ENERGY SECURITY BOARD

CONSUMER ENERGY RESOURCES AND THE TRANSFORMATION OF THE NEM

Critical priorities to support transformation: a call to action

Anna Collyer

Chair

Australian Energy Market Commission

Clare Savage

Chair

Australian Energy Regulator

Daniel Westerman

Chief Executive Officer

Australian Energy Market Operator

TABLE OF CONTENTS

FOREWORD

Since its establishment in 2017, the Energy Security Board (**ESB**) has maintained a collaborative, cross-agency program of work on consumer energy resources (**CER**) and data in recognition of the complex and intersecting challenges that CER presents to the national electricity market (**NEM**) systems, markets, and consumer outcomes. In 2021, the ESB released the CER Implementation Plan, which describes a range of reforms that are required to unlock the benefits of the rapid uptake of CER, while also reducing the risks created by the speed and scale of the change.

At the same time, the ESB released the NEM Data Strategy to manage changing data needs in the energy transition and optimise the long-term interests of energy consumers in a digitalised economy. These programs recognise the critical role of consumers in driving the energy transition – and the centrality of data in driving new services, underpinning sound policy development, and ultimately supporting consumer outcomes in the energy transition.

As the ESB's term has drawn to a close, there is an opportunity to harness the work to date to inform critical priorities for the next 12 months, and beyond. Building on learnings and work to date, it is timely for CER integration to progress from a demonstration and incubation phase to a reform design, delivery and implementation phase.

This report sets out:

- Key insights and learnings across the reforms on CER integration over the past 2 years;
- The role for government leadership in driving the CER transition to benefit all consumers; and
- Priorities in CER integration for governments, industry and market bodies over the next 12 months.

Realising the opportunity of efficient and effective CER integration will require new approaches. It will require new levels of cooperation and concerted action across industry, governments, consumer groups and market bodies to deliver in the best interest of all energy consumers.

ABBREVIATIONS AND TECHNICAL TERMS

ACL	Australian Consumer Law
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
CER	Consumer Energy Resources
CSIP-Aus	Common Smart Inverter Profile – Australia
DER	Distributed Energy Resources
DNSP	Distribution Network Service Provider
DPV	Distributed Photovoltaic
ESB	Energy Security Board
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FEL	Flexible Export Limits
IASR	Inputs Assumptions and Scenarios Report
ISP	Integrated System Plan
MW	Megawatt
NECF	National Energy Customer Framework
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NERO	National Energy Retail Objective
NERR	National Electricity Retail Rules
PV	Photovoltaic
SAPN	SA Power Networks
TNSP	Transmission Network Service Provider
TWh	Terawatt-hour
VPP	Virtual Power Plant

EXECUTIVE SUMMARY

As Australian government, industry and agencies grapple with the challenge of decarbonising Australia's electricity system, consumers are leading the way. Consumer adoption of small-scale distributed photovoltaic (**DPV**) systems has grown at an average rate of 25% year on year over the past 5 years. To put this in perspective, more photovoltaic (**PV**) has been installed on Australian rooftops than at a utility scale, and Australia's households and businesses have installed PV at rates unparalleled across the globe.[1]

Today, it is clear that Australia's path to net zero requires significant new investment in grid-scale generation and firming resources, as well as transmission infrastructure. It is equally clear that small-scale resources will play a critical role supporting an economically efficient pathway to decarbonising Australia's energy sector.

With consumer appetite for rooftop PV only increasing, uptake of electric vehicles (EVs) exceeding forecasts, and electrification key to achieving Australia's broader decarbonisation objectives – CER policy is at a critical juncture.

The past two years have been a rich time for demonstrations, new research and insights into consumer behaviour in buying, using and managing CER. Networks and traders have advanced their capability to manage CER, offering new products and services to consumers. The ESB and market bodies have progressed important programs of work across CER and enabling data reforms. All jurisdictions have also pressed forward with CER incentives, programs and trials.

In this report, the ESB summarises the key insights and lessons learnt across the CER reform journey to date. Building on learnings and existing work, it is timely for CER integration to progress from a demonstration and incubation phase to a reform design, delivery and implementation phase.

The reform journey to date has thrown light on the challenges inherent in adapting the existing regulatory frameworks to address the key priorities in CER integration. While the energy industry has an established value chain where roles and responsibilities, information flows, and financial arrangements are clearly understood, there is a need to review all of these arrangements to integrate CER well, and deliver choice and outcome for consumers.

Today, addressing the challenges and opportunities of CER integration requires coordinated leadership and action to drive outcomes across reform priorities. As the ESB's term draws to a close, new leadership from governments is required, as well as active coordination across many interrelated programs driven by market bodies and jurisdictions, to deliver the necessary policy reforms that will set Australia on a course to achieve its broader decarbonisation objectives.

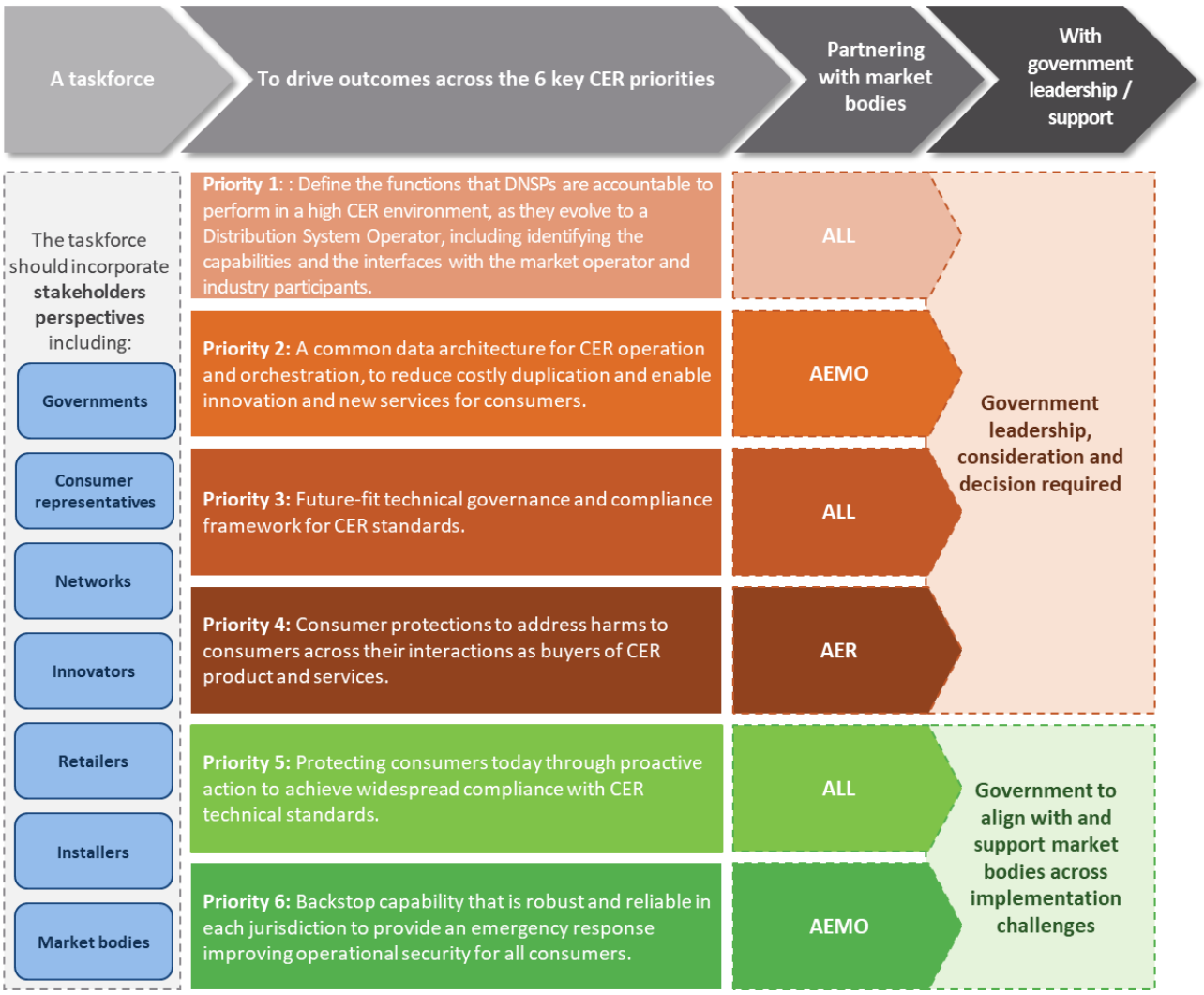
The ESB calls on governments to deliver a targeted program of work, working with market bodies, industry and consumer representatives, to deliver outcomes across the following priorities. The ESB recommends government convenes a CER taskforce, mandated with clear terms of reference to drive outcomes. The taskforce should focus on driving the following priorities across a 12 month period.

- **Priority 1**: Define the functions that distribution network service providers (**DNSPs**) are accountable to perform in a high CER environment, as they evolve to a Distribution System Operator (**DSO**), including identifying the capabilities and the interfaces with the market operator and industry participants.
- **Priority 2**: A common data architecture for CER operation and orchestration, to reduce costly duplication and enable innovation and new services for consumers
- **Priority 3**: Future-fit technical governance and compliance framework for CER standards.
- **Priority 4**: Consumer protections to address harms to consumers across their interactions as buyers of CER products and services.
- **Priority 5**: Protecting consumers today through proactive action to achieve widespread compliance with CER technical standards.
- **Priority 6**: Backstop capability that is robust and reliable in each jurisdiction to provide an emergency response improving operational security for all consumers.

[1] National Survey Report of PV Power Applications in Australia (IEA). Published 2023. Accessed at National Survey Report of PV Power Applications in COUNTRY (iea-pvps.org).

Consumers are playing their part in decarbonising Australia's electricity system. The task now is for governments, market bodies, consumer stakeholders and industry to ensure the regulatory, technical, governance and policy settings for CER harness the power of consumer and distribution-connected resources, as a key driver in decarbonising Australia's energy sector while supporting outcomes for all consumers.

Figure 1: 12-month action plan to drive outcomes against CER priorities



1. INTRODUCTION

1.1 Consumer energy resources as part of the future energy system

Consumer Energy Resources (**CER**) are emerging as a transformative force in the decarbonisation of Australia's energy system.

Consumer adoption of small-scale, distribution-connected resources is progressing at a rapid rate across the NEM. DPV generation contributed a substantial 12.1% to NEM's total electricity generation in the summer (Q1) of 2023. This outperformed utility-scale solar (7.5%), wind power (11.6%), hydro (6.1%), and gas (4.6%) over the period. [2] The momentum of CER adoption is evident in the year-on-year DPV growth of 1,888 MW (30%) in Q2 2023, notably the second-highest quarterly growth despite widespread economic slowdown.[3]

Australian Energy Market Operator's (**AEMO**) Integrated System Plan (**ISP**) maps potential pathways for the NEM as a whole, and includes consideration of CER uptake and orchestration across these pathways. Most recent projections, in the Inputs Assumptions and Scenarios Report (**IASR**) report, include:

- Forecasts of DPV generation surging from 19 TWh to 77 TWh by 2040, serving 22% of underlying electricity demand;
- a substantial 27-fold increase in CER storage by 2040;
- EVs comprising 60% of overall road transport by 2040 – and representing almost 20% of underlying electricity demand. [4]

In addition, electrification of end-use energy consumption currently served by other fuels is also expected to add an additional 76 TWh to total electricity demand by 2040 – highlighting the need for additional generation capacity as well as load shifting and shaping to efficiently and effectively manage demand. [5]

1.2 What does successful CER integration look like?

1.2.1 CER is central to the energy transition

The next decade presents an opportunity for Australia to harness the potential of CER to support the decarbonisation of Australia's energy systems. With more weather-dependent renewable generation in the market, CER will play a crucial role in helping balance fluctuations in energy demand and supply.

CER can help deliver a more reliable and secure energy system at lower cost for all consumers, and contribute to a lower emissions energy sector if they are an integrated part of the energy system. However, left unmanaged, the growing quantity of CER has the potential to increase energy costs. Costly network and generation infrastructure would need to be built to keep up with the forecast increase in electricity demand, which would have flow-on costs for industry and customers.

---

[2] The Quarterly Energy Dynamics Q1 report was published in April 2023. Further information can be found here: https://aemo.com.au/-/media/files/major-publications/qed/2023/qed-q1-2023-report.pdf?la=en&hash=B02BF39D3ED1F8EE1DDAF0F9BCF5267B

[3] The Quarterly Energy Dynamics Q2 report was published in July 2023. Further information can be found here: https://aemo.com.au/-/media/files/major-publications/qed/2023/qed-q2-2023-report.pdf

[4] Percentage based off AEMO's ESOO Electricity Demand Forecast for 2040 at 240TWh (2022). Accessed here: 2022-electricity-statement-of-opportunities.pdf (aemo.com.au) and Electric Vehicle Projections Report by CSIRO (2022) at which 48,000GWh in 2040 is the expected EV consumption figure. Accessed here: Microsoft Word - CSIROEVreport_20221124.docx (aemo.com.au)

[5] AEMO 2023 Inputs, Assumptions and Scenarios Report (IASR) accessed August 2023. (Step change scenario)

1.2.2 Successful CER integration will benefit all system users

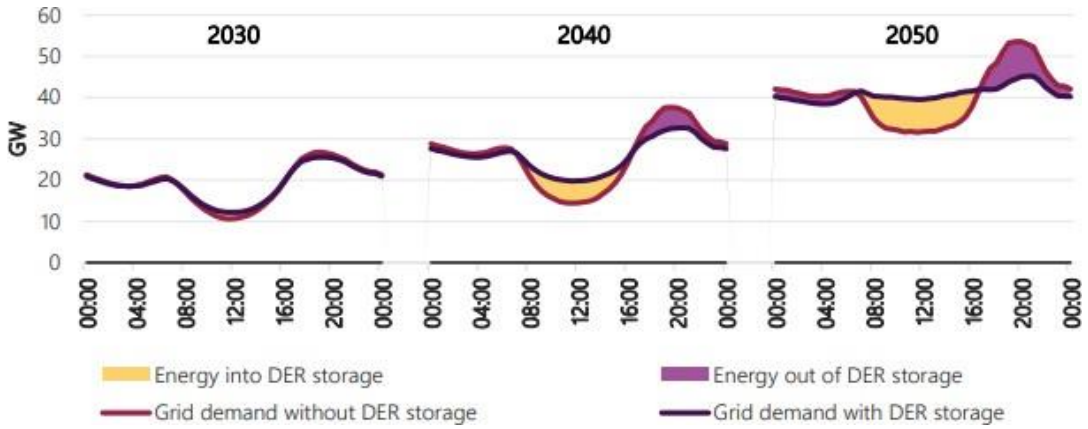
For individual customers, efficient integration could mean they have the opportunity to maximise the return on their investment through the operation of their CER. This could range from using their CER for bill reduction, to access and participate in the growing number of new energy services markets, support decarbonisation, energy security and reduce cost for their community.

The efficient integration of CER could also provide significant benefits to non-CER owners in the form of lower total system costs. CER is a flexible resource from both a load and generation perspective. Generation assets (such as DPV and batteries) could drive down energy costs by providing low cost energy, as well as ancillary services in competition with traditional providers. Devices or programs that promote and enable load flexibility could help deliver more efficient use of existing network infrastructure, helping to reduce the need for grid augmentation and saving costs for all consumers. Effectively integrated DER can also provide services that support the reliability and security of the system, helping the AEMO and network businesses maintain a reliable and secure system at a lower cost, for the benefit of consumers.

The net benefit of effective integration and coordination of CER has been estimated to be between $1 billion and $6.3 billion by 2030-2040. [6] A key way that value is derived is through shaping and shifting demand to make supply from CER. Figure 2 illustrates the potential role of coordinated DER storage under the 2022 Step Change scenario, demonstrating the potential for coordination of CER to reduce reliance on grid-scale resources, including generation and grid-scale storage.

To capture the benefits of these opportunities it is important that regulatory and market frameworks support consumers with CER to get the most of their investments. For individual consumers, new energy services are likely to be more complex than traditional energy services and consumers will need to be confident that new CER based services meet their needs and can also contribute to system benefits. To build consumer trust and engagement with new energy services will require that consumers are provided with clear information, the right incentives and appropriate protections, as well as clear frameworks for resolving disputes.

Figure 2 Average time of day profile - impact of co-ordinated DER and distributed storage, Step Change from AEMO ISP 2022.



[6] AEMC. (2023). Directions Paper: National Electricity Amendment (Unlocking CER Benefits Through Flexible Trading).

1.2.3 Successful integration of CER needs a holistic, planned and coordinated approach

Over the past decade, jurisdictional governments, market bodies, consumer groups, standards organisations, industry bodies, energy businesses and service providers, and researchers have all contributed to the energy transition through their individual programs of work. To date, there has been limited coordination of these important programs of work.

CER communications and data exchange highlights the risk of an uncoordinated approach

For example, the coordinated and orchestrated operation of CER is one way of unlocking their benefits. Achieving this will require communication between the party or parties orchestrating the CER, the flexible load or generation device, and the rest of the energy system. Today, disparate approaches to communicating with CER and data exchange between parties are under development across the NEM. This uncoordinated approach could lead to more costly approaches being adopted, as well as a number of disaggregated systems being implemented across the NEM and creating a barrier to future market services such as load flexibility from developing. A collection of disaggregated communications and data exchange network would also increase data security risk.

CER integration also needs to ensure adequate consumer outcomes and fit-for-purpose protections

Many of the recent CER integration programs have focused on technical and market integration, but the increasing CER uptake also raises questions about the current energy consumer protection frameworks, which were designed for the unidirectional sale of electricity from a retailer to a person or premises. As the energy market evolves, energy flows have become bidirectional between consumers and the distribution network and energy service offerings extend well beyond the traditional sale of electricity from retailers to end users.

Whilst many of these new energy services are innovative, they are also complex and can impact on the essential nature of energy service provision to consumers. At present, unlike traditional retail services, new energy services sit outside the National Energy Customer Framework (NECF) raising questions as to whether the existing energy consumer protection framework is fit for purpose.

Success requires a shared vision, collaboration, and outcomes to be delivered

CER integration is not a task that can be achieved by one organisation or one part of the industry alone or through traditional regulatory changes processes. It is clear that an uncoordinated approach is not a sustainable or effective way to integrate a much higher level of CER into the energy system. There is an opportunity for the transition to be planned, as opposed to evolving in a disaggregated and potentially inefficient manner. This report will draw on the insights gained from recent reform programs, highlight the need for government leadership to enable success and areas that require urgent reform actions in the near future.

1.3 Structure of this report

The remainder of this report is structured as follows:

- **Chapter 2**. This chapter outlines the key insights drawn from the CER integration programs implemented by governments, market bodies and the industry.
- **Chapter 3**. This chapter outlines key reform priorities and how governments, market bodies and industry can work to achieve critical outcomes.
- **Appendix A**. This appendix summarises the ESB CER & Data reform programs.
- **Appendix B**. This appendix reflects on the evolving policy and industry context for CER, and highlights areas of uncertainty today across the CER value chain, as well as the critical areas of uncertainty in the high CER future environment.
- **Appendix C**. Recognising that the ESB's program of work does not occur in a vacuum, this appendix summarises key lessons learnt across a range of demonstration programs. It also highlights the

breadth of jurisdictional policies which touch on CER, as well as identifying some of the key drivers of jurisdictional programs.

2. REFORMS & INSIGHTS

2.1 Overview of recent CER reforms

The past two years have seen significant progress across industry in integrating CER. Consumer research and knowledge sharing has established valuable insights into consumer behaviour in buying and using CER. Networks and traders have advanced their capability to manage CER, offering new products and services to consumers. A range of demonstration programs across the NEM and Wholesale Electricity Market have also trialled and tested new capability in CER operation and services.

Over this period, the ESB and market bodies have progressed interrelated programs which aim to integrate CER to support the decarbonisation of energy systems while minimising total system costs and protect consumers. The ESB program of work has recognised that policies need to work for consumers with CER investments, whether they are active or passive in their engagement with energy markets and services. Critically, CER integration reforms consider the impact on all consumers – by focusing on efficient and effective integration, CER reforms seek to support affordable, reliable, and secure electricity supply in the context of a decarbonising the electricity system.

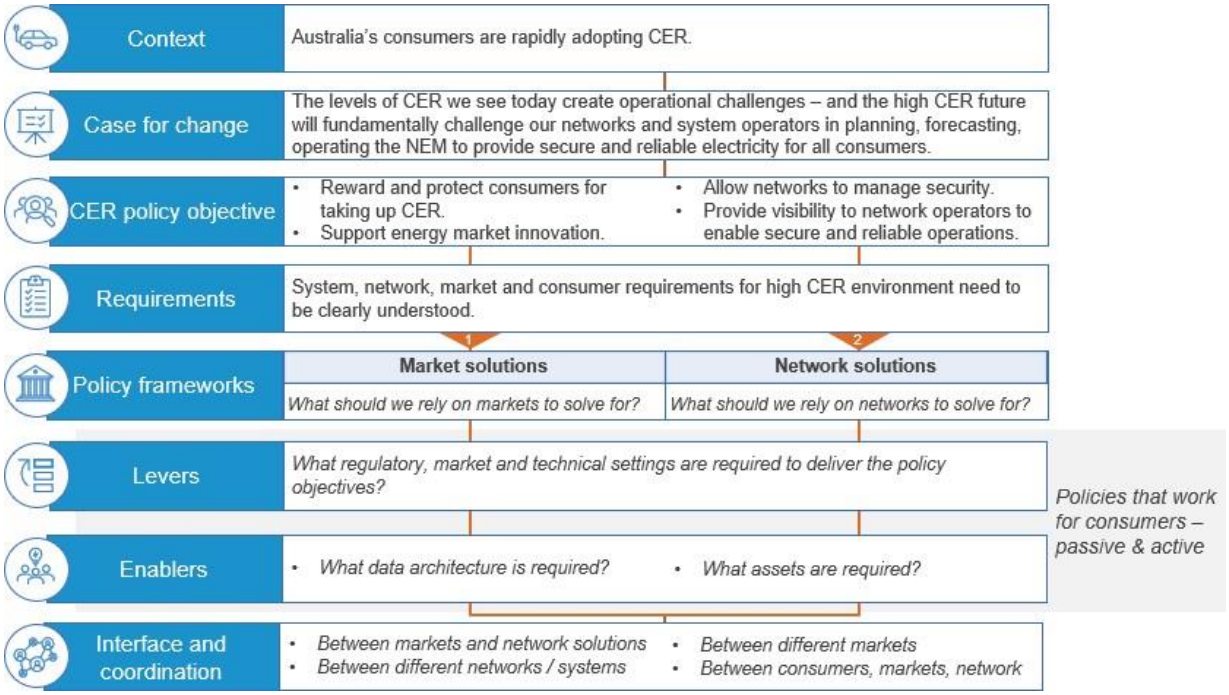
At the date of this report, the reforms previously progressed under the ESB banner are being taken forward by individual market bodies. Appendix A sets out a summary of the reform programs progressed by the ESB, and indicates the relevant market body which is taking forward the reform.

Many of the ESB's reform programs are focused on the **levers** and **enablers** required to support the decarbonisation of energy systems while minimising total system costs. These programs encompass both network and market solutions, recognising that both will be required to support efficient outcomes for all consumers.

At the same time, governments have been spearheading a range of initiatives that support consumer adoption of CER. The Australian Government has active policies to promote CER including via the EV strategy, community battery program and demonstration funding through Australian Renewable Energy Agency (**ARENA**). Jurisdictions have a range of policies and reforms on foot which seek to encourage CER uptake and manage risks. A range of programs focused on energy efficiency and energy performance also play an important part in the future of integrated, responsive CER and demand flexibility. Some of the broader jurisdictional reforms on foot are also summarised in Appendix C.

Figure 3 sets out a conceptual schema for approaches to CER policy – and highlights the many layers of policy issues to be worked through to effectively integrate CER.

Figure 3: CER Policy Schema



As the ESB's term has drawn to a close, it is timely for governments to step forward in a stronger leadership role across CER integration. In doing so, they can draw valuable insights from the broad CER integration program that can usefully inform the next phase of CER policy and reform.

2.2 Key learnings from the CER integration program

Insight 1: Social Consumer trust and confidence in new energy services and the sector more broadly will be critical to enabling orchestration in the future

Key Learnings:

- A broader narrative on the energy transition, the role consumers can play through CER, and the value of change needs to better be articulated.
- Services, products and markets to orchestrate CER need to be designed around consumer preferences and address barriers to participation.
- Customers need confidence in how they will be able to use the CER in which they invest, at the time of the investment and throughout the life cycle and use of the CER assets.
- Clear communication and transparency will be critical to growing the customer based for orchestrated services from CER.
- Fit-for-purpose customer protections framework are required to underpin consumer trust and ensure consumer outcomes are delivered.

As outlined in section 1.2.2, orchestration of CER will be key to delivering the decarbonisation of the electricity system at least cost. Insights from industry trials and the ESB's own Customer Insight Collaboration process indicate there are significant barriers to consumers accepting the orchestration or

control of their CER assets, which will need to be addressed in the policy response to integrate CER. The underlying theme in this area is that there is a need to build and maintain consumer trust, and this can be best achieved by considered, planned, policy evolution. Setting a vision for how consumer can expect their CER will be integrated and best deployed to meet their and system needs, and then facilitating this vision through consistent policy application is imperative.

The ESB's **Customer Insights Collaboration**[7] focused on an end-to-end view of customer issues associated with integration of CER and flexible demand. The knowledge sharing report recognised several overarching **barriers** for consumers in accessing services and products relating to CER (including flexible demand) including:

- Lack of trust in institutions and organisations, and in CER products and services.
- *Misalignment with motivation*: Expectations embedded in product or service not aligned with consumers expectations and aspirations.
- *Ineffective communication*: Information can be too complex or confusing or too generic, and may be oriented to English-speaking consumers using exclusionary language via an in accessible media channel.
- *Complexity*: Flexible CER and energy use involves the use of complex technology, automation and energy use, creating a more complex energy system.
- *Lack of Skills, Knowledge, Experience and Opportunity.* Most consumers start from a low level of interest and understanding of energy system issues. Some are not comfortable with technology, and some cannot access some CER products and services (e.g. renters).
- *Lack of Perceived Value:* Consumers generally prefer the status quo, and do not want to change unless there is a large-scale effect.
- *High Perceived Costs:* The upfront costs of flexible CER and energy use seen as too expensive, and out of reach without rebates.

Project EDGE, a demonstration program looking at how CER network services and markets can be optimised to improve outcomes in CER integration, included a multi-year consumer insight series (conducted by Deakin University's Better Consumption Lab). The Final Summary report explored how potential and current residential virtual power plant (**VPP**) customers perceive VPPs, highlighting (among other things):

- Potential consumers could not see a clear benefit for joining a VPP, over and above adopting DERs.
- For consumers who had signed on to Project EDGE VPP, the value proposition for joining a VPP requires work.
- Considerable effort is required to appropriate communicate the benefits, safeguards for customers in joining the VPP.

The AER's **Review of Customer Protections for Future Energy Services** recognises the increased availability of CER has created new ways for consumers to access products and services to meet their energy needs. This has sparked new entrants in the energy market providing services that impact on the essential supply of energy for consumers, but which are not covered under the existing National Energy Customer Framework, which is restricted to traditional retail services. Whilst the provision of new energy services can deliver the benefits of innovation to consumers it has also resulted in increasing complexity in an already complex market, which can easily confuse consumers and lead to a loss of confidence and trust in the sector. To overcome this, consumers need to have access to adequate information and advice to make decisions about these products and services. Energy solutions should be tailored to individual needs and circumstances, consumers of new energy services need to be supported with robust consumer protections and straightforward resolution processes should be available when things go wrong.

---

[7] Acil Allen's report on Barriers and enablers for rewarding consumers for access to flexible DER and energy use was published in June 2022. Further information can be found here: https://www.datocms-assets.com/32572/1658964119-barriers-and-enablers-final-report-v2-352146-1-3-1.pdf

Insight 2: CER performance is already impacting the system – and solutions from networks, markets and emergency measures are needed to manage risk today and in a high CER future.

Key Learnings:

- Australia's unparalleled levels of adoption of CER creates challenges for operating electricity systems for networks and AEMO
- Getting the right enabling infrastructure in place is critical to creating the conditions to manage the system into the high CER future scenario.
- Emergency backstop capability is needed today as an emergency measure to addresses system security issues created by minimum operational demand
- Future network and market settings create opportunities for new ways of managing the operational issues posed by CER, and should be considered when setting the requirements for enabling infrastructure and the emergency backstop capability

CER levels today are challenging operational systems for networks and AEMO, particularly the security and reliability of electricity supply for all consumers. [8]

The ESB's programs have identified and explored the operational and system security issues arising in a high CER context.

Recent reports by the AEMC and AEMO on **Compliance with Technical Standards** highlight systemic non-compliance of CER with technical standards. This non-compliance increases the risk that systems will unexpectedly disconnect from the system. For instance, in audits conducted in 2020, improper settings were identified in a substantial number of DPV systems. Approximately half of these systems exhibited incorrectly configured grid protection settings, including a maximum 10-minute average voltage limit, while the other half had improperly configured power quality response mode settings like Volt-Watt or Volt-VAr. In some cases, a small subgroup of these systems even had an inaccurately set power ramp rate limit, all contributing to the heightened risk of disconnections. [9] AEMO has found that, if left unaddressed, the level of non-compliance will impact the ability of system and network operators to maintain system security and reliability, and increase costs to consumers.

Emergency backstop measures are required to support system security issues arising with minimum operational demand

Emergency backstop mechanisms are measures to curtail CER in exceptional, emergency circumstances where required for system security. The Post-2025 program recognised the need for jurisdictional levers to address the system security risks associated with emerging minimum load conditions and unexpected DPV aggregate disconnection. South Australia, Queensland and Victoria have all introduced jurisdictional levers to do so – whilst other NEM jurisdictions are yet to act.

[8] AEMO's report on Engineering Roadmap to 100% Renewables was published in December 2022. Further information can be found here: engineering-roadmap-to-100-per-cent-renewables.pdf (aemo.com.au)

[9] AEMO's report on Compliance of Distributed Energy Resources with Technical Settings was published in April 2023. Further information can be found here: https://aemo.com.au/-/media/files/initiatives/der/2023/compliance-of-der-with-technical-settings.pdf?la=en

Further, recent system security challenges in South Australia have highlighted the need for the emergency backstop to be robust and reliable through end-to-end operational readiness, to ensure the capability is available when called on in an emergency.[10]

South Australia's concern is supported by evidence from the Trip of South East –Tailem Bend 275 kV lines on 12 November 2022 report[11], which highlights the critical role of maintaining the visibility and controllability of distributed PV systems to ensure that network operators possess an adequate number of controllable assets to effectively manage the grid. AEMO's report from the incident highlighted that: Directions to Relevant Agents under the Smarter Homes regulations revealed that only between 25% and 42% of the CER capacity installed under this scheme responded as required during the islanded event. SA Power Networks (**SAPN**) estimated that only 51% of systems were appropriately configured at the point of commissioning.

Enabling technology is required to support systems operating in high CER contexts

In addition, a range of programs have considered enabling functions to create the capability to orchestrate CER at either network or market level:

- **Interoperability** program has explored the need for a common interoperability requirements for new CER connecting to networks, to enable future network and market services to communicate with the CER;
- **Technical standards for EV charging** has recognised the need for new technical standards specific for EV charging infrastructure, as a foundational measure ahead of wide-spread adoption of EVs across Australia
- **AEMC Smart Meter Review** has considered the settings for metering today, and in future, where CER plays an increasingly prominent role in electricity sector.

Whilst these reviews and reforms have been supporting the efficient and effective integration of CER to deliver the decarbonising system at least-cost, the ESB has also recognised the critical need to address system challenges of today.

Market reforms to support future operation

The ESB program recognises that addressing operational issues today, and in the high CER future, requires a combination of network and market solutions. The AEMC is considering two rule change requests that could create enabling mechanisms to unlock future markets in CER include:

- **Unlocking CER benefits through flexible trading.** The AEMC is aiming to improve the flexibility and trading of CER to unlock value for consumers. It is also aiming to facilitate better integration of flexible CER into the power system to deliver a more reliable and secure energy system that would benefit all consumers
- **Integrating price responsive resources into the NEM.** This rule change process is considering a proposal from AEMO to introduce a voluntary mechanism – 'scheduled lite' that seeks to integrate non-scheduled price-responsive resources into NEM market scheduling processes. This would increase visibility of the likely actions of these resources, thereby improving the efficiency of the broader system and reducing overall costs for consumers.

---

[10] AEMO's report on the Trip of South East Tailem Bend 275 kV lines on 12 November 2022 was published in May 2023. Further information can be found here: https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2022/trip-of-south-east-tailem-bend-275-kv-lines-november-2022.pdf?la=en

Insight 3: CER requires evolved capability for distribution networks to manage their networks

Key learnings:

- Capabilities and accountability of distribution networks in a high CER context is critical to integrating CER– and not yet resolved. There are fundamental limitations in the current regulatory and investment frameworks which need to be considered to encourage the right capability build.
- Interactions between networks, market actors, and AEMO as bulk system operator all need to be clearly understood to ensure consumer outcomes are achieved.

Many of the ESB's reform programs have focused on the new capability required to better integrate CER. Interoperability reforms, cyber security requirements, metering and EV technical standards – all relate to technology capability which is required to enable CER integration into the future. There is a significant task ahead in developing the required capability and ensuring it is integrated across the value chain for CER – so that CER is effectively integrated into market and network systems.

The AER's review of **Flexible Export Limits** (FELs) considers network approaches to allocating capacity across consumers, to enable consumers to maximise their benefit from CER whilst addressing system requirements. FELs enable consumers to connect exporting CER with variable export limits, so that the consumer with DPV may benefit from a higher export limit (ie, the maximum that their network and inverter can handle) whilst enabling the network to allocate capacity differently at times of network congestion. The AER is progressing the development of guidelines governing allocation of network capacity to support FELs, as well as proposing requirements governing information that should be provided to consumers on FELs and their impacts on a customer's use of their CER. FELs are an important enabling step to help facilitate the integration of CER into the energy system, but it is important that consumers have an understanding of the implications of taking up FELs related products and services.

Recognising the importance of new capability to manage the high CER future, the ESB has conducted a gap analysis considering roles across the value chain for CER (refer Appendix B). The analysis recognises a high CER environment requires new capability, and clear accountability, across all of the players involved in CER integration, across:

- the supply of CER and electricity;
- the measurement and control of CER; and
- system and market with high CER.

The detailed gap analysis (summarised in Appendix B) provides an overview of the areas of uncertainty across the CER value chain today, and highlights which functions require particular attention in the context of high CER. It also provides clarity on areas of the value chain that are not traditionally regulated by the national cooperative energy regime.

Whilst all levels of the value chain will require new capability in a high CER role, the ESB recognises a fundamental question exists around the roles and capability required of distribution networks to forecast demand in the context of increasing CER, and plan and operate their networks in high CER context. Ultimately, as CER are distribution-connected resources, the role of managing CER's impact on the broader system falls first to distribution networks. The ability of distribution networks to manage their networks for all consumers, whilst enabling consumers with CER to enjoy the benefit of their investments (including self-consumption benefits), will be critical to any attempt to harness the benefit of CER in Australia's energy transition. Of course, distribution networks are part of the broader interconnected electricity system – and the interfaces and coordination across distribution networks, and between distribution networks and transmission networks and the bulk system operator, as well as with market actors are also critical.

At present each distribution network also has a different level of maturity in managing CER resources and developing their capability and as CER related services accelerate, distribution businesses will need to understand the implications for their own role, capability and investment programs. Further, the predicted pace of change is such that what may happen in the operating and regulatory context cannot always be anticipated five years in advance via the regulatory reset process undertaken by the AER.

It is therefore important that work is undertaken to define the roles and functions of distribution networks with respect to the integration of CER. A common position on the roles and capabilities required of networks to operate their systems in a high CER context should help resolve some of the uncertainty and challenges associated with assessing investment cases brought forward by networks during the 5 year reset processes administered by the AER. This should ultimately protect the interests of consumers by driving efficient investment and consistency in approaches across networks to addressing CER integration that may not otherwise occur.

Insight 4: CER fundamentally changes the data needs and capabilities required to efficiently and effectively manage CER for network, market and ultimately consumer benefit

Key learnings:

- As networks are driving the early data models, there is a risk that the 'BAU' approach will create a barrier to future market services developing, and risk disaggregated and potentially more costly approaches.
- To enable CER services and outcomes in the future, improved low voltage visibility will be critical for networks – and visibility of network congestion and hosting capacity will be vital to consumers accessing the right CER services for their needs.

Management of CER on networks, and participation by CER in markets, requires significant new amounts of data to be generated, exchanged, stored and managed. The ESB's program of work has recognised the importance of data as an enabler in CER reform. Issues explored in the program include:

- Availability of data on CER, including EVs. Currently, networks and AEMO do not have access to reliable data on the size, location, and characteristics of electric vehicle supply equipment (**EVSE**) to enable them to manage opportunities and challenges of increased EVs connecting to the network. The **EVSE Data workstream** focused on options for capturing standing data for new EVSE installations. This work has recommended EVSE data should be collected and included in AEMO's Distributed Energy Resources Register. AEMO is currently developing a rule change to implement this recommendation.
- **Interoperability requirements** to ensure that data exchanged from CER supports multiple different service providers interacting with the CER.
- Sharing of data to support consumer, business and policy decision making has also been a key theme. The **Network Transparency** workstream considered how information on network hosting capacity should be shared to support consumers and traders understand the local capacity of networks to host their CER. The **data reforms** and **data services workstreams** have recognised changing policy maker needs for data with the increasing prominence of CER.

The **CER Demonstrations** have tested a range of approaches to data exchange to support network and market services from CER, as well as management of network hosting capacity within dynamic limits. At the same time, networks have been developing approaches to managing flexible export limits and building capability across their data needs in both 'real time' and planning timeframes.

At the same time, networks are actively developing approaches to managing their networks including through FELs and other means of real-time communication and control with CER. The way these processes are evolving are a mixture of different communication and control pathways between

networks, customer devices, and market actors, and there left unchecked may result in disjointed and potentially inefficient results for customers.

Insight 5: Governance frameworks need to be adapted and developed to support consumers in a high CER value chain

Key learnings:

- There are many intersecting policy areas which impact CER. Increasing CER has profound impacts on markets and networks for CER and must be considered in all policy and regulatory settings for CER going forward
- The right governance is critical to ensuring CER reforms introduced are effective in practice
- Cooperation between all governments and market bodies will be required to ensure the overall objective of CER integration is achieved

Across the ESB's reform program, the challenges inherent in adapting the regulatory and governance arrangements designed for a system powered by large scale, transmission-connected generation, to a high CER context has become apparent. The issue of who to regulate (networks, installers, sellers, consumers) and how to regulate (rules, economic regulation, other instruments), in a manner that will lead to positive outcomes for consumers and instil high levels of compliance, has become a clear theme.

The NEM has an established value chain where roles and responsibilities, information flows, and market and financial arrangements for the supply of energy from the bulk system to energy consumer are well understood. The small scale, disaggregated, interconnected and consumer-led nature of CER means that the policy, regulatory, market and institutional frameworks that were originally designed for large scale electricity generation and supply will need to evolve so that they become fit for purpose for planning, operating and regulating a system and market with high CER.

The AEMC's **Review into CER Technical Standards** has identified a critical need to consider how parts of the value chain not traditionally regulated by the national energy regime can be appropriately regulated to address system issues and support consumer outcomes in a high CER context. This theme is echoed in the AER's **Review of Consumer Protections**, which recognises that the existing energy consumer protections framework, comprising the National Energy Customer Framework (**NECF**) and the Australian Consumer Law (**ACL**), need to be fit-for-purpose in addressing potential harms to consumers in the evolving energy market.

The **Interoperability** (CSIP-Aus) workstream has considered the best approach to introducing new technical requirements for interoperability, taking into account the learnings from the introduction of initial technical standards in the National Electricity Rules. The **EV Charging** workstream has likewise considered the appropriate vehicle to introduce minimum product standards for electric vehicle supply equipment (EVSE) that would improve consumer experience in EV charging.

The issue of governance also emerges in parallel reviews such as the Australian Government's National Energy Performance Strategy, which has recognised the need to strengthen governance to enable the role of demand-side considerations into energy system planning.[12] Similarly, the Energy Efficiency Council highlighted the significant 'supply-side bias' that permeates electricity markets across the world, including Australia. The Council has called for enhanced governance as critical to reforms addressing these issues – including the creation of market for demand-side services, and ensuring the demand-side is considered when developing measures such as capacity markets.[13]

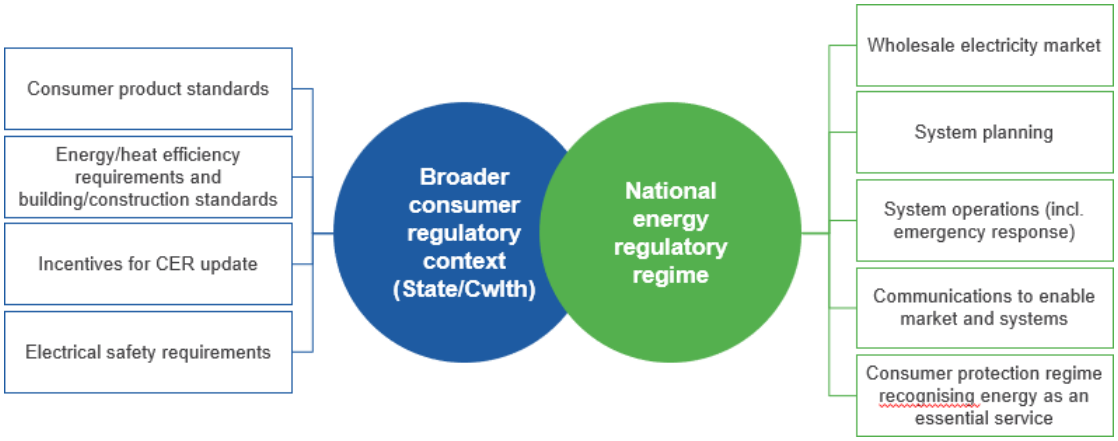
---

[12] National Energy Performance Strategy – Consultation Paper (10 November 2022) p 5

[13] Energy Efficiency Council's report on Clean Energy Clean Demand was published in April 2023. Further information can be found here: EEC Clean Energy Clean Demand - 2023.pdf

The ESB has recognised that CER touches on many issues which are regulated outside of the domain of the national energy regulatory regime. Consumer policy, consumer incentives, electrical safety and energy efficiency are all matters regulated by governments. Cyber security is regulated at both Commonwealth and jurisdictional level (with the Commonwealth taking a lead on major reforms in light of the *Security of Critical Infrastructure Act (2018)*). Technical regulation is dealt with differently by different jurisdictions, with South Australia notably having a stand-alone technical regulator. The role of governments in driving decarbonisation of energy systems is also critical to shaping the new policy and regulatory settings for CER.

Figure 4: Intersection between CER integration – role of governments and market bodies



3. KEY PRIORITIES AND CALL TO ACTION

3.1 Call to action

As the ESB draws to the close, government leadership and coordination is required to progress urgent reform priorities - supporting outcomes for all consumers while decarbonising Australia's energy sector. In section 3.2 below, the ESB has identified six reform priorities that require government leadership, coordination and concerted action. The ESB calls on governments to deliver a targeted program of work, working with market bodies, industry and consumer representatives, to deliver outcomes across the identified priorities, through:

1. **Leadership in the design of future settings for CER**: Government leadership is required in the design and decision making of reform priorities for CER. The ESB has identified priorities that require Government leadership, design and decision making. The outcomes across these priorities are needed critically – by mid 2024.

2. **Support in delivery and implementation**: Market bodies are progressing critical reforms – and across key priorities, government support is in the delivery and implementation to ensure reform objectives are achieved. These ESB has identified additional priority reforms that require active government leadership and support. These reforms are in process today – and support is needed immediately, to support lasting outcomes for consumers.

3. **Coordination and collaboration across all reforms**: In addition, government is called on to coordinate and collaborate across all reforms touching CER. Alignment and coordination is critical to ensure that the policies and reforms deliver the overall objective of CER integration.

   Coordination and collaboration should be an ongoing feature of how CER policy is delivered by governments, market bodies, industry and consumer representatives.

3.2 Outline of reform priorities

3.2.1 Government leadership in the design of future settings for CER

Leadership, consideration and decision is required to address the following key priorities.

Priority 1: Define the functions that DNSPs are accountable to perform as they evolve to a DSO in a high CER environment, including identifying the capabilities and the interfaces with the market and system operator and industry participants

To support consumers with active and passive CER, and all consumers, networks need to build and deliver the right capability, at the right time. Today, there is no clear framework for shaping how networks forecast CER, plan their networks in light of increasing CER or operate their networks in a high CER environment. Whilst networks are individually making strides in the right direction, the lack of an overarching maturity and capability framework, and lack of clear accountability for the operation of networks with high CER, risks divergent experiences for consumers across the NEM, and ultimately challenges the secure and reliable supply of electricity to all consumers.

Principles of efficiency in network investment remain critical to ensuring CER integration is least cost. At present with the current pace of change, it is also difficult for networks and the AER to forecast and assess network investment cases within the context of the 5 year network reset processes administered by the AER. This challenge is compounded by the fact that different networks are at different levels of maturity in their integration of CER.

There is a need for clarity on the roles and capability required of networks, clear accountability for networks to meet those requirements, and an ability to moderate the requirements based on the progress of the networks at a point in time. A common position on the roles and capabilities required of networks to operate their local systems in a high CER context should help resolve some of this uncertainty and drive efficient and consistent approaches to integration.

The interconnected nature of electricity networks also means that interfaces are critical. The capability networks are accountable for delivering needs to encompass clear accountability across interfaces between networks, and between networks, between networks and AEMO, and other actors.

Governments should lead a project that seeks to define the functions that DNSPs are accountable to perform. This project should involve collaboration and co-design with both industry and consumer stakeholders and market bodies.

Priority 2: A common data architecture for CER operation and orchestration, to reduce costly duplication and enable innovation and new services for consumers.

Data and communication is critical to enabling orchestration of CER by networks or traders. Today, there is no common data architecture or standards which apply to communications to CER by distribution networks or traders.

As networks are driving the early data models, and divergent approaches are emerging, there is a risk that the 'BAU' approach will create a barrier to future market services developing, and risk disaggregated and potentially more costly approaches. The ability of new market services enabling load flexibility will be critically undermined, and delay in considering the preferred option creates a risk of increased cost and data security risks to consumers in a high – and increasing – CER context.

Whilst interoperability reforms have considered the requirements at a device level to enable orchestration, it is critical to also consider the requirements of parties communicating with the CER. Cyber-informed engineering principles should also be applied from design to implementation. There is an opportunity to determine a pathway to achieving an efficient and effective data and communications infrastructure that underpins and supports CER integration.

A common data architecture will be critical to underpin the development of future orchestration methods. As set out in Appendix C, insights from the demonstration programs and internationally point to a clear and pressing need to determine an efficient and effective data approach to manage a high CER environment.

Priority 3: Future-fit technical governance and compliance framework for CER

Existing and future technical standards for CER devices are crucial in supporting CER's contribution to the NEM. This is because technical standards provide DNSPs and AEMO with more certainty about the operation of CER connected to the power grid. Standards also support CER interoperability and can help to ensure that consumers with that own CER or take up new energy services receive a seamless experience delivered through multiple parties including retailers, aggregators, networks, installers and technology providers.

The AEMC's *Review into of consumer energy resource standards* has identified broader governance challenges in relation to CER technical standards: how to effectively regulate CER when the manufacture, sale and installation of CER is not clearly captured within the current frameworks for regulation of energy sector. Deficiencies in the governance framework for standards can have multiple negative impacts including on system security, reliability, inter-operability of CER devices. These impacts can increase costs for consumers as well as damaging consumer trust and hindering the effective integration of CER resources in the electricity system.

The AEMC has conducted a preliminary assessment of four potential reform options for a national CER technical standards framework to develop, introduce and implement CER technical standards. Each of the options would allow policy makers to direct a full range of parties (including OEMs and installers) to undertake actions to promote the efficient integration of CER devices in the interests of all electricity

consumers. As the options have different implementation timeframes and considerations, further analysis needs to be conducted to consider the benefits and limitations of the options prior to a preferred option being selected for national implementation.

Priority 4: Consumer protections to address harms to consumers across their interactions as buyers of CER product and services.

As CER take up increases, consumers are being offered new energy services that enable them to optimise their CER assets and reduce their energy costs. These services however fall outside the scope of the current National Energy Customer Framework, which only captures the traditional retail sale of energy. Whilst these services are innovative, they are also complex and can also create new risks to consumers that impact essential nature of energy provision, namely the consumption and use of energy within the household (or small business).

The AER has recently completed its review of the consumer protections framework governing new energy services which has been informed by consultation with stakeholders and input from the ESB's Customer Insights Collaboration initiative. Following this consultation process, the AER has prepared advice for Energy Ministers setting out that the current consumer protection framework is not fit for purpose for new energy services. This advice includes case studies of how new energy services can impact upon the essential supply of energy, for example, through services that control the flow of energy to and from a customer's premises. Given the potential risks of harm to consumers and the impacts of any harm on the essential supply of energy, the AER has recommended that the National Energy Customer Framework be updated.

The ESB agrees that the National Energy Customer Framework needs to be updated to ensure that consumers can benefit from innovation in the sector whilst also being protected from negative impacts on their use of energy within the household or small business.

In its advice, the AER has set out a potential framework for reform of the National Energy Customer Framework. As this would require law changes, Governments should lead work on the development of an updated consumer protections framework in consultation with market bodies, industry and consumer stakeholders. This would involve consideration of the AER's case for reform for the National Energy Customer Framework to be updated. The ESB notes that these new services facilitate the efficient integration of consumer energy resources into the electricity system and considers that an effective consumer protection framework is essential to help build consumer trust in these services through the energy transition.

3.2.2 Government support in delivery and implementation of priority reforms

The ESB calls on government to support market bodies in the delivery of the following critical priorities.

Priority 5: Protecting consumers today through proactive action to achieve widespread compliance with CER technical standards

In parallel to the development of an enduring national framework for CER technical standards, the AEMC has also recommended 11 immediate actions to address non-compliance with current technical standards. These actions are voluntary actions to be taken forward by governments, market bodies and industry and do not require changes to the NEL or NER.

Government support can provide tangible improvements today. The AEMC has estimated that if all of the recommended immediate actions are implemented, the NEM can expect to see between half to almost all new devices compliant with CER technical standards. This compares with only one-third of new devices complying with CER technical standards upon the commencement of AS4777.2:2020 in the NER. In addition, compliance of existing devices is expected to improve by more than 40 per cent whilst longer term regulatory reforms are playing out.

Priority 6: Backstop capability robust and reliable in each jurisdiction to provide an emergency response improving operational security for all consumers.

Whilst the CER reforms are focused on market and network mechanisms to efficiently and effectively improve outcomes for consumers, 'last resort' capability is also required to be deployed in emergency contexts. The backstop mechanism (to enable curtailment of PV if minimum system load breaches operational thresholds posing system security risks) is the first such enabler.

To date, South Australia, Queensland and Victoria have introduced jurisdictional levers for an emergency backstop. Whilst this represents an important first step in establishing the 'last resort' mechanism in these jurisdictions, the Trip of South East Tailem Bend has underscored the need for the capability to be robust and reliable operationally to ensure the capability is available when called on.[14] Operational preparedness to deploy backstop capability meeting reliability and security requirements is critical to ensuring the network can respond to emergency low-demand events when called on.

The use of backstop capability should always remain a last resort to addressing problems such as minimum demand and the ESB encourages jurisdictions to pursue market-based initiatives such as VPP reforms and network tariff reform to encourage owners of CER to invest in storage and export to solar to the grid at times when it is needed.

3.2.3 Coordination and collaboration

Across CER initiatives and reforms, alignment and coordination is critical to ensure that the policies and reforms deliver the overall objective of CER integration. Misalignment across policies risks confusing signals for consumers, undermines trust and impedes the ability of industry to develop solutions which service customer needs and system outcomes. This creates a critical need for coordination and collaboration.

Government can play a key role coordinating across CER reforms, including:

- All six reform priorities identified in this report. The reforms are intrinsically interrelated.
- Jurisdictions and the Commonwealth have a range of programs which are incentivising CER uptake and shaping the broader energy transition.

In addition, market bodies are continuing a range of activities and reforms which intersect with both jurisdictional initiatives and the reform priorities. For example:

- The AEMC is actively considering rules changes on foot which look to realise the value of CER.
- The AER will make regulatory determinations with respect to network expenditure over the next five year period.
- AEMO is continuing a range of programs which will improve CER integration, including a renewed focus on orchestration of CER in the 2024 ISP.

Coordination and collaboration across these intersecting programs provides an opportunity to align on objectives, share learnings and ensure that the consequences of one change are understood across the broader regulatory, technical, policy and market landscape for CER.

---

[14] AEMO's report on the Trip of South East Tailem Bend 275 kV lines on 12 November 2022 was published in May 2023. Further information can be found here: https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2022/trip-of-south-east-tailem-bend-275-kv-lines-november-2022.pdf?la=en

3.3 Driving outcomes across the reform priorities

The next 12 months mark a critical period in Australia's CER reform journey. There is clear opportunity to set Australia on a course to harness the power of consumer appetite for CER – as a key driver in decarbonising Australia's electricity sector while supporting outcomes for all consumers. Failing to do so will increases operational risk in managing networks with high CER. Without leveraging the potential of CER – to balance supply and demand as well as address network needs – the total cost of the energy transition will increase, impacting Australia's households, businesses and economy.

Addressing the urgent identified priorities requires a targeted program of work, lead by government working with market bodies, industry and consumer representatives. It will be imperative that industry and consumer representative perspectives are taken into account across the reforms. There is a strong record of industry involvement in energy reform design – ensuring that regulatory and market design is effective and minimising unintended consequences. The energy sector also has a rich field of consumer advocates whose work ensures that diverse consumer perspectives are brought to the fore in energy policy discussions.

These stakeholder perspectives are particularly vital for priority reforms 1 – 4. The design of network capability, data architecture and governance of technical standards will all essentially involve industry to design, test and validate the settings for a future high CER environment. During its operation, the ESB sought to incorporate these diverse stakeholder perspectives through a range of collaboration and engagement tools. Going forward, these stakeholder perspectives could be integrated through a dedicated taskforce with clear terms of reference, tasked with delivering the outcomes of priority reforms 1 – 3 in this report.

Separately, priority 4 in relation to consumer protections will also require stakeholder consultation across both retailers, new service providers and consumer groups, drawing upon the work that the AER has undertaken through its recent review.

In addition, the establishment of the Energy Advisory Panel provides a forum of cooperation and consultation between market bodies and government. The Panel is a vehicle to support governments when they are developing policy. The Energy Advisory Panel is tasked with:

- Identifying, anticipating and providing advice on emerging and future energy market developments, focusing on providing early advice on policy or regulatory changes to sustain security, reliability and affordability through the transformation
- Providing a sounding board for Energy Ministers (through Senior Officials) on policy and regulatory reforms under consideration or development through the National Energy Transformation Partnership
- Facilitating continued coordination, collaboration and information sharing between all member agencies.

Effective development and implementation of policy to integrate CER will require new approaches. It calls for new levels of cooperation, collaboration and concerted action. Government leadership is needed to drive forward a targeted program of work over the coming 12 months. Market bodes, industry and consumer stakeholders will be critical partners in ensuring the reforms are effective and efficient, delivering outcomes for consumers.

4. APPENDIX

4.1 Appendix A: Summary of ESB CER & Data reform programs

Note of the table:

1. The table below sets out the key reform programs progressed as part of the ESB's NEM 2025 DER Implementation Program. Some programs were driven by market bodies with coordination and collaboration across the ESB, and some programs were driven forward by the ESB Secretariate with support from the market bodies.
2. An update is provided to each program. In the case of programs that had been driven by the ESB Secretariate, an individual market body has been tasked with the next steps for that program.
3. The detail in this table is correct as at 30 August 2023.

Table 1: CER Reform Programs progress update

Program Details	Summary of workstream	Key milestones	Status update/ next steps
1. CER Technical Standards **Key Body:** AEMC and AEMO	The reform introduced technical standards for CERs to ensure that they effectively respond to system disturbances, thereby enhancing the security and reliability of the electricity system. Specifically, the standards are aimed at addressing the issue of CER not riding through voltage fluctuations on distribution networks, which impacts the security and reliability of the electricity system. The workstream also involves ongoing work to contribute to the development and introduction of the new CER technical standards, as needed in the NEM.	In February 2021 the AEMC introduced CER technical standards in the National Electricity Rules (NER). The rule change introduced CER Technical Standards as part of the requirements for new CER connected to the power grid. In March 2022 the AEMC set out its work plan to support the development and implementation of CER technical standards. Under this plan, the AEMC committed to ongoing work on standards development, updating CER technical standards in the NER, and reviewing the effectiveness of existing CER technical standards. In April 2023, the AEMC published its draft review into CER compliance – refer to the 'Status Update' column. In April 2023, AEMO also published a report on the Compliance of DER with Technical Settings which describes the state	The AEMC self-initiated a review into the compliance of CERs with the required technical standards and released draft recommendations in April 2023 and final in September 2023 to improve compliance with technical standards for CER. The recommendations seek to create an enduring framework for compliance with existing and future CER technical standards. It includes immediate actions under existing regulatory frameworks, and a detailed plan for jurisdictions to reform national governance arrangements for setting and enforcing CER technical standards. Between May and June 2023, written submissions were provided on the draft report. This feedback was

		of compliance of DER with technical settings.	incorporated into the final report in September 2023.
2. Backstop Mechanisms **Key Body:** AEMO	The Backstop Mechanism work program involves implementing a jurisdictional lever for emergency backstops across each of the jurisdictions. The backstop mechanism can switch off CERs, specifically inverter systems. The 'emergency backstop mechanism' will be activated only as a last resort at the direction of AEMO. It will be useful for addressing the system security risks associated with emerging minimum load conditions.	Differing milestones and timelines apply given that emergency backstop mechanisms must be separately implemented across the states. South Australia introduced a backstop mechanism under the 'Smarter Homes' regulations on the 28th of September 2020. In Queensland, Ergon Energy Network and Energex conducted industry consultation in September 2022. This formed the basis for the mechanism introduced in February 2023. In July 2023, the Victorian Government announced a backstop mechanism to be introduced– refer to the 'Status Update' column.	AEMO will continue working with jurisdictions on the implementation of backstop mechanisms. To date, the backstop mechanism is effective in South Australia and Queensland. In Victoria, Stage 1 of the mechanism will apply to large systems (greater than 200 kW) from 25 October 2023. Stage 2 of the mechanism (for small and medium systems, 200 kW and less) is expected to apply from July 2024. Victoria concluded public consultation on Stage 2 on 2 August 2023. New South Wales, Tasmania and the ACT have not announced plans to introduce a backstop mechanism at date of report finalisation.
3. Cyber security for CER devices **Key Body:** AEMO	The reform involves the development of cyber security standards for CER devices and for consideration towards how cyber-informed engineering principles can be better applied throughout the integration of CER.	In December 2022, Ministers tasked the Department of Climate Change, Energy, Environment and Water with developing a rule change to clarify AEMO's roles and responsibilities in managing cyber security compliance.	AEMO is engaging with the Commonwealth on a range of measures related to cyber security. This includes actioning insights from the GHD Report (completed for the Commonwealth) noting the absence of governance and technical standards in CER cyber security. The Commonwealth has also commenced work with Standards Australia undertaking analysis of standards applicable for CER systems.
4. Review of regulatory framework for metering services	The AEMC's 'Review of regulatory framework for metering services' aimed to collaborate with stakeholders to identify	The AEMC published the final report on 30 August 2023. The report made 21 recommendations, including accelerated	Final review completed. A rule change request covering the

Key Body: AEMC	problems with the current framework, opportunities to improve the customer framework, and priority reforms to accelerate smart meter deployment in the NEM.	deployment of smart meters to reach universal uptake by 2030 and supporting measures to improve customer safeguards, installation processes and access to smart meter data.	majority of recommendations has been received by the AEMC. Stakeholders are yet to submit a rule change request for real time data component of the review.
5. Shared capabilities – NEM Reform Implementation Roadmap **Key Body:** AEMO	AEMO, in partnership with the Reform Delivery Committee (RDC) has compiled the NEM Reform Implementation Roadmap. The purpose of the NEM Reform Implementation Roadmap is to establish a basis upon which to navigate the breadth of reforms as either set out by the ESB or broader policy / rule makers over the coming few years, de-risking delivery and informing implementation timing. An integrated roadmap that considers the broader reform agenda highlights opportunities and risks for implementation and allows these to be considered as part of policy development.	In December 2020, the Regulatory Implementation Roadmap (version 6) was released. In September 2022, NEM Reform Implementation Roadmap (version 1) was released. In April 2023, AEMO released the NEM Reform Implementation Roadmap (version 2). In October 2023, AEMO released the NEM Implementation Roadmap (version 3).	A number of initiatives in the roadmap are currently in the planning and design phase, with implementation aimed to coincide with the underlying reforms they are intended to support. AEMO, in collaboration with the Reform Delivery Committee, will continue to update and publish new versions of the NEM Reform Implementation Roadmap and supporting artefacts.
6. Unlocking CER benefits through flexible trading **Key Body:** AEMC	The rule change is considering three core areas: - Optimising the value of CER flexibility: Opportunities for separately identifying and managing flexible CER. - Flexible trading of CER with multiple energy service providers at large customer premises. - Opportunities to improve how energy use is measured for street lighting and other street furniture (such as park BBQs). Through this rule change, the aim is to improve the flexibility and trading of consumers' energy resources (CER) to	In May 2022, AEMO submitted the rule change request. In December 2022, the AEMC published a consultation paper. On 3 August 2023, the AEMC released a directions paper setting out the Commission's initial views and directions for the rule change. AEMC received 53 submissions to the directions paper.	In preparation for the draft determination, a stakeholder forum and technical workgroup discussions will be held on options and proposals on the core areas. A draft determination is planned for February 2024, with a final determination for mid-2024.

	unlock value for consumers. We are also aiming to facilitate better integration of flexible CER into the power system to deliver a more reliable and secure energy system that would benefit all consumers.		
7. Integrating price-responsive resources into the NEM **Key Body:** AEMC	Unscheduled price-responsive resources (such as VPPs) are growing but are currently not fully integrated into the planning and operation functions in the NEM. AEMO proposed a voluntary mechanism to allow these resources to participate in scheduling processes.	AEMO submitted a rule change request in January 2023 to the AEMC which outlined the high-level design of the mechanism and its justification. On 3 August, the AEMC published a consultation paper. The AEMC received 34 submissions to the consultations paper.	The AEMC is considering stakeholder feedback and the next steps. The AEMC may consider an additional step before going to draft determination.
8. Flexible Export Limits **Key Body:** AER	The AER is reviewing the existing regulatory framework to assess the suitability of DNSPs implementing Flexible Export Limits (FELs). The objective is to establish guidelines that strike a balance between consumer welfare and the effective implementation of FELs. The primary objective of FELs is to maximise the efficient utilisation of shared hosting capacity on distribution networks. [1]	The AER commissioned FTI Consulting to produce a report on 'Dynamic Operating Envelope Policy in the NEM'. The report, which was published in June 2022, identified potential gaps in the regulatory and governance frameworks related to DOE/FEL implementation. In October 2022, the AER released the draft FEL Issues Paper, and in July 2023, a final response to the consultation was provided to the consultation undertaken.	The final response published by the AER provides policy direction on the regulatory framework for the implementation of flexible export limits. This paper considers the matters raised by stakeholders in consultation and identifies actions to ensure flexible export limits are implemented appropriately across the different jurisdictional contexts of the National Electricity Market.
9. Review of consumer protections for future energy services (formerly known as Retailer authorisation and exemption review) **Key Body:** AER	The AER is conducting a review of the retailer authorisation and exemption frameworks outlined in the NECF. The purpose of this review is to evaluate the continued suitability of the existing energy consumer protection framework within a transitioning energy market.	The AER published an issues paper for this review in April 2022 and received 31 public submissions. In October 2022, the AER released an options paper inviting stakeholder submissions regarding three reform options.	The AER completed its review in November 2023. Its preliminary position is that the current regulatory framework will not be fit for purpose for the future energy market given the potential risks posed by new energy products and services that the current framework is not designed to address.

[1] Currently, static limits are used to ensure conservative generation within a network's hosting capacity, which is distributed among all consumers, particularly during congested periods. These static limits function similarly to constant low-speed limits on roads, irrespective of conditions.

10. Development of technical standards – interoperability **Key Body:** Governments	The interoperability reform aims to introduce technical standards for CER interoperability to enhance access and utilization of various CER products and services by consumers, reduce complexity and time involved in managing equipment, provide greater flexibility to the energy system, and result in reduced costs and improved energy security for all consumers. The reform's priority is standardisation of interoperability for flexible exports through CSIP-Aus and to achieve a nationally consistent approach as the foundation for the broader integration of CER. This will be used as a building block for future considerations of the interoperability standard, including behind-the-meter interoperability and trader use-cases.	The ESB released an assessment framework in December 2021 to support policy development regarding the applicability of different feature sets within the CSIP-Aus interoperability technical standard. The 'Interoperability Directions Paper' was released in October 2022, detailing the ESB's first priority for standardisation as interoperability for flexible exports through CSIP-Aus. In 2023, a cost-benefit analysis conducted by an independent consultant for the ESB found that there are benefits in consistent national implementation of CSIP-Aus, but not for a national CSIP-ready mandate.	The ESB advice on interoperability, together with the CBA and advice on PKI and CSIP-Aus, is intended to be finalised and provided to the CERWG (under the National Energy Transformation Partnership) to support consideration of next steps on interoperability requirements for CER.
11. Tech standards – EV charging **Key Body:** ESB	This paper sought input from stakeholders regarding the development of regulatory and market settings to support smart EV charging in the NEM. This involved a consideration of potential gaps, barriers and enablers in policy settings that may impact effective uptake of smart EV charging infrastructure for both domestic and public EV charging.	The ESB published its Electric Vehicle Smart Charging Issues Paper in July 2022. The ESB has acknowledged the importance of understanding the consumer issues associated with EV charging, particularly in delivering Horizon One of the DER Implementation Plan (which identified that a coordinated charging policy would generate long-term benefits for consumers through better user experience and system efficiencies).	The ESB has advised jurisdictions on a series of recommendations that will seek to improve customer experience for EV charging.

Notes to the table:

1. The table below sets out the key reform programs progressed as part of the ESB's NEM 2025 Data Strategy. All programs were driven forward by the ESB Secretariate with support from the market bodies.
2. An update is provided for each program. The detail in this table is correct as at 30 August 2023.

Table 2: Energy Data Reform Programs progress update

Program Details	Summary of workstream	Project start date	Intended end date	Key milestones	Status update/ next steps
Initial reforms	This workstream seeks to enable greater value from existing data, held by AEMO, for trusted agencies and bodies (e.g. government and research institutions) by removing legislative and regulatory barriers to the sharing of that information. The reforms being pursued build on an ESB-commissioned review of existing data regulatory arrangements in the energy sector.	2021	End 2023	In July 2022, the ESB publicly consulted on proposed incremental legislative improvements and the institutions that should be given access. The consultation paper received 23 submissions, all broadly supportive. In April 2023, the ESB publicly consulted a second time, on a draft bill with proposed legislative amendments to the National Energy Rules.	These amendments have been approved, out of session, by Energy Senior Officials and have progressed to Ministers. If approved by Ministers the amendments will progress to South Australian Parliament in early 2024.
Data Services **AEMO** is taking forward this work.	The Initial Reforms, on their own, would have limited impact due to the practical constraints on AEMOs ability to safely share its data. The Data Services workstream aims to resolve these practical constraints, including resourcing, processes and capabilities to facilitate better access and use of protected data for a range of stakeholders.	2021	See key milestones column	In December 2022, the ESB publicly consulted on a proposed delivery model for this workstream. The proposed model included the establishment of a new Data Services unit within AEMO, supported by an advisory group that would inform the unit's priorities. The ESB received 12 submissions in response to this paper.	The ESB and AEMO are socialising a governance model for a Data Services unit with the Board and jurisdictions for feedback.
Common Guidelines **AEMO** is taking this work forward.	Like Data Services, the Common Guidelines workstream seeks to resolve practical barriers preventing the safe sharing of data. The Common Guidelines workstream focuses on reducing the administrative costs and uncertainty faced by entities seeking to access data by developing guidelines for common data gathering and templates for data sharing agreements.	April 2023	End 2023	With the initial reform work close to complete, in Q2 2023, the ESB appointed a legal advisor to begin work on the development of this workstream.	The guidelines and templates are expected to be complete by the end of the year.
EVSE Data	The Data Strategy identified a range of priority data gaps to manage risks in the	2021	Ongoing	Options to capture EVSE standing data were presented to	The DER Register has been proposed as the repository for

AEMO is taking this work forward.	energy market transition – including visibility of electric vehicle supply equipment (EVSE). Currently, networks and AEMO do not have access to reliable data on the size, location, and characteristics of EVSE to enable them to manage opportunities and challenges effectively. The EVSE Data workstream focuses on options for capturing standing data for new EVSE installations.			stakeholders in the December 2022 EVSE Standing Data consultation paper. In June 2023, the ESB released a consultation outcomes report which recommended that EVSE data should be collected and included in AEMO's Distributed Energy Resources Register. The outcomes report was informed by 16 stakeholder submissions and targeted consultation sessions.	EVSE standing data. AEMO was nominated by the ESB to prepare a the rule change request to extend the DER Register to capture EVSE standing data. AEMO is intending to submit this request to the AEMC by the end of 2023.
Billing Transparency **AEMC** is taking this work forward.	The Billing Transparency workstream was designed to design and cost options for visibility of customers bill outcomes, to provide jurisdictional regulators with necessary data with less duplication and burden on industry. The workstream was intended to address critical gaps in consumer protections as services become more complex, by allowing for better understanding of how different consumer segments, including vulnerable consumers, are impacted by new technologies and services; how consumers and technologies are responding to market price signals; and the effectiveness of competitive retail markets.	2021	Ongoing	A draft options paper was released for public feedback in June. Options have been developed for data collection, but no preferred option has been identified.	Stakeholder submissions closed in September. AEMC is evaluating the feedback provided and considering the best way to take this work forward.
Network Visibility **AER** is taking this work forward.	Low voltage network transparency is challenging to achieve in the short term, with diverse levels of data currently available across different networks, a wide range of data gap and significant costs to resolve data gaps. Optimising DER integration requires greater visibility of the low voltage network. The Network Visibility workstream was set up to design and cost options to optimise network data available to the DER market.	2021	Ongoing	This workstream is being undertaken in three phases. The ESB published a consultation paper on this project in July 2023 as part of phase one. The paper seeks feedback on datasets relevant to network and CER performance. The AER will take the lead of submissions to the paper, due September 2023.	Phases Two – review and publication of relevant existing LV network data and Three – identification of options to efficiently address priority data gaps – have not yet commenced.

4.2 Appendix B: Gap analysis

Gap Analysis Approach

The review of the CER program considers the evolving policy and industry context, whilst focusing on the specific ESB programs which have been progressed over the past 18 months. This gap analysis is intended to provide insight into the key areas that need to be prioritised in the coming 12 to 18 months. While it covers the end-to-end value chain and key functions relating to CER integration, it should not be interpreted as a full, comprehensive analysis of every function required to support CER integration. Instead, this gap analysis presents a useful checkpoint to locate the progression of policy development and implementation efforts for CER integration and highlight areas that require prioritisation in the next phase.

There are several steps in followed in the review:

Table 3: Steps in the analysis framework

Step 1	**Framework for analysis**
Task	Outline the key functions relating to CER integration
Outcome	Understanding of the key roles which play a part in CER and the conceptual framework for considering policy issues in CER.
Step 2	**Current and evolved state**
Task	Outline the current state for CER and the future evolved state for a high CER environment.
Outcome	Understand the key features of the high CER future state environment to inform the gap analysis
Step 3	**Functional gap analysis**
Task	For each identified function (refer Step 1) consider: • Whether the function is clearly regulated within the cooperative national energy regime • Whether the responsibilities of the relevant function are clear today • Whether the trajectory of current reforms will improve clarity • Whether the responsibilities of the relevant function are clear for a high CER environment in future
Outcome	This step provides an overview of the areas of uncertainty across the CER value chain today, and highlights which functions require particular attention in the context of high CER. It also provides clarity on areas of the value chain that are not traditionally regulated by the national cooperative energy regime, and highlights where there may be a broader need to consider appropriate oversight and governance arrangements for CER integration.
Step 4	**Priority gaps**
Task	In light of the gap analysis, highlight areas requiring particular attention across the next stage of CER reform.
Outcome	Clear areas to prioritise across CER integration to support consumer outcomes as energy systems decarbonise.

4.2.1 Step 1: Framework for analysis

The small scale, disaggregated, interconnected and consumer-led nature of CER means that the policy, regulatory, market and institutional frameworks that were originally designed for large scale electricity generation and supply will need to evolve so that they become fit for purpose for planning, operating and regulating a system and market with high CER.

This section provides an overview of the areas of uncertainty across the CER value chain today, and highlights which functions require particular attention in the context of high CER. It also provides clarity on areas of the value chain that are not traditionally regulated by the national cooperative energy regime.

The functions below are separated across three limbs:

- The **supply of CER and electricity**. The activities identified in this limb are critical to the individual consumer who has acquired CER (services or products) and/or electricity in the context of having CER.
- The **measurement and control of CER**. The activities identified in this limb are necessary enablers to both the supply of CER and electricity, and ongoing operation of the system and market with high CER.
- **System and market** with high CER. The activities identified in this limb are necessary for the ongoing planning and operation of the electricity system, for consumers with and without investments in CER, including active and passive consumers.

All functions are integral to ensuring outcomes for consumers.

Table 4: Functions across the CER value chain

Function	Description
Supply of CER and electricity	
Manufacture CER	The production of CER devices, including assembly of devices / kit to control and orchestrate CER.
Sell CER	The sale of physical CER systems to a consumer, including but not limited to solar photovolataic (**PV**) panels, inverters, behind-the-meter (**BTM**) electric vehicle (**EV**) chargers, etc. Also, the sale of services relating to physical CER systems on a 'behind the meter' basis (such as leases, power purchase agreements (**PPA**s) and other commercial structures).
Sell electricity	The sale of electricity to a consumer with CER, or to consumers in the context of a system with high CER.
Buy electricity	The act of paying for, or providing consideration in respect of, export from a connection point with CER.
Install CER	The installation of CER or devices/kit used to control or orchestrate flexible CER.
Configure CER	The technical configuration of CER, on installation or post-installation at a premises.
Connect CER to a network	The connection of CER to a network to export or import electricity.
Rectify CER	The rectification of a CER device or system.
Measurement & control	
Measure CER	The measurement of CER either at device level or at the connection point.
Control CER	The direct control or automated control of flexible CER to produce a response.

Orchestrate CER	The direct control or automated control of flexible CER behind multiple connection points, generally within a single region.
Supply data to support CER orchestration/control	Data architecture, governance and management frameworks to ensure the relevant parties have visibility of CER.
System & market	
Plan a network with CER – local	The planning of a distribution network with high levels of CER, including development of capacity and capability plans and conducting relevant network modelling (including taking into account any interfaces).
Operate a network with CER – local	The operation of a distribution network with high levels of CER, including ensuring distribution network security and dynamically managing the network with technical constraints.
Plan a network with CER – Transmission level	The planning of a transmission network with high levels of CER, including development of transmission investment plans considering impact of CER and conducting relevant network modelling (including taking into account any interfaces).
Operate a network with CER – transmission level	The operation of a transmission network with high levels of CER, including monitoring the impact of CER on the transmission network and managing transmission network stability and security.
Plan a bulk system with CER	The planning of an electricity system with high levels of CER, including projecting demand and CER participation to develop long-term forecasts and plans.
Operate and forecast in a bulk system with CER	The operation of an electricity system with high levels of CER, including incorporating consideration of CER within bulk system operation, impacts on CER for bulk power system stability and security and forecast demand of electricity and flexible resource response for operational, and market purposes.
Providing a CER service to consumers	Providing a service to consumers through the control of flexible CER, which may be secondary “off market” transaction.
Providing a CER network service	Providing a service to networks from aggregated CER in response to a network request.
Operate a central market with CER	The operation of wholesale and ancillary services markets with high levels of CER (including markets CER participate in, and other markets).
Participate in markets with CER	Participating in wholesale or ancillary services or network services markets with flexible CER.

4.2.2 Step 2: Current and evolved state

The current state of CER

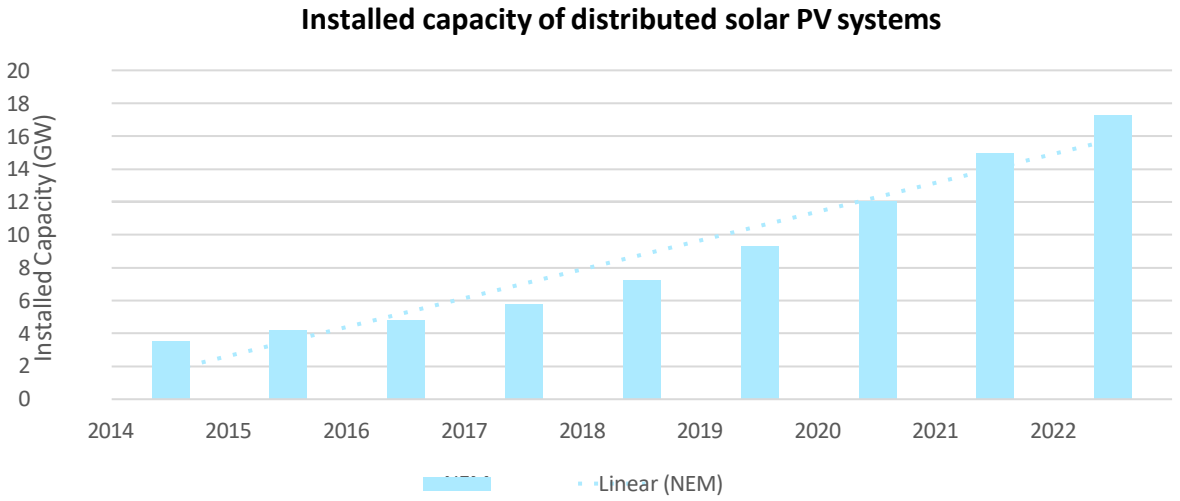
CER is already an important and significant feature of the NEM. In Q2 2023, DPV contributed 7.9% of generation in the NEM. This is compared to 5.4% for utility scale solar, 13.9% for wind, 8.2% for hydro and 6.2% for gas. [1]

Consumers across the NEM continue to embrace CER and its rate of uptake has gathered momentum. In Q2 of 2023, the distributed PV growth seen a year-on-year increase of 1,888 MW (30%), marking it as the second-highest growth rate for any quarter. Since 2014, both businesses and households have continued to connect small-scale solar PV at a rate of approximately 1.7 GW per annum in total installed capacity, to an estimated total capacity of 17.1 GW in 2022 as shown in Figure 1. That compares to approximately 1

[1] AEMO, The Quarterly Energy Dynamics Q2 Report (April 2023) (published: https://aemo.com.au/-/media/files/major-publications/qed/2023/qed-q2-2023-report.pdf?la=en&hash=B02BF39D3ED1F8EE1DDAF0F9BCF5267B)

GW of large-scale PV per annum over the same period.

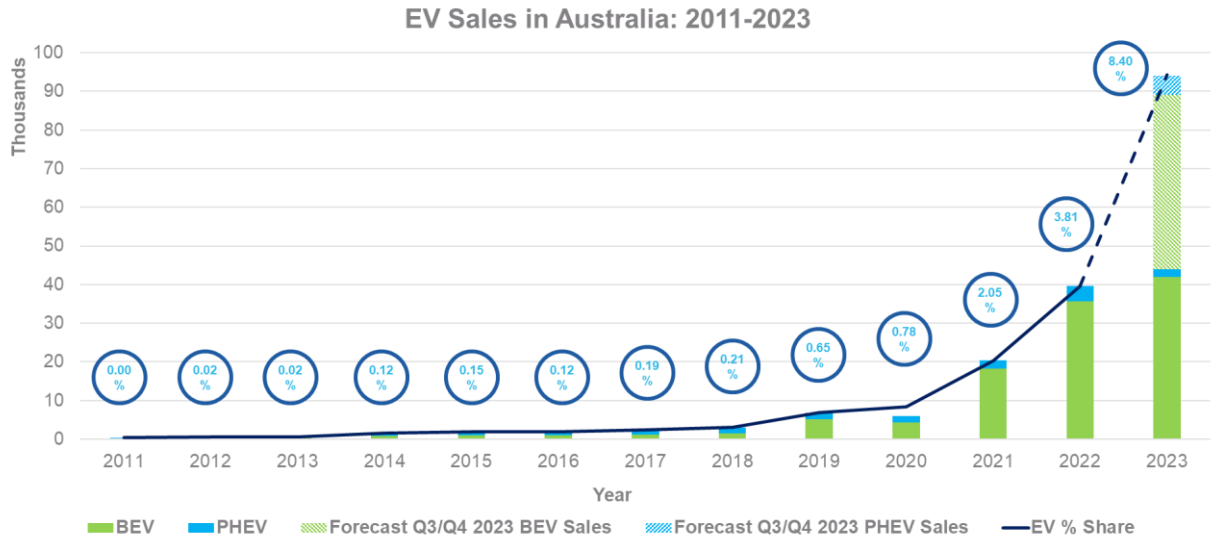
Figure 1: NEM Distributed Solar PV Installed Capacity 2014-2022 with a breakdown per NEM region (Australian PV Institute, 2023).[2]



While DPV is the leading driver of CER growth, other CER technologies are also becoming more prevalent, including controlled loads (such as hot water systems, swimming pool pumps and air conditioning systems), small-scale battery energy storage systems, and EV charging.

In 2023, EVs now represent 8.4% of all vehicle sales, a 110% increase on 2022, according to the Electric Vehicle Council's State of Electric Vehicles Report. The figure below shows the historical EV uptake in Australia from 2014- 2022.

Figure 2: EV Uptake in Australia. BEV refers to Battery Electric Vehicles and PHEV refers to Plug-In Hybrid Electric Vehicles (Electric Vehicle Council, 2023).[3]



An evolved state of CER

Given the uptake of CER is expected to accelerate in the coming decades, it is important that the policy and regulatory frameworks for CER are developed with an 'evolved state' in mind.

AEMO's ISP envisages different future scenarios for the NEM and uses these scenarios to identify an optimal development path (see Figure 1 below). This 'evolved state' of CER could mirror the AEMO Inputs Assumptions and

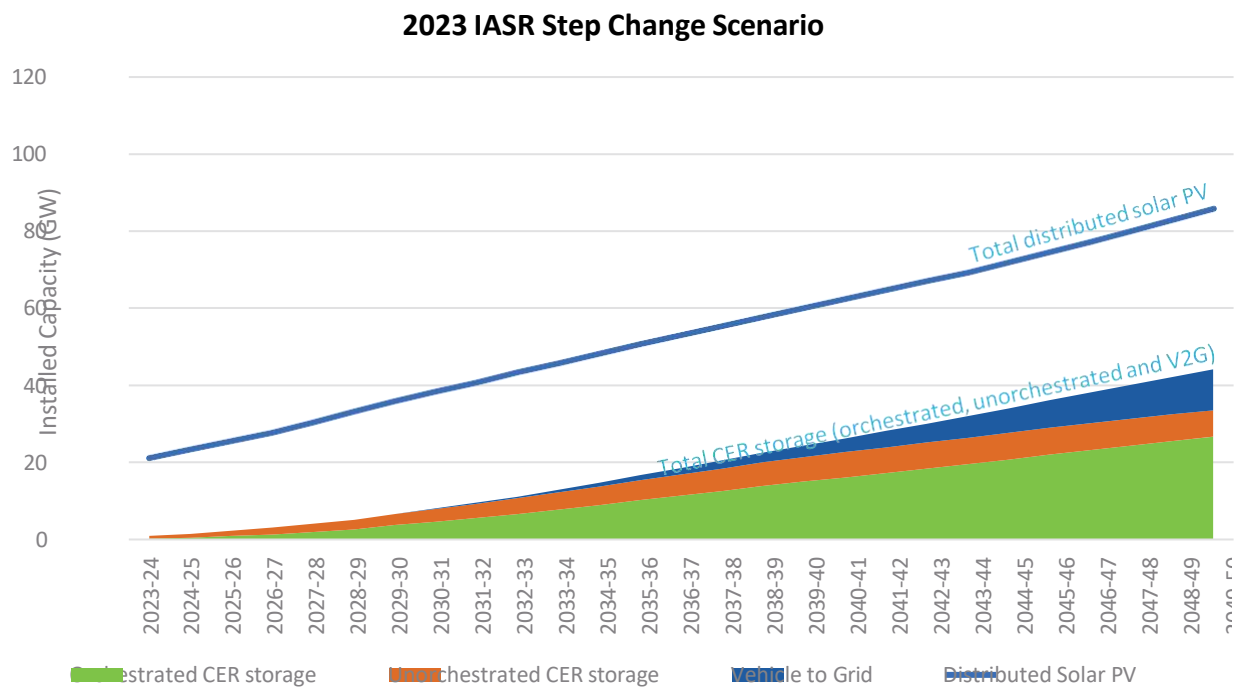
[2] PV Postcode Data accessed August 2023. (published: Australian Photovoltaic Institute PV Postcode Data (apvi.org.au))

[3] Electric Vehicle Council, State of Electric Vehicles Report (2023) (published: State-of-EVs_July-2023_.pdf (electricvehiclecouncil.com.au))

Scenarios Report (IASR) 2023 Step Change scenario. This projection anticipates a growth in distributed PV generation from around 19TWh to 77TWh by 2040, contributing 22% to the total underlying electricity demand in that year. The Step Change scenario also models a significant surge in CER storage (both coordinated and distributed) with levels 27 times higher than current levels by 2040.

Furthermore, the scenario forecasts that 60% of all vehicles in Australia will be electric.[4]

Figure 3: AEMO 2023 IASR forecast DPV and storage uptake



AEMO has recognised that the pace, scale, and orchestration of CER is a key uncertainty that will impact how the energy transition will evolve in practice.[5]

These uptake projections are contingent on consumer trends, which can be influenced by various factors including the customer's own cost-benefit analysis and usage requirements, market opportunities and the value that the retailer or aggregator can find for future revenue. While there is policy support and expectations of cost reductions in the long term, consumers continue to invest in CER including electrified transportation but hesitate to embrace the technologies and shared control required to orchestrate these assets. According to the Consumer Insights Survey conducted by AEMO and CSBA in 2021, some of the reasons for this hesitation may include cost, lack of understanding, complexity, and trust.[6] With less orchestration occurring, the ability to rely on these investments to operate the power system securely is reduced and the overall scale and contribution of consumers to the energy transformation is therefore lower, requiring greater action and diversified investments from utilities.'[7]

While the precise future role of CER in the NEM is uncertain, it is appropriate that the policy, regulatory and market settings should be developed to enable a scenario where CER uptake and orchestration levels have evolved to high levels which allow the full benefits of CER to be obtained and the risks of CER to be minimised.

---

[4] AEMO, 2023 Inputs, Assumptions and Scenarios Report (IASR) (December 2022) (Published: AEMO | 2023 Inputs Assumptions and Scenarios Consultation)

[5] AEMO, 2023 Inputs, Assumptions and Scenarios Report (IASR) (December 2022) (Published: AEMO | 2023 Inputs Assumptions and Scenarios Consultation)

[6] The report details the experience of consumers within the AEMO VPP Demonstration, exploring how best to improve it in the future and how consumers feel about letting VPP operators utilise their assets. Full report can be found here: https://arena.gov.au/assets/2021/09/vpp-power-plant-demonstrations-consumer-insights-report.pdf

[7] Ibid, page 5.

4.2.3 Step 3: Functional gap analysis

Each function was assessed to determine:

- **Application:** If the function articulated is clearly regulated within the construct of the NEL/NER and NECF;
- **Current state:** Whether the reforms to date (or broader industry context and discussion) clearly articulate what responsibilities attach to that function to manage outcomes for all consumers in CER today;
- **Evolved future state:** When viewed in the context of the evolved state for CER, whether the reforms to date (or broader industry context and discussion) appropriately address the requirements of a high CER context.

The functional assessment criteria and key is set out in **Table 5**:

Table 5: Assessment criteria and key

Criteria	Consideration	Key
Application	Whether the function is clearly regulated within the construct of the NEL/NER and NECF.	**Y** **Yes** **N** **No** **P** **Partial**
Today	Whether the current state, and reforms to date have clearly articulated the responsibilities attaching to that function to manage outcomes for CER.	**Unclear** **Some areas of uncertainty** **Clear** **No obligation**
Evolved	Whether the reforms to date appropriately address the requirements of a high CER context.	**Progress to be monitored, reforms tracking or not yet required** **Reforms underway, additional government support required** **Existing gap, while consideration may have been given to the area, requires government leadership and decision as to way forward**

A summary of assessment results is set out in **Table 6** below.

Table 6: Assessment across the industry value chain

Supply of CER and electricity

Manufacture CER: The production of CER, including assembly of devices / kit to control and orchestrate CER		
	Rationale for rating	**Rating**
Application	Not directly regulated today by NEL/NER/NECF. Included in Australian standards, including product safety standards, application of Australian Consumer Law (**ACL**) may impact manufacturer, e.g. through warranties.	**N**
Today	No obligation on the manufacturer to ensure CER products meet requirements of network or systems (eg, DER technical standards do not apply to the manufacture of CER). AEMO's investigations into inverter compliance with technical standards indicates that OEMs appear to design products to meet the requirements in test procedures, however compliance with additional specifications in standards is not specifically tested for and therefore can be poor.[8]	●
Evolved	It is important that CER connected to the system meets standards to enable the grid to be appropriately managed. Australian standards, once approved, may apply to CER at the point of manufacture. The Clean Energy Regulator has noted the quality and integrity at manufacture is critical and of concern.[9] Reforms currently on foot have identified the issues of CER meeting minimum technical requirements at manufacture, as well as installation. [The AEMC's Review of Technical Standards is a critical work program on point and lays out a path to address CER compliance at point of manufacture].	◆?
Sell CER: The sale of physical CER systems to a consumer, including but not limited to solar PV panels, inverters, BTM EV chargers, etc. Also, the sale of services relating to physical CER systems on a 'behind the meter' basis (such as leases, PPAs and other commercial structures)		
	Rationale for rating	**Rating**
Application	In general, not directly regulated today by NEL/NER/NECF. ACL applies.	**P**
Today	Sellers of CER capture a wide range of businesses with different levels of sophistication and a variety of product and service offerings. Voluntary codes of conduct, such as the New Energy Tech Consumer Code (**NETCC**), are supporting outcomes from consumers, however only capture a sub-set of the total.[10]	●

[8] AEMO, *Compliance of DER with technical settings* (April 2023) (published: compliance-of-der-with-technical-settings.pdf (aemo.com.au))

[9] Clean Energy Regulator, *Integrity review of the rooftop solar PV sector* (September 2020) (published: Integrity Review of the Rooftop Solar PV Sector (cleanenergyregulator.gov.au))

[10] NETCC, *New Energy Tech Consumer Code* (February 2023) (published: New-Energy-Tech-Consumer-Code.pdf (newenergytech.org.au))

	Retailers who are selling CER products are generally not captured by the NEL/NER/NECF – regardless of whether or not the product produces energy for the consumer (eg PV) or does not (eg pool pump). There is emerging uncertainty in this regard, with new business models emerging which raise questions as to whether retailers who provide consumers with CER services may be considered to supply electricity (and so fall within the ambit of the NEL/NER/NECF). ACL applies to the sale of CER to individuals and small businesses. Australian standards, once approved, may apply. Energy efficiency ratings and standards also apply (eg, to certain load devices that may be considered CER). NETCC, a voluntary scheme, applies to the sales stage under arrangements with approved sellers.	
Evolved	There is considerable uncertainty around the obligations on sellers of CER to ensure reliable and secure electricity supply, for example by ensuring CER meets standards and requirements enabling CER integration in the evolved state. The consumer protections available today under ACL and other instruments do not specifically address harms to consumers that may result from sale of CER products and services. Further, as CER includes many load devices (e.g., air conditioning), there is a need to consider what types of products and services may be captured as CER in future and what the obligations may be on sellers to ensure that consumers are able to effectively manage their load device. The AER has prepared advice for Energy Ministers setting out that the current consumer protection framework is not fit for purpose for new energy services. This includes recognising the need for new regulation of CER products and services. The advice recognises that government leadership is required as changes to the scope of the NECF are contemplated, requiring legislative change.	

Sell electricity: The sale of electricity to a consumer with CER, or to consumers in the context of a system with high CER		
	Rationale for rating	**Rating**
Application	Supply of electricity is regulated by NEL/NER/NECF.	**Y**
Today	Supply of electricity is regulated under the NEL and the sale of electricity to consumers is captured by the consumer protection regime in the NECF. This regime does not generally apply to electricity supplied BTM, noting however there is some emerging uncertainty around the application of NEL/NER/NECF to new services relating to CER (refer to discussion in function 'Sell CER' above).	
Evolved	In light of these potential evolutions to retail and wholesale markets in a high CER context, there is considerable uncertainty around regulation of supply of electricity. In a high CER context, greater demand-side participation is anticipated to be a feature of electricity markets (at a wholesale and retail level). Whilst today the supply of electricity is clearly regulated under the NECF and NEL, the future state with greater demand side participation and new business models	

	will blur the lines between sale of electricity and other services. If there are multiple sellers of electricity and/or related services to customers under future market designs, the complexity raises issues as to what obligations would apply to the seller (and how for example customer debt, disconnection and payment plans would be treated as between sellers). The AER has prepared advice for Energy Ministers setting out that the current consumer protection framework is not fit for purpose for new energy services. This includes recognising the need for new regulation of CER products and services. The advice recognises government leadership is required as changes to the scope of the NECF are contemplated, requiring legislative change. Further, the AEMC has considered future evolutions in retail markets in its Directions Paper published, 3 August 2023. The paper is in response to AEMO's rule change proposal for all consumers to be able to engage with multiple service providers at their premises if they choose to. The Directions Paper notes the Commission's initial views that consideration needs to be given to how energy-specific consumer protections would be applied and to whom. For example, if some CER services could be provided by parties that are not authorised retailers, which may be a way to enable market innovation, then new consumer protections would need to be designed for those secondary energy service providers. The level of protection would likely need to vary depending on the type of service being offered and the potential consumer harms that could occur. This would also include how responsibilities such as life support, disconnections, and hardship are split between the primary retailer and the second energy service provider	
Buy electricity: The act of paying for, or providing consideration in respect of, export from a connection point with CER.		
	Rationale for rating	**Rating**
Application	NER includes some provisions relating to export from CER, including obligations on DNSPs to provide export services and some services enabling consumers to participate in FCAS and wholesale demand response markets via export. NECF doesn't extend to any sale of energy from a consumer's connection point.	**P**
Today	Buying electricity exported from CER is not a concept directly recognised in the regulatory framework. Generally, the FRMP (retailer) at a connection point gains the market benefit (or disbenefit) of the energy exported from a customer's connection point. There are various regulatory and retail arrangements by which consumers may be paid for exports. Similarly, time-of-use network tariffs are able to reflect the value of import and export of electricity. Jurisdictional schemes for feed-in-tariffs may apply. These vary in the degree to which they reward consumers for exporting electricity and may not align with the needs of the system or market. Further, under the NEL/NER, there are currently limited provisions to reward customers for export in connection with specific markets, such as in Wholesale Demand Response (where a consumer's 'negative load' can form part of the response as part of an aggregated response or on its own for larger loads) and some FCAS markets (where consumers can provide raise or	

	lower services from exports, measured at the connection point, via aggregated responses).	
Evolved	There is considerable uncertainty around market and regulatory settings for 'buying' electricity from CER at either wholesale or retail level. Refer to discussion of demand side of market in assessment above. Key issues to be considered include: • the role of network services and market services in rewarding consumers for exporting at particular times (to provide load balancing and/or network services); • ongoing role of jurisdictional feed in tariffs; • evolution of off-market models for buying energy at local levels, e.g. through peer-to-peer platforms; • what future models will meet consumer needs and preferences. Key implementation challenges include how regulatory arrangements for buying energy from CER can develop without imposing inappropriate burdens or obligations on consumers. The AER has prepared advice for Energy Ministers setting out that the current consumer protection framework is not fit for purpose for new energy services. This includes recognising the need for new regulation of CER products and services. The advice recognises government leadership is required as changes to the scope of the NECF are contemplated, requiring legislative change. The AEMC has considered future evolutions in retail markets in in its Directions Paper for unlocking CER benefits through flexible trading rule change. The Commission outlined several opportunities to address these current limitations, including: • Separately identifying CER to allow it to be managed separately from other 'passive' consumer load. This could allow for specialised retail products to be developed. • Adding an additional connection point behind a consumer's primary connection point. This allows for CER flows from that additional settlement point to be subject to different metering standards and recognised in wholesale energy market settlements. • Efficient retail and network pricing to incentivise customers or their service providers to adjust their import or export of energy, or to agree for their CER to be used for the provision of network or market service.	
Install CER: The installation of CER or devices/kit used to control or orchestrate flexible CER.		
	Rationale for rating	**Rating**
Application	Indirectly regulated in NER via connection agreements, as between consumer and DNSPs (noting terms of connection agreements are regulated).	**P**

Today	Significant activity has occurred across networks with DNSP updating their connection agreements to require installations of CER in compliance with technical standards. Despite this, there is evidence of persistent non-compliance with CER at point of installation. AEMO has found that less than 50% of inverters are installed to the required standard, while CER on-site audits revealed only 28% of inverters could be confirmed as having the correct settings at installation.[11] In addition to contractual obligations under regulated connection contracts, installation of CER is regulated by electrical safety legislation that is applicable in each state or territory. Electrical safety regulations apply at installation and are a key focus of CER installers (with compliance certificates issued). The link of compliance with electrical standards to electrician licencing creates a clear incentive for compliance. However, electrical safety regulators and assessors are not required to assess installation compliance with technical standards, and certified installers do not face mandatory training requirements associated with technical standards and their associated device settings. NETCC, a voluntary scheme, applies to the installation stage under arrangements with approved sellers.	
Evolved	A high CER context involves increased CER uptake and also increased installation of devices which support load management (turning 'dumb' passive load into 'smart' flexible load which is capable of being orchestrated). It remains unclear how implementation of new technical requirements at an installation stage will be managed to ensure conformance in future. Uncertainty includes: • Whether and to what extent it will be an obligation on DNSPs to check installation complies with technical requirements. • If CER installation is more directly regulated (analogous to safety standards currently), who will set the standards and who is responsible for monitoring and enforcement. • If there is an issue with CER at installation, what the obligation is on the installer to address that issue. The AEMC's **Review into CER Technical Standards** has identified a critical need to consider how compliance with CER technical standards can be better managed at point of installation (along with other points along the value chain for CER).	

Configure CER: The technical configuration of CER, on installation or post-installation at a premises		
	Rationale for rating	**Rating**
Application	Indirectly regulated in NER via connection agreements, as between consumer and DNSP (noting terms of connection agreements are regulated)	**N**

[11] AEMO, Compliance of DER with technical settings (April 2023) refer page 3 and 5 (published: compliance-of-der-with-technical-settings.pdf (aemo.com.au))

Today	Today, there are identified compliance issues with configuring of CER. Generally, configuration of CER occurs at time of installation – see 'Install CER' for relevant discussion. [12] As noted above, electrical safety regulations apply and are a key focus for installers at point of installation. Configuration can also occur post-installation. AEMO's report on compliance with technical standards points to examples where OEMs supported remote re-configuring of CER to improve compliance.[13] Today, there is an identified gap in the regulatory framework in addressing any changes to configurations of CER post-installation. For example, if the inverter were subsequently reconfigured and was no longer compliant with the CER Technical Standards required by the DNSP connection agreements, there would be limited visibility of these changes unless DNSPs or other parties proactively undertook remote monitoring or a site inspection. NETCC, a voluntary scheme, applies to the configuration stage under arrangements with approved sellers.	●
Evolved	The issues with CER configuration (and specifically, non-compliance with technical standards at point of configuration) will have a greater impact as more CER enters the system. Standardised technical configuration to allow CER visibility and orchestration will be increasingly important in high CER environment. As existing CER increasingly ages over time there is a need to consider how to grandfather and update configurations over time. As CER can include many load devices (e.g., air conditioning that is able to be flexibly managed), there is a need to consider what types of products and services for may be captured as CER in future and what the obligations may be on configuration of such devices to ensure that consumers are able to effectively manage their load device. The AEMC's **Review into CER Technical Standards** has identified a critical need to consider how compliance with CER technical standards can be better managed at point of installation (along with other points along the value chain for CER).	?
Connect CER to a network: The connection of CER to a network to export or import electricity .		
	Rationale for rating	**Rating**
Application	The NER regulates connection contracts, creating an indirect regulation of services to connect CER to a network. The connection contract regime applies to many but not all forms of CER. In general, a new connection contract is required where CER will export (such as BESS or PV). A new connection contract may also be required for significant changes to load, or certain installations of EV charging infrastructure. However, this contract is as between the consumer and the DNSP. The 'downstream' arrangement between the consumer and the installer will be subject to separate contractual terms.	**Y**

[12] AEMC, Review Into Consumer Energy Resources Technical Standards, (April 2023) (published: Review into CER technical standards - draft report (aemc.gov.au))

[13] AEMO, Compliance of DER with technical settings (April 2023) refer page 5 (published: compliance-of-der-with-technical-settings.pdf (aemo.com.au))

Today	A range of reforms implemented over the past several years have improved the application of connection regimes to specifically address CER issues. These include: • The *Access, Pricing and Incentive Arrangements* rule change imposed a clear obligation on DNSPs to support DER connecting to the grid. Among other things, this rule change prohibited DNSPs from offering zero export limit to small customers unless a specific exception applies under the AER's connection charge guidelines) • The development of Flexible Export Limits, and associated capability uplift to manage FELs, by DNSPs. This has resulted in associated changes to connection arrangements to reflect the flexible export limits (instead of static). Despite these advances, there are identified compliance issues with CER at the point of connection as noted by AEMO. In April 2023, AEMO's report on Compliance of Distributed Energy Resources with Technical Settings considered compliance of DPV (Distributed Photovoltaic) inverters with AS/NZ 4777.2:2020. It found persistent non-compliance, with less than half of installed systems set correctly to the required standard. NETCC, a voluntary scheme, applies to the connection stage under arrangements with approved sellers.	●
Evolved	In a high CER context, the challenges with CER connections today (including compliance challenges) are likely to be more acute absent additional measures and interventions. Interventions could include new approaches to managing compliance by networks or different regulatory approaches to connections (which directly regulate the installer who is overseeing the connection), and automated post-installation assessments and rectification programs that mitigate risks of large CER portfolios remaining non-compliant with network and bulk power system technical requirements. It is anticipated that DNSP connection contract arrangements will continue to evolve to accommodate the range of different flexible export arrangements introduced for CER over time. The connection of CER is considered in reforms and reviews on cost, including interoperability reforms. The AEMC's Review into CER Technical Standards has identified a critical need to consider how compliance with CER technical standards can be better managed, noting the compliance issues presently faced where the obligation has hinged on the connection point arrangements.	↑

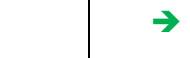
Rectify CER: The rectification of CER device or system.		
	Rationale for rating	**Rating**
Application	The NECF/ NER/NEL does not require rectification or repair of any CER. A connection contract may include express or implied terms which require the CER to be performing in a particular way. However, this contract is as between the consumer and the DNSP. Any obligation to rectify would sit with the consumer under the contract.	**N**

Today	Today, there are limited protections for consumers who have CER that requires rectification in order to perform in the manner required to support system outcomes (for example, in compliance with technical standards). This may impact the consumer's ability to enjoy the benefit of their own CER, and also impact system security and reliability for all consumers. ACL applies, and may require rectification in some instances. However, many OEMs interpret "like for like" warranty obligations to mean assigning "like for like" standard settings to replacement equipment, which may mean these get replaced with what has now become out of date standard settings (eg. Setting AS4777:2015 instead updating to AS4777.2 2020). SAPN's connection requirements specify that where the capability exists within replacement inverters, then settings must be updated to the current standard.[14] The NETCC recognises obligations to rectify. This is a voluntary scheme and is only applicable to a sub-set of total CER installed.	●
Evolved	In a high CER context, it will be increasingly important for all CER connected to the network to perform in the manner in which it is intended to perform, in compliance with technical and other standards. The current gap in regulatory arrangements and consumer protections for customers with CER (as identified by the AEMC Review of Technical Standards and the AER's review of customer protections for new energy services) create vulnerabilities for consumers and the broader system which need to be critically addressed. All DNSP connection requirements require that where the capability exists within replacement inverters, then settings must be updated to the current standard. The Review calls on governments to lead the development of enduring governance frameworks to better regulate CER.	?

Measurement and Control

Measure CER: The measurement of CER either at device level or at the connection point.		
	Rationale for rating	**Rating**
Application	Measurement is regulated under the NER to the extent it relates to provision of a market or ancillary service or supply of electricity to a consumer. Export from a connection point is also measured under metering provisions. The NER does not require measurement of self-consumed energy from CER.	**P**
Today	Today, there are no specific obligations relating to the measurement of energy produced by CER or consumer by specific CER at a connection point. Under the NER, measurement obligations apply where the electricity is exported to the grid. Metering data requirements focus on flows to and from the connection point for the purposes of retail and wholesale settlement. There are also obligations with respect to measurement where the CER is participating in a market, such as ancillary services markets or WDR. In these instances, generally the response is measured at the connection point although there are also areas where the relevant response is measured at the device level.	●

[14] See SA Power Networks, Small embedded generation – Inverter replacements. Available at: https://www.sapowernetworks.com.au/data/308283/small-embedded-generation-inverter-replacements/

Evolved	The issue of how CER should be measured remains a topic of debate, with considerable uncertainty as to how measurement of CER will evolve in a high CER future context. Key questions include: • whether regulatory arrangements should regulate measurement at device level or connection point; and • the fit-for-purpose approach to measuring CER response across an orchestrated portfolio of CER assets. The AEMC's unlocking CER benefits rule change is considering potential avenues to enabling use of technology with in-built measurement capability for CER and uses cases such as street lighting and public EV chargers. This also includes consideration of potential fit-for-purpose metering arrangements, through the use of minor energy flow metering.	
Control CER: The direct control or automated control of flexible CER to produce a response.		
	Rationale for rating	**Rating**
Application	There are no general obligations relating to the control of flexible CER. Consumer rights to export from CER are captured in connection contracts, which also impose terms about the ability of the CER to export (i.e., limitations on maximum export capacity). For some networks, the connection agreement may also include terms Where the CER is participating in a specific market (such as FCAS or WDR), whether alone or in an orchestrated portfolio, the roles and responsibilities of the relevant parties are described in the national energy co-operative regime.	**P**
Today	No obligations expressly attach to the control of flexible CER by a third party Obligations to ensure inverters are installed in accordance with technical standards (specifically, AS/NZS 4777.2.2020) are intended to ensure that CER behaves in certain ways. However, communication pathways to control and orchestrate CER are mostly reliant on the internet which raises significant risks as consumer grade equipment does not provide robust communications reliability, for example, with no back-up during power outages and many relying on third-party management from entities outside of Australia. Cyber security assessments of CER infrastructure point to significant vulnerabilities in this area. DNSPs have rights to control certain loads of customers who are on controlled load tariff arrangements. These have traditionally been used extensively in Queensland and is also a feature in other states. DNSPs will control CER in certain circumstances, e.g., in the event of automated activation of FELs. The DNSPs right to control the CER should be set out in the connection agreement. Currently, flexible export limits are focused on export only – and do not apply to control of CER demand-side (such as flexible load). The backstop mechanism is also regulatory lever permitting control of CER by third parties (i.e., not the consumer). This is to be used as a last resort to manage system impacts from CER.	

Evolved	The ability to control CER for network and market services is integral to efficient management of future high CER environment. Current reform discussions consider the relative hierarchy of control of CER across networks and other service providers. This will be critical to resolve to unlock future services and markets. Consideration is also required to ensure appropriate frameworks are in place to appropriately manage cyber security risks introduced with control of CER, across the cyber security posture. This includes appropriate hardening of the communication and control pathway to the CER device, and potential redundant pathways or ability to disable or isolate the CER if it is compromised through a cyber attack. There is also a need to ensure consumers are adequately protected in any services which control their CER. Consumer's self-consumption of energy is a critical driver of CER investments. The AER's consumer protections for new energy services (and related advice to Energy Ministers) explores how the current consumer protection framework is not fit for purpose for new energy services. This includes recognising the need for new regulation of CER products and services to ensure that the regulatory arrangements appropriately protect against harm.	
Orchestrate CER: The direct control or automated control of flexible CER behind multiple connection points, generally within a single region.		
	Rationale for rating	**Rating**
Application	Orchestration is indirectly regulated where the CER participates in a market via multiple orchestrated devices within a region (e.g., WDR or FCAS)	**P**
Today	The NER today recognises orchestration (or aggregation) of CER in terms of the regulated parties (which includes a DRSP), and in terms of various forms of market participation (including aggregated participation in FCAS markets). Orchestration may also be a feature of network operation of Flexible Export Limits (FELs), where a network implements FELs via means of remote control or automation across CER. In addition, there are a range of policy and regulatory responses which aim to better enable orchestration from a technical perspective, including: • Interoperability reforms, which create a common communication protocol to facilitate orchestration of CER. • Consideration of reforms to enable separation of controllable load at a connection point (in AEMO's FTA rule change proposal). • The ongoing work around FELs, including implementation of FELs by DNSPs. Risks of system security concerns arise where significant CER capacity is orchestrated. Orchestrated CER is not currently addressed in the NER. For example, a person who orchestrates CER with total combined capacity of equivalent of 50 MW in a region is not subject to equivalent requirements under NER Chapter 3. This may result in orchestrated CER operating at odds to system needs and with the potential to create additional system operating challenges. In contrast, a generator with that capacity at one connection point is scheduled. Such risks also need to be addressed with respect to cyber security concerns, to isolate and defend against rogue orchestrations or attacks upon CER portfolios (and restore once such compromises have been disabled).	

	There is no general regulation of orchestration from either a consumer perspective or system security perspective. In South Australia, there were previously obligations to register as a generator if orchestrating over 100 kW. A temporary exemption is in effect until November 2023 for VPPs up to 5 MW within the South Australian region.[15]	
Evolved	The future of high CER environment will require high levels of orchestration. There are a range of policy and regulatory issues under consideration today which aim to better enable orchestration from a technical perspective, including: • Interoperability reforms, which create a common communication protocol to facilitate orchestration of CER. • The ongoing work around FELs, including the AER's consideration of implementation of FELs by DNSPs. Current reform discussions consider the relative hierarchy of control of CER across networks and other service providers. This discussion goes to the question of role of networks and role of markets in a high CER context - and will be critical to resolve to unlock future services and markets. Several of the demonstrations have tested approaches to this – refer to Appendix C. Consideration will also be required to best practice management of cyber security in the evolved state. The AER's work on customer protections for new energy services is also critical – considering appropriate protections for consumers where their CER is orchestrated by a third party. Whilst there are a range of reforms underway considering orchestration of CER, it is anticipated that significant further policy and regulatory interventions will be required to achieve the levels of orchestration essential to efficient and effective integration of CER.	
Supply data to support CER orchestration /control: Data architecture, governance, and management frameworks to ensure the relevant parties have visibility of CER.		
	Rationale for rating	**Rating**
Application	The NEL/NER regulates metering data and data from large scale resources (generation and storage). There are additional regulations around data for FCAS and other services. Privacy law applies.	**Y**
Today	Today, there are a range of different data regulatory requirements that can apply to CER – however the rules governing data to support CER orchestration and control remain under significant debate. Whilst the NER have express data requirements for large-scale generation and storage (under AEMO's Power and Data Communication Requirements), equivalent regulation for small-scale generation and storage does not exist. The NER/NEL regulate data relating to energy supply in various ways, including via regulation of metering data which governs the data provided to and from connection points for retail and wholesale settlement, including household level data and also connections for large-scale supply points (including between Transmission Network Service Providers (**TNSP**s)	

[15] The Electricity generation license exception was approved in November 2023. Further information can be found here: ESCOSA - Electricity generation licence exemption – Virtual Power Plant Operations, Electric Vehicle Charging Operators, and Sub 5MW Operators

	to DNSPs). The VPP Demonstrations (refer Appendix C) tested ways of measuring data from CER and led to the introduction of new data requirements for CER participating in FCAS markets. Other data issues with orchestration and control are being tested across a suite of demonstration. • No specific obligations in connection with data to orchestrate CER.	
Evolved	A discussion continues around what measurement of CER is appropriate, the data regulation of CER in a high CER future is going to be increasingly important. This is central to: • Network and system operation • Future markets • Security of consumer data • Security of electricity supply. In addition, there is considerable discussion and debate around how to measure controllable CER in the context of the ESB's program, including: • Interoperability reforms • Flexible Trading Arrangements (including considerations for minor energy flow metering); and • FELs. The application of cyber security requirements at a small-scale level is also relevant in this context. • Reform debates today around interoperability focus on the obligation on the device to comply with data protocols and have not extended to clear articulation of obligations on any parties which are communicating with the device. The reforms on foot today will support further consideration of these issues. However, the data regulation needs to be considered holistically in the context of the evolving role of networks, interfaces between networks and AEMO, and the most efficient method for sharing and managing data from CER to support outcomes in a future high CER context.	

System and Markets

Plan a network with CER – local: The planning of a distribution network with high levels of CER, including development of capacity and capability plans and conducting relevant network modelling (including taking into account any interfaces)		
	Rationale for rating	**Rating**
Application	DNSPs have a responsibility to plan a reliable network that operates efficiently (reliable network at lowest possible cost). CER impacts their planning decisions and presents both challenges and opportunities for local network planning. DNSPs produce annual planning report (distribution annual planning reports, or DAPRs) which relate to planning across their systems.	**Y**

Today	Network planning at a local level should: • Include development of distribution network capacity and capability plans over different timeframes. • Ensure collaboration between transmission and distribution network service providers on network modelling and planning to reflect any requirements within the requirements of the local network. Today, networks devote considerable effort to planning their future distribution network, taking into account high levels of CER. For example: • Networks are investing significantly to unlock hosting capacity for CER. • Networks have amended their connection contracts to address new requirements around rights to export, FELs and obligations to comply with technical requirements. • Networks have been innovating and demonstrating new approaches to services from CER and network investments including, for example, neighbourhood batteries.	
Evolved	AEMO's Engineering Roadmap to 100% Renewables (Engineering Roadmap) outlines the challenges in planning a system with high CER. AEMO has been working with networks and broader industry to define the requirements for operating the future system. The high CER future will require networks to have increasing ability in planning networks with high CER. Planning networks with high CER needs to consider both capacity and capability of the networks; that is the ability to host CER and the ability to operate dynamically with new and evolved network flows introduced through the operation of CER. This also involves new interfaces across planning at a distribution level, transmission level and bulk system operator level. Co-ordination is required in order to reflect the interactions between these parties within the plans of the local network. Planning around consumers with high CER requires increasing capability at a network level to consider a range of issues which will drive an increase in CER. The predicted pace of change is such that what may happen in the operating and regulatory context cannot always be anticipated five years in advance via the regulatory reset process undertaken by the AER. Whilst various demonstrations, reforms and reviews on foot are considering the capability required of DNSPs to plan their network in the future, there is a critical gap around how this body of work will be progressed to ensure that all networks develop the required maturity at a rate that is appropriate for their circumstances. There are also critical gaps in how planning by each network intersects with the other, and with AEMO's planning functions, in the context of a high CER future.	

Operate a network with CER – local: The operation of a distribution network with high levels of CER, including ensuring distribution network security and dynamically managing the network with technical constraints		
	Rationale for rating	**Rating**
Application	DNSP has responsibility for operating distribution networks. This includes: • Ensuring distribution network security for high impact events; and • Dynamically managing the network within technical constraints.	**Y**

Today	Distribution system operation has traditionally been about managing one-way flow from transmission to customer premises. This is rapidly changing to two-way, both from predictable and unpredictable, and controllable and uncontrollable sources. This requires dynamic operation and significant new capability at a distribution network level. Today, the regulatory framework has limited obligations on distribution networks with respect to the operation of their network, compared to the framework applying to TNSPs. The obligations include: • Obligations relating to system security (keeping within limits). Compared with obligations on TNSPs with respect to system security, obligations on DNSPs in the NER are sparse and ill-defined. • Obligations regarding reliability in operational timeframe (STPIS). Networks are starting to invest in capability to dynamically operate their networks. The introduction of FELs has supported this, and networks have also updated their connection contracts to reflect the dynamic operation.	
Evolved	In a high CER environment, distribution network flows become much more variable and unpredictable, imposing a broader range of operating conditions on the networks than was accounted for in their original designs. Consequently, maintaining network operation within its technical parameters becomes more challenging. Without proper forecasting, monitoring and control, these deviations go unnoticed and cannot be actively managed by network operators. At worst, this could result in networks operating at unsafe levels, at best, this requires the network to be managed more conservatively to ensure the network remains within the bounds of its technical capability. Given the limited monitoring and control measures initially in place for a relatively predictable operational environment, it is imperative to substantially enhance these functions. This enhancement is essential to ensure a robust connectio of CER, keeping the network's capacity within safe technical bounds. Therefore, formalised functions for the advanced operation of high CER distribution systems are an essential step forward. In particular, ability to forecast CER is recognised as requiring additional capability, and called out in this gap analysis as a separate function.	
Plan a network with CER – transmission level: The planning of a transmission network with high levels of CER, including development of transmission investment plans considering impact of CER and conducting relevant network modelling (including taking into account any interfaces).		
	Rationale for rating	**Rating**
Application	TNSPs are responsible for planning, design and operation of their networks in accordance with system standards and network performance requirements in the NER and jurisdictional licence obligations. AEMO, as National Transmission Planner, has a system-wide overview role in the transmission planning process. While transmission planning responsibilities are well-established, further work is required on the interface between AEMO, TNSPs, and DNSPs, including further development of roles and responsibilities for requirements in relation to CER.	**Y**
Today	AEMO's development of the ISP which identifies transmission network investment needs over a 20-year optimal development path, and assessment of different system needs over a 5-year horizon (e.g. inertia, system strength and emergency frequency control) which TNSPs are required to address. TNSPs assess of optimal ways to meet network needs identified by AEMO,	

	and undertake an annual planning process, covering a 10-year outlook and undertaking regulatory investment test for transmission (RIT-T) cost-benefit assessment process for projects above a cost threshold. Joint planning arrangements between TNSPs and DNSPs undertaken as part of annual planning processes, and coordination across RIT-Ts and regulatory investment test for distribution (RIT-Ds). Across these processes, various DER uptake trajectories (often but not always aligned with AEMO's ISP scenarios) are considered as alternative scenarios across the different planning horizons. Network planning at the transmission network level needs to include: • Developing transmission investment plans considering impact of high level of CER; • Developing transmission network capacity and capability plans over different timeframes to take into account CER; • Ensuring collaboration between transmission and distribution on network modelling and planning.	
Evolved	AEMO's Engineering Roadmap to 100% Renewables (Engineering Roadmap) identifies effective planning and coordination at the transmission-distribution interface as a precondition that needs to be satisfied for securely and reliably operating a high DER power system. The roadmap identifies actions across the following areas: • DNSPs distribution network and DER modelling and analysis requirements for planning coordination with TNSPs and AEMO to assess system needs at the transmission-distribution interface and at system level. • Clarity on roles and responsibilities for voltage management at the transmission-distribution interface. • Assessment of protection adequacy with reducing fault levels and impact of reducing negative sequence current injection on protection schemes. • Collaboration between AEMO and DNSPs towards establishing integrated planning processes for managing and enabling DER uptake. Operation of CER changes the power flow dynamics for the interface between the transmission and distribution network, and the functional requirements for maintaining power system security require re-consideration. This includes consideration of processes such as managing reverse flows into the transmission network and impacts on the operation of emergency protection schemes, and voltage management for example. Key facets of coordination encompass a spectrum of activities, including information exchange, monitoring and analytics, pricing computations for electricity services, resource forecasting, scheduling, activation, and the broader responsibilities entrusted to system operators.	↑

Operate a network with CER – transmission level: The operation of a transmission network with high levels of CER, including monitoring the impact of CER on the transmission network and managing transmission network stability and security		
	Rationale for rating	**Rating**
Application	TNSPs are responsible for planning, design and operation of their networks in accordance with system standards and network performance requirements in the NER and jurisdictional licence obligations.	**Y**

	Transmission network obligations are well-defined, however clarity is required on how this interfaces with DNSP and bulk system level requirements as CER penetration grows.	
Today	Responsibilities for transmission system operation are split between TNSPs and AEMO. AEMO manages flows in the transmission system through constraints in the centralised dispatch process, relying on limits advice from TNSPs. Some transmission system operational functions, including operational coordination with DNSPs, are delegated to the TNSPs. TNSPs provide limits advice and network data (e.g. plant equipment ratings) required for AEMO to quantify and manage the secure technical envelope of the power system, through constraint equations in the dispatch process. AEMO operational interaction with DNSPs undertaken through TNSP delegations and covered in power system operating procedures. This spans coordination across several areas: managing planned outages, fault current contributions from embedded generating units, communicating underfrequency settings to relays, activation or de-activation of reactive plant in the distribution network, load shedding and load restoration and system restart plans. Today, a level of uncertainty surrounds how transmission requirements interface with distribution-level operation of CER. Operating a network with CER needs to include: • Monitoring impact of the CER on the transmission network; • Managing transmission network stability and security.	
Evolved	Operation of CER changes the power flow dynamics for the interface between the transmission and distribution network, and the functional requirements for maintaining power system security require re-consideration. This includes consideration of processes such as managing reverse flows into the transmission network and impacts on the operation of emergency protection schemes, and voltage management system restart, as well as forecasting and scheduling processes. Key to these considerations is to identify the roles and responsibilities of various actors (eg. AEMO, TNSPs, DNSPs / DSOs) in delivering these processes for example.	
Plan a bulk system with CER: The planning of an electricity system with high levels of CER, including projecting demand and CER participation to develop long-term forecasts and plans.		
	Rationale for rating	**Rating**
Application	AEMO has responsibility for projecting demand and how it will be met – publishing the Electricity Statement of Opportunities (ESOO) and the ISP reflecting this. The market and network then utilise these publications to do their own planning and consider appropriate investments.	**Y**

Today	AEMO's role as national planner relates to a transmission-level plan, where CER is treated as an input into the needs for large scale generation and storage. Over the past several ISPs, AEMO has increasingly focused on accuracy of forecasting of CER. The 2023 IASR has included an increased focus on orchestration, and the draft ISP to be published in November 2023 will include a CER sensitivity. There are challenges predicting electricity demand and accounting for CER uptake and portion that will be orchestrated. Ability to forecast the impact of CER integration on market prices and system operation is challenged by the increasing impact of consumer behaviour including how consumers utilise their CER and whether they will take up orchestration services. The portion that will be orchestrated directly impacts how CER can be utilised to meet system reliability and security needs into the future, and whether or not alternative investment in large-scale generation and additional network capacity may be required instead. CER is also relevant where AEMO is planning for future grid stability. *The Efficient Management of System Strength on the Power System* rule change (2021) introduced requirements for DNSPs to plan for system strength, as well as TNSPs. AEMO has some visibility of CER installations via the DER Register, to support visibility and planning. The DER Register does not apply to EV charging infrastructure. However, the ESB's Electric Vehicle Supply Equipment (EVSE) Standing Data Consultation Outcomes Report recommends AEMO propose a rule change to expand the DER Register to include EVSE, which AEMO intends to propose by end 2023 – see Appendix A.	
Evolved	AEMO's Engineering Roadmap to 100% Renewables (Engineering Roadmap) outlines the challenges in planning and operating a system with high CER. Planning and operational processes to support delivery of the attributes of controllability, performance, and visibility and predictability, including management of cyber security risks, requires consideration. For the purpose of planning a bulk system with high CER, this includes better visibility of flexible CER orchestration and ability to project uptake of flexible CER products.	

Operate and forecast in a bulk system with CER: The operation of an electricity system with high levels of CER, including incorporating consideration of CER within bulk system operation, impacts on CER for bulk power system stability and security and forecast demand of electricity and flexible resource response for operational, and market purposes.

	Rationale for rating	**Rating**
Application	The NER provides for AEMO's obligations to operate the bulk power system. However, AEMO's capabilities will need to evolve as CER penetration grows and CER (particularly coordinated, price responsive CER) plays a greater role in the power system. Additional clarity on the role and responsibilities of transmission and distribution network operators in facilitating a reliable high-CER power system also requires further consideration.	**Y**

Today	AEMO's Engineering Roadmap to 100% Renewables (Engineering Roadmap) outlines the challenges in planning and operating a system with high CER. AEMO has been working with networks and broader industry to define the requirements for operating the future system. Reforms are being progressed to efficiently integrate CER into the power system, by providing AEMO with enhanced visibility and enabling participation of CER in the NEM scheduling process.	
Evolved	Planning and operational processes to support delivery of the attributes of controllability, performance, and visibility and predictability, including management of cyber security risks, as described in AEMO's Engineering Roadmap requires consideration. In addition, holistic consideration of how (e.g. incentives and mechanisms) to integrate aggregations of price-responsive CER into the market and system is required, noting some resources will be in-market whilst others will not but may still be price-responsive. DOE constraints and control will also require consideration.	

Providing a CER service to consumers: Providing a service to consumers through the control of flexible CER, which may be secondary "off market" transaction		
	Rationale for rating	**Rating**
Application	Not directly regulated by the NER/NEL/NECF.	**P**
Today	Today, a range of energy efficiency service providers provide services which effective shift and shape load for business customers and there are also a range of service providers targeting households. In addition, demonstration programs have tested different models for services, such as off-market energy storage services from community batteries.	
Evolved	Like off-market transactions at a large scale, it may be appropriate for parts of CER markets of the future to not be 'on market' in the sense of integrated into wholesale market settings. However, unlikely large scale off-market transactions between sophisticated players, it is appropriate to consider consumer protections in the case of 'off market' CER services.	

Providing a CER network service: Providing a service to networks from aggregated CER in response to a network request		
	Rationale for rating	**Rating**
Application	Networks are economically regulated so services procured by networks operate within the regulatory framework (noting there is not specific regulation of distribution level network services today).	**Y**
Today	Today, CER can provide a range of network benefits. DNSPs consider CER assets alongside alternative assets when planning their network. Whilst network services for TNSPs are regulated as non-market ancillary services, services to support the distribution level from aggregated CER are not similarly regulated. The concept of 'CER network services' relates to services which may be provided by consumer energy resources behind a customer's connection point (e.g., through the orchestration of CER to provide the service). Provision of network services by customers is not a new concept. There	

	are many existing network support contracts between DNSPs and customers, although these contracts are largely between large customers and DNSPs. DNSPs have recognised the potential for CER, both individually and aggregated to provide network services. Some DNSPs have tested options for how CER can provide network support through demonstration programs and trials. Demonstration programs have tested means of providing network services from aggregated CER. The preferred model for network services from remains contested, including whether there should be alignment of defined network services, certainty of outcomes, any common regulatory approach to network services, or if network services are best managed by individual networks (and regulated contractually).	
Evolved	The concept and scope of CER network services is continuing to evolve and will be increasingly important in a high CER context. Conceptually, CER can provide network support through a number of means. For example, change in import/ export in response to dynamic pricing signals. Aggregated and orchestrated CER could also provide specific network support. A number of demonstration programs have considered network support services from CER. There is also a question about the extent to which network orchestration to manage network requirements can be achieved by FELs (limiting the optionality for additional network support service markets), or whether FELs in the future state will be complemented by additional markets in network support. This interrelates with a broader point of contention on who gets to orchestrate the CER – should networks be able to directly control and/or dispatch, or does it have to be through a market facing actor such as a trader. A key issue for networks will be the certainty of network services from CER. There is a need to test and trial the ability of network services from aggregated CER, ensuring that 100% of the contracted network services are available when they are called upon. The data architecture, identity and access management, and contracting arrangements, for managing future network services will also be critical to establishing trusted and effective capability. A common approach to data architecture, identify and contracting for any network services markets will minimise total costs across the NEM and support the development of nascent markets in competitive provision of network services from CER, enabling market actors to work across more than one distribution network.	↑

Operate a central market with CER: The operation of wholesale and ancillary services markets with high levels of CER (including markets CER participate in, and other markets)		
	Rationale for rating	**Rating**
Application	The operation of wholesale and ancillary services markets is regulated by the NER.	**Y**
Today	Rules continue to evolve to cater for issues with operating the wholesale market with high levels of CER. There are limited means today of active participation of CER in AEMO-administered markets, limited to WDR and some FCAS markets. At the same time, some existing market operation provisions require revisiting to recognise the impact of CER on existing processes.	●

	Moreover, the secure identification and access management processes, as well as data exchange requirements, to engage and transact with portfolios containing potentially millions of small-scale distributed devices has not been addressed (apart from trial assessments such as Project EDGE). Such infrastructure requirements are key enablers to any market(s) seeking to engage and obtain services from CER portfolios.	
Evolved	The operation of wholesale and ancillary services markets will need to continue to adapt to a high CER environment. Where new markets are introduced, this requires new capability for the market operator (including new technical capability) to operate the markets. The role of wholesale and ancillary services markets in orchestrated CER services remains under active consideration in rule change processes, including Unlocking CER benefits through flexible trading and Integrating price-responsive resources into the NEM. The evolved state of orchestrated CER will have a significant impact on NEM markets, and current uncertainty will increase unless resolved.	
Participate in markets with CER: Participating in wholesale or ancillary services or network services markets with CER		
	Rationale for rating	**Rating**
Application	The NER governs 'on market' activity (for wholesale and ancillary services). A range of off market activities also underpin the NEM which are not directly regulated by the NER – other regulatory arrangements apply (including financial service licencing requirements).	**Y**
Today	Today, there are limited means of active participation of CER in AEMO-administered markets. The wholesale demand response market and some FCAS markets facilitate participation from aggregated CER. In general, the wholesale market value of exports from CER is captured by the retailer at the customer's connection point (treated as a 'negative load' in the wholesale market and netted off against that retailer's liability). Wholesale markets in the energy sector were envisaged as a means to balance supply and demand for energy, supporting the operation of the market as a balancing mechanism. The wholesale market design and participation methods (including processes for forecasting, scheduling and dispatch) then have broader operational benefits in terms of controllability, performance, visibility and predictability of the load. CER today is not holistically integrated with the wholesale market. As a result, CER is unable to be used to meet system security and reliability requirements within market. System challenges are emerging to manage the increased variability and unpredictability from control of CER, where this is not in the market. Key digital infrastructure requirements are essential enablers for engaging volumes of CER to participate in markets. Such infrastructure includes identity and access management solutions, as well as data exchange platforms. Establishing arrangements for traders/aggregators to participate in different markets	

Evolved	Clarity is required for how the market and system operational processes will work together in this future. A range of demonstration programs have considered CER participation in markets and have been a useful testing ground for new markets (including the VPP demonstration, which tested participation in FCAS markets from aggregated CER). The role of wholesale and ancillary services markets in orchestrated CER services remains under active consideration in rule change processes. This includes consideration of how traders will be recognised in market systems and processes from registration, through operation and into settlements.	
Forecast with high CER – Operational: Forecast demand of electricity and flexible resource response for operational, and market purposes		
	Rationale for rating	**Rating**
Application	AEMO has responsibility under the NER to forecast operational demand for the purpose of dispatching the market.	**Y**
Today	Operational demand is impacted by behind the meter resources. As CER penetration increases, AEMO needs to manage increased variability and uncertainty in forecasts. This is increasingly driven by unscheduled price-responsive resources over which it has little visibility. Predictable (weather-dependent) responses can be forecast – controlled responses cannot.	
Evolved	Enhanced forecasting capabilities will need to be developed for the high CER power system and to effectively forecast the impact of coordinated, price responsive resources. This will need to be supported by reforms designed to provide visibility, predictability and dispatchability of price-responsive CER (e.g. Integrating price-responsive resources into the NEM). Clarity around responsibility for forecasting is required where DNSPs are managing the network dynamically, traders are managing aggregations of DER and there are other out-of-market responses. There are also key considerations around control (limits) verse operating envelopes.	

4.2.4 Step 4: Priority gaps

Below is a high-level summary of the gaps identified in the analysis above:

	Functions with existing gaps	Evolved State Assessment	Assessment and Issue – summary	Ask
Supply of CER and electricity	**Manufacture CER**		Critical issues have been identified in the ability of current regulatory frameworks and governance arrangements to address issues at these early stages in the value chain. The issues relate to both: - Governance of technical standards - Application of appropriate consumer protections	Government to support the recommended immediate actions outlined by the AEMC to ensure new and existing devices are compliant with CER technical standards across the supply chain. This includes recognising the need for new regulation of CER products and services. The advice recognises government leadership is required as changes to the scope of the NECF are contemplated, requiring legislative change. Governments should work with the AER and other market bodies to address the issues relating to the scope of existing consumer protections regimes – and any amendment will require legislative change
	Sell CER			
	Sell electricity			
	Buy electricity			
	Install CER			
	Configure CER			
	Connect CER to a network			
	Rectify CER			
Measureme nt & control	**Measure CER**		These parts of the value chain are essential enablers to delivering value from CER. They also impact consumer's directly – including their self-consumption of energy. The current consumer protection framework is not fit for purpose for new energy services where their CER is orchestrated by a third party.	Addressing these issues requires a two-fold approach: Collaboration and coordination are required across all reforms to ensure measurement, control and orchestration of CER evolves in a manner which supports the development of new markets, services, as well as meeting network and system needs; and • Any reforms to consumer protections should also consider these arrangements are fit for purpose
	Control CER			
	Orchestrate CER			

System and market	**Supply data to support CER orchestration/control**	As networks are driving the early data models, there is a risk that the varying approaches will create a barrier to future market services developing, and risk disaggregated and potentially more costly approaches.	Government leadership is required to align on data architecture and communication protocols across distribution networks and traders. Government to ensure that consumers can benefit from innovation in the sector whilst also being protected from negative impacts on their use of energy within the household or small business.
	Plan a network with CER - local **Operate a network with CER – local** **Plan a network with CER – Transmission level** **Operate a network with CER – transmission level** **Plan a bulk system with CER** **Operate and forecast in a bulk system with CER**	System planning and operations is an area of uncertainty. No current process which 'covers the field' on these topics. The issues relate both to the how relevant network operators and planners manage their systems in high CER context, and, critically, the interfaces between those roles. Interfaces with market actors and consumers are also critical and require holistic consideration.	Requires government leadership and concerted action to consider this issue, taking into account stakeholder and consumer advocacy perspectives. The issues raised are broader than any single market body's functions and will require centralised leadership to progress to design and implementation of solutions.
	Providing a CER service to consumers **Providing a CER network service** **Operate a central market with CER** **Participate in markets with CER**	System planning and operations is an area of uncertainty. No current process which 'covers the field' on these topics. Distribution networks are critical and need to continue to build capability. The current frameworks are not future fit for the role of Distribution System Operator. The issues relate both to the how relevant network operators and planners manage their systems in high CER context, and, critically, the interfaces between those roles. Interfaces with market actors and consumers are also critical and require holistic consideration. CER markets and services (including services on wholesale markets and network services)	Requires government leadership and concerted action to consider these issues. In particular, there is a clear need to define the functions that DNSPs are accountable to perform as they evolve to a DSO in a high CER environment, including identifying the capabilities and the interfaces with the market and system operator and industry participants In addition, as CER networks continue to evolve, government coordination and collaboration is required.

4.3 Appendix C: Demonstrations and jurisdictional developments

Introduction

The ESB has recognised that its program of reforms does not occur in a vacuum. Outside of the work of the ESB and the market bodies, there have been a wealth of programs led by jurisdictional governments and the Australian Government aimed at incentivising CER, addressing sectoral convergence and the challenges of equity, electrification and whole-of-economy transition at a jurisdictional level.

Industry has also developed a range of demonstration programs across the NEM and WEM that have trialed and tested new capabilities that will ultimately deliver new products and services for consumers. The NEM 2025 DER Implementation Program recognised the importance of demonstration programs in the context of CER – specifically Project Edge, a seminal demonstration program looking at how CER network services and markets can be optimised to improve outcomes in CER integration, included a multi- year consumer insight series (conducted by Deakin University's Better Consumption Lab).

The intersections between market-body-led programs, jurisdictional programs, and industry developments highlights the need for all policy, regulatory and industry actors in CER to collaborate to ensure CER integration outcomes are achieved. These programs tackle the issues from a range of different perspectives and angles which can complement the role of market bodies in progressing the energy transition.

The jurisdictional policies have been included in this section as part of the review to ensure that any gaps identified with the ESB program are not already being addressed by the policies undertaken within the respective jurisdictions. A range of demonstrations have also been included in the section to note the lessons learnt from each demonstration and the comparisons across demonstrations.

4.3.1 Industry CER Demonstrations

There are a broad range of demonstration programs introduced across the NEM and WEM to consider optimum arrangements for CER integration:

- **Table 7** – Industry CER Demonstrations and Lessons Learnt: explores several CER-related demonstrations across Australia, focusing on the lessons learnt from each of these programs. This includes the four demonstrations identified by ARENA in its 'DEIP DER Market Integration Trials Summary Report.'
- **Table 8** – Explores in more detail the learnings associated with the data architecture adopted by each of the four demonstrations identified in the 'DEIP DER Market Integration Trials Summary Report', including the data exchange approach, interoperability considerations, and customer visibility of data.

The detail in this table is correct as at 30 August 2023.

Table 7: Industry CER Demonstrations and Lessons Learnt

Demonstration 1: Project EDGE (Energy Demand and Generation Exchange) ***Identified in DEIP DER Market Integration Trials Summary Report[18]***	
Primary objectives and context	Project EDGE (Energy Demand and Generation Exchange) is a multi-year project to demonstrate an off-market, proof-of-concept Distributed Energy Resource (DER) Marketplace in which DER operates efficiently to provide both wholesale and local network services within the constraints of the distribution network. Project EDGE (Energy Demand and Generation Exchange) is an ARENA funded project completed in unison with AEMO, AusNet, Mondo Power and Melbourne University and additional participants Rheem, Discover Energy and AGL. [19]

[18] ARENA, DEIP DER Market Integration Trials Summary Report (September 2022). (Published: DEIP DER Market Integration Trials Summary Report - Australian Renewable Energy Agency (ARENA))

[19] Further project information on Project EDGE can be found here: https://aemo.com.au/en/initiatives/major-programs/nem-

What were the data infrastructure setup and market structures in place?	The project aimed to demonstrate an off-market, proof-of-concept CER marketplace that efficiently operates CER to provide both wholesale and local network services. A mix of residential and commercial/industrial customers in Victoria participated in the project through an aggregator. With AEMO and AusNet involved, this represented end-to-end capability required to coordinate CER to provide services within network limits. In terms of market services, Project EDGE is testing wholesale bidding models aligned with the Trader role considered under Unlocking CER benefits through flexible trading and integrating price-responsive resources into the NEM. For instance, it is assessing three different types of dispatch models that may inform Scheduled Lite (Visibility, Self-Dispatch, and Scheduled). Project EDGE is testing an interface to facilitate DER-based network support services called the local services exchange (LSE), where networks publish service requirements, select successful aggregator bids, and trigger the procured local service. The project is also using DOEs to manage local network constraints. Data in the EDGE program is supplied by a variety of players in the DER supply chain for the members of the report including: • AusNet Services (Network model forecasts, demand, voltage assessment, efficiency) • Mondo, Discover Energy, Rheem (bids, re-bids, DER portfolio orchestration, telemetry data) • AEMO (Dispatch instructions, registration information) Project EDGE tested two configurations of an industry data hub (centralised and decentralise). The centralised data hub is similar to AEMO's existing e-Hub where all messages and information is sent to a central broker that then partitions the information to the intended recipients. A decentralised data hub allows for many parties to host the hub as a 'node', in which parties can send a message to a node in the system, and that message is processed in a decentralised way then partitioned to the intended recipients.
What were the challenges and lessons learnt?	**DER-related Roles and Responsibilities Extend on current state** Building on previous industry work Project EDGE considered a set of integrated market-wide industry roles within the Hybrid Framework. This arrangement extended current roles and responsibilities rather than creating new or duplicating existing ones. Retailers & Aggregators represent DER customers: Retailers and aggregators are best placed and incentivised to represent the customer's DER assets, manage market risk, and develop innovative customer products via Virtual Power Plants (VPPs), Aggregators are best placed to co-optimise services they can provide, as their key objective is to deliver customer value while supporting their own commercial interests. • DNSPs become DSOs: Distribution Networks are best placed to perform the functions of a DSO such as calculating D-Network limits, operating the local network to these limits, and procuring DER-based services for constraint alleviation within the distribution network. • AEMO's role is a key enabler of a high DER future: AEMO should remain the whole of system and market operator responsible for clearing DER bids aggregated to the Transmission Node Identity (TNI). • Agreeing who should operate a DER data hub is one of the last major steps in defining DER integration roles and responsibilities. **Technical capability for DER Integration exists today** • End-to-End functionality operated successfully in field: Three aggregators, AusNet and AEMO successfully built and operated functionality to coordinate, in real time, the functions necessary to DER system and market integration. Functions included DOEs, DER Fleet forecasting, orchestration and bidding/visibility, local network support services and scalable data exchange between multiple industry actors.

distributed-energy-resources-der-program/der-demonstrations/project-edge

	• There is greater opportunity available for Aggregators and customers as they mature: Current level of industry readiness is helpful for system and market needs with effort to mature more sophisticated capability and customer offers required to maximise customer value and support a high VRE future with more dispatchable DER capacity. **Customer sentiment and Incentives Need Development** • Unclear customer value proposition: Customers in general are optimistic but unclear about value proposition of joining a Virtual Power Plant (VPP). Financial and Trust barriers. • DER Aggregators limited by market frameworks: Easier, low-cost access to revenue opportunities (Market and B2B) would support required product innovation. VPPs should take a stepping-stone approach to capability development based on revenue streams it can unlock. **Uneven Aggregator Enablement** • DER Operational and Market Enablement: Aggregator to Retailer services exist today in point-to-point fashion but are not accessible to all retailers as integrations are costly to establish. One integration via a data hub can serve this and many other use cases. **Scalable Data Exchange lowers customer barriers and provides visibility of DER** • Data Hub enables DER value: A DER data exchange hub could facilitate a lower cost, standardised interface between AEMO, DSOs, retailers, aggregators, and Original Equipment Manufacturers (OEM). Gaining visibility of DER data exchanges via a data hub will enable the management of markets and power systems, conscious of aggregated DER forecasts and operations. If designed flexibly, a hub arrangement can evolve with industry, supporting additional participants and innovative use cases incrementally over time as they are invented. Thus, DER aggregators will be able to scale whilst enabling AEMO and DNSPs to operate efficiently and rewarding DER customers. **Distribution Network Dynamic Operating Envelope design** • Nuances in 'fair' capacity allocation methods impact benefits to all consumers: Different methods for allocating network capacity can result in varying levels of benefits for consumers. While some methods may prioritize larger, more flexible energy resources, a balanced approach is needed to ensure all consumers, including those with smaller or no DER systems, can participate effectively. • Variety of methods and approaches tested, likely to start simple and less accurate: Initial implementations oof DOE are likely to be simpler but may lack the accuracy required for optimized DER coordination. As experience and data accumulate, more sophisticated and precise methods can be adopted to better align with real-world conditions. • Broad customer coverage of DOEs is a key enabler to economic value: By extending DOEs to a larger customer base, it becomes possible to remove consumer constraints that otherwise limit network capacity.
Demonstration 2: Project Symphony ***Identified in DEIP DER Market Integration Trials Summary Report***	
Primary objectives and context	Project Symphony is piloting end-to-end capability for aggregated DER to provide network, market, and customer use cases. The pilot aims to directly inform policy and regulatory reform under the WA Government's DER Roadmap. Project Symphony is a collaboration between the Western Australian Government (Energy Policy WA), Western Power, Synergy and the Australian Energy Market Operator. Project Symphony has received support from the Australian Renewable

	Energy Agency (ARENA) as part of ARENA's Advanced Renewables Program.[20]
What were the data infrastructure setup and market structures in place?	AEMO undertakes a central role in Symphony in simulating the WEM and providing dispatch instructions to the aggregator to provide WEM services. The DSO (Western Power) calculates and provides DOEs (site-level) to the aggregator (Synergy) to ensure local network constraints are considered. The aggregator ensures bids made to the market operator conform to those limits. The DSO also identifies opportunities for Network Support Services (NSS) engaging the aggregator via a bi-lateral contract. The aggregator undertakes all customer-facing activities and CER optimisation in order to deliver services to the simulated WEM and the DSO. Project Symphony tested DER in three system level market services: • Energy Services – Bi-directional: participation in balancing market to meet system demand • Constrain to Zero: constrain energy output from DER to zero • ESS Contingency Raise: Restoring deviation in frequency Project Symphony tested network support services by requiring the DSO to forecast network capacity shortfalls that could be resolved through non-network services. The project also used DOEs to manage local network constraints. Project Symphony utilised an integrated platform approach to data exchange infrastructure: • DSO Platform (Western Power) - Responsible for identifying maximum renewable energy hosting capacity at the distribution level, forecasting consumer generation and load, and using this information to create DOEs that equitably allocate network capacity to consumers. • DER Integration Platform (AEMO) - Responsible for providing Aggregator access to wholesale energy and essential system service markets with dispatches conforming to the constraints of the network • Aggregator Platform (Synergy) - Responsible for onboarding DER, registering facilities in the market, managing and dispatching flexibility, and post-event analysis
What were the challenges and lessons learnt?	Key lessons learnt include: • Customer data sharing: To enable VPP services and participation, higher levels of customer data sharing are required across the different value chain participants than has previously been the case for a traditional 'one-way' electricity network. • Customer benefits: Currently there are challenges in demonstrating the ongoing benefits of VPP participation when existing tariffs are not more cost reflective and are protecting customers against negative or peak pricing. Consideration needs to be given to adopting more cost reflective pricing / tariffs, with clear economic signaling, ahead of scaling a VPP roll out. • Customer engagement: Similar programs would likely benefit from adopting both broad and direct marketing approaches, including the use of different channels such as direct mail, electronic direct mail, outbound telephone 'nudge' calls, SMS, shopping centre 'pop up' stand, social media, website etc. • Customer recruitment: A phased recruitment strategy, along with the early adoption of customer feedback into product development, leads to new enhanced offerings which results in a larger pool of eligible customers to recruit from. Similar programs should gauge the level of prior understanding / knowledge of key DER integration concepts within the target recruitment area and should digitise the customer experience

[20] Further project information on Project Symphony can be found here: https://arena.gov.au/projects/western-australia-distributed-energy-resources-orchestration-pilot

	as much as possible from the outset of customer recruitment. • Technology integration – DER orchestration: Include a contingency to enable the pivot to product enhancements and offerings to customers, including compatible inverter replacements, battery energy storage offerings and compatible appliance replacement. Confirm vendors share a common understanding / interpretation of relevant standards and communication protocols. Future or scaled VPP rollouts will need to be supported by a common adoption of standards and protocols including consideration for mandatory application. Bring platform providers together early, and frequently, in the project to ensure understanding, collaboration and co-operation is achieved. • Technology integration – testing: Need to establish, document and agree high level strategic testing objectives / outcomes along with more specific tactical, technical objectives prior to each wave of testing. • Governance: Remit of Working Groups needs to be clearly defined at the outset of the project including effective 'independent' facilitation roles and decision / issue escalation pathways. In addition, achieving consensus/ compromise on technical design aspects is challenging and requires greater involvement from Project Managers and Product Owners or the establishment of independent facilitators to participate in technical working groups. • Roles and responsibilities: Involve policy makers at a project level, rather than only at a governance level, to align tactical and strategic directions for project partners. • Policy and regulation: Similar projects should remain open to testing different possible constructs and solutions in comparison with existing constructs to enable greater and faster VPP facilitation post project completion. Test against the existing market rules, identify and quantify the barriers, and if possible, accommodate the testing of alternative solutions to inform recommendations for DER participation in the future. • Markets and services: A range of on-market and off-market services will enable a greater technical and commercial understanding of VPP value. • Media coverage: Strong branding with aligned communications can create a greater buy-in from customers and key external stakeholders, including the media.
Demonstration 3: Project Edith **Identified in DEIP DER Market Integration Trials Summary Report**	
Primary objectives and context	Project Edith is an initiative that aims to showcase how the grid can facilitate technology and green energy solutions (like Virtual Power Plants (VPPs)) to participate in energy markets while staying within distribution network capacity limits.[21]

[21] Additional information on Project Edith can be found here: https://www.ausgrid.com.au/About-Us/Future-Grid/Project-Edith

What were the data infrastructure setup and market structures in place?	DSO sends the trader DOEs and DNPs (network charges that reflect level of constraint at different locations in the network), and the trader bids capacity that will conform to the limits of the DOEs. In terms of network services, Project Edith provides an alternative approach to other trials by testing the effectiveness of new, sophisticated price signals in managing network hosting capacity (dynamic network prices). Data on this would be provided to retailers and traders that have CER that is price responsive. The DSO is the administrator of the dynamic price. The project is also using DOEs to manage local network constraints. A key feature of Project Edith is that both Ausgrid and Reposit Power will aim to leverage as much of their existing systems and process as possible. Utilises a point-to-point data exchange.
What were the challenges and lessons learnt?[22]	**Procuring network support services** • Complexity of Contractual Agreements Hinders Scalability: One of the challenges in procuring network support services lies in the complexity of contracts between Distribution System Operators (DSOs) and customer agents. While DSOs need detailed contracts to manage network capacity and outline conditions, this complexity is often distilled into simplified agreements for customers. The simplified contracts may lack the granularity needed for optimal network management. Simplification is both a necessity for customer understanding and a challenge for nuanced capacity management. • Emergence of Centralized Flexibility Marketplaces to Encourage Competition: Traditional bilateral agreements are evolving into centralized flexibility marketplaces, either region-specific or shared among multiple DSOs. These platforms aim to streamline the procurement of network support services and foster competition in the market. However, these marketplace platforms are still maturing, and there is a need for further development to fully realize their potential for improving network support services. **Incentivising network support through dynamic pricing** • Challenge of Targeting Specific Network Constraints with Time-Varying Pricing: The initial focus in Australia on time-varying network pricing has not been sufficiently granular to address specific network constraints. While it helps represent the long-term costs better than flat-rate tariffs, it doesn't adequately incentivize customer behaviours that could relieve specific bottlenecks and defer the need for network upgrades. The lesson is that a more nuanced approach, such as dynamic network pricing, is required for effective network management. Emerging Success and Complexity of Dynamic Pricing: Dynamic pricing introduces additional layers of sophistication, utilizing real-time data and technology-enabled automation. This has shown promise in incentivizing behaviours that align with real-world network conditions, thereby making better use of available network capacity. However, the challenge lies in balancing the complexity introduced by dynamic pricing against the need for easy customer comprehension. Existing structures like NEM's five-minute increments offer a foundational understanding, but adapting these for DSO-specific, location-based conditions remains a lesson in progress. **Leveraging flexible CER for network support** • Importance of Business Model Dimensions in CER Network Support: The project identifies four key dimensions that are crucial for assessing the impact of various network support solutions: Activation mechanism, Payment type and recurrence, Firmness, and Pricing types. These dimensions influence the business model for the DSO, the customer agent, and the customer. Focusing on these dimensions rather than the solutions as a whole provides a more nuanced understanding, given the low maturity level of current offerings.

[22] Ausgrid, Project Edith Knowledge Share Report (July 2023) (published: Project-Edith-Knowledge-Sharing-Report-2.pdf (ausgrid.com.au))

	• Performance Metrics Highlight Value and Ease of Implementation: Four measures—Customers' ability to manage preferences, Adjustability, Simplicity, and Scale-up feasibility—were qualitatively assessed to gauge the impact of each dimension. These measures represent not just the value unlocked for all stakeholders but also how straightforward or complex the implementation is. Simplifying and scaling solutions are vital for future success, and these measures can act as effective indicators. • Assumption of Capability Build-up Benefits All Solutions: Ausgrid assumes that within the next 3-5 years, DSOs in Australia will develop capabilities to manage the variability introduced by Customer Energy Resources (CER), particularly in the context of Dynamic Operating Envelopes (DOEs). This capability build-up is expected to lower the costs and increase the benefits for more dynamic solutions, benefiting all participants in the network support ecosystem.
Demonstration 4: Project Converge ***Identified in DEIP DER Market Integration Trials Summary Report***	
Primary objectives and context	The Project Converge ACT Distributed Energy Resources aims to demonstrate new DER orchestration capabilities known as 'Shaped Operating Envelopes' (SOE) which will allow Distribution Network Service Providers (DNSPs) to improve network congestion management, minimise network expenditure and improve DER market bidding into energy and ancillary service markets.[23]
What were the data infrastructure setup and market structures in place?	In terms of network services, the project is exploring a 'real-time RIT-D' process that may more cost-effectively procure non-network solutions for smaller constraints than current processes. The project is also using DOEs to manage local network constraints. The project utilises a point-to-point data exchange approach.
What were the challenges and lessons learnt?	The project's initial report outlined the following insights shared by stakeholders (or intermediaries) working in the area of DER, in relation to the emerging application of DOEs, and possible opportunities for SOEs in Australia: • DOE Adoption in Australia: Dynamic Operating Envelopes (DOEs) are garnering considerable support as a viable approach and are projected to see wider adoption across Australia. However, experts advise that simpler solutions should be considered first where appropriate.

[23] ANU, Social science report 1: intermediary insights on dynamic and shaped operating envelopes Interim project insights (May 2023) (published: Social Science Report 1: Intermediary Insights on Dynamic and Shaped Operating Envelopes - Australian Renewable Energy Agency (ARENA))

	• Insights from South Australia Trials: Ongoing trials and the application of flexible exports in South Australia are gradually revealing more about the potentials and limitations of DOEs. • The Emergence of SOEs: System Operating Envelopes (SOEs) are relatively new and less understood. Intermediaries recognize the need for solutions in this space, emphasizing SOEs' potential to optimize capacity and include more stakeholders. However, the specifics of SOE solutions require further detailing for a proper evaluation. • Skillset for DOE and SOE Deployment: Both DOEs and SOEs require specialized expertise. Currently, those knowledgeable in this area form a relatively small group. As these technologies scale, the variety of roles, knowledge, and skills needed will expand significantly. Targeted support is deemed essential for fostering the growth of specialized intermediaries. • Consumer Impact and Awareness: Intermediaries involved in DOEs are conscious that their decisions significantly affect consumers. However, there's speculation that the technicalities of DOEs and SOEs might not be readily apparent to the average consumer. Future research aims to investigate consumer awareness and the impacts of these technologies on households.

Demonstration 5: Simply Energy Virtual Power Plant	
Primary objectives and context	This is an ARENA-funded project where a virtual power plant was integrated with a distributed energy market platform. This project ended in June 2023. The aim of the project was to host 1,200 home battery storage systems, which would deliver 6.5MW of flexible capacity to the South Australian grid. Although there was considerable innovation in the new technology applied to the project, one of the main knowledge sharing objectives was focused on how customers would respond, including how varying product offers or Government subsidies impacted uptake of VPP products. The initiative was based in Adelaide, South Australia.[24]
What were the data infrastructure setup and market structures in place?	The project led to the creation of an 8MW VPP, which was integrated with GreenSync's distributed energy exchange (deX) platform to test the capabilities of what a VPP can achieve. Through this combined VPP and energy exchange platform, "VPPx" demonstrated a technically capable, and potentially commercially viable solution. The deX platform was designed to showcase integration of DER into Australian electricity markets by making them visible and dispatchable. The integration with deX facilitated trade in the Wholesale Energy Market and the Frequency Control and Ancillary Services Market. This project also tested the practical roles of the distributed system operator, distributed market operator and aggregators.
What were the challenges and lessons learnt?	**Learnings on consumer behaviour:** • Price and Subsidies Drive Battery and VPP Adoption: The main factor influencing uptake of residential battery systems and VPP participation is price, including availability of a subsidy. Changes to the level of subsidy available led to spikes in demand. Covid-19 did not have any material impact on demand levels. • Effective Incentivization Through Tiered VPP Benefits: Applying different levels of VPP benefit payments, based on the size of the energy storage system's inverter and reflecting the benefit of the battery type to a VPPs trading activities, was an effective way to drive uptake in a preferred technology. **Learnings from Dispatch Testing:** • Technical Constraints Limit Dispatch Testing: While the majority of battery systems responded to the dispatch requests, the aggregated fleet was unable to provide its maximum available output due to technical constraints including export limitations,

[24] Additional information on the Simply Energy Virtual Power Plant (VPP) can be found here: https://arena.gov.au/projects/simply-energy-virtual-power-plant-vpp/

	excessive grid voltage and to a lesser extent, communication issues. • Accounting for seasonal variations: Tests were also undertaken on the seasonal variations in operating conditions to better understand these variations and how they impacted the operation of the ESS. Solar generation potential, electricity demand and usage behaviour significantly changed throughout the year, creating seasonal variation. **Overall findings:** • Community Ethos and Simplicity in Communication Valued by Customers: Customers saw the overall program as a community endeavour and were keen that this ethos is maintained. They were keen to know how their batteries were being used and contribute to the overall health of the grid. The project also found that it was effective when communications with the customers were shorter and less complex (such as the transition to a new BAU contract). • Complexity in AEMO VPP and FCAS Registration: Registering a battery onto the VPP fleet was highly manual, inefficient and prone to error – the process also involved multiple parties (the customer, the original equipment manufacturer, an energy retailer and a software vendor). This process continues to hamper the effectiveness of fleet management and market registration. The project noted that as the volume of VPP transfers in the market grows, there will be a requirement for more automated solutions to manage this process. • Inefficiency and Complexity in Fleet Registration: Registering the fleet via the AEMO VPP Demonstration program and updating the fleet details on the FCAS register was onerous. Process for registering the initial fleet was complex and time consuming. Additionally, the processes to update the fleet registrations, as an aggregators VPP customer base grows, or shrinks is also complex and time consuming. Simply Energy also recommends a new flat fee-based model whereby an annual fee is paid to AEMO that allows for a reasonable amount of updates to occur without AEMO incurring a substantial overhead. The fee should not deter smaller retailers from engaging in the process. There were also delays noted in terms of recognising when a customer moved to a different aggregator, which led to delays in FCAS revenues. • Need for Balanced MASS Updates: Updates to Market Ancillary Service Specification (MASS) must consider the risk that some providers of new technologies could find future MASS requirements either too stringent or drastically different to other similar, more prevalent international markets, whereby reducing participation and customer benefits.
Demonstration 6: Evolve DER Project	
Primary objectives and context	The evolve DER project, a research project led by Zeppelin Bend, aims to increase the network hosting capacity of DER by maximising their participation in energy, ancillary and network service markets, while ensuring the secure technical limits of the electricity networks are not breached. The project ended on the 31st of March 2023. The project sought to maximise customer investments in solar and batteries and in the future electric vehicles through increased visibility of areas with congestion and availability. The initiative is based in the Australian Capital Territory, New South Wales, and Queensland.[25]
What were the data infrastructure setup and market structures in place?	In the energy sector, a major concern is that there is no effective coordination of DER participation in both energy and network markets. This leads to DER causing contingency events or interruptions of network service to customers. In this context, there is a need for a distributed system operator. Although there are various potential DSO models available, the EVOLVE project focuses on a model where existing market mechanisms are augmented by capabilities that ensure the secure technical limits of the electricity networks are not breached - this is achieved through dynamic operating envelopes. The evolve Project demonstrates the operational mechanism by which DOEs can be calculated, published and utilised.

[25] Additional information on evolve DER project can be found on the ARENA website: evolve DER Project - Australian Renewable Energy Agency (ARENA)

	To calculate the envelopes for DER assets, the project used a range of data sources, including the current and forecast operating state of any connected asset (low voltage and medium voltage segments). Data requirements for the platform to perform its intended purpose: detailed information about the electricity network assets, historical and real time measure data for power and voltage, historical and forecast weather data, and energy data from individual consumers. The following structure was developed for the project: 1. For communications between the evolve Platform and the DER Aggregators – the IEEE 2030.5 protocol. 2. For Authentication of DNSP and Aggregator systems communicating with the evolve Platform – the OAuth2 protocol. 3. For the exchange of electrical network model and measurement data between existing DNSP systems and the evolve Platform – the IEC Common Information Model (CIM) set of standards.
What were the challenges and lessons learnt?	**Learning on DOE Benefits** • DOEs Improve Hosting Capacity and Facilitate DER Integration: The use of DOE's could potentially increase the hosting capacity of electricity distribution networks by managing solar generation (export) and EV charging, and V2G (both export and import), help enable DER market participation (both import and export) and assist with the maintenance of system security. It was found that using physical curtailment based on the hosting capacity value would reduce total generation export at the transformer by 15-20%. Both monthly and 30-minute dynamic operating envelopes result in greater energy export than fixed curtailment, whilst still ensuring that physical and operational network limits are not breached. • Clarity in Roles Essential for DOE Benefits: For DOE benefits to be realised, the DOEs must be set to DER assets, and the DER assets must respond. To achieve this, the roles, and responsibilities of DNSPs, aggregators and DER owners must be clear. • Data and Standards are Key for DER Management: More data about network assets and the behaviour of prosumers will be needed to support the development and ongoing operation of network and DER modelling and orchestration software systems. There is an opportunity for industry to adopt standards for network modelling and data sharing – this would ensure that data resources can be pooled to increase their value. **Learnings on Standardisation** • Aggregator Diversity Challenges Standard Adoption: The aggregators partnering in the evolve project represent a cross-section of the aggregator market, with different business models, hardware, software, and communications protocols. Although interoperability is a key consideration for the evolve project, a number of barriers to adoption of standards developed (including increased resourcing required to move from propriety approaches to adoption of standards and relative immaturity of the smart distributed energy resource market). Lack of Open-Source Components Hampers Standardisation: The project found that the lack of open-source components, as well as documentation and implementation guidance was a severe impediment to the development of standards-conformant communications mechanisms. The project is in the process of open-sourcing various components, including an IEEE 2030.5 utility server core. • Cybersecurity in High-DER Environments: There are challenges for cyber security assurance arising out of high DER penetration. Cyber security frameworks and standards provide strong foundations for any organisation seeking to protect their information assets and systems. However, these policies must be reasonable and adaptable to ensure that new developments can be accommodated.
Demonstration 7: Indra Monash Smart City	

Primary objectives and context	This initiative aims to demonstrate how smart and renewable technologies can be integrated at the Monash University Clayton embedded network to control the University's energy usage and assist the network during peak times. The project will enable control of DER, including a minimum of one MW of solar panels, 20 buildings, EV charging stations and one MWh of energy storage. The initiative is based in Clayton, Victoria and concluded in 2022.[26]
What were the data infrastructure setup and market structures in place?	The project involved the development of a grid-interactive microgrid, which maximises the utilisation of DER and loads in a coordinated way. The three framework layers are DER Integration, Active Grid Management and Smart Energy Management. The first layer requires integration of IoT devices with all DERs and the networking of the IoT devices together in a secure IoT network. The second layer involves introducing an Active Grid Management system, which draws on data to manage power quality. The third layer facilitates the participation of DERs in a distributed smart energy management system, where aggregation and orchestration of DER flexibility and forecasting is used to enact energy management strategies such as transactive energy markets. A new market was set up on the campus, with metering and monitoring technology that allows individual Monash departments to act as "customers". The market enabled customers to trade electricity and access revenue from market and ancillary services they provide to the broader electricity network.
What were the challenges and lessons learnt?	• DOE and Hosting Capacity: The use of DOE's could potentially increase the hosting capacity of electricity distribution networks by managing solar generation (export) and EV charging, and V2G (both export and import), help enable DER market participation (both import and export) and assist with the maintenance of system security. It was found that using physical curtailment based on the hosting capacity value would reduce total generation export at the transformer by 15-20%. Both monthly and 30-minute dynamic operating envelopes result in greater energy export than fixed curtailment, whilst still ensuring that physical and operational network limits are not breached. • Role Clarity for DOE Effectiveness: For DOE benefits to be realised, the DOEs must be set to DER assets, and the DER assets must respond. To achieve this, the roles, and responsibilities of DNSPs, aggregators and DER owners must be clear. • Data and Standards in Network Modelling: More data about network assets and the behaviour of prosumers will be needed to support the development and ongoing operation of network and DER modelling and orchestration software systems. There is an opportunity for industry to adopt standards for network modelling and data sharing – this would ensure that data resources can be pooled to increase their value. Aggregator Diversity and Standardisation: The aggregators partnering in the evolve project represent a cross-section of the aggregator market, with different business models, hardware, software, and communications protocols. Although interoperability is a key consideration for the evolve project, a number of barriers to adoption of standards developed (including increased resourcing required to move from propriety approaches to adoption of standards and relative immaturity of the smart distributed energy resource market). • Open-Source Components for Communication: The project found that the lack of open-source components, as well as documentation and implementation guidance was a severe impediment to the development of standards-conformant communications mechanisms. The project is in the process of open-sourcing various components, including an IEEE 2030.5 utility server core. • Cybersecurity Challenges in High-DER Scenarios: There are challenges for cyber security assurance arising out of high DER penetration. Cyber security frameworks and standards provide strong foundations for any organisation seeking to protect their information assets and systems. However, these policies must be reasonable and adaptable to ensure that new developments can be accommodated.

[26] Additional information on Indra Monash Smart City can be found here: Indra Monash Smart City - Australian Renewable Energy Agency (arena.gov.au)

Demonstration 8: Realising Electric Vehicle-to-Grid Services	
Primary objectives and context	The project, which is an Australian first, seeks to demonstrate how commercially available EVs and chargers can contribute to energy stability by transferring power back and forth into the grid. In this trial, EV owners will be remunerated for whenever their vehicles are plugged into the grid. The outputs from this project are expected to increase recognition and understanding of V2G services, and to increase confidence of all stakeholders involved. The initiative is based in Civic, Australian Capital Territory and is projected to end in March 2023.[27]
What were the data infrastructure setup and market structures in place?	The REVS project has two work streams: the development and demonstration workstream and the knowledge sharing workstream. The first involves the deployment of 51 V2G enabled vehicles in two fleets. This fleet of vehicles will provide high quality data on the vehicles' response to grid disturbances and on the financial viability of V2G services. The second work stream focuses on providing holistic insights into the economic, technical, and social implications of V2G services. The research considers the challenges and opportunities looking forward.
What were the challenges and lessons learnt?	Lessons learnt from certification/performance of charger against AS4777.2.2022: There was an initial assumption that certification against AS4777 would be easy. Although the charger had been certified against overseas standards, which were thought to be similar to Australian standards, there was difficulty in achieving compliance. Hardware and software updates were required by the vendor. One of the key difficulties faced was that the definition of bidirectional chargers within AS4777 presumed that the connected battery provides an earthing point. However, EVs do not provide any electrical routes to earth. Based on the experience, it was noted that AS4777 should be extended to include a dedicated classification and test procedure for bidirectional chargers. **Findings from Modelling V2G report** • The length of time vehicles are plugged into chargers is a critical determinant of V2G value. If plug-in times are sufficiently high, this would lead to the cost of adding EVs to a site negative. There is a differing value proposition for households and offices, potentially due to the longer times EVs are connected at offices. • FCAS revenue is the dominant component of the V2G value stack, accounting for two-thirds of the total value. However, this value could decrease as more flexible assets are connected to the market (batteries and demand response). • As a baseline, the scenarios in the study allowed the full capacity of vehicle batteries to be available for V2G uses, as long as there was sufficient energy available to meet known trips. However, given that EV drivers will likely expect charge for unexpected trips as well, the study considered the impact of more conservative uses of V2G. Notably, it was found that conservatively operating vehicle batteries still allows for significant value from V2G. • The project has found that the ability to operate V2G in pursuit of various objectives creates the potential for different values to be placed in tension with each other. For example, the pursuit of reducing costs may increase emissions and reduce driving range, whilst conserving energy for driving reduces V2G's ability to respond to price signals or emissions profiles. Therefore, choices will have to be made on the objectives of the V2G, and this will inherently influence its value. • Flexible resources need to be managed carefully as their penetration increases. V2G can impact the distribution network through peak loads or minimum demand caused by coincident price (or other) events. This can lead to rapid changes in demand, and therefore, grid instability. • Demand pricing is an effective tool for moderating demand. • V2G is not currently economic. Whilst it may soon become economic in situations where vehicles are plugged in for extended periods, in most cases charger prices still need to be dropped.

[27] Information on the V2G project can be found on the ARENA website: Realising Electric Vehicle-to-Grid Services - Australian Renewable Energy Agency (ARENA)

	Future work required • Future work needs to develop a way to navigate the tension between the way EV owners and the energy system may want V2G to operate. • Whilst flexibility is key to the future energy system, there are risks. Future work should look at how multiple, overlaid signals can be managed in a way that reduces the likelihood of unwanted coincident behaviour • This study assumed perfect foresight of price and driving needs. Future work should understand the impact of less accurate forecasts.

Each of these demonstrations also required data to be exchanged between parties. For some, testing the data exchange approach was an explicit aim. Regardless, there are lessons to be learnt from the data exchange approach utilised, both across actor-to-actor interactions and interoperability for the CER devices. The following table highlights some of those considerations for the four projects identified in ARENA's DEIP DER Integration Trials Summary Report. These learnings are a useful starting point for considerations towards an enduring data architecture.

Table 8: Industry CER Demonstrations and Data Architecture

			Considerations			
Data exchange "parties"	**Data exchange approach**	**Project/s testing model**	**Visibility of data**	**Ease and cost of implementation**	**Scalability**	**Cyber-informed engineering**
Actor-to-actor	Data-hub	Project EDGE Project Symphony	Data shared through a centralised or de-centralised hub allows access to that visibility by the market or the system or network operator and/or related participants without a separate transaction.	Implementation cost incurred once for "host" party and once for each party to onboard. Can start simply (e.g. limit types of transactions) and then expand incrementally.	Able to be scaled to additional participants (networks and aggregators or traders).	Cyber-informed engineering principles to be built-in from design to implementation.
Actor-to-actor	Point-to-point	Project Edith Project Converge	Data only visible between the parties sharing directly.	Simpler to implement for a bespoke or unique transaction. Implementation cost (including establishing relationships) born for each point-to-point exchange path between individual actors.	Potential pathway for industry to mature new use cases over time, considering international experiences with scale. In response to nearly 10 years of organic DER flexibility market development, the UK are investigating a 'digital spine' to provide common digital energy infrastructure for best enabling DER value by overcoming current challenges of	Cyber-informed engineering principles to be built-in from design to implementation.

					high transaction costs, barriers to market entry, limited value of individual services, limited access to information, and a lack of coordination. [28]	
Actor-to-device	CSIP-Aus	Varying amounts of consideration have been given to CSIP-Aus for Dynamic Operating Envelopes and one of many potential device communications protocol.	Consideration to be given to how the utility server interacts with the data exchange platform for the actor-to-actor, and opportunities to leverage common infrastructure or at least ensure there are no conflicts between instructions.	CSIP-Aus as a common protocol allows for interaction with some devices from different actors, based on requirements and established roles and responsibilities. None of the four integration trials have assessed requirements for full behind the meter DER interoperability (actor-to-device) which spans three interrelated and standardised elements: 1. Physical performance specifications 2. Communication protocol and protocol mapping 3. Information model and model mapping Consideration too to be given to appropriate registration and de-registration processes to ensure the actor-to-device data exchange and control approach allows for customer switching.		
Actor-to-device	Framework surrounding data exchange	Varying amounts of consideration have been given to the requirements for independent physical monitoring of the equipment to ensure compliance.	Independent conformance monitoring is required to provide visibility via an independent, verifiable, pathway.	Further consideration required for appropriate framework and infrastructure surrounding the data exchange approach.		End-to-end consideration of the cyber posture for independent monitoring, detect, and ability to isolate potentially compromised

[28] Ofgem has outlined their initial considerations paper on delivering a common digital energy infrastructure, covering institutional roles and financing approaches for consultation. The report can be found here: Call for Input: The Future of Distributed Flexibility | Ofgem

					equipment.
Consumer access to data	N/A	All four integration trials involved customers signing up to be part of the trial.	Project EDGE found that in addition to information about cost reduction and use of their devices, consumers wanted information regarding: • Data protection • Security Visibility of their participation activities	Up to how aggregators or traders engage with customers. Consumers may also be able to access independent data feeds depending on the framework surrounding the data exchange.	Consideration of appropriate cyber secure standards to facilitate consumer access.

4.3.2 Jurisdictional Programs

Background

The ESB has recognised that the Australian Government and jurisdictional governments have a significant body of programs on foot regarding CER and DER. A number of these programs have been summarised by the ESB, to provide a point-in-time snapshot (30 August 2023) which shows the breadth and divergence of programs across governments on CER . The list is not intended to be exhaustive rather highlight the drivers of reform as well as the linkages with ESB reform programs.

As the CER integration program is taken forward by governments and by market bodies , it will be important for ongoing cooperation and collaboration to ensure CER integration challengs are met.

Table 9: Jurisdictional Programs

Commonwealth			
Program	**Primary objectives**	**Status update and next steps**	**Key links with the ESB reform program**

Community Batteries Funding Incentive	This program, led by ARENA, aims to accelerate the deployment of community batteries to lower energy bills, cut emissions, reduce pressure on the electricity grid and enable further distributed solar installations.	Round 1 of funding opened for applications in April 2023, with a funding pool of $120 million. This program is ongoing.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies. However, there is scope for ongoing standards to ensure positive consumer outcomes continue beyond initial implementation.
Driving the Nation Program Incentive	This program, led by ARENA, aims to accelerate the uptake of zero-emission vehicles by overcoming barriers and optimising integration of charging infrastructure with the energy grid.	This program commenced in 2022 and is ongoing. The initial round of funding delivered $127.9 million towards accelerating EV uptake amongst business fleets (both light and heavy vehicle fleets). The current round of funding opened in April 2023 and is focused on supporting innovation in public charging infrastructure.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies. There is a clear linkage between this program and the ESB's 'policy advice for application of tech standards for EV's' and EVSE visibility programs.
Supporting demand flexibility in the energy transition Policy	Energy Consumers Australia (ECA) commissioned research on the significant role of demand flexibility in the energy transition and how it can be unlocked moving forward to lower energy costs and improve affordability.	The study, highlighted that although there are currently several policies and programs focused on energy efficiency and demand response in place in state and Commonwealth jurisdictions in Australia, these are disjointed and not well co-ordinated.	Integrating price-responsive resources is looking at potential mechanisms that could leverage demand flexibility through the role aggregators in participation in central energy markets.
Regional Australia Microgrid Pilots Program Incentive	This program, led by ARENA, aims to build on the Regional and Remote Communities Reliability Fund by piloting the use of microgrid technologies in remote areas.	This program commenced in 2021 with first round of $30 million in funding available in 2022. A further $20 million is available for applicants in 2023. Funding is available over 6 years (until 2027) or until funds are exhausted.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies. However, there is scope for ongoing standards to ensure positive consumer outcomes continue beyond initial implementation.
National Energy Performance Strategy Policy	Department of Climate Change, Energy, the Environment and Water (DCCEEW) is developing a national plan to accelerate demand-side action, including energy efficiency and electrification.	On 10 November 2022, DCCEEW released the NEPS Consultation paper. 135 public submissions were received by the 3rd of February 2023. This feedback will be considered and incorporated in the final strategy (mid-2023). The program is ongoing.	There are no direct links to the ESB programs. However, in developing and delivering the NEPS, consideration of the roles and arrangements of different entities will be considered, including government agencies, market bodies, and consumer groups.

Valuing Load Flexibility in the NEM Policy – research	ARENA engaged NERA Economic Consulting and Energy Synapse to complete a study into the potential value of load flexibility in the NEM over the next 20 years. The study explores how increased demand-side participation across major sectors of the Australian economy can contribute to the energy transition.	The study was completed in 2022 and published on the ARENA website.	This program will inform market participation frameworks that seek to improve ways in which demand side can participate directly through two-sided markets - ie. Unlocking CER benefits through flexible trading and integrating price-responsive resources into the NEM.
New South Wales (NSW)			
Electric Vehicle Strategy Cross-sectoral incentive	The NSW Electric Vehicle Strategy set a target of 52% of new private vehicle sales and 100% of all operational State buses as electric or zero emissions vehicles to help NSW achieve net-zero emissions by 2050. Some of the initiatives include rebates, a stamp duty exemption and $171 million committed for investments in infrastructure over four years.	This program commenced in 2021. As at 31 December 2021, 11,260 stamp duty exemptions were granted, and 4,125 out of the 25,000 rebates of $3,000 available were paid for eligible EV purchases. From 1 July 2027 or when EVs make up 30% of new car sales, plug-in hybrids will pay no stamp duty. This program is ongoing.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies. However, there are future opportunities to use government programs to help drive compliance with standards. The ESBs programs' policy advice for application of tech standards – EVs' and 'EVSE Visibility' are enabled to support the growth in EVs and ensure consumer outcomes are achieved.
Solar for Low-Income Households Policy, incentive	This program offers low-income homeowners free 3kW solar systems, potentially saving customers up to $600 a year in electricity bills.	This program is ongoing.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies. However, there are future opportunities to use government programs to help drive compliance with standards. The program's 'Review of consumer protections for future energy services' considers how the customer protections regime supports consumers with CER, including vulnerable consumers. The flexible Trading arrangements work also considers how consumers can get value from the orchestration of their CER – this can include PV with flexible load.
Queensland (QLD)			

Enabling Dynamic Customer Connections for DER Industry development	Energex and Ergon Energy led a stakeholder engagement process to facilitate a collaborative and industry- wide approach in shaping and delivering the pathway for DER connections in Queensland. Dynamic customer connections effectively future-proof the network and allow customers to access new market opportunities such as energy trading or VPPs.	Consultation occurred throughout 2020 and 2021, culminating in updated standards for AS/NZS 4777.2:2020. Energex and Ergon Energy did not immediately offer connections under these new standards but released them as a first step to enable industry to design and prepare compliant solutions and offerings. This program concluded in 2021.	This an implementation of policies consistent with the Flexible Export Limits workstream. It also has linkages with interoperability.
Queensland Energy and Jobs Plan (QEJP) Policy	The Queensland Government committed to a 70% renewable energy target by 2032 (80% by 2035) and outlines the pathway to achieve those targets through investments in transmission infrastructure, large duration storage and transformation of the coal assets. The QEJP outlines a range of policies to support CER, including public ownership of energy assets and smarter grids to support over 11GW of rooftop solar and 6GW of household batteries.	This program commenced in 2022. A smart connections framework is under development and the implementation of the other initiatives are ongoing.	The QEJP sets out policies to support CER uptake and orchestration consistent with the AEMO Step Change scenario. The ESB's program of enabling policies including interoperability aligns with this objective and supports the achievement of orchestration consistent with the Step Change.
South Australia (SA)			
Dynamic Export Limits Requirement Policy-lever	Dynamic export limits aim to offer a more sophisticated response than emergency backstop mechanisms in maintaining grid stability. This is because systems and network operators can automatically communicate and adjust limits to match network capacity, which can avoid the need for remote switch- offs. The Clean Energy Council lists the accredited exporting systems compliant with the new requirements.	This program commenced in 2023 and is ongoing. New technical standards for dynamic export limits will be effective in South Australia from 1 July 2023, requiring that prescribed electricity generating plants must be capable of remotely updating and enacting dynamic export limits. This follows an earlier standard that came into effect in 2020 requiring inverters to be capable of remote communications (as part of SA's Smarter Homes reforms).	South Australia is pioneering the enforcement of new flexible export limits. SA Power Networks is undertaking a Flexible Exports trial on overloaded parts of the network. This provides new and upgrading solar customers with a choice of either a fixed export limit (1.5kW per phase) or a flexible export limit (1.5kW up to 10kW per phase). This is aligned with and will inform, the AER's Flexible Exports Limits work. Flexible Exports are also supported by

			interoperability requirements.
Energy Advisory Service Policy, consumer information	This service provides free advice on how consumers can better understand bills, meters and running costs, as well as new opportunities such as battery storage.	This program is ongoing.	This supports consumer choice by improving consumer understanding of the benefits and risks of adopting CER technologies as well as by enabling greater market choices. Jurisdictions are better placed to take an active role in this compared to market bodies.
Tasmania (TAS)			
Advanced Meters Policy, lever	The Tasmanian Government (through Aurora Energy and meter provider TasMetering) are rolling out free advanced meters across the state. This aims to increase data reliability, remove the need for physical meter reads and enable users to have more visibility and control over their energy use.	This program, commencing in 2017, supports the Tasmanian Government's commitment to installing advanced meters for all Tasmanians by 2026.	Work by the market bodies (including cyber security standards for CER devices) supplements the oversight of physical infrastructure rollouts (e.g. advanced meters) happening at a more local level. This initiative is consistent with the findings of AEMC's Metering Review.
ChargeSmart Grants Policy, sectoral conveyance	The Tasmanian Government aims to improve charging infrastructure in strategic and publicly accessible locations to incentivise EV uptake.	The first round of this grants program (delivered in 2018) financially supported 14 fast chargers and 23 destination and workplace chargers across Tasmania. The second round (in 2021) provided funding to 20 fast chargers and 23 destination chargers. This program is ongoing.	Jurisdictions play a key role in targeting investments in priority areas, which they are better positioned to do, relative to market bodies. In particular, the policy advice of technical standards – EV's and EVSE data' workstreams consider EV charging infrastructure effectively into the grid.
Community Microgrids Policy, equity incentive	Microgrids are small power networks that can run independently of the main energy grid. They aim to ensure remote areas have access to more reliable electricity by leveraging renewable energy and effective storage.	This program commenced in 2018 and is ongoing. The Tasmanian Government supported a local not-for-profit community group to establish Tasmania's first community microgrid. This was able to improve energy security amongst a remote social housing development in Nubeena.	Jurisdictions play a key role in targeting investments in priority areas, which they are better positioned to do relative to market bodies.

Energy Saver Loan and Subsidy Program Policy, equity incentive	This program provides interest-free loans to eligible applicants to fund the purchase and installation of energy- efficient products including solar panel systems and household battery storage. It is run in conjunction with No Interest Loans Tasmania, which provides a subsidy of up to 50 per cent towards the cost of purchasing energy-efficient appliances.	The Tasmanian Government have committed an additional $1 million to the subsidy program for Health Care Card holders in 2023-24 (as outlined in the Tasmanian Renewable Energy Action Plan). This program is ongoing.	This program provides vulnerable consumers with opportunities to adopt new CER technologies they may not otherwise afford. It reflects similar interest-free loan schemes in the other NEM jurisdictions. This aligns with the ESB reform program via building of efficient and effective CER and increased uptake.
EV uptake initiatives Policy, incentive	The Tasmanian Government recognises that the transport sector is a major contributor to Tasmania's greenhouse gas emissions and aims to incentivise EV uptake.	The incentives include commitments to a stamp duty exemption for all new or second-hand battery electric or hydrogen fuel cell vehicles. This program is ongoing.	Incentive programs tend to occur at a jurisdictional level and are not the domain of the ESB or market bodies.
Victoria (VIC)			
Community Power Hubs Policy	This program involves dedicated local hubs to advise their communities on clean energy solutions across regional Victoria.	As of September 2022, the hubs had completed 42 community projects and were successful in obtaining funding for solar energy system installation at a further 16 sites. This program is ongoing.	The ESB's program of work will support consumers get value from their CER. Further, reforms integrated by ESB will boost consumer confidence with participation in CER and community initiatives.
Harnessing Victoria's Distributed Energy Resources Policy	This strategy aims to accelerate the shift to DER to enable households and businesses to save money and exercise greater control over their energy.	This program commenced in 2022 and is ongoing. Its key objectives are helping householders access the benefits of DER and future-proofing customer protections for our transforming energy system.	There are parallels between the issues under consideration in this policy, and the body of work being considered by the AER in the *Review of consumer protections for future energy services*.
Neighbourhood battery initiative Policy, incentive	This initiative seeks to encourage community batteries by providing funding for pilots, trials and demonstrations of neighbourhood-scale battery ownership and operational models. Amongst other outcomes, the initiative aims to support the understanding of the full range of benefits that batteries can provide and inform regulatory reform.	This program commenced in 2021 and is ongoing. It aims to support the introduction of different neighbourhood battery models from feasibility to implementation stage. Previously funded initiatives include feasibility studies and business cases for battery trials.	The ESB's program of work will support consumers get value from their CER. Further, reforms integrated by ESB will boost consumer confidence with participation in CER and community initiatives.

Protecting consumers of distributed energy resources Policy	The Department of Energy, Environment and Climate Action (DEECA) released a consultation paper inviting the public to share their views about whether further consumer protections are required along the road to a decarbonised grid.	This program commenced in 2022, with DEECA publishing a report in May 2023 summarising the 55 submissions that responded to its consultation paper. DEECA is scheduled to update stakeholders about potential consumer protection reforms by December 2023.	This program has parallels with the AER's *Review of consumer protections for future energy services*.
Solar Homes Program Policy, incentive	This program, delivered by Solar Victoria, offers rebates of up to $1,400 for installing approved solar panel systems in homes. It also enables eligible Victorians to access interest-free loans equivalent to the rebate amounts (to be repaid over four years or in a lump sum). This program offers rebates of up to $2,950 for eligible households to install approved solar batteries.	This program is ongoing.	The ESB's program of work will support consumers get value from their CER, specifically solar PV. Further, reforms integrated by ESB will uptake of solar and accessibility for all consumers including those that are most vulnerable. This program also highlights the importance of the backstop mechanism in managing the network impacts as a result of increase solar generation and exports.
Victorian Energy Compare Policy, incentive	This website helps consumers determine how to identify the best value CER and pricing plan combinations based on their individual household circumstances. It features a Solar Calculator that allows consumers to estimate annual savings and payback periods.	This program is ongoing.	This program supports consumers by educating them on the benefits and risks of adopting CER technologies and enabling informed consumers by choice. The ESB's Bill Transparency work program considers policy maker actions and insight on what consumer pay in respect of CER.
Gas Substitution Roadmap Policy	The roadmap describes regulatory and policy reform to decarbonise the gas sector in Victoria with the combination of energy efficiency, electrification and increased use of sustainable gas alternatives such as hydrogen and biogas. There are several initiatives under the pathway to promote consumer choice and a shift to electrification, including expanding the VEU scheme to new incentives.	The roadmap commenced in 2022 and is ongoing.	Household and business transition to electrification impact CER uptake. The ESB reform supports the whole-of- system transition.

Voltage management in the distribution networks -Consultation paper Policy	The consultation aimed to inform long- term government strategy, policy and regulatory decisions to support effective voltage management in the distribution system and support integrate high levels of CER. Feedback was sought on how to best manage the challenges imposed by the penetration of CER without limiting the output and use of those devices.	Consultation occurred from 25 May 2022 to 1 August 2022, followed by a policy analysis stage until December 2022. A report is expected to be released in 2023.	The consultation was seeking solutions to manage voltages through combinations of technical, regulatory and incentive-based measures, which is in line with the ESB objectives for managing the network's security in as cost-effective way while accommodating more CER. The findings of this program will support the 'over voltage impacts' program in the Data Strategy.

Contact details:
Energy Security Board
Level 15, 60 Castlereagh St
Sydney NSW 2000
E: info@esb.org.au