KPMG

Supporting demand flexibility in the energy sector transition

Report prepared by KPMG for Energy Consumers Australia

February 2023

Foreword

Transitioning our energy system to clean resources, such as wind and solar, will require some $320 billion of investment in generation, network, and storage assets. If we are to limit the impact this investment will have on consumers' bills, there must be equal importance given to reshaping the demand side of the energy system.

Australian households and small business are actively participating in the transition to a clean, affordable energy system by investing in their own energy infrastructure. Integrating the solar panels, batteries and electric vehicles that people are installing at their homes and business premises is essential to managing our transition to a net zero energy system, but we have not given sufficient thought to what we need to do to ensure people are willing to relinquish control of their assets. How we build trust and social licence, as well as providing advice and tools to minimise their energy bills.

In light of this, we engaged KPMG to investigate how our energy system can better support demand side flexibility. We wanted to know how consumers can be supported to reduce, shift, or increase their energy use at, or for, specific times. As we face a cost of living crisis, it's more important than ever to consider how we can reduce energy costs by encouraging consumers to be more flexible.

The KPMG analysis identifies the tremendous potential of demand flexibility to lower energy costs and improve affordability. The report identifies action that can be taken here in Australia to unlock this demand flexibility and provides examples of initiatives in other jurisdictions that could help accelerate action in Australia.

The report also supports Energy Consumers Australia's call for governments to embed the demand-side into energy market decision-making and address the barriers consumers face in taking control of their energy bills. We need market bodies to integrate demand flexibility into system planning. We need government and retailers to create programs and policies that recognise and reward – not punish – consumer assets and behaviour. And finally, we need governments and regulators to review and update consumer protections so consumers feel confident that they can participate in the market. Together, these actions will enable increased consumer agency and better outcomes for consumers overall.

Lynne Gallagher

CEO, Energy Consumers Australia

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Overview

Capturing the full potential of demand flexibility – the ability for consumers to shift electricity demand in response to changing price signals or incentives – is crucial to lowering wholesale electricity prices, lowering electricity bills, and enabling the system transition towards net zero. While Australia is progressing reforms towards enabling the demand side, greater focus and immediate action is needed to achieve the necessary scale and capability to make flexibility a reliable resource for planning and procurement purposes, and alleviate barriers customers face in participating. This report recommends the introduction of procurement targets for demand flexibility building on the recent NSW initiative and progress internationally to encourage investment in supporting infrastructure and increased customer participation.

Introducing targets can act as an immediate and powerful catalyst to make demand flexibility a reliable and credible resource

Establishing targets will help to better value the benefits of demand flexibility and compensate customers plus foster innovation and new business models, leading to the demand side to be better reflected in planning and operational decisions. Current policy reforms highlight reluctance to solely trust markets and merchant investment to address supply side issues in the National Electricity Market (NEM); however for the demand side there is an assumption that the market and commercial investment will provide the level of enabling infrastructure and customer capability. Targets, in combination with the National Energy Performance Strategy, will drive coordinated action to fully capture the potential of the demand side.

It is crucial to realise in full the untapped resource of demand flexibility now

The Australian energy system is going through significant change – it is important that all resources play a role to ensure that transition achieves a fair, affordable and reliable outcome for customers. Demand flexibility can support this by reducing costs through both lowering investment needed to service peak demand and also reducing inefficient spill of renewable generation. Achieving scale in demand flexibility capability will also generate benefits and confidence for customers in the energy transition. The energy sector should work together to ensure that consumers, particularly those who are vulnerable, are included in and not left behind by the transition.

Reforms are happening, but more can be done

Recent years saw a number of reforms in the NEM which are relevant to incentivising demand flexibility. This included a review of the metering framework, two-sided market development, new tariff structures and pricing signals. In addition, technology is improving from a cost and accessibility perspective. However, gaps remain – a coordinated, clear framework is required for value recognition, accountability, integration into planning and progress monitoring. The National Energy Performance Strategy provides a vehicle to push the agenda forward and to shift the focus to demand flexibility.

Energy performance can be achieved through both energy efficiency and demand flexibility

While energy efficiency and demand flexibility are both important for optimising energy use and reducing greenhouse gas emissions, they involve different approaches and technologies. Jurisdictions have established successful energy efficiency programs. A co-ordination approach across both can help to provide a robust platform for customer understanding and participation through better rewarding decisions by customer to invest in and participate in flexibility capability.

Australia should look to overseas examples to learn from the models that have been used

Given the long-term nature of the energy affordability crisis, various overseas jurisdictions have adopted unique and innovative demand flexibility models. Through the use of technology, cloud-based platforms and innovative customer solutions, programs have been able to improve grid stability and achieve material reductions in peak demand. Overseas markets demonstrate that customers are willing to be part of flexibility initiatives enabled by technology advances. An understanding of what has worked overseas provides lessons for further developing Australia's own demand flexibility arrangements

Purpose of this report

Purpose

With respect to Australia's position in the energy transition and the growing relevance of the role of the demand side of the energy market, KPMG has prepared this report to inform the discussion on how to facilitate demand flexibility in the energy sector moving forward.

The report aims to provide an overview of the positioning of demand flexibility in Australia's energy systems currently and looks forward to identifying the required actions and changes to unlock the full potential of demand flexibility in a timely manner. Such potential exists in multiple functions – to support the energy system in transition, to empower consumers experiencing vulnerabilities and those who are seeking to participate more actively in the energy market.

Energy Consumers Australia have engaged KPMG to prepare this report. In addition to the broader purpose of the report outlined above, in the first instance, this report will provide a resource to inform Energy Consumers Australia in engaging with stakeholders and influencing the policy agenda to achieve optimal outcomes for all consumers in an increasingly decentralised energy system.

This report seeks to:

- explore demand flexibility in Australia and relative to its international counterparts;
- consider the key factors and enablers required to realise and maximise demand flexibility benefits in a timely manner to effectively support the energy transition; and
- recommend changes required to release the benefits and potential of demand flexibility.

There is a large degree of progress in Australia in order to empower consumers. However, changes are disjointed and there is no collective framework to ensure the value of demand flexibility is recognised and reflected in the planning process. This report aims to set an agenda and provide recommendations as to the key actions that need to be progressed towards an ultimate outcome where:

- there are opportunities for all customers to participate or share in the benefits of demand flexibility;
- appropriate incentives or requirements are in place to unlock demand flexibility; and
- the role of demand flexibility is reflected in how energy is planned for and procured.

The National Energy Performance Strategy released for consultation in November 2022 demonstrates an increasing focus on energy efficiency and the role of the customer in the market. Demand flexibility complements the Strategy, and the introduction of targets for flexibility will support in the delivery of the Strategy and the Commonwealth Government's objectives more broadly.

Scope of this report

Scope

This report intends to remain high-level in its approach and accessible in its description of demand flexibility, seeking to serve as an overview of a number of the key factors influencing the ability of consumers to be flexible in their demand and outlining the potential for demand flexibility as it is unlocked in energy systems and markets.

Supporting the purpose described at left – the report provides:

- an overview of demand flexibility potential and its role in the transition;
- opportunities consumers have to participate, and the barriers they may face in doing so;
- Australia's current position and international development; and
- more targeted discussion on select key enablers to driving change and progress.

The report captures a broad range of concepts related to demand flexibility. However, flexibility is highly varied in how it is defined and considered in the market. This report may not be exhaustive in capturing all of the components of demand flexibility.

The report does not serve to provide precise forecasts of the potential and benefits of the demand side. We have drawn from existing studies and international outcomes to highlight the potential impact demand flexibility could provide if effectively supported.

Report structure

1. **What is demand flexibility?** – exploring the concept of demand flexibility, differentiating it from other concepts, and highlighting its application to residential consumers.
2. **Potential for demand flexibility** – an analysis of the current balance between supply-side and demand-side investment, the potential for batteries and EVs, and an overview of international demand flexibility models.
3. **Current situation in the NEM –** a look at demand flexibility enablers, progress in the existing energy efficiency schemes, and challenges to further demand flexibility development.
4. **Way forward** – considering how to drive effective change and action through introducing procurement targets to enable the scale and infrastructure needed for demand flexibility.

01

What is demand flexibility?

What is demand flexibility?

Demand flexibility involves shifting or shedding electricity demand to provide flexibility in energy markets, helping to balance the grid. It is based on two main mechanisms: price-based programmes, which use price signals and tariffs to incentivise consumers to shift consumption, and incentive-based programmes, which monetise flexibility through direct payments to consumers who shift demand.

Such flexibility can be enabled by communication and smart technologies to shift electricity use across times of the day while maintaining the quality and value of end-use services. It also includes the use of embedded customer energy resources (CER) that adapt net demand profiles. In addition, a customer may decide to shift their consumption activities at certain times in response to a price signal or incentive.

Historically, the focus on demand flexibility has been as a response tool during times of high stress on the grid and hence as a means to remove costs from the energy supply chain. Recently the value of enabling demand flexibility has increased given its potential to aid the integration of variable renewable generation plus as a tool to improve affordability and achieve net zero targets. Flexibility is generally seen as a way of balancing consumers demand for energy with renewables' output.

In response, the attention towards demand flexibility has increased with industry and policymakers working on expanding frameworks and incentives to better enable demand flexibility and for it to evolve into a reliable resource that is incorporated into energy procurement and forecasting processes.

The key to harnessing flexible demand is scale. All customers have a level of flexibility in their energy consumption but it comes in small increments. Furthermore, different consumers consumption profiles are very different, and imply different opportunities to be flexible at different points in the day and in different ways. As such, the change in demand is spread across many consumers, and only becomes worthwhile if the change in demand can be aggregated. The role of intermediaries to achieve such aggregation and manage risks across diverse customer portfolios is important. The scale will be achieved if these parties have the confidence to invest in supporting infrastructure and new business models.

As the concept of demand flexibility progresses and technologies become more integrated, it is likely that forms of demand flexibility will become more interconnected and integrated into how consumers make decisions about their energy use and the routine operation of the system. The perspective of an instantaneous demand response capability with technology enabling appliances to respond to signals is approaching.

Forms of demand flexibility

Smart technology

Smart appliances are able to respond to price and demand and supply conditions, or act on a timed basis, in order to initiate a load during low demand and low prices and reduce consumption during times of high demand and high prices.

Smart meters allow energy users to be rewarded for demand flexibility by measuring the extent of their demand response, as well as identifying additional opportunities to achieve greater outcomes by shifting their consumption behaviour.

For example…

smart thermostats initiate heating or air-conditioning units outside of peak demand times.

Embedded generation and storage

Using consumer-owned energy resources located behind the meter to generate or store energy to be used for an energy user's own consumption or to be fed back to the grid thereby reducing net demand.

For example…

storing energy generated through rooftop solar PV during the day with a battery to be used during the peak demand period later that day.

Shifting consumption patterns

An energy user changes their behaviour to shift consumption to times of low demand and low prices, and/or reduces their load at times of peak demand and high prices. This could be in response to a signal or request from a retailer, aggregator or market operator.

For example…

a consumer may choose to use their washing machine when they are home during the day, at times of lower prices, where it is practical to do so. Alternatively, a consumer may charge their electric vehicle during the day, and discharge the energy stored at times of peak demand.

Role of the consumer in demand flexibility

Energy patterns observed throughout the day and seasons are a direct consequence of what people and businesses do. Naturally, different people do different things over the course of a day but patterns of consumption across days and seasons contribute to common patterns and the occurrence of minimum and peak demand periods.

Energy demand goes hand in hand with what people do, so thinking about flexibility necessarily starts by looking at the rhythms of everyday life, including how technology is influencing behaviour. This covers both decisions that customer make on the day bur also their behaviour towards appliance changes and technology upgrades as this informs their capability for demand flexibility.

The role each consumer plays will differ

Opportunities to engage in demand flexibility are relevant for energy consumers of all types, including residential, small and medium business and large commercial and industrial (C&I) users.

However, the way in which residential customers use energy compared to C&I customers is very different, in terms of:

- the level of consumption;
- the nature of their consumption activities; and
- the purposes that various forms of consumption serve in the customer's household or business.

Additionally, the extent and means by which consumers engage in demand flexibility may depend on factors or barriers that influence a consumer's motivation, ability or opportunity, such as:

- the nature of their consumption activities and alignment with motivations;
- perceived value and costs;
- their skills, knowledge, experience and opportunity;
- the tools available and their complexity; and
- the ability and willingness of the consumer to be flexible and responsive to the opportunities offered.

The role of each consumer will also vary day-to-day. On some days participating in demand flexibility will work for a customer, while on other days the same customer will not want to be involved. Aggregation of customers can help to manage this situation and the arrangements need to support such pooling of capability and risks.

Demand flexibility captures both day-to-day behaviour and longer term decision making

Opportunities to engage in demand flexibility are clearly apparent within day-to-day energy consumption in the ordinary course of a customer's everyday life. Changes in behaviour to shift energy demand between peak, shoulder and off-peak periods of the day are perhaps the most simple form of demand flexibility.

However, considerations of demand flexibility are an increasingly important aspect of a consumer's longer term decision making. Noting the role of appliances and CER as technology enablers for customers to participate, decisions regarding investment in these technologies have a significant impact on a customer's energy outcomes, despite arising much less frequently than the day-to-day behavioural decisions.

The outcomes of these decisions inform each customer's ability to participate. Consideration needs to be given to the upfront decision to invest or not invest in a new appliance or technology, as well as decisions to manage the cost and function of the appliance over its life, through to managing disposal and replacement decisions.

The role of the consumer – incentives and enablers

Consumers have an active role to play in unlocking demand flexibility, however it is important that the consumer is not only a volunteer in this process. Consumers need to be aware, informed and willing participants, that are appropriately rewarded for doing so.

This requires two key aspects to be in place: incentives that are fit-for-purpose in driving and rewarding action, and that reflect the values of consumers; and tools and understanding in the hands of consumers to equip them to participate on an informed basis.

A diverse range of incentives are meaningful to driving customer participation

Consumers must be rewarded and incentivised to provide flexibility in a way that they understand and can respond to. This requires more than standard financial incentives and price signals. Rather, it requires a deeper understanding of:

- what drives consumer decision-making, including their diverse values, goals, and expectations for the future is needed; and
- the barriers and challenges consumers face, including perceptions with respect to concerns of security of supply or variation in prices.

Hence the arrangements for demand flexibility need to facilitate such diversity and recognise the role of “enablement infrastructure” to help achieve demand flexibility, such as data management, software, and channels to raise awareness.

What do consumers need to participate?

Information and data

Information on energy consumption, how this translates to bills, where opportunities for demand flexibility may be present.

Transparency

Clear link between action and reward that is well understood by the consumer before participating.

Processes

A defined role for the consumer that is well understood by all market participants. This includes platforms to communicate signals to customers and offer opportunities to respond.

Understand risks and liabilities

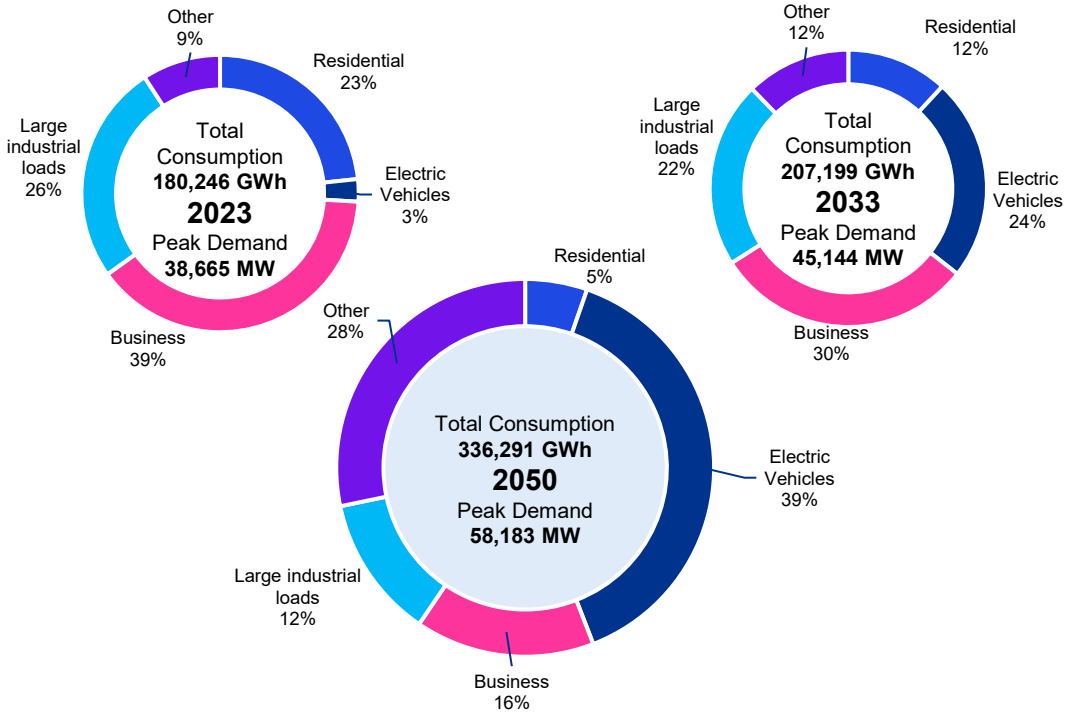
Understand the implications of participating in demand flexibility, including potential availability risks, and how these are shared among customers, third parties, and other market participants.

Demand for electricity in Australia is changing

The level and composition of demand for electricity in the NEM is changing with large increases forecast in the period to 2050.

As shown in Figures 1 and 2 below, the level of demand – both in terms of total consumption and peak demand – will increase significantly in the next 30 years and will be spread across more variable sources of load such as electric vehicles. In the absence of demand flexibility, further investment in the supply infrastructure of generation and networks is needed.

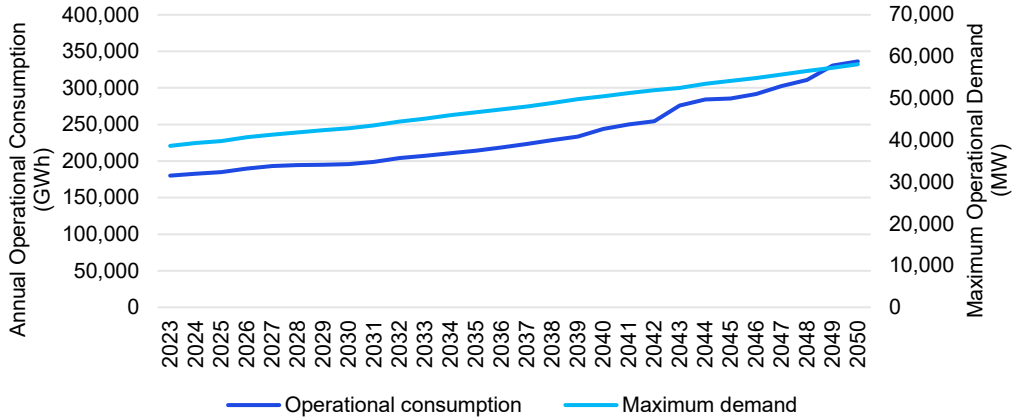
Figure 1 – Forecast consumption composition in the NEM



Business – refers to Business Mass Market (BMM) consumers as defined by AEMO, i.e. all business loads, except those in the large industrial sector.

Source: Australian Energy Market Operator, 2022 Electricity Statement of Opportunities (Central scenario)

Figure 2 - Forecast electricity demand in the NEM



Source: Australian Energy Market Operator, 2022 Electricity Statement of Opportunities 2022 (Central scenario)

The current environment is one of:

- increasing demand for electricity;
- rapid change in supply-side composition (including retiring of coal generation capacity); and
- increasing energy prices.

Timeframes required to achieve new generation and network infrastructure is a concern.

These factors underpin that now is the right time to focus on the role that customers can play in the energy transition, and unlock the value of the demand-side to meet the increasing level of demand in the most efficient, least-cost means.

Energy efficiency and demand flexibility are related but distinct

Customers have an increasing range of choices to meet their demand and lower their energy bills. Energy efficiency and demand flexibility both have an important role to play and arrangements should recognise their complementarity. All related options can help to minimise costs for customers and the grid, and a suite of mechanisms will be needed.

Customers now have the opportunity to optimise their energy use through:

1. Generating their own electricity using consumer energy resources
2. Reducing the need for electricity through energy efficiency
3. Shifting the timing of consumption

Energy efficiency and demand flexibility are related but distinct concepts – they are both important for optimising energy use but involve different approaches and technologies. Energy efficiency refers to the use of less energy to perform the same tasks, whereas demand flexibility refers to the ability to adjust energy consumption in response to changes in the availability of energy or its price.

Energy efficiency can be achieved through a variety of measures such as improving the insulation of a building, upgrading to energy-efficient appliances, or installing more efficient lighting systems. Current schemes in the NEM are described on page 28. These measures can help to reduce the amount of energy needed to perform the same tasks. Demand flexibility, on the other hand, may involve using smart technologies and controls to adjust energy consumption in response to changes in the electricity system. This can involve shifting energy-intensive tasks to times when electricity prices are lower.

Both can work together to lower energy costs and enable the transition.

Defining the cost curves for efficiency and flexibility

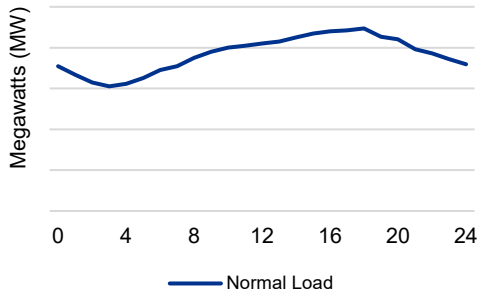
Understanding the marginal cost of providing flexible demand at each point on the cost curve, and how this changes with the load curve at different times of the day, is crucial to effectively value flexibility. Furthermore, determining the level of a target for demand flexibility must recognise the level at which people are most prepared to pay. The NEM is likely to progress further down the cost curve for demand flexibility as technology penetration and solutions becoming more widespread. While arrangements for energy efficiency are more mature and stable given the achievements in this sector, there is still widespread cost savings and environmental benefits available in the sector. Thinking about the complementarity role of both and the synergies between these customer actions will become more important going forward.

Energy efficiency and demand flexibility impact the load curve differently

Figure 3 – Impact on demand curve

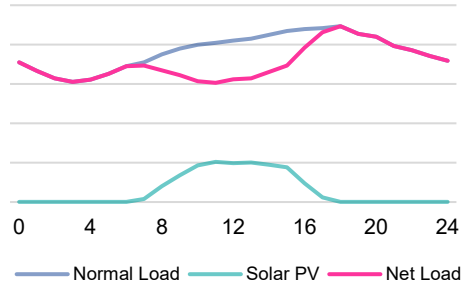
Grid purchases

Buy electricity from the grid as and when needed.



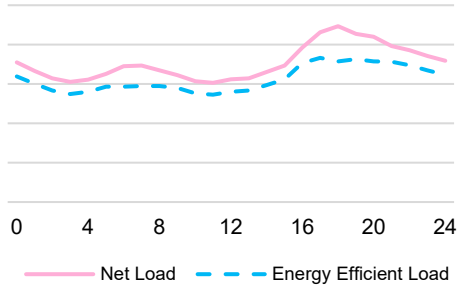
Consumer energy resources

Generate electricity, changing the profile of net system demand while reducing total grid demand.



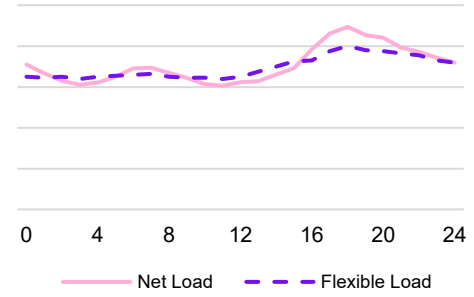
Energy efficiency

Reduce demand whenever a load is operated, thus lowering the daily load curve.



Demand flexibility

Shift eligible loads across the hours of a day to lower-cost times, reshaping the daily load curve.



Demand flexibility and energy efficiency are different

Have a different impact on the normal load curve.

Require different technologies that may vary in their sophistication and integration with the energy market.

Different parties are responsible: to date state governments have been responsible for energy efficiency, and market bodies for demand flexibility.

Can target different participating groups - residential, business, C&I users.

Energy efficiency measures and programs will evolve into more integrated and dynamic systems

There are multiple energy efficiency programs led by state governments that support a permanent reduction in the load curve (see Section 3). While there are still significant benefits to gain through energy efficiency, in the future these programs may want to consider synergies with dynamic load reductions and integration of renewable generation.

This could involve focusing less on individual technologies and appliances and more on holistic analysis at the household and factory level and the customer's role in the wider energy system.

This requires a focus on integrative design - choosing, combining, sequencing, and timing fewer and simpler technologies rather than deploying more and fancier, but disintegrated and randomly timed technologies.

Potential for demand flexibility in the residential consumption profile

The energy consumption of each individual households only represents a small portion of total load, however if opportunities for residential consumers to be flexible are mobilised and aggregated, this can have a material impact on the total demand curve.

It is important that participation does not significantly constrain the consumer's intended use of appliances in completing typical household activities. Smart technologies can support in this way, making it easier for customers that want to offer demand flexibility.

The case for residential energy consumers to be flexible in their demand

- The Australian Energy Market Operator (AEMO) forecasts total annual operational demand in the NEM in 2023 to be equal to 175,718 GWh, of which residential demand represents 40,986 GWh (23%).
- The residential demand curve is becoming more variable throughout the day, with minimum demand levels falling during the daytime due to increasing uptake of rooftop solar PV, and peak demand levels rising in the evenings. Therefore, residential loads are contributing more significantly to peaks and troughs in the overall network load curve.
- Many residential users can be flexible in their consumption, responding on shorter notice periods or almost instantaneously where appliance technology allows for automation.
- Due to shifts in work patterns in recent years which have been expedited by the COVID-19 pandemic, more consumers are working from home more often. These consumers may have a greater opportunity to engage with demand flexibility, as they are home during the day and potentially able to actively engage in demand flexibility during these times.
- As consumers have and continue to invest in CER, it is important that opportunities are available for them to recover the cost of the technology and maximise the benefits it can provide in reducing household energy bills.

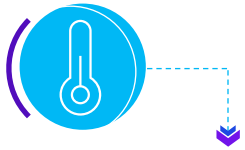
Integration of variable renewable generation

The role of demand flexibility towards helping variable renewable energy integration means that demand flexibility is not solely about reducing peak demand. It is also how to adapt consumption to be better managed and balanced with the output of renewable generation. Doing so will reduce the possibility of generation curtailment therefore improving market efficiency and commercial risks for participants. The coincidence of output from customers' own generation with large-scale VRE means that there is a greater emphasis on the ability of customers to adapt their consumption patterns to achieve this role.

This, therefore, requires thinking not only about the type of customer consumption at peak times but also about the discretionary nature of customers' use of electricity and the ability to shift to different times of the day.

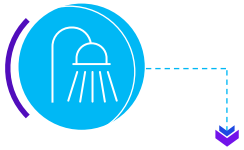
Sources of demand flexibility in the residential consumption profile

Figure 4 – Sources of load and flexibility in the average household consumption profile



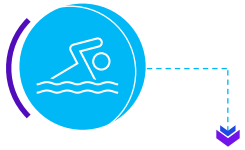
Heating and cooling

In most households, heating and cooling is the most significant source of energy use, accounting for 20 to 50% of energy consumption depending on the climate zone. Air conditioning loads in particular have a strong correlation with peak demand events, which often occur on hot summer days.



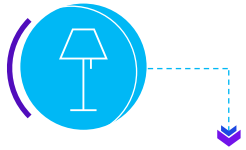
Water heating

Water heating is the second largest source of household energy use, ranging from 15% to 27% of energy consumption.



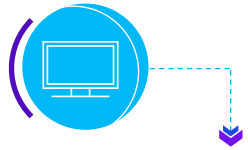
Swimming pool pumps

In households with a swimming pool or spa, the pump is often the largest user of electricity, making up about 18% of the electricity bill.



Lighting

Lighting accounts for 10% of the average household electricity bill.



Appliances

Appliances such as dishwashers, refrigerators, cooking equipment and home entertainment devices can account for 25% of home energy use in total. Although no one appliance is a major source of energy use on its own, in aggregate they are a large part of the household energy consumption profile.

There is potential for load from each of these sources of residential consumption to be flexible and time-shifted. It is important to recognise that the source of load flexibility within these appliances is secondary to their functional purpose to provide a service as an appliance to the consumer, and that consumers may be more willing to be flexible with some appliances than others. Opportunities to be flexible must not materially conflict with the consumers' intended use of the appliance.

However, smart technologies and behind-the-meter storage can play a role in supporting the flexibility of residential appliances without constraining the ordinary course of the consumer's consumption behaviour. Digitalization, automation, the Internet of Things, and other technological advances are creating an increasing number of customers that are capable of responding to real-time price signals. As evidenced in overseas demand flexibility schemes, technology is making it easier for customers that want to offer demand flexibility.

The application for residential water heating and air conditioning

New technologies to facilitate controlled load are increasing in availability and penetration and will likely contribute to an increased role of controlled load in residential demand flexibility in the future.

The potential demand flexibility in residential hot water loads

Water heating is the second largest source of residential energy consumption, behind heating and cooling. Furthermore, hot water service technologies that have the capacity to provide a controllable load are increasing in availability and penetration. This is a key driver of enabling electricity demand from hot water to be flexible and shifted to provide a controlled load at times of low demand.

The concept of the controlled load has been around for some time, and uptake is particularly well-progressed in Queensland. New technologies to facilitate controlled load are increasing in availability and penetration and will likely contribute to an increased role of controlled load in residential demand flexibility in the future.

The potential demand flexibility in residential air-conditioning loads

For all states except Tasmania, maximum operational demand occurs during summer – household and small business air conditioning loads are a substantial driver of system peak.

Small air conditioning unit loads are highly weather-sensitive and under current usage patterns are often activated in the afternoon when the space is already heated up. Therefore, there may be an application for demand flexibility in the way air conditioners are used, which could have a significant impact on the network load curve.

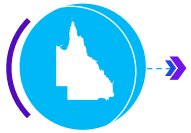
However, it is important to note that there are barriers to engaging demand response from air-conditioning loads. In the context of hot Australian summers and many homes with ineffective insulation, households may be limited in their ability to switch off their air-conditioner and maintain comfortable living spaces. As such, despite representing a large load, air-conditioners may not be the most flexible appliance in practice.

Air conditioning and water heating loads in the NEM

Figure 5 – Maximum air-conditioning load against corresponding rooftop PV generation

Victoria

Peak average hourly air-con consumption: 0.6029 kWh (5pm). Corresponding 5pm average hourly solar generation: 0.577 kWh



Queensland

Peak average hourly air-con consumption: 0.5633 kWh (2pm). Corresponding 2pm average hourly solar generation: 0.932 kWh

South Australia

Peak average hourly air-con consumption: 0.6289 kWh (5pm). Corresponding 5pm average hourly solar generation: 0.51 kWh

Source: CSIRO – Equipment Energy Efficiency (E3) program data dashboards

CSIRO has stated that over 50% of heating and cooling units currently available have the capability to engage demand response.

As the uptake of air-conditioning units with 'smart' or demand flexible capabilities increases, and solar PV penetration increases, the generation from solar PV and demand from air-conditioning may be coordinated to offset each other.

However, the timing of peak solar PV generation and peak demand is not coordinated, and storage will play a role in allowing such capabilities to be effectively harnessed.

Figure 6 – Total and controlled water heating load

	Controlled hot water load		Total hot water service energy demand from all sources per day
	Per day	% of daily demand	
Victoria	1.5 GWh	1%	21.1 GWh
New South Wales	7.4 GWh	4%	20.2 GWh
South Australia	1.3 GWh	5%	5.4 GWh
Queensland	6.0 GWh	5%	11.8 GWh

Source: CutlerMerz – Hot Water Demand Response study prepared for Energy Consumers Australia

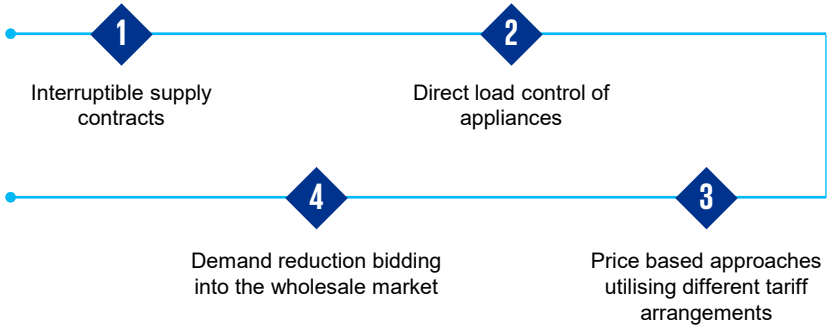
Demand flexibility in the C&I consumption profile

To date, almost all wholesale demand response has been by large, relatively sophisticated consumers who are willing to invest in the supporting capability and systems. While C&I demand flexibility could be easier to unlock, significant potential still sits with residential customers who may be able to respond on shorter notice periods.

AEMO predicts business annual consumption will constitute 60% of the total annual sent-out consumption by 2030 representing a major potential towards enabling greater demand flexibility. For example, recent trials demonstrated that shopping centres, equipped with a battery and solar PV, are able to reduce the load by up to 70% during peak times.

Demand flexibility could be achieved through a number of sources, including control and electrification of commercial and industrial loads such as heat pumps, electric furnaces and thermal storage for cold stores and commercial property.

The forms of demand response currently available to C&I users include:



To date, almost all wholesale demand response has been by large, relatively sophisticated consumers who are willing to invest in the supporting capability and systems. As technology improves and becomes cheaper, more C&I users will be well-placed to provide demand flexibility. Advanced metering, smart communications and energy monitoring can all enable such customers to participate.

Differences between residential and C&I demand flexibility

- C&I users could be considered typically more engaged with their energy usage, relative to other types of consumers. Energy forms a significant portion of costs, so C&I users have a clear incentive to investigate demand flexibility opportunities. However, this must be traded off against the opportunity cost of ramping down production, and any additional costs to re-start/ramp systems back up. Further, C&I customers have bespoke supply arrangements – meaning price signals and incentives, as well as peak and off-peak periods, can be tailored and likely more effective.
- Large C&I loads are predictable. This is because they operate large processes, often on fixed timetables and fixed hours. Given this, C&I users may be more suited to scheduled engagement with flexibility/demand response – whereas residential users may be able to respond on shorter notice periods.
- Technology cost and adapting systems can be a barrier in C&I contexts – given the specialisation of C&I operations, adapting a platform/solution that is fit-for-purpose can be more challenging relative to largely homogenous residential contexts.
- The demand flexibility reforms to date have been focused on C&I users as these are the biggest loads, potentially with the most potential to be time-shifted. While recognising and realising flexibility in residential load profile is more complex, it has significant potential for example via hot water, EVs and air conditioning which may be relatively more untapped to date. Based on Energy Synapse's analysis of the AEMO demand side participation information portal, the residential sector appears to have significantly more potential flexibility than the commercial and industrial sectors.

Smart Energy Hubs Deployment Project

Shell Energy has been developing its commercial and industrial load flex product (LoadFlex) capability since 2019, culminating in the launch of a Smart Energy Hub pilot project at Chirnside Parking Shopping Centre. This project optimises the centre's energy system and uses predictive technology to achieve electricity demand reductions of up to 70% of peak demand loads. Given its success, Shell Energy will aim to implement Smart Energy Hubs throughout Queensland, New South Wales and Victoria across 40 commercial and industrial customer sites to demonstrate new flexible demand capacity of 21.5 MW.

This project is co-funded by the Australian Renewable Energy Agency (ARENA), which announced $9.1 million in funding to Shell Energy. The total cost of the project amounts to $31.6 million.

02

Potential for demand flexibility

Planning for demand flexibility as a resource

Recognition of demand flexibility in planning

AEMO informs the planning and procurement of future energy assets through the development of the Integrated System Plan (ISP) and Electricity Statement of Opportunities (ESOO).

In developing the ISP, AEMO applies assumptions with respect to the proportion of peak demand to be addressed via demand-side participation. The assumption varies across different regions of the National Electricity Market, and for each ISP scenario modelled. In AEMO's latest 2023 Draft Inputs and Assumptions – 8.5% of operational maximum demand is assumed to be met by demand-side participation by 2053 – representing the upper bound of AEMO's forecasting.

The targeted level of demand-side participation is a forecasting assumption only – there is no obligation nor assessment of current capability to deliver the target over the forecast horizon.

In developing reliability forecasts in the ESOO, AEMO only includes existing or committed sources of demand-side participation. Over the 10-year horizon of the ESOO, demand-side participation levels are expected to remain relatively low consistent with current levels.

The exception to this is in NSW where the forecast impact of the new target under their Peak Demand Reduction Scheme is captured – implying that if all states were to introduce a similar target, there would be material changes to reliability assessments and investment forecasts.

The assumed profile for flexibility appears conservative against international counterparts – both in the level of the target and the pace at which it will be realised. Furthermore, only recognising committed demand response in reliability planning may underestimate the demand response capacity likely to arise in the market over the next 10 years – considering improvements in the cost and availability of technology, and continuing price pressures.

Flexibility being a reliable and established resource that is recognised in the planning process will deliver substantial benefits in capacity cost savings and support an efficient transition pathway, mitigating the risk of over-investment, and best capturing value in the role of the consumer. However, Australia has a way to go before demand flexibility is seen as a reliable and credible resource.

Potential demand flexibility capacity in the NEM

Top-down estimates – reduction in peak demand

Figure 7 – Estimated peak demand reduction

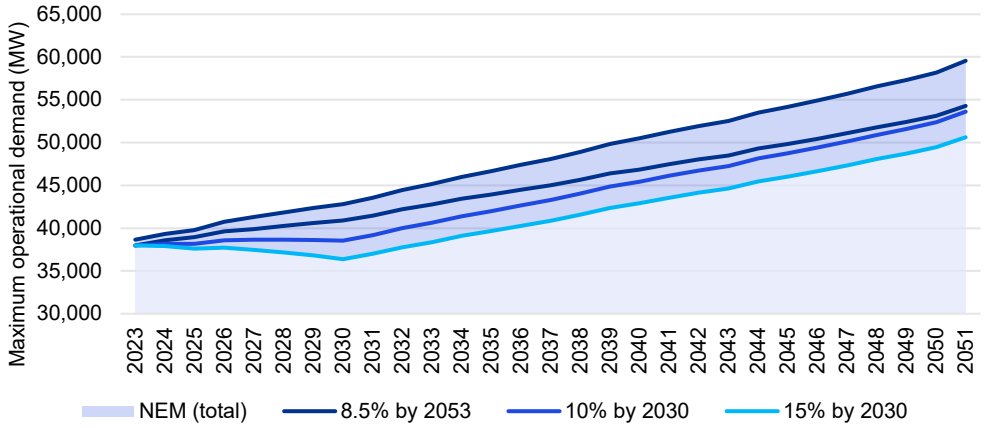


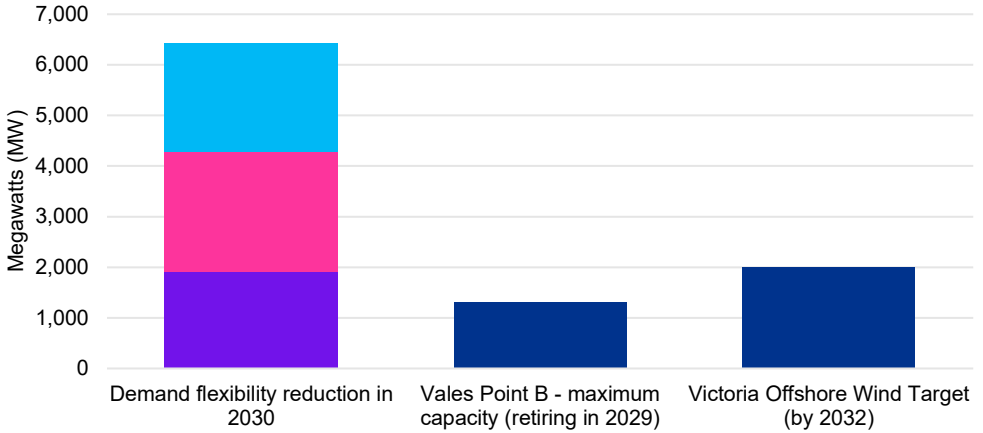
Figure 7 above displays high-level top-down estimates of the potential peak demand reduction that could be contributed by demand flexibility, applying the following assumptions for the % of peak demand met by demand flexibility:

- 8.5% by 2053 – consistent with the upper bound of AEMO's ISP forecasting.
- 10% by 2030 – consistent with the target under the NSW Peak Demand Reduction Scheme, applying this figure across all regions of the NEM.
- 15% by 2030 – informed by international benchmark estimates applied by the International Energy Agency. Furthermore, New Zealand began using demand response in 2007, and now meets over 16% of peak demand through demand response programs. We note for the USA, it has been forecasted that demand flexibility could equal up to 20% by 2030.

Source: AEMO, Draft 2023 Inputs and Assumptions Workbook, Electricity Statement of Opportunities 2022

Comparing demand flexibility with supply-side capacity

Figure 8 – Demand-side vs. Supply-side capacity



Estimated demand-side reduction in 2030

The top-down estimates shown in Figure 7 to the left indicate that, in 2030, demand flexibility could provide a reduction of:

- 1,919 MW under the **8.5% by 2053** scenario;
- 4,282 MW under the **10% by 2030** scenario;
- 6,423 MW under the **15% by 2030** scenario.

For comparison purposes – Figure 8 above shows how the contribution of demand flexibility compares (in MW terms) against supply-side capacity at a similar point in the transition:

- maximum operational capacity of the coal-fired Vales Point B, scheduled to be retired in 2029; and
- offshore wind generation capacity targeted by the Victorian Government for 2032.

Batteries will enable greater demand flexibility

Batteries represent key 'enabling technologies' to facilitate and maximise opportunities for consumers to engage in demand flexibility at scale.

Battery storage is a 'game-changer' for demand flexibility. Batteries enable energy to be stored and consumed at a later point in time, such that the load profile can be better matched to the generation profile.

An increased number of batteries across the grid, including large-scale, neighbourhood and small-scale behind-the-meter batteries, have the potential to contribute towards balancing consumption resolving both minimum demand and peak demand challenges. As the financial barriers to battery uptake fall, the benefits of consumers having access to energy storage must be recognised and maximised.

Medium-sized community batteries may be a key component in unlocking residential consumers' flexibility and support the benefits of flexibility being shared among consumers – including those who may face barriers to installing rooftop solar and/or batteries in their household.

Further work is needed to progress the framework for community batteries integration into energy markets and benefit sharing among all consumers. Importantly, State and Commonwealth Governments are driving the deployment of community batteries through various programs. In December 2022, the Commonwealth Government announced the $200 million Community Batteries for Household Solar program which will deliver 400 community batteries.

Virtual Power Plants (VPP) will maximise the value of batteries and EVs

VPPs will play a key role in aggregating and integrating the resources that support multiple customers' demand flexibility. This enables the value that each customer holds to be packaged as a service, the value of which is shared among the participating customers. The table below demonstrates that VPPs are forecast to reduce maximum demand between 6% and 16% in 2031-32.

Table 1 – Impact of VPPs on peak demand reduction

	NSW	QLD	SA	TAS	VIC
VPP for batteries (MW)	1,818	1,609	565	125	1,402
% impact on reducing maximum demand	13%	14%	16%	6%	13%
Approximate number of residential batteries in VPPs	379,000	335,000	118,000	26,000	292,000

Source: Australian Energy Market Operator, 2022 Electricity Statement of Opportunities (Central scenario), p.69

The challenge and opportunity EVs present

The value of flexibility in electric vehicle charging

EVs represent a valuable consumer-owned demand flexible resource. EV charging represents a significant source of load - consumers may adopt smart charging behaviour to support the network, by charging and discharging energy from their EV batteries at different times.

The annual charging load of EVs is expected to increase significantly from 160 GWh in 2022-23 to 12,607 GWh by 2032-33. The level and impact of EV demand will be informed by the timing of charging loads – greater charging during daytime hours when solar generation is present will reduce demand at the evening peak and potentially support the security of the grid against minimum demand challenges, alternatively charging loads in the evening will contribute to greater peak demand.

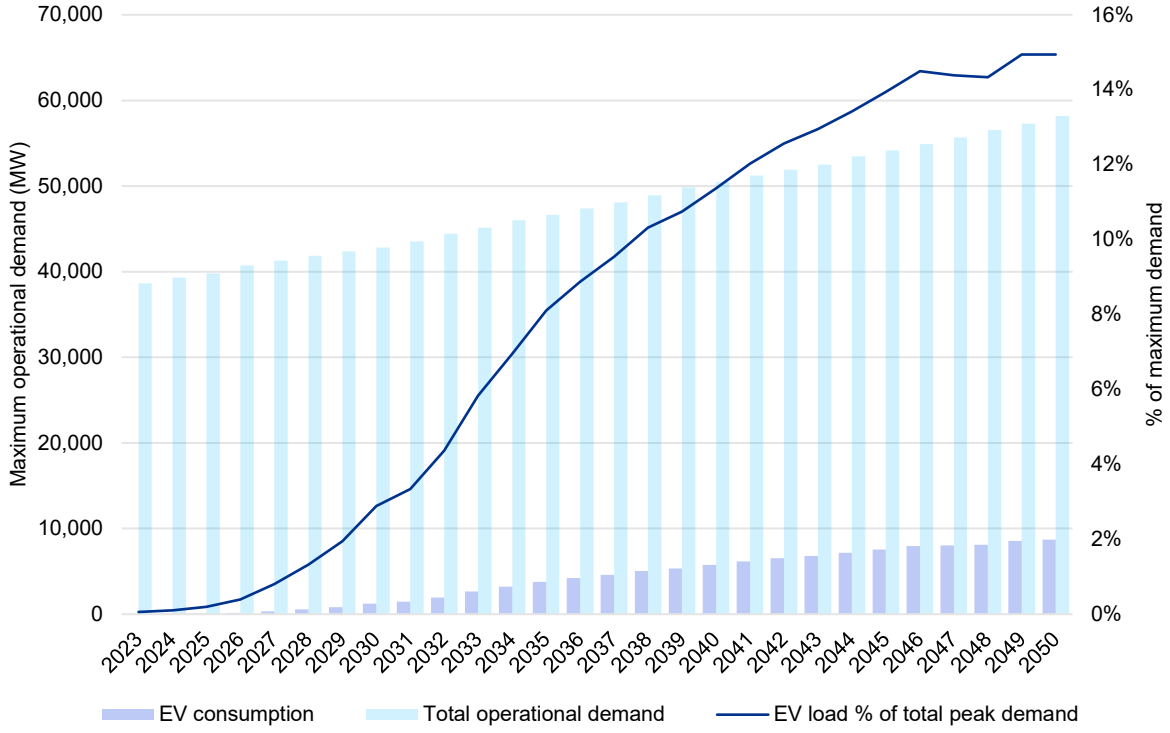
In planning for the demand impact of EVs, consideration needs to be given to consumers' needs and habits in commuting. It should not be taken as given that consumers will charge their EVs according to the needs of the grid. First and foremost, the EV is a resource to support a consumer's mobility in their day-to-day activities and charging behaviour will be informed by what is convenient to the consumer.

The emergence of EVs represents both an opportunity and a challenge for the energy sector. Maximising the benefit, and mitigating costs and risks are dependent on providing appropriate incentives for flexibility in charging, charging infrastructure in the right locations available at the right times, platforms to support consumers in providing flexible charging demand, and integrating vehicle-to-grid technologies into the network.

Figure 9 sets out AEMO's forecasting of the proportion of peak load contributed by EV charging. As EV loads represent an increasing share of peak demand, the value of flexibility in charging increases, highlighting the increasing need to consider opportunities for flexibility in charging.

Appendix B provides an overview of the policies currently in place in Australia to facilitate the uptake of EVs.

Figure 9 – EV charging load % of peak demand



Source: Australian Energy Market Operator, 2022 Electricity Statement of Opportunities (Central scenario)

International jurisdictions are capturing more demand flexibility

Overseas jurisdictions are adopting unique and innovative solutions to meet the current energy crisis, demonstrating that technology can enable greater utilisation of demand flexibility and that customers are receptive to participating in such projects. Australia can learn from the design of these initiatives to drive action and address affordability challenges.

International developments

In jurisdictions outside of Australia, governments have begun to realise the effectiveness of demand flexibility in combating rising electricity prices, reducing emissions and increasing the uptake of renewable energy. This has led to the development of innovative technologies and approaches to changing electricity consumption habits.

Certain countries have focused on adopting technology to enhance the effectiveness of demand flexibility. For example, in the United Kingdom, Ofgem recently explored the viability of flexibility platforms in electricity markets, where a market would be created to allow contracted flexibility services to be traded as products, generating a monetary value for flexibility products. On the other hand, states like Vermont in the US have adopted unique pro-social incentives, where individuals' efforts benefit a charitable organisation, to manage consumption.

Overall, consumers have been receptive to these new ways of utilising CER. These innovations challenge the common perceptions that CER is too difficult to implement or that it negatively impacts on customers' lifestyles. Importantly, most customers are drawn to the idea of taking control of their own energy resources and having a positive contribution.

1 Demand Flexibility Service (DFS) – United Kingdom

The DFS is a service developed to allow the Electricity System Operator to access additional flexibility by having electricity providers contact consumers when the national demand is at its highest. The first five trial DFS tests over November and December 2022 have seen over 780 MWh of real and projected demand reduction, with customers overdelivering by at least 35%.

2 Piclo Flex – United Kingdom

Piclo Flex is an independent marketplace for energy flexibility services that enables distribution operators such as UK Power Networks to source energy flexibility from flexible service providers when there is high demand or low supply of energy. Flexibility providers awarded contracts through the Piclo Flex marketplace include demand-side response, electric vehicles, storage facilities and generators. As of 2021, Piclo Flex's awarded flexibility contracts have totalled £55 million ($95m AUD) with 16 GW of flex capacity registered, and 739 GW of flexible capacity procured.

3 Vehicle-to-grid (V2G) Charging – France, Italy, and the US

There is increasing experimentation around utilising electric vehicles as a way of providing grid stability. For example, in California, Nuvve Holding Corp's V2G technology helped buses in the Cajon Valley Union School District to generate power for 277 homes during nine Flex Alerts (periods with high electricity prices due to extreme weather). In Massachusetts, Highland Electric Fleets utilized V2G technology of their two buses to supply over 7 MWh of energy back to the grid during spikes of energy use, enough to power about 600 homes.

4 Virtual Power Plant – Korea

VPPs, which digitally link and control CER, are also being used to effectively manage grid stability. In Korea, the Korea Power Exchange notifies aggregators (such as Enel X) to offer its portfolio's capacity during times where power is required. Through Enel X's model, the customers receive regular payments for both their availability to provide the service, and for when power is used to support the grid.

5 Defeat the Peak – Vermont

'Defeat the Peak' involved a unique approach to reshaping demand. Burlington Electric, a Vermont utility, launched a program where customers efforts to meet consumption goals would result in donations to non-profits. The program is estimated to have achieved a 13.5% decrease in peak energy use in August 2018 for 16,000 households.

The untapped potential of demand flexibility

Recognising the significant and currently untapped potential of demand flexibility in Australia's energy system – the focus now needs to shift to the way forward.

Sections 3 and 4 of this report discuss the key enablers to unlocking the role of demand flexibility, and provide a high-level blueprint for the pathway to drive action and scale.

The supply side of the energy sector is undergoing significant and fast-moving change with high levels of investment in new renewable generation and transmission capacity.

- AEMO estimates more than $12 billion of investment in new transmission lines is needed to ensure electricity security during the next decade. However, it is widely recognised that challenges such as supply chain, labour force shortages, and cost increases plus achieving community support could delay the delivery of planned large-scale investments.
- Changes of this magnitude come at a significant cost, which is recovered from customers through increased network charges on bills. Investments to support demand flexibility can also have a significant impact in supporting the transition, potentially at a relatively lower cost.
- Unlocking demand flexibility potential could help to relieve some of these pressures on the supply side investment.

International jurisdictions are progressing through the same transition challenges as Australia, and are implementing a greater role for demand flexibility as a solution to meet these challenges.

- Relative to the upper bound of AEMO's forecast (8.5% by 2053), international jurisdictions point towards demand flexibility addressing a higher proportion of peak demand, and sooner.
- Technology and digitalisation is helping customers' ease and willingness to adapt their consumption patterns.
- International estimates suggest that with the right arrangements in place, the targeted level of demand flexibility in the NEM could be closer to 15-20%.

To achieve the transition in the most efficient manner, demand flexibility should play a key role in enabling reliable and affordable outcomes for customers. It must be reflected in how investment is planned, and actively recognised as a resource of equal value to supply-side assets.

- Demand flexibility, if incentivised and coordinated, can meaningfully support an efficient transition.
- In planning for the transition, consideration should be given to balancing cost and risk across both demand and supply side resources.
- Customers have resources and opportunities to contribute to this transition and improve energy outcomes for themselves – however, the right incentives, capabilities and frameworks are not currently in place to empower these positive impacts.
- This could impact customers' sense of involvement and awareness in the energy transition and their willingness to participate which is not only driven by financial considerations but also social and environmental aspects.

Enabling technologies such as batteries (including aggregation in VPPs) and EVs is a key component of driving scale of demand flexibility.

- The volume of batteries and EVs in the system is increasing, driven by improvements in accessibility and affordability for the technology.
- The increased load associated with EVs, higher volume of storage capacity in batteries distributed across the NEM, and aggregation of resources in VPPs underpin the emerging role of demand flexibility.
- As total consumption in the NEM increases, the importance of shifting this load to alleviate pressure on the grid in peak times is magnified. Batteries play a key role in enabling energy to be stored and used at different times throughout the day.
- Effective integration of small-scale batteries and EVs can only happen if there are sufficiently robust arrangements for demand flexibility.

03

Current situation

System enablers to unlock demand flexibility

To fully unlock demand flexibility could be difficult in practice and depends on retail innovation and the key enablers outlined below. As demonstrated, many projects and reforms are happening to utilise the benefits of demand flexibility. However, as outlined on pages 29 and 30, some challenges remain. Importantly, the design of the system always needs to have the role of the consumer front of mind – reforms and changes should be cognisant of making it easier for the consumer to participate.

For demand flexibility to be seen as equal to the supply side, the credibility of demand response and scale are important. The framework for demand flexibility needs to provide confidence for commercial investment in the enabling infrastructure and business models needed to facilitate demand flexibility. Further, the reforms underway need to consider addressing the remaining regulatory challenges, such as achieving co-optimisation across multiple users, settlement of demand flexibility in the market, liabilities frameworks and roles and responsibilities.

Integration into planning

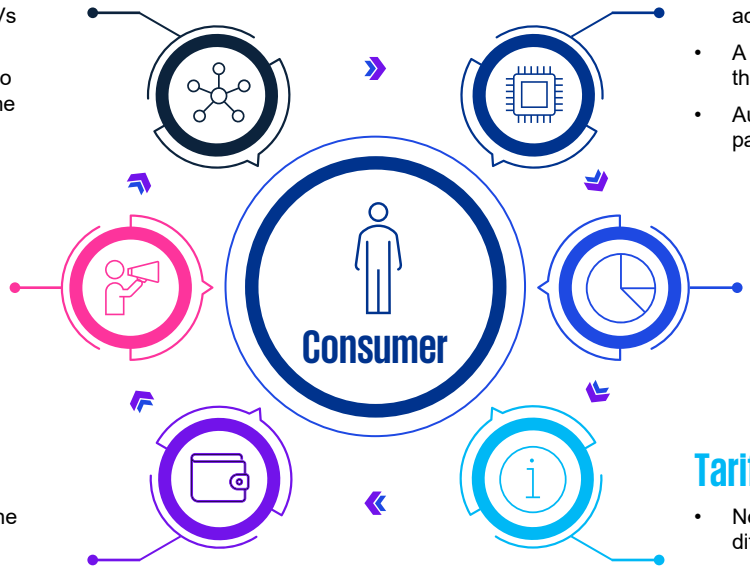
- ESB EV Smart Charging Policy aims to establish foundations and incentives to support the effective integration of smart charging for EVs into the NEM.
- AEMO consultation on inputs, assumptions and scenarios proposed to be used in its 2023-24 forecasting and planning activities, including the 2024 ISP.

Clarity on responsibilities

- AER Review of consumer protections for future energy services assesses whether the current energy consumer protection framework remains fit for purpose.
- ESB Customer Insights Collaboration aims to understand how customers might want to engage with different service providers or products.

Adequate compensation

- ARENA's Distributed Energy Integration Program aims to maximise the value of CER for energy users.
- Project EDGE aims to demonstrate an off-market, proof-of-concept CER marketplace.
- Ausgrid demand response air conditioning program and community batteries trials.



Technology capability

- AEMC Review of the regulatory framework for metering services aims to accelerate the deployment of smart meters.
- A rule change progressed by the AEMC considers unlocking CER benefits through flexible trading.
- Ausgrid's Project Edith aims to demonstrate how technology can participate in the market while staying within network limits.

Information flows

- ESB Data Strategy aims to manage changing data needs in the energy transition.
- Development of scheduled-lite mechanism by AEMO aims to promote opt-in visibility and dispatchability.
- Interoperability standards progressed by ESB aim to enable customers to easily access different products and services.

Tariff signals

- Network tariff reform progressed by networks through trials and tests of different tariff structures.
- AER work on the introduction of flexible export limits and static zero export limits.

Supporting energy efficiency

The Federal Government is considering the introduction of an energy efficiency target. This initiative is welcomed by the industry and will consolidate jurisdictional efforts in this space.

Recognising the potential of energy efficiency, the International Energy Agency (IEA) considers efficiency 'the first fuel' representing more than 40% of the emissions abatement needed by 2040.

Currently, jurisdictions are leading the introduction of energy efficiency programs. Only QLD and the NT do not have energy efficiency schemes in place.

In its 2022-23 budget, the Federal Government committed to providing $62.6m over 3 years to support SMEs to fund energy-efficient equipment upgrades.

In addition, through the National Energy Performance Strategy, the Federal Government is considering the introduction of an energy efficiency target, noting that many of Australia's top trading partners have ambitious targets. This includes the EU 42% energy efficiency target.

This initiative will likely be supported by the industry as it will consolidate jurisdictional efforts. However, the implementation of an energy efficiency target is insufficient as greater benefits of dynamic demand flexibility are still to be unlocked. In this context, the National Energy Performance Strategy provides a vehicle to push the agenda forward and to shift the focus to dynamic demand flexibility.

State	Overview of the scheme	Reported savings
Energy efficiency jurisdictional programs - obligations on retailers		
VIC	**Victorian Energy Upgrades (VEU)** Provides participants with access to discounted energy-efficient products and services. Accredited providers generate Victorian Energy Efficiency Certificates, which can be sold to energy retailers; retailers have a legal obligation to surrender a certain number of certificates each year. Targets set under the program aim to reduce Victoria's energy demand by seven per cent by 2025.	• **Energy emissions savings**: 70m tonne abatement of greenhouse gases since 2009. • **Energy bill savings**: Participating households are expected to save, on average, $136 per year. The average participating business can save $2,940 per year.
NSW	**Energy Savings Scheme (ESS)** The ESS provides financial incentives for organisations to invest in energy-saving projects, by installing, improving or replacing energy savings equipment. Accredited providers create energy savings certificates, which are purchased and surrendered by retailers to meet legislated energy savings targets. The ESS contributed an estimated peak demand reduction of 450 MW at the point of consumption in 2018.	• **Energy emissions savings**: 12.8 Mt of CO_2 emissions avoided under the scheme between 2009 and 2018. • **Energy consumption savings**: Reduction in electricity consumption of approximately 2,100 GWh per year between 2014 and 2018. • **Energy bill savings**: Estimated $1.5b between 2014 and 2018.
SA	**Retailer Energy Productivity Scheme (REPS)** The REPS sets energy productivity targets to be met by retailers. To achieve their obliged targets, retailers offer incentives to households and businesses to deliver energy efficiency activities. The REPS commenced in January 2021, replacing the existing Retailer Energy Efficiency Scheme (REES), which ran from 2009 to 2020. From January 2021, the expanded REPS provides incentives for participation in demand response programs and shifts to time-of-use tariffs.	• **Energy consumption savings**: 2.4m GJ of deemed energy savings were delivered in 2021. • **Energy bill savings**: REES deliver $1b in energy bill savings to households and businesses over the life of energy efficiency activities implemented between 2015 and 2020.
ACT	**Energy Efficiency Improvement Scheme (EEIS)** The scheme requires electricity retailers to deliver energy savings activities to households and businesses, or make a financial contribution to support ACT Government energy efficiency programs. As part of the scheme extension from 2021 to 2030, demand response capability was included in the minimum product requirements for eligible heating and cooling technologies.	• **Energy emissions savings**: Delivered lifetime emission reductions of 390kt CO2e from 2013 to 2017. • **Energy consumption savings**: Has been delivering an increasing trend in energy savings from 0.4% of total ACT stationary energy use in 2013, to nearly 2.9% in 2017. • **Energy bill savings**: Between 2013 and 2017, the total lifetime energy bill savings to EEIS participants were $240m.

Other jurisdictional energy efficiency initiatives include:
1. **ACT Minimum efficiency standards for new homes**: ACT recently implemented minimum energy efficiency standards for ceiling insulation for rental properties.
2. **TAS Energy Saver loan Scheme**: Provides interest-free loans between $500-$10,000 over 3 years to eligible applicants to invest in certain energy-efficient products.
3. **WA Household Energy Efficiency Scheme**: Four-year, $13m program aims to reduce energy costs for households experiencing hardship by providing individuals with tools and knowledge to improve energy efficiency.

Demand flexibility initiatives in progress

Demand flexibility, if incentivised and coordinated, can meaningfully support an efficient transition.

Recently, key reforms were progressed to unlock demand flexibility, including the NSW Peak Demand Reduction Scheme, Wholesale Demand Response (WDR) Mechanism and ESB CER Implementation Plan. However, barriers and challenges remain. Regulatory gaps should be addressed to fully unlock demand flexibility.

Customers have resources, access to technology and opportunities to contribute to the energy transition and improve energy outcomes for themselves – however, the right incentives and frameworks are needed to empower these positive impacts.

Key demand flexibility initiatives:

While considerable work is underway to unlock demand flexibility, more focus is required to realise its full potential

NSW Peak Demand Reduction Scheme (PDRS)

The Scheme was established in September 2021 to reduce peak demand by incentivising households and businesses to reduce energy consumption during peak demands. This is being achieved through a certificate scheme that began in November 2022. The Scheme sets a savings target for retailers and large energy users equivalent to their share of electricity sales each year. Participants create or buy certificates for eligible activities.

Wholesale Demand Response (WDR) Mechanism

The WDR mechanism commenced in the NEM on 24 October 2021. It allows demand-side participation in the wholesale electricity market. Demand Response Service Providers aggregate the demand response capability of large loads for dispatch through the NEM's bidding and scheduling processes. The DRSP receive payment for the dispatched response, measured in megawatt hours against a baseline estimate, at the electricity spot price.

ESB Horizon One CER Implementation Plan

The ESB post-2025 review proposed several reforms seeking to achieve better integration of CER. This included:

- Dynamic Operating Envelopes to dynamically vary network limits.
- Reforms to improve interoperability of the equipment that individuals install.
- Review of consumer protections for future energy services.
- Review of current metering arrangements.

Challenges in progressing demand flexibility

Identified regulatory challenges to unlock the full potential of demand flexibility:

Achieving co-optimisation across multiple users

The value of demand flexibility is maximised when it is able to be co-optimised across multiple value streams. VPP trials are a tangible example of such an application. The level of sophistication of platforms markets established will have implications for how demand flexibility value is maximised. Hence, how the concurrent operation of competitive platforms and commercial transactions allow co-optimisation may become more important in the longer term. The challenge is establishing the right environment to enable co-ordinated and sufficient investment in the enabling IT systems.

Settlement of demand flexibility in the market

A question raised by demand flexibility is the extent that local settlement of transactions outside the wholesale markets is required. For example, under a community battery scheme there could be multiple power flows to and from the customer premises and the battery, and the market only settles the net flows to and from the battery. Alternative peer-to-peer transactions may not need to be settled in the market. Hence, clarification on what exactly needs to be visible to market participants and system operators plus in what timeframes will become important in the future.

Liabilities

How the risks of participating and dispatching demand flexibility are managed should not create an unreasonable barrier to participation. There are international examples that share availability and diversity risks rather than placing these on participating residential customers. Third parties can also use monitors and affordable technology at the household level to determine the availability of discretionary household appliances (e.g., hot water systems) for dispatch in aggregated market services.

Roles and responsibilities

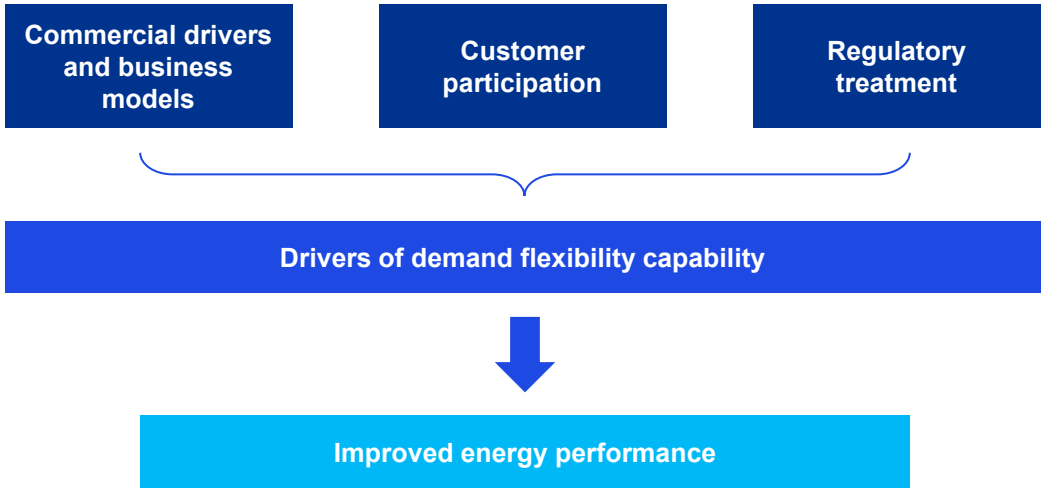
The clarification of responsibilities is especially needed in the context of models that are already underway such as community batteries, VPPs and distribution system operator (DSO) platforms. Striking the right balance between competition and providing certainty for business investment is extremely difficult. However, currently the policy thinking is not transparent nor defined.

04

Way forward

What is the way forward – how to drive scale in the right timeframes

There is a degree of action underway in Australia and things are moving in the right direction. Existing and emerging programs and policies are constructive, and consumers are becoming more engaged and aware of their energy consumption and how they may participate. Technology advances and increase uptake in electric vehicles will enable greater potential in demand flexibility capability across the NEM. However, the current level of activities and development alone are unlikely to be sufficient to achieve scale and fully incorporate flexibility as a reliable and credible resource into planning and operational decisions.



Setting clear targets for demand flexibility procurement will accelerate change and address the identified challenges

Targets will accelerate the establishment of frameworks for demand flexibility and can act to align the 3 key drivers of demand flexibility capability. It can encourage investment in supporting infrastructure and technologies due to increased certainty of treatment and returns. A target will facilitate an important and credible revenue stream helping to alleviate the transactional, financing and informational barriers facing providers of demand flexibility. In turn, it can provide a platform for engagement and awareness with customers, fostering greater participation.

Targets can help clarify roles and responsibilities by providing a clear and specific goal for policymakers and businesses to work towards. By defining a specific target, policymakers can communicate their expectations and intentions to those who are responsible for implementing the policy, making it easier for them to understand their role and what is expected of them. Policy targets can also help to identify which parties are responsible for achieving the target.

In addition, targets will be a basis for flexibility to be appropriately reflected in the planning and procurement process. Instead of having assumptions on demand-side participation based on desktop research and estimations, targets will provide a more accurate and reliable basis for forecasts. This is because there will be a clear pathway to achieving the required level of demand flexibility and parties responsible.

Defining targets helps to set expectations and provide a focal point to guide action and participation.

In addition to efficiency targets, governments can consider setting demand flexibility targets to establish a clear and ambitious goal for the use of demand flexibility as a means of optimising energy use and reducing greenhouse gas emissions. The benefits of integrating CER are significant, with potential savings estimated to be up to $6.3 billion over 20 years, which are intended to flow through to consumers through lower system costs and lower electricity prices. By setting targets, governments can provide a roadmap for the adoption and deployment of demand flexibility measures and create incentives for businesses and organisations to adopt these measures. In addition to setting demand flexibility targets, governments can also play a number of other roles in supporting the adoption of demand flexibility measures. These can include clarifying responsibilities, promoting co-ordination in decision making and providing targeted support where appropriate.

Enabling demand flexibility through a target based scheme

The energy system is evolving with a growing need for integration of renewables, utilisation of CER and increased pressures on network capacity availability. These challenges over the coming years amplify the need for innovative solutions as we transition to a low carbon energy system. As a result, the introduction of targets for demand flexibility is increasingly being seen as the key to solving these challenges and achieving a balanced, affordable and efficient energy transition.

It is now the right time to consider the implementation of a target in Australia, building on the introduction of the NSW peak demand reduction scheme.

Targets

Targets have been implemented in several jurisdictions in Australia and elsewhere around the world, requiring energy businesses to achieve an annual target of energy savings.

In most cases, these programs have used tradeable certificates ('white certificate' schemes) where liable parties must purchase certificates from businesses that create the action that generates the saving and then surrender these to meet their targets. This could be on either retailers, networks or integrated utilities.

While these existing measures have been effective at achieving annual reductions in energy consumption, recent initiatives have focused on creating further obligations and incentives to reduce peak demand (see Appendix A). In Europe, the EU has recently introduced a mandatory 5% reduction target on electricity consumption in peak hours to help relieve their current energy crisis.

These new schemes aim to reward activities which not only permanently reduce the peak demand, but also provide temporary peak demand response and peak demand shifting. The level of the target tends to be informed by economic analysis of the expected benefits and can increase over time as capability improves and scale in provision is achieved.

There are other considerations in designing a target scheme, including defining the peak period, eligibility, exemptions and verification plus the setting of any penalty price/safeguard arrangement.

The case for targets in Australia

Greater demand flexibility will address the following trends:

- Intermittency in generation which contributes to increased need for system balancing.
- Electrification placing pressure on network capacity.
- Need for network investment for resiliency and to accommodate CER.

Adapting demand across periods helps to manage stress on the system, and thereby improve reliability and lessen the need for investment. A target scheme can act as an immediate and powerful catalyst to better capture these benefits of demand flexibility. While the current reforms (discussed on page 30), will help encourage and better value flexibility, they do not address some of the fundamental market failures, such as enabling the full market value of flexibility provided to be compensated.

A target will facilitate an important and credible revenue stream, helping to alleviate the transactional, financing and informational barriers facing providers of demand flexibility. It would encourage participants to look below typical and standard demand-side management programs enabling greater innovation, labour skills and investment in supporting infrastructure to enable long term demand flexibility capability.

A fit for purpose target scheme, appropriately designed will promote the active participation of consumers and communities in providing flexibility and help accelerate and optimise the energy transition for all consumers.

Potential design

Any scheme must be administratively simple, quick to implement and deliver effective outcomes for customers. Ideally it should be market-based and open to all customers, not just large industrial customers. It should complement existing state energy savings schemes and encourage contribution from flexibility service providers and manufacturers of CER.

Extending the NSW scheme to apply nationally is one option. As shown by the NSW model, a peak demand target scheme can be designed to complement existing energy efficiency measures.

Another approach could be to place an obligation on network businesses to procure a defined percentage of peak demand reduction. This would help establish a market for such capability plus progress development of rules on service activation, verification, and remuneration of participants.

The development of a demand flexibility target can also help facilitate the objectives being considered through a capacity mechanism. This would help to achieve alignment in incentives and signals across the system and treat supply and demand side resources fairly.

Appendix A

Targets and Examples of Schemes

Demand flexibility target scheme examples

The table below provides an overview of specific targets that have been implemented by Governments, as well as examples of programs to meet demand flexibility targets.

Location	Project	Overview
		Demand flexibility targets that are being implemented, or already being utilised, in overseas jurisdictions
European Union	**September 2022 Proposal**	EU27 Energy Ministers agreed in September 2022 on a proposal for a Council Regulation to address high energy prices. This proposal stands out for its inclusion of a mandatory 5% reduction target of electricity consumption in peak hours. Member States are responsible for identifying peak hours corresponding to 10% of the overall hours of the period between 1 December 2022 and 31 March 2023. The demand reduction target will apply to the identified peak hours. Member States are free to choose the appropriate measures to reduce consumption.
Colorado	**Electric Demand-side Management Program**	To promote demand-side management programs for electricity, the public utilities commission was authorised in 2007 to establish electricity goals for electric utilities to achieve by 2018, including a demonstrated reduction of peak demand by at least 5% of the retail peak demand level in 2006. In 2017, a bill extended these programs till 2028.
United Kingdom	**Autumn 2022 Statement**	The UK announced a new target to reduce energy consumption from buildings and industry by 15% by 2030. The statement also made clear that a further £6bn ($10.3bn AUD) would be spent from 2025-2028 on energy efficiency, on top of the £6.6bn ($11.4bn AUD) already being provided until 2025. The new £1bn ($1.7bn AUD) ECO+ scheme will provide homes across the country with new home insulation – providing a saving of £310 ($540 AUD) per year for consumers. New campaigns are also being organised to give the public advice on how they can save on their energy bills without having to sacrifice comfort.
		Demand flexibility schemes that are being implemented to achieve targets in overseas jurisdictions
Ireland	**Beat the Peak – 2022**	"Beat the Peak" led by the ESB Networks (the Irish distribution system operator). It is limited to exploit flexibility of larger commercial consumers from 250kVA through aggregators. These initiatives aim at filling the gap in generation during peak hours of winter 2022/23, as well as for winter seasons until 2025.
Illinois	**Defeat the Peak – 2018**	In Illinois, there has been significant success in engaging customers through a peak time savings programme which also set out to move demand outside of peak hours. The programme supported over 300,000 families in reducing their peak usage with an average reduction of 6% - 9% and modest personal financial incentives (average saving of $15 per family).
Maryland	**EmPOWER Program**	Since 2008, Maryland has set energy efficiency goals through the EmPOWER Program, which states that utilities must achieve annual incremental cost-effective energy savings of 2% of retail electric sales through 2023, and a target of 15% reduction in per capita peak demand from 2007 levels by 2015. Residential account holders with installed smart meters are automatically enrolled in the program, and are notified by phone, email, or text before an Energy Savings Day. Customers who reduce their usage from 1:00 PM to 7:00 PM the following day receive a $1.25/kWh bill credit.

Energy Efficiency Resource Standards in the USA

The table below provides an overview of different energy efficiency resource standards that have been implemented across the United States. The following information has been extrapolated from the American Council for an Energy-Efficient Economy (ACEEE).

State	Average incremental electric savings per year	Description
Arkansas	1.2% (net)	Incremental savings targets began at 1.25% of sales in 2011, ramping up to 2.5% in 2016–20 for cumulative annual electricity savings of 22% of retail sales, 2% of which may come from peak demand reductions.
Colorado	1.7%	For 2015-18, Public Service Company of Colorado was required to achieve incremental savings of at least 400 GWh per year; starting in 2019, this was increased to 500 GWh, or roughly 1.7% of sales. HB 17-1227 extends programs and calls for 5% energy savings by 2028 compared with 2018.
Illinois	1.4%	Incremental savings targets vary by utility, averaging 1.77% of sales from 2018 to 2021, 2.08% from 2022 to 2025, and 2.05% from 2026 to 2030. SB 2814 also sets a rate cap of 4%, allowing targets to be adjusted downward should utilities reach spending limits.
Hawaii	1.4%	In 2009, transitioned away from a combined RPS-EERS to a stand-alone Energy Efficiency Portfolio Standard (EEPS) goal to reduce electricity consumption by 4,300 GWh by 2030 (equal to ~30% of forecast electricity sales, or 1.4% annual savings).
Maryland	1.6% (net)	Electricity use reduction goal of 15% per capita by 2015 (10% by utilities, 5% achieved independently); 15% reduction in per capita peak demand by 2015 compared with 2007. After 2015, targets vary by utility, ramping up by 0.2% per year to reach 2% incremental savings.
Nevada	1.1%	20% of retail electricity sales to be met by renewables and energy efficiency by 2015, and 25% by 2025. Energy efficiency may meet a quarter of the standard through 2014 but is phased out of the RPS by 2025. SB 150, signed June 2017, directed the Nevada Public Utilities Commission to set new savings goals for NV Energy. The utility's 2018 Joint IRP Demand Side Plan established state-wide goals of 1.18% in 2019, 1.14% in 2020, and 1.14% in 2021.
New Jersey	1.6%	Under 2018 legislation A3723/S2314, utilities must achieve 2% of electric savings (as a percentage of average annual usage from the prior three years) within five years.
New Mexico	1.0%	The state's three public utilities must achieve 5% savings of 2020 retail sales by 2025. HB 291 (2019) directs the Public Regulation Commission to set additional targets through 2030.
New York	2.0%	An April 2018 New York State Energy Research and Development Authority white paper called for 185 trillion British thermal units of cumulative annual site energy savings under the 2025 energy use forecast, as well as an electric site savings sub-target of 3% of IOU sales in 2025. A December 2018 Public Service Commission (PSC) Order adopting the 3% electric goal calls for utilities to propose detailed targets. Natural gas goals ramp up to 1.3% by 2025. In January 2020, the PSC authorized annual incremental utility-specific budgets and savings targets for electric, gas, and heat pump portfolios.
Pennsylvania	0.6%	Varying targets have been set for IOUs amounting to yearly state-wide incremental savings of 0.6% for 2021–2026. EERS includes peak demand targets. Energy efficiency measures may not exceed an established cost cap.

Appendix B

Electric Vehicle Policies in Australia

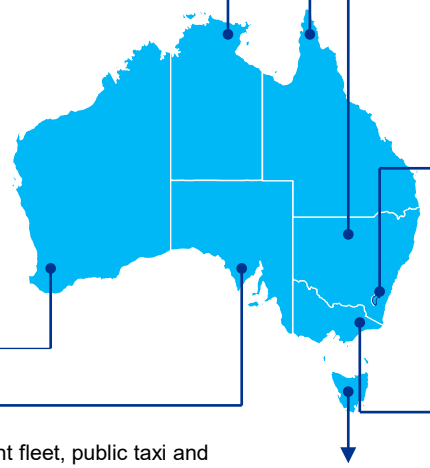
Electric vehicle policies in Australia

Northern territory

- NT Electric Vehicle Strategy and Implementation Plan: free NT registration and a $1500 reduction in stamp duty.
- Increase number of EVs in the NT Government Fleet by 20 per year over 10 years.
- Install 400 charging points at priority Government buildings.

Commonwealth

- The Federal Government recently published a consultation paper for its National Electric Vehicle Strategy.
- There has been limited federal policy on EVs, the Government released its initial discussion paper on their Future Fuels Strategy in February 2021, which indicates the early focus will be on commercial fleets and charging infrastructure rather than private vehicles.
- In 2021, a further $177.7m was allocated to the Future Fuels program to increase roll-out of enabling infrastructure in Australia.
- The Treasury Laws Amendment (Electric Car Discount) Bill exempts low and zero emissions cars from Fringe Benefits Tax.
- ESB EV Smart Charging Policy aims to establish foundations and incentives to support the effective integration of smart charging for EVs.



Queensland

- Zero Emission Vehicle Strategy 2022-2032: 50% of new passenger vehicles sales to be zero emission by 2030 and 100% eligible Qld Government fleet passenger vehicles to be zero emission by 2026.
- QLD Electric Vehicle Super Highway: network of 55 fast-charging stations to facilitate longer distance travel in EVs.
- Discounted vehicle registration and $3000 rebate for certain EVs.

New South Wales

- 30% electric and hybrid vehicle target for the NSW Government fleet by 2023.
- $209 million to ensure widespread, world-class EV charging coverage to future proof the EV network, including $149 million being invested into EV fast charging grants.
- Lower rate of tax for hybrid and EVs, including removal of stamp duty for certain EVs.

Australian Capital Territory

- Interest free loans of up to $15,000 under the Sustainable Household Scheme to assist in the upfront costs of investing in EVs and charging equipment.
- 2 years free registration: for vehicles purchased 24 May 2021 – June 2024, plus 20% ongoing discount.
- $2,000 incentives for installation of EV charging at multi-unit buildings in 2023.

Western Australia

- As part of the McGowan Gov's $43.5m investment to boost EV infrastructure, WA is building the longest continuously connected electric highway, with 98 EVSEs over 6,600kms.
- Minimum 25 per cent EV target for new light and small passenger, and small and medium SUV government fleet vehicles by 2025/26.

South Australia

- Target for all government fleet, public taxi and rideshare vehicles to be fully electric by 2030.
- Goal for all new passenger vehicles sold to be electric by 2035.
- Electric Vehicle Action Plan delivered in December 2020.
- Exploring demonstrations for EV VPPs – centrally coordinated charging and discharging of EV batteries.

Tasmania

- Target to transition the entire government fleet to EVs by 2030.
- EV home-charging trial launched by TasNetworks in 2021.
- ChargeSmart 2 Grant Program allocated $775,000 towards fast charging stations.

Victoria

- Road user charge of 2.6c/km for electric vehicle drivers.
- $3,000 subsidy for zero emissions vehicle purchases from May 2021.
- The Zero Emissions Vehicles Roadmap was introduced in May 2021, it has a target for zero emissions vehicles to make up 50% of all new light vehicle sales by 2030.
- $19 million to accelerate the roll-out of EV charging infrastructure.

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