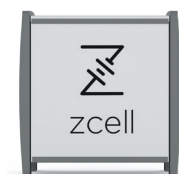


Maximising benefits of the Redflow battery

REDFLOW produces small 10kWh zinc-bromine flow batteries that tolerate daily hard work in harsh conditions. Marketed as **ZCell** and **ZBM2**, Redflow batteries are designed for frequent cycling, long duration discharge, stationary energy storage applications in the residential, commercial & industrial and telecommunications sectors, and are scalable from a single battery installation through to grid-scale deployments. Redflow batteries are sold, installed and maintained by an international network of energy system integrators.

Redflow's smart, self-protecting batteries offer unique advantages including secure remote management, 100 per cent daily depth of discharge, tolerance of high ambient temperatures, a simple recycling path, no propensity for thermal runaway, an electrolyte that does not sustain fire, and capacity that does not decrease during its operating life. The following table provides an overview of the types of energy storage applications for which Redflow batteries are optimally suited.

ENERGY STORAGE APPLICATION	BATTERIES	DESCRIPTION	ZBM2 CAPABILITIES
Telecommunications – active renewable energy system	2+	ZBM2 stores surplus renewable generation during the day to support the site at night, with or without diesel generator as additional power source. Batteries actively deep-cycled on a daily basis.	Well-suited – the more actively the batteries are cycled, the better.
Off-grid site applications needing more than 10kWh of battery energy per day	2+	ZBM2 batteries can turn intermittent energy sources into reliable 24x7 energy supplies for off-grid energy systems, supporting a hybrid of solar and/or diesel energy sources.	Well-suited
Renewable energy self-consumption <i>without</i> grid failure backup (residential or commercial)	1+	ZBM2 stores surplus renewable energy during the day and uses it to avoid or offset grid energy use at night. This augmentation of grid power with renewably-sourced energy does not require protection against grid failure.	Well-suited – applications with daily deep discharge play to the strengths of the battery and leverage its benefits.
Renewable energy self-consumption <i>with</i> grid-failure backup	2+	ZBM2 enables renewable energy self-consumption while reserving a percentage of the stored energy for backup, to support the site during occasional grid failures.	Well-suited with at least two batteries to reserve stored energy for 100% backup availability.
Peak shaving	1+	ZBM2 charges off-peak then discharges energy to reduce peak load during peak periods, reducing utility demand charges.	Well suited, especially to multiple hour peaks.
Telecommunications – generator efficiency improvement	2+	Multiple ZBM2s charged simultaneously by (existing) generator and discharged in sequence while generator is shut off. This reduces generator run time. Excellent pay-back period when the cost of diesel, fuel transportation and generator servicing is high.	Well-suited – frequent regular 100% DOD cycling is optimum operation for the ZBM2.
Telecommunications – backup generator replacement	1+	ZBM2 in Standby Power System (SPS) mode. If the grid fails, the fully charged battery enters Standby mode then automatically restarts in less than two minutes to supply backup energy.	Well-suited – replaces a backup diesel generator with a quiet, emission-free, non-fossil-fuel alternative, reducing generator run-time from days to hours
Diesel run-time reduction	1+	As for telecom generator efficiency improvement above, but in other environments. Assumes existing generator is operating inefficiently either due to over-sizing and/or variability in site load.	Well-suited, maximising diesel genset operating efficiency by always charging at peak generator efficiency. Lower fuel costs and reduced risk of theft.
On-grid and off-grid sites with short duration / high rate loads	2+	ZBM2s are designed for long duration / low power discharges rather than for short duration / high power discharge. Peak output is limited to 5kW per 10kWh ZBM2 module. Typically, if an energy storage application needs more than an average of 3kW per 10hWh battery, the ZBM2 is not a good economic fit.	Site load analysis required to ensure meeting peak demands of off-grid sites.
Online Uninterruptible Power Supply applications	2+	ZBM2 operating cycle is advantaged by applications that need to discharge at least one third of their total system energy storage every day. This is not optimal for UPS applications, where the requirement is generally to keep all batteries fully charged by default.	Additional ZBM2 batteries must be installed in dedicated UPS system applications to reserve some capacity for the battery maintenance cycle. Additional energy consumption will also be incurred in recharging batteries following each maintenance cycle.
Applications requiring very high peak charge or discharge rates		If energy storage applications require more than an average of 3kW per 10hWh battery, the ZBM2 is not a good economic fit.	Ill-suited, may require additional batteries to meet peak energy rates.
Applications requiring less than 10kWh per day of energy output		Some system energy storage capacity must be reserved in this scenario to support ZBM2 maintenance cycles.	Application efficiency may be adversely impacted by ZBM2 maintenance cycle.



Redflow's **ZBM2** battery is a unique energy storage system that redefines your understanding of how a battery works. This scalable 10 kilowatt-hour (kWh) zinc-bromine flow battery delivers 100 per cent depth of discharge each day for a warranted 10 years while retaining its nameplate storage capacity. The **ZBM2** is designed to work on its own and can scale to work as part of a much larger energy storage system, with as many batteries as you require. The Redflow battery management system (BMS) captures performance

data in real-time to enable 24/7 remote monitoring. Monitor and manage your **ZBM2** batteries from your computer or mobile phone. The **ZBM2** performs strongly in warm climates, in most circumstances without requiring external cooling. Made from recyclable and reusable components, **ZBM2** batteries avoid some of the hazards associated with some other chemistries, in particular in relation to fire and explosion with a fire retarding electrolyte solution and very low risk of 'thermal runaway'.

Advantages of the Redflow zinc-bromine flow battery over lithium-based batteries

Scenario	Lithium-ion battery	Zinc-bromine battery
Full battery discharge to zero	Damages battery	Benefits battery
Deep daily discharge	Shortens battery life	No impact on battery life
Capacity over operating life	Loses capacity over life	Retains day-one capacity over life
Energy capacity from a full charge / discharge cycle	Declines with cycle count	Sustained
High ambient temperature	May need active cooling to avoid life reduction	Ambient/free air cooling sufficient unless sustained ambient temperature is greater than 50C (122F)
Risk of thermal runaway	Potential	Minimal as the electrolyte is inherently non-flammable
Environmental impact	Expensive to recycle	Easy to recycle



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