action matters for business

Photo: C. Harding/OEH

Battery storage for business: the essentials

This essentials guide is for all those involved in the early analysis of the viability of battery storage for energy management. It provides a quick overview of battery storage technology and how it relates to the structure of electrical systems.

It is part of a set of resources on battery storage technology:

- *i am your battery storage guide* – a comprehensive guide to the technology and how it might apply to your business, and a buyer's toolkit
- *Battery storage for business: an investment decision tool*
- *Battery storage for business: price estimate template.*

It is recommended that businesses interested in further investigating this technology attend the NSW Office of Environment and Heritage (OEH) battery storage training course.

What is battery storage?

Battery storage involves the use of a battery to store energy for use when required. Technically, it is the conversion of electrical energy into chemical potential energy for storage followed by reconversion of chemical potential energy into electrical energy when desired.

A battery storage system allows a business to obtain electricity from a source that is relatively inexpensive (e.g. solar or off-peak grid energy), store it chemically, and then consume the energy electrically at a time when electricity is relatively expensive or unavailable.

NSW GOVERNMENT Office of Environment & Heritage

Other than a battery, there are multiple components in a battery storage system, including:

- battery inverters
- battery management systems
- installation in a secure, fire-rated battery room or enclosure.

Why invest in battery storage?

Battery storage enables greater self-consumption of renewable energy from sources that are variable, such as solar power.

Businesses that face difficulties in the reliability or capacity of their electricity supply can reap benefits from battery storage.

Battery storage can also save on power costs by reducing the need to purchase electricity at times when it is most expensive.

Is battery storage a new concept?

The use of batteries for energy storage is not new. Storage systems featuring lead-acid batteries have been used for over a century.

Development of lithium-ion batteries for devices such as mobile phones has improved the technology, while the increasing production of batteries for electric vehicles has placed downward pressure on the price of battery storage for homes and businesses.

Grid-connected battery storage has recently become popular in Australia due to heavy marketing and billions of dollars have been invested by various battery manufacturers.

Historical increases in the cost of electricity have made businesses interested in any potential cost-cutting technologies, including battery storage.

Greater adoption of solar photovoltaic (PV) systems has also contributed to the increase in demand for battery storage as consumers desire to use more renewable energy onsite.

The impending conclusion of the solar bonus scheme gross feed-in tariff will result in system owners receiving significantly less financial benefit from excess power generation. These businesses may be considering using battery storage to reap greater benefits from their solar PV systems.

Australian standards for newer battery storage technologies are still under development, however there are best practice guidelines available from the Clean Energy Council and the Australian Energy Storage Council.

How battery storage systems work

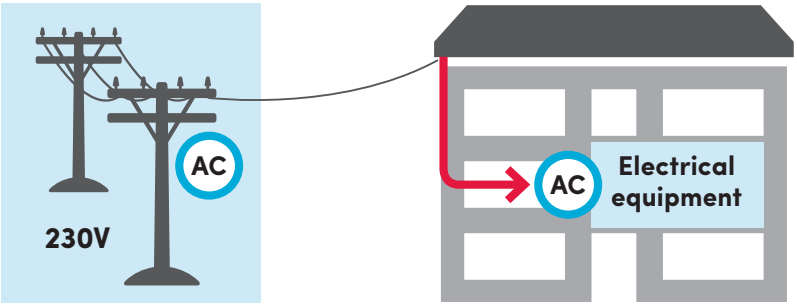


Figure 1: Electricity is generally supplied to businesses in New South Wales as alternating current (AC) at 230 volts single-phase or 400 volts three-phase.

Inverter/rectifier/battery charger

The devices that operate a battery, including the conversion of AC to DC (rectification) and DC to AC (inversion), as well as the management of the battery to ensure its correct charging and discharging (battery charger), are typically integrated and referred to as 'inverters'.

When the industry refers to 'inverters', these may include any or all of the above components.

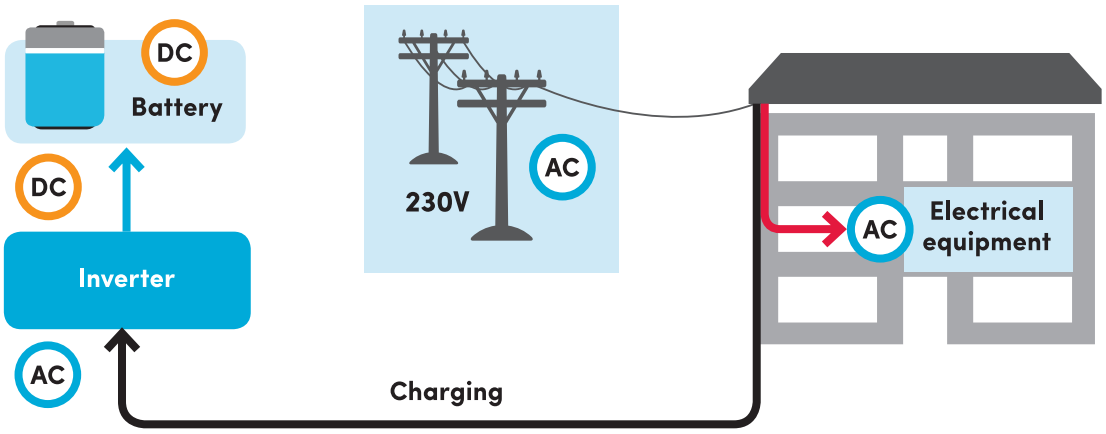


Figure 2: A battery system converts AC electricity, via an inverter, into DC electricity that charges a battery.

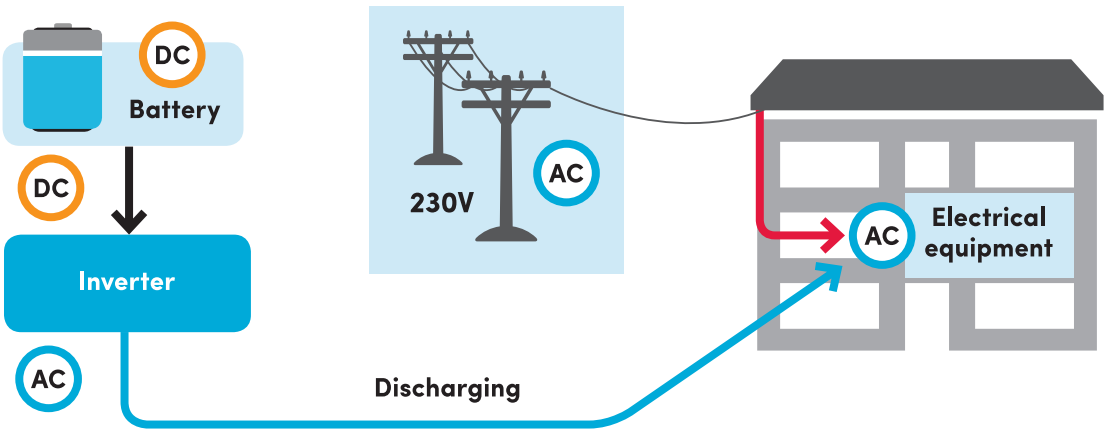


Figure 3: A battery system is designed to cycle between storing energy (charging) when the cost to do so is low and using the energy (discharging) when the benefit is high, for example, when the price of electricity is relatively high.

A battery system can function with or without solar PV, but together, businesses can optimise the use of low-cost renewable energy at times that produce the greatest financial benefit.

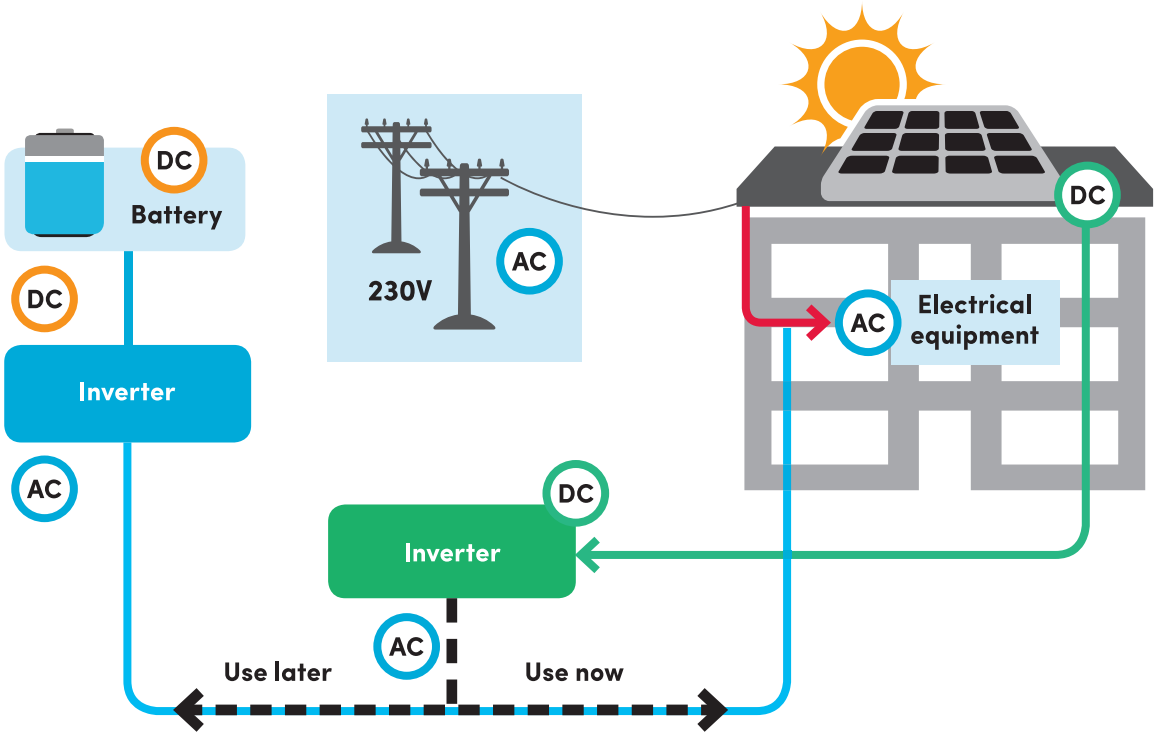


Figure 4: An AC-coupled system with two separate inverters: one for the battery and one for the solar PV.

Some inverters, known as hybrid inverters, can perform the function of a solar inverter and a battery inverter. This employs a configuration which is known as DC-coupling.

Solar photovoltaic systems and battery storage

Solar PV converts sunlight directly into electricity. Solar power is instantaneous and can be highly variable – it needs to be used at the moment it is generated, either by your business or by the grid, unless it is stored in a battery for consumption at a later time.

The financial benefit of consuming solar PV depends on the cost of purchasing electricity from the network.

Solar PV by itself is only cost effective if the price of electricity during the middle of the day is relatively high compared to the levelised cost of the solar panels.

Excess energy generated by solar PV can be fed back into the grid for a small credit, however, this is often less financially effective than self-consumption.

A correctly designed and specified battery storage system means that a business can increase the size of solar PV and self-consume through storage. In this way, the overall proportion of total energy consumed on site from renewable sources can be significantly increased.

Levelised cost of energy

Levelised cost of energy (LCOE) is a way to express the average cost of an energy source, taking into account lifetime costs, economic factors, and the lifetime energy output of the system. It is expressed in $/kWh.

Types of batteries

There are currently four different battery chemistries commercially available that are typically put forward by suppliers/installers for the applications discussed in this guide:

- lead-acid
- lithium-ion
- flow
- salt-water (sodium-ion).

Which chemistry for which application?

Any of the battery chemistries currently on offer are capable of performing for a variety of applications. However, some chemistries perform some functions more effectively than others. See *i am your battery storage guide* for more information.

Your system design process needs to include an assessment of the unique characteristics of your site so you can identify and specify the chemistry which will provide the best performance.

This overview alone can't identify the best solution for your specific needs. The selection of the correct solution for your project can only be achieved through a best practice engineered design.

Why install a battery storage system?

Batteries have a long lifetime and the cost savings over the life of the system can make economic sense for some businesses. The increased ability to use renewable energy is an attractive bonus.

Businesses can potentially reduce costs using battery storage in the following ways:

Time-of-use tariff optimisation

- Batteries are used to exploit the different cost of energy at different times of day.
- Energy can be sourced from solar PV or from the grid during off-peak tariff periods and consumed during peak tariff periods.

Application

- Most effective when the peak tariff rate is high.
- Larger energy users may find tariff optimisation to be ineffective because they are charged much less for energy than smaller energy users.

Reducing capacity charges

- Businesses that pay capacity charges can use batteries to limit the maximum power capacity used in a billing period.
- This technique limits the network component of charges which are calculated on peak power usage.

Application

- Only suitable for businesses on applicable tariffs: typically larger energy users with predictable loads.
- Good knowledge of power usage is required for the system to be effective.
- Power for battery charging can be sourced from the grid, solar or otherwise.
- Most economical when high power usage occurs for short durations.

Maximising solar photovoltaics

- The average cost of a solar PV installation means that solar energy is typically inexpensive compared to purchasing electricity from the grid.
- Batteries enable businesses to self-consume more solar PV by storing energy for when solar is not available.

Application

- Most economical for small to medium energy users.
- Requires surplus solar PV generating capacity.
- Suitable for businesses interested in increasing the proportion of energy they consume from renewable sources.
- Suitable for increasing energy self-sufficiency.

Other potential applications for battery storage

Basic back-up

- Businesses that will benefit from operational continuity in a power failure, or during periods of low network voltage, may choose battery storage. The system must be specifically designed for this application.

Uninterruptable power supply

- Distinctly different from basic back-up, a business whose operational continuity must not be interrupted can consider a specifically designed uninterruptable power supply. This is not a feature of most battery storage systems. Typically associated with IT applications such as data centres.

Network constrained businesses

- Businesses that occasionally cannot service all of their power needs from the grid may be faced with infrastructure upgrade costs.
- Battery storage potentially provides an alternative option of charging batteries with power from the grid in periods of low usage and drawing on both grid and batteries in periods of high usage.

Off-grid systems

Off-grid configurations include:

- solar PV and battery storage used as primary power sources with generator back-up
- solar PV and battery storage in parallel with generators which are the primary power source
- battery storage facilitating the purchase of a smaller generator, with the two power sources working together to service peak loads and the generator recharging the battery during low-load periods.

Sell power and ancillary services back to the grid

- A business may make arrangements to sell services from the battery back to the electricity grid.
- These services might include exporting power during high price periods or providing ‘ancillary services’ such as frequency support and reactive power support.
- Ancillary service applications are not yet widespread but may become more common in the future. They will require specific arrangements to be made with network service providers.

Where do I start?

1: Understand your energy use Start by understanding how and when your business uses energy	**Consider:** • Is energy usage constant or does it vary significantly? • Does energy usage occur mainly during the day or night? • Is there on-site solar power generated and not fully self-consumed?
2: Understand your electricity tariff Understand how your business pays for electricity – what types of tariffs and charges are applied to your bill.	**Consider:** • How much electricity is used per year? • Does the business pay network capacity charges? • Are billing rates based on the time of use? • What are the applicable tariffs in each time period? • What is your peak usage costing you?
3: Understand costs and savings Batteries are currently expensive and payback is usually longer than 10 years. Benefits may occur over a long lifetime of more than 10 years.	**Consider:** • Are there criteria for this decision other than cost savings? • Can a premium for renewable energy be accepted? • What is an acceptable duration for payback? • Does the battery system warranty cover the full payback period? • How much can you afford to spend? • Is there a business objective to use renewable energy?

Consider solar photovoltaics

Solar power in Australia makes sense – Australia has plenty of sunshine. Solar power can be cheaper than purchasing power from the network, which means it is a good way to reduce energy bills.

The downward trend in the cost of solar panels and the increased cost of electricity means that solar PV systems are now more economical than ever.

The challenge with solar power is that solar PV creates most of its power in the middle of the day and can be quite variable. Power consumption varies considerably from business to business, and some businesses will have much higher power usage in the afternoons and evenings when electricity tariffs are typically higher. Battery storage solves this problem by enabling excess energy from solar power to be stored for later use, when it can be consumed to achieve maximum cost savings.

Installation requirements, risks and safety considerations

There are a number of potential hazards associated with battery storage, including electrical and fire hazards. Best practice calls for a dedicated, secure, fire-rated battery room or enclosure.

Ahead of an Australian Standard being made available for all battery chemistries, the Clean Energy Council and the Australian Energy Storage Council have issued installation guides and battery guides recommending methods of battery installation.

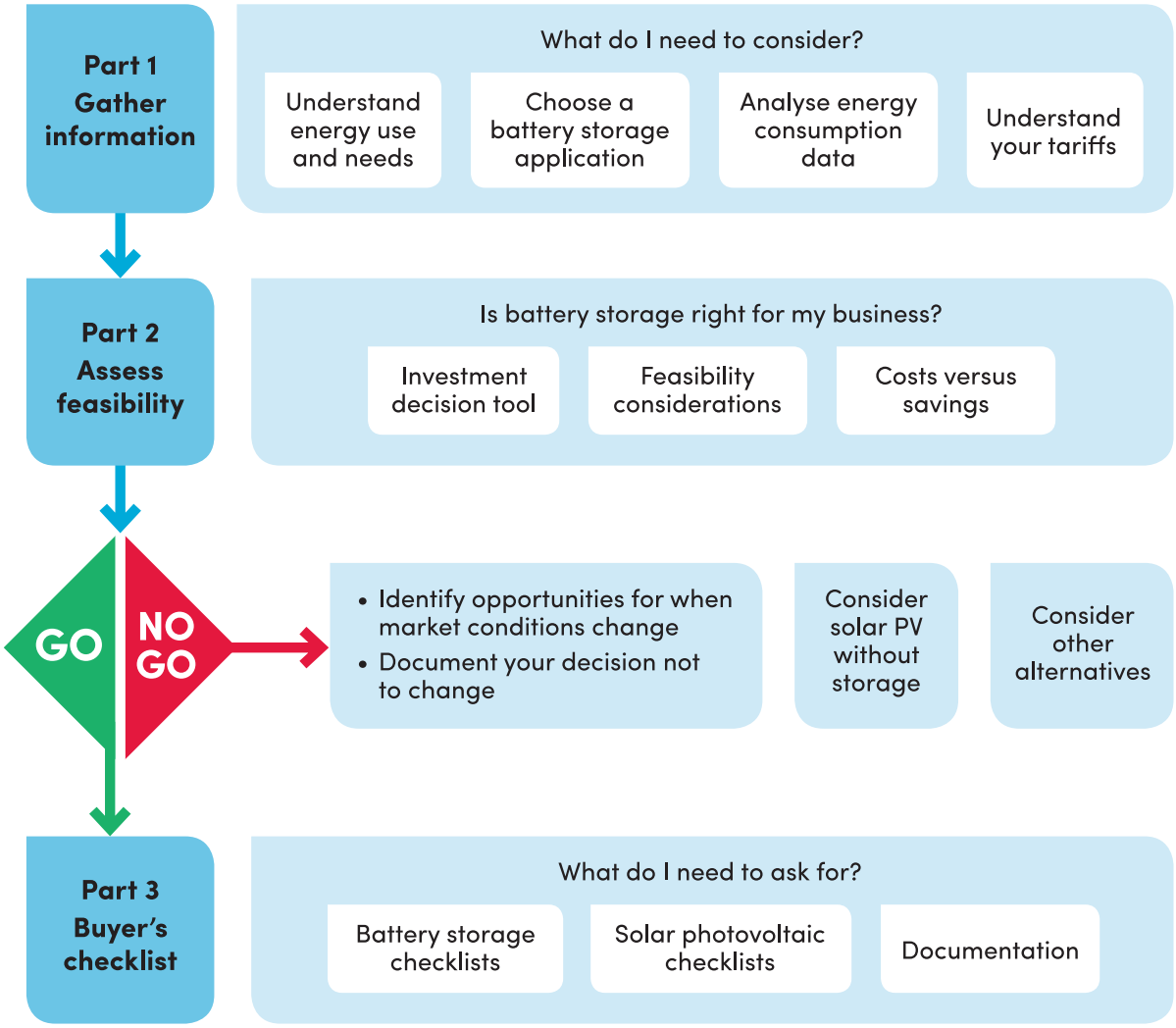
Life expectancy versus warranty

Currently we are not aware of a single testing methodology that is used by all manufacturers to establish the performance and life cycling of their products. Predicting the life expectancy of batteries is likely to be inaccurate and inconsistent between different manufacturers.

Most batteries in the market today offer a warranty of up to 10 years. Within this 10-year period, some batteries offer warranties with 3650 cycles, (one cycle per day), while other batteries have warranties of 8000 cycles or more (if used for more than one cycle per day). Batteries designed for high numbers of cycles could potentially last longer than the 10-year warranty period when cycled only once per day. Professional advice is required for these assessments.

Buyer's toolkit

The Buyer's toolkit in *i am your battery storage guide* provides tools and advice to help you determine the suitability of battery storage for your site, including how to collate the information a potential supplier/installer will need to evaluate your requirements and provide you with a quote.



For more information see the Battery storage for business webpage for the full set of resources on battery storage.

These resources are intended for end users who are interested in understanding the technology and evaluating its applicability to their site. They do not seek to provide any detailed engineering or financial analysis of the needs of a particular site. Advice should be sought from suitably qualified professionals to ensure your solution is robust and compliant with all standards and requirements.

Published by:
Office of Environment and Heritage
59 Goulburn Street, Sydney South NSW 2000
Phone: 131 555 (environment information and publications requests)
[or use 1300 361 967 (national parks, general environmental enquiries, and publications requests)]
TTY: +61 2 9211 4723
Email: info@environment.nsw.gov.au; Website: www.environment.nsw.gov.au

Report pollution and environmental incidents: Environment Line: 131 555 (NSW only)

ISBN 978 1 76039 572 8; OEH2016/0676; November 2016. Printed on environmentally sustainable paper.