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# Flexible Demand: A Guide for Commercial Buildings

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Prepared for the City of Sydney and Better Buildings Partnership

**Institute for Sustainable Futures**
**Positive Zero**
**Buildings Alive**

# Authors and acknowledgements

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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 guide. The authors do not accept any responsibility for any loss that may arise by anyone relying upon its contents.


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# Introduction

## The electricity grid is changing

Australia's electricity grid is undergoing a rapid transition as renewables increase and ageing coal-fired power stations are retired. This change is being driven by a combination of government policy and market forces. The way electricity is generated is becoming more diverse and distributed. Demand on the electricity grid will continue to increase through electrification, electric vehicle charging, climate change, population growth and large data centres.

The need to maintain a stable and reliable grid during the transition away from fossil fuels is driving changes to the way we both generate and consume electricity. Energy flexibility in buildings, which can help match demand and supply, is a core part of government policies for net zero, and the roadmap to transition the National Electricity Market (NEM) power system over the next 20 years.

## Buildings that are flexible will gain advantage

Buildings use a lot of electricity. Those that can shift when they use electricity can reduce their energy costs and greenhouse gas (GHG) emissions while helping to support a stable and reliable grid.

To make a building flexible means considering the following three key steps:

- Shifting electricity consumption from periods with high cost to lower cost.
- Managing peak loads to reduce peak demand charges.
- Reporting GHG emissions based on the carbon intensity of the grid at the time the electricity was consumed, which varies every hour of the year.

Buildings that can flex their demand, primarily through a combination of building controls and energy storage, will be able to respond positively to all three.

## Purpose of this guide

This guide provides building owners and asset managers with practical guidance on:

- Understanding why we need to shift demand in buildings
- How to shift demand including:
  - HVAC controls
  - thermal storage – domestic hot water and chilled water
  - batteries
- Preparing a feasibility study and business case, including key risks and opportunities.

The guide includes case studies illustrating how current technologies and approaches have been used to shift electricity demand in buildings.

The guide also discusses how NABERS and Green Star are responding to the need for flexible demand, and the potential shift to reporting Scope 2 GHG emissions based on time of use instead of annual grid averages.

## Why do we need to shift demand in buildings?

# The electricity grid is changing rapidly

Australia's energy system is changing rapidly. Coal-fired power stations are retiring and being replaced with a combination of renewable energy, storage and gas-powered generators. Australian households and businesses continue to invest in rooftop and grid-scale solar at a world-leading pace, leading to an abundance of electricity during daytime periods. At the same time, demand for electricity is increasing owing to population growth, electrification of buildings, the transition to electric vehicles, and new loads such as data centres.

The abundance of solar electricity is creating challenges for the stability of the grid, which is reflected in wholesale electricity prices. When renewables (primarily solar) are abundant during the day, the wholesale price of electricity is low and often negative.

As the sun goes down, demand for electricity is still high, resulting in an increase in wholesale prices between 5pm and 8pm. Then at night, demand for electricity reduces and the price also reduces – but this is also the period when fossil fuels are currently used to meet demand.

To address the abundance of solar electricity, the Federal Government has introduced two new schemes:

- In 2025, the Cheaper Home Batteries Program, which encourages households to invest in batteries to store solar-generated electricity.
- In 2026, the Solar Sharer Offer, which encourages households to change when they use electricity by offering free electricity for three hours in the middle of the day.

The way most businesses pay for electricity consumption and report greenhouse gas (GHG) emissions does not reflect real-time changes in electricity generation, and associated costs ($ per kWh) and GHG emissions (kg $CO_2$ per kWh). Monitoring and managing time of use is becoming increasingly important.

Figure 1 shows the average GHG intensity and wholesale cost of electricity in the NSW grid by time of day for:

- calendar year 2025, and
- June and November 2025.

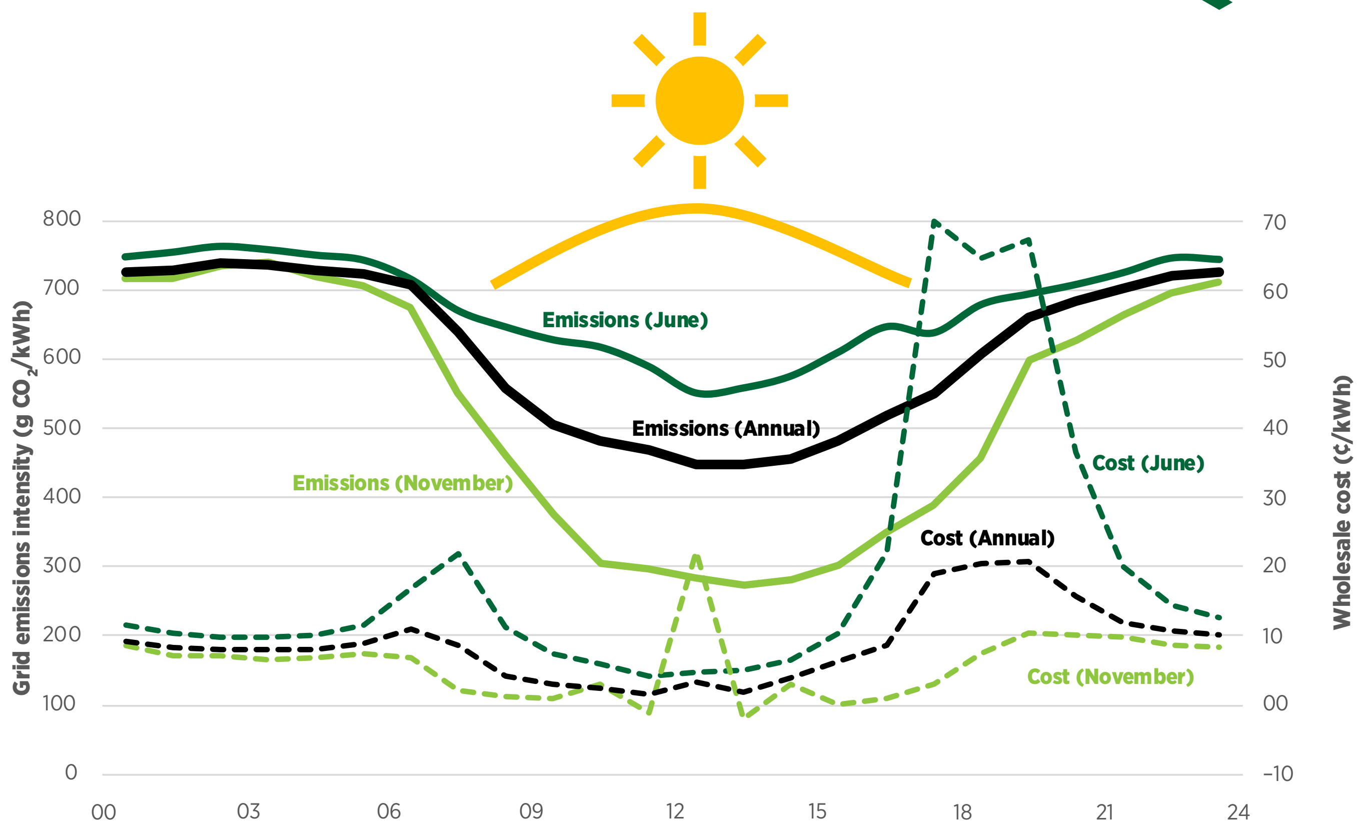


*Figure 1: NSW Electricity Grid 2025, GHG intensity and price change dynamics. Data source: Buildings Alive.*

| | | |
|---|---|---|
| Overnight, GHG intensity is highest due to fossil fuels. This hasn't changed much over the last four years. | During the day solar generation is abundant. The GHG intensity drops, particularly in summer. GHG intensity is still relatively high in winter. | The highest electricity prices occur between 4pm and 8pm when solar generation drops off but demand is still high. |
| More supply from wind and energy storage is expected to meet demand as ageing coal power stations close over the next decade. | To reduce GHG emissions and energy costs, this is typically the time to schedule demand and charge energy storage systems. | Hydro storage, batteries and gas peaking plants play a large role in meeting demand during this time. |

# The demand for electricity in commercial buildings will increase

The average consumption of electricity in commercial buildings has fallen over the last two decades, with NABERS Energy ratings playing a key role in making energy performance both visible and marketable. However, electricity consumption in many commercial buildings is set to increase over coming years, driven by:

- removal of gas use through electrification
- installation of electric vehicle charging in car parks.

## Electrification of buildings

Achieving net zero targets without relying on carbon offsets for Scope 1 GHG emissions requires electrification of gas systems. This will typically lead to an increase in electricity consumption in buildings – see Figure 2.

The main systems involved in electrification are:

- **space heating** – replacing gas boilers with heat pumps or VRF
- **hot water** – replacing gas heaters and boilers with heat pumps and storage tanks
- **cooking** – replacing gas cooktops with induction cooktops.

For further details on electrification opportunities, refer to the *BBP Electrification Resource Pack for Facility Managers and Asset Managers*.

## Electrification of transport

In the second quarter of 2026, over 30% of new car sales were either electric vehicles (EV) or plug-in hybrids (PHEV). In the same quarter in 2022 it was just 1%.

Unlike conventional vehicles, which are refuelled at roadside service stations, EVs are mostly charged while parked, at home, at shopping centres or increasingly at work.

Uptake of EVs is likely to continue increasing, resulting in an increase in the number of EVs being parked and charged in commercial buildings. This will require careful consideration of charging infrastructure and load management to avoid adding to the building's peak electrical demand, or charging when wholesale electricity prices are at their highest.

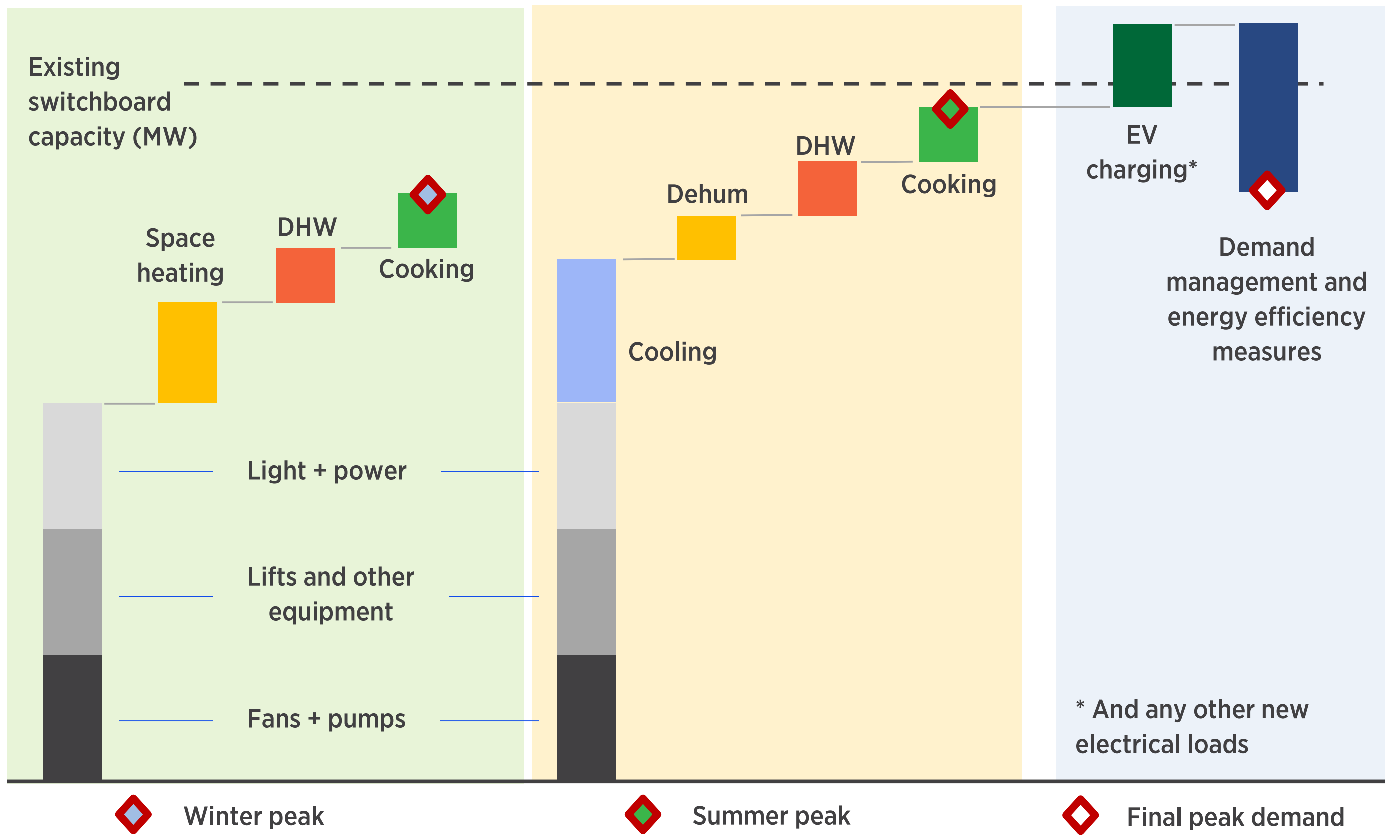


*Figure 2: Indicative increase in electricity demand for an existing office building from electrification. Source: A Practical Guide to Electrification: For Existing Buildings, Green Building Council of Australia.*

## Climate change impacts

The impact of climate change may also lead to changes in electricity demand in buildings, owing to more extreme heating, cooling and humidity control. Exposure to this impact depends on many factors including building thermal performance and HVAC system type.

# Emissions reporting needs to reflect the time at which electricity is consumed

The average emissions intensity of Australia's electricity grids is declining because of the growth in solar and other renewables, and the closure of coal-fired power stations.

Most businesses measure and report their Scope 2 GHG emissions from electricity using the annual emission factors (kg $CO_2$ per kWh) published by the Australian Government. However, these factors do not consider when electricity was consumed during the day, or which generators supplied that electricity.

Figure 3 shows the continued reliance on coal-fired generation to meet overnight demand. The contribution of battery discharge during early evening peaks is also evident and is expected to increase as more grid-scale and consumer batteries are installed.

Figure 4 shows the average emissions intensity of the NSW electricity grid by time of day for each year from 2022 to 2025.

Daytime emissions intensity has reduced year on year as more solar generation has come online, while overnight emissions intensity has remained relatively stable.

As shown in Figure 1, daytime emission intensity also varies seasonally with the proportion of solar generation in the grid, ranging from 60% below the annual average at midday in November 2025 to 25% above it in June 2025. In contrast, there is little variation at night because of the continued predominance of coal-fired generation.

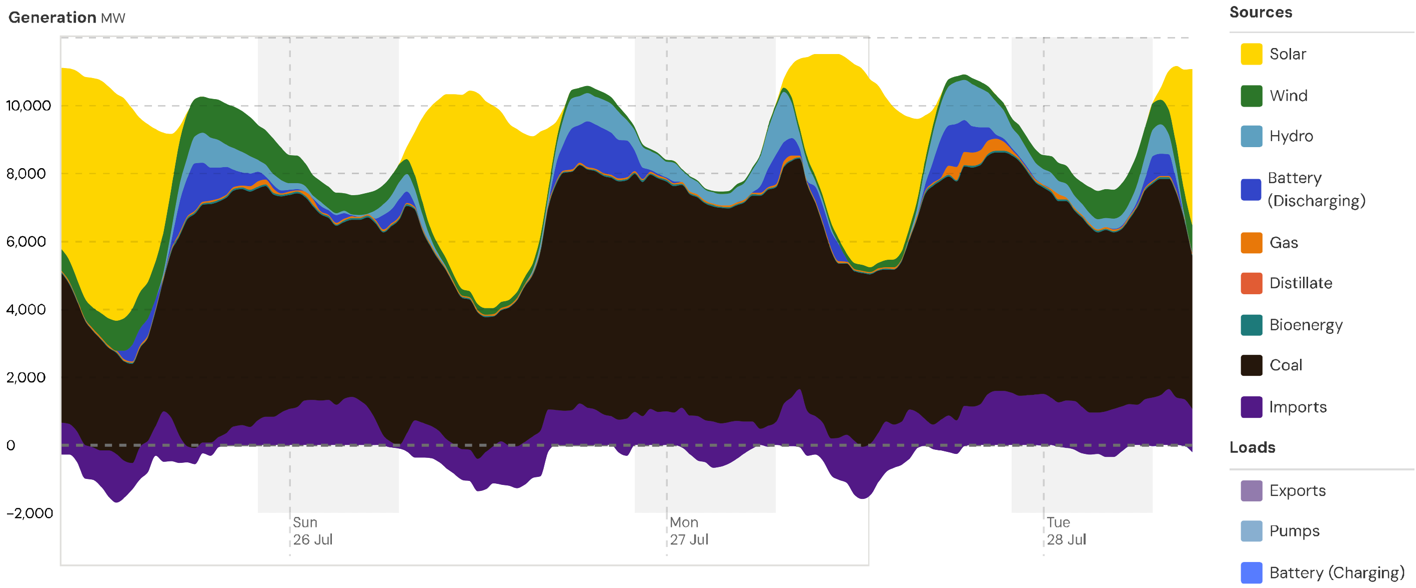


*Figure 3: NSW generation mix (in MW) for a three-day period in July 2026. Emissions intensity is dominated by coal generation, with a small amount from gas peaking plants. Source: Open Electricity.*

**All things being equal, a building that shifts electricity consumption from the evening to the daytime will have lower GHG emissions than one that does not. This benefit is not currently reflected in reporting based on average annual emissions factors, but that is likely to change.**

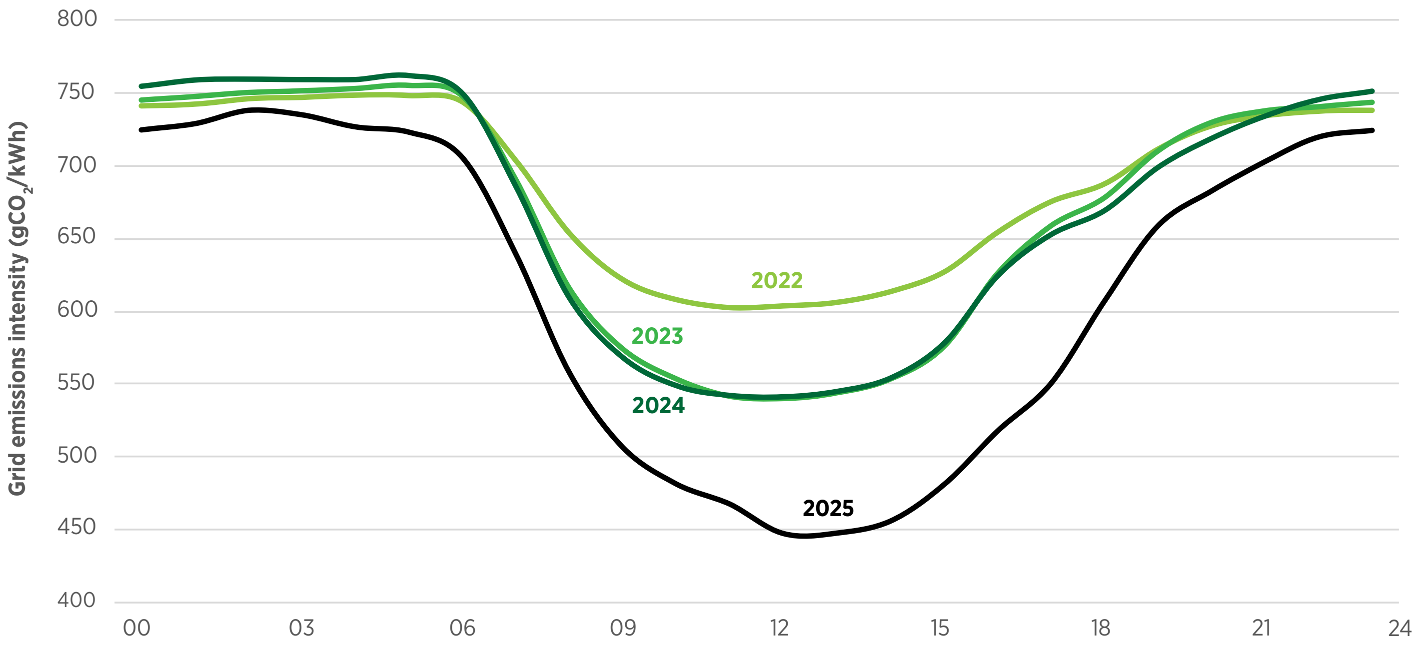


*Figure 4: NSW electricity grid average annual hourly GHG emissions intensity by time of day for 2022 to 2025. Data source: Buildings Alive.*

The importance of measuring and reporting GHG emissions based on time of use is gathering momentum.

The **GHG Protocol** establishes global standardised frameworks to measure and manage GHG emissions from private and public sector operations. A draft update to the Scope 2 GHG emissions reporting standard will be released in mid-2027, with a final version at the end of 2028. The inclusion of hourly consumption data and emissions factors is currently being considered. Australia has not yet committed to automatically adopting future GHG Protocol Scope 2 changes into either the National Greenhouse and Energy Reporting (NGER) scheme or AASB S2.

**Renewable Electricity Guarantee of Origin (REGO)** is a digital certificate scheme for tracking and verifying where and when renewable electricity was generated. REGO certificates (REGOs) will also be available for energy storage systems. They will replace Large-scale Generation Certificates (LGCs), which end in 2030. REGOs include a timestamp showing what day and time of day the REGO was generated.

# Energy costs also vary by time of day based on the generation mix

Wholesale electricity pricing is the cost of electricity traded between generators and retailers before it reaches end consumers. This process takes place through the National Electricity Market (NEM), where electricity is bought and sold every five minutes.

The average wholesale price in NSW in 2025 was around 12¢ per kWh, but prices fluctuate constantly based on supply and demand, between –$1 and +$23.20 per kWh.

Wholesale electricity prices can be affected by:

- the availability of different generators (solar, wind, hydro, gas, coal etc.) and battery storage
- fuel costs for gas and coal generators
- time of day and weather conditions, which impact solar and wind generators
- net demand, including sudden spikes in demand from heatwaves or cold snaps
- transmission constraints.

Figure 5 shows the distribution of wholesale electricity prices by time of day in NSW in 2025. Prices are typically lowest (and sometimes negative), between 8am and 4pm because of the abundance of solar electricity in the grid (both rooftop and solar farms). When the sun goes down, solar supply decreases but demand in the grid is still high. Consequently, prices go up as more expensive supply from gas, hydro and batteries is used to match demand. Later in the evening, overall demand falls and prices drop.

There are also seasonal variations. Electricity prices are typically highest in winter because of increased heating demand and lower solar generation, and lowest in spring and autumn when temperatures are mild and solar generation is high.

Most current retail tariffs do not reflect the seasonal and hourly variations in wholesale electricity costs. This is likely to change so that energy users are incentivised to align their electricity use with cheaper generation sources and avoid grid constraints.

**Building owners can reduce their electricity bills by selecting tariffs that more closely align with wholesale electricity prices and shifting their demand away from the morning and early evening price peaks.**

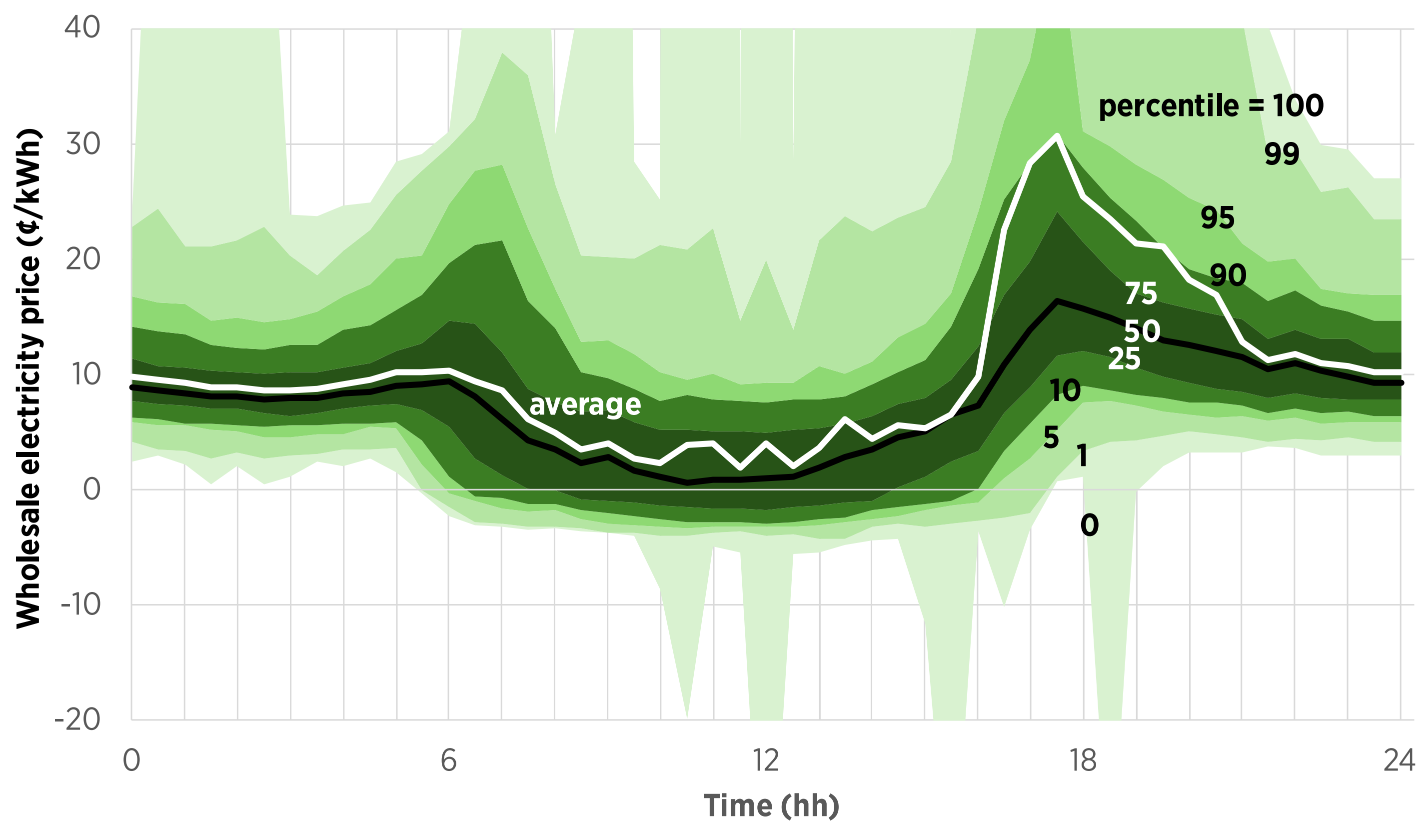


*Figure 5: Spread of wholesale electricity prices by time of day in NSW in 2025. Data source: AEMO.*

## Free electricity during the day

In July 2026, the Federal Government introduced the Solar Sharer Offer to allow households in some states to access free electricity for a minimum of three hours, typically between 11am and 2pm.

This period aligns with times when wholesale electricity prices are very low or even negative, owing to excess solar supply. Households are expected to use this free electricity to run air conditioners, water heaters, pool pumps and other appliances. They can also use it to charge batteries or electric vehicles.

While not applicable to commercial buildings, it illustrates the government's push to encourage energy users to use surplus electricity during the day and reduce consumption in the evening when supply is more constrained.

# Example of hourly costs and GHG compared to annual average

The following example is used to illustrate the impact of electricity pricing and emissions intensity by time of use compared to flat tariffs and annual average emissions factors.

A 19,000 m$^2$ office in the Sydney CBD has gas boilers and electric reheat. Hourly electricity consumption was provided by Buildings Alive. The average weekday and weekend hourly electricity consumption profiles are shown in Figure 6 (top). The annual electricity consumption is 48 kWh/m$^2$.

Hourly wholesale prices and GHG emissions intensity values for the NSW electricity grid are used, as shown in Figure 6 (middle). The annual average wholesale cost is assumed to be 10 ¢/kWh and adopted as a flat consumption tariff for comparative purposes. The actual tariffs will be more complex. The annual average emissions intensity for the grid is 600 kg $CO_2$-e/MWh.

Table 1 illustrates the difference between an annual average approach and an hourly time-of-use approach. An hourly breakdown is shown in Figure 6 (bottom).

*Table 1: Results of analysis for example CBD office building*

| | GHG emissions | Wholesale cost |
|---|---|---|
| | (t $CO_2$-e) | ($) |
| Annual average | 551.8 | 91,974 |
| Hourly basis | 493.1 | 66,489 |
| **Difference** | **11%** | **28%** |

Calculating emissions on an hourly basis in commercial buildings more accurately reflects actual GHG emissions and can lead to lower annual emissions for the current electricity grid.

Electricity consumption out of hours between 6pm and 7am accounts for 28% of annual consumption but 36% of annual emissions and 44% of wholesale electricity costs. The biggest cost saving opportunity for this building is to shift electricity consumption from between 5pm and 7pm into the middle of the day.

See the following sections of this guide for options to shift demand.

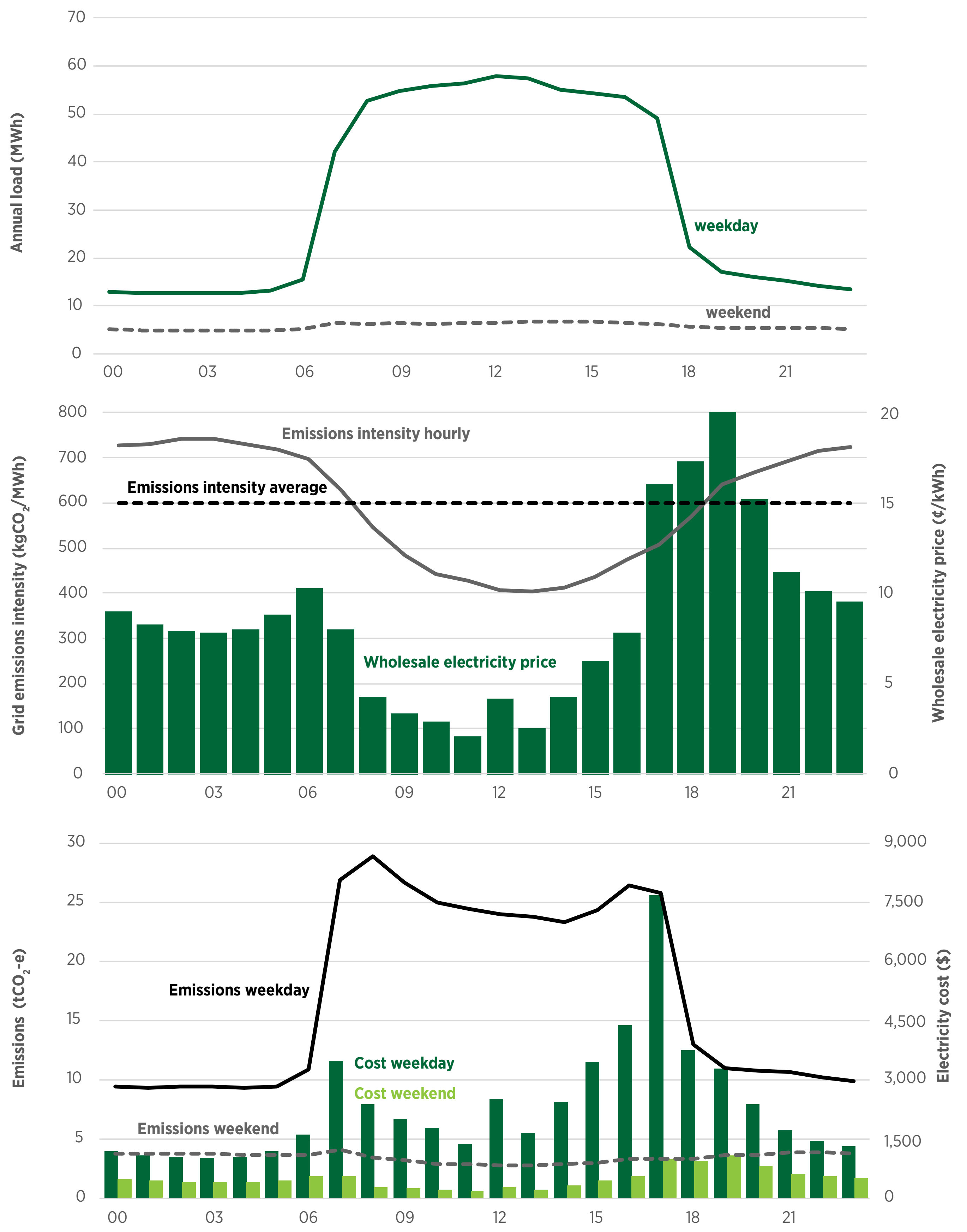


*Figure 6: (Top) Average hourly electricity profiles. (Middle) Average annual wholesale electricity costs and emission intensity by time of day for NSW. (Bottom) Annual emissions and costs by time of day. Data source: Buildings Alive.*

# Electricity bill = consumption + peak demand + fixed costs

The breakdown of a typical electricity bill is shown in Figure 7. It comprises:

- **Consumption-based costs ($/kWh)** including wholesale electricity costs, the retailer's wholesale margin, some network usage charges and other retailer variable costs. Depending on the tariff structure, reducing energy consumption and/or shifting the time that energy is used will reduce these costs.
- **Peak demand costs ($/kW or $/kVA)** such as a network peak demand charge. Reducing peak demand through demand management will reduce these costs.
- **Fixed costs ($/day)** such as the network daily supply charge. These costs are not affected by how much energy is consumed or when it is used.

Network peak demand charges are not based on total demand but on **peak demand**, often during specific time windows (e.g. 3 pm to 9 pm in summer and winter). Peak demand charges are designed to ensure the electricity distribution network (poles and wires, transformers etc.) that connects a building to the grid has sufficient capacity to meet peak demand. A peak demand charge is calculated from the period (typically 30 minutes) when electricity use is highest. This single 30-minute period can set the demand charge for the building for up to 12 months.

The load-duration curve in Figure 8 illustrates the distribution of half-hourly demand (during the peak demand window) for the example office building (see previous page) over an entire year. The peak demand was 400 kW. There were only 15 hours (0.17% of the year) when demand was above 360 kW (90% of peak load). This occurred on three days of the year, all in February, over a period of a few hours.

In seeking to shift electricity demand away from more expensive consumption tariff periods, it is important not to increase peak demand, as this could negate any energy consumption cost savings. Shifting time of energy use can also be used to reduce peak demand, but must be coordinated to avoid unintended consequences. On extreme days, minimising peak demand (kW or kVA) should take precedence over shifting time of use (kWh) from periods of higher consumption costs.

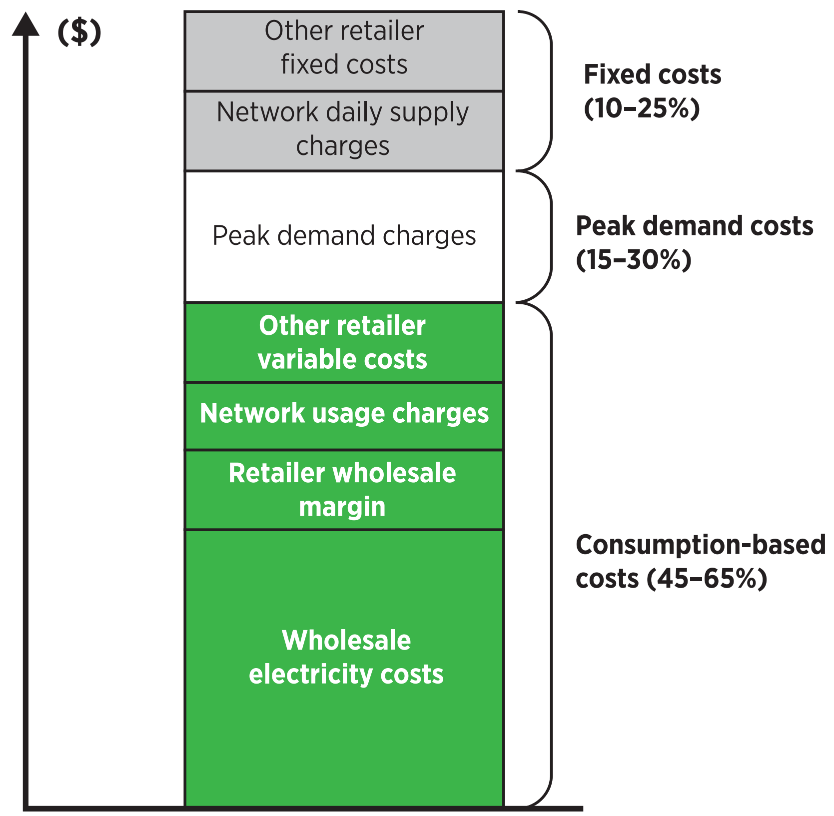


*Figure 7: Example bill breakdown for typical commercial office building*

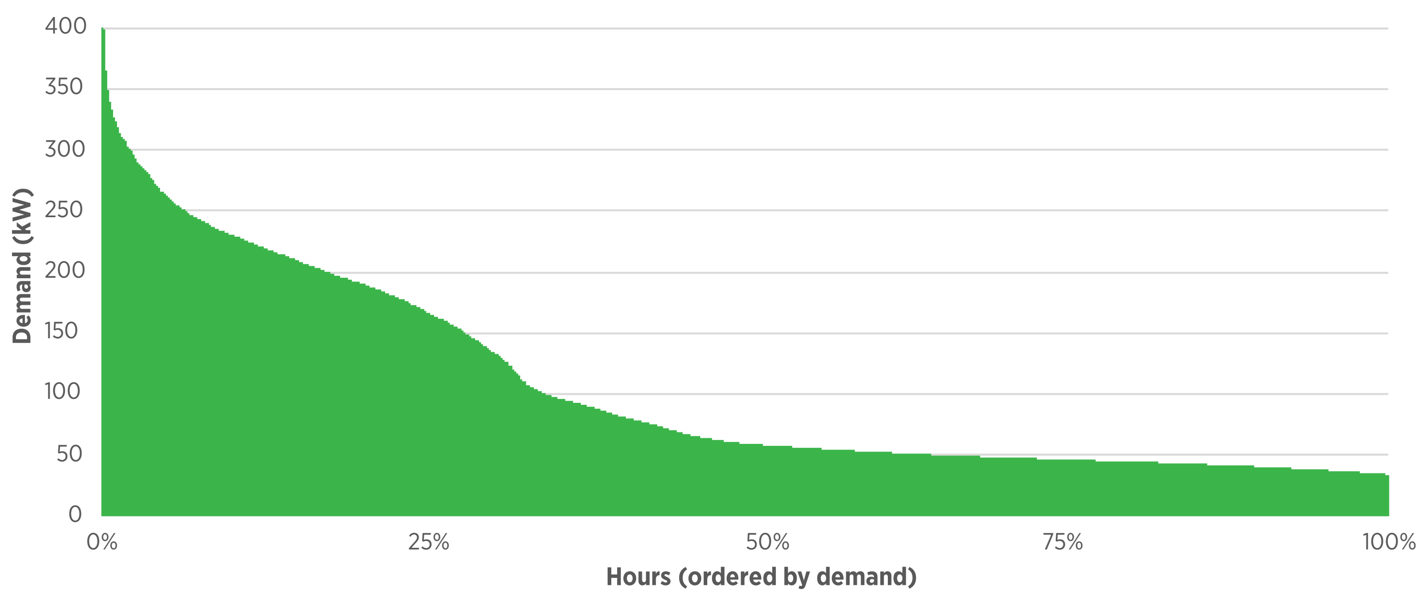


*Figure 8: Load-duration curve for an example office building, showing distribution of hourly demand (in kW) for an entire year. Data source: Buildings Alive.*

# How to shift demand and time of use

# What is flexible demand?

The electrification of commercial buildings and the rise of flexible demand are increasingly interdependent stages in the transition to low-carbon buildings. A few years ago, widespread electrification of commercial heating systems was not seen as business-as-usual, but this has changed rapidly.

In new commercial buildings, all-electric designs are now common, and across existing stock gas boilers are progressively being removed as part of plant upgrades and decarbonisation strategies. With electrification becoming the norm, flexible demand represents the next step in the evolution of low-carbon commercial buildings.

Flexible demand refers to the ability of electricity users to vary when and how they consume electricity in response to generation, network or market conditions. There are different types of flexible demand, which vary in time scale from seconds to months. In commercial buildings *shift* is the most relevant, bringing forward or delaying consumption by a few hours each day.

The systems that have the most potential to shift the time that electricity is consumed are:

- heating, cooling and ventilation system controls
- domestic hot water storage
- chilled water storage
- batteries, and
- EV charging.

The amount that each of these can shift electrical demand, and the feasibility and cost-benefit of implementation, will vary for each building.

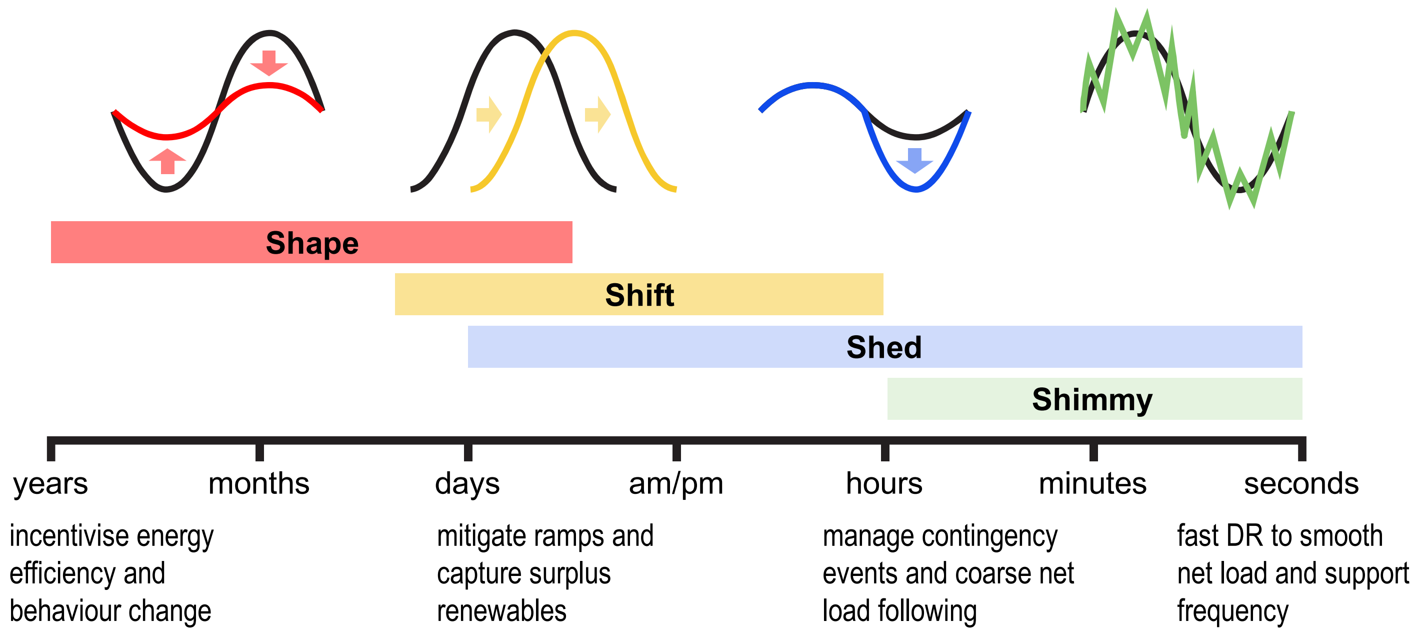


*Figure 9: Types of flexible demand.*

### Flexible demand is one part of the solution

There are three core components to reducing energy costs and GHG emissions in commercial buildings. These all work together and should not be considered in isolation.

1. **Electrification** – remove gas for heating, hot water and cooking to minimise Scope 1 GHG emissions and reduce exposure to volatile gas prices.
2. **Energy efficiency** – use electricity as efficiently as possible to reduce overall energy consumption and assist in reducing peak demand.
3. **Flexible demand** – change when electricity is used, through controls and storage, to reduce GHG emissions and reduce energy costs (both time-of-use consumption tariffs and peak demand charges).

# HVAC controls

## Outside air rates

Increase outside air during the day when occupancy is highest to maximise indoor air quality. This will increase electricity consumption, but at a time when electricity and REGOs are cheapest and GHG emissions are lowest. This improves indoor air quality for most of the occupancy period compared to a typical approach.

This approach also allows outside air rates to be wound back after 4pm, causing internal $CO_2$ concentrations to slowly rise, but still within an acceptable range. This reduces heating and cooling energy demand after 4pm when electricity costs increase, grid emissions intensity is starting to rise, and REGOs will be more expensive.

## Thermal set-points

Use the thermal mass of the building by cooling or heating the building more during the day, or when power prices are low, to charge the thermal mass, and then reduce the heating or cooling load later in the day, or when prices are high, by allowing the thermal mass to contribute to maintaining thermal comfort. This approach works by allowing temperature set-points to modulate between agreed limits, ideally 20°C to 25°C, but it will still work, although less effectively, within the standard 21°C to 24°C bands.

An example strategy is:

- lower the cooling setpoint to 21°C between 10am and 3pm, then incrementally raise the setpoint to 24°C by 5pm
- raise the heating setpoint to 24°C between 10am and 3pm, then incrementally lower the setpoint to 21°C by 5pm.

The thermal inertia in the building will slow down the change in temperature experienced by tenants. This will work best in summer if the west façade has good shading or thermal performance, combined with tenants pulling down blinds to reduce solar gain locally.

This strategy may require agreement with tenants and potential changes to lease conditions, particularly if temperature bands are to be widened to maximise benefits.

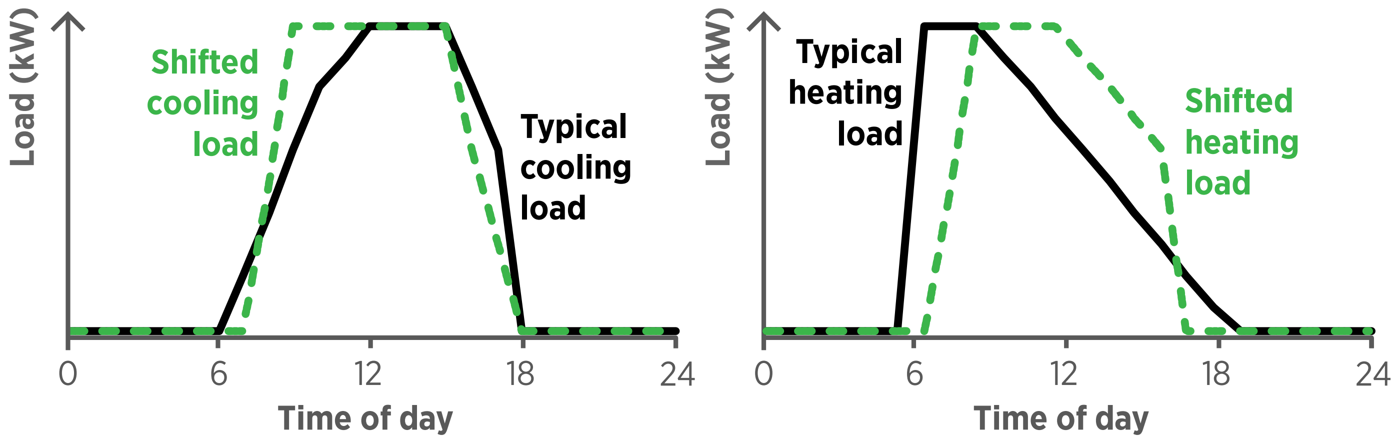


*Figure 10: Shifting cooling loads (left) and heating loads (right).*

## Building fabric

A well-designed building façade can reduce peak demand on heating and cooling systems in the perimeter zones of the building. Opportunities to consider include:

- effective western façade shading to reduce afternoon loads and allow cooling systems to turn down after 4pm when electricity prices and grid emissions intensity both start to rise
- improved insulation and air tightness to reduce overnight heat losses in winter, reducing the amount of early morning pre-heating required when grid emissions intensity is high.

## Internal thermal mass

Before the advent of refrigerative cooling, thermal mass was used for centuries to moderate internal and external temperatures. In modern commercial buildings, the opportunity to use the thermal mass of a structure, primarily concrete floors and ceilings, is often overlooked in managing thermal comfort and energy use.

Even if you can't see the concrete floor above (because there's a suspended ceiling hiding it), the space above the ceiling is often used to carry return air back to the air-conditioning system. As that air passes through the ceiling space, it comes into contact with the concrete floor slab, which can absorb and store heat.

# Case study: set point control

Using set points to shift demand is not a new approach. It has been used by some building managers to reduce electrical demand and associated peak demand charges. The following example illustrates how the approach can work.

31 January 2019 was forecast to be a very hot day and building managers at a large premium-grade office tower in the Sydney CBD were advised that their electricity demand was likely to be extremely high. In response to this forewarning, the building managers lowered the internal temperature target by 1°C from 8:30am to 2pm and restored the original temperature target at 2pm.

The objective was to reduce the network peak demand (capacity) charges that apply between 2pm and 8pm in the Sydney CBD while keeping occupants comfortable. Doing so would avoid an increase in the peak demand charge that would then apply for the next 12 months. There was no consideration of emissions or wholesale electricity cost savings when deciding to implement this strategy.

Figure 11 shows how the building managers were able to shift the demand to minimise the peak occurring after 2pm by simply changing the internal temperature target by 1°C for less than a day. The horizontal axis shows time of day, while the two vertical axes show temperature (external and internal) and electrical load.

The chart shows that the building was able to increase its demand above what was forecast between 9am and 2pm. Because the building was pre-cooled in the morning, after 2pm electricity demand could be reduced to 200 kW below forecast levels.

The outside air temperature rose from 23°C in the early morning to 38°C by late afternoon. Internal temperatures were initially lower than usual and were allowed to increase after 2pm but always remained within the building management's summer band temperature limits.

By avoiding one hour's peak demand, the building paid less for its electricity for the following 12 months because the peak demand charges were not increased.

This example illustrates how simple and effective set point control can be used to shift demand. While this was undertaken to reduce peak demand in the afternoon after 2pm (to avoid increasing peak demand charges), the same approach can be used to shift load on a daily basis to avoid cooling after 4pm and to reduce energy costs and GHG emissions.

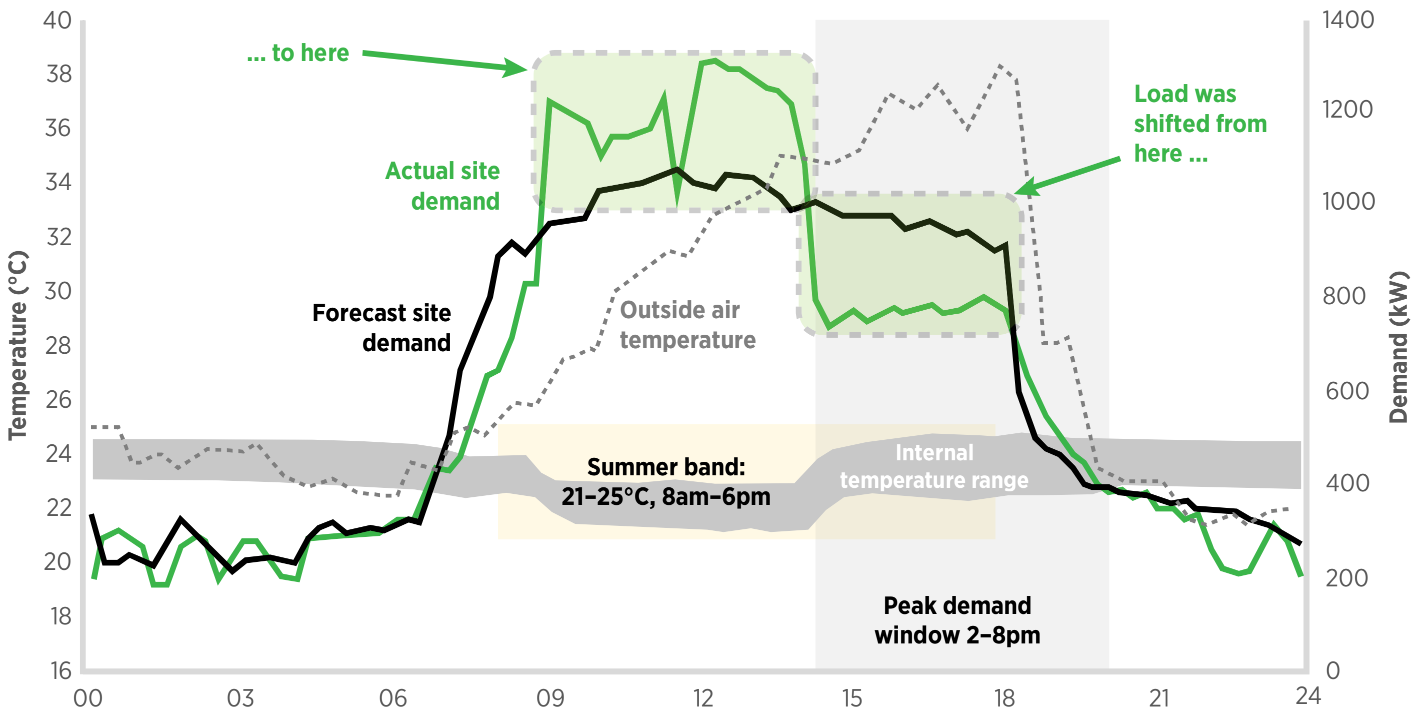


*Figure 11: Shifting cooling load in an office building by changing set points. Source: Adapted from Buildings as Batteries: How Buildings Can Support the Clean Energy Transition, discussion paper by Richard Denniss (The Australia Institute) and Craig Roussac (Buildings Alive), April 2024.*

# Domestic hot water storage

Electrification is seeing a shift from using gas heaters and boilers to generate domestic hot water, to heat pumps with storage tanks and/or local instantaneous electric heaters. For small loads, such as washbasin taps in toilets, local heaters are often a cost-effective solution and avoid the need for hot water reticulation pipework (with associated pump energy and thermal losses). For end-of-trip facilities and commercial kitchens where hot water demand is much higher, heat pumps with thermal storage can be used.

Hot water storage is the simplest and most cost-effective form of energy storage. It is particularly effective in residential and hotel buildings, owing to the relatively high demand for hot water. In commercial office buildings the largest use of hot water is typically in end-of-trip facilities. These typically have the highest water demand in the morning and just after lunchtime.

Hot water storage tanks should be sized so that all morning peak demand can be provided from the tanks without needing to turn on the heat pumps. The heat pumps should be controlled to generate hot water when electricity prices and GHG emissions are lowest, typically between 9am and 4pm, and not operate outside of these hours except in exceptional circumstances.

Depending on the expected lunchtime demand, the tanks may need to be slightly larger to avoid having to oversize the heat pumps to generate enough hot water between the morning peak and the lunchtime peak.

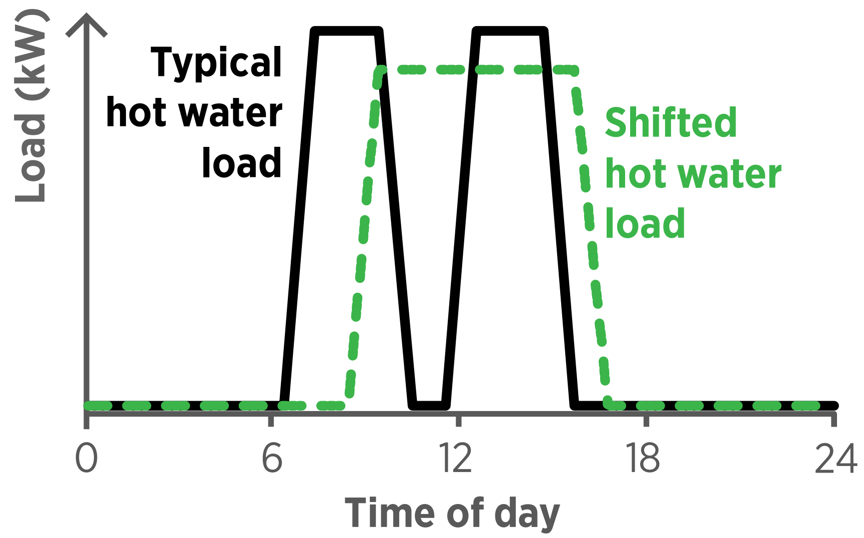


*Figure 12: Shifting hot water demand away from the morning peak using larger thermal storage tanks.*

## Scape electrification project

In November 2025 the Clean Energy Finance Corporation (CEFC) announced an investment of $50 million with Scape Australia to remove gas infrastructure from up to 20 buildings. This includes replacing gas boilers with heat pumps and thermal storage.

The funding also supports a pilot program to test behind-the-meter load-shifting initiatives to optimise how the buildings use energy. By installing advanced metering and control technologies, the buildings can manage their energy demand and respond to price signals from the grid, making electrification more cost-effective.

# Chilled water storage

Chilled water storage (also known as chilled water thermal energy storage or TES) has been used in some buildings and campus facilities to produce and store chilled water during overnight off-peak periods, and then to supply this to air conditioning systems during peak daytime hours. Benefits include resilience in the event of daytime power failures, reducing the number of chillers required to meet peak demand, and lowering energy bills by charging the tanks during off-peak periods (typically overnight when the chillers also run more efficiently) and discharging during peak cooling periods.

With changes to the grid, as discussed in the first section of this guide, charging chilled water storage overnight is now the period with the highest grid emissions intensity. It is also currently not the period with the lowest wholesale electricity prices. Over time the overnight emissions intensity is expected to fall as more wind and energy storage is added to the grid.

Chilled water storage is not commonly used in office buildings. A key reason is the space required for the tank taking up valuable real estate. To allow effective thermal stratification, the tanks are typically 10+ metres high. Horizontal versions with baffles can be used instead.

Where space permits, the use of chilled water storage could be considered to shift time of use, but with a different control strategy:

- charge the storage tanks in the morning before peak cooling demand occurs (typically from midday onwards)
- discharge the chilled water between 4pm and 6pm when wholesale electricity prices are highest and emissions intensity is starting to rise.

To reduce the size of the tank needed, this could be combined with a strategy to reduce outside air after 4pm and allowing the set point to drift (relying on thermal inertia) to limit use of cooling energy as the building occupancy starts to wind down.

## Heating hot water storage

A similar approach could be considered for heating hot water storage, to charge during the day for use during the morning pre-heat.

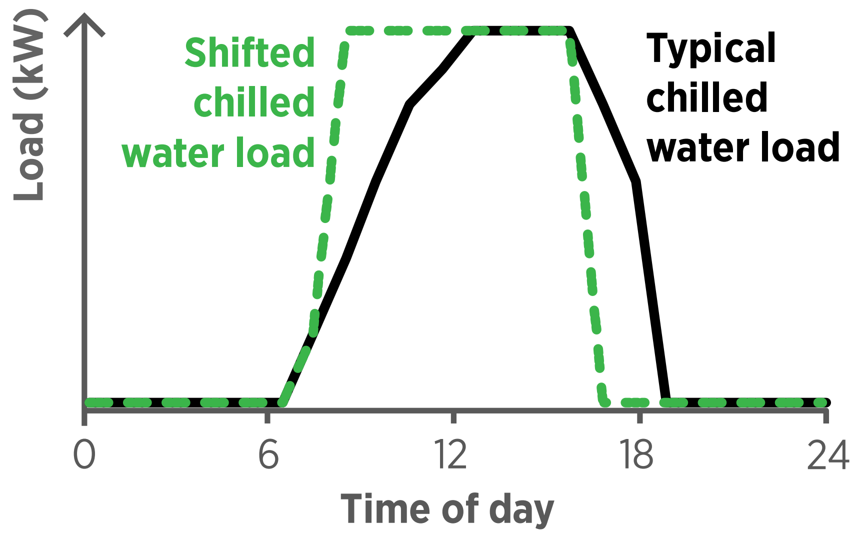


*Figure 13: Shifting chilled water demand away from the peak 4pm to 7pm period.*

### Why they disappeared – and why they make sense again now

Ice and chilled water storage in commercial building HVAC systems were popular in the past when utility companies provided significantly discounted consumption tariffs at night to make use of the surplus electricity from coal-fired power stations. This very cheap electricity offset the capital cost of the storage, the requirement for more space for the tanks, the losses in charging and discharging (between 15% to 25%) and the maintenance costs of installing and operating thermal storage systems.

As electricity tariffs became flatter, the economic benefit of the systems reduced. And with NABERS measuring annual energy consumption, the extra energy use associated with thermal storage made ratings worse. The systems fell out of favour.

Today, with rapid changes to the electricity grid underway, the need to once again shift demand to reduce electricity costs, support grid stability and reduce real-time GHG emissions, conditions similar to those that previously made ice and chilled water storage attractive are again emerging. Everything old is new again.

# The importance of batteries

Batteries can be installed in commercial buildings to soak up surplus daytime solar, either from the grid or from on-site PV systems, for discharge later when wholesale electricity prices and grid emissions intensity are higher.

Batteries in buildings are an essential part of AEMO's Integrated System Plan 2026:

> *By 2050, around half of households with solar are projected to have supporting batteries. Household and commercial battery installations are growing rapidly on the back of lower costs, easier-to-use technology, and government policies such as the Cheaper Home Batteries Program. Take-up is forecast to grow strongly in the next decade.*
>
> *The Step Change scenario forecasts growth in capacity from today's 2 GW to an estimated 5 GW in 2029–30, then 27 GW in 2049–50. In this scenario, 53% of batteries are forecast to be coordinated as part of a Virtual Power Plant (VPP) by 2049–50, as consumer confidence in their benefits rises. Increased coordination will benefit all consumers, not only the battery owners, as it reduces the extent of grid-scale investment needed.*

The National Construction Code 2025 requires some classes of new buildings, including offices and retail buildings, to provide space and switchboard connection provisions for future battery installation.

The financial benefits of batteries in commercial buildings very much depend on the electricity tariff structure, with many retailers still providing flat tariffs that do not recognise or reward changes to time of use. Shifting to time-of-use or dynamic tariffs adds complexity and risk to controlling the battery. This is why some commercial building owners are using third parties to own and operate batteries in their building.

As the energy transition gathers pace, and batteries become more common, many batteries are expected to be coordinated, either through control by a retailer or aggregator as part of a virtual power plant (VPP), or through dynamic tariffs that reward customers directly.

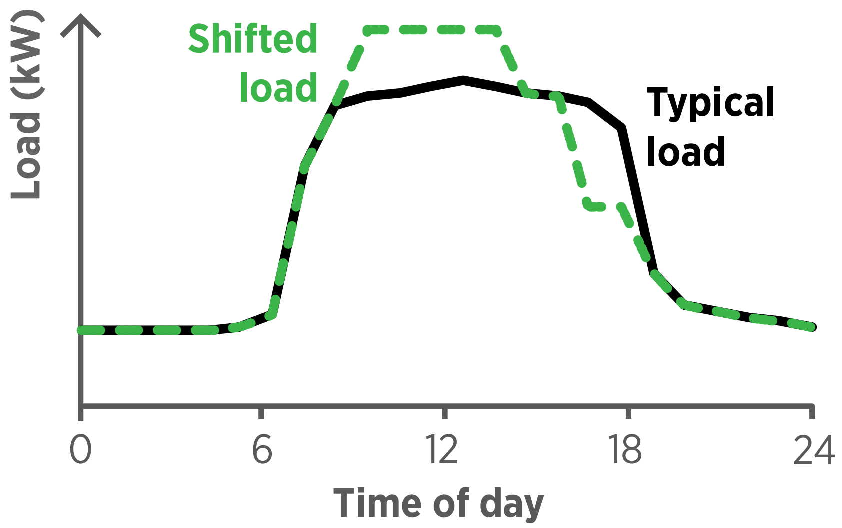


*Figure 14: Example load shift strategy with a battery: charge before 2pm then discharge between 4pm and 6pm.*

## GPT Group's Smart Energy Hubs

In June 2020 GPT Group published a *Battery Risk and Safety Study White Paper* and a *Battery Hazard Review Tool* in partnership with ERM Power and City of Sydney. The white paper addresses a range of issues including types of technologies and risk assessment processes with case studies covering health and safety, environmental, community and reputation, legal and compliance, operational, strategy, and financial.

GPT subsequently established Smart Energy Hubs at several of their shopping centres in partnership with Shell Energy. The first hub at Chirnside Square in Victoria has:

- a 650-kW solar PV array owned by GPT
- a 1-MW / 2-MWh battery energy storage system (BESS) owned and operated by Shell Energy
- an energy management system called HVAC LoadFlex, which optimises the operation of the chillers and generates revenue through participation in Shell Energy's Demand Response Program.

The BESS is located in the car park in a modular container system. The hub has reduced peak demand by 70% on AusNet's critical peak demand days.

# Sizing and locating batteries

There are many issues to consider when determining the feasibility of installing a battery in an existing commercial building, some of which will require specialist assessment.

## Sizing

Battery storage capacity is how much electrical energy a battery can store and later discharge, and is measured in kilowatt-hours (kWh). Depth of discharge is the amount of capacity available without degrading the battery, typically 90+%. Hence a 100-kWh battery could supply a 45-kW load for two hours or a 10-kW load for nine hours.

The correct size required primarily depends on the electricity demand and consumption profile of the building, but may also be influenced by electrical switchboard capacity and physical constraints (is suitable space available?).

A battery can be used to both shift the time of electricity consumption from the grid and to reduce peak demand.

- To reduce consumption costs ($ per kWh), batteries can be charged during the day and then discharged during the late afternoon and early evening when wholesale electricity prices tend to peak. This can also reduce GHG emissions.
- To reduce peak demand charges ($ per kW/kVA), batteries can be discharged during the day, typically mid-afternoon. This would only occur occasionally throughout the year to manage spikes in demand, typically on hot summer days.

## Location

Issues to consider in locating a battery in a building include:

- **Area and fire risk** – is there suitable space available and can the fire risk be managed safely? As there are no deemed-to-satisfy fire requirements in the NCC, batteries are considered a special fire risk. Consult with your insurer, as they will likely have their own battery standards.
- **Proximity to the switchboard** – can the battery be located near to the main switchboard?
- **Structural capacity** – is there sufficient capacity to support the weight of the battery?

### Using a battery to reduce peak demand charges

In many office buildings peak demand occurs for a few hours each year but sets the demand charge for the whole year. Batteries can be part of a coordinated strategy to reduce this.

Using the office building example from earlier, the peak demand was 400 kW and there were 15 hours when the demand was above 360 kW. This occurred on three days of the year, all in February, over a period of a few hours.

If a 100-kWh battery were installed (with 80% depth of discharge) and used to discharge 20 kWh over four hours (80 kWh), then the peak demand would be reduced by 5% (20 kW) without any other interventions. Working in combination with a set-point control strategy to reduce afternoon cooling loads, a peak demand reduction of 10% is readily achievable.

For the remaining 362 days of the year the battery could be used to reduce GHG emissions and electricity consumption costs ($ per kWh). Or it could be used to further reduce peak demand.

In building the business case for a battery consider both the time-of-use and peak demand benefits. If the battery is to be operated by a VPP then agreement will be needed to:

- allow the building owner to use the battery to reduce demand on peak days
- avoid the VPP operator from charging the battery in peak building periods, which could increase peak demand charges for the building owner and negate electricity consumption cost savings delivered by the VPP.

# EV charging

Commercial buildings with car parks are seeing increasing demand for electric vehicle (EV) charging. This can significantly increase the building's electrical demand and needs to be carefully managed. There are different levels of charger available as shown in Figure 15.

The National Construction Code (NCC) requires many building types to be EV ready, to support future installation of EV chargers. Class 5 to 9 buildings must provide:

- an EV distribution board on each parking level
- a load management system (LMS) capable of managing and scheduling EV charging in response to building demand
- space for future sub-metering of EV charging electricity use.

The electrical infrastructure must be sized to support future installation of a 7-kW (32-A) type 2 EV charger in 10% of car parking spaces, including delivering a minimum of 12 kWh from 9am to 5pm daily.

AEMO notes that EVs can contribute to grid stability by being charged outside the morning and evening peaks, preferably during the daytime solar window.

The control of EV charging by the building owner will be key to:

- using low emissions and low-cost electricity during the day and avoiding higher cost periods
- avoiding charging during times of peak building demand, to avoid excess peak demand charges.

Although EV charging is not a technology that can be used to shift the time of other building loads, it requires careful control to avoid negatively impacting other demand management strategies.

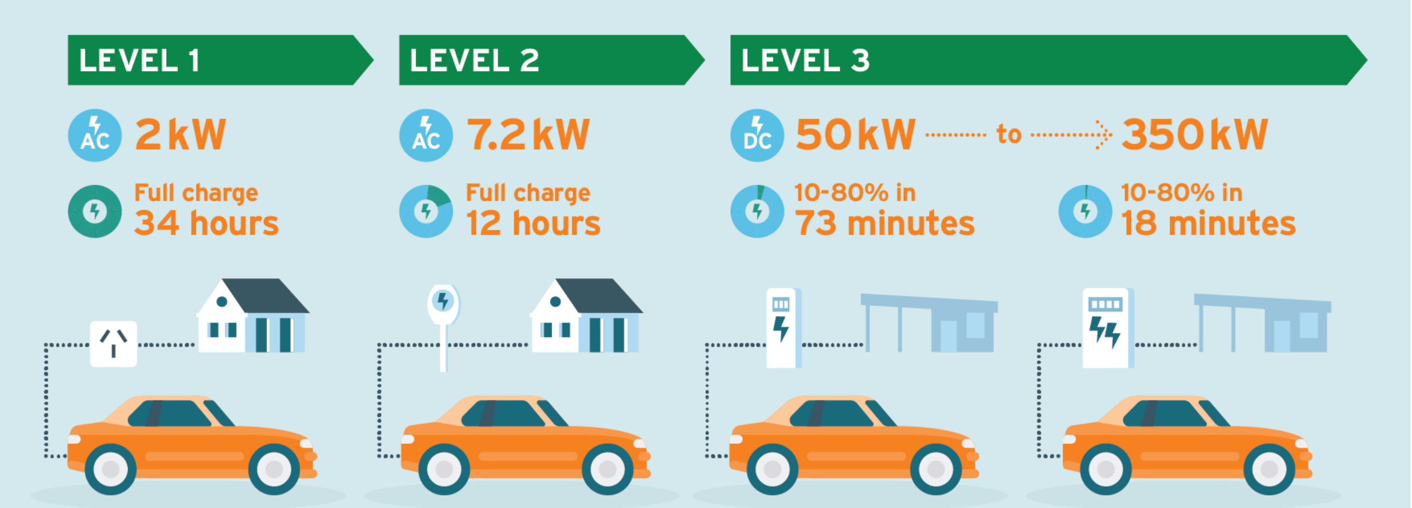


*Figure 15: EV charger types and typical charging times (based on Hyundai Ioniq6 with 77 kWh battery). Source: ARENA.*

## Bidirectional EV charging

An emerging opportunity is the use of EVs to supply electricity back to a building (known as vehicle-to-building or V2B) or to the electricity grid (known as vehicle-to-grid or V2G). With capacities of 40 to 120 kWh, EV batteries are much larger than typical home batteries (8 to 32 kWh).

Both V2B and V2G require a compatible EV and a bidirectional EV charger.

A 2026 trial involving Amber Electric and the Australian Renewable Energy Agency (ARENA) is allowing up to 1,000 participating households to export power from their cars back to the grid. The trial aims to generate critical insights into customer behaviour, technology performance and market integration, helping to inform future policy, industry investment and broader adoption of V2G technology in Australia.

The potential of bidirectional EV charging in commercial buildings is uncertain, as it requires financial or other incentives to be aligned between EV owners and building owners. Fleet vehicles are one example where these incentives may align.

Inclusion of bidirectional EV charging in the load management strategies of commercial buildings is an evolving space and may change as V2G and V2B technologies become more mainstream.

# Preparing a feasibility study and business case

# Getting started

Each organisation has different processes to evaluate changes to building operations and capital investment. The steps described in this section are provided to assist building owners in getting started on implementing flexible demand and time-of-use strategies.

1. **Review current energy profile and costs**
2. **Assess opportunities to shift demand**
3. **Estimate costs and benefits**
4. **Identify potential risks**
5. **Prepare the business case**

## Who prepares the business case?

| | |
|---|---|
| **Asset manager** | Manages the feasibility study and preparation of the business case. Discusses with tenants (e.g. potential set point strategy changes) and other stakeholders as required. |
| **Facility manager** | Provides hourly electricity consumption data for the building and key energy systems, and information that will inform evaluation of opportunities, such as operational issues, and the capacity and condition of plant and equipment. |
| **ESG team** | Evaluates the Scope 2 emissions reductions as part of an overall portfolio approach, including the costs of LGCs and REGOs to the organisation's Net Zero strategy. |
| **Energy procurement team** | Negotiates with energy retailers, VPP providers and PPA providers to determine the energy tariff structure that would maximise benefits and/or minimise costs of changing time of energy use and reducing peak demand. |
| **Consultants** | Engaged as required to support technical evaluation of opportunities including modelling of energy profiles and preparing concept design (for pricing) of potential technologies such as batteries, hot water storage etc. May be undertaken in conjunction with an electrification strategy. |


*Figure 16: Stakeholders involved in delivering energy flexibility in commercial buildings. Source: Energy Flexibility in Commercial Buildings: NABERS Feasibility Study (2026).*

# 1 – Review current energy profile and costs

## Review energy data and costs

Obtain detailed (5, 15 or 30-minute) electricity data for the building over the last one-to-two years. Use this data to:

- Prepare typical daily consumption profiles for weekdays and weekends and identify which systems are contributing to the loads using Building Management System (BMS) or sub-metering data. This should be undertaken either seasonally or monthly.
- Calculate annual carbon emissions using hourly (or 5/15/30 minute) grid emissions intensity factors and compare the result with annual carbon emissions calculated using the annual average factor. Real-time emissions intensity factors can be obtained from Open Electricity, CSIRO Data Shop or Buildings Alive.
- Calculate and compare annual electricity usage costs with different tariffs, including a time-of-use tariff. If considering a dynamic tariff, use historical 5-minute or 30-minute prices obtained from the retailer.
- Determine peak demand loads (kW or kVA), when they occur and how often, and use these to calculate peak demand charges.

## Review potential new loads

Review if any changes are planned to the building that would potentially change the electricity demand and time of use, such as:

- electrification of heating, hot water and/or cooking
- installation of EV chargers
- refurbishment or replacement of existing plant or equipment, or
- changes in building occupancy.

Undertake preliminary modelling to overlay these onto the existing daily profiles.

## Obtaining real-time data

AEMO's National Electricity Market (NEM) data dashboard provides real-time data for the NEM states (NSW/ACT, Victoria, Queensland, South Australia and Tasmania). It includes actual data for the past two days and a seven-day forecast, including:

- spot price ($/MWh) in 5-minute increments
- demand (MW) in 5-minute increments
- fuel mix – both as a percentage and MW, and
- 7-day outlook of scheduled energy capacity, demand and reserve.

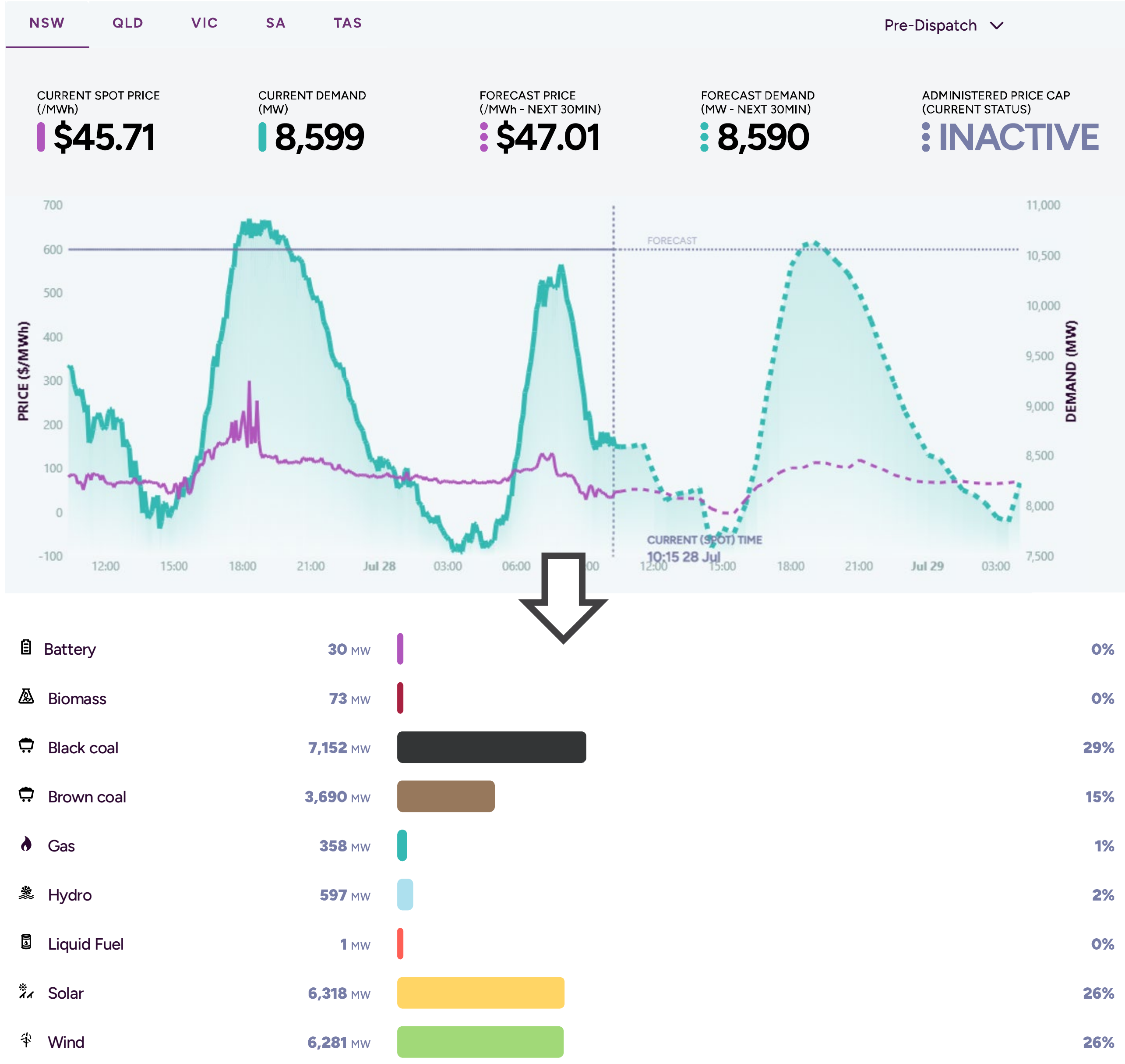


*Figure 17: Screenshot examples from AEMO's NEM data dashboard.*

# 2 – Assess the opportunities to shift demand

Following analysis of the electricity demand and consumption profiles, the next step is to identify which initiatives could potentially be used in the building and how much these could shift energy use and reduce peak demand.

Some initiatives are relatively simple and could be controlled using timers (e.g. domestic hot water) while others will require a more sophisticated control strategy to respond to real-time signals and forecasts from the electricity grid.

## Operational initiatives

- If ventilation or set-point control strategies are implemented, how far can these be pushed before there is a potential impact on tenants' air quality or thermal comfort?
- Does the tenant need to be consulted to have an optimised strategy?

## Energy storage systems

- Is there suitable space available?
- Does the switchboard need upgrading to allow charging and discharging of batteries?
- Test options for storage size to balance cost with benefit.
- Can batteries be installed prior to or alongside building electrification, reducing the need for substation upgrades?

## Control capabilities

- Does the BMS have the capacity to monitor and report electricity consumption, GHG emissions and wholesale costs in real time?
- What controls will be needed and does the BMS have sufficient control capability, including responding to forecast grid price signals?
- Can the BMS be programmed to adjust set points and/or ventilation rates as part of a time-of-use and peak-load-shedding strategy, or will it require manual intervention?

## Green Star requirements for energy management and information systems

The Energy Source credit in Green Star Buildings v1.1 sets out the requirements for energy management and information systems including:

- The ability to monitor the local electricity network's demand and GHG emissions intensity.
- Measure, process and report on energy used by all major energy uses and on-site energy generation and/or storage.
- Allow the building to automatically control different energy uses in the building to minimise GHG emissions and reduce peak demand.

The building must also have a strategy to shed at least 10% of its electricity consumption from a three-hour period of high GHG intensity in the grid to a period of low GHG intensity.

The Energy Source credit is mandatory for projects targeting 6 stars. It will become mandatory for 5-star ratings for projects that register after 2028, and for all projects that register from 2030 onwards.

# 3 – Estimate costs and benefits

For the opportunities identified, prepare a preliminary cost-benefit analysis.

## Capital costs

Some initiatives, such as set point and ventilation control, may have no capital costs unless the BMS needs to be upgraded to manage this.

For batteries and thermal storage, preliminary designs may be required to obtain market prices. Consultants may need to be engaged for this. Costs can include:

- new equipment costs (e.g. batteries, storage tanks)
- modifications to existing systems (e.g. switchboard upgrade, chilled water system)
- upgrades of controls
- creation of new plant area, enclosures and/or structural strengthening, and
- upgrades to fire protection systems for batteries.

## Operating costs

Operating costs and cost savings may include:

- reduced electricity consumption costs from a change in time of use based on a variable tariff
- reductions in peak demand charges from a reduced peak load
- cost savings for REGOs if these are being used to claim 100% renewable electricity supply to the building (noting that LGCs are not time based)
- increased facility management costs for managing the systems, and
- increased insurance premiums owing to installation of batteries.

## Electricity procurement

In large commercial building portfolios, electricity procurement can be a complex contractual negotiation using energy brokers and other specialists. Types of contracts can include:

- **Fixed** – no exposure to wholesale prices
- **Variable** – prices move with wholesale market
- **Hybrid** – a mix of fixed and variable.

How to negotiate is beyond the scope of this guide; however having a detailed understanding of the energy demand profile of the building (or portfolio of buildings) and the potential to shift time of use will assist in getting a better deal from your electricity retailer.

For the preliminary cost-benefit analysis, if time-of-use tariffs are not readily available from the retailer or energy brokers, then wholesale electricity prices could be used, with a fixed ¢/kWh amount added to represent other costs and retailer margin.

New dynamic pricing products are likely to become available to support shifting electricity while protecting customers from the volatile price spikes that can occur in the NEM.

# 4 – Identify potential risks: external

Following are some of the potential external risks to consider when developing a strategy to shift the time of energy use and reduce peak demand.

| Potential risk | Description |
|---|---|
| Changes to legislation making the building less competitive | Government policies, plans and initiatives acknowledge that managing time of electricity use is essential to achieving net zero targets by 2050. Upgrades to the National Construction Code align with this and are likely to become more stringent in the future. The main risk to building owners is having an existing building that does not have the capability to manage time of use as effectively as new buildings |
| Changes to tariff structure | Standard retail tariffs will likely become more aligned with the wholesale electricity market to support the grid's transition to renewables, and to reflect reduced dispatchable capacity as coal power stations close. Having the ability to manage time of electricity use to reduce energy costs reduces this risk to building owners. |
| Exposure to wholesale market spot prices | It is not necessary to participate directly in the wholesale electricity market; however this is where maximum cost savings can potentially be delivered. With full exposure to the wholesale market, the key risk is being alert to unexpected price spikes, which can raise the spot price from an average of around \$200 per MWh to the current NEM market cap of \$23,200 per MWh. These price spikes are typically very short duration and becoming rarer with the rapid uptake of batteries, both in buildings and at grid scale.<br><br>Although such price spikes only last for short periods, building owners can mitigate their risk by using retail products that cap their maximum price exposure. |
| Speed-up or slow-down in grid decarbonisation | This does not significantly impact the time of energy use strategy. It is likely that GHG emissions and wholesale electricity prices will continue to be highest either side of the daytime solar window when demand is high and solar power is limited. |
| Changes to GHG measurement and corporate reporting | If the GHG Protocol changes to include time of energy use, then buildings that are not responding may potentially report higher GHG emissions. Whether mandated by the Australian Government or not, real estate investors are likely to take a more critical view of buildings that claim to be net zero without time matching their electricity use to generation of renewable electricity through REGOs. |
| Impact on NABERS ratings and building valuation | NABERS is a key rating in the commercial office sector, and mandatory for many buildings. Many building owners have made significant investments to obtain better ratings. Under the current rating system, shifting time of energy use could reduce the rating because NABERS does not currently consider when electricity is consumed and what energy sources generated this electricity. NABERS has recognised this and published their *Energy Flexibility in Commercial Buildings Feasibility Study* in 2026. This confirms that NABERS has started a three-year plan to:<br>• recognise and support energy flexibility including developing new metrics<br>• ensure star ratings are maintained when buildings flex load, and<br>• strengthen market capability. |

# 4 – Identify potential risks: internal

Following are some of the potential internal or organisational risks that should be considered when developing a strategy to shift time-of-energy use and reduce peak demand.

| Potential risk | Description |
|---|---|
| Batteries – fire risk and insurance premiums | A compliant battery installation from a reputable supplier presents a very small fire risk. The location of the battery is important and locating externally is ideal from a fire risk perspective, although this may not always be possible. A thorough risk assessment needs to be undertaken for any battery installation. Tools such as the Battery Hazard Review Tool created by GPT, ERM and the City of Sydney can be used as an initial starting point during the feasibility stage.<br>If a battery is to be installed, then early discussions with the building insurer will inform the options available and potential cost impacts. |
| Tenant leases and appetite to participate | If the strategy includes changes to set points and/or outside air rates, then this may impact the tenants' enjoyment of the building, even if it still falls within the conditions of the lease. There are two potential approaches:<br>• implement the strategy and see if anyone notices (or complains), or<br>• advise tenants of the proposed strategy and the reason for implementing it (which also provides an opportunity to discuss with tenants the potential for them to shift some of their load). |
| Unintended consequences | There are lessons from the past in using technologies that seemed like a good idea at the time but were not implemented well. A familiar example is oversizing gas cogeneration plants to deliver GHG savings but without properly considering the costs of running the plant or making unrealistic assumptions for the difference between gas and electricity prices. Cogeneration was never suitable for office buildings owing to the low annual demand for heat, and adding absorption chillers did not make the economics any better.<br>While it is not possible to predict unintended consequences, the strategies to shift time of energy use are based on existing proven technologies (controls, thermal storage tanks, batteries) that, with the exception of chilled water storage, are widely used and/or supported by government policy. The key is to get the sizing right. For example if a battery is too small it will be ineffective, and if it is too large it may never pay back its investment. |
| Skills and resources in organisation | Managing time of electricity use will be a new requirement for many facility managers. Depending on the strategies to be implemented, additional training may be required, particularly in managing HVAC systems as part of a time-of-use strategy.<br>The control of batteries can range from a simple timed approach (charge in the morning, discharge between 4pm and 6pm) to a much more dynamic approach responding to both demand in the building (to minimise peak loads) and signals from the electricity grid (to optimise cost savings).<br>Batteries can also be owned and installed by third parties, such as VPP companies, who then take responsibility for control of the battery. As noted earlier, it is essential that relinquishing control does not lead to increased demand charges for the building. |

# 5 – Prepare a business case

There are a wide range of business drivers that can be included in the business case to implement flexible demand initiatives and technologies in a commercial building or portfolio. These will vary depending on the audience and the organisation's commitment to delivering zero carbon targets and reducing energy costs. The following is not an exhaustive list, and with investor sentiment and legislation changing rapidly, it is recommended to seek the latest information for each when preparing the business case.

### Lower energy costs

As the electricity grid transitions to renewables and coal power stations close, the traditional peak, off-peak and shoulder periods will continue to change to align more closely with the wholesale electricity prices. Buildings that are set up to manage time of energy use will reduce their exposure to higher electricity prices ($/kWh).

Electrification of heating, hot water and cooking, and the introduction of EV charging may lead to an increase in peak demand. Demand management is a key strategy to minimising peak demand charges ($/kW or $/kVA).

### Reduce GHG emissions (and net zero costs)

The current practice of using annual emissions factors for reporting GHG emissions is likely to be replaced with hourly matching between consumption and generation. The introduction of REGOs in Australia is clear evidence of this trend.

Shifting electricity consumption to periods of lower grid emissions can reduce emissions, strengthen the credibility of net-zero and ESG claims, and reduce the cost of procuring REGOs.

### Improved resilience

Demand management and energy storage (thermal and batteries) can be included in the resilience strategy for the building.

### Future proofing

The National Construction Code 2025 requires new buildings to have on-site PV and the capability to install batteries. These requirements are likely to become more stringent over time to align with government policy to support the grid transition. Existing buildings can be updated so that they are not seen as less responsive than new buildings.

### Enhance ESG credentials

Positioning the building or portfolio at the forefront of supporting the grid transition provides an opportunity to differentiate from competitors. Buying LGCs and claiming net zero Scope 2 GHG emissions will increasingly be seen as not credible, in the same way that buying offsets to reduce Scope 1 GHG emissions from burning natural gas is not a credible alternative to electrification.

### New revenue and incentive opportunities

There may be opportunities to access price-based and market incentives such as network demand payments, demand response programs such as the Wholesale Demand Response Mechanism (WDRM), and the NSW Peak Demand Reduction Scheme (PDRS). These are likely to be more effective at a portfolio level rather than for individual buildings.

### Building versus portfolio business case

Implementing demand management across a portfolio provides scale and therefore leverage in negotiating electricity tariffs. VPP operators aggregate small consumer batteries and other assets located in multiple buildings and households, then control these as a single (virtual) plant to sell electricity into the NEM when supply is constrained and wholesale electricity costs are high.

When preparing the business case, the opportunity to participate in the wholesale electricity market at a portfolio level may become viable and justify the resources needed to manage this effectively.

# Case studies

# Case study: University of Technology Sydney


## Location/building owner

University of Technology Sydney (UTS)

## Building type

Multi-building university campus comprising teaching, research, office, student and recreational facilities.

## Flexible demand initiatives

HVAC load management and peak-demand reduction through:

- global temperature resets via the BMS
- pre-cooling of buildings prior to peak-demand periods
- relaxation of temperature setpoints during peak periods
- improved HVAC scheduling and overnight shutdowns
- chiller optimisation and retirement of older, less efficient chillers
- occupancy-based control using lighting sensors
- emerging battery storage and thermal-storage opportunities.

## Incentives and motivations

- Reduce peak electricity demand charges.
- Improve energy efficiency and building performance.
- Lower electricity costs under retail energy contracts with market exposure.

## Other comments

The University has recently installed a 240-kW / 480-kWh battery in Building 10, which it is planning to use for a combination of research and building load management.

# Case study: Club Corowa

## Location/building owner

Club Corowa, NSW

## Building type

Large regional licensed club comprising hospitality, gaming, dining and community facilities, with significant electricity demand, on-site solar generation (400 kW) and EV charging infrastructure.

## Flexible demand initiatives

Site-wide energy management and load shifting through:

- energy management system (EMS) controls
- building management system (BMS) integration
- solar self-consumption optimisation
- event-based demand response
- virtual power plant (VPP) participation
- flexible control of connected electrical assets.

## Incentives and motivations

- Reduce electricity costs and demand charges.
- Increase utilisation of on-site solar generation.
- Participate in future demand-response and VPP programs.
- Improve resilience in a region that has experienced network reliability issues.
- Create additional value streams from flexible electrical loads.

## Other comments

A primary objective was to shift flexible loads into the solar generation window, reducing imports from the grid and lowering peak demand. The platform is also being prepared to participate in retailer and network demand response programs and potentially VPP arrangements.

DNA Energy reports that its platform can respond to control signals very quickly, while retailers and network operators typically provide advance notice of upcoming demand-response events, giving the system time to optimise building operation.

# Case study: The John and Kathy Schreiber Center

## Location/building owner

Loyola University's Water Tower Campus, Chicago, Illinois

## Building type

Ten-storey mixed-use vertical campus building, containing offices, classrooms and student facilities, completed in 2015.

## Flexible demand initiatives

- WattTime's marginal emissions data is used to identify periods when renewable energy is most abundant in the grid.
- BrainBoxAI then optimises energy consumption through a combination of pre-cooling (by lowering temperature setpoints), then allowing the building to gradually warm when the grid relies more heavily on fossil fuels.

## Incentives and motivations

- Reduce greenhouse gas emissions.
- Reduce peak electricity consumption and operating costs.

## Other comments

The Schreiber Center's modern envelope, shading systems, natural ventilation features, and HVAC design support pre-cooling and temperature drifting while maintaining occupant comfort.

BrainBoxAI was integrated with the building's existing HVAC system via the BACnet open communications protocol.

The project required BrainBoxAI, WattTime and UC Berkeley's Center for the Built Environment to work alongside the existing BMS and HVAC controls. Replicating this ecosystem may be more difficult in buildings with legacy controls or limited digital infrastructure.

# Case study: Scape student accommodation portfolio

## Location/building owner

Scape Australia

## Building type

Purpose-built student accommodation (PBSA) portfolio comprising 40 operational student accommodation assets across Australia.

## Type of flexible demand

Building electrification and load shifting through:

- hot water load shifting using electric hot water systems and storage tanks
- HVAC demand response through cloud-based control of variable refrigerant flow (VRF) systems
- exposure to wholesale-reflective dynamic electricity pricing.

## Incentives and motivations

- Reduce electricity costs and peak demand charges.
- Support building electrification and decarbonisation objectives.
- Test commercial viability of demand response in high-density residential buildings.

## Other comments

Scape operates under gross leases, meaning energy consumption remains under their direct control. Scape has committed to a range of demand response pilot projects and electrification initiatives designed to test the business case for flexible demand and assess potential benefits for both the portfolio and the electricity system.

A controls engineering consultant was engaged in 2025 to develop a cloud-based controls architecture capable of both monitoring equipment energy consumption and issuing control signals to modify building operation according to time-of-use or market conditions. Pilot implementation of this controls layer is planned for 2026 across 10 buildings.

A parallel electrification program is planned for four sites in 2026. As part of these projects, Scape will undertake analysis of hot water tank sizing to determine the potential for domestic hot water load shifting.

# Additional information

# The shift to renewables and energy storage

Electricity markets are transforming as coal plants approach their end-of-life, consumers add their own solar and batteries, and other sectors such as transport are electrified. The role of coal, which in 2010 delivered over 80% of grid electricity, will fall rapidly over the next decade. The ageing plants are becoming less reliable, more expensive to maintain, and cannot always operate flexibly alongside renewable electricity supply.

The decisions on how best to replace old coal-fired plants are made by private investors. That investment favours renewable energy and supporting technologies over fossil fuels. Globally in 2024, wind and solar received over three times as much investment as did coal. In the last quarter of 2025, about half of Australia's grid electricity was supplied from renewable sources.

Australia will replace ageing coal plants as they retire with new, cost-efficient generation, while maintaining reliability and increasing supply to meet a doubling of consumer demand by 2050. The Integrated System Plan (ISP) 2026, published by the Australian Energy Market Operator (AEMO), sets out the challenges and proposed delivery of this transition. The Optimal Development Path is the *proposed "mix of generation, storage and network investments to meet consumer needs at least cost through to 2050, as coal plants retire and while meeting government policies."*

Figure 18 and Figure 19 show the generation (TWh) and capacity (GW) in the National Electricity Market between 2025 and 2050 for AEMO's preferred 'step change scenario'. This builds enough generation capacity for reliability in all seasons. As grid demand and consumption is higher in winter than in summer, there will be surplus capacity in summer, typically from daytime solar generation.

For more details on the transition of the electricity network refer to:

- State of the Energy Market 2025, Australian Energy Regulator (AER)
- 2026 Integrated System Plan (ISP), Australian Energy Market Operator (AEMO).

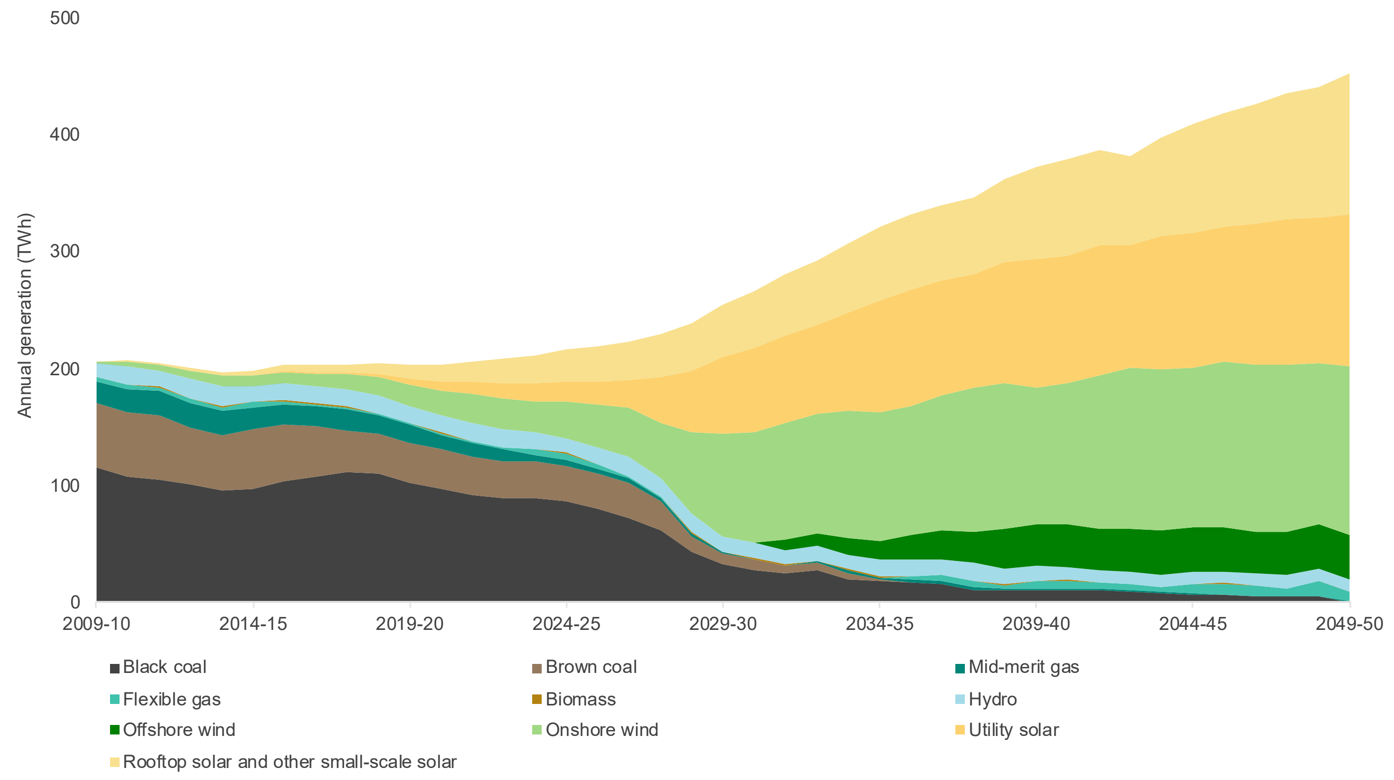


*Figure 18: NEM Generation mix of AEMO ISP Step Change Scenario (source: AEMO 2026 ISP)*

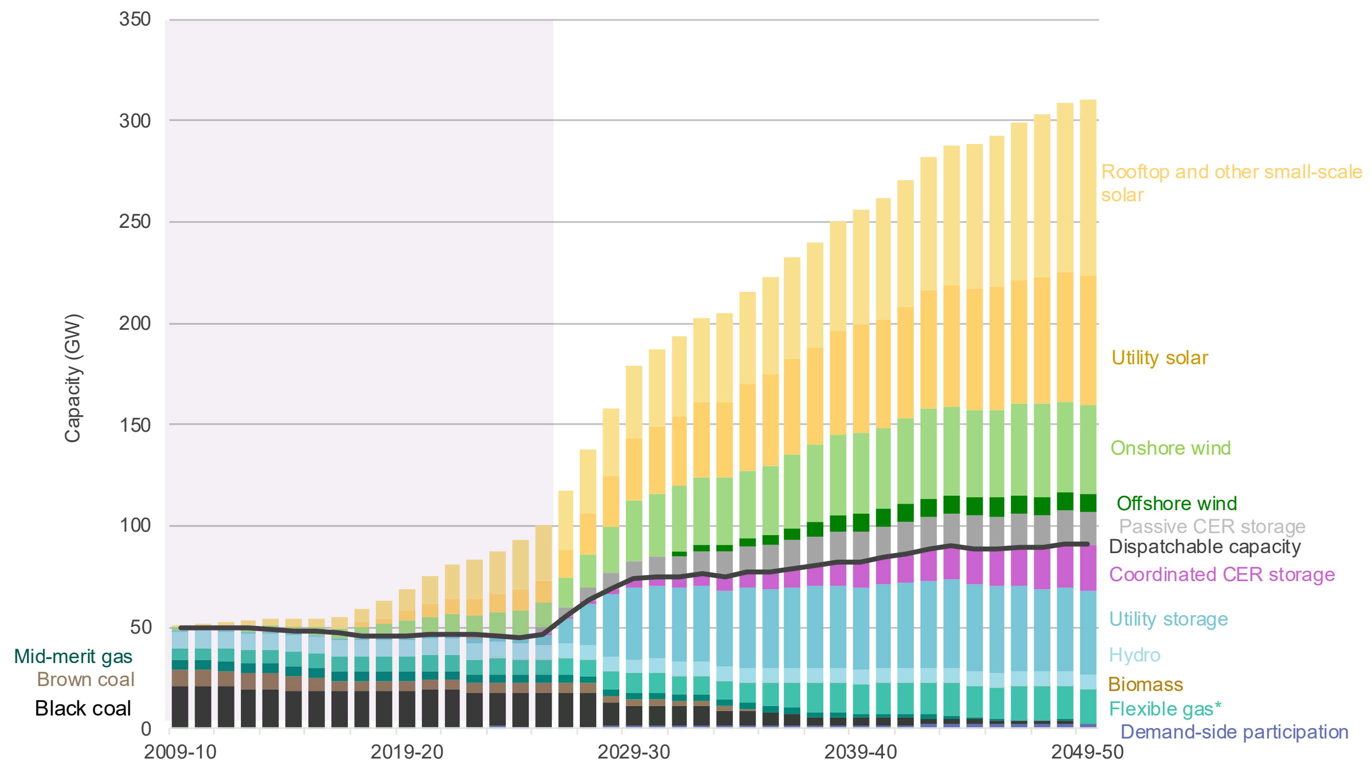


*Figure 19: NEM Capacity for AEMO ISP Step Change Scenario (source: AEMO 2026 ISP)*

# Government regulations and policy

State and federal governments are supporting the transition to net zero and a renewable electricity grid through a range of policies, plans and programs. Building owners should be aware of these to assess how their existing assets align with current best practice, and to determine potential risk going forward.

## Australian government

The Australian government has a range of policies and plans that support energy efficiency, electrification and flexible demand. These include the Trajectory for Low Energy Buildings, National Energy Performance Strategy and Australia's Net Zero Plan (2025), which includes separate plans for the built environment and the electricity and energy sectors. The GHG emission reduction targets are shown in Figure 20.

In the Electricity and Energy Sector plan, a key lever is flexible demand, which is defined as "increasing the capacity and capability for energy users to change the time electricity is used and to store electricity for use later". The aim is to:

- reduce peak electricity demand (to reduce the amount of energy infrastructure needed)
- improve grid stability and utilisation, and
- align demand with when clean electricity is available, reducing the cost of the transformation of the electricity grid.

## State governments

Each state government has set zero carbon targets and policy. For example, in NSW the Climate and Energy Action Plan sets out policies and actions to reduce emissions to net zero by 2050, transform the energy sector and accelerate renewable energy infrastructure, and ensure energy affordability and reliability for the people of NSW.

Some incentives and programs to support state government plans may be available for commercial building owners to access.

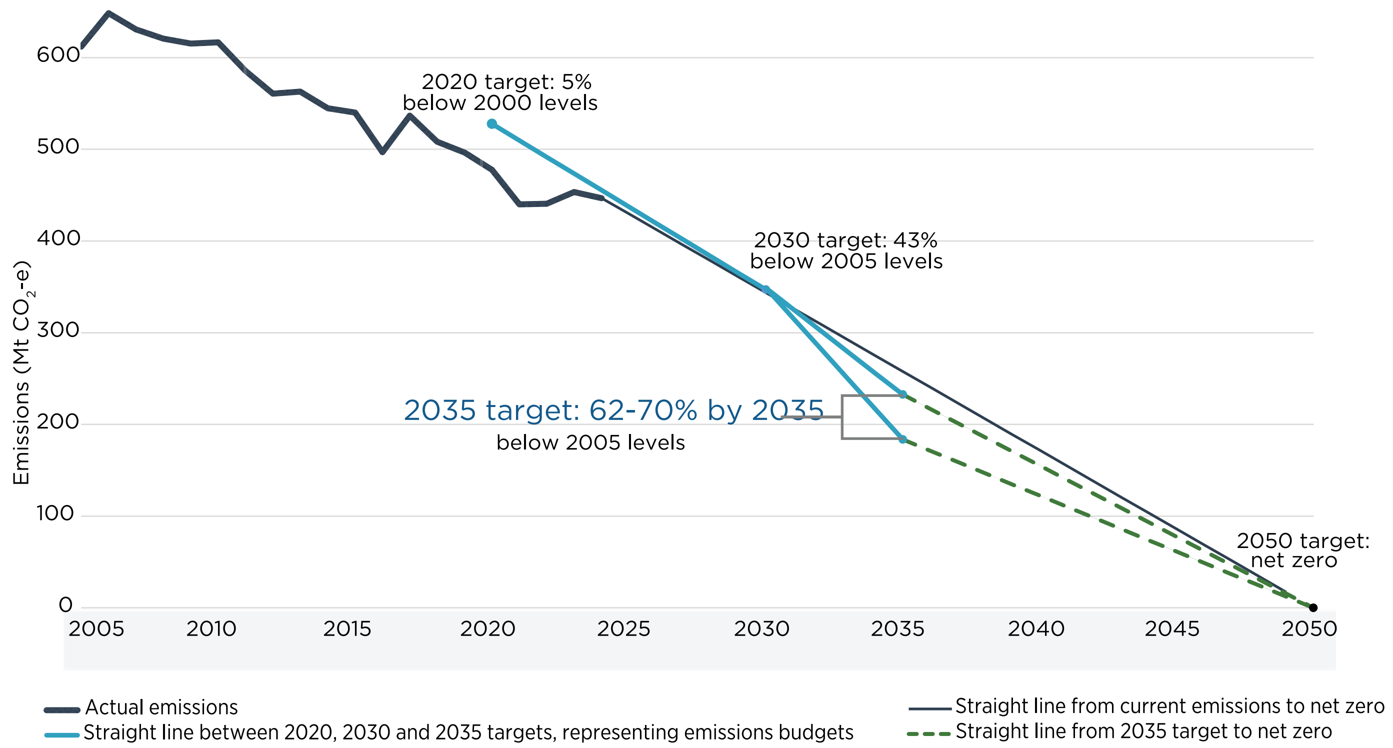


*Figure 20: Australia's GHG emissions reduction targets (source: Australia's Net Zero Plan, DCCEEW)*

### National Construction Code 2025

Section J9 of NCC 2025 includes requirements to support renewable energy generation and storage, such as:

- A minimum amount of PV panels must be installed based on either a minimum watts per $m^2$ of floor area (which varies by climate zone and whether the building has gas or not) or the area of roof available for panel installation.
- Provision on the electrical switchboard for a minimum of two connections for future battery systems.
- Energy metering and sub-metering configured to enable individual time-of-use energy data monitoring, analysis and reporting of energy systems in the building.
- Demand management control of building energy systems including renewable energy, batteries and EV charging.

# The role of buildings in the transition to renewable electricity

The Australian Government's Net Zero Plan (2025) refers to three key factors for improving energy performance:

- **Energy efficiency** – reduce the demand for energy.
- **Electrification and fuel switching** – reduce gas use in buildings and fossil fuels in transport.
- **Flexible demand** – increase the capacity and capability for energy users to change the time electricity is used and store electricity for later use.

Buildings are playing an increasing role in generating and storing electricity. What was once a relatively straightforward, one-directional market where large generators supplied electricity to consumers is evolving into a decentralised system that supports two-way power flows – refer to Figure 21.

Flexible demand in buildings aims to shift controllable loads into periods of low prices and low GHG emissions, while reducing demand during peak periods. In doing so, it improves grid stability, reduces renewable curtailment, supports further renewable investment and lowers the need for costly network augmentation.

The main technologies to shift grid demand are known as Consumer Energy Resources (CER), which include rooftop solar, batteries, electric vehicles and flexible loads. These enable households and businesses to generate, store and manage their own electricity.

Complementary services such as virtual power plants (VPPs), aggregation services, bidirectional charging and energy management systems can further empower consumers to optimise their energy use.

The technologies needed already exist. To make this all work effectively requires a coordinated approach, including real-time price and grid signals, so that the grid, local precincts and individual buildings all work together to balance supply and demand. (Refer to Figure 22 on page 38).

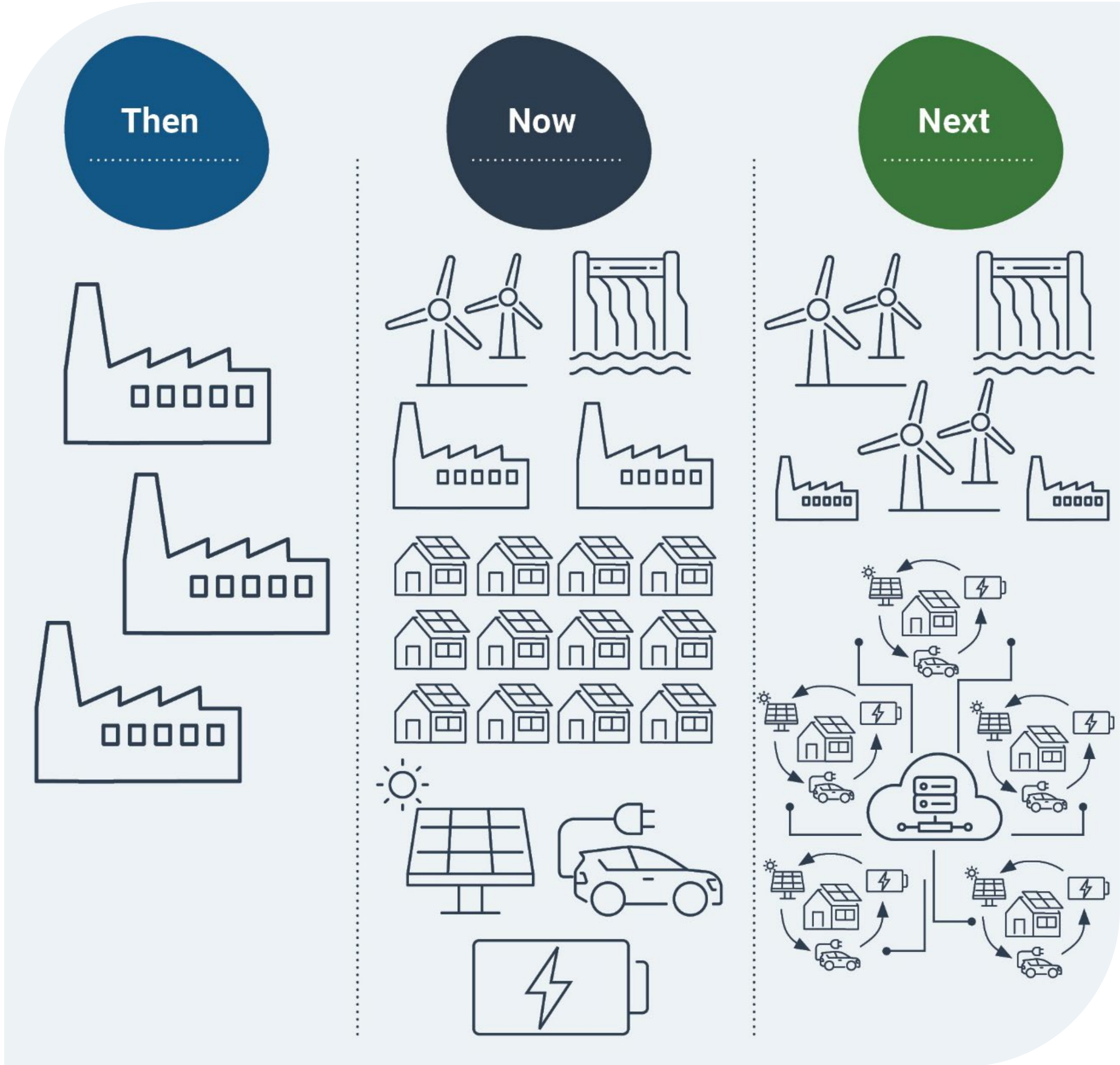


*Figure 21: Australia's electricity grids are transitioning away from centralised, fossil fuel generation to decentralised renewables (source: Electricity and Energy Sector Plan 2025, DCCEEW)*

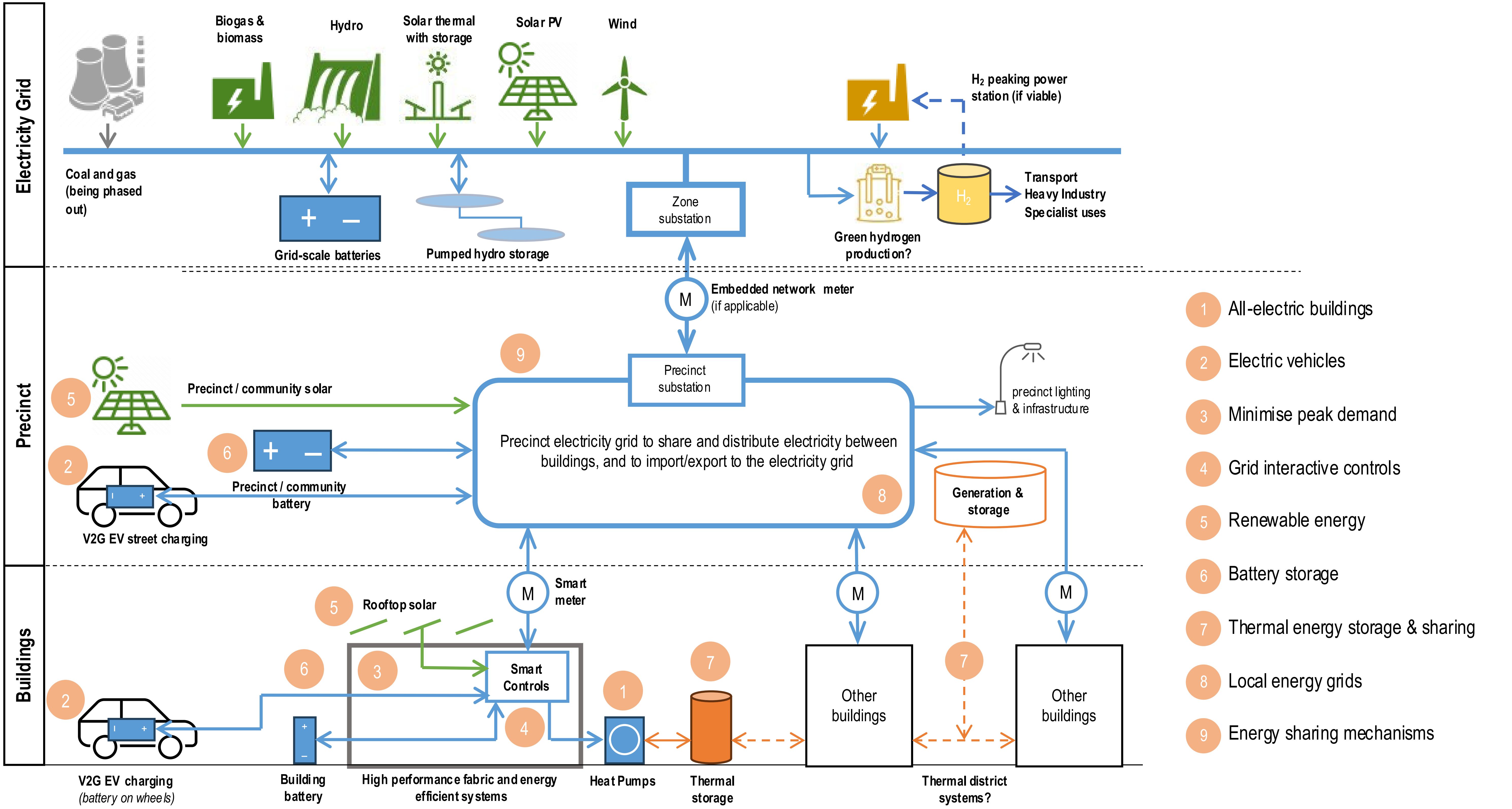


*Figure 22: Integration between building, precinct and grid-scale generation and storage. Source: Positive Zero.*

# Time of use in rating tools

## NABERS Energy

NABERS Energy ratings are currently calculated using metered energy consumption data, normalised for factors such as building size, climate, hours of operation and occupancy. The rating is based on total annual energy consumption and uses fixed emissions factors for electricity and gas to convert energy use into emissions-related performance. These factors are updated every five years to account for the ongoing decarbonisation of Australia's electricity grids. NABERS does not currently include energy time of use.

For over a decade NABERS has played a leading key role in driving down energy consumption in office buildings. However, with the shift to electrification and managing time of energy use, the methodology needs to change to align with the Australian Government's Net Zero Plan and to support the electricity grid transition to renewables.

For example, a building battery can be charged when electricity is abundant and cheap, then discharged when it is constrained and expensive. The net result is a reduction in GHG emissions and electricity costs. However, losses incurred in charging and discharging the battery will increase total electricity consumption, which impacts NABERS ratings under the current methodology.

In July 2026, NABERS published their feasibility study E*nergy Flexibility in Commercial Buildings* to explore how buildings can change when they use, store and share electricity to reduce emissions, lower costs and support a stable electricity grid. The literature reviewed for this feasibility study indicated that energy flexibility can deliver substantial economic, reliability and emissions-reduction benefits.

A three-year program of work is underway to recognise and support energy flexibility in commercial buildings, supported by the Australian Government and focusing on three priorities:

- Co-designing and developing metrics that recognise flexibility – to be ready for use in mid-2029.
- Ensuring buildings maintain NABERS Energy star ratings when they flex.
- Strengthening market capability, including quantifying the impacts of energy flexibility in commercial buildings, working with stakeholders to share insights and align with emerging developments, and help build market understanding through education, guidance and resources.

## Green Star Buildings (for new buildings)

In Green Star Buildings v1, projects are recognised for having a demand response strategy and reducing their electrical load in the optional Grid Resilience credit. The updated Green Star Buildings v1.1 acknowledges the changing landscape of the energy that powers the built environment and therefore requires the building to be set up for load shifting to take advantage of increasing renewables.

The Energy Source credit requires projects to have built-in capabilities in the energy management system and a load shifting strategy. This is mandatory for projects targeting 6 Stars initially, for 5- and 6-Star projects that register after 2028, and for all projects that register from 2030 onwards. The Grid Resilience credit also remains as an option for projects in Green Star Buildings v1.1.

Future versions of Green Star Buildings may by updated to include consideration of time of use in alignment with NABERS Energy.

## Green Star Performance (for existing buildings)

The Time of Energy Use Leadership Challenge established a process to measure and report hourly GHG emissions, set up the capability to shift time of energy use, and then measure the success of implementing the strategy.

A simplified Time of Energy-use Effectiveness Metric (TEEM) was established. This is the annual electricity consumption between 9am to 3pm divided by the total annual electricity consumption, expressed as a percentage. The leadership challenge is aimed at increasing the TEEM compared to a base year and then making year-on-year improvements.

The definition of the TEEM is likely to become more sophisticated over time to reflect the evolving nature of the electricity grid as generation and demand profiles change. The Leadership Challenge seeks to establish first steps to readiness for this evolving landscape.

Future versions of Green Star Performance may promote an existing Leadership Challenge on Time of Use to a credit in the Positive Category to drive uptake in existing buildings.

# REGOs: the new certificate for renewable electricity

Large-scale Generation Certificates (LGCs) have been the dominant instrument used in Australia for market-based electricity emissions accounting under frameworks such as the National Greenhouse and Energy Reporting (NGER) scheme and corporate Power Purchase Agreements (PPA). Each LGC represents one megawatt-hour of renewable electricity generated. Although LGCs are linked to a period in which renewable energy was generated, they are not highly time specific.

Organisations commonly use LGCs to make annual '100% renewable electricity' or net zero electricity claims, even though the timing of their actual consumption may still coincide with high-emissions periods on the grid such as overnight. In practice, LGCs function as a financial and accounting mechanism that supports renewable generation investment and matches consumption with renewables across the year, rather than as a tool for recognising and reducing real-time grid emissions.

Ongoing changes to Australia's National Greenhouse and Energy Reporting (NGER) scheme may enable time-based tracking of Scope 2 GHG emissions. These changes will affect all entities subject to mandatory GHG reporting and mandatory climate risk disclosure.

The new requirements for tracking, certifying and integrating renewable energy across supply chains have prompted the development of a new national certification system: Renewable Electricity Guarantee of Origin (REGO) certificates. The REGO scheme allows for certificates to be 'time-stamped', based on when they were generated (with four options: hour, day, month or year). They can include other information such as the type of generation. With the Renewable Energy Target ending in 2030, the REGO scheme is expected to become Australia's primary government-backed renewable electricity certification framework from 2031.

For commercial building owners, the transition from LGCs to REGOs has several implications. REGOs with hourly timestamps will allow more accurate tracking of the renewable energy used within buildings, strengthening the credibility of net zero claims, sustainability reporting and tenant disclosures.

As REGOs can incentivise flexible demand and better alignment with renewable generation profiles, they can encourage building owners to invest in load shifting, automation, building analytics and storage technologies that enable participation in time-varying energy procurement and new market opportunities.

### Illustrative example of LGCs versus REGOs

The following example uses REGO certificates with hourly time matching. The current REGO system provides timestamps but does not itself impose universal hourly matching.

On 1 July 2028, SUN Solar Farm generates 100 MWh of electricity between 4pm to 5pm and 50 MWh of electricity between 5pm to 6pm.

- Under the LGC system, SUN would have created and sold 150 LGCs for the electricity it generated during this two-hour period.
- Under the REGO system, it instead creates 100 REGOs and timestamps these as being generated 4pm to 5pm, 1 July 2028, and 50 REGOs timestamped 5pm to 6pm, 1 July 2028. It then sells the earlier REGOs for $10 each and the latter REGOs, which are less abundant, for $20 each.

On the same day, XYZ Property Group owns a building that uses 2 MWh of electricity between 4pm and 5 pm and another 2 MWh between 5pm and 6pm.

- Under the LGC system, all four MWh would be treated the same and offset by purchasing four LGCs.
- Under a reporting or procurement framework that values hourly matching, XYZ may choose to acquire REGOs generated during the same hour as its electricity consumption. Each MWh would be treated differently and covered by purchasing two REGOs tagged 4pm to 5pm, 1 July 2028, and two REGOs tagged 5pm to 6pm, 1 July 2028, at a total cost of $60.

XYZ pre-empts this price differential by bringing 1 MWh of load forward by one hour. They then cover their consumption by purchasing three of the cheaper REGOs and only one of the more expensive REGOs, saving $10.

# Glossary

| | |
|---|---|
| **ABCB** | Australian Building Codes Board – The body that maintains the NCC on behalf of federal, state and territory governments. |
| **AEMO** | Australian Energy Market Operator – The organisation responsible for operating Australia's electricity and gas markets, managing the power system, forecasting, and coordinating demand response programs. |
| **AER** | Australian Energy Regulator – The organisation that enforces the rules and regulates electricity and gas networks, wholesale markets, and retail markets to ensure affordability and fairness. |
| **Aggregator** | A company that pools many CERs so they can participate as a single unit in energy markets as a VPP. |
| **Baseline load** | A counterfactual estimate of what a load 'would have been' without a flexible demand intervention. |
| **Behind-the-meter** | Assets on the customer side of an electricity meter (as opposed to the grid side). |
| **BESS** | Battery energy storage system – A battery, grid inverter and their associated control systems. |
| **BMS** | Building management system – A computer-based control system for monitoring and managing the mechanical and electrical equipment of a building, including HVAC, lighting and other electrical loads. |
| **CER** | Consumer energy resources – Behind-the-meter energy resources that can be controlled to support grid stability. Examples include solar, batteries, EVSEs, HVAC systems and hot water systems. |
| **Curtailment** | Reducing or stopping electricity generation from a power source (e.g. solar), even though it could produce more, usually to ensure grid operating limits are not breached. |
| **Demand response** | A type of flexible demand that involves customers reducing or shifting load when asked by a market operator, retailer or aggregator. |
| **DER** | Distributed energy resources – An alternative term for CER. |
| **DNSP** | Distribution network service provider – The owner and operator of the poles, wires, substations and related infrastructure that deliver electricity from the transmission network to homes and businesses. |
| **Duck curve** | A visual description of one or more daily demand profiles, characterised by morning and evening periods of high demand, interspersed by a daytime period of low demand. |
| **ESG** | Environmental, Social and Governance – A widely used investment and corporate reporting framework for assessing how responsibly and sustainably an organisation is managed and operates in terms of its environmental impacts (e.g. carbon emissions), social factors (e.g. labour practices) and governance (e.g. transparency and board oversight). |
| **EV** | Electric vehicle. |
| **EVSE** | Electric vehicle supply equipment – the charger or other infrastructure that delivers electricity from the grid to an EV. |
| **FD** | Flexible demand – The capability to vary customer electricity demand in response to generation, network or market signals. |
| **FCAS** | Frequency control ancillary services – An electricity market where fast-responding loads and batteries help maintain grid frequency. |
| **GBCA** | Green Building Council of Australia – A national industry body that develops and administers the Green Star sustainability rating system for buildings, fitouts and communities, which promotes best-practice design, construction and operation to improve environmental performance across the built environment. |
| **GHG** | Greenhouse gas |
| **HVAC** | Heating, ventilation and air conditioning – Systems used to regulate temperature, humidity and indoor air quality in buildings. |
| **LGCs** | Large-scale Generation Certificates – Tradeable certificates created for every megawatt-hour of renewable electricity generated by accredited large-scale power stations in Australia. They are part of the Renewable Energy Target scheme and can be sold to businesses or electricity retailers, who use them to meet their renewable energy obligations or sustainability goals. |
| **Minimum demand** | A grid condition when net electricity demand is very low, usually in the middle of the day, when solar output is abundant. |

| | |
|---|---|
| **NABERS** | National Australian Built Environment Rating System – A government-run framework and rating system that measures how efficiently a building uses energy, water, waste services, and how well it performs for indoor environmental quality. |
| **NEM** | National Electricity Market – The system that connects electricity generators, retailers, and consumers across Australia's eastern and southern states. It operates as a wholesale market where electricity is bought and sold, and it also manages the physical flow of power through the grid to keep supply and demand balanced in real time. |
| **NCC** | National Construction Code – Australia's primary set of technical design and construction requirements for buildings, setting the minimum standards for safety, health, amenity, accessibility, and sustainability. |
| **Net zero** | Balancing the amount of greenhouse gases emitted with the amount removed from the atmosphere. This can be done by reducing emissions as much as possible and then offsetting any remaining emissions through actions like carbon capture or purchasing offsets. The goal is that net emissions equal zero. |
| **NGER** | National Greenhouse and Energy Reporting scheme – Australia's mandatory national framework for large corporations to measure and report greenhouse gas emissions, energy production and energy consumption. |
| **PDRS** | Peak Demand Reduction Scheme – A NSW government program that provides financial incentives for customers to reduce electricity use during peak demand periods. |
| **Peak demand** | A grid condition when electricity demand is very high. |
| **Peak demand charges** | Electricity charges based on a site's highest level of power demand during a billing cycle, aimed at reducing strain on the grid during peak times. Can comprise up to 40% of customers' bills. |
| **PPA** | Power purchase agreement – A long-term contract between an electricity generator and a buyer. Under a PPA, the buyer agrees to purchase electricity at a fixed price for a set period, usually several years. |
| **Pre-cooling or pre-heating** | Running HVAC earlier than usual to shift cooling/heating loads to periods of lower cost or lower emissions intensity. |
| **REGO** | Renewable Electricity Guarantee of Origin – Certificates that show electricity was generated from renewable sources. They provide transparency and allow businesses, energy retailers, and consumers to prove the origin of their electricity. Each certificate represents a specific amount of renewable energy and can be used for reporting, compliance, or sustainability claims. |
| **REI** | Renewable Energy Indicator – A component of a NABERS Energy rating that displays the proportion of a building's energy that comes from on-site renewable energy generated and off-site renewable energy procured. |
| **TES** | Thermal energy storage – A system for storing thermal energy, such as water tanks, used to store thermal energy (heat or coolth) for later use. |
| **ToU** | Time of use – An electricity pricing structure where the rate changes by time of day to encourage load shaping and shifting. Three tiers are typically used: peak, shoulder and off-peak. |
| **V2G** | Vehicle-to-grid – A system by which an electric vehicle can discharge energy from its battery back into the electricity grid. Also referred to as bidirectional charging. |
| **VPP** | Virtual power plant – An aggregation of CERs (e.g. batteries, EVSEs, solar and flexible loads) that can be coordinated to act like a power plant in electricity and ancillary service markets. |
| **VRF** | Variable refrigerant flow – An advanced HVAC technology that circulates only the precise amount of refrigerant needed to condition different zones in a building. |
| **WDRM** | Wholesale Demand Response Mechanism – An Australian market mechanism that allows large energy users to reduce load during high-price periods and get paid directly through the wholesale electricity market. |

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