

Embracing the New Role of the Federal Building

Jeremey Alcorn, CEM, U.S. General Services Administration

Sonal Larsen, U.S. General Services Administration¹

Abstract

Executive Order 14057 and the advancement of real property stewardship are accelerating GSA's continued leadership on high performance sustainable Federal buildings and our interagency roles in reducing greenhouse gas impacts across the Federal enterprise. GSA's real property portfolio is one of the largest in the Federal government and our energy efficiency investments, renewable energy procurement, benchmarking, and operational practices have resulted in over 50% reduction in greenhouse gas emissions since 2008. GSA is building on this progress as we reimagine the role of Federal buildings by revitalizing sustainability, catalyzing clean energy, prioritizing environmental justice in our community engagements, supporting the deployment of zero emission vehicles, and decarbonizing the federal footprint.

- ~50% of our energy is electricity, and it makes up 62% of our total Scope 1 & 2 GHG emissions
- ~90% of our onsite Scope 1 GHG emissions come from fuel combustion
- ~10% of our onsite Scope 1 GHG emissions come from refrigerant fugitive emissions

We are deploying new strategies and implementing actions to not only lead in government but also the design, construction, and real property management industries. For new construction and modernization, we've augmented our public building standards to require net zero ready baseline, GSA green proving ground technologies, and lower embodied carbon materials. For existing buildings, we are focusing on deep energy retrofits, building and vehicle electrification projects, refrigerant management, onsite renewables, procured carbon pollution free electricity, and grid-interactive efficient buildings. GSA's Federal buildings will not only reduce GHG emissions but can also serve in a new role by catalyzing the grid and transportation transformation while supporting occupant and community health.

Introduction

Executive Order 14057 and the advancement of sound real property stewardship practices are driving GSA's continued leadership on high performance sustainable Federal buildings and our interagency roles in reducing GHG impacts across the Federal enterprise. These new requirements and goals come at a time when the real property, construction, and material manufacturing industries are reimagining themselves, the future of work, and what they look like to operate and thrive in a post-pandemic, decarbonized world. GSA has led past real property transformations from sustainable building standards to mobile work and has continued to lay the foundation for these next steps over the last decade. We have positioned our portfolio to lead

¹ Sonal was previously employed by the U.S. General Services Administration as Senior Advisor on Climate. All of Sonal's contributions to this paper occurred while she was employed by GSA and were part of her official duties. Sonal is no longer authorized to speak on behalf of the U.S. government.

through innovation, implementation, and performance to the benefit of customer agencies, communities, and, ultimately, the taxpayer.

Quietly Leading an Industry Transition

GSA's Public Building Service is charged with providing safe, healthy, efficient, and sustainable workplaces for approximately one million Federal employees across 50 federal agencies and 400 bureaus. Our real property portfolio is one of the largest in the U.S. Federal government. We operate 1,400 owned buildings with over 186 million square feet across the U.S. and pay utilities on a real estate footprint that represents ~6% of the entire federal footprint (DOE 2021). This makes GSA the seventh largest U.S. Federal facilities energy user in FY20 (DOE 2021). GSA's two terawatt-hours electricity use alone represents ~4% of the entire U.S. Federal Government's electricity usage (DOE 2021). Our core real estate management role and energy management imperative has driven GSA to be a leader adopting and demonstrating efficient cost-saving practices, technologies, and sustainable building solutions.

Over the past two decades, GSA has invested in and cultivated a diverse, nationwide portfolio of Federal facilities that averages <55,000 Btus per gross square foot. Our sustainable building modernization projects, energy efficiency investments in Green Proving Ground technologies (e.g., advanced lighting controls and LEDs, magnetic bearing and variable-speed screw chillers, smart motors, onsite photovoltaic, etc.), continued audits and benchmarking, carbon pollution free electricity purchases, and operational practices have resulted in a 51% reduction of our annual scope 1 and 2 GHG emissions since 2008.

While it is important to celebrate this milestone, continuing to analyze and learn from our sustainability performance is important to understand the challenges, opportunities, and strategies that GSA and our peers can use to frame our next steps and investments.

GSA Scope 1 & 2 GHG Emissions

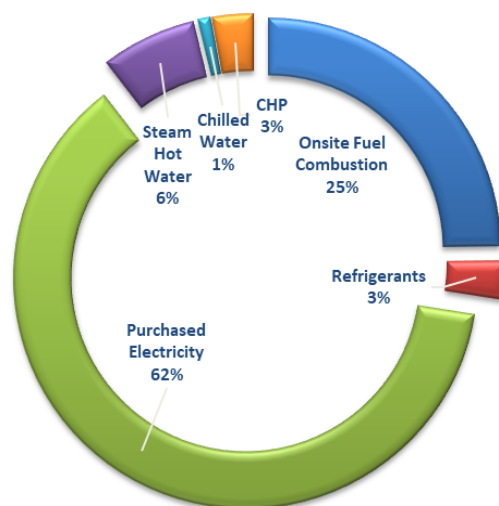


Figure 1. Scope 1 and 2 Emissions by Category, GSA 2021 Annual Energy Report. *Source:* GSA 2021a.

Key Takeaways

- Scope 2 Electricity Emissions: ~50% of GSA's energy is electricity, but it makes up 62% of our total Scope 1 & 2 GHG emissions.
- Scope 1 Onsite Emissions: ~90% of our onsite Scope 1 GHG emissions come from fuel combustion (primarily natural gas). ~10% of our onsite Scope 1 GHG emissions comes from hydrofluorocarbon (HFC) refrigerant fugitive emissions.

What does this mean for GSA's decarbonization strategies? First, efficient and effective operations and maintenance can (and will) continue to reduce emissions across all of these main categories. Second, building fuel sourcing should focus on onsite renewable energy systems, where feasible, and procurement of carbon pollution free electricity (CFE). 100% CFE effectively equals 62% GHG reduction potential, even without further building electrification projects. Third, new building and modernization projects need to be maximized to the extent life-cycle cost-effective in a strategic effort to transition buildings toward greater efficiency, electrification, net zero thermal energy sources and technologies, optimized building automation systems, smart building and resilient energy systems, and non-HFC refrigerant equipment.

It is not hyperbole to say that the first 50% reduction of operational GHG wasn't easy but the next half of our journey to net zero emissions building portfolio will be harder, particularly as we look to meet statutory fossil fuel free requirements, electrify our portfolio, and look to reduce scope 3 emissions, such as embodied carbon in materials, such as concrete. That said, GSA's community of real property professionals, from asset managers, project managers and facility managers to the engineering, energy, and sustainability subject matter experts, are excited to build on this success as we drive toward the new operational net zero goal while also leading the charge to embrace the new role of Federal buildings across the country.

Vision of the New Federal Building

GSA is building on this impressive progress as we reimagine the role of Federal buildings and their foundational role in our portfolio. Federal buildings have and will continue to be an anchor and hub of activity and public service in communities across the country. They are also an embodiment of GSA's industry leadership and quest to test, embrace, and deploy new concepts, strategies, and technologies in service of that mission (Figure 2). The new role of Federal buildings builds on that core public service mission and sense of place to become a beacon of what can be. Easy to say, but what does that mean in practice?

Sustainable Federal Services, Catalyzing Clean Innovations & Environmental Justice

1. Clean Energy Procurement
2. On-site Clean Energy Generation
3. On-site Energy Storage
4. Grid-Interactive Efficient Buildings (GEBs)
5. Ground Source Heat Pumps
6. Workplace Charging
7. Federal Zero-Emission Vehicle Fleet
8. Workplace Innovation
9. Climate Adaptation
10. Sustainable and Equitable Locations
11. Sustainable Procurement
12. Embodied Carbon
13. End of Life

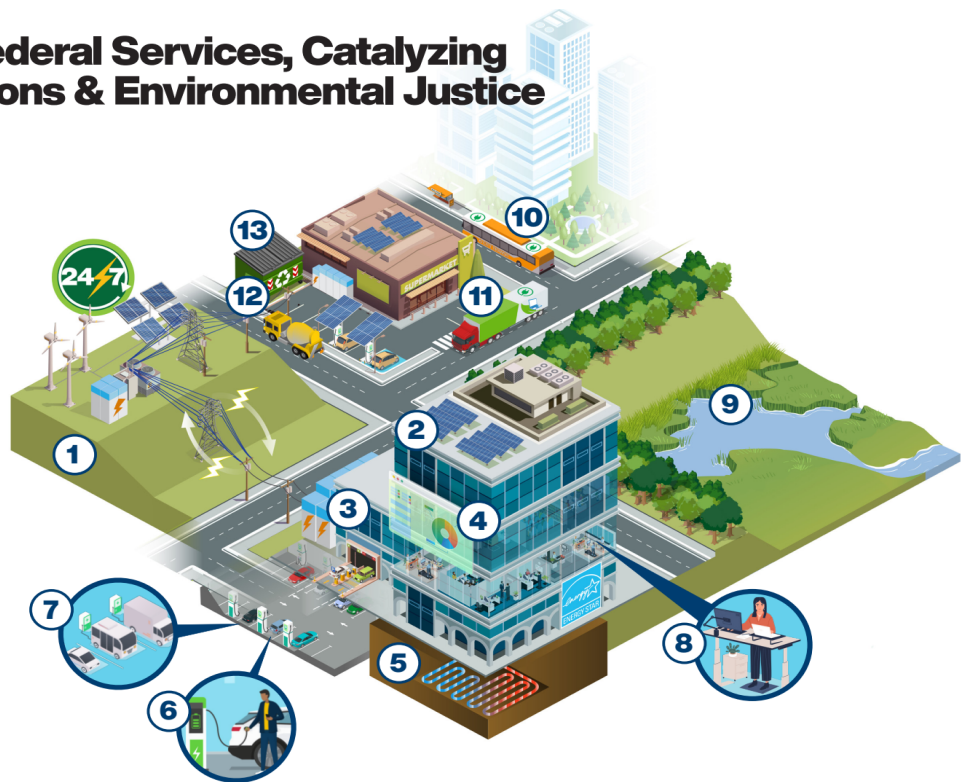


Figure 2. How GSA Supports the Administration’s Sustainability Priorities, Sustainable federal services, catalyzing clean energy innovations and environmental justice. *Source:* GSA 2021b.

The future role of the Federal building is multifaceted and built on the integration of strategies that include the tried and true, innovative, and revolutionary. GSA is starting with a post-pandemic future of work vision to support the core missions of customers through workplace concepts and technology innovations. New and existing Federal buildings will build on portfolio sustainable building strategies and standards that focus on integrated and operations, efficient GPG equipment, onsite renewables (e.g., ground source heat pumps, photovoltaics), and resilience through on-site storage and Grid-interactive Efficient Buildings (GEBs). We are expanding Federal site roles and infrastructure to reduce risk and safeguard assets and support zero emission vehicle (ZEV) deployment and charging infrastructure. From performance contracts, to sustainable procurement, CFE infrastructure, and embodied carbon specifications, GSA will continue to build on the powerful possibilities of partnership. GSA’s building design, equipment and technology, procurement, operations, and partnering are the key ingredients to realize this new role of the Federal building, the performance it can achieve across the portfolio, and broader benefits it represents for customer missions and communities across our Nation.

Future of Work

All of these strategies are being implemented within the context of supporting customers’ missions. This is at the center of how GSA operates, innovates, and makes decisions. GSA is working to enhance the workplace and empower a more distributed workforce to create a productive and sustainable work environment. The future of work will use optimized technology

in combination with building management strategies to improve the real estate and other work support services that GSA provides while increasing productivity. In short, these strategies will help agencies compete for, recruit, and retain talented staff, help support federal employees’ ability to accomplish their mission with a reduced physical footprint and less individual commuting, and, at the same time, reduce scope 1, scope 2, and scope 3 GHG emissions.

Portfolio Strategies

To achieve a net zero emissions building portfolio, GSA is building on its proven strategies to deliver and operate sustainable federal buildings while embracing the innovative approaches and technologies. GSA continues its decades of leadership on sustainable buildings and is leveraging that foundation with the strategies needed to support the future of work post-pandemic while concurrently moving toward a net zero emission building portfolio.

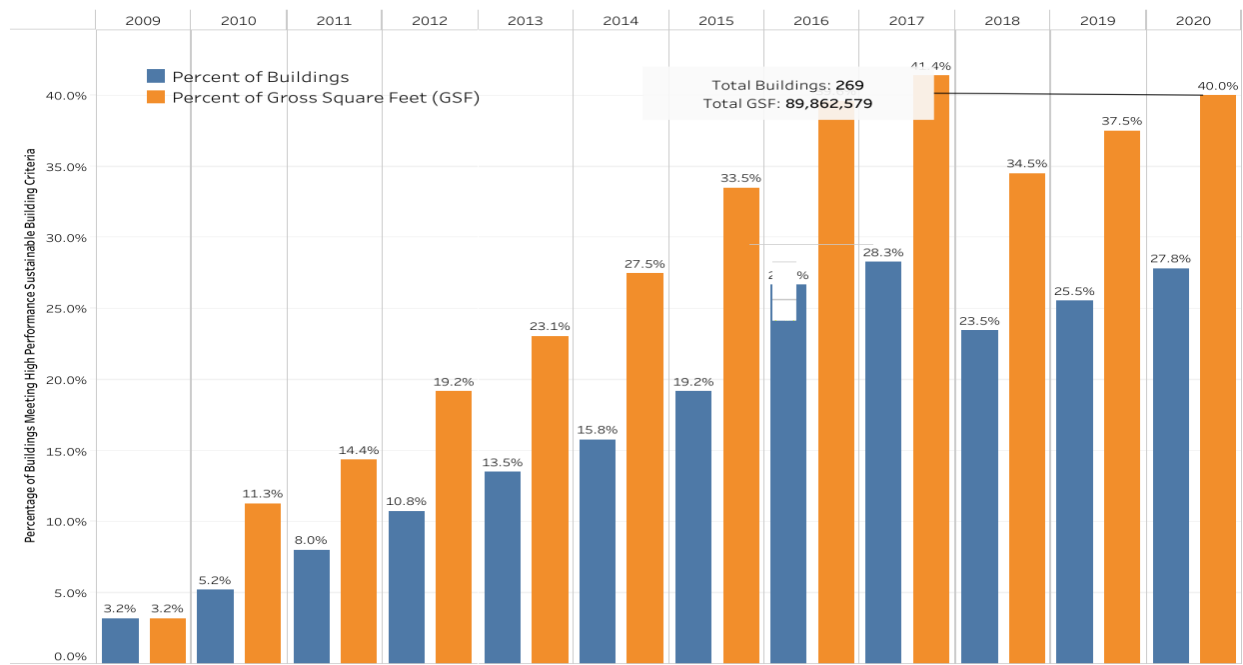


Figure 3. GSA Sustainable Building Performance Priorities, Sustainable federal services, catalyzing clean energy innovations and environmental justice. *Source:* CEQ 2021.

GSA’s steady focus on sustainable buildings has not only led in government but has also paved the way for design, construction, and real property management industries. Why was it successful?

First, our strategy of exploring and embracing innovation has allowed us to engage industry experts through venues, such as the Green Building Advisory Group. Second, we partner with Federal and technology partners to develop roadmaps (e.g., [Grid-interactive Efficient Building \(GEB\) Roadmap](#) (Dean et al. 2021) and to demonstrate/validate new

technologies through the [GSA Green Proving Ground](#). Third, GSA uses a combination of performance-based standards [*Facilities Standards for the Public Buildings Service (P-100)*] and outcome-based programs, such as Pilot-to-Portfolio, Key Sustainable Products, Design Excellence, Construction Excellence, and Operational Excellence to deliver new buildings, modernizations, and retrofits. Finally, our existing portfolio is operated and optimized using a combination of computerized maintenance management, advanced metering, virtual energy and water audits, recommissioning and retuning, smart building monitoring, benchmarking, sustainable building reassessments, project identification, reporting from building-level to portfolio-levels, and strategic planning and budgeting.

Sustainable Building Standards, Technologies, and Strategies

GSA's overarching baseline requirements for new construction and modernizations are the CEQ 2020 Guiding Principles for Sustainable Federal Buildings, LEED Gold, Smart Buildings, 30% below ASHRAE 90.1, 90% fossil fuel free, and net zero ready. This last requirement is a highly efficient building, without fossil fuel consuming equipment, and with infrastructure to accommodate onsite renewable energy and/or carbon pollution free electricity. P100-2021 established net zero ready as baseline requirement and added new language encouraging the deployment of GEBs. What technologies and strategies can be used to achieve net zero?

Ground Source Heat Pumps

Ground source heat pumps are a high-performance building technology that use the Earth's thermal energy to help heat or cool buildings using far less energy than a conventional system. A ground source heat pump uses deep temperate earth as a heat source in winter and a heat sink in summer. GSA currently has 12 operating ground source heat pump installations. Where feasible, this technology can yield substantial reductions in life cycle costs and greenhouse gas emissions.

Onsite Renewables

For over a decade, GSA has been maximizing opportunities for carbon pollution-free electricity with onsite clean energy generation. Installing, operating, and maintaining on-site energy generation helps to reduce building utility costs and offers opportunities for buildings to be more energy resilient. When constructing new buildings and modernizing existing ones, GSA requires buildings to be net zero energy ready upon completion, and where technically feasible and cost effective, incorporating on-site energy generation into the projects. From completely integrated systems, like the Columbus Land Port of Entry in New Mexico to our largest campus solar photovoltaic system (8 MW) at the Denver Federal Center, GSA uses site evaluations and feasibility studies to identify the most productive and cost-effective on-site energy generation source for the specific climate and site needs.

Onsite Energy Storage

GSA has long running experience with onsite energy storage from thermal ice storage to nickel-iron and lithium batteries. Such systems are not just for off-grid application and can be used on-grid applications, such as tariff optimization, peak load shaving, energy shifting, and automated demand response. Energy storage refers to systems that can be charged and strategically discharged to release thermal or electrical energy when needed. While energy storage systems lose some energy in the process and have first and ongoing costs, their key benefit is the control over the timing the use of utility energy. Given peak charges and demand ratchets, these technologies can provide benefits to the building, Federal portfolio, and the grid as a whole. These systems will be an even more important part of GSA's utility cost management, GEB strategy, and, ultimately, meeting Federal 24/7 CFE goals.

GEBs

GEBs are “an energy efficient building with smart technologies characterized by the active use of distributed energy resources (DERs) to optimize energy use for grid services, occupant needs and preferences, and cost reductions in a continuous and integrated way” (Neukomm et al. 2019). These characteristics present the opportunity to connect buildings dynamically to the power grid to coordinate energy loads to save costs, manage energy demands, and optimize energy use. GEBs build on the strategies and technologies of energy efficiency, renewables, energy storage, and load flexibility. Smart building technologies are central to delivering net-zero facilities and GEBs through monitoring and control systems, smart sensors, advanced metering, fault detection and diagnostics, and automated system optimization. GEBs are smart buildings that create communication and transmission to and from the electrical grid responding to demand flexibility. GEBs are able to adjust to the needs of the building occupants and the local utilities. In doing so, GEBs are becoming a key building strategy to help buildings transition from cost-centric demand response flexible customers to important partnerships with utility grid operators as GSA buildings and the utility grid transitions to CFE 24/7.

New Federal Site Risks, Roles, and Infrastructure

GSA building sites' and campus' risks and roles are expanding. As real property stewards, we have a statutory duty to identify, understand, and reduce financial and operational risks to assets. Changing climate hazards requires prospective site profiles and risk management. At the same time, GSA is supporting the Federal fleet's transition to zero emission vehicle (ZEV) and its deployment across Federal facilities across the Nation. In doing so, our Federal site infrastructure will be an important backbone for electric vehicle charging equipment.

Safeguarding Assets

While much of GSA's site strategies are focused on sustainability and achieving net zero building portfolio emissions, a core duty from strategy, to technology choice, and operations is to protect life and safeguard these valuable taxpayer assets. We proactively manage risk by identifying today and tomorrow's climate hazards and impacts and taking action to mitigate the risks to assets where we are stewards. Over the past decade, GSA has reviewed 100 capital

investment projects to assess climate change impacts during an asset's service life. Some strategies and actions GSA is taking include partnering with customers on climate-ready facilities, products, and services to help them achieve their missions in a changing climate, compiling building elevation data across the GSA portfolio to assess flooding risks, assessing our climate-related financial risk, and building climate literacy in key offices and programs. Managing risk is prudent leadership. Managing by hazard (unknown risks) is a failure to plan or conversely planning to fail.

Zero-Emission Vehicle Fleet

A new and greatly expanded role of Federal Buildings will be supporting the transition of the Federal vehicle fleet to zero emission vehicle (ZEV). Federal buildings have hosted government fleet vehicles for a century as parking garages and spaces. Despite the co-location, buildings and fleet vehicles were managed, fueled, and operated independently.

The Federal government has a goal to transition the entire federal fleet to ZEVs, with targets of 100% zero-emission vehicle (ZEV) acquisitions by 2035 and 100% zero-emission light-duty vehicle acquisitions by the end of fiscal year 2027. GSA Fleet serves as the required source for non-tactical vehicles purchased in the United States and the preferred source for leasing motor vehicle solutions in the federal government. GSA advises agencies as they develop and update a zero-emission fleet strategy, including optimizing fleet size and composition; deploying zero-emission vehicle refueling infrastructure; and maximizing acquisition and deployment of zero-emission light-, medium-, and heavy-duty vehicles.

Advances in batteries and charging technology also come with new opportunities to rethink energy storage in ZEVs but also develop new distributed generation and demand response solutions. The GSA GPG program and our new Applied Innovation Learning Laboratories are exploring smart charging technologies to find ways to optimize the timing of charging vehicles during off-peak hours, reducing demand charges, and enabling the next decade's 24/7 CFE goal through bi-directional charging solutions. We are at the dawn of a new century in terms of the marriage of necessity between buildings and fleet vehicles.

ZEV Charging Infrastructure

The core of this new connection between buildings and ZEV fleets is charging infrastructure. It is currently a unidirectional relationship where building electric infrastructure can charge ZEVs. This will evolve as bi-directional energy management and optimization technologies are developed, demonstrated, validated, and deployed. Concurrently, the GEB eco-system is evolving and broadening with increased interest from employees and the public for charging station access.

Establishing workplace charging for employees encourages the use of personal electric vehicles (EV) for commuting and reduces GSA scope 3 commuting emissions from transportation fuel. Where employee parking facilities are available, Federal employees are able to charge their personal electric vehicles at their workplace's existing EV charging stations for a

fee. Providing electric vehicle charging options at workplaces also allows employees to diversify their commuting options.

Powerful Partnerships

From customers, to vendors, and to the local communities we work and live in, GSA's success relies on the quality and depth of partnerships we establish at the personal-level to the organizational-levels. Over the last decade, GSA has been a leader in the use of performance contracting worth over \$650 million dollars. This not only represents a substantial investment in energy conservation measures and deep energy retrofits but, moreover, direct partnerships with energy service companies (ESCOs) and utilities via GSA's areawide contracts. During the same period, GSA programs have partnered with DOE and other Federal agencies via interagency agreements on joint efforts such as the GSA GPG program to turn potential into real performance.

These organizational and professional partnerships are even more important at the local community level. Federal facilities are sited and become part of the communities that operate in. From the beginning, GSA focuses on whether siting a new facility will have long-term impacts on the community and whether those impacts will be sustainable and beneficial. GSA is working to promote sustainable locations for Federal facilities to strengthen the vitality and livability of the communities where they are located and operated in.

Sustainable Procurement

GSA continues to lead Federal implementation of sustainable procurement using innovative models and its substantial purchasing power. GSA is leveraging its scale and procurement power to advance the Federal government toward its goal of net-zero emissions from federal procurement whether through CFE or lower embodied carbon materials. GSA collaborates with industry and partner agencies to offer purchasing solutions that meet or exceed sustainable procurement requirements in a wide range of product and service categories, from vehicles, to facilities, to IT, and beyond. These industry leading solutions support a whole-of-government approach toward reducing emissions, promoting environmental stewardship, supporting resilient supply chains, driving innovation, and incentivizing markets for sustainable products and services by prioritizing products that can be recycled, refurbished, or reused by local communities.

Carbon Pollution Free Electricity

GSA is not only the Federal government's lead on procurement but also manages the largest civilian government real property portfolio. The intersection of these primary agency missions is the purchase of utilities for GSA and customer agencies. [EO 14057](#) established an ambitious goal of sourcing 100% CFE on a net annual basis by 2030, including 50% 24/7 carbon pollution-free electricity.

CFE expands on the Energy Policy Act of 2005's statutory definition to: "electrical energy produced from resources that generate no carbon emissions, including marine energy,

solar, wind, hydrokinetic (including tidal, wave, current, and thermal), geothermal, hydroelectric, nuclear, renewably sourced hydrogen, and electrical energy generation from fossil resources to the extent there is active capture and storage of carbon dioxide emissions” (Biden 2021). 24/7 CFE is defined as: “carbon pollution-free electricity procured to match actual electricity consumption on an hourly basis and produced within the same regional grid where the energy is consumed” (Biden 2021).

One of GSA’s (as with much of the Federal government) largest opportunity to reduce its GHG operational emissions is its procurement of electricity. As such, the strategic procurement of CFE is a core decarbonization strategy over the next decade. GSA’s building strategies to achieve 100% fossil fuel free and net zero ready buildings and fuel a ZEV fleet rely upon the GSA’s ability to strategically source CFE.

GSA will expand its existing partnerships with agencies to identify their electricity needs, explore procurement options, and develop strategies for reaching 100% CFE across the broader Federal real property inventory. These actions will promote local, clean energy sources and help catalyze utility scale energy storage that ultimately can also help overcome peak energy demands, create a more resilient grid, and reduce air pollution burdens in local communities.

Embodied Carbon in Building Materials

GSA’s buildings, parking lots, and access roads literally represent tons of materials but also tons of scope 3 embodied carbon generated from their extraction, transportation, and manufacture. Each new building we construct and modernization project uses significant amounts of construction materials that represent additional scope 3 GHG emissions. To reduce this source, GSA is working to reduce the embodied carbon in its building design and construction projects.

Unlike operational carbon emissions that can be reduced over time through improving a building’s overall energy efficiency, embodied carbon emissions are locked in place as soon as a building is built. The entire life cycle of a building needs to be assessed to completely understand the full impact of embodied carbon reduction measures. Understanding embodied carbon can help encourage the reuse of both existing materials and the revitalization of older, existing buildings.

GSA has been collaborating with industry and Federal experts, through roundtable discussions and task groups, to explore high impact strategies to reduce embodied carbon in buildings. Our P100 requirements were updated in the fall of 2021 and now require project teams evaluate ways to decarbonize their projects, which can be assessed via whole building life cycle analysis and through the use of material specific environment production declarations. After analyzing two industry requests for information, GSA released a set of lower carbon concrete and environmentally preferable asphalt specifications in March 2022 that apply to all projects. Prioritizing government procurement of lower carbon and cleaner construction materials means helping American manufacturers and workers make products that are more globally competitive while reducing scope 3 GHG emissions. This is just one more example where GSA continues to be at the forefront of sustainable procurement by using innovative acquisition techniques and

offering a variety of resources and solutions available to help Federal agencies meet sustainability and climate goals.

Conclusion

GSA exists to efficiently, effectively, and sustainably support Federal customer missions as they provide critical services to the taxpayer. This is our mission day in and day out. The New Role of the Federal Building is simply the next evolution and waypoint in our over 70-year journey to meet this charge.

This vision, all the strategies and technologies, and partnerships it represents GSA's imperfect but still industry leading approach to fulfill our ongoing mission while transforming our buildings into a net zero operational emissions and sustainable portfolio. More than a response to executive orders' goals, it is the culmination of what we've learned, what we recognize needs done, and what we are doing to improve and bestow a Federal building portfolio deserving of the next generation of facility operators, customer agencies, community partners, and taxpayers.

References

- Biden, Joseph. 2021. "Executive Order 14057: Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability." Washington, DC: White House. www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/.
- CEQ (White House Council on Environmental Quality). 2021. "GSA High Performance Buildings." Washington, DC: CEQ. www.sustainability.gov/gsa.html#buildings.
- Dean, Jesse; Voss, Phil; Gagne, Douglas; Vásquez, Deb; and Langner, Rois. 2021. *Blueprint for Integrating Grid-Interactive Efficient Building (GEB) Technologies into U.S. General Services Administration Performance Contracts*. Golden, CO: National Renewable Energy Laboratory. NREL/TP7A40-78190. www.nrel.gov/docs/fy21osti/78190.pdf.
- DOE (U.S. Department of Energy). 2021. "Comprehensive Annual Energy Data and Sustainability Performance." A-15 All Agency Energy by End Use Sector and Type. Washington, DC: DOE. ctswebweb.ee.doe.gov/Annual/Report/AgencyMasterDataByYear.aspx.
- GSA. 2021a. "GSA 2021 Annual Energy Report." Washington, DC: GSA.
- GSA. 2021b. "How GSA Supports the Administration's Sustainability Priorities, Sustainable federal services, catalyzing clean energy innovations and environmental justice." Washington, DC: GSA. www.gsa.gov/governmentwide-initiatives/climate-action-and-sustainability/how-gsa-supports-the-administrations-sustainability-priorities.

Neukomm, Monica; Nubbe, Valerie; and Fares, Robert. 2019. “Grid-interactive Efficient Buildings: Overview.” Washington, DC: DOE.
www.energy.gov/sites/prod/files/2019/04/f61/bto-geb_overview-4.15.19.pdf.