



Voltage Optimization as **Capital Protection**

Financial Review of Real Operating Deployments
Across a Commercial Real Estate Portfolio

15–30%

Reduction in Annual
MR&R Spend

6.0–7.8%

Voltage Reduction
Achieved

25–45%

Reduction in MR&R
Year-to-Year Volatility

Executive Summary

Equipment replacements and elevated maintenance costs are material drivers of operating margins and long-term asset valuations in commercial real estate portfolios. A common but often overlooked reality is that building systems frequently experience higher electrical stress than their nameplate design allows for. This sustained stress accelerates equipment aging, resulting in earlier capital replacements and less predictable operating costs.

This study analyzes real operating Commercial Real Estate buildings with existing SmartGATE deployments, using multi-year transaction-level maintenance records and independent Measurement & Verification (M&V) reports. On buildings with sufficient post-installation history, average annual maintenance, repair, and replacement (MR&R) spend declined by 15–30%, and year-to-year MR&R volatility declined by 25–45% compared to pre-installation levels. These outcomes are consistent with reduced operating stress on major building systems.

For portfolio owners and operators, the primary value is capital preservation — lower and more predictable maintenance costs, and reduced risk of premature equipment replacement. Energy savings are a measurable secondary benefit. On the deployments analyzed, energy savings ranged from 4.0-6.1%, though the broader SmartGATE portfolio average is 2.5–4% depending on incoming voltage conditions.

Individual buildings in this asset class commonly contain \$5M–\$20M+ in critical mechanical, electrical, and life safety systems. When average operating voltage runs materially above nameplate, modeling indicates this can accelerate write-off risk by \$1.5M–\$3M+ per building over a 20-year horizon. Across portfolios of 20 to 100 buildings, this exposure compounds into tens to hundreds of millions of dollars in potential premature capital spend.

One scaled Commercial Real Estate owner has already deployed SmartGATE across over 50 buildings. The consistency of results across mature installations supports proceeding to a structured pilot to validate capital protection outcomes on additional assets.

Analysis of real operating Commercial Real Estate buildings with existing SmartGATE deployments shows consistent capital protection outcomes:

Executive Summary

Key Findings

- 15–30% lower average annual MR&R spend on buildings with multi-year post-installation data, compared to pre-installation levels. This reduction is consistent with lower operating stress on equipment.
- 25–45% lower year-to-year MR&R volatility, improving operating cost predictability and capital forecasting accuracy.
- 6.0–7.8% voltage reduction confirmed through on-site Measurement & Verification across five measured buildings, directly supporting reduced equipment stress.
- 4.0–6.1% energy savings validated through independent M&V, with achieved results exceeding pre installation projections in every report (noting that the broader SmartGATE portfolio average is 2.5–4%).
- One scaled Commercial Real Estate owner has already deployed SmartGATE across more than 50 buildings, demonstrating the potential for portfolio-level capital protection at scale.

Portfolio-Scale Capital Exposure

Individual buildings in this asset class commonly contain \$5M–\$20M+ in critical systems. When average operating voltage runs 30–40V above nameplate, industry modeling indicates this can accelerate write-off risk by \$1.5M–\$3M+ per building over a 20-year horizon. Across a portfolio of 20 buildings, exposure reaches \$30M–\$60M. Across 100 buildings, it reaches \$150M–\$300M.

MR&R Cost Reduction

The observed reduction in average annual MR&R spend is consistent with reduced operating stress on equipment, as SmartGATE brings incoming voltage closer to nameplate ratings. For this study, transaction-level MR&R data was analyzed for buildings with sufficient post-installation history. On the five buildings with multi-year post SmartGATE data, average annual maintenance, repair, and replacement spend declined after installation. This outcome aligns with the measured 6.0–7.8% voltage reduction, which lowers thermal stress and slows equipment degradation.

Metric	Portfolio Average	Observed Range	Reduction Basis
Reduction in Average Annual MR&R Spend	15–30% lower	12–35% lower	Pre vs Post
Reduction vs. Matched Control Buildings	18–28% lower	10–32% lower	SmartGATE buildings

MR&R Volatility Reduction

Across the analyzed buildings, year-to-year volatility in MR&R spend was 25–45% lower after SmartGATE installation compared to pre-installation levels. This reduction was also directionally lower than the volatility observed in matched control buildings.

Lower volatility improves operating cost predictability, reduces the need for contingency reserves, and lowers the risk of unexpected capital or operating expense spikes — a material benefit for portfolio-level capital planning and forecasting accuracy.

Metric	Portfolio Average	Observed Range	Basis
Reduction in Year-to-Year MR&R Volatility with SmartGATE	25–45% lower	20–50% lower	Pre vs. Post variance comparison
Volatility vs. Matched Control Buildings	20–35% lower	15–40% lower	SmartGATE buildings

Asset Life Extension & Capital Protection

SmartGATE installations delivered voltage reductions of 6.0–7.8%. On a typical 600V service with equipment nameplate ratings of 575V, this moves average operating voltage closer to nameplate conditions. Lower operating temperatures reduce thermal stress, which supports extended equipment life and deferred capital replacement.

Key Capital Protection Effects

- **Maintenance Volatility Reduction:** Year-to-year MR&R volatility declined 25–45% post-installation, improving cost predictability.
- **Deferred Replacement Timing:** Industry modeling aligned with observed voltage reductions indicates equipment life extensions of 2–5 years on major systems (HVAC, motors, life-safety, switchgear), shifting \$1.5M–\$3M of replacement capital per building by several years.
- **Capital Forecast Stability:** Lower MR&R volatility and extended equipment life improve the reliability of multi-year capital plans and reduce contingency requirements.

The Science: Thermal Stress & Arrhenius Principles

Building systems are engineered for specific nameplate voltages. Sustained operation above nameplate increases I^2R losses and operating temperatures. Degradation mechanisms — insulation breakdown, material degradation, bearing wear, winding stress — are temperature-dependent. Per Arrhenius principles, reaction rates increase exponentially with temperature. Therefore, even modest, sustained reductions in operating temperature produce disproportionately large reductions in cumulative stress over the service life of equipment.

In portfolio management terms, this creates three material effects:

- A significant portion of long-term capital expenditure is driven by the timing and scope of major equipment replacements.
- Higher thermal stress increases both the frequency and severity of failures, raising reactive maintenance costs and reducing cost predictability.
- Reductions in average degradation rates can shift replacement timing and improve the accuracy of capital forecasting.

Measurement & Verification Summary

All observations are drawn from actual operating Commercial Real Estate buildings. Primary data sources include five independent M&V reports using on-site power quality analyzers, multi-year transaction-level MR&R records from the owner's financial systems, utility billing consumption and cost data, and exact SmartGATE install dates.

Building	Install Date	Voltage Reduction	Achieved Energy Savings	vs. Pre-Install Target	Post-Install History at M&V
1	Feb 12, 2022	7.4%	6.1%	Exceeded	~3 years
2	Dec 1, 2022	7.8%	4.9%	Exceeded	~1 year
3	Apr 13, 2023	6.0%	5.0%	Exceeded	~2 years
4	Feb 12, 2022	6.5%	4.0%	Exceeded	~3 years
5	Jan 7, 2024	6.8%	4.1%	Exceeded	~2 years

** Energy savings achieved on these installations (4.0–6.1%) were higher than the company-wide SmartGATE portfolio average of 2.5 4%. This region experiences elevated incoming voltage relative to equipment nameplate, which contributed to stronger energy performance compared to the broader deployment portfolio.*

Pre vs Post SmartGATE — Maintenance Cost Performance

Transaction-level MR&R data was analyzed for buildings with meaningful post-installation history. Results for buildings with multi-year post-install data:

Building	Install Date	Pre-Install Period	Post-Install Period	Pre-Install Avg Annual MR&R	Post-Install Avg Annual MR&R	Change in Avg Spend	Change in Volatility
1	Feb 12, 2022	Multi-year baseline	2022–2025	Higher baseline	15–19% Lower	Decline observed 15–25%	Reduced 20–30%
2	Dec 1, 2022	Multi-year baseline	2023–2025	Higher baseline	15–25% Lower	Decline observed 18–30%	Reduced 20–35%
3	Apr 13, 2023	Multi-year baseline	2023–2025	Higher baseline	15–30% Lower	Decline observed 20–35%	Reduced 20–30%
4	Feb 12, 2022	Multi-year baseline	2022–2025	Higher baseline	15–25% Lower	Decline observed 15–25%	Reduced 25–35%
5	Jan 7, 2024	Multi-year baseline	2024–2025	Higher baseline	15–25% Lower	Decline observed 12–30%	Reduced 25–35%

Key Observations

- All five buildings with sufficient post-install history show both lower average annual MR&R spend and lower year-to-year volatility after SmartGATE installation.
- The reduction in volatility is particularly notable, as it improves predictability of operating costs.

Building-Level Financial Impact

Individual buildings in this asset class commonly contain \$5M–\$20M+ in critical systems. When average operating voltage runs materially above nameplate, this accelerates equipment aging and increases write-off risk.

Example: 150,000 sq ft Building

Average operating voltage 610V vs 575V nameplate = 35V deviation

Summary Financial Metrics

Premature CapEx Risk: \$2.66M
Risk Exposure (economic value lost from early failure): \$3.13M
20-Year Total Cost Reduction with Voltage Optimization: \$5.43M (19.3% reduction)
20-Year NPV of Optimization: \$2.08M
Total Write-Off Risk Across All Systems: \$1.3M

System-Level Detail

System	Replacement Cost	Design Life	PQ-Shortened Life	Write-Off Risk	Annual Savings
HVAC	\$1,200,000	15 yrs	11.3 yrs	\$300,000	\$9,360
Life/Safety Systems	\$1,200,000	20 yrs	15.0 yrs	\$300,000	\$9,252
Switchgear/Electrical	\$1,200,000	40 yrs	30.0 yrs	\$300,000	\$3,168
Motors/Pumps	\$500,000	20 yrs	15.0 yrs	\$125,000	\$3,340
Elevators	\$800,000	20 yrs	15.0 yrs	\$200,000	\$2,420
VFDs	\$300,000	10 yrs	7.5 yrs	\$75,000	\$2,334

These figures illustrate how voltage deviation translates into concrete capital exposure at the individual building level through shortened equipment life and higher write-off risk. Summary financial metrics include modeled effects across replacement timing, early-failure exposure, operating savings, and discounted 20-year cash flow impacts; system-level write-off risk shown below reflects selected major systems only.

Portfolio-Scale Implications

The effects observed at the building level compound across a portfolio. Even if only the lower end of observed effect sizes applies when scaled, the cumulative capital protection opportunity across mid-to-large portfolios reaches tens to low hundreds of millions of dollars over a 15–20 year horizon — before considering secondary benefits from reduced operating cost volatility and improved capital forecasting accuracy.

Illustrative Portfolio Math

Portfolio Size	Est. Write-Off Risk / Building	Total Portfolio Exposure	Conservative (40% mitigation)	Base (55% mitigation)	Aggressive (70% mitigation)
20 buildings	\$1.5M–\$3M	\$30M–\$60M	\$12M–\$24M	\$16.5M–\$33M	\$21M–\$42M
50 buildings	\$1.5M–\$3M	\$75M–\$150M	\$30M–\$60M	\$41M–\$82.5M	\$52.5M–\$105M
100 buildings	\$1.5M–\$3M	\$150M–\$300M	\$60M–\$120M	\$82.5M–\$165M	\$105M–\$210M

One owner has already deployed SmartGATE across 50+ buildings (with more scheduled) and is capturing these effects across a meaningful portion of its portfolio. The consistency of building-level results suggests the capital protection opportunity scales with deployment breadth.

Conclusion

Voltage optimization delivers measurable capital protection. Real operating data from existing deployments shows 15–30% lower average MR&R spend and 25–45% lower year-to-year volatility — outcomes consistent with reduced equipment stress and extended asset life. Energy savings provide an additional measurable benefit, with the analyzed deployments achieving 4.0–6.1% and the broader SmartGATE portfolio averaging 2.5–4.0% depending on incoming voltage conditions.

Individual buildings carry \$5M–\$20M+ in critical systems. When voltage conditions accelerate equipment aging, the financial exposure per building reaches millions of dollars. Across portfolios of 20, 50, or 100 buildings, this exposure compounds into material capital risk.

The evidence from mature deployments indicates that voltage optimization is already delivering capital protection at scale for owners who have deployed it.

Ready to Protect Your Portfolio?

Connect with Legend Power Systems to assess your portfolio's voltage risk exposure and capital protection opportunity.

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