

ENERGY STORAGE

A PRACTICAL GUIDE

AT A GLANCE

Best suited to:

Businesses with high energy use or a need for reliability in an unreliable system

Main benefit:

Supports better use of existing renewable energy production

Main barriers:

Your upfront costs and payback period depend on tariffs and usage

Good first step:

Understanding how storage will work with your existing power supply

Image: Qld Ag Energy Hub





OVERVIEW

Energy storage means holding energy so it can be used at a different time to when the energy is generated or purchased. For rural and regional businesses, this is most commonly about capturing solar energy during the day and using it later when energy demand is higher or when solar is no longer generating. Storage is becoming more important as more businesses look for ways to improve energy reliability and reduce energy costs.

There are three main types of storage relevant to rural and regional Australia:

- **Battery storage:** Battery Energy Storage Systems (BESS) store electricity directly. Cheap grid energy or excess solar energy charges the battery during the day, and the stored electricity can then be used when needed.
- **Thermal storage:** Thermal storage stores energy as heat or cooling. Examples include insulated water (hot or chilled) or glycol tanks, and ice storage. These systems use surplus electricity or waste heat to heat or cool something during the day (e.g. heat pumps, boilers and refrigeration systems) so the stored energy can be used later.
- **Mechanical storage:** Mechanical storage stores energy in movement or pressure. Examples include flywheels (using rotational kinetic energy from a spinning rotor or flywheel for smoothing peaks or stabilising power), pumped hydro, and compressed air energy storage (storing compressed air in a tank or underground storage for later release and expansion to generate energy to drive mechanical work).



SUITABLE BUSINESS TYPES

Energy storage is most valuable where there is either high energy use, variable demand, a need for reliability in an unreliable system, or for businesses that may be exporting surplus energy generated on site. Examples include:

- Businesses which require higher energy usage throughout the day or at critical times, such as refrigeration for butchers, poultry farms, and food processing facilities; or where outages can

have serious operational or animal welfare consequences. These businesses tend to have relatively predictable energy use, which can make it easier to size and get a return on storage systems.

- Businesses where the peak energy usage coincides with peak electricity prices, for example cropping – particularly where smaller electric pumps are used. In these cases, storage can help shift peak demand to times when electricity is cheaper.
- Remote properties, off-grid systems, or where water pumping and household energy use are key considerations.
- Businesses that already have heating or cooling equipment and sufficient land area for water to be heated or cooled and stored for peak demand periods, e.g. dairies, nurseries and greenhouses.
- Businesses that have the potential to use otherwise wasted heat.



BENEFITS

Adding on-site energy storage can offer a number of potential benefits, including:

- Supporting better use of solar energy production by storing excess daytime solar, then allowing use during peak energy prices and increasing self-consumption.
- Reducing peak demand and costs by smoothing large loads. This is achieved by drawing power from a battery, or drawing hot water from a storage tank.
- Improved reliability and backup where batteries allow continuous critical power supply during power outages, reducing reliance on both unstable grids and diesel generators.
- Supporting electrification by enabling switching from diesel/gas to electric.
- Allowing existing systems to be retrofitted, for example by adding an additional hot water storage tank, or using a spare dairy vat for chilled water storage. A thermal storage system may also achieve efficiencies by allowing equipment such as chillers to run at a more efficient operating level to heat or cool water.
- Where market mechanisms are available, stored electricity can be exported during periods of high demand or high prices.



CHALLENGES

Some of the challenges to consider include:

- A level of complexity is involved in designing and sizing systems. Storage needs to be matched to both the energy use profile and the generation profile. If systems are undersized or poorly configured, the expected benefits may not be realised.
- Batteries can have a large upfront cost and the payback period depends on tariffs and usage.
- New large-scale battery systems will generally need approval by the local Distribution Network Service Provider (DNSP).
- Batteries degrade over time (10–15 years is typical), and discharging batteries too deeply can reduce the lifespan. Thermal systems are simpler but still require maintenance, and mechanical systems are less common so there are fewer suppliers.
- Thermal management of batteries can be required in hotter rural environments.



TECHNICAL CONSIDERATIONS

Understanding your energy needs

- Implementing an energy storage system requires an understanding of the scale of energy use and use patterns. Patterns over one or two years should be reviewed to determine the suitability of storage and to design the right system. This is increasingly supported by the use of smart meters.
- It is important to consider how energy storage will be used, including whether there is already enough energy produced on site to allow for storage, when this excess energy is being produced, and when the stored energy will be used.
- Round trip efficiency is the proportion of power available after any losses in the transfer of power. There are higher losses associated with flywheels and compressed air storage, as mechanical work is required to store and recover the energy through a turbine. The system must be designed to ensure sufficient energy will be available after accounting for power losses.

Technology type

Different technology types come with different considerations. Some of the key considerations for each technology type are listed below:

Batteries

- Whether the battery is grid-connected or required to have off-grid capability.
- The size of the inverter needed to support the necessary power draw at equipment start up.
- Whether switchboard upgrades and protection are required.
- The depth of discharge available to ensure system sizing is large enough to avoid drawing the battery down to the extent that it affects battery life.

Thermal storage

- If a new system is being considered, consider whether there is sufficient physical space for the thermal storage tanks and other equipment.
- Where there is a heating or chilling system already in place, such as an electric storage hot water system, consider whether the storage tank can be expanded or connected to another tank to increase storage capacity.

Mechanical storage

- Mechanical storage systems like flywheels are usually packaged units that connect into the electrical system. They are more commonly used in industrial settings which will generate large power draw on start up. This means both the power rating (kW) and the storage capacity (kWh) need to be carefully considered.



IMPLEMENTATION CONSIDERATIONS

Suppliers or service providers

- Solar and battery installers are usually the main delivery channel, supported by electrical contractors and, in some cases, energy consultants for larger or more complex systems.
- For thermal storage, plumbers and HVAC or refrigeration specialists are often engaged in the design and installation.

Skills or training required

Most systems are designed and installed by specialist providers, and proper commissioning and instruction should be provided as part of the installation process so that the user can maximise the benefit of the battery.



DECISION FACTORS

When this option may make sense

Energy storage makes the most sense where there is a clear mismatch between when energy is generated and when it is used, and where this mismatch has a financial or operational impact.

Storage is particularly well suited to sites with existing or planned solar systems, high evening or overnight energy use, significant peak demand charges, or reliability concerns. It is also attractive where diesel is currently used for backup or off-grid supply.

When it may not be suitable

Factors that may reduce the effectiveness of a storage system include:

- Businesses with low energy use, flat tariffs, or highly reliable and low-cost grid supply.
- Where there is no solar generation, as the value of storage is reduced.
- Large or occasional energy use that spikes for short periods, such as seasonal irrigation pumps, flood lift pumps, or ventilation in intensive animal sheds on hot days. In these cases, it is often not economical to install enough storage to cover short bursts of high use.

Key decision criteria

Some factors to consider when deciding whether storage systems are right for you:

- Storage should be considered as part of a broader energy strategy rather than as a stand-alone investment. Starting with an understanding of energy use on-site, then optimising efficiency and solar, and finally assessing storage, is often the most effective approach.
- Costs vary widely depending on system size and configuration. Small battery systems of 10kWh suitable for homes or small businesses may range from around \$10,000 to \$25,000. Larger farm-scale systems can range from \$50,000 to several hundred thousand dollars or more.
- Thermal storage systems are often significantly cheaper, particularly where existing infrastructure can be adapted. Costs may range from a few thousand dollars to tens of thousands depending on scale.
- Mechanical storage systems such as flywheels are less common and costs are more variable. They are generally used in niche applications.



SPOTLIGHT.

DETERMINING YOUR ENERGY STORAGE NEEDS

There are a number of programs that help small-to-medium enterprises (SMEs) determine the most effective energy reduction and energy storage options for them. Examples include:

SunSPOT – Built by UNSW and the Australian PV Institute, SunSPOT helps you work out how much you could save with solar and batteries, what size solar system will fit on your roof, and which battery options suit your needs.

Pathfinder – The Towards Net Zero Agriculture Pathfinder looks at a range of agricultural emissions reduction options, including the use of solar and energy storage.

SME Industrial Decarbonisation Fund – Australian Government funding that supports SME manufacturers to lower emissions through renewable energy solutions (including electrification and energy storage).



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