the challenge requires a coordinated, and consistent approach by the sector.[70]

- ***Should the Customer Insights Collaboration workstream be leveraged to improve consumer understanding of flexible export limits and/or for consideration of impacts upon consumers and consumer sentiment?***
- ***What do consumers need to know about flexible export limits at each step in the journey to properly understand and engage with them?***
- ***What communication materials do consumers need to understand the opportunities offered by flexible export limits?***

4.2.9 Integration with export pricing

Under the access, pricing and incentive arrangements for distributed energy resources rule change, the AEMC removed the prohibition on export charges for customers who export onto the grid.[71] As a result, we have published guidelines describing how DNSPs should develop and justify two-way pricing proposals to obtain AER approval of such export tariffs.[72]

Export tariffs can be priced differently at various points in time, either negatively (as a rebate) or positively (as a cost), and as a customer protection mechanism must also include a basic export level (an amount of electricity a customer can export at no cost). Differential pricing reflects the network congestion levels, and when the network would benefit from less or more exported energy.

[69] ESB, Customer Insights Collaboration – Release One, Stakeholder Steering Group, ESB, December 2021.

[70] ESB, Customer Insights Collaboration – DER Implementation Plan Customer Insights Collaboration Release One, Knowledge Share Report, ESB, June 2022, p 22.

[71] AEMC, Access, pricing and incentive arrangements for distributed energy resources, Rule determination, AEMC, 12 August 2021.

[72] AER, Export Tariff Guidelines, AER, June 2022.

We will consider these interactions as part of our Export Tariffs Guidelines and Tariff Structure Statement review process and through the implementation of the AEMC's access, pricing and incentives arrangements for distributed energy resources rule change. As uptake of flexible export limits increases and export pricing is implemented, we may need to consider the interaction of the two mechanisms, given their potential to respond to network congestion. These interactions will likely increase in complexity as the market evolves. This may require future review and oversight to ensure consumers are receiving the correct incentives. There is currently a knowledge gap in how feed-in tariffs from retailers, export tariffs and flexible export limits will interact to create efficient incentives and outcomes for consumers.

- ***How do stakeholders see flexible export limits and network tariffs interacting, for example, on the basic export level?***
- ***What types of tariff structures could apply to flexible export limits?***
- ***Do stakeholders have views on how export tariffs and flexible export limits could be implemented to complement each other?***

4.2.10 Compliance and enforcement of technical standards that facilitate flexible export limits

There are multiple aspects of what 'compliance' could mean with regards to flexible export limits. In this context, 'compliance' refers to three distinct touchpoints or interactions of a consumer's device (where the consumer has opted into flexible export limits):

- Communication between the device and the DNSP / trader flexible export server, which refers to whether device communication is connected, receiving flexible export signals, and staying connected
- Whether the device is physically performing appropriately and is continuing to operate within the limit
- How the device behaves when it has lost communications

We understand that the AEMC review of DER technical standards in the NEM is considering the roles and responsibilities in the context of compliance with technical standards, which will include consideration of CSIP-Aus. We acknowledge that DNSPs are likely to monitor device performance relating to operating within the limit in line with the connection agreement. DNSPs are also likely to use the functionality under CSIP-Aus to specify performance in the event of communications loss.

We will seek to leverage the existing work set out above with regards to compliance of the consumer device to the export limit.

- ***Are there any issues stakeholders consider will fall outside the AEMC's review of technical standards and consideration of associated roles and responsibilities the AER should be aware of?***
- ***Are there any issues that stakeholders consider will fall outside of CSIP-Aus that the AER should consider?***

- ***Do stakeholders foresee issues with DNSPs monitoring device performance?***

4.2.11 Device monitoring

Device monitoring ensures that consumer energy resources at the connection point do not exceed the flexible limits that are set by the DNSP. The exact approach depends on the risk allocation and other technical considerations such as access to data and notifications of non-compliance. DNSPs currently have different approaches to monitoring their low voltage networks.

We understand through the experience of DNSPs trialling the use of flexible export limits that monitoring adherence with the flexible export limit using the existing CSIP-Aus functionality is not a difficult undertaking and DNSPs will likely establish processes to identify instances where a consumer's energy resources exceeds the export limit or stops responding.

5 Future Actions

5.1 Future Actions

As noted throughout this paper, there is scope for potential future applications of flexible export limits beyond export management. We acknowledge that DOEs are expected to form a core part of the power system in future, including in assisting consumers derive additional financial benefits from their investment by participating in the wholesale electricity and FCAS markets, with the assistance of a trader. As such, to broaden the discussion we have included the following sections that contain potential future areas of consideration. We welcome stakeholder feedback on the classification of these gaps and proposed future actions.

5.1.1 Location of flexible export limit application

Critical to implementing flexible export limits is first establishing where the export limit is applied. Export limits can be allocated at the connection point of a household (the electricity meter), at a location that provides the limit for the flexible generation at the customer premises, at the device level (behind the meter), or at a common point behind the primary meter (representing an aggregation of multiple devices).

There may be additional benefits for future applications with the integration of further interoperability behind the connection point, with regards to devices such as electric vehicles. We will refer to the outcomes of the work being undertaken in the ESB's Interoperability workstream to progress these issues.

We also note AEMO's recent rule change request to the AEMC, which is likely to form the basis for enabling Flexible Trader model 2,[73] the second of the two models put forward by the ESB. This rule seeks to enable end users to separate controllable electrical resources and have them managed independently.[74] We note this rule is yet to be considered by the AEMC. Once the AEMC makes a determination, should it establish the model, the interplay with flexible export limits will have to be considered.

5.1.1.1 Capacity allocation point – potential market design impacts

A spectrum of options is available for DNSPs to adopt for capacity allocation, ranging from a centralised approach whereby capacity is uniformly allocated between connection points, through to more sophisticated competition-based allocations and market-based mechanisms, which would require more significant reforms to implement. The overarching point of allocation could theoretically occur at four system levels, as identified in the DEIP Report[75]:

1. **Allocation to aggregators**
2. **At the customer point of connection to the network**

[73] AEMC, Flexible trading arrangements for consumer energy resources – rule change request, AEMC, accessed July 2022.

[74] AEMC, Flexible trading arrangements for consumer energy resources – rule change request, AEMC, accessed July 2022.

[75] DEIP, Dynamic Operating Envelopes Working Group: Outcomes Report, ARENA, March 2022, p. 51.

3. **Allocation only to flexible generation**
4. **Allocated directly to DOE-enabled devices**

The DEIP outcomes report did not undertake cost benefit analysis of each model with regards to consumer benefits, impacts on role and responsibilities of other consumer energy resource ecosystem participants, and how each of these models would impact levels of rooftop solar able to be exported or be shared between consumers.

Given flexible export limits are under development for the first time in the NEM, from some industry trials, we have sought practical real-world evidence of their operation to better understand the market and system implications of their technical design, to inform the regulatory response in the best interests of consumers. An industry case study (see Appendix 5) demonstrates preliminary research that if a flexible export limit is applied on a flexible group of devices, an additional 20 per cent of energy was exported across the premises involved in the trial.

We understand that while DNSPs are currently focused on the application of a flexible export at the connection point, we acknowledge this may change in the future. The ESB may need to give consideration as to which model best meets the NEO. We do not consider our approach will prevent the development of new approaches to managing and maximising flexible export limits of consumer energy resources.

5.1.1.2 Capacity allocation – approach to 'fairness'

Further work is required in the near term to determine how the above capacity allocation principles and their technical application determines overall levels of consumer energy resource export and fairness across the entire consumer base. The information included at Appendix 4 leverages research being undertaken in Project EDGE, and some thinking being tested on how different 'Objective Functions' of DOEs (more broadly than just flexible export limits) impact consumer fairness outcomes.[76]

The project explores six different 'Objective Function' approaches to the design of flexible export capability (detailed in Appendix 4). Within Project EDGE, the current testing of the capability seeks insights into the best consumer outcome that the function should fundamentally achieve. As such, we do not comment as to a preference of options, only to provide the information that these options exist, to drive stakeholder consideration and discussion on the issue.

The ways in which flexible export limits are allocated across the consumer base in response to local network conditions can be achieved via different methods. Each of these functional approaches have a different impact on how excess export capacity is shared between consumers, which results in some exporting more and some less. Export management is the 'function' of flexible export limits, while the objective is to fairly share this spare capacity between all consumers, not only those with their own energy resources.

[76] AEMO, Project EDGE, AEMO, 2022.

As can be seen from this preliminary work, the key flexible export limit implementation principle – fairness – can be interpreted, defined, and applied in different ways, each with a different impact on all consumers, including those without DER. The DEIP outcomes report did not define fairness. As noted in the DEIP outcomes report, and indicated by the Project EDGE work, increased oversight of DNSP approaches to capacity allocation and the approach to 'fairness' to maximise long-term benefits for consumers may need to be considered in the future.

As the results from the Project Edge trials are published and consulted on, including details of the Objective Functions, we may consider whether a NEM-wide approach to 'fairness' for DNSPs when developing capacity allocation methodologies. We note, further detail is needed before consulting on the potential application of these findings.

5.1.2 Types of connections to which flexible export limits may apply

Numerous types of consumers connect energy resources to the distribution network, such as:

- Residential properties
- Commercial properties
- Community batteries
- Utility solar farms

While all of these could see flexible export limits applied, it is critical for implementation for DNSPs to determine which of the above would be offered dynamic connections, if not all. We will be cognisant of the regulatory framework as it relates to each of these different types of connections when considering flexible export limit reform.

We do not consider action is required at this time to ensure that flexible export limits are implemented and operated at specific connection point types. At this early stage of the roll-out, DNSPS are most appropriately positioned to determine which connection points should be offered dynamic connections.

5.1.3 Incentivising consumers to use flexible export limits

By opting into flexible export limits, consumers can provide flexibility to the market, which is becoming increasingly valuable across the NEM. As dynamic connections become more commonplace, DNSPs may look to retailers and/or traders to incentivise consumers to take up dynamic connection agreements in place of potentially lower static export options.

It is expected that in their options analyses required under the regulatory reset process, DNSPs will consider flexible export limits as an alternative to network augmentation. DNSPs should demonstrate in their option analyses that flexible export limits have been considered as a viable alternative to network augmentation to manage network congestion.

DNSPs should work with technology providers or traders to provide incentives in the future to develop innovative products to customers that benefit them. This is likely more appropriate than relying on DNSPs to communicate directly with consumers, given that the commercial relationship exists more strongly between the consumer and the retailer or trader.

Given the early stages of development of flexible export limits, we are of the view this gap does not need to be addressed yet. There may be a case in future to incentivise consumers, for which we can consider the appropriate policy mechanism to drive uptake, should we move beyond the opt-in approach.

5.1.4 Specification of implementation and operation

It is currently unclear what information will be needed to be submitted by DNSPs to the AER as to how flexible export limits will be operated and utilised.

Given the early stage of implementation of flexible export limits and the dynamic nature of consumer energy resources, many aspects of flexible export limits design will vary significantly between DNSPs or over time in response to factors such as technological change, changing consumer requirements or evolving implementations of flexible export limits.

We expect DNSPs to demonstrate to the AER their designs achieve efficiency and optimal outcomes for consumers. There may be the case for future action to prescribe a market design for flexible export limits, should there be greater uptake of dynamic connection agreements such that there is critical mass across the NEM that requires a consistent and transparent approach by DNSPs.

5.1.5 Efficient communication of flexible export limits at scale

The operation of any power system of any type fundamentally requires the exchange of data and information. Historically, this has been characterised by relatively few large assets, controlled by relatively few entities, sharing data among TNSPs, DNSPs, retailers and AEMO. Key categories of power system data include real-time operational data and network limit and constraint data.

Under AEMO's ISP Step Change scenario, there could be times when the entire NEM demand for electricity may be met with distribution connected resources. To facilitate the operation of dynamic operating envelopes (or flexible export limits), there will need to be orders of magnitude more data being shared amongst many more industry participants relating to millions of consumer energy resources.

In a high consumer energy resource future, consumers will be able to choose from multiple traders to maximise the benefit they derive from their investment. Traders are expected to operate portfolios made up of consumer energy resource spanning across multiple DNSPs to deliver multiple different services both to the market (e.g., energy or frequency control ancillary services) and off-market to other industry actors (e.g., network support to DNSPs or dynamic export limits to retailers during negative spot prices). This will occur across many thousand if not millions of devices.

In considering the national electricity objective, the process to efficiently enable this data exchange will become a key consideration in the development of the regulatory framework around the implementation of flexible export limits.

We will continue to seek examples and evidence in relation to efficient energy system data exchange and flexible export development more broadly.

- ***Do stakeholders have any views on which data exchange model may be the most efficient for the NEM?***

Glossary

Term	Definition
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
CECV	Customer Export Curtailment Value
CER	Consumer energy resources – also known as distributed energy resources, this term refers to 'behind the meter' renewable energy resources and can include rooftop solar PV units, battery storage, thermal energy storage, electric vehicles/chargers, smart appliances and home energy management technologies.
CSIP	Common Smart Inverter Profile
CSIP-Aus	Common Smart Inverter Profile – Australia
DER	Distributed energy resources, also known as consumer energy resources
DNSP	Distributed network service provider
DOE	Dynamic operating envelope
ECA	Energy Consumers Australia
ESB	Energy Security Board
ESOO	Electricity Statement of Opportunities
EV	Electric Vehicle
ISP	Integrated System Plan
NEM	National Electricity Market
NER	National Electricity Rules
OEM	Original Equipment Manufacturer
TNSP	Transmission network service provider

Appendix 1 – Questions for stakeholder feedback

Stakeholders are asked to provide feedback on the following questions, as well as any other comments they wish to provide. This list of questions is not meant to be exhaustive.

General questions

- Do stakeholders agree with the primary use case for the implementation of flexible export limits? *[The primary use case is the efficient and increased utilisation of the shared hosting capacity on the distribution network to enable consumers to obtain the benefits of exporting their energy resources such as solar PV to the grid]*

Immediate actions

Capacity allocation

- Do stakeholders agree with the DEIP Working Group principles for capacity allocation? Why / why not?
- Should these principles for capacity allocation be binding for DNSPs?
- Should the application of capacity allocation principles by DNSPs be auditable to assure consumers of fairness?
- Should principles for static export limits also be developed for use by DNSPs going forward?
- Do stakeholders have a view as to whether existing AER guidance material is sufficient to communicate expectations regarding capacity allocation principles for flexible and/or static export limits?

Capacity allocation methodology

- Is the approach outlined above [see section 3.3.2] in allowing flexibility for DNSPs to develop their capacity allocation methodologies appropriate?
- Do stakeholders agree that DNSPs should include their capacity allocation methodology in their CER integration strategy?
- Should DNSPs be required to publish their capacity allocation methodologies, clearly outlining the trade-offs considered in setting their approach?
- Should the AER have a role in approving DNSP capacity allocation methodologies? If so, what form should this mechanism take?

Consumer participation (opt-in or opt-out)

- Do stakeholders agree with the expectation that over the near to medium term, consumers should continue to have the option of static export limits?
- Should consumers be expected to opt-in or opt-out of flexible export limits (where available)?
- Is it necessary for this expectation to be captured in the Model Standing Offer?

Governance of traders and consumer energy resources

- Do stakeholders require further guidance with regards to the interactions of retailers and aggregators and flexible export limits outside of what is being explored through the existing workstreams?

Connection agreement

- Should DNSPs be required to set out expectations of flexible export limit operation within the connection agreement where there is no trader, or third party involved in the operation? Do stakeholders agree with the rights and obligations outlined above?

Governance arrangements for flexible export limits

- Do stakeholders have concerns about the approach to governance outlined above, particularly embedding elements of the rectification process in the connection agreement?
- Is it appropriate for a technology provider/OEM be held responsible for devices that do not conform to the export limit set by the DNSP (i.e., where this is no active control)?
- What is the appropriate governance arrangement for managing flexible export limits?
- Is it necessary to develop a separate framework to manage governance where a trader or technology provider is involved in passing-through the flexible export limit (i.e., where there is active control)?
- Do stakeholders agree with our view of that consumers should not face significant penalties for non-conformance of their energy resources for flexible export limits?
- Do stakeholders believe there needs to be a standardised approach to enforcement for consumer energy resources under the control of a trader? For example:
    - If notified by the DNSP of an issue with device conformance (where no trader is involved), it is appropriate for the responsibility of rectification to rest with the consumer?
    - Where a trader is involved, should responsibility for rectification rest with the trader?
- What should be the responsibilities of traders in ensuring consumer energy resources do not exceed any export limit set by the DNSP?

Notification period for a dynamic limit

- Does the issue of a framework for providing forecast information on expected dynamic limits need to be considered in the short term?
- Do stakeholders consider this will be sufficiently addressed through the Scheduled Lite workstream?

Broad questions regarding immediate actions

- Do stakeholders agree with the areas identified above as requiring immediate attention?
- Do stakeholders consider there are additional matters requiring immediate attention not covered here? If so, what are they, and what specific factors should we be considering?

Leverage existing work

Monitoring export limit performance and information provision

- Are there any additional metrics that should be considered that have not been incorporated into the broader export services review?
- Should the AER publish data on the performance of individual DNSPs in terms of their flexible export service for consumers?

Device capability to respond to flexible export limits

- Regarding the governance of a potential CSIP-Aus requirement, do stakeholders consider there should be a mandate for devices to be CSIP-Aus compliant for new connections in the NEM?
- Do stakeholders have views on how this mandate could be most effectively implemented?

Interval length

- Do stakeholders agree that DNSPs are best placed to determine the interval length of flexible export limit operation? If not, what guidance would stakeholders like to see on this issue?

Demonstrating investment need

- Do you agree the AER has sufficient guidance on what information DNSPs are expected to provide to justify specific flexible export-related proposals?
- Do DNSPs need more information than is currently available to demonstrate the investment need for flexible export limits?

Consumer protections

- Beyond the issues being canvassed in the Review of Consumer Protections for Future Energy Services and the AEMC's review of CER technical standards, are there any other specific consumer protection issues we should explore in the context of the implementation of flexible export limits?

Data protection and privacy

- Are more data protection and privacy requirements needed for the implementation of flexible export limits beyond those already available in the current framework and what is being considered in the ESB data strategy?
- What impact is there likely to be on metering service providers from the implementation of flexible export limits?

Consumer understanding and interest

- Should the Customer Insights Collaboration workstream be leveraged to improve consumer understanding of flexible export limits and/or for consideration of impacts upon consumers and consumer sentiment?
- What do consumers need to know about flexible export limits at each step in the journey to properly understand and engage with them?
- What communication materials do consumers need to understand the opportunities offered by flexible export limits?

Integration with export pricing

- How do stakeholders see flexible export limits and network tariffs interacting, for example, on the basic export level?
- What types of tariff structures could apply to flexible export limits?
- Do stakeholders have views on how export tariffs and flexible export limits could be implemented to complement each other?

Compliance and enforcement of technical standards that facilitate flexible export limits

- Are there any issues stakeholders consider will fall outside the AEMC's review of technical standards and consideration of associated roles and responsibilities the AER should be aware of?
- Are there any issues that stakeholders consider will fall outside of CSIP-Aus that the AER should consider?
- Do stakeholders foresee issues with DNSPs monitoring device performance?

Future actions

Efficient communication of flexible export limits at scale

- Do stakeholders have any views on which data exchange model may be the most efficient for the NEM?

Appendix 2 – Current regulatory framework

Trials of flexible export limits are already underway in some distribution networks in the NEM, with plans for broader implementation by other DNSPs. These trials and the proposed implementation plans have occurred under our current regulatory framework that is outlined below in the context of flexible export limits.

Expenditure proposals under the regulatory framework

We assess expenditure forecasts under the regulatory framework set out in the National Electricity Rules. This is an input to the development of our revenue determinations. These determinations, often referred to as 'resets', involve an extensive regulatory process where we confirm how much a network business can recover from its customers over a five-year period (the regulatory control period). Network businesses generally recover capital expenditure over several regulatory control periods as the assets have long useful lives.

For electricity networks, we must decide whether the network business' proposal reflects prudent and efficient costs, including whether their demand forecasts are reasonable given the business' expectations of future demand. Where a network business seeks approval to undertake capital expenditure, it will also provide a quantitative cost-benefit analysis assessing all feasible options to show the proposal maximises net benefits.[77]

In our Better Resets Handbook, we set out our expectation that high quality consumer engagement is essential for ensuring network business provide the services that meet the needs of their consumers, at a price that is affordable and efficient.[78] In recent years, the AER has observed material improvements by network businesses engaging with consumers as part of the regulatory process. This consumer engagement will continue to be critical through the transition and is expected to form an important part of the implementation of flexible export limits.

DER integration expenditure guidance note

As consumer energy resource uptake grows and consumer expectations in relation to the performance of their energy resources develop, DNSPs are investing in projects to increase hosting capacity and support export services. DNSPs are expected to quantify the expected benefits of the project.

Our DER integration expenditure guidance note outlines our expectations for DNSPs in terms of developing their business cases and quantifying the associated impact of network investments for CER integration.[79] The guidance note also assists DNSPs to develop CER integration plans and investment proposals in consultation with their consumers.[80]

Customer Export Curtailment Value (CECV) methodology

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[77] AER, Better Resets Handbook – Towards Consumer Centric Network Proposals, AER, December 2021, p 21-22.

[78] AER, Better Resets Handbook – Towards Consumer Centric Network Proposals, AER, December 2021, p 12.

[79] AER, DER Integration Expenditure Guidance note, AER, June 2022.

[80] AER, DER Integration Expenditure Guidance note, AER, June 2022.

In August 2021, the AEMC made a final determination updating the National Electricity Rules and National Energy Retail Rules to integrate consumer energy resources more efficiently in the NEM (the rule change).[81] The determination requires us to develop a CECV methodology to be used to calculate CECVs each year and publish the associated values.[82]

In its determination, the AEMC indicated the use of CECVs would guide efficient levels of network expenditure for the provision of export services and serve as an input into network planning, investment, and incentive arrangements for export services.

In June 2022, we published our Final CECV methodology, setting out the objective that the methodology and customer export curtailment values should be fit-for-purpose for any current or potential uses of customer export curtailment values that we consider to be relevant.[83]

We have interpreted the CECVs to represent the detriment to all customers from the curtailment of consumer energy resource exports, where the curtailment limits customer export. Therefore, the CECVs also represent the benefit to all customers where the curtailment is alleviated to support greater levels of export.[84]

CECVs are expected to inform proposals for network investment to enable increased consumer energy resource export. Where flexible export limits are implemented by DNSPs, CECV determinations will have to account for the benefit to consumers and the market of additional investment in network infrastructure, over and above the benefit provided by flexible export limits.

Export Tariff Guidelines

Under its rule change, the AEMC requires us to make Export Tariff Guidelines. Any proposal to introduce export charges requires approval from us through the five yearly tariff structure statement process. These proposals must meet requirements specified in the National Electricity Rules.

In May 2022, we released the Export Tariff Guidelines and an accompanying explanatory statement that describes how DNSPs should develop and justify two-way pricing proposals. The Export Tariff Guidelines include guidance on customer protections, the need for any two-way pricing proposals to be justified, our process for approving or not approving any two-way pricing proposals, our expectations of networks to consult with their customers if they plan to introduce two-way pricing, and the basic export level, or free export service, which must accompany any two-way pricing proposals.

The explanatory statement to the Export Tariff Guidelines acknowledges the interactions between tariffs and export limits (static or dynamic/flexible), network investment and customer preferences are complex and likely to change over time. The Export Tariff Guidelines also note that DNSPs should consult meaningfully with consumers to enable

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[81] AEMC, Access, pricing and incentive arrangements for distributed energy resources, Rule determination, AEMC, 12 August 2021.

[82] NER rule 8.13

[83] NER rule 8.13(a)

[84] AER, DER Integration Expenditure Guidance note, AER, June 2022.

informed feedback on options for them to respond to large volumes of exported power into their networks while developing tariff structure statement proposals.

Network performance reporting

In recent years, we commenced annual electricity network performance reporting. These reports analyse outcomes and trends concerning the operational and financial performance data we collect from electricity network service providers. The latest report was published in July 2022 and includes data for DNSPs and transmission service providers in providing core regulated services.[85]

Consistent with the AEMC's final determination on the access, pricing and incentive arrangements for distributed energy resources, we must report annually on the performance of DNSPs in providing export services to customers. We recently released the *Incentivising and measuring export service performance consultation paper*[86] which outlines the approach to expanding the existing annual performance reporting to address this requirement.[87]

Static zero export limits for new rooftop connections issues paper

We are in the process of reviewing our connection charge guideline regarding whether DNSPs may, under exceptional situations only, impose a static zero export limit on new rooftop solar generators. A static zero export limit means that a customer is prevented from accessing the network to export electricity at any time. We have identified several issues in our consultation paper, including whether consumers with pre-existing rooftop solar connections should have higher priority access to exports.

The outcome of this work may influence future uptake of flexible export limits. Flexible export limits will inform distributors to design their specifications on dynamic operating systems to be added to customers' PV systems to avoid a static zero export limit. Zero export limits could be offered to customers who apply for connection of new rooftop solar connections, where the cost to otherwise augment the network has been deemed inefficient, unless they can install a suitable dynamic response system to avoid creating unacceptable voltage rise.[88]

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[85] AER, Electricity network performance report, AER, July 2022. Core regulated services are called Standard Control Serves for electricity DNSPs and Prescribed Transmission Services for electricity TNSPs

[86] AER, Incentivising and measuring export services performance, AER, August 2022.

[87] AEMC, Access, pricing and incentive arrangements for distributed energy resources, Rule determination, AEMC, 12 August 2021.

[88] AER, Connection Charge Guideline review 2022, AER, August 2022.

Appendix 3 – Consumer risk assessment tool

Context
The foundation of the National Electricity Market's energy consumer protections framework is the Australian Consumer Law (ACL), National Energy Customer Framework (NECF, set out primarily in the National Energy Retail Law and Rules) and Victorian Energy Retail Code (Victorian Retail Code). As more consumers move to distributed energy resources (DER), and digitalisation and better data are increasing control and communication options, we need to consider what consumer protections and other measures are needed to ensure customers do not bear unreasonable risks. The market bodies will use this tool to consider consumer risks and benefits in policy development, including rule change requests (as part of considering the National Energy Retail Objective), reviews of guidelines and processes that would impact consumers. It will also be used through the maturity plan releases to help ensure solutions identified appropriately consider risks and benefits.

Communicate and consult

Benefits assessment

- How would the change, or new product/service deliver benefits to different types of consumers? Are there individual, customer-side or system-wide benefits? How do consumers with DER benefit compared to those without? What are the impacts on vulnerable and disengaged customers?
- How are these benefits likely to change as the future energy system changes? Will these benefits only be realised in the future?
- How will consumers find out about the benefits?
- What evidence is there that consumers want this? And whether it solves current problems?

Map out how it achieves the following consumer protection principles:

- **Access to energy**: Recognising that energy is an essential service, customers should have access to at least one source of electricity.
- **Switching providers**: Customers should be able to change retail providers when they choose.
- **Access to information**: Customers should have access to information that is sufficient, accurate, timely and minimises complexity and confusion to allow them to make informed decisions.
- **Vulnerable consumers**: The needs and circumstances of vulnerable consumers will need to be explicitly considered.
- **Dispute resolution**: Customers should have easy access to no cost dispute resolution mechanisms when things go wrong.

Identify risks

- What are the barriers to consumers receiving the benefits?
- What risks or issues could arise for consumers considering the multiple aspects of the consumer experience, situations and the diverse range of customers?
- What consequences could arise if the risk is not addressed or the barrier is not removed?

Evaluate

Evaluate the magnitude of the risk or issue:

- Consider whether it is a significant risk of harm or an inconvenience.
- Rank the risks based on severity of consequences and the likelihood of it occurring.

Evaluate how the market bodies can address the risk or issue:

- Can they **act**? Is it within their regulatory powers to address? For example, can it be addressed through changes to the National Energy Retail Rules or to the retailer authorisation/exemption process?

Monitor and review

	• Can they **influence**? Can market bodies influence actions by jurisdictions or the ACCC to address the risk? • Should they **monitor**? Is the risk beyond the scope of energy policy or a risk that is not yet imminent and would benefit from ongoing monitoring?	
	Treat risks • What are the mitigation options? Are the options proportional to the impacts? • Which option is best considering the consumer protections principles in combination with the National Energy Retail Objective? • Re-analyse risk after selecting treatment to determine if there are any residual risks that require action. • Who is responsible for progressing the risk mitigation? • How will it be done and by when?	

Appendix 4 – Dynamic Operating Envelopes: how their Objective Function can influence fairness

Objective Function: Maximise NEM Export

The aim of this Objective Function is to unlock the most network capacity possible under a constraint. The spare capacity can be utilised by traders of consumer energy resources to maximise provision of rooftop solar, battery and EV export for the benefit of all consumers, including without consumer energy resource, via the wholesale market benefits additional supply provides.

When the DOE is activated – the spare capacity is shared in a manner that allows the most CER export across the entire NEM, rather than all owners receiving an equal amount of export reduction to meet the constraint.

The NEM consists of nine million connection points with a subset of this figure, around three million including consumer energy resources. The surplus network capacity that may be available at any time is funded by all consumers, and so when access to that spare capacity must be shared, it is shared in a manner that benefits all consumers including those without consumer energy resource, by maximising rooftop solar, battery and EV export. In practice this also means that when a DOE is activated some individual energy resources will be constrained more than others.

This Objective Function considers fairness as defined by what is ‘fair’ for everybody as shared users of a shared power system, rather than fairness specific to the subset of individual sites that have consumer energy resource installed. Of all options, the relative network and market efficiency of this Objective Function and its benefit to all electricity consumers is considered to best align with the National Electricity Objective (NEO).

Objective Function: Policy Based

The aim of this Objective Function is to enable policy integration flexibility in DOE application. The DOE allocation is designed to meet a policy objective, such as environmental, economic or bespoke local area requirements. Such Objective Functions are applied a ‘weighting’ when the DOE is calculated. A ‘weighting’ is assigned to the consumer energy resource or site based on meeting the policy objective, such as:

- Assigned based on socio – economic considerations – those that can least afford constraint reduced last / the lowest
- Assigned based on economic considerations - higher weighting to consumer energy resources with lower costs/bids.
- Assigned based on CER firmness – priority given to more reliable consumer energy resources.
- Assigned based on location – priority given to stronger areas of the network.

This Objective Function considers fairness by integrating externalities.

Objective Function: Proportional Asset

The aim of this Objective Function is to apply relative fairness among CER owners in meeting the DOE by allowing them all to export the same percentage of their devices' total capacity.

The value of the X per cent is determined by the DSO to meet the DOE while maximising all CER export.

Under this model there is a percentage of export reduction that is equal across all systems. For example, if the CER are all allowed to export at 80 per cent to meet the DOE, then each system has been constrained by 20 per cent. This means consumers with larger systems are given a higher allocation of the shared network capacity, because a bigger system is reduced to a level that is still a higher kW total than the amount of a smaller system.

This Objective Function considers relative fairness based on system capacity.

Objective Function: Equal Individual Conservation

The aim of this Objective Function is to apply fairness among CER owners in meeting the DOE by reducing everyone's export by the same amount of kW.

This value of X kW is determined by the DSO to meet the DOE while maximising all CER export.

Under the above Proportional Asset approach, the level of CER export for all consumers is equal by system capacity, but in practice this means the KW level of reduction that occurs to meet the DOE differs based on system size. A 20 per cent reduction on a 10kW system = 2 kW, and on 5 kW system = 1 kW. This is not equal in terms of the number of kW that are exported and monetized. It should be noted that this Equal Individual Conservation objective can result in smaller CER being allocated no capacity.

This Objective Function extends on the principle of fairness among CER owners by moving from a relatively fair allocation (%) to more absolute values (kW).

Objective Function: Shared Equal Individual Allocation

The aim of this Objective Function is to apply fairness specifically among CER owners by allocating them all equal export capacity in kW, without over allocating capacity to customers that cannot be used. CER owners receive the smaller of a universal kW value or their CER rated capacity.

The value of kW allocated is determined by the DSO to meet the DOE, using knowledge of customers' CER rated capacity.

This Objective Function's approach to fairness means CER owners are meeting the DOE with as close to equal export capacity possible, with spare capacity shared among CER owners in the widest manner possible. This approach could result in less total export to the NEM and a corresponding diminished benefit to non-CER consumers. This is because the consumers' location in the network is not considered, and due to physics of energy flow and voltage, those customers closest to the 'head of the feeder' may have been able to utilise

more than their export capacity allocation based on very localised network voltage conditions.

Objective Function: Absolute Equal Individual Allocation

The aim of this Objective Function is to apply a strict definition of fairness among CER owners by allocating each individual site or CER the same kW export capacity regardless of whether the site's CER can utilised the full allocation.

Each participating CER is assigned X kW. The value of X is determined by the DSO to meet the DOE while maximising individual CER export. There is no consideration of system size or reduction by kW to meet the DOE - rather the overall export reduction required is met by simply dividing the total DOE constraint across the fleet to a number that is the highest level any system could export regardless of size.

This Objective Function's approach sees fairness applied here by ensuring each individual consumer's CER can always export the maximum amount possible when a DOE is applied. This means if a system's size is under that export allocation level / sharing – the constraint may not apply to them but overallocated export capacity would represent a wasted opportunity to benefit all electricity consumers including non-CER.

Appendix 5 – Dynamic Operating Envelopes: Point of allocation

This research was performed using GridQube's DOE system which was deployed in real-time within an Australian distribution network. Real-world load and generation data for a both a peak generation (sunny day) and low generation (cloud/rainy day) day was applied to one of this network's feeders.

This load and generation data was scaled to match the number of customers on the feeder to simulate a network with 50 per cent and 100 per cent DPV penetration. The power flows on the network's feeder were modelled with this scenario and applied the network's standard technical limits to ensure the DOEs calculation was realistic. The DOE allocation was applied equitably across the consumer base, and then tested two alternative 'premise level' points of allocation of the DOE – the separated flexible devices and the net connection point.

1) FLEX: Allocation to flexible load and generation only (excluding native load)

2) NET NMI: Allocation to individual connection points (including native load)

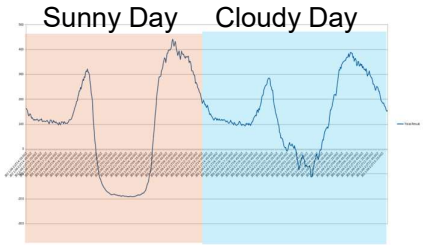

Figure 1 Flex Aggregated load on the feeder

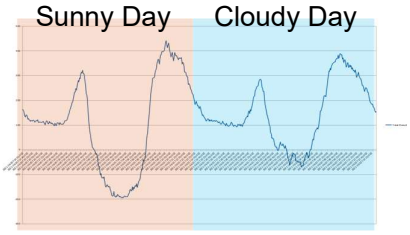

Figure 2 NET NMI Aggregated load on the feeder

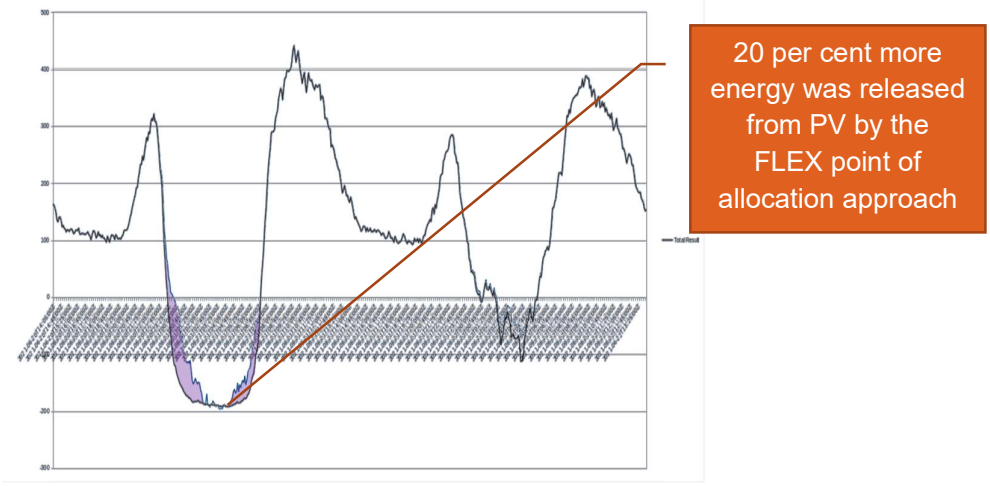

Figure 3 Overlaying the two points of allocation across aggregated load on the feeder

The results of this preliminary study demonstrate for a sunny day there was a 20 per cent difference in the amount of DPV generation released into the network, when the DOE was applied on the flexible devices rather than at the net connection point.

This highlights that there are different outcomes in the DOE point of allocation at the premise that should be further tested and trialled to ensure consumers are receiving the maximum benefit available of this technology.