FLEXIBLE DEMAND – THE CURRENT STATE OF PLAY IN AUSTRALIA

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Abbreviations

ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ANU	Australian National University
ARENA	Australian Renewable Energy Agency
BESS	battery energy storage systems
C&I	commercial and industrial
CER	consumer energy resources
CIS	Capacity Investment Scheme
CL	controlled load
CRC	Cooperative Research Centre
DER	distributed energy resources
DIEF	Digital Infrastructure Energy Flexibility
DMIA	Demand Management Innovation Allowance
DMIS	Demand Management Innovation Scheme
DNSP	distribution network service provider
DOE	dynamic operating envelope
EEC	Energy Efficiency Council
EV	electric vehicle
FCAS	Frequency Control Ancillary Services
FD	flexible demand
FiT	feed-in tariff
GW	gigawatt
GWh	gigawatt-hours
HEMS	home energy management systems
HVAC	heating, ventilation and air conditioning
HWS	hot water system
kWh	kilowatt-hours
LTESA	Long-Term Energy Service Agreements
MW	megawatts
MWh	megawatt-hours
NA	not applicable
NABERS	National Australian Built Environment Rating System
NEM	National Electricity Market
NSW	New South Wales
NT	Northern Territory
PDRS	Peak Demand Reduction Scheme
PV	photovoltaic
QLD	Queensland
RACE for 2030	Reliable Affordable Clean Energy for 2030 CRC
RERT	Reliability and Emergency Reserve Trader
SA	South Australia
SAPN	SA Power Networks
SOE	shared operating envelope

TAS	Tasmania
TBD	to be determined
ToU	time-of-use20
UNSW	University of New South Wales
UTAS	University of Tasmania
UTS	University of Technology Sydney
UWA	University of Western Australia
V2X	Vehicle-to-everything
VIC	Victoria
VPP	virtual power plant
WA	Western Australia
WDRM	Wholesale Demand Response Mechanism
WEM	Wholesale Electricity Market (WA)

Background

Australia is transitioning towards an energy system in which bulk electricity is sourced from variable renewable energy generators, primarily solar and wind. As energy supply becomes dominated by solar and wind, increasing the flexibility of energy demand to match or fill in the gaps from variable renewable energy becomes increasingly important.

There are a wide range of sources of flexible demand which are not yet being fully utilised – such as smart charging of electric vehicles or changing the timing of hot water heating to use surplus solar power in the middle of the day, remote control to shave demand from a portfolio of air-conditioners on hot days when the grid is under strain or fast-response charging and discharging from batteries to maintain frequency levels. As flexible demand involves using existing assets more efficiently to match supply, it is generally lower cost than building new supply to match demand and enhances the reliability of the electricity grid.

- Flexible demand is an emergent field in Australia with changes underway across markets, regulation, policy and energy institutions:
- There are a variety of innovation pilots and trials to trial new technologies, systems and processes to increase flexible demand being funded by ARENA, the RACE for 2030 Cooperative Research Centre and State Governments.
- New rule changes and programs are being developed to remove barriers to the scaling up of flexible demand and coordination to deliver benefits across the network and markets.
- Retailers and networks are developing new tariffs to create better incentives for consumers to be rewarded for changing their energy usage.

Policies and programs for flexible demand are relatively small-scale in Australia compared to leading jurisdictions, but a National Consumer Energy Resources Roadmap is currently under development.

However, there is currently no consolidated source of information on trends in flexible demand markets, policy, tariffs regulation and pilots. Information is distributed across many sources and is sometimes difficult to access. Increasing flexible demand needs to be a central feature of the energy transition but stakeholders commonly say they find the area complex and information opaque.

The aim of this report is to consolidate information on flexible demand to provide an accessible and cohesive view of the landscape for policy-makers, regulators, industry and energy institutions. It is a 'scene-setter' report which aims to improve the visibility of flexible demand, enabling stakeholders to both find information on specific policies, pilots and regulations as well as get an overarching view on the state of flexible demand. The report maps the current state of play for policy, regulation, markets and pilots alongside profiles of individual pilots. In this way, the report aims to contribute to understanding of the opportunities, barriers, changes and gaps to scale up flexible demand alongside renewable energy, energy efficiency and storage in Australia's energy transition.

Contents

1 Introduction

There are many potential sources of increased flexible demand (FD) in our energy system. These include smart charging to alter the time at which electric vehicle (EV) batteries are charged, shifting the timing of hot water heating or commercial refrigeration to better match solar generation, or moderating demand from residential air conditioners on hot days. Modelling commissioned by ARENA estimated the net benefit of increased FD to be $8-18 billion, and this benefit increases as the share of renewable energy grows (Energy Synapse, 2021).

Despite its potential, FD currently plays a modest role across the Australian energy system. Unlike renewable energy or energy efficiency, FD policy, markets and technologies are still in their nascent stages, presenting both challenges and opportunities for growth and development. As the energy landscape evolves, fostering the maturity of FD becomes increasingly crucial in balancing supply and demand dynamics to enhance grid stability and maximise integration of renewable resources.

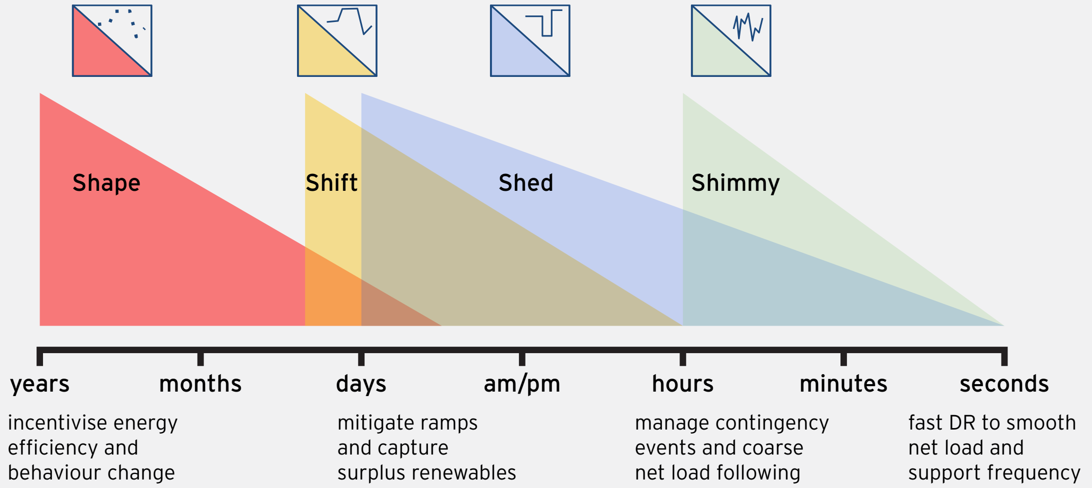
Consequently, increasing FD has been identified as a strategic priority since ARENA's 2021 Investment Plan. Through strategic investments, innovative regulatory frameworks, and technological advancements, Australia can harness the full spectrum of FD to navigate the complexities of the energy transition more effectively.

WHAT IS FLEXIBLE DEMAND?

Flexible demand is defined by ARENA as 'the capability to vary customer demand in response to generation, network, or market signals.'

There are several types of flexible demand including:

- 'Shape' and 'Shift': bringing forward or delaying consumption. e.g. charging EVs or heating water in the middle of the day to take advantage of low prices when there is surplus solar generation.
- 'Shed': avoiding high prices by temporarily reducing consumption. e.g. reducing air-conditioning.
- 'Shimmy': very rapid changes in demand to manage frequency over millisecond-second timescales. e.g. battery charging/discharging.



Flexible demand, rooftop solar generation and storage are different types of 'Consumer Energy Resources' (CER) or 'Distributed Energy Resource' (DER), which may be uncoordinated or 'orchestrated' and aggregated to increase their value.

Note: 'flexible demand' and 'demand flexibility' are inter-changeable terms.

PURPOSE OF REPORT

The purpose of this report is to provide stakeholders with a 'scene-setting' document that identifies all current FD policies, market incentives and trials underway in Australia. The report contains the following sections:

Section 2: What is the potential for flexible demand? An overview of studies analysing the major sources of FD and estimating the benefits to understand the scope of the opportunity – and conversely the risks if flexible demand is not harnessed to reduce costs and maintain system security.

Sections 3–4: What are governments and regulators doing to increase flexible demand? Sections 3 and 4 provide an overview of current flexible demand programs by governments, the interface with energy efficiency programs and rule changes currently underway to increase flexible demand.

Section 5: What are the current schemes for flexible demand in the National Electricity Market? The size and trends in the current market schemes for flexible demand – the Wholesale Demand Response Mechanism, the Frequency Control and Ancillary Services market and Reserve and Emergency Reliability Trader – are profiled.

Section 6: What are the current retailer and network incentives for flexible demand? This section profiles a range of new retailer and network tariffs emerging to create incentives for flexible demand, such as 'solar soak' tariffs with lower rates for consumption in the middle of the day.

Section 7: What are the current flexible demand pilots trialling? In this section, FD pilots are mapped by technology, sector and energy services, and a one-page profile is provided for each pilot.

Section 8: What are the next steps for flexible demand? The current timetables for policy roadmaps, rule changes and pilots are outlined.

2 What is the potential for flexible demand in Australia?

A comprehensive evaluation of the current value of Flexible Demand (FD) or its potential for Australia does not currently exist. A recent meta-review of studies on the potential of FD and CER by Kuiper[1] noted "there is no analysis of the overall economic value of the currently available flexible demand." Each of the major studies is incomplete in coverage in some way (e.g. technologies). Notwithstanding these data gaps and limitations, there are a range of studies that illustrate there is a large-scale benefit if FD can be unlocked, the most valuable sources of flexible demand and some studies have modelled the impact of specific policy and regulatory changes.

Conversely, these studies highlight the consequences of not implementing flexible demand. There is a large volume of CER forecast by the Australian Energy Market Operator in the Integrated Systems Plan (and forecasts have historically under-estimated growth). The rising costs of transmission upgrades and lost value from curtailment of existing large-scale and rooftop solar underline the importance of flexible demand to increase utilisation of installed generation. The benchmark against which the benefits of FD are estimated are scenarios in which CER grows in an uncoordinated way which would make the energy system harder and more expensive to run. Realisation of economic benefits is dependent on aggregating and coordinating flexible demand alongside other consumer energy resources such as solar power and battery storage. Flexible demand is not just 'nice to have' – it is an essential component of a successful energy transition.

WHAT ARE THE BENEFITS OF FLEXIBLE DEMAND?

Broadly, there are four types of energy services or benefits that can be provided by FD:

Wholesale: shifting the timing of consumption in response to wholesale electricity price signals to increase demand in low-price times or reduce demand in high-price times. Increasingly, the wholesale price aligns with the volume of renewable energy, so in addition to saving money wholesale flexible demand can also increase the match with renewable energy generation – especially rooftop solar that is being curtailed.

Network: network services that can be provided include:

- Peak demand reduction: avoiding or deferring costly investment in network upgrades.
- Minimum demand: shifting consumption into low-demand periods associated with high volumes of solar generation to improve grid stability.
- Increasing hosting capacity: FD at distribution network level to ease constraints on utilisation of rooftop solar.

Frequency Control and Ancillary Services: fast-response increases or decreases in consumption to maintain frequency and ensure the stability and reliability of the grid.

Emergency: rapid demand response in periods of extreme demand to address risks of blackouts.

THE BENEFITS FROM FLEXIBLE DEMAND ARE LARGE AND INCREASE WITH THE MARKET SHARE OF RENEWABLE ENERGY

A study by NERA Economic Consulting commissioned by ARENA found FD achieves savings in generation and storage costs ranging from $3 billion to $18 billion to 2042, with the highest benefits occurring in scenarios with the highest levels of DER.[2] Kuiper notes that NERA is the most comprehensive recent study but does not include network benefits.

Modelling by Baringa Partners for the Energy Security Board found DER (including but not limited to FD) could save $11.3 billion in network costs, based on the Step Change scenario in AEMO's 2020 Electricity Statement of Opportunities.[3]

1 Kuiper, G. (2024) *DER could provide $19 billion economic boost by 2040*, Institute for Energy Economics and Financial Analysis. https://ieefa.org/resources/der-could-provide-19-billion-economic-boost-2040

2 NERA Economic Consulting (2022) *Valuing Load Flexibility in the NEM*. https://arena.gov.au/knowledge-bank/valuing-load-flexibility-in-the-nem/

3 Baringa Partners. (2021) Potential Network Benefits from more efficient DER Integration. https://www.datocms-assets.com/32572/1629948077-baringaesbpublishable-reportconsolidatedfinal-reportv5-0.pdf.

TABLE 1. SAVINGS UNDER THE VARIOUS SCENARIOS MODELLED BY NERA ECONOMIC CONSULTING (2022).

SCENARIO	DESCRIPTION	SAVINGS
State of World 1	Baseline case (greater flexibilitywith current technologies)	$1-6 billion
State of World 2	High electric vehicle uptake	$3-5 billion
State of the World 3	High electrification	$4-5 billion
State of the World 4	High distributed energy resources	$8-18 billion
State of the World 5	High hydrogen uptake	$3 billion

The largest opportunities for flexible demand appear to be electric vehicles and residential hot water – but information on the commercial and industry sectors is low

NERA observed differences in potential by sector occurred depending on the scenario, but the largest opportunities, at least in the short-to-medium term, were likely to be in electric vehicles and residential hot water.

These projections have been supported by other more recent studies focussing on electric vehicles and hot water.

Analysis of the electrification of hot water by the Institute for Sustainable Futures, University of Technology Sydney, estimated a 'highly flexible' scenario with a combination of more efficient heat pumps and more flexible electric resistance water heating could save $6.7 billion in energy use and $14.3 billion in grid storage.[4]

The V2X Summary report by ENx commissioned by ARENA found electric vehicles will be the largest and lowest-cost storage resource, and bidirectional charging from just 10% of Australia's electric vehicle fleet in 2050 could provide over one-third of storage requirements for the NEM.[5]

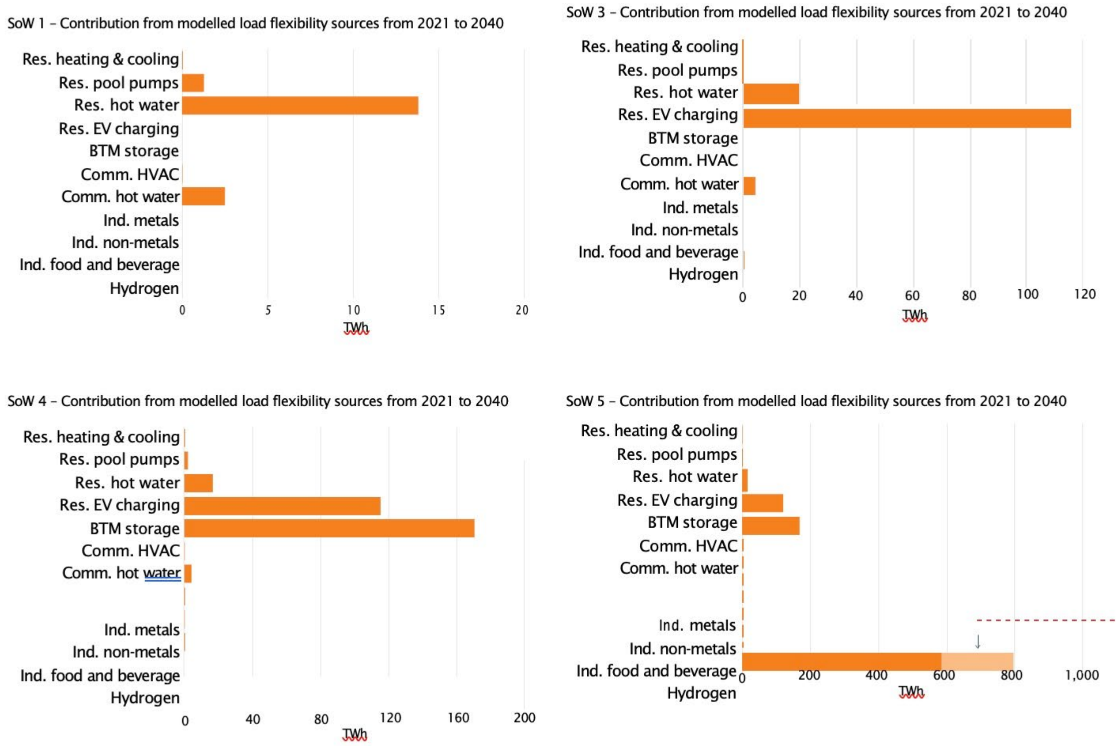


Figure 1. FD potential under different energy scenarios
Note: SOW 1 = baseline; SOW 3 = high electrification; SOW 4 = high DER uptake; SOW 5 = high hydrogen scenario.

4 Roche, D, Dwyer, S., Rispler, J., Chatterjee, A., Fane, S and White, S. (2023) *Domestic Hot Water and Flexibility*, https://www.uts.edu.au/sites/default/files/2023-06/Domestic%20Hot%20Water%20and%20Flexibility.pdf

5 enX (2023) *V2Xau Summary Report Opportunities and Challenges for Bidirectional Charging in Australia*. https://arena.gov.au/knowledge-bank/v2x-au-summary-report-opportunities-and-challenges-for-bidirectional-charger-in-australia/

The flexible demand potential in the commercial and industrial (C&I) sectors could be very large, but as the Opportunity Assessment for RACE for 2030 noted, current information is poor. Based on techno-economic factors, the RACE for 2030 report identified commercial refrigeration and storage, mining, water pumping and commercial buildings as likely to be good sites for FD.[6] A recent discussion paper by Buildings Alive and The Australia Institute found that developing 60% demand side load shifting in institutional grade office buildings would deliver about 2.6 GW of flexible capacity in the NEM.[7] Further studies are required to understand the potential for flexible demand in C&I sectors.

THERE IS MODELLING ON SOME POLICY AND REGULATORY OPTIONS

Most of the modelling focusses on overall system benefits but there has been some modelling focussed on specific policy and regulatory options which also underline the benefits of FD.

Modelling commissioned by the AEMC as part of the integration of price-responsive CER estimated there is a benefit of $1.5–1.9 billion from the rule change to integrate 'firm' CER into market dispatch and information on less firm or unpredictable CER into market forecasting.[8]

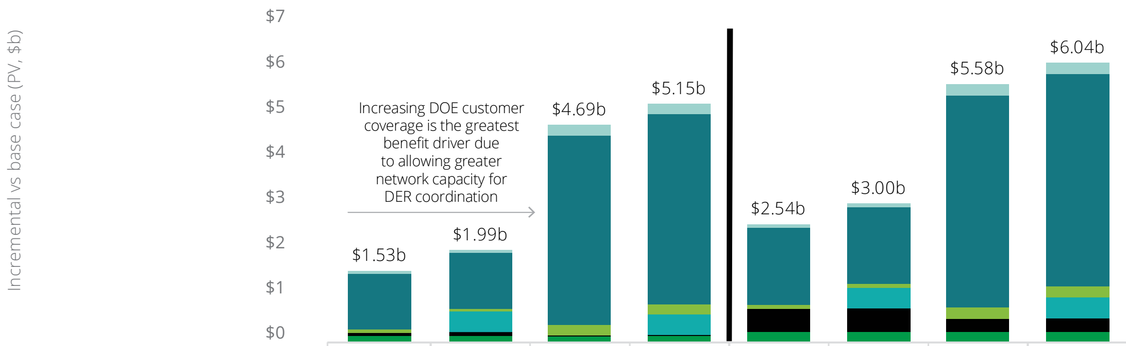
Under Project EDGE, an ARENA pilot between AEMO, Ausnet and Mondo, 3.5 MW of FD was orchestrated through three VPPs over an 11month period. Cost-benefit analysis of different FD models were analysed under two scenarios. Increasing the coverage of **Dynamic Operating Envelopes** was the greatest source of value (around 80%) in the cost benefit analysis (Figure 2), as it unlocks additional CER which is cheaper than alternatives such as increasing supply of new generation, followed by establishing a common data hub to streamline costs of integrating CER.[9]

6 Brinsmead, T., White, S., Bransden. C., Stanley, C., Hasan, K., Alexander, D., Sprague, M., Northey, J. Walgenwitz, G., Nagrath, K., Briggs, C., Leak, J., Harkins-Small., L, Murray-Leach. R and Jennings, K. (2021). *Flexible Demand and Demand Control. Final report of opportunity assessment for research theme B4*, Race for 2030 CRC.

7 Dennis, R. & Roussac, C. (2024). Buildings as batteries: How buildings can support the clean energy transition. Discussion paper. https://australiainstitute.org.au/wp-content/uploads/2024/04/P1278-Buildings-as-batteries-2024-update-Web.pdf. Accessed 10 May 2024.

8 AEMC, Integrating price-responsive resources into the NEM, https://www.aemc.gov.au/rule-changes/integrating-price-responsive-resources-nem. Accessed 19 March 2024.

9 Deloitte Access Economics, *Project EDGE Cost Benefit Analysis*, October 2023. https://aemo.com.au/-/media/files/initiatives/der/2023/project-edge-independent-cba-full-report.pdf?la=en.



Key drivers of value across the CBA Scenarios	Scenario 2 (Simple DOE, Moderate Coverage)	Scenario 3 (Simple DOE, Moderate Coverage with Data Hub)	Scenario 4 (Advanced DOE, High Coverage)	Scenario 5 (Advanced DOE, High Coverage with Data Hub)	Scenario 7 (Simple DOE, Moderate Coverage)	Scenario 8 (Simple DOE, Moderate Coverage with Data Hub)	Scenario 9 (Advanced DOE, High Coverage)	Scenario 10 (Advanced DOE, High Coverage with Data Hub)
DOE Constraint Optimisation Frequency (more total network capacity unlocked for DER coordination)	$0.06	$0.06	$0.22	$0.22	$0.08	$0.08	$0.24	$0.24
DOE Customer Coverage (more total network capacity unlocked for DER coordination)	$1.21	$1.21	$4.12	$4.12	$1.67	$1.67	$4.60	$4.60
DOE Objective Function (more network capacity allocated to DER)	$0.06	$0.06	$0.22	$0.22	$0.08	$0.08	$0.24	$0.24
Data Hub (reduced costs and enables additional DER services)	$-	$0.45	$-	$0.45	$-	$0.45	$-	$0.45
LSE (reduced DER curtailment)	$0.07	$0.08	$0.00	$0.01	$0.50	$0.51	$0.29	$0.30
Visibility of DER (enhanced power system operations) [24]	$0.12	$0.12	$0.12	$0.12	$0.20	$0.20	$0.20	$0.20

Figure 2. Findings from Project EDGE Cost Benefit Analysis – key drivers of value incremental to the base cases.

Project Symphony, an ARENA pilot between Western Power, Synergy and AEMO, enrolled 500 households and managed over 900 appliances in WA's \South-West Interconnected System (SWIS). A cost benefit analysis on the potential impacts of a VPP looked at various scenarios and found net economic benefits of $453–967 million over 15 years, including the addition of over 1600 MW of dispatchable generation/load by the end of the period.[10]

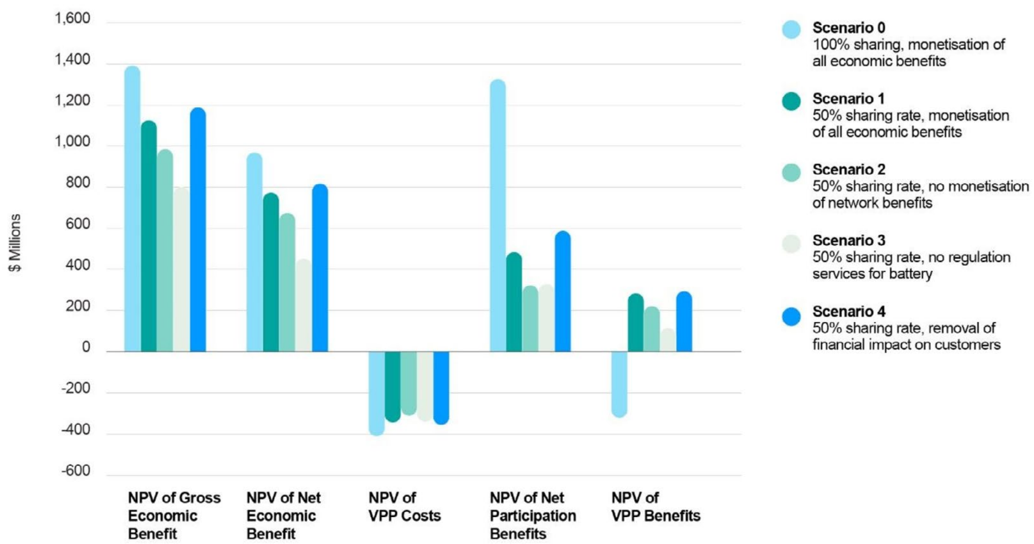


Figure 3. Summary of scenario results for Project Symphony.

10 Oakley Greenwood. (2022). *Project Symphony. Work Package 2.1:The economic value of a virtual power plant in the South West Interconnected System of Western Australia.* https://arena.gov.au/assets/2022/03/project-symphony-der-services-report.pdf

3 Flexible demand programs in Australia

There are a small number of Flexible Demand (FD) government or regulator programs currently in operation in Australia, which relative to leading international jurisdictions are less well developed. Nexa's review found demand-side participation ranges from **5–11% of peak demand** in leading international jurisdictions.[11] KPMG concluded that based on international estimates a target of **15–20% of peak demand** could be achieved for the NEM with the right arrangements in place.[12]

Some of the key factors for the smaller scale of Australia's FD programs include:

Capacity payments are used in the Western Electricity Market but they are limited in the National Electricity Market. Owing to high levels of uncertainty in developing a business case for FD investments at a site or organisational level, international studies have found jurisdictions that provide revenue certainty have the highest levels of demand response participation, especially through capacity payments (i.e. payments to have FD capacity available).[13] As a review for the Australian Energy Market Commission noted: 'jurisdictions with capacity markets consistently attract the most demand response participation'.[14]

FD projects can bid for NSW Long-Term Energy Supply Agreement (LTESA) auctions only if they are eligible for the Wholesale Demand Response Mechanism (WDRM). WDRM Eligibility is also proposed to be a requirement for the Capacity Investment Scheme (CIS) (although the CIS could be open to Virtual Power Plants in future rounds).[15]

Only one provider is registered under the WDRM.[16] Opening access to WDRM or providing alternative pathways to access LTESAs and the CIS is required to increase participation. A report by Seed Advisory on regulatory reform options noted stakeholders observed that if FD is not on a level playing field with generation or storage in the CIS, it could reduce the business case for cost-effective FD.[17]

There is a lack of policy mechanisms with pathways for scaling FD: Given the limits on participation in LTESAs and CIS, the NSW Peak Demand Reduction Scheme is currently the only program with a pathway for scaling that includes a target, mechanism and process for increasing the volume and types of activities over time.

Network incentives have been under-utilised to date: There are incentives for network demand management in the Demand Management Incentive Scheme (DMIS) and Demand Management Incentive Allowance (DMIA). Funding available under both schemes has been significantly under-utilised with only $3 million of the potential $1 billion of investment accessed through the DMIS (see Table 2), though networks have implemented tariffs and participated in ARENA grant programs. A public review has not yet been undertaken of the DMIS and DMIA.

11 Nexa Advisory (2024) *Accelerating Commercial and Industrial Demand Demand-Side Participation in NSW*, https://nexaadvisory.com.au/site/wp-content/uploads/2024/02/Nexa-Advisory-Report-Accelerating-CI-demand-response-in-NSW.pdf.

12 KPMG (2023) *Supporting Demand Flexibility in the Energy Transition*, Report prepared for the Energy Consumers Association. https://energyconsumersaustralia.com.au/publications/supporting-demand-flexibility-in-the-energy-transition.

13 Liu, Y. (2017). Demand Response and Energy Efficiency in the Capacity Resource Procurement: Case studies of forward capacity markets in ISO New England, PJM and Great Britain, *Energy Policy*, 100.

14 Brown, T., Newell, S., Spees, K & Wang, C. (2019) *International Review of Demand Response Mechanisms in Wholesale Markets*, Prepared for the AEMC.

15 Department of Climate Change, Energy, the Environment and Water (2024), *Implementation Design Paper – Capacity Investment Scheme*, https://storage.googleapis.com/files-au-climate/climate-au/p/prj2c881026ae734a70e1030/survey/Capacity%20Investment%20Scheme%20-%20Implementation%20Design%20Paper.pdf

16 There a range of barriers to participation in the Wholesale Demand Response Mechanism such as the eligibility requirements for (see p.20 for further discussion).

17 Seed Advisory (2024) *Smart Energy Hubs: Accelerating Growth in C&I Flexible Demand Participation*, https://arena.gov.au/assets/2023/03/smart-energy-hubs-stage-1-report-regulatory-reform.pdf.

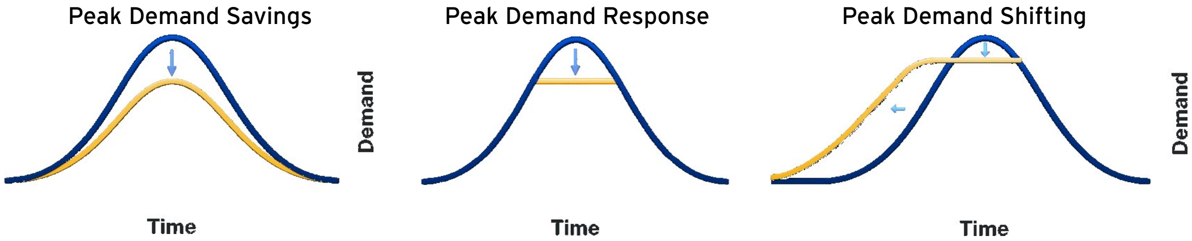
TABLE 2: SUMMARY OF FD PROGRAMS IN AUSTRALIA.

	DESCRIPTION	SCALE	TECHNOLOGIES	FUNDING TYPE	SERVICE
Capacity Investment Scheme (CIS), Long-Term Energy Supply Agreements (NSW) (2024–27)	Eligibility to bid limited to Demand response projects greater than 1 MW capable of participating in the WDR mechanism. Eligibility rules include minimum availability of 2-hours demand response and mandatory response to lack of reserve conditions events.	Only one provider (Enel X) is registered under the WDRM. Enel X was awarded an LTESA contract for three VPPs totalling 95 MW in November 2023.	Technology-neutral	Demand Response LTESAs. Ten one-year options contracts with an agreed revenue under which wholesale revenues are topped up where there is a shortfall. The **Capacity Investment Scheme** discussion paper notes VPPs, demand response and other flexible loads may be eligible in future rounds	Wholesale, Emergency
Peak Demand Reduction Scheme (PDRS) (2022–30)	Installation of technologies or activities that save energy in the summer peak demand period (4–8 pm) are eligible to create Peak Reduction Certificates (PRCs).	The PDRS demand reduction target will increase from 0.5% (2022) to 10% of peak demand by 2030.	Consultation occurring to include orchestrated battery storage and residential air-conditioning. Other technologies to be considered in future include electric vehicles, pool pumps, C&I batteries, and behavioural demand response.	Capacity payment (Peak Demand Response): WDRM participants will be eligible to earn capacity payments in addition to participation revenue. Peak Demand Shifting: up-front installation subsidy.	Peak demand, Minimum demand
Demand Management Incentive Scheme (DMIS) (2017–)	The DMIS provides a financial incentive of up to 50% of the cost of non-network demand management projects.	\$3 million of projects delivering consumer benefits of \$50 million were used 2017 – 2022 (AER, 2023). The DMIS is capped at 1% of distribution network allowable revenue which equated to around \$1 billion of investment in the 2017–2022 network revenue period.[18]	Technology-neutral	Grant	Network peak
Demand Management Incentive Allowance Mechanism (DMIAM) (2019–)	Networks can be awarded funding or allowances for research and development in demand management projects.	\$11.5 million of projects have been approved from 2019 to 2022. Distribution networks have used between 5% (Essential Energy) and around 55% (Evo Energy) of their permissible allowance.	The largest recipients of funding have been. in order: DER integration, battery VPPs, EV integration, stand-alone power systems, tariff incentives, and voltage management.	Grant	Network

18 Australian Energy Regulator (2017). *AER Incentive Scheme to drive potential $1bn in demand management action.* https://www.aer.gov.au/news/articles/news-releases/aer-incentive-scheme-drive-potential-1bn-demand-management-action

PEAK DEMAND REDUCTION SCHEME

The Peak Demand Reduction Scheme (PDRS) is the only certificate-based scheme for FD in Australia. Consultation is currently occurring on expanding the PDRS from ‘peak demand savings’ (energy-savings activities that reduce peak demand) to include ‘peak demand response’ (capacity available to reduce peak demand or participate in the WDRM) and ‘peak demand shifting’ (capacity available for permanent load shifting out of peak periods).



Peak Demand Savings	Peak Demand Response	Peak Demand Shifting
One-time installation of energy efficient equipment to reduce peak demand	Peak Reduction Certificates earned based on annual commitment of demand response capacity during summer peak (Nov–Mar) which can be activated by an aggregator. Available for orchestrated battery storage, residential air-conditioning with demand response capability and end-users participating in the WDRM.	Permanently shifting demand away from peak periods. Battery systems (currently registered on AEMO’s DER register) are eligible to earn PRCs to reduce cost of installation.[19]

ENERGY EFFICIENCY SCHEMES AND FLEXIBLE DEMAND

Energy efficiency certificate schemes, rating tools and regulations are more established than FD programs, and their design can influence the uptake of FD technologies and practices. While some schemes incorporate elements relating to FD, most do not. There is an opportunity to positively influence the uptake of FD through energy efficiency schemes by, for example:

› Requiring that technologies installed through these schemes are ‘FD ready’ (e.g. air-conditioning with demand response capability).

› Avoiding any disincentives for FD technologies (e.g. energy efficiency schemes provide funding for heat pump hot water systems as the most energy efficient technology, which has impacted uptake of more flexible electric resistive systems. Not all building types (especially apartments) have suitable space to install heat pumps, and therefore incentives should balance encouragement for both in different contexts as a superior alternative to gas hot water systems).

› Creating positive incentives for uptake of FD technologies or tariffs (e.g. the South Australian Retailer Energy Productivity Scheme has incentives for flexible tariffs or integrating devices to aggregators that can orchestrate them in response to price signals or incentives).

19 Office of Energy and Climate Change (2023) *Peak Demand Reduction Scheme: Rule change 2 Public Consultation Forum*, https://www.energy.nsw.gov.au/sites/default/files/2023-11/NSW-202311-PDRS-Rule-change-2023-Public-Consultation-Forum.pdf.

TABLE 3. ENERGY EFFICIENCY SCHEMES AND THEIR RELATIONSHIP WITH FD.

JURISDICTION	SCHEME	FD LINK	HOW DOES SCHEME INCORPORATE OR LINK TO FD CRITERIA?
National	Green Star Buildings[20]	✗	There are credits for grid resilience which is related but does not directly cover FD.
National	NABERS[21]	✗	Inclusion of FD in NABERS ratings is under consideration, but no planned changes that would incentivise FD have been announced.
NSW	Energy Savings Scheme (ESS)	✓	The ESS links to the PDRS and enables demand saving activities during peak periods to earn certificates. Air-conditioners also are required to be demand-response enabled to participate.
Victoria	Victorian Energy Upgrades (VEU) program	✓	Commercial battery storage systems are eligible. From 1 March 2024, all eligible hot water heat pumps have an integrated timer that allows the unit to run between during a specified time window.[22]
South Australia	Retailer Energy Productivity Scheme (REPS)[23]	✓	Switching electric hot water systems (heat pump or resistive) to solar sponge or off-peak block tariff or connecting a new or existing electric heat pump to an approved DR aggregator. Switching household to time-of-use tariffs. Connecting new or existing battery, EV charger or pool pump to approved VPP.
ACT	Energy Efficiency Improvement Scheme (EEIS)	✗	-

20 GBCA, Green Star Buildings, 2024, accessed on 22 February 2024. The electrification guides of the Green Building Council of Australia refer to peak demand implications and opportunities for peak demand such as potential impacts from the transition from gas boilers to electric heat pumps and implications from electric vehicle charging. See GBCA, A practical guide to electrification: for existing buildings, March 2022.

21 NABERS, NABERS Energy, 2024, accessed on 22 February 2024.

22 https://www.solar.vic.gov.au/product-lists

23 Retailer Energy Productivity Scheme, https://www.escosa.sa.gov.au/industry/reps/overview, accessed March 18 2024.

4 Flexible Demand rule changes

There are a range of processes underway to change electricity market rules to increase the uptake and integration of Flexible Demand (FD) into the NEM and WEM. The major rule changes and reviews are listed below.

TABLE 4. CURRENT ELECTRICITY MARKET RULE CHANGES, FLEXIBLE DEMAND, NEM

REGULATORY PROCESS	DESCRIPTION	STATUS AND TIMING
Accelerating Smart Meter Deployment	In April 2023, the AEMC review of smart meters recommended 100% deployment of smart meters by 2030. The AEMC has received a rule change from the SAPN, Intellihub and Alinta to implement a package of reforms based on the Review's recommendations to accelerate deployment of smart meters.	Draft Determination scheduled for April 2024. Implementation scheduled to start July 2025
Unlocking CER Benefits through Flexible Trading	In the draft determination, proposed changes to improve flexibility and trading of CER include: › CER resources to be separately metered and managed from 'passive' loads (e.g. lights). › Large customers to choose multiple energy service providers for their premise through the same meter. A separate provider can be engaged for standard retailing and management of CER resources. › Retailers to provide separate pricing for CER and other retailing services to smaller businesses and households without separate metering. Smaller businesses and households would still only be able to engage a single provider. › In-built measurement capabilities (e.g. EV chargers) to be used instead of a separate meter to lower costs	› Draft Determination was released February 2024 and open for consultation until April 2024 › Rule change scheduled to commence February 2026
Integrating Price Responsive resources into NEM	The AEMC and a Technical Working Group are currently examining models for integration of price responsive CER into the NEM. The model is under development but includes two streams for different types of CER: › 'dispatch mode': inclusion of 'firm' price-responsive CER into the central dispatch process; › 'visibility mode': participants provide greater information (e.g. indicative bids) for price-response CER to be integrated into forecasting and planning.	› Rule drafting underway. Draft Determination scheduled for 25 July 2024 › Final determination expected 12 December 2024 › Commencement scheduled May 2026 – May 2028
Frequency Performance Payments	The Frequency Performance Payments (FFP) reforms update the 'causer pays' regime for Regulation Frequency Control Ancillary Services under which facilities that make an 'unhelpful contribution' make payments to generators, large loads and batteries which make a 'helpful contribution' to frequency performance.	› In 2022, the AEMC published its final determination and AEMO published the final Frequency Contribution Factors in June 2023 › Non-financial operation will operate from December 2024 – May 2025 before the system commences in June 2025
Flexible Export Limits	The Australian Energy Regulator (AER) is consulting on the design, implementation and operation of Flexible Export Limits for CER, following on from ARENA trials of Dynamic Operating Envelopes. Flexible export limits enable DNSPs to send signals to inverters that vary household electricity export capacity based on network conditions. The AER has proposed submitting a rule change that will seek a head of power for the AER to develop an Export Limit Guideline that will be binding on DNSPs implementing Flexible Export Limits. The AER has recommended DNSPs develop interim Model Standing Offers for flexible and static exports that consumers can choose from in the meantime.	› The draft interim guideline note was released in November 2023, with the final due for release in Q1 2024. › Final rule estimated release late 2024-2025. › Flexible export limit guideline estimated to commence December 2026.

REGULATORY PROCESS	DESCRIPTION	STATUS AND TIMING
CER Technical Standards Review	The Australian Energy Market Commission recommended 10 immediate actions that did not require regulatory change to simplify device settings in manufacture and supply, promote compliant installation and support on-going compliance. The AEMC recommended a national regulatory framework for setting and enforcing CER technical standards be established and undertook a preliminary evaluation of four models.	A review of CER technical standards was completed in September 2023.
Scada Lite	Scada Lite will enable a bi-directional communication path to exchange telemetry data and control signals with AEMO for demand response providers to participate in wholesale electricity market.	Scheduled to 'go-live' in August 2024

Mapping these rule changes against a customer journey framework used by ARENA, it can be seen rule changes are targeting different stages of the journey consumers undertake to access CER (including FD, solar generation and storage) and for these CER to be coordinated to deliver the highest value. In general, the rule changes underway tend to apply to either the first half or the second half of the customer journey but it is notable that they mostly relate to the integration of CER instead of rule changes that focus on customers.

FIGURE 4. MAPPING RULE CHANGES, THE CER CUSTOMER JOURNEY

<table>
<tr><th>#1 BUY/CHECK CER</th><th>#2 INSTALL/ CONFIGURE CER</th><th>#3 REGISTER CER</th><th>#4 OPERATE/ ORCHESTRATE CER</th><th>#5 MARKET PARTICIPATION</th></tr>
<tr><td>Customers to buy/ check certified equipment and/or the sale of service (e.g. leases)</td><td>Customers install/ configure equipment to communicate with other devices, meet grid requirements and be market-ready.</td><td>Registration of devices to access grid incentives via agent/ aggregator.</td><td>Monitoring of devices to access incentive payments and ensure performance.</td><td>Customers are incentivised to participate in markets, products and service via retailers/ aggregators/ third part agents. Customers can switch offers and providers.</td></tr>
<tr><td colspan="3">100% Smart Meter Roll-Out: all households to have smart meters to access CER benefits and enable orchestration</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="3">Integrating Price Resources/Schedule Lite: incorporating price-responsive CER into either dispatch or forecasting</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Flexible Trading for CER: unbundling CER from retailing services and single metering</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Flexible Exports Limits: flexible energy exports based on network capacity replacing static export limit</td></tr>
<tr><td colspan="3">CER Technical Standards: establishing common technical standards for CER</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Inter-Operability Standard: Common smart inverter profile enabling interoperability of CER devices</td><td></td></tr>
</table>

Note: there are multiple CER customer journey frameworks. See Project Symphony for an alternative journey framework which focuses especially on end-to-end transactions and integration platforms for CER.

THE WESTERN AUSTRALIA DISTRIBUTED ENERGY RESOURCE ROADMAP

Western Australia's Energy Transformation Taskforce has developed a Distributed Energy Resources Roadmap. The Roadmap outlines a series of actions to address the opportunities and challenges associated with DER including pilots to address technical, market and regulatory barriers, changes to technical settings and provided consumers with information and protections. Actions implemented include an Electric Vehicle Action Plan, a 'Midday Saver' time-of-use pilot, bringing forward inverter standards and release of a network opportunities map for location of storage and other technologies to support the network.[24]

24 Western Australian Government (2023) *Distributed Energy Resources Roadmap*, https://www.wa.gov.au/government/distributed-energy-resources-roadmap.

TOWARDS A NATIONAL CONSUMER ENERGY RESOURCES ROADMAP

It is important that the policy and rule changes underway proceed in a coordinated fashion. Australia's Federal and State energy ministers agreed in November 2023 to develop a **National Consumer Energy Resources Roadmap – Powering Decarbonised Homes and Communities.** The objective is to deliver national reforms for efficient and effective integration of CER, deliver on greenhouse and renewable energy targets and positive outcomes for consumers at all income levels. Energy Ministers also agreed to consider developing a national approach to technical standards for CER and the establishment of an expert taskforce.[25]

25 Energy and Climate Change Ministerial Council, Meeting Communique, November 24

5 Flexible demand schemes in Australia

There are three flexible demand (FD) schemes within the NEM:

Wholesale: The Wholesale Demand Response Mechanism (WDRM) was established to also enable aggregators to bid demand response into the wholesale electricity market as a competitive alternative to supply.

FCAS: There are multiple markets for the provision of Frequency Control Ancillary Services (FCAS) for registered participants in the NEM and WA.

Emergency: The Reliability and Emergency Reserve Trader (RERT) scheme provides pawyments for contracted users to have capacity availability for emergency demand response and event payments when activated.

WHOLESALE DEMAND RESPONSE MECHANISM

Since commencing in 2019, only one participant (Enel X) has registered in the WDRM, with 65.3 MW of registered capacity across 34 National Meter Identifiers (NMIs).[26] Nexa Advisory notes this equates to just 0.2% of peak demand which is lower than 5-11% in leading international jurisdictions.[27]

The volumes of FD in the WDRM – which has been in operation for over four years – are low. A total of 749.3 MWh has been dispatched. No WDRM dispatches were recorded in 2019 or 2021. The major activity occurred during the extraordinary wholesale electricity prices of mid-2022, peaking at 418.7 MWh (Q2). Most activity during the past two years has been during winter.

There are some other avenues for wholesale demand response, such as retailers contracting directly with large energy users, some users being registered as market customers or having spot exposure in their retail contracts. However, there is no public information on the size of transactions.

There are a range of barriers to the growth of the WRDM.[28] According to analysis by Oakley Greenwood, the use of baseline methodologies for measurement of FD, which require very stable, predictable loads, excludes up to 80% of loads.[29] The small pool of available loads discourages new entrants. The WDRM also excludes the residential sector.

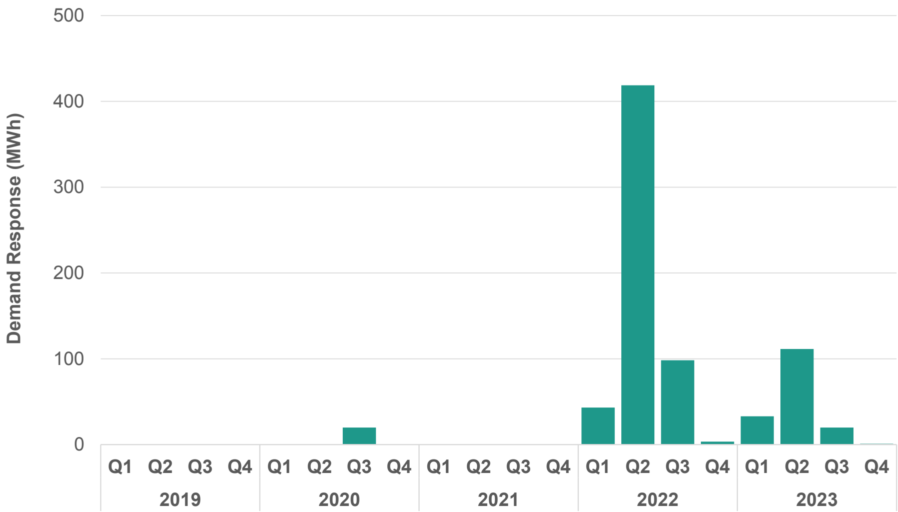


Figure 5. WDR dispatched, 2019–23.

26 AEMO, Quarterly Energy Dynamics Q1 2024, April 2024.

27 Nexa Advisory (2024) *Accelerating Commercial and Industrial Demand Demand-Side Participation in NSW*, https://nexaadvisory.com.au/site/wp-content/uploads/2024/02/Nexa-Advisory-Report-Accelerating-CI-demand-response-in-NSW.pdf.

28 See Briggs, C., Hasan, K., Dwyer, S., Bashir, U., Niklas, S, Alexander, D and Chatterjee, A. (2023) *ARENA Demand Flexibility Portfolio: Retrospective Analysis*. https://arena.gov.au/assets/2023/07/demand-flexibility-portfolio-retrospective-analysis-report.pdf.

29 AEMO (2021) *National Electricity Market: Baseline Eligibility Compliance and Metrics Policy*, https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2020/wdrm-becm-policy/first-round/final-report-and-determination.pdf, p.18.

FREQUENCY CONTROL ANCILLARY SERVICES

In the NEM, FCAS is procured and dispatched through AEMO, which oversees the entire market and manages FCAS requirements, while in the WEM, FCAS operates as a bilateral market between electricity generators and retailers.

From January 2019 to December 2023, the accumulated value of the NEM Frequency Control Ancillary Services (FCAS) market was $1.45 billion. FCAS market revenues increased from 2019, peaking in 2021 at $439 million, but have declined in both 2022 ($279 million) and 2023 ($151 million).[30]

In Q4 2023, two new contingency services (Very Fast Raise Contingency and Very Fast Lower Contingency) were introduced, adding $4.6 million (14%) and $1.8 million (5%), respectively, to FCAS market revenues.

Grids (2023) estimates that 10–20% of FCAS has been provided by DER since 2018, mostly by commercial and industrial facilities such as water treatment plants and data centres.[31]

Batteries have emerged as a major technology for FCAS, holding a 50% market share,[32] largely owing to the introduction of very fast FCAS services and the commissioning of new batteries in residential, commercial and industrial sites. Technical barriers need to be addressed before electric vehicles can provide FCAS services.

Batteries and demand response were the main contributors to the new very fast services market (R1SE/L1SE services), with batteries averaging 110 MW of quarterly enablement (76 MW for raising and 33 MW for lowering) and demand response contributing 31 MW (all for raising). VPPs have also supplied these services, albeit on a much smaller scale of 2 MW for both raise and lower; nonetheless this indicates VPPs may play a more significant role in future.[33]

Small volumes of power were discharged during FCAS events in one electric vehicle pilot (REVs).[34] Analysis by Energia of the REVs pilot found each vehicle could have earned up to $12,000 in the NSW FCAS contingency raise market in 2022.[35] Enabling participation of EVs in FCAS markets at scale will require further pilots to understand and address the specific technical impediments of vehicle-to-grid (V2G) energy transfer and introducing new models, such as operating envelopes, to help accommodate high local demands when overall network capacity allows.[36]

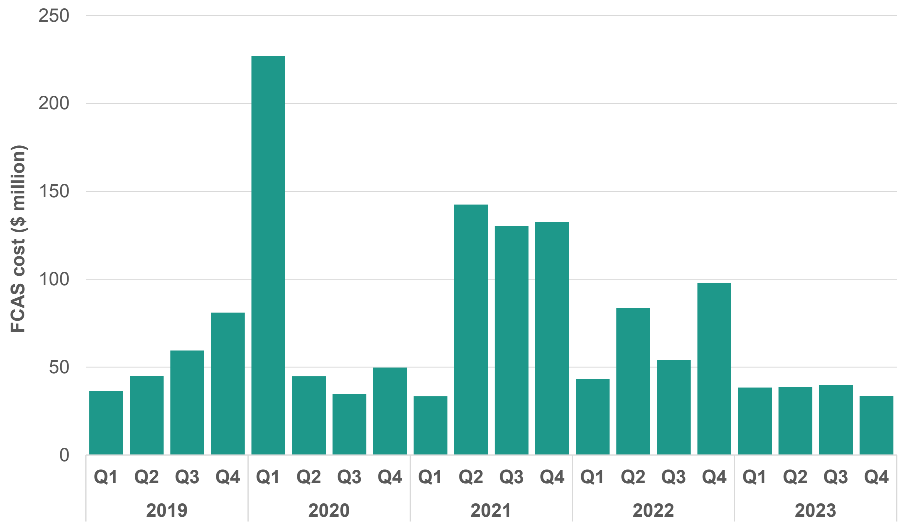


Figure 6. FCAS cost, 2019–23.

30 AEMO (2023). Quarterly Energy Dynamics (QED). December 2023. Accessed 13 March 2024.

31 Grids (2023). *2023 DER in Energy Markets*, www.grids.dev.

32 AEMO. (2024). Quarterly Energy Dynamics Q4 2023, January 2024.

33 *Ibid*.

34 https://arena.gov.au/projects/realising-electric-vehicle-to-grid-services/

35 Energia (2024). Insights from the Realising Electric Vehicle-to-Grid Services Project. Final Report. https://arena.gov.au/assets/2024/02/ARENA-Vehicle-to-Grid-Insights-Final-Report.pdf

36 Briggs, C., Hasan, K., Dwyer, S., Bashir, U., Niklas, S., Alexander, D & Chatterjee, A. (2022) *Knowledge Sharing Demand Flexibility Portfolio Retrospective Analysis Report*, p. 22-23.

EMERGENCY DEMAND RESPONSE

The Reliability and Emergency Reserve Trader (RERT) allows AEMO to procure emergency reserves, such as generation or demand response, to be deployed to prevent critical reserve shortfalls, during low reserve or lack of reserve periods. AEMO has a panel of RERT suppliers, but also have the capacity to contract for up to three years if there are shortfalls identified in AEMO's Electricity Statement of Opportunities (ESOO).[37]

From January 2019 to December 2023, the accumulated costs for RERT amounted to $172.5 million. The RERT has been used intermittently, peaking at $131.7 million in 2022. In 2023, the costs were $2.3 million.

From 1 December 2023 to 31 March 2024, AEMO set out to contract Interim Reliability Reserve (IRR) to cover a reliability reserve gap of 118 MW in South Australia, and 120 MW in Victoria based on the Electricity Statement of Opportunities. AEMO contracted 119 MW in Victoria but only 10 MW in South Australia due to the limited availability of eligible reserves.[38]

A range of different sources of flexible demand have participated in RERT, including residential behavioural demand response programs operated by retailers, residential battery VPPs, and industrial sites (smelters, paper mills, concrete producers).

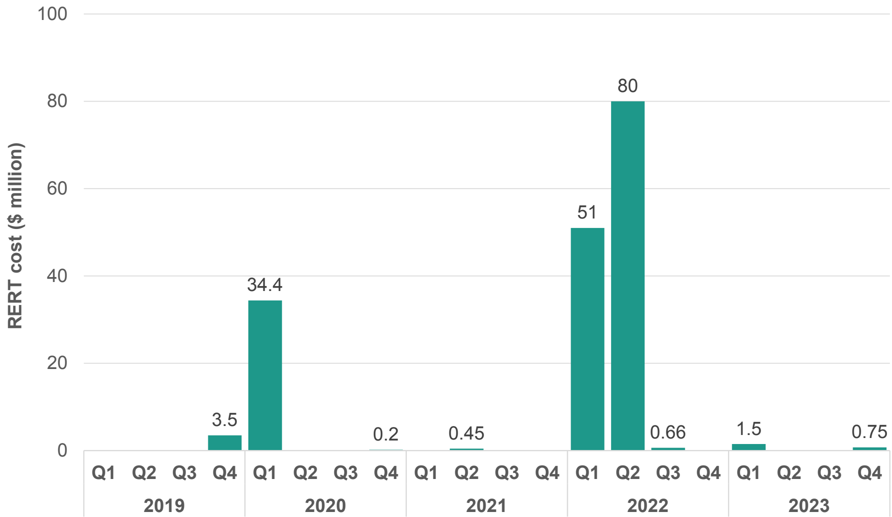


Figure 7. RERT cost of dispatched 2019–23.

37 AEMO, 2023 Electricity Statement of Opportunities, August 2023.

38 AEMO, RERT Activation Quarterly Report Q4 2023, February 2024.

6 Flexible demand tariffs in the National Electricity Market

An increasing number of tariffs being offered by both DNSPs and retailers in the National Electricity Market create incentives for increasing flexible demand (FD). The AER estimates that around one-quarter of consumers are on some form of 'cost-reflective' electricity tariff.[39] Many large C&I customers and most residential and small business consumers remain on either flat electricity tariffs or simple time-of-use tariffs (peak, shoulder and off-peak blocks), which often do not provide an effective incentive for FD. Unlocking greater value for consumers from FD requires tariffs that are more cost-reflective.

WHAT ARE 'FLEXIBLE DEMAND' TARIFFS?

In general, 'flexible demand' tariffs provide incentives for shifting consumption from peak periods to lower demand periods through more cost-reflective pricing. Some examples of flexible demand tariffs include:

- **'Solar soaker' tariffs:** low or free electricity is offered to incentivise users to shift electricity consumption to the middle of the day (e.g. 10am–3pm).
- **Electric vehicle tariffs:** tariffs for electric vehicle owners that provide incentives for charging outside the evening peak e.g. late morning to mid-afternoon, especially on weekends, and/or night-time from 9pm onwards.
- **Network two-way tariffs:** Network two-way tariffs include export charges and rewards to discourage or encourage energy exports[40] at different times.[41]
- **Controlled load tariffs:** tariffs are provided for load control of hot water systems (HWSs), pool heaters and other such loads by DNSPs. The number of HWSs on load control tariffs is falling as customers move away from resistance hot water and align loads with solar generation or orchestrate multiple devices.
- **Wholesale pricing:** there are retailer offers that pass-through wholesale pricing for both residential and commercial and industry customers.[42]
- **High voltage network tariffs:** high-voltage battery tariffs provide incentives to install and operate grid-scale batteries.

It can be extremely complex and time-consuming to find information on electricity tariffs, making it hard for consumers to find and compare different offers. Appendix A provides a comprehensive sample of current and proposed DNSP and retailer tariffs that incentivise flexible demand.

Some visualisations of FD tariffs by DNSPs and retailers (Figure 9) are provided below to illustrate how they work in practice. The tariff structures are visualised in the form of polar plots, with time of day (0–24 hours) on the polar axis and the tariff rate (in ¢/kWh) on the radial axis.

FLEXIBLE DEMAND TARIFFS IN PRACTICE: DNSPS

Solar soaker tariffs: Ausgrid's Residential ToU (Figure 8a) and Essential Energy's Sun Soaker Residential (Figure 8b) tariffs are typical of many DNSP ToU tariffs. They exhibit a 'bowtie' structure, where substantially increased rates correspond to morning and evening demand peaks with lower, relatively flat rates at other times.

By comparison, many other tariffs such as Essential Energy's Residential ToU (Figure 8c) exhibit a similar structure but much less prominent peak rates and therefore weaker FD incentives.

Demand-charges: Some network tariffs are trialling demand charges that vary by time of day, such as Essential Energy's Grid Scale Battery LV (Figure 8d).

39 Grids (2023) *2023 DER in Energy Markets*, www.grids.dev.

40 There is a basic export level which is the quantity of electricity that a customer can export to the grid without incurring any cost. This level is set to remain constant for a 10-year period, covering two regulatory cycles. However, adjustments to this level may be made within the 10-year timeframe.

41 In the determination by the AEMC on *Access, Pricing, and Incentive Arrangements for Distributed Energy Resources*, networks were permitted to propose two-way tariffs. The AER released Export Tariff Guidelines for the networks in May 2022 https://www.aer.gov.au/industry/registers/resources/guidelines/export-tariff-guidelines. Two-way-pricing tariffs can take effect from the next revenue determination in either 2024 (NSW, ACT, Tasmania, Northern Territory), 2025 (SA, Queensland) or 2026 (Victoria).

42 For some examples of customers implementing flexible demand strategies on wholesale pricing, see Alexander, D., Briggs, C & Assaf, J. (2021) *More for Less: how businesses can flex their energy to get more from a Renewable PPA*. https://www.uts.edu.au/sites/default/files/2021-08/More%20for%20Less-2021.pdf

Two-way tariffs: Two-way tariffs intended for batteries, such as Ausgrid's trial two-way residential load and generation tariffs (Figure 8e and f), exhibit a very different structure. Higher consumption rates are combined with high payments for generation in the afternoon/evening peak (2–8pm). Exports are penalised at other times through an export charge.

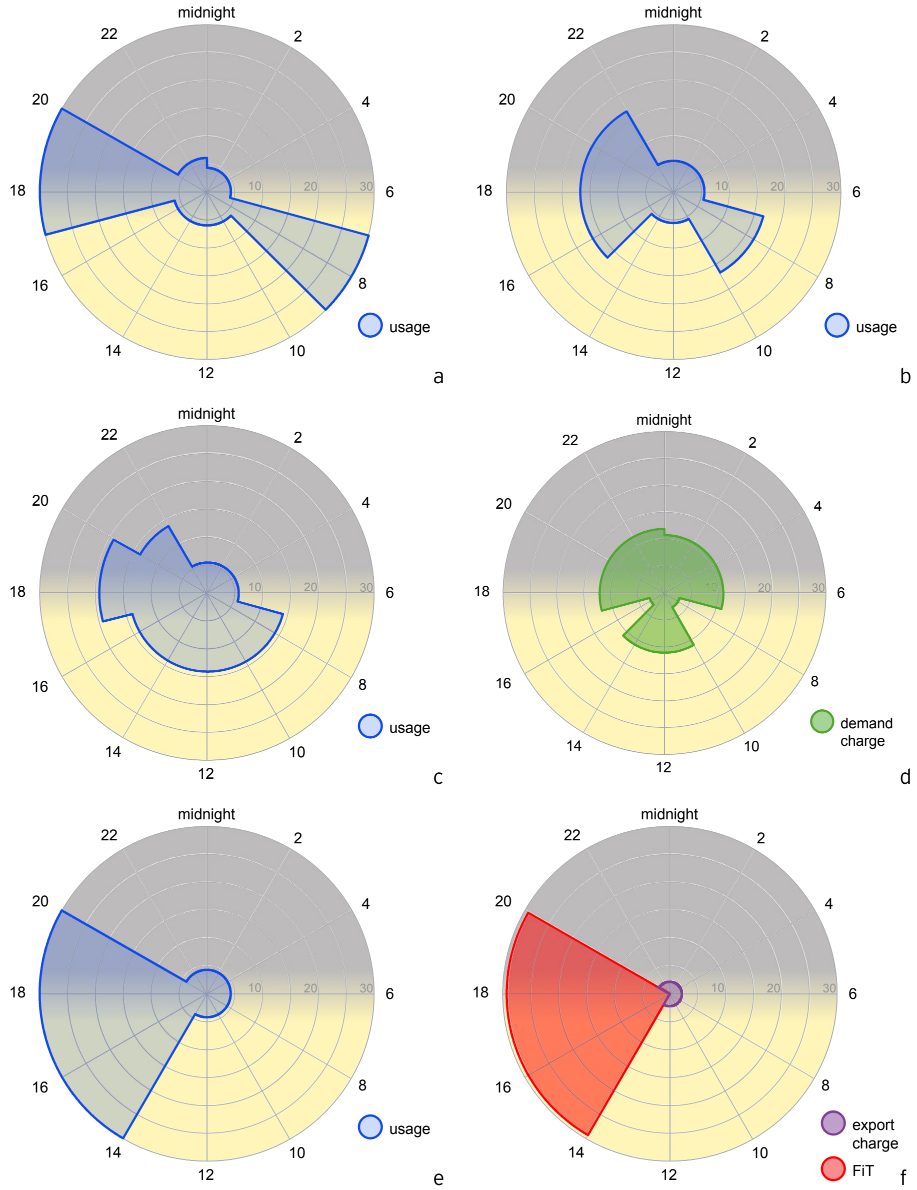


Figure 8. Selected DNSP tariffs that incentivise FD, with time of day (0–24 h) on the polar axis and the tariff rate (0–30 ¢/kWh) on the radial axis. (a) Ausgrid Residential ToU, (b) Essential Energy Sun Soaker Residential, (c) Essential Energy Residential ToU, (d) Demand charges for Essential Energy's Grid Scale Battery LV in $/kVA/month, (e) Ausgrid Two-Way Residential (load), (f) Ausgrid Two-Way Residential (generation).

DNSPs are exploring location-specific and time-specific incentives rather than uniform network-wide approaches to better utilise unused network capacity and manage local constraints due to varying DER uptake.[43] Two main strategies are being considered:

Dynamic, real-time network pricing: This method involves adjusting prices based on the real or near-real-time costs to serve customers,[44] thereby making unused network capacity available to DER and rewarding behaviours that support local network stability.

Dynamic operating envelopes (DOEs): DOEs adjust the upper and lower limits on customers' load and generation capacity, varying over time.[45] This flexibility could, for instance, support increased and faster electric vehicle charging during off-peak times, improving network service, and potentially reducing network costs.

43 Ausgrid, Project Edith: Project Overview Report, July 2022.

44 Network tariffs are determined based on the long-term costs of serving customers, a method known as long-run marginal cost pricing. This approach is mandated by the National Electricity Rules (NER).

45 More precisely, DOEs are applied to the portion of load or generation that is either drawn from or injected into the electricity grid, specifically affecting customers' imports and exports of energy.

FLEXIBLE DEMAND TARIFFS IN PRACTICE: RETAILERS

Retailers ultimately set the tariffs that customers actually pay, and network tariffs may or may not be passed through to customers. Some examples of flexible demand tariffs being implemented by retailers are detailed below.

EVs: Engie's EV Night Time Saver TOU (Victoria; Figure 9a) also exhibits a 'bowtie' structure that incentivises shifting demand away from morning and evening peak periods towards the middle of the day and night. In contrast, the non-TOU version of this tariff (Figure 9b) provides weak incentives to shift demand to the midnight–6am period, with only a moderate decrease in rates.

Several retailers offer weekly periods of free or cheap EV charging, especially on weekends.

Origin Energy's EV Power Up plan provides scheduled, app-controlled EV charging for 8.0 ¢/kWh.

Wholesale pricing: Pricing models from Amber Electric (Figure 9d) and Flow Power pass through wholesale prices, which often include large variations between low demand times and price spikes in high demand times.

There are also notable differences in tariffs between states, including the time periods applied to peak and off-peak rates. For example, the Momentum Suit Yourself tariff differs substantially between SA (Figure 9e) and Victoria (Figure 9f).

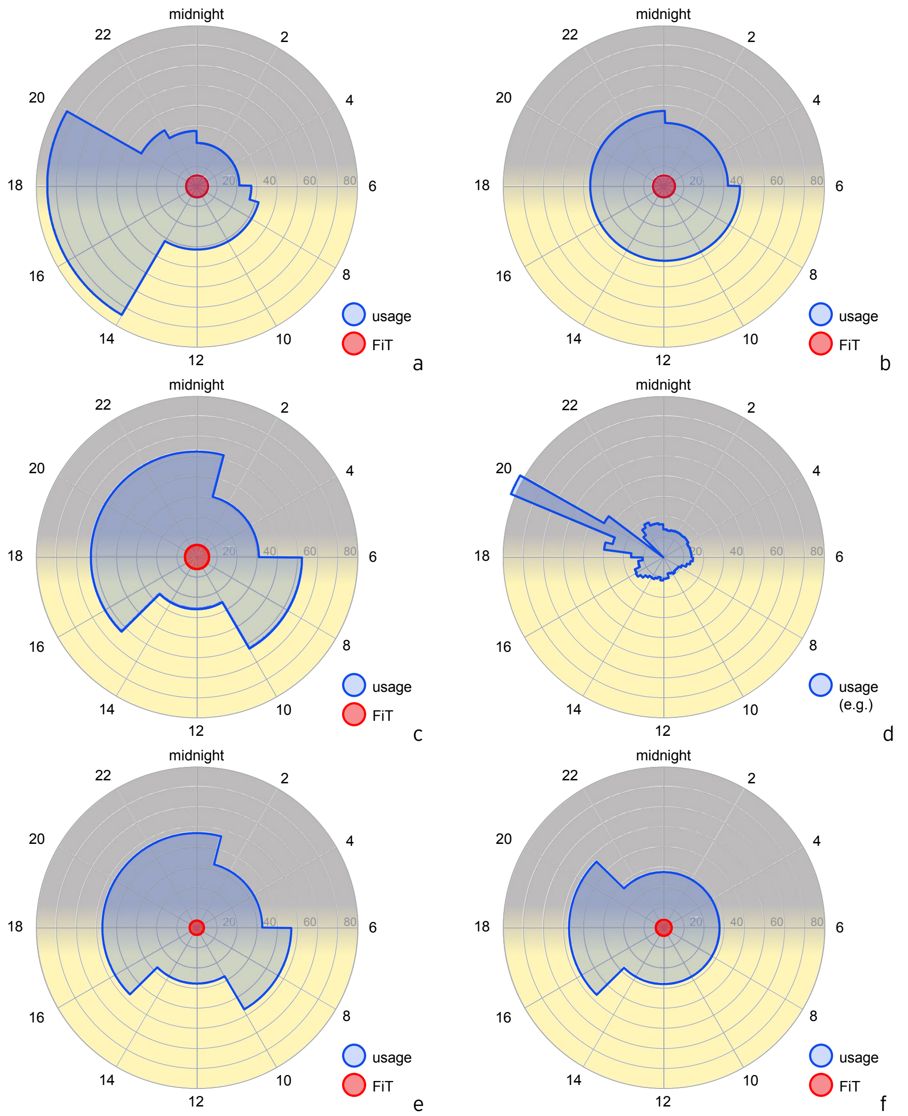


Figure 9. Selected retailer tariffs that incentivise FD, with time of day (0–24 h) on the polar axis and the tariff rate (0–80 ¢/kWh) on the radial axis. (a) Engie EV Night Time Saver TOU (NSW). (b) Engie EV Night Time Saver (NSW). (c) Origin Energy Go Variable (SA) (d). A daily example of Amber Electric fully wholesale-reflective retail pricing. (e) Momentum Suit Yourself, SA. (f) Momentum Suit Yourself, Victoria.

ELECTRIC VEHICLE TARIFFS: OUTCOMES FROM PILOTS

There have been four major electric vehicle orchestration pilots, conducted by AGL, Origin, Jemena Energy and Ergon/Energex. These are summarised inTable 5. These pilots have broadly found similar outcomes from testing the impact of tariffs on charging behaviour and demand.

Residential electric vehicle charging patterns are more diverse and do not align as strongly with the evening peak as expected. Origin, AGL and Jemena Energy each observed that the baseline charging patterns of participants did not correspond with some other residential loads (e.g. cooking) and were reasonably distributed across both the day and week. Consequently, none of the trials observed a spike in charging demand in the evening peak (4–9pm) before they applied trials. EV charging peaks were typically post-evening peak (9–11pm).

Solar panel owners did respond to incentives to charge in the day. One of the questions for pilots was whether incentives would be sufficiently attractive to encourage drivers with panels to charge by self-consuming excess solar. The trials did find higher levels of charging during the day by solar owners. The Origin and Jemena pilots found much higher daytime charging by solar owners. The Energex/Ergon pilots observed that where there was no solar ownership or tariff incentives 'convenience charging' predominated. The AGL pilot found higher daytime charging by solar owners but that most charging still occurred at night-time.

High-levels of customer satisfaction with both time-of-use tariffs that provided incentives for smart charging and controlled charging. Each of the trials found strong consumer participation and satisfaction with the trials of both time-of-use tariffs (to incentivise charging out of evening peaks) and controlled charging (to limit charging during evening peaks). All trials were dominated by 'early adopters' who are relatively knowledgeable and motivated and not representative of the wider population.

TABLE 5. ELECTRIC VEHICLE ORCHESTRATION PILOTS: VALUE AND QUANTUM OF LOAD SHIFTING.

	WHOLESALE		NETWORK	
TRIAL OWNER	VALUE	VOLUME OF LOAD SHIFT	VALUE	VOLUME OF LOAD SHIFT
AGL	$33/EV charger		Not included	Not included
Origin	$46/charger relative to trial participant baseline.	E1: 20% reduction in peak charging demand with 90% outside evening peak E2: 22% reduction in peak charging demand	Victoria (Powercor/CitiPower/United Energy): $80/charger NSW (Ausgrid): $12 million in avoided or deferred network investment if peak demand savings were replicated across EV users to 2029. Average: Origin estimates $28/charger	Not estimated
Jemena Energy	Not included	Not included	$400–800 of avoided network investment per EV charger through 'demand response' (DR) $0.30–0.40 of consumer benefit for avoided customer export curtailment value (CECV) per EV charger per 'solar soaker' (SS) event	6 kW/EV charger (DR) 10–11 kWh/EV charger (SS event)
Ergon/ Energex	Not estimated	Not estimated	Queensland (Ergon/Energex): network peak demand savings were noted but no value was estimated	Not estimated

7 Flexible demand pilots in Australia

There are currently a range of pilots aiming to demonstrate solutions to technical, financial, regulatory barriers to scaling Flexible Demand (FD). Each of the recently completed pilots or those currently underway are mapped below based on the sector, technologies and energy services involved before individual profiles for each pilot underneath. In the closing section on next steps, the pilots are also mapped against current rule change and policy development processes.

There are a few observations based on the map of pilots against sectors, technologies and energy services:

- **Electric Vehicles (residential):** ARENA and the South Australian government have funded a significant number of pilots with households which have unearthed important insights on residential charging patterns. Preliminary results have been encouraging on the potential for FD amongst early adopters but there is a need for pilots that incorporate wider consumer groups and test ability to provide grid and market services as uptake scales.
- **Electric vehicles (public, commercial or industrial fleets):** smart charging in commercial and government fleets has not yet been piloted at the same level as households. Fleets were a component of two pilots but no performance data was generated by either pilot. The Origin (Electric Vehicle Smart Charging) trial knowledge sharing report catalogued the concerns of fleet managers and no data was released specifically on fleets. The Realising Electric Vehicle-to-Grid Services pilot aimed to deliver FCAS from a government EV fleet but the technical capability and standards for Vehicle-to-Grid were not yet sufficiently developed for implementation. The Strategic Electric Vehicle Initiative by RACE for 2030 CRC is developing pilots for commercial and government fleets.
- **Residential hot water:** residential hot water has been identified as one of the largest opportunities for FD and there are now a significant number of overlapping pilots underway. There will be an important coordination role to ensure innovation and knowledge sharing occurs from these pilots.
- Industrial sectors and hydrogen: there are few pilots occurring in heavy industry (although some industrial users are already providing FD via a retailer, RERT or as a market customer) and it is too early in the development of hydrogen yet for FD pilots.
- **Commercial sectors:** there are several pilots testing FD in commercial sectors (shopping centres, cold storage, supermarkets) but only one pilot for commercial buildings (CSIRO – Digital Infrastructure).
- **Energy services:** most pilots are focussed on wholesale and/or network services and value-streams – which is to be expected as FCAS and RERT are more mature markets. The level of network activity in pilots is much higher than the DMIS and DMIA and some pilots are developing new network services. It is also notable that as observed in the ARENA Retrospective Report that most pilots are 'value-pairing' (combining two types of service and revenue) instead of 'value-stacking' across the other streams. Combining RERT with network revenue streams is considered 'double-dipping' and as the ARENA Retrospective Report noted there are barriers to combining more than two value-streams (e.g. some loads are inherently not well suited to particular value-streams).
- **Consumer research:** a consistent feature of consumer or social research undertaken for flexible demand pilots is that the populations are heavily skewed towards demographics that are highly engaged with technology (especially men aged 50 and over) which are unlikely to be representative of the wider population. As many of the technologies are at early stages of adoption, the owners and participants in pilots have an in-built bias towards these demographics. Nonetheless, consumer or social research of wider populations remain an important gap in understanding how to scale up FD.

TABLE 6. CURRENT FLEXIBLE DEMAND PILOTS BY SECTOR, TECHNOLOGY AND ENERGY SERVICE.

			Sector							Technologies										Energy service			
Name of Project	Page	Sponsor	Residential	Shopping Centre	Supermarket	Cold storage	Water	Commercial buildings	Commercial fleets	PV	BESS	EV charging	Hot Water	Heat pumps (incl. pools)	Residential AC	Refrigeration	Water pumping	Commercial HVAC	Software	Wholesale	Network	Emergency	FCAS
AGL - Dynamic Pricing Load Flex Trial	30	ARENA			✓	✓	✓									✓	✓	✓		✓			
AGL - Electric Vehicle Orchestration Trial	31	ARENA	✓									✓								✓	✓		
Birdwood Energy - Flexible Report Card Platform	32	ARENA																					
Enel X - Unlocking Flexible Demand in the Commercial Refrigeration Sector	32	ARENA			✓	✓										✓		✓		✓	✓		✓
Intellihub - Flexibility Load Platform	33	ARENA								✓	✓	✓	✓	✓					✓	✓	✓		✓
Jemena - Dynamic Electric Vehicle Charging Trial Project	34	ARENA	✓									✓									✓		
Origin - Electric Vehicle Smart Charging Trials	35	ARENA	✓									✓								✓			
PLUS ES - South Australia Demand Flexibility Trial	36	ARENA	✓										✓										
Realising Electric Vehicle-to-Grid Services (REVS)	37	ARENA							✓			✓											✓
Rheem - Smart Network (Hot Water Load Under Active Control)	38	ARENA	✓										✓						✓	✓	✓		✓
SA Power Networks - Energy Masters	39	ARENA	✓							✓	✓	✓	✓	✓	✓				✓				
SA Power Networks - Flexible Exports Trial	40	ARENA	✓							✓											✓		
SA Power Networks - Market Active Solar Trial	41	ARENA	✓							✓										✓			
Shell Energy - Smart Energy Hubs Deployment	42	ARENA		✓	✓	✓				✓	✓	✓			✓					✓			
Solar Analytics - Smart CER Consumer Uptake Tool	43	ARENA	✓							✓	✓	✓	✓	✓					✓	✓	✓		
United Energy - Flexible Services Trial	43	ARENA								✓			✓										
United Energy - Low Voltage BESS trial	44	ARENA									✓										✓		
Project Converge	45	DER Market Integration	✓							✓	✓									✓	✓		✓
Project EDGE	46	DER Market Integration	✓							✓	✓									✓	✓		✓
Project Edith	47	DER Market Integration	✓							✓	✓										✓		
Project Symphony	48	DER Market Integration	✓							✓	✓				✓					✓	✓		✓
Business Power Flex: Business customer solutions to minimum demand	49	RACE			✓	✓	✓		✓			✓			✓		✓			✓	✓		
SolarShift: Turning electric water heaters into megawatt batteries	50	RACE	✓										✓							✓	✓		
Strategic Electric Vehicle Integration	51	RACE	✓						✓			✓								✓	✓		
CSIRO - Digital Infrastructure Energy Flexibility (DIEF) pilot projects	52	STATES						✓			✓	✓	✓					✓	✓	✓	✓		
Embertec - Efficient targeting and automated control of residential air conditioning loads	53	STATES								✓					✓				✓	✓	✓		
Enel X - Using commercial customers' existing backup generators to provide DR	54	STATES									✓												
Ergon/Energex - Electric Vehicle Smart Charge	55	STATES																					
SA EV Smart Charging Trials	56	STATES		✓					✓			✓								✓	✓		
SAPN - Closed-loop Voltage Control Trial	57	STATES								✓									✓		✓		

Another way of mapping pilots is to plot them against current rules changes and programs/market schemes to understand where they might have relevant insights or learnings that relate to these rule changes, as shown below in Table 7.

TABLE 7. CURRENT FLEXIBLE DEMAND PILOTS, MAPPED BY RULE CHANGE AND PROGRAM/MARKET SCHEME.

		Rule change						Program or market scheme				
Name of project	Sponsor	Smart meters	Flexible trading	Price responsive	Flexible exports	Technical Standards	Inter-operability	WDRM	RERT	Network DM	FCAS	PDRS
AGL - Dynamic Pricing Load Flex Trial	ARENA			✓				✓				✓
AGL - Electric Vehicle Orchestration Trial		✓				✓		✓		✓	✓	
Birdwood Energy - Flexible Report Card Platform								✓		✓	✓	✓
Enel X - Unlocking Flexible Demand in the Commercial Refrigeration Sector		✓	✓	✓				✓			✓	
Intellihub - Flexibility Load Platform				✓			✓					
Jemena - Dynamic Electric Vehicle Charging Trial Project		✓				✓				✓	✓	
Origin - Electric Vehicle Smart Charging Trials		✓				✓		✓		✓	✓	
PLUS ES - South Australia Demand Flexibility Trial		✓		✓			✓	✓				
Realising Electric Vehicle-to-grid Services (REVS)				✓		✓					✓	
Rheem - Smart Network (Hot Water Load Under Active Control)		✓		✓	✓		✓	✓		✓		
SA Power Networks - Energy Masters		✓		✓		✓	✓	✓		✓		
SA Power Networks - Market Active Solar Trial					✓		✓	✓		✓		
SA Power Networks - Flexible Exports Trial					✓		✓			✓		
Shell Energy - Smart Energy Hubs Deployment				✓				✓		✓		✓
Solar Analytics - Smart CER Consumer Uptake Tool				✓	✓					✓		
United Energy - Flexible Services Trial		✓		✓	✓		✓			✓		
United Energy - Low Voltage BESS trial					✓					✓		
Project Converge	DER Market Integration				✓					✓	✓	
Project EDGE				✓	✓					✓	✓	
Project Edith				✓	✓					✓		
Project Symphony				✓	✓	✓	✓			✓	✓	
Business Power Flex: Business customer solutions to minimum demand	RACE			✓				✓		✓		
SolarShift: Turning electric water heaters into megawatt batteries		✓		✓	✓			✓		✓		
Strategic Electric Vehicle Integration						✓		✓		✓	✓	
CSIRO - Digital Infrastructure Energy Flexibility (DIEF) pilot projects	STATES		✓	✓		✓	✓					✓
Embertec - Efficient targeting and automated control of residential air conditioning loads				✓						✓		
Enel X - Using commercial customers' existing backup generators to provide demand response			✓	✓	✓				✓	✓		
Ergon/Energex - Electric Vehicle Smart Charge				✓						✓		
SA EV Smart Charging Trials		✓				✓		✓		✓		
SAPN - Closed-loop Voltage Control Trial					✓					✓		

PILOT PROFILES – ARENA

<table>
<tr><th colspan="4">AGL – Dynamic Pricing Load Flex Trial</th></tr>
<tr><td rowspan="6">PROJECT DESCRIPTION</td><td rowspan="6">The project aims to dynamically shift commercial and industrial loads to match renewable energy production on a day-to-day basis. AGL is trialling the use of a 30-minute interval price intensity forecasting tool (with seven bands from 'very high' to 'very low') as a proxy for renewable energy utilisation (as there is a correlation between price and renewable energy market share). Automated loads will be shifted up and down during the day based on the price forecast.
The aim is to trial seven sites within four sectors:
› Large scale cold stores (freezers)
› Supermarket refrigeration/air conditioning
› Large site air conditioning
› Water utilities.
The pilot will test and refine the price intensity tool, API communication system, software and hardware systems to integrate site energy management systems. The pilot will test if these loads can in practice flex up and down in response to price signals, identify any barriers, unintended consequences for networks, the value-proposition and commercial model and customer responses and experiences.
AGL aims to commercialise the offering based on the trial. Capital requirements for participation are relatively low which is considered scalable if demonstrated effective through the pilot.</td><td>PILOT SPONSOR</td><td>ARENA</td></tr>
<tr><td>DELIVERY PARTNER</td><td>AGL</td></tr>
<tr><td>TECHNOLOGIES</td><td>Commercial Refrigeration, HVAC, Water pumping</td></tr>
<tr><td>LOCATIONS</td><td>NSW</td></tr>
<tr><td>TIMEFRAME</td><td>Oct 2023 – Apr 2025</td></tr>
<tr><td>BUDGET</td><td>$1.78 million</td></tr>
<tr><td rowspan="3">LESSONS LEARNED</td><td rowspan="3">No learnings released to date.</td><td>SCALE</td><td>25 MW</td></tr>
<tr><td>VALUE STREAM(S)</td><td>Wholesale</td></tr>
<tr><td>INDUSTRY POTENTIAL</td><td>385 MW</td></tr>
</table>

Further information: https://arena.gov.au/projects/agl-dynamic-pricing-load-flex-trial/.

AGL – Electric Vehicle Orchestration Trial			
PROJECT DESCRIPTION	AGL's EV orchestration trial had three streams: › 200 residential electric vehicles being orchestrated through controlled charging (allowing participants to opt-out). › A control group of 100 residential electric vehicles on time-of-use tariffs for the testing of the effectiveness of price incentives for influencing household charging relative to 'controlled charging' where charging was externally controlled. › A trial of two technologies: Application Programming Interface (API) and Vehicle to Grid (V2G).	**PILOT SPONSOR**	ARENA
		DELIVERY PARTNERS	AGL
LESSONS LEARNED	› The pilot provided insights into EV charging patterns which were analysed before the interventions: • overall residential charging load is smaller and more diverse than expected. The projected early evening peak in EV charging was not observed as charging patterns are more diverse than residential uses like air-conditioning and cooking. • Most residential charging occurs from 9pm onwards, particularly on weekdays, but is scattered throughout the day and week. Generally, only one-in-six chargers were operating at the same time and only one-in-six participants said they charged their car every day; half charged their vehicle every few days. • Residents with solar panels charged EVs significantly more during the day, but still mostly during off-peak night-time periods. There was more day-time charging on weekends. › Controlled charging was only marginally more effective in reducing peak charging demand than time-of-use tariffs, reducing peak demand by 80%. The opt out facility for controlled charging was used infrequently. › Customer response to the trial was very positive, with over 90% saying it met or exceeded expectations. No major customer issues with either controlled charging or TOU tariffs emerged, but the participants are 'early adopters', which limits the ability to generalise to the wider population. › Around 20% of smart chargers were not returning data at any one point, which would be a problem at higher rates of penetration. › Controlled charging would suppress demand during RERT events and the pilot concluded EVs could participate in FCAS, but there were currently no chargers that allow for frequency response control. › The absence of common technical standards for chargers was identified as one of the major barriers to V2G, which in AGL's view is 'some years away'.	**TECHNOLOGY**	Electric Vehicles
		LOCATION	QLD, NSW, SA, VIC
		TIMEFRAME	2021 – 2023
		BUDGET	$7.69 million
		SCALE	300 vehicles
		VALUE STREAM(S)	Wholesale
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/knowledge-bank/agl-ev-orchestration-trial-lessons-learnt-report-4/.

Birdwood Energy – Flexible Report Card Platform

PROJECT DESCRIPTION	Birdwood Energy's Flexible Report Card Platform pilot aims to trial a streamlined report card system which identified flexible demand opportunities for businesses, and assess its impact on uptake of FD. Birdwood Energy's platform will allow users to collect and process site data, in turn providing them with information to support decision-making on implementing FD activities. Each report card categorises the types of FD available, such as HVAC or cold storage facility loads, and the types of technology required to unlock FD. The pilot aims to deliver 100 report cards to participating businesses. The project aims to reduce the cost to identify load flexibility opportunities in the C&I sector by more than 50% relative to current approaches.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	Birdwood Energy, ANU, EEC
		TECHNOLOGIES	HVAC, cold storage, hot water, batteries, PV
		LOCATIONS	Not specified
		TIMEFRAME	2024 –
		BUDGET	$2.58 million
		SCALE	2–5 MW
LESSONS LEARNED	No learnings released to date.	VALUE STREAM(S)	Wholesale, Network, FCAS
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/news/flexible-demand-software-to-give-power-back-to-customers/.

Enel X – Unlocking Flexible Demand in the Commercial Refrigeration Sector

PROJECT DESCRIPTION	The project aims to demonstrate the business case for different uses of FD in commercial refrigeration across two sectors: › 15.5 MW across ~440 grocery stores, focusing on reducing costs of metering and controls to access smaller loads (20~30+ kW each) › 5.4 MW across 13 refrigerated warehouses (12 existing and one new), focussing on: • incentivising and optimising 2–6 hours per day of load shifting. • new 'Flex Retail' commercial structure and site upgrades. The key objectives of the pilot are to demonstrate: › The business case for daily load-shifting of commercial refrigeration into the middle of the day. › Fast-response flexing of commercial refrigeration for FCAS. › Metering costs can be halved which can extend the market into smaller sites where the costs of metering currently make FD financially unviable.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	Enel X
		TECHNOLOGY	Virtual Power Plant (HVAC-R)
		LOCATION	VIC
		TIMEFRAME	May 2023 – Mar 2027
		BUDGET	$9.25 million
LESSONS LEARNED	It is early in the project, but some barriers have been identified: › Many smaller refrigeration sites have multiple NMIs (due to lower thermal mass and requirement for redundancy) which limits their ability to participate. The pilot therefore has relevance for the CER Flexible Trading rule change which could enable sub-metering for FD. › The 50-millisecond requirement for FCAS adds costs that are too high for smaller sites.	SCALE	21 MW
		VALUE STREAM(S)	FCAS, Wholesale
		INDUSTRY POTENTIAL	~500 MW

Further Information: https://arena.gov.au/projects/enel-x-commercial-refrigeration-flexible-demand-project/.

Intellihub – Flexibility Load Platform

PROJECT DESCRIPTION	Intellihub is developing a flexible demand platform to orchestrate 510 MW of load across 100,000 consumer devices, including hot water systems, rooftop solar PV, battery storage, pool pumps, and EVs. The platform integrates Intellihub's smart meter technology with GreenSync's CER registration and control software. The project seeks to address the challenge of integrating diverse CERs into a VPP at scale and reduce cost and complexity for aggregation. By providing an end-to-end solution that offers connectivity to multiple device types through a single platform, the project aims to enable VPP operators to integrate CER device types from different manufacturers efficiently, offering a cost-effective, secure pathway to scale device connectivity and participation in VPPs.
LESSONS LEARNED	Key learnings from the first knowledge sharing report include: › Retailers and networks are 'still early in the journey' on the development of CER management, they are at different stages and trialling various approaches to register, connect and control devices. › The value of flexible demand varies by device and for each retailer depending on factors such as their typical load or generation profile. › Preliminary analysis of the annual wholesale savings from different flexible loads found daily shifting of EV charging has the highest wholesale value ($631 per annum). On average pool pumps have higher savings ($151 per annum) than hot water ($130 per annum). However, the wholesale value of hot water and pool pumping as flexible loads varies significantly by state, peaking at $388 per annum for pool pumps in Queensland and $203 per annum for hot water in South Australia, with the lowest savings $35 per annum for hot water and $16 per annum for pool pumps in Tasmania.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	Intellihub, GreenSync
TECHNOLOGIES	VPP (HWS, PV, BESS, pool pumps, and EVs)
LOCATIONS	NSW
TIMEFRAME	Jul 2023 – Jan 2025
BUDGET	$22.01 million
SCALE	510 MW
VALUE STREAM(S)	Wholesale, Network, FCAS
INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/intellihub-demand-flexibility-platform-project/.

Jemena - Dynamic Electric Vehicle Charging Trial

PROJECT DESCRIPTION

Jemena Electricity Network led a trial with a group of other networks (Ausnet, Evoenergy, TasNetworks and United Energy) and the EV charging company JET Charge to:

- Develop hardware and software to calculate, design, communicate and operate dynamic operating envelopes through smart EV chargers.
- Trial different combinations of incentives for 170 participants across five 'demand response' events (to shift charging out of peak demand periods) and five 'solar soak' events (with incentives to charge from 10am-4pm).

LESSONS LEARNED

Key learnings from the trials were:

- The residential charging load was quite distributed across the week. In almost all networks, participants were charging EVs 1-2 days per week which therefore distributed load across the week.
- Charging load did not vary significantly across the day and with the exception of one network (Evoenergy) did not peak in the early evening. Most residential charging occurred 8-9pm. Participants with PV were charging a lot more in the middle of the day.
- An average of 60% of customers participated in demand response events, with 35% unable to participate and only 5% opting out of events. Participation in solar soak events was 57%.
- Charging decreased in response to demand response events and increased in response to solar soak events, but there were no major relationships observed between different types or scale of incentives. Household incomes were relatively high and the size of the incentive may not have been sufficient to influence participation.
- 20% did not participate for various reasons including chargers being switched off when not in use, WI-FI connectivity or inconvenient timing.
- An unintended consequence of the demand response events were secondary demand peaks just outside the event window, which need to be considered in future incentive design.
- There was high consumer satisfaction, with 64-85% indicating they would like to participate in future trials or product offerings based on either demand response or solar soak events. 74% said they 'preferred managing charging'. The feedback from consumers included a desire for greater, clearer communications on events and their purpose.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	Jemena Electricity, Ausnet, Evoenergy, TasNetworks, United Energy, JET Charge
TECHNOLOGY	Electric Vehicles
LOCATION	ACT, VIC, TAS
TIMEFRAME	Dec 2020 - Aug 2023
BUDGET	$3.83 million
SCALE	176 vehicles
VALUE STREAM(S)	Wholesale, Network
INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/jemena-dynamic-electric-vehicle-charging-trial/.

Origin – Smart Energy Smart Charging Trial

PROJECT DESCRIPTION

Origin connected 200 EV smart chargers to a VPP ('Loop'). The aims of the trial were to increase understanding of:

- the potential to shift EV charging outside of peak demand periods and towards times when they are high renewables.
- consumer willingness to allow management of EV charging, and their experience and satisfaction with managed charging.
- the business case for managed EV charging.

Origin conducted two 'experiments' in which residents were offered either:

- A 10 ¢/kWh incentive to charge 10am–3pm or 9pm–5am (Experiment 1);
- Controlled charging limited to 3–9pm, in exchange for a 25 ¢/day reward (Experiment 2).

LESSONS LEARNED

- Technical knowledge is important for getting customers comfortable with EVs and training sessions were recommended for future participants. Over 70% of the respondents to the EOI already owned solar and were skewed towards early adopters who were relatively well-informed on energy issues.
- The baseline charging load of this early adopter group already involved a large amount of optimising behaviour, charging during the day or overnight. Experiment 1 led to an increase in charging outside peak periods from 70% to 90%. Experiment 2 led to a reduction in charging during peak periods of 22% relative to baseline and 4% relative to Experiment 1.
- Around three-quarters of participants said the 10 ¢/kWh incentive was sufficient to alter their charging behaviour. 97% said they would be happy to stay with whichever of the TOU or controlled charging experiments they were included.
- Customers were provided an opt out for controlled charging. Only 44 of the 73 participants used the opt-out at any point and only 3 participants exercised this option regularly.
- Origin estimated the wholesale savings relative to trial participants' baseline was $46 per charger, but considered this an underestimate, as the participants were early adopters who were already managing charging more than an average customer. Using a 'convenience-charger' load-profile from CSIRO's EV projections report as a proxy for a mass uptake baseline, the wholesale and network value of controlled charging was estimated to be $170 per EV charger.
- Origin also trialled charging with fleets in local government, aged care, managed service providers, water authorities and education. Some of the findings were that installation costs were higher than expected (usually >$4000, up to $10,000 for more complex sites). Due to concerns about impacts on operational requirements, pilots generally occurred with pool vehicles. Aside from concerns about impacts on operations, the other barrier was identifying the key stakeholders within businesses. No results were reported in the knowledge sharing report.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	Origin Energy
TECHNOLOGY	Electric Vehicles
LOCATION	All states and territories
TIMEFRAME	Aug 2020 – Dec 2022
BUDGET	$2.92 million
SCALE	200 vehicles
VALUE STREAM(S)	Wholesale, Network
INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/knowledge-bank/origin-energy-smart-charging-trial-final-report/.

PLUS ES – South Australia Demand Flexibility Trial

PROJECT DESCRIPTION

The project aims to demonstrate use of existing smart meters to manage existing electric hot water systems (HWSs) as flexible loads. The pilot successfully grouped ~20,000 trial participants into 10 load control groups and randomised their switch-on times to create a more balanced electric hot water load curve, reducing demand spikes that tends to occur at the beginning of the heating period.

The trial focuses on developing two software platforms that provide a FD solution without hardware upgrades. These platforms comprise:

- a dynamic load management portal, which allows AGL to oversee and control eligible loads, and
- an API for seamless integration with AGL's systems to enable automated control of each meter.

Using these platforms, AGL can both schedule hot water loads dynamically (i.e. planned FD) and react to tariff and market price signals (i.e. real-time FD).

LESSONS LEARNED

- The amount of daily energy demand that was shifted (based on comparing nighttime and daytime loads) was 40~50%, averaging about 35 MWh (~1.75 kWh per household).
- Both lead times for controlled load (CL) calls and load control randomisation periods of 60, 30 and 15 minutes were validated, such that different groups can be scheduled at different time periods without delays, overlaps or latency issues related to smart meter communications and operations. Further testing of 5-minute lead times is planned.
- The average success rate for load control calls was >96%. Failures include some CL circuits that have previously been de-activated. Load control calls must be carefully scheduled to avoid overlap, which can cause execution errors by the smart meters, including unexpected disconnection.
- Across SA, NSW, Qld and Vic, about 25% of CL circuits had no load, which significantly affects the overall load shifting potential of domestic HWSs.
- About 3% of the water heating systems in the trial were heat pumps. These were observed to have much smaller electrical loads than traditional electric HWSs and require longer heating periods.
- A few edge cases were identified where participants have wired their CL HWS with third-party control devices such as timers, diverters, and home energy management systems (HEMS), which tended to interfere with AGL's central orchestration strategies, and vice versa. Solar thermal water heaters with auxiliary electric heating elements connected to CL circuit also created problems, requiring further investigation.
- Some trial participants with under-floor slab heating on CL noticed changes in operating times, meaning such heating loads may require different control strategies.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	AGL, PLUS ES, UNSW
TECHNOLOGY	Domestic hot water
LOCATIONS	SA
TIMEFRAME	Oct 2022 – Oct 2024
BUDGET	$5.43 million
SCALE	35 MWh/day (~1.75 kWh/day per household)
VALUE STREAM(S)	Wholesale, Network
INDUSTRY POTENTIAL	9 GWh/day[46]

46 Assuming ~1.75 kWh/day per household, applied across >5 million Australian households with electric water heaters.

Realising Electric Vehicle-to-grid Services (REVS)			
PROJECT DESCRIPTION	The REVS pilot tested vehicle-to-grid services using 51 Nissan Leafs in the ACT Government fleet. The project took delivery of the EVs, installed charging infrastructure and integrated hardware and software across multiple sites. The object of the pilot was to deliver FCAS from a fleet of EVs.	PILOT SPONSOR	ARENA
LESSONS LEARNED	Ultimately, the project was unable to deliver FCAS from the EV fleet. Some of the learnings that have been shared through a series of knowledge sharing reports include: › Complexities and delays were experienced in the set-up phase e.g. delays in charging infrastructure led to EVs going to other customers and procurement delays, site approvals were bespoke and subject to technical challenges, hard-wired internet connections were found to be required for charging speeds › EVs operate between electricity and transport systems which leads to a range of translation and integration issues without a 'common language'. › Certification of the charger against the technical standard (AS4777.2:2020) was very difficult and delayed the project. The fundamental problem is that the standard requires an earthing point whereas EVs do not provide any connection to the ground. The charger was modified to comply but then also the Electromagnetic Compatibility test. Wallback Quasar became the first and only bidirectional charger certified against AS4777.2:2020. The project recommends the AS4777.2:2020 be extended to include a bi-directional charger category. › When configured for the UK grid code, the charger response times are suitable for FCAS but did not meet the response time requirements operating in the Australian grid code. The project identified changes to be made either to the AS4777.2:2020 or AEMO's Market Ancillary Service Specification. The project has published reports based on stakeholder interviews and desktop analysis on the business models for V2G, gaps and recommendations for electric vehicles and the grid, a technical evaluation of the FCAS properties of the charger used in the trial and scenario modelling on the economic and technical value proposition for V2G.	DELIVERY PARTNERS	Icon Retail Investments, ACTEW AGL, ACT Government, Australian National University, SG Fleet, JET Charge, Nissan, Jemena Networks
		TECHNOLOGIES	Electric Vehicles
		LOCATIONS	ACT
		TIMEFRAME	Jun 2020 – Mar 2023
		BUDGET	$6.59 million
		SCALE	51 electric vehicles
		VALUE STREAM(S)	FCAS
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/realising-electric-vehicle-to-grid-services/.

Rheem – Smart Network (Hot Water Load Under Active Control)

PROJECT DESCRIPTION

SAPN control over electric water heaters is largely limited to time switchers, which cannot be controlled dynamically or remotely. The project sought to:

- Explore the potential for 2400 residential hot water systems along with (at a minimum) 200 air conditioning systems and 200 pool pumps to provide aggregated demand response within a VPP to deliver wholesale market value to participating customers.
- Test the potential to derive further wholesale and FCAS value, in addition to bill optimisation for trial participants.
- Test different strategies to shift the timing of water heating to consume excess solar PV generation during the day.
- Assist the development, deployment and demonstration of three solar-smart electric water heater solutions (PowerStore, PowerStore Lite and a retrofit device) and two load control adapters, one for air conditioning systems and one for pool pumps.
- Advance the commercialisation of a locally manufactured retrofit device to control hot water load.

LESSONS LEARNED

- Sales channels need to be well supported and incentivised to sell. There is also a need to separate the sale of physical products from the complexities of retail ewnergy contracting. While equipment resellers and installers can sell hardware, they struggled to manage the retail energy contract, tariff changes and meter exchange at the point of sale. Energy retailers struggled to deliver the required volume of hardware sales.
- Meter exchange processes (where required) need to be well-defined to avoid multiple visits and additional costs.
- Including heat pumps while excluding smart electric hot water systems in energy efficiency certificate schemes reduced demand for the latter creating challenges for the pilot to recruit participants.
- Both grid and consumer benefits are maximised by having full knowledge and control over on-site generation, and other passive and flexible loads.
- A 'whole of home' approach to orchestrating HWSs for the benefit of consumers delivers a better outcome for consumers than separate disparate control of HWSs.
- The lack of inter-operability technical standards created major issues for the pilots as other devices that are not orchestrated with the hot water system 'fight' for the surplus solar, which could negate the network service it is contracted to perform with detrimental financial impacts on the consumer and network.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	Rheem, Combined Energy Technologies (CET), SAPN, Simply Energy, AGL
TECHNOLOGY	Domestic hot water
LOCATION	SA
TIMEFRAME	Dec 2019 – Dec 2023
BUDGET	$8.8 million
SCALE	48 MW
VALUE STREAM(S)	Wholesale, Network, FCAS
INDUSTRY POTENTIAL	1.08 GW (3.0-4.5 GWh) in SA alone

Further information: https://arena.gov.au/knowledge-bank/arena-insights-spotlight-rheem-smart-network/.

SA Power Networks – Energy Masters			
PROJECT DESCRIPTION	This pilot is being developed by SAPN together with the SA Government (Department for Energy and Mining), energy retailer Amber Electric, finance partners Plenti and the Clean Energy Finance Corporation, appliance installer MAC Trade Services, and research partner RACE for 2030. The pilot includes 500 homes and focusses on home electrification and flexible demand. The pilot aims to identify opportunities, barriers and risks associated with widespread uptake of electric home and FD technologies, while trialling new technologies and services to minimise impacts on the grid and maximise value for consumers, including basic, sophisticated and orchestrated home energy management systems (HEMS). There are four work packages: › Networks: identify and understanding network options to equitably manage benefits and minimise negative impacts of mass uptake of HEMS and CER › Households: quantifying costs and benefits, identifying and understanding the factors that shape household decisions and interactions with flexible demand technologies, and household behaviours and sentiments towards flexible demand technologies › Industry-readiness: understanding capacity and constraints of key agents in the supply-chains and the workforce which can identify any challenges for scaling flexible demand. › Policy and regulation: understand the suite of policy, regulation and standards that could aid the delivery of flexible demand at scale beyond the pilot.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	SAPN, SA DEM, Amber Electric, Plenti, CEFC, MAC Trade Services, RACE for 2030, UniSA, UNSW, UTS
		TECHNOLOGIES	EV charging, HEMS, HWS, airconditoners
		LOCATION	SA
		TIMEFRAME	May 2024 – Sep 2026
		BUDGET	$13.8 million
		SCALE	Not estimated
LESSONS LEARNED	No learnings released to date.	VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Not estimated

SA Power Networks – Flexible Exports Trial

PROJECT DESCRIPTION	The aim of the pilot was to trial a Flexible Export connection offer for customers with solar panels that would otherwise be subject to a zero or near zero export limit. Under the offer, customers are able to export most of the time but are subject to limited exports when the distribution network is constrained. The overall outcome was to demonstrate a flexible exports offer, operational systems and technology solutions that can be applied across other regions. SAPN has included Flexible Exports as a standard connection offer and South Australian regulations now require all new or upgraded systems to be capable of participating in flexible exports.	**PILOT SPONSOR**	ARENA
		DELIVERY PARTNERS	SAPN, AusNet, Fronius, SMA, Solar Edge and SwitchDin
LESSONS LEARNED	› Significant network capacity was unlocked; an additional 154.6MW in Victoria, while in South Australia devices reached export limits of 10kw or 99.4% of their capacity. › A draft specification for an Australian version of the Common Smart Inverter Profile (CSIP) IEEE 2030.5 was developed and submitted to the national DER API Technical Working Group in 2021, which has been converted into a Standards Australia handbook (SA HB 218 CSIP-AUS) and is supporting flexible exports rollouts in South Australia, Victoria, and Queensland. › SwitchDin developed a new utility server that was used by SAPN and Ausnet to communicate flexible export limits. The two first CSIP-Aus compliant technologies were developed for the project – a gateway device that enabled non-compliant solar inverters to join the trial (the 'droplet', SwitchDin) and a cloud-based integration for inverters (Fronius). › Contractors were able to install equipment, but it was noted training materials and support will be required to do so at scale. As solar retailers typically align to inverter brands, there are potential constraints associated with compatibility. SAPN found some installers were not attracted to the offer as they had developed 'work arounds' for export constraints (e.g. up-selling to include batteries, sizing for no export, sometimes just ignoring constraints). › As one of 5 DNSPs in Victoria, Ausnet found it very hard to connect effectively with installers as part of a relatively small-scale trial and that many were adopting a 'wait and see' approach (some customers couldn't find an installer). Coordination between DNSPs and government were identified as essential for future implementation which was more complex than a single DNSP in South Australia. A national framework is required to create regulatory certainty to roll-out at scale. › Customers initially were found to have low awareness of the offer. A mail-out was unsuccessful in raising awareness but targeting social media yielded stronger results. Messaging needs to be carefully framed so it's understood as higher exports rather than a limitation. Satisfaction amongst participating customers was high based on survey respondents (60-85% approvals across various measures). › SAPN estimated the up-front cost to be around $1.5m and on-going costs of $3.8 over the 2020-2025 regulatory period (though in practice including elements that have broader applications).	**TECHNOLOGIES**	Solar PV
		LOCATIONS	South Australia, Victoria
		TIMEFRAME	July 2020 – September 2023
		BUDGET	$4.84m
		SCALE	Not estimated
		VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/sa-power-networks-flexible-exports-for-solar-pv-trial/.

SA Power Networks – Market Active Solar Trial

PROJECT DESCRIPTION	SAPN and Ausnet are trialling the use of dynamic operating envelopes (DOEs) with retailers AGL Energy and Simply Energy to manage the output of rooftop solar based on wholesale price signals and network congestion. Instead of applying a fixed export limit, smart inverters download a dynamic export limit which varies based on time and location. The project has proceeded through phases of standards development, technology development, consumer offer development, through to the trial itself. Customer research was undertaken through multiple surveys and interviews. The Market Active Solar Trial follows on from the Flexible Export trial to test and demonstrate integration within retailer offers and extension to a range of other flexible assets such as EVs, battery storage and smart loads.	**PILOT SPONSOR**	ARENA
		DELIVERY PARTNERS	SAPN, Ausnet, AGL Energy, Simply Energy
		TECHNOLOGY	Photovolatics
LESSONS LEARNED	› SAPN and Ausnet provided their flexible export offering through solar retailers and installers to test its effectiveness. In the first nine months, 168 customers signed up, which was considered a success. Barriers to higher enrolment were lack of awareness, limited compatible technology, up-front costs, and additional time for installation of hardware, which discouraged some installers. For some customers there were question-marks over value in view of the up-front cost and only a 12-month guarantee of flexible exports. Ausnet found lower participation interest among solar installers focussed on sales. › Notwithstanding these implementation issues, there was high customer satisfaction among participants, with 75% saying they would recommend flexible exports to others. › Across 77 systems in SAPN's network, an additional 44 MWh of energy was exported, with the average customer doubling their exports. In the Ausnet network, an unspecified number of customers exported an additional 54 MWh in 'the most constrained areas of the network'. Export limits have been gradually increased through the flexible exports algorithm where no adverse network impacts have been observed.	**LOCATION**	SA, VIC
		TIMEFRAME	Dec 2022 – Nov 2024
		BUDGET	$4.84 million
		SCALE	98 MWh
		VALUE STREAM(S)	Wholesale, Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/sa-power-networks-market-active-solar-trial

Shell Energy – Smart Energy Hubs Deployment

PROJECT DESCRIPTION

Shell Energy is deploying 40 Smart Energy Hubs, whole-of-site solutions which integrate Solar PV, Battery Storage, EV chargers, and high-energy-use equipment with smart control strategies to demonstrate new revenue sources for flexible demand and support regulatory reforms.

The Smart Energy Hubs are being demonstrated in shopping centres, supermarkets, and a refrigeration distribution centre.

- The aim of the project is to:
- Demonstrate integrated FD solutions instead of on a technology-by-technology basis.
- Trial three new distribution network services (voltage support, minimum demand, negative flows) to increase the paid services that can be delivered by FD.
- Pursue three regulatory reforms to increase FD by:
    - Creating new baselines and deeming methods to get a more balanced approach to risks, accurate and simplicity in measurement for FD.
    - Testing value-stacking to address concerns about 'double-dipping' by using FD for multiple services.
    - Developing consistent aggregation models for network services to streamline the customer acquisition process and reduce transaction costs.

LESSONS LEARNED

Shell has published the first Knowledge Sharing Report and Regulatory Reform Report for the project.

- Scaling battery storage for export as well as site demand leads to a larger battery and lower cost per unit installation, but this requires information on available network capacity. Some DNSP's will provide fast, free preliminary feedback but most will not provide indicative capacity until a grid connection application is submitted – which inhibits efficient sizing of battery storage. Early access to export capacity is important to reduce cost and facilitate additional FD.
- Shell has identified several features of candidate locations that make them more or less suitable to host battery storage within a Smart Energy Hub; specifically, physical space, and proximity to existing infrastructure such as switchboards, solar PV and point of supply. Battery location and packing needs to be considered as early as possible to determine feasibility.
- Integrated solutions require large, cross-functional projects which cross business units. Onboarding subject matter experts across functionalities is key to enabling the project.
- Onboarding of site operations personnel & technical service providers early is crucial to ensure smooth access, facilitating the validation of site suitability and avoiding delays.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	Shell Energy
TECHNOLOGIES	HVAC-R, EVs, PV, BESS and thermal storage
LOCATIONS	QLD, NSW, VIC
TIMEFRAME	Jul 2022 – Sep 2024
BUDGET	$31.55 million
SCALE	21.5 MW
VALUE STREAM(S)	Wholesale, Network
INDUSTRY POTENTIAL	417 MW (direct) 1000 MW (indirect)

Solar Analytics – Smart CER Consumer Uptake Tool			
PROJECT DESCRIPTION	Solar Analytics is developing an online Smart Energy Tool called the 'Solar Maximiser', which enables households to undertake a financial evaluation of CER investment decisions. This tool will provide a no-cost evaluation of CER investment decisions, incorporating energy usage, tariffs and market data in relation to smart electric hot water, heat pumps, solar PV, batteries and EVs. The aim is to improve consumer awareness and knowledge of CER options such as flexible electric hot water, batteries and EVs, where Solar Analytics observes 'consumer confusion'. Additionally, the project includes software integration for the active control of smart hot water systems, optimised based on retail tariffs and solar generation profiles. The aim is to develop 1 MW of FD capacity via the control of 1000 smart hot water systems.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	Solar Analytics
		TECHNOLOGIES	HWS, heat pumps, PV, BESS, EVs
		LOCATIONS	NSW
		TIMEFRAME	Apr 2023 – May 2024
		BUDGET	$2.73 million
		SCALE	1 MW
LESSONS LEARNED	No learnings released to date.	VALUE STREAM(S)	Wholesale, Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/smart-cer-consumer-uptake-tool/.

United Energy, CitiPower, Powercor – Flexible Services Trial			
PROJECT DESCRIPTION	There are three components to the pilot, which aims to develop options that leverage the smart meter network for managing minimum demand: › Leveraging AMI with no hardware installation to shift hot water from midnight to midday to soak up solar exports. Pilot participants have 280,000 customers and 260 MW of load. › Flexible exports trial for up to 100 residential customers and five C&I customers (30–200 kW), leveraging AMI data to create a closed loop dynamic operating envelope. › testing and developing low voltage DER management systems that can incorporate learnings from the flexible exports trial. The aim is to be able to offer dynamic operating envelopes to 30,000 new solar PV systems being installed annually with 100s of MW.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	United Energy, CitiPower, Powercor
		TECHNOLOGIES	Hot Water, Solar PV
		LOCATIONS	VIC
		TIMEFRAME	Mar 2023 – Dec 2025
		BUDGET	$7.59 million
		SCALE	280,000 customers (HWS) 100 residential and five C&I customers (PV)
LESSONS LEARNED	No learnings released to date.	VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Hot Water: 260 MW

United Energy – Low Voltage BESS Trial			
PROJECT DESCRIPTION	This trial aims to demonstrate the use of pole-mounted, low-voltage batteries to increase the hosting capacity for solar PV and ensure the maximum demand for distribution transformers remains within physical limits. This approach helps defer the need for costly investments in augmenting distribution transformers in areas experiencing growing peak demand. The project is expected to save approximately $3 million by avoiding network upgrades. The key benefits of this trial include: › Ensuring maximum demand for distribution transformers is within limits, thus deferring expenditure on distribution augmentation. › Addressing issues such as voltage rise, thereby increasing the hosting capacity for distributed solar power on low voltage networks. › Supporting the reliability of electricity supply, particularly during peak demand times, and increasing network capacity to accommodate more rooftop solar PV systems. › Improving the quality of electricity supplied and reducing network charges for customers by avoiding the need for traditional network upgrades.	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	United Energy
		TECHNOLOGIES	Pole-mounted BESS
		LOCATIONS	VIC
LESSONS LEARNED	Two knowledge sharing reports have been published – at the time of the second report 10 of the 40 units were about to be installed. To date, the trial has identified some learnings relating to technical, standards, social, and regulatory aspects of the project: › There were challenges reaching households in a culturally and linguistically diverse area, with the project exploring options including partnerships with council. › Significant time and cost were associated with onsite testing during installation, highlighting the need for optimal engagement with installation service providers during the design phase. › Limited Australian standards for addressing fire risks and cyber security concerns necessitated engaging offshore providers for IEC 2030.5 integration. › Addressing community concerns about noise, electromagnetic fields, and visual impact early in the project is crucial for successful BESS unit siting. › There were upfront challenges in streamlining and organising project management and governance with some recommendations on changed processes	TIMEFRAME	Mar 2021 – Jan 2025
		BUDGET	$10.98 million
		SCALE	40 pole-mounted BESS units
		VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/projects/united-energy-low-voltage-battery-trial/.

PILOT PROFILES – DER MARKET INTEGRATION TRIALS

<table>
<tr><th colspan="4">Project Converge</th></tr>
<tr><td rowspan="2">PROJECT DESCRIPTION</td><td rowspan="2">Project Converge aimed to demonstrate the use of 'Shared Operating Envelopes' (SOEs) to enable DNSPs to better manage network congestion, expenditure and CER bidding into energy and ancillary markets. SOEs were tested in ACT suburbs with high penetrations of solar and battery storage to collaborate with owners to optimise their performance. SOEs seek to build on Dynamic Operating Envelopes (DOEs) to reflect the incorporation of consumer preferences and equity as well as network constraints.</td><td>PILOT SPONSOR</td><td>ARENA</td></tr>
<tr><td>DELIVERY PARTNERS</td><td>Evoenergy, Australian National University, Zeppelin Bend, ACT Government</td></tr>
<tr><td rowspan="7">LESSONS LEARNED</td><td rowspan="7">Key learnings in progress knowledge sharing reports included:
› SOEs deliver benefits but they only become material at high levels of CER penetration.
› While there is growing knowledge about the concept of DOEs, there is still limited understanding and differences in calculation methods, inputs and objectives. Greater industry consistency in definitions and processes are required to develop.
› Definitions of DSO functions also require further work to achieve consistency.
› All operating envelope models will need to consider equity. While that is a feature of SOEs, there is also significant work required to define equity and how it should be incorporated.
› There have been complexities in the development of SOEs, with issues relating to accessing NMI-level data and sufficiently granular data to operate the model.
› The social science knowledge sharing report noted that SOEs are little known or understood by intermediaries and they require specialised knowledge. However, the intermediaries working in this space are currently a very small group that will require support to scale. Intermediaries are broadly supportive of DOEs and SOEs.</td><td>TECHNOLOGIES</td><td>Integration of CER</td></tr>
<tr><td>LOCATIONS</td><td>ACT</td></tr>
<tr><td>TIMEFRAME</td><td>Aug 2021 – Jan 2024</td></tr>
<tr><td>BUDGET</td><td>$8.4 million</td></tr>
<tr><td>SCALE</td><td>Not estimated</td></tr>
<tr><td>VALUE STREAM(S)</td><td>Wholesale, Network, FCAS</td></tr>
<tr><td>INDUSTRY POTENTIAL</td><td>Not estimated</td></tr>
</table>

Further information: https://arena.gov.au/assets/2022/09/der-market-integration-trials-summary-report.pdf and https://arena.gov.au/projects/project-converge-act-distributed-energy-resources-demonstration-pilot/.

Project EDGE

PROJECT DESCRIPTION

Project EDGE trialed a variety of models for integrating price-responsive CER, including facilitation of system level services via both a centralised common data hub and a decentralised data hub. Ausnet and AEMO built and operated systems and processes that would be required for real-time integration including distribution operating envelopes, forecasting, bids and dispatch.

LESSONS LEARNED

Key learnings include:

- DER coordination can achieve savings of up to $5.15 billion under AEMO's Step Change scenario and up to $6.04 under the High DER scenario. The largest savings are in dynamic connection agreements which enable higher exports which displace more expensive alternatives.
- Customers were positive towards VPPs that aggregate CER but they will need incentives and confidence they will be better off. Participating in initiatives with their CER before signing up for a VPP could be an important bridge to build trust.
- Limitations on access to real-time data and inter-operability were identified as key barriers.
- A data exchange hub which each network connects to with their own digital solution aligned to an industry standard was recommended to reduce the cost of inter-connectivity and integration instead of 'point-to-point' systems developed by each network or a fully centralised platform
- Consistent approaches across networks to dynamic connection agreements will be critical to maintaining network security as well as minimising costs.
- A raft of key priorities for policy-makers were identified as:
  - enabling real-time access to information for consumers
  - inter-operability reforms that simplify integration of DER into portfolios to enable consumer switching and choice.
  - DER export policies that benefit all consumers and other reforms to build social licence.
  - A national approach to the implementation and standard-isation of distribution operating envelopes which could include a roadmap and support for DNSPs to roll-out DOEs at scale.
  - Cost-effective ways of providing minimum levels of aggre-gated visibility of CER
  - Consider whether regulatory incentives are required to maximise network hosting capacity.
  - AEMO to develop a roadmap for VPP visibility and dis-patchability.

PILOT SPONSOR	ARENA
DELIVERY PARTNERS	AEMO, Ausnet, Mondo Power, University of Melbourne
TECHNOLOGIES	Integration of CER
LOCATIONS	VIC
TIMEFRAME	Aug 2020 – Aug 2023
BUDGET	$12.92 million
SCALE	Not estimated
VALUE STREAM(S)	Wholesale, Network, FCAS
INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/assets/2022/09/der-market-integration-trials-summary-report.pdf.

Project Edith			
PROJECT DESCRIPTION	Project Edith is testing the use of: › dynamic pricing to allocate network capacity and reward network services such as voltage support › the use of Dynamic Operating Envelopes (DOE). The price comprises three components – a fixed charge, a subscription charge based on a minimum DOE, and a dynamic 5-minute price based on spare network capacity (positive or negative). Aggregators then use these price signals to optimise imports and exports of CER. The pilot also investigated a dynamic price for voltage support. Customers participating in the scheme purchase solar and a battery system and agree to the system being controlled by project partner Reposit.	PILOT SPONSOR	Ausgrid
		DELIVERY PARTNERS	Ausgrid, Reposit, Australian National University, Zeppelin Bend
		TECHNOLOGIES	Solar, Battery Storage
		LOCATIONS	NSW
		TIMEFRAME	Sep 2021 – Mar 2023
LESSONS LEARNED	No knowledge sharing report with detailed learnings has been released to date. However, the project was the winner of the Energy Network Australia Innovation Award for 2023. Alex McPherson, Group Executive of Market Development and Strategy, stated "we have demonstrated a proof-of-concept dynamic pricing engine with modest extensions to existing systems and that this model is increasingly engaging to market bodies, customer advocates, retailers and Distribution Service Operators". The pilot is being scaled up to 1000 customers.[47]	BUDGET	Not provided
		SCALE	1000 customers
		VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://arena.gov.au/assets/2022/09/der-market-integration-trials-summary-report.pdf.

47 https://reneweconomy.com.au/project-that-calmed-network-fears-about-rooftop-solar-wins-innovation-award/.

Project Symphony			
PROJECT DESCRIPTION	Project Symphony recruited 900 DER assets from approximately 470 customers on a single electricity distribution feeder in Southern River, Southeast of Perth, to design, procure, develop, implement, and test software based 'platforms' to register, aggregate and orchestrate DER. Four scenarios were tested: › a Bi-directional energy market with selling and buying of DER to balance the market while DER facilities adhered to dispatch instructions and Dynamic Operating Envelopes; › Network support services to resolve local network constraints, such as voltage constraints, at lower cost than new capacity; › 'Constrain to zero': demonstrating the constraint of DER output to zero as a market or retail service; › Essential system services to raise frequency in case of a contingency event (e.g. loss of generator).	PILOT SPONSOR	ARENA
		DELIVERY PARTNERS	Western Power, Synergy, AEMO, EPWA, UTS, UWA, UTAS
		TECHNOLOGIES	Solar, battery, AC
LESSONS LEARNED	A series of knowledge sharing reports were released on DER services, DER valuation, distribution constraint optimisation algorithms, platform functional requirements, the combined platform for DSO, DMO and Aggregator, a Social Research report in addition to three lessons learnt reports. Some of the learnings that have been shared include: › In the recruitment phase, slower customer acquisition occurred due to tight eligibility requirements (e.g. export solar) and inadequate incentives for customers, especially in relation to PV and air-conditioning. Contracting via consumer-facing third-party aggregators improved recruitment. › In relation to technology integration, the key learnings identified were that the end-to-end technical capacity and understanding of VPPs were insufficient and there were delays as technical challenges were resolved. Detailed design up-front was recommended for other projects. › Technologies and communication standards for inter-operability vary across DER assets and they are not yet mature. Comprehensive pre-deployment testing was recommended for other projects. › Customers were unsure of what they were signing up for initially and there were concerns about the value, installation and implications of 'constrain to zero'. Once platform stability was achieved and the testing schedule was in place, consumer understanding and sentiment improved. › Some of the issues identified for policymakers and regulators included: • there is a lack of consistent inter-operability standards for orchestrating different technologies • the regulatory framework does not adequately integrate third-party aggregators and emerging business models e.g. the current metering code does not allow for third-party aggregation and better consumer protections are required as information passes from to parent aggregators • the DOEs were considered to work well but there is a lack of a monitoring and compliance framework.	LOCATIONS	WA
		TIMEFRAME	Jul 2021 – Feb 2024
		BUDGET	$8.55 million
		SCALE	470 customers, 900 CER assets
		VALUE STREAM(S)	Market integration of wholesale, network and FCAS
		INDUSTRY POTENTIAL	1600 MW dispatchable generation/load Net economics benefits $453-967 million over 15 years

Further information: https://arena.gov.au/projects/western-australia-distributed-energy-resources-orchestration-pilot/ and https://arena.gov.au/assets/2022/09/der-market-integration-trials-summary-report.pdf.

PILOT PROFILES – RACE FOR 2030

Business Power Flex: Business customer solutions to minimum demand			
PROJECT DESCRIPTION	This three-year project focusses on shifting commercial and industrial loads from times of peak demand to address the problem of minimum demand. The research team (UTS, Griffith University, UNSW) is working with project partners, including AGL, Sydney Water and the air-conditioning manufacturer Seeley International, to identify and implement up to five pilot studies involving flexible electricity loads such as HVAC-R, pumping and EV charging. This includes AGL's ARENA-funded Dynamic Pricing Load Flex Trial. The project is also looking to map and value potential FD solutions for busineses, and deliver a workshop with policymakers and regulators to support adoption of innovative electricity pricing and incentives.	PILOT SPONSOR	RACE for 2030
		DELIVERY PARTNERS	UTS, Griffith University, UNSW, AGL, Sydney Water, Seeley International
		TECHNOLOGIES	HVAC, refrigeration, pumping, EVs
		LOCATIONS	VIC, NSW, SA
		TIMEFRAME	Nov 2023 – Oct 2026
		BUDGET	$1.26 million
LESSONS LEARNED	No learnings released to date.	SCALE	Not estimated
		VALUE STREAM(S)	Wholesale, Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://racefor2030.com.au/project/business-power-flex/.

SolarShift: Turning electric water heaters into megawatt batteries			
PROJECT DESCRIPTION	The RACE for 2030 SolarShift project is a partnership between UNSW, Endeavour Energy, Ausgrid, Energy Smart Water, IEA, NSW DCCEEW and Solar Analytics. The project is exploring optimal ways to control and orchestrate operation of domestic hot water systems. There are three key components to the project: › Investigating HWS orchestration at an individual and network level using thermal and other modelling to determine the potential impacts of solar soaking on networks, household hot water availability, and carbon emissions. › Piloting control of 2850 domestic hot water systems using smart meters by Endeavour Energy at Albion Park NSW, to evaluate the amount of consumption shifted to daytime, impact on electricity bills, and impacts on distribution feeders. › Developing a roadmap for customers, providing pathways and decision guidance on efficient and flexible hot water that accounts for various customer-side scenarios, including household size, climate zone, availability of rooftop solar, switching from gas to electric etc.	PILOT SPONSOR	RACE for 2030
		DELIVERY PARTNERS	Various (see details at left)
		TECHNOLOGIES	HWS
		LOCATIONS	NSW
		TIMEFRAME	2024 - 2025
LESSONS LEARNED	While results from the project are preliminary, initial work has found that: › Recent increases in electricity prices (while solar feed-in tariffs remain static) have increased incentives to solar-soak. › DNSPs have started to offer new network tariffs to encourage consumption during solar-soak periods, but new and innovative retailer tariffs are required to pass these savings to households to maintain central control/ orchestration for hot water flexible demand. › Lack of coordination between retailers and DNSPs can hinder solar soaking through HWSs. In Victoria, DNSPs have the ability to use and control smart meters with controlled load, but not retailers. Whereas in NSW, metering coordinators tend to shy away from changing controlled load without approval from the retailer. › Heat pumps HWSs offer much less potential for load shifting, especially as many heat pump manufacturers and installers recommend installing them on a continuous rather than controlled load circuit.	BUDGET	$0.552 million
		SCALE	5 MWh/day48
		VALUE STREAM(S)	Wholesale, Network
		INDUSTRY POTENTIAL	9 GWh/day49

https://racefor2030.com.au/project/solarshift-turning-electric-water-heaters-into-megawatt-batteries/.

48 Assuming ~1.75 kWh/day per household, as demonstrated through the .PLUS ES - South Australia Demand Flexibility Trial, applied across 2850 households involved in pilot.

49 Assuming ~1.75 kWh/day per household, as demonstrated through the .PLUS ES - South Australia Demand Flexibility Trial, applied across >5 million Australian households with electric water heaters.

<table>
<tr><th colspan="4">Strategic Electric Vehicle Integration</th></tr>
<tr><td rowspan="6">PROJECT DESCRIPTION</td><td rowspan="6">The SEVI project is based on three demonstration pilots across three states, each focusing on a separate topic:
› EVs in Fleets (NSW)—inclusion of EVs in business fleets in both at-work and at-home charging settings, with optional support from a mix of energy storage options
› EVs in Precincts (WA)—focus on private EVs that form part of residential precincts and developments with embedded networks, with optional support from a mix of behind-the-meter and front-of-meter storage options.
› EVs in Regions (SA)—private EVs in regional locations that interact with behind-the-meter energy storage. Of particular interest is how EVs and private storage in holiday parks can be orchestrated to provide town-wide benefits.
The project is divided into six work packages:
› Project design and implementation
› Social, market research and trends
› Technologies deployment and data
› Value propositions and business models
› Legal aspects and regulatory reform, and
› Energy system and network analysis.
The project is also looking to deliver three TV-ready short videos involving partners and findings, packaged in various formats, and a capacity-building module of six units with the Australian Power Institute.</td><td>PILOT SPONSOR</td><td>RACE for 2030</td></tr>
<tr><td>DELIVERY PARTNERS</td><td>Various (see details at left)</td></tr>
<tr><td>TECHNOLOGY</td><td>EVs</td></tr>
<tr><td>LOCATIONS</td><td>NSW, WA, SA</td></tr>
<tr><td>TIMEFRAME</td><td>Feb 2023 – Feb 2026</td></tr>
<tr><td>BUDGET</td><td>$3.4 million</td></tr>
<tr><td rowspan="3">LESSONS LEARNED</td><td rowspan="3">A co-design process has been the focus of the initial stage of this project with the implementation of the demonstration projects due to start from mid-2024. The main lessons so far have arisen from the market landscaping exercise for the NSW Fleets. Building upon the national survey by the Australian Fleets Managers Assocation, the market landscaping found the early mover fleets are primarily Government fleets (State and Local), public utilities (energy, water etc), and some ASX listed companies with strong ESG drivers. Major barriers to fleet uptake of electric vehicles relate to cost and complexity, including upgrading local electricity infrastructure at work sites and establishing financial and organisational arrangements for employees home garaging vehicles.</td><td>SCALE</td><td>Not estimated</td></tr>
<tr><td>VALUE STREAM(S)</td><td>Wholesale, Network</td></tr>
<tr><td>INDUSTRY POTENTIAL</td><td>Not estimated</td></tr>
</table>

Further information: https://racefor2030.com.au/project/strategic-electric-vehicle-integration/.

PILOT PROFILES – STATES

<table>
<tr><th colspan="4">CSIRO – Digital Infrastructure Energy Flexibility (DIEF) pilot project</th></tr>
<tr><td rowspan="8">PROJECT DESCRIPTION</td><td rowspan="8">The DIEF project aims to provide industry and researchers with digital-grid infrastructure to aggregate FD resources. These services are intended to help the property industry reduce emissions by synchronising demand with the availability of variable renewable energy generation.

The project will develop flexibility characterization methods that can be used to register assets on a proposed Flexible Demand Asset Register, and to transparently communicate forecasts of asset availability.

Led by CSIRO and funded by NSW government as part of the NSW Clean Technology Research, Development and commercialisation infrastructure grants program, the project brings together a consortium of NSW-based industry and research organisations.

Through CSIRO's Data Clearing House (DCH) digital infrastructure platform, the project will connect 5 MW of flexible capacity from over 200 NSW-based commercial and industrial buildings. Using the developed 'data-driven' flexibility characterization methods, assets (that are capable of providing flexible demand) will be provided with a report card and registered as deployable assets on the Flexible Demand Asset Register. Flexible demand trials will be conducted.

Buildings will also be able to access energy performance software applications within the DCH digital infrastructure ecosystem. Deidentified data from buildings will be used to run AI competitions, as a way of innovative in the field energy performance software applications/analytics.</td><td>PILOT SPONSOR</td><td>NSW Government</td></tr>
<tr><td>DELIVERY PARTNERS</td><td>Amber Electric
DNA Energy
EVSE Australia
Nube iO
Property and Development NSW, RACE for 2030,
UNSW
UOW
Wattwatchers</td></tr>
<tr><td>TECHNOLOGIES</td><td>HVAC-R</td></tr>
<tr><td>LOCATIONS</td><td>NSW</td></tr>
<tr><td>TIMEFRAME</td><td>Aug 2023 – Jun 2026</td></tr>
<tr><td>BUDGET</td><td>$11 million</td></tr>
<tr><td>SCALE</td><td>5 MW</td></tr>
<tr><td>VALUE STREAM(S)</td><td>Wholesale, Network</td></tr>
<tr><td rowspan="2">LESSONS LEARNED</td><td rowspan="2">No learnings released to date.</td><td>INDUSTRY POTENTIAL</td><td>Not estimated</td></tr>
</table>

Further information: https://www.csiro.au/en/news/all/news/2023/august/smart-buildings-project-to-cut-emissions-and-electricity-costs-in-nsw.

<table>
<tr><th colspan="4">Embertec – Efficient targeting and automated control of residential air conditioning loads</th></tr>
<tr><td rowspan="4">PROJECT DESCRIPTION</td><td rowspan="4">The aim of the project was to assess the ability to automate household air conditioning (AC) using machine learning in a manner that can address grid energy supply constraints and grid power price peaks, while maintaining a cost-effective and comfortable outcome for householders.
This pilot targeted deployment of an Emberpulse energy monitoring and advisory system in 1000 households. To assist with community engagement to participate in the trial, Embertec worked with the Royal Automobile Association of South Australia (RAA) in the promotion of the offer to their members.
A total of 211 AC controllers were deployed to 189 participating households. Participants for the initial phase of the trial were focused on homes where there was a reasonable level of AC usage during typical grid peak demand periods and where there would likely be potential for AC load shifting.</td><td>PILOT SPONSOR</td><td>SA Government</td></tr>
<tr><td>DELIVERY PARTNERS</td><td>Embertec, RAA</td></tr>
<tr><td>TECHNOLOGY</td><td>HVAC-R and PV</td></tr>
<tr><td>LOCATION</td><td>SA</td></tr>
<tr><td rowspan="5">LESSONS LEARNED</td><td rowspan="5">› The pilot successfully achieved up to 90% reductions in AC power use at critical times, with minimal disruption to homeowners. This was achieved through intelligent machine learning algorithms and distributing control across multiple homes to evenly reduce grid load, without sacrificing comfort.
› Participating households were not adversely affected financially through any overall increase in energy use, as short-term interventions do not lead to an overall increase in AC energy usage.
› Some 54 of 189 households participating in the pilot responded as follows to an online consumer survey:
• 91% found the Emberpulse device provided useful feed-back on their energy use and would be used at some level in future
• 87% said they did not realise the AC had been controlled during the five month period when automated AC control was being undertaken
• 13.7% reported that their comfort was negatively affected during the control event periods.
› Understanding appliance usage parameters is crucial for comfort and cost-efficiency, and for adoption of intelligent automation.</td><td>TIMEFRAME</td><td>2020 – 2023</td></tr>
<tr><td>BUDGET</td><td>$1.355 million</td></tr>
<tr><td>SCALE</td><td>189 households</td></tr>
<tr><td>VALUE STREAM(S)</td><td>Wholesale, Network</td></tr>
<tr><td>INDUSTRY POTENTIAL</td><td>Not estimated</td></tr>
</table>

Further information: https://emberpulse.com/wp-content/uploads/2023/04/230411-Embertec-South-Australia-Project-Final.pdf

Enel X – Backup Boost			
PROJECT DESCRIPTION	The project tested the viability of recruiting small- to medium-sized commercial and industrial businesses with back-up generators and battery storage, upgrading them and integrate them into a VPP. Eleven sites with 7 MW of back-up generators and 8 MW of battery storage were recruited. The project sought to demonstrate how these upgraded assets can provide dispatchable demand response capacity in the NEM, and assess the feasibility of selling a cap product tied to aggregated generation capacity as a more predictable offering for customers than selling into energy-only markets. Key objectives include creating an aggregated portfolio of fast-responding, dispatchable generation, improving liquidity in the contract market, and showcasing the financial benefits of demand response for participating businesses and consumers.	**PILOT SPONSOR**	SA Government
		DELIVERY PARTNERS	Enel X
		TECHNOLOGIES	Backup generators, Batteries and VPPs
LESSONS LEARNED	› There was ‘significant interest’ but not all sites are suitable or feasible owing to technical and commercial factors; some generators are too old or poorly maintained, high installation costs due to network connection costs or peaky, unpredictable loads. One of the major learnings was which sites are not likely to be suitable. › Network connection costs and requirements in particular pose significant barriers, leading them to avoid sites that require significant works and not to build in export capacity. › Engaging with the key decision makers quickly is important, as site managers priorities sometimes do not align with higher management. › Existing contracts can hinder participation as they either require retailer consent to participate in DR or explicitly prohibit the use of the back-up generator for anything other than emergency use › Enel X dispatches generators during high spot price periods, but the impact during times of high solar PV output has not yet been unassessed. › Strong communication with customers is crucial for technical issues, performance expectations, and interruptions. › In general, customer responses were positive with a preference for firm availability payments for steady revenue over uncertain spot prices. Enel did use them for $300 caps but found market conditions had shifted impacting on financial returns.	**LOCATIONS**	SA
		TIMEFRAME	Dec 2019 –
		BUDGET	$6.877 million
		SCALE	20 MW targetted (14 MW at April 2023)
		VALUE STREAM(S)	Wholesale Network
		INDUSTRY POTENTIAL	Not estimated

Further information: South Australian Backup Boost Program,

Ergon/Energex – Electric Vehicle Smart Charge			
PROJECT DESCRIPTION	Ergon and Energex conducted a smart EV charging trial using funding from the Demand Management Innovation Allowance. The trial included five 'demand response' events (shifting load out of peak demand periods) and five 'solar soak' events (optional charging 10am-4pm) with varying combinations of incentives for participants. The trial also involved developing hardware and software to calculate, design, communicate and operate dynamic operating envelopes through smart EV chargers. EV trip and charging data at 15-minute intervals was collected using devices in each EV. The raw data was supplemented with in-depth interviews and a behavioural change study. Most participants (85%) were located in Southeast Queensland and were observed to be 'early adopters', with three-quarters also owning rooftop solar and one-fifth owning a battery.	PILOT SPONSOR	Energex, Demand Management Innovation Allowance
		DELIVERY PARTNERS	Ergon, Energex
		TECHNOLOGY	Electric vehicles
		LOCATION	QLD
		TIMEFRAME	May 2020 – Nov 2021
LESSONS LEARNED	› A diversified residential charging load was observed, but evening charging load tripled on the network's 10 top peak demand days 4–9pm from 0.25 to 0.75 kW per vehicle. › A high responsiveness of drivers to time-of-use tariffs was observed. Peak charging occurred at 1am. For solar owners, EV charging became part of the overall home energy management. › For consumers without solar PV or a time-of-use tariff, 'convenience charging' was predominant. › Over 90% of participants responded to the maximum extent for incentives for charging events of $10–30. › There was less home charging observed than expected.	BUDGET	$0.47 million
		SCALE	167 vehicles
		VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	Not estimated

Further information: https://www.energex.com.au/__data/assets/pdf_file/0008/1096496/EV-SmartCharge-Queensland-Insights-Report.pdf.

SA EV Smart Charging Trials

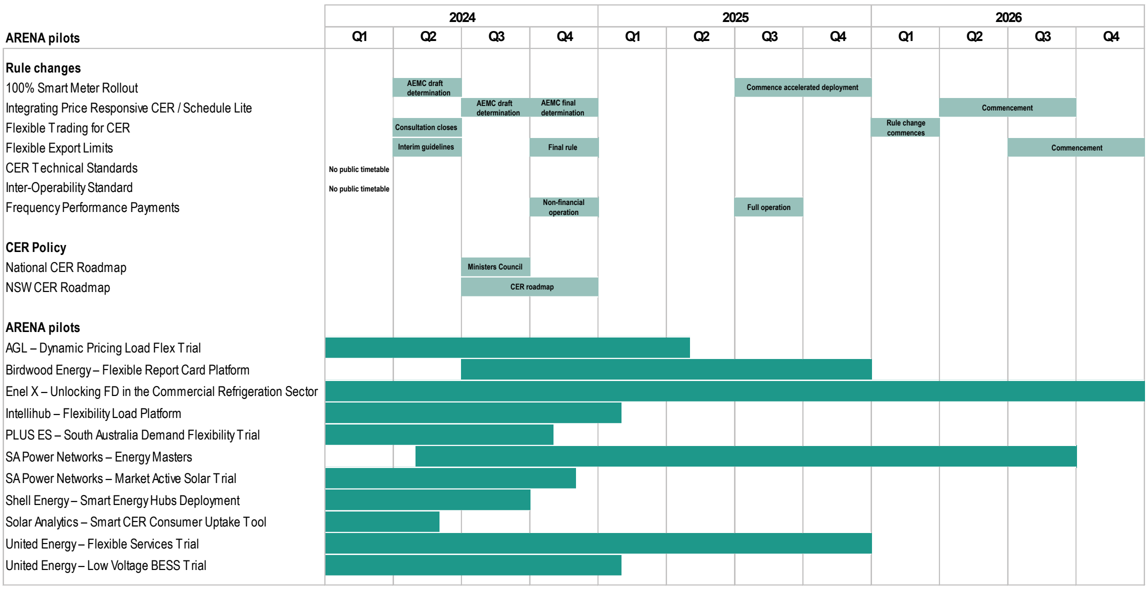
PROJECT DESCRIPTION	The South Australian government has allocated $3.2 million for EV Smart Charging Trials. The trials cover a range of approaches to EV charging, and are aimed at enhancing EV integration, addressing service shortcomings, and coordinating optimal charging times through mechanisms such as variable pricing. Priority areas include VPP integration, Adelaide CBD off-street car parks (non-ancillary), hotels, motels and holiday parks, commercial fleets, and public rapid charging with time-of-use pricing. The grant recipients were: › AGL SA Smart Charging Trial: 18 smart chargers were installed in off-street CBD carparks to better understand the behaviour of commercial fleet drivers with price and event signals to test responses; › Chargefox Rapid DC Time of Use Pricing Smart Charging Trial: 12-month trial to test how drivers respond to price signals at a metropolitan DC charging site; › ENGIE/Flinders University EV Virtual Battery Smart Charging Trial: 20 vehicle to grid, bi-directional chargers were installed and integrated into Engie's VPP; › JET Charge, EV Ready Commercial Buildings of the Future Trial: smart charging was introduced as a service in commercial buildings with a third-party ownership business model; › JOLT Charge, 50 kW Rapid Charger and Dynamic Signal Pricing Trial: charging incentives were tested on consumers using 50kw rapid chargers; › NRMA and JET Charge, EV Smart Holiday Parks Trial: bi-directional V2G chargers were installed in Victor Harbour Beachfront Holiday Park with a flexible pricing plan to incentivise charging during high renewable energy times; › Planet Ark Power, Pasadena Shopping Centre Customer Boost EV Smart Charging Trial: demonstrating a scalable model for smart charging in shopping centres; › City of Adelaide, UPark and Flow Power, UPark EV Fleet Smart Charging: commercial fleet EV charging with wholesale electricity prices; › Rocland Group and JET Charge, Rocland Nuriootpa Rapid Highway Smart Charging Trial: 10 rapid charging bays in a regional service station to test time of use tariffs in a regional setting.	PILOT SPONSOR	South Australian Government
		DELIVERY PARTNERS	Various, as listed
		TECHNOLOGIES	EV charging, VPPs, BESS
		LOCATIONS	SA
		TIMEFRAME	2022 – 2023
		BUDGET	$3.2 million
		SCALE	Not estimated
		VALUE STREAM(S)	Wholesale Network
LESSONS LEARNED	› No knowledge sharing reports have been released.	INDUSTRY POTENTIAL	Not estimated

SAPN, CSIRO and Future Grid – Closed-loop Voltage Control Trial			
PROJECT DESCRIPTION	This project aimed to develop dynamic voltage control technology for SA Power Networks' distribution network, similar to initiatives in Victoria by United Energy, albeit without the benefit of full customer voltage visibility provided by smart-meter infrastructure. Despite limited data, the project used external sources and modelling to propose a dynamic voltage control approach, termed closed loop voltage control (CLVC), to optimise voltage management. Implemented during a trial at the Hope Valley Zone Substation, the CLVC algorithms, developed by CSIRO, leveraged data streams from up to 1085 smart meters and 10 distribution transformer monitoring units. The Future Grid platform aggregated data inputs and communicated output recommendations for substation voltage setpoints to SAPN's Control Room, with the project evaluating the effectiveness of dynamic voltage control in supporting increased DER hosting capacity and delivering demand response services while maintaining or enhancing customer power quality.	PILOT SPONSOR	SA Government
		DELIVERY PARTNERS	SAPN, CSIRO, Future Grid
		TECHNOLOGIES	VPP (PV)
		LOCATIONS	SA
		TIMEFRAME	Nov 2019 – May 2021
LESSONS LEARNED	› CLVC demonstrates superior voltage management, enhancing DER hosting capacity without over- or under-voltages, and offering significant potential for demand response services. › CLVC significantly improves DER network capacity compared to BAU and line-drop compensation (LDC) approaches, with a headroom margin three times larger on average than BAU and nearly twice larger than LDC, showcasing its efficacy in network optimisation. › CLVC enables substantial voltage reduction within regulatory bandwidths, providing larger margins for demand response services through Conservation Voltage Reduction (CVR), surpassing BAU and LDC setpoints, emphasising its role in promoting grid flexibility and efficiency.	BUDGET	$1.953 million
		SCALE	Not estimated
		VALUE STREAM(S)	Network
		INDUSTRY POTENTIAL	$400 million of market value over next 15 years

Further information: https://publications.csiro.au/publications/publication/PIcsiro:EP2021-1894.

8 Next steps for Flexible Demand: policy roadmaps, rule changes and pilots

There are a range of rule changes and policy development processes occurring alongside flexible demand pilots. The following timetable, based on current information, shows regulatory changes, policy processes and ARENA pilots currently in progress.



Appendix A – Flexible demand tariffs

This appendix provides a comprehensive sample of tariffs from both Distribution Network Service Providers (DNSPs) and retailers that support flexible demand. These include cost-reflective time-of-use (ToU), controlled load, EV and battery tariffs. DNSP tariffs include existing (2023–24), trial and proposed tariffs. All rates include GST.

EXISTING NETWORK TARIFFS 2023-24

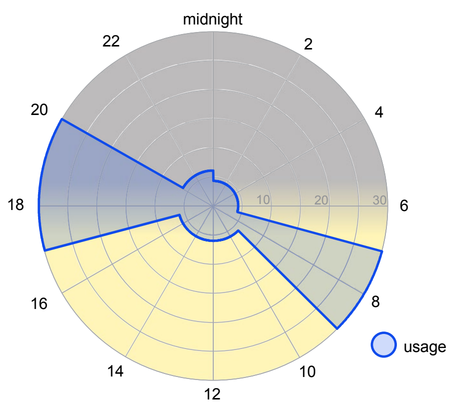
The existing network tariffs listed below, taken from the following reference documents, include a sample from at least one of each of the NEM states.

AUSGRID[50]

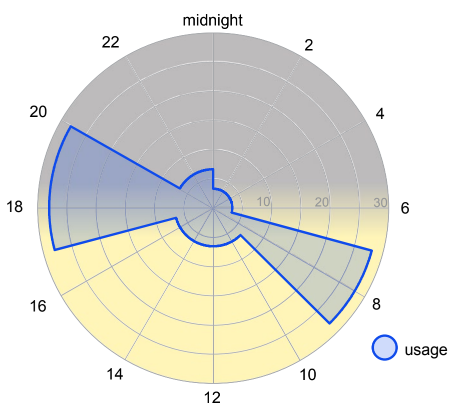
DNSP	**Ausgrid**	Supply usually available for at least 6 hours in any 24-hour period, from midnight to midnight.
State	**NSW**	
Name	**CL 1**	
Code	**EA030**	
Non-ToU	**2.02 ¢/kWh**	

DNSP	**Ausgrid**	Charge applied to controlled energy consumption where supply is available for restricted periods not exceeding a total of 17 hours in any period of 24 hours.
State	**NSW**	
Name	**CL 2**	
Code	**EA040**	
Non-ToU	**4.28 ¢/kWh**	

DNSP	**Ausgrid**	
State	**NSW**	
Name	**Residential ToU**	
Code	**EA025**	
Energy	*Times*	*¢/kWh*
Peak	**07-09, 17-20**	**29.99**
Shoulder	**09-17, 20-22**	**6.05**
Off-peak	**22-07**	**4.25**



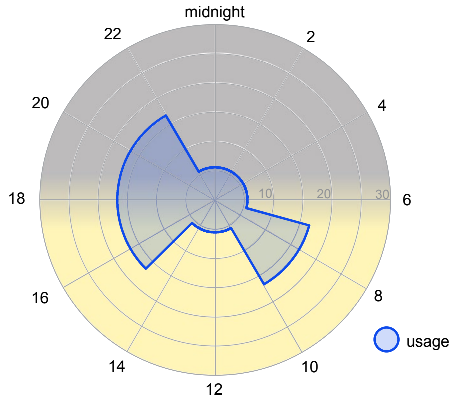
DNSP	Ausgrid	
State	NSW	
Name	Small Business ToU	
Code	EA225	
Energy	*Times*	*¢/kWh*
Peak	07-09, 17-20	28.04
Shoulder	09-17, 20-22	6.59
Off-peak	22-07	3.25



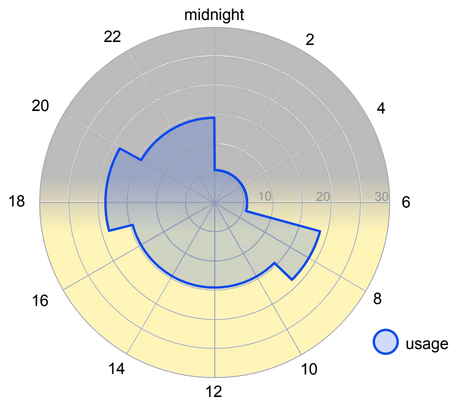
50 Ausgrid. (2023). Network Price List 2023-2024. https://cdn.ausgrid.com.au/-/media/Documents/Regulation/Pricing/PList/Ausgrid-Network-Price-List-2023-24.pdf

ESSENTIAL ENERGY (NSW)[51]

DNSP	**Essential Energy**	
State	**NSW**	
Name	**Sun Soaker Residential**	
Code	**BLTTSS2**	
Energy	*Times*	*¢/kWh*
Peak	07-10, 17-20	16.69
Off-peak	10-17, 22-07	5.56
DER export rebate	N/A	N/A
This trial tariff ends on 30 June 2024.		



DNSP	**Essential Energy**	
State	**NSW**	
Name	**Residential ToU**	
Code	**BLNT3AU**	
Energy	*Times*	*¢/kWh*
Peak	07-09, 17-20	18.6871
Shoulder	09-17, 20-22	14.5217
Off-peak	22-07	5.5604

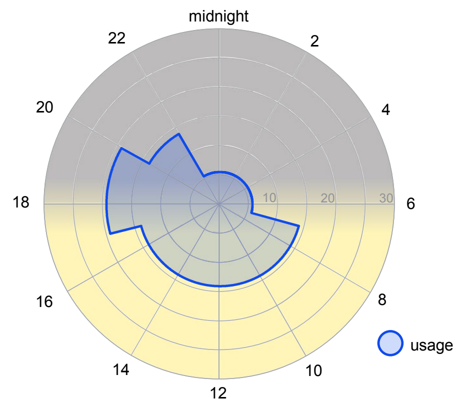


DNSP	**Essential Energy**	Between five and nine hours on weekdays and extra hours at the weekend, except where the load is controlled by a clock.
State	**NSW**	
Name	**Controlled Load 1**	
Code	**BLNC1AU**	
Non-ToU	**2.6296 ¢/kWh**	

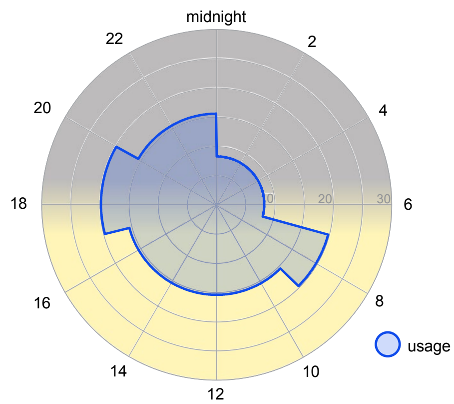
DNSP	**Essential Energy**	Between 10 and 18 hours a day on weekdays and extra hours at weekends, except where the load is controlled by a clock.
State	**NSW**	
Name	**Controlled Load 2**	
Code	**BLNC2AU**	
Non-ToU	**5.8797 ¢/kWh**	

51 Essential Energy (2023). Network Price List and Explanatory Notes. https://www.essentialenergy.com.au/-/media/Project/EssentialEnergy/ Website/Files/Our-Network/NetworkPriceListandExplanatoryNotes 202324.pdf

DNSP	**Essential Energy**	
State	**NSW**	
Name	**LV Residential ToU_Interval meter**	
Code	**BLNT3AL**	
Energy	*Times*	*¢/kWh*
Peak	17-20	19.4087
Shoulder	07-17, 20-22	13.9654
Off-peak	22-07	5.5604

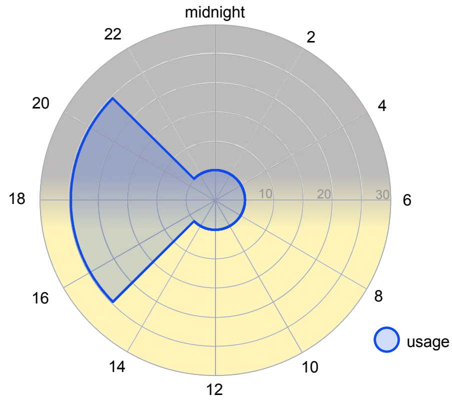


DNSP	**Essential Energy**	
State	**NSW**	
Name	**Business ToU**	
Code	**BLNT2AU**	
Energy	*Times*	*¢/kWh*
Peak	07-09, 17-20	19.7844
Shoulder	09-17, 20-22	15.4719
Off-peak	22-07	8.1607

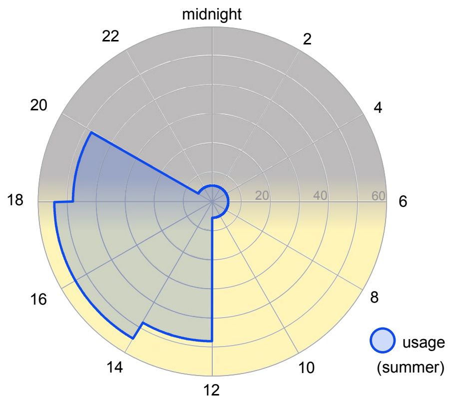


AUSNET SERVICES (VIC)*

DNSP	AusNet Services	
State	VIC	
Name	Small residential ToU standard feed in	
Code	NAST11S	
Energy	*Times*	*¢/kWh*
Peak	15-21 (M-F)	24.65
Off-peak	21-15 (M-F), 0-24 (S-S)	5.10

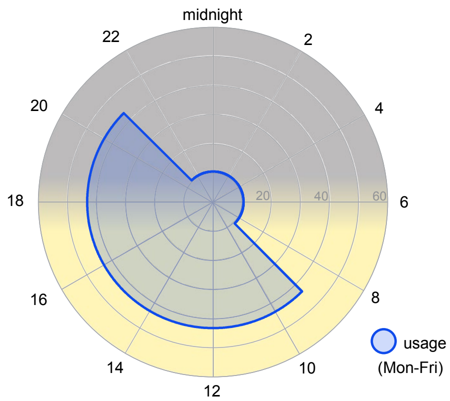


DNSP	AusNet Services	
State	VIC	
Name	Small interval meter ToU solar installation standard feed in	
Code	NSP23	
Energy	*Times*	*¢/kWh*
Sum. Peak	14-18 (M-F)	54.27
Sum. Shoulder	12-14, 18-20 (M-F)	47.86
Wint. Peak	16-20 (M-F)	12.25
Off-peak	All other times	5.53
Summer Dec-Mar, Winter Jun-Aug.		

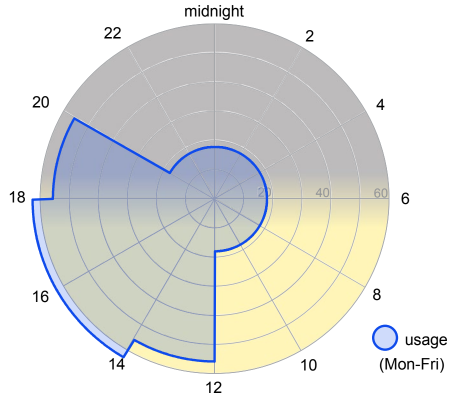


* AusNet. (2023). Annual pricing proposal 2023-24. https://www.ausnetservices.com.au/-/media/project/ausnet/corporate-website/files/electricity/tariffs-and-charges/2023/ausnet---annual-pricing-proposal-2023-24.pdf

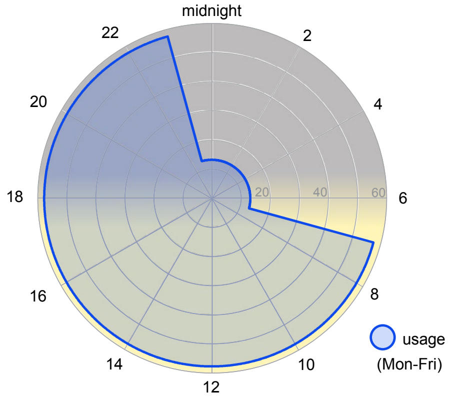
DNSP	AusNet Services	
State	VIC	
Name	Small business time of use standard feed in	
Code	NAST12S	
Energy	*Times*	*¢/kWh*
Peak	9-21 (M-F)	21.61
Off-peak	21-9 (M-F), 0-24 (S-S)	5.22



DNSP	AusNet Services	
State	VIC	
Name	Small interval meter ToU solar installation standard feed in (bus)	
Code	SSP27	
Energy	*Times*	*¢/kWh*
Sum. Peak*	14-18 (M-F)	31.34
Sum. Shoulder*	12-14, 18-20 (M-F)	27.84
Wint. Peak^	16-20 (M-F)	24.77
Off-peak	All other times	8.95
Summer Dec-Mar, Winter Jun-Aug.		

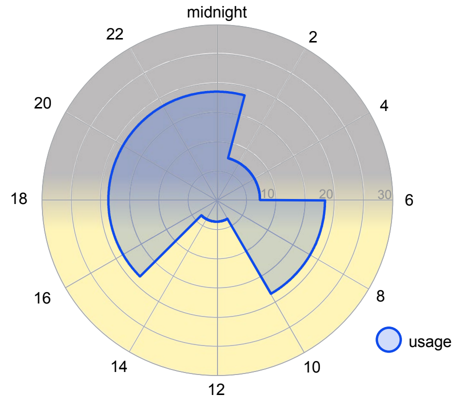


DNSP	AusNet Services	
State	VIC	
Name	Medium two rate	
Code	NEE51	
Energy	*Times*	*¢/kWh*
Peak	7-23 (Mon-Fri)	28.79
Off-peak	23-7 (Mon-Fri), 0-24 (Sat & Sun)	6.63

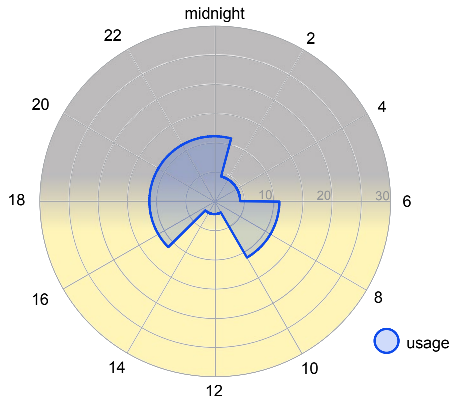


SA POWER NETWORKS (SA)[52]

DNSP	SA Power Networks	
State	SA	
Name	Residential Time of Use	
Code	RTOU	
Energy	*Times*	*¢/kWh*
Peak	6-10, 15-1	18.5
Off-peak	1-6	7.4
Solar Sponge	10-15	3.7
Various CL rates also available.		

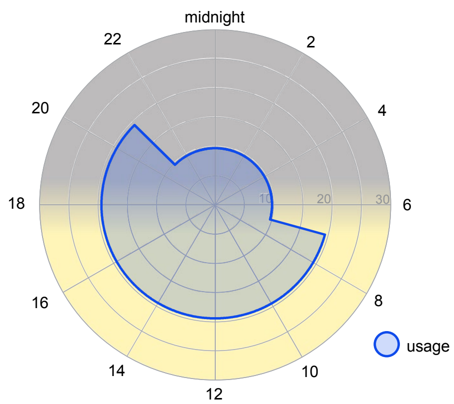


DNSP	SA Power Networks	
State	SA	
Name	Residential Prosumer	
Code	RPRO	
Energy	*Times*	*¢/kWh*
Peak	6-10, 15-1	11.1
Off-peak	1-6	4.4
Solar Sponge	10-15	2.2
Demand	*Times*	*¢/kW/mth*
Demand peak	17-21	82.0



DNSP	SA Power Networks	
State	SA	
Name	Business CL	
Code	B2R/BCL/BSRT	
Control load	*Times*	*¢/kWh*
CL usage	10-15, 23-7	7.5

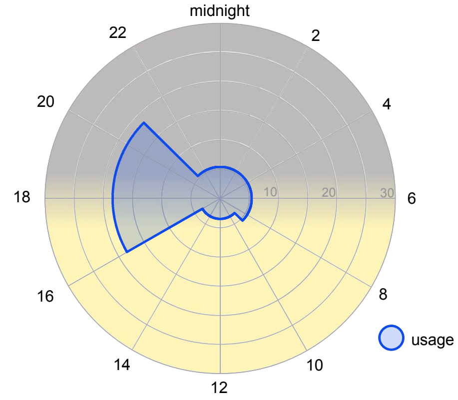
DNSP	SA Power Networks	
State	SA	
Name	Business Two Rate	
Code	B2R	
Energy	*Times*	*¢/kWh*
Peak	7-21	19.4
Off-peak	21-7	9.7



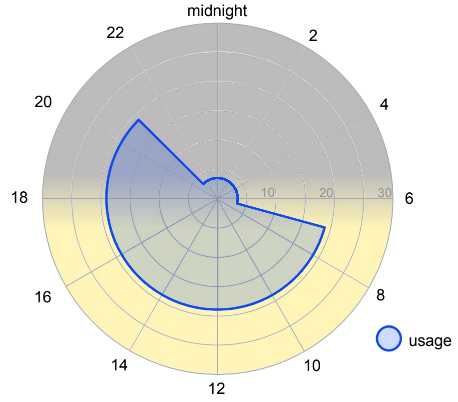
52 SA Power Networks. (2020). Tariff Structure Statement Part A. https://www.sapowernetworks.com.au/public/download.jsp?id=9508

ERGON ENERGY (QLD)[53]

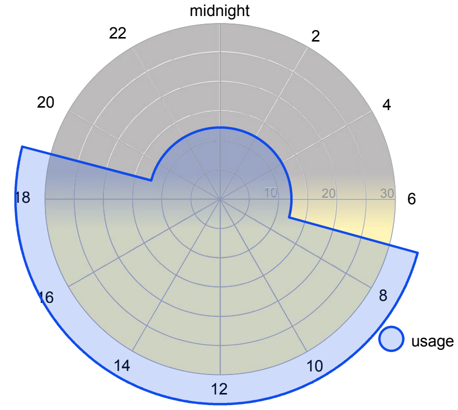
DNSP	Ergon Energy	
State	QLD	
Name	East SAC<100MWhpa Resi. TOU Energy	
Code	ERTOUE	
Energy	*Times*	*¢/kWh*
Evening (Peak)	16-21	18.4
Overnight (Shoulder)	21-9	5.4
Day (Off-peak)	9-16	3.5
Tariff rates and times differ by region		



DNSP	Ergon Energy	
State	QLD	
Name	East Transitional Network ToU Energy Tariff 1	
Code	EBFRM	
Periods	*Times*	*¢/kWh*
Peak Block 1^	7-21	48.0
Peak Block 2†	7-21	38.0
Off-peak	21-7	6.9
Tariffs rates and times differ by region. ^ <97 MWh/year † >97 MWh/year		



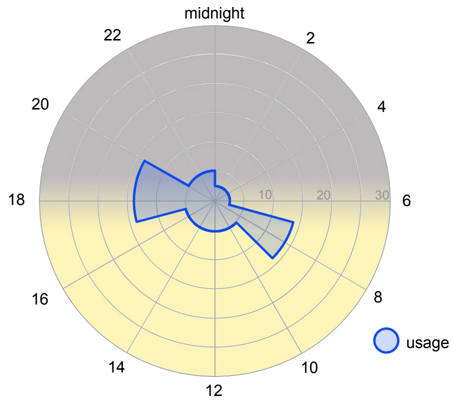
DNSP	Ergon Energy	
State	QLD	
Name	East Transitional Network ToU Energy Tariff 2*	
Code	EBIRR	
Energy	*Times*	*¢/kWh*
Peak	7-19 or 7.5-19.5 or 8-20	35.0
Off-peak	All other times	12.2
Tariffs rates and times differ by region. Times as agreed between retailer and customer.		



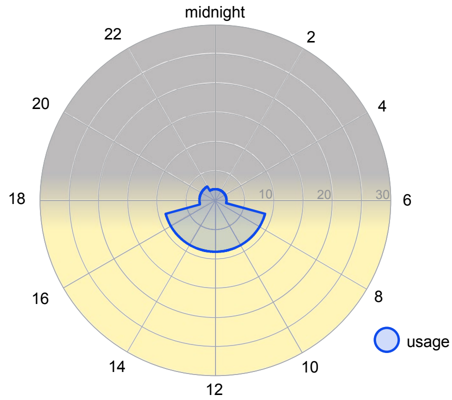
53 Ergon Energy. (2023). Network Tariff Guide https://www.ergon.com.au/__data/ assets/pdf_file/0010/1084852/ERG-Network-Tariff-Guide-2023-24.pdf

EVOENERGY (ACT)[54]

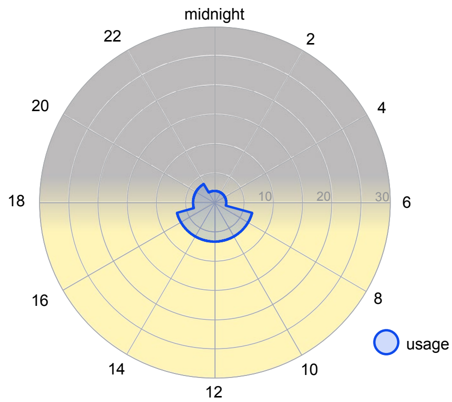
DNSP	EvoEnergy	
State	ACT	
Name	Residential TOU Network	
Code	015	
Energy	*Times*	*¢/kWh*
Peak (max)	7-9, 17-20	13.86
Shoulder (mid)	9-17, 20-22	5.19
Off-peak (econ.)	22-7	2.54



DNSP	EvoEnergy	
State	ACT	
Name	General TOU Network	
Code	090	
Energy	*Times*	*¢/kWh*
Peak (Business)	7-17 (M-F)	17.59
Shoulder (Evening)	17-22 (M-F)	8.45
Off-peak	22-7 (M-F), 0-24 (S-S)	3.82



DNSP	EvoEnergy	
State	ACT	
Name	TOU Capacity Network	
Code	103	
Energy	*Times*	*¢/kWh*
Peak (Business)	7-17 (M-F)	6.65
Shoulder (Evening)	17-22 (M-F)	3.67
Off-peak	22-7 (M-F), 0-24 (S-S)	2.00
Demand	*Times*	*¢/kVA/ day*
Peak demand*	7-17 (M-F)	16.97
Capacity^	NA	16.97



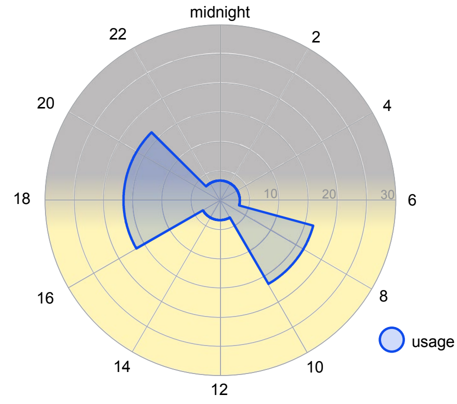
* Maximum demand charge based on highest demand in any 30-minute interval during the specified times, during the billing month.

^ Maximum demand is highest demand recorded over 30-minute interval during previous 13 months inclusive of current billing month.

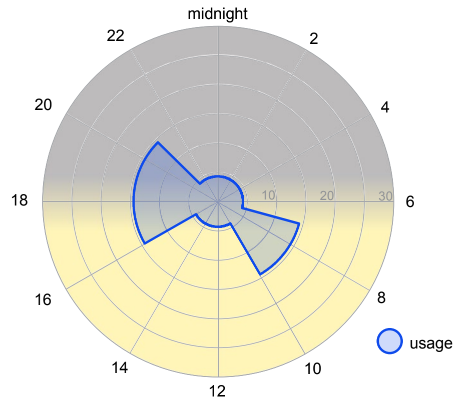
54 Evoenergy. (2023). Final schedule of electricity network charges 2023/24 https://www.evoenergy.com.au/-/media/Project/Evoenergy/EVO/Documents/ Electricity/Evoenergy-electricity-schedule-of-charges-2023-24.pdf

TASNETWORKS (TAS)[55]

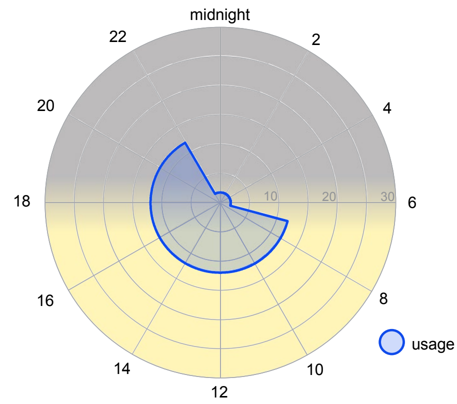
DNSP	TasNetworks	
State	TAS	
Name	Residential low voltage ToU consumption	
Code	TAS93	
Energy	*Times*	*¢/kWh*
Peak	7-10, 16-21 (M-F)	16.50
Off-peak	21-7, 10-16 (M-F), 0-24 (S-S)	3.38



DNSP	TasNetworks	
State	TAS	
Name	Residential low voltage ToU demand DER	
Code	TAS97	
Demand	*Times*	*¢/kVA/day*
Peak	7-10, 16-21 (M-F)	28.77
Off-peak	21-7, 10-16 (M-F), 0-24 (S-S)	8.62



DNSP	TasNetworks	
State	TAS	
Name	Small business low voltage time of use consumption	
Code	TAS94	
Energy	*Times*	*¢/kWh*
Peak	7-22 (M-F)	11.92
Shoulder	7-22 (S-S)	7.15
Off-peak	22-7 (M-F), 22-7 (S-S)	1.79

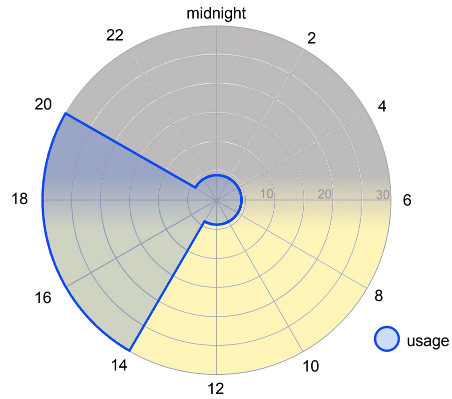


55 TasNetworks. (2023). Network tariff application and price guide 2023-24. https://www.tasnetworks.com.au/config/getattachment/07e6ccc2-f0c3-401f-ac41-c26eca064860/2023-24-network-tariff-application-and-price-guide.pdf

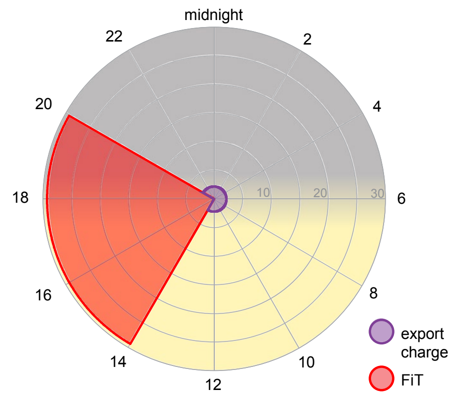
TRIAL NETWORK TARIFFS

Following are a selection of trial network tariffs, mostly covering the 2023-24 period.

DNSP	**Ausgrid**	
State	**NSW**	
Name	**Two-Way Residential (load)**	
Code	**EA959**	
Energy	*Times*	*¢/kWh*
Peak	**14-20**	**29.99**
Off-peak	**20-14**	**4.25**

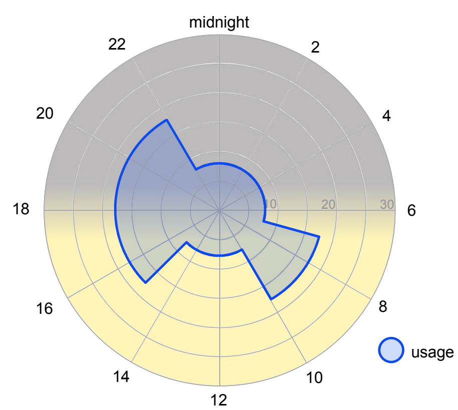


DNSP	**Ausgrid**	
State	**NSW**	
Name	**Two-Way Residential (generation)**	
Code	**EA960**	
Energy	*Times*	*¢/kWh*
Peak	**14-20**	**29.24**
Off-peak	**20-14**	**-2.19**
Peak = Export Reward Off-peak = Export Charge		



DNSP	**Ausgrid**	*Periods*	*Times*	*¢/kWh*
State	**NSW**	Peak	**NA**	**167.20**
Name	**Flexible load**	Off-peak	**NA**	**94.89**
Code	**EA964/EA965**	Peak charges are critical peaks and apply when called by Ausgrid.		

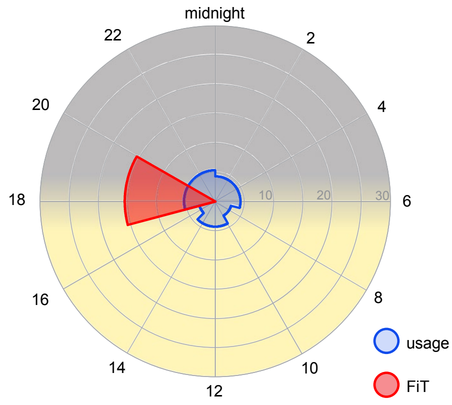
DNSP	**Ausgrid**	
State	**NSW**	
Name	**Community Battery (load/ generation)**	
Code	**EA962/EA963**	
DNSP	**Essential Energy**	
State	**NSW**	
Name	**Sun Soaker Small Business**	
Code	**BLTTSS1**	
Energy	*Times*	*¢/kWh*
Peak	**07-10, 17-20**	**17.71**
Off-peak	**10-17, 22-07**	**7.88**



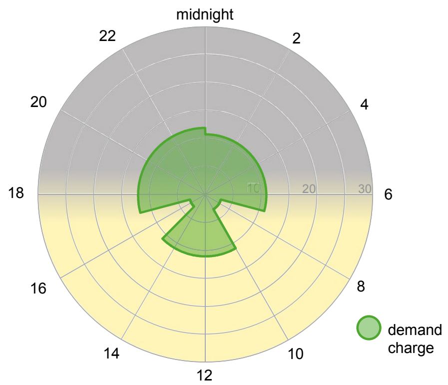
DNSP	Essential Energy	
State	NSW	
Name	Export charge	
Code	BLTTEX1	
Energy	*Times*	*¢/kWh*
Export rebate	17-20	-14.85, -15.52
Export charge (1.5-3, >3 kW)	10-15	0.72, 1.60

Stepped $/kW capacity payment is based on the relevant band that highest level of power is exported into the network in the month. The first 1.5 kW of power exported during 10-15 window is free. The higher export rebate applies to small businesses.

DNSP	Essential Energy	
State	NSW	
Name	Grid Scale Battery LV	
Code	BLTTBD1	
Energy	*Times*	*¢/kWh*
Peak	17-20	5.34
Shoulder	7-10, 15-17, 20-22	2.79
Off-peak	10-15, 22-07	4.30
DER export	17-20	-15.52

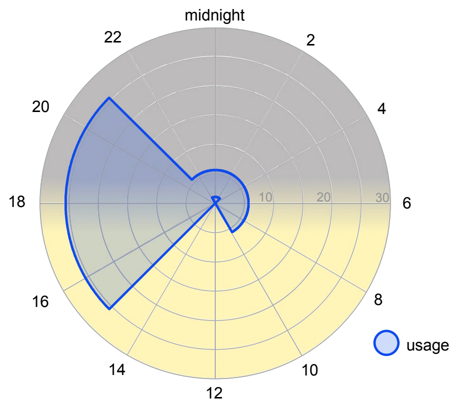


DNSP	Essential Energy	
State	NSW	
Name	Grid Scale Battery LV (Demand charges)	
Code	BLTTBD1	
Demand	*Times*	*$/kVA/month*
Peak	17-20	12.06
Shoulder	7-10, 15-17, 20-22	2.86
Off-peak	10-15, 22-07	10.91
Period	*Times*	*$/kW*
Export charge (1.5-3, >3kW)	10-15	0.72, 1.60



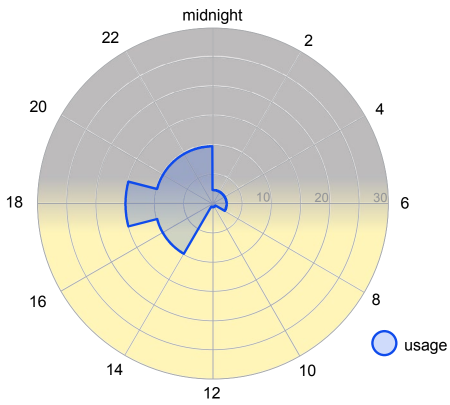
Dollars per kVA based on the highest measured half-hour kVA demand registered in each of the peak, shoulder and off-peak periods during the month.

DNSP	AusNet Services	
State	VIC	
Name	EV Dynamic	
Code	NAST16T	
Energy	*Times*	*¢/kWh*
Peak	15-21	25.61
Solar soak	10-15	-1.10
Off-peak	21-10, 0-24 (Sat)	5.69
Rebate	Times	$/kW
Event rebate*	NA	-1.10



Includes a scaled rebate of -1.10 $/kW per event. Available to residential customers with a smart meter and ownership of an EV. Customers are required to opt in to participate and may opt out at any time during the trial period.

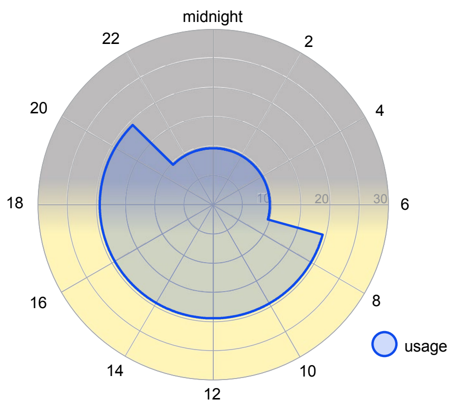
DNSP	AusNet Services	
State	VIC	
Name	CPD Flex	
Code	NSP79T	
Energy	*Times*	*¢/kWh*
Peak	17-19 (M-F)	14.90
Shoulder	14-17, 19-21 (M-F)	9.84
Solar soak	8-14 (M-F)	0.55
Off-peak	21-8 (M-F), 0-24 (S-S)	2.38
Demand	*Times*	*$/kVA/yr*
Capacity	NA	63.85
Critical peak	NA	107.31



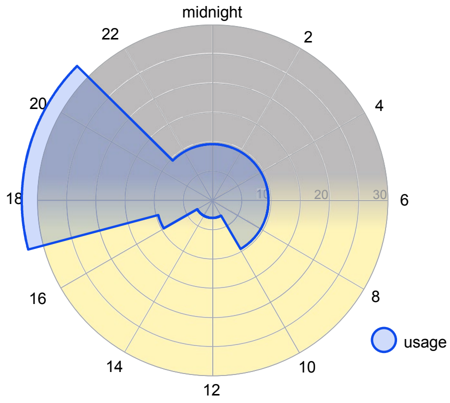
Critical peak demand (CPD) tariff with a solar soak component and shorten CPD event notification. Available to new and existing customers. To qualify for the trial, customers' annual consumption must be greater than 400 MWh, demand must be greater than 150 kVA, and connected to AusNet's low voltage network. Customers are required to opt in to participate and may opt out at any time during the trial period.

Capacity and critical peak charges are Fixed amounts.

DNSP	SA Power Networks	
State	SA	
Name	Large LV Business Agreed Demand Flexible	
Code	LBADF-SA	
Energy	*Times*	*¢/kWh*
Peak	7-21	8.0
Off-peak	21-7	5.0
Demand	*Times*	*$/kVA/year*
Demand peak	11-17 (CBD), 17-21 (non-CBD)	0.314
Demand*	N/A	0.116
Demand	*Times*	*$/kVA*
Flex demand*	N/A	0.058
* Agreed demand interval (30 minutes)		



DNSP	SA Power Networks	
State	SAPN	
Name	Residential Electrify	
Code	RELE	
Energy	*Times*	*¢/kWh*
Peak	17-21	32.6
Shoulder	21-10, 16-17	9.6
Solar sponge	10-16	3.0
Control load	*Times*	*¢/kWh*
CL Peak*	6:30-9:30, 15:30-23:30	18.5
CL Off-peak^	23:30-6:30	74.1
CL solar sponge#	9:30-15:30	3.7

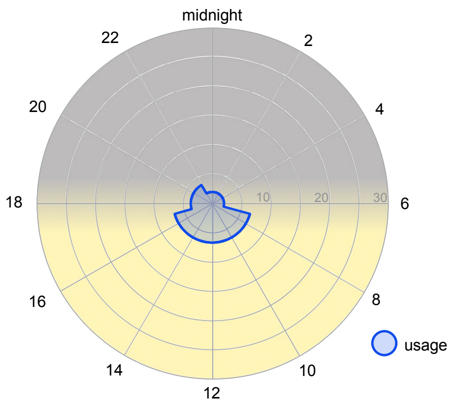


* 11 hours per day not captured in the Off-peak/Solar Sponge windows.

^ Seven-hour window of 11:30pm-6:30am with a randomised start time of at least one hour.

\# Six-hour window of 9:30am-3:30pm with a randomised start time of at least one hour.

DNSP	EvoEnergy	
State	ACT	
Name	Residential Battery Network	
Code	027	
Energy	*Times*	*¢/kWh*
Peak (max)	7-9, 17-20	11.58
Shoulder (mid)	9-11, 15-17, 20-22	7.50
Off-peak (economy)	22-7	3.69
Solar sponge	11-15	1.84
Peak export rebate*	N/A	-215.21



Demand charges also levied on excess exports and exports during critical peak events. Charges vary by season.

PROPOSED NETWORK TARIFFS 2024-29

Proposed network tariffs for the 2024-29 period are based on the requirements of the NER, the AER's Export Tariff Guidelines and the AER's final decision for the 2024–29 period.

AUSGRID

Under the AEMC's recent rule changes, Ausgrid has set the Long Run Marginal Cost (LRMC) for electricity exports as follows:

- 0.90–1.17 ¢/kWh for exports between 10am–3pm, and
- a negative LRMC of –(1.84–2.33) ¢/kWh for exports 4–9pm, encouraging evening exports.

Ausgrid offers a basic export allowance of 2,500 kWh annually 10am–3pm for residential and small business customers; exports outside these hours are free or rewarded, with no allowance. Starting 1 July 2024, Ausgrid will also introduce utility-scale storage tariffs across various voltage classes, aligning with national objectives and guided by NER principles. Concurrently, Ausgrid will phase out several tariffs, such as the small business TOU demand (EA255), transitioning affected customers to appropriate new tariffs.

Ausgrid's proposed tariffs for 2024–29 are explained in the *Ausgrid Electricity Distribution Determination 2024 to 2029.*[56]

ESSENTIAL ENERGY

Essential Energy has updated its tariff structure to streamline charges and incentives for various customer segments. The revised approach includes a basic export level set at 7.5 kWh per day between 10am and 3pm for residential and small business customers under the sun-soaker, time-of-use two-way tariff.

- **Two-way tariffs:** Essential Energy has simplified its tariff design by eliminating the initially proposed inclining block structure, opting instead for a uniform export charge calculated on a dollar per kWh basis, with the basic export level adjusted to 1.5 kWh per hour.
- **Storage tariffs:** Essential Energy removed the rebate parameter for the high voltage (HV) battery/storage tariff, broadened the eligibility for low voltage (LV) and HV storage customers, and introduced a new small LV battery/storage tariff suitable for systems up to 250 kW. This adjustment was made in response to feedback on their proposed tariff structure.
- **Opt-in controlled load tariff for flexible load:** Essential Energy decided against proposing new tariffs specifically for flexible loads such as electric vehicles (EVs), deeming their current suite of tariffs and policies sufficient to handle EV charging demands effectively.

Essential Energy's proposed tariffs for 2024–29 are explained in the *Essential Energy Electricity Distribution Determination 2024 to 2029*.[57]

AUSNET SERVICES

AusNet Services has made significant adjustments to their tariff structures to accommodate the evolving demands of the electricity network, influenced by residential and small business consumers. The main changes implemented for the 2022–26 regulatory period include:

- **Introduction of new ToU tariff:** A two-rate ToU tariff has been introduced as the default for residential customers. This change is aimed at managing the increased peak demand caused by air conditioners, electric vehicles, and the shift in solar generation usage due to home batteries.
- **Adjustments for existing residential customers:**
  - Single rate, demand charge, and controlled load tariffs from the 2016–20 period have been retained.
  - Customers previously on legacy ToU tariffs were transitioned to the new ToU tariff on 1 July 2021.
  - Legacy ToU tariffs were removed from the tariff schedule.
- **Changes for small business customers:**
  - The default tariff for businesses consuming up to 40 MWh/year has been switched from a single rate to a two-rate ToU tariff active 9am–9pm weekdays.

56 AER. (2024). Final Decision – Overview – Ausgrid – 2024-29 Distribution revenue proposal. April 2024.

57 AER. (2024). Final Decision Attachment 19 – Tariff structure statement – Essential Energy – 2024-29 Distribution revenue proposal. April 2024.

- Similar to residential customers, all small business customers on legacy ToU tariffs were moved to the new default tariff on 1 July 2021, and all legacy tariffs were removed.

› **Closure to New Entrants for Seasonal ToU Tariffs:** The suite of seasonal ToU tariffs for residential and small business customers has been closed to new entrants. Customers with basic meters on legacy ToU tariffs were moved to single rate tariffs on 1 July 2021.

› Modifications for Larger Consumers: For customers likely to exceed 40 MWh/year, existing tariffs were largely maintained, with the notable exception of the NSP56 tariff:
  - The morning peak charging window (7–10am) was removed.
  - The evening peak window was narrowed from 4–11pm to 4–9pm.
  - The shoulder and off-peak windows remain largely unchanged, except for an extended off-peak period on weekdays.

AusNet Services proposed tariffs for 2024–26 is explained in the *AusNet Services distribution determination 2021-26 – Attachment 19 – Tariff structure statement*[58] and in the *Annual pricing proposal 2024-25*.[59] In addition, the 2024–2025 flexible demand tariff figures are published in the *AusNet Services 2024–25 annual SCS pricing model*.[60]

SA POWER NETWORKS

Starting 1 July 2025, new export tariffs will be implemented for all residential, small, and medium business SAPN customers with small, embedded generation systems (solar and/or battery) of less than 30 kW capacity. Customers cannot opt out of these tariffs. Key details include:

› **Free export thresholds:** Interval-metered customers will receive a 9 kWh daily free export threshold. Accumulation-metered customers will have an 11 kWh daily free threshold.

› **Export charges:** For exports exceeding the threshold in the period 10am–4pm, interval-metered customers will be charged 1 ¢/kWh, and accumulation-metered customers 0.75 ¢/kWh.

› **Export credits:** During November–March, 5-9pm, residential and small business customers on the 'Prosumer' tariff will receive credits for any electricity exported.

For customers with systems larger than 30kW (usually connected at higher voltages and not facing forecasted network constraints), there will be no export tariffs. However, these customers will still receive pricing signals through the connection process, reflecting their impact on the network.

The new tariff proposals focus on enhancing cost reflectivity and managing network demand more effectively across various customer segments:

› **Export Tariffs for Systems <30kW:** A new export tariff will be implemented from 1 July 2025, for all customers with generation capacity under 30 kW. There is no opt-out option. This tariff aims to recover expenditures associated with low voltage network augmentation from customers who benefit directly from these enhancements. By setting a universal start date for these tariffs at the onset of the regulatory period, the strategy aims to foster more equitable pricing outcomes.

› **Export Tariffs for Systems >30kW:** No new export tariffs will be introduced for systems larger than 30kW, as these are typically connected at higher voltages with no immediate congestion issues. Instead, pricing signals will be integrated during the connection process, aligning with the existing Connection Policy to handle augmentation charges effectively.

› **Residential Time of Use (ToU) Tariffs – Solar Sponge:** This tariff extends the lowest price window by an hour to 4pm to reflect times when the network can handle increased load. This change aims to leverage periods of low or sometimes negative demand, easing one of the major challenges on the distribution network.

› **Residential and Small Business ToU Tariffs:** As electric vehicle (EV) usage rises, these tariffs encourage shifting EV charging away from peak demand times, thereby preventing new demand peaks that could lead to inefficient capital expenditures and higher prices.

› **Electrify ToU Tariffs:** Based on the 2022 Electricity Statement of Opportunities (ESOO) growth projections, these tariffs are designed to accommodate increased electricity demands from broader electrification trends, EV uptake, and renewable targets. They aim to encourage usage during off-peak times to avoid the need for significant network capacity increases.

58 AER. (2011). Final decision – AusNet Services distribution determination 2021-26 – Attachment 19 – Tariff structure statement. April 2021

59 AusNet Services. (2024). Annual pricing proposal 2024–25. 28 March 2024

60 AusNet Services. (2024). 2024-25 annual SCS pricing model. 28 March 2024

- **Large Business Flexible Tariffs:** These tariffs are structured to incentivise large and major business customers to use the distribution network efficiently, especially during critical periods like hot summer evenings. Flexibility in these tariffs aligns with the connections policy, allowing businesses that opt for flexibility to avoid costs associated with network augmentation.

SAPN's proposed tariffs for 2025–30 are explained in the *SAPN - 2025-30 Regulatory Proposal Overview*.[61] The proposed tariffs and their values for 2024–25 are published in the *SA Power Networks 2024–25 Annual SCS pricing model*.[62]

ERGON ENERGY

Ergon Energy has outlined several key updates to its network tariffs for the period of 2025–30.[63] Here is a summary of the proposed changes:

- **Strengthened Peak Price Signals:** Ergon Energy is revising the long-run marginal cost that underpins their peak prices to better incentivise customers to shift their energy use from peak to off-peak times. This change is expected to benefit customers by reducing their costs and will also alleviate the need for further investment in network infrastructure.
- Adjustments to Time of Use Windows:
  - Starting 1 July 2025, residential customers will benefit from zero distribution charges for energy used daily between 11am and 4pm. Energy used during the peak window of 4pm to 9pm will be charged at a peak rate, with other times charged at normal rates.
  - For small business customers, zero distribution charges will apply for energy used from 11am to 1pm daily. Peak rates will shift to 5pm to 8pm on weekdays, with shoulder rates at other times.
  - Large businesses on the low voltage network will align with the small business time windows, and most high voltage customers will also have the option to choose tariffs with these time frames from 1 July 2025.
- **Introduction of Two-Way Tariffs:** From 1 July 2026, Ergon Energy plans to introduce two-way tariffs for new customers with export capacities below 30 kW (optional for existing customers). By 1 July 2028, all customers with export capacities below 30 kW will be moved to these tariffs, with the option for dynamic connections that adjust export limits based on network capacity.
- **Expansion of Load Control Options:** Load control tariffs will be more broadly available from 1 July 2025, providing customers with more flexible and cost-effective options for managing energy use, especially when using appliances in combination with solar PV and storage technologies.
- **Streamlining of Tariffs:** Ergon Energy will phase out several tariffs that are either outdated, have limited customer uptake, or do not align with the future direction of the network tariffs.

Ergon Energy has published the values of the proposed tariffs, including the 2024–2025 flexible demand tariff figures in the *Ergon Energy 2024–25 annual SCS pricing model*.[64]

EVOENERGY

Evoenergy's tariff structure statement for the 2024–29 regulatory period, starting 1 July 2024, extends the application of battery-specific tariffs to include storage technologies with similar connection and load characteristics, including:

- **Withdrawal of contingent tariff adjustments:** Evoenergy has removed all contingent tariff adjustments, which were initially set to address specific trigger events as outlined in earlier proposals.
- **Withdrawal of residential export reward tariff:** Due to new cost considerations related to billing system updates and mixed retailer feedback, the proposed residential export reward tariff has been removed.
- **Introduction of a basic export level:** A basic export level has been added to the grid-scale battery tariff, enhancing the structure to better align with current energy storage integration trends. Evoenergy is proposing to set a nominally low basic export level at 2 kVAh per critical export event. This approach aligns with the AER's acceptance of a similar strategy in Ausgrid's case for its low voltage utility scale storage tariff. Specifically, Ausgrid had argued that an efficient basic export level for critical export events would ideally be zero but settled on the lowest practical level of 1 kWh per hour during peak events.
- **Introduction of individually calculated tariffs:** This allows for more tailored billing that can adapt to

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61 SA Power Networks. (2024). 2025–30 Regulatory Proposal Overview. January 2024

62 SA Power Networks. (2024). 2024–25 annual SCS pricing model. 9 April 2024

63 Ergon Energy. (2024). Tariff Structure Statement – Compliance Statement. January 2024

64 Ergon Energy. (2024). 2024–25 annual SCS pricing model. 28 March 2024.

individual consumption patterns, promoting fairness and efficiency.

- **Adjustment of residential ToU tariffs:** Evoenergy is permitted to modify the structure of its proposed residential tariffs to better suit consumer needs and system efficiencies. Evoenergy is planning to simplify its TOU tariff by removing the two existing shoulder periods. This adjustment reflects the reduced appropriateness of a higher price during the middle of the day, a time when residential demand typically diminishes, thereby increasing available capacity on the network.
- **Solar soak period:** Evoenergy is proposing the implementation of a solar soak period 11am–3pm (AEST) in its network tariffs, aimed at managing the influx of electricity generated by household solar PV systems during these hours.

Evoenergy proposed tariffs for 2024–29 are summarised in the *Final Decision - Overview – Evoenergy – 2024–29 Distribution revenue proposal*[65] and explained in detail in the *Final Decision – Evoenergy distribution determination 2024-29 – Revised Tariff Structure Statement*.[66]

TASNETWORKS

TasNetworks is not introducing new tariffs specifically for flexible loads like electric vehicles (EVs) at this time. Instead, TasNetworks will continue to manage EV charging loads using its existing suite of residential tariffs. TasNetworks' existing tariffs, including a 'super off-peak' period from midnight to 4 am, aim to incentivise EV charging during times that minimise network strain.

65 AER. (2024). Final Decision – Overview – Evoenergy – 2024–29 Distribution revenue proposal. April 2024

66 Evoenergy. (2024). Final Decision – Evoenergy distribution determination 2024-29 – Revised Tariff Structure Statement. April 2024.

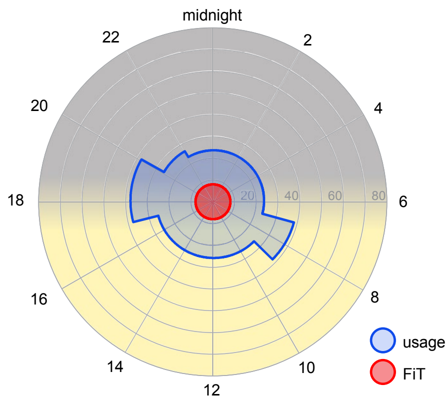
RETAIL TARIFFS

Following is a selection of retail ToU tariffs.

Retailer	**ActewAGL**	
State	**ACT**	
Name	**Home TOU**	
Periods	*Times*	*¢/kWh*
Peak	**07-09, 17-20**	**38.17**
Shoulder	**09-17, 20-22**	**26.30**
Off-peak	**22-07**	**23.16**
FiT	**NA**	**8.00**

evEnergy Saver available to EV owners with smart meters. Provides super off-peak rate of 0 ¢/kWh, 12-2pm Sat and Sun.

Night Saver EV also available with rate of 8.0¢/kWh, 12-6am. Does not apply to CL usage.



Retailer	**ActewAGL**	
State	**ACT**	
Name	**Battery Saver**	
Periods	*Times*	*¢/kWh*
Usage	**NA**	**28.80**
FiT	**NA**	**10.00***

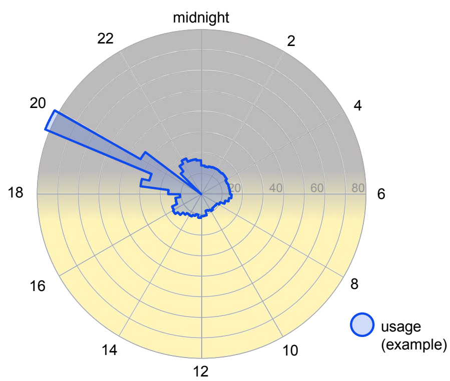
* First 10 kWh/day. Tesla Powerwall 2 or SolarEdge/LG Chem HV battery storage system.

Retailer	**ActewAGL**	
State	**ACT**	
Name	**Solar Saver**	
Periods	*Times*	*¢/kWh*
Usage	**NA**	**27.28**
FiT	**NA**	**15.00***

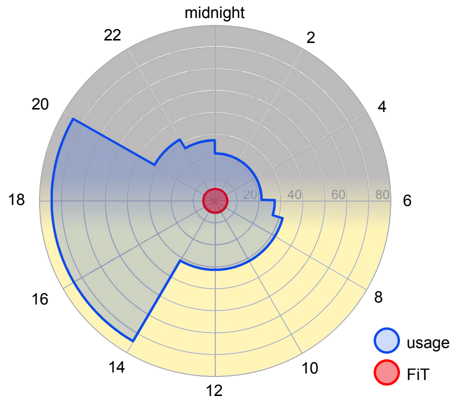
* First 15 kWh/day; 11.00 ¢/kWh thereafter

Retailer	**Amber Electric**	
States	**NSW, ACT, VIC, SA, SE QLD**	
Name	**Retail offer**	
Periods	*Times*	*¢/kWh*
Tariff	**NA**	**variable**
FiT	**NA**	**variable**

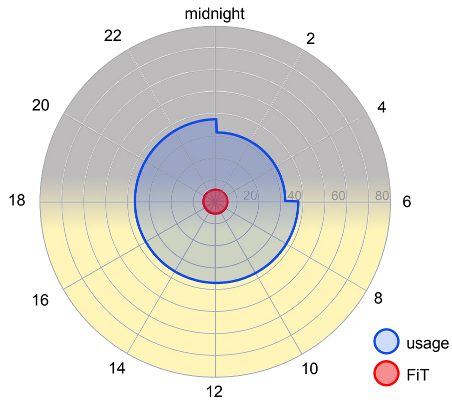
Wholesale price pass-through. Residential customers only. Chart is a representative example only. During surge periods, prices can exceed $19/kWh.



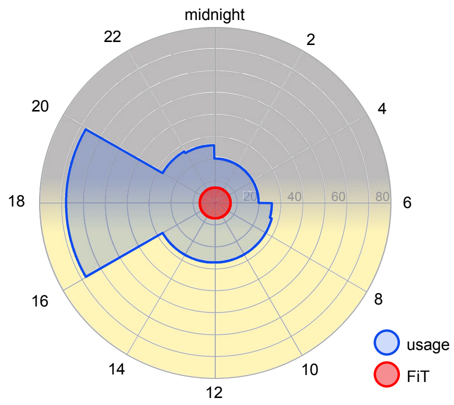
Retailer	**Engie (Simply Energy)**	
States	**NSW**	
Name	**EV Night Time Saver TOU**	
Periods	*Times*	*¢/kWh*
Peak	**14-20**	**74.40**
Shoulder	**07-14, 20-22**	**31.85**
Off-peak	**22-00, 06-07**	**27.18**
Super off-peak	**00-06**	**21.18**
Controlled load	**NA**	**18.18**
FiT	**NA**	**5.50**
No peak period on weekends. Time periods vary throughout year. Rates shown for summer.		



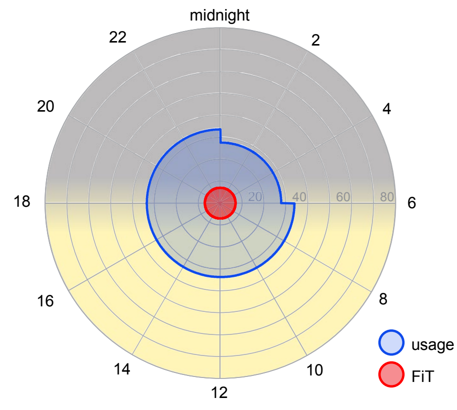
Retailer	**Engie (Simply Energy)**	
States	**NSW**	
Name	**EV Night Time Saver**	
Periods	*Times*	*¢/kWh*
Peak	**06-00**	**37.27**
Super off-peak	**00-06**	**31.27**
Controlled load	**NA**	**18.18**
FiT	**NA**	**5.50**



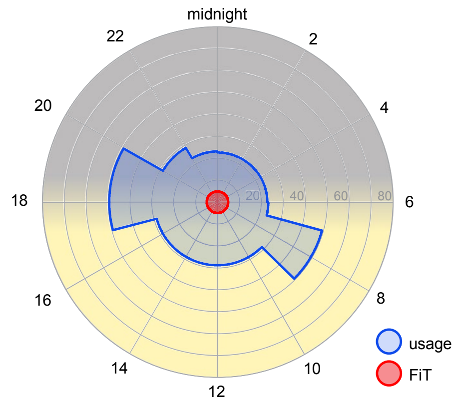
Retailer	**Engie (Simply Energy)**	
States	**QLD**	
Name	**EV Night Time Saver TOU**	
Periods	*Times*	*¢/kWh*
Peak	**16-20**	**67.41**
Shoulder	**07-16, 20-22**	**27.12**
Off-peak	**22-00, 06-07**	**26.24**
Super off-peak	**00-06**	**20.24**
FiT	**NA**	**7.00**
No peak period on weekends. Time periods vary through the year. Rates shown for summer.		



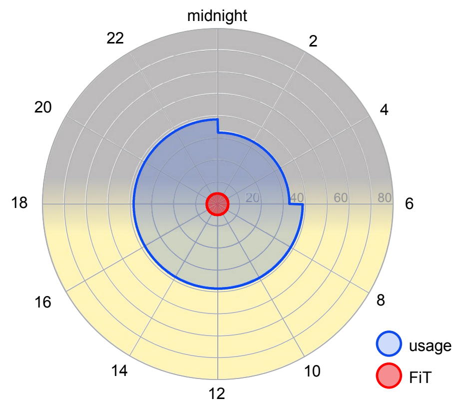
Retailer	Engie (Simply Energy)	
States	QLD	
Name	EV Night Time Saver	
Periods	*Times*	*¢/kWh*
Peak	06-00	33.62
Super off-peak	00-06	27.62
Controlled load	NA	23.63
FiT	NA	7.00



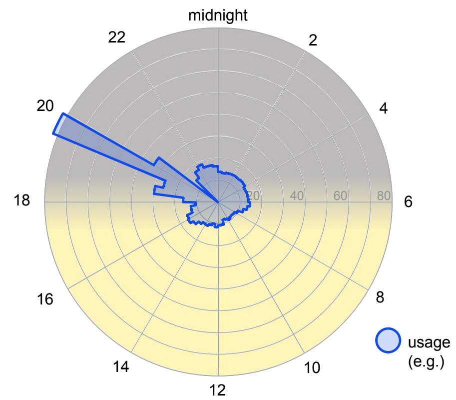
Retailer	Engie (Simply Energy)	
States	VIC	
Name	EV Night Time Saver TOU	
Periods	*Times*	*¢/kWh*
Peak	07-09, 17-20	49.31
Shoulder	09-17, 20-22	28.69
Off-peak	22-00, 06-07	23.16
Super off-peak	00-06	22.69
FiT	NA	4.90



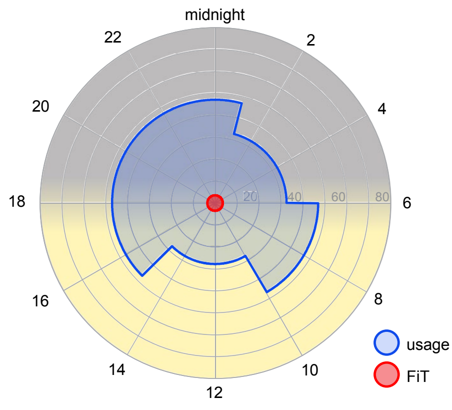
Retailer	Engie (Simply Energy)	
States	VIC	
Name	EV Night Time Saver	
Periods	*Times*	*¢/kWh*
Peak	06-00	38.50
Super off-peak	00-06	32.50
Controlled load	NA	28.69
FiT	NA	4.90



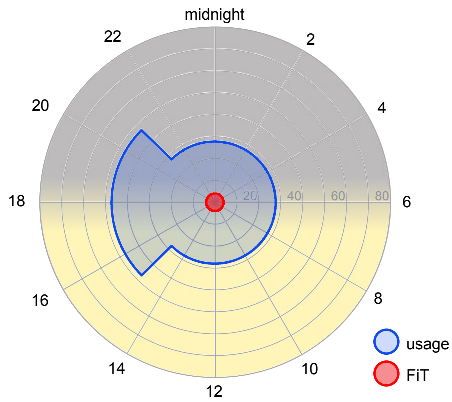
Retailer	Flow Power	
States	NSW, ACT, VIC, SA, SE QLD	
Name	Power Wholesale	
Periods	*Times*	*¢/kWh*
Tariff	NA	variable
FiT	NA	variable
Wholesale price pass-through. C&I customers only		



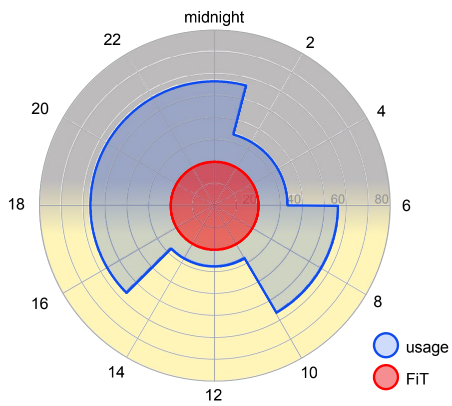
Retailer	Momentum	
States	SA	
Name	Suit Yourself	
Periods	*Times*	*¢/kWh*
Peak	06-10, 15-01	46.97
Shoulder	01-06	32.56
Off-Peak	10-15	27.83
FiT	NA	3.50



Retailer	Momentum	
States	VIC	
Name	Suit Yourself	
Periods	*Times*	*¢/kWh*
Peak	15-21	46.97
Off-Peak	21-15	27.83
FiT	NA	5.40

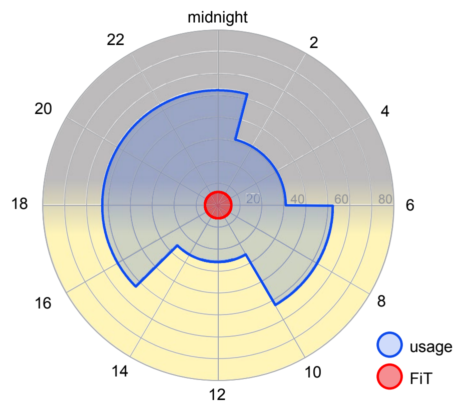


Retailer	Origin Energy	
States	ACT, NSW, QLD, SA, VIC	
Name	Solar Boost Plus	
Periods	*Times*	*¢/kWh*
Peak	06-10, 15-01	56.43
Shoulder	10-15	27.78
Off-Peak	01-06	33.40
FiT (< 7kW)	NA	20.00
FiT (> 7kW)	NA	17.00
FiT rates available for 24 months for those buying new solar system from Origin. FiT rate of 12.0 ¢/kWh for existing solar system owners.		

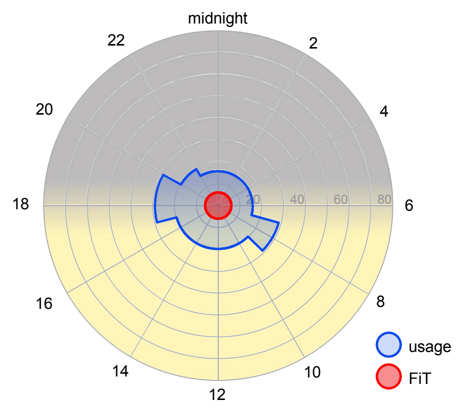


Retailer	Origin Energy	
States	SA	
Name	EV Power Up	
Periods	*Times*	*¢/kWh*
Off-Peak	Variable	8.00
Provides scheduled EV charging via an app.		

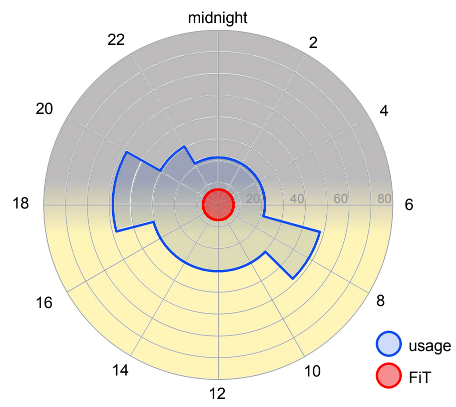
Retailer	Origin Energy	
States	SA	
Name	Go Variable	
Periods	*Times*	*¢/kWh*
Peak	06-10, 15-01	52.48
Shoulder	10-15	25.83
Off-Peak	01-06	31.06
CL	NA	20.94
FiT	NA	6.00



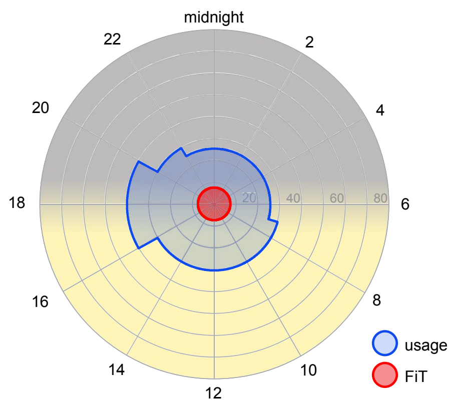
Retailer	Red Energy	
States	ACT	
Name	Red EV Saver - TOU	
Periods	*Times*	*¢/kWh*
Peak	07-09, 17-20	28.82
Shoulder	09-17, 20-22	19.58
Off-Peak	22-07	15.95
Sup. Off-Peak	12-14 WE	0.00
FiT	NA	6.00
Super Off-Peak exclusively for EV owners with smart/interval meter.		



Retailer	Red Energy	
States	NSW	
Name	Red EV Saver - TOU	
Periods	*Times*	*¢/kWh*
Peak	07-09, 17-20	48.24
Shoulder	09-17, 20-22	30.64
Off-Peak	22-07	21.43
Sup. Off-Peak	S-S 12-14	0.00
FiT	NA	7.00
Super Off-Peak exclusively for EV owners with smart/interval meter.		



Retailer	Red Energy	
States	QLD	
Name	Red EV Saver - TOU	
Periods	*Times*	*¢/kWh*
Peak	M-F 16-20	39.95
Shoulder	M-F 07-16, 20-22	30.03
Off-Peak	M-F 22-07	25.69
Sup. Off-Peak	S-S 12-14	0.00
FiT	-	8.00
Super Off-Peak exclusively for EV owners with smart/interval meter.		



Further information is available at
arena.gov.au

Australian Renewable Energy Agency

To explore potential for funding visit:
arena.gov.au/funding

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