



Firm Power, Day and Night

Why concentrated solar thermal with storage is the lowest-cost way to firm a 24/7 industrial load — and supply process heat — in the Pilbara. A two-page summary.

Western Australian operations face rising energy costs, mounting carbon liability, and a firming gap that short-duration batteries cannot close. The cheap daytime kilowatt-hour is not the problem — solar PV already wins that. The hard part is firm power in the evening, process steam overnight, and stability in a weak, islanded grid. That is what concentrated solar thermal (CST) is built to deliver: sunlight captured as high-temperature heat in molten salt, stored cheaply for many hours, then released on demand as power, heat, or both.

\$240–450

A\$/MWh — remote diesel power today (fuel basis)

~\$8/GJ

WA gas, roughly doubled in 5 years and rising

~33x

Cheaper to store energy in molten salt than in a battery

~\$144

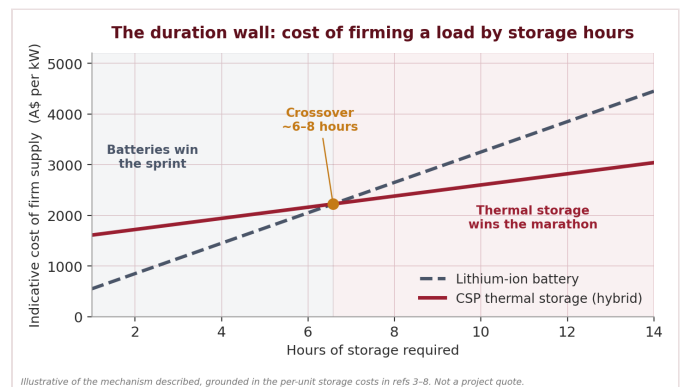
A\$/MWh — CST+PV, lowest-cost firm supply in a modelled Pilbara case

The core idea: the duration wall

A battery's cost rises almost in a straight line with the hours you need it to run — each extra hour means another stack of cells. A 12-hour battery costs roughly three times a 4-hour one. CST stores energy as heat in molten salt, so adding hours just means more salt in a bigger tank — the cheapest part of the plant.

Batteries win the sprint — 1 to 4 hours. Thermal storage wins the marathon — 8 to 14 hours and beyond. The reason is the cost of the bucket you store the energy in.

The answer is not one technology but a hybrid: cheap PV for daytime energy, a small battery for instant response, and CST thermal storage for the deep overnight block and for process heat.



Illustrative of the mechanism described, grounded in the per-unit storage costs in refs 3-8. Not a project quote.

Cost of firming a load by storage hours. Beyond ~6–8 hours, thermal storage is the cheaper way to firm. Illustrative; grounded in published storage costs.

The heat bonus and the hidden value

When the need is process heat — as it is in alumina, lithium and green-iron processing — CST delivers stored heat *directly* at high temperature, skipping the costly round trip of an all-electric "make power, then re-heat" pathway that throws away more than half the energy at the turbine. CST also generates through a synchronous steam turbine, providing the grid strength (inertia, fault current, voltage support) that solar and batteries cannot — a service worth hundreds of millions when bought separately, here included for free. Add the avoided diesel, gas and carbon costs, and the full picture favours a CST-anchored hybrid well beyond its headline price.

The options, compared honestly

Option	Firm 24/7	Long-duration storage	Process heat	Grid strength	Cost / risk
Diesel gensets	Yes	n/a	Burn more fuel	Yes	\$240–450/MWh; carbon liability
Gas turbines	Yes	n/a	Yes	Yes	Rising gas; carbon liability
PV + large battery			No	No	Cheap energy; costly deep storage

Option	Firm 24/7	Long-duration storage	Process heat	Grid strength	Cost / risk
	Day + short firming	Hits the duration wall			
PV + small battery + CST	Yes	Yes — cheap	Yes — direct	Yes	Lowest total cost as duration & heat grow

Where CST does not win — and we will say so. It is not the cheapest daytime energy (PV is), nor the best choice for 1–4 hour firming (batteries are). It is capital-intensive and first-of-a-kind in Australia. We design around these limits: PV for energy, CST for the long-duration firming and heat where nothing else competes, and a mature Chinese supply chain to manage build risk.

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We model the crossover point for your specific load — the storage duration at which CST beats batteries — and return a clear go / no-go verdict. No technology is forced. If PV and batteries serve you best, we will tell you.

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Selected sources: IRENA, *Renewable Power Generation Costs in 2024* (PV, CSP and battery costs); CSIRO *GenCost 2024–25* (firmed-renewable benchmark); ASTRI / Fichtner / ITP Thermal, *Australian CST Value Proposition 2023* (modelled A\$144/MWh Pilbara case; process-heat LCOH); Ember, NREL, Lazard (battery storage costs); BVES / Solarthermalworld, CleanTechnica, Thunder Said Energy (molten-salt vs lithium storage cost); ACWA Power (Noor Energy 1); SolarPACES/ASME (China CSP); CEFC/Marsden Jacob (Pilbara avoided fuel costs); Clean Energy Regulator & DCCEEW (Safeguard Mechanism). Full citations in the companion industry briefing. All figures screening-grade and indicative; not investment advice.