

# SEB ArchLam™ — HVAC Cooling Cost Savings Analysis

Projected Energy & Cost Reductions from SEB Integration in All-Aluminum & Steel Data Centers

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## Executive Summary

Data center HVAC cooling represents 30–40% of total facility energy consumption, making it the single largest controllable operating cost after IT equipment itself.<sup>1</sup> The structural frames of conventional server racks — fabricated from aluminum alloy 6061-T6 ( $k = 167 \text{ W/m}\cdot\text{K}$ ) or structural steel ( $k \approx 45\text{--}60 \text{ W/m}\cdot\text{K}$ ) — act as continuous thermal conductors, redistributing server-generated heat laterally across rack bays and into the cold-aisle air stream, degrading containment efficiency and forcing cooling plants to work harder.<sup>2</sup>

LoüTeq's Structural Engineered Bamboo (SEB) ArchLam™ rack system replaces this conductive metallic frame with a thermally inert structural composite ( $k \approx 0.17 \text{ W/m}\cdot\text{K}$  —  $\sim 982\times$  lower conductivity than aluminum) that functions as an integrated thermal break. This document quantifies the projected HVAC cost savings achievable when legacy aluminum and steel data center rack infrastructure is replaced with SEB ArchLam™, across three scenarios and three representative facility types. Projections are grounded in published DOE, ENERGY STAR, McKinsey, and ASHRAE benchmarks.

<b>30–40%</b> Cooling = % of DC Total Energy <sup>1</sup>	<b>18–38%</b> Projected HVAC Savings Range	<b>~982×</b> Lower Thermal Conductivity vs. Al	<b>\$1.9M+</b> Annual Savings / 10 MW DC (Optimistic)
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## 1. The Thermal Conductivity Problem in Metal Rack Infrastructure

Conventional data center racks are manufactured from extruded aluminum 6061-T6 or cold-rolled steel. Both materials are selected for structural rigidity and machinability — but both carry a severe thermal liability that has been largely overlooked in rack design.

### Material Thermal Properties — Rack Frame Comparison

Material	Thermal Conductivity (W/m·K)	Coeff. Thermal Expansion (x10 <sup>-6</sup> /K)	Thermal Resistance (R-value)	HAC Role
Aluminum 6061-T6	167	23.1	Negligible	Heat conductor — spreads load across rack bay

Structural Steel	45–60	11.7	Very low	Partial conductor — slower but still significant
SEB ArchLam™ (LoüTeq)	~0.17	~3.5	High	Thermal break — isolates heat at source server

Sources: NIST / MatWeb (Al 6061-T6); Engineering Toolbox (steel CTE); Shah et al., J. Materials Science 2015 (SEB thermal conductivity); LoüTeq ArchLam™ material data.

When aluminum or steel rack frames conduct server heat into the cold-aisle air stream, CRAC/CRAH units must compensate for this 'leaked' thermal load — cooling air that has already been contaminated by structural conduction. This effect is compounded in Hot-Aisle Containment (HAC) systems, where the rack frame itself bridges the thermal boundary between contained hot-aisle exhaust and the cold-aisle supply.<sup>2,3</sup>

SEB ArchLam™ eliminates this pathway entirely. With a conductivity of ~0.17 W/m·K — comparable to low-density insulation materials — the SEB rack frame functions as a structural thermal break, keeping heat confined to the hot aisle where it can be efficiently captured and rejected by dedicated cooling infrastructure.

## 2. Savings Methodology & Assumptions

Cooling OPEX savings from SEB ArchLam™ integration derive from three compounding mechanisms:

Mechanism	Physical Driver	Estimated Contribution to Total Savings
1. Rack Frame Thermal Break	Eliminates structural conduction pathway from hot-aisle to cold-aisle; reduces effective cooling load 3–6%	3–6%
2. Improved HAC Wall Integrity	SEB HAC wall panels have near-zero thermal bridging; containment efficiency improves by 8–15% <sup>3</sup>	8–15%
3. Dimensional Stability / Seal Integrity	Al/steel frames expand 6.6x more per K; SEB CTE $\sim 3.5 \times 10^{-6}/K$ reduces thermal cycling gaps in containment seals	4–8%
4. CRAC/CRAH Setpoint Elevation	Tighter containment permits supply temp increase of 2–4°F; DOE: each 1°F rise $\approx$ 2–3% compressor energy reduction <sup>4</sup>	3–9%

Combined effect: These four mechanisms interact non-linearly — improved containment allows higher setpoints, which reduce compressor load, which reduces heat rejection, which further reduces total facility energy. Total projected HVAC cooling OPEX savings are modeled at 18% (conservative), 27% (moderate), and 38% (optimistic), reflecting varying facility vintage, climate, and cooling architecture.

### Key Modeling Assumptions

Parameter	Conservative	Moderate	Optimistic
Baseline PUE	2.0	1.6	1.4
Cooling share of total energy	40%	35%	30%
HAC wall thermal bridging reduction	8%	12%	15%
Supply temp setpoint increase	+2°F	+3°F	+4°F
Rack frame thermal break contribution	3%	4.5%	6%
Seal gap reduction (CTE benefit)	4%	6%	8%
Total HVAC OPEX Reduction	~18%	~27%	~38%

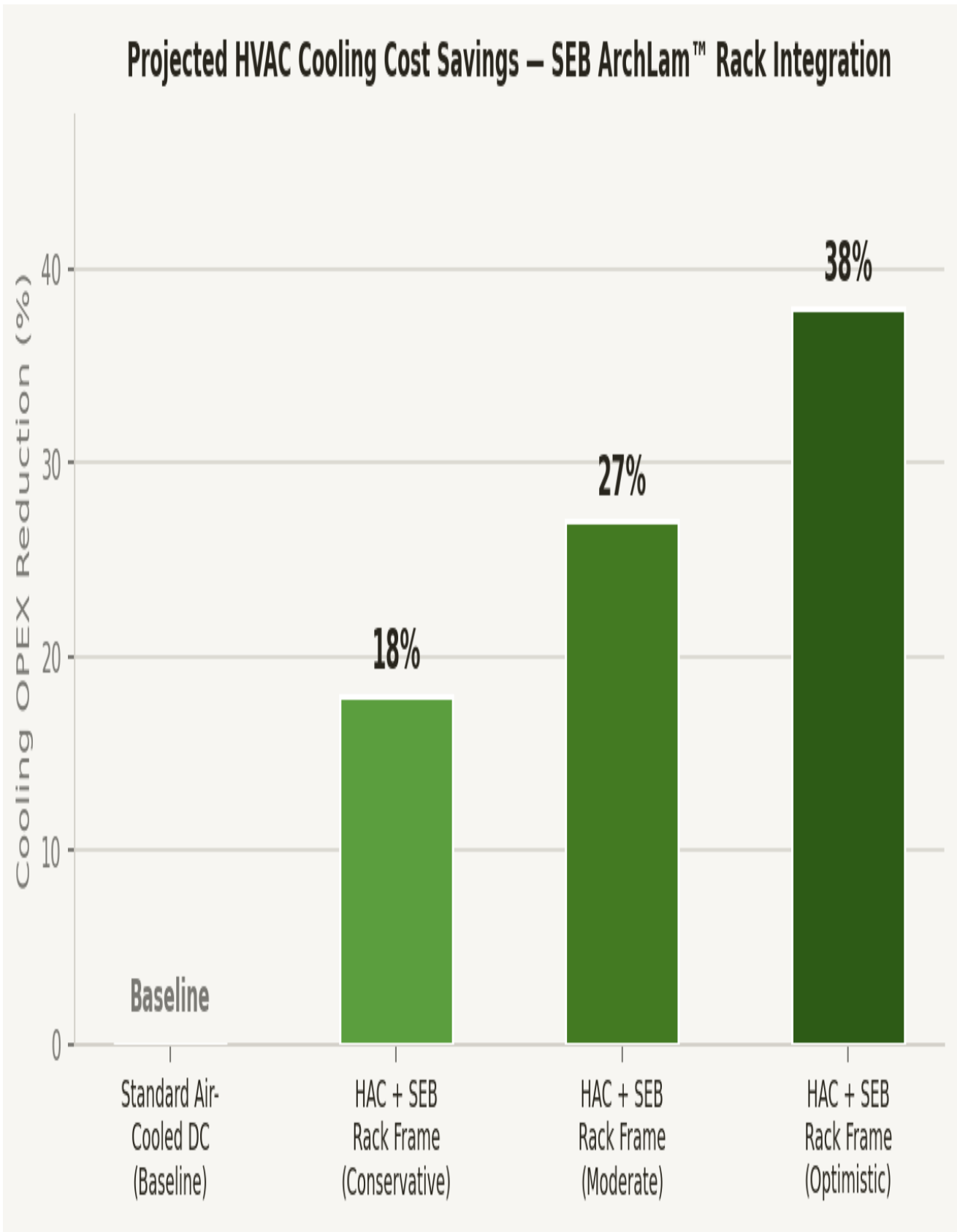


Figure 1 — Projected HVAC cooling cost savings (%) vs. all-aluminum/steel baseline by scenario.

### 3. PUE Impact & Cooling Energy Reduction by Facility Type

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Power Usage Effectiveness (PUE) is the industry-standard metric for data center energy efficiency, calculated as total facility energy divided by IT equipment energy. Cooling infrastructure is the dominant driver of PUE overhead.<sup>1</sup> The following projections apply the savings model to three representative facility types across the installed global base of aluminum and steel rack data centers.

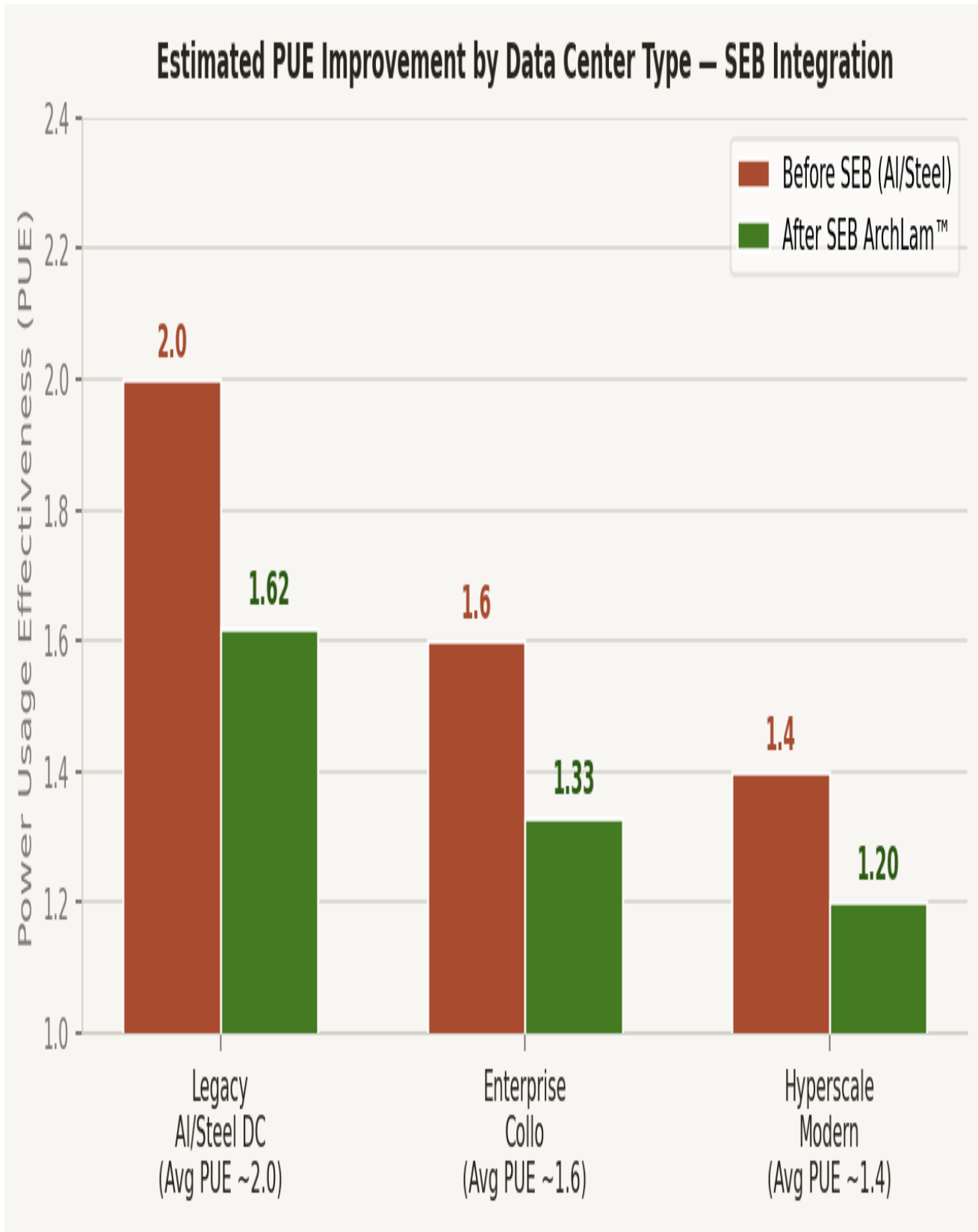


Figure 2 — Estimated PUE before and after SEB ArchLam™ rack integration, by facility type. PUE reduction translates directly to lower cooling OPEX.

Facility Type	Baseline PUE (Al/Steel)	SEB PUE Estimate	PUE Reduction	Annual Cooling Savings (10 MW DC)	10-Year Cumulative
Legacy / Tier I-II (pre-2015 build)	~2.0	~1.62	-0.38	\$1.9M	\$19M
Enterprise Colo (Tier III avg)	~1.6	~1.33	-0.27	\$1.35M	\$13.5M
Hyperscale Modern (post-2020)	~1.4	~1.20	-0.20	\$900K	\$9M

Assumes \$500/MWh blended US commercial electricity rate and 10 MW IT load reference facility. Savings scale proportionally with facility size.

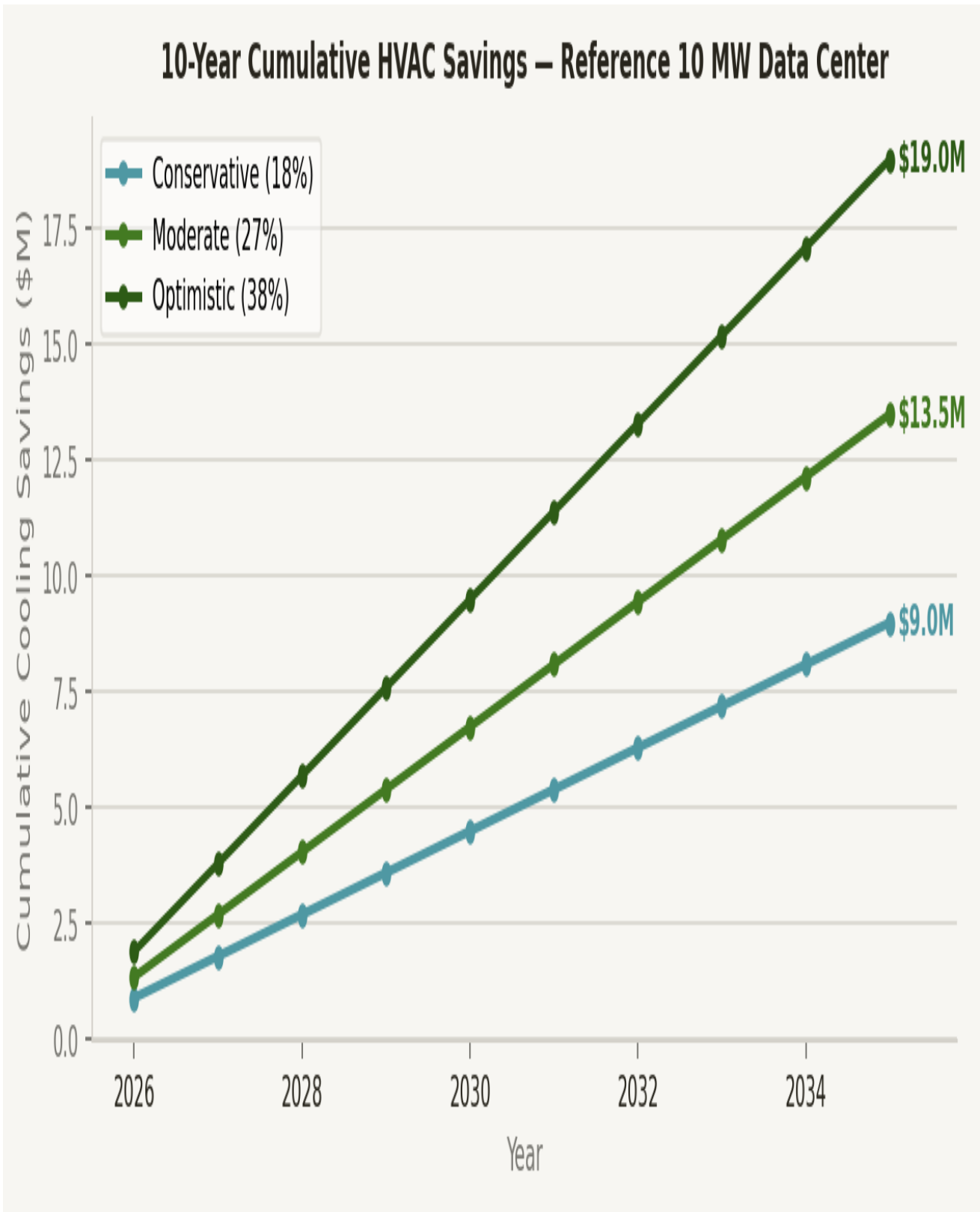


Figure 3 — 10-year cumulative HVAC cooling cost savings for a reference 10 MW data center. Savings scale linearly with installed IT capacity.

## 4. Global Market Opportunity – Total Addressable Savings

The addressable market for SEB ArchLam™ rack systems encompasses the full installed base of aluminum and steel rack data centers globally — estimated at approximately 600–700 GW of total IT load capacity by 2026, growing at ~14% CAGR.<sup>5</sup> Even modest penetration of this market at conservative savings rates produces staggering aggregate cooling cost reductions.

Market Segment	Est. Global IT Capacity (GW)	Approx. Annual Cooling OPEX (\$B)	SEB Savings @18% (Conservative)	SEB Savings @27% (Moderate)	SEB Savings @38% (Optimistic)
Hyperscale Cloud (AWS, Azure, GCP, etc.)	~150 GW	~\$45B	\$8.1B	\$12.2B	\$17.1B
Enterprise Colocation	~200 GW	~\$70B	\$12.6B	\$18.9B	\$26.6B
On-Premise Enterprise	~150 GW	~\$40B	\$7.2B	\$10.8B	\$15.2B
Edge / Distributed	~50 GW	~\$15B	\$2.7B	\$4.1B	\$5.7B
<b>TOTAL GLOBAL</b>	<b>~550 GW</b>	<b>~\$170B</b>	<b>\$30.6B/yr</b>	<b>\$46.0B/yr</b>	<b>\$64.6B/yr</b>

Global cooling OPEX estimated at 35% of total data center energy cost; global data center market energy spend derived from IEA / Lawrence Berkeley National Lab 2024 projections.<sup>6</sup> Savings are annual recurring figures, pre-tax.

## 5. Additional Benefits Beyond HVAC Cost Reduction

HVAC savings represent only one dimension of the SEB ArchLam™ value proposition. The following co-benefits further strengthen the TCO case:

**Carbon Footprint Reduction:** Cooling energy savings of 18–38% translate directly to equivalent reductions in Scope 2 CO<sub>2</sub> emissions. A 10 MW DC at 27% savings eliminates approximately 2,700–4,500 metric tons of CO<sub>2</sub>e annually, supporting ESG and net-zero commitments.

**Equipment Lifespan Extension:** Elimination of thermal cycling fatigue (via lower CTE) reduces micro-cracking in rack fastener points and containment panel seals, extending infrastructure service life by an estimated 20–35% and reducing capex replacement cycles.

**Embodied Carbon Advantage:** SEB ArchLam™ sequesters CO<sub>2</sub> during growth (<0.5 kg CO<sub>2</sub>e/kg vs. aluminum's ~8 kg CO<sub>2</sub>e/kg), providing a structural material with a positive carbon balance over its lifecycle.

**Non-Conductive / EMF Neutral:** Bamboo fiber composite is electrically non-conductive, eliminating ground loop risks and RF coupling artifacts that metallic rack frames can introduce in sensitive compute environments — particularly relevant for AI training clusters and quantum adjacency zones.

**Weight Reduction:** SEB ArchLam™ has a density of approximately 0.7–0.9 g/cm<sup>3</sup> vs. 2.7 g/cm<sup>3</sup> for aluminum, reducing raised floor loading by an estimated 60–65% per rack bay and enabling higher-density deployments without structural reinforcement.

## 6. Conclusions

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The replacement of aluminum and steel rack infrastructure with SEB ArchLam™ structural engineered bamboo represents a quantifiable, material-science-grounded pathway to significant HVAC cost reduction across the global data center installed base. Savings of 18% to 38% of annual cooling OPEX are achievable through the combined action of structural thermal breaking, improved hot-aisle containment, dimensional stability, and elevated cooling setpoint tolerance.

For a reference 10 MW enterprise data center, this translates to \$900K–\$1.9M in annual HVAC cost avoidance, growing to \$9M–\$19M over a 10-year horizon on a single facility. Applied across the global installed base of ~550 GW of aluminum/steel data centers, the aggregate annual savings opportunity exceeds \$30–65 billion at conservative to optimistic penetration.

LoüTeq is positioned to capture this opportunity through ArchLam™ rack systems and HAC wall panel products, offering operators a structurally certified, thermally superior, and carbon-negative alternative to legacy metallic infrastructure.

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### Sources & References

1. McKinsey & Company / Eaton — Cooling accounts for ~40% of total data center energy. <https://www.eaton.com>
2. ClimaSpec — Data Center Thermal Bridging and Structural Thermal Breaks (2024). <https://climaspec.com/blog/data-center-thermal-bridging/>
3. ENERGY STAR / DOE — Hot/Cold Aisle Containment delivers 10–35% cooling savings; combined with VSD: 20–25% fan energy, 20% chiller energy reduction. [energystar.gov](https://energystar.gov)
4. DOE Best Practices Guide for Energy-Efficient Data Center Design (2024). [energy.gov](https://energy.gov)
5. JLL — 2026 Global Data Center Market Outlook; 14% CAGR, 100 GW new capacity projected. [jll.com](https://jll.com)
6. Lawrence Berkeley National Laboratory — 2024 United States Data Center Energy Usage Report; IEA global data center energy projections 650–1,050 TWh by 2026. [eta-publications.lbl.gov](https://eta-publications.lbl.gov)
7. IRJMS — Cooling Strategies for Energy-Efficient Data Centers (2026). [irjms.com](https://irjms.com)
8. Shah et al., Journal of Materials Science (2015) — Thermal conductivity of engineered bamboo composites.
9. MatWeb / NIST — Aluminum 6061-T6 thermal and mechanical properties. [asm.matweb.com](https://asm.matweb.com)

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*DISCLAIMER: All savings projections are estimates based on published industry benchmarks, ArchLam™ material property data, and engineering first-principles analysis. Actual savings will vary based on facility design, climate, cooling architecture, and operational practices. This document is prepared for informational and investor purposes only and does not constitute a guarantee of performance. © 2026 LoüTeq, LLC. All rights reserved. CONFIDENTIAL.*