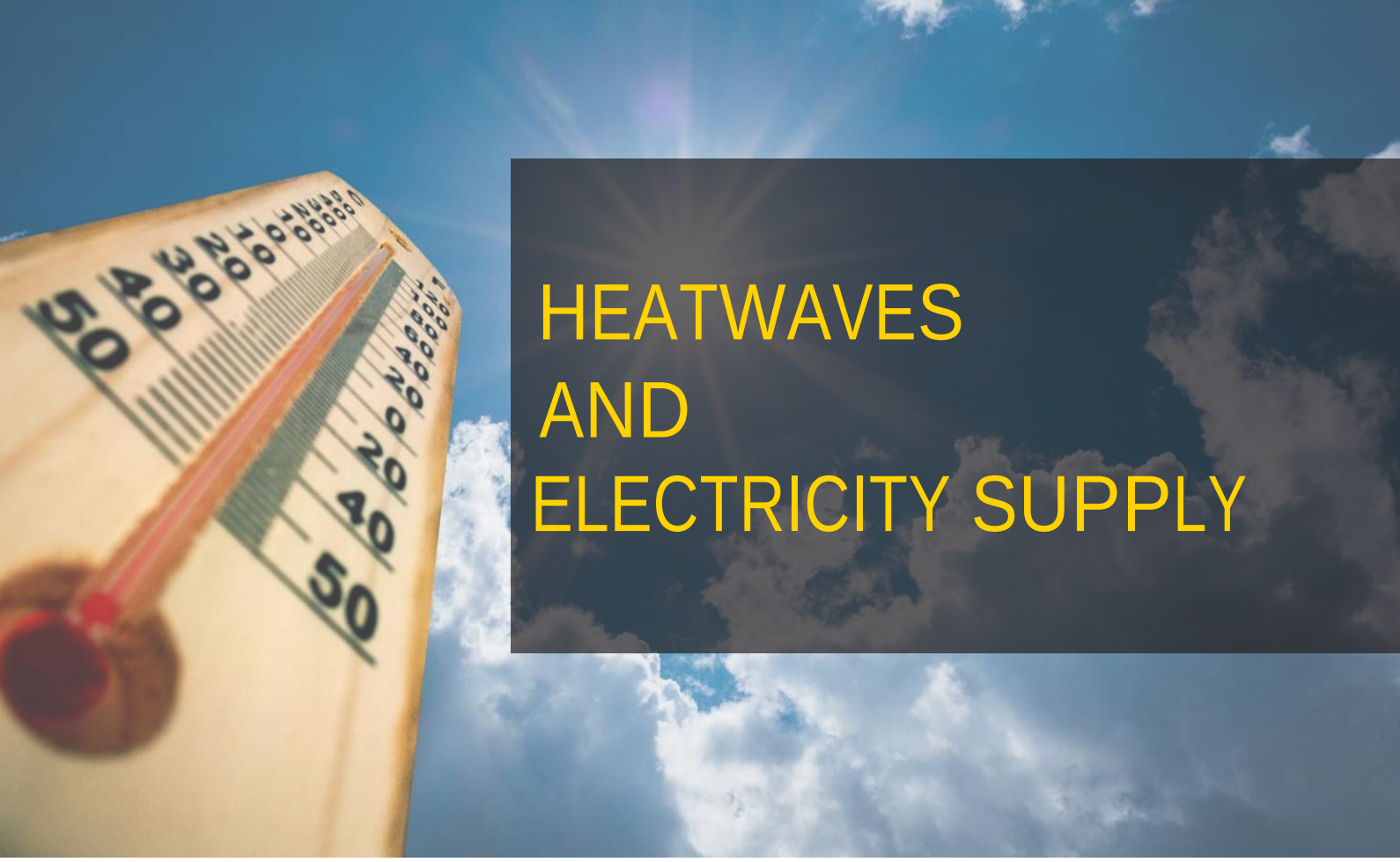

HEATWAVES AND ELECTRICITY SUPPLY

Summer is the time of heatwaves in many parts of Australia.

Hot weather places significant demand on the electricity system. This demand has increased over recent decades with the growing use of air conditioners in homes and businesses.

Extended hot summer weather can cause significant demand on the electricity system. This strain has increased over recent decades with the growing use of air conditioners in homes and businesses.

Heatwaves are three or more consecutive days of unusually high temperatures. They place the grid in many parts of mainland Australia under great stress, sometimes resulting in blackouts. These can be caused by a number of factors, including local faults, bushfires or generator faults.

PEAK DEMAND

Peak demand is the maximum amount of electricity needed by a state, region, or even a street. The grid is built to meet demand for most of the year, but can sometimes struggle to handle spikes in power usage caused by air conditioners. In all Australian states, except Tasmania, peak demand occurs in summer during heatwaves. Peak demand is measured in megawatts (MW). The scorecard for peak demand events and the season in which they occurred are shown below.

Peak	QLD	NSW	VIC	SA	TAS	WA
MW	10 179	14 764	10 490	3 397	1 884	4 304
Period	Summer 2018/19	Summer 2010/11	Summer 2008/9	Summer 2010/11	Winter 2008	Summer 2015/16

Source: AER; Western Power. WA data covers the South West Interconnected System, with population centres in the state's south-west region. Summer demand refers to the period 1 Nov-31 Mar and winter demand refers to the period 1 May-31 Jul each year. Data is current at 30 June 2020.

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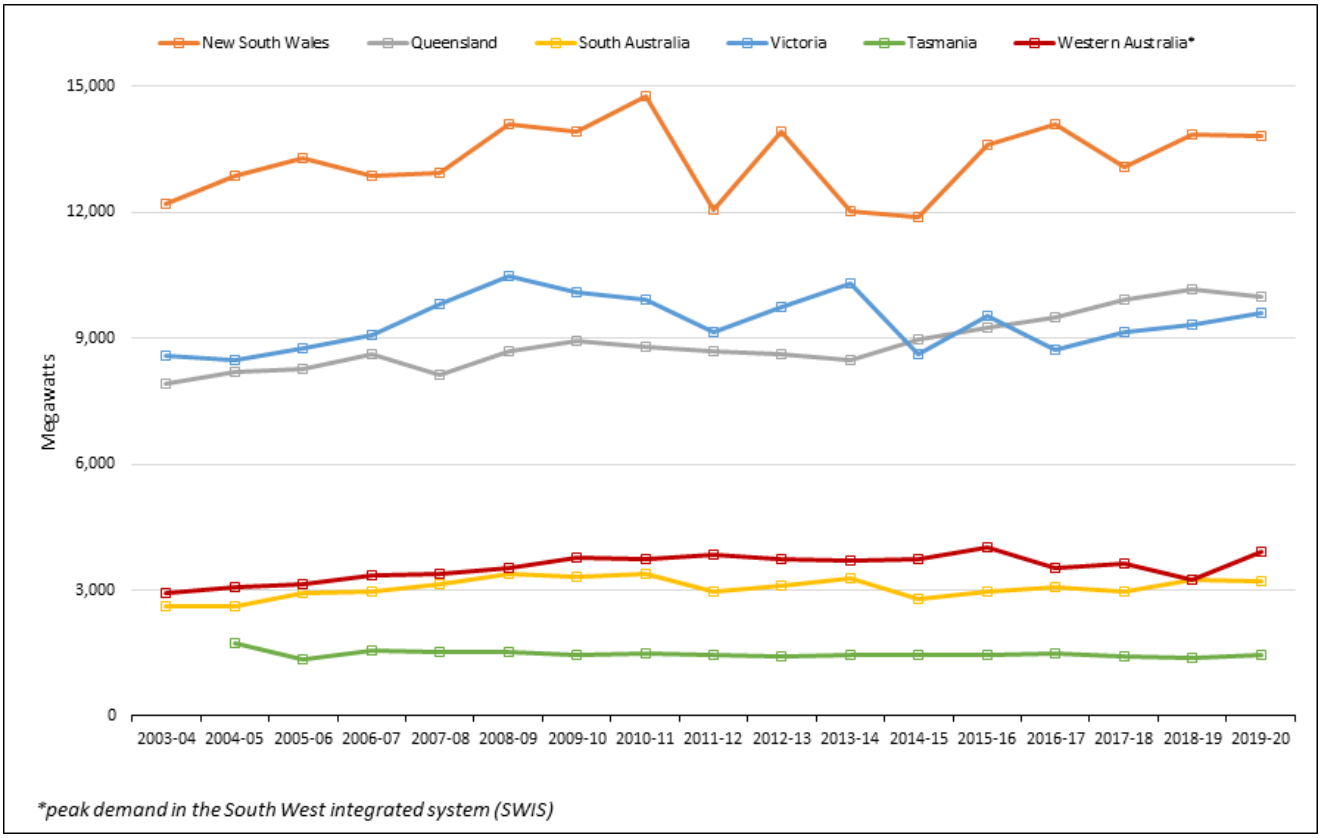
While the increased reliance on air conditioning has caused a rise in peak demand over the past couple of decades, in recent years this has been somewhat offset by the greater role household solar and batteries are playing, and a reduction in demand from large industrial facilities. In the National Electricity Market (NEM), the exception has been Queensland, where a large uptake of rooftop solar PV has been offset by growing industrial demand, particularly in liquefying coal seam gas for export. The chart below shows the trend for peak demand in summer and winter over the past two decades by state

Figure 1. Peak demand by state, summer 2003-04 – 2019-20



Source: Electricity Gas Australia 2005 – 2019, AEMO

Power systems across the eastern seaboard have interconnections, so high demand in one state can usually be met by extra generation from another. Heatwaves have the biggest impact on the electricity grid during January and February, especially when multiple states experience heatwaves at the same time. Multi-region heatwaves, such as those on 30-31 January 2020, increase pressure on the grid as less supply can be drawn from neighbouring regions to meet higher demand. South Australia and Victoria, for example, often have heatwaves at the same time.

Heatwaves and electricity demand

The occurrence and severity of heatwaves can be unpredictable, and there are a number of identifiable factors and patterns that can help us predict the level of electricity demand:

Duration of the heatwave: electricity demand tends to increase in the third and fourth days of consecutive hot days, as air conditioners increase output to manage the accumulating heat in buildings.

School holidays and weekends: demand tends to be higher from mid-January as schools and businesses resume, and weekdays have higher demand than weekends.

Solar PV: increased deployment of rooftop solar PV helps reduce system demand during most summer heatwave peaks (providing there is no cloud cover) but shifts the maximum peak event to later in the day as the sunlight dwindles. In future this is likely to be offset by a higher uptake of batteries to store power generated by rooftop solar.

WHAT HAPPENS IN A HEATWAVE?

Networks, operators, regulators, governments and emergency services know when heatwaves are coming and plan accordingly. Ongoing maintenance takes place to keep the grid and generators in good working order before summer. Electricity networks have specific operational plans developed in advance of the hottest days to keep customers safe and comfortable while maintaining the reliable performance of the grid during periods of increased demand. They also have emergency crews ready to respond if equipment fails or if there is an emergency, to minimise the time customers are without power.

A challenge leading into the 2020-21 summer has been to ensure critical maintenance and planned upgrade work continued while managing the impact of COVID-19. The industry has worked closely with the market operator to mitigate the impacts to customers and prepare for summer.

While pressure is placed on the grid by high demand, high temperatures can also impair the operation of key infrastructure like generators and transmission lines. Bushfires can lead to outages on major transmission lines and have the potential to impact solar output if there is extensive smoke haze (see page 6). These impairments can impact on the operation of the system.

Networks use smart technology and demand response to manage demand on the hottest days. The energy sector is also seeing new services and technology working with the grid to allow customers to make the most of their solar and batteries, and to engage and incentivise them to shift their electricity usage.

In preparation for an extreme heatwave, some large industrial customers will undertake voluntary load shedding, known as demand response. That is, they agree to switch off part, or all, of their operations. This helps reduce demand on those days. Some industrial customers have greater flexibility than others in being able to voluntarily reduce their electricity demand on these days.

What happens in a heatwave? *(cont.)*

During hot days, it is not unusual to see high spot prices in that particular state's wholesale electricity market. This is how the market is designed to work. Higher prices provide signals to generators to enter the market to help meet supply. Peak plants, such as hydro or gas, are built specifically for these types of events, and can sometimes run for only a few days a year.

These higher wholesale prices do not translate into higher retail electricity prices during a heatwave, because retail prices are fixed across a year and retailers manage the price risk for their customers.

LOSS OF SUPPLY

There are three basic types of power interruptions that can occur during a heatwave:

1. **Localised outages**: these can be for any number of factors – i.e. a tree branch on a line, a truck hitting a pole, or equipment failure Some may be due to heat and high demand. These are generally communicated by local network operators to customers via SMS, websites, Twitter and other social media. They can involve a handful or a few thousand households depending on the cause, and supply is restored as quickly as possible once repairs take place.

2. **Power system disturbance**: When a major event has disturbed the security of the power system, customers may be interrupted over a wide area. There are many possible causes, but most frequently it is caused by a weather event which creates a sudden interruption to critical transmission lines. For example, on 4 January 2020 transmission lines in southern NSW tripped due to bushfires.

3. **Involuntary load shedding**: in the unlikely event there is still not enough supply to meet demand, the Australian Energy Market Operator (AEMO) will order sections of the grid to be switched off until increased supply can be restored or demand reduces, generally in the evening. These are known as rolling blackouts, as different parts of the grid take turns being without power. These are infrequent and efforts are taken to minimise their frequency and duration.

A shortage of electricity supply can be the result of a number of factors. It could be a fault or heat-related stress in a generator (or generators) which reduces supply at critical times. A transmission line may have its capacity reduced to avoid equipment damage from high temperatures (the lines can sag under heavy load and high temperatures) or shut off because of the risk of bushfires. Any of these events, under certain conditions, can increase the risk of outages, but most will affect only localised parts of the grid at any time.

Rooftop solar PV or batteries by themselves will not protect your house from experiencing an outage unless they are configured to do this. At present few systems have been set up for this, so even if you have a solar PV system installed, you might still be affected and should be prepared.

AEMO has identified off-market reserves that may be available via the Reliability and Emergency Reserve Trader (RERT) process. The RERT is a mechanism which helps AEMO manage the supply-demand balance. These reserves are mostly forms of demand-side response, where customers have offered to reduce their consumption for a few hours in return for a fee. AEMO attempts to use these reserves only as a last resort to avoid having to order blackouts once normal market supplies are fully committed. Costs are then recovered from customers.

Last summer, RERT was used on 30 December 2019 (Vic), 4 January 2020 (NSW), 23 January (NSW), and 31 January (Vic and NSW.)

Impact of increased renewables

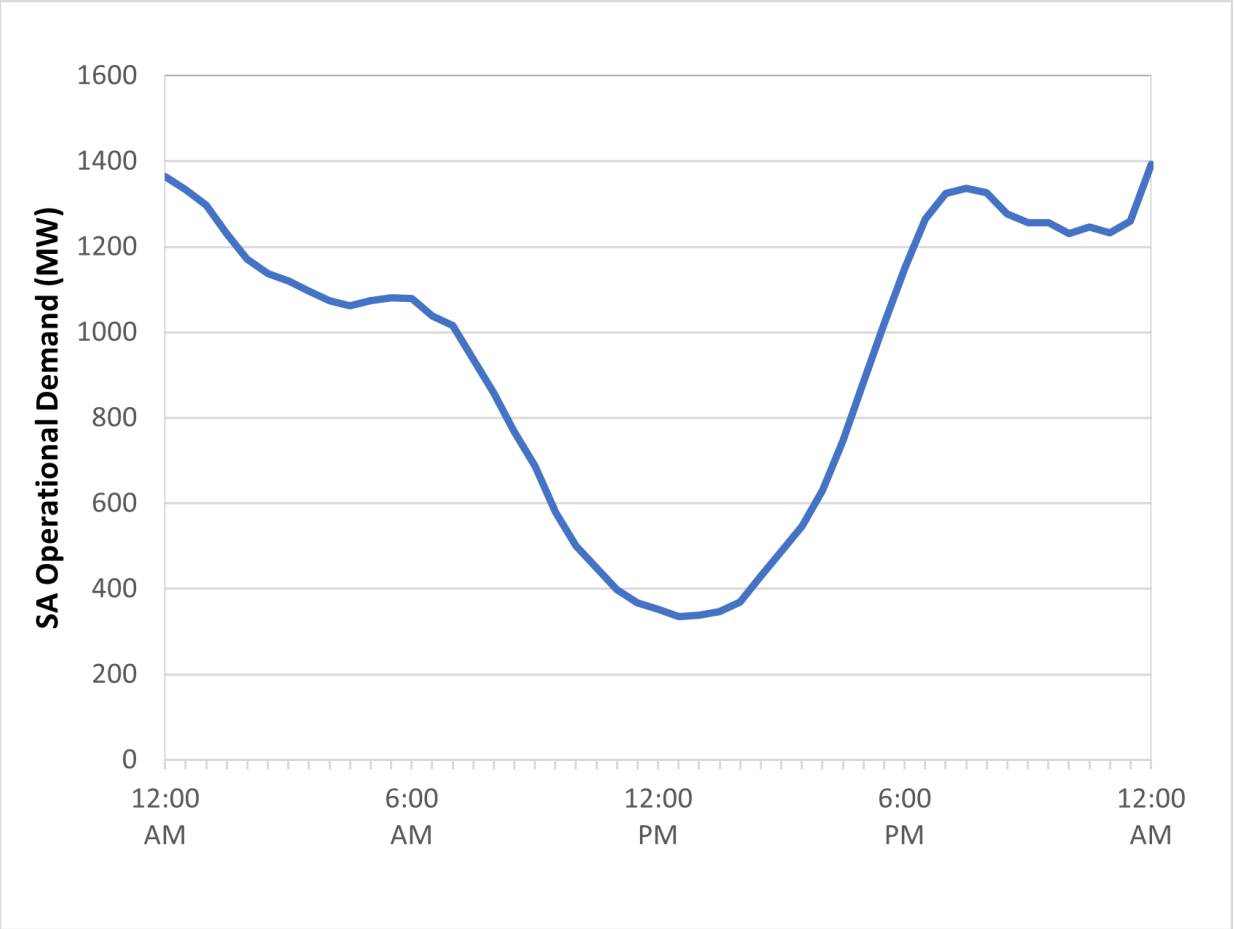
Rooftop solar PV contributes to the supply of electricity on hot sunny days. Wind generators may also contribute to supply during heat waves, depending on the amount of wind blowing.

Renewable generation, particularly from rooftop solar, is changing the shape of daily energy demand. An occurrence called a ‘duck curve’ is shown in figure 2; this curve is caused by the shifting energy demands. Due to the increased uptake of rooftop solar, during the day solar PV "hides" how much electricity people actually use. When the sun goes down it reveals itself as a massive spike in the evening.

Historically peak hot day demand was typically experienced in the early afternoon, however it has now shifted to late afternoon/early evening. During the day when the sun is shining and the wind is blowing, there is less reliance on the grid due to the increased use of renewable energy. While daytime demand is considerably lower, there is now a sharper spike in grid demand as the sun goes down.

As renewable energy grows further and coal plants retire, grid demand in the middle of the day is expected to continue to shrink, moving to later in the evening once the sun sets. This demand peak and subsequent quick drop needs careful planning to ensure supply risks are managed. The shifting demand requires firm generation to start up and shut down more often and in a very short space of time to meet the population’s energy needs.

Figure 2. Rooftop solar is changing NEM demand and time of peak (South Australian operational demand 14 November 2020)



Source: NeoExpress

Impact of increased renewables *(cont.)*

The ongoing growth of solar PV means the 'duck curve' challenge will continue to grow, with even sharper ramp up of demand in the late afternoon as solar output falls and households draw on the grid. This means weather forecasting becomes a more critical element – the timing of peak temperatures (which will drive use of air conditioners, for example), when cool changes are expected, and wind availability, will all impact demand forecasts.

Another factor that was evident in the 2019-2020 summer as a result of the extensive bushfires in eastern Australia was the impact on output from solar generation. AEMO estimates its output fell by 6-13 per cent as a result of smoke plumes at times. Overall, AEMO notes that actual solar generation output is often lower than forecast, while for wind generation output is generally higher than forecast. There is a major focus on improving the forecasting as the grid continues to transition to more renewable generation.

MEDIA CONTACTS

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What can households do?

Every household in Australia is in a different part of the electricity network – so only one network supplies electricity to your community. Find out which network business services your suburb. Follow them on social media and bookmark their website to receive timely information in the event of a local fault. This will help you know how long the power will be out, so you can plan ahead.

Stay informed during heatwaves. AEMO is in charge of managing the electricity system and will advise how the system is performing. You can follow AEMO on social media (Twitter; Facebook) and monitor news reports to receive updates on system demand.

Life support customers should register their details with their local energy networks and their electricity retailer who issues their bill. If you rely on a continuous power supply for life support equipment, you are urged to have a back-up plan in case there are any unplanned power outages.

In some situations, governments or regulators may ask households to minimise energy usage to help reduce peak demand and avoid the risk of rolling outages. Simple measures such as increasing the cooling temperature on your air conditioner by a couple of degrees can help everyone and save on your power bill.