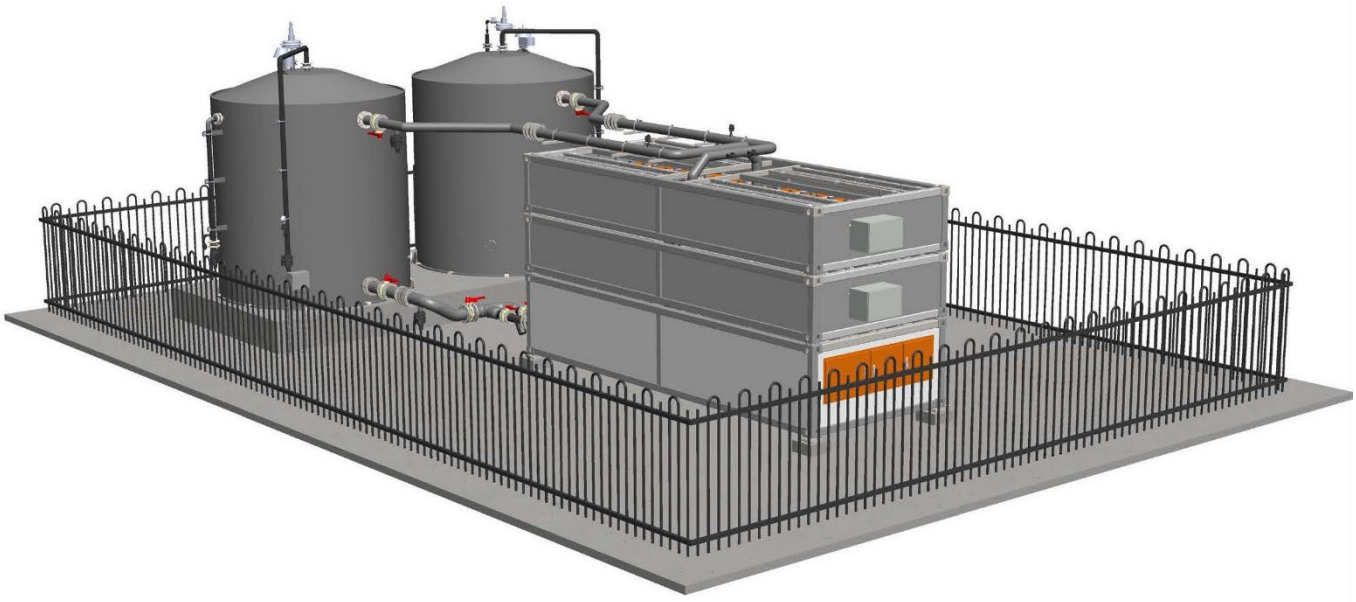
CASE STUDY

Remote Mine Hybridisation – Australia

Diesel Reduction through Solar + Battery Energy Storage System

Prepared by: The Green Energy Company Pty Ltd



Executive Summary

A remote mining operation in Australia was assessed to determine the commercial and operational impact of integrating solar PV and battery energy storage into an existing diesel power system.

The site is powered by a 10 MW diesel power station with estimated diesel consumption of approximately:

- 50,000 litres per day
- 18.25 million litres per annum
- $29.2 million annual fuel cost
- $37 million total annual energy cost including generation infrastructure and operations

The assessment compared:

- Diesel-only operation
- Diesel + Solar PV
- Diesel + Solar PV + Lithium-ion or MeFB BESS
- Diesel + Solar PV + Long-Duration Flow Battery MeFB

The Commercial Reality

At remote industrial sites, fuel is often the dominant operating cost.

At this scale:

- Every 10% reduction in diesel consumption = $3.0 million/year
- Every 1 million litres of diesel avoided = $1.6 million/year

The assessment demonstrated that hybridisation is not primarily a technology decision.

It is an operating cost reduction strategy.

At remote mine sites, fuel is often the single largest controllable operating expense.

Hybridisation Opportunity

The study identified a strong opportunity to transition from a diesel-dominant power system toward a renewable-led hybrid microgrid.

Illustrative hybrid configuration:

- 6–8 MW Solar PV
- Battery Energy Storage System (BESS)
- Existing diesel generation retained for reliability and backup support
- Hybrid microgrid control integration

The primary role of storage was not merely backup power.

The storage system enabled:

- ✓ Increased solar utilisation
- ✓ Generator optimisation
- ✓ Reduced spinning reserve requirements
- ✓ Energy shifting beyond daylight hours
- ✓ Reduced generator runtime and maintenance exposure
- ✓ Material diesel displacement

Indicative Outcomes

Configuration	Indicative Diesel Reduction	Indicative Annual Fuel Saving
Diesel Only	Baseline	-
Diesel + Solar PV	30%	$4M/year
Diesel + Solar + Medium duration BESS	50%	$6–7M/year
Diesel + Solar + Long-Duration Storage	60–70%	$9M+/year

Why Long-Duration Storage Matters

Traditional solar integration reduces diesel use during daylight hours.

Long-duration storage changes the operating model.

By storing excess renewable generation during the day and dispatching energy after sunset, long-duration storage enables:

- ✓ Extended diesel shutdown periods
- ✓ Greater renewable penetration
- ✓ Lower fuel consumption
- ✓ Reduced operating cost volatility
- ✓ Improved long-term energy stability

From an operational perspective, the system behaves more like long-life infrastructure than a conventional battery asset.

Strategic Observations

The assessment identified several broader commercial and operational trends relevant to remote industrial operations:

- Diesel-only systems remain operationally reliable. However, they represent the highest whole-of-life operating cost structure.
- Solar PV provides immediate low-risk fuel reduction
- Even moderate renewable penetration can materially reduce fuel consumption.
- Battery storage performs multiple operational functions
- Beyond energy shifting, storage improves generator efficiency, operational flexibility and system stability.
- Long-duration storage materially improves diesel displacement
- Extended duration enables renewable energy to be shifted beyond daylight operating windows.
- Fuel exposure is increasingly strategic
- Hybrid systems convert a portion of volatile fuel expenditure into stable long-life infrastructure.

Technology Positioning

The study considered both lithium-ion and long-duration flow battery systems (MeFB).

The long-duration storage configuration demonstrated particular advantages where:

- High fuel costs exist
- Daily cycling is expected
- Long operational life is valuable
- Thermal tolerance is important
- Deeper diesel displacement is required

Key characteristics of the long-duration flow battery configuration (MeFB) included:

- ✓ Water-based non-flammable electrolyte chemistry
- ✓ High cycling capability
- ✓ Minimal long-term degradation
- ✓ Reduced reliance on critical minerals
- ✓ Strong suitability for harsh environments
- ✓ Scalable deployment from commercial through utility-scale systems

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Commercial Interpretation

The key conclusion from the assessment was clear:

The decision is not simply between technologies.

It is between operating cost structures.

A diesel-only solution commits the operation to ongoing fuel exposure.

A hybrid renewable system converts part of that expenditure into infrastructure capable of reducing long-term operating cost.

Conclusion

The study demonstrated that hybridisation can materially reduce diesel dependence at remote industrial sites while maintaining operational reliability.

Under the assumptions used in the assessment:

- ✓ Solar PV alone delivered significant fuel reduction
- ✓ Battery storage improved operational efficiency and renewable utilisation
- ✓ Long-duration storage delivered the strongest whole-of-life economic outcome where deeper diesel displacement was targeted

For many remote operations, the strategic question is no longer whether diesel consumption can be reduced.

It is how rapidly it can be displaced without increasing operational risk.

Contact

Michael Wake
Senior Energy Consultant / Managing Director
The Green Energy Company Pty Ltd
michael@thegreenenergycompany.com.au
www.thegreenenergycompany.com.au