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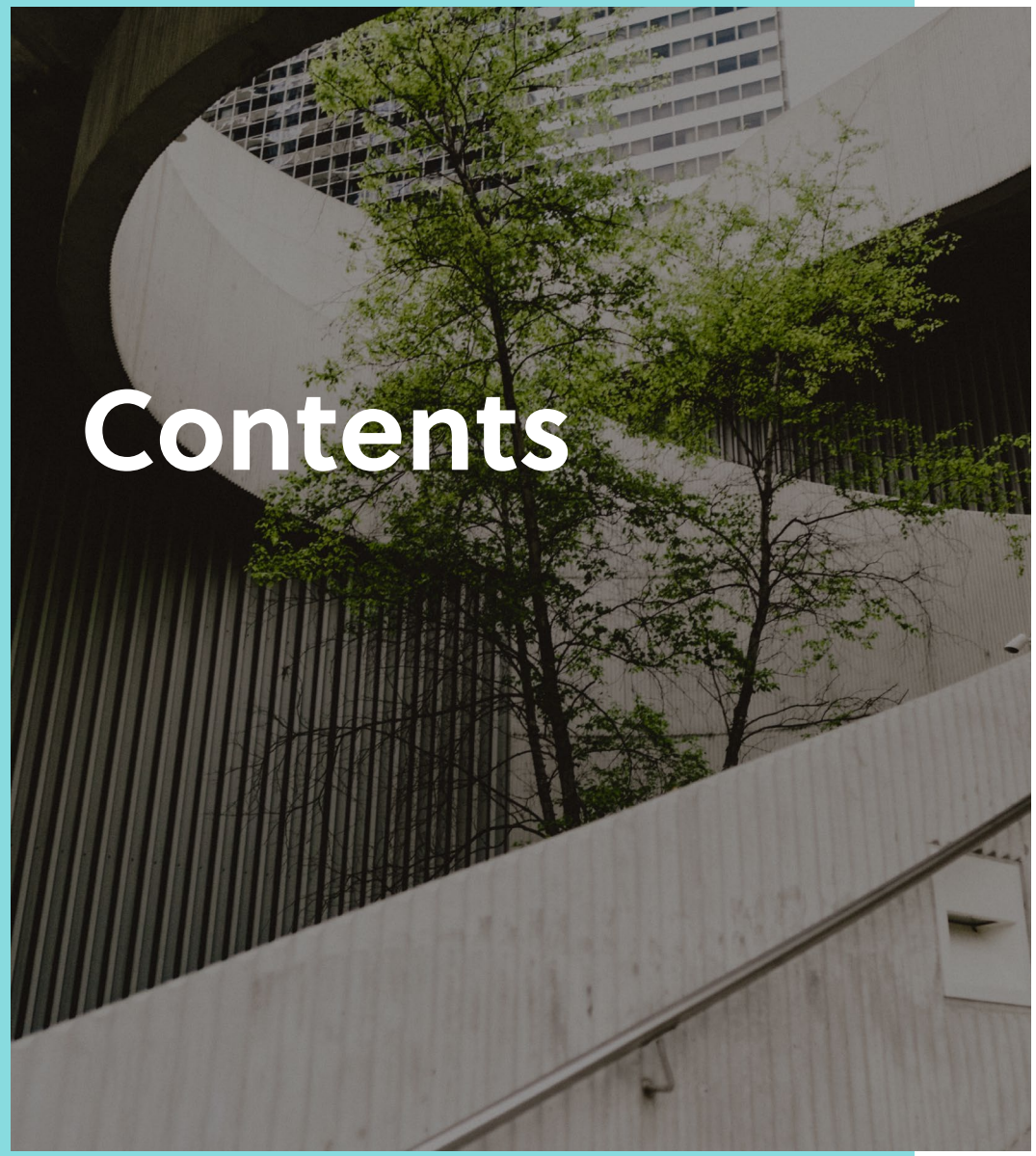
Opportunities for CER participation in wholesale markets and grid services – Final Report

Energy Consumers Australia
June 2025



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1. Executive summary

Increased participation of CER in wholesale markets and grid services has the potential for both system and consumer benefits

The potential benefits of greater integration of CER are significant and, with the correct market and regulatory settings, could flow through to consumers through lower system costs and lower electricity prices

- Effective Consumer Energy Resources (CER) integration and increased demand flexibility will improve the utilisation of existing generation capacity, reduce lost value from curtailment of existing utility-scale and residential solar installations and mitigate increasing transmission costs.
  - Modelling commissioned by ARENA finds a net benefit from increased CER and greater demand flexibility, with reduced generation and storage costs of up to ~ $18b.[1]
  - Greater amounts of CER and demand flexibility can also provide network benefits, including peak demand reduction, minimum demand (shifting consumption into low demand periods), and increased hosting capacity. Some sources estimate savings in network costs of > ~$10b through reduced capital investment, reducing the costs passed through to consumers. [2]
- The behind-the-meter (BTM) CER ecosystem is rapidly evolving, with new technologies creating greater opportunity for all consumers to harness benefits.
  - Consumers with CER will benefit through cost savings through increased CER participation, potentially including reward mechanisms for energy export.
  - Energy security will be improved through enhanced grid stability and more flexible energy use.
  - Increased participation by more households in CER technologies can also provide social benefits, improving social licence and reducing cross-subsidies that may be borne by vulnerable consumers.

Notes: [1] As per NERA Economic Consulting modelling commissioned by ARENA in 2022; [2] As per the UTS Institute for Sustainable Futures report prepared for ARENA, which utilised Baringa Partners modelling prepared in 2021

Priority areas

- This report identifies three key priorities to enable increased CER participation in wholesale markets and provision of grid services within the NEM, supported by three key recommendations.
- Further to these recommendations, the report identifies five general enabling actions that must be accelerated through the CER Roadmap and/or NEM Wholesale Review to support these key recommendations, along with broader NEM design considerations.
- Our findings, informed by stakeholder interviews and international research, highlight the need for these recommendations and enabling actions to be implemented in a coordinated manner to unlock the full potential of CER participation.

There are three key priorities to enable increased CER participation in wholesale markets and provision of grid services within the NEM

Maximising the value CER brings to the system unlocks the greatest benefits for all consumers – both for those with and without the capacity to invest in a more active relationship between their energy resources and the broader energy system

1. CER Coordinating Body

Assign formal responsibility for overall coordination and direction of CER to a dedicated and enduring national body.

2. CER Vision and Targets

Set a clear vision and targets for CER participation for incorporation into NEM planning documents.

3. Targeted NEM Reform

Lower barriers for CER participation in the NEM through focused reform to existing NEM processes.

Supported by enabling actions and broader NEM design considerations

There is a need for a clear delineation of roles and responsibilities across the CER value chain, with enduring national oversight

RECOMMENDATION 1: Assign formal responsibility for overall coordination of CER to a dedicated and enduring national body.

CER offers the potential for a lower cost energy transition – achieving that potential requires an enduring national body to coordinate CER's role in the NEM.

Specific actions to assign roles and responsibilities:

1. An independent national body with sufficient power and authority should be responsible for the coordination of the CER ecosystem, including (but not limited to):
    i. setting an enduring vision for the role of CER in the NEM and developing a strategy to achieve that vision
    ii. setting clear short and long-term targets for CER adoption and coordination
    iii. monitoring and reporting on the delivery of the CER Roadmap and annual achievement of targets for CER adoption and coordination, identifying actions to address shortfalls
    iv. development of fit-for-purpose policy and rule change requests, including the recommended reforms to existing NEM processes (identified in this report) to lower barriers for CER participation
    v. sponsoring and coordinating industry trials (both policy and market-led) to inform further system redesign aimed at optimising customer, network and whole-of-grid value (as identified in this report).

A clear vision for CER participation must be established through setting CER targets to inform NEM planning

RECOMMENDATION 2: Set a clear vision for CER and targets for CER participation in the NEM.

The establishment of a formalised annual planning and target setting process for CER will help to establish CER as a mainstream pillar of the energy ecosystem and will allow for a clear vision for the future of CER participation in the NEM.

Specific actions to establish targets:

1. The enduring national body is to be responsible for the establishment and ongoing operation of an annual planning process that sets specific targets for CER participation over different planning horizons.
2. These targets should be accompanied by an action plan with short, medium and long-term goals for CER participation with executive accountability.
3. The national body is to establish the framework and parameters for the development of CER-specific forecasts for incorporation into AEMO and other system planning documents.

CER participation can be encouraged by lowering wholesale market barriers through targeted reforms to the existing NEM

RECOMMENDATION 3: Implement targeted reforms to existing NEM processes to lower barriers for CER participation.

Facilitating participation in the wholesale market can lead to beneficial market and system outcomes, and will provide increased revenue potential for CER owners through access to markets. Higher participation may lower costs for all customers.

Specific actions to encourage greater CER participation:

1. Lower participation thresholds for CER from their current level of 1MW to 100kW[1], in line with international markets. For example:
    i. PJM allows small scale resources (minimum 100kW) to aggregate and participate in wholesale markets, and CAISO enables aggregations as small as 0.5 MW.
    ii. NEBEF allows consumers with a minimum demand response capacity of 100kW to participate directly as a 'demand response aggregator'
2. Enable multi-node aggregation for CER, with geographical restrictions limited to those critical for management of power system security, as applies for Wholesale Demand Response.
3. Modernise metering and telemetry rules and standards to account for both supply and demand-side market integration, reflecting the characteristics of CER to the extent practicable while ensuring power system security and the integrity of markets.
4. Enhance the dispatch methodology in the NEM as required to achieve optimised system and resource allocation outcomes that incorporate CER, factoring in dynamic operating envelopes, VPP status and the provision of local network support. Opportunities for investigation based on international markets include, for example:
    i. NEBEF has introduced more flexible dispatch protocols and longer dispatch lead times for CER.
    ii. The UK (through the Open Networks Project) has established clear rules for dispatch prioritisation.

Notes: [1] Changes to participation and bidding thresholds for other technology types could also be considered.

Enabling actions must be accelerated through the CER Roadmap and/or NEM Wholesale Review to support these recommendations

Enabling Action 1: Accelerate technical standards	Enabling Action 2: Formalise the DSO role	Enabling Action 3: CER-specific consumer empowerment	Enabling Action 4: CER-specific consumer protections	Enabling Action 5: Pricing reform
Harmonised standards with central coordination will ensure faster and more cost-effective technical solutions to CER implementation and allow smoother CER integration in markets.	A formalised and consistent DSO role across the NEM, with clearly defined DSO responsibilities, will support retailers and aggregators to facilitate increased participation in existing markets, and enhance the potential for new markets (e.g., flexibility markets).	Fit-for-purpose consumer empowerment and protections will improve social licence through a more engaged customer base that understands its role in the new energy future, and seeks to benefit through participation in energy markets.		Pricing reform, to improve cost-reflectivity of tariffs for those customers and loads with the capacity to respond, has the capacity to increase CER participation through improved investment signals, and can help to socialise the benefits from CER participation through lower network costs.
Key considerations: • Standardisation should be sought between different DNSPs in the NEM, across Australia (including WA), as well as with international standards. • Cyber security is viewed by many stakeholders as the most critical area for standards development and should be fast-tracked.	Key considerations: • The DSO role must be defined, encompassing the management and coordination of CER, with consideration given to potential integration of responsibilities into the DNSP function, and/or establishment of a new Distribution Network Operator role. • In line with this shift, network regulation needs to evolve to promote innovation, recognise the various roles CER can play and reflect the new/modified roles of actors across the ecosystem.	Key considerations: • The CER Coordinating Body should have responsibility for the development of best-practice consumer empowerment campaigns and materials for CER, and oversight of consumer empowerment activities. This is to ensure activities are tailored, trusted and publicised, and that consumers have a one-stop-shop to access relevant information and guidance.	Key considerations: • Consumer protection frameworks should evolve, with the flexibility to account for the broader range of energy services available to consumers. • The CER Coordinating Body should have an overarching market obligation (such as a duty of care) which ensures consumers that purchase and operate CER are confident they will be protected from harm.	Key considerations: • The lid should be lifted on the NERL to recognise the changing nature of energy markets to a dynamic two-way flow of energy and revenue. • Consideration should be given to new dynamic pricing models, with greater coordination between distribution and retail tariffs, while maintaining simplicity for those who desire it. • Network revenue determinations should be made fit-for-purpose and reflect the role CER can play in avoiding capital expenditure.

Broader NEM redesign must account for the contribution of CER, at both the local grid level and the power system as a whole

The role and contribution of CER must be also promoted through broader NEM redesign

Controllable and predictable CER at scale will lead to deferred investment in local and utility-scale network, generation and storage assets by avoiding and/or alleviating network constraints at the source, reducing costs for consumers. CER will also be accounted for in any major overhaul to NEM design or new market mechanisms.

Specific actions to maximise market efficiency through CER participation:

1. Examine new models for CER participation, including through CER trials (e.g., regulatory sandboxing or ARENA funding programs depending on whether policy or market-led), to advance the efficient provision of an optimal level of CER, including consideration of:
    i. a good, better, best approach to device optimisation for all customers, to support bill relief, and maximise network /wholesale market value
    ii. the potential for local flexibility markets that allow for both supply and demand-side participation and are co-optimised with the wholesale market, such as those developed in the UK
    iii. the balance of incentives for Distribution Network Service Providers (DNSPs) between traditional Capex and Opex models for network determination to minimise disincentives to the use of non-network solutions
    iv. fit-for-purpose ringfencing and asset sharing rules and guidelines to avoid locking out efficient solutions that minimise costs for consumers

Research conducted

- The findings and recommendations in this report have been informed by research into mechanisms to support greater participation of CER and demand response in 5 different jurisdictions, identifying design features with relevance to the NEM and lessons learned through implementation and operation.
- Supplementing this desktop research, stakeholder interviews provided the perspectives of parties playing differing roles in the developing CER ecosystem, drawing out existing limitations and opportunities for improvement.
- Stakeholders interviewed for this report include market bodies, DNSPs, specialist CER/demand response aggregators, peak industry bodies and independent experts.

Significant opportunity exists for CER participation in the NEM, with the national CER Working Group driving national reforms

CER opportunity and integration initiatives in the NEM

Status of CER integration initiatives in the NEM	AEMO's Integrated System Plan projects that coordinated CER will play a significant role in the NEM, providing up to 37GW of capacity by 2050, supporting grid reliability, improving system resilience and reducing overall costs for consumers. The **National CER Roadmap**, agreed to by Energy Ministers, contains a range of initiatives planned for the NEM to facilitate the integration of CER. The Roadmap is organised into four workstreams – Consumers, Technology, Markets and Power System Operations – and sets out a range of priorities to address barriers and harness the full potential of CER. The program of work underpinning the Roadmap is being led by the Consumer Energy Resources Working Group and Taskforce, comprising state and territory government officials. The workstreams outlined in the CER Roadmap are being led by various organisations, including AEMO, AEMC, AER and state/national bodies.
NEM overview - CER participation and barriers in the NEM	Our market research, supported by insights from key energy industry experts, has identified several significant barriers affecting CER participation within the NEM: • **Insufficient economic incentives (i.e., rewarding economic value)**, including high upfront costs, limited financial returns and restricted access to the full CER value chain, discourage investment in CER technologies and participation in programs such as demand response. • **The complexity of systems and services** creates challenges for consumers, particularly small customers, navigating technologies, regulations and markets. • **A lack of confidence and trust in the market**, alongside a growing consumer preference for investing in CER to achieve self-sufficiency and disengage from traditional energy markets, further constrains active market participation, driven by scepticism about CER benefits and distrust of energy providers. • **Limited consumer empowerment** reduces awareness of CER opportunities, while delays in regulatory reform hinder effective market integration. • **Misalignment and lack of coordination between wholesale and distribution-level markets** restrict CER's ability to provide grid services efficiently. • **Participation thresholds** exclude small-scale CER owners from accessing wholesale or ancillary service markets. Addressing these barriers is essential to unlocking the coordinated CER services needed to support the dynamic future state of the NEM.

Notes: [1] For the purposes of this report we have used 2024 AEMO's Step Change scenario for CER forecasts in the NEM as it was voted the most likely by stakeholders.

Our analysis from a jurisdictional scan of five markets identified useful insights for addressing barriers to CER participation

Key findings from jurisdictional review – Overview

Overview

In this phase, we conducted a jurisdictional scan and desktop research to inform and target stakeholder engagement.

This included analysing market settings affecting CER participation in the NEM, reviewing five jurisdictions for demand-side participation models and reported benefits of CER participation, exploring consumer access to wholesale markets and understanding mechanisms for load management and capacity investment.

Our research examined several market mechanisms and programs of note, including:

- PJM's DER Aggregator Model, which utilises PJM's locational marginal pricing and streamlined processes to boost CER participation.
- CAISO's Proxy Demand Resource mechanism, which enhances flexibility through dynamic pricing and robust telemetry.
- The UK's Open Networks Project, which standardises processes to reduce barriers and promote flexibility markets.
- France's NEBEF mechanism, which lowers participation thresholds to expand CER participation.
- The WEM's Reserve Capacity Mechanism design, with particular focus on the modes through which CER interacts with it.

These insights helped to shape both our stakeholder engagement and findings and recommendations.

The UK Open Networks Project demonstrates the benefits of central coordination, and the standardisation of roles and services

Key findings from the jurisdictional review – UK

Key findings from UK

Our analysis of the UK, particularly the Open Networks Project, provides numerous key insights that offer valuable context for the NEM and its future development:

- **Coordination:** The central coordination observed through the UK's Open Networks Project enabled the establishment of clear rules on dispatch prioritisation, harmonised data sharing and improved planning processes to streamline market operations and enhance network management. The UK implemented network flexibility markets within two years by leveraging standardisation and coordination across distribution companies, market bodies, Government and industry stakeholders.
- **Local Flexibility Markets:** The UK has successfully created standardised local flexibility markets that recognise the value of CER to distribution networks while ensuring integration with wholesale markets for coordination and visibility.
- **Tech Standardisation:** The UK's standardisation of flexibility products across distribution networks has simplified market participation and improved efficiency, with 80% of flexibility tenders using common technical specifications.
- **Totex:** The UK's Totex approach combines capital and operational expenditure, balancing incentives so as to promote cost-effective solutions like flexibility services over traditional infrastructure investments.
- **Role and Success of DSOs:** DSOs in the UK have clearly defined DSO roles and responsibilities, and play a critical role in managing CER, ensuring real-time grid stability and facilitating local energy markets. The DSO roles contributes to the active balancing of supply and demand through advanced data management and automation, while maintaining reliability and efficiency.

The US markets show that successful CER integration requires clear aggregation frameworks, pricing signals and technical standards

Key findings from the jurisdictional review – USA (PJM and CAISO)

Key findings from USA

Our analysis from the USA scan found several innovative approaches being implemented to address participation barriers, including:

- **Lower Participation Thresholds:** PJM's DER Aggregator Model allows small-scale resources (minimum 100kW) to aggregate and participate in wholesale markets, reducing barriers to entry. CAISO's Proxy Demand Resource (PDR) mechanism enables aggregations as small as 0.5MW, combined with dynamic pricing, to incentivise demand flexibility and improve grid responsiveness.
- **Locational Marginal Pricing (LMP):** Transparent pricing systems in PJM and CAISO provide real-time price signals reflecting grid congestion and marginal costs. This allows CERs to optimise participation based on location-specific value (e.g., higher prices in constrained areas during peak demand).
- **Aggregation Frameworks:** Both PJM and CAISO use aggregation models that allow multiple small-scale CER to participate in wholesale markets as larger units, highlighting the importance of coordination between aggregators, utilities and system operators.
- **Dynamic Pricing Mechanisms:** CAISO incentivises demand flexibility through dynamic pricing, enabling CER to adjust energy usage based on real-time price signals and enhancing market responsiveness.
- **Streamlined Registration Processes:** PJM's structured registration process includes standardised agreements and technical assessments, lowering entry barriers while maintaining reliability.
- **Technology Standards and Interfaces:** Simplified communication requirements (e.g., CAISO's standardised telemetry) and robust data-sharing protocols (e.g., PJM's DER data specifications) reduce integration costs and improve market confidence.

Insights from France and the WEM highlight the value of inclusive policies, flexible designs and capacity market participation

Key findings from the jurisdictional review – France and WEM

Key findings from France	Mechanisms such as the NEBEF demand response scheme and France's decentralised capacity market demonstrate how inclusive policies, flexible protocols and economic incentives can enhance CER integration. • **Lowering Participation Thresholds:** The 100kW minimum threshold for participation encourages broader engagement in energy and capacity markets. • **Flexible Dispatch Protocols**: Longer dispatch lead times in NEBEF broaden participation but may limit responsiveness. • **Economic Incentives (i.e., rewarding economic value):** In markets that provide bifurcated energy and capacity revenue streams, CER participation can be enhanced by enabling eligibility for CER to earn capacity payments, as observed in France's capacity market. • **Baselining Challenges:** Baselining of consumption can be a useful approach to measure customer-side participation, but accuracy can be challenging, particularly for small consumers. France's experience includes an ability for an aggregator to use self-forecasting for baselining, backed by robust monitoring and assessment to mitigate against manipulation or inaccuracies.
Key findings from the WEM	The WEM shows that capacity mechanisms are highly sensitive to design and that inflexible obligations can limit CER participation despite technical readiness. Project Symphony, a CER orchestration pilot, demonstrates how aligning market frameworks with CER capabilities and customer preferences can unlock CER potential. • **Capacity Market Participation Pathways**: Customers need not be 'sellers' in capacity markets or mechanisms. They can engage in the WEM's Reserve Capacity Mechanism (RCM) as demand netted from capacity targets, "sell-side" providers (e.g., aggregated CER), or "buy-side" purchasers (e.g., retailers hedging risks). • **Addressing Design Barriers:** Restrictive facility class obligations have historically limited CER participation in the WEM. Reforming these rules is critical to accommodate new technologies and aggregation models effectively. Projects Symphony and Jupiter highlight how tailored approaches can unlock CER potential. • **Economic Incentives (i.e., rewarding economic value):** Ensuring up-front costs do not outweigh benefits is vital for small customers and aggregators to actively participate in markets, including in capacity markets/mechanisms. Transparent financial structures can drive broader engagement.

Our interviews uncovered key themes of concern to stakeholders around incentives, standard harmonisation, tariffs and coordination

Key insights from stakeholder engagement

Rewarding economic value

- Stakeholders consider that CER is not rewarded for the full value of the services it can and does provide to the energy system.
- Stakeholders noted there is a need for more dynamic pricing models and better financial incentives to overcome issues with social licence and customer motivations
- Stakeholders also suggested a role for government incentives, with clear communication on purpose
- Participation thresholds were also seen as a blocker to uptake, especially in a nascent market

Technical standards

- Stakeholders viewed consistency in technical standards as a major barrier for CER uptake in Australia, noting the importance of aligning with international standards given that Australia is a relatively small market
- There was a call for more central coordination, with all stakeholders interviewed calling for faster reform in this area

Tariffs and pricing

- Stakeholders acknowledged the work being undertaken by the AEMC on pricing reform, while also calling for greater innovation, especially in relation to network pricing models
- Dynamic pricing models and a greater range of tariffs were cited as tools to unlock more value for consumers through personalised pricing based on behaviour and consumer preferences
- There is a call for principle-based regulation to facilitate more flexible and faster pricing resets, allowing for more dynamic market responses

Coordination

- The lack of a formal entity to effectively coordinate CER presents significant integration challenges and lost opportunity
- A faster pace of reform is desired, including in relation to the DSO role definition and establishment of data sharing protocols and processes
- In the meantime, DNSPs have needed to react to, and implement backstop measures (e.g., emergency solar curtailment) to mitigate emerging grid security challenges
- Ring-fencing rules restrict DNSPs' ability to deliver innovative CER solutions as the focus remains on traditional models and definitions for Capex

Social licence

- Managing consumer expectations and earning trust is crucial throughout the process of integrating CER as flexible responsive assets
- Current policies, such as backstop mechanisms and export tariffs, complicate social acceptance and exacerbate consumer distrust
- Consumers are primarily motivated by energy independence and self-consumption, resisting external control over their assets
- It is essential to ensure that the benefits of CER are equitably distributed among all consumers, not just those who own CER

2. Introduction and context

Overview

ECA engaged Rennie to consider how CER can provide grid services and consumer value through new or improved market settings

Objective, approach and structure

Objective	ECA engaged Rennie to explore how consumer energy resources (CER) can provide grid services and demand flexibility through new or improved market settings, ensuring consumers receive fair value for their contributions while unlocking additional services. This research aims to inform ECA's advocacy in key consultation processes, including the National Electricity Market (NEM) wholesale market settings review, by analysing international and state-based demand-side mechanisms and identifying barriers to CER participation. The work examines ways to enhance CER access to markets, support grid services, load management and consumer value, and ultimately provide actionable insights to shape policy and regulatory reform in Australia's energy transition.
Approach	By examining Australian and international examples of CER participation, and the views and experiences of a variety of relevant stakeholders, this analysis seeks to identify market settings and processes that could further unlock CER's potential in the NEM and the priority areas that need to be focussed upon to overcome identified barriers. We have taken a comprehensive view of the grid market interactions, including services at the distribution and transmission level, to consider the full value proposition for CER and the natural interactions between distribution and transmission services and grid. The key stages in developing this research included: • **Jurisdictional review:** Rennie conducted targeted research, commencing with a jurisdictional scan of international and state markets to identify market settings and models that allow CER to participate in grid services and load management. • **Stakeholder engagement:** This was followed by stakeholder engagement with DNSPs, the AEMC, AEMO, industry bodies, aggregators and independent industry experts to gather insights on participation motivations, barriers, potential pathways and consumer engagement. • **Analysis and report preparation:** Rennie then developed the report, including case studies on CER participation mechanisms and initiatives applied in other jurisdictions, and covering how these could inform NEM policy development.
Report structure	This report is presented in four main parts: 1. An overview of the status of CER in the NEM, including barriers to participation and current CER reforms and initiatives. 2. Case studies on the implementation of CER market settings and reforms in the United States (PJM and CAISO), the United Kingdom, France and the Wholesale Electricity Market (WEM) in Western Australia. 3. A summary of insights from a series of interviews conducted with key stakeholders in the NEM, including AEMO, the AEMC, Tesla, Energy Networks Australia, Ausgrid, Ausnet, EnelX and independent industry experts. 4. Our key findings, informed by the research conducted for this report, represented as priority areas and aligned recommendations.

ECA engaged Rennie to consider how CER can provide grid services and consumer value through new or improved market settings

Limitations and definitions

Limitations	This report, including its findings and recommendations, has been largely informed by research on jurisdictional case studies and insights gleaned from interviews with key stakeholders in the NEM. We acknowledge that this research is not comprehensive and that limited insight was able to be gained into the work that is being undertaken within the various working groups and workstreams under the CER Roadmap. The recommendations of this report are presented under priority areas that have been identified through the research, as requiring further attention to drive CER participation in grid services and load management in the NEM. These recommendations are intended to inform further discussion, research and analysis to fully understand design and implementation considerations, which have not been considered in detail within this report.
Definition of CER within the context of this report	The term consumer energy resources (CER) has, to a large degree, taken over from the term distributed energy resources (DER) as the dominant moniker for small-scale installations of equipment capable of interacting with, and potentially responding to circumstances on, the electricity grid. For this report, we have used the term CER in a similar fashion to the Consumer Energy Resources Working Group, which describes CER and DER as: *"...consumers' resources that generate or store electricity and includes flexible loads that can alter demand in response to external signals. CER includes:* • *Rooftop solar* • *Batteries* • *Electric vehicle chargers*[1] • *Controlled loads such as water heaters and air conditioners.* *Distributed energy resources (DER) is sometimes used to describe CER but also includes larger assets such as community batteries installed in the distribution network."*

Note [1] – Another example of the distinction between CER and DER is provided by EV chargers, where behind-the-meter chargers on a customer's premises would be considered as CER, while kerbside EV chargers would be DER.

Sources: DCCEEW - https://www.energy.gov.au/energy-and-climate-change-ministerial-council/working-groups/consumer-energy-resources-working-group

Context

Increased participation of CER in wholesale markets and grid services has the potential for both system and consumer benefits

The potential benefits of greater integration of CER are significant and, with the correct market and regulatory settings, could flow through to consumers through lower system costs and lower electricity prices

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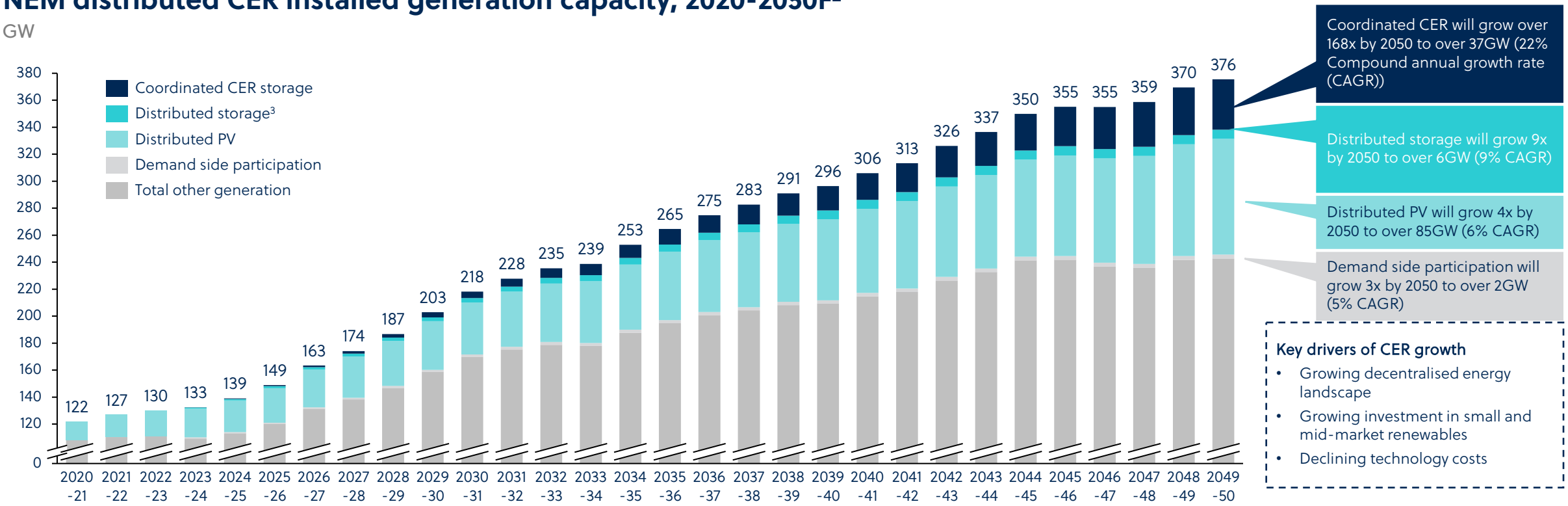
Status of CER in the NEM

CER is forecast to grow substantially from 2025-2050, with coordinated CER predicted to play a key role in supporting the grid[1]

NEM distributed CER installed generation capacity, 2020-2050F[2]

GW



Note: [1] AEMO's 2024 ISP forecasts that coordination of consumer batteries can offset the need for an additional $4.1 billion in grid-scale storage investment, as well as help deliver more reliable and secure energy and contribute to lower emissions. [2] At a high level the drivers of the demand growth include electrification of the economy, growth of EVs within the economy and electricity as the primary fuel source and capacity required to meet generation volatility. Additional components of the forecast include CER uptake and generation/charging/discharging patterns, economic and population growth drivers, climate and stakeholder surveys. The ISP is informed by the Inputs and Assumptions Report prepared by AEMO. All scenarios and potential power system investments have been analysed by AEMO through an integrated suite of forecasting and planning models and assessments; [3] Passive CER storage has been used as a proxy for distributed storage.
Source: AEMO – 2024 Integrated System Plan, Step Change Scenario (2024).

There is a range of barriers impacting CER participation and value creation, as acknowledged by key stakeholders

Key barriers impacting CER participation in the NEM as recognised by stakeholders

Key Barrier	Description
Insufficient economic incentives	Lack of financial rewards for CER programs reduces motivation for consumers to invest in CER or participate in demand response, due to high upfront costs and limited payback periods.
Complexity in systems and services	Navigating complex technologies, markets, and regulations discourages consumer engagement and creates barriers for small-scale participants, delaying widespread CER adoption.
Lack of confidence and trust in the market	Consumer scepticism about CER benefits and distrust in energy providers, particularly retailers, has led to low adoption rates and reluctance to participate in programs like VPPs.
Limited consumer empowerment and understanding	Insufficient knowledge about CER opportunities and benefits prevents informed decision-making by consumers, reducing uptake of CER technologies and participation in demand response and flexibility initiatives.
Complexities delaying regulatory reform	Slow implementation of reforms needed to integrate CER into markets effectively delays access for CER owners and limits their ability to provide grid services or earn revenue.
Lack of market integration	Misalignment between wholesale and distribution-level markets reduces the ability of CER to provide local services, load management or ancillary services at both local and system levels.
Participation thresholds	Market rules, driven by system limitations, requiring high minimum bid sizes or thresholds exclude small-scale CER resources, preventing smaller CER owners from directly participating in wholesale or ancillary service markets.

"Households and small businesses need not just incentives, but confidence that they will be better off by participating, and that lower-income households are often unable to benefit from CER due to the prohibitive cost of installation" - **National CER Roadmap, Energy Ministers**

The Clean Energy Regulator recognises that "engagement, education and outreach are vital to ensure scheme participants are equipped with the knowledge to meet their obligations," indicating a need for improved consumer understanding.

"Consumers have low levels of trust in energy market institutions and organisations, and in CER products and services." **- Consumer Insights Collaboration Findings, Energy Ministers**

"There is an enormous opportunity on the table to work collaboratively to deliver the transition for the benefit of consumers, however we need to be better aligned as an industry and be more willing to work together to find the best solutions for the market and for customers." – **Wholesale Market Settings Review – A Shared Vision Is Required, Australian Energy Council**

Sources: ARENA - Enabling Data Exchange for Consumer Energy Resources (2024); ARENA - Project EDGE Findings Report (2023) AEMC - Draft Determination: National Electricity Amendment (Integrating Energy Storage Systems) Rule 2024 (2024); ACCC - Inquiry into the NEM: Preliminary Report (2024); Clean Energy Regulator - Annual Report 2023-24 (2024)

Effective coordination and consistency across jurisdictions will be key to driving CER participation in the NEM

Key stakeholders and the key coordination challenges in focus

Stakeholder Group	Key Coordination Challenges with CER
Regulators	• Inconsistent standards (e.g., technical standards) across jurisdictions create complexity and costs[1, 2]
AEMO	• Maintaining system security with increased CER penetration • Coordinating large numbers of small-scale CERs across different NEM regions • Ensuring new market players understand NEM dispatch and bidding processes
DNSPs	• Implementing cost-reflective network tariffs that align with NEM wholesale pricing • Distribution network technical standards and asset base implications under increasing CER penetration • Managing local network constraints through dynamic operating envelopes
Energy retailers	• Developing innovative products compliant with NEM and jurisdictional requirements • Educating consumers about the benefits of CER participation in the NEM context • Balancing consumer protection with market innovation in a rapidly evolving NEM
Aggregators	• Building consumer trust in new market models within the NEM framework • Ensuring fair compensation for CER owners, balanced with profit margins • Managing potential conflicts with existing retailers
End-use consumers/CER owners	• Understanding consumer options and the protections that are in place, as well as the complex NEM mechanisms (e.g., backstop mechanisms) and dynamic pricing models • Navigating multiple new service providers and market options within the NEM • Balancing privacy concerns with data sharing requirements for market participation

Commentary

- The integration of CER into the NEM presents significant coordination challenges, requiring a balance between the benefits of increased penetration and the technical and operational complexities it introduces to the electricity system.
- For AEMO, the key challenge lies in coordinating a vast number of small-scale CER across the NEM, while maintaining system security.
- DNSPs are required to manage local network constraints and ensure network stability as CER participation increases, which can lead to new operational challenges.
- Energy retailers and aggregators need to develop innovative products and services that comply with rules and regulations, which are frequently evolving. This requires close coordination with DNSPs and alignment with existing and future market structures – as well as providing clear communication and empowerment for consumers.
- Consumers face the challenge of understanding the technical information and coordinating with multiple service providers to optimise their CER assets.
- Overlaying these challenges is the need for leadership across the various initiatives and competing challenges/objectives, particularly with the goal of empowering and educating consumers.

Notes: [1] The AEMC's 2023 Review into consumer energy resources technical standards has recommended the development of a national regulatory framework for CER technical standards to address this issue; [2] AEMO's Compliance of Distributed Energy Resources with Technical Settings Update highlights the need for improved compliance with DER technical standards to ensure grid stability and reliability
Sources: AEMO - Consumer Data Right (2024); KWM - Consumer Energy Resources: data and privacy (2024)

CER national governance and key initiatives

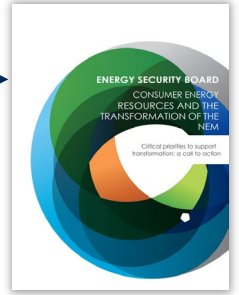
Energy ministers have recently established a national CER Working Group focusing on jurisdictional direction and technical expertise

National CER governance structure

	Role	*Members*
Energy & Climate Change Ministerial Council **(ECMC)**	Established by DCCEEW with Ministers from the Commonwealth and each state and territory, with portfolio responsibility for climate change and energy	• Chair: Federal Minister for Climate Change and Energy • Members: Energy Ministers from each state and territory
National Energy Transformation Partnership **(NETP)**	A framework for state, territory and Commonwealth governments to collaborate to transform Australia's energy systems for our net zero future.	
CER Working Group **(CERWG)**	Established by the ECMC under the NETP, the interjurisdictional working group delivers advice to support the integration of CER into electricity markets and networks	
CER Taskforce **(CERT)**	An as-needed expert taskforce to provide subject matter expertise on priority reforms	• Chaired by the Australia Government • Government and market bodies • Industry & consumer representatives
CERT Reference Group	A pathway for key stakeholders to consider and provide advice on CER reforms	• Senior Industry Executives • Senior Executives from Consumer Representative Groups • Others with deep expertise in relevant areas

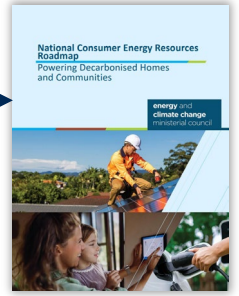
Key CER reports

Energy Security Board: Consumer Energy Resources and the Transformation of the NEM



ECMC Endorsed

National Consumer Energy Resources (CER) Roadmap: Powering Decarbonised Homes and Communities



Source: DCCEEW - https://www.energy.gov.au/energy-and-climate-change-ministerial-council/working-groups/consumer-energy-resources-working-group

The national CER Roadmap sets out a range of priorities to address barriers and harness the full potential of CER

		National reform priorities	Key Projects/Initiatives and Timeframes[1]
Consumers	1	Extending consumer protections for CER	• Extending consumer protections (2024-2026) • Further consumer protections delivered (2026-2028) • More equitable access to the benefits of CER (2024-2027) • National Energy Equity Framework (2024) • Energy reform package (2024-2025) • Review of AER exemptions framework for embedded networks (2024-2025) • Communication framework and strategy (2024-2026)
	2	More equitable access to the benefits of CER	
	3	CER information to empower consumers	
Technology	1	Nationally consistent standards, including electric vehicle to grid	• Initial interoperability standards developed (2024) • CER device cyber standards developed (2024-2026) • Define EVSE minimum technical standards for power system security (2024-2027) • Review of minimum operating standards for government support public EVSE (2025) • Jurisdictions to ensure no barriers to vehicle to grid (2024-2025)
	2	National regulatory framework for CER to set and enforce standards	
	3	Establish secure communication systems for CER devices	
Markets	1	Enable new market offers and tariff structures to extract greater benefits from CER	• Enable new market offers and tariff structures (2025-2027) • Flexible Trading Arrangements Determination (2024) • Establish metrics for collection and sharing of data (2025-2026) • Establish arrangements necessary for operational CER data (2025-2027) • Data sharing arrangements to inform planning and enable future markets (2027) • Distribution level market roles and responsibilities defined (2025) • Smart meter rollout finalised (2024-2030)
	2	Data sharing arrangements to inform planning and enable future markets	
	3	Redefine roles for market operations	
Power system operations	1	Faster, harmonised CER connection processes, including for EV chargers	• Draft National Energy Equity framework delivered (2024) • Identify options for harmonised CER connection processes, including for EV chargers (2025) • Options developed to enable consumers to export and import more power to and from the grid (2025) • Removal of barriers to enable Vehicle to Grid (2025) • Backstop mechanisms in place (2026) • Roles and responsibilities for power system operations defined (2026)
	2	Improve voltage management across distribution networks	
	3	Redefine roles for power system operations	

Notes: [1] Not comprehensive.
Source: DCCEW - National Consumer Energy Resources Roadmap Powering Decarbonised Homes and Communities (2024)

3. Market settings for CER participation in global jurisdictions and the WEM

Our jurisdictional scan and case study review focused on the following five jurisdictions

JURISDICTION	Market overview	Reviewed market settings/mechanisms
 PJM Interconnection, USA	PJM Interconnection is the largest wholesale electricity market in the United States, covering all or parts of 13 states and the District of Columbia. PJM operates a complex market structure including day-ahead, real-time, capacity and ancillary services markets.	• Locational Marginal Pricing (LMP) • Reliability Pricing Model (PJM's capacity market) • DER Aggregator Participation Model
 California, USA	The California Independent System Operator (CAISO) operates a competitive wholesale electricity market and manages the reliability of its transmission grid, covering about 80% of California and a small part of Nevada. CAISO operates day-ahead, real-time, ancillary services, congestion revenue rights[1] and energy imbalance markets, and a mandatory resource adequacy requirement.	• Distributed Energy Resource Provider (DERP) Programme • Proxy Demand Response (PDR) PDR – Load Shift Resource (PDR-LSR) • Reliability Demand Response Resource (RDRR)
 UK	The National Energy System Operator (NESO) serves approximately 67 million consumers across Great Britain (England, Wales, and Scotland), operating energy markets (day-ahead and intraday), the Balancing Mechanism (real-time adjustments), ancillary services and the capacity market.	• Capacity Market Mechanism • Open Networks Project • Flexible Grid Connection Regime • Local Markets for Flexibility Services
 France	France's energy market is dominated by nuclear power and the state-controlled EDF, with a growing share of renewables, regulated tariffs for consumers and a wholesale market that includes day-ahead and intraday trading, while operating within the broader European electricity market framework.	• French Capacity Market • NEBEF (Notification d'Échange de Blocs d'Effacement)
 Western Australia	The WEM, operated by AEMO, facilitates electricity trading within the South West Interconnected System (SWIS) using a Short Term Energy Market. The WEM features day-ahead, real-time and Essential System Services markets, supplemented by the Reserve Capacity Mechanism.	• WEM Reserve Capacity Mechanism • Market participation of CER aggregation • Project Jupiter

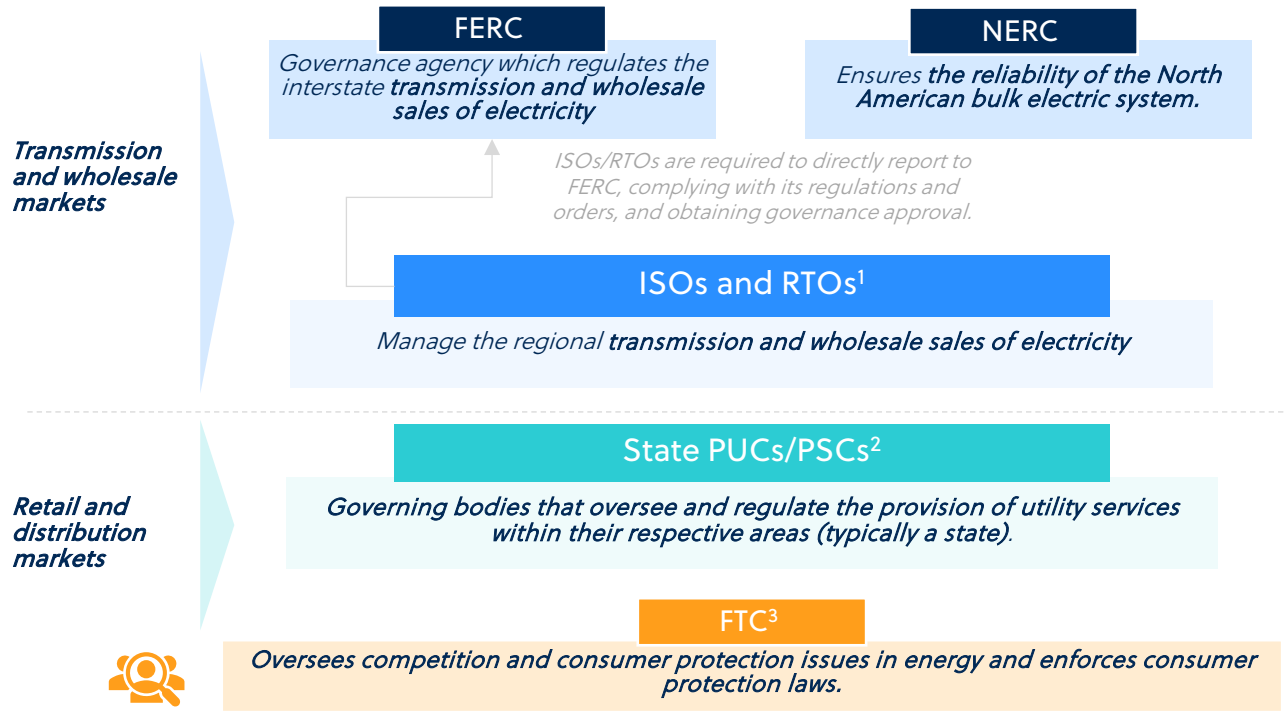
Notes: [1] Congestion Revenue Rights (CRR) market is a mechanism used to allocate the revenue generated from congestion management, allowing market participants to bid for the right to receive payments when congestion occurs, essentially compensating them for the cost of congestion.

Sources: Rennie research and analysis

USA

In the U.S., FERC Order 2222 sets up the governance framework for CER participation across regulated ISOs and RTOs

USA Energy System Governance



Key Responsibilities

Federal Energy Regulatory Commission (FERC):
- Sets service quality standards, including specific standards for voltage, frequency and other technical requirements for transmission services
- Issues orders to regulate and oversee various aspects of the energy sector, such as approving tariffs for RTOs and setting policies for wholesale electricity markets
- Issues interconnection requirements for large generators (>20MW)

North American Electric Reliability Corporation (NERC):
- Develops and enforces reliability standards, which are approved by FERC
- Assesses seasonal and long-term reliability of the grid

Independent System Operators (ISO) and Regional Transmission Organisations (RTO):
- Manage the flow of electricity across the transmission grid within their regions
- Foster competition for electricity generation among wholesale market participants
- Long-term regional planning of transmission system

State Public Utility Commissions (PUCs)
- Regulate retail electricity rates
- Oversee local distribution
- Implement state energy policies
- Approve state utility investments

Federal Trade Commission (FTC)
- Monitors energy markets for anticompetitive practices harmful to consumers
- Enforces laws against false advertising of energy products
- Educates consumers on avoiding energy market scams
- Advocates for fair competition and consumer protection in energy markets

Notes: [1] RTOs typically cover a larger geographic area, often spanning multiple states, while ISOs generally operate within a single state or a smaller region. [2] Public Utilities Commissions or Public Service Commissions. [3] Federal Trade Commission.
Sources: USEIA - Electricity explained - How electricity is delivered to consumers (2024)

PJM

PJM's approach to integrating CER/DER into energy markets is driven by its DER Aggregator Participation Model, which uses locational marginal pricing (LMP) to provide clear price signals and real-time data. With a 100kW participation threshold, multi-nodal aggregations and a structured 60-day registration process including utility reviews, PJM lowers barriers while ensuring grid security. This approach enhances transparency, coordination and opportunities for CER participation across energy, capacity and ancillary markets.

PJM governs the wholesale electricity market and transmission grid, and State Public Utility Commissions govern distribution and retail

Overview of the regulatory framework and oversight in the PJM region

Segments/ actors	Transmission (TSOs/ISOs)	Distribution (DNSPs)	Retail (Energy retailers)	Aggregation (CER aggregators/VPP providers)	End use (CER owners/consumers)
Operation	• PJM manages the HV transmission grid, ensuring reliability and fair access for wholesale electricity buyers and sellers.	• Local electric distribution companies (EDCs) deliver electricity from substations to end-users at lower voltages.	• Retail electricity providers or utilities supply electricity to end-users.	• Aggregators combine CER to participate in PJM's wholesale electricity market and capacity market.	
Regulatory framework and oversight	• **FERC** oversees **PJM's** transmission operations under its Open Access Transmission Tariff, Operating Agreement, and Reliability Assurance Agreement. • PJM must be compliant with **NERC**[1] reliability standards.	• State Public Utility Commissions (PUCs)[1] regulate distribution utilities, ensuring compliance with state laws for safe, reliable and cost-effective service delivery.	• State PUCs regulate retail services, including pricing structures, customer protections and service quality standards.	• PJM market rules (approved by FERC) govern aggregator participation and demand response programs. PJM is developing a new DER Aggregator Participation Model to enable aggregator participation in compliance with FERC Order 2222. • State PUCs oversee retail consumer protection and regulate retail rates and service quality for consumers.	

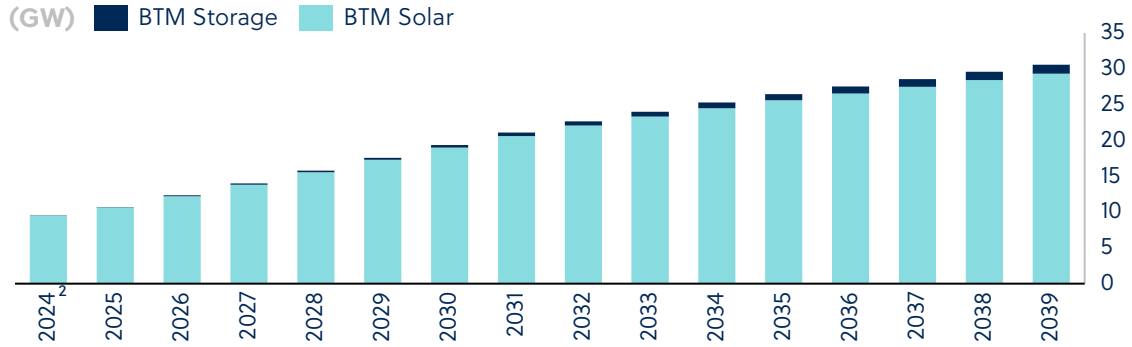
Governed by PJM Interconnection Association

Notes: [1] The North American Electric Reliability Corporation (NERC) sets standards to ensure the safety and reliability of the power grid, and these standards are regulated by the FERC.

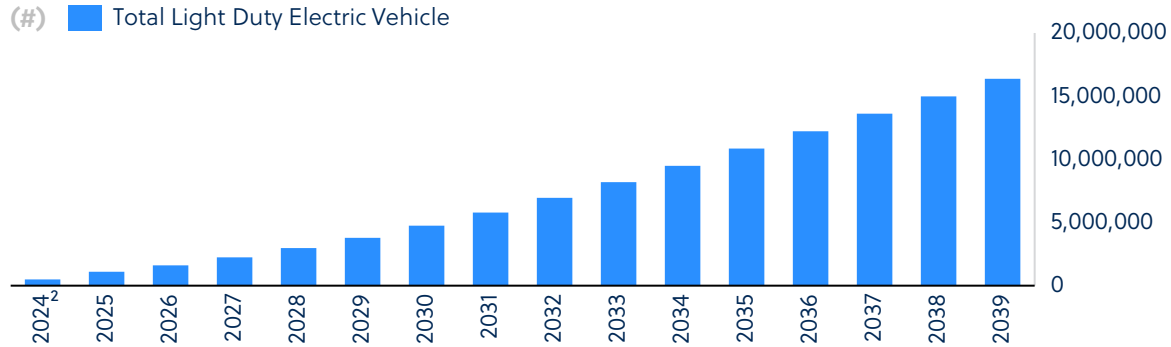
PJM – CER, policy and regulatory context

Market Overview	• PJM serves around 65 million consumers across 13 states and the District of Columbia, manages over 140,000km of transmission lines and oversees 1,436 electric power generators with a total installed capacity of around 200GW. • As a Regional Transmission Organisation (RTO) and Independent System Operator (ISO), PJM operates a competitive wholesale electricity market, including a capacity market and day-ahead market, and manages over 1,000 member companies.
Policy and Regulatory Context	• The Federal Energy Regulatory Commission (FERC): Regulates PJM and approves its open access transmission tariff (the market rules) for the wholesale electricity market. • PJM Board of Managers: Independent governing board that considers and approves the Regional Transmission Expansion Plan (RTEP) for the entire PJM region. • Transmission Expansion Advisory Committee (TEAC): Provides advice and recommendations to aid in the development of the RTEP to resolve potential reliability violations. • Interconnection Process Reform Task Force: Stakeholder group that supported the development of PJM's proposed revised interconnection study process, which was filed with FERC in 2022.
CER Context	• As of 2025, PJM has 10.6GW of BTM solar capacity, forecast to grow at a 7.6% CAGR to 29.3GW by 2039; and 43.4MW of BTM storage, forecast to grow at a 26.6% CAGR to 1,264.6MW by 2039. • Over 6GW of demand response capacity was offered in PJM's July 2024 auction. • In 2024, PJM recorded ~500,000 light-duty EVs, and PJM's 2024 Long-Term Load Forecast projects about 16.4 million light-duty EVs by 2039, growing at a CAGR of 28.97%.

PJM Forecast BTM Solar and Storage Cumulative Nameplate Capacity, 2024-2039



PJM Forecast Light Duty Electric Vehicle Uptake, 2024-2039



Notes: [1] 2024 Figures are based on actual figures as stated in PJM's 2025 Preliminary PJM Load Forecast.
Sources: PJM Load Analysis Subcommittee - 2025 Preliminary PJM Load Forecast (2024); PJM Interconnection - PJM State of the Market Report (2024); Monitoring Analytics - Quarterly State of the Market Report for PJM (2024); PJM Interconnection - Distributed Energy Resources and Inverter-Based Resources Subcommittee Report (2024)

PJM – Key CER market settings and mechanisms

Key drivers for CER participation	
	• **Regulatory Initiatives:** FERC Order 2222 mandates PJM to enable CER aggregations in wholesale markets, removing barriers to entry while maintaining system reliability. • **Market Coordination:** PJM's DER Aggregator Participation Model introduces a pre-registration coordination requirement where aggregators must work with distribution utilities to determine locational and data requirements before formal PJM registration to ensure operational efficiency. Following the pre-registration, and PJM's initial review, distribution utilities have 60 days to assess the proposed CER Aggregation Resource for potential distribution reliability impacts to ensure there is not disruption to network stability. • **State Policies**: Renewable Portfolio Standards across PJM states drive CER uptake, but implementation has been challenging due to inconsistent mandates across states complicating compliance for energy generators and retailers operating across multiple jurisdictions.

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key consumer barrier/challenges addressed (as relevant to the NEM)	Stakeholders supported	Relevance to the NEM
Reliability Pricing Model (PJM's Capacity Market)	The Reliability Pricing Model (RPM) is PJM's forward capacity market mechanism[1], which enables CER to compete and earn revenues alongside generators. The RPM is a multi-stage competitive auction mechanism that procures capacity resources across a series of auctions: for a given delivery year, the Base Residual Auction is held three years in advance, followed by three incremental auctions, with the last of these held approximately four months before the start of the delivery year.	• **Insufficient economic incentives:** Offering a revenue stream through capacity payments for resources that clear the auction and contribute to the reliability of the power system	• CER Owners • ISOs	Could offer insights for CER participation in capacity markets, if such a reform is considered for the NEM. Design features relevant to CER would include product design, eligibility requirements and the timing of procurement processes.
DER Aggregator Participation Model	Allows CER aggregations to participate in wholesale markets with a minimum offer size of 100kW, lowering barriers to participation in energy, capacity and ancillary services. It establishes coordination between PJM, aggregators and utilities. Initially planned for 2026, implementation has been delayed to 2028 due to regulatory clarity issues, software updates and system development requirements.	• **Minimum thresholds for participation:** Establishes a 100kW participation threshold for CER, providing clearer guidelines for market entry and service provision	• DNSPs • Aggregators • CER Owners • ISOs	Important to understand the implementation challenges and to review in comparison with AEMO's established registration process for Small Resource Aggregators and the ability of aggregations to participate in current and future markets.
Locational Marginal Pricing (LMP)	Pricing mechanism that reflects electricity costs at specific grid locations, updated every five minutes. The LMP system will provide clearer opportunities for CER participation to meet local requirements in both day-ahead and real-time energy markets.	• **Lack of confidence and trust in the market**: Offers transparent, real-time data for market participants and provides accurate price signals reflecting true electricity value at specific locations • **Lack of market integration:** Sends clear price signals to generators and consumers	• CER Owners • Energy Retailers	Potential future consideration of LMP in the NEM could improve pricing efficiency and improve the ability for CER to both provide and capture benefits.

Notes: [1] The RPM in PJM features a Variable Resource Requirement curve to set capacity prices, locational pricing to reflect regional capacity values, allows participation from demand-side resources and new transmission upgrades, and includes performance incentives and penalties to ensure resource availability during critical periods, thereby maintaining reliability.
Sources: FERC - Order No. 2222 (2020); PJM - DER Aggregator Participation Model Documentation (2022); PJM - Reliability Pricing Model (RPM) Overview (2020); PJM - Locational Marginal Pricing (LMP) Documentation (2020); PJM - Order 2222 Filing Furthers DER Market Participation (2022); NCEL - Understanding RTOs: the PJM (2023)

PJM DER Aggregator Participation Model | Deep Dive

Mechanism overview:

- Introduced in 2022, PJM's DER Aggregator Participation Model, developed in response to FERC Order 2222, aims to enable CER aggregations to participate in PJM's energy, capacity and ancillary services markets. The model includes a pre-registration process with distribution utilities to address reliability concerns and prevent double counting of resources.
- The model seeks to balance market access with distribution system reliability, though some aspects, such as the proposal to limit energy market participation to single-node aggregations, have faced criticism from stakeholders.

Operation of the mechanism

- Operates by allowing aggregators to combine multiple small-scale energy resources (called Component DERs) into larger units called DER Aggregation Resources, each being between 100kW and 5MW. These aggregated resources can participate in PJM's wholesale energy, capacity, and ancillary services markets.
- The process involves:
  - **Registration**: Aggregators submit detailed forms for each Component DER and undergo a 60-day review, including a 15-day Component DER review and a 45-day reliability assessment by the Electric Distribution Company.
  - **Market Participation**: Once registered, aggregators can submit cost-based and price-based offers, and self-schedule resources into day-ahead and real-time energy markets.
  - **Pricing and Settlement**: PJM uses a nodal approach (Locational Marginal Pricing) for energy markets and a multi-nodal approach for capacity and ancillary services. Component DER must have hourly metering, and aggregators submit daily meter data. PJM settles by summing all load reduction and injection megawatt-hours for the underlying CER.

Key insights to date

- The implementation of this model faces significant challenges, including technical complexities, regulatory hurdles and stakeholder concerns, and PJM has proposed postponing the full implementation from 2026 to 2028, citing the need for extensive software changes and system upgrades.
- While the minimum participation threshold of 100kW is viewed positively, PJM's proposal to limit energy market participation to single-node aggregations has faced criticism for potentially restricting CER participation.
- Coordination between PJM, distribution utilities and state PUCs is necessary but complex, with concerns about data access, settlement processes and operational impacts.

Consumer barriers intended to be addressed

Insufficient Economic Incentives	Complexity in Systems and Services	Lack of Confidence and Trust in the Market	Lack of Market Integration	Participation Thresholds
Provides revenue opportunities through energy, capacity and ancillary services markets	Simplifies participation through streamlining registration and operational processes for aggregators	Introduces potential for net benefits to consumers with simplified processes	Facilitates integration with wholesale markets, allowing aggregated CER to participate alongside traditional resources	Establishes a 100kW participation threshold for CER, providing clearer guidelines for market entry and service provision

Sources: FERC - Order No. 2222 (2020); PJM - DER Aggregator Participation Model Documentation (2022); PJM - Reliability Pricing Model (RPM) Overview (2020); PJM - Locational Marginal Pricing (LMP) Documentation (2020); Utility Dive- FERC orders PJM to revise plan for DER aggregations; Enel 'encouraged' that single-node limit may be lifted (2023); Rennie research and analysis (2025).

Impact on Consumer Barrier Reduction

- High Impact
- Medium Impact
- Low Impact

PJM DER Aggregator Participation Model | Deep Dive

Considerations for the NEM

Market design differences	• PJM operates a net pool[1] model with LMP, supplemented by a capacity market, that allows CER participation through its DER Aggregator Participation Model, while the NEM uses a gross pool market structure with regional pricing, without a capacity market.

Relevance for the NEM and market participants	• The PJM DER Aggregator Participation Model offers insights for the NEM's ongoing reforms, including the *Integrating price-responsive resources into the NEM* rule change which introduces a voluntary 'dispatch mode' framework for price-responsive resources.
	• The key differences between the mechanisms include:
	  • **Nodal Pricing:** PJM applies locational marginal pricing (LMP) for its energy markets, with potential multi-nodal approaches for other services. This differs from the NEM's zonal pricing approach with a gross pool market design.
	  • **Registration process:** PJM requires a 60-day registration process, including a distribution utility review for reliability impacts. This process involves a 15-day period to review Component DER and a 45-day period to conduct any incremental reliability assessment of the DER Aggregation Resource. In the NEM, the timeline to review an application to classify a facility is not time bound, though 20 business days limits apply to participant registration and facility aggregation applications[2]. AEMO liaises with DNSPs when reviewing applications to aggregate wholesale demand response units.

Considerations for the NEM	• **Aggregation rules can make a difference to participation**
	  • Low minimum threshold lowers barriers to entry and building of scale. The NEM's integer-based bidding requirements may be restrictive.
	  • Participation across nodes should be looked at for all markets and services. This is already possible in the WDRM.
	  • Coordination with DNSPs may be complex but is necessary, and processes should be standardised to the maximum extent possible. AEMO has already established one such approach via its WDR Guidelines.
	• **Standards and interfaces require careful design**
	  • Simplifying the offering to, and interfaces with, consumers is a key ongoing implementation challenge.
	  • Technology standards (including data access) are a crucial element in ensuring consumer rights.
	• **Implementation may require substantial market IT changes, requiring clarity on regulatory design**
	  • Substantial change requires regulatory certainty and, once this is received, it's time to implement.
	  • Getting the settings wrong, and not getting stakeholder buy-in, is likely to lead to delays. Delays in PJM implementation have largely been triggered by long FERC approval timelines.

Notes: [1] A net pool model allows participants to nominate quantities of energy that they will self-schedule, with the market determining deviation quantities. [2] See section 2.9 and clause 3.8.3 of the NER.
Sources: - AEMO -Distributed Energy Resources Register (2019); AEMC - Draft Determination and Draft Rule on Voluntary Dispatch Mode (2024); AEMC -Draft rule determination National Electricity Amendment (Integrating price-responsive resources into the NEM) Rule 2024(2024)

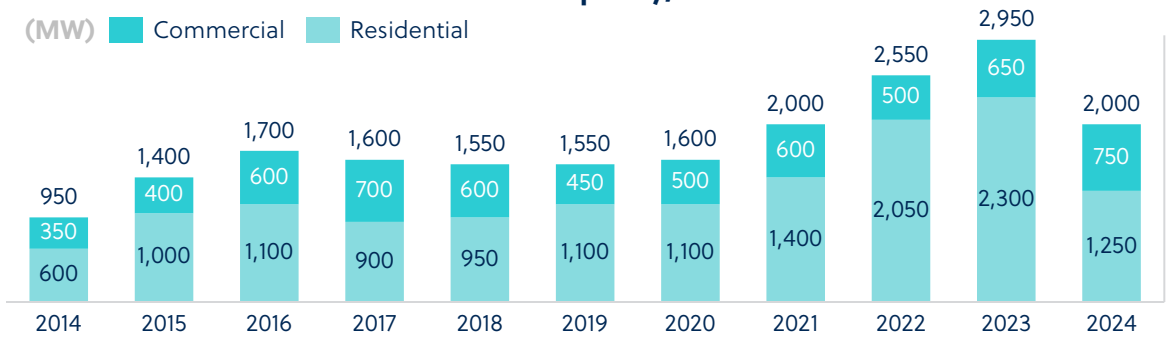
CAISO

CER participation in CAISO's markets is driven by its Proxy Demand Resource (PDR) mechanism, which enables demand-side resources to bid as virtual generators in energy and ancillary markets. By leveraging nodal pricing, robust telemetry requirements and technical innovations like the Load Shift Resource (PDR-LSR) model, CAISO ensures accurate performance tracking, grid reliability and bidirectional dispatch capabilities. Dynamic pricing mechanisms further incentivise customers to adjust energy usage based on real-time price signals, enhancing demand flexibility and market responsiveness. Additionally, CAISO reduces barriers to entry by allowing Demand Response Providers (DRPs) to operate independently of Load-Serving Entities (LSEs), fostering greater participation and optimising the integration of distributed energy resources into wholesale markets.

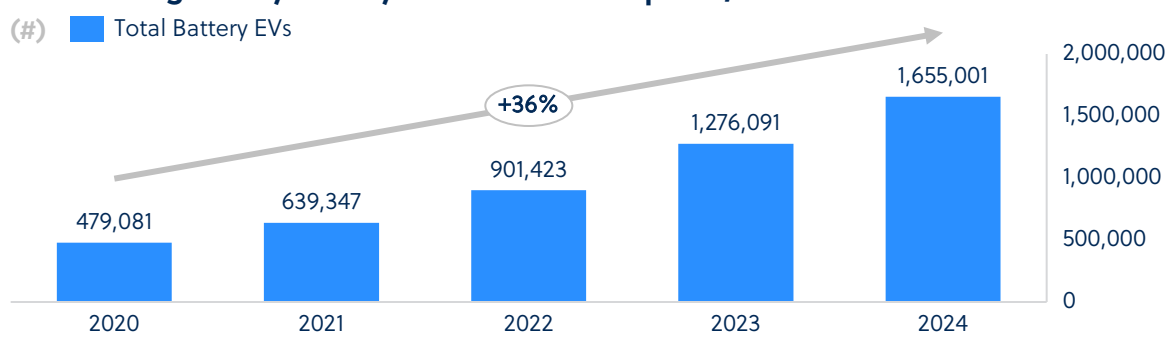
CAISO – CER, Policy and Regulatory Context

Operations and Responsibilities	• CAISO serves about 32 million consumers across 2 states (California and a portion of Nevada), managing approximately 41,200km of transmission lines, and overseeing 331 electric power generators with a total installed capacity of around 32GW. • CAISO manages generators, load-serving entities, CER aggregators and transmission system owners (TSOs). It has no direct connection with Distribution Operators (DO) as communication goes through the TSO as an intermediary, but CAISO is exploring options to have more direct coordination with DOs in the future[1]. • Markets include energy (day-ahead and real-time), ancillary services, congestion revenue rights[2] and the Energy Imbalance Market (EIM). • CAISO does not operate a central capacity market, instead overseeing a mandatory resource adequacy requirement.
Policy and Regulatory Context	• Federal Energy Regulatory Commission (FERC): Regulates interstate transmission of electricity and oversees CAISO • California Public Utilities Commission (CPUC): Regulates investor-owned utilities within CAISO's balancing authority area • California Energy Commission (CEC): State's primary energy policy and planning agency • California Electricity Oversight Board (EOB): Provides oversight for CAISO, monitoring and evaluating state interests in transmission system operation and energy markets.
CER Context	• California leads the US in EV adoption, with over 1.6 million EVs registered and a high per capita ownership, and the state has a mandate to achieve 100% EV sales by 2035. • CAISO has over 12,000MW of installed solar capacity in systems smaller than 1MW, while residential battery storage capacity reached 1,354MW by September 2024. • In 2024 the EV market share reached approximately 22%. There were 105,000 public or shared private EV chargers installed, in addition to over 500,000 at-home chargers. • Demand response accounted for approximately 2.6% (or 1,400MW) of total system resource adequacy capacity in the summer of 2024. • CAISO was one of the first ISOs to allow DER aggregation, giving it a head start in compliance with FERC Order 2222.

California Annual BTM Solar Installed Capacity, 2014-2024



California Light Duty Battery Electric Vehicle Uptake, 2020-2024



Notes: [1] CAISO is exploring initiatives to enhance coordination with DOs, such as through its Strategic Plan 2022-2026, which emphasises developing communication protocols for reliable operation of distribution-level resources. CAISO's Demand and Distributed Energy Market Integration initiative also involves stakeholder engagement with recommendations to have better coordination with entities involved in distribution. [2] Congestion Revenue Rights (CRR) market is a mechanism used to allocate the revenue generated from congestion management, allowing market participants to bid for the right to receive payments when congestion occurs, essentially compensating them for the cost of congestion.
Sources: California Energy Commission - New ZEV Sales in California (2025); SEIA - California State Solar Overview (2024)

CAISO - CER Market Settings and Mechanisms

Key drivers for CER participation

- **Regulatory Initiatives:** FERC Orders 841 and 2222, and CAISO's DERP model, have been key drivers for CER participation in CAISO markets. These initiatives allow storage resources from 100kW and CER aggregations from 0.5MW to bid into wholesale markets, providing energy and ancillary services
- The CEC is looking at mandating bidirectional charging for light-duty vehicles starting in 2027, and ~2 million EVs are expected to be sold that year, which is forecast to theoretically add 119GWh of demand to the grid
- **Market Coordination**: CAISO's integration of CER into day-ahead and real-time markets, through platforms like the Non-Generator Resource (NGR) model and Proxy Demand Response, has enhanced market coordination. The DERP participation model requires a 30-day review process where utility distribution companies and municipal utility districts must provide concurrence that there are no concerns about the resources forming part of an aggregation before CER aggregations can participate in CAISO markets
- **State Policies:** California's Renewable Portfolio Standard mandates 60% renewable energy by 2030 and 100% by 2045, driving the integration of CER into CAISO's grid.

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key consumer barrier/challenges	Stakeholders supported	Relevance to the NEM
Distributed Energy Resource Provider (DERP) Programme	This model allows aggregation of small distribution-connected energy resources totaling at least 0.5MW. DERPs can participate in day-ahead and real-time energy markets, as well as ancillary services markets. It enables smaller CER to collectively meet minimum size requirements for market participation.	• **Minimum thresholds for participation:** Establishes a 0.5MW participation threshold for CER, while providing clearer guidelines for market entry and service provision	• CER owners • Aggregators • ISO, DNSPs	For further consideration in comparison to the NEM Small Resource Aggregator model.
Proxy Demand Response (PDR)	This model enables CER to participate in CAISO's day-ahead and real-time energy markets, as well as ancillary services markets. It allows aggregators to bundle small-scale CER into larger virtual resources, enabling them to bid into these markets for load curtailment. The minimum participation threshold[1] for PDR is: • 100kW for energy bids in day-ahead and real-time markets. • 0.5MW for ancillary services such as spinning and non-spinning reserves.	• **Lack of market integration:** Increases the opportunities for consumers to take part in energy markets in a more dynamic and flexible manner.	• Third-party aggregators • Retailers • CER Owners	Consideration of the effects of adopting lower minimum thresholds for CER participation in the NEM, similar to CAISO's 100kW for energy bids and 0.5MW for ancillary services
PDR - Load Shift Resource (PDR-LSR)	This is a specialised version of PDR that enables CER, particularly batteries, to participate dynamically (bidirectionally) in the real-time energy market. It allows CER to both increase consumption during oversupply events (e.g., negative pricing) and decrease consumption during high-demand periods.[2]			
Reliability Demand Response Resource (RDRR)	This model is designed for emergency conditions, allowing CER to participate in real-time markets during critical grid events, such as Energy Emergency Alerts. RDRRs must meet the following participation thresholds: • Minimum load curtailment of 0.5MW. • Resources must reach full curtailment within 40 minutes of dispatch instructions and sustain it for at least 1 hour, with a maximum run time of 4 hours per event.[3]	• **Insufficient economic incentives:** Offering a revenue stream through the emergency energy payment for resources that contribute to the reliability of the power system in an emergency	• Third-party aggregators • DNSPs • ISOs • CER Owners	Consideration of potential strategic reserve products, noting the trade-off between providing greater clarity/certainty vs maximising flexibility.

Notes: [1] Smaller loads can be aggregated to meet this thresholds; [2] PDR-LSR requires resources to register two separate Resource IDs: one for load curtailment and one for load consumption. For load curtailment, the minimum bid size is 0MW, and bids must meet or exceed the Net Benefits Test (NBT) threshold price. In contrast, dispatchable consumption bids can range from slightly negative values (just below $0) down to the bid floor, typically set at -$150/MWh. This setup enables resources to participate in scenarios where consuming energy is economically beneficial, such as during periods of low or negative pricing; [3] Unlike PDRs, RDRRs are not dispatched for economic purposes but strictly for reliability needs.
Sources: CAISO - Proxy Demand Resource (PDR) & Reliability Demand Response Resource (RDRR) Participation Overview (2024); Utility Dive - V2G law could grow California battery capacity 119GWh in 2027: ClearView Energy (2024)

Proxy Demand Response | Deep Dive

Mechanism overview:

- Proxy Demand Response (PDR) was introduced in 2010 by CAISO in response to Federal Energy Regulatory Commission (FERC) orders and California Public Utilities Commission (CPUC) rulings.
- The primary purpose of PDR was to integrate utility demand response programs and provide open access for third-party participation in wholesale electricity markets.
- The PDR mechanism allows aggregated demand response resources to bid into day-ahead and real-time energy markets, as well as ancillary services markets. It enables both load curtailment and load consumption.

Operation of the mechanism

The PDR enables demand-side resources to engage in wholesale electricity markets. This process involves the following:

- Demand Response Providers (DRPs) aggregate smaller loads to meet minimum participation thresholds within defined regions that include multiple transmission nodes[1].
- DRPs can bid directly into CAISO markets, operating independently of Load Serving Entities (LSEs, akin to retailers).
- PDR resources participate in day-ahead and real-time energy markets, as well as non-spinning reserve markets.
- Each PDR resource is assigned a unique CAISO resource ID for market representation.
- Bids are submitted and dispatched in a manner similar to traditional generators, with bids representing load curtailment.
- Load reductions are calculated using CAISO-approved baseline methodologies.

Key insights to date

- On high load days in summer 2024, 44% of utility PDR resource adequacy capacity bid into the market, showing an improvement from 41% in 2023.
- PDRs accounted for about 2.6% (1,400MW) of total system resource adequacy capacity in summer 2024, with utility demand response comprising 76% of this capacity.
- The availability of bids for utility proxy demand resources was very low, but these resources reportedly performed well when dispatched, reporting load reductions averaging about 91 percent of their scheduled load reductions.
- In 2024, the CPUC introduced a $949/MWh bid cap for PDR resources to ensure they are dispatched before reliability demand response resources, which bid at 95% of the market cap (typically $950). This change was necessary because many PDR resources were bidding above $950/MWh in 2023, often not being used first. The new cap forces PDR resources to offer capacity at a lower price, increasing their likelihood of being called upon and improving overall demand response efficiency.

Consumer barriers intended to be addressed

Insufficient Economic Incentives	Complexity in Systems and Services	Limited Consumer empowerment and Understanding	Lack of Market Integration	Participation Thresholds
Provides revenue opportunities for aggregated resources, with tailored participation requirements.	Reduces complexity by enabling participation of specialist DRPs who handle bidding and dispatch.	Indirectly addresses by shifting technical responsibilities to DRPs, though consumer awareness of market mechanics remains limited.	Integrates demand response into CAISO's day-ahead, real-time and ancillary service markets as "proxy generators."	Establishes a 100kW participation threshold for CER, providing clearer guidelines for market entry and service provision

Impact on Consumer Barrier Reduction

- High Impact
- Medium Impact
- Low Impact

Notes: [1] CAISO allows aggregation within a sub-Load Aggregation Point (LAP), which is a defined set of pricing nodes with minimal internal risk of constraint. At the time of establishing the PDR mechanism, 24 sub-LAPs were defined.
Sources: CAISO - Demand response issues and performance 2023(2023); CAISO - Demand response issues and performance 2024(2024); CAISO - PDR-DERP-NGR-LFA Summary Comparison Matrix (2023); CAISO - Comments on Barriers to Demand Response and the Symmetric Treatment of Supply and Demand Resources (2009)

Proxy Demand Response | Deep Dive

Considerations for the NEM

Market design differences	• CAISO operates a nodal pricing system with a decentralised resource adequacy framework, focusing on granular grid management and integration of renewables through mechanisms like the Energy Imbalance Market. In contrast, the NEM uses a regional zonal pricing model with an energy-only market structure.

Relevance for the NEM and market participants	• The PDR mechanism offers insights for the NEM's evolving CER framework, with parallels to the Wholesale Demand Response Mechanism (WDRM) introduced in 2021 and ongoing Post-2025 reforms. Both jurisdictions utilise baselines for measurement of demand response, but key structural and operational differences include:
	  • CAISO: PDRs bid as virtual generators at specific pricing nodes, with real-time telemetry requirements (4-second updates for ancillary services).
	  • NEM: Operates zonal pricing, with a single-node WDRU bidding at its node, while multi-node WDRUs bid at the regional reference node; and lower real-time telemetry requirements (typically 60-second data frequency).
	• The ability of DRPs to engage customers independently of the retailer enables multiple trading relationships, as was enabled in the NEM via the WDRM.

Considerations for the NEM	• **Bespoke bidding structures and requirements are likely to be necessary, at least initially, to enable aggregated CER participation in the existing spot market.**
	  • The AEMC has allowed the two main options for defining bid quantities and measuring delivery:
	  • The Unlocking CER benefits through Flexible Trading rule change facilitates separation of flexible load/CER from passive load at a connection point, involving some establishment costs but greater accuracy.
	  • The WDRM utilises baselines to determine a counter-factual level of demand, which have low cost but are inherently less accurate
	• **Multi-node aggregation can be workable, and can account for transmission constraints**
	• **Innovation by specialist aggregators, when enabled, can provide benefits and innovative products for customers**
	• **Experience indicates that a high degree of bid-to-dispatch accuracy can be achieved through appropriate demand response mechanisms**
	• **Reasonable levels of participation are likely to be made available when required, potentially avoiding costly capital investment**

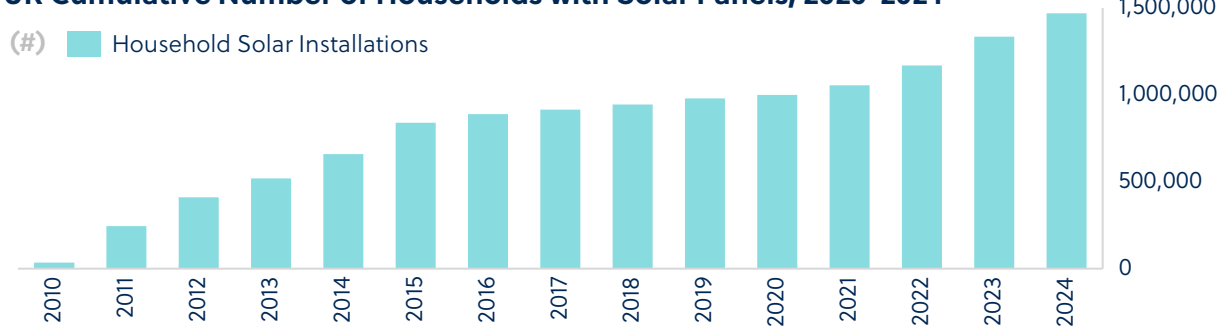
UK

The UK's Open Networks Project, which has underpinned the implementation of network flexibility markets, demonstrates the benefits of standardisation and coordination. By aligning processes such as prequalification, contracts, dispatch APIs and settlement mechanisms across DNOs and the NESO, the UK has streamlined market participation, reduced barriers to entry and boosted engagement in flexibility markets. The UK's DSO Totex approach, which combines Capex and Opex into a unified framework, has further enabled cost-effective solutions like flexibility services over traditional infrastructure, optimising network use and promoting flexibility markets.

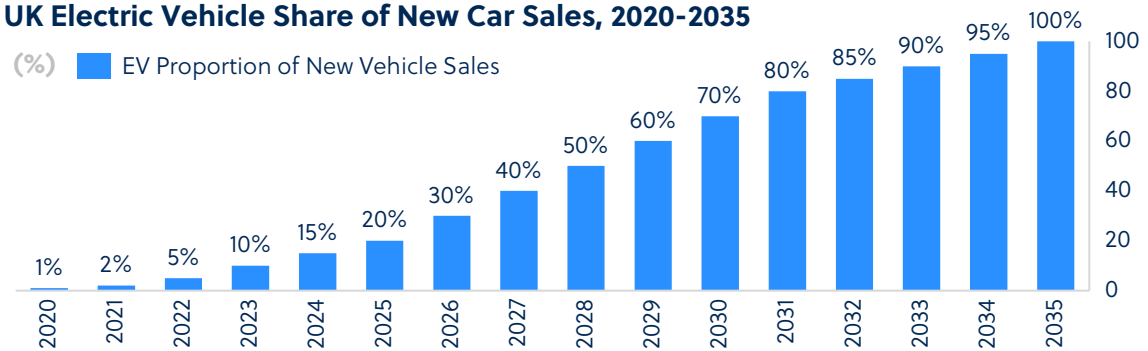
UK – CER, Policy and Regulatory Context

Market Overview	• The National Energy System Operator (NESO) serves approximately 67 million consumers across Great Britain (England, Wales, and Scotland). It manages approximately 26,550 circuit km of transmission lines and oversees 181 large power stations connected to the grid, with a total generating capacity of approximately 80GW. • Markets include energy (day-ahead and intraday), the Balancing Mechanism (real-time adjustments), ancillary services and the Capacity Market. • The Distribution Network Operators, UK Power Networks and National Grid, have transitioned into Distribution System Operators (DSOs), which involves a shift towards more active management of the network to integrate CER and flexibility services, where DSOs can procure flexibility from consumers to manage local network congestion.
Policy and Regulatory Context	• Office of Gas and Electricity Markets (Ofgem): The independent energy regulator for Great Britain, responsible for protecting consumers and regulating electricity markets • Department for Energy Security and Net Zero (DESNZ): Responsible for setting energy policy direction across Great Britain • National Energy System Operator (NESO): A newly formed independent, public corporation responsible for planning Great Britain's electricity and gas networks and operating the electricity system • Electricity Market Reform Delivery Body: Administers key electricity market mechanisms such as Contracts for Difference (CfD) and the Capacity Market • Competition and Markets Authority (CMA): Investigates and enforces competition law in the energy sector
CER Context	• UK Power Networks launched its dedicated DSO in 2023, marking a significant step in managing flexibility and integrating CER. • The NESO was established by the UK's 2023 Energy Act, and acts as an independent system planner and operator to accelerate the transition to net zero. • Over 1.4 million UK households have solar panels, representing about 5% of the country's 28.4 million households. The adoption of residential solar in the UK has been driven by schemes like the Smart Export Guarantee and rising energy costs. • The UK has set targets for zero-emission vehicles, requiring 80% of new cars and 70% of new vans to be zero-emission by 2030, increasing to 100% by 2035.

UK Cumulative Number of Households with Solar Panels, 2020-2024



UK Electric Vehicle Share of New Car Sales, 2020-2035



Notes: The EV forecasts have been sourced from the UK Office For Budget Responsibility's Economic and Fiscal Outlook Report Chart C: Electric vehicle share of new car sales.
Sources: Department for Energy Security and Net Zero -Solar photovoltaics deployment (2025); UK Office For Budget Responsibility - Economic and Fiscal Outlook Report (2025); Sunsave - How many homes have solar panels in the UK? (2025)

UK – CER Market Settings and Mechanisms

Key drivers for CER participation	

	• **Regulatory Initiatives**:
	  • **The Open Networks Project** is a strategic initiative that brings together all electricity network companies, the NESO, the government, the regulator and the wider industry to lead the UK's transition to a smart, flexible energy system, driven by the government's Smart Systems and Flexibility Plan
	  • **Totex Approach** implemented by Ofgem incentivises utilities to optimise asset interventions, including the integration of CER. This approach encourages a holistic view of network management, where flexibility services are prioritised over traditional infrastructure investments
	• **Market Coordination**: Simplified and flexible connection options for CER; participation in the Flexible Grid Connection regime; participation for aggregated CER in capacity auctions.

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key consumer barrier/challenges addressed	Stakeholders supported	Relevance to the NEM
Capacity Market Mechanism	A competitive auction process where energy and demand response providers can secure payments for being available when required, ensuring sufficient capacity to meet future electricity demand.	• **Lack of Market Integration:** Allows both large consumers and aggregated smaller consumers to participate in capacity auctions through demand response providers.	• CER owners • Consumers.	Can offer insights for CER participation in capacity markets, if such a reform is considered for the NEM.
Open Networks Project	A major industry initiative aimed at enabling homes, businesses and communities to flexibly use and provide clean energy back to the networks through standardisation of processes, improving operational coordination and improving transparency.	• **Lack of Confidence and Trust in the Market**: Seeks to reduce the complexity in the UK electricity system. Additionally, addresses concerns about limited consumer empowerment and understanding.	• DNSPs • Energy retailers • CER owners • Consumers	Example of a model for integrating CER and improving network flexibility in a complex energy system across day-ahead, real-time and capacity markets with multiple market actors.
Flexible Grid Connection Regime	Enables consumer-led CER to participate in demand response programs and offer grid services like frequency response and voltage regulation in exchange for payments. This also offers flexible connection options for CER, allowing them to connect to the grid without the traditional, costly and time-consuming processes.	• **Lack of Market Integration:** Seeks to reduce market complexity of CER participation to encourage consumer engagement	• DNSPs • CER owners • Consumers	Removes barriers to CER participation through simplified connection processes tailored to CER's flexible nature.
Local Markets for Flexibility Services[1]	DNO Flexibility Services in the UK are local distribution markets allowing CER to provide various grid services to the local distribution grid. These marketplaces are valuable for enabling CER to participate in and contribute to grid balancing services, monetising their flexibility.	• **Participation Thresholds:** Allows both large consumers and aggregated smaller consumers to participate in grid services.	• DNSPs	Promotes CER integration and uptake through increased value streams for the provision of local grid services.

Notes: [1] These local markets were influenced by the Open Networks Project but are now independent initiatives that are planned to continue to evolve beyond the end of the Open Networks Project.
Sources: EMR Settlement - What is the Capacity Market (CM) and why do we need it? (2025); UK Government - Capacity Market: 10-year review (2024); The Oxford Institute for Energy Studies - Harnessing the Power of Distributed Energy Resources in Developing Countries: What Can Be Learned from the Experiences of Global Leaders? (2023); Energy Networks Association Open Networks Programme

Open Networks Project | Deep Dive

Mechanism overview:

- The Open Networks Project is led by the Energy Networks Association (ENA), is a strategic initiative that brings together all 9 electricity network companies, the NESO, the UK Government, the regulator and the wider industry to lead the UK's transition to a smart, flexible energy system, driven by the Government's *Smart Systems and Flexibility Plan*. The Open Networks Project is part of the UK's broader DSO (Distribution System Operator) transition.
- Focus areas of the Open Networks Project include: opening local flexibility markets to demand response, renewable energy and new low-carbon technology and removing barriers to participation, opening data to allow these flexible resources to identify the best locations to invest, and delivering efficiencies between the network companies to plan and operate secure efficient networks. Objectives include the standardisation of flexibility services, operation coordination between Distribution Network Operators and the Electricity System Operator and transparency in network development plans. Key workstreams include network operation, market development and planning and network development.

Operation of the mechanism

- The Open Networks Project standardises flexibility services, including prequalification processes, contracts, dispatch APIs and settlement mechanisms, to create a consistent and transparent market. CER can bid into local flexibility markets to provide services such as demand response, generation curtailment or storage dispatch. These products are standardised across the UK, ensuring a uniform experience for flexibility providers.
- The Open Networks Project enhances transmission-distribution interfaces and data sharing to improve coordination between network operators. This ensures that CER can operate seamlessly across different parts of the grid without conflict. CER data is also used to enhance network planning and demand forecasting. Real-time monitoring of CER enables network operators to manage grid constraints and optimise CER dispatch, including curtailment instructions during network congestion and verification of flexibility service provision.
- CER owners/aggregators are able to stack revenue by participating in multiple markets (e.g., wholesale and local flexibility services) without conflict. The project ensures that rules for revenue stacking are clear and fair, maximising CER value. CER can also provide non-network solutions.

Key insights to date

- The Open Networks Project has significantly **expanded flexibility** in the UK market, growing from 0.1GW to nearly 3GW, making it Europe's largest local flexibility market.
- In 2022, a record 3.7GW of flexibility was tendered, with 2GW contracted by July. This capacity is equivalent to powering over 4 million homes or connecting 2.8 million EV charge points without additional infrastructure.
- **The project has standardised processes** including prequalification processes, contracts, dispatch APIs and settlement mechanisms **across DNOs and the NESO, simplifying participation in local flexibility markets.** This standardisation reduces complexity, lowers barriers to entry and increases participation in flexibility markets. This contrasts with Australia, where coordination is more complex due to multiple DNSPs and diverse technical standards across states, which many stakeholders have flagged as a key challenge in the NEM with CER integration.
- **Focus on improving transmission-distribution interfaces, data sharing and ensuring consistent operational rules** has enhanced coordination between network operators and improved network planning capabilities.
- **Emphasis has been given to improving customer experience** through standardised connection processes and clear access rights, as well as transparent reporting of Network Development Plans and associated carbon impacts to improve market predictability. However, evidence of consumer empowerment is still lacking.

Consumer barriers intended to be addressed

Complexity in Systems and Services	Lack of Market Integration	Participation Thresholds
Standardising flexibility services to increase participation in flexibility markets.	Focus on improving transmission-distribution interfaces, data sharing and consistent operational rules.	Standardising flexibility services to increase participation in flexibility markets.

Impact on Consumer Barrier Reduction

- High Impact
- Medium Impact
- Low Impact

Sources: Rennie Analysis; Open Networks Project Documents & Publications; Energy Systems Integration Group – An assessment of UK and Australian Open Network initiatives (2022); ENA - Open Networks 2023 Success Framework Details of key outcomes (2023)

Open Networks Project | Deep Dive

Considerations for the NEM

Market design differences	• The Open Networks Project focusses on the standardisation of flexibility products (as well as prequalification processes, contracts, dispatch APIs and settlement processes), whole of system coordination and transparency in Network Developments Plans, and carbon impacts. • In terms of DER integration, the UK is focussing on standardised access rights and contracts, whereas the NEM is focussing on Flexible Trading Arrangements. In terms of pricing, the UK is focussing on local flexibility pricing with capped network fees, whereas the NEM is focussed on connecting CER with the spot market. • Generally, the NEM is also undertaking incremental reforms to integrate CER and demand response into existing arrangements. For example, Project EDGE focussed on the development of a DER Marketplace with wholesale market integration, a scalable data exchange and local grid services, as well as developing Dynamic Operating Envelopes to manage DER operations within network constraints to ensure grid stability.
Relevance for the NEM and market participants	• The Open Networks Project has standardised flexibility services to create a consistent and transparent market. This has led to increased participation in local flexibility markets. NEM arrangements currently lack the same level of standardisation and market fluidity seen in the UK. • The Open Networks Project has also developed clear rules for revenue stacking and primacy, enabling flexibility providers to offer multiple services without conflicts. This has streamlined market participation. • The UK's energy regulator, Ofgem, plays a central role in overseeing implementation of reforms and ensuring alignment with national energy goals. Regulatory frameworks in the NEM are less centralised, leading to fragmented initiatives and a lack of coordination. Project EDGE has aimed to overcome this in some respect, however the lack of a centralised coordinating body to progress the CER Roadmap and associated reforms remains. Similarly, while the UK involves all network operators, relevant Government bodies and some NGOs to align market design, the decentralised oversight model in the NEM has ultimately led to regulatory lag. • The Open Networks Project also emphasises empowering consumers through new technologies and services. NEM arrangements aim to deliver consumer benefits but has a stronger focus on technical solutions and DER optimisation rather than consumer-centric market reforms.

Considerations for the NEM	• **Central coordination of the CER policy framework can deliver significant benefit.**
	  • The Open Energy Networks program in Australia attempted to do something similar, but did not go to the same level as Open Networks in the UK.
	  • Engagement-driven consensus across all stakeholders and accelerated market reforms are key drivers to CER participation.
	• **Well-considered transmission-distribution interfaces and data sharing requirements will enhance coordination between network operators for system management, demand forecasting and system planning.**
	• **CER needs to be able to stack revenue by participating in multiple markets (e.g., wholesale and local flexibility services) without conflict.**
	• **Standardisation of services and standards reduces complexity, lowers barriers to entry and increases participation in flexibility markets.**
	• **Even in a well-coordinated ecosystem, there is still room for improvement in terms of end-consumer engagement and empowerment.**

Sources: Rennie Analysis; Open Networks Project Documents & Publications; Energy Systems Integration Group – An assessment of UK and Australian Open Network initiatives (2022).

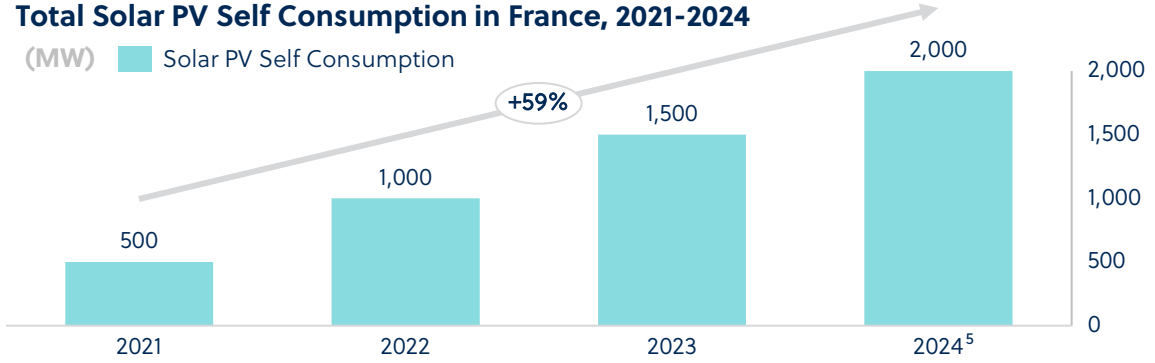
France

France's experience in load management highlights the importance of lowering participation thresholds, as seen in its NEBEF mechanism with a 100kW aggregation threshold. This approach has expanded CER participation by reducing barriers and introducing flexible dispatch protocols, such as longer activation lead times. Simplified administrative processes and aggregation-friendly market designs have further enhanced system flexibility and boosted consumer engagement in energy markets. While NEBEF primarily targets load reductions, it represents a step toward integrating demand-side resources into the energy market.

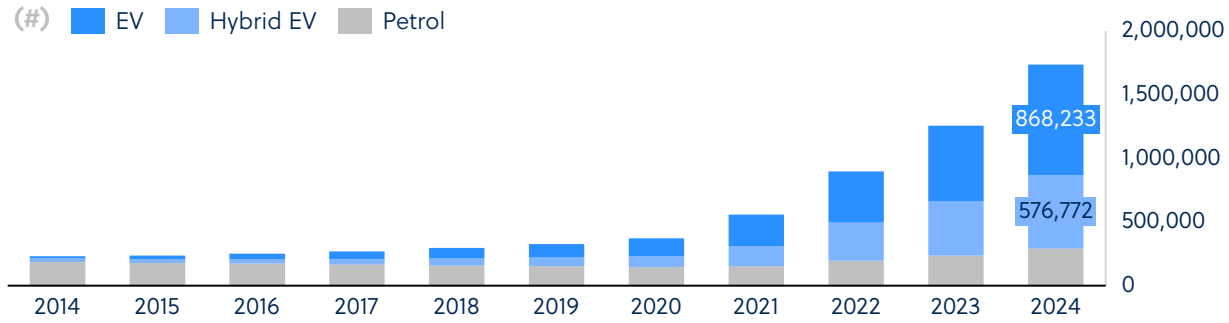
France – CER, Policy and Regulatory Context

Operations and Responsibilities	• RTE (Réseau de Transport d'Électricité), France's Transmission System Operator, serves approximately 35 million consumers across France's mainland regions. It manages approximately 106,000km of high and ultra-high voltage transmission lines and oversees 144GW of installed generation capacity from various energy sources, including nuclear (67%), renewables (31%) and others (2%)[1] • As RTO and ISO, RTE operates the energy markets (day-ahead and intraday), ancillary services market and capacity market • The French electricity distribution network is managed predominantly by Enedis, a subsidiary of EDF, which oversees 95% of the network and the rest is managed by local companies. The retail and generation network also predominately managed by EDF[2]
Policy and Regulatory Context	• Energy Regulatory Commission (CRE): Regulates electricity and gas markets, ensuring non-discriminatory grid access and overseeing tariffs • Ministry of Ecological Transition: Sets national energy policies, including the Multiannual Energy Plan, and approves major transmission projects • Dispute Settlement and Sanctions Committee (CoRDiS): Resolves disputes between grid users and operators[3] • French Competition Authority: Monitors anti-competitive practices in the energy sector and works in cooperation with the CRE to ensure fair competition in the French energy markets and has the power to investigate and impose sanctions on companies engaging in anti-competitive behaviour[4]
CER Context	• France set a demand-side response goal of 6.5GW by 2028 • At the end of 2023, 48% of photovoltaic installations in mainland France, representing 11% of installed capacity, were BTM (i.e., partial or total self-consumption). Installed BTM capacity has increased by 71% since 2022 • As of 2024, France had more than 1.4 million electric vehicles (2.2% of the total vehicles), with electric vehicles accounting for 20.1% of new registrations in August 2024

Total Solar PV Self Consumption in France, 2021-2024



Uptake of Electric, Hybrid and Petrol Vehicles in France, 2014-2024



Notes: [1] This % breakdown has been taken from RTE's Electricity Analysis and Data Statistics in 2024. [2] Since 2000, France's energy market has shifted from EDF's state monopoly to a more competitive system. While EDF dominated all aspects of electricity from 1946, generation and supply are now open to competition. [3] CoRDiS comprises four members, including two from the Conseil d'Etat (French Council of State) and two judges from the Cour de cassation (France's Supreme Court). Its primary responsibilities include settling disputes concerning access to and use of public electricity and gas networks between operators and users, and penalising infringements of the Energy Code and Regulation on Wholesale Energy Market Integrity and Transparency regulations. [4] As demonstrated by the €300 million fine imposed on EDF and its subsidiaries in 2022 for abusing their dominant position. [5] This data is based on the final quarter of the previous year, so relates to the end of 2024 data.

Sources: EU Commission France: over 2 million rechargeable vehicles in 2024 (2025); RTE - Mid-term adequacy report (2020);International Energy Agency (IEA) - Demand response (2023); European Parliament - France's climate action strategy (2024); Reuters - Electricity regulation in France: overview (2020); SDS - Data and statistical studies or climate change, energy, environment, housing, and transport (2024) Ministere De La Transition Ecologique – Data Lab – Key Figures on Renewable Energies (2024); RTE Electricity Analysis and Data – Generation (2025)

France – CER Market Settings and Mechanisms

Key drivers for CER participation	• **Regulatory Initiates:** France has a high smart meter penetration rate, with 93% of electricity meters now smart meters, supporting consumers to make informed decisions about their consumption patterns, manage their load and participate in demand response services; the Block Exchange Notification of Demand Response (NEBEF) allows third-parties, including aggregators, to offer demand response in the wholesale electricity market • **Market Coordination:** Demand response aggregators can declare their schedules from the day before and up to 1 hour before the start of load reduction, enhancing market responsiveness • **National Policies:** France aims to reduce final energy consumption by 50% by 2050 compared to 2012 levels. This target promotes the adoption of CER and encourages consumer engagement in energy management and load management services

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key consumer barrier/challenges addressed	Stakeholders supported	Relevance to the NEM
French Capacity Market	A decentralised capacity market that was designed to ensure electricity supply is available in winter by obligating suppliers to cover peak consumption. Generators (including CER aggregators) are required to meet CO2 limits to be certified by RTE (the French transmission system operator) and to earn capacity guarantees. Demand response services can voluntarily participate if they meet CO2 limits.[1]	• **Insufficient economic incentives:** Offering a revenue stream through capacity payments for resources that clear the auction and contribute to the reliability of the power system	• **CER Owners** • **ISOs**	Could offer insights for CER participation in capacity markets, if such a reform is considered for the NEM. Link to CO2 emissions provides a point of difference.
NEBEF (Notification d'Échange de Blocs d'Effacement) Capacity Market Mechanism	This scheme benefits consumers by allowing them to participate in electricity markets (ahead of RTE's operational window for balancing the power system) with their demand response capacity in the same way as generation capacity and without the need to inform their supplier or ask their consent. A consumer can participate: • directly by becoming a "demand response aggregator", if it has a minimum demand response capacity of 100kW; or • indirectly, calling on a third-party aggregator. The consumer then receives payment according to the terms of the contract with the aggregator.	• **Minimum thresholds for participation:** The scheme allows consumers with a minimum demand response capacity of 100kW to participate directly as a "demand response aggregator".	• **CER Owners** • **ISOs** • **Aggregators**	Important to understand the NEBEF mechanism's approach to demand response integration, aggregator models, trading relationships and flexible scheduling and to review in comparison with the NEM's current frameworks for demand-side participation market access for aggregators.[2]

Notes: [1] This requirement aligns with broader European regulations aimed at reducing carbon emissions in the energy sector. While traditional demand response methods like simply reducing consumption (e.g., turning off non-essential equipment) would easily meet CO2 limits, some demand response approaches (e.g., using on-site diesel backup generators) may exceed the emission limits. The CO2 emission limit for participation is set at 550g CO2 of fossil fuel origin per kWh of electricity. All generation capacities (including battery storage) that comply with the CO2 emission limits in accordance with Article L.335-3 of the French Energy Code must participate in the capacity mechanism by getting certified. It is not an obligation for demand response capacities to participate in the capacity mechanism, but they must respect CO2 emission limits to receive capacity remuneration. [2] The energy regulator (CRE) notes that the adjustments of NEBEF's rules over time led to an increase in the volume and the number of actors involved and, in 2021, it was estimated that 95% of sector revenues were capacity related.
Sources: RTE - Overview of market mechanisms managed by RTE (2024); ENEFIRST - Participation Of Demand Response In French Wholesale Electricity Market (2020); The Conversation - France: The road to a low-carbon building sector by 2050 will be a long one (2018); EU Commission - Electricity capacity markets (2025); RTE - Be remunerated for your generation and consumption flexibilities (2024)

NEBEF | Deep Dive

Mechanism overview:

- Introduced in 2014, the NEBEF (Block Exchange Notification of Demand Response) mechanism is a French initiative designed to enable consumers to participate in energy markets through load reductions. It allows all consumption sites in mainland France to offer demand response services on wholesale power markets without requiring a supplier (i.e., retailer) agreement, either directly (with a minimum 100kW load reduction capacity) or through a third-party aggregator.
- The NEBEF scheme aims to organise financial flows between actors to allow for participation of demand response in the wholesale electricity market, including through aggregators.

Operation of the mechanism

The NEBEF (Block Exchange Notification of Demand Response) mechanism in France primarily focuses on demand response rather than broader CER integration. However, it does contribute to some aspects of CER integration:

- **Market Participation:** NEBEF allows consumers to participate in energy markets and capacity markets through load reductions, providing an additional economic area beyond the balancing mechanism.
- **Inclusivity:** All consumption sites in mainland France can participate, either directly (with a minimum 100kW load reduction capacity) or through a third-party aggregator.
- **Market Access:** Consumers can offer demand response services on wholesale power markets without requiring supplier agreement.
- **Equal Footing:** The mechanism enables demand response resources to compete directly with generation, aligning with the Energy Efficiency First principle[1].
- **Flexibility Valuation:** NEBEF organises financial flows between actors to allow for the participation of demand response on the wholesale electricity market.

While NEBEF primarily targets load reductions, it represents a step towards integrating demand-side resources into the energy market. Providers may nominate from a range of baseline methods, subject to eligibility – either using pre-event/post-event consumption, similar consumption history, or a self-nominated forecast. Each approach has its downsides, including failure in some cases to accurately reflect real-time conditions, and risk of manipulation that typically requiring mitigations (e.g., for self-nominations, earlier provision of forecasts and monthly accuracy monitoring).

Key insights to date

- Faces challenges with baseline accuracy, as variability in consumer behaviour, weather conditions and other external factors can lead to discrepancies between predicted and actual consumption reductions.
- While NEBEF supports load reductions, its activation times (e.g., 30 minutes or more for certain services) can be slower compared to other balancing mechanisms like Manual frequency restoration reserve and replacement reserve, limiting its ability to address fast-changing grid conditions effectively.
- From 2025, there will be a shift to 15-minute and 5-minute granularity for consumption data reporting, requiring significant system updates for new Load Shifting Operators.
- The Ministère de la Transition écologique et solidaire is working on a significant reform of this mechanism to allow for greater volumes.
- In 2024 the CRE indicates that, as expected, load curtailment is generally only profitable in tight market conditions. Load Shifting Operators report that 80%+ of their income comes from the capacity mechanism, with only 0-20% from other markets[2].

Consumer barriers intended to be addressed

Insufficient Economic Incentives	Complexity in Systems and Services	Lack of Market Integration	Participation Thresholds
Provides financial returns for load reductions, but supplier compensation may reduce the profitability for aggregators.[3]	Simplifies participation by allowing third-party aggregators to manage demand response processes	Explicitly allows demand response to compete directly with generation in wholesale markets	By enabling aggregation of smaller loads to meet the 100kW threshold, NEBEF significantly lowers entry barriers for smaller consumers.

Notes: [1] A guiding principle in EU energy policy that prioritises energy efficiency measures over new energy supply infrastructure when they are more cost-effective. This principle aims to enhance energy efficiency across the energy value chain, reduce energy system costs and support the transition to a climate-neutral economy. [2] As stated in the French Senate's Lighting the Future: Electricity to 2035 and 2050 Report. [3] NEBEF requires demand response aggregators to pay compensation to electricity suppliers affected by demand response activation, as specified in Articles L.271-3 and R.271-8 of the French Energy Code. This compensation is based on regulated energy prices, which can reduce the net profitability for aggregators. The supplier compensation framework under NEBEF is indexed to previous spot prices and has been noted as a design barrier, potentially limiting the attractiveness of the mechanism for demand-side response players.
Sources: RTE - NEBEF compensation payment (2024); French Senate's Lighting the Future: Electricity to 2035 and 2050 – Report (2024); TotalEnergies – The methods of control of the achievement (2025).

Impact on Consumer Barrier Reduction

- High Impact
- Medium Impact
- Low Impact

NEBEF | Deep Dive

Considerations for the NEM

Market design differences	• France operates a net pool model with a decentralised capacity mechanism that requires suppliers to secure guaranteed capacity, while the NEM uses a gross pool market structure without a formal capacity mechanism (the Retailer Reliability Obligation (RRO) has features of a decentralised capacity mechanism). NEBEF is designed to work alongside France's capacity market, while the NEM is adapting demand response within its energy-only market structure[1].
Relevance for the NEM and market participants	The NEM does not currently have an exact equivalent to NEBEF, but it has been implementing various demand response mechanisms: • The WDRM was introduced in October 2021, allowing large customers and aggregators to bid demand reductions into the wholesale market. • The RRO encourages retailers to contract with dispatchable resources, including demand response. The NEBEF mechanism in France offers insights for the NEM's ongoing reforms, including the AEMC's current (2025) review of the WDRM. The key differences between the mechanisms include: • **Participation thresholds:** NEBEF allows smaller consumers to participate through aggregation, whereas the NEM's WDRM is currently limited to larger consumers with annual consumption above 100-160MWh (threshold varies by jurisdiction). • **Dispatch protocols:** NEBEF allows for more flexible notification of demand response, while the NEM's WDRM requires scheduled participation in the spot market.

Considerations for the NEM	• **Considered market design can enable aggregations of small consumers to successfully participate in energy and capacity markets.**
	  • However, baselining consumption of small consumers has been challenging, as foreshadowed by the AEMC in its final decision on the WDRM rule.
	• **The value derived by individual small consumers from market participation may be low, so minimisation of barriers is important to incentivise participation.**
	  • As observed in other markets, lowering aggregation thresholds to 100kW supports greater participation.
	• **Bespoke bidding structures and requirements can enable greater consumer participation in the spot market.**
	  • In the case of the NEBEF mechanism, the ability for longer dispatch lead time has broadened participation.
	• **In markets that provide bifurcated energy and capacity revenue streams, CER participation can be enhanced by enabling eligibility for CER to earn capacity payments.**

Notes: [1] Demand response may be considered as a qualifying contract under the RRO.
Source: Mondaq - International Review Of Demand Response Mechanisms (2015); RTE - NEBEF compensation payment (2024)

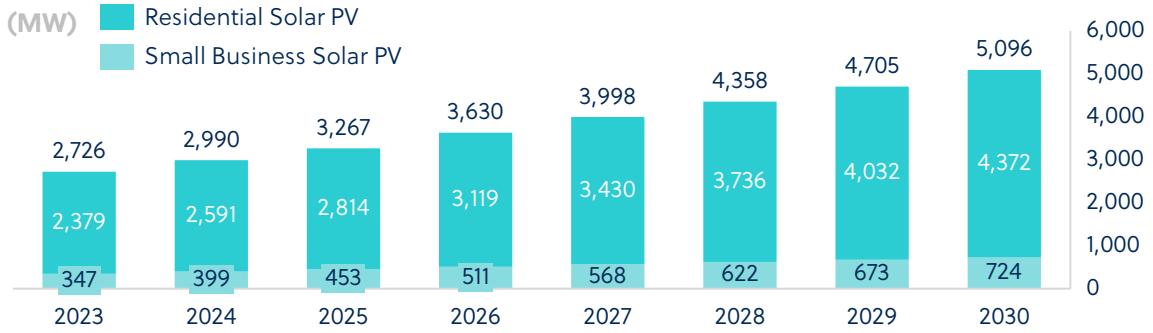
WEM

The WEM's experience in accounting for CER in its Reserve Capacity Mechanism offers valuable lessons for capacity market design. Customers can engage as demand netted from capacity targets, "sell-side" providers (e.g., aggregated CER), or "buy-side" purchasers (e.g., retailers hedging risks). The WEM shows that capacity mechanisms can be highly sensitive to design and that restrictive facility class obligations can limit CER participation despite technical readiness. Projects Symphony and Jupiter demonstrate how aligning market frameworks with CER capabilities and customer preferences can unlock CER potential.

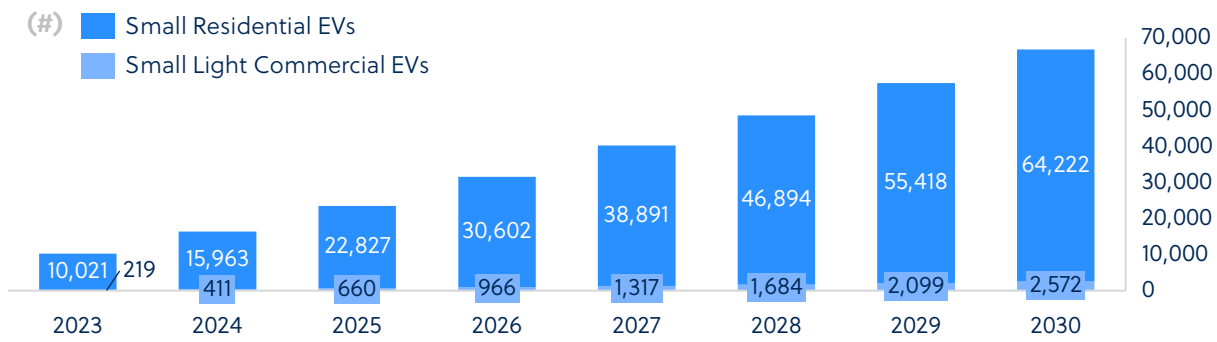
WEM – CER, Policy and Regulatory Context

Market Overview	• The Wholesale Electricity Market (WEM) in Western Australia serves over 1 million customers across the South West Interconnected System (SWIS), the largest isolated electricity grid in the world, which comprises of 7,750km of transmission and 93,350km of distribution lines, supplying approximately 20 TWh of electricity annually • The WEM includes energy (day-ahead and real-time) and essential system services (ancillary services) markets, and the Reserve Capacity Mechanism that seeks to ensure sufficient generation capacity to meet future demand. • AEMO operates as both ISO and market operator, while Western Power is the TNSP and DNSP, and Synergy has a regulated monopoly on electricity sales to residential customers and small businesses that do not consume large amounts of electricity (using less than 50,000kWh per year)
Policy and Regulatory Context	• Minister for Energy: Approves changes to Protected Provisions and makes amending rules. • Coordinator of Energy (statutory role that is the head of EPWA): Administers changes to the WEM Rules and conducts market reviews. • Energy Policy WA (EPWA): Supports the Coordinator of Energy in providing energy policy advice to the government. • Economic Regulation Authority (ERA): Monitors and enforces compliance with the WEM Rules. • Electricity Review Board: Adjudicates appeals related to WEM decisions and can make orders following rule breaches.
CER Context	• Approximately 40% of SWIS households have rooftop solar as of early 2025, approximately 2.8GW, with ~30,000 new systems added annually • Approximately 65MW of BTM battery storage was installed as at the end of 2024. • AEMO forecasts 1.4 TWh additional EV consumption in the SWIS by 2033-34

Total Residential and Small Business Solar PV Capacity in the WEM, 2023-2030



Uptake and Forecast Residential and Light Commercial Vehicles in the WEM, 2023-2030



Sources: WEM ESOO (2024); CSIRO - Electric vehicle projections 2023: update to the 2022 projections report Commissioned for AEMO's draft 2024 Forecasting Assumptions Update (2024)

WEM - CER Market Settings and Mechanisms

Key drivers for CER participation	
	• **Regulatory Initiatives**: Recent market reviews (e.g., Demand Side Response Review, Reserve Capacity Mechanism Review) are updating market settings to, among other things, improve frameworks for demand side and CER aggregation participation at greater scale. Further change will be informed by Project Jupiter (following from the Project Symphony/Encore pilots) • **Market Coordination**: Framework for CER aggregation participation in the Reserve Capacity Mechanism exists but faces market structure issues with restrictions on retail competition. CER aggregation can also participate in the WEM more broadly as a Small Aggregation facility but this concept is not fully defined in the rules and aspects are overly restrictive • **State Policies**: The WA Energy Transformation Strategy Taskforce produced a DER Roadmap out to 2025 (published 2020) which aims to plan the integration of DER resources into the South-West Interconnected System; this has been progressively updated through three progress reports

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key Consumer Barrier/Challenges Addressed	Stakeholders Supported	Relevance to the NEM
WEM Reserve Capacity Mechanism	The WEM Reserve Capacity Mechanism (RCM) aims to ensure sufficient generation capacity to maintain acceptable reliability of supply. This is achieved through setting reserve capacity targets annually[1] and the provision of 'Capacity Credits' for plant based on its ability to provide reserve capacity. Participation of demand side response in the RCM can be on: • the sell side, primarily through allocation of Capacity Credits to a **Demand Side Programme**. Small customers are unlikely to participate in this way, including via aggregators, as up-front customer acquisition and application costs may exceed benefits • the buy side, by reducing consumption during peak demand periods to avoid capacity costs. Theoretically, this could incentivise small customers to reduce their contribution to peak demand, but Synergy, as the monopoly retailer for small customers and dominant gentailer, faces diminished incentives as capacity costs are allocated proportionally, meaning it would still bear a significant share of the avoided cost.	• **Insufficient economic incentives:** Offering a revenue stream through Capacity Credits for resources providing reserve capacity.	• CER owners • Retailers • Aggregators • ISO, DNSPs	• Can offer insights for CER and demand response participation in capacity markets, if such a reform is considered for the NEM.
Market participation of CER aggregation	CER aggregations can participate in the WEM as a **Small Aggregation** facility – a collection of distribution-connected technologies at a single electrical location (i.e., transmission node). This facility type can also participate in Supplementary Capacity tenders (similar to RERT), which has less restrictive conditions. However, in practice, there are several limitations: • This facility type appears to only be included as a placeholder until DER Roadmap reforms are crystallised; • While this facility type can apply for Capacity Credits, it is practically difficult unless exporting to the shared network regularly (i.e., at times of peak demand); • This facility type can participate in FCESS,[2] but is limited by minimum capacity thresholds[3]; • Aggregation of sites is limited to a single transmission node (similar to the PJM model)	• **Participation thresholds**: Establishes a category of participation, however, is overly restrictive in terms of minimum thresholds and practicalities.	• CER owners • Aggregators • ISO, DNSPs	• Important to understand the implementation challenges and to review in comparison with AEMO's established registration process for Small Aggregators and the ability of aggregations to participate in current and future markets. • In the NEM, limitation of CER aggregation connection to a singular node may want to be avoided in any future market design.[4] • Understanding of similarities and lessons for the RERT.

Note: [1] AEMO accounts for the effect of CER on grid demand when determining the Reserve Capacity Target. [2] Frequency co-Optimised Essential System Service, analogous to FCAS in the NEM; [3] AEMO has specified a minimum capacity of 10MW for Regulation services and 5MW for Contingency Reserve services; [4] The approach in the WDRM allows for aggregation across nodes within a region except where this may compromise system security and management of constraints.
Sources: Rennie Analysis; Wholesale Electricity Market Rules; WA Government – DER Roadmap (2020); AEMO – WEM Market Design Summary (2023); EPWA – Review of the Participation of DSR in the WEM: Information Paper (2024)

WEM - CER Market Settings and Mechanisms (cont.)

Key Market Settings, Mechanisms and Features

Design/Feature	Description	Key consumer barrier/challenges addressed	Stakeholders supported	Relevance to the NEM
Project Jupiter – Live DER Market Trial	Using the findings and recommendation from Project Symphony, an earlier CER orchestration pilot, and building on earlier policy on DER Roles and Responsibilities, Project Jupiter intends to deliver the technical solutions to allow DER in the SWIS to be coordinated and participate in the market via Virtual Power Plants – through a live DER marketplace integrated with the wholesale market. It will develop new customer products, tariffs and education programs to support customer participation and allow customers to gain more value from their DER investments. Project Symphony found that, in terms of ability for CER aggregation to participate, access to the WEM is not limited by technical capability, rather it is limited by existing obligations that place barriers to participation, which are largely founded in a misalignment between the underlying technical capabilities of aggregated DER, customer preferences and the existing market framework (i.e., facility class registration arrangements).	• **Complexities delaying regulatory reform**: This project intends to centralise market trials and inform future reforms for the integration of CER. • **Lack of market integration**: this project intends to support the integration of distribution-level CER into the wholesale market. • **Limited consumer empowerment and understanding/lack of confidence in the market**: Education programs intend to support customer participation.	• CER owners • Aggregators • ISO, DNSPs	• Important to understand implementation challenges and to review in comparison with Project EDGE in the NEM. • Key learnings can be derived for NEM arrangements re. governance, customer experience, technical solutions and interoperability, value creation and policy/regulatory settings. • The results of consumer education programs could inform similar consumer engagement activities in the NEM.

Sources: Rennie Analysis; Wholesale Electricity Market Rules; WA Government – DER Roadmap (2020); ARENA – Unlocking a future energy market in Western Australia (2025); ARENA – Project Symphony – Lessons Learnt Report: Project Completion (2024)

WEM Reserve Capacity Mechanism | Deep Dive

Mechanism overview:

- The WEM Reserve Capacity Mechanism (RCM) operates on a four-year cycle, requiring AEMO to secure capacity from market participants two years in advance of its need. For example, in 2025, AEMO will be securing capacity for the period from October 2027 to September 2028 (Capacity Year).
- The primary objective of the WEM RCM is to ensure sufficient generation capacity to maintain an acceptable reliability of supply. This is achieved by establishing reserve capacity targets and issuing Capacity Credits to facilities based on their capability to provide reserve capacity, including accreditation of new facilities before they become operational.
- The WEM has lower energy price caps relatively to an energy-only market design, so effectively splits the energy-only revenue pool between its energy markets and the RCM. Capacity pricing is fixed annually.

Operation of the mechanism

- The RCM functions by issuing tradeable Capacity Credits to projects in exchange for their commitment to provide capacity during a specific Capacity Year. This ensures sufficient generation capacity to maintain grid reliability in SWIS during peak demand periods. Capacity Credits quantify the notional capacity (in MW) a facility must deliver in a given Capacity Year, providing an availability payment to suppliers.
- To obtain Capacity Credits, facilities must either submit an EOI or undergo an indicative facility class assessment. The allocation of these credits is influenced by several factors:
  - **Certified Reserve Capacity:** This evaluates a facility's physical capabilities, its commitment (e.g., access contracts with Western Power), and trade nominations; and
  - **Network Access Quantity (NAQ):** This imposes limits on a facility's capacity provision due to network constraints.
- Capacity Credits come with specific obligations, such as ensuring capacity availability[1] and adhering to outage planning requirements, with refunds payable for non-performance.

Key insights to date

- Participation of demand side response in the RCM can be on:
  - **The sell side**, primarily through allocation of Capacity Credits to a Demand Side Programme. Small customers are unlikely to participate in this way, including via aggregators, as up-front customer acquisition and application costs may exceed benefits; or
  - **The buy side** by reducing consumption during peak demand periods to avoid capacity costs. Theoretically, this could incentivise small customers to reduce their contribution to peak demand, but Synergy, as the monopoly retailer for small customers and dominant Gentailer, faces diminished incentives as capacity costs are allocated proportionally across energy consumers, meaning it would still bear a significant share of any cost avoided by a small subset of its customers.
- The WEM saw development of a large volume of demand response in its early days (with 560MW allocated Capacity Credits), but regulatory changes saw this almost completely disappear. It has only recently begun to return following updated regulatory arrangements influencing both the price and the measurement of quantity of demand response[2].

Consumer barriers intended to be addressed

Insufficient Economic Incentives	Lack of Market Integration	Participation Thresholds
Offering a revenue stream through Capacity Credits for resources providing reserve capacity.	Facilitates integration with wholesale markets, allowing demand side response to participate alongside traditional resources	Allows participation of demand side response in wholesale markets, however up-front customer acquisition and application costs may exceed benefits

Notes: [1] Precise requirements vary by facility type. [2] Demand response resources were arguably over-rewarded up until September 2017 – earning the same Reserve Capacity Price as generation capacity but with low availability requirements and a generous baseline calculation. Rule changes commencing October 2017 arguably over-reached – paying a lower capacity price for demand response, applying a punitive baseline calculation and increasing availability requirements – resulting in a reduction in Capacity Credits allocated to demand response from 560MW in 2026-17 to 57MW in 2018-19 as it became significantly more lucrative for customers to make targeted reductions to consumption to reduce their share of the cost of Capacity Credits. Recent rule changes have restored price parity between generation and demand response and implemented a new baseline calculation, with 110MW of new demand response capacity commencing in October 2026.
Sources: Rennie analysis; Wholesale Electricity Market Rules; AEMO – WEM Market Design Summary (2023); Allens - The Reserve Capacity Mechanism and eligibility criteria (2024); WA Government – Improving Reserve Capacity pricing signals – a recommended capacity pricing model, Final Recommendations Report (2015); AEMO – Assignment of Capacity Credits (2024).

Impact on Consumer Barrier Reduction
High Impact
Medium Impact
Low Impact

WEM Reserve Capacity Mechanism | Deep Dive

Considerations for the NEM

Market design differences	• The WEM is a capacity-plus-energy market, where generation capacity is accredited and remunerated through the separate RCM to take a 'hands-on' approach to ensuring reliability of supplying the geographically isolated SWIS. • Alternatively, the NEM operates as an energy-only market without a formal capacity mechanism, instead relying on price signals (including a high market price cap), contract and futures markets, Reliability and Emergency Reserve Trader (RERT) and the Retailer Reliability Obligation (RRO) mechanisms as an approach to forward-looking capacity management.

Relevance for the NEM and market participants	• The NEM operates an energy-only market, which does not currently feature a capacity market. Instead, the NEM relies on a combination of market mechanisms and regulatory frameworks to ensure reliability of supply. This includes:
	  • **Reliance on market signals** – with forward contracting and contract/futures markets to ensure investment in new capacity, where generators and retailers manage risks through derivative contracts;
	  • **RERT** – where AEMO procures emergency services during periods of insufficient supply (emergency only);
	  • **RRO** – requiring retailers to contract sufficient capacity to cover their share of peak demand, encouraging forward contracting and hedges against supply shortages.
	• If the NEM was to introduce a capacity market, the operation of the WEM RCM can offer insights for CER and demand response participation. This can include:
	  • **On the sell side**, incentivising small customers to participate, including via aggregators, by ensuring up-front customer acquisition and application costs do not exceed any benefits of participating in the capacity market; or
	  • **On the buy side,** making sure dominant Gentailers (e.g. Origin, AGL, EnergyAustralia) do not face diminished incentives.

Considerations for the NEM	• Customers can interact with capacity markets/mechanisms in different ways: netted out of demand prior to setting capacity targets, as 'sell-side' capacity providers, and/or as 'buy-side' capacity buyers. • If a centralised capacity market or mechanism was to be introduced, involving a bifurcation of the revenue in the existing energy-only market, it will be vital to ensure that the same opportunities are available to CER owners and aggregators to access value in return for contributions to the power grid. • Capacity mechanism operation can be highly sensitive to rules and design parameters, as evidenced by the history of demand response in the WEM.

Sources: Rennie Analysis; National Electricity Rules; Wholesale Electricity Market Rules; AEMO – WEM Market Design Summary (2023); Allens - The Reserve Capacity Mechanism and eligibility criteria (2024).

4. Stakeholder insights on CER integration challenges and opportunities in the NEM

Key stakeholders active in the CER landscape were engaged to understand key participation barriers and opportunities in the NEM

Key stakeholder groups engaged

Organisations	Stakeholder Group	Reasons for Engagement
AEMO	AEMO Reform Delivery Team	To understand AEMO's perspective on limitations of the current wholesale market settings and opportunities for change.
AEMC AUSTRALIAN ENERGY MARKET COMMISSION	AEMC Consumer, Markets and Analytics Team	To understand the AEMC's latest thinking on CER integration, especially around consumer protections through interoperability standards and opportunities for better CER participation through pricing reform.
Ausgrid AusNet services	DNSPs	To explore network challenges and opportunities associated with integrating CER into the grid, including dynamic operating envelopes, capacity allocation and network support benefits. We engaged AusNet and Ausgrid due to their involvement in trials such as AusNet's solar flexible exports trial and Ausgrid's Project Edith DER integration initiaves.
TESLA enel X	Retailer/Third Party Aggregators	To understand what is currently working, identify gaps related to wholesale market interactions and gain any insights from consumer feedback on wholesale market CER trials. We engaged Enel X and Tesla due to their extensive VPP experience, including Enel X's ARENA-supported 50MW demand response project and Tesla's South Australia VPP.
Energy Networks Australia	Other Peak Industry Bodies/ Consumer Representative Groups	To gain diverse perspectives on market integration of CER, emerging technologies and industry-specific challenges and opportunities. We engaged with ENA on advocacy for community batteries and flexible export models.
	Independent industry experts	Using Rennie's key contacts, we engaged with a diverse range of stakeholders, including members of an advisory board for a Victorian energy distribution network, a senior executive from a technology platform specialising in CER visibility, and a national leader in energy policy and research from a well-known social services organisation.

Source: Rennie Analysis

Current economic incentives are seen as insufficient, and a lack of coordination prevents the value stack from being fully realised

NEM – Stakeholder Insights – Economic incentives and participation thresholds

Overview

- Current economic incentives are seen as insufficient by stakeholders and there is consensus the CER value stack is not being realised
- Stakeholders noted there is a need for more dynamic pricing models and better financial incentives to overcome issues with social licence and customer motivations
- Stakeholders also highlighting a need for more government incentives with clear communication on purpose
- Participation thresholds were also seen as a blocker to uptake, especially in a nascent market

Current economic incentives alone are insufficient to motivate consumer participation

"Our understanding from trials is that a financial incentive wasn't big enough to move the dial for consumers"

"Financial incentives alone weren't enough to encourage customers to 'hand over the keys' for VPP programs."

"Why would people allow their energy usage to be controlled, especially if it comes at a cost? The value proposition simply hasn't been validated."

"The concept of value stacking is really important – particularly where people are putting up their hand and using their resources to deliver a dependable resource, it needs to be valued. It needs to be recognised, no different to if a large generator or grid-scale battery was providing some form of network service."

Participation thresholds may be a barrier to deriving value

"The current 1MW participation threshold could be reviewed, with some stakeholders expressing that it may deter smaller participants and that a shift to a 100kW threshold may be beneficial."

There is a need for a more coordinated approach across industry participants to ensure the value stack can be realised

"I think it's important for the various market participants to work together and work in a coordinated way. And that's not really happening a great deal."

"Lack of central coordination of CER participation is preventing the full value stack from being realised"

Note: Quotes have been deidentified at the request of stakeholders. Some quotes have been combined or paraphrased where multiple stakeholders have made similar observations.
Sources: Rennie market intelligence; Rennie research and analysis (2025).

Inconsistent technical standards across networks complicate integration, creating challenges for OEMs, operators and security

NEM – Stakeholder Insights – Technical Standards

Overview

- Stakeholders viewed consistency in technical standards as a major barrier for CER uptake in Australia
- The stakeholders interviewed all called for faster reform in this area and the application of consistent standards across DNSPs
- There was also a call for more central coordination and a more unified approach of technical standards and alignment with international standards, especially given that Australia is a relatively small market

The lack of unified standards across different jurisdictions complicates CER integration

"Each network has its own test protocol for inverter standards (CSIP-AUS), which complicates integration."

"Australia is recognised as a small market, in the global context, having multiple fragmented standards across jurisdictions makes it difficult for OEMs to operate effectively and reduces commercial appeal and incentives for participating in the Australian market."

"There is an importance of getting agreement on standards – if we end up with a fragmented set of standards, across multiple jurisdictions that becomes very hard for OEMs to operate within that space."

Cybersecurity is a key challenge, with the rollout of new emerging technologies requiring real time control and flexible exports

"Interoperability requires standards across devices, markets, and access, along with strong encryption and cybersecurity and we are not seeing this across industry – this is creating challenges in data exchange and market dynamics due to information asymmetry."

"Cybersecurity concerns are significant, especially with flexible exports being rolled out."

"Security is critical – we will have GWs of CER being controlled in real-time and that's a huge challenge."

"There remains a layer of communication standards relating to CER that lacks standardisation, resulting in high integration costs and significant risks of cybersecurity breaches and non-compliance – this CER data exchange component is crucial."

Note: Quotes have been deidentified at the request of stakeholders. Some quotes have been combined or paraphrased where multiple stakeholders have made similar observations.
Sources: Rennie market intelligence; Rennie research and analysis (2025).

Dynamic pricing models and principle-based regulation were recommended as solutions to unlock greater consumer benefits

NEM – Stakeholder Insights – Pricing Models

Overview

- A key topic for stakeholders was pricing reform, acknowledging the work being undertaken by the AEMC in this area while also calling for innovation, especially in relation to network pricing models
- Implementing dynamic pricing models and offering a greater range of tariffs was said to unlock more value for consumers by offering more personalised pricing based on behaviour and consumer preferences
- There is a call for principle-based regulation to facilitate more flexible and faster pricing resets, allowing for more dynamic market responses.

Dynamic pricing models and a greater range of tariffs could unlock more value for consumers

"The current framework really inhibits our ability to be more dynamic (i.e., revenue determinations that are not conducive to innovation)"

"There needs to be a menu of network pricing options, including flat tariffs"

"Australia has a history of cost-reflective tariffs and the best thing we can do with CER is through tariffs that offer implicit flexibility, such as time-of-use pricing or solar soak tariffs, this approach is more scalable and suitable for targeting smaller CER customers."

Principle-based regulation is needed for market evolution/more flexible pricing structures

"Moving more to a principle-based regulation, and I think we're very supportive of that, faster iterations of the pricing resets would be beneficial, even like a bit of relaxation of that regulation might help in terms of being more dynamic and being able to offer prices that are more reflective of the market."

"Five-year regulatory environment acts as handbrake for innovative pricing models"

"The current tariff structure acts as a barrier, it's clear that the system needs to change. We should incentivise desired outcomes not just in the short term, but also in the long term – and we're not there yet."

Note: Quotes have been deidentified at the request of stakeholders. Some quotes have been combined or paraphrased where multiple stakeholders have made similar observations.
Sources: Rennie market intelligence; Rennie research and analysis (2025).

Market reform and integration are being hindered by unclear roles and responsibilities and limited data visibility

NEM – Stakeholder Insights – Market integration, coordination and pace of reform

Overview

- The lack of a formal entity to effectively coordinate CER presents significant integration challenges and lost opportunity
- This is exemplified through the limited visibility into low-voltage networks and underdeveloped grid services opportunities
- The slow pace of reforms, such as DSO role definition, and constraints on data sharing delay CER participation. In the meantime, DNSPs are forced to react to, and implement expensive systems to manage, policy measures such as the backstop mechanism
- Ring-fencing rules restrict DNSPs ability to deliver innovative CER solutions as the focus remains on traditional models and definitions for Capex

The slow evolution and unclear roles of DSOs means that there is no formal entity to coordinate CER

"There is a definition of DSO the in the NER. It has nothing to do with what we're talking about. DSO isn't really defined anywhere consistently."

"DNSPs are seen as the logical entities to manage the DSO role due to their operational focus on managing local networks. However, there is debate over whether this role should sit with AEMO or DNSPs. "

The lagging pace of reforms is impeding CER participation

"To accelerate progress, it's about maintaining momentum and taking action rather than waiting for new rules or interventions."

"There's a common consensus that if we're going to implement some of these reforms, it needs to be at an overhaul level rather than this incremental approach."

Data sharing constraints and a lack of low voltage (LV) visibility restrict networks' ability to engage CER actively in markets

"LV data has been super difficult for DNSPs to get a hold of and is a major challenge for networks"

"LV data is really important as it gives you that localised view of what's happening on the network and it's just hard to get."

"The data set that's not available makes it hard for third parties is understanding which areas have got network constraints."

DNSPs' ability to deliver innovative CER solutions is constrained by ring-fencing rules

" Ring-fencing needs to be looked at far more strategically and far more pragmatically, for the benefit of the customer because it's the customers who are losing out here from higher cost"

"Current ring-fencing rules limit the ability of DNSPs' batteries to be included in RAB unless they contribute to network services."

Note: Quotes have been deidentified at the request of stakeholders. Some quotes have been combined or paraphrased where multiple stakeholders have made similar observations.
Sources: Rennie market intelligence; Rennie research and analysis (2025).

Social licence is being eroded by unclear communication and reactive policy, as consumers seek energy independence

NEM – Stakeholder Insights – Consumer confidence and trust in the market and empowerment

Overview

- Managing consumer expectations and earning trust is crucial throughout the process of integrating CER as flexible responsive assets
- Current policies, such as backstop mechanisms and export tariffs, complicate social acceptance and exacerbate consumer distrust
- Consumers are primarily motivated by energy independence and self-consumption, resisting external control over their assets.
- It's essential to ensure that the benefits of CER are equitably distributed among all consumers, not just those who own CER.

There is a lack of clear communication and realistic expectation setting for CER consumers	*"The education piece is challenging for small CER resources, it's very taxing to have to educate extensively."*	*"Managing expectations is a key thing throughout this whole process, and earning consumer trust is valuable capital"*
	"The consumer trust and social licence aspect of it is a huge challenge"	
The spread of CER costs is disproportionately affecting consumers	*"A challenge with CER is who bears the cost. As more consumers adopt solar, it increases network charges for those without solar, disproportionately affecting vulnerable customers."*	*"Consumers have installed solar systems mainly to earn money back through high tariffs, often unaware that these systems are subsidised by **all** consumers.*
Reactive policy measures complicate social license	*"The backstop mechanism has forced DNSPs to address CER integration challenges in a reactive manner."*	*"Been bad at engaging with communities on the transition – we haven't properly told people why we have the backstop mechanism."*
	"Communication around export tariffs has been poor, and almost deliberately negligent ."	
Consumer behaviour is primarily driven by energy independence	*"Telling consumers their assets will be controlled or turned off is a big turn-off. It's diametrically opposite to what they want – they want to be off grid and have a self consumption maximised and low bills."*	*"There's a disconnect between the altruistic view of maintaining the grid for greater good and realistically individuals who install solar and batteries to achieve independence and self-reliance."*

Note: Quotes have been deidentified at the request of stakeholders. Some quotes have been combined or paraphrased where multiple stakeholders have made similar observations.
Sources: Rennie market intelligence; Rennie research and analysis (2025).

5. Priority areas and recommendations to enhance CER participation in the NEM

Priority areas

- This report identifies three key priorities to enable increased CER participation in wholesale markets and provision of grid services within the NEM, supported by three key recommendations.
- Further to these recommendations, the report identifies five general enabling actions that must be accelerated through the CER Roadmap and/or NEM Wholesale Review to support these key recommendations, along with broader NEM design considerations.
- Our findings, informed by stakeholder interviews and international research, highlight the need for these recommendations and enabling actions to be implemented in a coordinated manner to unlock the full potential of CER participation.

There are three key priorities to enable increased CER participation in wholesale markets and provision of grid services within the NEM

Maximising the value CER brings to the system unlocks the greatest benefits for all consumers – both for those with and without the capacity to invest in a more active relationship between their energy resources and the broader energy system

1. CER Coordinating Body

Assign formal responsibility for overall coordination and direction of CER to a dedicated and enduring national body.

2. CER Vision and Targets

Set a clear vision and targets for CER participation for incorporation into NEM planning documents.

3. Targeted NEM Reform

Lower barriers for CER participation in the NEM through focused reform to existing NEM processes.

Supported by enabling actions and broader NEM design considerations

There is a need for a clear delineation of roles and responsibilities across the CER value chain, with enduring national oversight

RECOMMENDATION 1: Assign formal responsibility for overall coordination of CER to a dedicated and enduring national body.

CER offers the potential for a lower cost energy transition – achieving that potential requires an enduring national body to coordinate CER's role in the NEM.

Specific actions to assign roles and responsibilities:

1. An independent national body with sufficient power and authority should be responsible for the coordination of the CER ecosystem, including (but not limited to):
    i. setting an enduring vision for the role of CER in the NEM and developing a strategy to achieve that vision
    ii. setting clear short and long-term targets for CER adoption and coordination
    iii. monitoring and reporting on the delivery of the CER Roadmap and annual achievement of targets for CER adoption and coordination, identifying actions to address shortfalls
    iv. development of fit-for-purpose policy and rule change requests, including the recommended reforms to existing NEM processes (identified in this report) to lower barriers for CER participation
    v. sponsoring and coordinating industry trials (both policy and market-led) to inform further system redesign aimed at optimising customer, network and whole-of-grid value (as identified in this report).

A clear vision for CER participation must be established through setting CER targets to inform NEM planning

RECOMMENDATION 2: Set a clear vision for CER and targets for CER participation in the NEM.

The establishment of a formalised annual planning and target setting process for CER will help to establish CER as a mainstream pillar of the energy ecosystem and will allow for a clear vision for the future of CER participation in the NEM.

Specific actions to establish targets:

1. The enduring national body is to be responsible for the establishment and ongoing operation of an annual planning process that sets specific targets for CER participation over different planning horizons.
2. These targets should be accompanied by an action plan with short, medium and long-term goals for CER participation with executive accountability.
3. The national body is to establish the framework and parameters for the development of CER-specific forecasts for incorporation into AEMO and other system planning documents.

CER participation can be encouraged by lowering wholesale market barriers through targeted reforms to the existing NEM

RECOMMENDATION 3: Implement targeted reforms to existing NEM processes to lower barriers for CER participation.

Facilitating participation in the wholesale market can lead to beneficial market and system outcomes, and will provide increased revenue potential for CER owners through access to markets. Higher participation may lower costs for all customers.

Specific actions to encourage greater CER participation:

1. Lower participation thresholds for CER from their current level of 1MW to 100kW[1], in line with international markets. For example:
    i. PJM allows small scale resources (minimum 100kW) to aggregate and participate in wholesale markets, and CAISO enables aggregations as small as 0.5 MW.
    ii. NEBEF allows consumers with a minimum demand response capacity of 100kW to participate directly as a 'demand response aggregator'
2. Enable multi-node aggregation for CER, with geographical restrictions limited to those critical for management of power system security, as applies for Wholesale Demand Response.
3. Modernise metering and telemetry rules and standards to account for both supply and demand-side market integration, reflecting the characteristics of CER to the extent practicable while ensuring power system security and the integrity of markets.
4. Enhance the dispatch methodology in the NEM as required to achieve optimised system and resource allocation outcomes that incorporate CER, factoring in dynamic operating envelopes, VPP status and the provision of local network support. Opportunities for investigation based on international markets include, for example:
    i. NEBEF has introduced more flexible dispatch protocols and longer dispatch lead times for CER.
    ii. The UK (through the Open Networks Project) has established clear rules for dispatch prioritisation.

Notes: [1] Changes to participation and bidding thresholds for other technology types could also be considered.

Enabling actions must be accelerated through the CER Roadmap and/or NEM Wholesale Review to support these recommendations

Enabling Action 1: Accelerate technical standards	Enabling Action 2: Formalise the DSO role	Enabling Action 3: CER-specific consumer empowerment	Enabling Action 4: CER-specific consumer protections	Enabling Action 5: Pricing reform
Harmonised standards with central coordination will ensure faster and more cost-effective technical solutions to CER implementation and allow smoother CER integration in markets.	A formalised and consistent DSO role across the NEM, with clearly defined DSO responsibilities, will support retailers and aggregators to facilitate increased participation in existing markets, and enhance the potential for new markets (e.g., flexibility markets).	Fit-for-purpose consumer empowerment and protections will improve social licence through a more engaged customer base that understands its role in the new energy future, and seeks to benefit through participation in energy markets.		Pricing reform, to improve cost-reflectivity of tariffs for those customers and loads with the capacity to respond, has the capacity to increase CER participation through improved investment signals, and can help to socialise the benefits from CER participation through lower network costs.
Key considerations: • Standardisation should be sought between different DNSPs in the NEM, across Australia (including WA), as well as with international standards. • Cyber security is viewed by many stakeholders as the most critical area for standards development and should be fast-tracked.	Key considerations: • The DSO role must be defined, encompassing the management and coordination of CER, with consideration given to potential integration of responsibilities into the DNSP function, and/or establishment of a new Distribution Network Operator role. • In line with this shift, network regulation needs to evolve to promote innovation, recognise the various roles CER can play and reflect the new/modified roles of actors across the ecosystem.	Key considerations: • The CER Coordinating Body should have responsibility for the development of best-practice consumer empowerment campaigns and materials for CER, and oversight of consumer empowerment activities. This is to ensure activities are tailored, trusted and publicised, and that consumers have a one-stop-shop to access relevant information and guidance.	Key considerations: • Consumer protection frameworks should evolve, with the flexibility to account for the broader range of energy services available to consumers. • The CER Coordinating Body should have an overarching market obligation (such as a duty of care) which ensures consumers that purchase and operate CER are confident they will be protected from harm.	Key considerations: • The lid should be lifted on the NERL to recognise the changing nature of energy markets to a dynamic two-way flow of energy and revenue. • Consideration should be given to new dynamic pricing models, with greater coordination between distribution and retail tariffs, while maintaining simplicity for those who desire it. • Network revenue determinations should be made fit-for-purpose and reflect the role CER can play in avoiding capital expenditure.

Broader NEM redesign must account for the contribution of CER, at both the local grid level and the power system as a whole

The role and contribution of CER must be also promoted through broader NEM redesign

Controllable and predictable CER at scale will lead to deferred investment in local and utility-scale network, generation and storage assets by avoiding and/or alleviating network constraints at the source, reducing costs for consumers. CER will also be accounted for in any major overhaul to NEM design or new market mechanisms.

Specific actions to maximise market efficiency through CER participation:

1. Examine new models for CER participation, including through CER trials (e.g., regulatory sandboxing or ARENA funding programs depending on whether policy or market-led), to advance the efficient provision of an optimal level of CER, including consideration of:
    i. a good, better, best approach to device optimisation for all customers, to support bill relief, and maximise network /wholesale market value
    ii. the potential for local flexibility markets that allow for both supply and demand-side participation and are co-optimised with the wholesale market, such as those developed in the UK
    iii. the balance of incentives for Distribution Network Service Providers (DNSPs) between traditional Capex and Opex models for network determination to minimise disincentives to the use of non-network solutions
    iv. fit-for-purpose ringfencing and asset sharing rules and guidelines to avoid locking out efficient solutions that minimise costs for consumers

Appendices

Appendix 1 – NEM Context: *Example VPP trials and NEM-wide initiatives*

Recent VPP trials have highlighted some of the key consumer sentiment and barriers around CER participation

Key Learnings from VPP trials

Project	Counterparties	Key Challenges	Key Learnings
Project Edith	Australian National University; AusNet services	• Project Edith found that one of the primary challenges is low consumer awareness about the benefits and opportunities of participating in network support services. • Dynamic pricing, while offering flexibility, can be complex for consumers to manage without the assistance of a customer agent. • Consumers need to perceive tangible benefits from participating in network support services. If the rewards are not clear or substantial, participation rates may remain low. • Availability and integration of smart meters and other necessary technologies can be a barrier for some consumers, limiting their ability to participate in dynamic pricing schemes.	• Project Edith demonstrates that dynamic pricing can offer consumers more flexibility and choice in managing their energy resources. This approach allows consumers to optimise their energy use based on price signals. • By leveraging existing network pricing capabilities, dynamic pricing simplifies the process for consumers to participate in network support. It avoids the need for complex baselining and contracting processes, making it more accessible.
Project Jupiter/ Symphony	western power; synergy; AEMO; ARENA Australian Government Australian Renewable Energy Agency	• There was a lack of clear financial visibility and communication about how participants' assets were being used, leading to customer concerns. • Difficulties in precisely forecasting and communicating the bill impacts of orchestration hindered a clear understanding of financial benefits for customers. • The upfront orchestration payment exceeded the actual impact, causing perceived value loss among participants.	• The need for simple, transparent, and accurate information on VPP participation to enhance customer understanding and retention. • Developing comprehensive tools for customer engagement to manage and enhance the VPP experience.
Project Edge	AusNet services; AEMO; ARENA Australian Government Australian Renewable Energy Agency	Project Edge found that consumers investing in CER are primarily motivated by the desire to reduce electricity bills and achieve energy self-reliance and that, while consumers are open to the idea of joining VPPs, they are generally unenthusiastic, requiring significant incentives and confidence in financial benefits. • Managing limited network capacity in export-congested local networks and developing scalable data exchange system.	• Demonstrated that price-responsive CER are technically feasible and can maintain electricity supply and reliability. • Highlighted the need for clear incentives and trust-building measures to encourage consumer participation in VPPs. • Showcased the importance of cross-industry collaboration and the use of virtual tools to enhance stakeholder engagement.

Sources: ARENA - Project Symphony - Final Lessons Learnt Report (2024); Ausgrid - Project Edith - Network support: a comparison of current and emerging solutions -Knowledge Share Report (2023); ARENA - Project Edge Final Lessons Learnt (2023)

The AEMC is setting up the regulatory architecture and foundations to increase CER participation in various markets

AEMC-led initiatives

Legend: Rule Change; Mechanism; Market Review; Program of Work; Framework; Guideline; Guidance Note; Strategy

Completed	Underway	Pending
Wholesale Demand Response Mechanism	Integrating energy storage systems into the NEM	Electricity Pricing for a Consumer-Driven Future Review	Expanding eligibility under the Wholesale Demand Response Mechanism
Enhancement to the Reliability and Emergency Reserve Trader	Review into CER technical standards		
Unlocking CER benefits through Flexible Trading	Improving consideration of demand-side factors in the ISP	Real-time data for consumers	
Integrating Price-Responsive Resources into the NEM	National Energy Customer Framework		
Access, pricing and incentive arrangements for DER	Accelerating smart meter deployment	Review of Wholesale Demand Response Mechanism (WDRM)	Integrated distribution system planning
Technical standards for DER			

While AEMO is implementing initiatives around technical implementation, most initiatives are currently in progress

AEMO-led initiatives

Legend: Rule Change; Mechanism; Market Review; Program of Work; Framework; Guideline; Guidance Note; Strategy

Completed	Underway	Pending
Initiative		
VPP demonstrations	DER Data Hub/Exchange/Registry Services	FRC Target State
2024 Transition Plan for System Security	Distribution Local Network Services	Metering Services Review
Supporting Secure Operation with High Levels of Distributed Resources – Q2 2024	DER Operational Tools	Dynamic Operating Envelopes
		Electric Vehicle Data

The AER is implementing compliance initiatives, primarily guidance notes and guidelines for CER participation

AER-led initiatives

Legend

Rule Change | Mechanism | Market Review | Program of Work | Framework | Guideline | Guidance Note | Strategy

Completed

Initiative
Export tariff guidelines
Regulatory Sandboxing Toolkit
DER integration expenditure guidance note
Export Limit guidance note
Review of energy consumer protections

Many other initiatives are also underway, being led by various bodies to support CER participation in the NEM

Other general initiatives

Legend: Rule Change; Mechanism; Market Review; Program of Work; Framework; Guideline; Guidance Note; Strategy

Completed		Underway
Initiative		
Emergency Backstop Mechanism		
Project EDGE	NSW Consumer Energy Strategy	National CER Roadmap
Consumer Data Right	Harnessing Victoria's Distributed Energy Resources	National EV Strategy
National Energy Performance Strategy	Demand Management Plan & Demand Flexibility Strategy	National Energy Equity Framework
		CER Installer Portal
		CER consumer protections review

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