Dairy Australia

Batteries

Only consider a chemical battery if you want to increase reliability or if electricity supply limitations are reducing your ability to expand. It can also be considered if you are wanting to reduce or offset your emissions by increasing the usage of zero emissions on-site solar.

Can I reduce my energy bills using battery storage?

Yes. Although payback is likely to be longer than the life of the battery and the return on investment (ROI) will be very low when just considering energy bill reductions. However, if you need better electricity reliability that allows you to reduce milk losses from intermittent grid supply – or invest in supplying new products such as ice cream – then the investment may be worthwhile.

Key questions to ask when considering a battery

How often will I have excess solar PV to charge the battery?

This depends on the size of your solar PV system and the size of the battery. If you have 'over-invested' in your solar PV system, you may have excess more than 90 per cent of the time. If you are utilising more than 50 per cent of the current solar PV output, which is likely if you have sized it correctly, your extra kilowatt-hours (kWh) from solar production may not be enough to regularly charge a battery.

What battery size should I select?

In general, a 30 kilowatt (kW) solar PV array is best supported by a 40-kWh battery (note that is kWh is kilowatt-hours not kilowatts).

Unlike a diesel back-up generator, you would not size a battery to do 100 per cent of your load unless you are going completely off-grid. A salesperson offering the battery may select perfect operating and financial conditions for the battery ROI calculation.

It is highly recommended you contact your energy consultant to verify these calculations. A $1,000 investment in advice from an energy consultant could save you $40,000 in a wasted investment in batteries.

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What type of battery technology should I use?

In general, there are two types of chemical batteries readily available on the market: lithium-ion and zinc-bromine. The lithium-ion batteries, as used in electric vehicles, are fast to charge and discharge and can be used to support a variety of farm services. However, 'deep cycling' – where the battery is completely depleted and then completely recharged – reduces the lifetime of the battery. Therefore, ironically, the more you use the battery and the more optimal the battery size and investment, the shorter the lifetime will be.

Lithium-ion batteries also degrade in performance over time but have a round-trip efficiency greater than 90 per cent. Zinc-bromine batteries are an alternative battery chemistry that allow deep cycling and have a longer lifetime; however, they have traditionally been more expensive per kilowatt-hour of energy supplied.

Zinc-bromine batteries have lower electrical output at ambient temperatures below 10°C and typically have a round-trip efficiency of 80 per cent – although recent on-farm experience indicates a much lower efficiency.

Additionally, pumped hydro is another energy storage option for consideration on farms. However, recent experience at the Ellinbank Dairy Research Farm suggest the ROI is extremely low and the payback period is long.

Available rebates as of January 2023

Jurisdiction	Grant/subsidy	Further information
ACT	Battery rebate of $3,500 (excluding GST) or 50% of the battery price (excluding GST), whichever is lowest.	**www.climatechoices.act.gov.au/policy-programs/next-gen-energy-storage**
NSW	Interest-free loan of up to $14,000 for solar PV and battery system, or $9,000 for retrofitting a battery system.	**www.energysaver.nsw.giv.au/browse-energy-offers/household-offers/apply-empowering-homes-solar-battery-loan-offer ** link doesn't work**
SA	$150 per kWh of battery capacity up to $2,000 per battery installation.	**www.homebatteryscheme.sa.gov.au/about-the-scheme**
VIC	Rebate of up to $3,500 upfront.	**www.solarvic.gov.au/solar-battery-rebate **link doesn't work**
QLD	There appears to be no state government battery rebate scheme at present.	
WA	There appears to be no state government battery rebate scheme at present.	
NT	$450 per kWh of battery system capacity, up to a maximum grant of $6,000 per installation.	**nt.gov.au/industry/business-grants-funding/home-and-business-battery-scheme**
TAS	There appears to be no state government battery rebate scheme at present.	

Savings and benefits from using batteries

The savings for using batteries on-farm are summarised in the table below.

Battery technology	Typical costs for 40kWh of storage capacity	Annual savings	Payback
Lithium-ion	$51,000	$1,684	30 years
Zinc-bromine	$40,000	$1,621	24 years

Assumptions:

- Cost of electricity is $0.25/kWh.
- The feed-in tariff (FIT) for exporting excess solar is $0.052/kWh.
- 90 per cent round trip efficiency.
- Utilisation of 60 per cent of the capacity each day.

Notes:

- Price and availability of chemical batteries have been volatile over 2021-22. Caution needs to be taken when seeking updated pricing.
- For lithium-ion technologies, care should be taken with the ROI calculations as the usable storage is typically 80 per cent of the nameplate storage and this declines over time. For example, a Tesla Powerwall rated at 13.5 kWh is only recommended to supply 80 per cent of this during typical cycling so in reality is only a 10.8 kWh battery.

Table 1 Annual energy savings for various electrical supply and battery utilisation assuming a feed-in tariff of $0.052/kWh for exporting excess solar PV to the grid.

Electricity supply cost when discharging	Utilisation of battery					
	30%	60%	90%	30%	60%	90%
	Li-ion with 90% efficiency			ZnBr2 with 80% efficiency		
$0.10/kWh	$185	$370	$555	$153	$307	$460
$0.15/kWh	$404	$808	$1,212	$372	$745	$1,117
$0.20/kWh	$623	$1,246	$1,869	$591	$1,183	$1,774
$0.25/kWh	$842	$1,684	$2,526	$810	$1,621	$2,431
$0.30/kWh	$1,061	$2,122	$3,183	$1,029	$2,059	$3,088
$0.35/kWh	$1,280	$2,560	$3,840	$1,248	$2,497	$3,745
$0.40/kWh	$1,499	$2,998	$4,497	$1,467	$2,935	$4,402
$0.45/kWh	$1,718	$3,436	$5,154	$1,686	$3,373	$5,059
$0.50/kWh	$1,937	$3,874	$5,811	$1,905	$3,811	$5,716
$0.55/kWh	$2,156	$4,312	$6,468	$2,124	$4,249	$6,373
$0.60/kWh	$2,375	$4,750	$7,125	$2,343	$4,687	$7,030

* At 90% utilisation, the battery may degrade faster than warranted. Note that Li-ion will degrade over time resulting in less stored and discharged electricity.

Notes:

- Price and availability of chemical batteries have been volatile over 2021-22. Caution needs to be taken to get updated pricing.
- Recent pilot studies of zinc-bromide batteries carried out with NSW Department of Primary Industries (DPI) has indicated battery utilisation of around 53 per cent with an efficiency of around 75 per cent. One case found that using a grid electricity price of $0.25/kWh can produce an annual saving of around $1,400 – giving a payback of approximately 28 years.

TIP

Using a battery is not set-and-forget like plugging in your phone to re-charge. The charging and discharging of the battery needs a control system to ensure that the battery does not charge itself during peak tariffs or peak demand times.

Vehicle-to-home (or vehicle-to-shed) battery energy supply

Electric vehicles are increasingly being built with the capability to discharge their stored energy to buildings, the electricity or other external loads using a bidirectional charger.

However, as of January 2023, the protocols and technology approvals are not yet in place beyond limited trials in the Australian Capital Territory and South Australia. It may be viable and a reasonable future solution to use vehicle batteries as a back-up to power households or dairy farm sheds but not at present.

Combined electric and thermal battery systems

New energy storage products that store both heat and electricity are entering the Australian market. A combined system, such the Azelio TES.POD® long-duration energy storage, provides 13 kWh of electricity and 60 kWh of hot water. Providing dispatchable clean heat and electricity day and night, the system enables dairy farmers to reach their sustainability goals and futureproof their business.

TES.POD charges with electricity from renewable sources such as solar PV and stores energy as heat in recycled aluminium. This is dispatched on demand, delivering combined heat and power at a total efficiency of up to 90 per cent.

Businesses contending with price spikes and outages can gain energy self-sufficiency by accessing stable and affordable clean power.

Sources

Is the Redflow ZCell better than a Lithium Ion Battery? (solarquotes.com.au)

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