

# THE ROLE OF FLEXIBLE DEMAND IN AUSTRALIA'S ENERGY FUTURE

NOVEMBER 2021



Australian Government  
Australian Renewable  
Energy Agency

**ARENA**

# INTRODUCTION

Australia's transition to renewable and distributed energy will fundamentally change how our electricity systems and markets operate.

Rooftop solar and home storage has enabled Australian households and businesses to generate more energy and consume less electricity from the grid. This is driving down minimum demand and presenting challenges for the Australian Energy Market Operator (AEMO). In its [2021 Electricity Statement of Opportunities](#),<sup>1</sup> AEMO predicts that mainland regions in the National Electricity Market (NEM) and Wholesale Electricity Market (WEM) will experience daytime minimum operational demand that exceeds minimum voltage thresholds within the next five years, which presents system security risks.

Traditionally, Australia's electricity market has operated to vary generation output to balance system supply and demand. This approach has been supported by more storage and greater infrastructure connectivity, the cost of which can be significant. Demand side flexibility is an increasingly viable alternative that can achieve balance efficiently and cost-effectively. However, this approach will require new technologies, market processes and ways of engaging with customers.

**Demand flexibility is the capability to vary customer demand in response to generation, network, or market signals. Demand flexibility can operate in real time and can be incorporated into long-term investment decisions.**

ARENA's new [Investment Plan](#)<sup>2</sup> has identified demand flexibility as a key focus area under our strategic priority to optimise the transition to renewable electricity.

## OPTIMISE THE TRANSITION TO RENEWABLE ENERGY



### SUPPORT FLEXIBLE DEMAND

- › Demonstrate the **potential value of flexible demand to the electricity system**, including through the avoidance of additional network and storage build costs
- › Demonstrate the **technical and commercial viability of a range of novel flexible demand options**, including managed charging of electric vehicles, flexible operation of hydrogen electrolyzers, and other load shifting technologies in industrial, commercial and residential settings
- › Effectively **integrate and orchestrate novel sources of flexible demand and supporting infrastructure and services**, such as demand management systems, dynamic operating envelopes and virtual power plants
- › Support projects and knowledge sharing that will **inform the regulatory framework** on flexible demand, such as how it can best support two-sided markets.

We expect to support demonstration projects across the commercial, industrial and residential segments to help make a broader range of flexible demand services available to the electricity system.

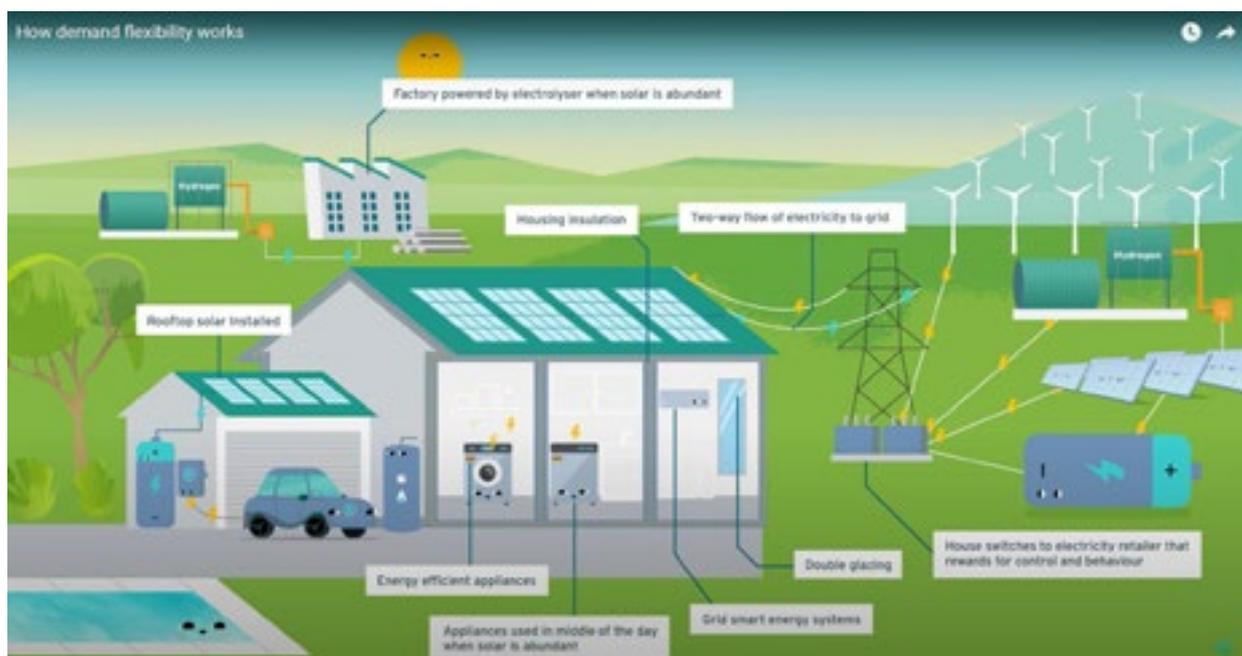
1 AEMO Electricity Statement of Opportunities 2021, [www.aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo](http://www.aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-reliability/nem-electricity-statement-of-opportunities-esoo)

2 ARENA Investment Plan 2021, [www.arena.gov.au/about/publications/funding-investment-plan](http://www.arena.gov.au/about/publications/funding-investment-plan)

# SOURCES OF DEMAND FLEXIBILITY

ARENA's portfolio of projects have already demonstrated how demand flexibility can improve systems and market integration, enhance products and price signals, and empower customers.

Whether it's through electric vehicle (EV) smart chargers, home energy management systems, or demand response, ARENA-funded projects are showcasing how demand flexibility can transform our energy system.



[View a gif of how demand flexibility works<sup>3</sup>](#)

However, more work is needed to support the technological, commercial and regulatory innovation necessary to enable a more flexible system and unlock the benefits for customers.

Demand flexibility could be achieved through a number of sources, including:

- › **Flexible hydrogen electrolysis** operated dynamically in response to market signals, or abundance of renewable energy generation.
- › **Managed EV charging and vehicle-to-grid (V2G)** to ensure vehicles are charged by low cost, low emissions electricity and avoid extensive network builds to cope with coincident charging patterns.
- › **New retail commercial products** such as energy-as-a-service, dynamic tariffs and demand-based market hedges.
- › **Orchestration of customer appliances** such as water heaters, pool pumps and air conditioners operated dynamically to utilise abundant low cost solar during the day.
- › **Electrification and control of commercial and industrial loads** such as heat pumps, electric furnaces and thermal storage for cold stores and commercial property.
- › **Market reforms to integrate demand side resources** to efficiently incorporate demand side flexibility into the future supply mix.

<sup>3</sup> How demand flexibility works <https://arena.gov.au/blog/how-to-lower-energy-bills-and-emissions-with-demand-flexibility/>

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# OPPORTUNITIES FOR INVOLVEMENT

The types of demand flexibility ARENA is most interested in investigating include load 'shaping', 'shifting' and 'surging'. Other opportunities for demand flexibility include load 'shaving' (e.g. traditional demand response), load 'shedding' (i.e. load shed at substation and feeder level) and load curtailment.

'SHAPING'	'SHIFTING'	'SURGING'
Load shaping refers to a permanent/regular change in time of day electricity usage (e.g. using timers).	Load shifting refers to dynamically changing the time of day electricity usage (e.g. based on price signals).	Load surging is when flexible demand sources take advantage of excess power generation by ramping up operations.
Examples: Rescheduled equipment (e.g. water heating) and production.	Examples: Batteries, EVs, pre-cooling/heating, production changes.	Examples: H <sub>2</sub> production, desalination, industrial processes.

To accelerate the opportunities offered by demand flexibility, ARENA is expanding its portfolio of projects that can provide new flexible demand capacity. ARENA welcomes proposals for projects that:

1. involve 'load shaping' and/or 'load shifting' to align customer electricity demand with variable renewable energy
2. demonstrate bi-directional flexibility in end-use customer loads and not rely solely on battery storage and/or solar curtailment
3. demonstrate innovation in customer incentives that result in greater demand side participation in the energy market
4. are capable of responding to minimum demand including in response to AEMO Minimum Demand Level 1 (MSL 1) market notices
5. are able to offer new flexible demand capacity by 1 December 2022 or earlier.

If you wish to receive more information on ARENA's future activities in demand flexibility, please contact [knowledge@arena.gov.au](mailto:knowledge@arena.gov.au).

# APPENDIX

## ARENA'S PORTFOLIO OF FLEXIBLE DEMAND PROJECTS AS AT NOVEMBER 2021

THEME	ARENA PROJECTS	FUNDED BY ARENA / TOTAL PROJECT COST	PROJECT PAGE
 EVs	AGL EV Orchestration Trial	\$2.89m / \$8.25m	<a href="https://arena.gov.au/projects/agl-electric-vehicle-orchestration-trial/">arena.gov.au/projects/agl-electric-vehicle-orchestration-trial/</a>
	Origin Energy EV Smart Charging Trial	\$838k / \$2.92m	<a href="https://arena.gov.au/projects/origin-energy-electric-vehicles-smart-charging-trial/">arena.gov.au/projects/origin-energy-electric-vehicles-smart-charging-trial/</a>
	Jemena Dynamic EV Charging Trial	\$1.55m / \$3.83m	<a href="https://arena.gov.au/projects/jemena-dynamic-electric-vehicle-charging-trial/">arena.gov.au/projects/jemena-dynamic-electric-vehicle-charging-trial/</a>
	ActewAGL Realising Electric Vehicle-to-Grid Services (REVS)	\$2.73m / \$6.59m	<a href="https://arena.gov.au/projects/realising-electric-vehicle-to-grid-services/">arena.gov.au/projects/realising-electric-vehicle-to-grid-services/</a>
 Hydrogen	Australian Hydrogen Centre	\$1.26m / \$4.15m	<a href="https://arena.gov.au/projects/australian-hydrogen-centre/">arena.gov.au/projects/australian-hydrogen-centre/</a>
 Other sources of demand flex	A2EP Renewable Energy for Process Heat Opportunities Study	\$473k / \$949k	<a href="https://arena.gov.au/projects/renewable-energy-for-process-heat-opportunity-study/">arena.gov.au/projects/renewable-energy-for-process-heat-opportunity-study/</a>
	DKRI Alice Springs Future Grid	\$2.17m / \$9.15m	<a href="https://arena.gov.au/projects/alice-springs-future-grid-project/">arena.gov.au/projects/alice-springs-future-grid-project/</a>
	Element 25 Intermittent Dynamic Electrowinning Using Renewable Energy	\$266k / \$756k	<a href="https://arena.gov.au/projects/intermittent-dynamic-electrowinning/">arena.gov.au/projects/intermittent-dynamic-electrowinning/</a>
	Rheem Smart Networks Trial	\$1.98m / \$8.8m	<a href="https://arena.gov.au/projects/rheem-active-hot-water-control/">arena.gov.au/projects/rheem-active-hot-water-control/</a>
	Curtin University White Gum Valley	\$900k / \$2.59m	<a href="https://arena.gov.au/projects/increasing-the-uptake-of-solar-photovoltaics-in-strata-residential-developments/">arena.gov.au/projects/increasing-the-uptake-of-solar-photovoltaics-in-strata-residential-developments/</a>
	Brimbank Aquatic and Wellness Centre Integrated Energy System	\$1.53m / \$8.09m	<a href="https://arena.gov.au/projects/brimbank-aquatic-and-wellness-centre-integrated-energy-system/">arena.gov.au/projects/brimbank-aquatic-and-wellness-centre-integrated-energy-system/</a>
	AIRAH Affordable Heating and Cooling Innovation Hub (iHub)	\$6.48m / \$16.72m	<a href="https://arena.gov.au/projects/affordable-heating-and-cooling-innovation-hub-ihub/">arena.gov.au/projects/affordable-heating-and-cooling-innovation-hub-ihub/</a>
 Managing system - level response	Demand Response RERT Trial	N/A	<a href="https://arena.gov.au/knowledge-bank/demand-response-short-notice-trial-rert-trial-year-3-report/">arena.gov.au/knowledge-bank/demand-response-short-notice-trial-rert-trial-year-3-report/</a>
	Zepben Evolve	\$4.29m / \$12.94m	<a href="https://arena.gov.au/projects/evolve-der-project/">arena.gov.au/projects/evolve-der-project/</a>
	AEMO Project EDGE	\$12.92m / \$28.03m	<a href="https://arena.gov.au/projects/victorian-distributed-energy-resources-marketplace-trial/">arena.gov.au/projects/victorian-distributed-energy-resources-marketplace-trial/</a>
	Evoenergy Project Converge	\$2.05m / \$4.11m	<a href="https://arena.gov.au/projects/der-integration-and-automation-project/">arena.gov.au/projects/der-integration-and-automation-project/</a>

THEME	ARENA PROJECTS	FUNDED BY ARENA /TOTAL PROJECT COST	PROJECT PAGE
 <p>Improving systems integration</p>	Solcast Nowcasting	\$781k / \$2.57m	<a href="https://arena.gov.au/projects/solcast-nowcasting-solutions-for-solar-farms/">arena.gov.au/projects/solcast-nowcasting-solutions-for-solar-farms/</a>
	Solar Analytics Enhanced Reliability Through Short Time Resolution Data	\$491k / \$1.28m	<a href="https://arena.gov.au/projects/enhanced-reliability-through-short-time-resolution-data-around-voltage-disturbances/">arena.gov.au/projects/enhanced-reliability-through-short-time-resolution-data-around-voltage-disturbances/</a>
	UniMelb Advanced Planning of PV-Rich Distribution Networks Study	\$203k / \$497k	<a href="https://arena.gov.au/projects/advanced-planning-of-pv-rich-distribution-networks-study/">arena.gov.au/projects/advanced-planning-of-pv-rich-distribution-networks-study/</a>
	CitiPower Powercor DER Hosting Capacity Study	\$164k / \$353k	<a href="https://arena.gov.au/projects/distributed-energy-resources-hosting-capacity-study/">arena.gov.au/projects/distributed-energy-resources-hosting-capacity-study/</a>
 <p>Optimising regulation &amp; pricing mechanisms</p>	LO3 Latrobe Valley Microgrid Feasibility Study	\$370k / \$775k	<a href="https://arena.gov.au/projects/latrobe-valley-microgrid-feasibility-study/">arena.gov.au/projects/latrobe-valley-microgrid-feasibility-study/</a>
	Oakley Greenwood Pricing and Integration of DER	\$207k / \$569k	<a href="https://arena.gov.au/projects/pricing-and-integration-of-distributed-energy-resources-study/">arena.gov.au/projects/pricing-and-integration-of-distributed-energy-resources-study/</a>
 <p>Influencing customer demand behaviours</p>	UPowr Customer Focused Design for DER Participation	\$446k / \$943k	<a href="https://arena.gov.au/projects/der-2-0-customer-focused-design-for-der-participation/">arena.gov.au/projects/der-2-0-customer-focused-design-for-der-participation/</a>

Further information is available at  
arena.gov.au

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