ACADEMIC POSTER

SAMPLE

Solar-Plus-Battery Microgrids for a Remote Australian Community

Postgraduate sample · Australian academic standard

Background

Many remote Australian communities rely on diesel generation for electricity, which is costly, emissions-intensive and exposed to fuel supply risk. Falling costs of solar photovoltaics and lithium-ion batteries, supported by programmes from the Australian Renewable Energy Agency, have made hybrid microgrids a credible alternative. A solar-plus-battery microgrid can displace a large share of diesel while maintaining reliability, but sizing must balance capital cost, fuel savings and the risk of unmet demand across seasonal load and solar variation.

Aim and Research Question

The project aimed to size and evaluate a solar-plus-battery microgrid for a modelled remote community of about 400 people in northern Australia currently supplied by diesel. The research question asked what combination of photovoltaic and battery capacity minimises the levelised cost of electricity while keeping the renewable fraction high and reliability within accepted limits.

Methods

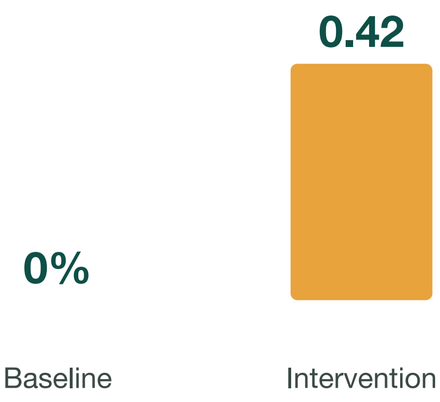
An hourly techno-economic simulation was built for a full year using typical meteorological data and a synthesised community load profile with a peak demand of 320 kilowatts.

- Candidate systems combined photovoltaic arrays from 400 to 1,200 kilowatts with battery storage from 0.5 to 3 megawatt hours.
- A dispatch rule prioritised solar, then battery, then diesel, with the battery charged from surplus solar.
- Levelised cost of electricity, renewable fraction and unmet load were calculated for each configuration.
- Capital and fuel costs used current Australian benchmarks, with a 20-year project life and a 6% discount rate.

A sensitivity analysis varied the diesel price by plus or minus 30%.

Results

The preferred configuration paired an 800 kilowatt array with 1.5 megawatt hours of storage.



Configuration	Renewable fraction	Levelised cost (A$/kWh)
Diesel only (baseline)	0%	0.42
600 kW PV plus 1.0 MWh	58%	0.34
800 kW PV plus 1.5 MWh	71%	0.31
1,200 kW PV plus 3.0 MWh	83%	0.35

- The 800 kilowatt and 1.5 megawatt hour system cut modelled diesel use by about 70% and lowered levelised cost by roughly a quarter.
- Unmet load stayed below 0.5% of annual demand.
- Oversizing beyond this point raised cost through curtailed solar and underused storage.

Discussion

The results show a clear economic optimum, where added solar and storage stop paying for themselves because surplus generation is curtailed. A renewable fraction near 71% captured most of the fuel saving without the steep cost of chasing the last portion of diesel displacement. Diesel price sensitivity was significant: a 30% rise in fuel price widened the advantage of the hybrid system, underlining the value of fuel-cost hedging for remote networks. The model assumes stable equipment performance and does not capture maintenance logistics or battery degradation in detail, both of which would affect a real deployment.

Conclusion

A solar-plus-battery microgrid can displace most diesel generation for a remote Australian community at a lower levelised cost than diesel alone, with an economic optimum around a 71% renewable fraction in this model. Detailed engineering, community consultation and consideration of battery degradation and maintenance access are the logical next steps before implementation.

References

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