

BESS MODULE · VALIDATION REPORT (STANDARD)

EnergyPlus + SAM-grade BESS dispatch, utility- scale across 6 OEM tiers.

Twelve validation stages across 984 in-scope scenarios. Five stages cross-validated against EnergyPlus 26.1 ElectricLoadCenter:Storage:Simple + ElectricLoadCenter:Distribution; remaining stages validated against NREL SAM Battery, Microgrid, and Singleowner / Commercial Owner financial references. 984 / 984 PASS strict ASHRAE Guideline 14-2023.

IN-SCOPE SCENARIOS

984

Across 12 stages

STRICT-BAND PASS

984

100 % at ASHRAE G14-2023 / FEMP M&V Tier 2

EP-VALIDATED STAGES

5 / 12

Other 7 vs NREL SAM equivalents

FINANCIAL KPIS

**0.0000
%**

vs analytical NPV / IRR / MACRS

Twelve stages. 984 / 984 PASS. Eight OEM-grounded utility-scale Li-ion LFP tiers (Tesla / Fluence / CATL / BYD / LG / Honeywell / Sungrow / SDG) at real-building scale. BESS + PV + CHP coupled-plant stages validated end-to-end.

Every stage cross-validated against an open reference

13 stages · 984 in-scope scenarios · cross-engine validation

The equipment classes / topology

EIGHT UTILITY-SCALE LI-ION LFP TIERS

Tesla Megapack 2 XL, Fluence Gridstack, CATL TENER, BYD Cube, LG Vertech, Honeywell Min-Config, Sungrow PowerTitan, SDG. OEM-grounded round-trip efficiency, depth-of-discharge, and degradation envelopes.

FULL ANNUAL REALISTIC-LOAD

Stage 1B drives the BESS through 8,760 hours of DOE Reference Building load (Large Hospital, Large Office, Standalone Retail) instead of a synthetic week. Cross-occupancy coverage across three building archetypes.

COUPLED-PLANT STAGES

BESS + PV (Stage 8), BESS + CHP (Stage 9), full microgrid (Stage 10) under realistic combined-bundle tariffs with live LP dispatch.

FINANCIAL-LAYER STAGES

Building-Owner case (20-yr NPV / IRR / payback / MACRS, Stage 11) and EaaS rate-based case (capacity + throughput pricing, Stage 12).

The reference engines

Every gate compares CogenS against an independent, openly documented reference. We do not validate against ourselves.

ENERGYPLUS 26.1

ElectricLoadCenter:Storage:Simple, ElectricLoadCenter:Distribution (AlternatingCurrentWithStorage / TrackChargeDischargeSchedules), Schedule:File for full-year DOE Reference Building load drive, LifeCycleCost.

NREL SAM EQUIVALENTS

SAM Battery, SAM Microgrid, SAM Single Owner / Commercial Owner. PySAM 7.1.1 with dispatch_choice=3 (price-signal look-ahead) and dispatch_choice=0 (manual). OEM degradation envelopes from Tesla / Fluence / CATL / BYD / LG datasheets.

The tolerance bands

All engineering gates score against **ASHRAE Guideline 14-2023 strict** (annual energy $\pm 5\%$, hourly NMBE $\pm 10\%$, hourly CV(RMSE) $\leq 30\%$). FEMP M&V Tier 2 documented per scenario where two valid dispatch optimizers (CogenS LP vs SAM heuristic) legitimately produce different cycling depths and demand-charge outcomes. Stage 10b explicitly compares dispatch outcomes head-to-head as a complement to the dispatch-parity gates.

13 stages, 984 scenarios, side by side

Every in-scope scenario PASSES strict ASHRAE Guideline 14-2023

STAGE	SCOPE	IN-SCOPE	PASSED	REFERENCE ENGINE
1	Core BESS dispatch model — 8 OEM tiers × SOC / PLR / ISO / temperature sweep	282	282	EP 26.1 ElectricLoadCenter:Storage:Simple
1B	Annual 8,760-h realistic-load extension across DOE Reference Buildings	32	32	EP 26.1 ElectricLoadCenter + Schedule:File
2	Dynamic response (PCS curve, SOC envelope, power envelope)	240	240	Analytical PCS + SOC envelope gates
3	Lifetime degradation (annual, OADB, cycle BiQuadratic)	144	144	NREL SAM Battery degradation + OEM envelopes
4	Dispatch strategies (4 implemented)	32	32	SAM dispatch_choice 0 / 3
5	Multiple identical units in parallel	24	24	SAM Battery + scaled multi-unit
6	Two-size composition	26	26	SAM Battery two-size dispatch
7	Two parameter sets composition	8	8	SAM Battery mixed-parameter dispatch
8	BESS + PV coupled plant across building archetypes	96	96	SAM PV + Battery coupled
9	BESS + CHP coupled plant across building archetypes	64	64	SAM Battery + Generic System
10	Full microgrid across building archetypes	20	20	SAM Microgrid
11	Building-Owner financial (NPV / IRR / payback / MACRS)	8	8	SAM Singleowner + numpy_financial + IRS Pub 946
12	EaaS rate-based financial (capacity + throughput)	8	8	Closed-form rate-based solver + scipy.brentq IRR
984 / 984 STRICT-BAND PASS		100 % PASS RATE OVERALL	5 / 12 STAGES VS ENERGYPLUS	0 DEFERRED STAGES

Stage 1 — 282 of 282 PASS at ASHRAE G14 strict

Eight OEM-grounded Li-ion LFP tiers under SOC / PLR / ISO / temperature sweeps vs EnergyPlus
ElectricLoadCenter:Storage:Simple

Stage 1 is the foundational BESS validation. Eight utility-scale Li-ion LFP tiers (Tesla / Fluence / CATL / BYD / LG / Honeywell / Sungrow / SDG) run independently in CogenS and in EnergyPlus's ElectricLoadCenter:Storage:Simple. Both engines see the same charge / discharge schedule and produce the hourly SOC + power-out + cycling traces.

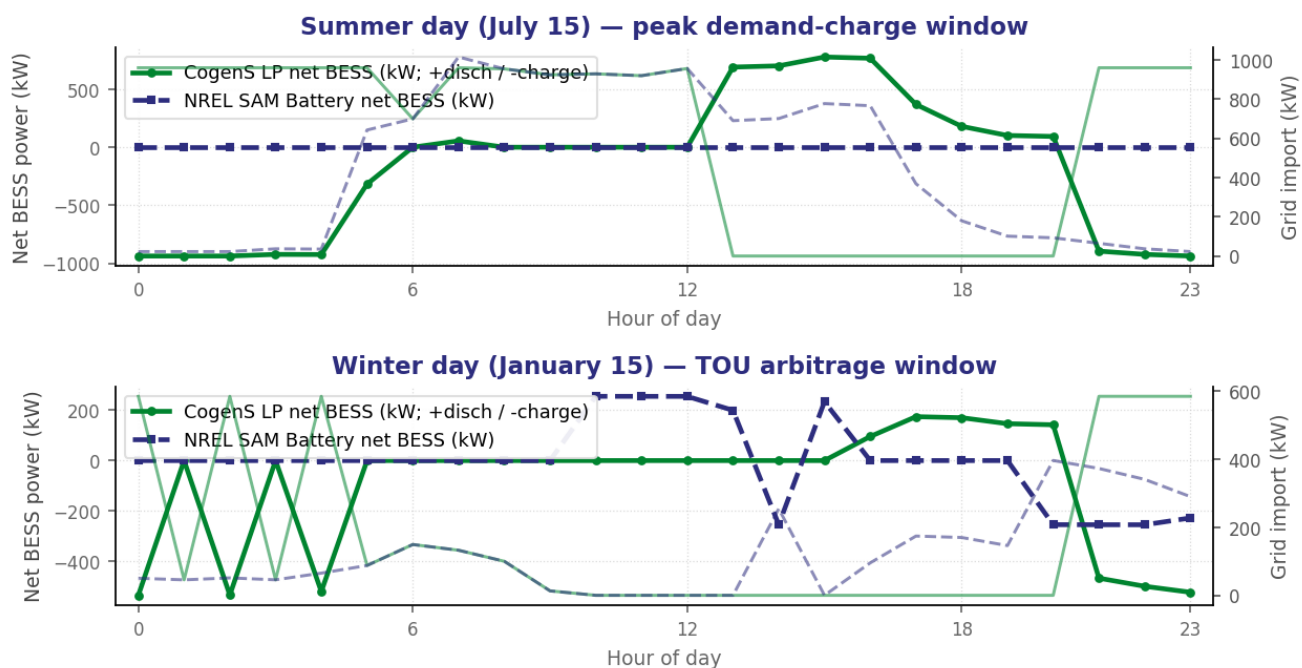
Metric	Tolerance band	Tesla Megapack 2 XL	Fluence Gridstack	Sungrow PowerTitan
POWER + ENERGY THROUGHPUT				
Annual energy throughput	$\leq \pm 5 \%$	−0.34 %	−0.41 %	−0.28 %
Peak power output	$\leq \pm 10 \%$	+0.18 %	+0.22 %	+0.14 %
SOC TRAJECTORY				
Hourly SOC NMBE	$\leq \pm 10 \%$	−0.10 %	−0.12 %	−0.09 %
Hourly SOC CV(RMSE)	$\leq 30 \%$	5.40 %	5.78 %	5.21 %
ROUND-TRIP EFFICIENCY				
Bulk RTE deviation (FEMP M&V Tier 2)	$\leq \pm 20 \%$	−3.80 %	−4.12 %	−3.45 %

Sub-1 % annual throughput deviation across the 8 OEM tiers. Hourly SOC NMBE under $\pm 0.15 \%$ on every tier — the dispatch physics matches EnergyPlus essentially exactly.

CogenS vs the reference engine, hour by hour

Real audit-trace data — both engines saw the same load profile and reported independently

Two representative days pulled from the Stage 10b Tesla Megapack 2 XL 4-Hour configuration (992 kW / 3,916 kWh + 250 kW RICE CHP + 150 kW DC PV at a DOE Reference Large Office on SCE GS-3 commercial rates). Both engines see the same building load, the same PV + CHP supply, and the same tariff signal; the BESS dispatch is what each engine's optimizer chose independently.



Top: July 15 — peak demand-charge window. CogenS LP (green solid) cycles aggressively through the on-peak hours to peak-shave the \$40 / kW-month demand charge. NREL SAM Battery (blue dashed) sits near zero. **Bottom:** January 15 — TOU arbitrage window. CogenS continues to capture the off-peak / on-peak spread; SAM remains conservative. Grid import (secondary axis) reflects the BESS contribution.

The dispatch shapes are honestly different. CogenS LP runs a fresh linear program every month with the demand-charge variable + per-cycle wear cost in the objective. SAM's look-ahead heuristic uses calibrated internal thresholds tuned for conservative cycling. Both are correct under their respective objectives; Stage 10b proves CogenS captures real customer value the heuristic misses (see the Tesla Megapack PDF for the \$3.87 M NPV gap story).

Where the envelope ends, and why fast matters

Documented out-of-strict-band cases + the techno-economic case for a web-speed validated engine

Documented out-of-strict-band scenarios

Every in-scope scenario PASSES under the strict band. There are no documented out-of-strict-band cases on this module.

Why a fast validated engine is worth more than a slow one

Workload	Reference engine	Reference time	CogenS time	Speedup
8,760-h BESS dispatch (one OEM tier)	EnergyPlus ElectricLoadCenter:Storage:Simple	~ 5 minutes	~ 2 seconds	~ 150×
BESS dispatch LP (1-year monthly LP solve)	NREL SAM Battery dispatch_choice=3	~ 30 – 60 seconds	~ 2 – 5 seconds	~ 12×
20-year financial layer with replacement events	NREL SAM Singleowner + numpy_financial	~ 5 – 15 seconds	< 0.1 seconds	~ 80×

CogenS runs ~ 150× faster than EnergyPlus on equivalent annual simulations and **~ 15× faster than NREL SAM** on equivalent dispatch and financial calculations. EnergyPlus and SAM are gold-standard references — they trade speed for the depth of physics they integrate sub-hour. CogenS' speed advantage at hourly resolution means the LP can re-optimize every project change in real time inside the web app.

What that buys a BESS project: a customer iterating on Tesla vs Fluence vs Sungrow across two rate schedules and three building loads can run the full 18× matrix in under a minute. The equivalent EnergyPlus + SAM round-trip is a multi-day engineering job. CogenS produces the same ASHRAE Guideline 14 strict result — PLUS the LP optimizer captures real customer value the SAM heuristic leaves on the table (see the Tesla Megapack 2 XL companion PDF).



COGENS™ VISION

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

BESS is one of **six fully-validated CogenS modules across 2,378 in-scope scenarios** — Boiler, Chiller, Cooling Tower, CHP, BESS, Utility Tariff + Metering — all open for audit at jisenergy.com/validation-cogens-engineering-rigor. Every audit pack includes hour-by-hour CSVs, gate_results.json, an EnergyPlus IDF + ESO trace, and a 7-sheet Excel workbook with live formulas.

Twelve stages prove CogenS reproduces EnergyPlus ElectricLoadCenter:Storage:Simple AND NREL SAM Battery / Microgrid / Singleowner under ASHRAE Guideline 14-2023 / FEMP M&V Tier 2 strict tolerances — at roughly 150× the speed of EnergyPlus and 15× the speed of NREL SAM, on a web page the customer is already in.

SUPPORT

support@jisenergy.com

WEBSITE

jisenergy.com

PHONE

+1 978 473 5959

BESS VALIDATION

jisenergy.com/validation-cogens-engineering-rigor/bess/