ENERGY SECURITY BOARD

INTEROPERABILITY POLICY FOR CONSULTATION

DIRECTIONS PAPER

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Abbreviations and Technical Terms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
AS	Australian Standard
CA	Certificate Authority
CBA	Cost Benefit Analysis
CEC	Clean Energy Council
CER	Clean Energy Regulator
CER	Consumer Energy Resources
CIC	Customer Insights Collaboration
CSIP	Common Smart Inverter Profile
CSIP-Aus	Common Smart Inverter Profile – Australia
CSML	Contingency and Minimum System Load
DEIP	Distributed Energy Integration Program
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
DOE	Dynamic Operating Envelope
DRSP	Demand Response Service Providers
FEL	Flexible Export Limit
ECA	Energy Consumers Australia
ESB	Energy Security Board
FEL	Flexible Export Limits
FRMP	Financially Responsible Market Participant
HEMS	Home Energy Management System
IEEE	The Institute of Electrical and Electronics Engineers
IEEE 2030.5	IEEE Standard for Smart Energy Profile Application Protocol
IP	Internet Protocol
IRP	Integrated Resource Provider
ISC	DEIP Interoperability Steering Committee
ISP	Integrated System Plan
LAN	Local Area Network
NECF	National Energy Customer Framework
NEL	National Electricity Law

NEM	National Electricity Market
NEO	National Electricity Objective
NERO	National Energy Retail Objective
NER	National Electricity Rules
MASP	Market Ancillary Service Providers
MSGA	Market Small Generation Aggregator
OEM	Original Equipment Manufacturer
PKI	Public Key Infrastructure
PV	Photovoltaic
SAHB	Standards Australia Handbook
SAPN	South Australia Power Networks
SEP2	Smart Energy Profile 2 (IEEE 2030.5)
SRES	Small Scale Renewable Energy Scheme
SWG	Stakeholder Working Group
TNSP	Transmission Network Service Provider
TS	Technical Specification
VPP	Virtual Power Plant

Executive Summary

Consumers are leading a distributed energy transition enabled by technology

Australian energy consumers are leading the world in the uptake of rooftop solar PV and are also investing in a range of other forms of 'Consumer Energy Resources' (CER) such as batteries, home energy management systems, and increasingly, smart chargers for electric vehicles. In doing so, consumers are making a major contribution to the decarbonisation of the energy sector. Greater interoperability of the equipment people install in their homes, businesses and communities will help these energy resources connect and work together as part of a clean and smart consumer energy resources ecosystem.

The fundamental benefit of interoperability flows to customers where it enables them to easily access and take up different products and services *where they wish to do so*. Interoperability supports the customer journey for consumer energy resources, by making it easier to choose different energy services (including switching), expanding opportunities to be rewarded for participating in different markets, and reducing the complexity and time associated with managing and maintaining equipment. By streamlining the customer experience, and value on offer, interoperability also plays a critical role in supporting the overall flexibility of the energy system, reducing costs and improving security for all electricity customers whether they have consumer energy resources or not.

Process to date

The Energy Security Board (ESB) has been tasked by Ministers to deliver the CER Implementation Plan as part of the Post-2025 Market Reforms.[1] In its advice to Ministers, the ESB outlined the need to move towards mandates for technical standards for active consumer energy resources and to progress the development of accompanying policies that can ensure these standards meet the changing needs of energy consumers. The ESB engaged FTI Consulting (FTI) to support development of its advice regarding the implementation of CSIP-Aus as a first step towards delivering consumer energy resource interoperability. This built on prior work by FTI that developed an assessment framework for consumer energy resource interoperability policy, which was consulted on by the ESB in 2021 and provided the basis for feedback from a wide range of stakeholders.[2] Feedback from stakeholders has provided an important input into the development of the ESB's proposed policy direction.

Stakeholders support effective, national interoperability policies

Australia is contributing to international efforts to develop common communications protocols and technical standards for CER interoperability. CSIP-Aus is an Australian adaptation to the Common Smart Inverter Profile (CSIP) IEEE 2030.5 Implementation Guide for Smart Inverters, which provides capability to deliver Flexible Export Limits (as well as Dynamic Operating Envelopes). Stakeholder feedback has conveyed a need for overarching guidance from the energy market bodies on how CSIP-Aus can be implemented in a nationally consistent manner and more broadly, how Australia can progress common interoperability and communication standards for consumer energy resources in the NEM. Stakeholders pointed out that national standardisation would provide clarity to industry, including manufacturers, and confidence to invest in the development and offering of a wider range of more sophisticated services and smoother experiences for customers.

A national CSIP-Aus mandate for 'flexible export ready' installations

A primary purpose of this paper is to seek input from stakeholders on pathways to achieve a nationally consistent implementation of CSIP-Aus that supports positive outcomes for all energy consumers. This includes how a national certification process for products that support CSIP-Aus should be delivered, and a

[1] energy.gov.au/[...]/national-electricity-market-reforms/post-2025-market-design

[2] Available from – energy.gov.au/[...]/der-implementation-plan-interoperability-policy-framework

mandate for all new installations to be 'flexible export ready' with a target commencement of July 2024. Stakeholder feedback is sought on benefits, costs, and risks of a mandate and potential timeframes. The 'flexible export ready' mandate would not require Distribution Network Service Providers (DNSPs) to implement flexible export limits before it is economically efficient for them to do so.

The mandate is proposed to relate to new systems and assets only from the date of commencement of the requirements and would not apply to pre-existing systems that households and businesses have already installed. Stakeholder feedback is also sought on what format 'CSIP-Aus' should take and what may be the most appropriate 'standardisation' process.

Interoperability beyond Flexible Export Limits

It is acknowledged that CSIP-Aus is a building block within the broader interoperability standards ecosystem. This initial step is not intended to restrict innovation in energy services for consumers. Rather, a 'flexible export ready' mandate for consumer energy resources should act to increase the opportunity and urgency of other interoperability use-cases. These include behind-the-meter interoperability and interoperability with retailers (and other traders and aggregators), that could support product and service innovation and greater customer choice, while also helping protect consumers from technology lock-in. This paper seeks stakeholder feedback on future priorities for standardisation and potential mandates for these and other use-cases. Initial advice from the Distributed Energy Integration Program's Interoperability Steering Committee (DEIP ISC) regarding the technical viability of these use-cases is expected toward the end of 2022, and the ESB proposes to focus on future use-cases following the ISC's advice, under its Horizon 2 of the CER Implementation Plan in 2023.

1. Introduction

1.1 Background

The Energy Security Board (ESB) was tasked by the former COAG Energy Council to deliver a market design for the National Energy Market (NEM) to meet customer needs through the energy transition beyond 2025. In its final advice to Ministers for Post-2025 Market Reforms, the ESB recommended a Distributed Energy Resources (DER) Implementation Plan to support the effective integration of DER and flexible demand.[3] The term 'DER' has since been replaced with 'CER', or consumer energy resources, to emphasise and focus on consumers' direct and indirect interest in new technologies and services.

In October 2021, Ministers endorsed ESB recommendations and tasked ESB with delivery of the CER Implementation Plan over the next three years. As part of this, the ESB outlined the immediate need to move towards mandates for technical standards for active consumer energy resources and, in parallel, to progress the development of accompanying policies that can ensure these standards work in customers' best interests. The principal customer outcome targeted is that consumers have access to secure, reliable, affordable and sustainable energy no matter how they choose to participate and whether they have consumer energy resources or not.

For customers to have access to a wide range of energy providers and plans to enable choice in how they want to manage their energy use and their devices, providers will require the ability to communicate with and operate these devices. This is referred to as the 'interoperability' of devices. Horizon One of the Implementation Plan targets the first phase of technical interoperability, communications, and cyber standards for consumer energy resources, and definition of interoperability polices.[4] Effective standards will enable customers to make choices to take up new products and services and unlock greatest value to customers from their flexibility.

Policy advice regarding the application of relevant features within these standards is important to ensure they are applied weighing up factors in the overall interests of consumers consistent with the National Electricity Objective (NEO), and the National Energy Retail Objective (NERO). Clear policy direction regarding application of the standard will also provide the benefit of forward visibility to product vendors and service providers in the market. This will assist forward planning and support future readiness for new capabilities.

1.2 Approach

Work to progress the development of relevant technical standards has been progressed via the Distributed Energy Integration Program (DEIP), facilitated by the Australian Renewable Energy Agency (ARENA).[5] This has included development of the interoperability standard 'CSIP-Aus', adapting the CSIP IEEE 2030.5 implementation guide from the United States to facilitate Network-Customer communication for the purposes of Dynamic Operating Envelopes (including Flexible Export Limits).[6] This supports Horizon One

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[3] Available from – ESB | Post-2025 market design: Final advice to Energy Ministers – Part A

[4] Available from – ESB | DER Implementation Plan – reform activities over three-year horizon | December 2021

[5] The ARENA-facilitated Distributed Energy Integration Program (DEIP) has established an industry led steering committee on technical standards, referred to as the Interoperability Steering Committee (ISC), with wide representation across the sector.

[6] CSIP-Aus (Common Smart Inverter Protocol - Australia) is the Australian adaptation of the IEEE 2030.5 implementation that has been mandated for inverter-based resources in California (CSIP).

activities, particularly first steps towards phasing in of dynamic operating envelopes (DOEs) as the long-term feature of the NEM DER ecosystem.

The ESB engaged FTI Consulting (FTI) to develop policy advice regarding the implementation of CSIP-Aus as a first step towards delivering consumer energy resource interoperability. This built on prior work by FTI that developed an assessment framework for consumer energy resource interoperability policy which was consulted on by the ESB in 2021, with feedback received from a wide range of stakeholders.[7] The second and third horizon of activities in the Implementation Plan will include trader services models and processes for switching between providers.

FTI analysis has informed our thinking, which has continued to develop with stakeholder input. The ESB's interoperability work has been informed by engagement with stakeholders including representatives from jurisdictions, market bodies, DNSPs, OEMs and NEM market participants, consumer groups as well as publicly available information. The engagement with stakeholders under the CER Implementation Plan has included regular sessions with the ESB's CER Stakeholder Working Group (SWG). This engagement has been invaluable in identifying the benefits, costs, and risks of proposed technical standards to support consumer energy resource interoperability.

1.3 Outcomes from stakeholder consultation and analysis

The ESB Customer Insights Collaboration[8] has identified a range of barriers to customers managing and being rewarded for managing their energy use and consumer energy resources in flexible ways. Insights from research and trials surveyed as part of this work indicates that consumers who have already invested in consumer energy resources are not necessarily motivated to change the way they use their assets for the rewards that are currently on offer, and access, understanding, and trust are material barriers for consumers who are yet to engage with new products and services.[9] This has profound implications for the energy sector, which cannot take consumer participation in new products and services for granted. It also highlights the critical role interoperability can play in overcoming barriers to participation, provided the settings are aligned with the interests and expectations of consumers – particularly where they enable remote communication and third-party management of consumer energy resources.

FTI analysis also noted consumers' desire to be informed about how consumer energy resource usage fits into the broader energy transformation, just as DNSPs and OEMs do. Consumers need better and clearer information at each stage of their journey, consistent messaging, and guidance on who to turn to for help. Concerted efforts are required by the sector to take customers on a journey to get to the point where they can have confidence in smart devices in homes and businesses so they can talk to and engage with the market in the ways contemplated by the CER Implementation Plan.

Non-interoperable consumer energy resources restricts consumers' future choices, reduces the value consumers can derive from their flexibility, and poses significant challenges for grid security. Greater interoperability, on the other hand, can create value for customers, directly through increasing revenue opportunities for those customers with consumer energy resource, and by improving the efficiency and reducing costs across the electricity system, indirectly benefiting all consumers. A key challenge is to develop technical, regulatory and governance frameworks that enable an effective balance of some active management of consumer energy resource assets, to avoid more onerous requirements that restrict the potential value of consumer energy resource to consumers.

A key focus for stakeholder feedback was the need for greater clarity around the roles and responsibilities of stakeholders – including consumers, who should be assumed to not have the bandwidth to engage with their energy services any more than they already do – in relation to interoperability compliance. There has

[7] Available from – energy.gov.au/[...]/der-implementation-plan-interoperability-policy-framework

[8] Available from – esb-post2025-market-design.aemc.gov.au/[...]how-we-are-delivering-for-customers

[9] Available from – ESB | CIC Knowledge Share Report

also been significant interest by stakeholders in setting out how the roles and responsibilities associated with interoperability interact with existing regulatory frameworks. The ESB is seeking to work on these issues together with its market body colleagues, including through consultation papers released in parallel with this Directions Paper, as discussed below.

1.4 Relationship to other activities

Three consultation papers are being released in September-October 2022 as part of the CER Implementation Plan.

The ESB and market bodies welcome stakeholder consideration and input into these processes. We are aware of the interlinked nature of these issues and the importance of considering how they work together as a package for consumers. We are also very mindful of the considerable time commitment required of multiple consultations on stakeholders and interested parties.

To support this broader consideration, where stakeholders provide feedback into any of these processes, these insights will be shared across the agencies. The ESB and market bodies will be seeking to hold joint webinars to enable collective stakeholder consideration of issues also. Dates for submissions and stakeholder webinars will shortly be published on the ESB website (https://esb-post2025-market-design.aemc.gov.au/).

The following table summarises the scope of the papers to assist stakeholders plan their engagement.

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.
Implementation of Flexible Export Limits by Distribution Network Service Providers (DNSPs) 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.

The ESB notes that there are several other reform initiatives underway, or planned, that have close relationships with this work. In coordinating reform activities across the CER Implementation Plan, the ESB and market bodies are considering the implications for related work programs. These include:

- The **ESB Data Strategy:** The ESB was tasked by Energy Senior Officials with delivering the Data Strategy in December-2021 together with market body colleagues. The Data Strategy is seeking to reduce barriers to accessing existing data sets, enabling more effective policy and decision making and delivering value to consumers. Initial consumer energy resources related projects in the Data Strategy are focussed on developing market use-cases for low-voltage network data and undertaking real-world trials of alternative data definitions to meet these needs, considering the varied state of network data in different regions in the near and longer term.
- The **Customer Insights Collaboration** (CIC) is an ESB-led initiative bringing a diverse range of consumer and stakeholder interests together, to build an evidence base to inform reforms (and related policy initiatives) across the Post-2025 CER Implementation Plan.
- **Review of Consumer Protections for Future Energy Services** is an AER led initiative that will review the retailer authorisation and exemption framework as defined in the Retail Law. This will include an assessment of the adequacy of the current consumer protection framework and their application.
- The **Flexible Trading Arrangements** rule change request, put forward by AEMO, seeks to better support consumers with unlocking the value of the consumer energy resource assets. The rule change, if successful, will enable customers to engage with a single retailer for their electricity supply and a second provider for consumer energy resource specific services (i.e. battery services).
- **Scheduled Lite** workstream seeks to develop a voluntary mechanism to incentivise the participation of non-scheduled load and generation in the NEM. AEMO has been tasked by the ESB to prepare a high-level design for the scheduled lite mechanism which will be used to inform the development of a rule change request.

1.5 Document structure

The first half of this paper (Sections 2 and 3) provides context for interoperability of consumer energy resources. Section 2 explains the foundation of consumer energy resources in technology innovation and investment being driven by consumers, for consumers. The value of interoperability in providing options for customers and enabling ongoing innovation is outlined, before explaining the need for effective national interoperability policy to support consumers and industry. Section 3 describes the interoperability landscape for consumer energy resources in more detail, including roles and responsibilities for delivering on customer and energy system outcomes.

There are five interoperability domains, and a number of use-cases, which have been presented as a framework to form the basis for policy prioritisation and work planning. The subsequent parts of this paper lay out the ESB's first priority for standardisation as interoperability for flexible exports through CSIP-Aus. Section 4 describes possible actions to achieve a nationally consistent approach as the foundation for the broader integration of consumer energy resources. This will be used as a building block for the consideration of other domains in 2023 including behind-the-meter interoperability and trader use-cases.

1.6 Next steps

The ESB invites feedback from interested parties in response to this consultation paper by 17 November 2022.

The ESB intends to hold a workshop with stakeholders and interested parties on the material covered in this paper on 24 October 2022.

Interested parties are invited to register their interest by email to info@esb.org.au.

2. The need for an interoperability policy

2.1 Technology innovation and investment is being driven by consumers, for consumers

Section summary

The foundation of consumer energy resources in technology innovation and investment being driven by consumers, for consumers.

The value of interoperability in providing options for customers and enabling ongoing innovation.

The need for effective national interoperability policy for consumers and industry.

Technology is enabling new ways for consumers to manage their energy needs and engage with the electricity system and markets. Scalable equipment, particularly rooftop solar, is powering a consumer energy resources revolution, with customers at its heart. As distinct from the centralised energy system built around large-scale thermal generation, these are consumer assets owned and operated directly for consumers' benefit.

The uptake of rooftop solar is, in important ways, an Australian success story. The photovoltaics (PV) solar cell technology that came to dominate the global solar panel market has been pioneered by Australian researchers and Australia is world-leading in per capita uptake of rooftop solar.[10] We are seeing continued rapid uptake across the NEM – currently at over 3 million residential solar installations, the 2022 Integrated System Plan (ISP) forecasts a near five-fold increase in distributed solar by 2050.[11] Rooftop solar is now part of our culture and increasingly present throughout our built environment.

Energy consumers are also investing in other forms of consumer energy resources – from home energy management systems through to electric vehicles and smart chargers – motivated by a range of drivers including to increase control over their energy use and manage their bills, and for environmental and community reasons. Energy Consumers Australia's latest Behaviour Survey indicates that 30 percent of households expect most of their home appliances to be internet connected, and automated in the next 5-10 years.[12]

2.2 Interoperability provides options and enables ongoing innovation

Interoperability can enable device management by third parties, but it does not inherently impose it. A laptop with electronics utilising standardised Wi-Fi (IEEE 802.11) communications protocols can communicate with other computers using Internet Protocol (IP). This enables communication between devices, but adopting these communications protocols does not inherently mean one computer can control another. The fundamental benefit of interoperability flows to customers where it enables them to easily access and take up different products and services *where they wish to do so*.

Rooftop solar, and other complimentary technologies including household batteries, rely on inverters to convert DC power, the form in which it is generated or stored, to AC power – the form it is transmitted and often consumed. These resources include a control system to ensure safe operation and to avoid adverse impacts on customer equipment and the broader grid. Device management can include manual switching via a hardware or application interface, and automation. In practice it is usually a combination of both. Even the simplest solar installation has a management system that limits exports to remain within local (static) export limits.

Home energy management systems (HEMS) can also loop in smart appliances, such as air conditioners or water heaters, and coordinate them to make the best use of local generation or wider market conditions.

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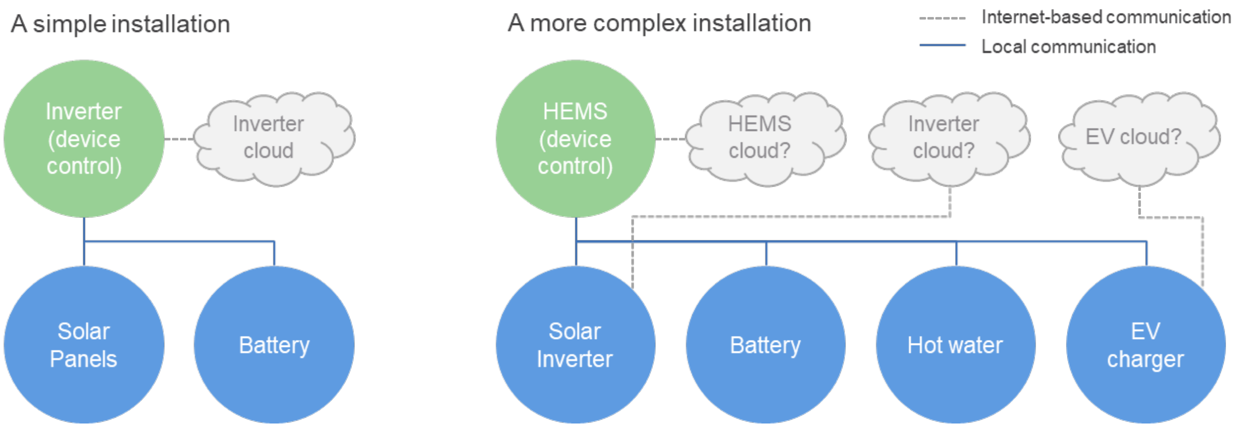
[10] Clean Energy Regulator, Quarterly Carbon Market Report, March 2022.

[11] Australian Energy Market Operator, 2022 Integrated System Plan, June 2022.

[12] Available from – [Energy Consumers Australia, Behaviour Survey Findings, October 2021]

This may include cloud-based software that incorporate current or predicted weather conditions, or real time market incentives. HEMS can include 'Applets' programmed by customers themselves using platforms such as *If This, Then That* (IFTTT). In any case, more advanced device management fundamentally requires communication – devices must have the ability to exchange and make use of data and/or information. This requires a degree of device interoperability.

Figure 1: Examples of simple and complex consumer energy resource installations



Basic device management is essential to the safe and effective operation of a customer's installation, and the grid. In the simplest case, an isolator switch can be activated to stop the flow of power from a generator to the customer's premises and the grid. In the case of inverter-based resources like rooftop solar, technical standards define how consumer energy resources must perform under different system conditions. This includes autonomous responses to voltage to offset the impact of solar generation on local networks and avoid nuisance tripping of solar PV systems. Without these controls, much stricter limits would have to be placed on solar installations to keep the power system safe and secure.

Installations are increasingly internet connected to enable periodic firmware updates and upgrades, and to enable remote visibility and device management. Remote management can enable consumers with consumer energy resources to take advantage of real time signals and unlock flexibility from their assets. This remote management may take the form of customers directly managing their devices themselves (e.g. via a mobile phone app) or via automation. Signals can include tariffs and other incentives provided by retailers, networks or other parties such as Market Ancillary Service Providers (MASP) or Demand Response Service Providers (DRSP).[13]

Methods of communication include wired and wireless connections. Cable connections can include Modbus or CAN bus (similar technology that makes a modern factory or car function). Ethernet and Wi-Fi local area network (LAN) connections allow consumer energy resource devices to connect to a home or business network in the same way a laptop would. Consumer energy resource devices may also have their own dedicated cellular (i.e. 3G, 4G or 5G) connection to a mobile network just like a mobile phone. The methods of communication and the purposes of those communications are explained in more detail in the following section.

The ability of smart devices to speak to each other has unlocked many consumer technology innovations; interoperability specific to energy can do the same for technology in this sector. This is fundamental to ongoing innovation in consumer energy resources and continuing to unlock value for consumers from these assets.

[13] Demand Response Service Providers classify and aggregate the demand response capability of large market loads for dispatch through the NEM's standard bidding and scheduling processes.

2.3 The value of an interoperability policy to consumers

The functioning of the NEM is based on engineering management of the physical characteristics of the network, the economic regulation of the market for energy and system services and technical regulation of activities such as equipment design and installation. Australia's energy market bodies have been tasked by Ministers to reform the power system to enable a once-in-a-century step change in electricity generation and use, that will allow customers to power their homes, businesses, and vehicles with low-emission electricity.

System operators are adapting to how customers with consumer energy resources want to manage their devices. A good example of this is Flexible Export Limits, currently being trialled in South Australia, Victoria and Queensland, which allow customers to export electricity up to the physical limits of the power system, as those limits change over the course of a day or year. Dynamic Operating Envelopes (DOE) can facilitate customers who may be on, for example, 5 kW static export limits at all times to access export limits up to 10 kW at most times. During times of network constraint, the level of export may be dialled down incrementally, but overall the customer will be able to export more into the grid and receive the associated revenue. Trials in Victoria and South Australia are showing that customers are in reality exporting more than they might otherwise, and the Queensland Government recently announced that 'Dynamic Connection Agreements are the future of energy connections in Queensland'.[14]

The DEIP DOE outcomes report set out a conflict management hierarchy, which is consistent with current practice and the principal that customers should be free to use their energy resources as they wish within the physical limitations of the power system.[15] This sets out the priority order (1 being the highest) in which systems are expected to resolve potential conflicting instructions:

1. Mandated inverter controls as prescribed by regulation or connection agreement (e.g. for voltage response and ride-through).
2. Bulk system export constraints issued by AEMO via the NSP (this is expected to be incorporated into the DNSPs flexible export limits[16] in most network locations).
3. Flexible export limits issued by the DNSP.
4. Market participation.

This hierarchy broadly aligns with the way large-scale generators participate in markets within the limitations of their generator performance standards and real-time transmission constraints ('security-constrained dispatch'). In principle, it means that customers can do 'whatever they want' within the physical limitations of the power system.

Flexible Export Limits can provide customers who wish to install solar or other embedded generation technologies with opportunities for increased export volumes and potentially greater financial returns on their investment. These benefits can be enhanced by ensuring a nationally consistent approach to consumer energy resource interoperability so that manufacturers and installers have consistent national requirements to work to, reducing risks to consumers associated with product and installation compliance. Greater consistency in technical requirements can also support more streamed and consistent communication with customers, helping them make more informed and confident decisions and a smoother customer journey overall.

While the initial interoperability focus in the CER Implementation Plan is Flexible Export Limits, the longer-term aspirations include enabling those customers that wish to share data with various service providers, while providing a level of portability between those providers. Interoperability of consumer energy resource devices could avoid help avoid the situation where customers are locked-in to certain providers or offerings, enabling consumers to engage with multiple providers or switch providers more easily,

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[14] Available from – [Queensland Energy and Jobs Plan | September 2022]()

[15] Available from – [DEIP | Dynamic Operating Envelope Working Group Outcomes Report | March 2022]()

[16] See section *The value of an interoperability policy to consumers* on p.13.

promoting more competitive, customer-focussed service provision. This could extend from contractual arrangements, similar to switching your mobile phone number to a new provider, to physical roaming, like a mobile phone moving between networks and their base stations.

Greater national (and international) standardisation can create a range of opportunities and cost savings across the supply chains. While Australian customers are leading on rooftop solar and battery storage adoption, other markets have taken the lead in other fields such as electric vehicle adoption and integration. It is therefore important that we learn and benefit from their experience and the product and service innovations in those markets (including, potentially, their interoperability standards).[17]

2.4 Stakeholders support effective, national interoperability policies

FTI analysis of stakeholder feedback on interoperability work found the need for overarching guidance from the energy market bodies on interoperability and communication standards for consumer energy resources in the NEM.[18] Stakeholders pointed out that national standardisation would provide clarity to industry, including manufacturers, and confidence to invest in the development and offering of a wider range of more sophisticated services to customers.

Stakeholders have noted that interoperability creates value for customers by simplifying and standardising communication between devices, utilities, and service providers, enabling consumer energy resources to play a greater role in the electricity system. To achieve this, effective regulatory and governance frameworks are needed to ensure that network and market interoperability standards and compliance measures are working in consumers' interests and that consumers can participate, with confidence and appropriate protections, in competitive markets.

Interoperability with the consumer energy resource ecosystem is not just one discrete thing. It can be taken to represent the communication between multiple parties for multiple purposes and in many formats. In this context, stakeholders have expressed a wide range of views representing different interests and priorities. ESB has sought to synthesise these views and, in this paper, provide direction as the prioritisation and future direction of interoperability policies.

Feedback provided to FTI through stakeholder consultation indicated that any assessment of interoperability policy should focus on the functionality, or 'use-cases', as this provides a better framing to identify benefits for consumers. For example, several stakeholders noted that CSIP-Aus was developed specifically to enable the communication and operation of Dynamic Operating Envelopes, and that further work would be required before the scope of the CSIP-Aus could be extended to other use-cases (e.g. greater standardisation of how traders (including electricity retailers) interface with consumer energy resources. Explaining the consumer energy resources interoperability landscape in more detail is essential, includes roles and responsibilities for delivering on energy system and customer outcomes.

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[17] Available from – [Electric Vehicle Smart Charging Issues Paper | ESB]()

[18] Consultation and responses available from – [energy.gov.au/[...]/der-implementation-plan-interoperability-policy-framework]()

3. Mapping the CER interoperability landscape

3.1 Summary of the current state of roles and responsibilities in the consumer energy resource interoperability landscape

Within the consumer energy resources technology and market ecosystem, different parties have distinct roles and responsibilities in relation to consumer energy resources participation, power system operation and regulation and governance. This section describes these parties in the context of the current state of consumer energy resource deployment and how they are expected to evolve over time.

Customers

At the centre of this transformation, customers are investing in and receiving benefits from consumer energy resources. Here we consider all electricity customers, not only those directly engaging with consumer energy resource technologies but also those without consumer energy resources. Customers with consumer energy resources benefit from lower bills, and customers, more broadly, can benefit from more competition in energy resources and reduced pressure on generation and network infrastructure (reducing wholesale energy and network costs respectively).

Various industry trials and deployments are underway, being led by traders, market bodies, network businesses, and technology providers (e.g. Projects Edge, Edith, Converge and Symphony)[19] that are generating insights into potential future service models and interoperability frameworks. Customer engagement with consumer energy resources is expected to increase over time and the technology and services available will become more sophisticated – simpler or more complex depending on consumer preferences. The key interface for customers at present are technology providers.

Section summary

The interoperability landscape for consumer energy resources is described in more detail, including roles and responsibilities for delivering on energy system and customer outcomes.

Five interoperability domains and a number of use-cases are presented as a framework to form the basis for policy prioritisation and work planning.

This informs the ESB's first priority for interoperability standardisation as flexible exports in the CER-DNSP domain through CSIP-Aus. This will be used as a building block for the consideration of other domains in 2023 including behind-the-meter.

Technology providers and device management

Technology providers are driving innovation and producing new products and services to provide customers with more choice and control of their energy generation and use. Technology providers can include consumer energy resource retailers, installers, and original equipment manufacturers (OEMs), and can be vertically integrated or linked through a range of supply chain and contracting arrangements including Traders.

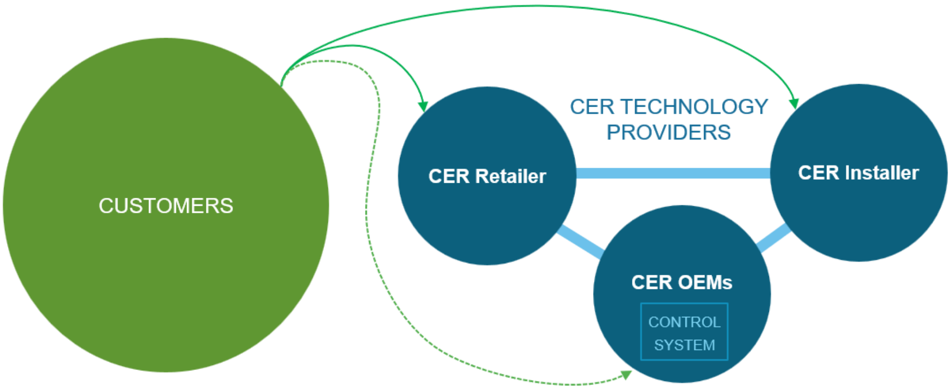
Technology providers respond to consumer preferences, including preferences about what level of engagement the customer wishes to have in energy markets and what degree of interoperability of devices is suited to their individual needs. They provide the main customer interface through consumer energy resource product selection, installation, and operation, and they are usually the first port of call for customers when things go wrong.

Within a consumer energy resource 'technology stack' there is always a *control system* that is responsible for managing equipment operation. This could be embedded into the solar inverter, in the case of a simple solar installation, or part of a HEMS used where multiple consumer energy resources are coordinated at a

[19] Available from – arena.gov.au/[...]/deip-der-market-integration-trials-summary-report/

customer's premises. For embedded generators, the device management system is responsible for ensuring static or dynamic export limits, set by the local distribution network operator (DNSP), are not exceeded.

Figure 2: Technology providers are the main customer 'touch points' during consumer energy resource selection, installation, and operation



The scope for innovation is broad and ongoing, and closely related to broader technology trends around the miniaturisation of computing and power electronics, digitalisation of communication and the development of the services economy which is changing supplier-customer relationships.

Electricity retailers, traders and aggregators

Traders are intermediaries that allow customers to buy and sell energy and related services in wholesale markets. They can include electricity retailers, Market Ancillary Service Providers (MASPs) or Demand Response Service Providers (DRSPs). Traders can also offer services to networks. For the purposes of this paper, a trader is an entity registered with AEMO in an energy and/or ancillary services markets. The ESB's Post-2025 market design review envisages that traders will be more active in consumer energy resource management in the future.

Aggregators are a term often used to describe traders that aggregate fleets of consumer energy resources for market participation purposes (e.g. Virtual Power Plants providing Frequency Control Ancillary Services (FCAS)). Sometimes the term is also used to refer to a network of coordinated consumer energy resources that is not market-registered, and instead optimises around customer self-consumption or other customer needs.

All customer premises have a Financially Responsible Market Participant (FRMP) who is responsible for settling the customers generation or consumption in a wholesale electricity market. In most but not all cases, this is the customer's electricity retailer. MASPs and DRSPs require management of customer devices to provide flexibility services and can do so independently of the FRMP.

Alternately, larger customers may register themselves as a wholesale market participant while some customer connections are registered with a Market Small Generation Aggregator (MSGA). As a result of the recent Integrating Energy Storage in the NEM Rule Change, all market registrations are being merged into a single category: the Integrated Resource Provider (IRP)[20] which is then able to provide services in multiple markets.

Electricity retailers are increasingly engaging with consumer energy resources to win and retain customers, to help manage the retailer's own electricity spot market exposures and to help customers gain access to

[20] Available from – [Integrating energy storage systems into the NEM | AEMC]

other revenue streams. This can occur through third-party technology providers or through more vertically integrated service models.

There is a broad expectation that more consumer energy resources will have a direct trader relationship into the future. For example, the ISP step change scenario assumes that by 2030, around 30% of embedded generating capacity will be aggregated into Virtual Power Plants (VPPs). Currently, however, this figure is currently estimated to be 13%.[21]

Today, electricity retailers typically have no direct visibility or remote management capability over technologies deployed at customer premises. The relationship between device management and the electricity retailer is increasingly cooperative, however it is important to note this is often not the case at present. During the operation of an interoperable generating system, it is typically the role of technology to minimise the customer's energy bills within the tariff structure provided by the customer's electricity retailer.

Distribution Network Service Providers (DNSPs)

Distribution networks were originally developed to facilitate the transfer of electricity from transmission networks to customer premises. In 2021, the AEMC changed the rules to better integrate small-scale solar into the grid and to support the choices customers are making to invest in batteries and electric vehicles. This included an obligation on DNSPs to provide a hosting service for embedded generation while giving them the ability to propose two-way tariffs (for customer imports and exports).

DNSPs are expected to demonstrate a prudent and efficient level of investment in export services. One way that networks can increase their hosting capacity for customer generation is by implementing Flexible Export Limits (instead of static export limits). Customers that opt into this arrangement have consumer energy resources that can receive these limits over the course of the day and adhere to them.

The Australian Energy Market Operator (AEMO)

AEMO has a dual role as a market and power system operator. AEMO has implemented frameworks to help keep supply and demand in balance, and to ensure the power system stays stable. In rare situations, AEMO can instruct to DNSPs (via TNSPs) to reduce demand (the Lack of Reserve framework) or reduce generation (the Minimum System Load framework). In either case, a DNSP may respond by curtailing load or generation in their local areas including by changing the Flexible Export Limits that are sent to consumer energy resources in the local network.

AEMO collects standing data on consumer energy resources installations via the National Distributed Energy Resources Register[22] as an input into its system planning and market operations. Future reforms are being contemplated to give AEMO's greater visibility of consumer energy resources *operation* – known as Scheduled Lite[23]. This would provide an incentive (rather than a requirement) for traders to share consumer energy resource operational information with AEMO at an aggregate level rather than providing AEMO with direct visibility or management of consumer energy resources.

Australian Energy Regulator (AER)

The AER oversees network expenditure, tariff arrangements and customer connection agreements, as well as electricity retailer compliance with the National Energy Customer Framework (NECF). While the AER does not have a direct role in consumer energy resource interoperability, they are responsible for ensuring that networks and retailers comply with laws and guidelines and that consumers are adequately protected when

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[21] Available from – [aemo.com.au/[...]/2021-inputs-assumptions-and-scenarios-report.pdf]

[22] Available from – [Distributed Energy Resource Register | AEMO]

[23] Available from – [Scheduled Lite | AEMO]

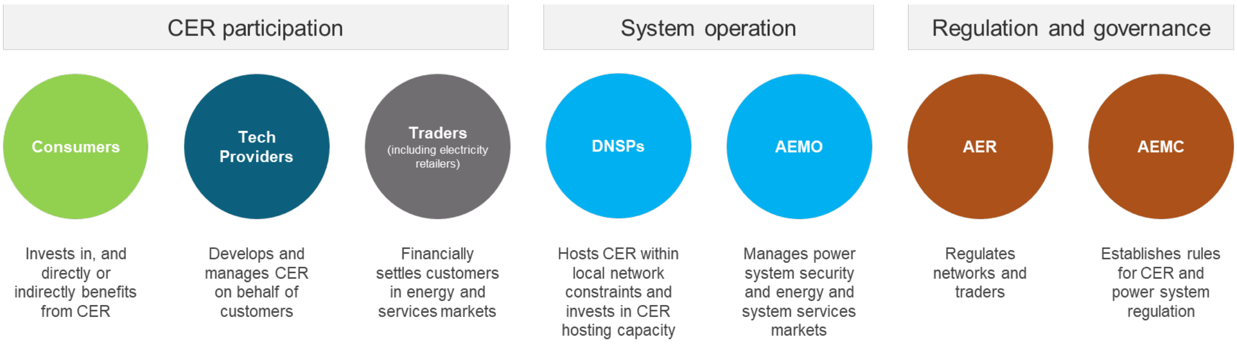
they engage in electricity market services. A current consideration for the AER is the extent to which new energy services, such as by technology providers, should be captured under the National Electricity Law.[24]

Australian Energy Market Commission (AEMC)

The AEMC is the rule-maker for the NEM and establishes Rules for market participants, AEMO, networks and the AER. These rules extend to the operation of consumer energy resources as it relates to their interaction with the electricity system. The AEMC is currently undertaking a *Review into consumer energy resources technical standards*, including the governance of interoperability standards compliance.[25]

The roles and responsibilities outlined above are summarised in Figure 3 below.

Figure 3: Summary of roles and responsibilities in consumer energy resource interoperability



Other parties

A range of other parties are also involved in the consumer energy resources ecosystem as it relates to interoperability, including standards bodies and technical regulators.

Standards bodies

Standards Australia has made a range of standards for consumer energy resources including AS/NZS 4777 for the grid connection of energy systems via inverters and AS/NZS 4755 for the demand response capabilities for electrical products. Other groups such as the DEIP Interoperability Steering Committee are exploring or developing communication protocols to assist with the grid integration of consumer energy resources, and these protocols may provide the basis for future Standards development.

Technical regulators

Jurisdictional technical regulators are responsible for utilities licencing and electrical safety. In some cases, this includes the regulation of interoperability requirements, such as SA Office of the Technical Regulator's mandate for CSIP-Aus under its Smart Homes initiative. Generally, jurisdictional regulators are not responsible for product testing unless there is a safety component.

Metering providers

Metering of electricity market settlement is the responsibility of a customer's FRMP (usually an electricity retailer) however consumer energy resources can also have embedded metering for participation in FCAS. The interoperability requirements for these meters are set out in the National Metrology Procedures and Market Ancillary Services Specification respectively. Requirements for market metering are currently being reviewed by the AEMC[26] and are outside the scope of this paper.

[24] See for example: Review of Consumer Protections for Future Energy Services | AER

[25] Available from – Review into consumer energy resources technical standards | AEMC

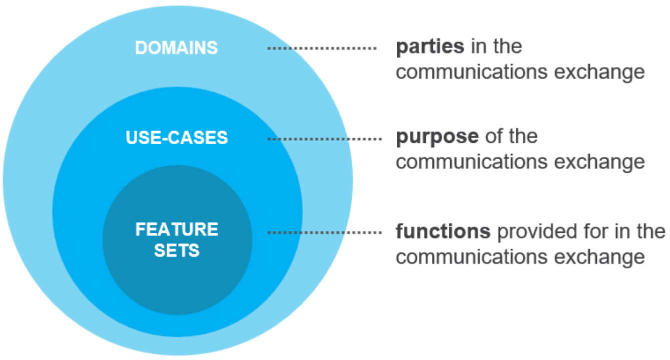
[26] Available from – Review of the regulatory framework for metering services | AEMC

3.2 Interoperability domains, use-cases and feature sets

Interoperability protocols and standards have features that enable specific functionality, such as data exchange or device management. Stakeholders have reported that individual feature sets are not necessarily mutually exclusive and stated that it is therefore difficult to assess the costs and benefits of each of these in isolation. For example, AEMO and networks may communicate for a range of purposes including to issue Minimum System Load constraints or to have greater visibility of local network constraints.

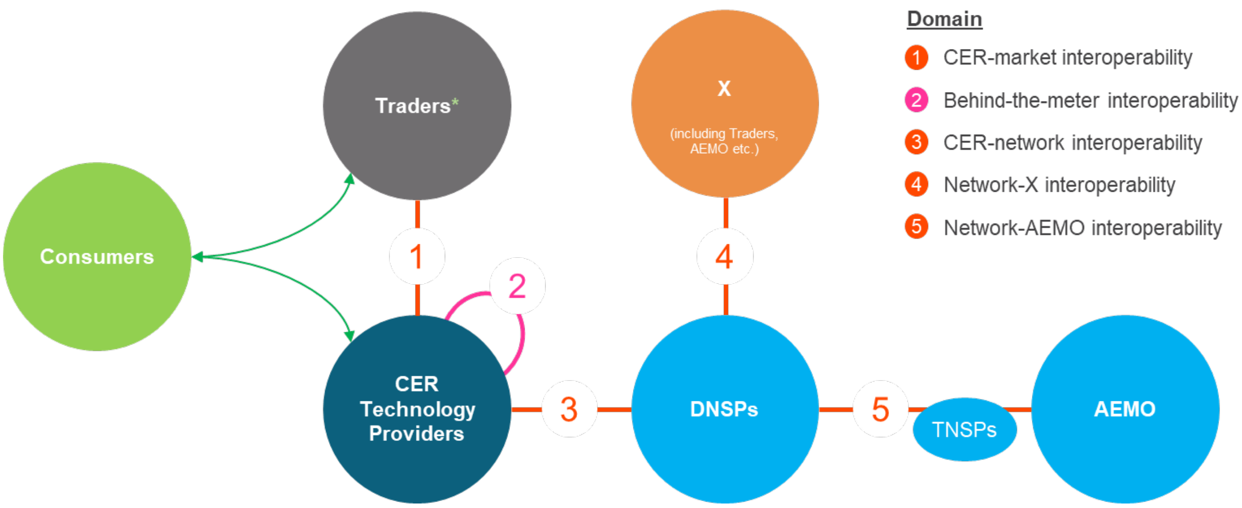
To provide more flexibility to consider the benefits and limitations between parties in a communications exchange, the ESB considers it useful to group use-cases into interoperability 'domains'. The relationship between interoperability domains, uses cases and feature sets is shown in Figure 4 below. Grouping these as domains enables the consideration of approaches that could streamline interoperability between parties for multiple purposes.

Figure 4: The relationship between interoperability domains, use-cases and feature sets



The ESB has identified five interoperability domains as a simple way of clustering its interoperability program considerations, summarised in Figure 5 below. The following section explains these domains in more detail, including in relation to current and potential future use-cases. This is a non-exhaustive, illustrative consumer energy resource centric diagram – it does not show all communication relationships, such as Trader-AEMO links for bidding.

Figure 5: consumer energy resource interoperability domains (incorporating the dynamic export limits use-case)



Based on stakeholder feedback to date, CER-network communication (3) is considered the immediate priority and is the focus of later sections of this report which set out approaches to achieve a nationally consistent approach to CSIP-Aus implementation to support the implementation of Flexible Export Limits (FELs) which is the current use-case. However, each of the domains is relevant to the effective implementation of FELS and the broader integration of consumer energy resources.

CER-market interoperability (1)

Traders have a range of reasons to interface with consumer energy resources and these are increasing as their customers adopt more consumer energy resources and seek to manage their energy use, and as the power system incorporates more variable renewable energy and flexible demand. An important motivation for traders for communicating with consumer energy resources is being able to forecast the net load of their customers so they can manage their exposures in electricity spot markets and reduce the costs of hedge contracting. More actively engaged traders may also facilitate customer participation in energy, frequency control or demand response markets and therefore require visibility of a customer's headroom (the capacity to increase or decrease demand or generation) as well as the ability to change levels of generation or demand by managing consumer energy resources.

Major use-cases in this domain include:

- Ability to manage consumer energy resources in smarter ways – consumer energy resources can provide a range of flexibility services (e.g. frequency control or demand response) that are valued in various markets. Where customers opt into the provision of these services, traders need the ability to manage how the consumer energy resource operates to ensure service provision. Customers opting into to the provision of these services do so in exchange for some benefit. This means that how the consumer energy resource is managed needs to be monitored to enable customers to be renumerated for consumer energy resource service provision.
- Increased visibility of consumer energy resource behaviour – Traders can improve their ability to forecast and manage wholesale market exposure risks while also providing information services to customers such as through web and mobile applications. This can help customers respond to tariffs or other incentives provided by the trader themselves, or other parties.

AEMO, as market operator, has a strong interest in market innovations facilitated by CER-market interoperability and links to traders as formal market participants. Relevant reforms, initiated by AEMO and currently under consideration include:

- Flexible trading arrangements – Future reforms may enable some consumer energy resources to be separately metered and settled in energy or other markets. In this case, traders will need to establish arrangements for consumer energy resource behaviour monitoring and, in the case of more actively engaged customers, device management.
- Scheduled Lite – Future reforms may enable customers to opt into frameworks to allow greater visibility and management of their devices in the energy market. In this case, the FRMP will need greater visibility and management of relevant consumer energy resources to forecast likely generation and demand across their 'scheduled lite' portfolio of customers, and to meet dispatch targets.

Behind-the-meter (CER-CER) interoperability (2)

Various studies have highlighted the value to customers of integrated approaches to embedded generation and demand management. ARENA has estimated that flexible demand can reduce new generation and storage costs by $8-18 billion.[27] It found that, for example, rapid EV uptake substantially increases requirements for wind, solar and utility-scale storage investment. However, more flexible EV charging can deliver savings to consumers between $3-5 billion, fully mitigating increases in electricity prices on a

[27] Available from – arena.gov.au/[...]/load-flexibility-study-technical-summary.pdf

$/MWh basis. This means that a rapid uptake of EVs, with effectively managed charging, can reduce costs for all customers, not just those with EVs.

Other studies have estimated that improved integration of demand side resources may present saving of $11.3 billion in avoided or deferred distribution and transmission network capital expenditure.[28] These savings benefit all consumers, not just those with consumer energy resources.

A key enabler of demand side flexibility is the ability of consumer energy resources to be coordinated inside a customers' home or business premises to make use of local generation, respond to cost reflective tariffs, respond to real-time electricity wholesale market conditions or provide other power system services. Dynamic Operating Envelopes (initially only for export management) are currently allocated at the customer connection point, and where multiple consumer energy resources can be present, they will need to coordinated by a single gateway device (the 'gateway model'). This coordination requires a degree of interoperability to enable orchestration of multiple consumer energy resource devices at the premises (often called 'behind-the-meter' interoperability).

Another area where behind-the-meter interoperability will become important is with the rollout of EVs, and the use of smart charging that attempts to coordinate with other devices in the home or business premises, such as rooftop solar. In these situations, the devices may need to interact either locally at the premises, or coordinate via the cloud. In both cases there needs to be a party that is responsible for the coordination or orchestration of the two devices and devices need standard interface points (either software or hardware) to enable communication.

Major use-cases for CER-CER interoperability include:

- **Inverter-device** – the management system within a smart solar inverter may turn an appliance (such as a water heater) on or off via a hard-wire relay. This could be on a timer, activated manually by a customer through a mobile or web app, or automated by the inverter in response to solar export constraints or other real-time conditions.
- **Gateway-device** – a HEMS may coordinate multiple devices at a customer premises including energy using appliances, solar or battery inverters, EV chargers (etc). This may be via a simple hardwired relay, or the monitoring and management may use a standards-based communications protocol if the consumer energy resource is interoperable. For smart devices the physical connection between the consumer energy resources may be communications cable, wireless or even power-line communications which uses the site/home existing electrical wiring to communicate.
- **Cloud-mediated management** – device management (such as a solar or battery inverter) may occur through the device's cloud platform. This may be the only option available where a device does not have a local and interoperable interface.
- **Meter-to-gateway data sharing** – HEMS providers can make use of real time meter data where meters provide an appropriately accessible local data sharing port. This is separate to permissioned access that may be provided via the meter providers' cloud. Local meter data sharing can reduce the cost of consumer energy resources deployment by reducing the need for separate monitoring hardware.

CER-DNSP interoperability (3)

IEEE 2030.5 is a protocol for communications between 'smart grids' and consumers. Information exchanged using the protocol includes pricing, demand response, and energy usage, enabling the integration of devices such as meters, plug-in electric vehicles, smart inverters, and smart appliances. This protocol was adapted under the California Rule 21 as the *Common Smart Inverter Profile* (CSIP), in turn adapted locally as the *Common Smart Inverter Profile – Australia* (CSIP-Aus).

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[28] Available from – Potential network benefits from more efficient DER integration | Baringa Partners | June 2021

CSIP-Aus v1.1 sets out specific extensions that enable the communication of Dynamic Operating Envelopes (including Flexible Export Limits) between a network and a CSIP-Aus client. Communication to the customer site can be direct to an inverter, to a gateway device at the customer premises or via a consumer energy resource aggregator cloud. In the case of network-cloud communication, the cloud operator may use a different communications protocol to communicate with the customer site (see Figure 6 on page 29).

DNSPs such as SA Power Networks and AusNet are adopting CSIP-Aus as a communications protocol to support the implementation of Flexible Export Limits. Trials are also being developed to explore how dynamic connections can enable more charging capacity being made available for electric vehicles or assist with the grid-integration of community-scale storage.

This domain is the focus of Section 4 – *Achieving a nationally consistent approach to CSIP-Aus implementation*.

DNSP-X interoperability (4)

Flexible Export Limits increase the export capacity available to generators outside of peak times and decrease it when the grid is congested. The timing, duration and shape of available export capacity is an important input into investment and operational decisions of a wide range of parties.

In investment timescales, customers and technology providers need some foresight of likely future congestion to make informed decisions about deploying solar, storage or demand management. On a given day, technology providers might make use of congestion forecasts to inform decisions about when to charge a battery or an electric vehicle, or the best time for water heating. In real-time, traders will need to know what export limits are being applied to consumer energy resources to enable them to make firm bids in electricity or flexibility markets. Major data users and use-cases in the network-X domain include:

- **Consumer energy resource investors** (including households, large users, community storage, non-network service providers etc.) need to understand the expected future shape, duration and timing of network constraints at a local-area level. Investors look at the site-level opportunities, as well network-wide for opportunity scoping.
- **Traders** need to understand constraints at pre-dispatch to inform their market forecasting and bidding decisions.
- **Emergency services and infrastructure providers** seek real time operational information for emergency management purposes.
- **Non-network services providers** need communications with DNSPs to commit and dispatch locally contracted resources (operational data).
- **Government, market bodies and researchers** – analysis of ex-post outcomes and forecasts for policy analysis. Could be granular or high-level.
- **Meter data providers** – transmit voltage and other data to inform network state estimate and for DOE/FEL compliance verification.

The *ESB's Data Strategy* identified *network visibility for market planning* as one of three priority data gaps, as it supports optimisation of consumer energy resources investment and reduces risks of unnecessary network costs. Once the challenges and potential benefits of use-cases, and potential feature sets have been explored, options for efficient delivery will be considered and consulted on in 2023.

DNSP-AEMO interoperability (5)

The system operator, AEMO, and electricity network operators have worked together to put in place strategies to manage risks during rare periods of power system stress, including both lack of supply and surplus of supply. To support Consumer Focussed Power System Operations,[29] AEMO has implemented a notification process and operating framework to minimise power system risks while supporting future

[29] Available from – aemo.com.au/[...]/power_system_ops/market-notices-fact-sheet.pdf

solutions as they are being developed, including those in the ESB Post-2025 reforms. The Contingency and Minimum System Load (CSML) Framework [30] will help address declining Minimum Operational Demand [31], which has emerged as a challenge for power system operations.

In activating this framework AEMO's control room will communicate directly to TNSP control rooms. If the action to maintain system security falls under the purview of the distribution network, DNSPs will determine how demand is maintained above the minimum system security thresholds and this may include curtailing rooftop solar where this capability is available.[32]

Generally, AEMO sets bulk system constraints, which are passed onto DNSPs via TNSPs. Local system constraints are determined by the DNSP, potentially incorporating AEMO bulk system constraints. In the other direction, AEMO will require information on local network constraints to estimate the impact of these constraints on its broader market operation and system planning functions. AEMO will need to be aware of any generation constraints to balance supply and demand.

3.3 Future priorities for interoperability policy

Consumers have a strong interest in knowing that consumer energy resources, or other appliances, purchased at a point in time will not materially limit their future choices. In other technology domains, consumers increasingly expect appliances to communicate seamlessly, such as sending a video from a smart phone to a smart TV. It should not matter whether the phone is Apple or Android, or if the TV is LG or Samsung. Greater interoperability increases choices for consumers and the benefits received from their investment.

Interoperability in the consumer energy resources ecosystem is relatively immature by comparison, and this means customers may face unreasonable integration risk and complexity with every consumer energy resource or appliance purchase. Limited interoperability increases cost and complexity for consumers when they purchase new products or otherwise engage more actively in the energy system.

Some technology providers have voiced concerns about their inability to deliver value-adding services to customers due to the limited interoperability of devices at the customer's premises. In other cases, stakeholders have noted that standardising physical and software interoperability could provide a barrier to the development of new services.

Traders typically use an internet protocol to interface with consumer energy resources in a customer's home or business premises and the specific communications features used are understood to be highly varied, incorporating both open-standards and proprietary approaches. Given that customer participation in energy and other markets is currently determined at their point of connection to the network, a customer's choice of retailer, who deploys consumer energy resources, has the potential to lock their consumer energy resources into a specific trader relationship – even where the customer has paid for the consumer energy resources upfront. This could provide a barrier to customer switching between traders in cases where the customer considers another provider offers higher value services.

National and international standardisation would mean OEMs do not need to produce equipment to meet different standards in different jurisdictions, and that service providers can compete in consistent national markets, increasing choice and reducing costs for consumers. There is, however, an inherent tension between the benefits and risks of standardisation. Without careful consideration and management, standardisation can stifle innovation by locking in arrangements that inhibit the future developments. It is therefore important that standardisation appropriately balances unlocking benefits today, while enabling innovation in the future.

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[30] Available from – aemo.com.au/[...]/pv-rooftop-solar-consumer-fact-sheet.pdf

[31] Available from – aemo.com.au/[...]/minimum-operational-demand-factsheet.pdf

[32] Available from – aemo.com.au/[...]/system-operations/power-system-operation

Further consideration is needed to determine what consumer and system benefits could be achieved through greater standardisation across domains 1, 2, 4 and 5 (see Figure 5, p.20) including trader use-cases. Greater standardisation could allow for easier customer switching and create more competitive pressures on industry to offer value to customers. This could be achieved, for example, by mapping trader use-cases to CSIP-Aus functionality. Voluntary, industry-led approaches, need to be considered as an alternative and mandatory approaches should be subject to appropriate cost-benefit analysis.

Flexible Export Limits increase the urgency of regulatory considerations behind-the-meter or 'behind-the-connection point' interoperability. The ESB has requested the DEIP ISC explore potential use-cases and feature sets in the CER-CER and CER-market interoperability domain. This work is ongoing and initial ISC advice is expected toward the end of 2022. The ESB considers it is prudent to wait for the outcomes of the ISC's work and industry trials before forming directions on how standardisation could be applied to enhance outcomes for consumers. The ESB proposes to continue this work in 2023 under its Horizon 2 work program, following the outcomes out the ISC current exploratory work.

Irrespective of the direction of market developments, network operations to manage local constraints is considered a common feature of any future state. The ESB's first priority for standardisation of interoperability is thus CSIP-Aus to support the implementation of flexible exports limits by network operators in the CER-DNSP domain. The following section of this paper sets out a proposed approach for the standardisation of CSIP-Aus for the Flexible Export Limits use-case and related activities to ensure national consistency in its adoption and use.

Questions for Consultation

Consultation Question 1: Are the five identified domains correctly summarised? Are there gaps or major limitations in this framing?

Consultation Question 2: What priority should each domain be assigned, considering the interest of all electricity consumers within the consumer energy resource interoperability landscape?

4. Achieving a nationally consistent approach to CSIP-Aus implementation

4.1 What is CSIP-Aus and how is it being used today

The Common Smart Inverter Profile – Australia, Version 1.1 (CSIP-Aus) specifies a minimum communication protocol to support the visibility of consumer energy resources, and active management though provision of dynamic limits on real power import and export. This common functionality supports the minimum levels of interoperability needed to support the implementation of Dynamic Operating Envelopes (including Flexible Export Limits).

From a consumer perspective, effective implementation of CSIP-Aus requires that:

- compliant products are available for purchase
- the consumer can make an informed purchasing decision
- the customer's installer needs to be able to install and configure the products safely and correctly
- the system needs to operate in a compliant manner and meet customer expectations.

Section summary

How Common Smart Inverter Profile – Australia (CSIP-Aus) is being used today and a new mandate for 'flexible export ready' installations.

Flexible export ready product whitelisting and compliant technology models to support he NEM mandate.

The form of CSIP-Aus as a Standards Australia Handbook as the local implementation guide for IEEE 2030.5 based on CSIP.

Digital device certificate management considerations and the certificate authority role for Public Key Infrastructure (PKI) across a national implementation.

Obligations for the consumer

For a customer to take advantage of Flexible Export Limits during the operation of a generating system, a range of energy market bodies and industry participants are engaged. Under the National Electricity Rules (NER), responsibility for ensuring the compliance with a Flexible Export Limits rests primarily with the energy customer. Essentially, the NER establishes a contractual obligation on the energy customer to meet the requirements set by the DNSP in the standing offer for a basic connection service.

The NER specifies the terms and conditions that must be included in a DNSP's model standing offer for connection services.[33] The model standing offer must be submitted for approval by the AER.[34] By connecting to a particular DNSP, the customer is required to accept the terms and conditions of that approved model standing offer. The required terms and conditions are non-prescriptive, but allow the DNSP to specify detailed requirements flexibly, in response to local jurisdictional requirements, and to change the requirements of those terms and conditions when required.

A network may specify the interoperability requirement (CSIP-Aus) for participating in a flexible export agreement, and this requirement sits with the customer.

The NER specifies several requirements on networks that relate to the connection of micro-embedded generators.[35] These require the DNSP to specify:

- special requirements for metering
- the required qualification for installers of relevant equipment
- the special safety and technical requirements that are required to be complied with by the trader (retailer), or the customer, or both

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[33] NER, Rule 5A.B.2(b)

[34] NER, Rule 5A.B.2(a)

[35] NER, Rule 5A.B.2(7)

- the DER generation information that the DNSP requires
- the requirement that the system comply with 'DER Technical Standards'[36].

CSIP-Aus in practice

In practice, it is the customer's technology provider (including consumer energy resource retailers, installers and OEMs) that ensures an installation is compliant with the DNSP's requirement.

CSIP-Aus establishes a communications client for the purposes of managing customer power flows at the point of connection to the network within limits set by the DNSP. The ability of a customer to respond to a flexible export (or import) limit is directly affected by the operation of that communication client.

South Australia and Queensland networks are at advanced stages of implementing Flexible Export Limits. In South Australia, the State Government has declared a Technical Regulator Guideline[37], which calls up CSIP-Aus as the communication protocol that is required to be supported. AusNet is partnering with SA Power Networks (SAPN) to trial Flexible Export Limits in Victoria.[38]

In Queensland, the two DNSPs (Energex and Ergon Energy) have developed a standard[39] to govern the connection of small energy export systems (less than or equal to 30 kVA). The standard calls up IEEE 2030.5 (SEP2) as the protocol for the communication of dynamic monitoring information using CSIP, the California-based implementation guide. The variation that exists in the NEM even at present with limited numbers of implementations speaks to the need for national coordination.

4.2 A new mandate for 'flexible export ready' installations

As more networks offer Flexible Export Limits to their customers there is an increasing scope for variations. This can result in technology providers having different requirements in different network areas, increasing the cost and complexity of servicing their customers. A nationally consistent approach would mean OEMs do not need to produce equipment to meet different standards, installers can work more seamlessly across network regions and traders do not need to develop different capabilities for different jurisdictions.

This section sets out the ESB's proposed process for achieving a nationally consistent implementation of CSIP-Aus to enable DNSPs to implement Flexible Export Limits in a way that future-proofs

South Australia

Following the successful completion of an ARENA project run by South Australia Power Networks, South Australia is preparing for the state-wide implementation of Flexible Export Limits for small customers.

From 1 December 2022, all new electricity generating plant on a grid-connected site will be required to be capable of being export-limited at the point of connection to the relevant electricity distribution network.

SA has developed mandatory guidelines to support this, including connectivity requirements for all new electricity generating plants – the inclusion of a CSIP-Aus compliant IEEE 2030.5 software client configured to communicate with the DNSP utility.

The DNSP has a responsibility to develop test procedures and assess compliance during commissioning. Otherwise, the existing regulatory framework applies. OEMs apply for certification of an inverter by an accredited test-lab, and the product is then listed by the Clean Energy Council. The inverter is installed by an accredited installer, and rectification of non-compliance is undertaken by the installer.

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[36] Defined as "*The requirement for embedded generating units under Australian Standard AS4777.2:2020 as in force from time to time*".

[37] Available from – Technical-Regulator-Guidelines-Distributed-Energy-Resources.pdf (energymining.sa.gov.au)

[38] ausnetservices.com.au/[...]/Projects-and-Innovation/Solar-Flexible-Exports-Trial

[39] Available from – STNW3510 Dynamic Standard for Small IES Connections (energex.com.au)

customer installations and reduces risk and complexity for consumers in their engagement with consumer energy resources.

The ESB see a strong case for requiring all new and replacement embedded generator installations must be capable of implementing a CSIP-Aus communication model. Considering the advanced state of industry preparation for the South Australian requirement, the ESB proposes a target date for commencement of a national mandate in July 2024 or sooner.

What installations would be covered by the mandate

The mandate would apply to new or replacement embedded generator installations only from the date of commencement of the requirements and would not apply to pre-existing systems. Full compliance would be anticipated to be achieved with asset replacement over time.

Although CSIP-Aus has been developed to apply to residential and small commercial and industrial resources, it is not prescriptive in determining size limits of generating systems. Consumer energy resource units are classified according to their size (installed capacity).[40] Residential systems are typically 'micro' and 'mini' units, up to 10 kW single phase or 30 kW three phase. Systems greater than 10 kW single phase or 30 kW three phase are typically commercial and industrial installations. The mini to small system scale (10 kW per phase) is the threshold between automatic and negotiated agreements. The CSIP-Aus mandate is proposed to apply to automatic agreements up to and including 30 kW (three phase).

Implementation model

Such a mandate is intended to be similar, in effect, to the new requirements commencing in South Australia from 1 December 2022. In South Australia, new installations must be CSIP-Aus capable, but the customer may choose whether the functionality is active (i.e. whether they enter a flexible export agreement or opt for a static export limit).

A national mandate could be achieved by:

1. An obligation on DNSPs to ensure that, when implementing Dynamic Operating Envelopes (including Flexible Export Limits), their server-side communications are consistent with CSIP-Aus. This requirement is not intended to bring forward the implementation, by DNSPs, of Dynamic Operating Envelopes but rather ensure that when implementation occurs (in an economically efficient manner) it is done in using nationally consistent approach.
2. An obligation on DNSPs to require that new installations are 'flexible export ready' by reference to a CSIP-Aus product certification (see the section *Flexible export ready product whitelisting* on p.32) and common installation commissioning procedure (where the DNSP has established a CSIP-Aus compliant utility server).

These requirements could be established directly under NER Rule 5A.B.2(7) which would require the Rules to reference CSIP-Aus directly. Alternately, the rules could refer to a separate 'interoperability requirement for consumer energy resources' made by another authority. If this regulatory authority were to be a national energy market body (such as the AER or AEMO), further rule changes may be required to establish or clarify their powers to make such a requirement.

This latter option reflects stakeholder feedback that CSIP-Aus is not currently in a form that is legally enforceable, and that a degree of redrafting may be required to make it binding (see section *The form of CSIP-Aus as a technical standard* on p.30). Having the requirements set out in a subordinate instrument

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[40] Available from – [AEMC | Distributed energy resources]

would also allow the authority to have oversight of variations and extensions to CSIP-Aus overtime, including whether new features, or versions of the CSIP-Aus, should be made mandatory or not, when considering the National Electricity Objective. Stakeholder views are sought as to whether, if a mandate is applied, whether CSIP-Aus should be referred to directly in the Rules or via a subordinate instrument, and if an instrument, then who should manage it.

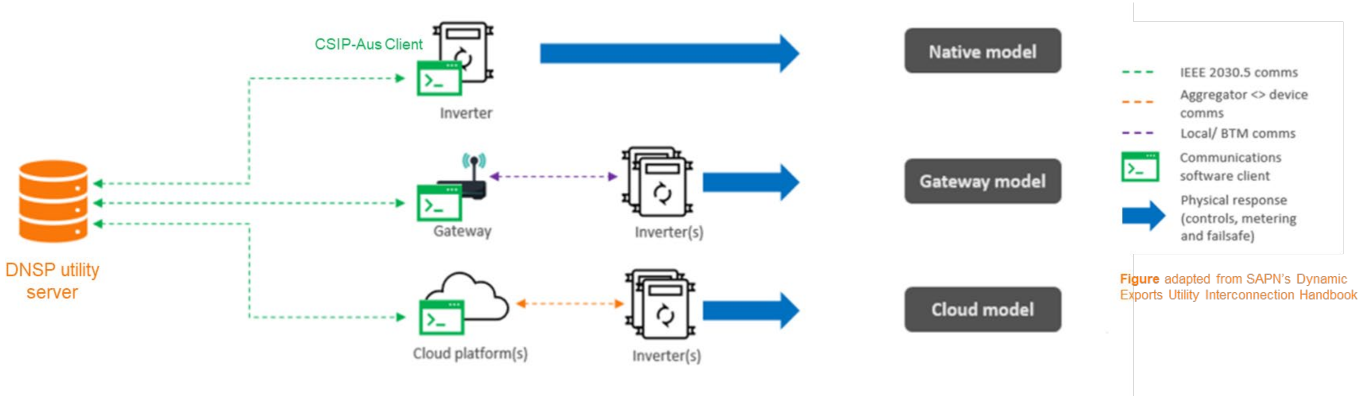
Consideration of alternative models for a mandate

Stakeholder views are sought on the appropriate form of the mandate. Other options for establishing a legal obligation have been considered, such as State law change and other Commonwealth law changes. Establishing a distinct Commonwealth scheme for CSIP-Aus compliance may create an opportunity to capture and address other systemic issues in technical compliance, but would likely significantly delay implementation. A suitable Constitutional head of power would also need to be determined. Reliance on consistent application of state/territory regulatory responsibilities to support critical national infrastructure is not considered viable. This is because CSIP-Aus does not align well with the predominantly safety-related mandate of jurisdictional regulators and jurisdictional variations could pose significant risks to efficient electricity market operation. Establishment in the NER involves a relatively minor change to established market frameworks, however it will require the development of compliance and enforcement capabilities of the selected regulatory authority.

Compliant technology models

To comply with the mandate, at least one part of the technology model needs a compliant CSIP-Aus Client. Figure 6 below shows some supported technology models, however these are not intended to be limiting. By supporting a range of technology models, the ESB intends to leave room for the continuing evolution of consumer energy resource technology and commercial models over time.

Figure 6: Supported technology models



CSIP-Aus interoperability is built on internet communications, making stable and reliable internet connectivity a key issue to consider. This can be problematic for customers and industry. For example, a customer may change their Wi-Fi password, their energy device then loses connectivity and as a result is non-longer able to conform to flexible export limits. To support more stable and resilient communication some installation models require a physical ethernet connection to a customer’s router, while other implementation models include a dedicated cellular connection integrated in the consumer energy resource equipment. This option is more reliable, however a mandate for this may impose additional costs for consumers.

The ESB understands that the new requirement in South Australia requires a temporary connection to be established for the purposes of device commissioning. Compliant devices need not have an embedded cellular connection.

Questions for Consultation

Consultation Question 3: What are the likely costs and benefits for consumers associated with a national 'flexible export ready' mandate including in relation to future readiness of customer installations and installation costs?

Consultation Question 4: Do stakeholders agree that DNSPs are best placed to enforce a 'flexible export ready' mandate at the time of installation? If not, what alternative models should be considered?

Consultation Question 5: What requirements should a 'flexible export ready' installation have with regard to internet connectivity (e.g. embedded mobile communication versus LAN connectivity)?

Consultation Question 6: What are the pros and cons of a flexible export ready mandate set in the Rules, via a subordinate instrument, or under a separate head of power (e.g. jurisdictional technical regulation)?

Consultation Question 7: If implemented under the Rules, which market body is best placed to establish and oversee the proposed requirement on DNSPs?

4.3 The form of CSIP-Aus as a technical standard

The development and implementation of CSIP-Aus to date can be seen as representing a flexible approach to the incorporation of standardised consumer energy resource feature sets in Australia. CSIP-Aus has been developed by the DER Integration API Technical Working Group, formed in 2019 as a collaboration of Australian energy sector businesses from across the supply chain, including distribution networks, retailers, equipment manufacturers and aggregators.

Interoperability policy benefits from strong international engagement, not least because international technology transfer is a two-way street. Like rooftop solar technology, Wi-Fi wireless networking *protocol* would have limited benefit without the Wi-Fi *devices* we import from overseas. CSIP-Aus leverages existing Australian and international standards from both engineering (AS/NSZ 4777.2:2020) and communications (IEEE 2030.5). CSIP-Aus, as an Australian variant of the CSIP implementation guide for IEEE 2030.5, focusses on features to enable Dynamic Operating Envelopes. Developments here are considered for incorporation into the reference standard from the United States, making it easier for technology providers to offer products in the Australian market.

CSIP-Aus is currently formally progressing through Standards Australia to be made a Handbook with an accompanying test procedure. A process to develop CSIP-Aus as an Australian Standard has not commenced and is not planned in the near term. This does not, however, preclude its use in a regulatory context. All 'standard' levels, including Standards Australia Handbooks (SAHB) though to Technical Specifications (TS) and Standards (AS), are inherently voluntary documents that require regulatory instruments to be binding (e.g. by reference in the NER).

Questions for Consultation

Consultation Question 8: What are the pros and cons of a flexible export ready mandate referring to CSIP-Aus in Standards Australia Handbook form?

4.4 Digital device certificate management

One important implementation consideration for CSIP-Aus is the requirement for device authentication and authorisation, which is achieved practically using digital certificates installed within devices. These certificates serve to verify identities, much like a driver's licence. The management of these device certificates requires Public Key Infrastructure (PKI), including one or more certificate authorities (CA) that issue digital certificates for use by other entities. This creates a trust relationship to manage with hardware, software, people, policies, and procedures.

An example of PKI policy is the Commonwealth Gatekeeper PKI Framework, which governs the way the Australian Government uses digital keys and certificates to assure the identity of subscribers to authentication services.[41] The framework sets out accreditation requirements to allow organisations to issue digital keys and certificates for use in government for PKI-based authentication. Competent Authorities, including agencies and private entities, are then granted accreditation to provide Certification, Registration and/or Validation services under the framework.

IEEE 2030.5 PKI requirements has been identified as a key issue for industry. OEMs must work with a CA to authenticate devices as genuine and prove specific device identity. Focused on fulfilling California Rule 21 compliance in the United States, SunSpec provides a IEEE 2030.5 PKI program for authenticating and securing communications for SunSpec Certified™ products and services.[42] This integrated approach combines product certification (discussed more in section 4.5 below) with PKI certificates.

A national approach to Public Key Infrastructure

The DEIP Dynamic Operating Envelopes Outcomes Report noted that DNSPs are currently developing their own ICT systems to support DOEs including CA functionality and commented it was *expected in the future that a national body will take on the CA role as this is considered beneficial in standardising and simplifying requirements for industry*.[43] A national CA for IEEE 2030.5 would provide a consistent national market for CSIP-Aus compliant technology developers. As well as efficiency, this also impacts optionality for interoperability.

IEEE 2030.5 based interfaces can facilitate multi-party communications. This means that in addition to hosting the CSIP-Aus client for the purposes of Dynamic Operating Envelopes, a compliant client-side device or cloud platform could use that interface to communicate with other parties such as aggregators, traders or other service providers. A nationally consistent approach to PKI would help facilitate interoperability beyond the CER-network interoperability domain. This includes multi-device, multi-utility configurations through the CER-market and CER-CER interoperability domains outlined above in Section 3 – *Mapping the CER interoperability landscape*.

It may not be considered appropriate for network businesses to be responsible for authenticating communication between traders and their customers in the provision of competitive market services. Common national communication frameworks will enable data sharing to maximise the value technology providers and traders can unlock for consumers. Like a passport for people, a sovereign approach to certificate management would in the long-term allow the unification of various CA's in the energy/utility sector.

Secure certificate management must also consider the whole lifecycle including creation and distribution, store and use, expiry and revocation. Native IEEE 2030.5 certificates are indefinitely valid, which means they do not expire and the Manufacturing PKI has no inherent revocation mechanism to manage compromised devices. This requires additional mechanisms to manage network access that would be better managed nationally, particularly when device mobility is considered.

Cyber security for consumer energy resources communications

FTI analysis considered that the step-up in risk to consumer privacy, data security, and grid security associated with communications between DNSPs and DER facilitated by CSIP-Aus is likely to be limited relative to the counterfactual with smart consumer energy resources present in any case. Cyber security related to consumer energy resources does need to be managed, however, and the DEIP workplan includes support to agencies to progress cyber security for consumer energy resources integration. This stream covers the design of capabilities and frameworks for security of communications platforms as well as support to identify an appropriate regulatory lever to implement minimum cyber security capabilities.

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[41] Available from – dta.gov.au/[...]/gatekeeper-public-key-infrastructure-framework

[42] sunspec.org/sunspec-public-key-infrastructure/

[43] Available from – dynamic-operating-envelope-working-group-outcomes-report.pdf (arena.gov.au)

The approach to CSIP-Aus client certificate management can present trade-offs and raises questions regarding PKI for consumer energy resources more broadly, including electric vehicle smart charging. A case-by-case approach to certificate management makes it difficult for device manufacturers to manage certificates and degrades security through a lack of consistency and guidance. Contrarily, whilst a single CA can create efficiencies, in terms of digital security this creates a single point of failure.

The examples presented above offer alternative models to a national body fulfilling the role of CA. Gatekeeper and SunSpec define frameworks for managing certificates, then accredit authorities based on those frameworks – the Gatekeeper PKI Framework accredits a number of authorities, while Kyrio manages the SunSpec PKI.[44] Stakeholder views are sought on the merits of agreeing a national approach to PKI for consumer energy resources.

QUESTIONS FOR CONSULTATION

Consultation Question 9: Would there be value in agreeing a national approach to public key infrastructure for consumer energy resources?

Consultation Question 10: Are there existing examples that could be used as a model for the consumer energy resources ecosystem?

Consultation Question 11: What are the pros and cons of establishing a national certificate authority?

Consultation Question 12: Do stakeholders have a view as to who should perform the role of national certificate authority, if it were created?

4.5 Flexible export ready product whitelisting

During the selection and installation of an interoperable energy generating system, a customer will engage with a range of technology providers. When advising on product selection, these providers need to be able to rely on a prior product certification process, to have confidence that the product complies with relevant standards and is fit for purpose. The Clean Energy Council currently maintains a whitelist on a self-managed basis, and this is referred to in South Australian Regulation. SAPN has developed a test procedure and manages product testing. OEMs have expressed a strong preference for a national testing and certification regime to ensure efficient and consistent processes across the Australian market.

Industry stakeholders have expressed the view that, while building the capability for CSIP-Aus compliance is non-trivial, the product development processes are well advanced. Most major OEMs expect to be able to demonstrate CSIP-Aus compliant for inverters, gateway devices and aggregator cloud platforms in the near term. This process has been accelerated by the need to comply with the CSIP implementation of IEEE 2030.5 under Rule 21 in California and the CSIP-Aus mandate that comes into effect in South Australia from 1 December 2022.

The ESB understands that the South Australian requirement has substantially brought forward product compliance in the Australian market and most major suppliers will be ready at or soon after the commencement of the mandate. It is accepted that a small number of manufacturers may choose to exit the Australian market rather that comply with a ‘Flexible Export Ready’ mandate. Stakeholder views are sought on the materiality of this with regard to installation costs and other impacts on consumers.

The implementation of a national certification process for Flexible Export Ready (CSIP-Aus compliant) products is considered a precondition of a Flexible Export Ready mandate, however it could also be progressed without a mandate being in place. Were a mandate to be in place, it would, in effect, mean that every installation must include a product on the list. This would not mean non-compliant products cannot be sold (i.e. make them illegal), rather that these products must be incorporated into an installation that includes a CSIP-Aus compliant product (i.e. a flexible export ready installation).

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44 kyrio.com/sunspec-alliance-pki-certificates/

Further work is required to develop an effective governance arrangement around the listing (and delisting) process. The ESB considers that this arrangement must ensure transparent and fair treatment of OEMs, with appropriate incentives and penalties to ensure that products being installed are consistent with those listed. A compliance program would be required to enable non-compliant products to be identified (e.g. by networks, installers, consumers or competitor OEMs). A key incentive in this framework would be the threat of product-delisting however, interim penalties and make-good arrangements should also be considered.

Separate to the issue of whether CSIP-Aus becomes a mandate for new installations, a suitable regulatory authority needs to be identified to oversee the certification of products against CSIP-Aus. While the former relates to requirements at the time of installation, the certification of products more closely aligns to technical standards for consumer products that generally sit outside of the national frameworks that govern the electricity system (such as for the inverter standard AS 4777.2).

Options for establishing governance arrangements include:

- Industry self-regulation – noting the limitations industry has in enforcement and the potential conflicts of interests that may arise.
- Jurisdiction technical regulation – noting that this may limit the achievement of a critical 'national consistency' objective and require jurisdictional regulation to extend beyond safety regulation.
- The AER – noting that the AER is principally an economic regulator and may need new powers and regulatory services models to ensure effective governance.
- The Clean Energy Regulator – noting its scope is limited to the voluntary SRES scheme, which covers only solar installations, and which is due to end in 2030.
- A new national consumer energy resource technical regulator – noting this would be a major policy decision for governments and it is beyond the powers of the energy market bodies to implement.

Subject to the approach to broader governance arrangements discussed above, stakeholder views are sought on whether product certification processes for CSIP-Aus should be brought under the National Electricity Rules.

In any case, the ESB expects that product certification processes could be largely outsourced, with appropriate oversight and controls being put in place. For example, an existing CSIP-Aus test server (such as SAPN's) could be accredited (and funded) to verify product compliance on a national basis, or this role could be assigned to an independent test laboratory. The hosting of the list, and oversight listing/delisting processes, could be implemented via a regulatory services agreement with an industry group such as, for example, the Clean Energy Council or Smart Energy Council.

A key consideration in governance arrangements, including any outsourcing, is the ability to generate confidence in the efficiency and integrity of listing and de-listing processes. Existing national product certification infrastructure supports compliance with a range of product standards that apply to renewable energy systems. The ESB considers existing processes are potentially suitable for supporting a national certification process, subject to appropriate regulatory oversight.

The ESB has identified a series of activities and tasks needed to effectively plan for the commencement of CSIP-Aus product certification processes (subject to further consultation):

- identify the appropriate form of regulatory oversight of the product listing processes, and the appropriate body to be responsible for providing regulatory oversight
- investigate the viability of industry-led product listing processes being adapted for a national CSIP-Aus implementation, including the review and development of compliance assurance and enforcement arrangements
- consultation to ensure that manufacturers are prepared and able to participate in a product listing program, and that sufficient test-laboratory capacity exists

Given the mandate discussed here relates to CSIP-Aus for flexible export limits implemented by DNSPs, the ESB expects that network operators may often be best placed to identify products that are not correctly communicating via the CSIP-Aus protocol. Stakeholder views are sought on the appropriate role of DNSPs in product certification/de-certification processes when considering that, while initial version of CSIP-Aus (v1.1) is limited to enabling DOE, in the future it could be expanded to enable future use cases, such as in the CER-Market domain.

QUESTIONS FOR CONSULTATION

Consultation Question 13: What views do stakeholders have about the adaptability of existing industry-led product certification and compliance processes for future use?

Consultation Question 14: What views do stakeholders have about the most appropriate body to have oversight of the product certification and listing/delisting processes?

Consultation Question 15: What role could DNSPs have in the product certification/decertification process in the context of improving outcomes for industry and consumers?

5. Next steps

The ESB's CER Implementation Plan seeks to ensure that consumers have access to secure, reliable, affordable and sustainable energy no matter how they choose to participate in the energy system. New technologies can support energy service delivery, however more sophisticated standards are needed to enable safe and market responsive consumer energy resources and support broader customer choices.

The first step on interoperability policy proposed in this paper, CSIP-Aus for flexible export ready installations, is focused on the uptake of consumer energy resources and removing barriers so that consumers can better realise the value of their flexible consumer energy resources. This is a building block for future interoperability policy development that will work to facilitate the ability of service providers trading flexible consumer energy resources in the market on behalf of customers to manage these resources within dynamic operating limits.

It is acknowledged here that the consistent approach to CSIP-Aus outlined above represents minimum levels of functionality to enable the consumer choice and participation discussed. The market is free to innovate and offer more advanced functionality over and above minimum requirements. As noted previously in this paper, future work on technical standards will also explore this more advanced functionality, including trader use-cases.

Section summary

Interoperability roadmap for consumer energy resources including standards related to electric vehicle supply equipment and behind the meter interoperability as well as cyber considerations.

Next steps on the implementation of the CSIP-Aus mandate with compliance and enforcement considerations together with the AEMC and AER.

Comprehensive and cohesive consideration of consultation outcomes through the AEMC's *Review into consumer energy resources technical standards* and the AER's *Implementation of Flexible Export Limits by Distribution Network Service Providers (DNSPs)*.

It should also be acknowledged that there are two elements to interoperability that require minimum levels of functionality: consistent *communication* and the consistent *physical response* to this request. Such consistency is not only beneficial for consumers, but also critical for power system operational management. A consistent way to communicate means the request is being asked for in the same way across multiple different providers and hundreds of different devices, such that it could deliver the same response required for reliability. This consistent request is important, but how the devices physically respond to this request must also be addressed in future standards development.

Future work will also focus on the principle that customers should be able to access a choice of service providers. As new products emerge, customers should not unduly be 'locked in' to choices based on manufacturers design of their consumer energy resource assets. As interoperability policy progresses into the second horizon of activities under the plan in 2023, standards-based approaches to support customer choices and switching will be explored. This will occur in parallel with consideration of next steps on the implementation of the CSIP-Aus mandate with compliance and enforcement considerations together with the AEMC and AER.

The Implementation Plan is also focused on ensuring a fit-for-purpose protections framework that improves experience for all customers. While this paper focusses on the CSIP-Aus implementation, stakeholder feedback will be considered by the AEMC in its broader consideration of consumer energy resources technical standards in the NEM.[45] This reflects a desire to establish clear and future-ready frameworks that

[45] AEMC, *Review into consumer energy resources technical standards*, consultation paper, 29 September 2022.

cover the range of technical standards required to effectively serve consumers' interests as the electricity system incorporates greater market participation by consumer energy resources.

6. Consultation

6.1 Workshop discussion

The ESB intends to hold a workshop with stakeholders and interested parties on the material covered in this paper on 24 October 2022. Interested parties are invited to register their interest by email to info@esb.org.au.

6.2 How to make a submission

The ESB invites comments from interested parties in response to this consultation paper by 17 November 2022. Submissions will be published on the COAG Energy Council's website, following a review for claims of confidentiality. All submissions should be sent to info@esb.org.au.

Submission information	
Submission close date	17 November 2022
Lodgement details	Email to: info@esb.org.au
Naming of submission document	[Company name] Response to Interoperability Policy, [Directions Paper] – Consultation Paper
Form of submission	Clearly indicate any confidentiality claims by noting "Confidential" in document name and in the body of the email.
Publication	Submissions will be published on the Energy Ministers website, following a review for claims of confidentiality.

6.3 Matters for consultation

In responding to consultation questions, stakeholders are asked to consider interdependencies between suggested approaches. For example, a governance arrangement for one implementation activity may necessitate a particular model for another. It would be most useful if submissions presented an internally consistent proposal where possible.

#	Consultation question
1	Are the five identified domains correctly summarised? Are there gaps or major limitations in this framing?
2	What priority should each domain be assigned, considering the interest of all electricity consumers within the consumer energy resource interoperability landscape?
3	What are the likely costs and benefits for consumers associated with a national 'flexible export ready' mandate including in relation to future readiness of customer installations and installation costs?
4	Do stakeholders agree that DNSPs are best placed to enforce a 'flexible export ready' mandate at the time of installation? If not, what alternative models should be considered?
5	What requirements should a 'flexible export ready' installation have with regard to internet connectivity (e.g. embedded mobile communication versus LAN connectivity)?

6	What are the pros and cons of a flexible export ready mandate set in the Rules, via a subordinate instrument, or under a separate head of power (e.g. jurisdictional technical regulation)?
7	If implemented under the Rules, which market body is best placed to establish and oversee the proposed requirement on DNSPs?
8	What are the pros and cons of a flexible export ready mandate referring to CSIP-Aus in Standards Australia Handbook form?
9	Would there be value in agreeing a national approach to public key infrastructure for consumer energy resources?
10	Are there existing examples that could be used as a model for the consumer energy resources ecosystem?
11	What are the pros and cons of establishing a national certificate authority?
12	Do stakeholders have a view as to who should perform the role of national certificate authority, if it were created?
13	What views do stakeholders have about the adaptability of existing industry-led product certification and compliance processes for future use?
14	What views do stakeholders have about the most appropriate body to have oversight of the product certification and listing/delisting processes?
15	What role could DNSPs have in the product certification/decertification process in the context of improving outcomes for industry and consumers?

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