GSA Building 49 Adaptive Reuse Modernization

The Denver Federal Center Building 48 represents a transformational adaptive-reuse project that converted a vacant 1940s-era munitions plant into a cutting-edge, net-zero-energy office facility. This 150,000-square-foot modernization achieves remarkable sustainability goals through innovative engineering solutions while utilizing standard, cost-effective building systems. The project serves as a new model for federal building performance, demonstrating how thoughtful design can achieve net-zero energy, net-zero operational carbon, and an 89% reduction in embodied carbon through adaptive reuse.

ENERGY EFFICIENCY

Building 48 meets net-zero targets through a disciplined, four-step process. First, the team optimized the envelope: open-cell spray foam behind original masonry yields an R-15+ wall; a R-25 white membrane roof sits on tapered polyiso; and acoustical spray on the deck raises the effective R-value without altering the structure. Post-retrofit blower-door tests verified infiltration at just 0.05 cfm/ft^2 at 1.57 psf, exceptional for a 150,000-square-foot warehouse. Seventy-three new low-e windows and 85 skylights reduce heating load and provide the daylight needed for visual tasks. Second, internal loads fell through a task-ambient lighting strategy, daylight harvesting, and controls that shed half of the receptacle circuits; lighting power density is 58% below ASHRAE 90.1-2016. The third step used a “keep it simple” water-source heat pump plant with direct evaporative cooling to serve the conditioned area. Four interior VAV heat pumps and multiple single-zone perimeter units share energy via condenser-water piping, trimming HVAC energy use by 75% in the shoulder seasons. Three 240kW, six-step electric boilers are used only when the loop temperature warrants. In the last step, a 200kW rooftop photovoltaic array, backed by 121kW from the campus field, offsets the modeled gross EUI of 23 kBtu/ft^2-yr, reducing net EUI to zero.

Figure 1 presents sub-metered HVAC, lighting, and plug/process loads from April 1, 2025, to March 31, 2026. HVAC peaks at roughly 120,000 kWh in winter and drops below 40,000 kWh in summer, when direct evaporative cooling and heat-swap piping replace compressor work. Lighting and plug demand stay flat because daylight harvesting, task lighting, and 50% receptacle shedding restrain use.

Figure 2 overlays actual loads on the ASHRAE 90.1 Appendix G model. Lighting uses 18% less energy than predicted, and plug loads 22% less, reflecting 36% post-pandemic occupancy and effective controls. HVAC runs 14% above the model during the first winter

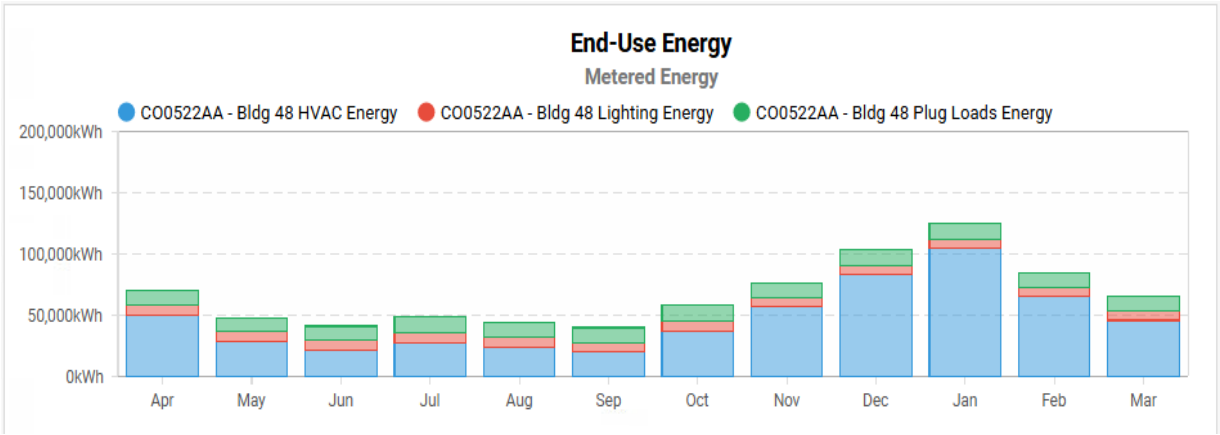

Figure 1: End-of Use Energy Consumption for Building 48

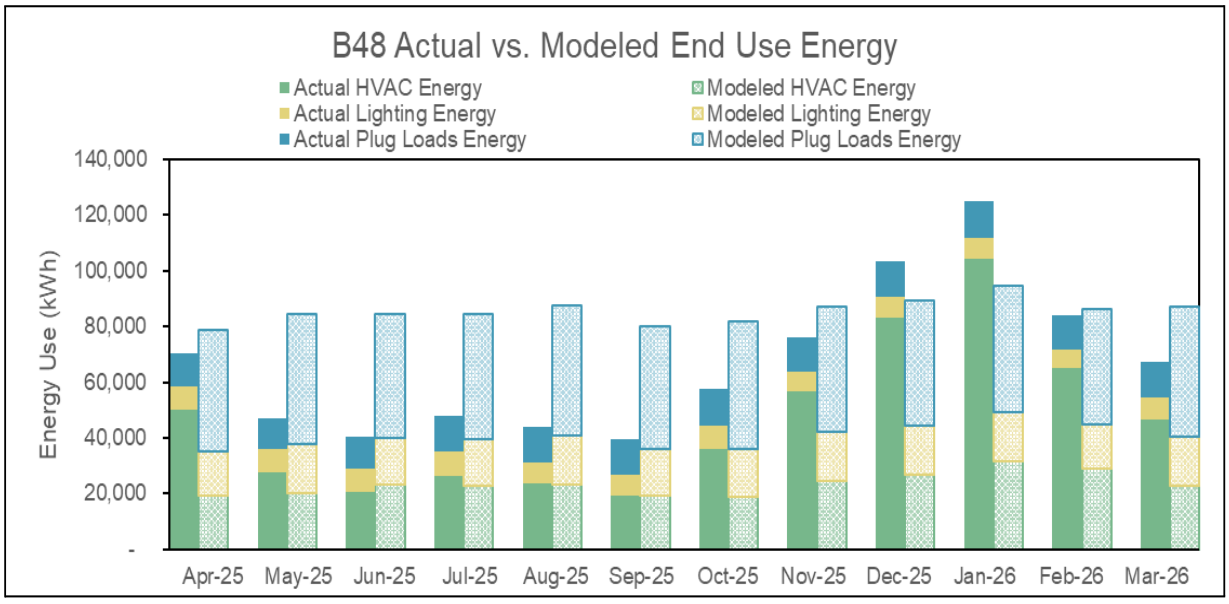

Figure 2: Building 48 Actual vs. Modeled End Use Energy

while boiler set points remained conservative; spring tuning of boiler staging, condenser-water temperature, and pump speeds is narrowing the gap.

These results verify the four-step net-zero strategy, align field performance with design intent, and supply the data stream required for LEED Zero Energy certification.

INDOOR AIR QUALITY

The design embraces daylight as a primary environmental driver: 73 new 10-foot × 14-foot windows and 85 skylights flood 70% of the occupied space, while matte-white ceilings and low partitions distribute vertical illuminance without glare; open-plan areas maintain a unified glare rating below 15. Building 48 is the first GSA facility to adopt UL 24480 guidelines, targeting a circadian stimulus of 0.3 for at least two morning hours. Post-occupancy measurements average 0.19 and, together with occupant surveys and ongoing tuning by Mount Sinai's Light & Health Research Center, inform iterative improvements. Low-emitting materials, controlled ventilation, CO2 sensors, and full-building air flushes meet P100 Tier-2 criteria, while 100% outdoor-air economizer cycles during mild seasons further enhance indoor freshness.

INNOVATION

The project converts a brownfield munitions plant into a fully electric, LEED Gold and SITES Silver workplace. Early adoption of DG 24480 prompted redesign of skylight locations, workstation heights, and ceiling finishes to prioritize occupant health. The system efficiency exceeds ASHRAE 90.1 by 40%. The electrical team reused a retired campus transformer for 20 EV chargers, avoiding a costly switchgear upgrade and keeping building service below 4000A. Whole-building life-cycle assessment documents an 89% reduction in embodied carbon relative to new construction. Asphalt pavement contains 25% recycled content, the highest RAP percentage in the GSA portfolio for 2023, and records the agency's lowest global-warming potential at 54 kg CO2e per ton.

OPERATIONS AND MAINTENANCE

Simplicity underpins long-term reliability. Four interior VAV WSHP units, perimeter single-

zone heat pumps, one cooling tower, three six-step electric boilers, and direct evaporative modules form a plant that maintenance technicians can service with standard skills and minimal spares. The BAS regulates lighting, plug-load shedding, ventilation, and EV charging, while advanced fault detection from SkySpark flags anomalies before they escalate. Reusing existing bond beams to support new glazing simplified structural upkeep and eliminated additional façade interfaces. All critical equipment is floor-mounted with lift access, and floodlights in “The Forest” can be aimed and cleaned from a standard scissor lift that enters through the adjacent plaza.

COST EFFECTIVENESS

By consolidating Interior Business Center staff from three leases into a government-owned asset, the project saves taxpayers nearly $6 million per year, delivering a simple payback of under nine years. Remaining within the original 4000A service avoided $1 million in gear replacement and repurposed structural steel for window openings avoided market-volatile steel costs during a period of 200% escalation. Energy-cost savings of 50.5% below the code baseline, verified by early utility billing, and the all-electric design further strengthen the life-cycle return as grid carbon intensity declines.

ENVIRONMENTAL IMPACT

Keeping and modernizing the shell eliminated 88% of the embodied carbon of a comparable new facility—about 19 million kg CO2e, equal to 43 million miles of automobile travel. On-site generation and all-electric systems reduce operational emissions to zero, aligning with the White House Federal Building Performance Standard. High-efficiency fixtures and seventeen-cycle cooling-tower operation reduce indoor potable water use by 39% and outdoor use by 87%. Smart metering and drought-tolerant landscaping double as a pollinator habitat and capture the 95th-percentile storm on-site. The project achieved LEED-Gold and SITES Silver, reinforcing its role as a replicable blueprint for low-carbon, health-centered federal workplaces.