U.S. General Services Administration

The Impact of High-Performance Buildings

U.S. General Services Administration

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The Impact of High-Performance Buildings

GSA's high-performance buildings save energy, save water, cost less to operate, produce less waste, and have more satisfied occupants compared with typical buildings. In short, they deliver cost savings and tenant satisfaction.

This data-driven study examined 200 buildings with over 13,000 data points over a three-year period, and is the first to combine an internal analysis of GSA buildings with comparisons to industry-accepted benchmarks. GSA's experience from nearly two decades of integrating and optimizing high-performance building attributes — including energy efficiency and healthy workplaces — shows that high-performance buildings function more efficiently than their legacy stock counterparts, and operate better than industry benchmarks.

key findings

Compared to legacy stock buildings, GSA's high-performance buildings show:

- ***23%*** ↓ *energy use*
- ***28%*** ↓ *water use*
- ***23%*** ↓ *building operating expenses*
- ***9%*** ↓ *waste landfilled*
- ***2%*** ↑ *overall tenant satisfaction*

GSA's high-performance buildings save energy, save water, cost less to operate, produce less waste, and have more satisfied occupants compared with typical buildings.

These findings demonstrate the value of high-performance buildings as part of the federal government's building portfolio. GSA is the single largest owner/operator of office space in the United States, controlling over 370 million rentable square feet including office buildings, courthouses, land ports of entry, and warehouses.[1] Within GSA's owned portfolio, high-performance buildings comprise 27% of buildings, and 40% of total gross square footage. Reducing costs and increasing building efficiencies directly benefits American taxpayers, both in the short term, and over the lifetime of federal buildings.[2]

GSA will leverage the results of this study to promote cost savings, technology advancement, and operational excellence in our nation's federal buildings. GSA's data collection efforts and publication of these findings can help other federal, state, and local agencies understand the benefits of tracking building performance and using the resulting data to drive building- and portfolio-level decisions.

[1] U.S. General Services Administration, Facilities Management Overview: www.gsa.gov/facilitiesmanagement.

[2] GSA buildings are typically built for a 100-year life.

The Guiding Principles

1. Employ integrated design principles
2. Optimize energy performance
3. Protect and conserve water
4. Enhance indoor environmental quality
5. Reduce environmental impact of materials
6. Assess and consider climate change risks

High-Performance Versus Legacy Stock Buildings

In this study, high-performance buildings are federally-owned, GSA-managed buildings that meet the Guiding Principles for Sustainable Federal Buildings.[3] Legacy stock buildings are federally-owned, GSA-managed buildings that have not been upgraded to meet the Guiding Principles. Not all high-performance buildings are recently-constructed – older and historic buildings that GSA successfully upgraded to meet the Guiding Principles are also included in this study as high-performance buildings. Within GSA's owned, eligible portfolio, high-performance buildings comprise 27% of buildings and 40% of gross square feet.

Benefits of high-performance buildings include boosting energy independence, lowering utility costs, and reducing stress on infrastructure.

Since 2006, the Guiding Principles for Sustainable Federal Buildings have served as a common set of performance goals aimed at helping federal agencies reduce the total cost of owning and operating facilities, while improving resource efficiency and providing safe, healthy, and productive built environments.

GSA's mission is to deliver value and savings in real estate, acquisition, technology, and other mission-support services across government — in short, to enable effective and efficient government for the American people. GSA is committed to providing safe, healthy, and productive workplaces for federal workers at the best value for the American taxpayer. High-performance buildings are an essential element supporting this commitment.

[3] Guiding Principles for Sustainable Federal Buildings and Associated Instructions: http://sftool.gov/guidingprinciples

Our Approach

This study used the following steps to examine the performance of GSA's high-performance buildings, and compare them against legacy stock GSA buildings and industry-accepted benchmarks. The Methodology section at the end of this report contains additional details about each step.

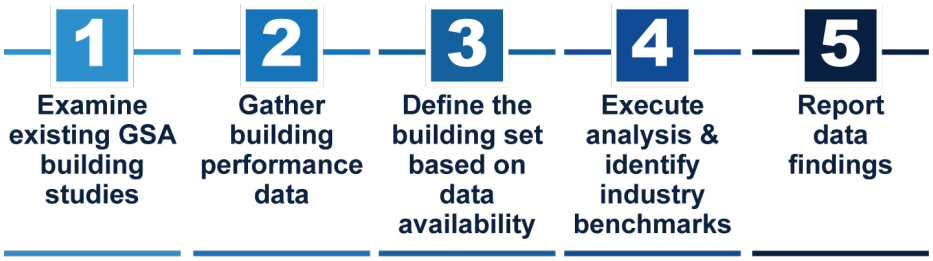


Figure 1: GSA's Approach for this Study

GSA collected Fiscal Year (FY) 2015, 2016, and 2017 building performance data for the following five metrics: energy use, water use, building operating expenses, solid waste (generation and diversion), and tenant satisfaction. These data cover three full years, from October 2014 through September 2017. Data used for the analysis came from GSA systems of record, as listed on page 20 of this report.

Energy Efficiency	*Annual energy consumption and costs*
Water Efficiency	*Annual water consumption and costs*
Building Operating Expenses	*Annual building operating expenses including O&M, janitorial, and utility costs*
Solid Waste Generation & Diversion	*Annual waste and recycling amounts*
Tenant Satisfaction	*Occupant satisfaction ratings for air quality, noise, temperature, cleanliness, light, and overall satisfaction*

Figure 2: Building Performance Metrics

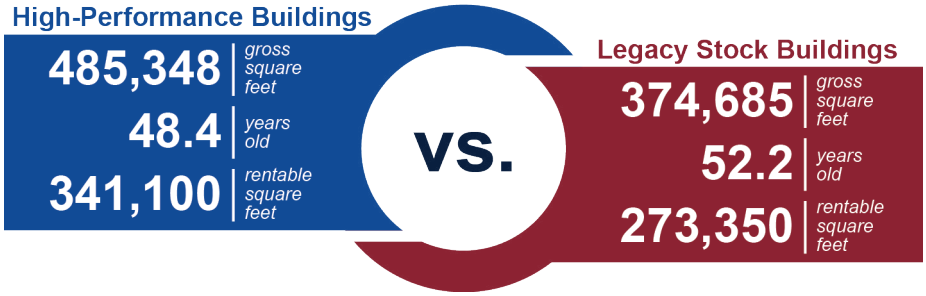


Figure 3: Average Building Size and Age

Buildings included in the study were federally-owned, GSA-managed office buildings, courthouses, or combination office/courthouse buildings with complete FY 2015–2017 data for all of the analyzed performance metrics. **The resulting building set included 100 high-performance buildings and 100 legacy stock buildings.**

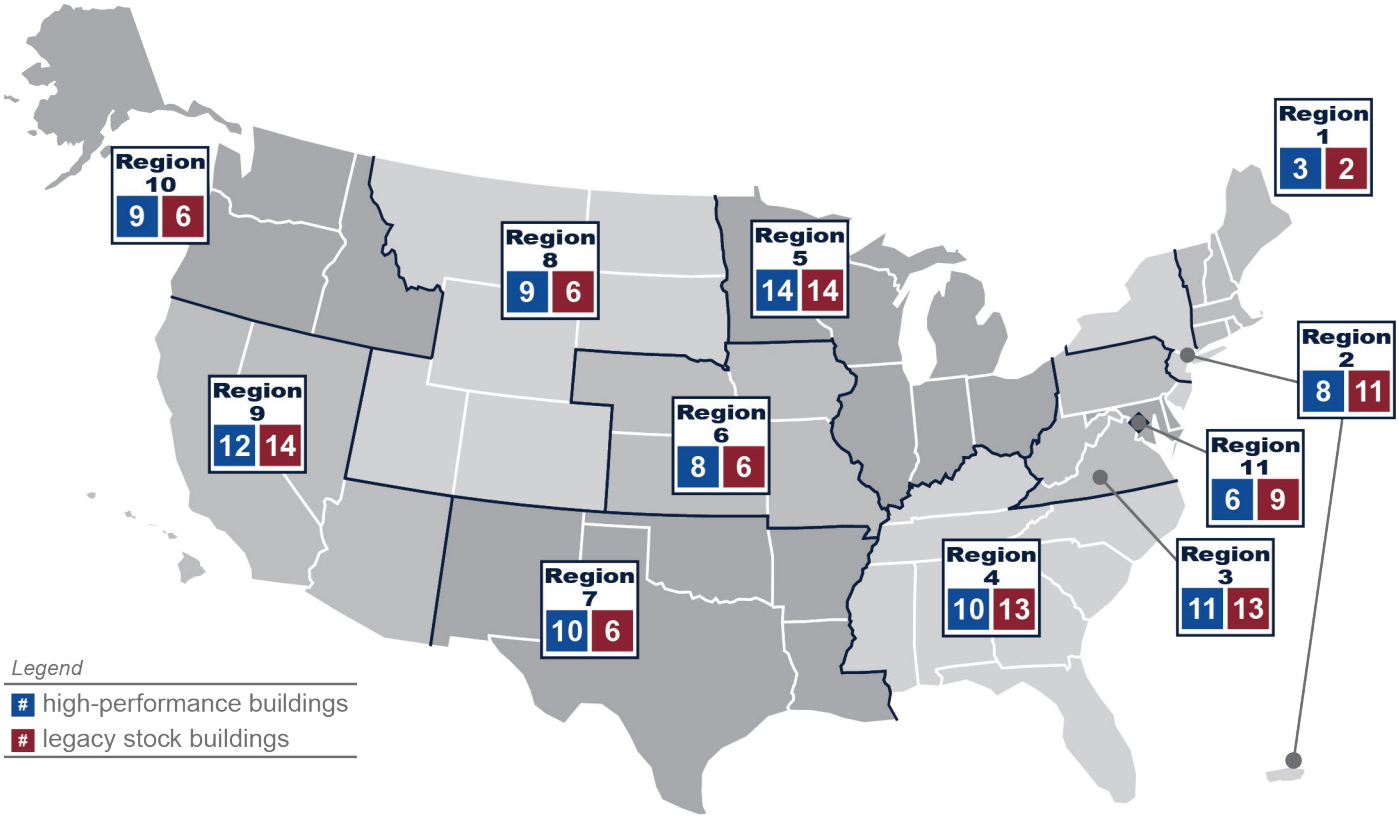


Figure 4: Distribution of buildings by GSA Region

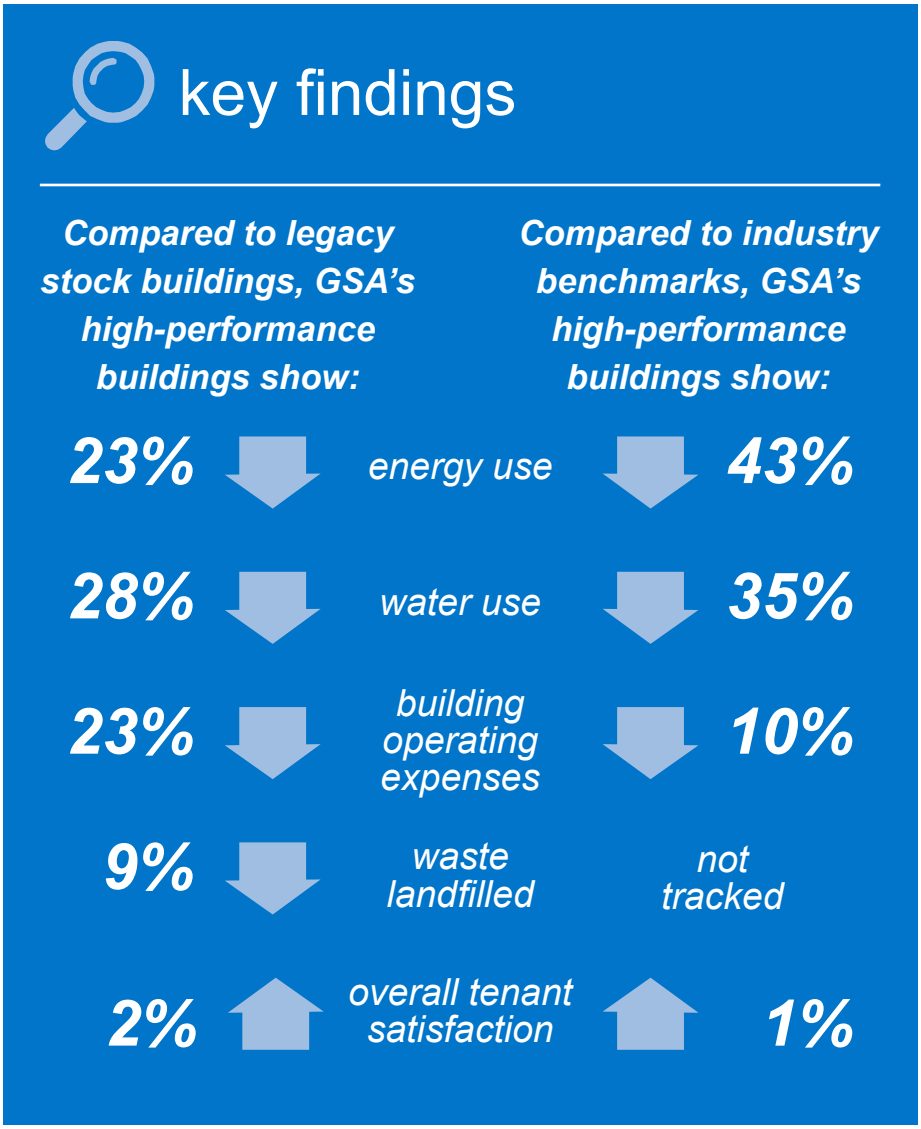
GSA used the following industry-accepted private sector office building benchmarks to compare performance on key metrics.

Performance Metric	Measurement Units	Industry Benchmark Source
Energy Use Intensity	British Thermal Units (Btu) of energy used per gross square foot (GSF)	*Department of Energy (DOE), Energy Information Administration (EIA) Commercial Buildings Energy Consumption Survey (CBECS) 2012*
Water Use Intensity	Gallons of water used per GSF	*ENERGY STAR® Portfolio Manager 2012*
O&M Expenses	Building mechanical operation and maintenance (O&M) expenses per rentable square foot (RSF)	*Building Owners and Managers Association Experience Exchange (BOMA)*
Janitorial Expenses	Building cleaning expenses per RSF	
Utility Expenses	Total building utility expenses per RSF, including electricity, gas, oil, water, and steam	
Tenant Satisfaction	Average tenant satisfaction for building air quality, noise, temperature, cleanliness, light, and overall satisfaction	*Center for the Built Environment (CBE) Occupant Indoor Environmental Quality Survey 2015*

Figure 5: Industry Benchmark by Performance Metric

Analysis Results

This analysis examines five building metrics: energy use, water use, building operating expenses, solid waste (generation and diversion), and tenant satisfaction. Additionally, the high-performance and legacy stock buildings are compared against each other and against industry-accepted private sector office building benchmarks. Results shown are the three-year average values for each building performance metric. **The results are definitive, sustained, and make a strong case for high-performance building investments.**



Energy Efficiency

Buildings account for about 40% of total U.S. energy consumption — more than industry or transportation.[4] Increasing the built environment's energy efficiency has many benefits:

- **Boosting energy independence**: efficiencies achieved in the building sector have a major impact on national energy consumption, which helps to reduce dependence on foreign energy sources and increase national security
- **Lowering utility costs**: lower utility costs in federal buildings positively impact agency budgets, reduce vulnerability to cost fluctuations, and save American taxpayers' money
- **Reducing stress on infrastructure**: energy-efficient and well-controlled buildings reduce peak demand on the U.S. electrical grid and overall stress on energy infrastructure, improving mission resilience

Opportunities for increasing building efficiency include equipment upgrades, improved building and energy management systems, commissioning measures, and industry-leading building design practices.

Energy Data Results

FY 2015–2017 energy consumption data for each building in the analysis was converted to British Thermal Units (Btu), then expressed in terms of average consumption per gross square foot per year: energy use intensity (EUI). The results indicate that GSA's high-performance buildings are more energy efficient than both its legacy stock buildings and commercial office building counterparts. More specifically, over a three-year average:

- High-performance buildings' energy use intensity was **23% lower** than legacy stock buildings
- High-performance buildings' energy use intensity was **43% lower** than the CBECS benchmark
- Legacy stock GSA buildings' energy use intensity was **25% lower** than the CBECS benchmark
- High-performance buildings used **13.6 kBtu**[5] **less energy** per gross square foot than legacy stock buildings
- High-performance buildings used **33.1 kBtu less energy** per gross square foot than the CBECS Benchmark

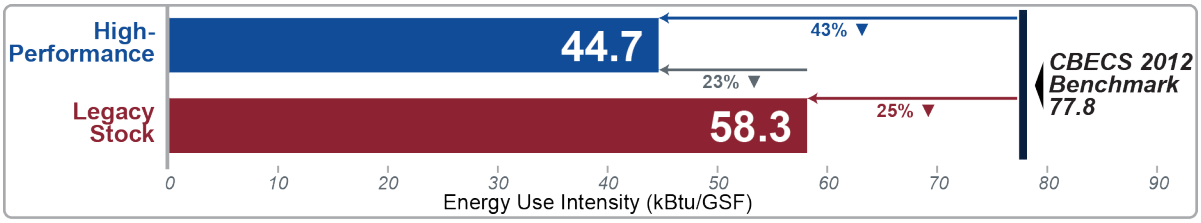


Figure 6: Energy Use Intensity Findings

If an average-sized legacy stock building achieved the same energy use intensity per gross square foot as GSA's high-performance buildings, one building alone would save 5.1 billion Btu annually, or the equivalent annual energy usage of 138 average American homes. Extrapolating these savings to 100 legacy stock buildings is equivalent to saving 510 billion Btu annually, or the annual energy usage of more than 13,800 homes.

[4] U.S. Energy Information Administration Frequently Asked Questions: www.eia.gov/tools/faqs/faq.php?id=86&t=1

[5] Energy use intensity is typically measured in thousands of Btu, or kBtu, per square foot per year.

Energy Efficiency

Case Study

Buildings can achieve high performance regardless of age — the Wayne N. Aspinall Federal Building and U.S. Courthouse was built in 1918, and is now one of the nation's most energy-efficient historic buildings, thanks to GSA's building modernization completed in 2013. Updates included installing a variable refrigerant flow HVAC system, LED lights with daylight sensors and dimmers, a thermally-enhanced building envelope, a geothermal heat pump, and a rooftop photovoltaic solar electricity generation system.

The first year after renovation, the Aspinall Federal Building's energy use dropped 47%. It was the first building listed on the National Register of Historic Places designed to produce all the energy it needs to operate over the course of a year onsite.

The Aspinall Federal Building's three-year average energy use intensity was 15 kBtu/GSF, which is 74% lower than the average energy use intensity of GSA's legacy stock buildings, and 81% lower than the CBECS 2012 office building benchmark.

Figure 7: The Wayne Aspinall Federal Building and U.S. Courthouse, Grand Junction, Colorado. Photo by Kevin G. Reeves, Courtesy of DLR Group|Westlake Reed Leskosky.

Water Efficiency

Building-related water efficiency efforts seek to reduce water consumption and related expenses without sacrificing occupant needs or building performance. Buildings' water use includes both indoor water use, such as restroom fixtures, and outdoor water use, such as irrigation systems. Saving water has many benefits:

- **Reducing energy use**: saving water reduces the energy needed to treat, pump, heat, and/or cool water in buildings
- **Reducing wastewater**: water efficiency reduces costs and stress on sewer infrastructure
- **Drought mitigation and environmental benefits**: water conservation can reduce the impacts of drought by making more water available for other users, streams, and wetland ecosystems

This study compares high-performance buildings' water usage with both GSA's legacy stock buildings, and with median water use for U.S. office buildings.[6]

Water Data Results

Water consumption data for each building included in this study is calculated as water use intensity (WUI), or the total water consumed, in gallons, divided by total gross square feet of space. These results demonstrate that high-performance buildings are more water efficient than both legacy stock buildings and benchmark commercial office buildings. Specifically, results show that over a three-year average:

- High-performance buildings' water use intensity was **28% lower** than legacy stock buildings
- High-performance buildings' water use intensity was **35% lower** than the ENERGY STAR® Portfolio Manager 2012 office building median
- Legacy stock GSA buildings' water use intensity was **10% lower** than the Portfolio Manager median
- High-performance buildings used **3.1 fewer gallons** per gross square foot per year than legacy stock buildings

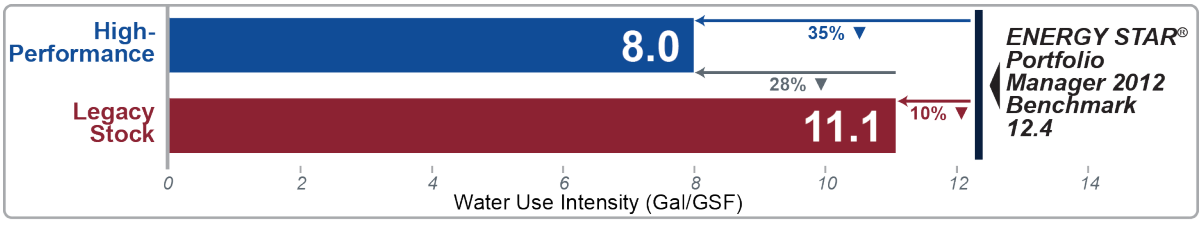


Figure 8: Water Use Intensity Findings

Based on these findings, if an average-sized legacy stock building used the same number of gallons per gross square foot as GSA's high-performance buildings, one building alone would save 1.15 million gallons annually, or the equivalent daily water usage of over 3,800 average American homes.[7]

[6] Median office building water usage data from ENERGY STAR® Portfolio Manager 2012.

[7] The average American home uses 300 gallons of water a day, per the U.S. Environmental Protection Agency: www.epa.gov/watersense/how-we-use-water.

Water Efficiency

Case Study

The U.S. Army Corps of Engineers' GSA-built facility at Federal Center South in Seattle is a prime example of how a building that uses innovative indoor and outdoor water-reducing technologies and practices can realize significant water and cost savings each year.

The office building, completed in 2014, captures rainwater in a 25,000 gallon cistern, and uses it — instead of potable water — for toilet flushing, process water, and irrigation. High-efficiency bathroom fixtures reduce the amount of water used in the building, saving resources and lowering costs. Federal Center South's three-year average water use intensity was 5.1 gallons per GSF, which is twice as efficient as GSA's legacy stock buildings.

Figure 9: Federal Center South, Seattle, Washington

Building Operating Expenses

Building operating expenses are the costs associated with keeping a building maintained and functional. GSA collected available cost data for the following three categories:

- **Operations and Maintenance (O&M) Expenses**: services that keep buildings in working order, such as regular mechanical equipment maintenance and general building upkeep
- **Janitorial Expenses**: cleaning the building, maintaining its grounds, taking out waste, and removing snow
- **Utility Expenses**: total building utility costs, including electricity, natural gas, water, and steam

These three categories comprise most of a building's regular operating costs.

Building Operating Expenses Data Results

Building operational costs were calculated as total expense dollars per rentable square foot for each category above. High-performance buildings outperformed both GSA's legacy stock buildings and the Building Owners and Managers Association (BOMA) commercial office building benchmark in all building operating expense categories.[8] On average, high performance buildings saved $1.64 per rentable square foot in total annual expenses compared to legacy stock buildings. High-performance buildings saved $0.60 per rentable square foot in total annual expenses compared to BOMA commercial office building benchmarks.

For individual expense categories, on average:

- High-performance buildings cost $0.60 less per rentable square foot in O&M Expenses, $0.50 less per rentable square foot in Janitorial Expenses, and $0.53 less per rentable square foot in Utility Expenses, compared to legacy stock buildings

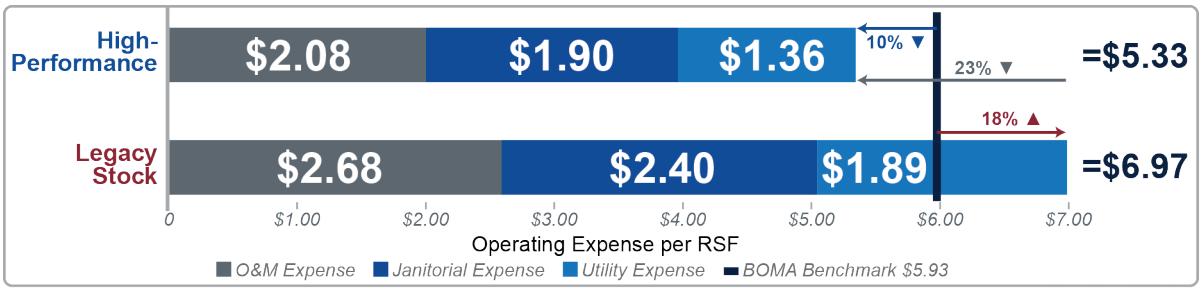


Figure 10: Building Operating Expenses Findings

Based on average building operating cost savings of $1.64 per rentable square foot, and this data set's average federal building size of 324,018 rentable square feet, each federal building could shave over $531,000 from its annual operating budget by matching the cost efficiency of GSA's high-performance buildings.

[8] BOMA International's Office and Industrial Benchmarking Report: http://www.boma.org/research/newsroom/press-room/PR16/Pages/BOMA-Internationals-Office-and-Industrial-Benchmarking-Reports-Released-.aspx

Solid Waste Generation & Diversion

Municipal solid waste generated by building occupants, thrown into refuse bins, and hauled away in the form of landfilled waste or diverted recycling is a cost incurred by property owners and frequently passed on to tenants. Waste diversion reduces or avoids hauling expenses. In February 2015, the U.S. Environmental Protection Agency reported a national average tipping fee of $49.78 per ton, with fees rising each year. The 200 buildings in this study's data set reported generating over 20,000 tons of solid waste, representing almost a million dollars per year in waste hauling expenses, if all were landfilled.

Solid Waste Data Results

GSA collects solid waste and waste diversion data for buildings in its inventory. The graph below shows municipal solid waste generated and diverted from landfills for high-performance buildings and legacy stock buildings. Results are shown as pounds of solid waste per rentable square foot.[9]

The results show that on average:

- High-performance buildings generated **0.07 pounds or 10% less** solid waste per rentable square foot compared to legacy stock buildings
- High-performance buildings landfilled **9% less** solid waste per rentable square foot compared to legacy stock buildings
- GSA's high-performance buildings and legacy stock buildings both **diverted from landfills more than 50%** of total solid waste generated, with high-performance buildings diverting a slightly higher percentage of waste.

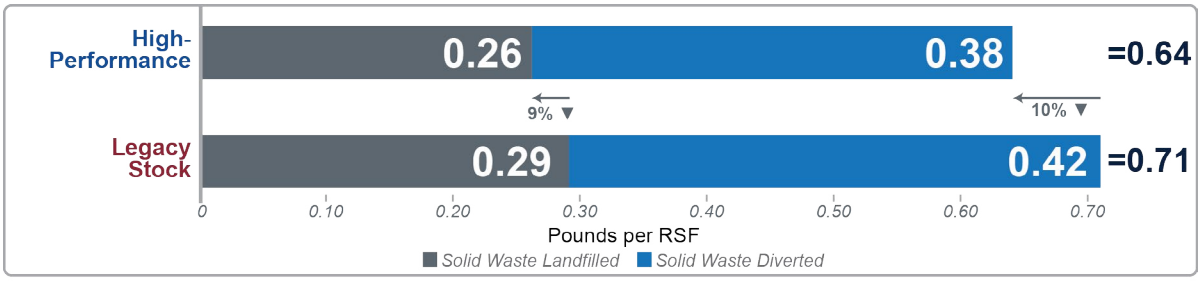


Figure 11: Municipal Solid Waste Findings

[9] Reliable commercial building solid waste benchmark data for comparison is currently not available.

Solid Waste Generation & Diversion

Case Study

The Edward Roybal Federal Building and Courthouse in Los Angeles, CA, increased its waste diversion rate from 31% to 80% in five years, and continues to maintain a high waste diversion rate compared to the goal of 50%. The Roybal Federal Building diverted an average of 79% of total solid waste over this study's three-year period.

In 2012, GSA implemented a food waste and organics composting program at the Roybal building, where both landscape and food waste are collected and taken to a composting facility. In addition to benefiting the environment by decreasing the amount of methane-generating organic waste shipped to landfills, the decreased need for waste removal services has saved money. The building generates recycling revenue from the sale of paper, cardboard, and other recycled materials. These proceeds support tenant agency programs and GSA's Child Care Tuition Assistance Program.

Figure 12: The Edward Roybal Federal Building, Los Angeles, California

Tenant Satisfaction

GSA administers a Tenant Satisfaction Survey (TSS) to all federal employees in its buildings. The survey's goal is to assess satisfaction with various attributes of each building and how it is managed. Tenants are asked to rate their level of satisfaction with building cleanliness, indoor air quality, lighting, noise levels, and thermal comfort on a scale of one to five, with five being most satisfied. For a comparative benchmark, GSA used the Occupant Indoor Environmental Quality Survey from the Center for the Built Environment (CBE) at the University of California in Berkeley.

Tenant Satisfaction Data Results

The graph below shows average tenant satisfaction ratings across five major TSS categories for high-performance buildings and legacy stock buildings for FY 2015–2017, as well as the CBE benchmark.[10]

- The tenant satisfaction responses for occupant comfort and building features show that high-performance buildings have **higher average satisfaction rates** for **cleanliness, air quality, thermal comfort, and overall satisfaction**, as compared to both legacy stock buildings and CBE benchmarks
- Legacy stock buildings show slightly higher average satisfaction for noise levels and lighting
- High-performance buildings and legacy stock buildings show **higher average satisfaction rates** for **cleanliness, air quality, lighting, noise levels, and thermal comfort** as compared to CBE 2015 average tenant satisfaction for office buildings

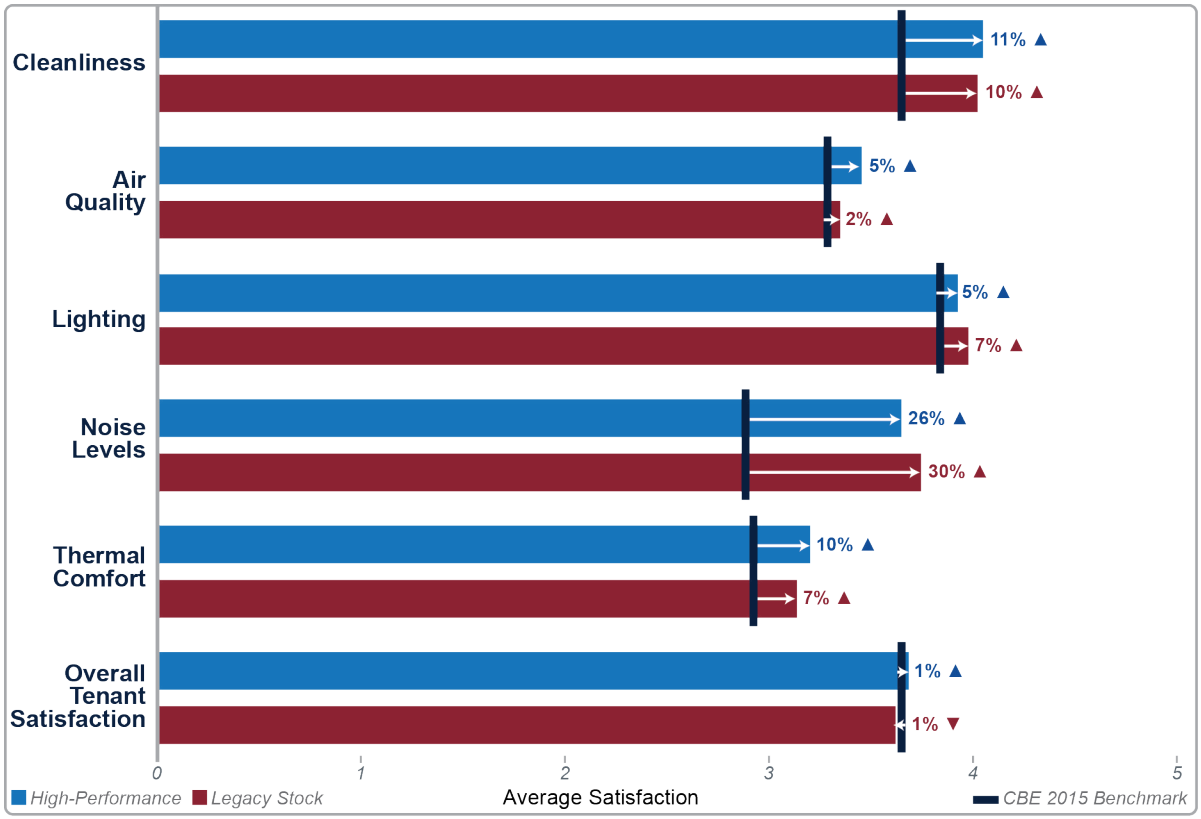


Figure 13: Tenant Satisfaction Findings

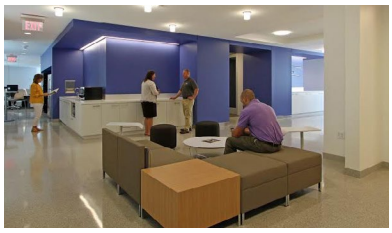
[10] These results are based on buildings within this study's total 200-building set, where tenant satisfaction survey responses were reported for at least 17% of total building occupants for each year assessed.

Tenant Satisfaction

Case Study

GSA's historic Headquarters Building in Washington D.C. was built in 1917 and modernized in 2013. This project used glazing glare control, occupant thermal comfort systems, and individually-controlled thermal zones to promote efficiency and comfort. GSA's atrium is fitted with electrochromic glass that tints to control solar glare and heat in the summer while optimizing daylighting. This modernization also capitalizes on natural light with a new daylight harvesting control system. Window shades are automatically raised and lowered throughout the workday to block out the sun's strongest morning and afternoon rays, and thereby reduce cooling load. Automatically-dimming office lights similarly enhance tenant satisfaction and save energy by using free light from the sun. Finally, operable windows in renovated wings of the building are linked to room-specific ventilation systems, enabling no-cost, occupant-controlled natural ventilation in suitable weather. These innovative features reduce operating costs while creating pleasant indoor workspaces.

In the tenant satisfaction survey launched roughly a year after the first half of the building modernization was completed, occupants in the newly-renovated or newly-constructed wings reported particularly high satisfaction with temperature, air quality, and light, compared to GSA building averages. Improved indoor environmental quality affects occupant health and well-being, which can translate into higher tenant satisfaction and financial paybacks from more attractive office spaces.



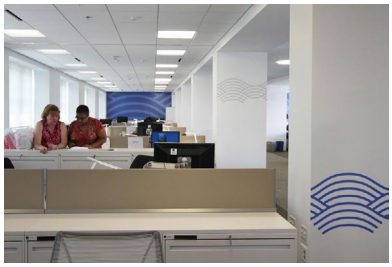


Figure 14: GSA Headquarters, Washington D.C.

High-Performance Buildings Save Money

These results demonstrate the value of high-performance buildings as part of the federal government's building portfolio. GSA extrapolated this study's findings to show the estimated cost savings if the 100 legacy stock buildings in the data set matched the average efficiency rates of the high-performance buildings. The table below shows the annual savings that could be realized in a scenario where the 100 legacy stock buildings in the data set matched the efficiency of GSA's high-performance buildings.

Performance Metric	Current Actual Cost *(200 buildings)*[11]	Projected Cost if All 200 Buildings were High-Performance[12]	Potential Additional Savings in Legacy Stock Buildings
Energy	$105,206,021	$92,304,650	$12,901,371
Water	$10,090,138	$8,626,759	$1,463,379
Building Operating Expenses	$287,876,172	$257,624,529	$30,251,644
Solid Waste	$440,341	$422,359	$17,982
Total	***$403,612,962***	***$358,978,297***	***$44,634,376***

Figure 15: Extrapolated Savings Analysis

Based on these data, if the 100 legacy stock buildings met the average performance rates of high-performance buildings, they could save over $44 million per year. Extrapolating these results across GSA's current portfolio, GSA could save nearly $185 million per year in operating expenses if all buildings met the average efficiency of high-performance buildings. Achieving this amount of portfolio-wide savings would require funding to upgrade the legacy stock buildings to meet the Guiding Principles for Sustainable Federal Buildings.

[11] This column shows the average annual total cost in FY2015-2017 for this study's 200 buildings.

[12] This column sums the actual costs for the 100 high-performance buildings plus the projected costs for the 100 legacy stock buildings using the average performance values of high-performance buildings.

Conclusion and Recommendations

Based on this study, high-performance buildings perform better than their legacy stock counterparts. As agencies seek to reduce the federal government's expenses, investments in high-performance building infrastructure will save utility and operating costs.

There is no one-size-fits-all solution to improving building performance, so upgrading legacy stock buildings to become high-performance will vary depending on the existing conditions of individual buildings. The Guiding Principles for Sustainable Federal Buildings provide a framework for improvements that will save money and reduce resource use.

In deciding which upgrades will best maximize performance on each measure, GSA recommends that decision makers:

- Examine the existing conditions and performance of legacy stock buildings to identify opportunities for improvement
- Maintain a portfolio-wide approach to reducing excess costs of legacy stock buildings via updates or replacement with high-performance buildings
- Prioritize improvement opportunities within a single building according to net present value, savings to investment ratio, and net operating income
- Leverage external financing wherever possible, such as Energy Savings Performance Contracts (ESPC) and Utility Energy Service Contracts (UESC)

key findings

Compared to legacy stock buildings, GSA's high-performance buildings show:

23% ↓ *energy use*

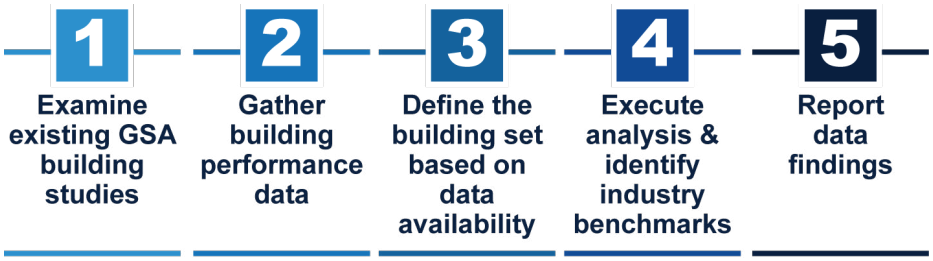
28% ↓ *water use*

23% ↓ *building operating expenses*

9% ↓ *waste landfilled*

2% ↑ *tenant overall satisfaction*

Appendix



Methodology

The following steps were used to examine the performance of GSA's high-performance buildings and compare them against GSA's legacy stock buildings and industry-accepted benchmarks:

1 Build upon Existing GSA Building Analyses

GSA and the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL) published two previous studies assessing GSA's sustainably designed buildings.[13] The studies were based on a Department of Energy data collection protocol, and compared building performance metrics for 12 and 22 GSA buildings, respectively, located within seven of GSA's 11 regions, against industry benchmarks.[14]

This study is an extension of the earlier analysis. It looks at similar building metrics and industry benchmarks, but increases the set to 200 buildings across all 11 GSA regions. This is also the first study to compare GSA's high-performance buildings against both overall industry benchmarks and GSA's legacy stock buildings.

2 Gather Building Performance Data

To achieve a representative sample of buildings, GSA collected building performance data across its national building portfolio for energy use, water use, building operating expenses, municipal solid waste, and tenant satisfaction. Data used for the analysis came from GSA systems of record for FY 2015–2017. Using existing GSA data systems enabled timely expansion of the building set, and efficient completion of data collection and analysis.

[13] Based on previous research performed by the U.S. Department of Energy, Pacific Northwest National Labs (KM Fowler, EM Rauch, JW Henderson, AR Kora) in 2008 and 2011.

[14] U.S. Department of Energy, Building Cost and Performance Metrics: Data Collection Protocol. https://www1.eere.energy.gov/femp/pdfs/datacollectionprotocol.pdf.

3 Define the Building Set

The building set for this study compares the following types of GSA buildings:

1. High-performance: buildings that meet the Guiding Principles for Sustainable Federal Buildings
2. Legacy stock: buildings that do not meet the Guiding Principles for Sustainable Federal Buildings

Buildings included in the study met each of the following criteria:

1. Federally-owned, under GSA's management
2. An office building, courthouse, or combination courthouse/office building (energy-intensive building types such as laboratories and data centers were excluded)
3. Complete FY 2015 – 2017 data for energy use, water use, solid waste, building operating expenses, and tenant satisfaction survey responses

Buildings were then categorized as either high-performance or legacy stock based on whether or not each building met the Guiding Principles.

After gathering all available data on GSA buildings that met the above criteria, the building set was distributed proportionally across the 11 GSA Regions with equal representation by building type (high-performance or legacy stock). GSA removed buildings from the set to achieve a representative distribution of building types by Region, while maintaining equal overall numbers of high-performance and legacy stock buildings.[15] The resulting set includes 100 high-performance buildings and 100 legacy stock buildings, with representation across all 11 GSA Regions.

4 Execute Analysis and Identify Industry Benchmarks

Using the finalized building set and prepared data, GSA's analysis yielded findings for the five building performance metrics for each fiscal year. GSA calculated the average performance for each metric across the three performance years to report results. This showed that results are sustained across multiple years. GSA then identified industry standard private sector office building comparisons for key metrics used. This study's Analysis Results section details the metrics and industry benchmarks used.

5 Report Data Findings

This study summarizes GSA's data analysis findings. It provides an overview of building performance differences for high-performance buildings, legacy stock buildings, and industry-accepted benchmarks. Where possible, the study also contextualizes building performance findings in terms of cost savings. The analysis method used in this and previous GSA studies can be replicated for assessing the performance of either individual buildings, or a broader real property portfolio. This paper is intended to be a useful long-term reference that can also inform future performance baselining efforts. It provides perspective on the value of proposed new or renovated buildings' design goals. These results support money-saving efficiencies in both the public and private real estate sectors. Distribution across regions helps account for variables like topography, climate zone, and local energy and water prices.

[15] Each region's building set contains 38% to 62% of high-performance buildings, and 38% to 62% of legacy stock buildings.

GSA Data Systems Used

Energy Usage Analysis System (EUAS)

GSA's system for utility billing information, including energy and water consumption data. GSA's owned portfolio tracks billing and utility expenses based on the metering configuration of the building or project.

Financial Management Information System (FMIS)

GSA's financial reporting system for building-related expenses.

Sustainable Operations and Maintenance Tool

GSA's system for tracking buildings that meet the Guiding Principles for Existing Buildings, and for collecting the amount of solid waste generated and recycled for each GSA-owned building.

Real Estate Across the United States (REXUS)

GSA's system for identifying physical building details including the building's name, property type, age, address, GSA Region, and gross square footage (GSF).

Tenant Satisfaction Survey (TSS)

GSA's process for capturing annual Federal Tenant Satisfaction Survey results by building and by tenant.

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U.S. Department of Energy, Energy Information Administration, Commercial Buildings Energy Consumption Survey

Building Owners and Managers Association

The Office of Federal High-Performance Buildings advances federal building innovations in planning, design, and operations to reduce costs, enable agency missions, enhance human health and performance, and minimize environmental impacts.

The Office of Design and Construction provides national leadership and policy direction in the areas of architecture, engineering, urban development, sustainable design, fine arts, historic preservation, construction services, and project management.

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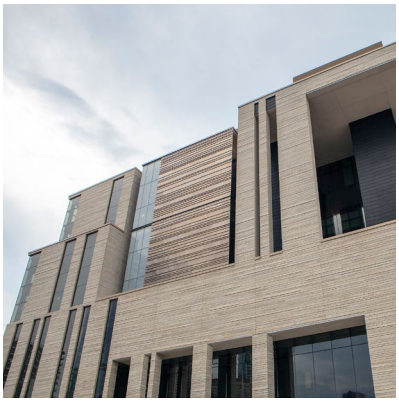

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