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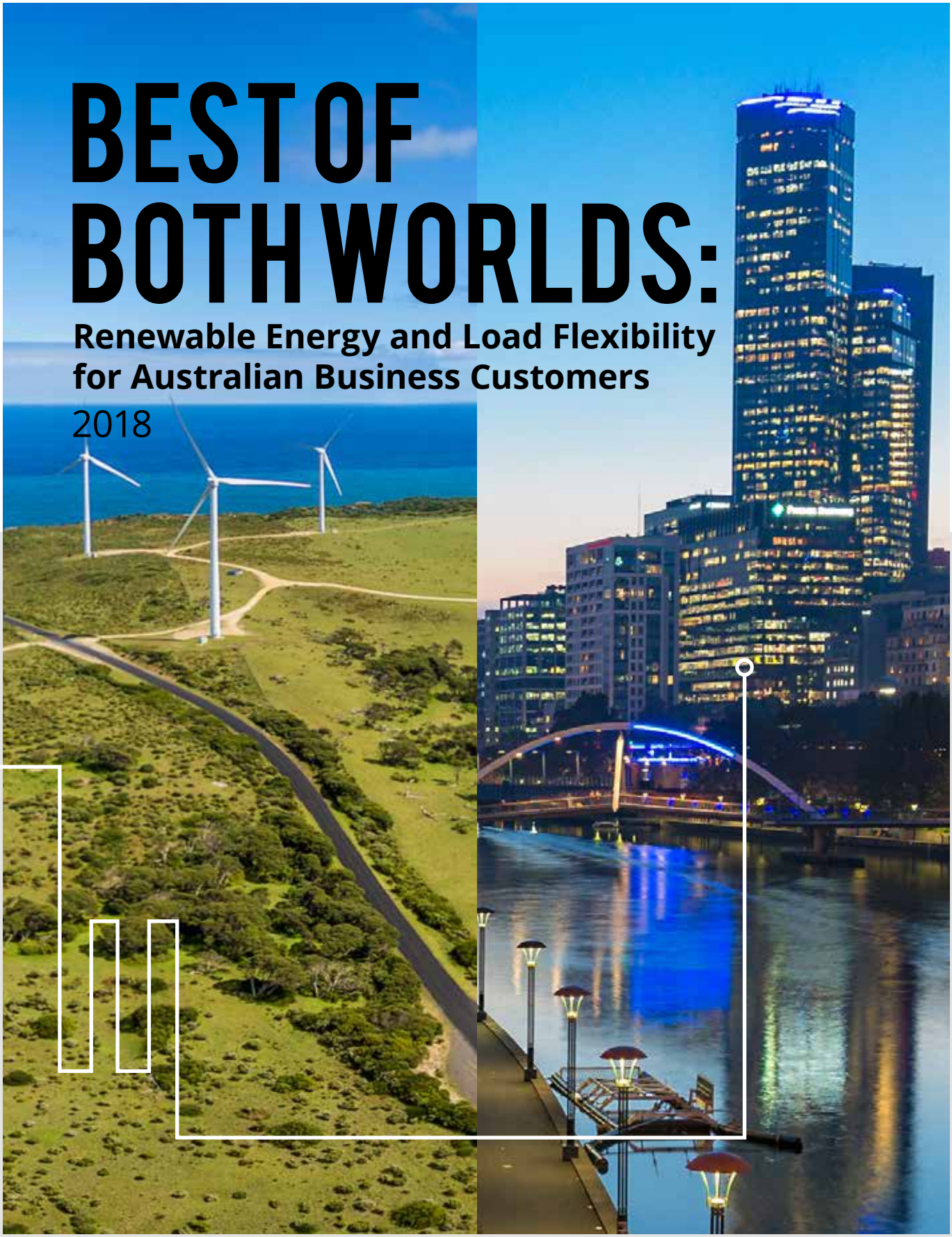
BEST OF BOTH WORLDS:

Renewable Energy and Load Flexibility for Australian Business Customers

2018



ABOUT THIS REPORT

The Institute for Sustainable Futures (ISF) is recognised as a leading advisor to Government and industry on demand response in Australia. Most recently this has culminated in the Demand Management Incentives Review on behalf of ARENA, supporting the AER in developing the new Demand Management Incentive Scheme. With renewable energy PPAs and demand response both being relatively new in an Australian context, Flow Power – in partnership with WWF-Australia - commissioned ISF to apply its expertise to conduct an independent evaluation of its value to three real businesses.

The electricity consumption, operations, and potential flexible loads of the three businesses were analysed to assess the potential of demand response, using price and energy usage data from Q2 2017 through to Q1 2018. The organisations selected represent diverse industries (an industrial manufacturer, a water utility, and a nut and health food company) and all were based in Victoria, Australia. They were also drawn from existing customers of Flow Power (also based in Victoria).Different approaches to demand response were assessed, including the shutting down of nonessential plant and the on-site generation of electricity.

The modelling in this evaluation was conducted using data provided by Flow Power and supplemented by ISF. Assumptions have been made where data was not readily available.

CITATION

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DISCLAIMER

The authors have used all due care and skill to ensure the material is accurate as at the date of this report. ISF and the authors do not accept any responsibility for any loss that may arise by anyone relying upon its contents.

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ABOUT ISF

The Institute for Sustainable Futures (ISF) is an interdisciplinary research and consulting organisation at the University of Technology Sydney. It has been setting global benchmarks since 1997 in helping governments, organisations, businesses and communities achieve change towards sustainable futures. ISF utilises a unique combination of skills and perspectives to offer long term sustainable solutions that protect and enhance the environment, human wellbeing and social equity.
For further information visit www.isf.uts.edu.au

ABOUT FLOW POWER

Flow Power is a licensed wholesale electricity retailer that gives businesses a better way to buy power. Powered by advanced energy technology, it connects Australian business to the wholesale power market to give them data and signals that result in real cost savings. Flow Power believes in the role of users in integrating renewables into the Australian power market through demand response.
For further information visit www.flowpower.com.au

ABOUT WWF-AUSTRALIA

WWF-Australia is a not-for-profit organisation working with businesses, governments and communities to accelerate the solutions and speed up Australia's transition to zero carbon pollution. Since early 2015, WWF-Australia has worked with a wide range of organisations to address the barriers to purchasing renewable energy through Power Purchase Agreements (PPAs) under the banner of the WWF Renewable Energy Buyers' Forum.
For further information visit http://www.wwf.org.au/what-we-do/climate/renewable-energy-buyers-forum

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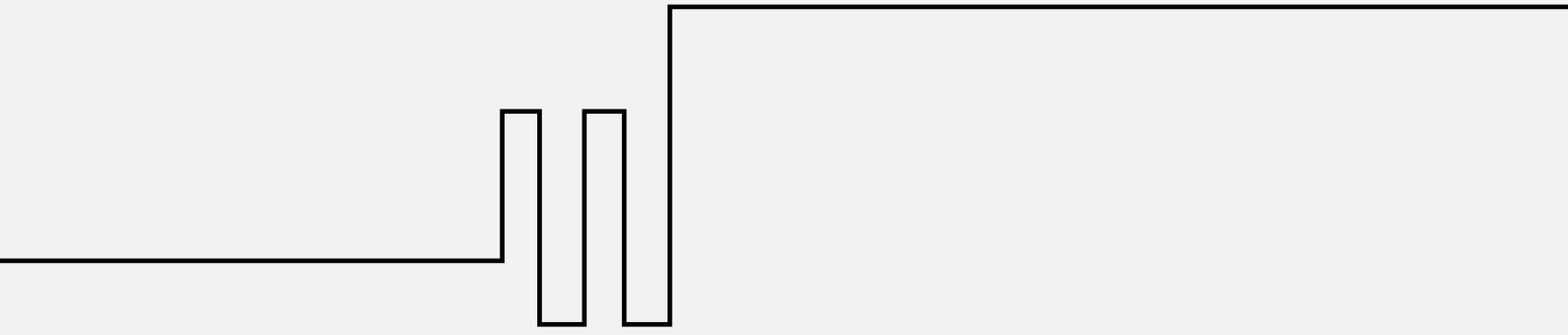

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FOREWORD

SIMON CORBELL

Victorian Renewable Energy Advocate

As Australia's energy transition accelerates large corporations, state and territory government entities, small and medium businesses are all exploring the opportunities to reduce their electricity costs by entering into renewable power purchase agreements (PPAs). By switching from being a "retail" to a "wholesale customer", large and medium electricity users are securing the significant price reductions for electricity available in the wholesale market.

The disruption, driven by the technological advance of wind and solar power generation technologies, coupled with significant prices increases in the gas sector, is likely to see price volatility continue in the medium term. Corporate renewable PPAs are therefore emerging as a critical risk management strategy for government and business operations in response to this disruption.

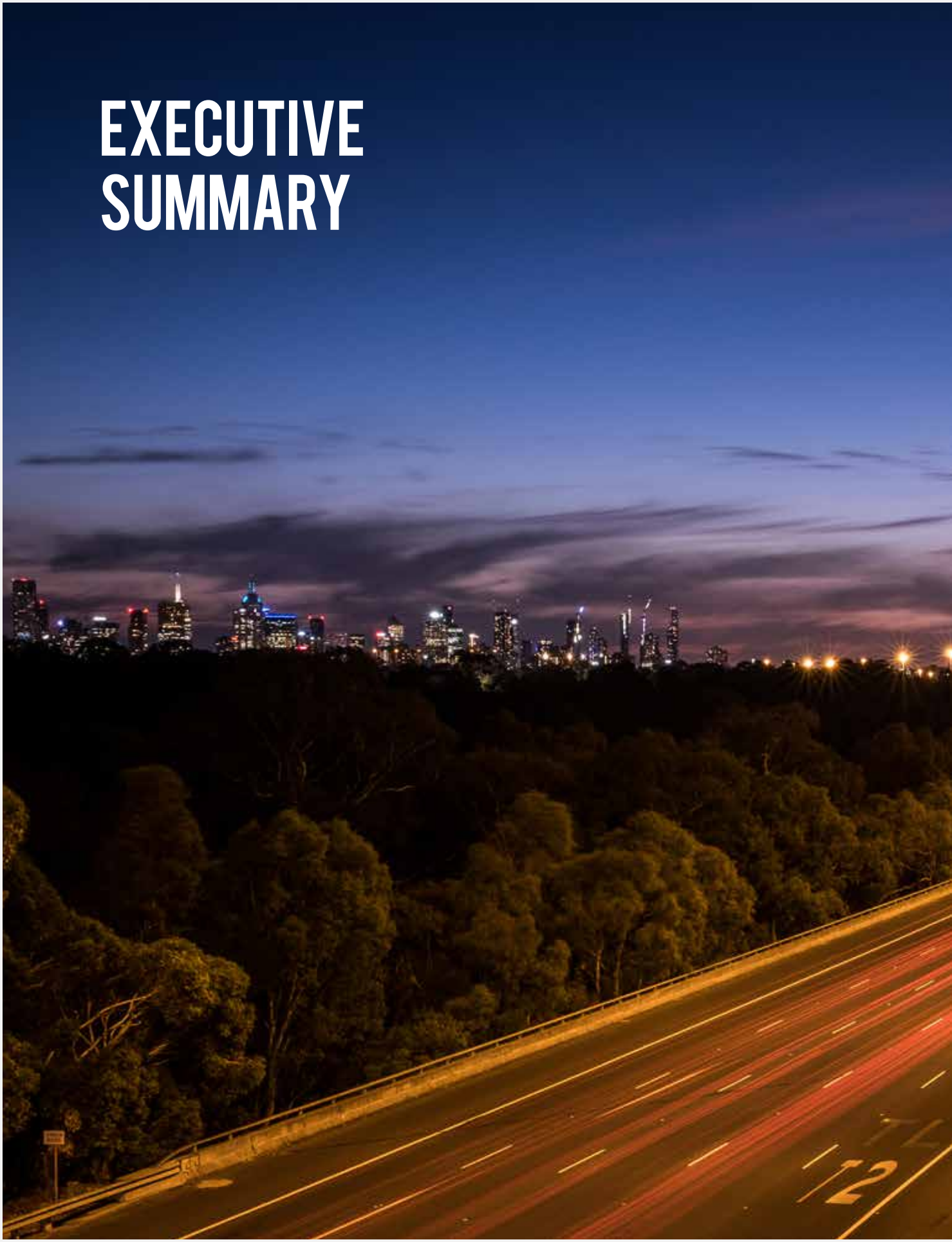
The rapid development of the corporate renewable PPA market is also providing a platform for future renewable energy growth. In Victoria, large scale corporate renewable PPAs have enabled the development of over 1200MW of renewable (wind) energy capacity in 2017.

As more of our electricity sector transitions to forms of renewable, affordable but distributed generation the complexity of managing the National Electricity Market is increasing. A key response to managing a tight supply demand balance in the sector, and to reducing prices, is the emergence of demand response. The development of market incentives for large electricity users to reduce their non-critical energy use at times of high demand means businesses can further improve on the cost savings already being delivered by corporate renewable PPAs. The establishment by the Australian Energy Market Operators (AEMO) of market incentives to provide demand response, along with increased availability of on-site generation and the evolution of technologies to manage demand response capability, will see this measure grow in importance for the reliability and affordability of our electricity sector.

This report unpacks these rapidly emerging trends through a focused and real-world analysis which can help the many businesses considering these issues better understand their options. It is an important contribution to developing a wider understanding of how renewable energy and demand response go hand in hand in this rapidly transforming sector, and how they can help businesses stay competitive at this critical time.

Simon Corbell
Victorian Renewable Energy Advocate

EXECUTIVE SUMMARY



THE AUSTRALIAN ENERGY MARKET IS CHANGING, AND ORGANISATIONS ARE BECOMING MORE ENGAGED WITH THEIR ENERGY USAGE AND COSTS, AND FINDING NEW OPPORTUNITIES TO REDUCE COST AND MANAGE RISK.

Organisations are shifting the way they buy power and are entering into corporate renewable PPAs to achieve cost savings and reduce long term risk, but this also brings exposure to some new risks.

Demand response is growing in Australia and is being adopted more widely for large energy customers and organisations. It has a particular benefit for wholesale customers with corporate renewable PPAs in protecting against high price events and achieving greater cost savings.

Our study assessed the potential savings for demand response for wholesale customers in Victoria over a 12-month period, and found energy cost savings from 2.3% to 33.3%, depending on the type of customer and type of demand response deployed. More significant savings were seen where the business was able to shut down a larger scale of plant for shorter periods (2 hours). Demand response provides organisations with an on-going capacity to manage exposure to high price events.

New technology is broadening the opportunity for demand response in terms of cost, scale and effectiveness. In addition to cost reductions and risk management for organisations, demand response can reduce the cost of wholesale electricity, ancillary and emergency services and network management across the NEM - and new revenue sources are opening up to unlock this value.

Demand response options should be explored by any organisation interested in reducing costs, especially when considering entering into a corporate renewable PPA.

INTRODUCTION

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REPORT SNAPSHOT

This study found that three organisations from diverse sectors could achieve additional savings of up to 33.3% of energy costs, on top of a corporate renewable PPA by implementing demand response.

- The Australian energy market is changing, creating new challenges and opportunities for organisations to manage their energy costs and risks.
- A small but growing number of organisations are achieving cost savings by directly purchasing power from the wholesale market and from renewable projects using corporate renewable energy power purchase agreements (or PPAs).
- Demand response has the potential to take this approach one step further, by further reducing the costs and risks that arise from the mismatch between the output of renewable energy generators and the energy demand profile of customers.
- The future potential for cost savings is expected to increase as the price of renewable energy falls and its penetration increases, and as the potential for demand response expands via new technology developments, energy market changes and improved understanding.

AUSTRALIA'S ELECTRICITY MARKET IS UNDERGOING FUNDAMENTAL CHANGE

Australia's electricity market is undergoing fundamental change, particularly as coal-fired power stations reach the end of their economic life and investment in new wind and solar farms increases. This transition is not only changing the electricity supply system, it is also impacting on how Australia's business customers are choosing to purchase their electricity.

In order to reduce electricity procurement costs, some large electricity consumers are opting to move from fixed price retail electricity contracts (being a Retail Customer), to paying the variable 'pool' or 'spot' price for electricity from the wholesale market.

ORGANISATIONS ARE LOOKING FOR WAYS TO MANAGE THEIR RISK AND TAKE CONTROL OF THEIR ENERGY COSTS

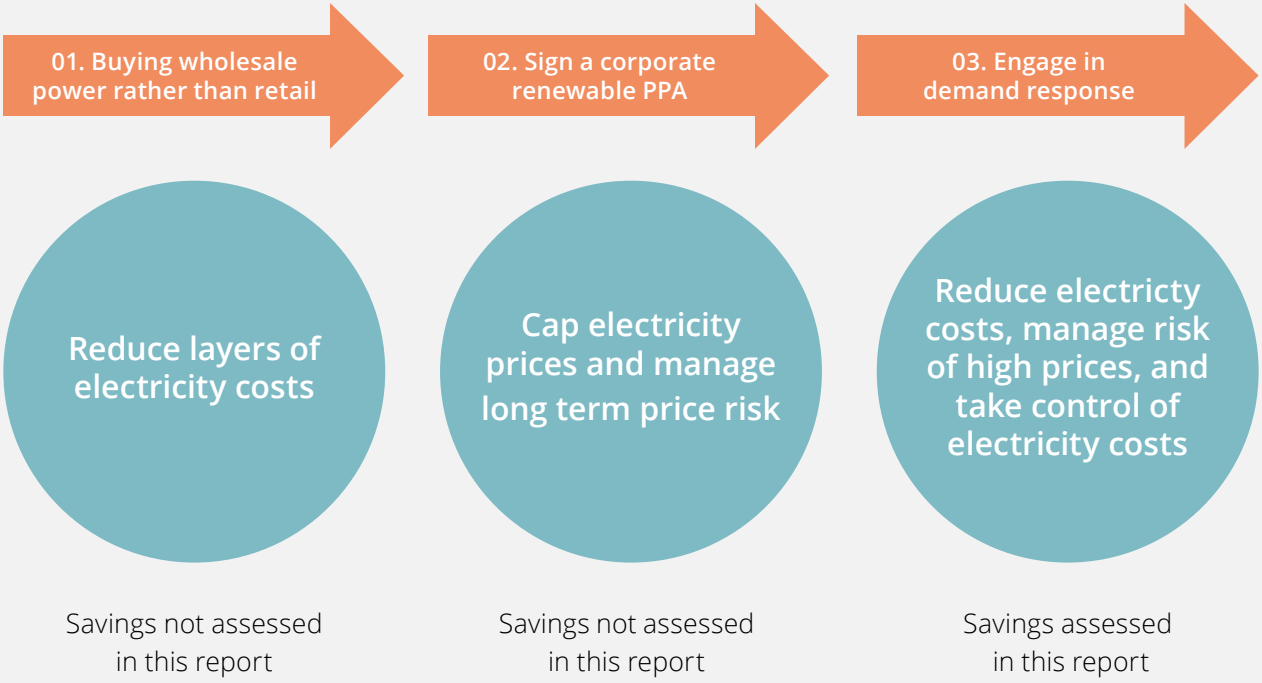
Paying pool prices can reduce layers of electricity costs. Entering into a corporate renewable PPA can cap exposure to high energy prices and improve longer term budget certainty.

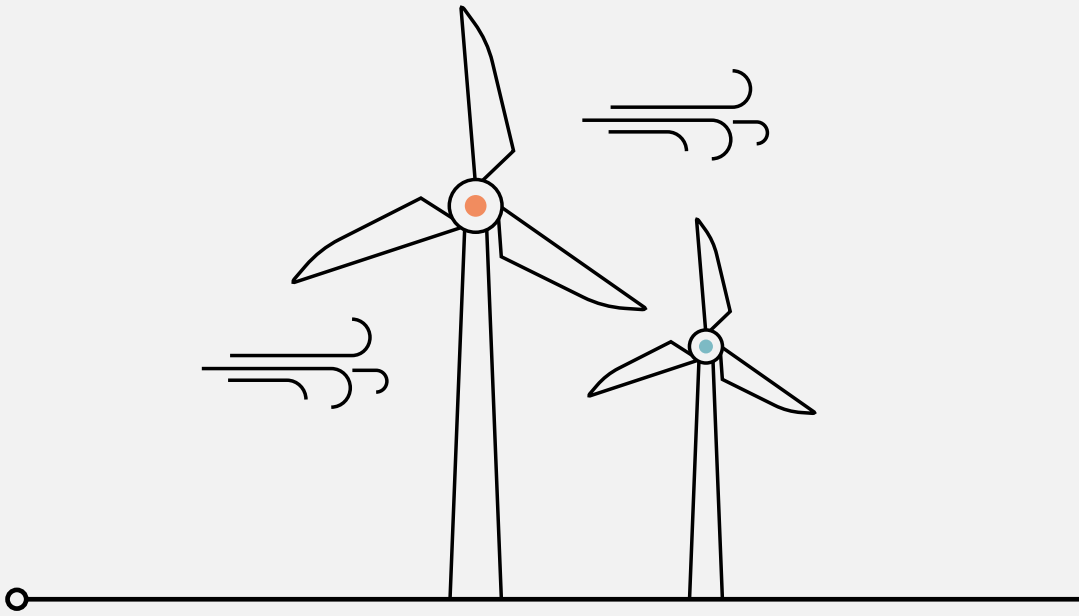
By combining this with demand response, businesses can manage their risk and take more control of their energy costs.

To further reduce costs or manage longer-term budgetary risk, organisations can enter into a corporate renewable power purchase agreement (PPA) – where an agreement is made between a buyer and a generator for the purchase of renewable electricity at a fixed rate. This can be facilitated through a retailer for medium size business so that they do not need to become a market customer.

Demand response enables customers to deliberately reduce their electricity demand in response to high spot market prices or other incentives, reducing costs even further and managing shorter-term budgetary risk. Entering into a corporate renewable PPA can help manage long-term energy cost risk. However, it does introduce new exposure to wholesale electricity spot pricing. Demand response can help to manage this risk, giving organisations more control over their electricity costs.

This document specifically examines the savings an organisation could make from the final step in this process, once the business has begun buying wholesale power with a corporate renewable PPA.





THREE DIVERSE ORGANISATIONS WERE ASSESSED TO UNDERSTAND WHAT ADDITIONAL SAVINGS WERE POSSIBLE THROUGH THE ADDITION OF DEMAND RESPONSE TO A CORPORATE RENEWABLE PPA.

Three organisations representing three different industries (an industrial manufacturer, a water utility and a nut & health food company) located in the state of Victoria (south-eastern Australia), were assessed for possible cost savings due to adding demand response measures to their energy management practices under a prospective corporate renewable PPA. Using actual data from a full 12 month period (Q2 2017 to Q1 2018), the results indicated that demand response was capable of delivering additional financial savings of between 2.3% and 33.3% - on top of those savings achieved from buying wholesale power with a PPA. The table below provides a summary of these results.

KEY RESULTS: PROSPECTIVE COST SAVINGS FROM DEMAND RESPONSE FOR WHOLESALE CUSTOMERS WITH RENEWABLE ENERGY PPAs

Customer	ANCA	YVW	SELECT HARVESTS
Sector	Industrial Manufacturer	Water Utility	Nut and Health Food
Demand response type	Shut Down of Non-Essential Plant	Onsite Generation	Shut Down of Non-Essential Plant
Reduction in energy costs from demand response (in addition to modelled PPA Savings).	2.3%	24%	33.3%

Note: The percentage savings in the table are reductions in the Energy Charge portion of Total Electricity Costs. Energy Charges are also known as "Contestable Charges" or "Retail Charges" and tend to make up 30% to 70% of total electricity costs depending on the customer, their state and their network. Customers pay Energy (Generation and Retail) Charges along with Network, Environmental and Other Charges. The savings shown here refer to energy cost savings only.

Note: The modelling results presented are potential (hypothetical) savings. Actual savings will depend on pool prices, their variability, willingness and cost to activate Demand Response, and ability to implement and execute Demand Response successfully for the correct time periods.

NOTE:

The modelling results presented are potential (hypothetical) savings. Actual savings will depend on pool prices, their variability, willingness and cost to activate Demand Response, and ability to implement and execute Demand Response successfully for the correct time periods. While cost savings were also made by these organisations from renewable energy PPAs, these are not included here as it is a small snapshot (in the context of a long-term agreement) during a period of high average wholesale electricity prices.

While these cost savings may seem moderate, for some customers this equates to several hundred thousand dollars per year (and these are additional savings on top of those achieved from becoming a corporate renewable PPA customer). Furthermore, an additional benefit from implementing demand response in the case of these organisations is that these cost savings can often be achieved with marginal additional capital or operating expenditure.[1]

1 For organisations interested in commissioning specialists to advice and implement on energy management and demand response, the Energy Efficiency Council can provide further information and a directory of providers: http://www.eec.org.au/for-energy-users/overview#/overview.

WHAT IS DEMAND RESPONSE?

Demand response involves electricity customers deliberately reducing their demand in response to high spot market prices or other incentives, in order to manage the risk of very high prices in the short-term.

A very common form of demand response is a short-term reduction in electricity consumption by a commercial building's cooling system, where a portion of its air conditioning is shut-off for 1 to 2 hours. There are many other demand response options such as energy storage, shutting down of non-essential plant, or altering work shift patterns.

New and emerging technologies are making it easier to automate demand reduction, maximising value through improving speed, reducing the operational resources required, accessing new loads, and enabling the storing and discharging of energy without impacting on business operations.

DEMAND RESPONSE IN ACTION

FIGURE 1

How electricity demand can change over a day with 2 hours of demand response

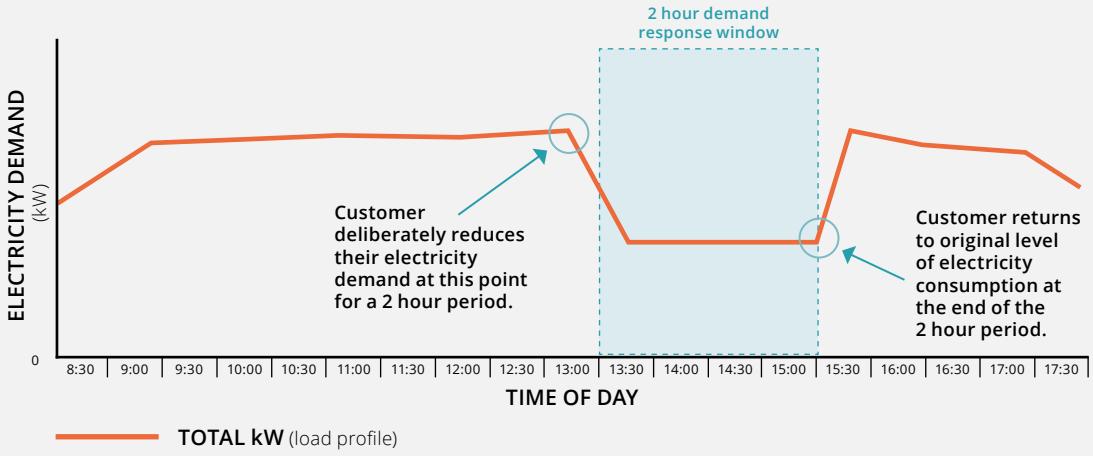


Figure 1 provides an illustration of 24 hours of electricity demand within a commercial building. At 1:30pm it participated in demand response, reducing its electricity demand for 2 hours by shutting off various plant, such as air conditioning. The demand response period is shown by the shading.

01. MARKET CONTEXT AND OPPORTUNITY

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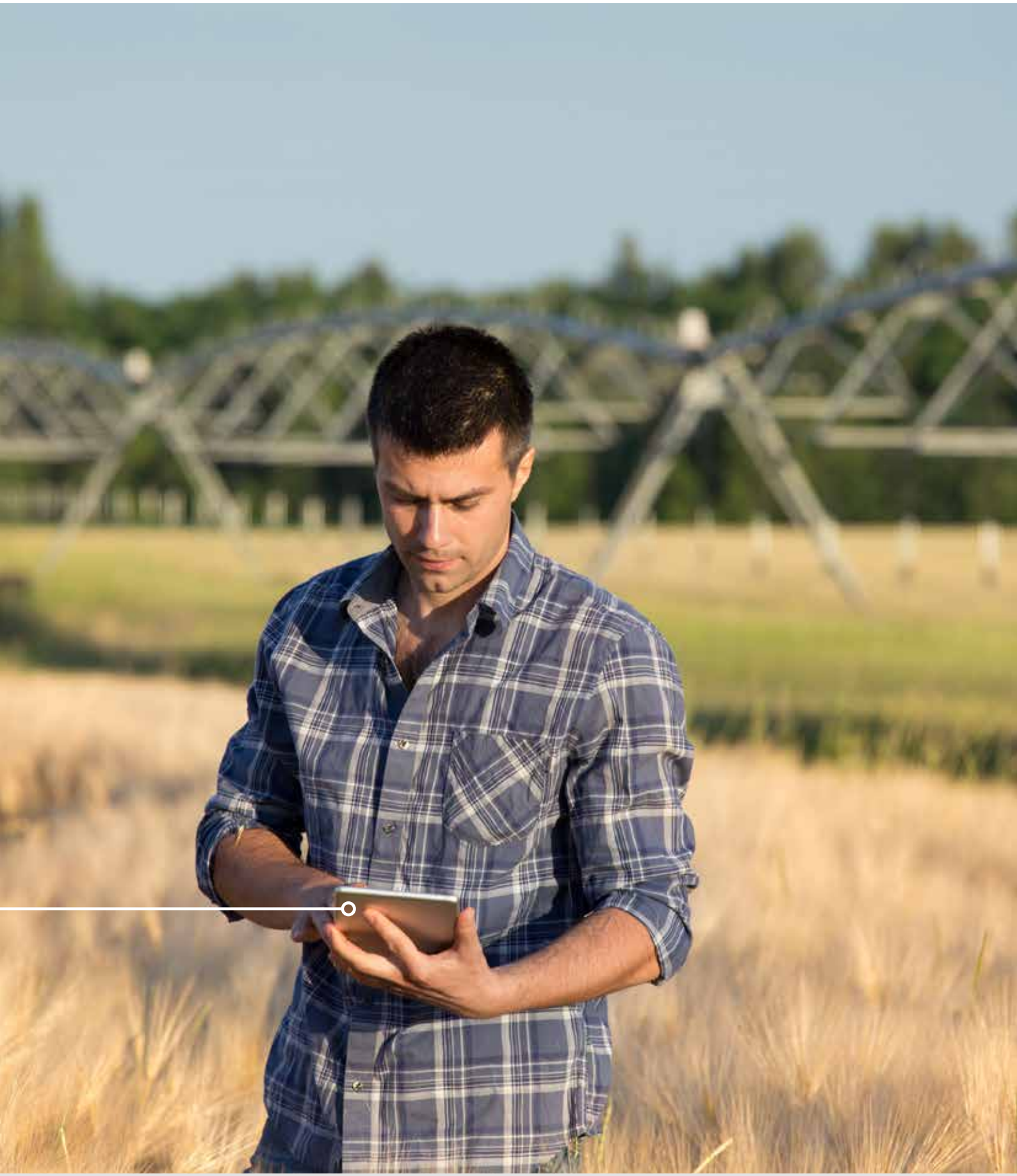


The Australian energy market is shifting. Australian organisations are becoming more pro-active in managing energy in response to dramatic changes in price, the falling cost of renewable energy, and the emergence of new technologies and business models. Some large electricity users are choosing to pay the pool price to take advantage of the lower costs than would be available under a retail electricity supply contract. As business electricity costs increase and renewable energy costs fall, corporate renewable Power Purchase Agreements (PPAs) are also growing in popularity as a further step towards lowering cost, increasing price certainty, and reducing carbon emissions.

Commissioned by Flow Power and in partnership with WWF-Australia, the Institute for Sustainable Futures (ISF, a research institute at the University of Technology Sydney) conducted an independent evaluation of combining demand response with corporate renewable PPAs. Three organisations were selected for this evaluation, each of which is a Flow Power customer. To estimate the cost savings resulting from the demand response measures adopted, ISF used actual data provided by each of these organisations on their electricity consumption, costs, operations, and flexible loads in the modelling.

This section provides the market context for this study, and a description of the opportunity presented by corporate renewable PPAs combined with demand response.

TRADITIONAL ELECTRICITY PURCHASING

Corporates and other large electricity users seek budget certainty for their electricity costs, while also looking to minimise cost and risk within a potentially volatile electricity market. Typically, corporate electricity purchasing is conducted via electricity retailers, who provide a fixed rate for electricity and pass through network charges and other associated costs to the customer. Such retail contracts are procured through competitive tenders every two to three years.

Once a retailer is selected by an organisation customer for the term of the retail contract, the electricity is forward purchased. This is done either via the ASX Energy Futures market, through direct contracts with generators (outside the ASX Energy Futures market), or alternatively via internal hedging in the case where the retailer owns generation assets.

Standard retail electricity contracts are set up in a way that allows business customer to use as much electricity as required and whenever it is required. While they may be limited to annual electricity consumption volumes within a certain margin (e.g. +/-10%), they are usually protected from the actual short term high prices experienced during peak demand events through their contract terms. This is the equivalent of an 'All-you-can-Eat' contract, where a customer can use as much electricity when it wants, with no regard of the 'pool' price (see Box 1) at that time.

However, there are direct and indirect costs to consumers using traditional electricity purchasing. Direct costs include a premium price that electricity customers pay for these contracts, compared to typical average NEM (National Electricity Market[2]) pool prices. Indirectly, all electricity consumers pay the cost of deploying more expensive generation and network infrastructure investment to meet peak demand – this is because there is usually little or no incentive for customers to better manage their loads.

2 The NEM is a wholesale electricity market in which electricity is bought and sold by generators and retailers, with the latter then selling it on to consumers.

BOX 1 - THE 'POOL' – HOW THE NEM WORKS

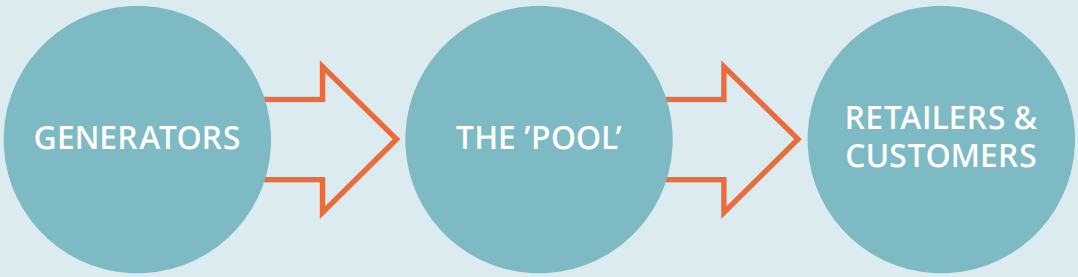
The Australian National Electricity Market (NEM) is a series of inter-connected state and territory markets, each with its own price. Electricity is generated by numerous power stations across the NEM and contributes to a 'pool'; transmission and distribution lines then deliver the electricity to customers from the pool.

The electricity price is set by supply and demand. For example, when demand rises each day as organisations commence operations, the pool price rises. The Australian Energy Market Operator (AEMO - the body responsible for operating Australia's largest electricity markets and systems) - forecasts demand according to weather, historical data and other means. Generators offer to sell into the market at certain prices, with generators who provide the lowest bids ($/MWh) called upon first to generate electricity to meet the demand.

As demand and prices increase, AEMO schedules more expensive (i.e. higher bidding price) generation to switch on to meet demand. This is done on a 5-minute basis, where the highest offer accepted sets the 'Pool Price' for that 5 minutes. The price is averaged over a 30-minute 'Trading Interval', which sets the revenue each generator receives from AEMO for its generation.

Over the last 2 years, the pool price averaged between $70 and $100 per MWh[3] across the NEM states (all states and the ACT but excluding Western Australia and the Northern Territory). The pool price had a maximum price of $14,000 per MWh (occurring during high demand or outages) and a minimum price of negative $1,000 per MWh[4] (occurring during low demand during over-supply).

FIGURE 2
The flow of electricity in the NEM: from generator to customer



As the energy market undergoes fundamental changes, consumers are choosing to more pro-actively manage their energy use. Just as we see many Australian businesses and households become 'prosumers' by generating their own electricity, more large electricity consumers and other types of organisation are being introduced to the wholesale market and the opportunities it presents.

Coupled with the opportunity for considerable cost savings, there is the potential for many organisations to benefit from switching from a traditional fixed-rate retail electricity contract to pay the varying pool price. This is achieved through actively managing electricity demand, responding to pool pricing, and adding products such as corporate renewable PPAs to manage medium- to long-term risk exposure to high prices.

3 AEMO Price Tables - https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data-dashboard#average-price-table
4 AEMO NEM Fact Sheet https://www.aemo.com.au/media/Files/Other/corporate/AEMO16839_FactSheet_NationalElectricityMarket_D6.pdf.pdf

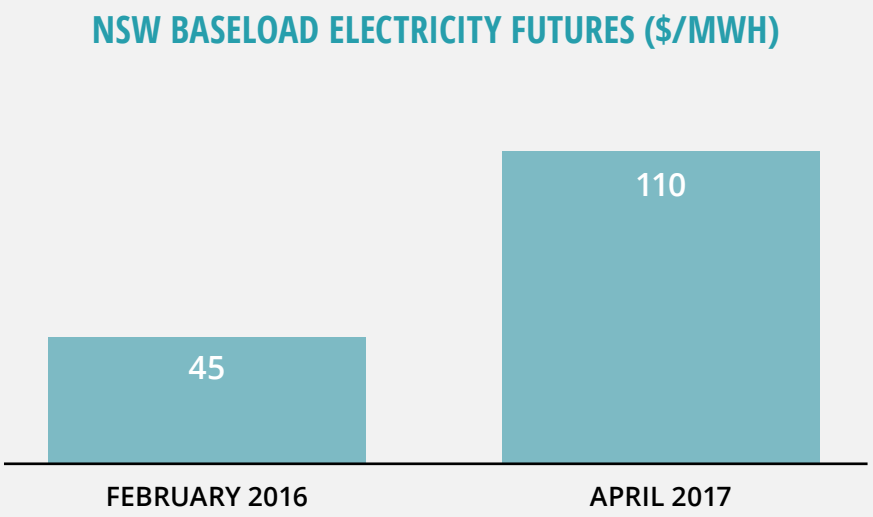
The following section describes how corporate renewable PPAs work, why their use in Australia is growing, and the opportunities and challenges they present.

CORPORATE RENEWABLE POWER PURCHASE AGREEMENTS (PPAs)

While nine coal power stations have been shut-down across the NEM over the nine years to 2016 with limited effect on electricity prices, the announcement of the retirement of the Hazelwood Power Station in Victoria in 2016/17 had a dramatic effect on electricity prices. Baseload futures rose significantly from around $45 per MWh to over $110 per MWh in New South Wales and Victoria. As corporate and other large electricity customers entered into new retail contracts, these price increases sent shockwaves through the market.

FIGURE 3

New South Wales Baseload Electricity price change following the announcement of the Hazelwood Power station closure



One outcome of this was the realisation that while retail electricity contracts manage short-term budget risk for customers, they do little to incentivise energy companies to manage medium- to long-term price risks. In fact, high prices are advantageous for energy companies, particularly those that own generation facilities or have long-term contracts with generators.

Historically, electricity buyers have relied on the market and the shared grid to deliver the best prices and outcomes. However, they are now becoming more proactive about managing this price risk. Consequently, corporate renewable PPAs , which generally involve an agreement between a large energy buyer organisation (business or government agency) and a renewable energy generator for the purchase of electricity at a fixed rate, are now growing in popularity in Australia. Increasingly this is facilitated by retailers for medium sized businesses to remove the need to become a market customer.

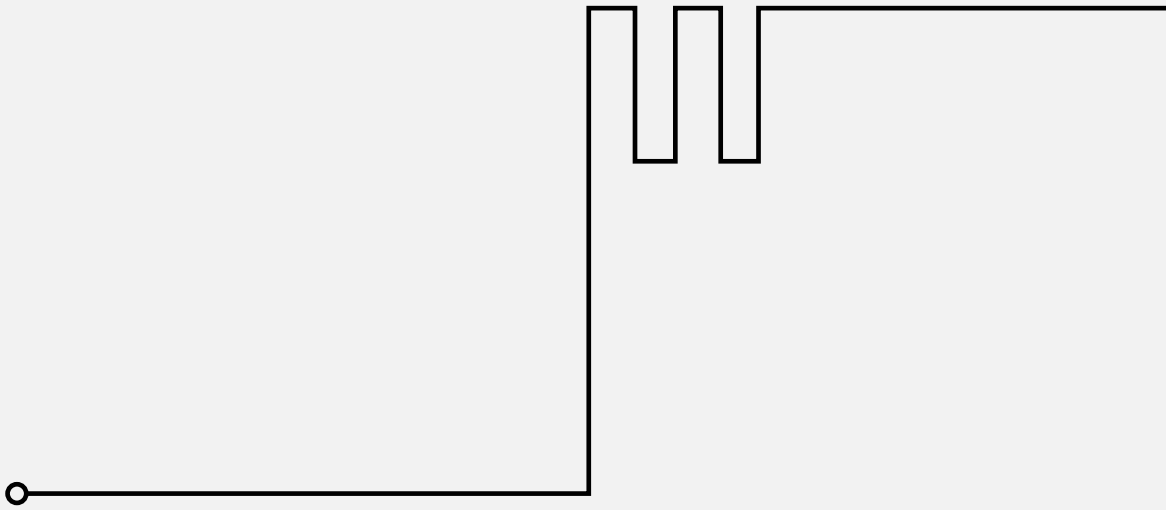
5 In practice, there are a variety of corporate renewable PPA contract types. For a description of these, see the report "Green Hedging: A Guide to Structuring Corporate Renewable PPAs" (https://www.bakermckenzie.com/-/media/files/insight/publications/updated-wwf-1443corporate-ppa-reportonline-15--june2018-.pdf?la=en)

By entering into a corporate renewable PPA, or even by investing in renewable energy generation, organisations are capping their exposure to market price increases; it is not a matter of beating the energy companies but joining them. Corporate renewable PPAs can also benefit organisations through alignment with Corporate Social Responsibility goals and carbon commitments and targets. Corporate renewable PPAs have grown significantly in popularity recently – the table below lists just a handful of the larger deals.

SIGNIFICANT CORPORATE RENEWABLE PPAs IN AUSTRALIA IN 2017/2017

Year	CUSTOMER	PROJECT	UTILITY	DEVELOPER
2017	Telstra	Emerald Solar Farm – 70MW	None	RES
2017	City of Melbourne (and others)	Crowlands Wind Farm - 80MW (PPA for 25MW)	Tango	Pacific Hydro
2018	UNSW	Sunraysia Solar Farm – 250MW (PPA for 60MW)	Origin	Maoneng
2018	Carlton & United Breweries	Karadoc Solar Farm – 112 MW (PPA for 37 MW)	None	BayWa r.e.

While corporate renewable PPAs present some challenges for organisations and large electricity users (being both a relatively new instrument and electricity purchasing being non-core business for most), they do present a gateway to more proactive energy management and potentially lower costs. There are also a new range of businesses offering services to facilitate this transition. Organisations may consider corporate renewable PPAs as a useful tool to achieve these goals but as well as the opportunities they present, they should also be aware of the risks. These risks are explained in the demand response section of this report.



EMERGING MARKET TRENDS

Currently, there are five key trends leading to growth of Market Customers and corporate renewable PPAs, which are described in detail below:

1. **Market transformation**
2. **Greater capability & technological change**
3. **Less liquidity in futures market could increase the cost of traditional retail contracts**
4. **Less market power by big players and new business models**
5. **Wholesale pricing is lower than futures market**

MARKET TRANSFORMATION

Historically, the Australian electricity system was operated by State Government departments, primarily as engineering companies. In the 1990s, the NEM was created connecting the states of New South Wales, Victoria, South Australia, Queensland, Tasmania and the Australian Capital Territory (but not Western Australia and the Northern Territory), with pricing determined through generation bidding and supply and demand. State Electricity Commissions were separated between generation, network and retail companies, most of which have since been privatised.

Until 2009, Australia's energy industry continued much like before: demand would grow each year, delivering new investment in generation and network infrastructure as required. However, in 2009, electricity consumption within the NEM started to reduce due to increased pricing from network charges and energy efficiency and rooftop solar.

Additionally, new investment in renewable energy power stations, supported by the Renewable Energy Target (RET)[6], reduced wholesale electricity prices. This has transformed the market, with ten coal power stations[7] now retired or 'mothballed' since 2012.

In 2017, Hazelwood Power Station was retired, seeing wholesale electricity and baseload futures pricing increased by 100% or more. Over $6 billion of new wind and solar generation investment has been committed under the RET and will come online in 2018 and 2019.

GREATER CAPABILITY & TECHNOLOGICAL CHANGE

Electricity customers are gradually becoming more knowledgeable about the electricity they are purchasing, and their capability is increasing with more tools at their disposal to manage their risks and reduce costs.

As electricity prices have increased or shown increased volatility, large electricity customers have become motivated to better manage their electricity budget, drive cost reductions, and focus on how to better manage long-term energy price risk.

Early projects typically involved investment in on-site infrastructure (such as on-site solar) and in energy efficiency measures. Corporates and other organisations began utilising data platforms to better understand their electricity usage and to find new ways to reduce costs. Batteries and the emergence

6 The RET is a legislated target for 33,000 Gigawatt-hours of electricity to come from renewable sources by 2020.
7 In order of closure from the earliest to the most recent: Munmorah, Redbank, Wallerawang C, Morwell, Anglesea, Collinswille, Swanbank B, Northern, Playford, Hazelwood. Source: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Coal_fired_power_stations/~/media/Committees/ec_ctte/Coal_fired_power_stations/Interim_Report/c02.pdf

of demand control technologies are creating new opportunities to reduce consumption and help organisations adjust their demand profiles.

While corporate renewable PPAs can be relatively complex, recent market growth suggests they are becoming more accepted and are entering the mainstream. In the future, the NEM may reflect greater variance for pool prices during the days, weeks and months. This may motivate organisations to enter into new grid level storage projects (such as pumped hydro), in addition to adding on-site batteries and undertaking demand management.

LESS LIQUIDITY IN FUTURES MARKET COULD INCREASE THE COST OF TRADITIONAL RETAIL CONTRACTS

As described previously, electricity for corporate and large customer retail contracts is often forward purchased. Such 'baseload futures' and 'market caps' trades rely on a liquid futures market, and enough sellers of the futures.

As renewable generation increases across the NEM and coal and gas power stations leave the market over time, there may be reduced liquidity in the futures market. There may be fewer generators (in particular fewer independent generators) offering baseload futures and market caps. This may leave corporates and large electricity customers less able to secure fixed pricing via retailers, or paying a higher premium to do so. To avoid exposure to these higher prices, organisations should review their options to become market customers (including consideration of executing a corporate renewable PPA) before their current retail electricity contract expires.

LESS MARKET CONTROL BY BIG PLAYERS AND NEW BUSINESS MODELS

Typically, the largest 3 to 4 energy companies control over 80% of the generation (wholesale) and retail markets. This produces an element of control of the market, but we are already seeing customers taking charge, becoming prosumers, illustrated by the growth in the commercial and residential rooftop solar. Further growth is anticipated as batteries become more affordable. Corporate renewable PPAs, on-site generation, and other innovations can take this a step further for organisations. New retailers and start-ups are entering the market with alternative business models to attract more pro-active consumers.

WHOLESALE PRICING IS LOWER THAN FUTURES PRICING

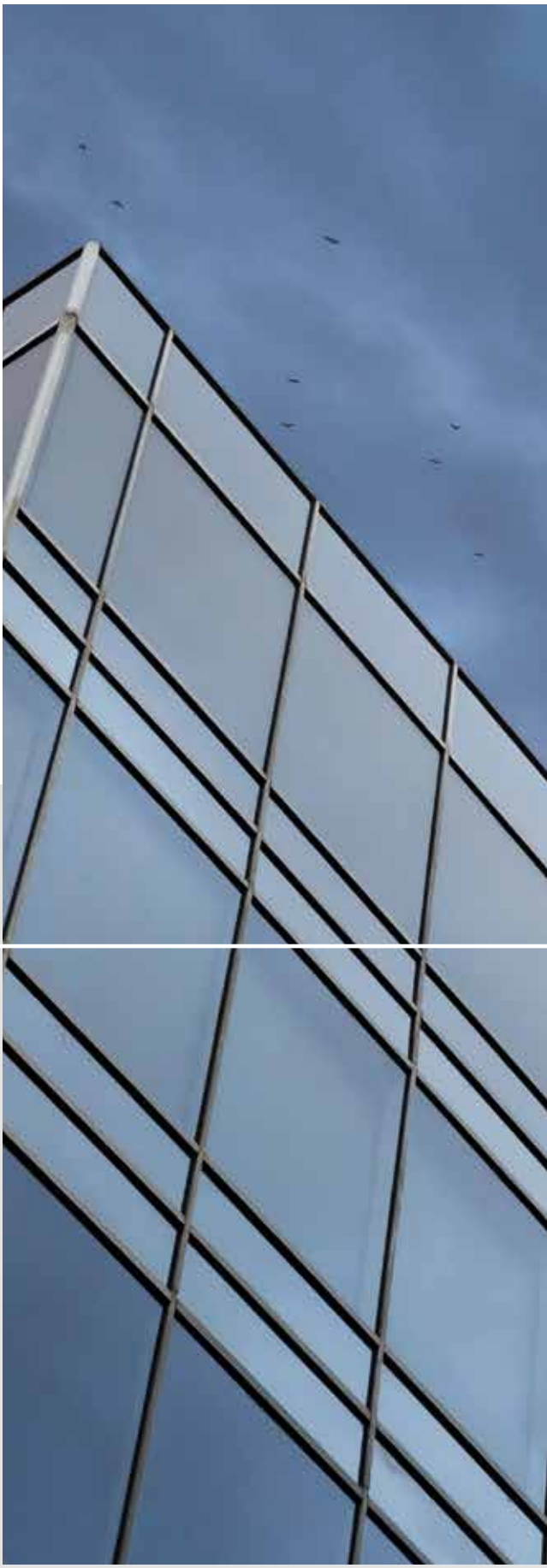
The NEM is a delicate balance of supply and demand, and even moderate shifts can see substantial price changes. With (near) zero marginal cost generation such as wind and solar, NEM pool pricing could be reduced significantly in coming years as new renewable electricity generation comes online. Prices may reduce and stay low, but solar and wind farms are unlikely to leave the market. This is in contrast to coal and gas power stations, which have substantial fuel and operating costs and cannot afford to keep operating in low cost environments.

RENEWABLES – LACKING THE 'REBOUND EFFECT'

An interesting economic characteristic of renewable energy is the lack of 'rebound effect'. If prices reduce, solar and wind farms are unlikely to leave the market; prices may reduce and stay very low, with no rebound. This is in contrast to coal and gas power stations, which have substantial fuel and operating costs and cannot afford to keep working in low cost environments.

The result could be a widening gap between futures and average NEM pool pricing. It is unclear how the electricity retail market will react to this. If there is a lack of innovation by retailers, all electricity customers may find accepting NEM pool price risk more attractive due to the savings offered.

02. UNDERSTANDING DEMAND RESPONSE



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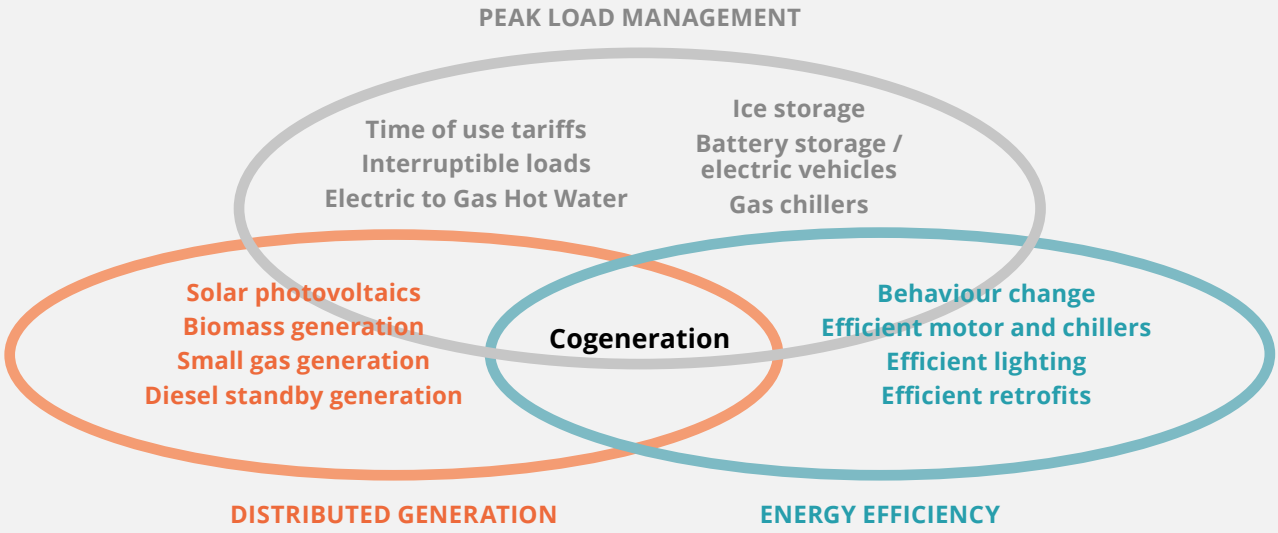
"Demand response includes all intentional modification to consumption patterns of electricity to induce customers that are intended to alter the timing, level of instantaneous demand, or the total electricity consumption".

Albadi, M. H.; E. F. El-Saadany (2007). Demand Response in Electricity Markets: An Overview. IEEE

Demand response involves deliberate action to reduce or shift demand for electricity. It can directly support low-cost carbon emission reductions, reduce energy consumption, and indirectly provide flexible demand to complement variable output from wind and solar generation.

Figure 4 shows some examples of demand response options available in three key areas of management: peak load management, distributed generation and energy efficiency.

FIGURE 4
Types of demand response used by organisations to reduce electricity demand



DEMAND RESPONSE: ADDING VALUE

Australia's energy markets have not usually rewarded customers for offering demand flexibility – instead they have been treated as 'fixed loads' with supply-side options being used to manage energy reliability and security. Consequently, electricity tariffs don't usually provide effective incentives or rewards aligned to peak demand events and therefore organisations have rarely been able to bid to provide these market services.

However, this is changing. Australia's energy market operator (AEMO) is now considering and implementing a range of changes that will open up new opportunities for organisations to earn revenue if they can provide demand flexibility in response to a price signal.

There are different types of revenue opportunities open to those engaging with demand response. Value can be derived from:

- The energy market, such as by exporting generation or reducing load during high price events, or
- The site, such as by displacing more expensive backup generators.

Figure 5 outlines various revenue opportunities offered by demand response in each of these areas.

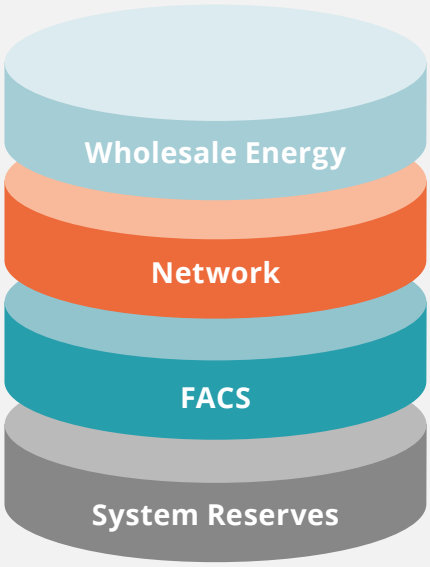
FIGURE 5
Revenue Opportunities from providing demand response

WHOLESALE ENERGY
- Exported generation or load reduction during high-price events

NETWORK
- Reduced peak demand (capex)
- Reduced energy throughput (repex)
- Frequency & voltage control

FCAS
- There are 8 Frequency control & ancillary services markets

SYSTEM RESERVES
- Reliability & Emergency Reserve Trader
- AEMO can pay for generation or load reduction to be available to meet reliability standards



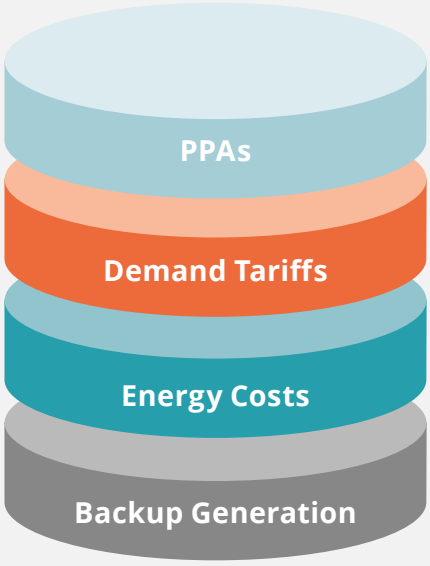
ENERGY MARKET

RENEWABLE PPAs
- Demand response can reduce the firming cost from mis-match between generator output and load profile

DEMAND TARIFFS
- Load shifting to reduce network tariffs based on monthly peak demand

ENERGY COSTS
- Load shifting to lower price times (time of use tariff)
- Increased solar (storing excess output to avoid grid exports paid low rates)

BACK UP GENERATION
- Augment or displace more expensive back-up generations (e.g. diesel)



SITE

The actions required to take advantage of these revenue opportunity range in complexity but are often relatively low-cost. Measures can be segmented according to three levels of complexity:

- **SIMPLE:** Uses existing generation and/or investment in new or upgraded load management automation (or Building Management Systems) to turn loads on and off, adjust timings, and store and use energy in existing storage mediums (as cold, as heat, or in a battery).
- **MEDIUM:** Involves better use of existing plant through additional investment (e.g. extending cold tank storage), changing operating procedures (e.g. shift times), or adding or extending rooftop solar.
- **COMPLEX:** Requires significant investment in demand controls and monitoring, new generation, or adding thermal and battery storage.

DEMAND RESPONSE: REDUCING COSTS

Demand response also offers sources of value for the energy market and networks through cost reduction. It can reduce the cost of the following:

- **WHOLESALE ENERGY** - by meeting peak demand at a lower cost than that of providing additional generation (e.g. peaking gas plants).
- **TRANSMISSION AND DISTRIBUTION NETWORK CHARGES** - by avoiding or deferring network upgrades to meet higher peak demand and reducing replacement expenditure for ageing assets.
- **ANCILLARY SERVICES** - by providing frequency and voltage control at a lower-cost than centralised generation.
- **SYSTEM RESERVES** - by providing low-cost on-demand capacity to the market operator to manage contingencies.

DEMAND RESPONSE IN ACTION: SOLAR POWER PLUS CHILLERS

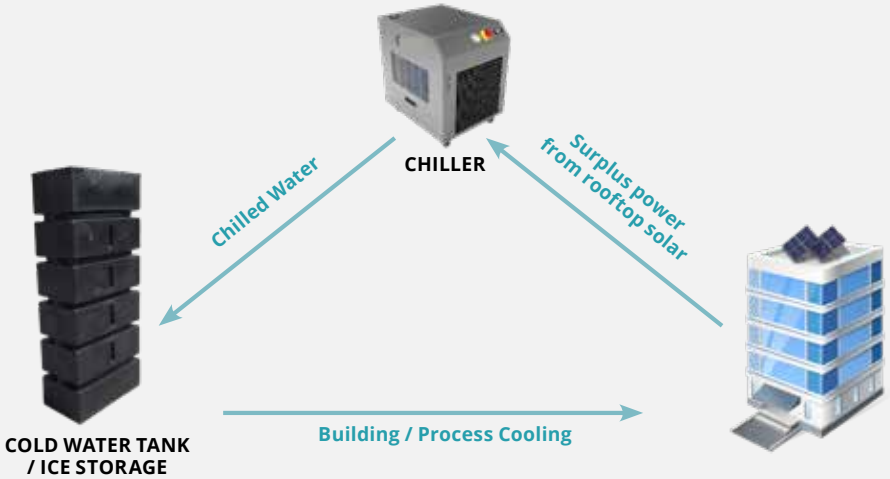
Flexibility of demand and demand response can reduce or even eliminate the risk of exposure to high price events (downside risk).

> *The first reaction of many businesses is to say "we have no flexibility" – but the opportunities are often greater than they realise.*

Existing refrigeration, chillers, cold water tanks, ice water storage, or hot water tanks can be used to store energy by drawing down power from the grid during low-price periods, or absorbing excess power outputs from solar panels (which can be expanded cost-effectively by avoiding exports to the grid).

Figure 6 provides an example of how organisations can store surplus power from rooftop solar, by pushing cool storage tanks down to their lowest temperature and turning chillers off or down during high price events.

FIGURE 6
On-Site Energy Storage – Cold Water Tanks or Ice Storage



Chillers can be controlled to cool storage tanks down to their lowest temperature during low energy cost periods (or to use surplus solar generation on site) and turned off/down during high energy cost periods, so that the load is met from the stored cold in water or ice.

OTHER DEMAND RESPONSE OPTIONS

There are a range of other strategies organisations can use to limit exposure to high price events through load reduction or generation. These options include:

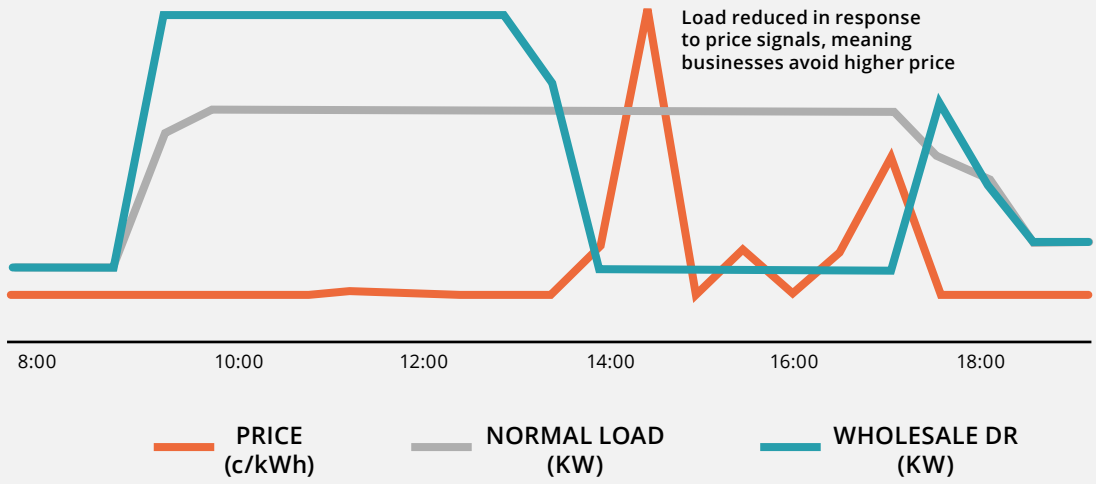
- **ADJUSTING THE TIMING OF DISCRETIONARY LOADS** such as staff amenities, water pumping, cooking, shift times.
- **ON-SITE GENERATION** such as bio-gas, co- and tri-generation, other generators (ideally avoiding diesel generators as this negates the emissions reductions benefits of renewable energy purchase and comes with high fuel costs).
- **ENERGY STORAGE** some types of sites such as data-centres have existing batteries or electric vehicles (e.g. forklifts) or have storage potential in existing cooling/refrigeration units, as illustrated in Figure 6.
- **MATERIALS STORAGE** such as in-line storage or resource pre-processing.

DEMAND RESPONSE IN ACTION: LOAD SHIFTING

The chart below shows how demand response can work in reality for an electricity customer. In this example, the customer shifted its operations to earlier in the day, switching its afternoon shift from a production program to a maintenance program.

This flexibility minimised electricity consumption during the price variation time-of-day and brought the business' load-weighted price down for that period, which resulted in significant savings when compared to not doing so. This was a ~45% reduction in total Victorian load for Flow Power.

FIGURE 7
The impact of demand response on a customer's load profile
Source: supplied by Flow Power, 2018



DURING PRICE EVENTS FLOW POWER'S CUSTOMER BASE REDUCES LOAD AROUND 45%

COUPLING CORPORATE RENEWABLE PPAS AND DEMAND RESPONSE

Corporates and other large electricity customers now have new, emerging and maturing options to manage their energy usage and energy budget risk in the medium- to long-term. A key challenge of entering into a corporate renewable PPA is timing of generation, demand and pricing. There is both a downside and an upside price risk.

However, there are still residual risks to manage, and businesses will have to remain engaged and proactive to do this effectively amid a dynamically changing environment.

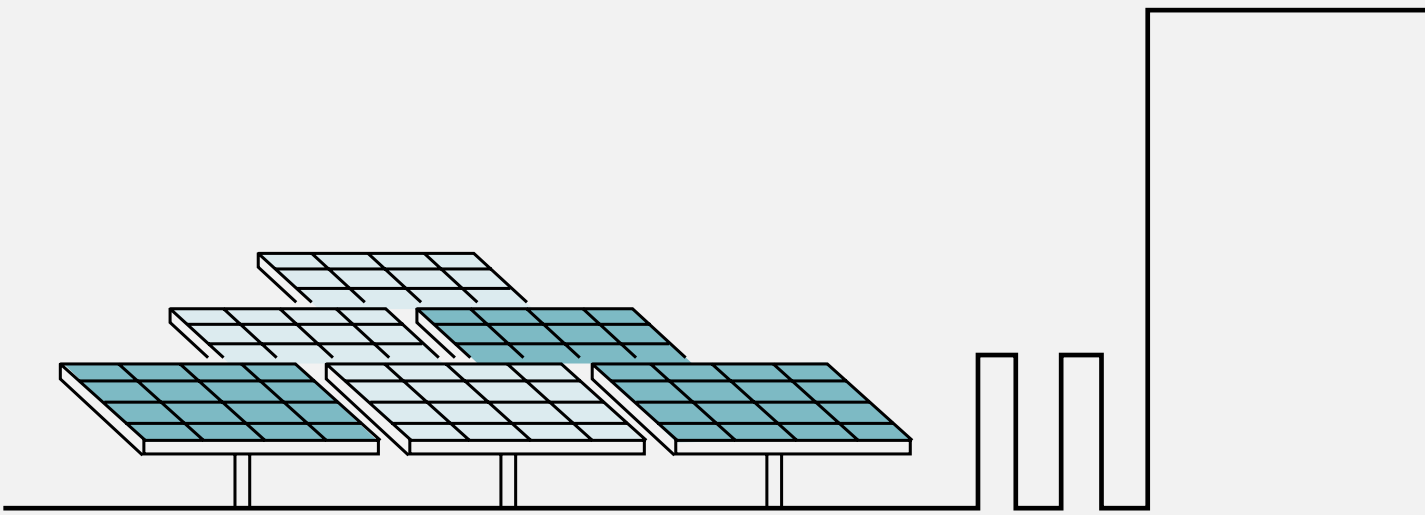
- On the downside, customer demand may occur during those times when their contracted solar or wind farm is not generating, leaving them exposed to the market and costly price spikes.
- On the upside, over time the average price for the contracted wind or solar farm under a corporate renewable PPA may start to reduce compared to the pool price. This could occur if significant wind or solar investment occurs in the region, making electricity abundant when it is windy and sunny and reducing pool prices during those time. This can see access to cheap electricity increase but reduces the net revenues received from the PPA.

DEMAND RESPONSE REDUCING UPSIDE PRICE RISK: AN EXAMPLE

Consider a 5MW customer with an 8MW wind corporate PPA, who may have high demand at 2pm on a hot summer's day. The NEM pool price may have risen from a typical $60 per MWh to $2,000 per MWh due to this high demand.

For a period, this could see the cost of electricity for the market customer rise from $300 per hour to $10,000 per hour. If their contracted wind power station is not generating at that time, the buyer will be exposed to the high wholesale electricity price.

Corporate renewable PPAs offer customers the opportunity to fix prices and lower costs but they also need a solution to avoid exposure to high price events.



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03. THIS STUDY: EVALUATING CORPORATE RENEWABLE PPAs & DEMAND RESPONSE IN PRACTICE

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METHODOLOGY

Flow Power engaged ISF to independently evaluate the performance of demand response implemented by three businesses.[8] These three businesses are existing Flow Power[9] customers located in the state of Victoria, South-East Australia.

THE THREE ASSESSED BUSINESS FEATURED IN THIS STUDY

© ANCA

ANCA is a global market leader of high quality CNC tool and cutter grinders, founded and headquartered in Melbourne.

© YARRA VALLEY WATER

Yarra Valley Water is Melbourne's largest retail water utility, providing essential water and sanitation services to more than 1.8 million people.

© MRMAGNIFICENT / ISTOCK

Select Harvests is Australia's largest vertically integrated nut and health food company.

ISF assessed the value of corporate renewable PPAs and demand response relative to standard retail electricity arrangements for the above organisations. The data sets were provided by Flow Power, with validation and modelling by ISF.

For each of the three electricity customers, the electricity purchasing costs for 2017 were evaluated and compared in terms of electricity costs to the customer over a year. The electricity customers chosen were treated as follows:

- **ACCESS TO THE WHOLESALE MARKET.** These customers are each paying the 'pool' price for electricity by participating in the market, as opposed to retail customers with a standard retail contract, and were thereby already avoiding many of the charges associated with retail contracts.[10]
- **CORPORATE RENEWABLE PPAs.** The analysis included the prospective signing of a PPA for renewable energy, each involving an agreement for the purchase of renewable electricity at a fixed rate for a fixed time-period (generally 10 years).
- **DEMAND RESPONSE.** The modelling took into account each organisation's capability for demand response actions, although the specific demand response method differed between each organisation.

8 It should be noted that not all customers have signed PPAs with Flow Power at the point of modelling.
9 Flow Power offers its customers the option of corporate renewable PPA's, financial hedges and demand response products to reduce their customers' exposure to high price events.
10 They also have the option to hedge using financial contracts for the balance of supply but this has not been included in the analysis.

The types of demand response implemented and assessed in the chosen case studies were:

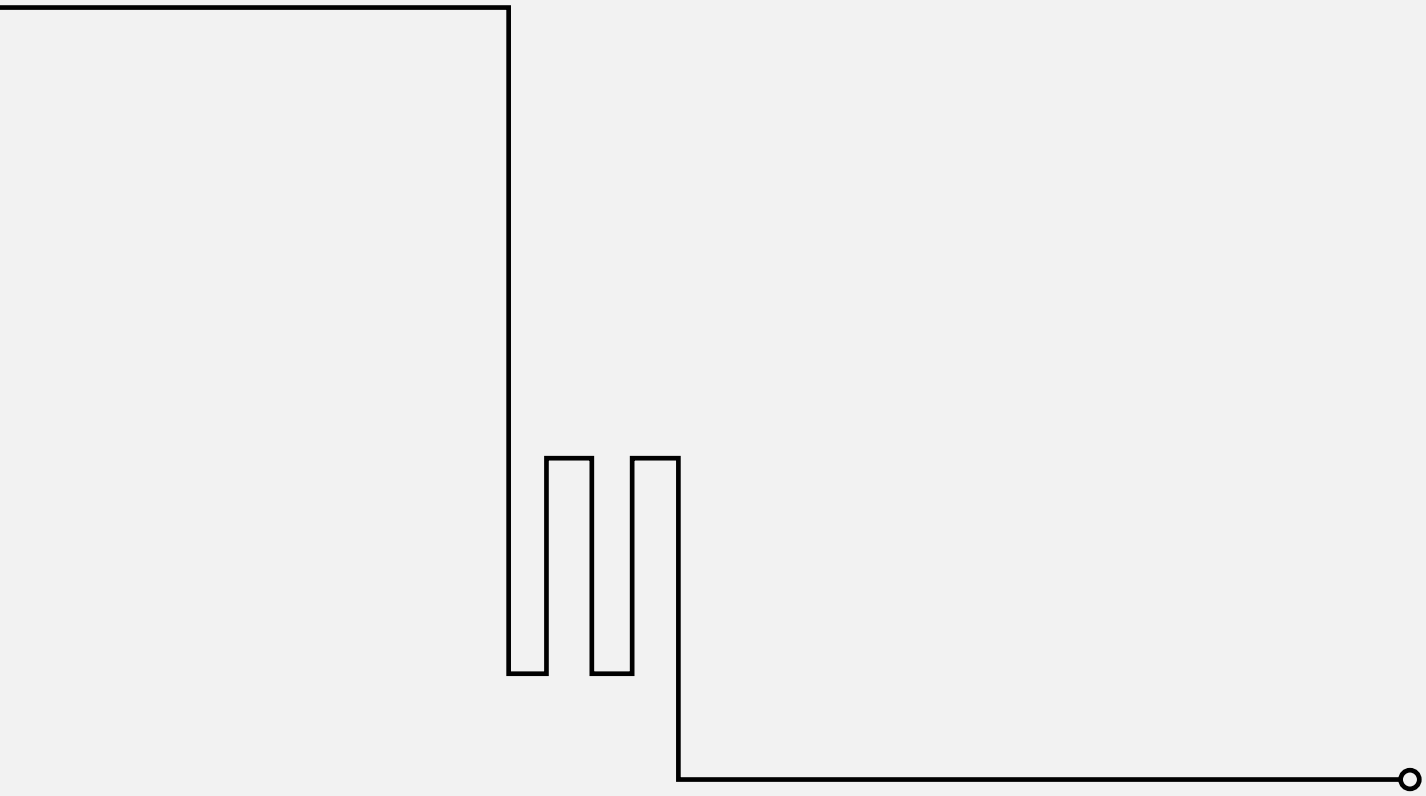
- Shut down of non-essential plant (industrial manufacturer and the nut & health food company).
- On-site generation (water utility).

These were selected based on the loads the customers were aware of themselves and considered flexible enough to participate in a demand response program.

In order to analyse the benefits of the demand response to each organisation in our study, a model was run with 30-minute interval data of customer demand and local regional pool prices over a 12-month Q2 2017 to Q1 2018. It was then adjusted to estimate the additional savings when the different types of demand response were deployed in high-price events to avoid consuming grid electricity: each time this price event occurred, the demand response mechanism was activated and cost savings made due to demand response could be identified.

It is important to note that the modelling undertaken by ISF represents a snapshot in time in a given location (i.e. 2017 electricity prices in the state of Victoria).

- **HIGH PRICE EVENTS.**
  There were twenty-one high price events over $500/MWh where demand response would typically be deployed.



ON-SITE GENERATION

For organisations with existing on-site electricity generation, the on-site generator was utilised as demand response in reaction to high prices over a certain threshold. Currently, there are cases where the existing generator uses diesel fuel, which are considerably more expensive to run and emitting much higher greenhouse emissions than other demand response options (such as load shifting, energy storage and bio-energy generators). As the market for demand response matures and the price of battery storage and rooftop solar continue to fall, greater use of alternatives to diesel generators are likely and preferred.

THE TREATMENT OF EXPORT BY ON-SITE GENERATION

The analysis also considered the outcome of on-site generation producing electricity at levels beyond the sites local demand, and therefore included the export of electricity to the grid during times of high prices. By exporting to the grid, businesses are able to tap into revenues generated from high pool prices. However, there may be challenges for some organisations wanting to use on-site generation for export to the grid, with local network and AEMO approval required in certain cases.

ELECTRICITY COSTS AND THE ASSESSMENT OF OVERALL SAVINGS

Electricity costs for customers are made up of several inputs:

- Retail costs are also known as 'energy costs' or 'contestable charges', and are the cost of the purchase of electricity from the grid along with any hedging products that protect the customer from high prices.
- Network charges are passed through by the retailer from the local network company, and include transmission and distribution costs.
- Environmental and other charges are added for market operator costs, as well as for various federal and state environmental programs.

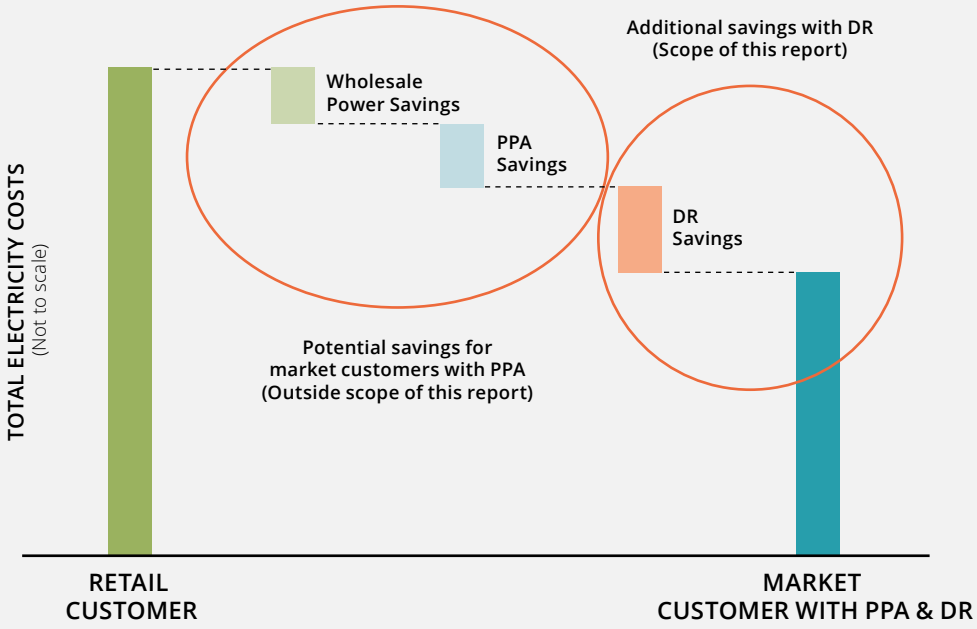
The portion of each of these changes over time and depends on the type of electricity customer and other considerations. Energy Charges are also known as "Contestable Charges" or "Retail Charges" tend to make up 30% to 70% of total electricity costs depending on the customer, state and network. Customers pay Energy (Generation and Retail) Charges along with Network, Environmental and Other Charges. For this study, all savings refer to those related to Energy Charges.

It is important to note that demand response can also significantly reduce network demand charges and there is a high correlation between high price events and critical peak demand charges from the networks. The value from demand response is therefore greater than just retail costs, especially in contexts with higher numbers of high-price events.

OUR STUDY RESULTS

There are a number of steps for organisations to save on electricity costs – firstly moving from a retail customer to become a wholesale customer, secondly adding a corporate renewable PPA and finally using demand response. – as illustrated in Figure 8.

FIGURE 8
How the energy cost savings were analysed within the scope of this report



DR = Demand response PPA = Corporate renewable power purchase agreement

The focus of this study is the last step – the use of demand response in combination with a corporate renewable PPA. Cost savings for market customers using a corporate renewable PPA were calculated as a base for estimating the additional savings from demand response.

Our study found that the electricity cost savings due to demand response (which were over and above any cost savings made due to PPA terms) were as follows:

- The largest energy cost savings (around 33.3% reduction in energy costs) were identified in the case of the nut & health food company, which was able to reduce its electricity demand by shutting down non-essential plant during peak price periods.
- The Water Utility was able to tap into around 24% savings on energy costs by utilising on-site generation, including exporting to the grid during times where the pool price exceeded $300 per MWh.
- The Industrial Manufacturer achieved modest energy cost savings from the shutdown of non-essential plant (around 2.3% saving).

It should be noted that this analysis captures only the 12-month period from Q2 2017 to Q1 2018. It should also be noted that each of these customers made significant cost savings through the corporate renewable PPAs, but these are not presented here (this is because it represents a small portion of a long-term agreement) and wholesale prices were relatively high during the study year.

Our focus was to evaluate the savings that could be made additionally through demand response with these savings calculated for the use of demand response to remove exposure to high-price events in the wholesale electricity market.

It is also important to note these figures should not be used to imply that one type of demand response is better than any other, with each organisation in our study just using any known and readily available flexible loads. However, in all cases, demand response produced a positive impact on cost reductions irrespective of the method adopted.

As explained previously, many businesses have more sources of load flexibility than they realise. Load management and demand response are under-utilised resources by Australian organisations. Over time, as greater use is made of different types of demand response, there will be stronger evidence to assess which types of demand response are most cost-effective.

Furthermore, the use of demand response provides for more than just cost savings. While the 2017 study period involved a relatively small number of high price events for Victoria, by utilising demand response, these organisations will be able to continue to manage their exposure to high price events in the future whenever they occur. This has the potential to result in further energy cost savings where high price events are more severe and/or more frequent.

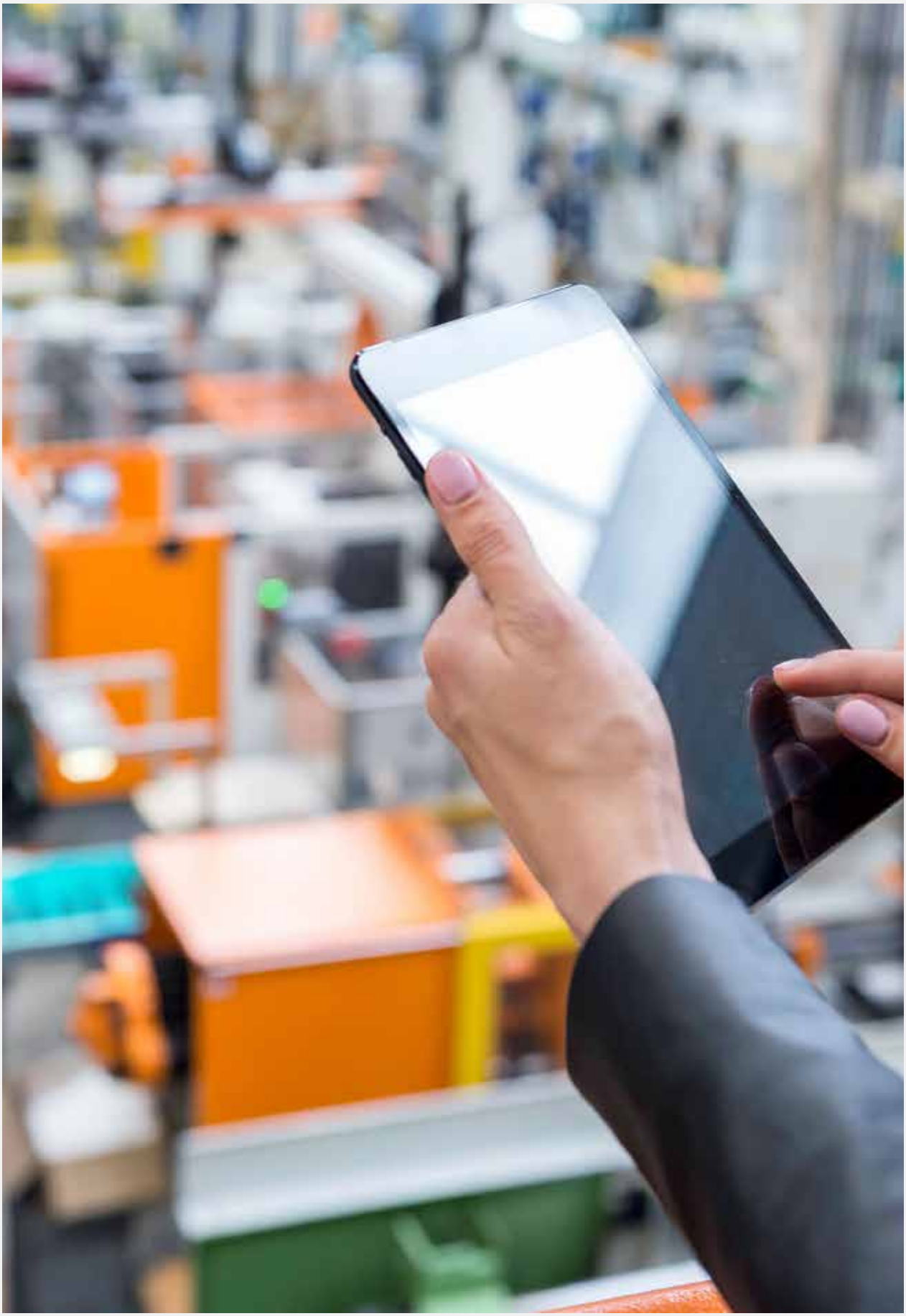
It is important to note that while these results cannot be used to imply that one type of demand response is better or more effective than another, these results were generally dependent on the type and scale of demand response, which indicated the following patterns:

- Notionally shifting operating hours seasonally to deliver higher consumption during lower price hours of the day has a modest benefit. Seasonal prices vary, providing an opportunity for some savings by varying operating hours, but greater savings are to be made by avoiding the extreme price events.
- More significant cost savings were observed where the organisation was able to shut-down a larger portion of the plant for shorter periods (2 hours); high-price events are generally relatively short-lived so the greatest savings are achieving by larger, focussed demand response.
- Where higher levels of on-site generation are possible (resulting in more than 10% export to the grid), better overall energy cost reductions are achieved: on-site generation also creates the flexibility to bid into the wholesale market during high-price events for market customers.

KEY RESULTS: MODELLED SAVINGS FROM DEMAND RESPONSE FOR WHOLESALE CUSTOMERS WITH CORPORATE RENEWABLE PPAs

Customer	ANCA	YVW	SELECT HARVEST
Sector	Industrial Manufacturer	Water Utility	Nut and Health Food
Demand response type	Shut Down of Non-Essential Plant	Onsite Generation	Shut Down of Non-Essential Plant
Reduction in energy costs from demand response (in addition to modelled PPA Savings).	2.3%	24%	33.3%

Note: The modelling results presented are potential (hypothetical) savings. Actual savings will depend on pool prices, their variability, willingness and cost to activate Demand Response, and ability to implement and execute Demand Response successfully for the correct time periods.



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BEST OF BOTH WORLDS:

Renewable Energy and Load Flexibility for Australian Business Customers

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