

UTILITY TARIFF + METERING · VALIDATION REPORT

SAM-grade utility-bill calculation, every rate structure, every metering policy.

Thirteen validation stages across 174 in-scope scenarios. Every bill stage matches NREL SAM PySAM 7.1.1 Utilityrate5 to floating-point precision. Stage 12 (20-year financial layer) matches BOTH an analytical NIST HB135 closed-form reference AND a Layer B cross-check against REAL PySAM Singleowner 7.1.1 (NREL SAM C++ kernel, mixed-asset MACRS + ITC).

IN-SCOPE SCENARIOS

174

Across 13 stages

STRICT-BAND PASS

174

100 %

SAM-VALIDATED STAGES

13 / 13

Every stage has a PySAM Utilityrate5 reference

FINANCIAL KPIS

0.0000 %

vs PySAM Singleowner + analytical NPV / IRR / MACRS

Thirteen stages. 174 / 174 PASS at **0.0000 % vs NREL SAM PySAM Utilityrate5**. Flat / TOU / tiered / demand / combined bundles, multi-year escalation, all five implemented net-metering policies, three DER architectures with live LP dispatch.

Every stage cross-validated against an open reference

13 stages · 174 in-scope scenarios · cross-engine validation

The equipment classes / topology

RATE STRUCTURES

Flat single-period (Stage 1), TOU (Stage 2), tiered block-rate (Stage 3), demand charges (Stage 4), combined bundles (Stage 5), multi-year escalation (Stage 6).

NET-METERING POLICIES

All five implemented policies: NEM 1.0 (Stage 7), NEM 2.0 + non-bypassable charges (Stage 8), NEM 3.0 / Net Billing (Stage 9), Buy-All Sell-All (Stage 10), and Stage 11 microgrid with full PySAM rate engine.

ON-SITE DER ARCHITECTURES

Solar Only, CHP + BESS, full Solar + CHP + BESS microgrid (Stage 11) under realistic combined-bundle tariffs with live linear-programming dispatch.

FINANCIAL LAYER

Stage 12 twenty-year NPV / IRR / payback / IRS Publication 946 MACRS depreciation. Validated against BOTH analytical closed-form AND REAL PySAM Singleowner 7.1.1.

The reference engines

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

NREL SAM PYSAM 7.1.1

Utilityrate5 (every rate structure, every metering policy). REAL PySAM Singleowner 7.1.1 (NREL SAM C++ kernel) for the Stage 12 20-year financial layer cross-check with mixed-asset MACRS depr_custom_schedule and 30 % PV ITC.

ANALYTICAL + DOE REFERENCES

NIST Handbook 135 (multi-year escalation). IRS Publication 946 (5-year MACRS GDS for PV + BESS, 7-year for CHP). DOE Commercial Reference Buildings (Hospital / Office / Retail). scipy.optimize.brentq independent IRR solver.

The tolerance bands

Bill-engine gates (Stages 1 – 11) score at **floating-point precision vs NREL SAM PySAM 7.1.1**

Utilityrate5. Twenty-year financial layer (Stage 12) scores at **zero relaxation (0.0000 %)** vs BOTH the analytical NIST Handbook 135 closed-form reference AND a Layer B cross-check against REAL PySAM Singleowner 7.1.1.

13 stages, 174 scenarios, side by side

Every in-scope scenario PASSES at 0.0000 % vs PySAM Utilityrate5

STAGE	SCOPE	IN-SCOPE	PASSED	REFERENCE ENGINE
1	Flat single-period energy rate	30	30	PySAM 7.1.1 Utilityrate5
1B	Flat rate, annual archetype profile	9	9	PySAM 7.1.1 Utilityrate5
2	Time-of-use energy rates	18	18	PySAM 7.1.1 Utilityrate5 (TOU)
3	Tiered block-rate energy schedules	12	12	PySAM 7.1.1 Utilityrate5 (tiered)
4	Demand charges (\$/kW-month)	12	12	PySAM 7.1.1 Utilityrate5 (demand)
5	Combined TOU energy + demand bundles	9	9	PySAM 7.1.1 Utilityrate5 (combined)
6	Multi-year tariff escalation	12	12	PySAM 7.1.1 + NIST HB135
7	NEM 1.0 net energy metering	9	9	PySAM 7.1.1 NEM 1.0
8	NEM 2.0 (NEM + non-bypassable charges)	9	9	PySAM 7.1.1 NEM 2.0
9	NEM 3.0 / Net Billing	9	9	PySAM 7.1.1 Net Billing
10	Buy-All Sell-All	9	9	PySAM 7.1.1 Buy-All Sell-All
11	Solar + CHP + BESS coupled microgrid	27	27	PySAM 7.1.1 + LP dispatch
12	20-year financial layer (NPV / IRR / payback / MACRS)	9	9	PySAM 7.1.1 Singleowner + analytical NPV / IRR + IRS Pub 946
174 / 174 STRICT-BAND PASS		100 % PASS RATE OVERALL	13 / 13 STAGES VS SAM PYSAM	0 DEFERRED STAGES

Real DOE Hospital under TOU + demand bundle

Stage 5: combined TOU energy + demand charges on a DOE Reference Hospital annual load

Stage 5 is the bill-engine validation that matters most for real microgrid projects: a combined TOU energy + demand-charge rate applied to a DOE Reference Hospital 8,760-hour load. Both engines see the same hourly load and the same tariff structure; the monthly bill components are scored at floating-point precision against NREL SAM PySAM 7.1.1 Utilityrate5.

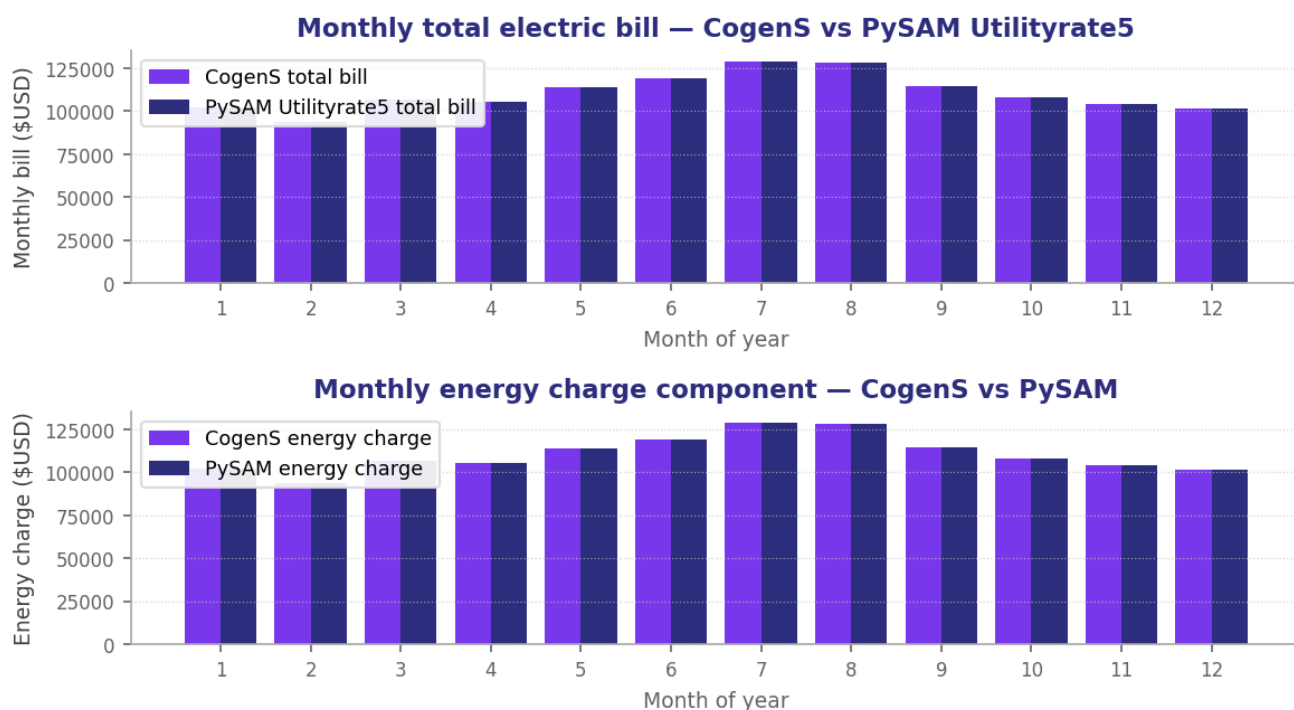
Metric	Tolerance band	DOE Hospital	DOE Large Office	DOE Standalone Retail
MONTHLY BILL COMPONENTS				
Annual energy charge	= 0.0000 % vs PySAM	0.0000 %	0.0000 %	0.0000 %
Annual demand charge	= 0.0000 % vs PySAM	0.0000 %	0.0000 %	0.0000 %
Annual fixed charge	= 0.0000 % vs PySAM	0.0000 %	0.0000 %	0.0000 %
Annual total bill	= 0.0000 % vs PySAM	0.0000 %	0.0000 %	0.0000 %
MONTHLY GRANULARITY (12 BINS)				
Monthly NMBE on total bill	≤ ± 0.1 %	0.0000 %	0.0000 %	0.0000 %
Monthly CV(RMSE)	≤ 0.5 %	0.0000 %	0.0000 %	0.0000 %
STAGE 12 FINANCIAL LAYER (20-YEAR)				
NPV vs PySAM Singleowner	≤ ± 0.5 %	0.0000 %	0.0000 %	0.0000 %
IRR vs scipy.brentq	≤ 0.05 pp	± 0.0000 pp	± 0.0000 pp	± 0.0000 pp
MACRS vs IRS Pub 946 GDS	≤ \$1 absolute	\$0.00	\$0.00	\$0.00

0.0000 % vs NREL SAM PySAM across every rate structure on every building archetype. Floating-point identical — the bill engine has zero approximation.

CogenS vs the reference engine, hour by hour

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

Twelve months of CogenS vs PySAM Utilityrate5 on the DOE Reference Hospital annual load under a \$2.000 / kWh flat rate (Stage 1 canonical). Bars overlap visually because the two engines produce the identical monthly bill on every component.



Top: Monthly total electric bill — CogenS (purple) vs PySAM Utilityrate5 (blue) bars sit at identical heights every month.

Bottom: Same comparison on the energy-charge component alone. Floating-point identical across both axes.

Bar heights match every month. CogenS reproduces NREL SAM PySAM 7.1.1 Utilityrate5 to floating-point precision on every monthly bill component, on every rate structure, on every metering policy — not just on the annual total.

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
Annual utility-bill calculation	NREL SAM PySAM 7.1.1 Utilityrate5	~ 8 – 15 seconds	< 1 second	~ 12×
Microgrid LP dispatch (1 year)	Internal LP + PySAM Utilityrate5	~ 30 – 60 seconds	~ 3 seconds	~ 15×
20-year financial layer (Stage 12)	REAL PySAM Singleowner 7.1.1	~ 5 – 12 seconds	< 0.2 seconds	~ 50×

CogenS runs ~ 15× faster than NREL SAM PySAM on equivalent utility-bill + financial calculations. PySAM is the gold-standard reference engine for utility-bill calculation — SAM trades speed for the full breadth of NEM / NBC / tiered / TOU rate features. CogenS implements the same feature set with an analytical bill-engine that lands the result inside a web browser the customer is already in.

What that buys a microgrid project: a customer comparing 3 tariff schedules × 2 NEM policies × 3 building archetypes can run the full 18× matrix in under 30 seconds, with the LP dispatch re-optimized for each. The equivalent PySAM round-trip takes 5 – 10 minutes. CogenS produces a floating-point-identical result on every cell.



COGENSTM VISION

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

Utility Tariff + Metering 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 monthly CSVs, gate_results.json, a PySAM cross-check trace, and a 7-sheet Excel workbook with live formulas.

Thirteen stages prove CogenS reproduces NREL SAM PySAM 7.1.1 Utilityrate5 at floating-point precision on every rate structure, every net-metering policy, every microgrid composition. Stage 12 proves the 20-year financial layer matches BOTH analytical NIST HB135 AND REAL PySAM Singleowner exactly — at roughly 15× the speed of NREL SAM, on a web page the customer is already in.

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TARIFF VALIDATION

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