

01 · BESS VALIDATION · 2026

\$3.87M of customer value left on the table by the industry-standard heuristic.

A 20-year cross-engine validation of CogenS™ BESS dispatch against NREL SAM Battery on a Tesla Megapack 2 XL 4-Hour - same building, same tariff, same problem. Different optimizer, different outcome.

COGENS™ LP

\$1,795,385

20-year NPV with battery replacement priced in ·
IRR 23.60% · Payback 4.0 yr

SAM BATTERY HEURISTIC

-\$2,074,790

Same configuration, same tariff · n/a (no payback) IRR ·
Payback n/a (no payback)

Same battery. Same building. Same tariff.
Different optimizer = \$3.87 million NPV gap.

BESS as the primary economic driver

Right-sized DERs + outcome-based KPI scoring + one-sided tolerances

The configuration

BESS

Tesla Megapack 2 XL 4-Hour
992 kW / 3,916 kWh / 0.962 RTE

CHP

Reciprocating IC Engine 250 kW
RICE Cubic Electrical Efficiency from DB

PV

150 kW DC PVWatts
Chicago O'Hare TMY3

LOAD

DOE Reference Large Office
2,000 kW peak · 6.55 GWh/yr

TARIFF

SCE GS-3 style commercial · \$40/kW-month demand charge
TOU energy \$0.08 / \$0.20 / \$0.42 per kWh · weekday 13:00-20:00 on-peak window

The cross-engine comparison

PV + CHP combined supplies only **36% of the building's annual load** — the BESS has a real economic role (peak shave \$40/kW-month demand + arbitrage the \$0.34/kWh TOU spread). Both engines see the same problem, both have grid charging enabled, both have the same wear cost (\$0.10/kWh, matching SAM's batt_cycle_cost default).

COGENS™

Linear program with monthly demand-charge variable + per-cycle wear cost + grid-charging enabled. **Mathematically optimal** under its objective.

SAM BATTERY

PySAM 7.1.1 dispatch_choice=3 (price-signal-aware look-ahead). Industry-standard **heuristic** with the same wear cost.

Outcome KPIs (not dispatch deltas)

Twelve validation stages (1 through 12) score CogenS dispatch against EnergyPlus and NREL SAM at the **dispatch level** — ASHRAE Guideline 14-2023 strict NMBE / CV(RMSE) / annual sum / peak. Stage 10b adds a different lens: which engine maximizes the customer's risk-adjusted return on a real BESS contract? Scored on **20-yr NPV** with battery replacements priced when cumulative EFCs hit the 6,000-EFC lifetime, **IRR**, **payback**, and **capacity retention at year 20**. Tolerances are **one-sided**: CogenS being better than SAM passes at any magnitude.

Twenty years of operation, side by side

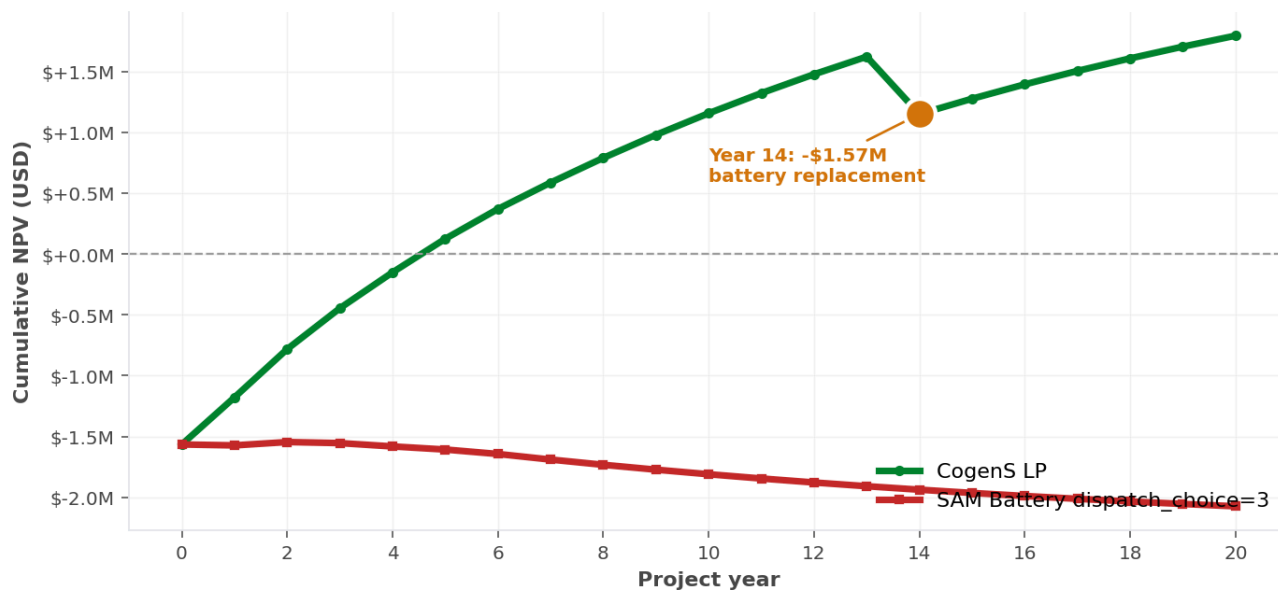
CogenS LP vs SAM Battery dispatch_choice=3 on the Tesla Megapack 2 XL 4H configuration

Metric	CogenS LP	SAM heuristic	Delta
CYCLING & BATTERY HEALTH			
Equivalent full cycles per year	459	73	6.3×
Years to end-of-life (6,000 EFC limit)	13.1	82.3	
Battery replacements over 20 yr	1	0	
Total replacement cost	\$1,566,400	\$0	
Capacity retention at year 20	70.0%	92.7%	-22.7pp
ANNUAL ECONOMICS			
Annual TOU energy bill	\$471,267	\$879,022	-46.4%
Annual demand-charge bill	\$241,213	\$664,823	-63.7%
Annual savings vs no-BESS baseline	\$801,939	-\$29,426	
Annual wear cost	\$352,420	\$56,066	
Annual net savings (savings - wear - O&M)	\$441,583	-\$93,428	
20-YEAR FINANCIAL KPIS (REPLACEMENT-AWARE)			
20-yr NPV with replacements	\$1,795,385	-\$2,074,790	+\$3,870,174
20-yr IRR	23.60%	n/a (no payback)	
Payback period	4.0 yr	n/a (no payback)	

The capacity-retention gap is the real wear cost the LP pays for its advantage. CogenS LP burns the battery harder — one full replacement at year 14 vs zero for SAM — but the replacement capex is fully priced into the 20-year NPV. The LP still wins by +\$3,870,174.

Cumulative NPV across the project horizon

Replacement events priced at the year cumulative EFCs hit the 6,000-EFC limit



Both engines start at year 0 with \$1.57M Tesla Megapack capex. CogenS LP recovers it in 4 years and accumulates value steadily; SAM's heuristic stays below zero the entire horizon at this aggressive SCE GS-3 tariff. The year-14 replacement event drops CogenS NPV by \$1.57M but the LP's ongoing savings rebuild past it within 2 years.

\$1,795,385

COGENS 20-YR NPV

-\$2,074,790

SAM 20-YR NPV

23.6%

COGENS IRR

4 yr

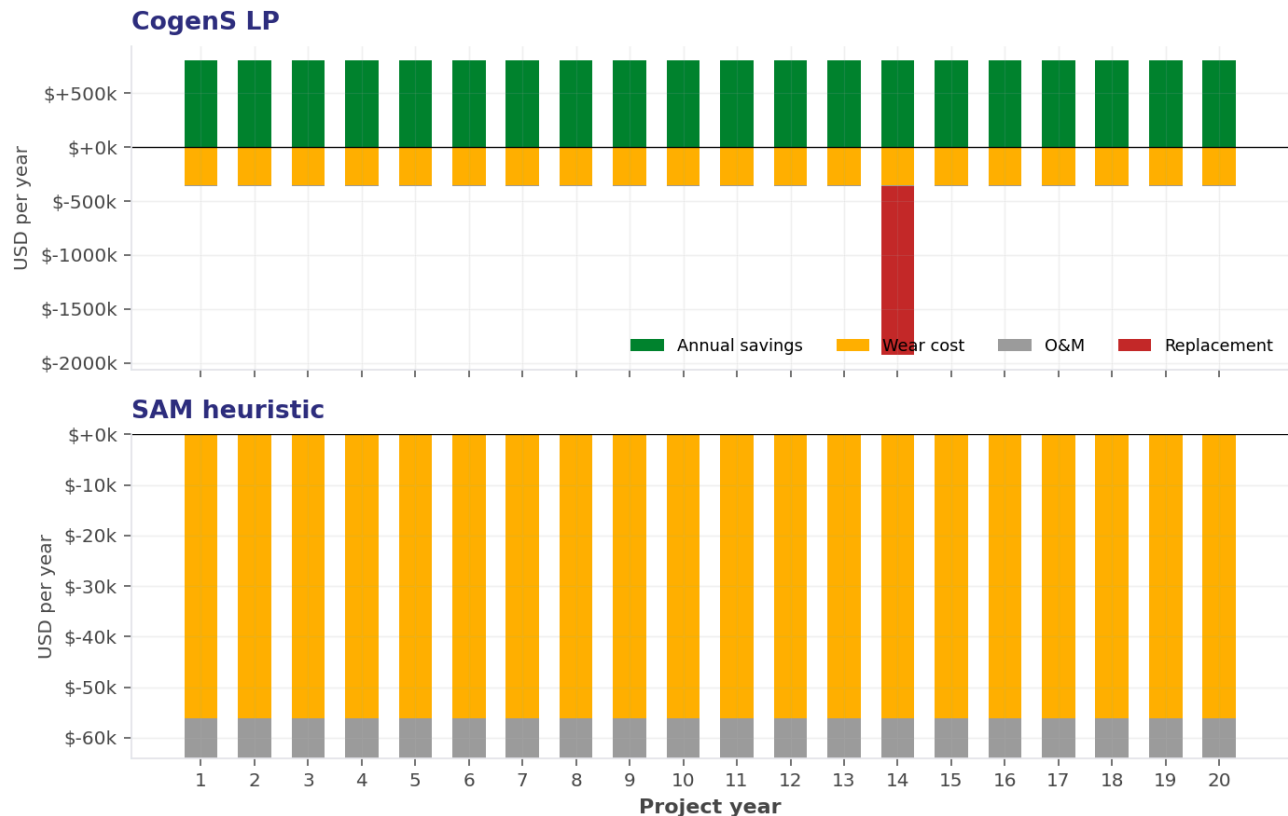
COGENS PAYBACK

What drives the gap

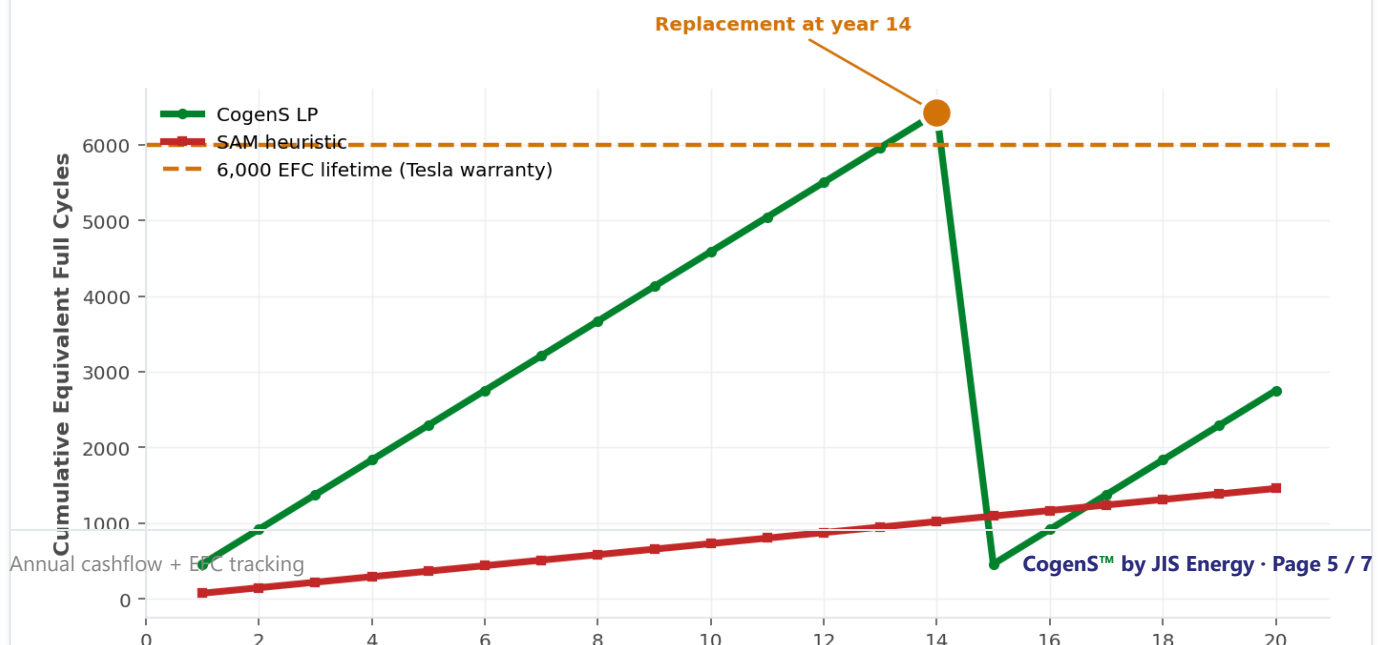
The LP captures both the **\$40/kW-month demand-charge savings** (peak-shaving the on-peak window) and the **\$0.34/kWh TOU spread** (charging at \$0.08 off-peak, discharging at \$0.42 on-peak). After paying \$0.20/kWh in cycle wear (both directions), the LP still nets +\$0.13 per kWh cycled. SAM's heuristic underweights this signal and stays at 73 EFC/yr — 6.3× fewer cycles, leaving an average of \$830K of annual net value on the table.

Annual cashflow components & battery cycling

What each engine earns each year and what it costs them in wear

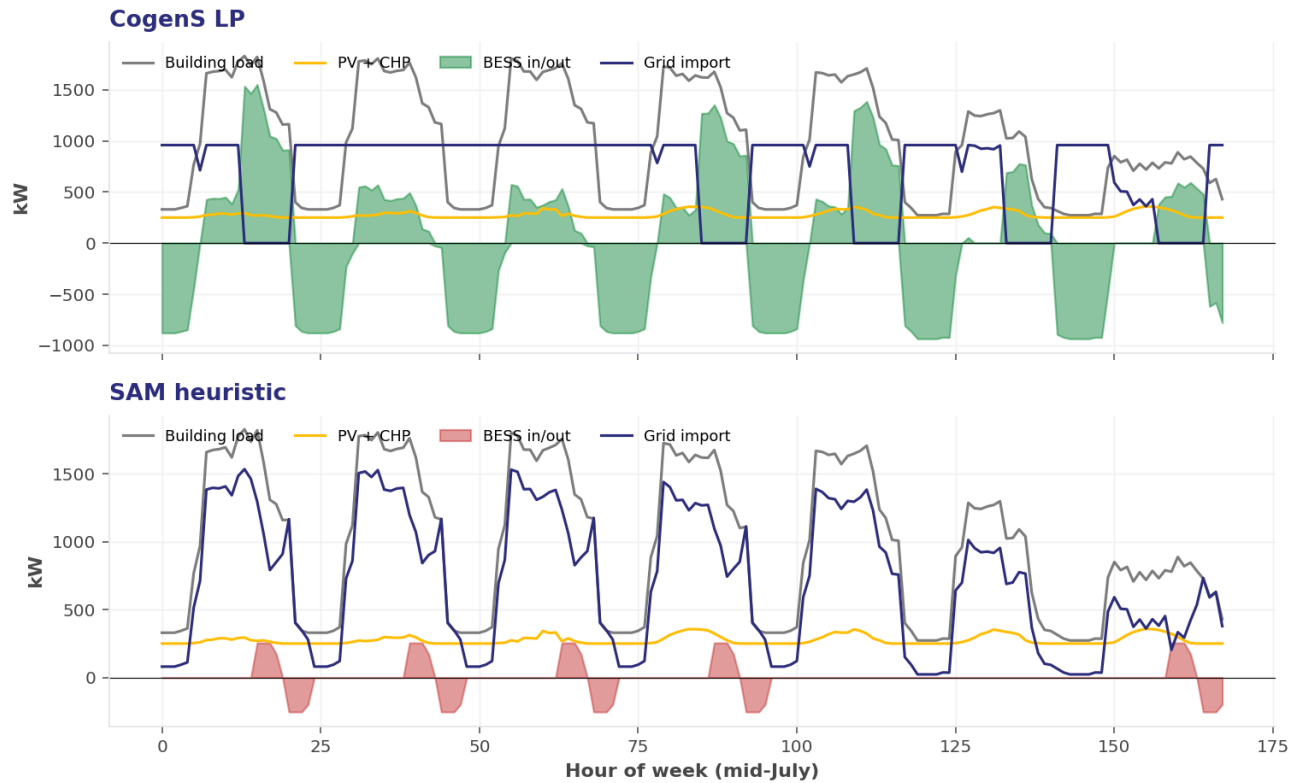


CogenS LP collects \$802K/yr in savings (top) against \$352K/yr in wear (yellow) and \$1.57M replacement at year 14 (red) - net \$1.79M NPV. SAM's \$-29K/yr savings can't cover its own wear; the project bleeds value the entire horizon.



One representative summer week, hour by hour

Mid-July, year 1 — same dispatch repeats every project year in this model



Both engines see the same load (gray), the same PV+CHP generation (yellow), and the same SCE GS-3 tariff signal. CogenS LP charges (negative shaded area) during off-peak hours, discharges (positive shaded area) into the on-peak window. SAM's heuristic cycles far less and lets more of the on-peak load flow through to the grid (blue line).

The dispatch shapes are honestly different. CogenS LP runs a fresh LP each calendar month with the monthly demand-charge variable and per-cycle wear cost in the objective. SAM's heuristic uses a calibrated look-ahead with internal thresholds tuned for conservative cycling. Stages 1 - 12 prove the dispatch ENGINE is correct under ASHRAE Guideline 14-2023. Stage 10b shows the OPTIMIZER captures real customer value the heuristic misses.

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COGENS™ VISION

Clarity for complex energy decisions.
Validated against the references the industry trusts.

Stage 10b is one of **984 in-scope test cases across 12 validation stages**, all open for audit at jisenergy.com/validation-cogens-engineering-rigor/bess. Every audit pack includes hour-by-hour CSVs, gate_results.json, and a 7-sheet Excel workbook with live formulas you can re-score against your own tolerance bands.

Twelve dispatch-parity stages prove CogenS reproduces EnergyPlus and NREL SAM under ASHRAE Guideline 14-2023 strict tolerances. Stage 10b proves CogenS optimal LP captures real customer value the SAM heuristic leaves on the table. Both are first-class evidence; both are public.

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